DRAFT MEMORANDUM
November 6, 2020

To: Six Basins Watermaster

From: Carolina Sanchez, PE, Senior Engineer; Andy Malone, Principal Geologist, WEI

Re: Development and Evaluation of Conjunctive Water Management Alternatives to Support the Program Environmental Impact Report (PEIR) for the Strategic Plan for the Six Basins

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Background and Objectives

In 2012, the Watermaster parties collectively agreed to enhance the management of the Six Basins beyond the execution of the Judgment by developing a Strategic Plan for the Six Basins (Strategic Plan). The Strategic Plan is a water-resources management program that sustains and enhances the water supplies available to the Six Basins in a cost-effective manner and in accordance with the Judgment. The development of the Strategic Plan was a multi-year effort that occurred in two phases.

Phase 1 of the Strategic Plan process was completed in 2013 and included the following:

- A description of the physical water resources of the Six Basins.
- A description of the past, present, and future water demands of the water purveyors in the Six Basins, and the water supplies available to meet those demands.
- A description of the needs and wants of the parties, their common goals for management of the Six Basins, and the impediments to achieving those goals.
- A conceptual-level description of recommended Strategic Plan initiatives that, if implemented, will remove the impediments and achieve the goals of the parties.
- A draft Strategic Plan report.

Phase 2 of the Strategic Plan process was completed in December 2015 and included the following:

- A more detailed description of potential Strategic Plan projects that were developed on a conceptual level during Phase 1.
- The construction and calibration of a numerical, computer-simulation model of the Six Basins and the use it to evaluate the Strategic Plan projects.
- Economic and institutional evaluations of the Strategic Plan projects.
- A recommended Strategic Plan.
- An implementation plan.
- A draft final Strategic Plan report.

At the July 26, 2017 Board meeting, the Six Basins Watermaster Board approved the final *Planning Proposal for Strategic Plan Implementation* (Planning Proposal) and approved Task Order 2017-2 directing Watermaster Staff to begin executing the first set of recommended implementation steps, which includes preparing a program environmental impact report (PEIR) pursuant to the California Environmental Quality Act (CEQA).[1] CEQA requires that any public agency making a decision on a project (e.g. to approve, permit, implement) must consider the project's potential significant environmental impacts and the potential mitigation measures and project alternatives that reduce or eliminate the environmental impacts, if appropriate.

The Strategic Plan report was finalized in November 2017.[2] The Strategic Plan report describes the Strategic Plan for the Six Basins as a regional "conjunctive water management" (CWM) program. CWM, as defined herein, is the coordinated use and management of all surface water and groundwater resources available to the Parties to enhance basin yield and improve regional water-

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[1] WEI, 2017. *Planning Proposal for Strategic Plan Implementation*. June 2017.

[2] WEI, 2017. Strategic Plan for the Six Basins. November 2017.

supply reliability during dry periods. The operational concept is to maximize the use of surplus local and imported surface water when it is available in greater volumes during wet periods, so that groundwater will be more available and reliable during dry periods when surface-water supplies are reduced. A key feature of the program is to utilize the Pomona Basin, which has the greatest regulatable storage potential in the Six Basins, as a storage reservoir for a dry-year storage program. The storage program "puts" or recharges water into storage during wet years, "holds" water until needed, and "takes" or pumps the stored water when surface-water and imported-water supplies are reduced due to drought or otherwise not available. This type of program will help achieve the following goals of the Strategic Plan:

- *Goal 1 – Enhance water supplies*. Increased pumping and treatment in the Pomona Basin during "take" years will (1) lower groundwater levels, and thereby reduce subsurface outflow from the basin and increase basin yield, and (2) put contaminated groundwater to beneficial use.
- *Goal 2 – Enhance basin management*. The coordinated use and management of all available water supplies will increase local water-supply reliability during dry periods.
- *Goal 3 – Protect and enhance water quality*. Increased pumping and treatment of Pomona Basin groundwater during "take" years will remove the contaminants from the basin.

A form of CWM is currently practiced in the Six Basins—largely through Pomona Valley Protective Association's (PVPA) efforts to divert and recharge storm water, and the Parties' efforts to recover that recharge via groundwater pumping pursuant to the physical solution in the Judgment. However, in its current practice, CWM is constrained by the following impediments:

- Not all stormwater runoff is diverted and recharged by PVPA during very wet years, which is a permanently lost opportunity for recharge.
- The threat of high groundwater conditions can limit the amount of stormwater spread by PVPA in wet years, which limits the ability to "maximize" the use of local and imported surface-water supplies during wet periods.
- The location, pumping capacity, and operation of wells are not coordinated or optimized among the Parties to increase pumping during dry periods or to prevent high groundwater conditions during wet periods.
- Poor groundwater quality in the Pomona Basin is a barrier to increasing pumping during dry periods.
- High groundwater in the Pomona Basin limits its unused storage space that is necessary to store water during wet periods.
- There is no Watermaster-approved Storage and Recovery Agreement for managing groundwater storage in the Pomona Basin.

The Strategic Plan describes various projects, that if constructed and operated in a coordinated fashion with existing water-supply infrastructure, could minimize or eliminate these constraints to implement a more robust CWM program in the Six Basins (the Project), and thereby, achieve the objectives of the Strategic Plan.

The PEIR will describe various Project alternatives that will bracket the potential range of Project size and operations. The objective of the PEIR is to describe the cumulative environmental impacts of Project implementation and any monitoring and mitigation measures as required by CEQA.

This memorandum describes: the development of the Project alternatives; the evaluation of the potential environmental impacts of the Project alternatives, specifically with regard to the hydrology of the Six Basins; and recommendations for potential monitoring and mitigation measures.

Methods to Evaluate the Conjunctive Water Management Alternatives

The potential hydrologic impacts of implementing the Project are changes in groundwater-levels and the water budget. To characterize the potential hydrologic impacts, the following work was performed:

1. Updated and recalibrated the Six Basins groundwater flow model used to characterize the potential hydrologic impacts of the Project (see Appendix A).
2. The CEQA guidelines state that: "[an] EIR must include a description of the physical environmental conditions in the vicinity of the project, as they exist at the time the notice of preparation [NOP] is published." This is sometimes referred to as the "baseline" or "no project" condition, and is used as a comparison to characterize the relative environmental impacts of the project and its alternatives. In this effort, we developed a "Baseline" alternative that does not include the Project (no project alternative).
3. Developed three Project alternatives that represent the potential range of Project size and operations from probable smallest to largest.
4. Used the Six Basins groundwater-flow model to simulate the hydrologic response of the Baseline and the three Project alternatives over a long-term hydrologic period, and compared and contrasted the model-simulation results. The planning period was constant between the Project alternatives and was defined as July 2017 to June 2075, and it assumes a variable hydrology based on the historical precipitation from 1960 to 2017. The hydrologic responses and the potential impacts that were evaluated included:
    a. *Chronic lowering of groundwater levels*. Chronic lowering of groundwater levels refers to groundwater levels that decline through the planning period indicating that, on average, discharge exceeds recharge. In other words, chronic lowering of groundwater levels indicates overdraft, and is an undesirable impact. The potential adverse impacts of overdraft include (1) increased pumping lifts that result in increased pumping costs, (2) land subsidence, (3) water of unusable quality being caused to migrate and make a groundwater supply unusable.[3]

[3] California Department of Water Resources (DWR), 2016. California's Groundwater – Working Toward Sustainability.

b. *Threat of high groundwater*. Historically, high groundwater problems have occurred in the City of Claremont, in the active sand and gravel mining pits on the eastside of the San Antonio Spreading Grounds (SASG), and within the City of Pomona in the Palomares Cienega. High groundwater is problematic because it can (1) impact infrastructure through flooding, (2) reduce the yield of the Six Basins by increasing outflow from the Six Basins and/or limiting the volume of stormwater recharge that can occur during wet periods, and (3) cause liquefaction hazards during earthquakes. Based on the January 2017 Board-adopted methodology to evaluate the threat of high groundwater conditions, high groundwater conditions are defined to occur when groundwater levels rise to within 40 feet of the ground surface. Herein, this threshold is referred as the "liquefaction threshold."

c. *Pumping sustainability at wells*. The term sustainability, as used herein, refers specifically to the ability to pump water from a specific well at a desired production rate, given the groundwater level at that well, its specific well construction, and current equipment details. A pumping sustainability metric is specific water level defined for each well by its owner. Different Parties may choose to set their pumping sustainability metrics using different criteria. For instance, one Party may set the metric at the top of the well screens versus another Party that may set the metric at 10 feet above the pump bowl assembly. Groundwater production at a well is presumed to be sustainable if the model-projected groundwater level at that well is greater than the sustainability metric. If the groundwater level falls below the sustainability metric, the owner will either need to lower the pumping equipment in their well or reduce the well's pumping rate. The Project will raise and lower groundwater levels as water is stored in the basin and then subsequently removed by pumping. The increases and decreases in groundwater levels may impact the Parties in the basin disproportionately. Pumping sustainability becomes a concern if the Project causes groundwater levels to fall below the sustainability metric at the Parties' wells when the stored water is removed. Because the pumping sustainability metric is defined by each Party, the best method to evaluate impacts to pumping sustainability is by comparing one alternative to the other.

d. *Developed yield*. As defined herein, the "developed yield" of the basin is the annual average yield that was pumped from the basin over a finite period of time, but is corrected for the change in groundwater storage and the volume of supplemental water recharge that occurred during the period. The developed yield is reflective of the hydrology and water management practices of that period. As described below, developed yield is a key factor in the calculation of the Operating Safe Yield (OSY) of the Six Basins, and therefore a reduction in developed yield would cause a reduction on the OSY.

e. *Subsurface outflow from the Six Basins to the Chino Basin*. Subsurface outflow to the Chino Basin occurs across the San Jose Fault. An increase in subsurface outflow to the Chino Basin suggests a loss of developed yield for the Six Basins (see item d above). A decrease in subsurface outflow to the Chino Basin could be a significant impact to the beneficial uses and users in the Chino Basin.

Planning Period

There are two key conditions that must be defined when developing a planning scenario for model simulation: hydrologic conditions and cultural conditions. The hydrologic conditions define when and how much precipitation and stormwater runoff will occur during the planning period. The cultural conditions define overlying land uses and the behavior of the Parties as it pertains to water use, such as pumping, outdoor water use, and in the case of the Six Basins, how water rights are exercised pursuant to the Judgment.

Precipitation and stormwater runoff in the Six Basins are highly variable and the resulting recharge has a relatively large effect on the groundwater basin response. This is true for two main reasons: (i) the groundwater basin is relatively small, so large changes in recharge result in large changes in groundwater levels, and (ii) the mix of water supplies utilized by many of the Parties changes significantly when stormwater runoff is more available for recharge or direct use. Thus, the evaluation of the Project must include a variable hydrology over a "representative" hydrologic period in order to adequately characterize the potential future response of the groundwater basin and the actions of the Parties (i.e. how they use water supplies).

The planning period is from July 1, 2017 to June 30, 2075. The assumed hydrology for the planning period is based on the historical hydrology from July 1, 1959 to June 30, 2017. The average precipitation across the study area for 58-year period is 19.3 inches, which is about the same as the long-term average precipitation of 19.7 inches from 1896 to 2018. The initial condition for all alternatives is the current condition as of July 1, 2017. Figure 1 shows the hydrologic characteristics of the planning period. The assumed hydrology of the planning period begins with an extended dry period from 2018 to 2035 (corresponding to the historical period 1961 through 1977) that includes a brief wet period between 2024 to 2027. This early dry period is a conservative assumption for the evaluation of groundwater impacts. This period is followed by alternating wet and dry periods from 2036 to 2056; and ends with an extended dry period from 2057 to 2075 (end of the planning period).

Methodology Used to Estimate OSY

The pumping in the Four Basins (Pomona, Upper Claremont Heights [UCHB], Lower Claremont Heights and Canyon sub-basins) is dependent on the OSY. Thus, the for the planning period OSY needed to be developed to estimate the pumping of the Project alternatives. For the PEIR, the OSY for the Four Basins was estimated using an iterative process that produces a similar range of OSY values compared to the actual OSY values that have been approved by the Six Basins Watermaster:

- Run the Baseline alternative (see assumptions of the Baseline Alternative below) with the Six Basins model, an initial variable OSY based on the following equation:

$$OSY_{t_i} = X + k\left(\overline{DY}_{t_{i-3}-t_{i-1}} - X\right)$$

where:

OSY_{t_i} is the OSY of year i

$\overline{DY}_{t_o-t_f}$ is the long-term average DY during the baseline period

k is a constant (0.25) to limit OSY to a practical range

$\overline{DY}_{t_{i-3}-t_{i-1}}$ is the average DY from the three years prior to year i

X is a constant adjusted as part of the iterative process

k is a constant (0.3) to limit OSY to a practical range

- Determine if the Baseline alternative is sustainable by answering the following questions:
  - Is the projected occurrence of rising groundwater unreasonable?
    - If the answer is yes, increase *X* in the equation above.
    - If the answer is no, move to the question below.
  - Does the Baseline Alternative result in overdraft?
    - If the answer is yes, decrease *X* in the equation above.
    - If the answer is no, the OSY is sustainable, and the iterative process is complete.

The Baseline alternative was run three times before achieving a "sustainable" Baseline alternative. The first two versions of the runs resulted in unreasonable occurrence of rising groundwater compared to historical values as estimated during model calibration. The final OSY equation used was:

$$OSY_{t_i} = 16{,}500 + 0.3\left(\overline{DY}_{t_{i-3}-t_{i-1}} - 16{,}500\right)$$

Figure 2 shows the estimated OSY of the Four Basins over the planning period using the PEIR Baseline method. The OSY increases during wet years/periods, decreases during dry years/periods, and ranges between about 11,000 to 23,000 afy, which is consistent with historical production from the Four Basins.

The development and evaluation of the Baseline and three CWM alternatives are described below.

Baseline Alternative for the Strategic Plan PEIR

The Baseline alternative does not include the implementation of the Project and must be described in enough detail to perform numerical groundwater-flow modeling of the Six Basins. The Baseline alternative, or the no-project Alternative, will serve as a comparison metric for evaluating the impacts of the Project alternatives.

Baseline Alternative Operations

The Baseline alternative represents future cultural conditions and operating conditions in the absence of a CWM Program. The main assumptions for the Baseline Alternative are:

Groundwater pumping. During the development of the Baseline alternative, the Parties expressed that groundwater from the Six Basins is the preferred source of water supply. Therefore, in the Baseline alternative, each Party pumps its share of the annual OSY with the following exceptions:

- The TVMWD plans to pump groundwater up to its well capacities, and total annual pumping ranges from 1,750 to 2,600 afy during dry and wet years, respectively, and averages 2,100 afy. This represents overproduction of its water rights, so it satisfies its Replacement Water obligation with its Storage and Recovery account (see below).
- The City of La Verne plans to pump its share of the OSY from the Pomona Basin in the Baseline alternative but also has independent discretion to pump groundwater from the Two Basins. The City plans to pump 1,980 afy from the Two Basins during the Baseline alternative.

Figure 3 shows the active pumping wells in the Baseline alternative.

Storage and Recovery accounts. There are three parties with Storage and Recovery accounts in the Six Basins: TVMWD, San Antonio Water Company (SAWCo) and City of Pomona (Pomona).

- TVMWD was assumed to satisfy its Replacement Water obligation by exercising its Storage and Recovery account.
- SAWCo and Pomona are assumed to not utilize their Storage and Recovery accounts.

Artificial recharge. There are two types of artificial recharge in the Six Basins: artificial recharge of native water from the San Antonio Canyon conducted by Pomona and SAWCo, and artificial recharge of imported water to increase Storage and Recovery accounts or satisfy a Replacement Water obligation caused by over-production (which historically has only been done by TVMWD).

- *Artificial recharge of native water.* The Baseline assumed that Pomona and SAWCo do not recharge any water in the future. This ensures that the Baseline OSY is sustainable regardless on increased water levels due to increasing storage accounts.
- *Artificial recharge of imported water.* Artificial recharge of imported water is assumed to occur in the Baseline by TVMWD to store water and satisfy its Replacement Water obligation. In the Baseline alternative, this artificial recharge occurs at the SASG and the Miramar Ponds in the UCHB. Total annual artificial recharge of imported water ranges from about 770 to 2,500 afy, and averages about 2,100 afy.

Baseline Alternative Results

Table 1 is the model-estimated, annual water budget of the Six Basins for the Baseline alternative. The hydrologic responses and the potential impacts of the Baseline alternative are described below.

Threat of rising groundwater. The main observations and interpretations regarding the occurrence of high groundwater conditions during the Baseline alternative are:

- Figures 4a through 4e are time-series charts of model-estimated water levels at selected wells in each of the primary subbasins. These charts show that water levels can rise to near or above the liquefaction threshold during or soon after very wet periods, such as 2041, 2056, 2057, and 2063—years when spreading in the Six Basins are assumed to be relatively high, and hence, groundwater levels were relatively high.

- Figure 5 is a map that shows the areas of concern for high groundwater during the Baseline alternative in 2041, 2056, 2057, and 2063—years when spreading in the Six Basins are assumed to be relatively high, and hence, groundwater levels were relatively high. Figure 5 shows that the areas of concern for high groundwater are generally behind faults and the impermeable bedrock of the San Jose Hills, which are barriers to groundwater flow.
- Table 1 shows that volume of rising groundwater decreased from about 300 af in 2018 to 0 af in 2027, and then occurred again in 2037 until the end of the planning period. Rising groundwater averages 1,500 afy over the planning period. This is an improvement compared to the historical calibration period where rising groundwater was estimated to occur at about 2,600 afy between 1978 and 2017 (see Appendix A).
- The iterative modeling process to determine the appropriate OSY formula for the Baseline alternative indicated that rising groundwater could not be mitigated through the OSY. Hence, the future occurrence of rising groundwater is best mitigated through the Project alternatives that include the pumping of a Temporary Surplus and/or pump-and-treat projects in the Pomona and Two Basins.

