DRAFT

Eastern Management Area Groundwater Sustainability Agency

Santa Ynez River Valley Groundwater Basin – Eastern Management Area Groundwater Sustainability Plan

Section 5 – Sustainable Management Criteria

June 18, 2021

EMA

Santa Ynez River Valley Groundwater Basin
Eastern Management Area
Groundwater Sustainability Agency

Prepared by:

GSI Water Solutions, Inc.
418 Chapala Street, Suite H, Santa Barbara, CA 93101

GEI Consultants

This page intentionally left blank.

Contents

Tables

Appendices

Abbreviations and Acronyms

AFY	acre-feet per year
Agency	Groundwater Sustainability Agency
Basin Plan	Water Quality Control Plan for the Central Coastal Basin
Basin	Santa Ynez River Valley Groundwater Basin
BMP	Best Management Practice
CAG	Citizen's Advisory Group
CASGEM	California Statewide Groundwater Elevation Monitoring
CGPS	Continuous Global Positioning System
CMA	Santa Ynez River Valley Groundwater Basin – Central Management Area
CMA-GSA	Santa Ynez River Valley Groundwater Basin – Central Management Area Groundwater Sustainability Agency
DDW	Division of Drinking Water
DWR	California Department of Water Resources
EMA	Santa Ynez River Valley Groundwater Basin – Eastern Management Area
EMA-GSA	Santa Ynez River Valley Groundwater Basin – Eastern Management Area Groundwater Sustainability Agency
EPA	U.S. Environmental Protection Agency
ESA	European Space Agency
GAMA	Groundwater Ambient Monitoring and Assessment
GDE	groundwater-dependent ecosystem
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
ID No. 1	Santa Ynez River Water Conservation District ID No. 1
ILRP	Irrigated Lands Regulatory Program
InSAR	Interferometric Synthetic Aperture Radar
MA	management area
MCL	maximum contaminant level
mm	milliliter
MO	measurable objective
MT	minimum threshold
MTBE	methyl tert-butyl ether
NCCAG	Natural Communities Commonly Associated with Groundwater
NWIS	National Water Information System
Plan	Groundwater Sustainability Plan
RMS	representative monitoring site
RWQCB	Central Coast Regional Water Quality Control Board
SACV	San Antonio Creek Valley Groundwater Basin

SGMA	California Sustainable Groundwater Management Act
SMC	sustainable management criterion
SMCL	secondary maximum contaminant level
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
UNAVCO	University NAVSTAR Consortium
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey
VOC	volatile organic compound
WQO	water quality objective

SECTION 5: **Sustainable Management Criteria [Article 5, Subarticle 3]**

§354.22 Introduction to Sustainable Management Criteria. This Subarticle describes criteria by which an Agency defines conditions in its Plan that constitute sustainable groundwater management for the basin, including the process by which the Agency shall characterize undesirable results, and establish minimum thresholds and measurable objectives for each applicable sustainability indicator.

This section defines the conditions that constitute sustainable groundwater management and discusses the process by which the Santa Ynez River Valley Groundwater Basin – Eastern Management Area Groundwater Sustainability Agency (EMA-GSA) will characterize undesirable results and establish minimum thresholds and measurable objectives for each sustainability indicator in the Santa Ynez River Valley Groundwater Basin – Eastern Management Area (EMA) in accordance with the Sustainable Groundwater Management Act (SGMA).

Section 5 presents the data and methods used to develop sustainable management criteria (SMCs) and demonstrates how these criteria take into consideration beneficial uses and groundwater users. The SMCs presented in this section are based on currently available data and application of the best available science. As noted in this EMA Groundwater Sustainability Plan (GSP or Plan), data gaps exist in the hydrogeologic conceptual model. Uncertainty caused by these data gaps was considered when developing the SMCs. These SMCs are considered initial criteria and will be reevaluated and potentially modified in the future as new data become available.

The SMCs are grouped by sustainability indicator. The following five sustainability indicators are applicable in the Santa Ynez River Valley Groundwater Basin (Basin) and could lead to significant and unreasonable effects:

- Chronic lowering of groundwater levels
- Reduction of groundwater in storage
- Degraded groundwater quality
- Land subsidence
- Depletion of interconnected surface water

The EMA is isolated from the Pacific Ocean and is not threatened by seawater intrusion; therefore, the sixth SMC, seawater intrusion, is not applicable in the EMA.

According to SGMA regulations, “Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.” (GSP Regulations, § 354.26(a)).

To retain a consistent and organized approach, this section follows the same format for each sustainability indicator. The description of each SMC includes all the information required by § 354.22 et seq. of the SGMA regulations and outlined in the SMC Best Management Practice (BMP) guidance (DWR, 2017), including the following:

- How the definition of what might constitute significant and unreasonable effects was developed,
- How undesirable results were developed, including:

  - The criteria for defining when and where the potential effects on beneficial uses and users of groundwater as described by the sustainability indicators cause undesirable results (when the effects are significant and unreasonable), based on a quantitative description of the combination of minimum threshold exceedances (§ 354.26 (b)(2))
  - The potential causes of undesirable results (§ 354.26 (b)(1))
  - The effects of these undesirable results on beneficial users and uses, and on land uses and property interests (§ 354.26 (b)(3))

- How minimum thresholds were developed, including the following:
  - The information and methodology used to develop minimum thresholds (§ 354.28 (b)(1))
  - The relationship between minimum thresholds and each sustainability indicator (§ 354.28 (b)(2))
  - The effect of minimum thresholds on neighboring basins (§ 354.28 (b)(3))
  - The effect of minimum thresholds on beneficial uses and users, and on land uses and property interests (§ 354.28 (b)(4))
  - How minimum thresholds relate to relevant federal, state, or local standards (§ 354.28 (b)(5))
  - The method for quantitatively measuring minimum thresholds (§ 354.28 (b)(6))
- How measurable objectives and interim milestones were developed, including the following:
  - The methodology for setting measurable objectives (§ 354.30)
  - The methodology for setting interim milestones (§§ 354.30 (a), 354.30 (e), and 354.34 (g)(3))

5.1 Definitions

SGMA and the SGMA regulations include several terms relevant to the SMCs. The terms below use the definitions in the SGMA regulations (§ 351, Article 2). Where appropriate, additional explanatory text is added in italics. This explanatory text is not part of the official definitions of these terms. To the extent where appropriate, plain language, with only a limited use of highly technical terms and acronyms, was used to assist as broad an audience as possible in understanding the development process and implications of the SMCs.

Groundwater-dependent ecosystem (GDE) refers to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface.

Interconnected surface water refers to surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted. Interconnected surface waters are parts of streams, lakes, or wetlands where the groundwater table is close enough to the ground surface to influence water in the lakes, streams, or wetlands or vice versa.

Interim milestone refers to a target value representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan.

Management area (MA) refers to an area within a basin for which the Plan may identify different minimum thresholds, measurable objectives, monitoring, or projects and management actions based on differences in water use sector, water source type, geology, aquifer characteristics, or other factors.

Measurable objectives (MOs) refer to specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the basin. Measurable objectives are goals that the Plan is designed to achieve.

Minimum thresholds (MTs) refer to numeric values for each sustainability indicator that are used to define undesirable results. Minimum thresholds are established at representative monitoring sites. Minimum thresholds are indicators of potential undesirable results where an unreasonable condition might occur. For example, a particular groundwater level might be a minimum threshold if lower groundwater levels would result in a significant and unreasonable reduction of groundwater in storage.

Representative monitoring site (RMS) refers to a monitoring site within a broader network of sites that typifies one or more conditions within the basin or an area of the basin. This term is synonymous with representative well site.

Sustainability indicator refers to any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, They are the set of six conditions defined by the California Department of Water Resources (DWR) that may be present in a basin that may result in effects, when significant and unreasonable, that cause undesirable results (defined below), and impact sustainability of the basin as described in California Water Code § 10721(x).

Uncertainty refers to a lack of understanding of the basin setting that significantly affects the Agency's[1] ability to develop SMCs and appropriate projects and management actions in the Plan,[2] or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed.

Undesirable result refers to the definition provided in § 10721(x) of SGMA, which states that:

> Undesirable result means one or more of the following effects caused by groundwater conditions occurring throughout the basin:
>
> (1) *Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.*
>
> (2) *Significant and unreasonable reduction of groundwater storage.*
>
> (3) *Significant and unreasonable seawater intrusion.*
>
> (4) *Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.*
>
> (5) *Significant and unreasonable land subsidence that substantially interferes with surface land uses.*
>
> (6) *Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.*

Section 354.26(b)(2) of the SGMA regulations states that "The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin."

[1] The EMA-GSA is the Agency referred to in this definition.

[2] The EMA GSP is the Plan referred to in this definition.

5.2 Sustainability Goal [§ 354.24]

§ 354.24 Sustainability Goal. Each Agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The Plan shall include a description of the sustainability goal, including information from the basin setting used to establish the sustainability goal, a discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield, and an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and implementation horizon.

Per § 354.24 of the SGMA regulations, this GSP's discussion of the sustainability goal consists of three parts:

- A description of the sustainability goal
- A discussion of the measures that will be implemented to ensure the EMA will be operated within sustainable yield
- An explanation of how the sustainability goal is likely to be achieved

Sustainability Goal: Because each of the groundwater management areas together encompass the entire Basin, a single sustainability goal has been adopted for the entire Basin as follows:

> The sustainability goal for the Santa Ynez River Valley Groundwater Basin is to sustainably manage the groundwater resources in the Western, Central, and Eastern Management Areas for current and future beneficial users of groundwater within the sustainable yield. Sustainable management will be defined as groundwater management that:
>
> (1) Maintains long-term groundwater elevation at levels adequate to support existing and anticipated ongoing beneficial uses of groundwater,
> (2) Maintains a sufficient volume of groundwater in storage to ensure groundwater availability during periods of drought and recovery during wet climate conditions,
> (3) Maintains water quality conditions to support ongoing beneficial uses of groundwater for agricultural, municipal, domestic, and industrial supply.
>
> The groundwater resource will be managed through management actions and projects implemented by the respective Groundwater Sustainability Agencies. Management of the Basin will be supported by monitoring (where appropriate) groundwater levels, groundwater in storage, groundwater quality, land surface elevations, and interconnected surface water, and seawater intrusion. If significant and unreasonable effects are identified resulting from groundwater pumping, management actions will be taken to address the undesirable results to reach sustainability within 20 years of the adoption date(s) for the three Groundwater Sustainability Plans submitted for the Basin. The absence of undesirable results by January 2042 and, defined as significant and unreasonable effects of groundwater conditions, throughout the planning horizon will indicate that the sustainability goal has been achieved. The GSAs will adaptively manage the projects and management actions to ensure the GSPs are effective and undesirable results are avoided.

The EMA GSP includes a monitoring program (see Section 4) that addresses each of the applicable sustainability indicators. If, based on the results of the monitoring program, minimum thresholds are exceeded such that undesirable effects are present or imminent, the GSA GSP will identify management actions and projects that will be implemented to avoid an undesirable result (see Section 6). Other projects and management actions may be implemented immediately upon GSP adoption, without a specific nexus to undesirable results, to address data gaps and collect important data regarding basin conditions.

5.2.1 Qualitative Objectives for Meeting Sustainability Goals

Qualitative objectives are designed to help stakeholders understand the overall purpose for sustainably managing groundwater resources (e.g., avoid chronic lowering of groundwater levels) and reflect the local economic, social, and environmental values within the EMA. A qualitative objective is often compared to a mission statement. The qualitative objectives for the EMA are the following:

- **Avoid Chronic Lowering of Groundwater Levels**
  - Maintain groundwater levels that continue to support current and ongoing beneficial uses and users of groundwater use in the EMA.
- **Avoid Chronic Reduction of Groundwater in Storage**
  - Maintain sufficient groundwater volumes in storage to sustain current and ongoing beneficial uses and users of groundwater which maintains access to groundwater supplies, including during prolonged drought conditions while avoiding permanent degradation of groundwater dependent ecosystems (GDEs) resulting from groundwater pumping.
- **Avoid Degraded Groundwater Quality**
  - Maintain groundwater access to suitable water quality for all beneficial uses to ensure sustainability of groundwater drinking water supplies for all beneficial uses.
  - Evaluate changes in groundwater quality resulting from groundwater pumping.
- **Avoid Land Subsidence**
  - Reduce or prevent land subsidence that causes significant and unreasonable effects to groundwater supply, current land uses, and water supply infrastructure, and property interests.
- **Avoid Depletion of Interconnected Surface Water**
  - Avoid depletions of interconnected surface water that have significant and unreasonable adverse impacts to beneficial uses of the surface water, including GDEs, caused by groundwater pumping.
  - Maintain sufficient groundwater levels to maintain areas of interconnected surface water existing as of January 2015 when SGMA was enacted.
- **Avoid Seawater Intrusion**
  - Not applicable due to the inland location of the EMA.

5.3 Process for Establishing Sustainable Management Criteria [§ 354.26(a)]

§ 354.26 Undesirable Results.

(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

This section presents the process that was used to develop the SMCs for the EMA, including input obtained from EMA stakeholders, the criteria used to define undesirable results, and the information used to establish minimum thresholds and measurable objectives.

5.3.1 Public Input

The public input process was developed in conjunction with the GSA member agencies and included engagement with local stakeholders and interested parties on GSP issues. This included the formation of the Citizens Advisory Group (CAG), whose members were selected by the GSA Committee because they have an interest in maintaining a healthy agricultural and business community, good water quality, and a healthy environment as being representative of the various beneficial uses and users of groundwater in the EMA. The SMCs and beneficial uses presented in this section were developed using a combination of information from public input, public meetings, written comments submitted to the GSA, hydrogeologic analysis, and meetings with CAG members.

The general process for establishing SMCs included the following:

- Holding a CAG meeting that outlined the GSP development process and introduced stakeholders to SMCs.
- Conducting public meetings to present initial conceptual minimum thresholds and measurable objectives and receive additional public input. Six public meetings on SMCs were held.[3] The meetings were held virtually due to COVID-19 restrictions on public gatherings.

5.3.2 Criteria for Defining Undesirable Results [§ 354.26(b)(1) and (d)]

§ 354.26 Undesirable Results.

(b) The description of undesirable results shall include the following:

(1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

Section 5.2.1 discusses the qualitative objectives for meeting sustainability goals. These goals were discussed in terms of avoiding undesirable results for each of the sustainability indicators. The general criteria used to define undesirable results in the EMA are as follows:

- There must be significant and unreasonable effects caused by groundwater conditions occurring throughout the basin
- A minimum threshold is exceeded in a specified number of representative wells over a prescribed period such that there is a depletion of supply

[3] See https://portal.santaynezwater.org/calendar?gsaKey=EMA for details on the meetings and workshops.

- Impacts to beneficial uses, including GDEs, are likely to occur, including to GDEs and/or threatened or endangered species

These criteria may be refined during the 20-year GSP implementation period based on monitoring data and analysis.

5.3.3 Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives [§ 354.28(b)(1),(c)(1)(A)(B), and (e)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by the uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(1) Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:

(A) The rate of groundwater elevation decline based on historical trend, water year type, and projected water use in the basin.

(B) Potential effects on other sustainability indicators.

(e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

The following information and data were used to establish minimum thresholds and measurable objectives for each of the sustainability indicators.

5.3.3.1 Avoid Chronic Lowering of Groundwater Levels

The information used for establishing the minimum thresholds and measurable objectives that pertain to chronic lowering of groundwater levels includes the following:

- Information gathered from the public meetings about the public's perspective of significant and unreasonable conditions and preferred current and future groundwater levels.
- Historical groundwater level data plotted versus time from wells monitored by the U.S. Geological Survey (USGS), Santa Ynez River Water Conservation District ID No. 1 (ID No. 1), U.S. Bureau of Reclamation (USBR), mutual water companies, Santa Barbara County, and other public agencies.
- Well construction details and locations of existing wells were compiled from DWR databases and from water purveyors. A well impact analysis was performed by comparing spring 2018 water level elevations

with top of well screen elevations for agricultural, municipal wells, and domestic wells. The percentage of wells with water levels below top of screen was calculated in 5-foot increments, starting with spring 2018 water levels (see Section 3.2). Water levels that are chronically below the top of screen in more than 40 percent of wells used in the analysis is considered undesirable because a reduction in well production and depletion of supply may occur.

- Maps of current and historical groundwater level data.
- Mapping of the location and types of GDEs where groundwater is interconnected with surface water.

The monitoring network and protocols that will be used to measure groundwater levels at the representative monitoring sites (RMSs) are presented in Section 4.

5.3.3.2 Avoid Chronic Reduction of Groundwater in Storage

Groundwater levels can be used as a proxy for assessing changes in groundwater in storage and evaluating whether total groundwater withdrawals within the EMA could lead to undesirable results. Therefore, the information that is used to establish minimum thresholds and measurable objectives for the chronic groundwater level decline sustainability indicator will be used to define the sustainability criteria for chronic reduction of groundwater in storage.

5.3.3.3 Avoid Degraded Groundwater Quality

The information used for assessing degraded groundwater quality thresholds includes the following:

- Historical groundwater quality data from wells in the EMA
- Municipal drinking water supply wells (City of Solvang, ID No. 1, and mutual water company wells) and water quality data obtained from the State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) public supply well water quality program
- Domestic and irrigation well water quality data obtained from the SWRCB Irrigated Lands Regulatory Program (ILRP) and USGS National Water Information System (NWIS)
- Observation well water quality data obtained from Santa Barbara County and the California Statewide Groundwater Elevation Monitoring (CASGEM) program, the USGS Groundwater Ambient Monitoring and Assessment (GAMA) Program, and SWRCB GeoTracker database
- Federal and state drinking water quality standards (SWRCB, 2019) and EMA water quality objectives (WQOs) presented in the Water Quality Control Plan for the Central Coastal Basin (Basin Plan) (RWQCB, 2019)
- Feedback about significant and unreasonable conditions from the GSA members and the public

The historical groundwater quality data used to establish thresholds are presented in Section 3.2.3.

Thresholds for contaminants (e.g., volatile organic compounds [VOCs]) are not proposed because assessment, source identification, and cleanup of these constituents of concern are regulated under the authority of state agencies, including the Central Coast Regional Water Quality Control Board (RWQCB). The GSA does not have the responsibility nor the authority to manage contaminants. It is, however, the responsibility of the GSA to ensure concentrations, if any, of these constituents present in groundwater prior to the enactment of SGMA in January 2015 are not increased because of groundwater pumping, or actions taken by the GSA. Elevated concentrations of salts and nutrients (e.g., total dissolved solids [TDS], sulfate, chloride, and nitrate) can impact beneficial uses, including drinking water and agricultural uses. Thus, minimum thresholds and measurable objectives are proposed for these constituents in accordance with the Basin Plan.

5.3.3.4 Avoid Land Subsidence

Minimum thresholds for land subsidence were established to protect groundwater supply, land uses, and infrastructure from significant and unreasonable land subsidence that may lead to undesirable results. Changes in land surface elevation may be caused by tectonic activity, oil and gas production, and groundwater pumping. Changes in ground surface elevation are presently measured using Interferometric Synthetic Aperture Radar (InSAR) data available from DWR and the two University NAVSTAR Consortium (UNAVCO) Continuous Global Positioning Systems (CGPSs), located on the periphery of the EMA in Solvang and Los Olivos. The general minimum threshold is the absence of long-term significant and unreasonable land subsidence arising from groundwater pumping in the EMA that substantially interferes with surface land uses. Section 3.2.4 includes a detailed discussion of the InSAR data provided by DWR and the measured land subsidence data collected by the UNAVCO CGPSs.

As described in Section 3.1.3 of the GSP, the Principal Aquifers in the Basin include the Paso Robles Formation and Careaga Sand. The Paso Robles Formation contains relatively thin, often discontinuous sand and gravel layers interbedded with thicker layers of silt and clay; however, the fine-grained material that would be subject to subsidence are not laterally continuous, which tends to reduce the likelihood for significant subsidence. The Careaga Sand consists of fine-grained to medium-grained, uniform, massive, marine sand with some gravel and limestone; therefore, lacking laterally continuous fine-grained material susceptible to significant subsidence. Land surface elevation changes recorded by the UNAVCO CGPSs located in periphery of EMA during the 19-year period of record (approximately 2001 through 2020) is approximately plus or minus 10 millimeters (mm), or 0.03 feet. There have been no reports from landowners or public agencies of impacts resulting from subsidence.

To supplement the InSAR and UNAVCO data, a preliminary subsidence evaluation was completed to assess the range of possible long-term ground surface elevation changes related to withdrawal of groundwater from the EMA. The preliminary evaluation included developing stratigraphic profiles from well logs and estimating ranges of possible long-term subsidence that might be expected in the future. The analysis was completed at two well locations (ID1 5a and ID1 6) with estimated potential subsidence on the order of 0.5 to 3 feet over the next 20 years resulting from the changes in groundwater elevation reported in the hydrographs. This report is presented in Appendix D-2 and additional discussion is included in Section 3.2.4. This estimate is considered speculative due to the lack of data on material properties of geologic materials in the basin. Due to a lack of subsidence data for the portion of the EMA where pumping effects are likely to be the greatest, a subsidence monitoring program is proposed and presented in Section 4.

5.3.3.5 Avoid Depletion of Interconnected Surface Water

The information used for establishing minimum thresholds and measurable objectives for depletion of interconnected surface water includes the following:

- Available data from streamflow gauging stations (see Table 3-1).
- Water budget computations using the groundwater model that show estimated exchanges between surface water and groundwater within the areas where groundwater is interconnected with surface water (distal ends of Zanja de Cota and Alamo Pintado Creeks).
- Published documents and independent analysis that identify the extent and distribution of potential GDEs.

5.3.4 Relationship between Individual Minimum Thresholds and Other Sustainability Indicators [§ 354.28(b)(2)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

Section 354.28 of the SGMA regulations requires that the description of all minimum thresholds include a discussion about the relationship between the minimum thresholds for each sustainability indicator. In its BMP guidance for SMCs (DWR, 2017), DWR has clarified this requirement. The GSP must describe the relationship between each sustainability indicator's minimum threshold and describe the relationship between the selected minimum threshold and minimum thresholds for other sustainability indicators.

5.4 Representative Monitoring Sites

Minimum thresholds and measurable objectives are measured at RMSs (also referred to as representative wells) that are deemed to be representative of local and EMA-wide groundwater conditions in each Principal Aquifer. Representative wells were selected from a subset of the wells that have been monitored over time in the EMA and have the following characteristics:

- They are screened exclusively within a Principal Aquifer.
- They are spatially distributed to provide information across most of the EMA.
- They are presently being monitored and have a reasonably long record of data (period of record) so that trends can be determined.
- They have signatures (groundwater levels or water quality trends) that are representative of wells in the surrounding area.

See Section 4 for a detailed discussion of the rationale for selecting RMSs. In summary, the RMS network for groundwater levels consists of 24 wells (15 wells in the Paso Robles Formation and 9 wells in the Careaga Sand) that will be used to help identify whether chronic reductions in groundwater levels and significant and unreasonable reductions of groundwater storage are occurring. Seven wells are municipal drinking water supply wells operated by the City of Solvang and ID No. 1, ten wells are production wells used for agricultural irrigation, and seven wells are domestic drinking water wells. These active pumping wells are currently included as RMSs because of their location in the EMA, available well construction data, and a long period of record.

RMS wells and many other wells with historical water level data were used in the modeling of groundwater level changes under historical and predicted future groundwater demand with and without climate change influences. Minimum thresholds and measurable objectives have been established using measured groundwater level data.

Minimum thresholds and measurable objectives for chronic groundwater level decline are presented in Section 5.5, and minimum thresholds and measurable objectives for reduction of groundwater in storage are presented in Section 5.6. The potential for impacts to GDEs for the chronic lowering of groundwater levels sustainability indicator are discussed in Section 5.5 and for the interconnected surface water sustainability indicator in Section 5.10. Minimum thresholds and measurable objectives for degraded groundwater quality are discussed in Section 5.8 and for land subsidence in Section 5.9.

5.5 Chronic Lowering of Groundwater Levels Sustainable Management Criterion

5.5.1 Undesirable Results [§ 354.26(a),(b)(2),(c) and (d)]

§ 354.26 Undesirable Results.

(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

(b) The description of undesirable results shall include the following:

(2) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

(d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

Conditions in the EMA that could lead to significant and unreasonable effects on groundwater levels include the following:

- **Extended drought.** Extensive droughts may lead to excessively low groundwater levels and undesirable results. Short-term impacts due to drought are anticipated in the SGMA regulations with recognition that management actions need sufficient flexibility to accommodate drought periods and ensure short-term impacts can be offset by increases in groundwater levels or storage during normal or wet periods.
- **High rate of pumping in the Paso Robles Formation.** If the amount of pumping in the Paso Robles Formation exceeds the long-term rate of recharge, then groundwater levels may decline, which could affect Paso Robles Formation well production and result in depletion of supply, a reduction in groundwater discharge to surface water, and potential impacts to GDEs.
- **High rate of pumping in the Careaga Sand.** If the amount of pumping in the Careaga Sand exceeds the long-term rate of natural recharge then groundwater levels may decline, which could affect Careaga Sand well production and result in depletion of supply, a reduction in groundwater discharge to surface water, and potential impacts to GDEs.

Significant and unreasonable lowering of groundwater levels that are likely to cause undesirable results are characterized as follows:

- Groundwater levels in the Paso Robles Formation or Careaga Sand aquifers remain below minimum thresholds (see Section 5.5.2) after 2 consecutive years of average and above-average precipitation in 50 percent of representative wells.
- Existing agricultural, municipal, and domestic wells are unable to produce historical average quantities of groundwater due to chronic decline in groundwater levels (e.g., depletion of supply).

As discussed in Section 3.2.1, Paso Robles Formation and Careaga Sand well hydrographs illustrate that water levels go up and down in response to changes in rainfall. Water levels have still not recovered fully from the severe drought observed between water year (WY) 2012 and 2016 and rainfall continues to be below average. Based on input from water users in the EMA and review of available water level data, no significant and unreasonable effects associated with groundwater level decline have been observed in the EMA, including the period since 2015 after SGMA came into effect. However, if current and/or increased rates of pumping continue and drought conditions persist (see Section 3.3.5), undesirable results could occur in the future.

5.5.2 Minimum Thresholds [§ 354.28(a),(b)(1),(c)(1)(A)(B),(d), and (e)]

§ 354.28 Minimum Thresholds.

(a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by the uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(1) Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:

(A) The rate of groundwater elevation decline based on historical trend, water year type, and projected water use in the basin.

(B) Potential effects on other sustainability indicators.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

(e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

Section 354.28(c)(1) of the SGMA regulations states that “The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results.” In a public GSA meeting, one of the GSA Committee members identified several guiding principles for setting minimum thresholds that other committee members supported, including:

- Thresholds should be adaptive to observed conditions – not everything is known
- Learn from other basins that have significant problems that must be avoided
- Use the same thresholds for all well types
- Protect the most vulnerable well types

- An ounce of prevention is worth more than a pound of cure

The Committee considered these and other principles, along with data from the well impact analysis in making decisions about what thresholds to select.

A well impact analysis was performed for 487 municipal, agricultural, and domestic wells in the EMA that have well construction data to help identify conditions that could result in a significant and unreasonable depletion of supply (see Section 3.2). Water levels that consistently fall below the top of screen are likely to result in increased well clogging from biological growth and mineral precipitation, cascading water, sand pumping, and reduced yield and pump efficiencies and possibly if continued, well failure. Fundamental to this analysis is the assumption that these conditions are indicative of a significant and unreasonable result in a depletion of supply [4].

Spring 2018 groundwater elevations were used to assess how many wells have water levels that are below the top of screen elevation as of that date and how many would be below top of screen if water levels were lower. Groundwater water elevations in spring 2018 were below top of screen in 28 percent of domestic wells and 34 percent of agricultural wells screened in the Paso Robles Formation. No municipal wells had groundwater elevations below the top of well screen. Groundwater elevations in the Careaga Sand aquifer were below top of screen in 35 percent of domestic wells, 28 percent of agricultural wells, and 17 percent of municipal wells (a single well owned by the City of Solvang). The well impact analysis was used to determine the number and type of wells in the EMA that would be further impacted (groundwater elevations below well top of screen elevation) if groundwater elevations decline further compared to spring 2018 groundwater elevations (see Figures 3-20 and 3-21). When considering where to set the minimum thresholds, specific consideration was given to domestic wells, which are generally shallower, and municipal wells, which serve larger populations.[5]

Table 5-1 presents the minimum thresholds and measurable objectives to be measured at representative wells completed in the Paso Robles Formation and Careaga Sand. Appendix D-3 of the GSP presents a well location map and hydrographs showing the minimum thresholds for each representative well that will be used to monitor for chronic lowering of groundwater levels.

---

[4] There was considerable debate among stakeholders about how much depletion of supply could result from water levels falling below the top of screen. Municipal, agricultural, and domestic wells have different sensitivities to this condition and will experience depletion of supply differently. The methodology and results of this analysis were discussed with stakeholders and ultimately accepted by the GSA Committee as the basis for establishing undesirable results and minimum thresholds.

[5] Domestic well owners and local municipalities cannot easily respond to a reduction in supply, particularly during extended dry periods, and would have to absorb substantial cost if wells had to be deepened. The GSA decided to not allow water levels in municipal wells to drop below the top of screen if possible. Local agricultural interests were less concerned about water levels falling below top of screen and so wanted to set the minimum thresholds deeper.

Table 5-1. Chronic Lowering of Groundwater Levels Minimum Thresholds and Measurable Objectives for the Paso Robles Formation and the Careaga Sand

RMS ID[1]	Well Type	Minimum Threshold (feet NAVD 88)	Measurable Objective (feet NAVD 88)
Paso Robles Formation			
6N/29W-07L01	Agricultural	639	681
6N/29W-08P01	Domestic	676	712
6N/29W-08P02	Domestic	654	686
6N/30W-07G05	Municipal	515	554
6N/30W-07G06	Municipal	513	552
6N/30W-11G04	Agricultural	512	609
6N/31W-01P03	Municipal	516	556
6N/31W-02K01	Domestic	557	592
6N/31W-13D01	Domestic	495	520
7N/30W-16B01	Agricultural	1,021	1,047
7N/30W-19H01	Agricultural	912	932
7N/30W-29D01	Agricultural	850	893
7N/30W-30M01	Agricultural	559	669
7N/30W-33M01	Agricultural	514	565
7N/31W-36L02	Domestic	616	681
Careaga Sand			
7N/31W-34M02	Agricultural	484	--[2]
6N/31W-03A01	Domestic	573	598
6N/31W-04A01	Domestic	483	506
6N/31W-09Q02 21	Municipal	446	--[2]
6N/31W-10F01	Agricultural	464	483
6N/31W-11D04	Agricultural	502	526
6N/31W-16N07 4	Municipal	377	397
6N/31W-xxxx 22	Municipal	467	484
Solvang HCA	Municipal	320	--[2]

Notes

[1] Refer to Figure 3-19 in Section 3 and Appendix D-3 for representative well locations.
[2] No water level data is available for spring 2011.
NAVD 88 = North American Vertical Datum of 1988 RMS = representative monitoring site

5.5.2.1 Minimum Thresholds for the Paso Robles Formation

Based on the well impact analysis, the GSA Committee agreed to set the minimum threshold for representative wells screened in the Paso Robles Formation at 15 feet below spring 2018 groundwater levels. If groundwater levels continued to decline at current rates (2019–2021) in representative wells, minimum thresholds for the chronic lowering of groundwater levels sustainability indicator would be exceeded in 50 percent of representative wells (see Section 5.5.2.7), approximately one to two years following implementation of the GSP. Section 6 discusses management actions and projects that are intended to reduce the chances for this to occur. These thresholds are not expected to cause significant and unreasonable depletion of supply in municipal, agricultural, and domestic wells, or cause a significant and unreasonable reduction of groundwater in storage.

5.5.2.2 Minimum Thresholds for the Careaga Sand

Based on the well impact analysis, the GSA Committee agreed to set the minimum threshold for representative wells screened in the Careaga Sand at 12 feet below spring 2018 groundwater levels. If groundwater levels continued to decline at current rates (2019–2021) in representative wells, minimum thresholds for the chronic lowering of groundwater levels sustainability indicator would be exceeded in 50 percent of representative wells (see Section 5.5.2.7), approximately four to five years following implementation of the GSP. These thresholds are not expected to cause a significant and unreasonable reduction of groundwater in storage.

5.5.2.3 Relationship between Individual Minimum Thresholds and Relationships to Other Sustainability Indicators [§ 354.28(b)(2) and (d)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

Groundwater level minimum thresholds can potentially influence other sustainability indicators, such as the following:

- **Avoid Chronic Significant and Unreasonable Reduction of Groundwater in Storage.** Changes in groundwater levels reflect changes in the amount of groundwater in storage. Pumping at, or less than, the sustainable yield will maintain long-term average groundwater levels in the EMA. Likewise, the groundwater level minimum thresholds will maintain an adequate amount of groundwater in storage over an extended period when pumping is equal to or less than the sustainable yield. Thus, the groundwater level minimum thresholds will not result in long-term significant and unreasonable reduction of groundwater in storage.

- **Avoid Significant and Unreasonable Degraded Groundwater Quality.** A significant and unreasonable condition for groundwater quality is the increase in concentration of constituents of concern exceeding EMA WQOs or state or federal maximum contaminant levels (MCLs) or secondary maximum contaminant levels (SMCLs) (regulatory thresholds) for drinking water caused by groundwater pumping. As described below, maintaining groundwater levels above minimum thresholds helps minimize the potential for experiencing degraded groundwater quality (since enactment of SGMA in 2015) or exceeding regulatory thresholds for constituents of concern in drinking water and agricultural wells. Groundwater quality could be affected through two processes:

  1. Low groundwater levels caused by pumping in an area could cause deeper, poor-quality groundwater to flow into existing supply wells. Groundwater level minimum thresholds are set below current groundwater levels, meaning a flow of deep, poor-quality groundwater could occur in the future at or below minimum threshold levels. The Careaga Sand is underlain by marine deposits. Consequently, groundwater within these underlying marine deposits likely contains increased salt concentrations and is of poorer quality than the groundwater within the overlying Careaga Sand. Should groundwater quality degrade due to lower groundwater levels, the groundwater level minimum thresholds will be reviewed.

  2. Changes in groundwater levels arising from management actions implemented by the GSA to achieve sustainability could change groundwater gradients, which could cause poor-quality groundwater to flow towards supply wells that would not have otherwise been impacted. Examples of these actions may include installation of groundwater recharge facilities (e.g., gravity stormwater recharge or aquifer recharge with recharge wells using treated wastewater). Because these kinds of projects are subject to review under the California Environmental Quality Act, concerns about the potential to introduce or mobilize contaminant plumes would be evaluated before such a project could be implemented.

- **Avoid Significant and Unreasonable Land Subsidence.** A significant and unreasonable condition for subsidence is permanent pumping-induced subsidence that substantially interferes with surface land use and damages infrastructure. The groundwater level minimum thresholds are set just below existing and historical groundwater elevations, which is unlikely to induce additional subsidence. Based on a geotechnical study performed for the EMA, local geological conditions do not appear to be susceptible to compaction and subsidence because there are no known thick clay layers that extend across the full area where the Paso Robles Formation is present (although some clay layers are distinctly present in localized areas). Groundwater levels would likely have to be substantially lower than are predicted to occur in the future to produce significantly more subsidence (refer to Appendix D-2 for this subsidence report). Should significant and unreasonable subsidence be observed from lowering groundwater levels, the GSA may consider adjusting groundwater level minimum thresholds to avoid this subsidence.
- **Avoid Significant and Unreasonable Depletion of Interconnected Surface Water.** Increased groundwater pumping beyond what has been observed in the past could result in **the** depletion of interconnected surface water resulting in impacts to GDEs on the distal, or lower, ends of Zanja de Cota and Alamo Pintado creeks where the interconnection exists. Although the minimum thresholds for groundwater levels are set a short distance below the historical low groundwater elevation observed in some RMSs, no significant or unreasonable effects have been observed in association with interconnected surface water during the historical period (1981–2018) and none are expected in the future.
- **Avoid Seawater Intrusion.** This sustainability indicator is not applicable to the EMA.

The minimum thresholds set for chronic groundwater level decline are protective of all beneficial uses and users of groundwater and do not result in significant and unreasonable effects for the other sustainability indicators.

5.5.2.4 Effects of Minimum Thresholds on Neighboring Basins [§ 354.28(b)(3)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

Neighboring basins include the Santa Ynez River Valley Groundwater Basin – Central Management Area (CMA) of the Santa Ynez Basin and San Antonio Creek Valley Groundwater Basin (SACV). The CMA is hydrologically downgradient of the EMA and the SACV is not hydraulically connected to the EMA; groundwater flows from the Paso Robles Formation in the EMA to the Santa Ynez River Alluvium where gaps in the underlying Monterey Formation bedrock occur. The Santa Ynez River Alluvium is present in the EMA and CMA management areas. Groundwater present within the Careaga Sand flows from the EMA and discharges directly to the CMA as subsurface flow. Therefore, changes in groundwater levels within the EMA could have an impact on groundwater levels in the CMA if a substantial reduction in groundwater levels in the EMA were to occur (depending on the location in the EMA) and over a long period, the amount of groundwater flowing into the CMA could be reduced. The groundwater level minimum thresholds for the EMA are set just below historical and current levels, which could theoretically reduce groundwater flow into the adjacent CMA during certain periods. Changes in groundwater levels in the EMA are not anticipated to result in significant and unreasonable changes in groundwater flow to the CMA because, as discussed in Section 3.3, the average surface water outflow and groundwater subsurface outflow was less than 2,000 acre-feet per year (AFY) over the historical period (1981–2018). This amount of annual subsurface outflow is small compared with annual variations in pumping and the amount of annual climate-driven variation that occurs in several of the water budget terms in the EMA and CMA. The EMA-GSA has developed a cooperative working relationship with the downstream Santa Ynez River Valley Groundwater Basin – Central Management Area GSA (CMA-GSA) that is preparing the GSP for the CMA. Additionally, a SGMA-compliant Coordination Agreement is being prepared and will remain in place between the EMA-GSA, the CMA-GSA, and the downstream Western Management Area GSA.

Based on available information, groundwater gradients at the boundary between the EMA and SACV are such that groundwater does not flow between the EMA and SACV and therefore, the SACV would not be impacted by the minimum threshold for the chronic lowering of groundwater levels sustainability indicator in the EMA.

Based on available information, groundwater gradients at the boundary between the EMA and SACV are such that groundwater does not flow between the EMA and SACV and therefore, the SACV would not be impacted by the minimum threshold for the chronic lowering of groundwater levels sustainability indicator in the EMA.

5.5.2.5 Effects of Minimum Thresholds on Beneficial Uses and Land Uses [§ 354.28(b)(4)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

The groundwater level minimum thresholds have been selected to protect beneficial uses in the EMA while providing a reliable and sustainable groundwater supply. Groundwater modeling indicates that future projected water levels in the Paso Robles Formation and Careaga Sand are unlikely to impact Category A GDEs; however, extended extreme droughts could reduce groundwater elevations below historically measured levels and thus impact Category A GDE areas identified near the confluence of Alamo Pintado and Zanja de Cota Creek with the Santa Ynez River (see Section 3.2 and Figure 3-40).

As presented in Section 3.2, the well impact analysis was used to determine the amount of additional groundwater elevation decline that could occur without causing undesirable results (including significant and unreasonable depletion of supply) and impacts to beneficial uses. This was the basis for setting the minimum threshold for this sustainability indicator.

5.5.2.6 Relevant Federal, State, or Local Standards [§ 354.28(b)(5)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

No federal, state, or local standards exist for chronic lowering of groundwater levels.

5.5.2.7 Methods for Quantitative Measurement of Minimum Thresholds [§ 354.28(a) and (b)(6)]

§ 354.28 Minimum Thresholds.

(a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

Groundwater level minimum thresholds will be directly measured from existing representative monitoring wells. The groundwater level monitoring program will be conducted in accordance with the monitoring plan outlined in Section 4 and will consist of collecting groundwater level measurements that reflect non-pumping conditions. The groundwater level monitoring program will be designed and conducted to meet the requirements of the technical and reporting standards included in the SGMA regulations. As discussed in Section 5.5.1, the potential exists for undesirable results to occur if minimum thresholds are exceeded in 50 percent of the representative wells for 2 consecutive years of average and above-average precipitation.

5.5.3 Measurable Objectives [§ 354.30(a),(b),(c),(d), and (g)]

§ 354.30 Measurable Objectives.

(a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.

(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.

(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.

(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.

(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.

The measurable objectives for chronic lowering of groundwater levels provides a target to be reached over the 20-year GSP implementation period to ensure reliable access to groundwater through dry to critically dry hydrologic periods, such as the critically dry period from 2012 through 2016. Measurable objectives for chronic lowering of groundwater levels provide operational flexibility above minimum threshold levels to ensure that the EMA can be managed sustainably over a reasonable range of climate and hydrologic variability. Measurable objectives may change after GSP adoption, as new information and hydrologic data become available.

5.5.3.1 Methodology for Setting Measurable Objectives

Measurable objectives were established to meet the sustainability goal and were based on trends in historical groundwater level data, historical precipitation data, and input from the CAG, other public stakeholders, and the EMA-GSA Committee. The measurable objective levels were set so that: (1) natural variations in groundwater levels as were observed in the past during wet and dry periods are considered, and (2) there is enough groundwater in storage to get through a multi-year drought as was observed in WY 2012 to 2021 with two wet years in WYs 2017 and 2019 without undesirable results. Table 5-1 includes the estimated elevations for the measurable objectives established for the Paso Robles Formation and the Careaga Sand. Hydrographs showing the measurable objectives are presented in Appendix D-3.

5.5.3.2 Measurable Objectives for the Paso Robles Formation

The measurable objectives for the Paso Robles Formation are the average groundwater levels measured at each RMS prior to the recent drought beginning in WY 2012. These levels were selected using available groundwater elevation monitoring data and climatic data.

5.5.3.3 Measurable Objectives for the Careaga Sand

The measurable objectives for the Careaga Sand are the average groundwater levels measured at each RMS prior to the recent drought beginning in WY 2012. These levels were selected using available groundwater elevation monitoring data and climatic data.

5.5.4 Interim Milestones [§ 354.30(e)]

§ 354.30 Measurable Objective.

(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin with 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

Interim milestones show how the GSA would move from current conditions to meeting the measurable objectives in the 20-year GSP implementation horizon. Prior to the recent drought (WY 2012 to 2021 with two wet years in WYs 2017 and 2019), the cumulative change of groundwater in storage in the EMA was positive (see Table 3-11). During the historical period (1981–2018), which included the recent drought, the estimated average annual change in groundwater in storage was -1,830 AFY (see Table 3-11). The recent drought was the most severe drought during the historical period and, consequently, much of the observed decline in water levels and current groundwater in storage deficit is due to the drought and not pumping of groundwater. Additionally, no significant and unreasonable effect has been observed in the EMA as a result of lowering of groundwater levels to date. Therefore, no interim milestones are being proposed. However, the GSA intends to move forward with selected projects and management actions (see Section 6) to ensure that groundwater levels recover when normal or above normal rainfall conditions return.

5.6 Reduction of Groundwater in Storage Sustainable Management Criterion

5.6.1 Undesirable Results [§ 354.26(a),(b)(2),(c), and (d)]

§ 354.26 Undesirable Results.

(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

(b) The description of undesirable results shall include the following:

(2) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

(d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

Conditions in the EMA that could lead to significant and unreasonable effects on groundwater in storage include the following:

- **Extended drought.** Extensive droughts may lead to excessively low groundwater levels, a reduced amount of groundwater in storage, and undesirable results. Short-term impacts due to drought are anticipated in the SGMA regulations with recognition that management actions need sufficient flexibility to accommodate drought periods and ensure short-term impacts can be offset by increases in groundwater levels or storage during normal or wet periods.
- **High rate of pumping in the Paso Robles Formation.** If the amount of pumping in the Paso Robles Formation exceeds the long-term rate of recharge, then groundwater levels may decline, which could affect Paso Robles Formation well production, groundwater discharge to surface water, GDEs, groundwater quality, and the volume of groundwater in storage.
- **High rate of pumping in the Careaga Sand.** If the amount of pumping in the Careaga Sand exceeds the long-term rate of natural recharge, then groundwater levels may decline, which could affect Careaga Sand well production, reduce groundwater discharge to surface water, GDEs, groundwater quality, and the volume of groundwater in storage.

Significant and unreasonable reduction of groundwater in storage that are likely to cause undesirable results are characterized as follows:

- Groundwater levels in the Paso Robles Formation or Careaga Sand aquifers fall below minimum thresholds (see Section 5.5.2) after 2 consecutive years of average and above-average precipitation in 50 percent of representative wells.
- Existing agricultural, municipal, and domestic wells are unable to produce historical average quantities of groundwater due to chronic decline in groundwater levels (e.g., depletion of supply).

As discussed in Section 3.2.1, Paso Robles Formation and Careaga Sand well hydrographs illustrate that water levels go up and down in response to changes in rainfall. Water levels continue to decline from the severe drought observed between WY 2012 to 2021 with 2 wet years in WYs 2017 and 2019 and rainfall continues to be below average. Based on input from water users in the EMA and review of available water level data, no significant and unreasonable effects associated with the observed groundwater level decline or reduction in storage have been observed in the EMA. However, the decline indicates the potential for undesirable results and if current/or increased rates of pumping continue and drought conditions persist (see Section 3.3.5), undesirable results could occur in the future.

The practical effect of protecting against undesirable results arising from a reduction of groundwater in storage is that it encourages the maintenance of long-term stability in groundwater levels and storage during average hydrologic conditions over multiple years and decades. Maintaining long-term stability in groundwater levels also maintains long-term stability in groundwater storage and prevents chronic declines, thereby providing beneficial uses and users with continued access to groundwater on a long-term basis and preventing undesirable results associated with groundwater withdrawals. Pumping above the long-term sustainable yield during drought years would likely temporarily lower groundwater levels and reduce the amount of groundwater in storage. Such short-term impacts due to drought are anticipated in SGMA and the SGMA regulations with recognition that management actions need sufficient flexibility to accommodate drought periods and ensure short-term impacts can be offset by increases in groundwater levels or storage during normal or wet periods. Prolonged reductions in the amount of groundwater in storage could lead to undesirable results affecting beneficial users and uses of groundwater. In particular, groundwater pumpers that rely on water from shallow wells (e.g., domestic wells) in the EMA may be temporarily impacted by temporary reductions in the amount of groundwater in storage and lower groundwater levels in their wells.

5.6.2 Minimum Thresholds [§ 354.28(a),(b)(1),(c)(2),(d), and (e)]

§ 354.28 Minimum Thresholds.

(a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by the uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(2) Reduction of Groundwater Storage. The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that my lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

(e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

Section 354.28(c)(2) of the SGMA regulations states that "The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin."

The minimum threshold for reduction of groundwater in storage is based on the estimated sustainable yield and is consistent with the minimum thresholds for chronic groundwater level decline because they are interrelated; therefore, the minimum thresholds for reduction in groundwater in storage is established for the EMA as a whole, not for individual aquifers.

In accordance with the SGMA regulation cited above, the minimum threshold metric is a volume of pumping per year, or an annual pumping rate. Conceptually, the sustainable yield is the total volume of groundwater that can be pumped annually from the EMA on a long-term (multi-year/multi-decadal) basis without leading to undesirable results. This GSP adopts changes in groundwater levels as a proxy for the change of groundwater in storage metric. As provided in § 354.36(b)(1) of the SGMA regulations, an average of the groundwater elevation data at the RMSs will be reported annually as a proxy to track changes in the amount of groundwater in storage.

Based on well-established hydrogeologic principles, maintaining long-term stability in groundwater levels above the minimum threshold for chronic lowering of groundwater levels will limit continued depletion of groundwater from storage. Therefore, using groundwater elevation levels as a proxy, the minimum threshold for chronic reduction of groundwater in storage at each RMS is defined by the minimum threshold for chronic lowering of groundwater levels (see Table 5-1).

5.6.2.1 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators [§ 354.28(b)(2)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

The minimum threshold for reduction of groundwater in storage is based on the groundwater level minimum thresholds established for chronic groundwater level decline at RMSs. Therefore, the concept of potential conflict between minimum thresholds at different locations in the EMA is not applicable.

The minimum threshold for reduction of groundwater in storage could influence other sustainability indicators. The minimum threshold for reduction of groundwater in storage was selected to avoid undesirable results for other sustainability indicators, as outlined below:

- **Avoid Chronic Lowering of Groundwater Levels.** Because groundwater levels will be used as a proxy for estimating groundwater pumping and changes in groundwater storage, the groundwater in storage sustainability criteria would not cause undesirable results for this sustainability indicator.
- **Avoid Degraded Groundwater Quality.** The minimum threshold proxy of long-term stability in groundwater levels helps minimize the potential for experiencing degraded groundwater quality or exceeding regulatory limits for constituents of concern in supply wells.
- **Avoid Land Subsidence.** Future groundwater levels would likely have to be substantially lower than are predicted to occur in the future to produce significant subsidence. Should significant and unreasonable subsidence be observed from future groundwater levels, the groundwater level minimum thresholds for this sustainability indicator will be revisited by the EMA-GSA to avoid this subsidence.
- **Avoid Depletion of Interconnected Surface Water.** A significant and unreasonable condition for depletion of interconnected surface water is a pumping-induced reduction in groundwater discharge in specific locations where groundwater is interconnected to surface water and resulting impacts to Category A GDEs (see Section 3.2 and Figure 3-40). As discussed in Section 5.10, groundwater levels and related groundwater in storage that continues to decline below historical levels in the future may have an impact on Category A GDEs. No significant or unreasonable effects have been observed thus far in association with interconnected surface water during periods of historical low groundwater levels and groundwater in storage.
- **Avoid Seawater Intrusion.** This sustainability indicator is not applicable to the EMA.

5.6.2.2 Effects of Minimum Thresholds on Neighboring Basins [§ 354.28(b)(3)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

Neighboring basins include the CMA of the Santa Ynez Basin and SACV. The CMA is hydrologically downgradient of the EMA; groundwater flows from the Paso Robles Formation in the EMA to the Santa Ynez River Alluvium where gaps in the underlying Monterey Formation bedrock occur. The Santa Ynez River Alluvium is present in the EMA and CMA management areas. Groundwater present within the Careaga Sand flows from the EMA and discharges directly to the CMA as subsurface flow. Therefore, changes in groundwater levels within the EMA could have an impact on groundwater levels in the CMA if a substantial reduction in groundwater levels in the EMA were to occur (depending on location in the EMA) and over a long period, the amount of groundwater flowing into the CMA could be reduced. The groundwater level minimum thresholds for the EMA are set just below historical and current levels, which could theoretically reduce groundwater flow into the adjacent CMA during certain periods. Changes in groundwater levels in the EMA are not anticipated to result in significant and unreasonable changes in groundwater flow to the CMA because, as discussed in Section 3.3, the average surface water outflow and groundwater subsurface outflow was less than 2,000 acre-feet per year (AFY) over the historical period (1981–2018). This amount of annual subsurface outflow is small compared with annual variations in pumping and the amount of annual climate-driven variation that occurs in several of the water budget terms in the EMA and CMA. The EMA-GSA has developed a cooperative working relationship with the downstream Santa Ynez River Valley Groundwater Basin – Central Management Area GSA (CMA-GSA) that is preparing the GSP for the CMA. Additionally, a SGMA-compliant Coordination Agreement is being prepared and will remain in place between the EMA-GSA, the CMA-GSA, and the downstream Western Management Area GSA. Based on available information, groundwater gradients at the boundary between the EMA and SACV are such that groundwater does not flow between the EMA and SACV and, therefore, the SACV would not be impacted by the minimum threshold for the groundwater in storage sustainability indicator in the EMA.

5.6.2.3 Effects on Beneficial Uses and Land Uses [§ 354.28(b)(4)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

The minimum thresholds for reduction of groundwater in storage and lowering of groundwater levels have been established to avoid undesirable results for multiple sustainability indicators. For this reason, groundwater serving beneficial uses (including current pumpers, pumping volumes, and GDEs) and land uses will not be adversely affected.

5.6.2.4 Relevant Federal, State, or Local Standards [§ 354.28(b)(5)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

No federal, state, or local standards exist for reductions in groundwater storage.

5.6.2.5 Methods for Quantitative Measurement of Minimum Thresholds [§ 354.28(b)(6)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

The measurement program for evaluating the minimum thresholds for reductions in groundwater in storage will rely on the groundwater elevation monitoring program described previously for chronic lowering of groundwater levels (see Section 5.5). Groundwater levels (as a surrogate for change of groundwater in storage) that drop below the minimum threshold values for decline in groundwater levels in 50 percent of the same representative wells over 2 years of average or above-average precipitation may lead to long-term reduction of groundwater in storage.

5.6.3 Measurable Objectives [§ 354.30(a),(c),(d), and (g)]

§ 354.30 Measurable Objectives.

(a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.

(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.

(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.

(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.

The sustainability indicators for avoiding chronic reductions of groundwater in storage use average groundwater levels as a proxy. The minimum thresholds and measurable objectives that protect against significant and unreasonable reduction in groundwater storage are based on those used to protect against chronic lowering of groundwater levels. The measurable objective for chronic reduction in groundwater in storage, using the groundwater level proxy, is equivalent to the measurable objective for chronic lowering of groundwater levels, using average groundwater levels measured at each RMS prior to the recent drought beginning in WY 2012. These levels were selected using available groundwater elevation monitoring data and climatic data. Measurable objectives may change after GSP adoption, as new information and hydrologic data become available.

5.6.4 Interim Milestones [§ 354.30(e)]

§ 354.30 Measurable Objective.

(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin with 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

Interim milestones show how the GSA would move from current conditions to meeting the measurable objectives in the 20-year GSP implementation horizon. Prior to the recent drought (WY 2012 to 2021 with two wet years in WYs 2017 and 2019) the cumulative change of groundwater in storage in the EMA was positive (see Table 3-11). During the historical period (1981–2018), which included the recent drought, the estimated average annual change in groundwater in storage was -1,830 AFY (see Table 3-11). The recent drought was the most severe drought during the historical period and, consequently, much of the observed decline in water levels and current groundwater in storage deficit is due to the drought and not pumping of groundwater. Rainfall continues to be well below average and so the drought may not actually be over. Additionally, no significant and unreasonable effect has been observed in the EMA as a result of lowering of groundwater levels or reduction of groundwater in storage to date and so there are no apparent undesirable results that must be addressed. Therefore, no interim milestones are being proposed for this sustainability indicator at this time. However, the GSA intends to move forward with selected projects and management actions (see Section 6) to ensure that groundwater levels and storage recover when normal rainfall conditions return.

5.7 Seawater Intrusion Sustainable Management Criterion (Not Applicable)

The seawater intrusion sustainability indicator is not applicable to the EMA.

5.8 Degraded Groundwater Quality Sustainable Management Criterion

This sustainability indicator takes into consideration protection of municipal drinking water supplies, domestic uses, and agricultural uses of groundwater in the EMA. For municipal wells and drinking water supplied by domestic wells, federal and state regulatory standards (MCLs and SMCLs) established by the SWRCB DDW and U.S. Environmental Protection Agency (EPA), respectively, were used to establish thresholds. For agricultural uses, thresholds were established using WQOs presented in the Basin Plan (RWQCB, 2019). The GSA is not charged with managing groundwater quality unless it can be shown that water quality degradation is caused by pumping in the EMA or the GSA implements a project that degrades water quality.[6]

[6] A group of agricultural stakeholders proposed establishing minimum thresholds for concentrations of salts and nutrients in groundwater considering constituent concentrations suitable for agricultural use and SMCLs (whichever standard was higher). Feedback was offered that different standards could also be applied to different well types, depending upon their use (e.g., agricultural vs. domestic). Some of the proposed concentration standards are higher than WQOs in the Basin Plan. The GSA determined it appropriate to reference the WQOs established by the RWQCB because they were developed to be protective of all beneficial uses. It was also decided to use a consistent methodology for all wells when setting minimum thresholds for salts and nutrients because there are multiple well types located in proximity to one another, and all wells share a common resource (the Paso Robles Formation and Careaga Sand aquifers).

5.8.1 Undesirable Results [§ 354.26(a),(b)(1),(b)(2), and (d)]

§ 354.26 Undesirable Results.

(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

(b) The description of undesirable results shall include the following:

(1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(2) The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.

(d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

The following conditions may lead to an undesirable result for groundwater quality in the EMA:

- **Concentrations of regulated contaminants** in untreated groundwater pumped from private domestic wells, agricultural wells, or municipal wells exceed regulatory thresholds as a result of pumping or GSA activities.
- **Groundwater pumping or GSA activities** cause concentrations of TDS, chloride, sulfate, boron, sodium, or nitrate to increase and exceed WQOs and is greater than concentrations since SGMA was enacted in January 2015.

5.8.2 Minimum Thresholds [§ 354.28(b)(1),(c)(4), and (e)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by the uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(4) Degraded Water Quality. The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.

(e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

Section 354.28(c)(42) of the SGMA regulations states that "The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin." The purpose of the minimum thresholds for constituents of concern in the EMA is to avoid increased degradation of groundwater quality from baseline concentrations since enactment of SGMA in January 2015. Minimum thresholds established for contaminants and for salts and nutrients are presented in the following subsections.

5.8.2.1 Contaminants

No minimum thresholds have been established for contaminants because: 1) there is little if any documented contamination in the basin and so setting minimum thresholds for contamination is not warranted, and 2) state regulatory agencies, including RWQCB and DTSC, have the responsibility and authority to regulate and direct actions that address contamination.

Groundwater quality samples have been collected and analyzed throughout the EMA for various studies and programs. Historical groundwater quality data was acquired from the SWRCB GeoTracker GAMA database. Water quality data was also obtained for wells owned by municipal water purveyors as part of its DDW compliance monitoring program.

Constituents of concern for agricultural and domestic use will be assessed as part of the state Irrigated Lands Regulatory Program (ILRP) and reported on the GeoTracker website (refer to Section 4). According to the RWQCB proposed Ag Order 4.0, beginning in 2022, all ranches enrolled in the ILRP must conduct annual sampling of all on-farm domestic drinking water supply and irrigation wells between March 1 and May 31 of each year. The GSA will use this database to track water quality in domestic and agricultural wells (private wells) in the EMA. Exceedance of water quality objectives in the Basin Plan in 50 percent of the private wells will be the basis for minimum thresholds for degraded groundwater quality at private agricultural and domestic wells. It may be necessary to adjust the threshold for the percentage of wells exceeding the limit if there are many wells in a particular area that experience degraded groundwater quality.

Table 5-2 presents regulatory standards for selected constituents of concern for drinking water listed in the Basin Plan (RWQCB, 2019) and California Code of Regulations, Title 22, drinking water quality standards (SWRCB, 2019), and concentration of select constituents of concern in groundwater around the time SGMA was enacted (January 2015). The constituents with reported concentrations at or above the respective WQO for all wells, for wells known to be completed in each Principal Aquifer, and for surface water samples are presented as Table 3-9. Based on available data, wells with reported constituent concentrations in groundwater at or above the respective WQO are distributed throughout the EMA with increasing concentrations in the direction of the groundwater flow towards the southwest. Wells with reported concentrations of TDS, sodium, chloride, and boron at or above the WQO are located in the Uplands, adjacent to Santa Ynez River and its tributaries, with the largest number of wells in the southwest region of the EMA (specifically for concentrations of TDS and boron).

While there are some wells that have constituent concentrations that exceed regulatory standards, it is possible that these exceedances are a result of natural conditions and not caused by land use or other anthropogenic activities. Elevated boron concentrations are naturally occurring in many central coast basins and elevated TDS, chloride, and sodium are often associated with rocks of marine origin that are present in the EMA.

Figure 3-25 shows the locations of potential groundwater contaminant point sources and the locations of completed/case closed sites. The single open/active leaking underground storage site case is Jim's Service Center (GeoTracker Site ID T0608300118) that was eligible for closure as of January 30, 2019, per the RWQCB Low Threat Closure Policy (SBCPHD, 2019). Site assessment reports indicate there are dissolved-phase benzene and methyl tert-butyl ether (MTBE) concentrations in groundwater beneath the site. Alamo Pintado Creek was determined to be the sensitive downgradient receptor. Due to the measured groundwater gradient in the area of the site, the classification of Alamo Pintado Creek as a losing stream by the USGS NHD, and decreasing benzene and MTBE concentrations, this site was determined to be a minimal threat to groundwater as a drinking water source (Flowline Consulting, Inc., 2018). Figure 3-25 also shows a landfill site (L10004697449) that is presently closed. Site monitoring wells indicate that contaminants are either not detected or below regulatory standards. One active oil and gas project site (T10000011845) is present in the northwest corner of the EMA (see section 3.2.3.1.3 for more details on these sites). Based on available information, none of the identified sources of contamination have widespread unremediated contaminant plumes and detected contaminants appear to be localized.

Table 5-2. Water Quality Standards for Selected Constituents of Concern

Constituent	MCL (mg/L)	SMCL[2] (mg/L)	WQO (mg/L)
Chromium	0.05		
Fluoride	2		
Gross Alpha[2]	15		
Nitrate[3]	10		1
Trihalomethanes	0.080		
Carbon Tetrachloride	0.0005		
Foaming Agents (MBAS)	--	0.5	
Iron	--	0.3	--
Manganese	--	0.05	--
Boron	--	--	0.5
Chloride	--	500	50
Sodium	--	--	20
Sulfate	--	500	10
Total Dissolved Solids	--	1,000	600

Notes
[1] Nitrate concentration measured as nitrogen (EPA MCL)
[2] Upper consumer acceptance level
[3] State of California DDW MCL
--: No value
SWRCB. 2019. California Code of Regulations, Title 22. April 16. California State Water Resources Control Board (SWRCB).
RWQCB. 2019. Water Quality Control Plan for the Central Coastal Basin, June 2019 Edition. California Environmental Protection Agency. Central Coast Regional Water Quality Control Board (RWQCB).
DDW = Division of Drinking Water EPA = U.S. Environmental Protection Agency
mg/L = milligram per liter MCL = maximum contaminant level (drinking water)
SMCL = secondary maximum contaminant level (drinking water)
WQO = water quality objective (median groundwater objective)

5.8.2.2 Salts and Nutrients [§ 354.28(a) and (d)]

§ 354.28 Minimum Thresholds.

(a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

Minimum thresholds pertaining to salts and nutrients measured in groundwater are as follows:

- Concentrations of TDS, chloride, sulfate, boron, sodium, and nitrate are equal to or greater than WQOs in 50 percent of representative wells or are equal to concentrations present when SGMA was enacted (January 2015).

The WQOs for each constituent are presented in Table 5-2 are considered the minimum thresholds for salts and nutrients. In cases where the ambient (prior to January 2015) water quality exceeds the WQO, the ambient water quality is considered the minimum threshold.

5.8.2.3 Relationship between Individual Minimum Thresholds and Other Sustainability Indicators [§ 354.28(b)(2) and (c)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

(c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

The groundwater quality minimum thresholds were set based on state and federal drinking water quality standards, as well as WQOs included in the Basin Plan.

Because SGMA regulations do not require projects or actions to improve groundwater quality beyond what existed prior to January 1, 2015 (Water Code, § 10727.2(b)(4)), or beyond that required by other regulatory agencies with clear jurisdiction over the matter and because the basin has no history of material water quality issues in this regard, there will be no direct actions under the GSP associated with the groundwater quality minimum thresholds at this time, though the GSA will continue to monitor water quality. Therefore, there are no actions that directly influence other sustainability indicators, as described below.