Pumping sustainability. Figure 6 shows the pumping wells in the Six Basins for the Baseline alternative. The wells are symbolized by their model-estimated water levels as compared to their pumping sustainability metrics during periods of low groundwater levels–2023, 2030, 2034, and 2075. The wells with pumping sustainability challenges during dry periods are symbolized with yellow and red dots. Most of these wells are located in the UCHB, where water levels tend to fluctuate significantly between wet and dry periods. Also, many of these wells are owned by the GSWC, which set pumping sustainability metrics at the top of the well screens, which was higher compared to where most other Parties set their pumping sustainability metrics. Because the pumping sustainability metric is defined by each Party, the best method to evaluate impacts to pumping sustainability is by comparing one alternative to the other.

Chronic lowering of groundwater levels. Figure 7 shows the change in groundwater levels over the planning period (2075 groundwater elevations *minus* 2017 groundwater elevations). Figure 7 shows that groundwater levels generally increased by up to 20 feet in the Pomona Basin and Ganesha Basin. Water levels decreased by more than 30 feet in certain areas of the UCHB, most likely due to the assumed dry conditions at the end of the planning period hydrology. The time-series charts of groundwater levels at wells in Figures 4a through 4e show that there is no chronic of groundwater levels at these wells which are located across the Six Basins (see Appendix B for all well hydrographs). Additionally, Table 1 shows that the total storage change during the Baseline alternative was about +18,000 af. In summary, there is no chronic lowering of water levels estimated for the Baseline alternative.

Developed yield. Table 1 shows the annual estimates of developed yield for the Six Basins over the planning period for the Baseline alternative. The long-term average developed yield was about 18,500 afy for the Baseline alternative–about 500 afy more compared to the historical calibration period.

Subsurface Outflow to the Chino Basin. Table 1 shows the annual estimates of subsurface outflow from the Six Basins to the Chino Basin over the planning period for the Baseline alternative. The long-term average subsurface outflow to the Chino Basin was about 6,400 afy for the Baseline alternative – about 800 afy less compared to the historical calibration period.

Conjunctive Water Management Alternatives for the Strategic Plan PEIR

In preparation of the Planning Proposal, Watermaster staff conducted a series of meetings with individual Parties and other stakeholders to identify specific Strategic Plan projects that are of interest for implementation. These projects, along with existing water-supply infrastructure, can be operated in a coordinated manner to enable the implementation of a CWM program that will increase water-supply reliability during dry periods.

The Strategic Plan projects were categorized by type:

- **Pump-and-treat projects** – Pump-and-treat projects were conceptualized to (i) remove contaminants from groundwater and put the treated groundwater to beneficial use and (ii) lower groundwater levels to reduce the threat of high groundwater and increase the yield of the Pomona Basin by reducing subsurface outflow. These types of projects also can facilitate the implementation of a CWM program in the Six Basins by creating storage space in the Pomona Basin to facilitate the implementation of a storage and recovery program, and by increasing groundwater-pumping capacity to enable "takes" from storage.
- **Stormwater and supplemental-water recharge projects** – The stormwater and supplemental-water recharge projects were conceptualized to enhance the yield of the Six Basins by increasing the capacity to divert and recharge stormwater, improve groundwater quality through the recharge of high-quality stormwater, and increase the volume of groundwater that can be sustainably pumped from the Six Basins via recharge of supplemental water. These types of projects can facilitate the implementation of a CWM program in the Six Basins by increasing the volumes of stormwater recharge and providing additional recharge capacity for supplemental water recharge during "put" years.
- **Temporary Surplus projects** – The Temporary Surplus projects were conceptualized to increase groundwater pumping during wet periods to minimize the potential for high groundwater conditions, provided that the pumping wells that extract the Temporary Surplus are located in areas that will mitigate the potential for high groundwater. Temporary Surplus projects can facilitate the implementation of a CWM program in the Six Basins by increasing the use of surplus groundwater during wet periods, which can then be used for in-lieu recharge of the Pomona Basin.

The specific projects under each project type, their estimated capacities, and projected facilities needed to implement them are listed in Table 2 and are described in detail in the Strategic Plan report.

Description of Conjunctive Water Management Alternatives

There are numerous permutations for CWM alternatives (i.e. puts, takes, holds, and total storage program volumes). The objective here is to define a reasonable range of CWM programs that can be evaluated for the PEIR, so that future implementation of specific projects and CWM programs will be covered by the PEIR. Thus, three CWM alternatives were developed, each consisting of the following general rules:

- Takes from the dry-year storage program are accomplished by expanding the treatment at Reservoir 5 and Lincoln and Mills facilities and utilizing this new pump-and-treat capacity in the Pomona Basin.
- Puts to the dry-year storage program are accomplished through in-lieu recharge. The put is accomplished by reducing the pumping of OSY rights in the Pomona Basin and replacing those OSY rights with other water supplies including the Temporary Surplus or treated imported water.
- Declare Temporary Surplus during very wet years. The Temporary Surplus is accomplished by pumping more groundwater than the Parties' OSY rights at wells within the LCHB and UCHB.

The three CWM alternatives (Project alternatives) evaluated are describe below.

Conjunctive Water Management — Alternative 1

The first alternative evaluated for the Strategic Plan PEIR was CWM-1. The operating rules for puts, takes, and holds are based on a statistical characterization of the precipitation and recharge of the planning period hydrology and are summarized in Table A below.

Table A. CWM-1 Operating Rules

Criteria	Action	Put (+) or Take (-)*
If more than 9,500 af of stormwater is recharged at the SASG from October through March	Put water in storage through in-lieu recharge by reducing OSY pumping in Pomona Basin from April to December. The reductions in pumping are replaced with water made available through: • pumping a Temporary Surplus if the two-year cumulative recharge at the SASG is larger than 30,000 af, or • delivering treated imported water, if the two-year cumulative recharge at the SASG is less than 30,000 af.	+ 4,250 af
If more than 0 but less than 9,500 af of stormwater is recharged at the SASG from October through March	Hold water in dry-year storage account (no action).	0 af
If stormwater recharge at the SASG is zero	Take water from storage by increasing pumping in Pomona Basin over planned OSY production from April to December.	- 3,500 af

*Note that the value of the puts and takes was estimated based on the capacity available to increase or decrease production in the Pomona Basin compared to the final Baseline run.

The annual puts, takes, holds, and storage account balances over the planning period are shown in Table 3 and Figure 8. Based on these rules over the 58-year planning period, water was taken from the dry-year storage account during 17 years (59,500 af). Water was put into the storage account during 14 years (59,500 af). Water is held in storage in 27 years. If the storage account balance starts at zero, the storage account reaches a minimum of -9,750 af and a maximum of 30,000 af. Therefore, the dry-year storage account is set to 40,000 af to be able to accommodate puts and takes based on the variability of the planning period hydrology. The facilities used to operate CWM-1 are shown on Figure 9.

The Temporary Surplus is invoked in seven years over the 58-year planning period. Existing wells in the UCHB with existing unused capacity were used to produce the Temporary Surplus.

No new recharge facilities are included in this alternative.

It was assumed that the Reservoir 5, Lincoln and Mills, and Del Monte 4 pump-and-treat projects were implemented to be able to conduct the 3,500 af takes without the need for blending with treated imported water.

Conjunctive Water Management — Alternative 2

CWM-2 includes:

- A 65,000 af dry-year storage account that resides in the Pomona Basin.
- Puts to the storage account are accomplished through in-lieu recharge and wet-water recharge.
    a. *In-lieu put*. The put is accomplished by reducing the pumping of OSY rights in the Pomona Basin and replacing those OSY rights with other water supplies including the Temporary Surplus or treated imported water. This method is the priority and is maximized before conducting wet-water recharge.
    b. *Wet-water put*. Untreated imported water is physically recharged at existing spreading grounds and/or planned recharge basins.
- Takes from storage are accomplished by (1) expanding the treatment at Reservoir 5 and Lincoln and Mills facilities, (2) rehabilitating and constructing wellhead treatment at the Old Baldy well, and (3) constructing Durward 2 and its corresponding treatment facilities, and utilizing this new pump-and-treat capacity in the Pomona and Two Basins.

The operating rules for puts, takes, and holds were based on the same methodology used for the CWM-1 and are summarized in Table B below.

Table B. CWM-2 Operating Rules

Criteria	Action	Put (+) or Take (-)
If more than 9,500 af of stormwater is recharged at the SASG from October through March AND the two-year cumulative recharge at the SASG is more than 30,000 af	Put water in storage by reducing OSY pumping in Pomona Basin from April to December. The reductions in pumping are replaced with water made available through a Temporary Surplus.	+ 4,250 af in-lieu
If more than 9,500 af of stormwater is recharged at the SASG from October through March AND the two-year cumulative recharge at the SASG is less than 30,000 af	Put water in storage by: • reducing OSY pumping in Pomona Basin from April to December. The reductions in pumping are replaced with deliveries of treated imported water, and • recharging untreated imported water at a recharge basin.	+ 5,060 af (+ 4,250 af in-lieu and + 1,135 af wet-water)
If more than 0 but less than 9,500 af of stormwater is recharged at the SASG from October through March	Put water in storage by recharging untreated imported water at a recharge basin.	+ 1,135 af wet-water
If stormwater recharge at the SASG is zero	Take water from storage by increasing pumping in Pomona Basin over planned OSY production from April to December.	- 5,700 af

The puts, takes, and storage account balances over the planning period are shown in Table 4 and Figure 10. Based on these rules over the 58-year planning period, water was taken from the dry-year storage account during 17 years (96,900 af) utilizing existing well capacity with the proposed improvements at Del Monte-4, Lincoln and Mills, Reservoir 5 and the Old Baldy well, and with the proposed Durward well. Water was put into the storage account as in-lieu recharge during 14 years (59,500 af). Water was put into the storage account as wet-water recharge during 33 years (37,455 af; resulting in a total put of 96,955). If the storage account balance starts at zero, the storage account reaches a minimum of -17,415 af and a maximum of 47,445 af. Therefore, the dry-year storage account is set to 65,000 af to be able to accommodate puts and takes based on the variability of the planning period hydrology. Note that the Two Basins are included in this alternative with the operation of the Old Baldy well for takes, and assumes that puts by wet-water recharge occur in the Live Oak Basin in an amount that offsets the takes from the Old Baldy well. The facilities used to operate CWM-2 are shown in Figure 11

The Temporary Surplus is invoked in seven years over the 58-year planning period. Existing wells in the UCHB with existing unused capacity, P-20 in the Lower Claremont Heights Basin, and one new well will be used to produce the Temporary Surplus. The operating rules for Temporary Surplus and are summarized in Table C below.

Table C. CWM-2 Operating Rules for Temporary Surplus

Criteria	Temporary Surplus Amount
If the two-year cumulative recharge at the SASG is larger than 30,000 af	5,450 af
If the four-year cumulative recharge at the SASG is larger than 60,000 af	6,450 af

Conjunctive Water Management — Alternative 3

CWM-3 is an alternative to CWM-2 that includes the expected stormwater recharge from the MS4 recharge projects evaluated in the *Reconnaissance-Level Recharge Study in the Six Basins* completed in February 2020 (WEI, 2020). Adding these projects provides an additional recharge source to the Six Basins. Under CWM-3, it is assumed that the recharge from the MS4 recharge projects is recovered (pumped) the same year as it is recharged. The MS4 facilities are shown in Figure 12 and their expected recharge is shown in Table 5. As shown in Table 5, the expected stormwater and dry-weather recharge from the sites is about 1,200 afy and 250 afy, respectively.

Summary of the Project Alternatives

Table D below summarizes the three Project alternatives.

Table D. Summary of Project alternatives

<table>
<tr><th></th><th>CWM-1</th><th>CWM-2</th><th>CWM-3</th></tr>
<tr><td>Storage Program</td><td>40,000 af dry-year storage account with in-lieu recharge only</td><td colspan="2">65,000 af dry-year storage account with in-lieu and wet-water recharge</td></tr>
<tr><td>Temporary Surplus Pumping</td><td>4,250 af</td><td colspan="2">5,450 to 6,450 af</td></tr>
<tr><td>New Facilities</td><td>Expanded Treatment Only</td><td>CWM-1 + Two New Wells for Takes (Old Baldy, Durward) + New Wells for Temporary Surplus (P-20 and a new well in the UCHB)</td><td>CWM-2 + MS4 facilities</td></tr>
</table>

Conjunctive Water Management Alternative Results

Tables 6a through 6c are model-estimated, annual water budgets of the Six Basins for the three Project alternatives. The hydrologic responses and the potential impacts of the three Project alternatives are described below.

Chronic Lowering of Groundwater Levels

The main observations and interpretations regarding chronic lowering of groundwater levels for the Project alternatives are:

Figures 13a through 13e are time-series charts of model-estimated water levels at selected wells in each of the primary subbasins for the Baseline and the three Project alternatives. These charts show that the Project alternatives generally result in lower groundwater levels compared to the Baseline alternative. Review of these charts suggests that there are no concerns with chronic lowering of groundwater levels. Figure 13e suggests that the Old Baldy well responds highly to pumping during takes (see groundwater levels for CWM-2 and CWM-3 compared to CWM-1 and Baseline). There is about a 100-foot drawdown between the Baseline alternative and the CWM-2/3 alternatives after a long-term dry period that consists of five consecutive take years. Based on the response to put periods observed in the groundwater levels of the Old Baldy well, it is expected that groundwater levels would partially recover after one or two put years.

Figures 17a through 17c show the change in groundwater levels between the end of the planning period (2075) and initial conditions (2017) for the Project alternatives. Figures 18a through 18c show the change in groundwater levels between each Project alternative and the Baseline alternative at the end of the planning period (2075). These figures show that:

- The CWM-1 alternative resulted in a water-level decrease of up to 60 ft in the UCHB in the southern part of the SASG – compared to 30 feet in the Baseline. The additional 30-foot decrease in water levels compared to the Baseline is likely as a result of the Temporary Surplus pumping. The CWM-1 alternative resulted in a water-level decrease of up to 40 ft in the Pomona Basin and 20 feet in the Two Basins – compared to 30 feet and 10 feet. The additional 10 feet of water level decrease in these subbasins is likely due to both the Temporary Surplus, which may reduce the subsurface outflow from the UCHB to the Two Basins and the Pomona Basin, and due to the takes in the Storage Program.
- The CWM-2 alternative resulted in a water-level decreases in the UCHB similar to those observed in CWM-1. This suggests that the additional Temporary Surplus pumping in CWM-2 compared to CWM-1 did not significantly impact water levels in the UCHB. The CWM-2 alternative resulted in a water-level decrease of up to 90 ft in the Pomona Basin and 70 feet in the Two Basins – compared to 30 feet and 10 feet – as a result of the larger storage program compared to CWM-1.
- The CWM-3 alternative resulted in a water-level decrease of up to 40 ft in the UCHB in the southern part of the SASG – compared to 30 feet in the Baseline and 60 feet in CWM-1 and -2. This suggests that the recharge from the MS4 facilities helped mitigate some of the lowering of water levels observed in CWM-1 and -2. The CWM-3 alternative resulted a water-level decrease in the Two Basins and Pomona Basin similar to that observed in CWM-2. This suggests that the recharge from the MS4 facilities within the Two Basins and the Pomona Basin did not significantly impact water-levels in this area.

Based on these observations, the Project alternatives result in operating at lower groundwater levels when compared to the Baseline, but no indication of chronic lowering of persistent downward trend of groundwater levels.

Threat of High Groundwater

The main observations and interpretations regarding the occurrence of high groundwater conditions for the Project alternatives are:

Figures 13a through 13e are time-series charts of model-estimated water levels at selected wells in each of the primary subbasins for the Baseline and the three Project alternatives. These charts show that the Project alternatives generally result in lower groundwater levels compared to the Baseline alternative, which reduces the occurrences and duration of high groundwater during wet periods. The lower groundwater levels of the Project alternatives in the UCHB are caused by the pumping of the Temporary Surplus. The lower groundwater levels of the Project alternatives in the Pomona and Ganesha basins are caused by the increased pumping during takes from the storage program.

Figures 14a through 14c are maps that show the areas of concern for high groundwater during the Project alternatives in 2041, 2056, 2057, and 2063—years when spreading in the Six Basins are assumed to be relatively high, and hence, groundwater levels were relatively high. Just as with the Baseline alternative, these areas of concern for high groundwater are generally behind faults and the impermeable bedrock of the San Jose Hills, which are barriers to groundwater flow. That said, the extent of the areas of concern for high groundwater in the UCHB is reduced for the three Project alternatives compared to the Baseline alternative—most likely because of the pumping of the Temporary Surplus.

Figures 15a through 15c are a time-series charts of model-estimated rising groundwater discharge from the UCHB, the Two Basins, and the Pomona Basin for the Project alternatives compared to the Baseline. The figures also show the end of year storage account balance for the Project alternatives, and the timing of pumping the Temporary Surplus. The main observations of Figures 15a through 15c are:

- Figure 15a shows that the pumping of Temporary Surplus in Project alternatives reduces rising groundwater discharge in the UCHB compared to the Baseline.
- Figure 15b shows that the Project alternatives have little to no effect on rising groundwater discharge from the Two Basins.
- Figure 15c shows that adding water to the storage account increases rising groundwater discharge in the Pomona Basin, and extracting water from the storage program reduces rising groundwater discharge in the Pomona Basin.

Tables 6a through 6c show the annual model-estimated rising groundwater discharge from the Six Basins for the Project alternatives. Generally, rising groundwater discharge increases as total storage increases, and vice versa. Table E below summarizes the average rising groundwater discharge from the UCHB, Two Basins, Pomona Basin, and the Six Basins for the Baseline and each Project alternative. All Project alternatives cause decreases in rising groundwater discharge compared to the Baseline.