- **Avoid Chronic Lowering of Groundwater Levels.** Groundwater quality minimum thresholds could influence groundwater level minimum thresholds by limiting the types of water that can be used for groundwater recharge to raise groundwater levels. Water used for recharge cannot exceed any of the groundwater quality minimum thresholds.
- **Avoid Chronic Reduction of Groundwater in Storage.** Nothing in the groundwater quality minimum thresholds promotes pumping in excess of the sustainable yield. Therefore, the groundwater quality minimum thresholds will not result in an exceedance of the groundwater storage minimum threshold.
- **Avoid Land Subsidence.** Nothing in the groundwater quality minimum thresholds promotes a condition that will lead to additional subsidence; therefore, the groundwater quality minimum thresholds will not result in a significant or unreasonable level of subsidence.
- **Avoid Depletion of Interconnected Surface Waters.** There is no information indicating that the groundwater quality minimum thresholds would have significant and unreasonable effects on interconnected surface waters. Nothing in the groundwater quality minimum thresholds promotes additional pumping or lower groundwater levels in areas where interconnected surface waters may exist. Therefore, the groundwater quality minimum thresholds will not result in a significant or unreasonable depletion of interconnected surface waters.
- **Avoid Seawater Intrusion.** This sustainability indicator is not applicable to the EMA.

5.8.2.4 Effects of Minimum Thresholds on Neighboring Basins [§ 354.28(b)(3)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

The CMA is hydrologically downgradient of the EMA; thus, groundwater generally flows from the EMA into the CMA. Poor groundwater quality, should such condition ever occur in the EMA, could flow into the CMA, affecting the ability to achieve sustainability in the CMA. The degraded groundwater quality minimum threshold for salts and nutrients is set to prevent unreasonable movement of poor-quality groundwater or further degrade groundwater quality that could impact overall beneficial uses of groundwater. Therefore, it is unlikely that the groundwater quality minimum thresholds established for the EMA will prevent the CMA from achieving sustainability. The groundwater gradients at the boundary between the EMA and SACV are such that groundwater does not flow between the EMA and SACV and, therefore, the SACV would not be impacted by the minimum threshold for the degraded groundwater quality sustainability indicator in the EMA.

5.8.2.5 Effects of Minimum Thresholds on Beneficial Uses and Land Uses [§ 354.26(b)(3)]

§ 354.26 Undesirable Results.

(b) The description of undesirable results shall include the following:

(3) Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.

The minimum thresholds for degraded groundwater quality have been established to avoid undesirable results. For this reason, groundwater serving beneficial uses (including GDEs) and land uses will not be adversely affected, as described below:

- **Agricultural land uses and users.** The degraded groundwater quality minimum thresholds generally benefit the agricultural water users in the EMA. For example, setting the minimum threshold for salts and nutrients at the WQOs described in the Basin Plan ensures that a supply of usable groundwater will exist for beneficial all agricultural uses.
- **Municipal uses and users.** The degraded groundwater quality minimum thresholds generally benefit the municipal water users in the EMA because there are existing regulatory programs and agencies that ensure there is an adequate supply of good quality groundwater are in place to ensure that drinking water standards are satisfied for municipal uses. In addition, water quality standards and the related minimum thresholds for salts and nutrients are intended to be protective of drinking water uses.
- **Domestic users.** The degraded groundwater quality minimum thresholds for municipal generally benefit the domestic water users in the EMA because these uses share the aquifer with municipal water supply wells. In addition, water quality standards and the related MTs for contaminants, salts, and nutrients are intended to be protective of drinking water uses.
- **Ecological land uses and users.** Although the degraded groundwater quality minimum thresholds do not directly benefit ecological uses, it can be inferred that the degraded groundwater quality minimum thresholds will indirectly benefit ecological water uses in the EMA because these thresholds limit future increases in concentrations of constituents of concern from what they are now, or prior to what they were when SGMA was enacted in January of 2015.

5.8.2.6 Relevant Federal, State, or Local Standards [§ 354.28(b)(5)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

The degraded groundwater quality minimum thresholds for salts and nutrients specifically incorporate federal and state drinking water standards. State regulatory agencies have responsibility and authority for responding to contaminant detections that may impair drinking water quality.

5.8.2.7 Methods for Quantitative Measurement of Minimum Thresholds [§ 354.28(b)(6)]

> **§ 354.28 Minimum Thresholds.**
>
> **(b) The description of minimum thresholds shall include the following:**
>
> **(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.**

Degraded groundwater quality will be directly measured from existing or new municipal (DDW compliance monitoring program), domestic (if landowners participate in monitoring), and agricultural supply wells (ILRP). Degraded groundwater quality minimum thresholds will be directly measured from RMSs. Exceedances of regulatory standards and WQOs will be assessed on an annual basis in accordance with the monitoring program (see Section 4). Minimum thresholds for the degradation of groundwater quality sustainability indicator are met when concentrations of constituents of concern exceed the regulatory threshold (WQOs defined in the Basin Plan and concentrations present when SGMA was enacted [January 2015]) for three consecutive monitoring events in more than 50 percent of RMSs.

5.8.3 Measurable Objectives [§ 354.30(a),(b),(c),(d), and (g)]

> **§ 354.30 Measurable Objectives.**
>
> **(a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.**
>
> **(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.**
>
> **(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.**
>
> **(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.**
>
> **(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.**

5.8.3.1 Measurable Objectives Pertaining to Contaminants

Remediating groundwater contamination Improving groundwater quality is not a required under SGMA; however, protecting it from further degradation due to groundwater production or GSA activity is important to the beneficial users and uses of the resource in the EMA so that pumping can be maintained at desired levels. Thus, the measurable objective as it relates to contaminants is to not make contamination issues worse and to maintain groundwater quality equal to or below regulatory standards or, equal to or below concentrations present in groundwater when SGMA was enacted.

5.8.3.2 Measurable Objectives Pertaining to Salts and Nutrients

The measurable objective as it relates to salts and nutrients (i.e., TDS, chloride, sulfate, boron, sodium, and nitrate) is to maintain groundwater quality equal to or below WQOs presented in the Basin Plan, or equal to or below concentrations present in groundwater when SGMA was enacted.

5.8.4 Interim Milestones [§ 354.30(e)]

§ 354.30 Measurable Objective.

(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin with 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

Interim milestones show how the GSA anticipates moving from current conditions to meeting the measurable objectives. No significant and unreasonable results have been observed in the EMA in association with degraded groundwater quality. Therefore, no interim milestones are being proposed.

5.9 Land Subsidence Sustainable Management Criterion

5.9.1 Undesirable Results [§ 354.26(a),(b)(1),(b)(2), and (d)]

§ 354.26 Undesirable Results.

(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

(b) The description of undesirable results shall include the following:

(1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(2) The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.

(d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

Conditions that may lead to an undesirable result in the EMA include a shift in pumping locations or substantial increase in pumping beyond what has been observed, which could lead to a substantial decline in groundwater levels that could result in land subsidence that exceeds the minimum thresholds. Presently, there is no data to indicate whether the geologic materials comprising the basin are susceptible to subsidence. The Basin is located in a very tectonically active region and so the ground surface may rise or fall as a result.

Locally defined significant and unreasonable conditions for land subsidence are land subsidence rates exceeding rates estimated by using the data sets described below and land subsidence that causes damage to groundwater supply, land uses, infrastructure, and property interests:

- Estimated land subsidence using InSAR data that are collected by the European Space Agency (ESA) Sentinel-1A satellite and processed by TRE ALTAMIRA Inc. for the period from June 13, 2015, through September 19, 2019 (TRE ALTAMIRA, Inc., 2020)
- Estimated land subsidence using InSAR data processed by ESA Sentinel-1A satellite and processed by the National Aeronautics and Space Administration Jet Propulsion Laboratory for the period between spring of 2015 and summer of 2017 (NASA JPL, 2018)
- Measured land subsidence data collected by a network of CGPS stations operated by UNAVCO. Measured land subsidence data collected by CGPSs located in areas immediately outside of the EMA were reviewed (UNAVCO, 2020)

For clarity, this SMC uses two related concepts to define significant and unreasonable conditions:

- **Land subsidence** is a gradual settling of the land surface caused by, among other processes, compaction of subsurface materials due to lowering of groundwater levels from groundwater pumping. Land subsidence from dewatering subsurface clay layers can be an inelastic process and the potential decline in land surface could be permanent. This can also be caused by exploitation of oil and gas from fields located within or near the EMA.
- **Land surface fluctuation.** Land surface may rise or fall, elastically, in any one year. Land surface fluctuation may or may not indicate long-term permanent subsidence. This can be caused by tectonic activity in the earth. It can also be caused by grading activities, particularly in agricultural areas or housing developments.

By regulation, the ground surface subsidence undesirable result is a quantitative combination of subsidence minimum threshold exceedances. Therefore, the ground surface subsidence undesirable results include the following:

- Significant and unreasonable subsidence caused by groundwater extraction exceeds the minimum threshold and causes damage to structures and infrastructure and substantially interferes with surface land uses.

Figure 3-36 shows the InSAR measured subsidence in the EMA. The dark blue areas are areas with measured ground surface rise of between 0 feet and 0.25 feet. The teal area on Figure 3-36 is the area with measured ground surface drop of 0 feet to 0.25 feet. Random sampling of the 100-meter by 100-meter (328-foot by 328-foot) calculation grid cells indicates the greatest amount of subsidence in the EMA has occurred in the wedge-shaped area that is bound by and includes Los Olivos, State Highway 154, and the base of the San Rafael Mountains. Total measured subsidence in the area from June 13, 2015, through September 19, 2019, is less than 0.06 feet, or 0.015 feet per year. The data accuracy report for the InSAR data (Towill, Inc., 2020) states that "InSAR data accurately models change in ground elevation to an accuracy tested to be 16 mm at 95% confidence." Therefore, the InSAR-based annual subsidence rate of 0.015 feet (0.18 inches) is below the accuracy range of 0.053 feet (0.63 inches). The reported subsidence is within the range of uncertainty of the InSAR data, indicating that no significant subsidence within the Basin has been recorded.

Elevation data recorded from the UNAVCO CGPS Stations is presented on Figure 3-37, which includes time-series plots of subsidence. One of these stations is located near the Santa Ynez Airport, while the other two stations are located in the periphery of the Basin and indicate what is occurring with regard to surface elevations regionally. Total subsidence, or uplift, recorded by the station within the EMA, indicate that, since 2015, subsidence is 4 millimeter (mm) per year (plus or minus approximately 1 mm per year), for a total subsidence of 20 mm (0.065 feet). For the stations immediately surrounding the EMA during the approximately 19-year period of record (approximately 2001 through 2020) total subsidence has been approximately plus or minus 10 mm (0.03 feet). This is a minor rate of subsidence or uplift and is insignificant.

To supplement the InSAR and UNAVCO data, a preliminary evaluation was completed to assess the range of possible long-term ground surface elevation changes related to withdrawal of groundwater from the EMA. The preliminary evaluation included developing stratigraphic profiles from well logs and estimating ranges of possible long-term subsidence that might be expected in the future. The analysis was completed at two well locations (ID1 5a and ID1 6) with estimated potential subsidence of on the order of 0.5 to 3 feet resulting from the changes in groundwater elevation reported in the hydrographs. This report is presented in Appendix D-2 and additional discussion is included in Section 3.2.4. Due to a lack of subsidence data for the portion of the EMA where pumping effects are likely to be the greatest, a subsidence monitoring program is proposed and presented in Section 4.

Recorded subsidence could be due to tectonic activity, groundwater extraction, oil and gas extraction, or a combination of the three. Should potential subsidence be observed, the GSA will first assess whether the subsidence may be due to (1) groundwater pumping and (2) elastic processes (subsidence that will recover with rising groundwater). If the subsidence is not elastic or is due to pumping, the GSA will undertake a program to correlate the observed subsidence with measured groundwater elevations.

Staying above the minimum threshold will avoid the subsidence undesirable result and protect the beneficial uses and users from impacts to groundwater supply, land uses, infrastructure, and property interests.

5.9.2 Minimum Thresholds [§ 354.26(c) and 354.28(a),(b)(1),(c)(5)(A)(B),(d), and (e)]

§ 354.26 Undesirable Results.

(c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

§ 354.28 Minimum Thresholds.

(a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by the uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(5) Land Subsidence. The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results. Minimum thresholds for land subsidence shall be supported by the following:

(A) Identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including an explanation of how the Agency has determined and considered those uses and interests, and the Agency's rationale for establishing minimum thresholds in light of those affects.

(B) Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

(e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

Section 354.28(c)(5) of the SGMA regulations states that "The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results."

The subsidence minimum threshold is as follows and summarized in Table 5-3:

- The rate of subsidence does not exceed 0.08 feet (1 inch) per year for 3 consecutive years.

This minimum threshold was selected because undesirable results have not been observed and this rate of subsidence is consistent with what has been measured by the InSAR and UNACVO CGPS datasets. The GSA may conduct land surface elevation monitoring using high-resolution GPS equipment at benchmarks located in the vicinity of critical infrastructure. The expected precision and accuracy of this method will be equal to or better than the InSAR and UNAVCO CGPS methods.

Table 5-3. Land Subsidence Minimum Threshold

RMS ID	Rate of Land Subsidence (feet per year)
InSAR and UNAVCO Methods	0.08[1]

Notes

[1] Land subsidence must also cause damage to groundwater supply, land uses, infrastructure, and property interests.
RMS = representative monitoring site InSAR = Interferometric Synthetic Aperture Radar

5.9.2.1 Relationship between Individual Minimum Thresholds and Other Sustainability Indicators [§ 354.28(b)(2)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

Subsidence minimum thresholds have little or no impact on other minimum thresholds, as described below:

- **Avoid Chronic Lowering of Groundwater Levels.** Subsidence minimum thresholds will not result in significant or unreasonable lowering of groundwater levels.
- **Avoid Chronic Reduction of Groundwater in Storage.** The subsidence minimum thresholds will not change the amount of groundwater pumping and will not result in a significant or unreasonable change of groundwater in storage.
- **Avoid Degraded Groundwater Quality.** The subsidence minimum thresholds will not change the groundwater flow directions or gradients of groundwater pumping and therefore and will not result in a significant or unreasonable change in groundwater quality.
- **Avoid Depletion of Interconnected Surface Waters.** The groundwater level subsidence minimum thresholds will not change the amount or location of groundwater pumping and will not result in a significant or unreasonable depletion of interconnected surface waters.
- **Avoid Seawater Intrusion.** This sustainability indicator is not applicable in the EMA.

5.9.2.2 Effects of Minimum Thresholds on Neighboring Basins [§ 354.28(b)(3)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

The ground surface subsidence minimum thresholds are set to prevent any long-term subsidence that could harm groundwater supply, land uses, infrastructure, and property interests. Therefore, the subsidence minimum thresholds for the EMA will not prevent the downstream CMA and adjacent SACV from achieving sustainability.

5.9.2.3 Effects of Minimum Thresholds on Beneficial Uses and Land Uses [§ 354.28(b)(4)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

The subsidence minimum thresholds are set to prevent subsidence that could harm groundwater supply, land uses, infrastructure, and property interests. Available data indicate that there is currently little subsidence occurring in the EMA, and no subsidence that has been observed to substantially interfere with groundwater supply, land uses, infrastructure, and property interests. Therefore, there is no likely negative impact on any beneficial uses or users of groundwater.

5.9.2.4 Relevant Federal, State, or Local Standards [§ 354.28(b)(5)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

There are no federal, state, or local regulations related to subsidence.

5.9.2.5 Methods for Quantitative Measurement of Minimum Thresholds [§ 354.28(b)(6)]

> **§ 354.28 Minimum Thresholds.**
>
> **(b) The description of minimum thresholds shall include the following:**
>
> **(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.**

Minimum thresholds will be assessed using DWR-supplied InSAR and UNAVCO CGPS data and land surface elevation monitoring (see Section 4).

5.9.3 Measurable Objectives [§ 354.30(a)]

> **§ 354.30 Measurable Objectives.**
>
> **(a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.**

5.9.3.1 Methodology for Setting Measurable Objectives

The measurable objectives are set based on maintaining current conditions (e.g., rate of subsidence does not significantly change). Changes are measured by DWR-supplied InSAR data, UNAVCO CGPS data, and land surface elevation monitoring if performed by the GSA.

5.9.3.2 Measurable Objectives for the Basin [§ 354.30(b),(c),(d), and (g)]

> **§ 354.30 Measurable Objectives.**
>
> **(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.**
>
> **(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.**
>
> **(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.**
>
> **(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.**

The measurable objectives for subsidence represent target subsidence rates in the EMA. Available information does not suggest the occurrence of significant and unreasonable subsidence in the EMA. Therefore, the measurable objective for subsidence is the accuracy range of the InSAR data at 95 percent confidence (0.053 feet) and is summarized in Table 5-4.

Table 5-4. Land Subsidence Measurable Objective

RMS ID	Rate of Land Subsidence (feet per year)
InSAR	0.053

Notes

RMS = representative monitoring site

InSAR = Interferometric Synthetic Aperture Radar

5.9.4 Interim Milestones [§ 354.30(e)]

§ 354.30 Measurable Objective.

(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin with 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

Interim milestones show how the GSA anticipates moving from current conditions to meeting the measurable objectives. No significant or unreasonable effect has been observed in the EMA in association with land subsidence. Therefore, no interim milestones are being proposed.

5.10 Depletion of Interconnected Surface Water Sustainable Management Criterion

5.10.1 Undesirable Results [§ 354.26(a),(b)(1)(2), and (d)]

§ 354.26 Undesirable Results.

(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

(b) The description of undesirable results shall include the following:

(1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(2) The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.

(d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

The conditions that may lead to an undesirable result for interconnected surface water in the EMA include the following:

- **Groundwater level declines.** A significant and unreasonable condition for depletion of interconnected surface water is a pumping-induced reduction in groundwater levels in specific locations where groundwater is interconnected with surface water that causes depletion of the interconnected surface water, resulting in significant and unreasonable adverse impacts to Category A GDEs (see Section 3.2 and Figure 3-40). As discussed in Section 5.10, groundwater levels that continue to decline below historical levels in the future may reduce groundwater flow in areas that are connected to surface water and have significant and unreasonable adverse impacts on Category A GDEs. No significant or unreasonable effects have been observed thus far in areas identified as being interconnected with surface water during periods of historical low groundwater levels and groundwater in storage.
- **Severe drought** would reduce recharge to the Paso Robles Formation and Careaga Sand aquifers; thus, lowering groundwater levels and reducing surface water flow in Alamo Pintado and Zanja de Cota Creeks, which could result in depletions of interconnected surface water that could have a significant and unreasonable adverse impact to Category A GDEs. Short-term impacts due to drought are anticipated in SGMA and the SGMA regulations, with recognition that management actions need sufficient flexibility to accommodate drought periods and ensure short-term impacts can be offset by increases in groundwater levels or storage during normal or wet periods.

Locally defined significant and unreasonable conditions for depletion of interconnected surface water that could cause significant and unreasonable adverse impacts to Category A GDEs were assessed using several resources:

- Potential GDE identification using the Natural Communities Commonly Associated with Groundwater (NCCAG) data set from DWR and The Nature Conservancy guidance on screening for potential GDEs (see Section 3.2.6)
- Identification of interconnected surface water (see Section 3.2.5)
- Groundwater elevation monitoring data (see Section 3.2.1)

The focus of this sustainability indicator is avoiding significant and unreasonable adverse impacts on beneficial uses of interconnected surface water in the EMA caused by groundwater use. Category A GDEs are the only identified beneficial use in the subject areas. Section 3.2 describes the methodology used to identify GDEs in the EMA. In summary, measured groundwater level data and groundwater elevation contours within the Principal Aquifers were compared to the NCCAG data set available from DWR to identify locations within the EMA where groundwater levels were within 30 feet of ground surface. The Nature Conservancy's guidelines suggests that potential GDEs in areas where groundwater occurs more than 30 feet below ground surface can be removed from the GDE category since this depth is too great to support habitat (The Nature Conservancy, 2019). Based on this evaluation, GDEs (Category A) associated with one of the Principal Aquifers were identified on the downstream ends of Alamo Pintado and Zanja de Cota Creek (see Figure 3-40) where there is evidence that groundwater is interconnected with surface water. Other potential GDEs were identified in other parts of the Basin; however, they were excluded from consideration because they are located in higher elevations above the regional water table, likely supported by perched water, not associated with a Principal Aquifer, or are outside of the areas that are affected by groundwater use in the Basin (e.g., north and east of Lake Cachuma).

According to local stakeholders, Alamo Pintado and Zanja de Cota Creeks are generally dry except during periods of rainfall. The lower end of these creeks near the confluence with the Santa Ynez River are perennially wet because groundwater present in the underlying Principal Aquifer (Paso Robles Formation or Careaga Sand) is "upwelling" into the creek at these locations. The upwelling occurs because low permeability marine rocks that underly the Santa Ynez River form a groundwater dam that causes the upwelling and discharge to surface water. This is the reason why GDEs have been sustained in these areas. The current GDEs have survived through the recent drought (WY 2012 to 2021 with two wet years in WYs 2017 and 2019) that saw historical low groundwater levels in many EMA groundwater wells. When surface water is present or when groundwater levels are above the maximum rooting depth of the plants, it can be inferred that GDEs are not adversely affected (because no impacts to GDEs have been observed to date).

No studies have been found that evaluated historical or existing habitat composition or condition in the GDE area along Alamo Pintado and Zanja de Cota Creek. Without completing an additional assessment, it cannot be determined whether the Alamo Pintado and Zanja de Cota Creek's ability to support GDEs has changed over time as a result of drought conditions in the region or whether pumping in the EMA has caused impacts. To avoid impacts to Category A GDEs in the future, construction of shallow monitoring wells, or piezometers, are proposed within the Category A GDE areas identified near the confluence of Alamo Pintado and Zanja de Cota Creek with the Santa Ynez River (see Figure 3-40). Groundwater elevation will be used as a proxy for the depletion of interconnected surface water sustainability indicator.

Because GDEs are the only beneficial use of interconnected surface water in the subject areas, the minimum threshold for depletion of interconnected surface water is focused on avoiding significant and unreasonable adverse impacts to Category A GDEs. The areas near the confluence of Alamo Pintado and

Zanja de Cota Creek with the Santa Ynez River (see Figure 3-40) are the only locations identified in the EMA where groundwater from a Principal Aquifer is interconnected with surface water.

Significant and unreasonable adverse impacts on beneficial uses of surface water that result in undesirable results include the following:

- Permanent loss or significant and unreasonable adverse impacts to existing native riparian or aquatic habitat in the Category A GDE area due to lowered groundwater levels caused by pumping

A sustained drop in groundwater levels below root zones caused by groundwater pumping could result in permanent loss of GDEs. Monitoring of groundwater levels near the confluence of Alamo Pintado and Zanja de Cota Creek with the Santa Ynez River will be conducted by the GSA as part of EMA monitoring programs (see Section 4) to assess whether there is potential for significant and unreasonable adverse impacts to a long-term decline in the health of the GDEs in the subject areas and eventual permanent habitat loss.

5.10.2 Minimum Thresholds [§ 354.28(a),(b)(1),(c)(6)(A)(B),(d), and (e)]

§ 354.28 Minimum Thresholds.

(a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by the uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(6) Depletions of Interconnected Surface Water. The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results. The minimum threshold established for depletions of interconnected surface water shall be supported by the following:

(A) The location, quantity, and timing of depletions of interconnected surface water.

(B) A description of the groundwater and surface water model used to quantify surface water depletion. If a numerical groundwater and surface water model is not used to quantify surface water depletion, the Plan shall identify and describe an equally effective method, tool, or analytical model to accomplish the requirements of this Paragraph.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

(e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

Section 354.28(c)(6) of the SGMA regulations states that "The minimum thresholds for depletion of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results."

The numerical groundwater model was used to assess the timing and magnitude of potential depletions of interconnected surface waters that may have occurred in the past along these two creeks since there are no surface water gauging sites. The model was also used to assess whether future predicted changes in land use, pumping, and climate (assuming no climate change) cause depletion that may cause significant and unreasonable adverse impacts to beneficial uses [e.g., GDEs] in the Category A GDE area shown on Figure 3-40. As has been observed from past monitoring, groundwater levels vary significantly in response to wet and dry cycles and so the interconnection with surface water is also expected to vary. Groundwater modeling results show similar groundwater level fluctuations in response to historical climate variability and that there is no evidence of significant and unreasonable depletion of interconnected surface water during the historical period. The model predicts similar results for the future 2042 and 2072 periods, except during droughts when water levels are at their lowest.

The minimum threshold for depletion of interconnected groundwater and surface water is presented below and in Table 5-5:

- Groundwater levels measured at the piezometers proposed to be installed in the GDE areas of Alamo Pintado and Zanja de Cota Creek are 15 feet or more below the stream bed.

This minimum threshold was selected because it represents the lowest groundwater level that most GDE plants can typically access with their roots. Capillary action in fine-grained sediments within the creek bed will also bring water farther up (as much as several feet) into the vicinity of the plant roots. Based on groundwater modeling results presented previously, it appears that this threshold has never been reached in the past and is not expected in the future with the assumed climate and land use changes. Groundwater levels measured at proposed monitoring wells located within the Category A GDE areas of Alamo Pintado and Zanja de Cota Creeks will be used to assess whether depletion of interconnected surface water is occurring and whether significant and unreasonable adverse impacts to GDEs are likely to occur.

Table 5-5. Depletion of Interconnected Surface Water Minimum Thresholds

RMS ID	Minimum Threshold
Piezometer(s)[1]	15 feet below respective stream bed[2]

Notes

[1] See Figure 4-4 for locations of proposed piezometers.

[2] To meet the minimum threshold, groundwater levels in piezometers must be equal to or below 15 feet below the stream bed in the Category A GDE areas of Alamo Pintado and Zanja de Cota Creek.

RMS = representative monitoring site

Figure 4-4 shows the location of the proposed piezometers in the Category A GDE areas identified in Alamo Pintado and Zanja de Cota Creek.

5.10.2.1 Relationship between Individual Minimum Thresholds and to Other Sustainability Indicators [§ 354.28(b)(2)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

Because of the interrelationship between groundwater level, changes in storage, and interconnected surface water, it is possible that one set of thresholds could affect the other set of thresholds for these indicators. The relationship between the depletion of interconnected surface water and the other sustainability indicators is presented below:

- **Avoid Chronic Lowering of Groundwater Levels.** The depletion of interconnected surface water minimum threshold is related to groundwater level minimum thresholds because they are interdependent. If groundwater levels in the Principal Aquifers decline such that there is a significant reduction in upwelling to Zanja de Cota and Alamo Pintado Creeks near their confluences with the Santa Ynez River, surface water depletion of interconnected surface water and significant and unreasonable adverse impacts to GDEs is possible. Monitoring of groundwater levels within the Category A GDE areas will indicate whether this is occurring. If groundwater levels reach depletion of surface water minimum thresholds, then an evaluation, and potentially management actions, would be conducted in a timely manner to avoid significant and unreasonable adverse impacts to GDEs.
- **Avoid Chronic Reduction of Groundwater in Storage.** Nothing about the minimum threshold promotes groundwater pumping in excess of the sustainable yield. Therefore, the minimum threshold for depletion of interconnected surface water will not result in an exceedance of the groundwater in storage minimum threshold.
- **Avoid Degraded Groundwater Quality.** The minimum threshold for depletion of interconnected surface water will not change the groundwater flow directions or gradients, and, therefore, will not result in a significant or unreasonable change in groundwater quality.
- **Avoid Land Subsidence.** Nothing about the minimum threshold for depletion of interconnected surface water promotes a condition that will lead to additional subsidence. Therefore, the minimum threshold for depletion of interconnected surface water will not result in a significant or unreasonable level of subsidence.
- **Avoid Seawater Intrusion.** This sustainability indicator is not applicable to the EMA.

5.10.2.2 Effects of Minimum Thresholds on Neighboring Basins [§ 354.28(b)(3)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

The CMA is hydrologically downgradient of the EMA. As discussed in Section 3.1, groundwater and surface water generally flow from the EMA into the CMA. The minimum threshold for depletion of interconnected surface water is set to protect habitat and sensitive species at specific locations in the EMA where there is a connection between groundwater and surface water. The minimum threshold for depletion of interconnected surface water in the EMA is not anticipated to impact sustainability in the CMA because conditions that are necessary to avoid impacts to Category A GDEs in the EMA will continue to support flows into the CMA.

Groundwater gradients at the boundary between the EMA and SACV indicate that groundwater does not flow between the EMA and SACV and, therefore, the SACV would not be impacted by the minimum threshold for the depletion of interconnected surface water sustainability indicator in the EMA.

5.10.2.3 Effects on Beneficial Uses and Land Uses [§ 354.28(b)(4)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

The minimum threshold for depletion of interconnected surface water has been selected to avoid significant and unreasonable adverse impacts to Category A GDEs in the EMA, while providing a reliable and sustainable groundwater supply. The minimum thresholds for reduction of groundwater in storage and lowering of groundwater levels have been established to avoid undesirable results. For this reason, groundwater serving beneficial uses (including GDEs) and land uses will not be adversely affected.

5.10.2.4 Relevant Federal, State, or Local Standards [§ 354.28(b)(5)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

There are no federal, state, or local regulations related to interconnected surface water depletion where this interconnection with groundwater has been identified.

5.10.2.5 Methods for Quantitative Measurement of Minimum Thresholds [§ 354.28(b)(6)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

As a surrogate for surface water flow measurements, groundwater levels will be measured in piezometers proposed to be installed in the Category A GDE areas of Alamo Pintado and Zanja de Cota Creek as shown on Figure 4-4. Details of this monitoring program are presented in Section 4.

5.10.3 Measurable Objectives [§ 354.30(a),(b),(c),(d), and (g)]

§ 354.30 Measurable Objectives.

(a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.

(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.

(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.

(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.

(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.

The measurable objective for depletion of interconnected surface water uses groundwater levels as a proxy because of the lack of locations of existing surface water gaging stations and because avoiding impacts to GDEs is the focus for this sustainability indicator. The measurable objective for depletion of interconnected surface water has been established in groundwater at 5 feet below the streambed level measured at the piezometers proposed to be installed in the Category A GDE areas of Alamo Pintado and Zanja de Cota Creek (see Figure 4-4). This groundwater level was chosen because it is well within the root zone of vegetation commonly associated with GDEs. The measurable objective for depletion of interconnected surface water is summarized in Table 5-6.

Table 5-6. Depletion of Interconnected Surface Water Measurable Objectives

RMS ID	Measurable Objectives
Piezometer(s)[1]	Groundwater level that is 5 feet below the stream bed[2]

Notes

[1] See Figure 4-4 for locations of proposed piezometers.

[2] To meet the measurable objective, groundwater levels in piezometers must be 5 feet below the stream bed in the Category A GDE areas of Alamo Pintado and Zanja de Cota Creek for consecutive summer and fall monitoring events.

RMS = representative monitoring site

5.10.4 Interim Milestones [§ 354.30(e)]

> **§ 354.30 Measurable Objective.**
>
> (e) **Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin with 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.**

Interim milestones show how the GSA anticipates moving from current conditions to meeting the measurable objectives. Interim milestones are set for each 5-year interval following GSP adoption. For this sustainability indicator, there has been no known or documented significant and unreasonable adverse impact to beneficial uses of surface water, nor impacts to GDEs, to date. The recent historical drought resulted in low groundwater levels and surface water flows. However, there is no indication that any impacts to GDEs were a result of groundwater extractions. For these reasons, no interim milestones are planned.

5.11 References and Technical Studies [§ 354.4(b)]

§ 354.4 General Information.

(b) Each Plan shall include the following general information: A list of references and technical studies relied upon by the Agency in developing the Plan. Each Agency shall provide to the Department electronic copies of reports and other documents and materials cited as references that are not generally available to the public.

DWR. 2017. "Best Management Practices for the Sustainable Management of Groundwater: DRAFT Sustainable Management Criteria." Prepared by the California Department of Water Resources Sustainable Groundwater Management Program.

Flowline Consulting, Inc. 2018. "Fourth Quarter 2018 Monitoring Report and Request for Case Closure, 2015 Mission Drive (Hwy 246), Solvang, California, LUFT Site #50121, SWRCB Global ID #T0608300118." December 20, 2018.

NASA JPL. 2018. InSar Land Surveying and Mapping Services in Support of the DWR SGMA Program Technical Report. Department of Water Resources. Ben Brezing. February.

RWQCB. 2019. Water Quality Control Plan for the Central Coastal Basin, June 2019 Edition. California Environmental Protection Agency. Central Coast Regional Water Quality Control Board (RWQCB).

SBCPHD. 2019. 2015 Mission Drive, Solvang, California; Jim's Service Center, LUFT Site # 50121. Santa Barbara County Public Health Department, Environmental Health Services Division: Letter from E. Steven Nailor, REHS, EIT, SBCPHD, to Jim Enderle, Jim's Service Center.

SWRCB. 2019. California Code of Regulations, Title 22. April 16. California State Water Resources Control Board (SWRCB).

The Nature Conservancy. 2019. Identifying GDEs Under SGMA, Best Practices for using the NC Dataset. July 2019.

Towill, Inc. 2020. "InSar Data Accuracy for California Groundwater Basins, CGPS Data Comparative Analysis, January 2015 to September 2019." Prepared for the California Department of Water Resources. March 23.

TRE ALTAMIRA, Inc. 2020. InSar Land Surveying and Mapping Services in Support of the DWR SGMA Program Technical Report. March.

UNAVCO. 2020. ORES - Overview | Station Page. September. https://www.unavco.org/instrumentation/networks/status/nota/overview/ORES.

This page intentionally left blank.

APPENDIX D-2

Land Subsidence Evaluation

Technical Memorandum

To: Mr. Jeff Barry, GSI Water Solutions, Inc.

From: Michael Cornelius, PG
Joseph de Larios, PE, GE

c:

Date: May 27, 2021

Re: DRAFT FOR REVIEW
Preliminary Subsidence Evaluation
Santa Ynez River Valley Groundwater Basin - Eastern Management Area
Groundwater Sustainability Plan (GSP)
Santa Barbara County, California
GEI Project No. 1902081

As requested by GSI Water Solutions, Inc. (GSI), GEI Consultants, Inc. (GEI) performed a preliminary evaluation of potential subsidence within the Eastern Management Area (EMA) of the Santa Ynez River Valley Groundwater Basin. The groundwater basin in located in northwestern Santa Barbara County, California.

The purpose of the preliminary evaluation is to assess the range of possible long-term ground surface elevation changes related to withdrawal of groundwater from the basin. GEI's evaluation of possible long-term subsidence is based on limited information and is therefore a screening-level study for the purpose of assessing relative risk. GEI's scope of services for the preliminary evaluation, which is described in the contract scope document dated January 6, 2021, included:

- Reviewing information regarding land surface elevations and indications that subsidence has occurred in the past.
- Reviewing subsurface geologic information and groundwater level data provided by GSI to assess the general susceptibility of the EMA to experience subsidence as a result of lowering groundwater levels below historical levels.
- Developing stratigraphic profiles from well logs provided by GSI and estimating ranges of possible long-term subsidence that might be expected in the future, based on a simple one-dimensional settlement model, assumed soil parameters, and professional judgement.

This technical memorandum (TM) describes the background, approach, and results of the preliminary subsidence evaluation.

OVERVIEW

Historically, subsidence of land in California has typically been related to excessive groundwater pumping. In sedimentary aquifers, groundwater is pumped from the pore spaces between sand and gravel grains, causing a lowering of pore-water pressure and a corresponding increase in the effective stress in the aquifer. The increased stresses can induce elastic (reversable) and inelastic (permanent) settlement of the ground surface, depending on a number of factors (including the magnitude and duration of groundwater elevation decline). Fine-grained soil materials (e.g., clays) within the aquifer tend to be much more compressible than the coarser-grained materials (sands and gravels). Consequently, the typical causes of land subsidence are related to compression of the finer-grained strata within a given aquifer.

The relationship between groundwater level decline-and-recovery and subsidence is complex. There are time-dependent and non-linear interactions between the various aspects of the aquifer system, such as the variable thicknesses of the soil strata within a given aquifer, time-dependent changes in effective stress (typically related to lowering and raising of groundwater levels), and variability in the rates and distribution of drainage from the different soil types found within the aquifer. If the magnitude and duration of groundwater elevation decline is limited, land subsidence may be elastic (reversable). Otherwise, some inelastic (permanent) subsidence could be induced.

A check of the U.S. Geological Survey (USGS) land subsidence website (USGS, 2021) indicates that the Santa Ynez River Valley Groundwater Basin Eastern Management Area (EMA) is not in a mapped area of ongoing USGS subsidence studies.

The draft Groundwater Sustainability Plan (GSP)prepared by GSI includes a summary of existing information for long-term changes in ground surface elevation within the groundwater basin (GSI, 2020). The available information regarding elevation changes within the basin is somewhat limited. A TRE Altamira monitoring station about 2 miles southeast of Los Olivos (Figure 3-36 of GSI, 2020) indicates about 0.07 feet of net settlement between July 2015 and October 2019.

The UNAVCO CGPS data reported for the EMA (Figure 3-37 of GSI, 2020) indicates that ground surface elevations are generally stable, with station SYNG-NA (located near the Santa Ynez airport, about 4 miles east of Solvang) indicating net settlement of less than about 0.1 feet between early 2016 and the end of 2020. The rate of subsidence at station SYNG-NA estimated to be about 4 mm per year (plus or minus about 1 mm per year). In the data that we reviewed, GEI did not find any reports indicating specific observations of ground deformation attributed to subsidence within the EMA.

PRELIMINARY EVALUATION OF SUBSIDENCE POTENTIAL

The subsurface geologic information and groundwater level data provided by GSI to GEI was reviewed and the general susceptibility of the EMA to experience subsidence as a result of lowering groundwater levels below historical levels was assessed. The selection of data, the approached used for the first-order estimates of subsidence, and the limitations and uncertainties of the subsidence estimates are discussed below.

> *§354.16 Groundwater Conditions. Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following: (e) The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or the best available information.*

GEI performed a screening-level, preliminary evaluation of the potential for ground surface subsidence within the basin. Our preliminary evaluation included developing stratigraphic profiles from well logs provided by GSI and estimating ranges of possible long-term subsidence that might be expected in the future. There is limited data on the historic groundwater levels across the EMA (GSI, 2020).

The hydrographs (groundwater elevation data plots) contained in the Groundwater Sustainability Plan (GSP) extend back several decades (GSI, 2020). Four groups of "representative" hydrographs are provided, one group for each of the geologic formations that are major groundwater sources (i.e., Paso Robles Formation, Careaga Sand, Santa Ynez River Alluvium, and Tributary Alluvium). The Representative Hydrographs for the Paso Robles Formation (figures 3-24 and 3-25 of GSI, 2020) show groundwater levels fluctuating (declining and recovering) over a period of decades. Depending on the hydrograph, the range of elevation changes is on the order of about 50 feet (records for 6N/29W-08P01 and 6N/30W-07G06 on Figure 3-24) to just over 110 feet (records for 7N/30W-35R01 and 7N/31W-36L02 on Figure 3-25). With the exception of 7N/30W-35R01, the plotted elevations for the most recent data are within the historical ranges for that location.

The groundwater elevations for the hydrographs representing Careaga Sand, Santa Ynez River Alluvium, and Tributary Alluvium are relatively consistent, with the range of groundwater elevation changes generally 20 feet or less. The exception is the record for 8N/31W-36H01, which is screened in the Tributary Alluvium. From 1989 to 2018, the reported high groundwater elevation was about 1,175 feet and the low elevation was about 1,125 feet (a range of about 50 feet).

The well logs for the specific hydrographs presented in the GSP were not available for our review. In addition, there is limited information on the geotechnical conditions within the EMA aquifers (i.e., no site-specific data on the geotechnical properties or engineering parameters).

We used the available "representative" hydrograph information and adjusted groundwater elevations to correspond to the estimated Ground Surface Elevation (GSE) for the specific well log. The hydrographs and well logs used for our evaluations are included in Attachment A. Locations analyzed:

Well ID	**Well No. 5A**	**Well No. 6**
Coordinates (estimated from information on the individual well log and Google Maps):	34.665, -120.116	34.65300, -120.11324
Estimated Ground Surface Elevation (GSE), feet (estimated from Google Maps):	810±	780±
Formation, In Well Screen Interval	Paso Robles Formation	Paso Robles Formation

Sources of Water Level Data Used in Evaluations*:	
7N/30W-35R01 (GSE 850±) Groundwater High Elev. 690 feet Groundwater Low Elev. 575 feet	7N/31W-36L02 (GSE 740±) Groundwater High Elev. 720 feet Groundwater Low Elev. 610 feet

*Figure 3-25 of GSI, 2020

To estimate possible ranges of past and ongoing ground surface settlement, GEI used assumed geotechnical parameters (e.g., unit weights, compressibility, stress history), professional judgement, and classical consolidation theory developed by Terzaghi (Holtz et al., 2011):

$$\delta_c = \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_{zc}}{\sigma'_{z0}}\right) + \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_{zf}}{\sigma'_{zc}}\right)$$

Where:

δ_c = the settlement due to consolidation in a given stratum.
C_c = the compression index.
Cr = the recompression index.
e_0 = the initial void ratio.
H = the height of the compressible soil stratum.
σ_{zf} = the final vertical stress.
σ_{z0} = the initial vertical stress.
σ_{zc} = the preconsolidation stress of the soil.

The stratigraphy, assumed parameters, and the above equation were used to develop simple, one-dimensional settlement models for each of the two sites. First-order estimates of the soil parameters were based on a range of possible values. The estimates from these models are considered first-order estimates and are subject to confirmation through additional investigations.

An important factor and key limitation in assessing the magnitude of potential settlement is the stress history within the soil column (including long-term groundwater levels prior to the available hydrographs). The sediments in the groundwater basin were assumed to be "unconsolidated" from a geologic perspective, but to be near-normally consolidated from a geotechnical perspective. The estimated ranges of possible consolidation settlement were based on model consolidation curves, which were in-turn based on assumed over-consolidation ratio (OCR) values ranging from 1.2 to 2.0 and Janbu's tangent modulus approach (Holtz et al. 2011).

Other key assumptions included:

- Soil layer discretization was based on the available well logs.
- Settlement of soil strata assumed to be predominantly coarse-grained (i.e., material retained on the No. 200 sieve) was considered to be negligible.
- All soil properties (unit weights, compressibility, etc.) were assumed based on soil types indicated on well logs.
- Individual soil layers assumed uniform.
- Layers indicated in the well logs as being clayey were assumed to have clay behavior (i.e., be compressible).
- No settlement assumed below the materials listed in the well logs.

- Unit weights were assumed to be constant, with clay assumed to be 120 pounds per cubic foot (pcf), sand unit weight assumed to be 125 pcf, and gravel unit weight assumed to be 140 pcf.

- All calculations estimate the ultimate consolidation settlement (time rate effects are not included; assumes groundwater levels do not recover).

The soil and groundwater conditions vary widely across the EMA basin. The models produced similar subsidence estimates for the two selected locations, with estimated potential subsidence on the order of ½ to 3 feet resulting from the changes in groundwater elevation reported in the hydrographs.

It should be noted that the well logs used in the evaluations include relatively thick sections of clayey materials (which would be expected to drain slowly) and that groundwater levels have fallen and recovered over the time period documented in the hydrographs. It is unlikely that the full amount of estimated subsidence would be observed unless groundwater elevations declined significantly and did not recover for an extended period. The available ground elevation data do not cover a time period comparable to the hydrograph information, making it difficult to compare the apparent rate of ground surface movement indicated in the GSP (GSI, 2020).

The estimated range of settlement assumes that the sediments in the EMA remain at or above the "normally consolidated" stress state (i.e., the current stresses on the soils are less than the maximum those soils have previously been subjected to over geologic time). If the present or future stresses on the soils exceed the maximum past pressure, the potential long-term subsidence could be several times the estimated range.

DISCUSSION AND CONCLUSIONS

As noted above, ground subsidence is a complex, time-dependent phenomenon. There is commonly significant time-lag between the lowering of groundwater levels and observed subsidence. Figures 1 and 2 include descriptions of the mechanisms, three-dimensional effects, and time-dependent aspects of ground subsidence.

It is important to note that while settlement of the ground surface may have adverse effects on constructed facilities, the relative impact is dependent on the specific facility and the magnitude of settlement (both total and differential). The greatest potential for damage is along linear surface features, including pipelines, canals, levees, railroad tracks, highways. While there is the potential for localized impacts at bridges or building foundations, it is likely that limited amounts of subsidence will not adversely affect the performance of surface improvements and infrastructure.

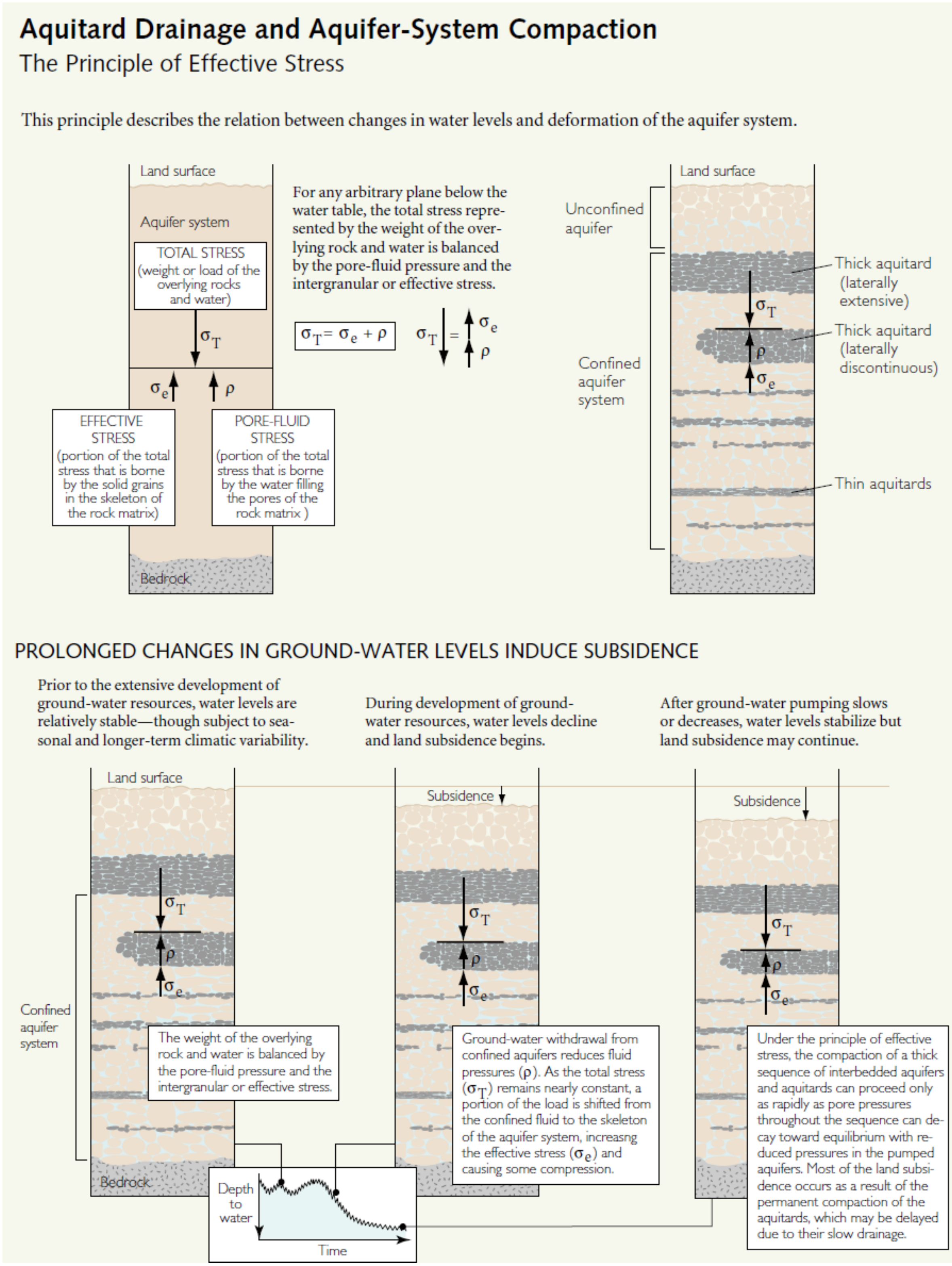


Figure 1: Schematic diagram of land subsidence due to groundwater withdrawal (from Galloway et al., 1999).

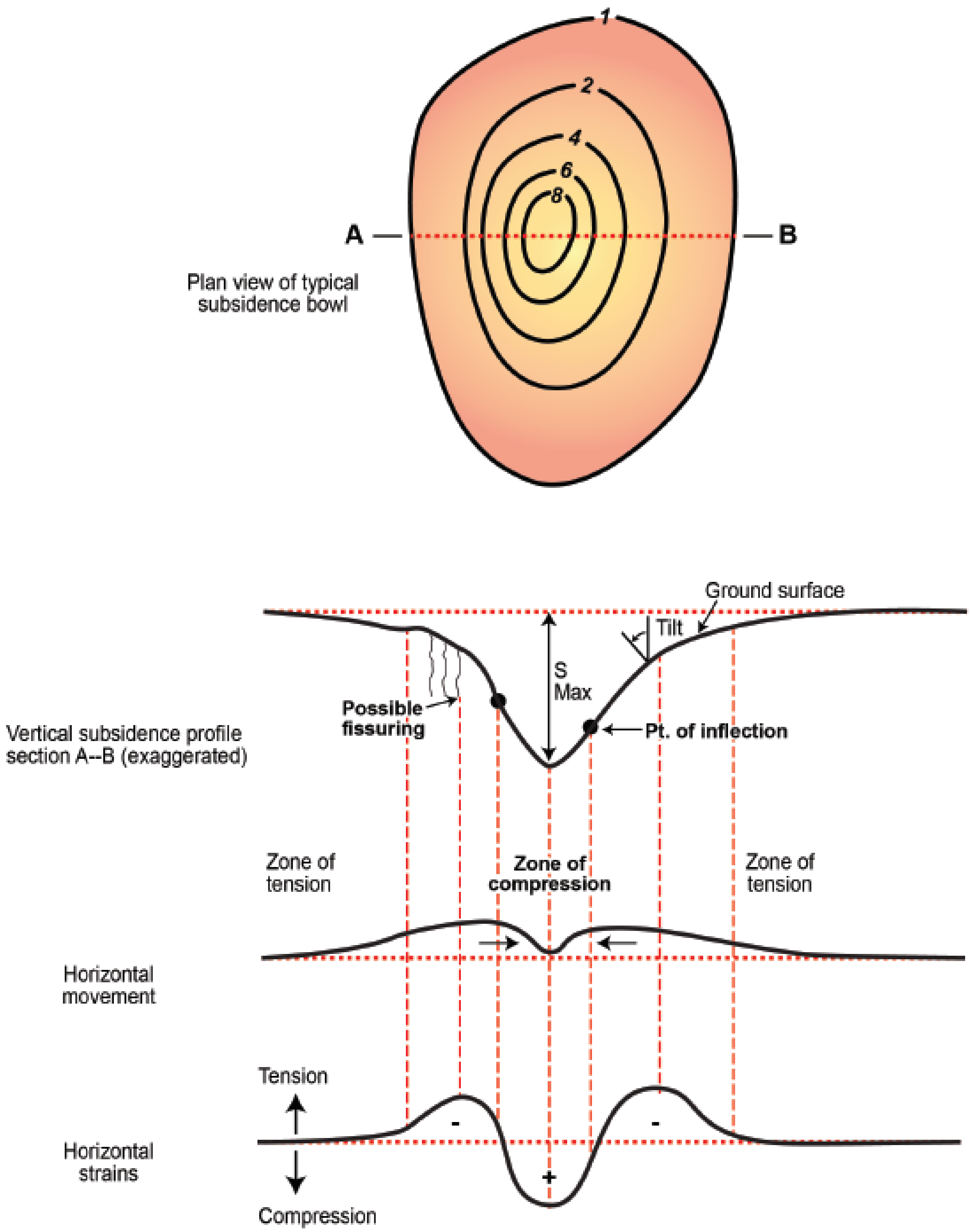


Figure 2: Schematic diagram of land-surface movements associated with subsidence bowls (from Lowe, 2012, modified from Viets and others, 1979). S max is maximum vertical subsidence.

Groundwater Management Perspective

From a groundwater management perspective, we are interested in the magnitude of subsidence that may take place as a result of removal of groundwater from the aquifer system. In California much of the land subsidence resulting from groundwater extraction has occurred in the San Joaquin Valley where the Corcoran Clay is present. As ground water levels in the aquifers beneath the Corcoran Clay are lowered, the water no longer provides the buoyancy to help support the above soil column, so the sediments may compress.

Consolidation of sediments typically takes a relatively long time, often tens of years before it becomes evident at the ground surface. Once the mechanism to initiate subsidence has been started, it may persist for years after groundwater levels have returned above e the threshold which triggered it. Also, compressed sediments cannot be "uncompressed" by adding water to the system. Even if groundwater levels are returned to the "original" elevation, subsidence may continue for some period of time (as the system comes to the new equilibrium).

In the EMA there has been no reported historical or anecdotal information regarding land subsidence as a result of groundwater extractions. There may be, and likely has been some subsidence as a result of groundwater extraction, but we are not aware of documented impacts to surface features. With observed groundwater declines of roughly 100 feet occurring within the EMA (e.g., at 7N/31W-36L02 between about 1943 and 1968, see Figure 3-25 of the GSP), some subsidence may have occurred prior to the initiation of SGMA, but there is not readily available information documenting that. We do not know how much movement has occurred, or how it relates to the maximum amount that may occur based on the geotechnical analysis based on the limited data available.

Recommendations

Future declines in groundwater levels may result in land subsidence, but we are not able to accurately estimate those with the available data. If subsidence is a threat to the groundwater basin, more rigorous investigation and analysis can be conducted to estimate the amount of compaction that has taken place to allow to estimate the maximum amount of compression that may be experienced at a specific location. In order to avoid the potential for additional subsidence from groundwater extraction, groundwater levels should be maintained at or above the historic lows.

During planning and defining of groundwater management goals for the EMA, the need for additional studies should be assessed. Studies could include performing reconnaissance or inspection of critical infrastructure and other facilities to assess whether signs of deformation or subsidence can be observed. If additional ground surface data becomes available, it may be beneficial to evaluate the estimated basin storage and compare it to the measured subsidence.

As a minimum, we recommend that the ground surface elevations within the groundwater basin be periodically surveyed and that apparent changes in elevation be assessed. If total and differential settlements across the basin are of concern, additional measures should be developed to fill data gaps and allow for more-detailed evaluation. If a more-detailed evaluation of potential subsidence is desired, a plan should be developed to investigate the geotechnical parameters and stress history within the aquifer materials, which could include in situ and laboratory testing of soil samples.

Limitations

In the performance of its professional services, GEI Consultants, Inc., its employees, and its agents comply with the standards of care and skill ordinarily exercised by members of our profession practicing in similar localities. The analyses, conclusions, and recommendations discussed in this memorandum are based on limited information about the sites evaluated. Subsurface conditions may vary from those assumed for the purposes of this study.

No warranty, either express or implied, is made or intended in connection with the services performed by us, or by the proposal for consulting or other services, or by the furnishing of oral or written reports or findings. In the event conclusions or recommendations based on information in this memorandum are made by others, such conclusions and recommendations are not our responsibility unless we have been given an opportunity to review and concur with such conclusions or recommendations in writing.

REFERENCES

Galloway, D.L., Jones, D.R., and Ingebritsen, S.E., Editors, 1999, Land subsidence in the United States: U.S. Geological Survey Circular 1182 (https://pubs.usgs.gov/circ/circ1182/#pdf).

GSI Water Solutions, Inc. (GSI), 2020. PUBLIC REVIEW DRAFT Santa Ynez River Valley Groundwater Basin – Eastern Management Area Groundwater Sustainability Plan (DRAFT Section 3 – Basin Setting: HCM & Groundwater Conditions), prepared for Eastern Management Area Groundwater Sustainability Agency, November 20.

Hoffmann, Jörn, Leake, S.A., Galloway, D.L., and Wilson, Alicia M., 2003. MODFLOW-2000 Ground-Water Model—User Guide to the Subsidence and Aquifer-System Compaction (SUB) Package, U.S. Geological Survey Ground-Water Resources Program, Open-File Report 03-233.

Holtz, R. D., Kovacs, W. D., and Sheahan, T. C., 2011. An Introduction to Geotechnical Engineering, Second Ed., Pearson Education Inc. Upper Saddle River, NJ.

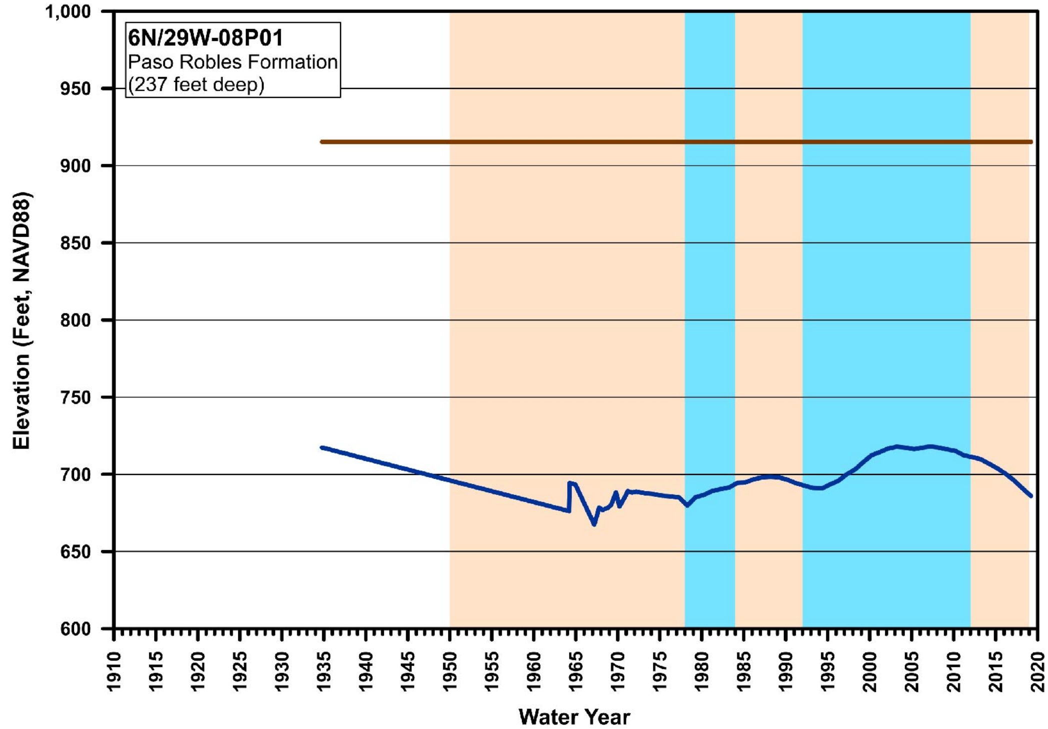
Lowe, M., 2012. Subsidence in Sedimentary Basins Due to Groundwater Withdrawal for Geothermal Energy Development, Utah Geological Survey Open-File Report 601, (https://ugspub.nr.utah.gov/publications/open_file_reports/OFR-601.pdf).

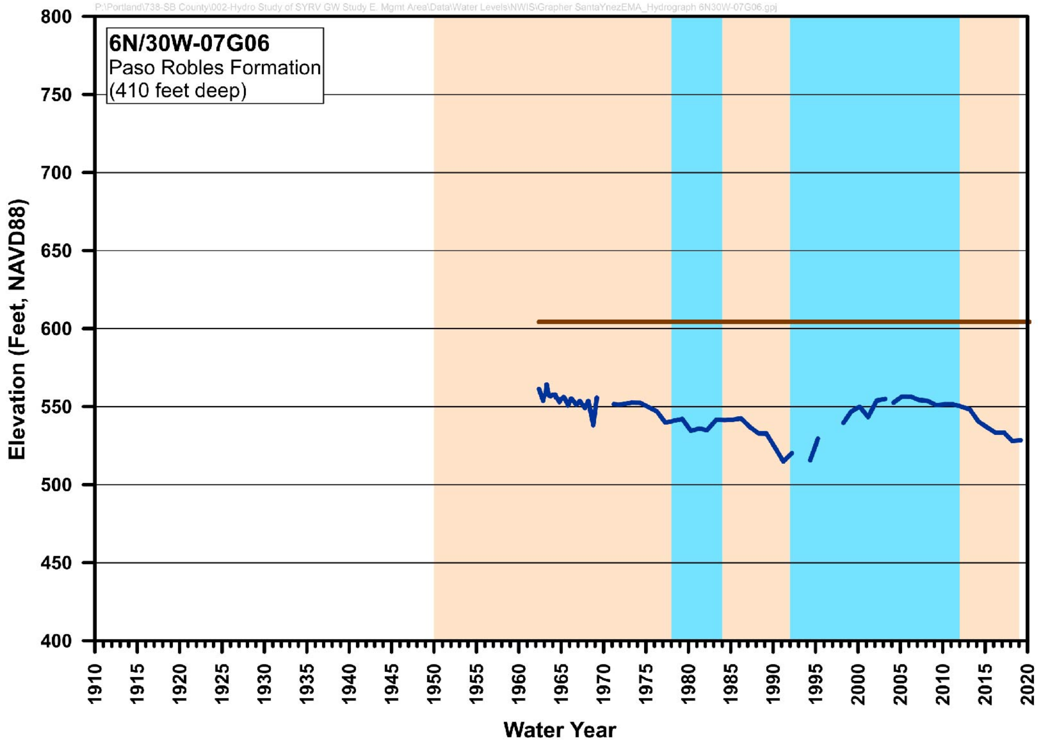
Poland, J.F., Editor, 1984. Guidebook to Studies of Land Subsidence Due to Ground-Water Withdrawal (https://wwwrcamnl.wr.usgs.gov/rgws/Unesco/), prepared for the International Hydrological Programme, Working Group 8.4., United Nations Educational, Scientific and Cultural Organization (UNESCO).

U.S. Geological Survey (USGS), 2021. "Areas of Land Subsidence in California," https://ca.water.usgs.gov/land_subsidence/california-subsidence-areas.html, accessed February 23.