Table E. Model-Estimated Rising Groundwater in the Six Basins (afy)

Sub-Basin	Baseline Average	CWM-1			CWM-2			CWM-3		
		Average	Change from Baseline	Percent Change from Baseline	Average	Change from Baseline	Percent Change from Baseline	Average	Change from Baseline	Percent Change from Baseline
UCHB	83	19	-64	-77%	28	-55	-66%	34	-49	-59%
Two Basins	918	825	-93	-10%	879	-39	-4%	915	-3	-0.3%
Pomona Basin	508	335	-173	-34%	269	-239	-47%	228	-280	-55%
Six Basins	1,509	1,179	-330	-22%	1,176	-333	-22%	1,177	-332	-22%

Pumping Sustainability

The main observations and interpretations regarding the challenges with pumping sustainability for the Project alternatives are:

Figures 13a through 13e are time-series charts of model-estimated water levels at selected wells in each of the primary subbasins for the Baseline and the three Project alternatives. These charts show that the Project alternatives generally result in lower groundwater levels compared to the Baseline alternative. However, this does not appear to impact the pumping sustainability at the five wells show in Figures 13a through 13e.

Figures 16a through 16c show the pumping wells in the Six Basins for the Project alternatives. The wells are symbolized by their model-estimated water levels as compared to their pumping sustainability metrics during periods of low groundwater levels–2023, 2030, 2034, and 2075. The wells with pumping sustainability challenges during dry periods are symbolized with yellow and red dots. These figures show that:

- The wells with pumping sustainability challenges generally remain constant between periods.
- There period with most wells below the pumping sustainability metric is July 2023. This coincides with the end of a long-term dry period that includes the historical period of 1999 to 2017 and planning period of 2018 to 2023 (equivalent to the hydrology of 1960 to 1965).
- The wells with pumping sustainability challenges, remain constant between Project alternatives and the Baseline alternatives. This suggests that the Project does not improve or exacerbate the issues with pumping sustainability observed in the Baseline.

Developed Yield

The developed yield of the Six Basins is estimated to be higher under the Project alternatives when compared to the Baseline. Table G below summarizes the impacts to developed yield under each alternative. The main observations from Tables 6a through 6c and Table F below are:

- The CWM-1 alternative resulted in a decrease in developed yield in the Two Basins and the Pomona Basin, but in an increase in developed yield in the Upper Claremont Heights; the overall increase in developed yield in the Six Basins was about 300 af or 2 percent.
- The CWM-2 alternative resulted in an increase in developed yield in all sub-basins; the overall increase in developed yield in the Six Basins was about 350 af or 2 percent.
- The CWM-3 alternative results in the largest increase in developed yield, 1,847 afy or 10 percent, in the Six Basins; this suggests that the recharge from the MS-4 projects, and the subsequent recovery of this recharge, result in an increase in yield in the basin.
- The increases in developed yield are likely due to the operation of the basin at a lower storage (see Table F above), which reduces the outflow through rising groundwater and, in the case of CWM-2 and -3, the subsurface outflow to the Chino Basin (see Tables 1 and Tables 6a through 6c).

Tables 6a through 6c show the annual model-estimated developed yield of the Six Basins for the Project alternatives. Table F below summarizes long-term average developed yield for the Project alternatives of the UCHB, Two Basins, Pomona Basin, and the Six Basins.

Table F. Model-Estimated Developed Yield in the Six Basins (afy)

Sub-Basin	Baseline Average	CWM-1			CWM-2			CWM-3		
		Average	Change from Baseline	Percent Change from Baseline	Average	Change from Baseline	Percent Change from Baseline	Average	Change from Baseline	Percent Change from Baseline
UCHB	9,568	10,139	570	6%	9,759	190	2%	10,373	805	8%
Two Basins	1,994	1,956	-39	-2%	2,082	88	4%	2,188	194	10%
Pomona Basin	6,988	6,763	-225	-3%	7,062	74	1%	7,837	849	12%
Six Basins	18,551	18,858	307	2%	18,903	352	2%	20,398	1,847	10%

Subsurface Outflow to the Chino Basin

Tables 6a through 6c show the annual model-estimated subsurface outflow to the Chino Basin. Generally, subsurface outflow to the Chino Basin discharge increases as total storage increases, and vice versa. Table G below summarizes the average subsurface outflow to the Chino Basin from the

UCHB, Pomona Basin, and the Six Basins for the Baseline and each Project alternative. The Project alternatives have no significant impact in the subsurface outflow to the Chino Basin.

Table G. Model-Estimated Subsurface Outflow to the Chino Basin (afy)

Sub-Basin	Baseline	CWM-1			CWM-2			CWM-3		
		Average	Change from Baseline	Percent Change from Baseline	Average	Change from Baseline	Percent Change from Baseline	Average	Change from Baseline	Percent Change from Baseline
UCHB	3,093	3,062	-31	-1%	3,067	-26	-0.8%	3,073	-20	0.6%
Pomona Basin	3,299	3,354	55	2%	3,307	8	0.2%	3,273	-26	-0.8%
Six Basins	6,392	6,416	24	0.3%	6,374	-18	-0.2%	6,346	-46	-0.7%

Summary of Basin Response

Table H below summarizes the impacts to the basin from the Project alternatives.

Table H. Summary of Basin Response Under the Project Alternatives

<table>
<tr><th colspan="2"></th><th>CWM-1</th><th>CWM-2</th><th>CWM-3</th></tr>
<tr><td rowspan="3">Project Description</td><td>Storage Program</td><td>40,000 af dry-year storage account with in-lieu recharge only</td><td colspan="2">65,000 af dry-year storage account with in-lieu and wet-water recharge</td></tr>
<tr><td>Temporary Surplus Pumping</td><td>4,250 af</td><td colspan="2">5,450 to 6,450 af</td></tr>
<tr><td>New Facilities</td><td>Expanded Treatment Only</td><td>CWM-1 + Two New Wells for Takes (Old Baldy, Durward) + New Wells for Temporary Surplus (P-20 and a new well in the UCHB)</td><td>CWM-2 + MS4 facilities</td></tr>
<tr><td rowspan="4">Project Evaluation</td><td>Chronic Lowering of Groundwater Levels</td><td colspan="3">Operating at lower groundwater levels when compared to the Baseline, but no indication of chronic lowering of persistent downward trend of groundwater levels</td></tr>
<tr><td>Threat of High Groundwater (characterized by rising groundwater and area/duration of threat)</td><td colspan="3">-330 afy compared to Baseline
Reduced occurrences and duration of high groundwater during wet periods</td></tr>
<tr><td>Pumping Sustainability</td><td colspan="3">No new wells experience pumping sustainability challenges compared to the Baseline alternative.</td></tr>
<tr><td>Developed Yield</td><td>+300 af compared to Baseline</td><td>+350 af compared to Baseline</td><td>+1,850 af compared to Baseline</td></tr>
</table>

Conclusions and Recommendations

All of the Project alternatives described herein are physically feasible based on the model-estimated hydrologic responses and the potential adverse impacts that were evaluated herein. Additionally, the Project alternatives improve the water-supply reliability of the Six Basins Parties by (1) providing an additional local groundwater supply during dry periods through the operation of a dry-year storage account and (2) increasing the yield of the basin. Lastly, the Project alternatives maximize the use of local resources during wet periods by implementing a Temporary Surplus.

The potential for adverse hydrologic impacts associated with Project alternatives are less than significant. The reasons behind this conclusion are summarized below for each potential adverse impact, along with potential monitoring and mitigation measures if such measures are deemed necessary to comply with CEQA.

Threat of high groundwater.

- The Project alternatives are projected to decrease the threat of high groundwater in the Six Basins relative to the Baseline alternative due to lower groundwater levels and reduced occurrences of high groundwater.
- Watermaster conducts comprehensive groundwater-level monitoring and modeling. Additionally, Watermaster has a methodology to curtail spreading to mitigate the threat of rising groundwater. The information developed from these efforts will be used to identify

potential for high groundwater and to develop mitigation requirements to mitigate for these impacts. Potential mitigation include: (1) modifying the put and take cycles to minimize impacts the threat of rising groundwater, (2) strategically re-distributing supplemental water recharge to mitigate the threat of rising groundwater, (3) curtail spreading per Watermaster's methodology and deduct the estimated reductions in spreading from the responsible party's Storage and Recovery account, (4) construct and operate pumping facilities in the areas of concern to eliminate the threat of rising groundwater, (5) a combination of (1) through (4), and (6) the implementation of a monitoring program to verify the effectiveness of the mitigation actions.

Pumping sustainability.

- The Project alternatives are not projected to cause greater pumping sustainability impacts relative to the Baseline alternative.
- Watermaster conducts a comprehensive groundwater-level monitoring program across the basin. The information developed from this monitoring program will be used to identify potential impacts on pumping sustainability and to develop mitigation requirements to mitigate for these impacts. Potential mitigation include: (1) modifying the put and take cycles to minimize impacts to pumping sustainability, (2) strategically increasing supplemental water recharge to mitigate loss of pumping sustainability, (3) modifying a party's affected well (e.g., lowering pump bowls), (4) providing an alternate supply to the affected party to ensure it can meet its demands, (5) a combination of (1) through (4), and (6) the implementation of a monitoring program to verify the effectiveness of the mitigation actions.

Chronic lowering of groundwater levels.

- The Project alternatives are projected to result in lower groundwater levels compared to the Baseline, but in no alternative is there evidence of chronic lowering of groundwater levels that would indicate a persistent state of overdraft.
- Watermaster conducts a comprehensive groundwater-level monitoring program. The information developed from this monitoring program will be used to identify potential impacts on groundwater-levels in the basin and to develop mitigation requirements for these impacts. Potential mitigation include: (1) modifying the put and take cycles to minimize the potential chronic lowering of groundwater levels, (2) strategically increasing supplemental water recharge to mitigate chronic lowering of groundwater levels, (3) a combination of (1) and (2), and (4) the implementation of a monitoring program to verify the effectiveness of the mitigation actions.

Developed yield.

- The Project alternatives are projected to result in an increase in developed yield relative to the Baseline alternative.
- Watermaster conducts comprehensive groundwater-level monitoring and modeling. The information developed from these efforts will be used to identify potential impacts on the developed yield of the basin and to develop mitigation requirements to mitigate for these

impacts. Potential mitigation include: (1) modifying the put and take cycles to minimize impacts to developed yield, (2) strategically increasing supplemental water recharge to mitigate any reductions in developed yield, (3) deduct the estimated decrease in developed yield from the storage account, (4) strategically increase pumping in areas that will eliminate the decrease in developed yield, (5) a combination of (1) through (4), and (6) a periodic model recalibration and use of the model to estimate the impacts of the Project on developed yield.

Subsurface outflow to the Chino Basin.

- The Project alternatives are projected to result in no change in subsurface outflow to the Chino Basin relative to the Baseline alternative.
- Watermaster conducts comprehensive groundwater-level monitoring and modeling. If the data collected through the monitoring program indicate chronic lowering of groundwater levels along the Chino Basin boundary, Watermaster will evaluate potential impacts to the Chino Basin through modeling and develop mitigation measures, if appropriate.

In addition to the mitigation measures described above, Watermaster is in the process of updating its Operating Plan to include procedures that will enable the Watermaster to identify potential impacts and mitigation measures when projects are proposed and as they are implemented:

- A procedure to analyze projects for the potential to cause Substantial Injury. The objective of the procedure is to establish a standard process to decide whether a project should be evaluated for the potential to cause Substantial Injury, and if so, to conduct the evaluation. This procedure will allow Watermaster to review the potential impacts of specific projects prior to their implementation. And for projects that require Watermaster approval, it will enable Watermaster to develop terms and conditions for the approval of such projects.
- A procedure for developing storage and recovery agreements that takes into consideration the potential impacts described herein.
- A procedure for implementing a Temporary Surplus. The objective of the procedure is to establish the process to determine the timing and volume of implementing a Temporary Surplus to protect against the threat of high groundwater.

Attachments

List of Tables

List of Figures

Appendices

Figure 1
Historical Precipitation of the Hydrologic Period Used for the Baseline Alternative
(Fiscal Year 1960-2017)

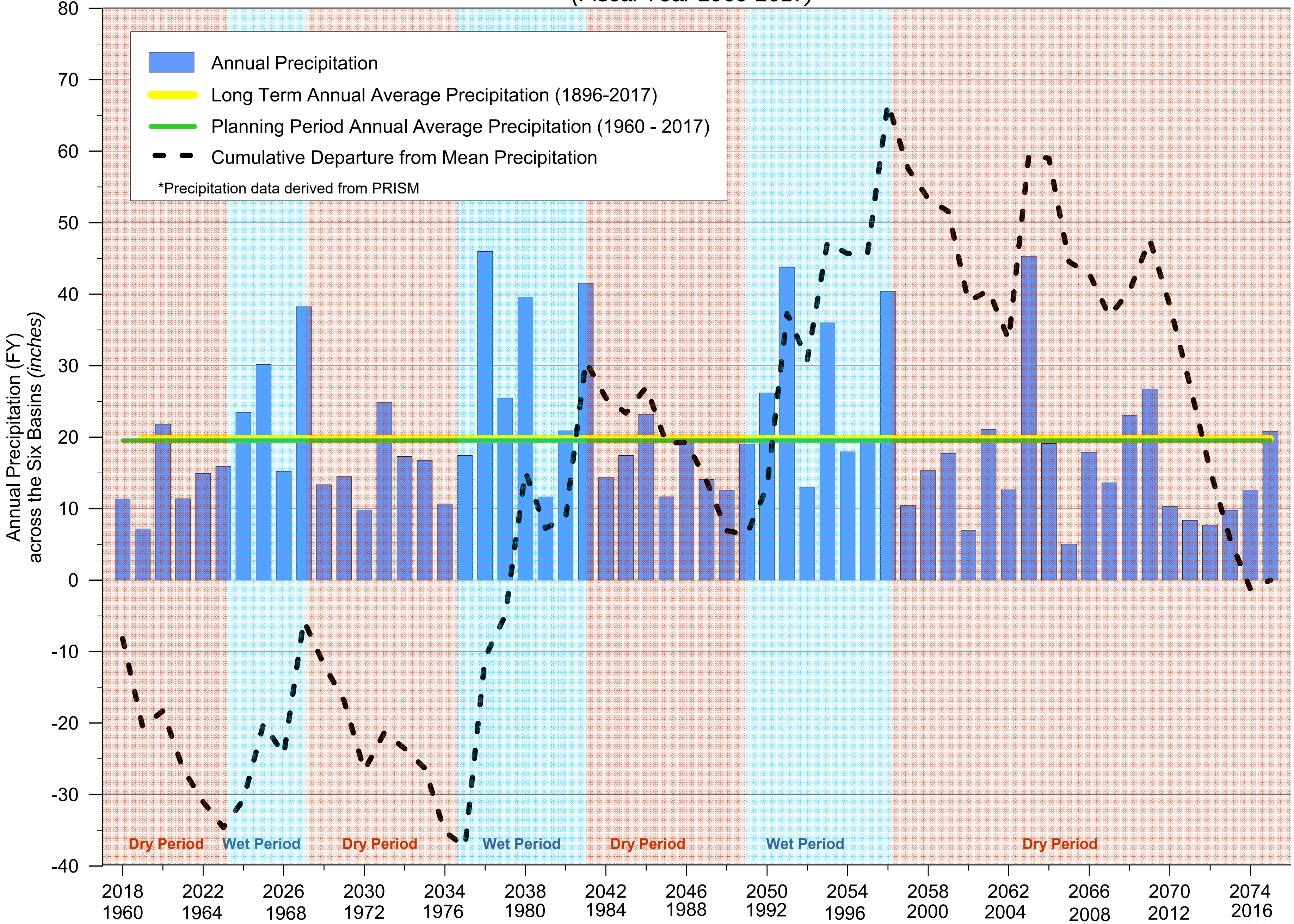

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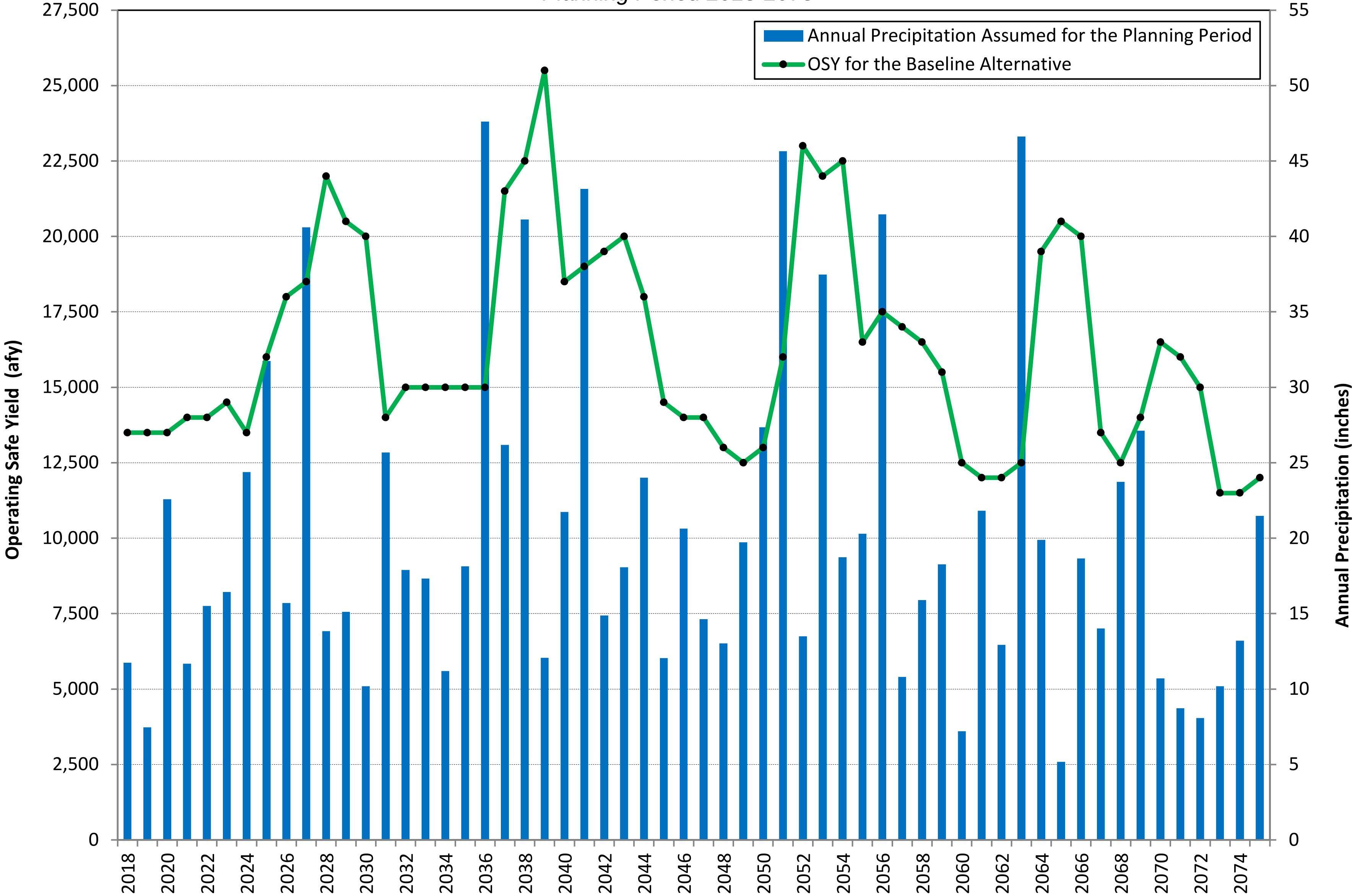
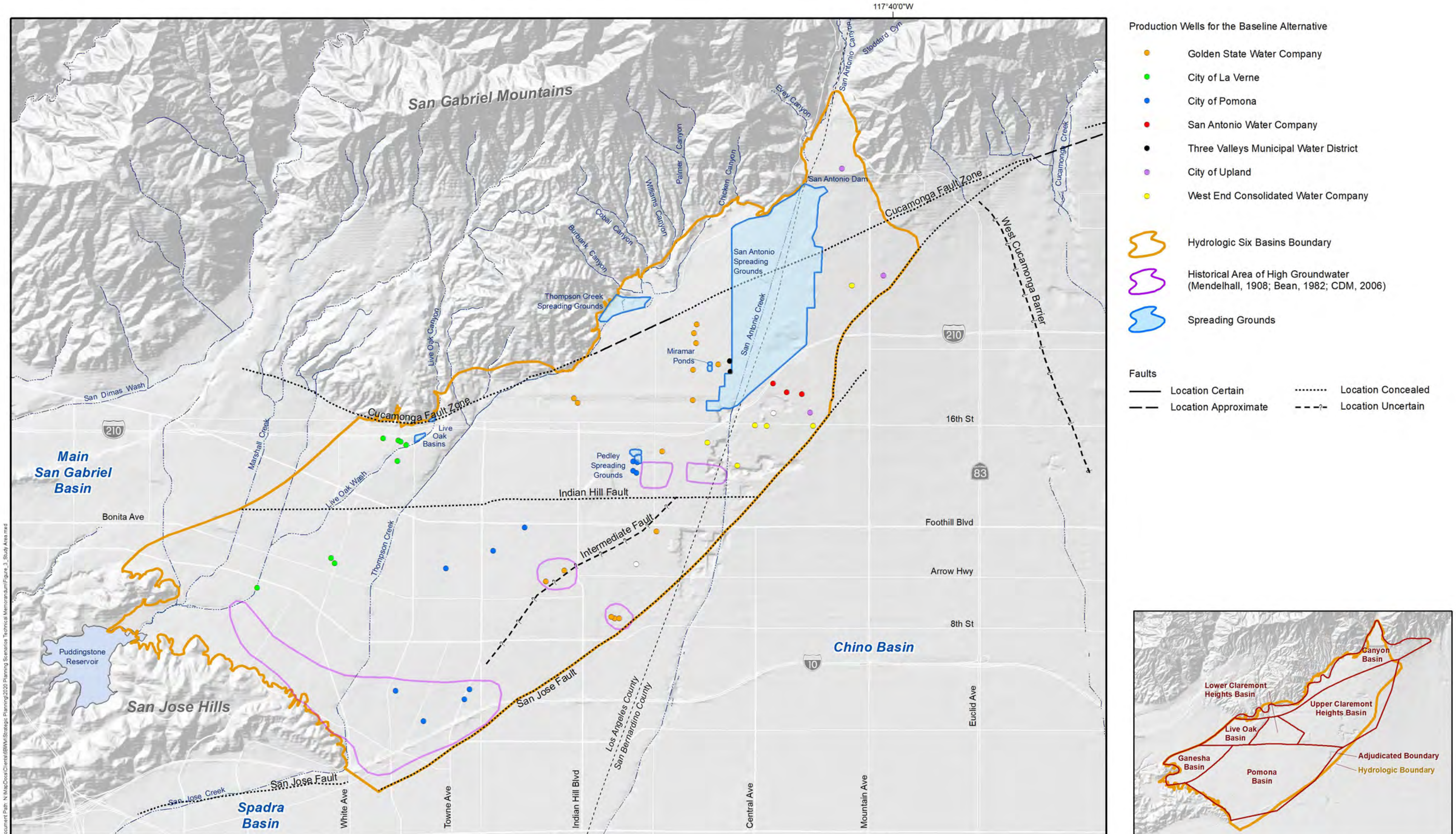
Figure 2
Operating Safe Yield of the Four Basins for the Baseline Alternative
Planning Period 2018-2075





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Author: RT
Date: 20200802

0 1 2 Miles
0 2 4 Kilometers

Six Basins Watermaster

Six Basins Study Area

Figure 3

Figure 4a
Model-Estimated Groundwater Levels for the Baseline Alternative at Mountain View 4 Well
(Upper Claremont Heights Basin)

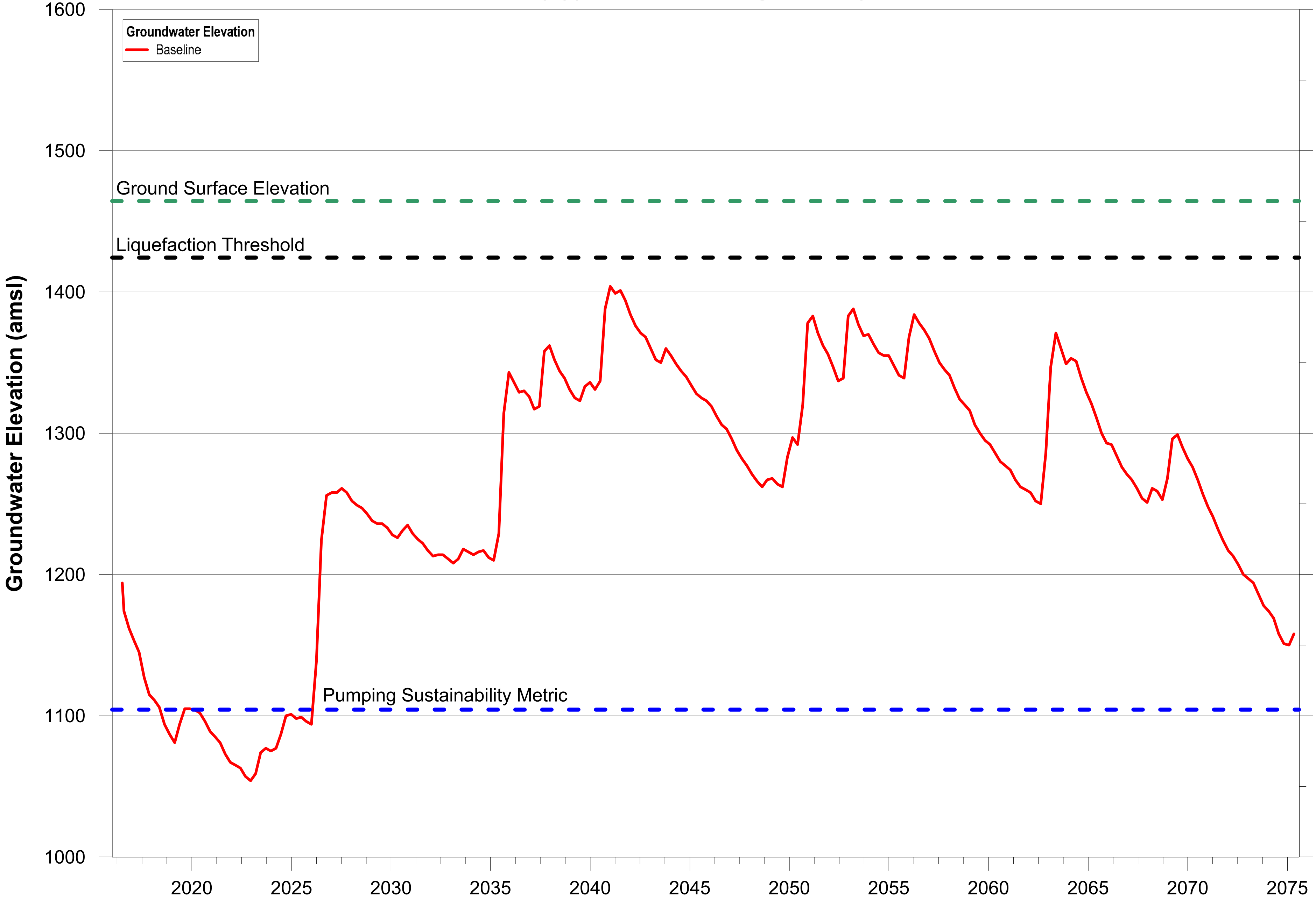

Figure 4b
Model-Estimated Groundwater Levels for the Baseline Alternative at P-20 Well
(Lower Claremont Heights Basin)

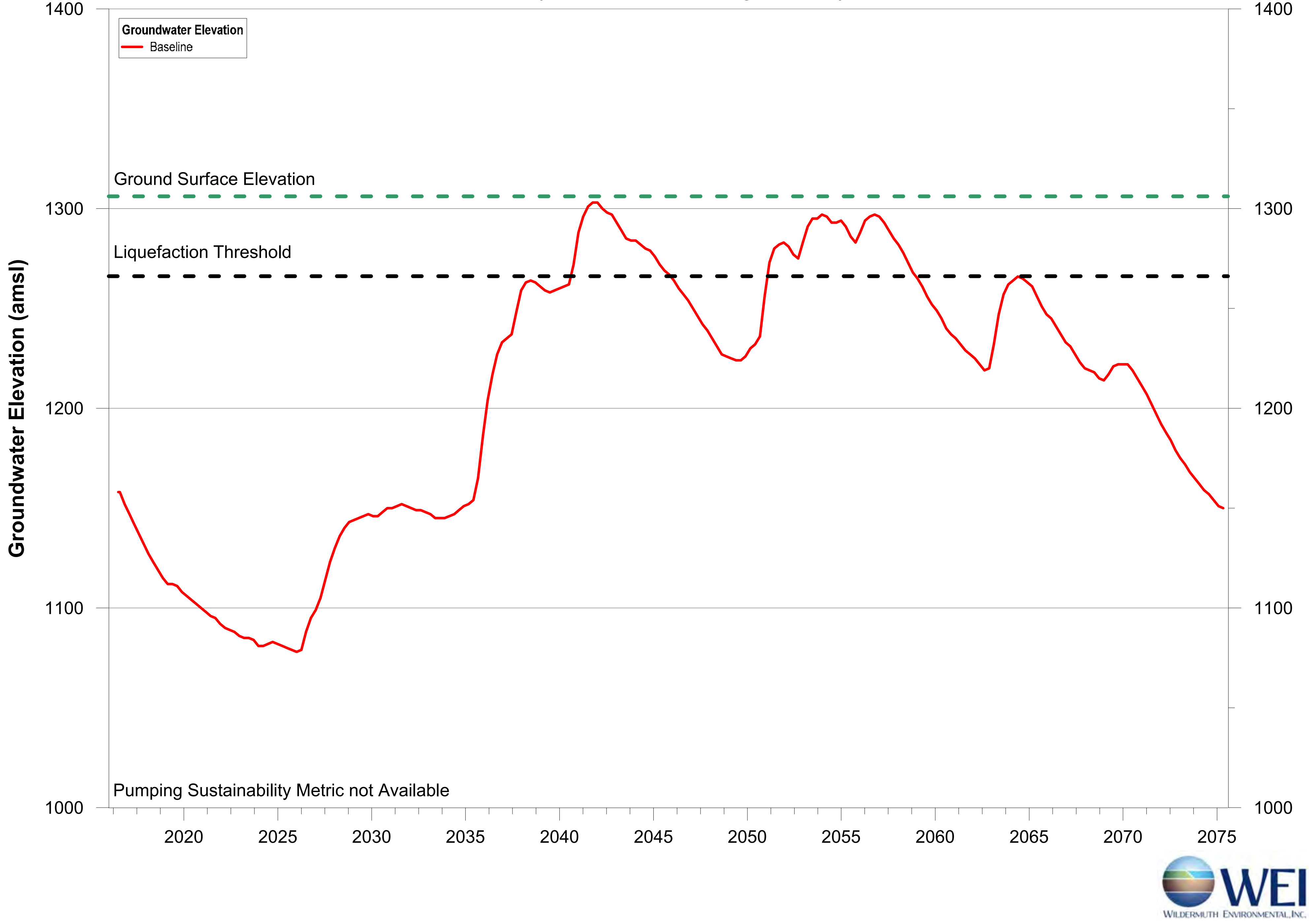

Figure 4c
Model-Estimated Groundwater Levels for the Baseline Alternative at P-03 Well
(Pomona Basin)

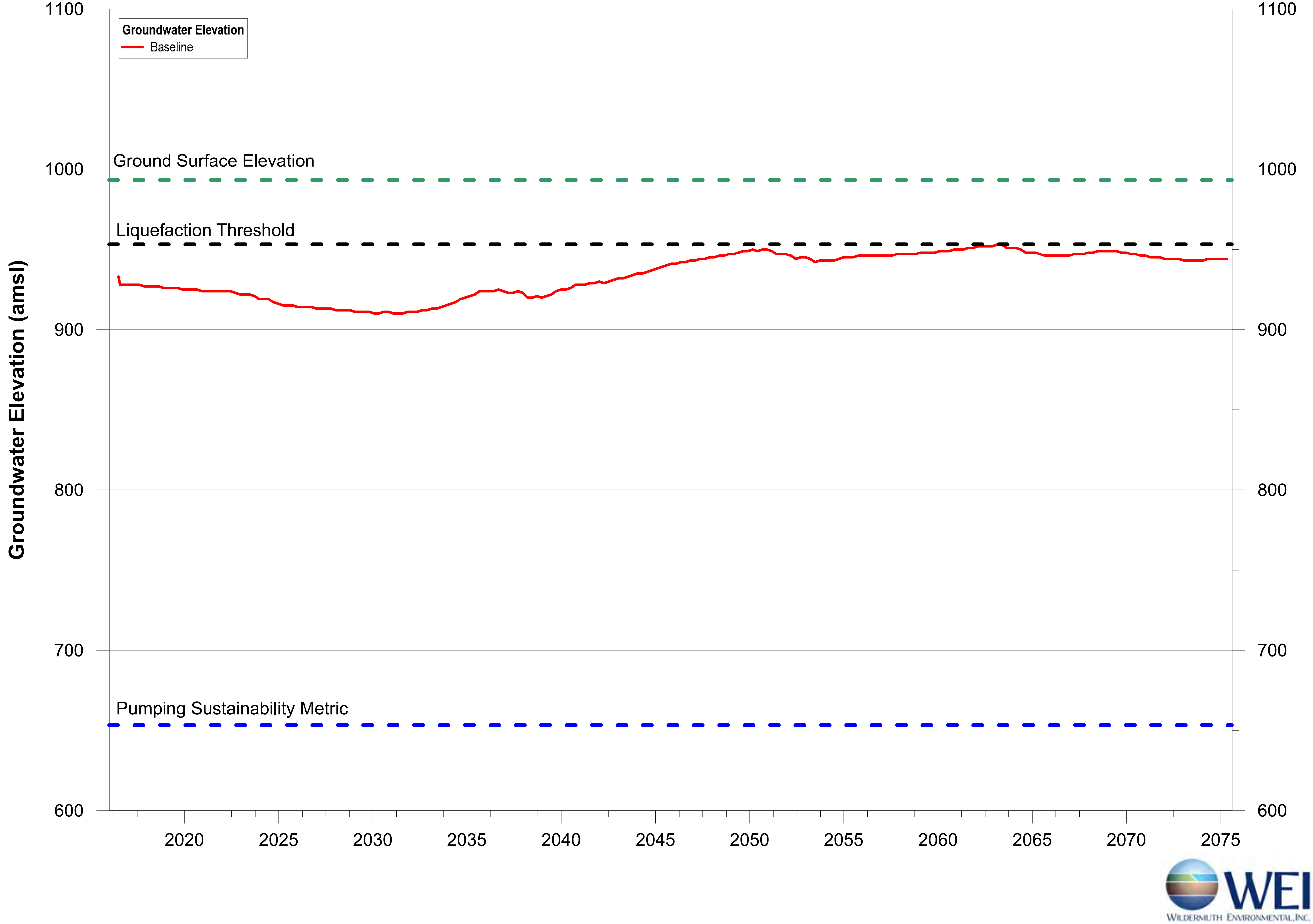

Figure 4d
Model-Estimated Groundwater Levels for the Baseline Alternative at LaVerne Heights 1 Well
(Live Oak Basin)