ATTACHMENT A

Hydrographs, Well Locations, and Stratigraphic Information Used in Analyses (well logs and excerpts from GSI Water Solutions, Inc., 2020)





LEGEND

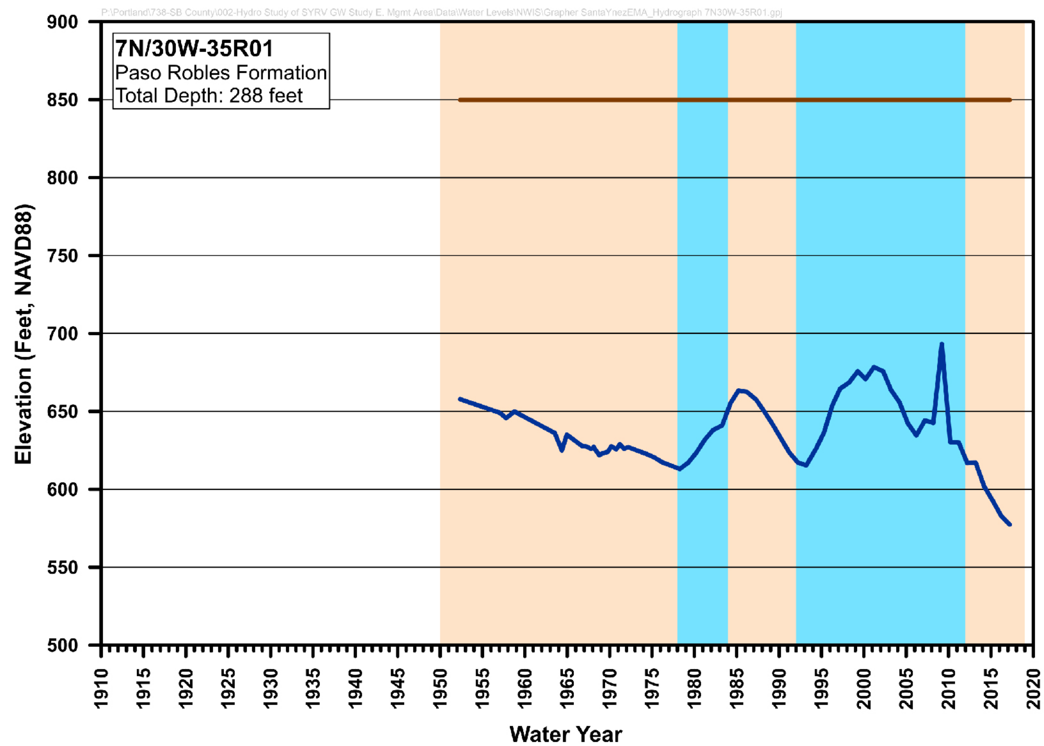
- Ground Surface Elevation
- Groundwater Elevation
- Dry Climatic Cycle
- Wet Climatic Cycle

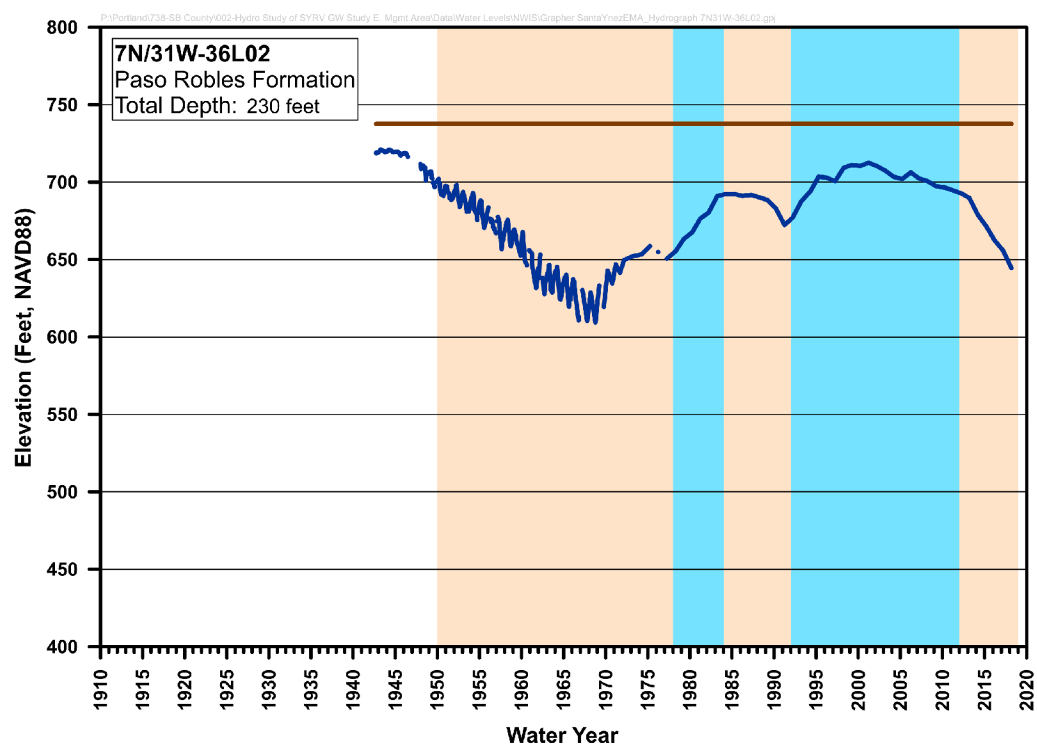
FIGURE 3-24

Representative Paso Robles Formation Hydrographs: Wells -08P01 and -07G06

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.





LEGEND

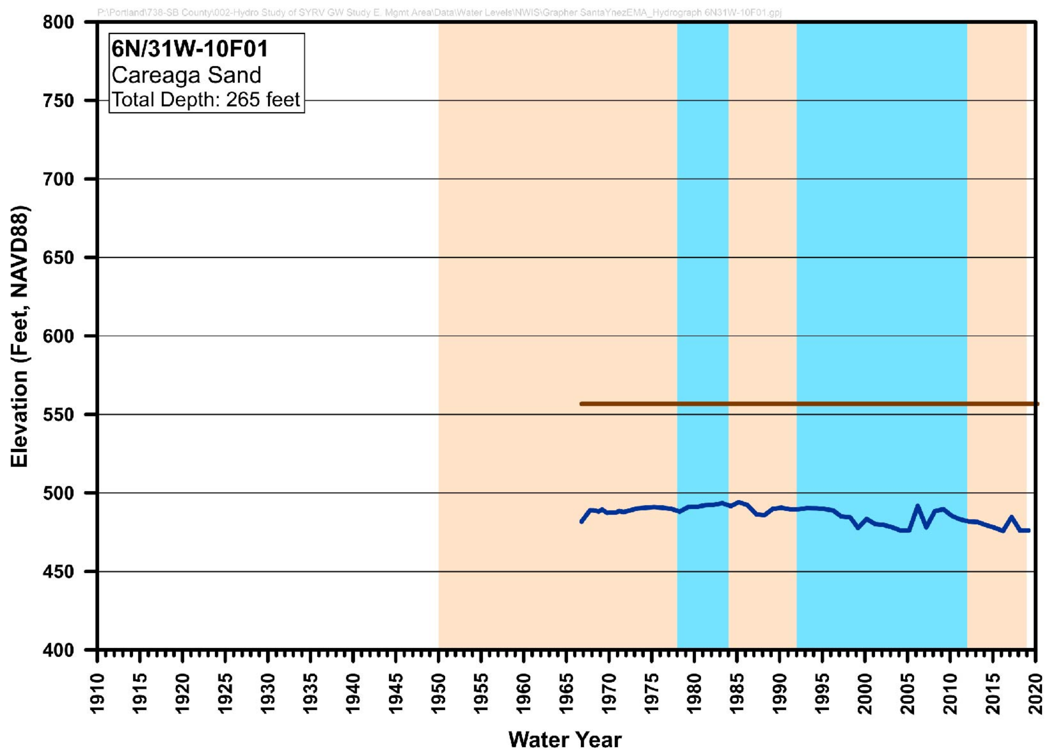
- Ground Surface Elevation
- Groundwater Elevation
- Dry Climatic Cycle
- Wet Climatic Cycle

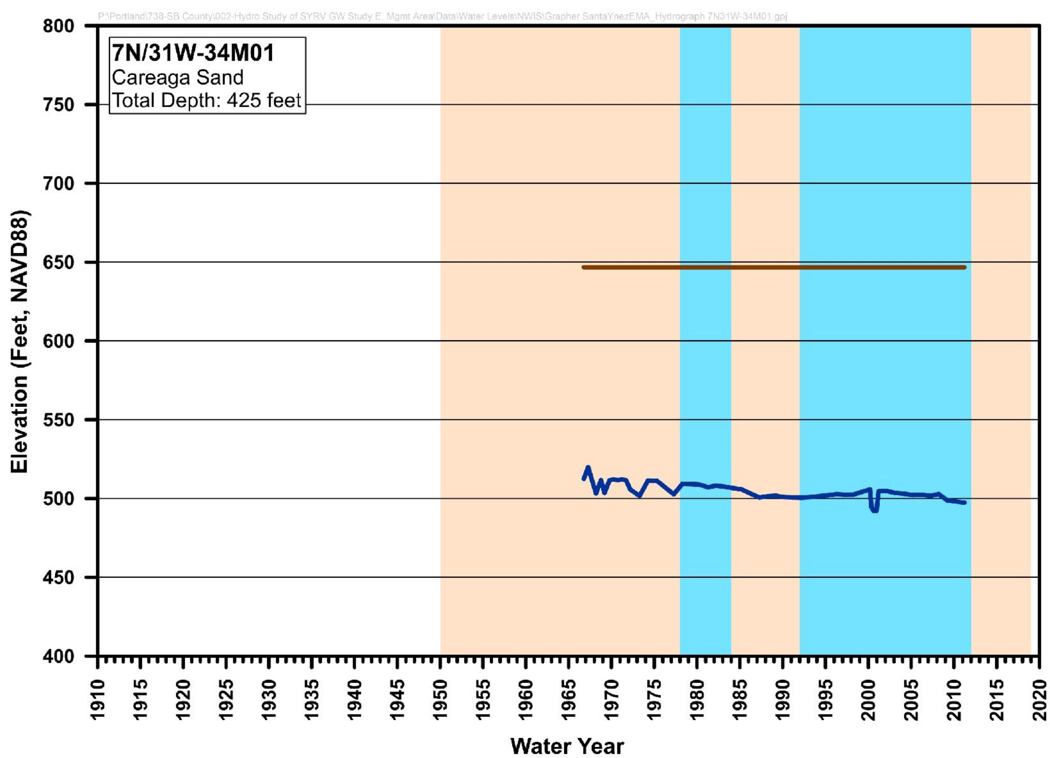
FIGURE 3-25

Representative Paso Robles Formation Hydrographs: Wells -35R01 and -36L02

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.





LEGEND

- Ground Surface Elevation
- Groundwater Elevation
- Dry Climatic Cycle
- Wet Climatic Cycle

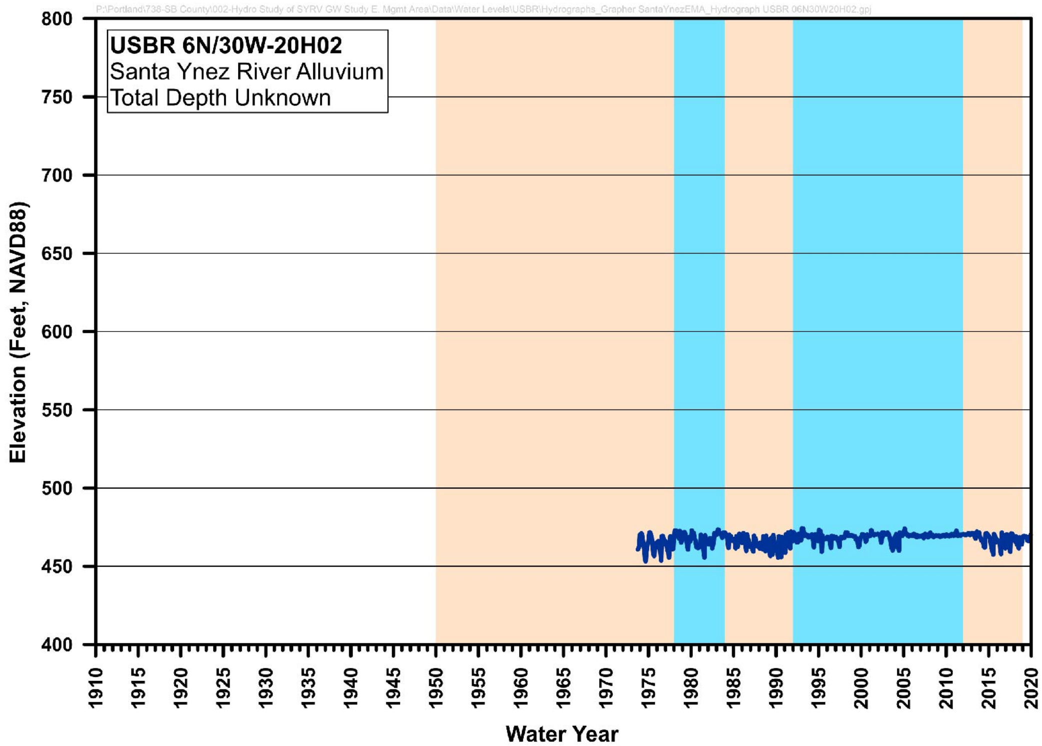
FIGURE 3-26

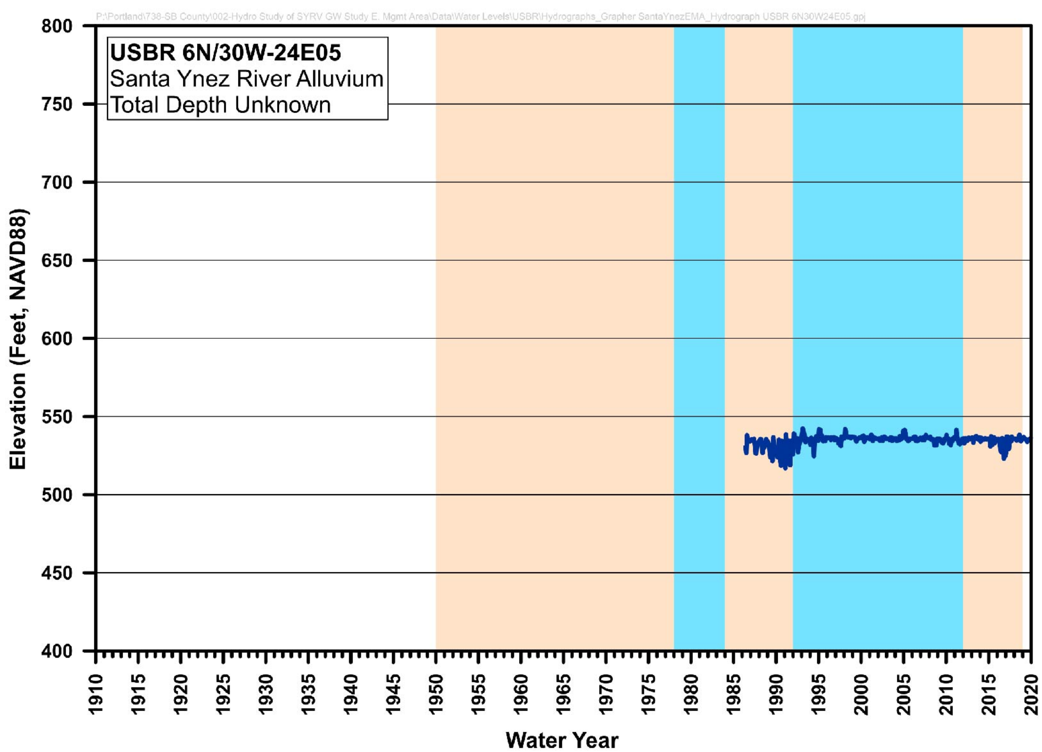
Representative Careaga Sand Hydrographs: Wells -10F01 and -34M01

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.

Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP





LEGEND

- Ground Surface Elevation
- Groundwater Elevation
- Dry Climatic Cycle
- Wet Climatic Cycle

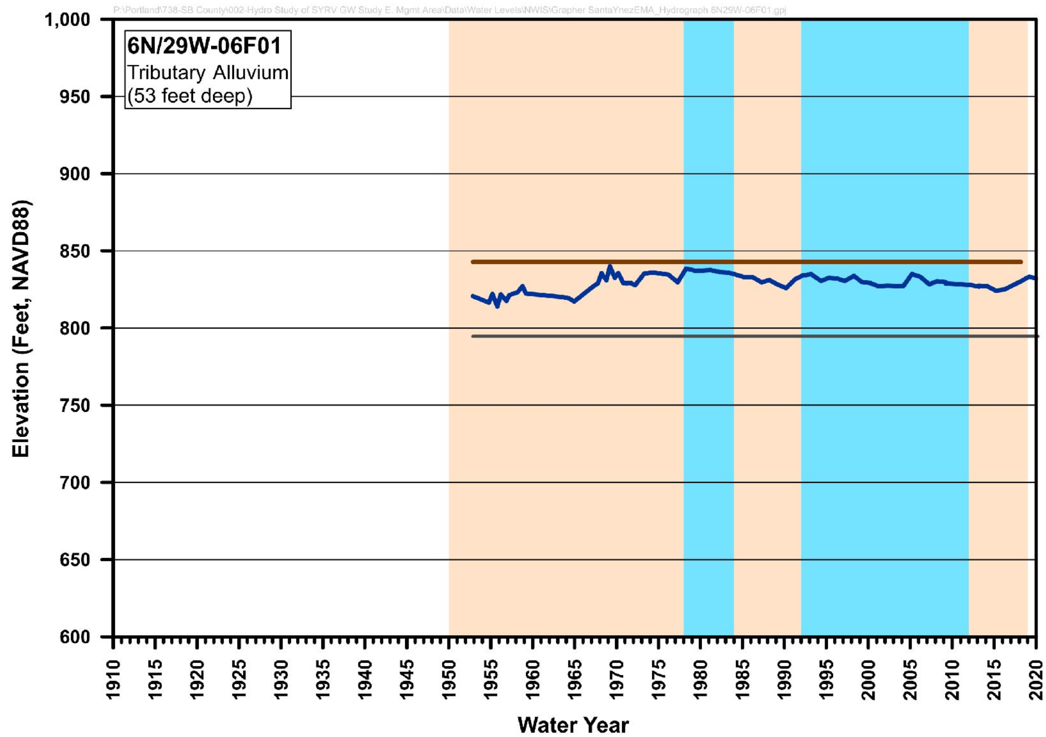
FIGURE 3-27

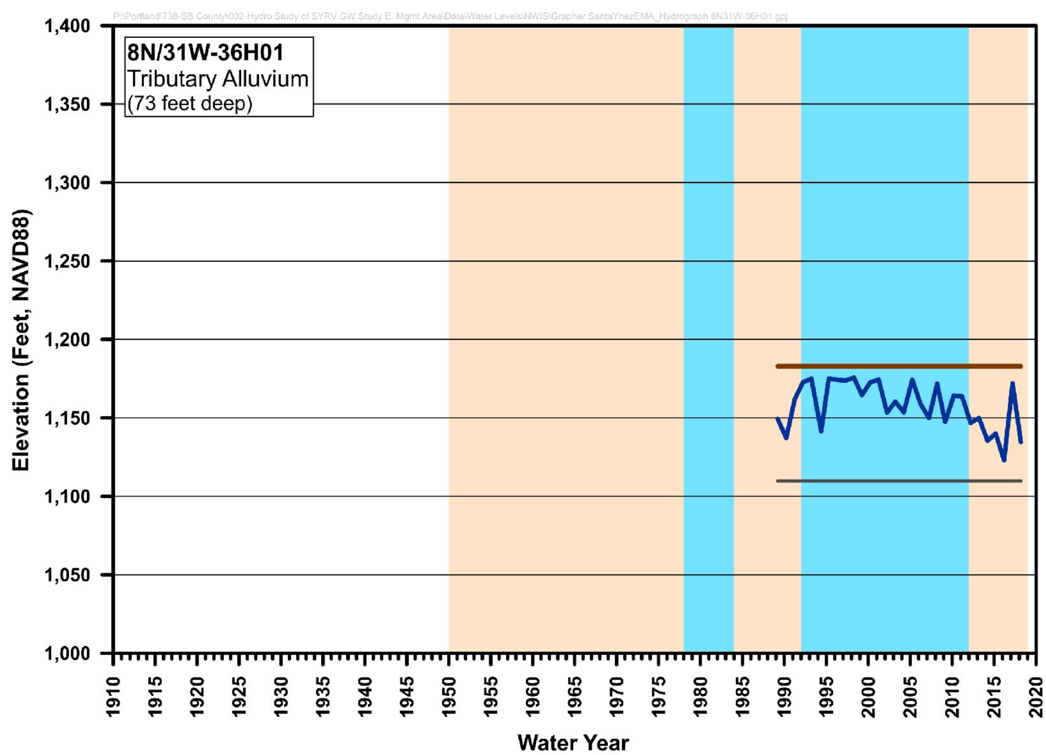
Representative Santa Ynez River Alluvium Hydrographs: Wells –20H02 and -24E05

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.

Y:\0738_SB_County\Source_Figures\002_HydroStudy\EMA_GSP





LEGEND

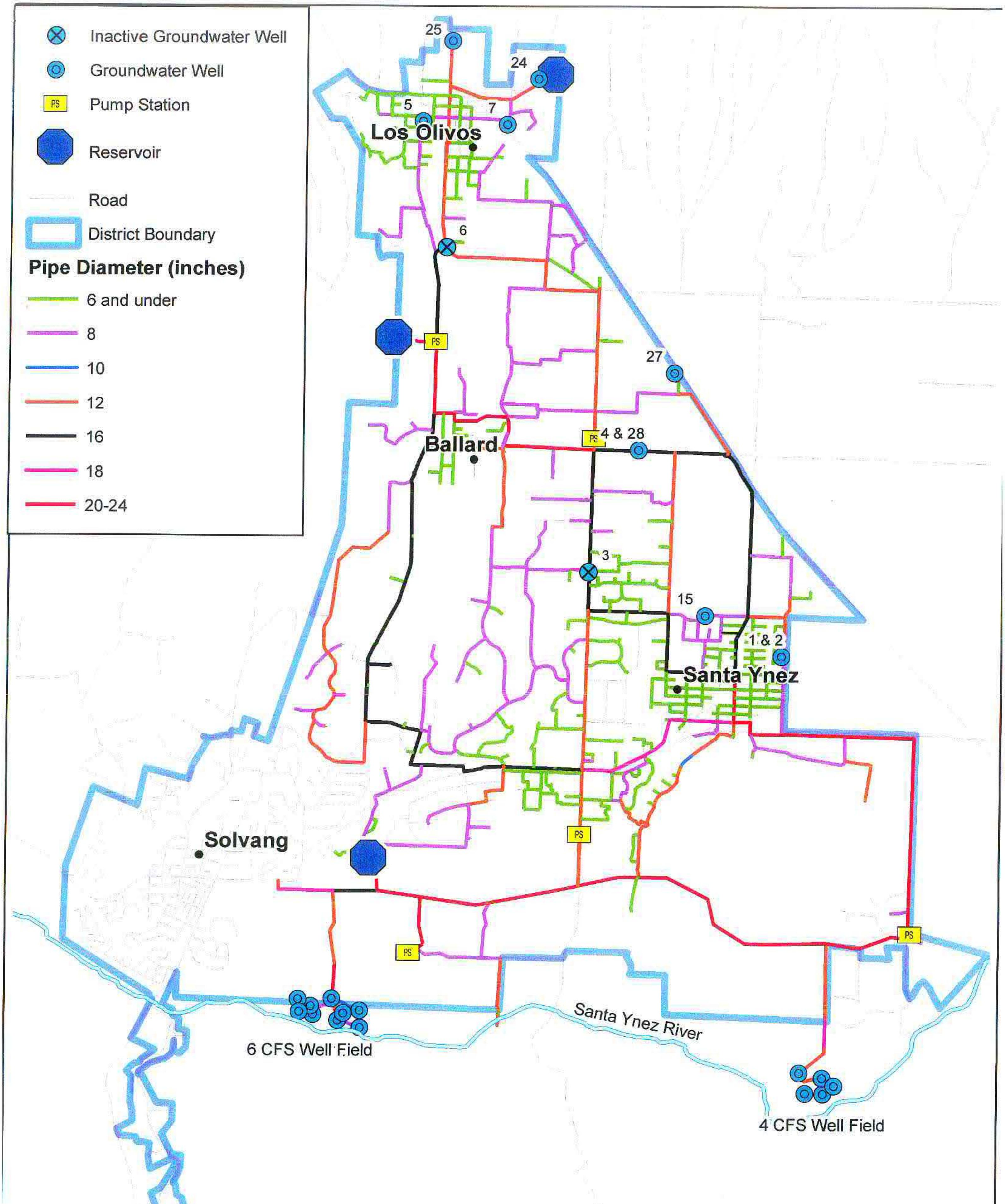
- Ground Surface Elevation
- Groundwater Elevation
- Dry Climatic Cycle
- Wet Climatic Cycle

FIGURE 3-28

Representative Tributary Alluvium Hydrographs: Wells –06F01 and –36H01

Groundwater Sustainability Plan
Eastern Management Area

GSI Water Solutions, Inc.



Notes: 1 inch = 4,000 feet	Santa Ynez River Water Conservation District, ID #1 **Distribution System Pipe Diameter**	Date: 10/21/2013

DISTRICT WELL NO. 3

LOG OF WELL FOR
SANTA YNEZ RIVER WATER CONSERVATION DISTRICT
SANTA BARBARA COUNTY, CALIFORNIA

Drillers: J. Montesino
M. Eagle

July 25	0 to	2	2 Ft.	Top Soil
25	2	20	18	Yellow Sandy Clay & Rock
25	20	41	21	Yellow Sandy Clay
25	41	43	2	Hard Yellow Clay
25	43	70	27	Gravel & Boulders (Tight)
25	70	93	23	Loose Gravel
25	93	106	13	Yellow Clay & Gravel
25	106	132	26	Gravel & Clay (Very Tight)
25	132	137	5	Yellow Clay & Gravel
26	137	144	7	" " " "
26	144	161	17	Yellow Sandy Clay
26	161	204	43	Yellow Sandy Clay & Gravel
26	204	210	6	Gravel (Tight)
26	210	220	10	Yellow Sandy Clay & Gravel
26	220	237	17	Yellow Clay & Gravel (Hard)
26	237	242	5	Yellow Clay
26	242	261	19	Hard Grey Sandstone
26	261	276	15	Blackish Sandrock (Somewhat Softer)
26	276	316	40	Cemented Gravel with Clay Streaks
27	316	328	12	Yellow Clay & Gravel (Hard)
27	328	368	40	Yellow Clay
27	368	388	20	Yellow Clay, some Gravel
27	388	458	70	Yellow Clay
30	458	463	5	Gravel
30	463	479	16	Yellow Sandy Clay
30	479	485	6	Gravel
30	485	503	18	Yellow Sandy Clay & Gravel
30	503	569	66	Hard Brown Clay (Very Tight)
31	569	574	5	Yellow Clay
31	574	619	45	Hard Brown Clay (Very Tight)
Aug. 1	619	655	36	" " " " "
1	655	674	19	Soft Sandy Clay with Gravel
1	674	680	6	Brown Sandy Clay, very little Gravel
1	680	710	30	Brown Clay & Gravel
2	710	800	90	Very Hard Brown Clay (Tight)
3	800	877	77	Brown Clay with Gravel Streaks (Very Tight)
3	877	890	13	Brown Sandy Clay & Gravel (Water-Bearing)
4	890	895	5	Brown Sandy Clay & Gravel
8	895	920	25	Sandy Clay & Gravel
9	920	1006	86	Brown Sandy Clay & Gravel

WELL 5A

6-30-86

WATER WELL DRILLERS REPORT

WELL NO. 5A

1. Owner: Santa Ynez River Water Conservation District, Improvement District No. 1
   P. O. Box 157
   Santa Ynez, California 93460

2. Location of Well: T.7N., R.31W., SE 1/4 SW 1/4 Section 23 - Town of Los Olivos, Santa Barbara County (Refer to attached map)

3. Owner's Well No.: No. 5A

4. Type of Work: New Well

5. Proposed Use: Domestic and Irrigation

6. Drilling Method: Reverse Rotary

7. Filter Pack:
   a. Size: 50/50 mix of 8 x 16 and 6 x 12 Monterey sand.
   b. Diameter of Bore: 28 Inches
   c. Interval Packed: 0 - 1,300 Feet

8. Casing Installed:
   a. Material: Copper Bearing Steel
   b. Cased Interval:
      30-Inch Diameter (0.375 Inch Thick), 0-180 Feet
      16-Inch Diameter (0.375 Inch Thick), 0-1,300 Feet

9. Perforations:
   a. Type: 1/16-Inch R. Moss Louvered Fulflo
   b. Perforated Interval:
      16-Inch Diameter Casing, 650-1,300 Feet

10. Well Seal:
    a. Type: Minimum 2-Inch Thick Surface Sanitary Seal from 0-180 Feet
    b. Material: Grout, Class C Cement With Two Percent CaCl.

11. Water Levels:

a. Depth to First Water: Unknown
b. Standing Water Level After Completion - 227 Feet

12. Well Test: Pump test performed under the direction of Stetson Engineers Inc.

a. Static Water Level - 277 Feet
b. Pumping Water Level - 344 Feet
c. Pumping Rate - 1,000 gpm
d. Pumping Period - 8 hours

13. Well Log: Total Depth - 1,345 Feet; Completed Well Depth - 1,300 Feet

115 - 125	Round Gravel with some sand
125 - 135	Coarse gravel
135 - 145	Boulder, coarse gravel with clay
145 - 155	Boulder
155 - 165	Boulder with clay
165 - 180	Clay with gravel (coarse to round)
180 - 190	Coarse to round gravel with clay
190 - 200	Sand, gravel and clay
200 - 210	Light brown clay with trace of sand and gravel
210 - 220	Light brown clay with trace of sand and gravel
220 - 230	-
230 - 240	Coarse to round gravel with some clay
240 - 250	Boulders, coarse gravel with some clay
250 - 270	Coarse to round gravel with clay
270 - 280	Light brown clay
280 - 310	Yellow brown clay with some sand and gravel
310 - 320	Round gravel and trace of dark brown clay
320 - 330	Light brown clay
330 - 340	-
340 - 360	Yellow brown clay with gravel and some dark brown clay
360 - 370	Sand with gravel and light brown clay
370 - 380	Sand and clay
380 - 390	Coarse gravel with light brown clay
390 - 400	Yellow brown clay with coarse sand
400 - 410	Gravel with light brown clay
410 - 430	Light brown clay with gravel
430 - 460	Light brown clay
460 - 490	Sticky light brown clay with sand and gravel
490 - 520	Light brown clay
520 - 530	Yellow brown clay with trace of sand
530 - 550	Light brown clay with trace of gravel
550 - 580	Light brown clay
580 - 590	Gray clay

590 - 600	Gray and light brown clay
600 - 620	Light brown clay
620 - 630	Yellow brown clay
630 - 690	Light brown clay
690 - 700	Sticky clay
700 - 710	Yellow brown clay with trace of gravel
710 - 730	Yellow brown clay and sand
730 - 750	Boulder, sand and gravel with clay
750 - 760	Yellow brown clay
760 - 770	Yellow brown clay with some sandy clay
770 - 780	Light brown clay with sand and gravel
780 - 790	-
790 - 810	Light brown clay, trace of sand and yellow clay
810 - 820	Yellow brown clay and some sand
820 - 830	Light brown clay
830 - 840	-
840 - 855	Yellow clay with coarse sand
855 - 865	Gravel, sand, clay
865 - 875	Sand and clay
875 - 915	Gravel, sand and clay
915 - 925	Boulders
925 - 935	Sand, clay and gravel
935 - 955	Gravel, sand and clay
955 - 965	Yellow brown clay, sand and gravel
965 - 975	Yellow brown clay with trace of sand
975 - 995	Yellow brown clay, sand, trace of gravel
995 - 1025	Light brown clay
1025 - 1035	Light brown sand clay
1035 - 1045	Yellow brown sand clay
1045 - 1055	Yellow brown clay, gravel and sand
1055 - 1065	Dark brown clay
1065 - 1085	Dark brown clay (hard packed)
1085 - 1095	Yellow brown sandy clay
1095 - 1105	Brown clay (sandy and silty)
1105 - 1110	Sticky yellow brown clay with sand
1110 - 1115	Clean coarse to round sand with gravel and some clay
1115 - 1125	Yellow brown compact clay
1125 - 1135	Dark brown clay with trace of sand
1135 - 1145	Dark brown clay with compact gray-green clay
1145 - 1185	Clean gravel with round sand
1185 - 1195	Gravel, sand and some clay
1195 - 1215	Gray brown clay
1215 - 1225	Light brown sandy clay
1225 - 1235	Fine grained sand and some coarse sand and clay
1235 - 1245	Sand, gravel with clay
1245 - 1255	Light brown clay
1255 - 1275	Light brown clay with sand
1275 - 1285	Dark brown clay
1928 - 1295	Dark brown sandy clay with gray-green clay and fine sand

1295 - 1335	Gray-green, packed clay
1335 - 1345	Dark brown, sticky clay

14. Well Driller's Statement:

Well Driller:
B & W Drilling
P.O. Box 1309
Clovis, California 93613

Report Prepared by:

Stetson Engineers Inc.
2171 E. Francisco Blvd., Suite K
San Rafael, California 94901

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

Do not fill in

No. 04348

Notice of Intent No. 140154
Local Permit No. or Date ____

State Well No. ____
Other Well No. ____

(1) OWNER: Name Santa Ynez River Water
Address Conservation Dist. P O Box 157
City Santa Ynez, California Zip 93460

(2) LOCATION OF WELL (See instructions):
County Santa Barbara Owner's Well Number [redacted] #6
Well address if different from above ____
Township 7N Range 31W Section 26
Distance from cities, roads, railroads, fences, etc. at Intersection of Alamo Pintado Rd. and Roblar St., So. of Los Olivos, [redacted]Calif.