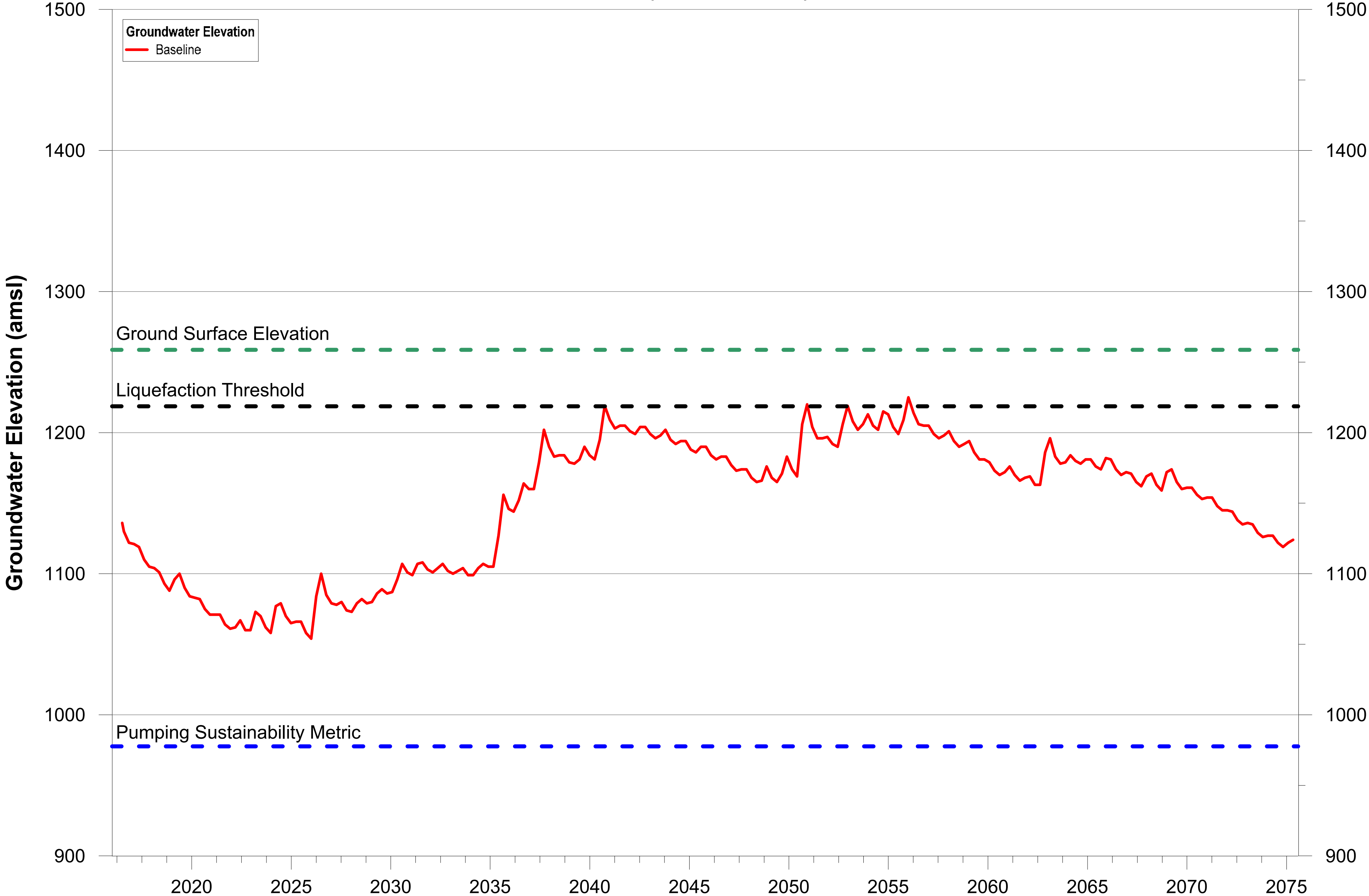

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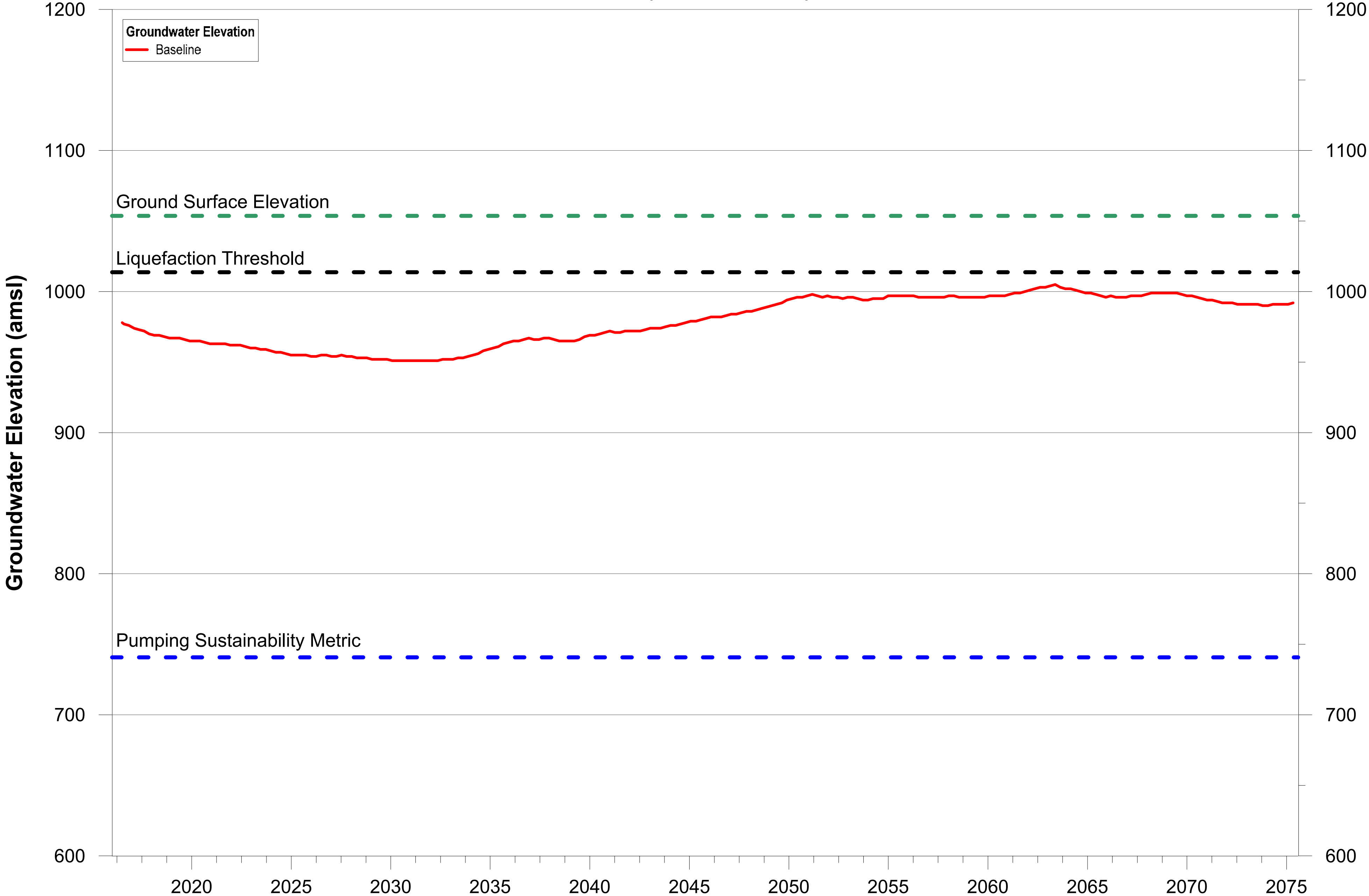
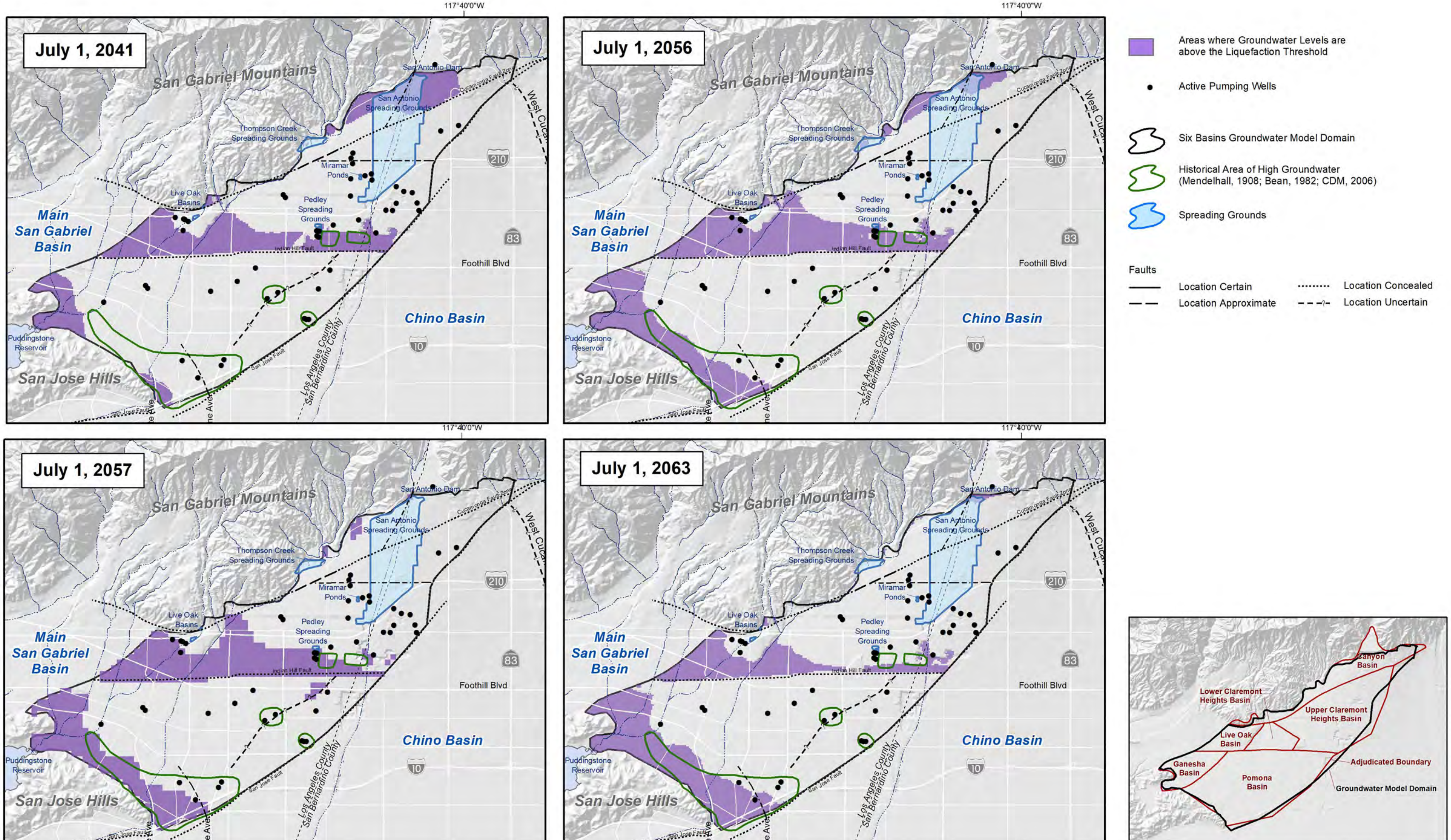
Figure 4e
Model-Estimated Groundwater Levels for the Baseline Alternative at Old Baldy Well
(Ganesha Basin)





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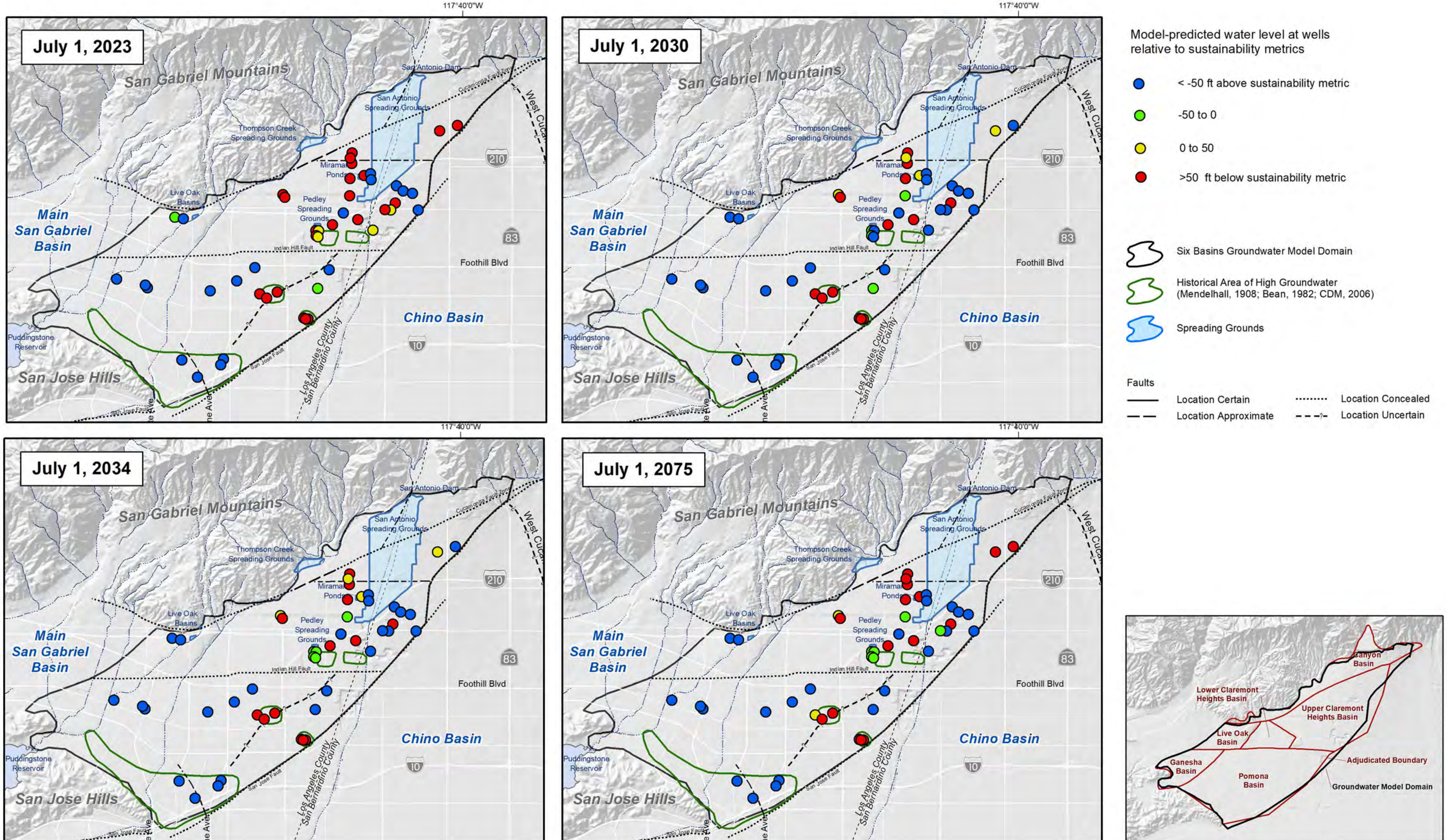
0 2 4 Kilometers

Six Basins Watermaster

Areas of Concern for High Groundwater Conditions

Baseline Alternative -- During Times of High Groundwater Levels

Figure 5



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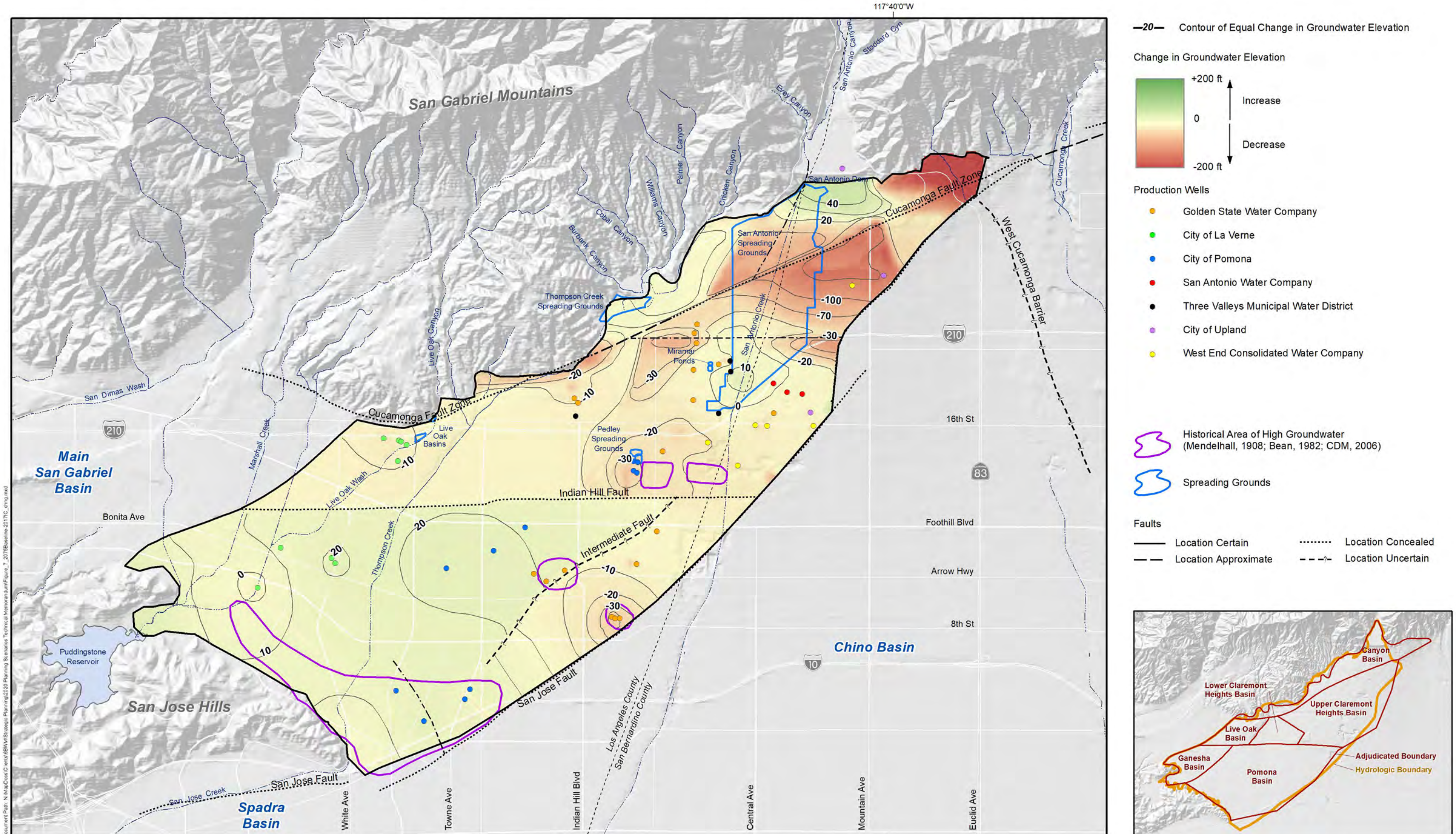
Date: 20200721