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well [X] Deepening [ ]
Reconstruction [ ]
Reconditioning [ ]
Horizontal Well [ ]
Destruction [ ] (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic [ ]
Irrigation [ ]
Industrial [ ]
Test Well [ ]
Stock [ ]
Municipal [ ]
Other [ ]

(5) EQUIPMENT:
Rotary [ ] Reverse [X]
Cable [ ] Air [ ]
Other [ ] Bucket [ ]

(6) GRAVEL PACK:
Yes [ ] No [ ] Size 3/8 minus
Diameter of bore 26
Packed from 0 to 885 ft.

(7) CASING INSTALLED:
Steel [X] Plastic [ ] Concrete [ ]

(8) PERFORATIONS: Moss Ful-Flo
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	200	30	.281	365	865	1/16" x
0	885	16	5/16			2-3/8"

(9) WELL SEAL:
Was surface sanitary seal provided? Yes [X] No [ ] If yes, to depth 200 ft.
Were strata sealed against pollution? Yes [ ] No [X] Interval ____ ft.
Method of sealing neet cement - pressure grout

(10) WATER LEVELS:
Depth of first water, if known 153-1/2 ft.
Standing level after well completion ____ ft.

(11) WELL TESTS:
Was well test made? Yes [X] No [ ] If yes, by whom? Beylik Drilling
Type of test Pump [ ] Bailer [ ] Air lift [ ]
Depth to water at start of test ____ ft. At end of test ____ ft.
Discharge 1450 gal/min after 65-1/2 hours Water temperature 72°
Chemical analysis made? Yes [ ] No [X] If yes, by whom? ____
Was electric log made? Yes [X] No [ ] If yes, attach copy to this report

(12) WELL LOG: Total depth 1320 ft. Depth of completed well 1320 ft.
from ft. to ft. Formation (Describe by color, character, size or material)

0-70 sand and gravel
70-90 brown caly
90-140 brown clay, and sand
140-170 brown clay, sand and bits of gravel
170-200 brown clay, gravel
200-210 hard white shale
210-250 brown clay, black & grey clay & sha
250-266 brown clay with little blk. & grey cla
266-290 sandstone, seashells, rock and clay
290-330 gravel and rock
330-370 clay
370-400 brittle sandstone and soft clay
400-440 sand, gravel and rock, some shells
440-470 gravel and rock, sandstone
470-500 sandy clay, rock & gravel, seashells
500-530 clay and gravel
530-545 rock and gravel
545-670 sandstone and brown & grey clay
670-720 grey clay and bits of sandstone
720-750 grey clay with little sand
750-800 grey clay and gravel
800-830 gravel and sandstone and clay
[redacted] 830-920 grey clay
920-990 sandy brown and grey clay
990-1030 gravel and rock, some clay
1030-1050 shale and clay
1050-1100 clay and sandstone
1100-1160 grey clay and little sandstone
1160-1180 brown clay and sandstone
1130-1200 brown clay
1200-1220 flakes of shale and brown clay
1220-1250 clay and gravel
1250-1280 clay
1280-1300 clay and sandstone conglomerate

Work started 9-6-77 19__ Completed 10-2-77 19__

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

SIGNED John R. Beylik (Well Driller)
NAME BEYLIK DRILLING, INC.
(Person, firm, or corporation) (Typed or printed)
Address 591 S. Walnut St.
City La Habra, Calif Zip 90631
License No. 306291-C-57 & SC-61 Date of this report Oct 21, 1977

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM 43816-950 7-76 50M QUAD OSP

SANTA YNEZ RIVER WATER CONSERVATION DISTRICT
IMPROVEMENT DISTRICT NO. 1

Water Well Drillers Log

Well #6 - Intersection of Alamo Pintado Road and Roblar Avenue, south of Los Olivos, California.

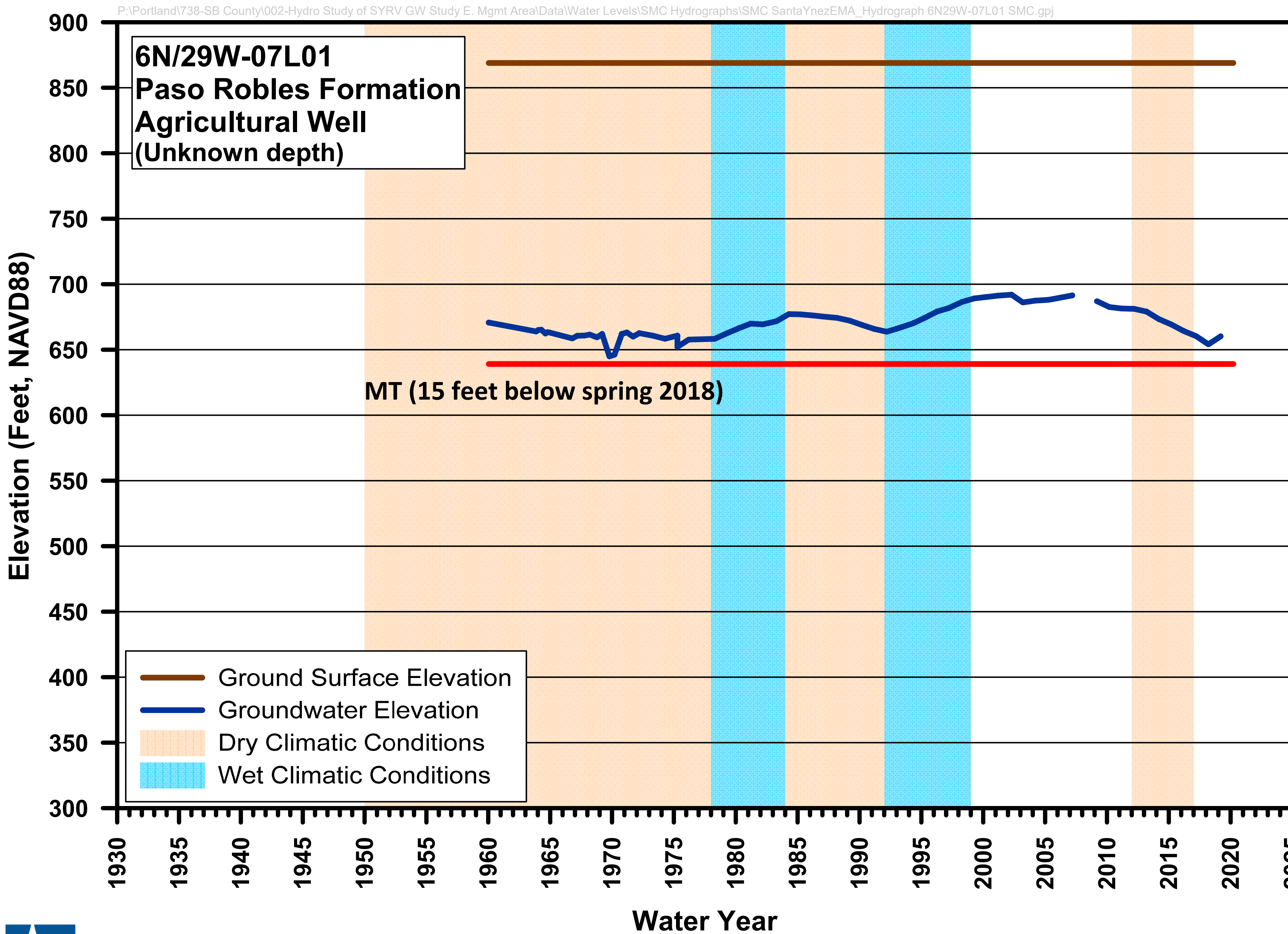
Completed 10-2-77 Beylik Drilling Inc.

Pilot Hole depth 1320 ft. Well completed 885 ft.

0-70	sand and gravel
70-90	brown clay
90-140	brown clay and sand
140-170	brown clay, sand and bits of gravel
170-200	brown clay, gravel
200-210	hard white shale
210-250	brown clay, black & grey clay & shale
250-266	brown clay with little blk. & grey clay
266-290	sandstone, seashells, rock and clay
290-330	gravel and rock
330-370	clay
370-400	brittle sandstone and soft clay
400-440	sand, gravel and rock, some shells
440-470	gravel and rock, sandstone
470-500	sandy clay, rock & gravel, seashells
500-530	clay and gravel
530-545	rock and gravel
545-670	sandstone and brown & grey clay
670-720	grey clay and bits of sandstone
720-750	grey clay with little sand
750-800	grey clay and gravel
800-830	gravel and sandstone and clay
830-920	grey clay
920-990	sandy brown and grey clay
990-1030	gravel and rock, some clay
1030-1050	shale and clay
1050-1100	clay and sandstone
1100-1160	grey clay and little sandstone
1160-1180	brown clay and sandstone
1180-1200	brown clay
1200-1220	flakes of shale and brown clay
1220-1250	clay and gravel
1250-1280	clay
1280-1300	clay and sandstone conglomerate

APPENDIX D-3

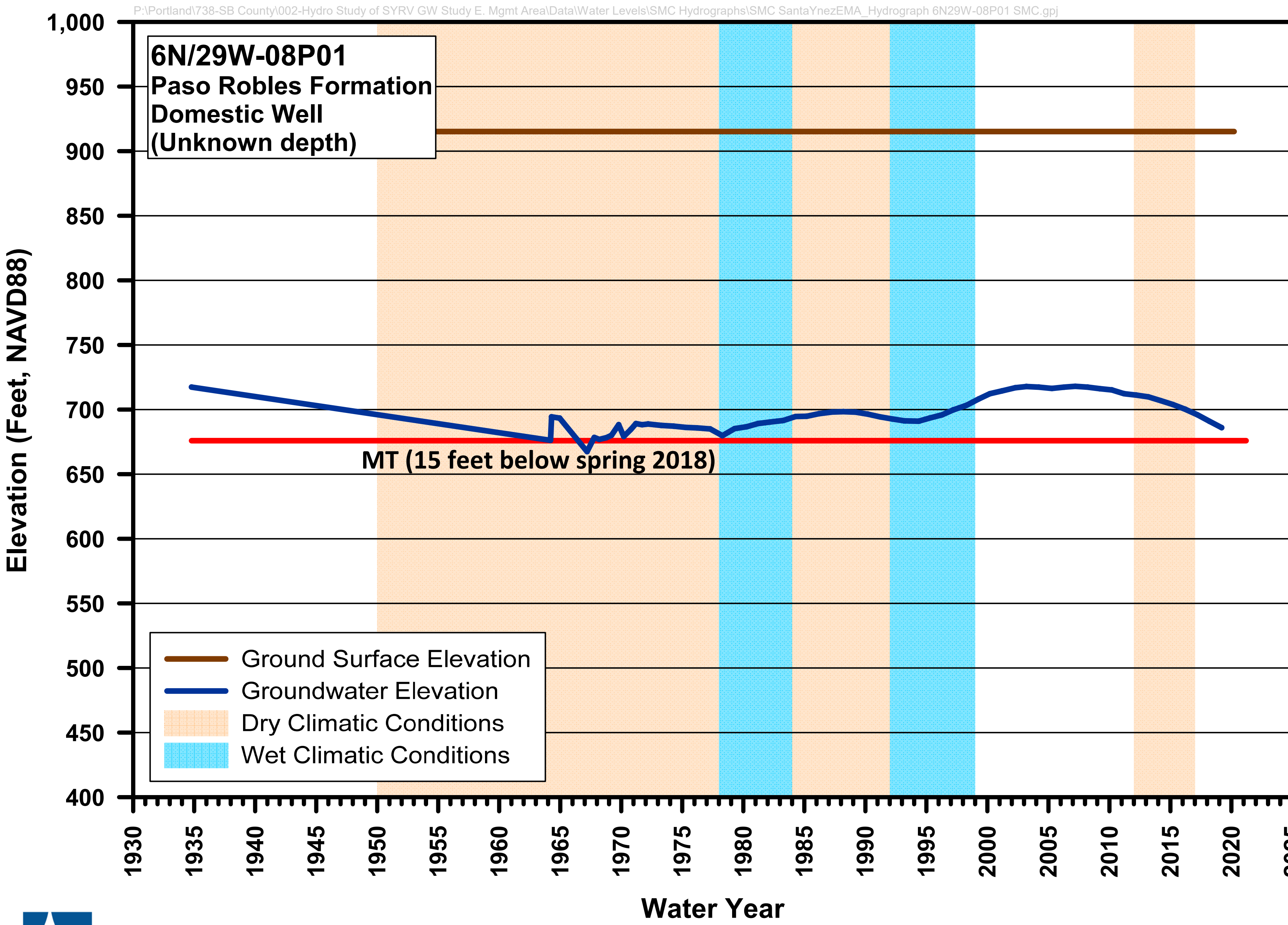
Representative Well Hydrographs



GSI Water Solutions, Inc.

FIGURE 5-1

Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-2

Groundwater Elevation Hydrograph

Eastern Management Area of the Santa Ynez River Valley Groundwater Basin

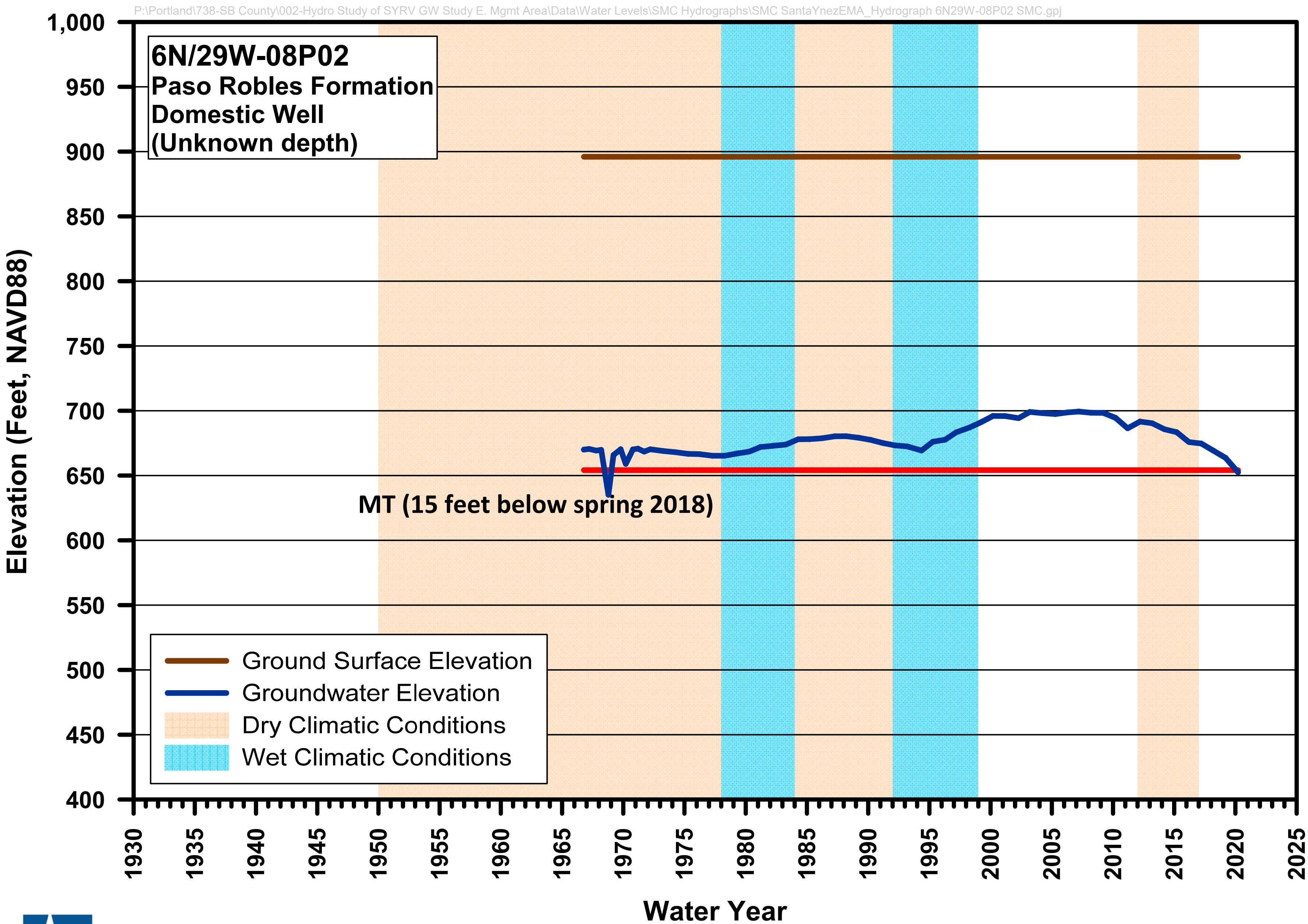
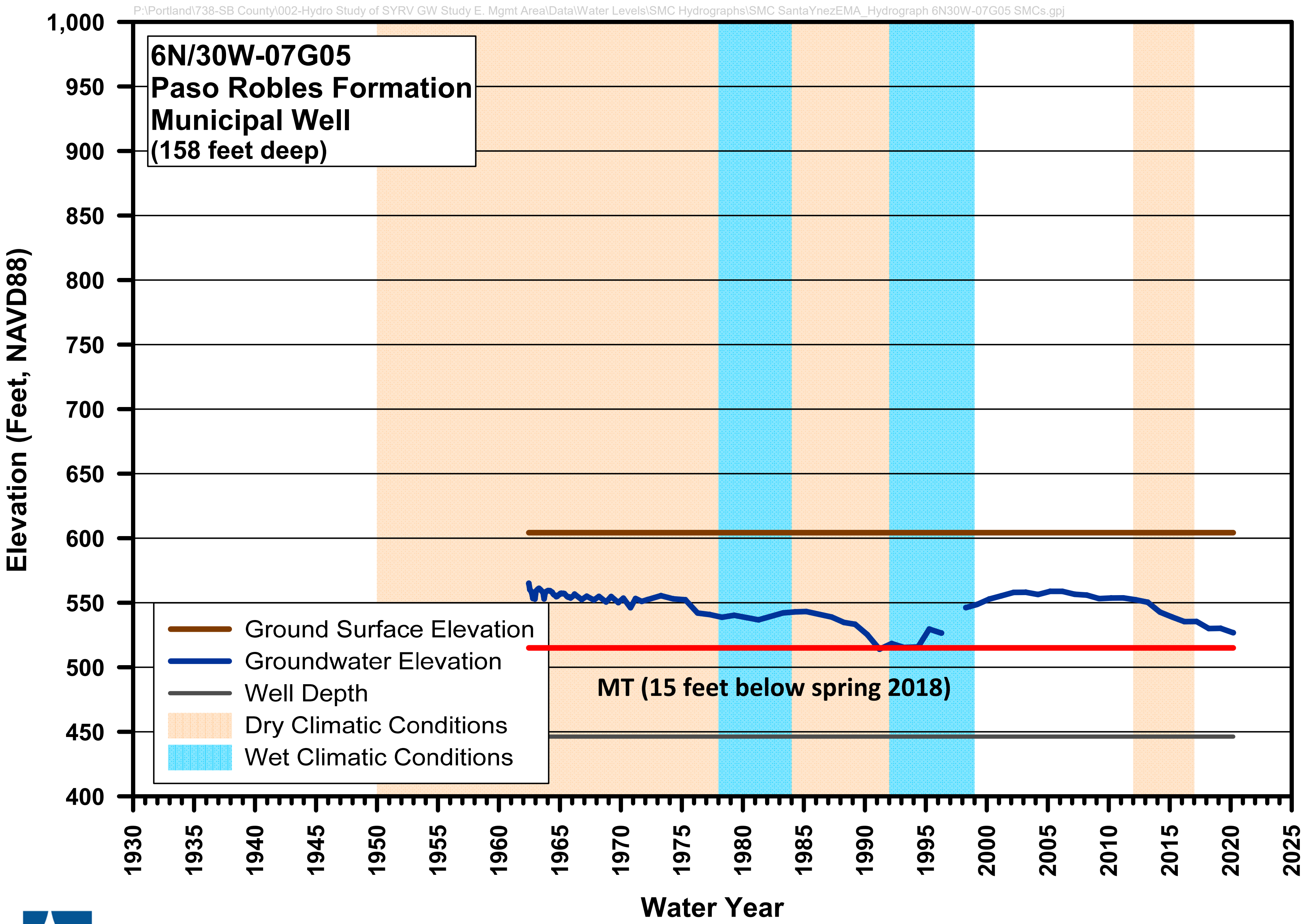


FIGURE 5-3

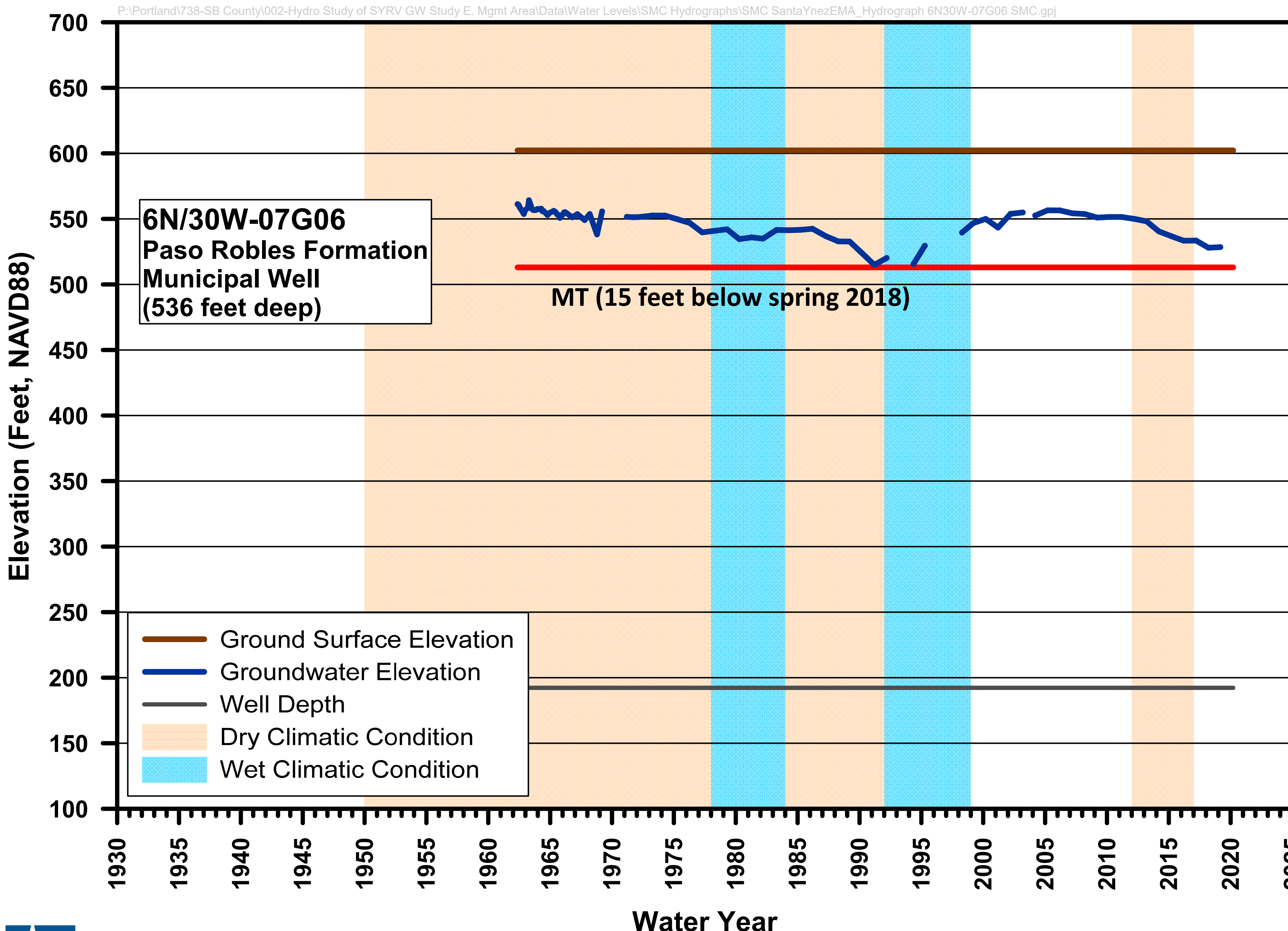
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-4

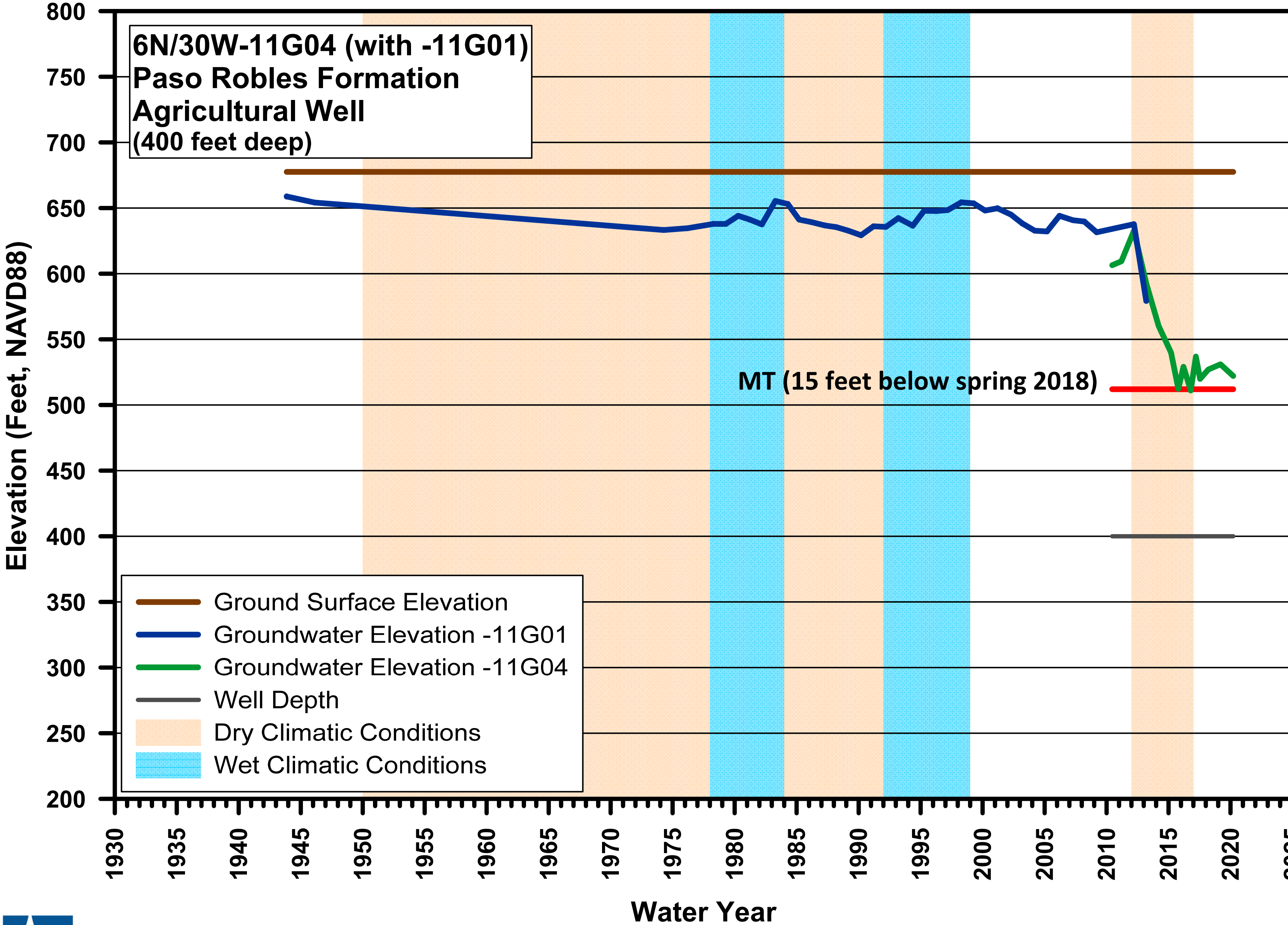
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-5

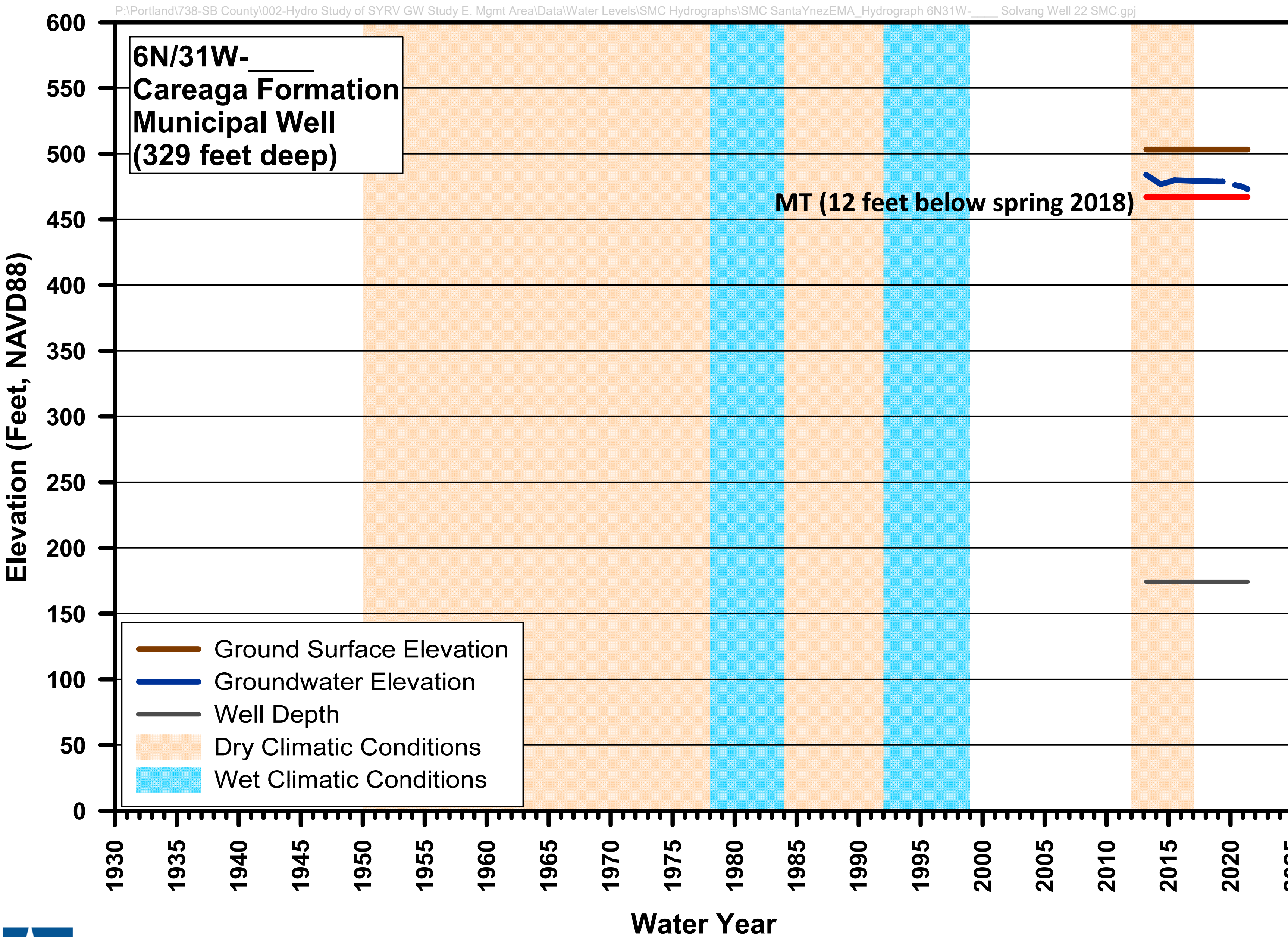
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-6