Six Basins Watermaster

Pumping Sustainability at Wells during Dry Periods

Baseline Alternative

Figure 6



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0 1 2 Miles

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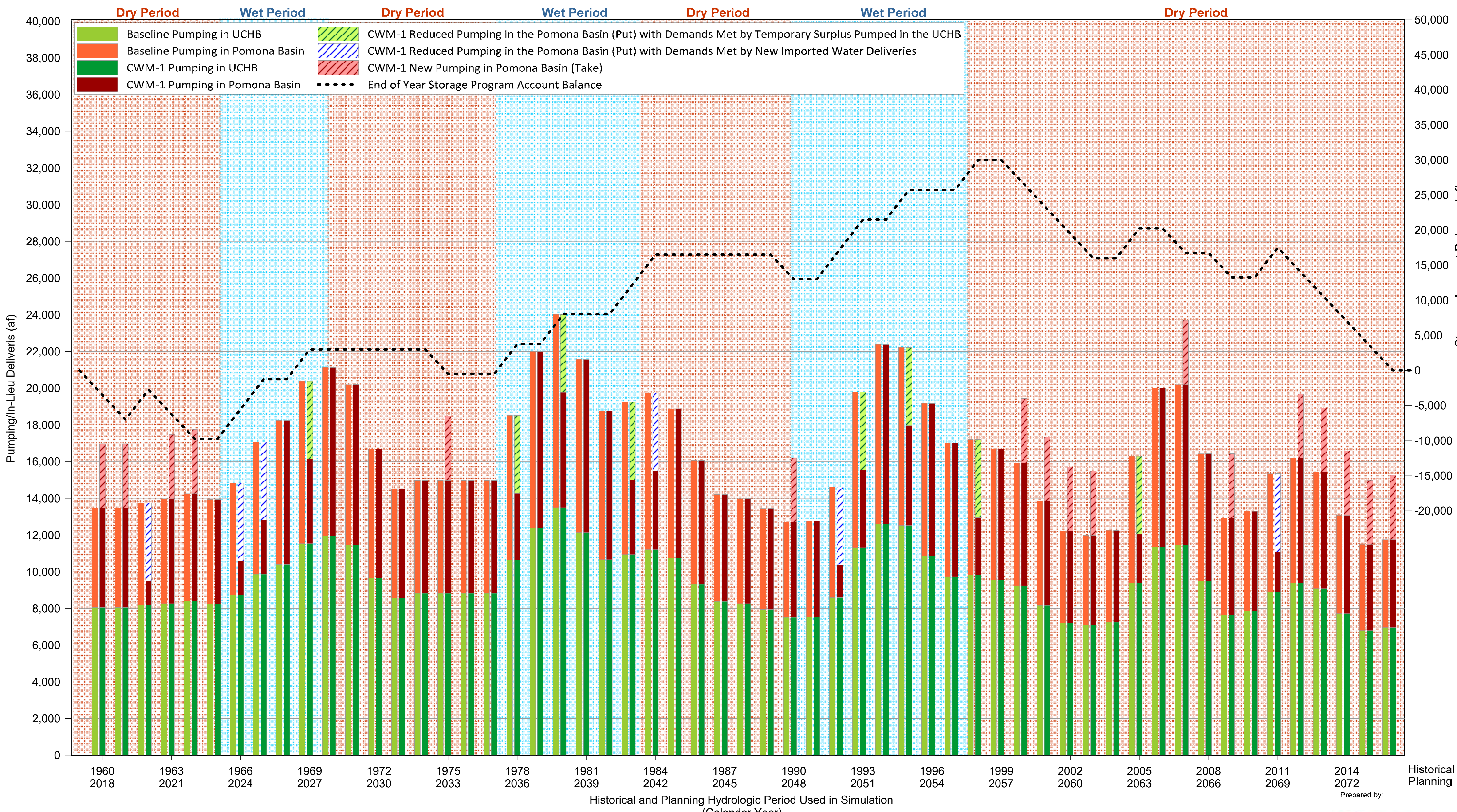
Six Basins Watermaster

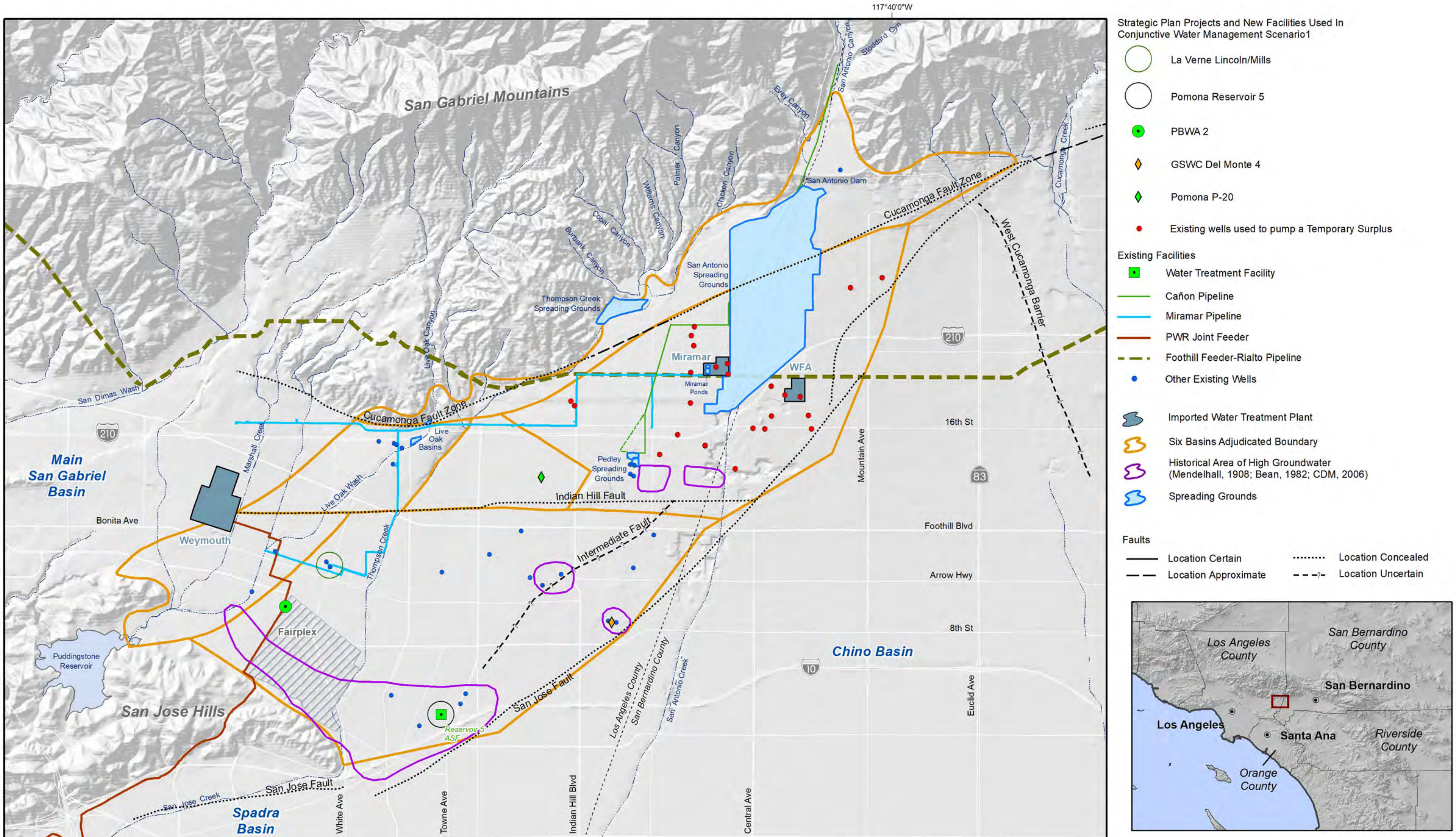
Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Change in Groundwater Levels: Baseline Alternative (2017 - 2075)

Figure 7

Figure 8
Dry-Year Storage Program Accounting
Conjunctive Water Management - Scenario 1





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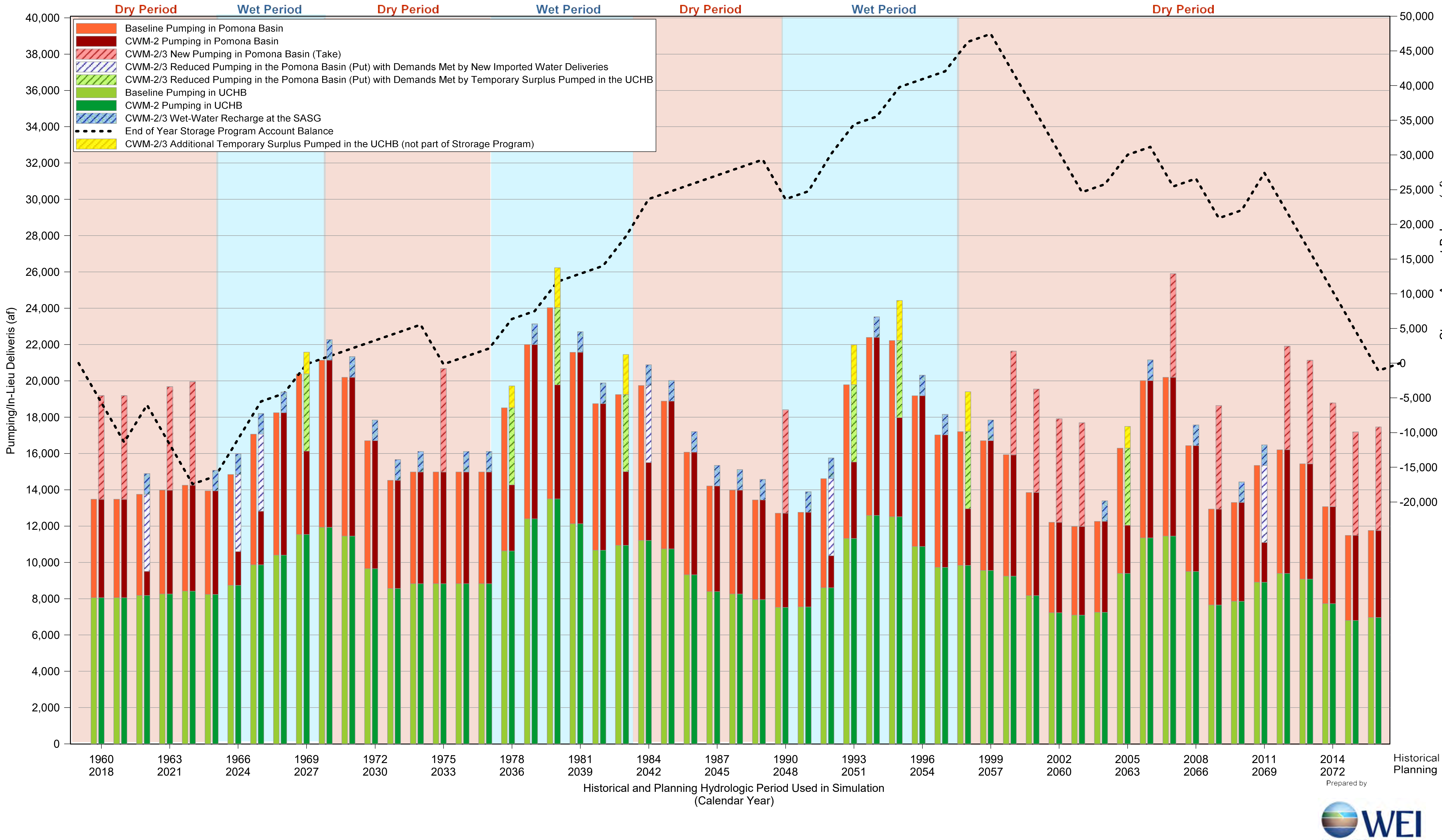
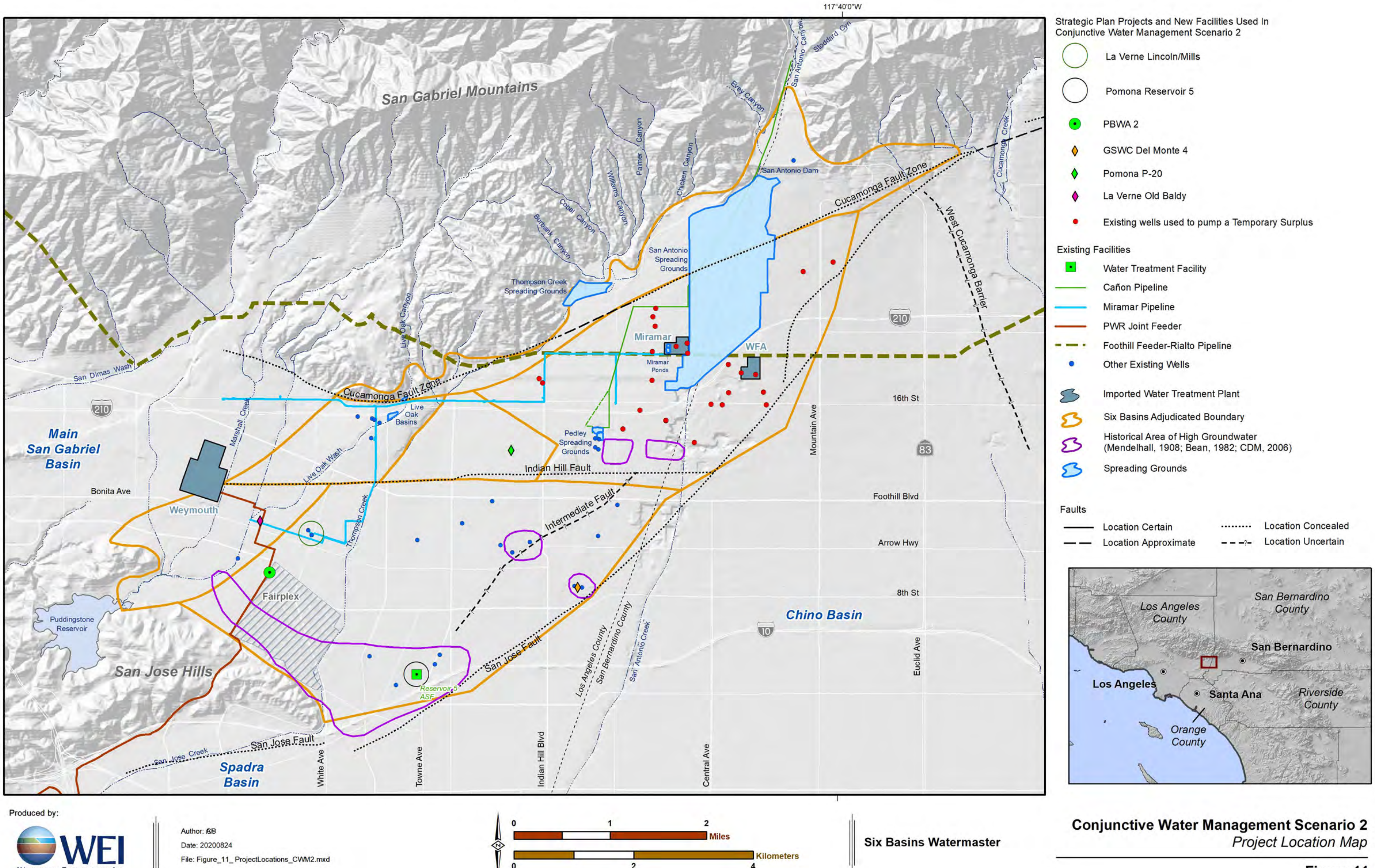
Six Basins Watermaster

Conjunctive Water Management Scenario 1
Project Location Map

Figure 9

Figure 10
Dry-Year Storage Program Accounting
Conjunctive Water Management - Scenarios 2 and 3





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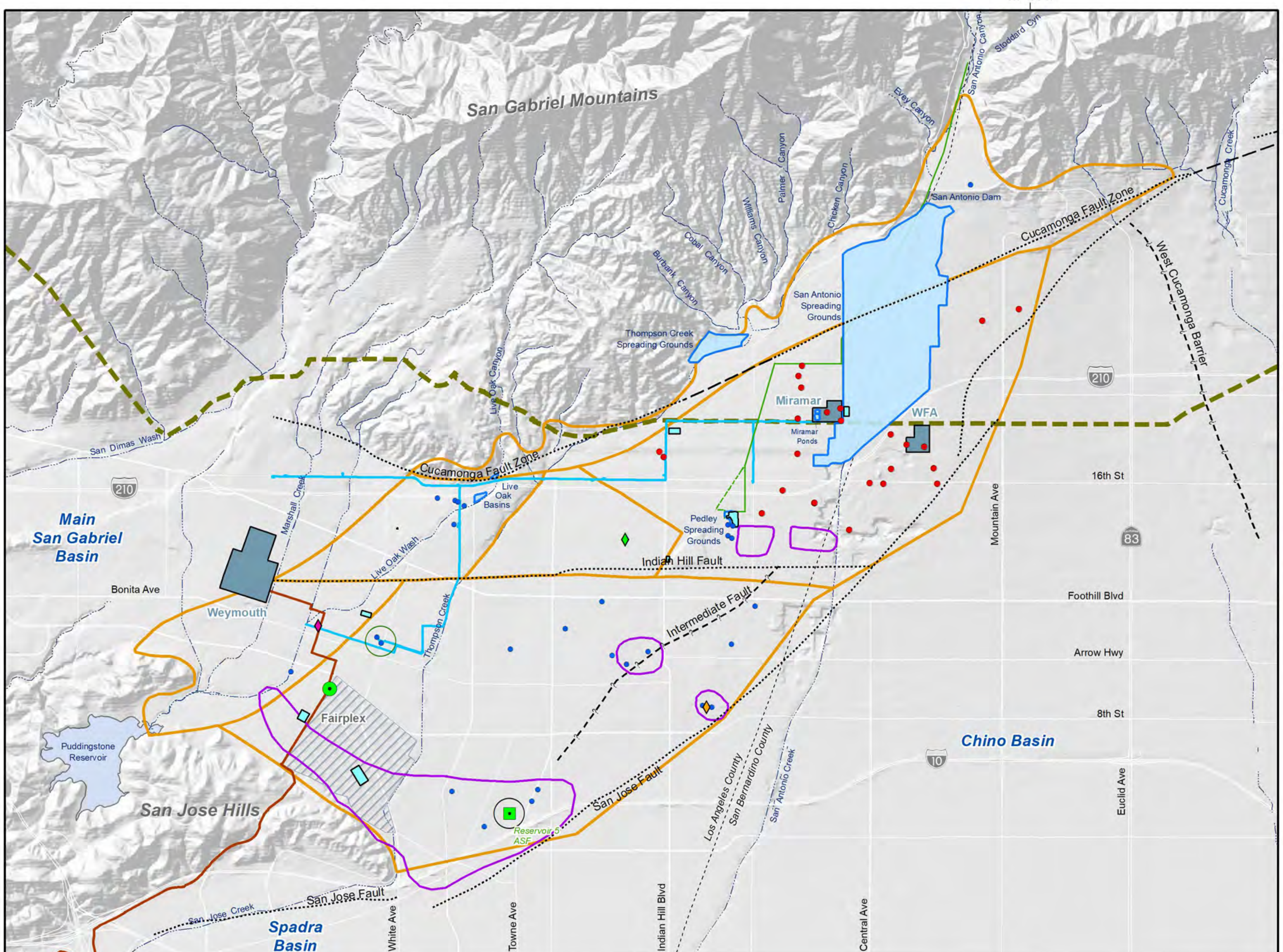
Six Basins Watermaster

Conjunctive Water Management Scenario 2
Project Location Map

Figure 11



Strategic Plan Projects and New Facilities Used In Conjunctive Water Management Scenario 2

- La Verne Lincoln/Mills
- Pomona Reservoir 5
- PBWA 2
- GSWC Del Monte 4
- Pomona P-20
- La Verne Old Baldy
- Existing wells used to pump a Temporary Surplus

Existing Facilities

- Water Treatment Facility
- Cañon Pipeline
- Miramar Pipeline
- PWR Joint Feeder
- Foothill Feeder-Rialto Pipeline
- Other Existing Wells
- MS4 Project (CWM-3)
- Imported Water Treatment Plant
- Six Basins Adjudicated Boundary
- Historical Area of High Groundwater (Mendelhall, 1908; Bean, 1982; CDM, 2006)
- Spreading Grounds

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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0 1 2 Miles
0 2 4 Kilometers

Six Basins Watermaster

Conjunctive Water Management Scenario 3
Project Location Map

Figure 12

Figure 13a
Model-Estimated Groundwater Levels for the Baseline Alternative and CWM-1,-2,-3 at Mountain View 4 Well
(Upper Claremont Heights Basin)

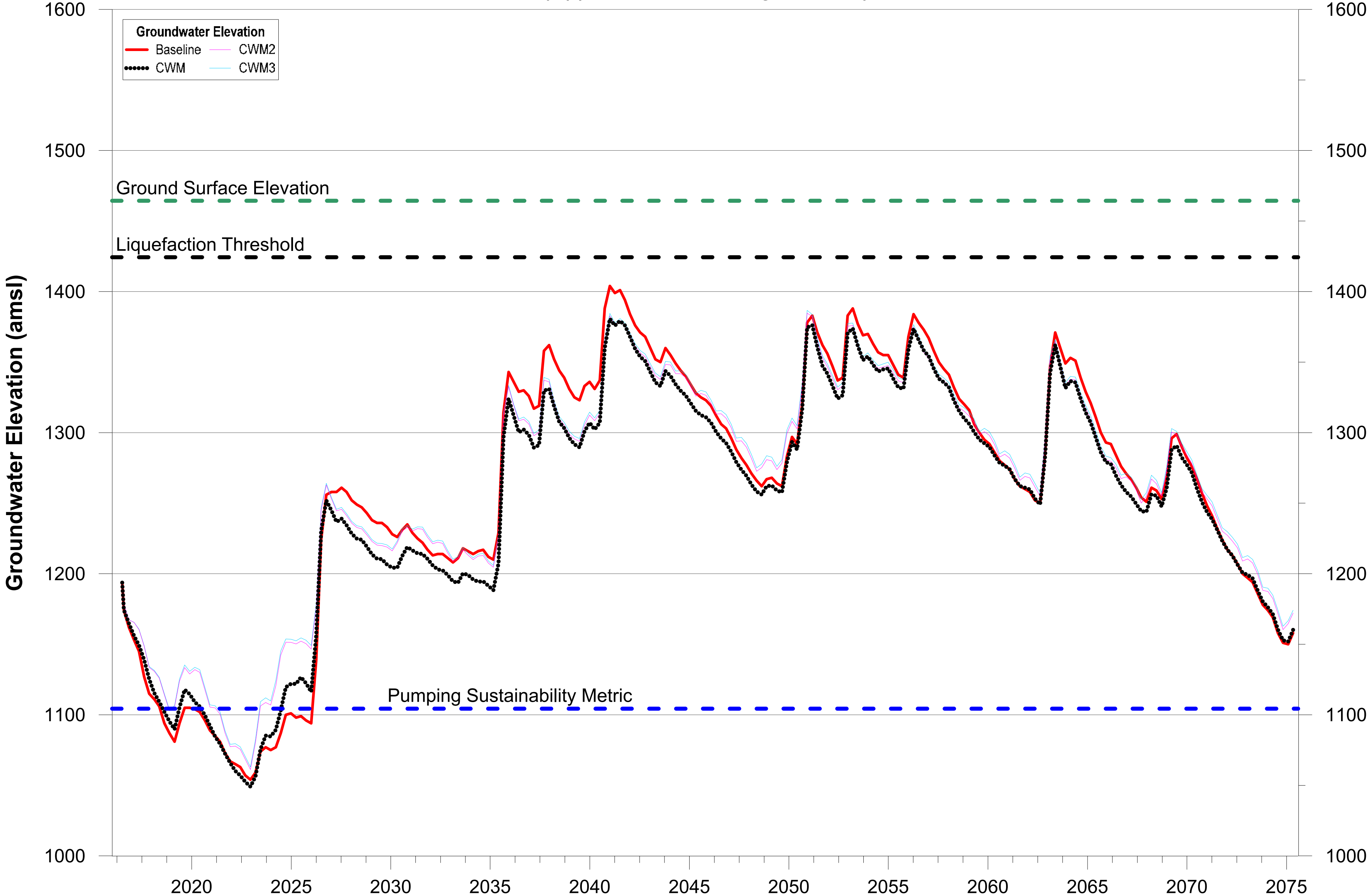

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Figure 13b
Model-Estimated Groundwater Levels for the Baseline Alternative and CWM-1,-2,-3 at P-20 Well
(Lower Claremont Heights Basin)

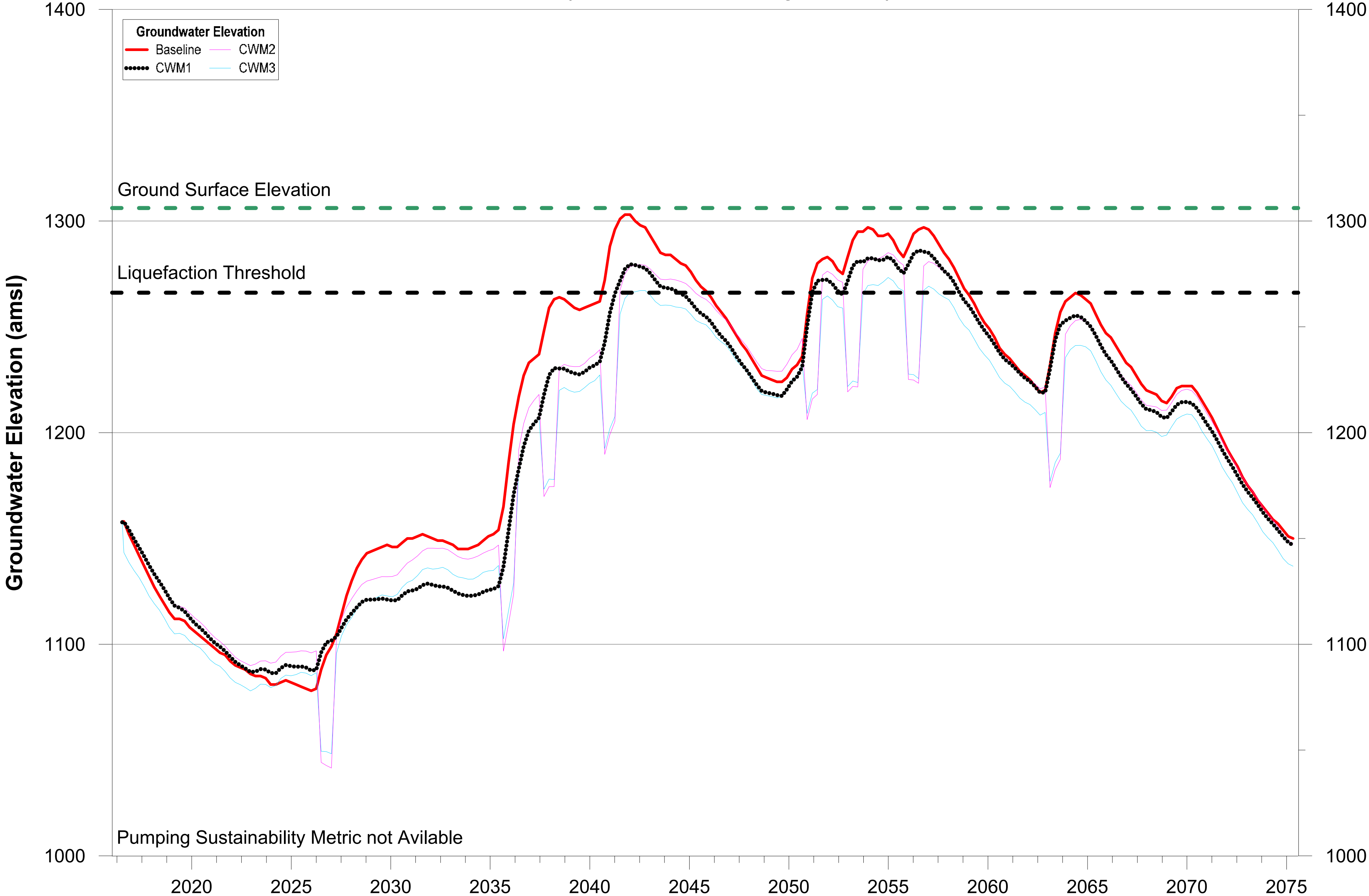

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Figure 13c
Model-Estimated Groundwater Levels for the Baseline Alternative and CWM-1,-2,-3 at P-03 Well
(Pomona Basin)

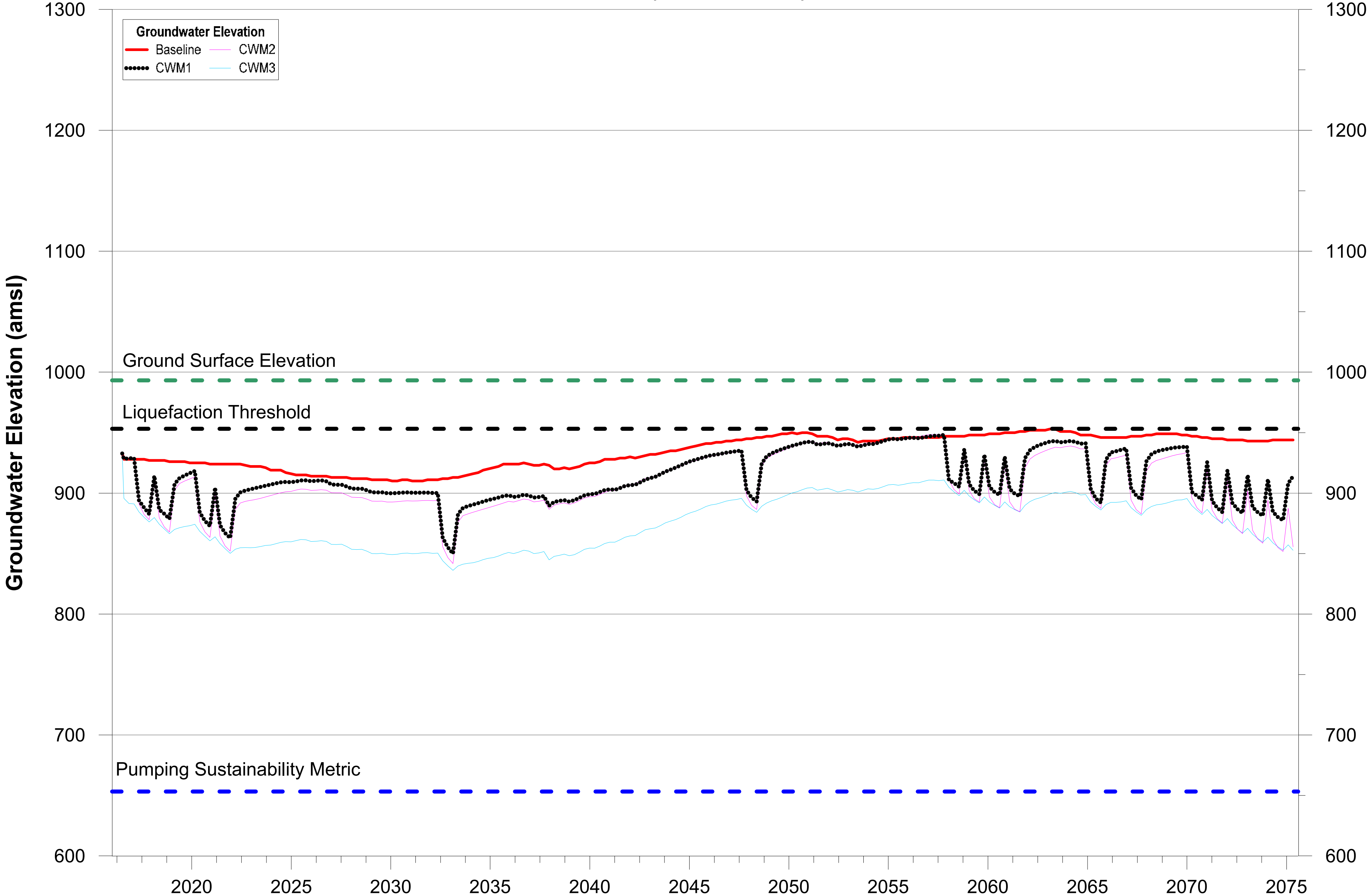

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Figure 13d
Model-Estimated Groundwater Levels for the Baseline Alternative and CWM-1,-2,-3 at LaVerne Heights 1 Well
(Live Oak Basin)