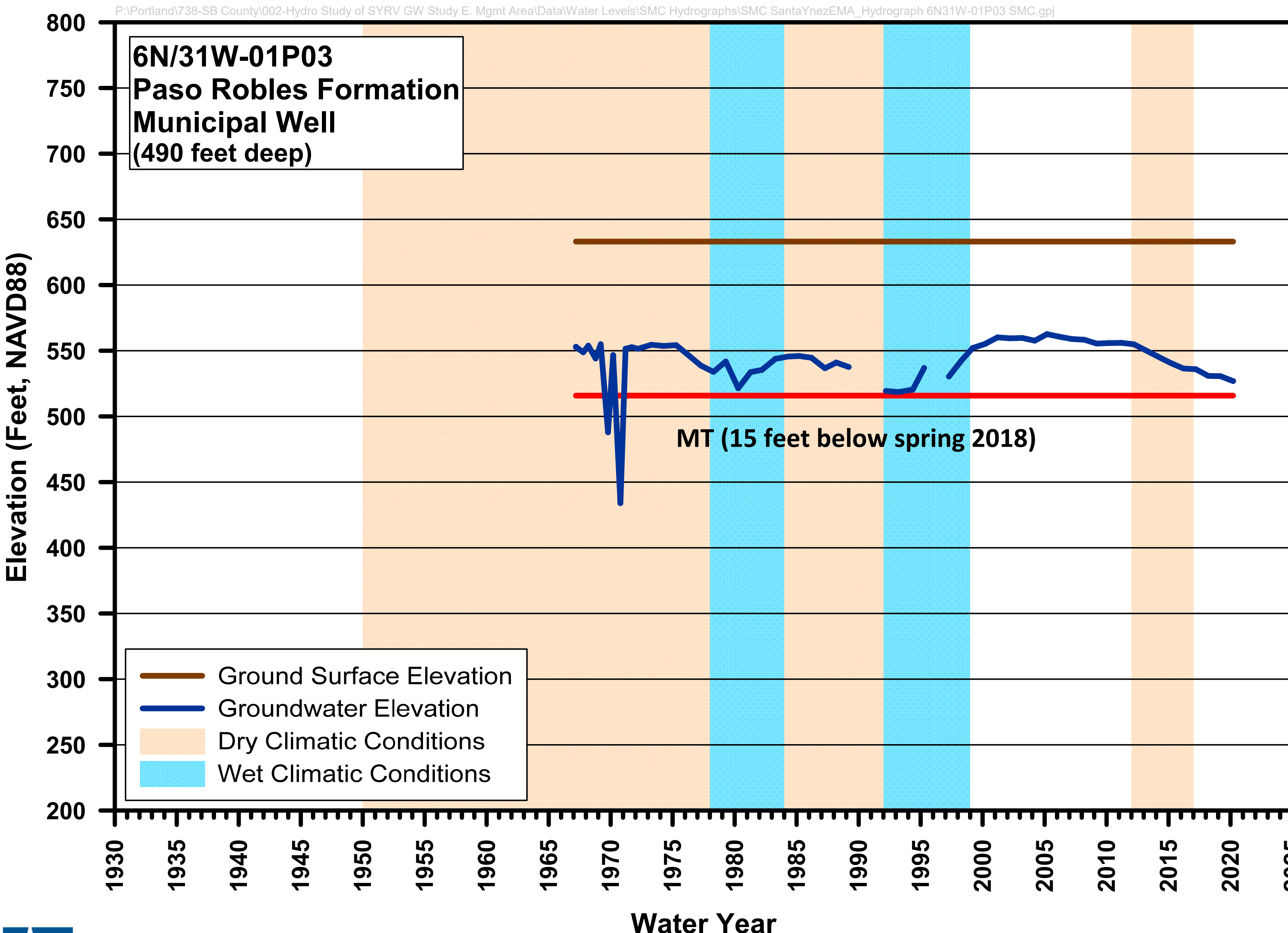
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-7

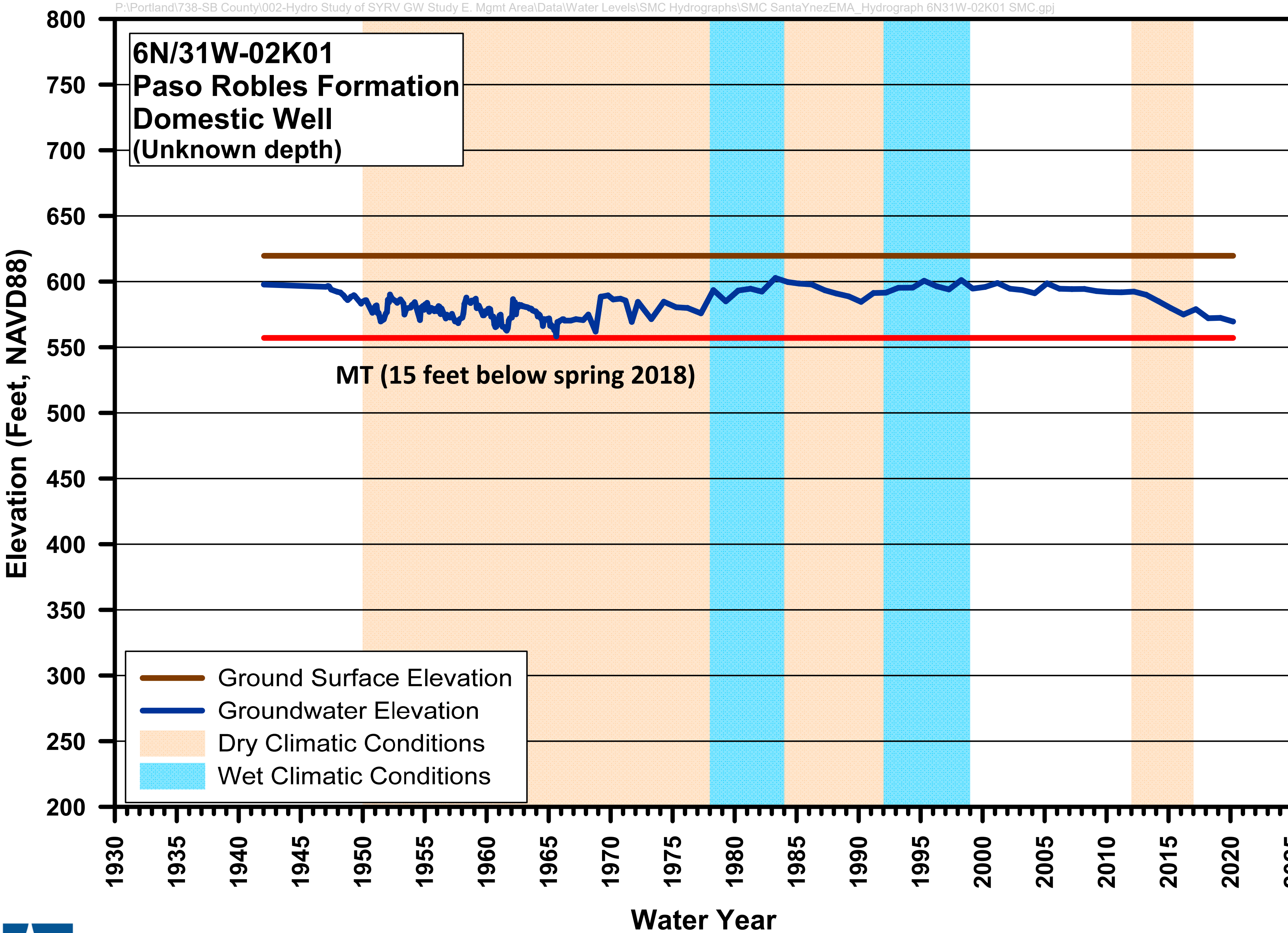
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-8

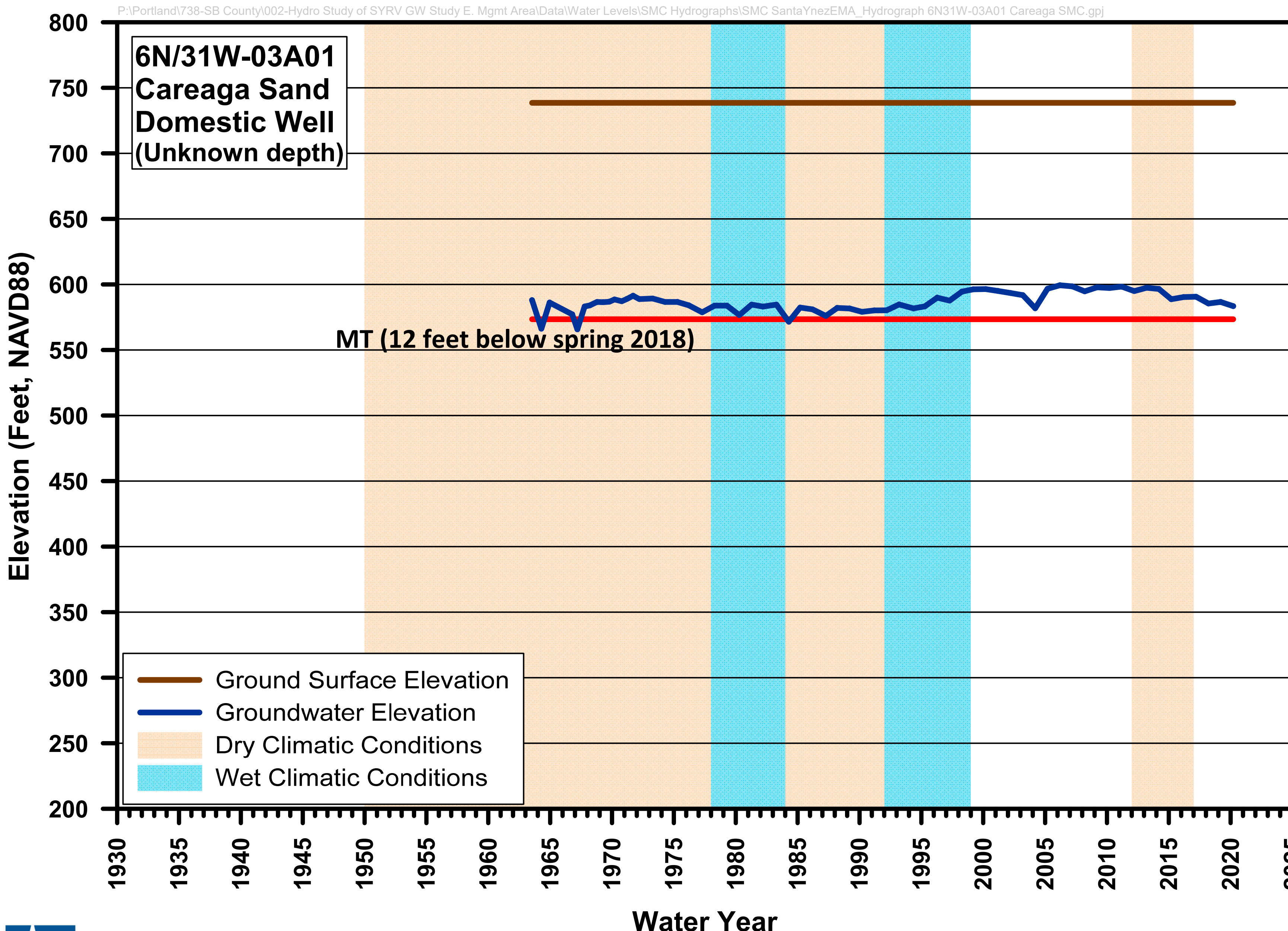
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-9

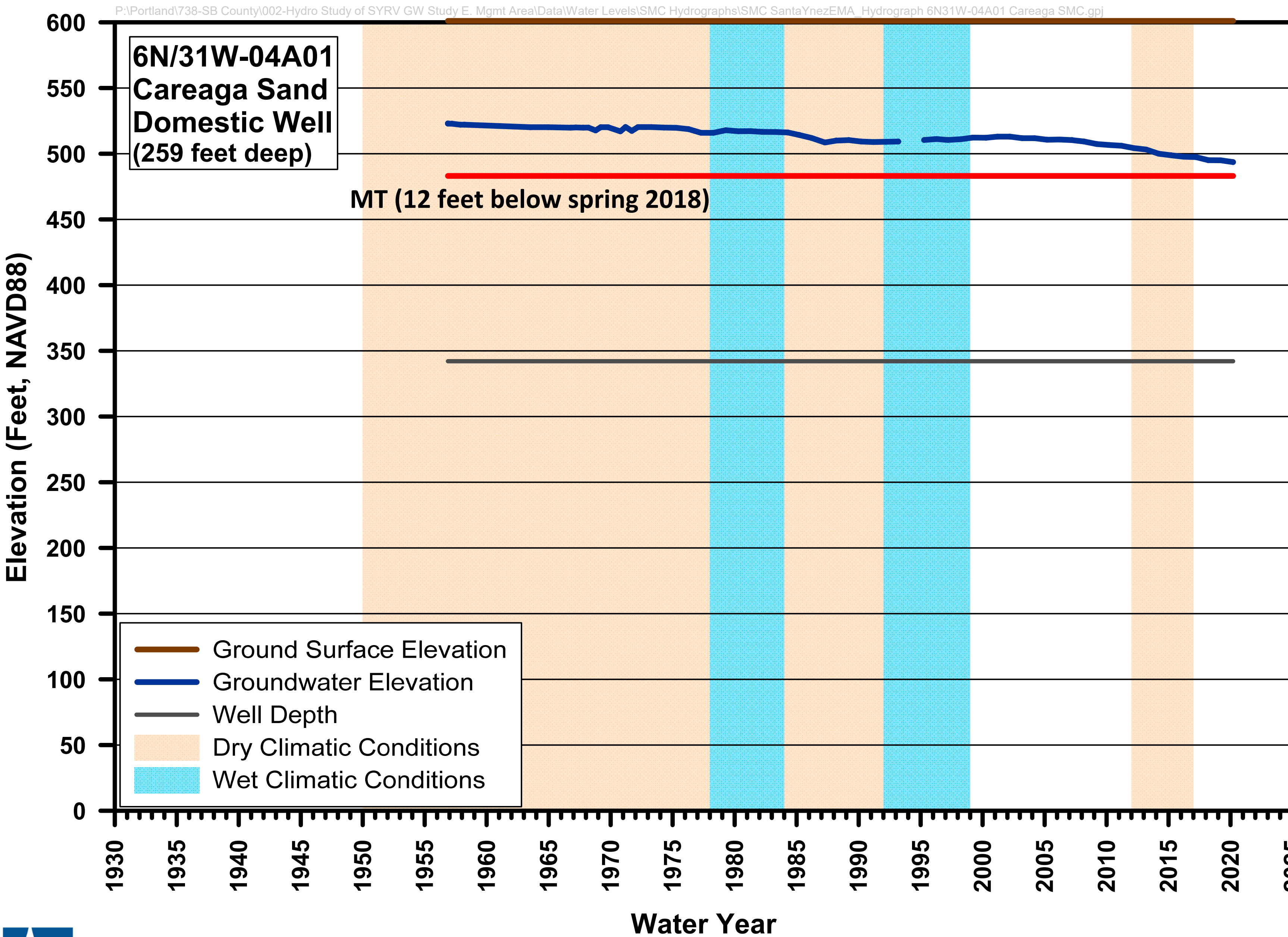
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-10

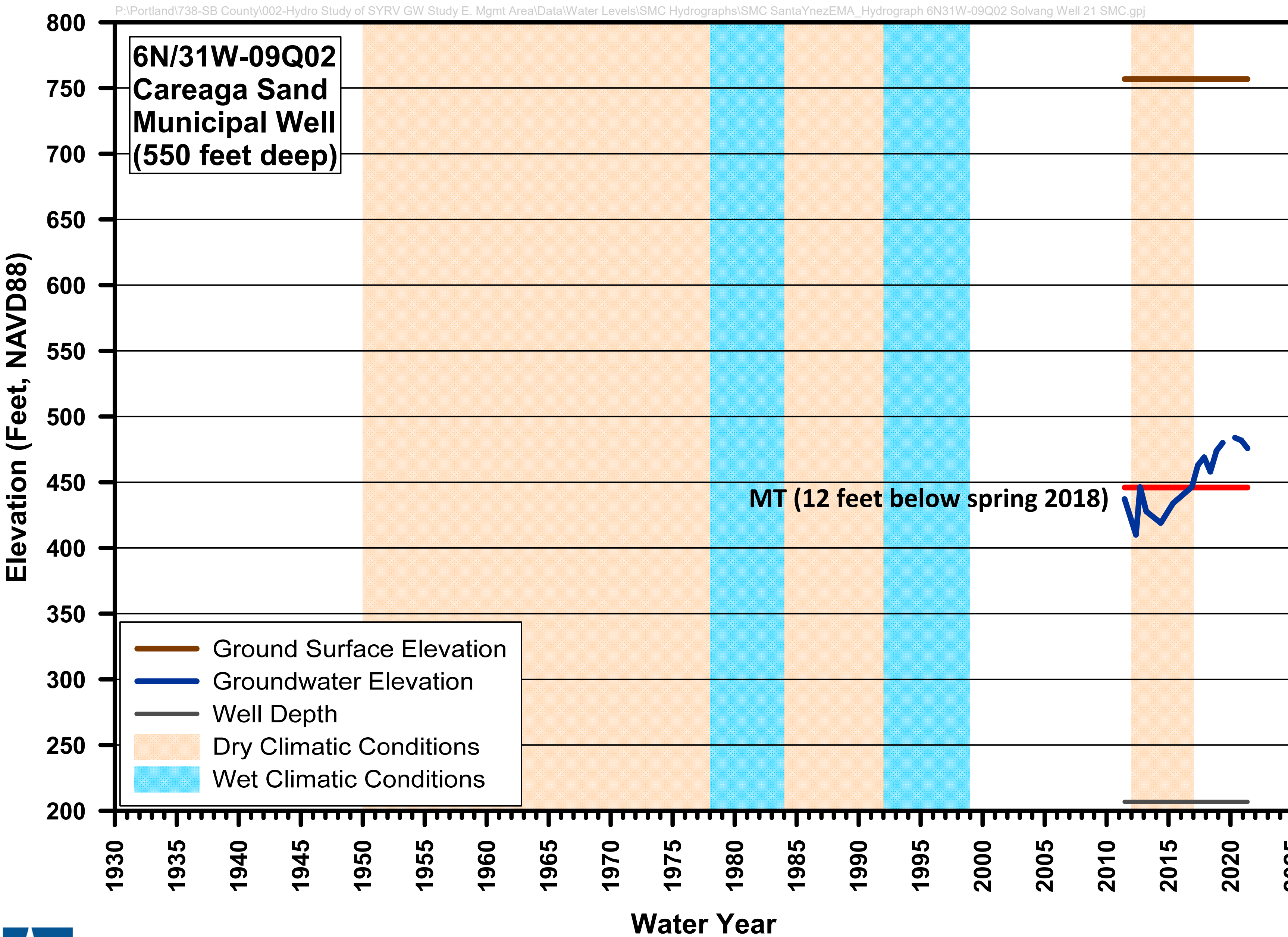
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-11

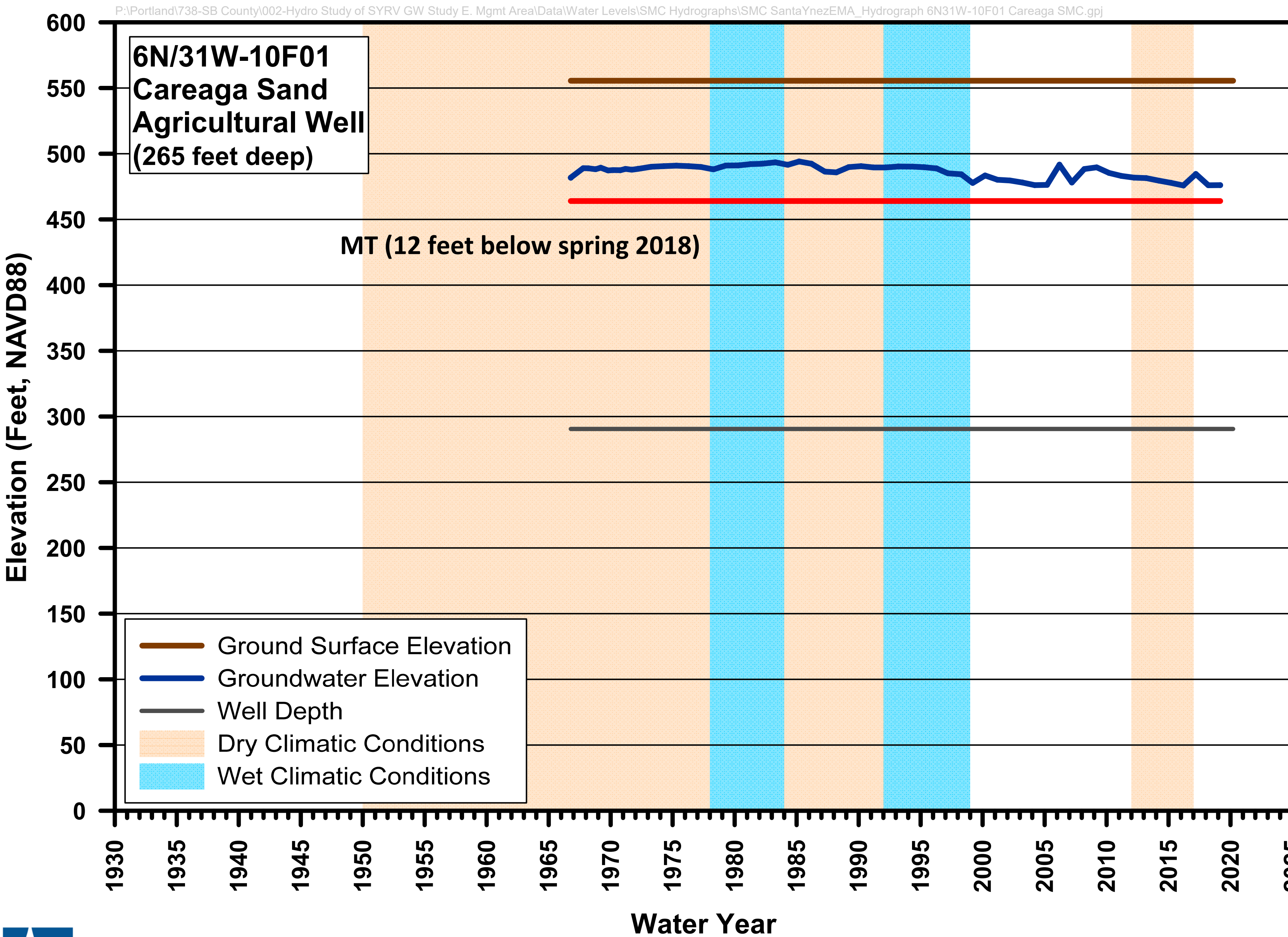
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-12

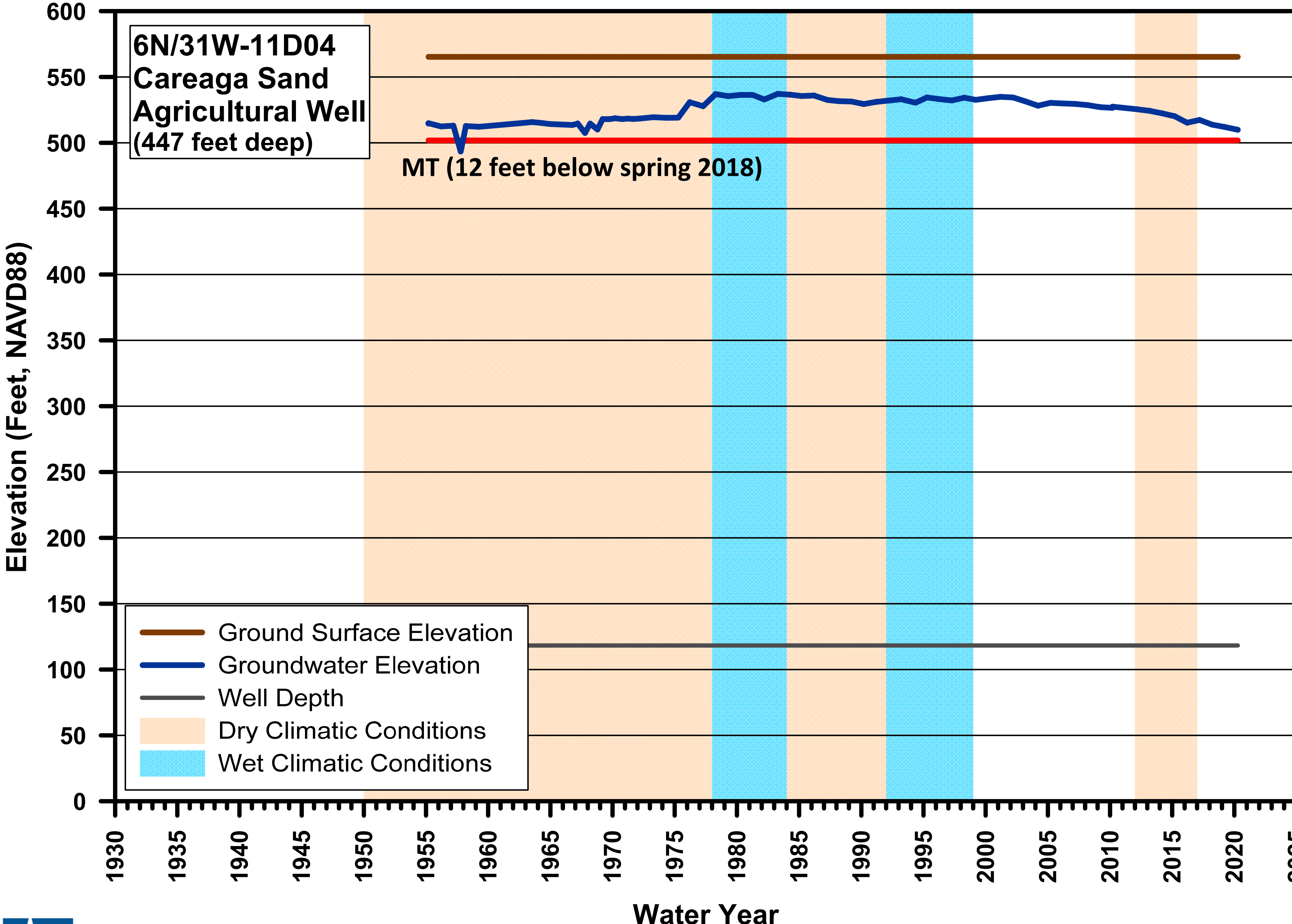
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-13

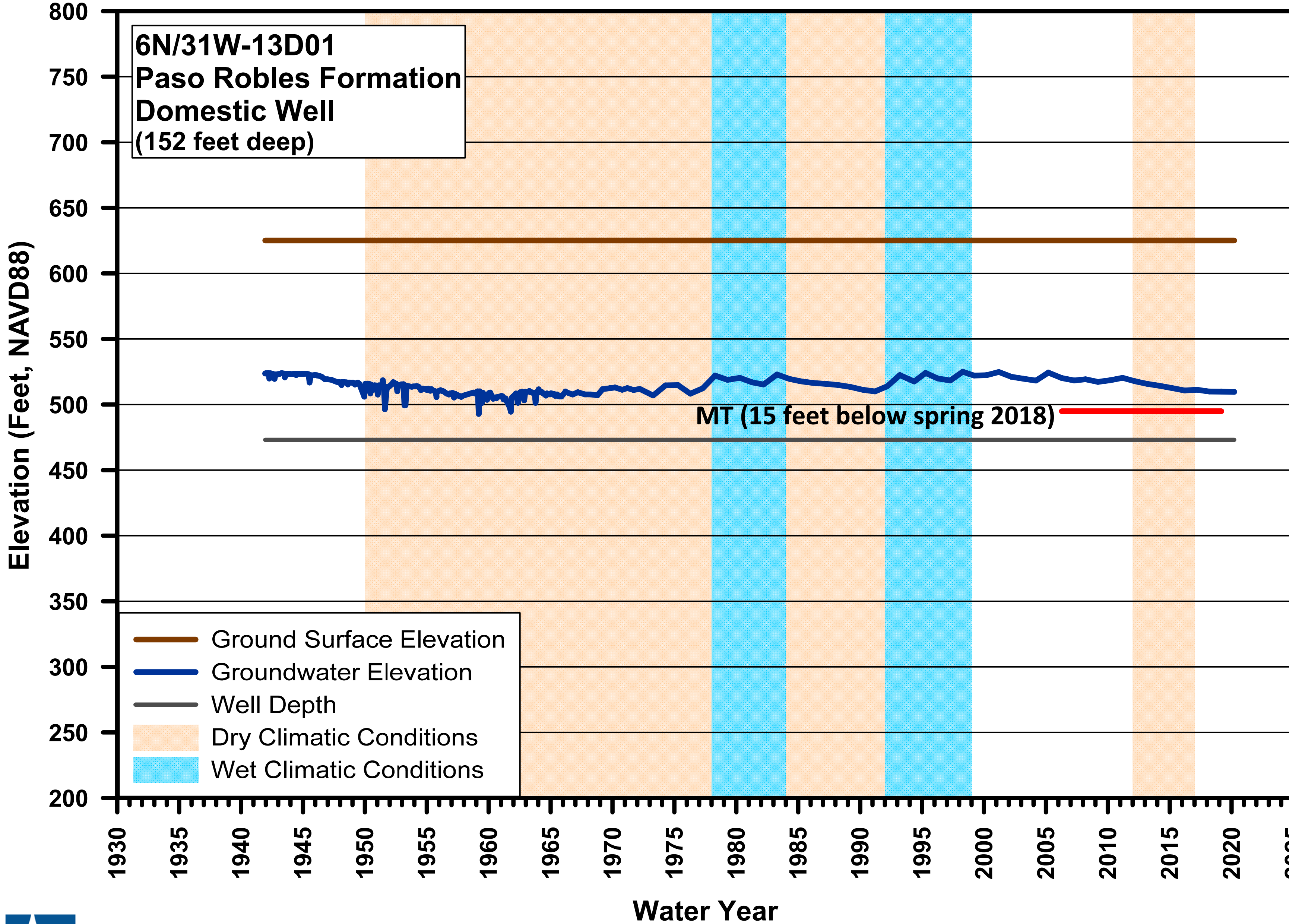
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-14

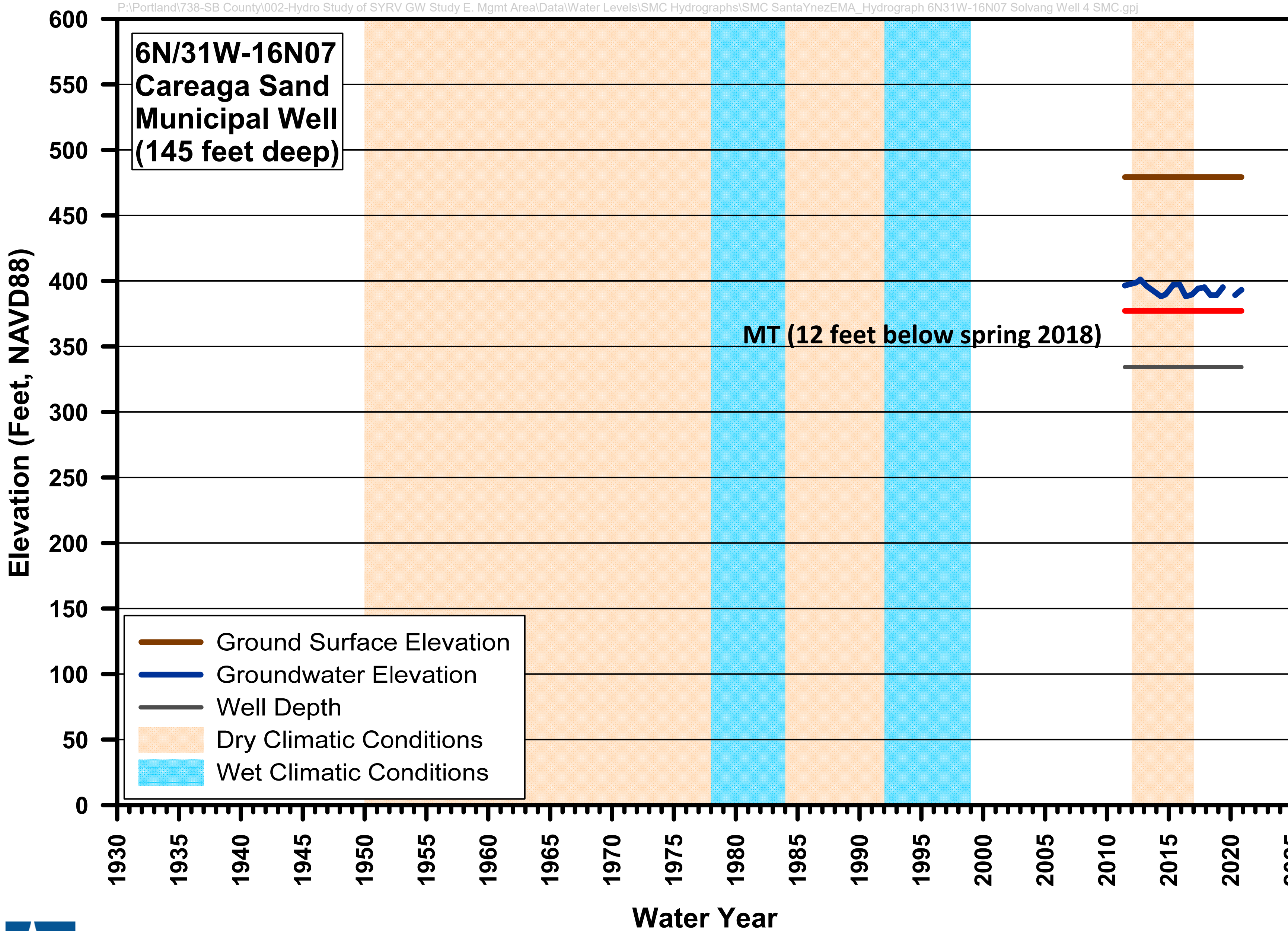
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-15

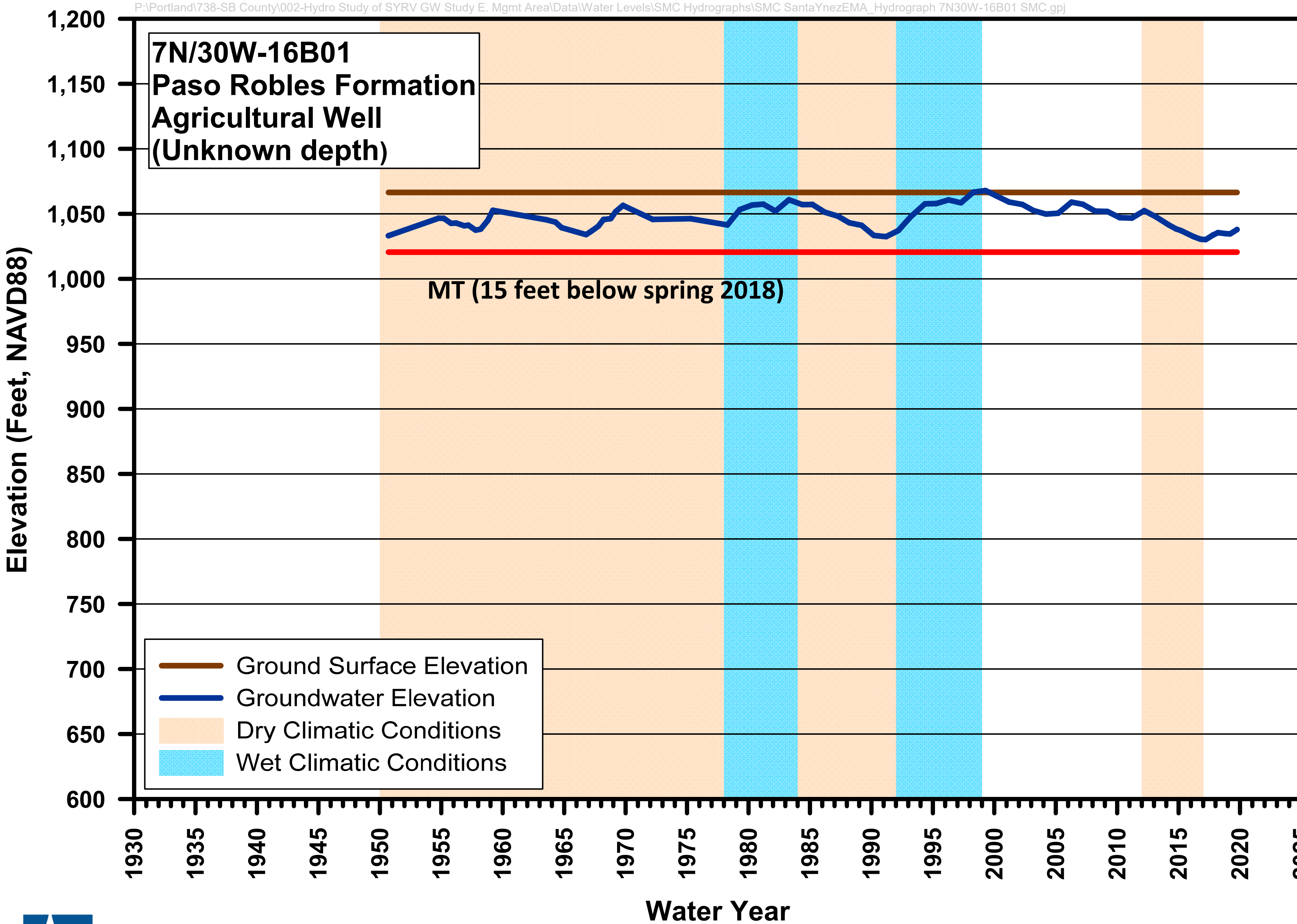
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-16

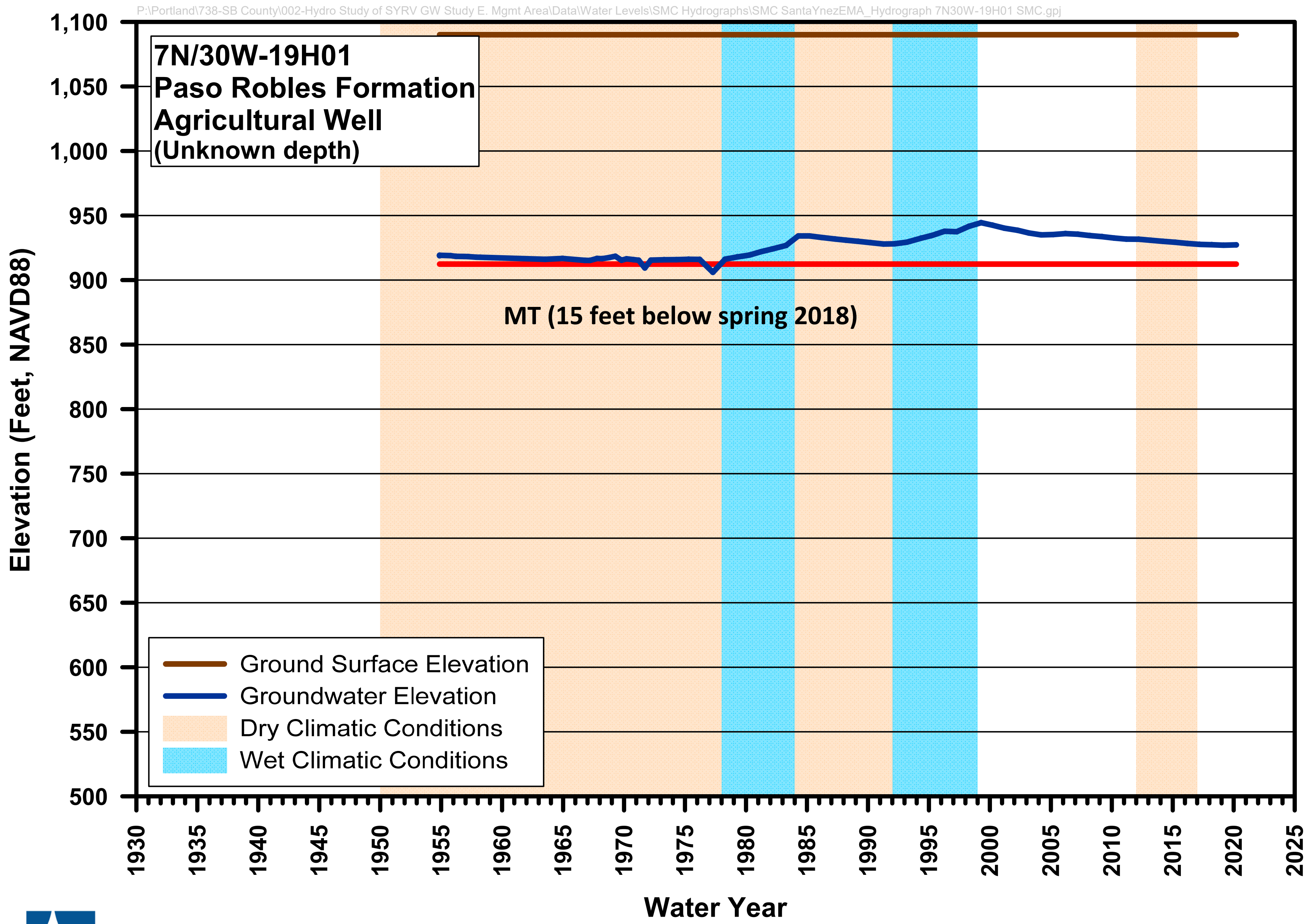
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-17

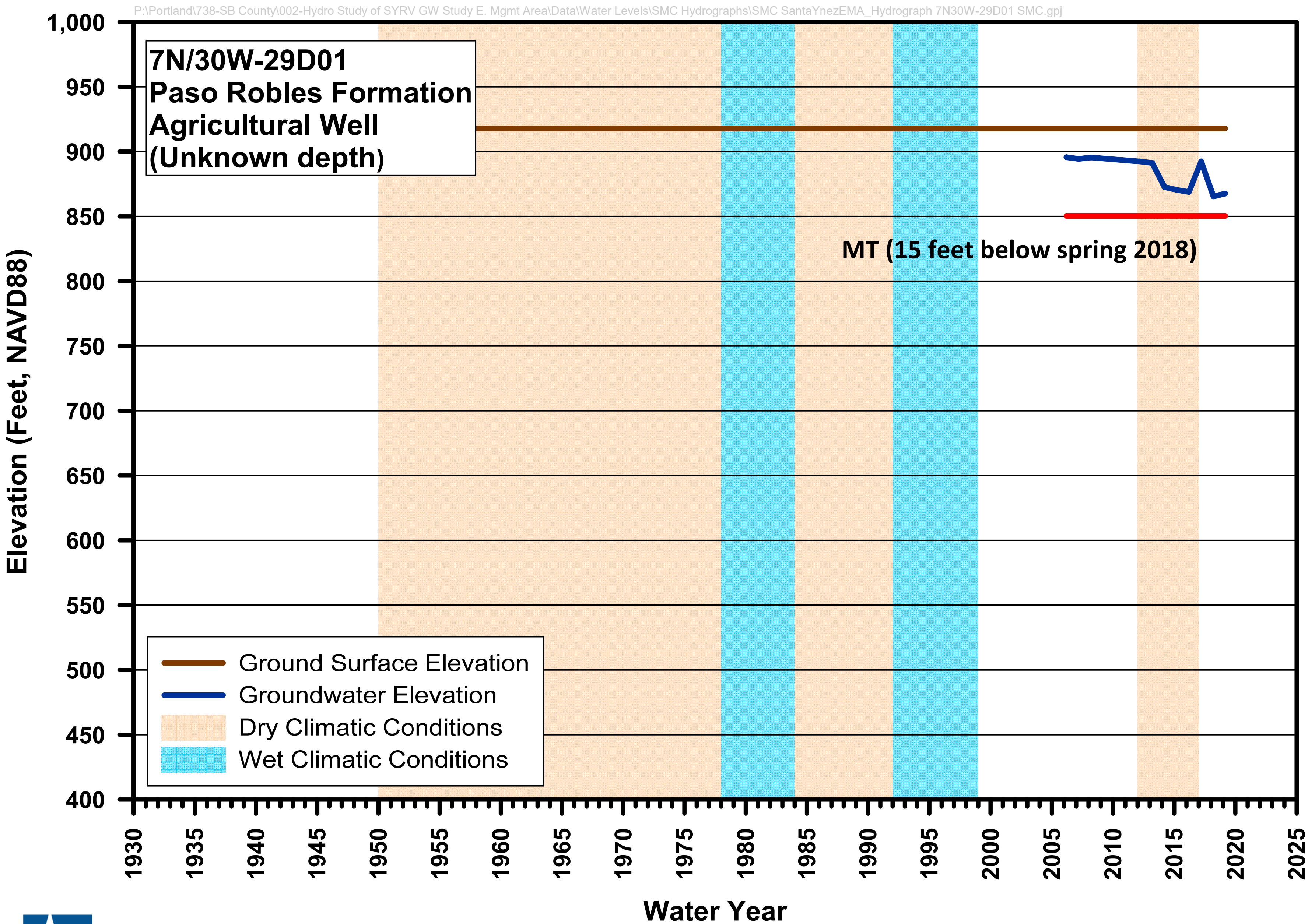
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-18

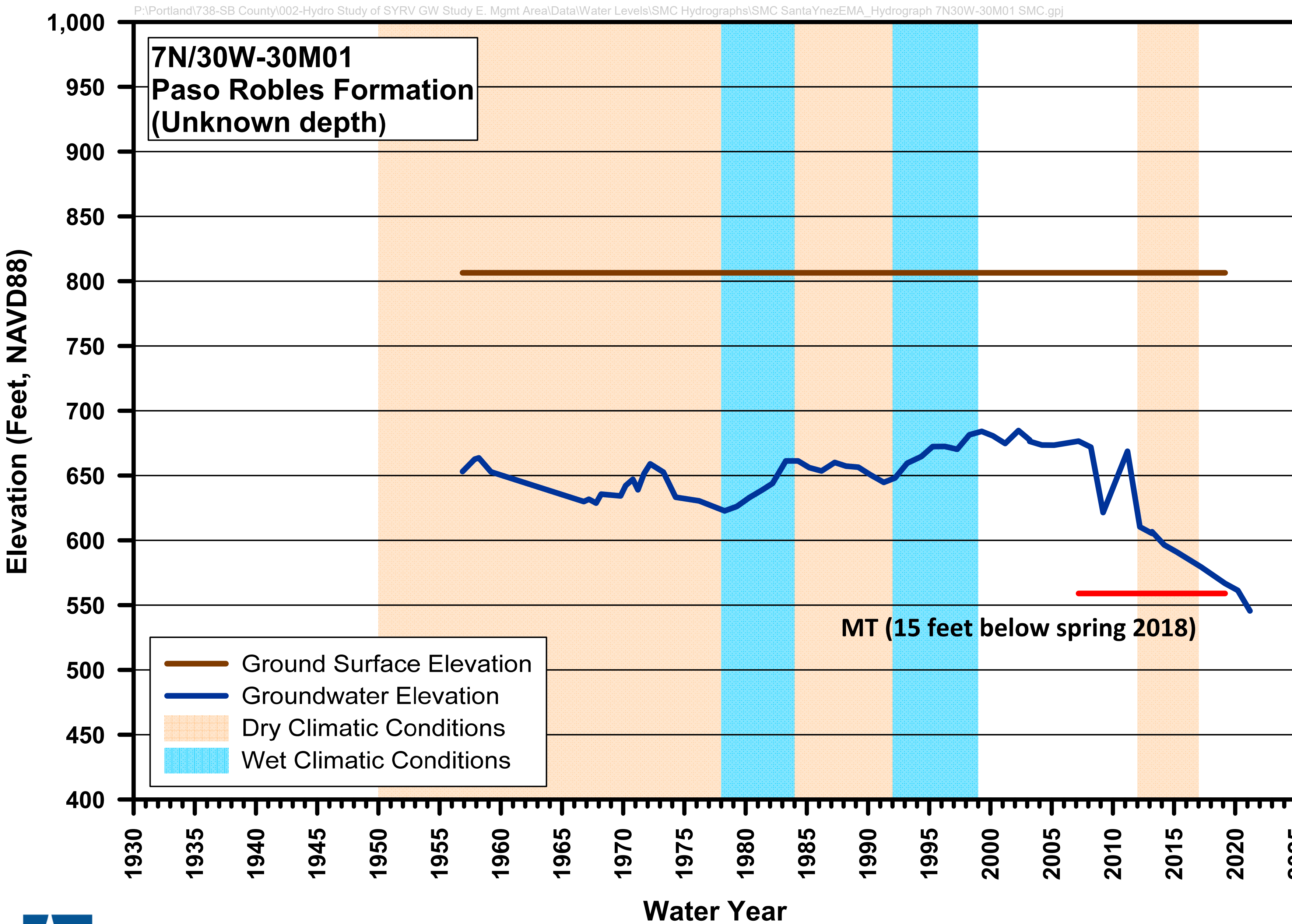
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-19

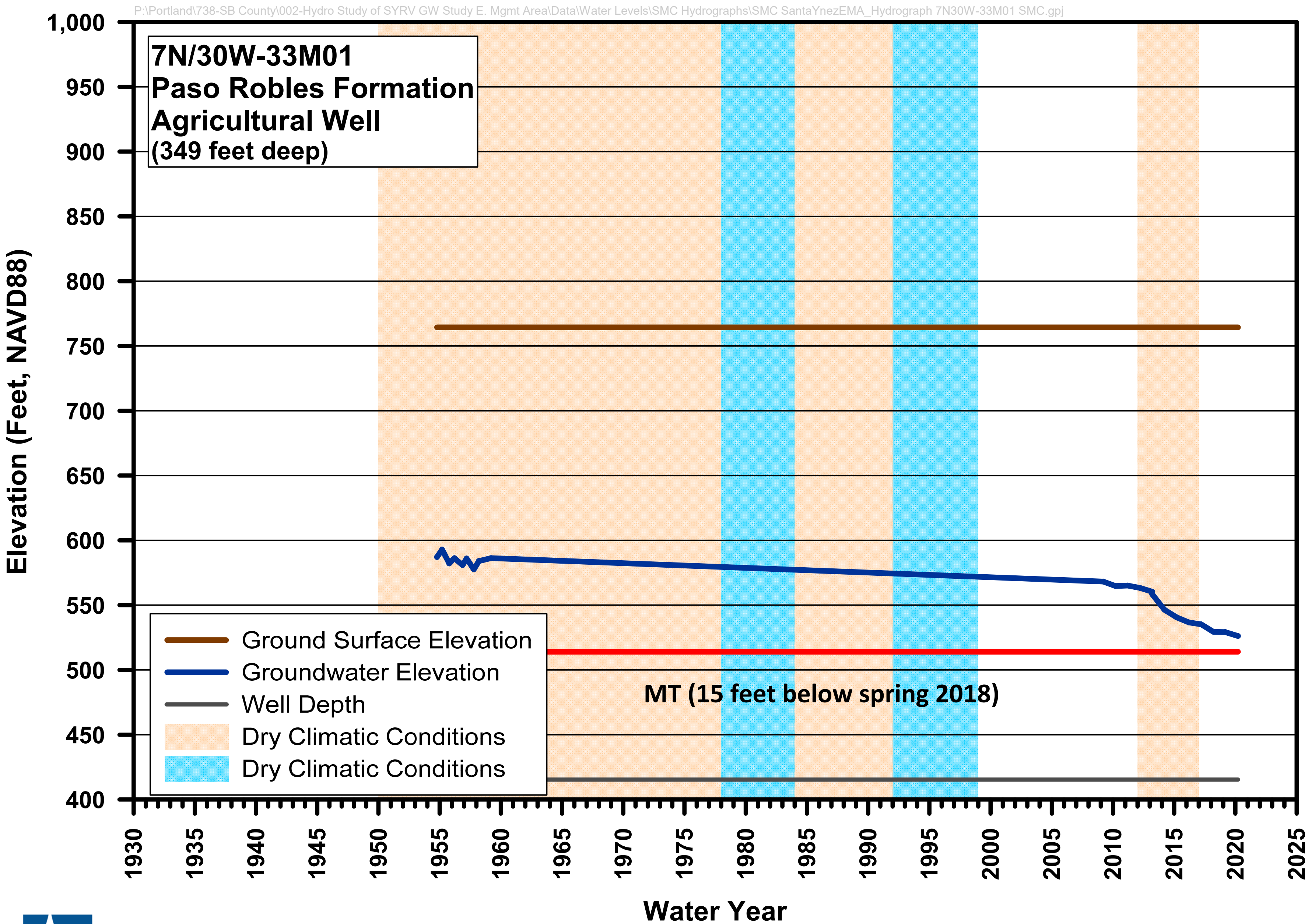
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-20

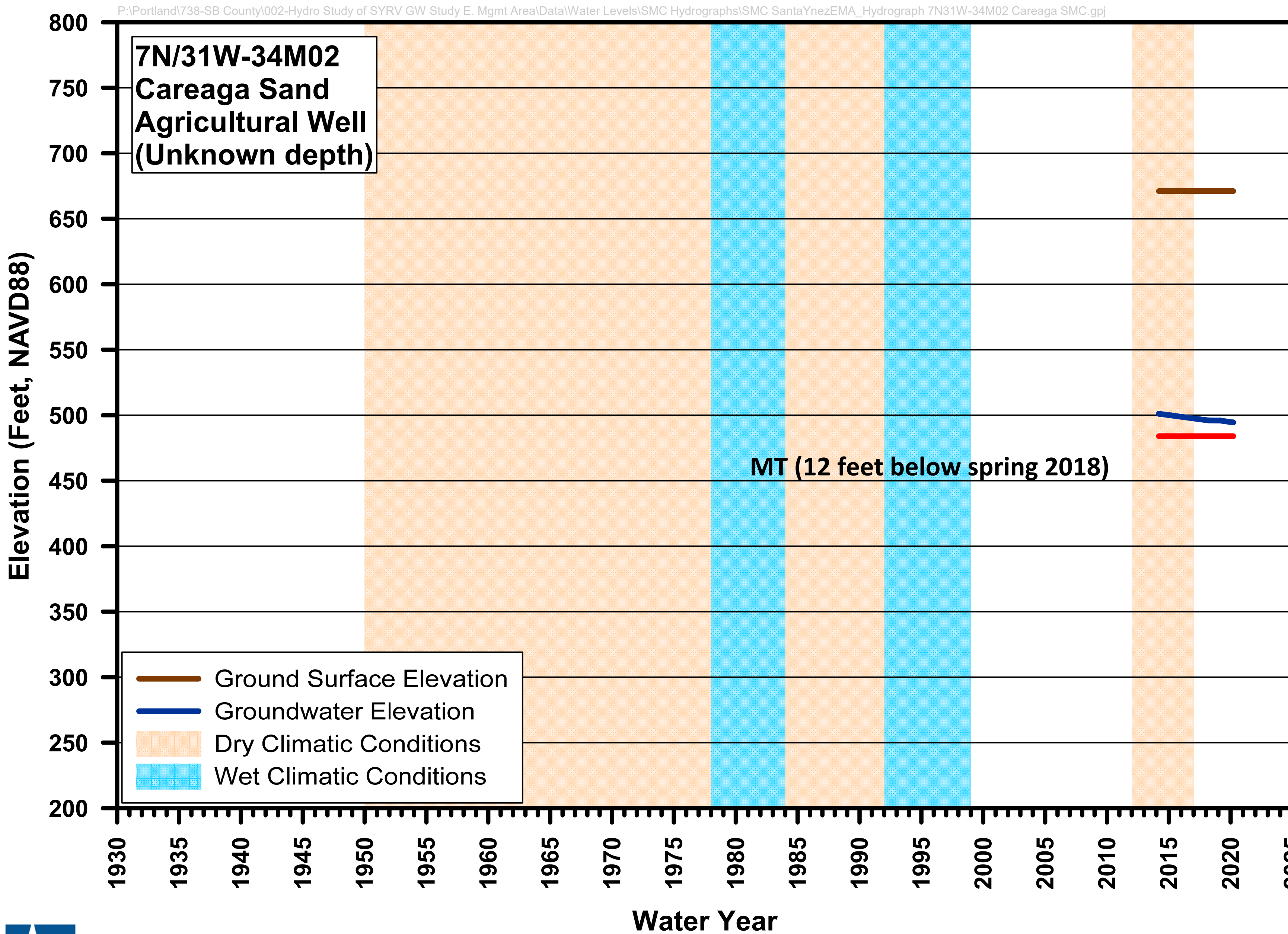
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-21

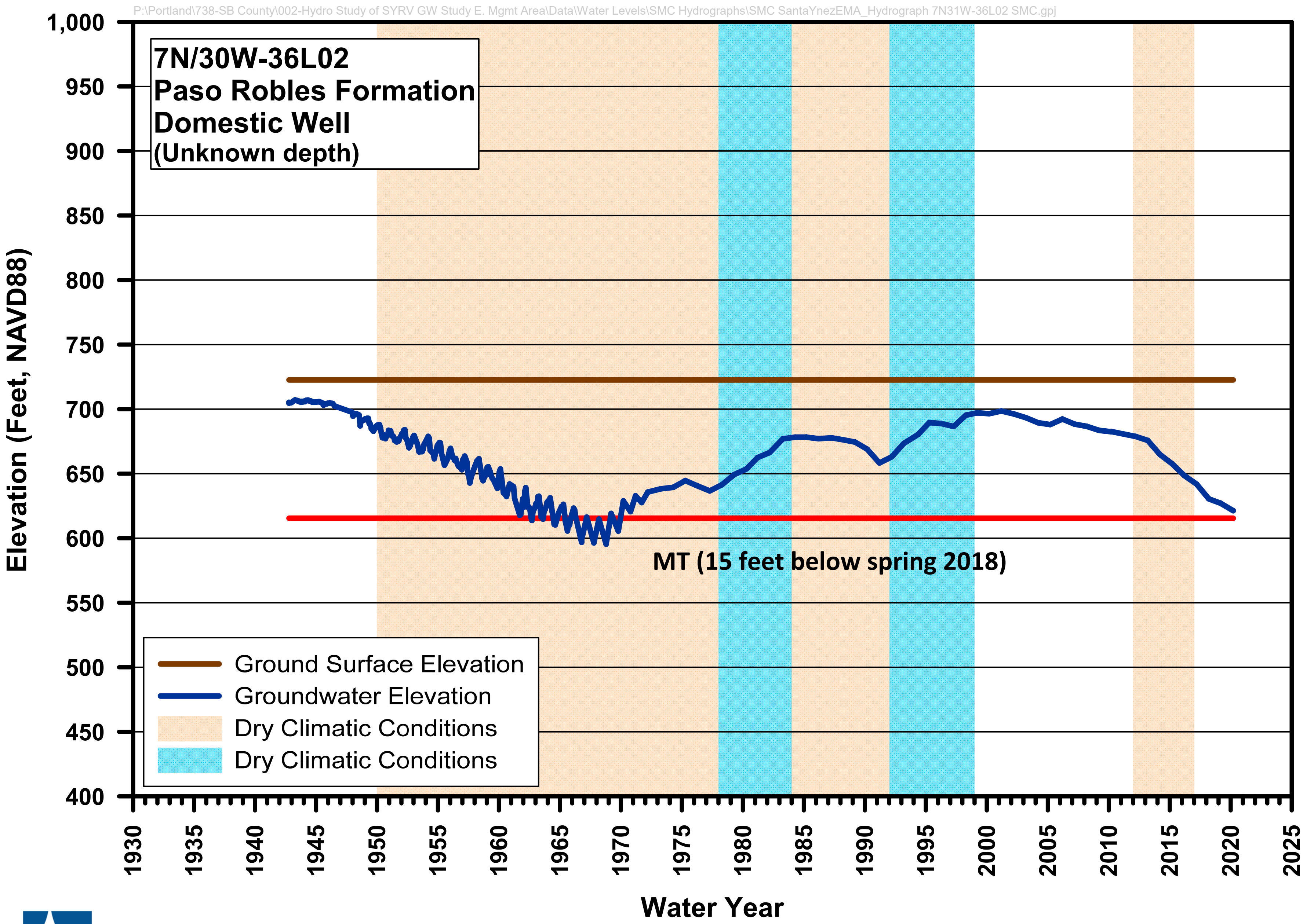
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-22

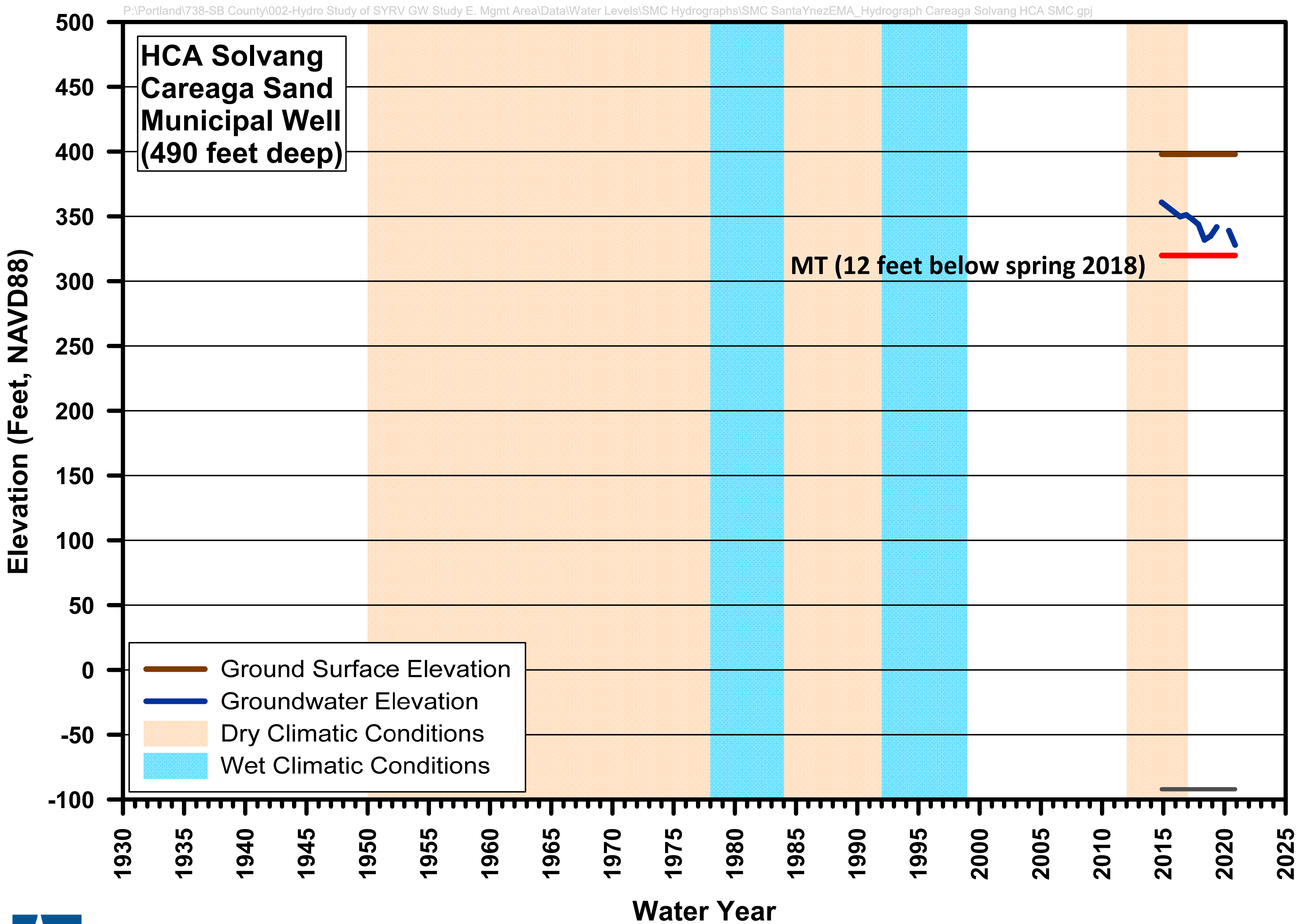
Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-23

Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin



GSI Water Solutions, Inc.

FIGURE 5-24

Groundwater Elevation Hydrograph
Eastern Management Area of the Santa Ynez River Valley Groundwater Basin