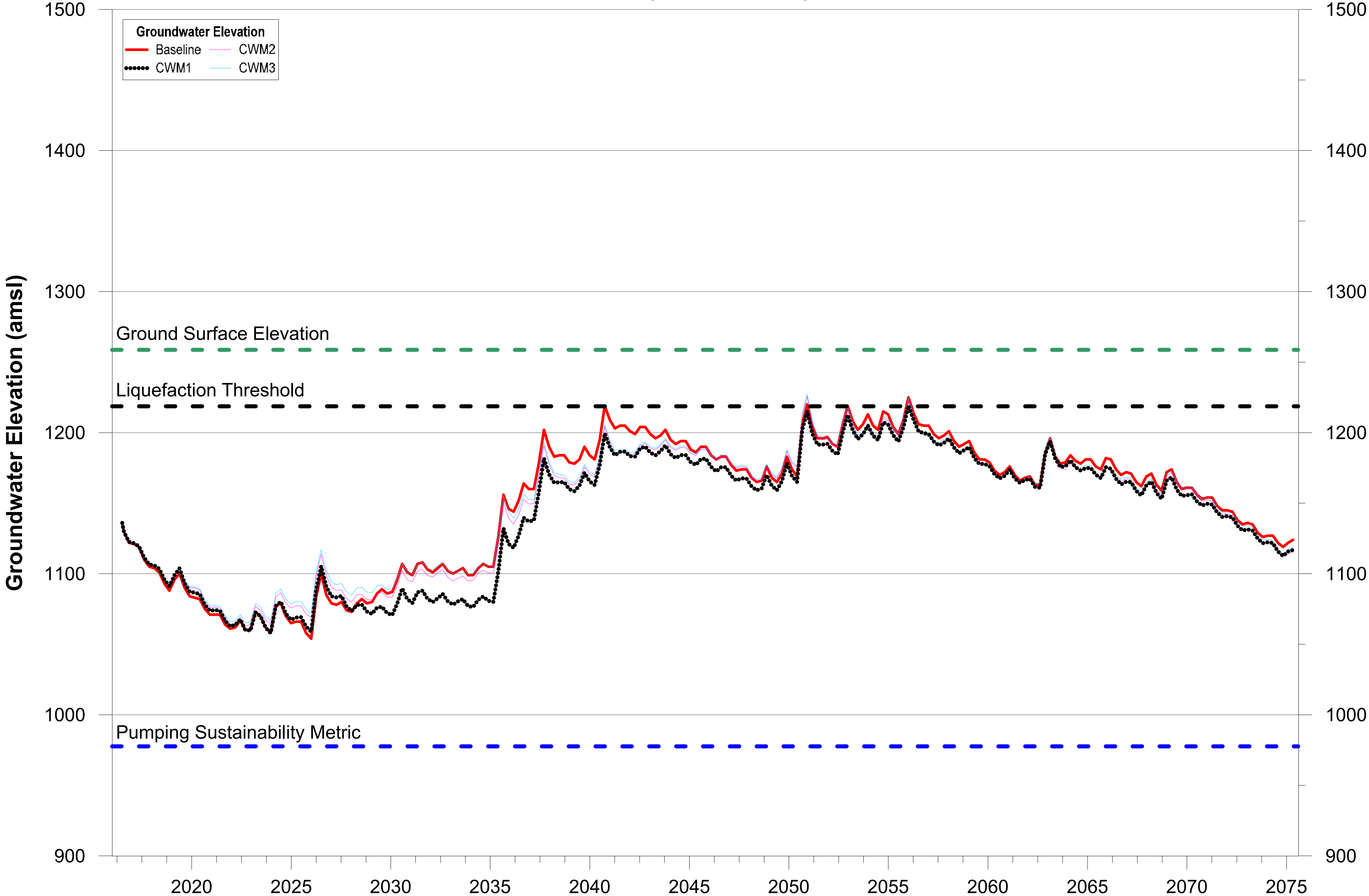

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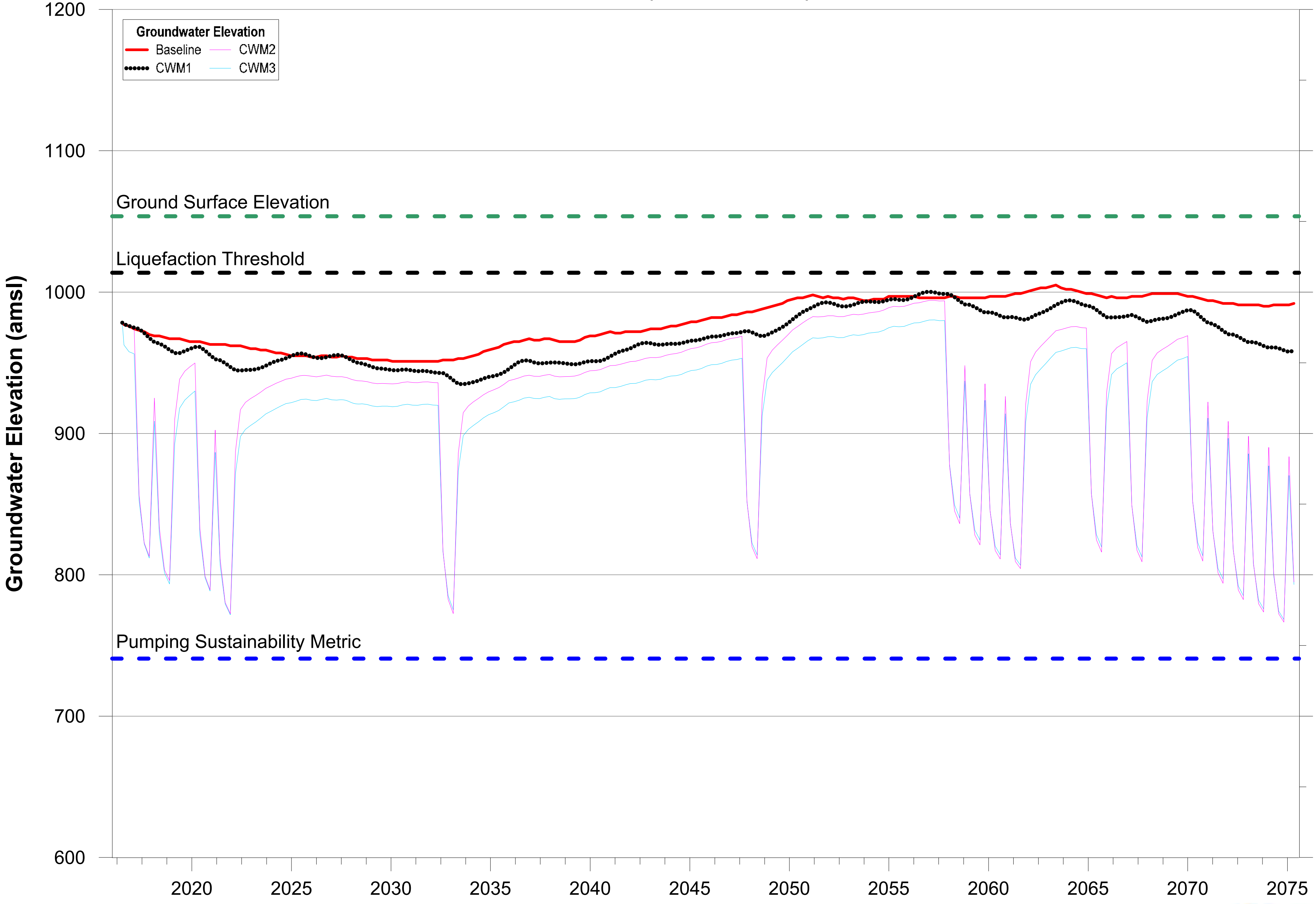
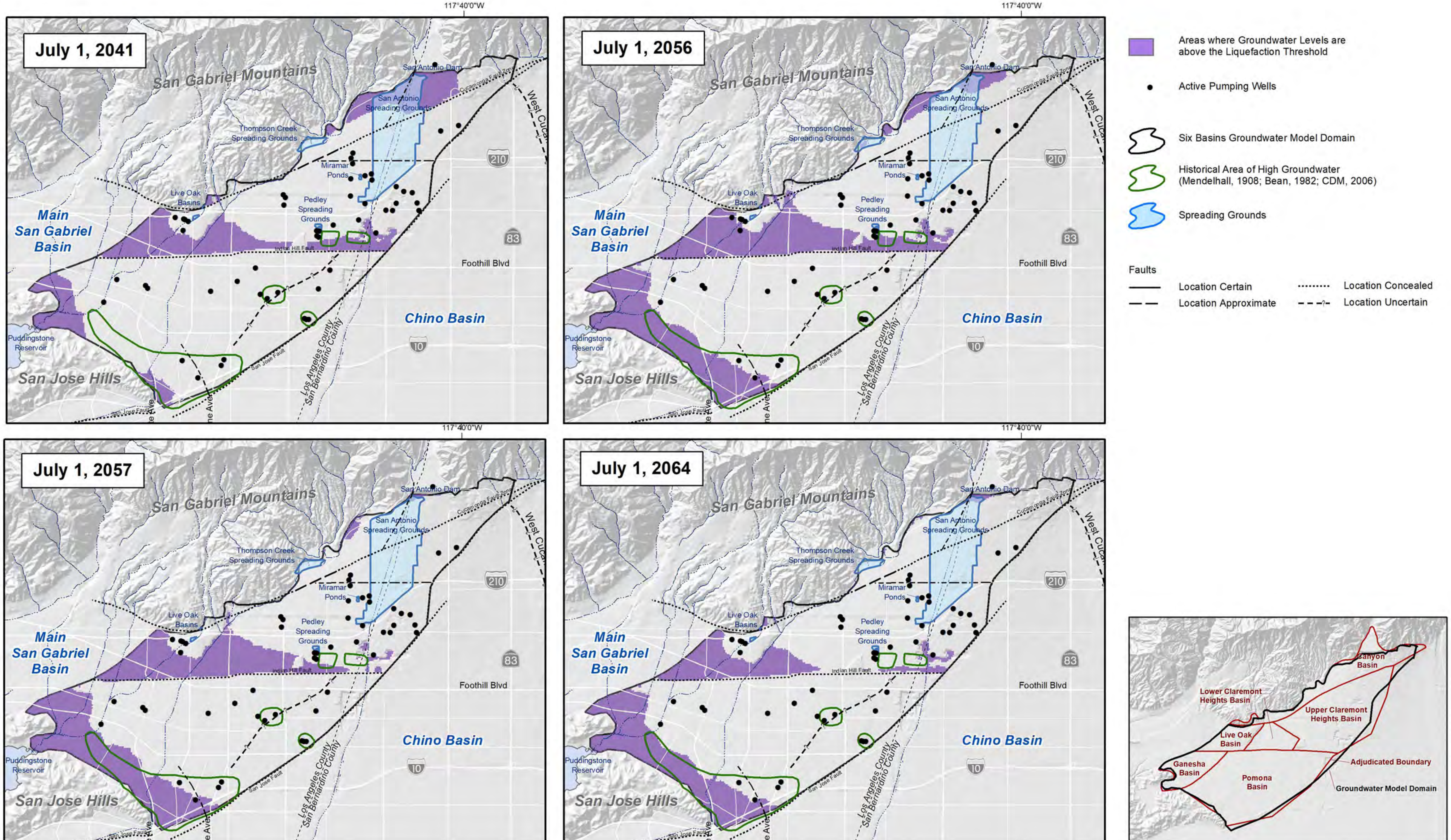
Figure 13e
Model-Estimated Groundwater Levels for the Baseline Alternative and CWM-1,-2,-3 at Old Baldy Well
(Ganesha Basin)





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WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 20200721

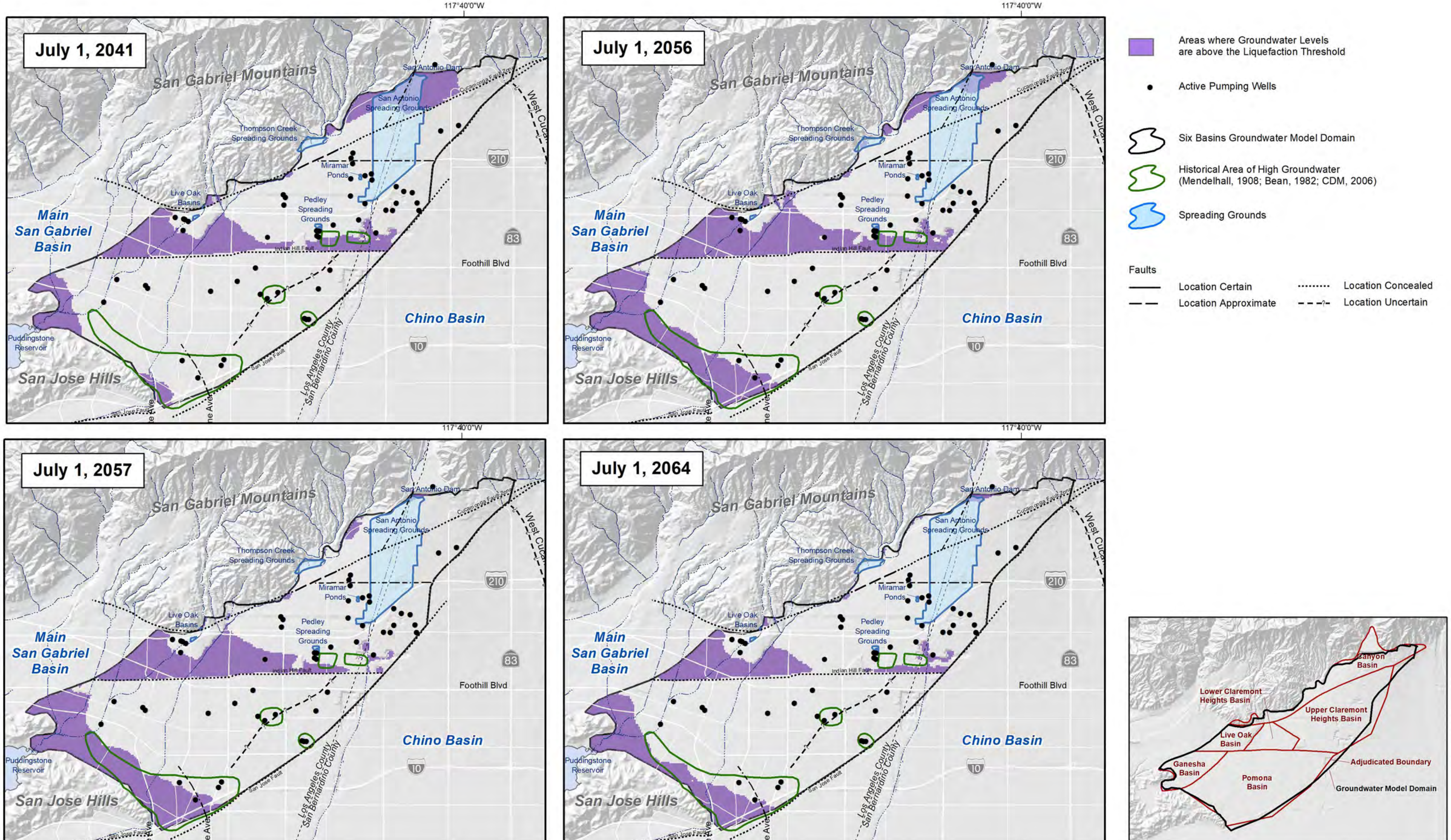
0 1 2 Miles
0 2 4 Kilometers

Six Basins Watermaster
Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Areas of Concern for High Groundwater Conditions

CWM-1 -- During Times of High Groundwater Levels

Figure 14a



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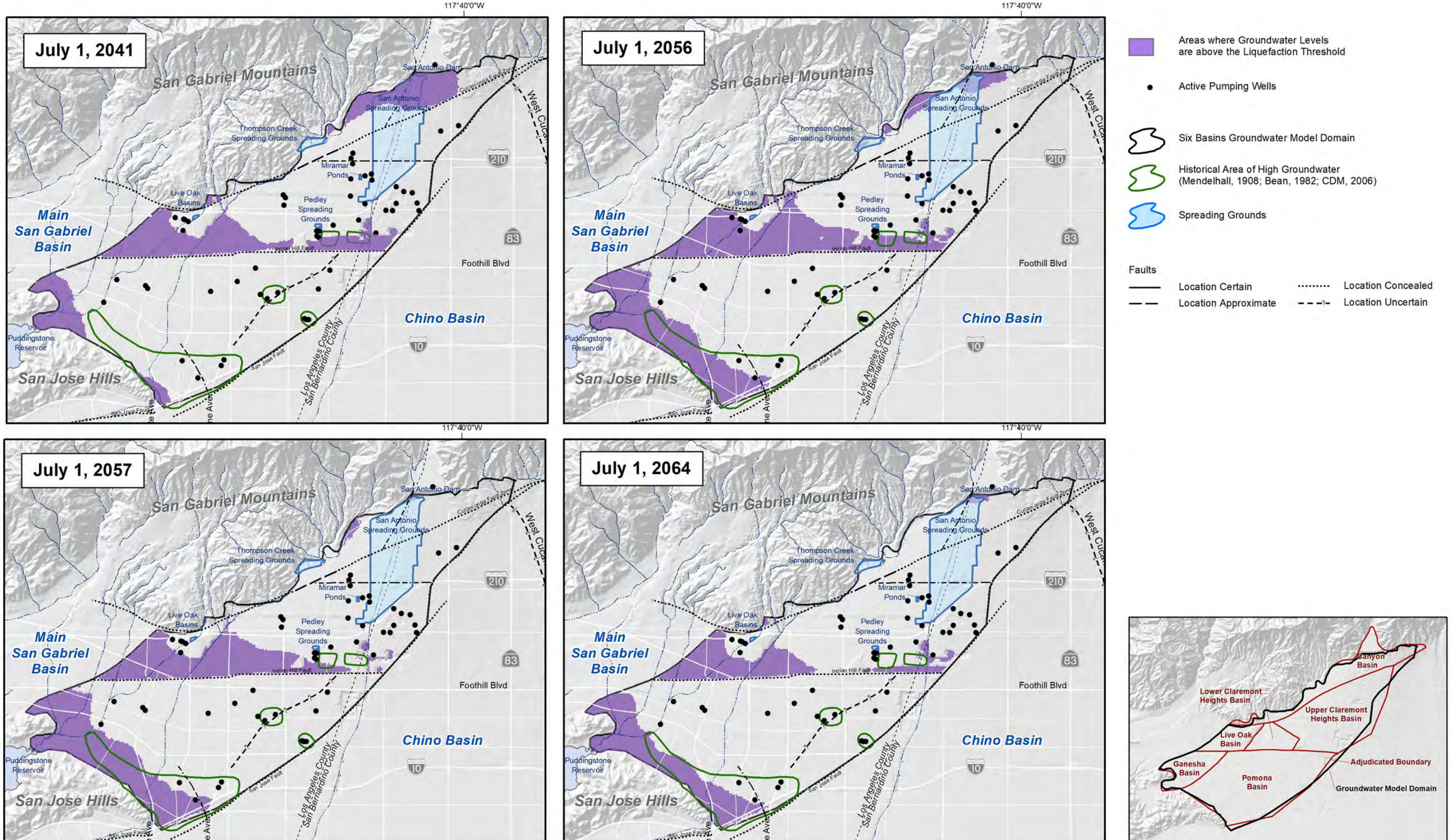
Date: 20200721

Six Basins Watermaster
Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Areas of Concern for High Groundwater Conditions

CWM-2 -- During Times of High Groundwater Levels

Figure 14b



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Date: 20200721

Six Basins Watermaster

Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Areas of Concern for High Groundwater Conditions

CWM-3 -- During Times of High Groundwater Levels

Figure 14c

Figure 15a
Rising Groundwater in the Upper Claremont Heights Basin (UCHB)

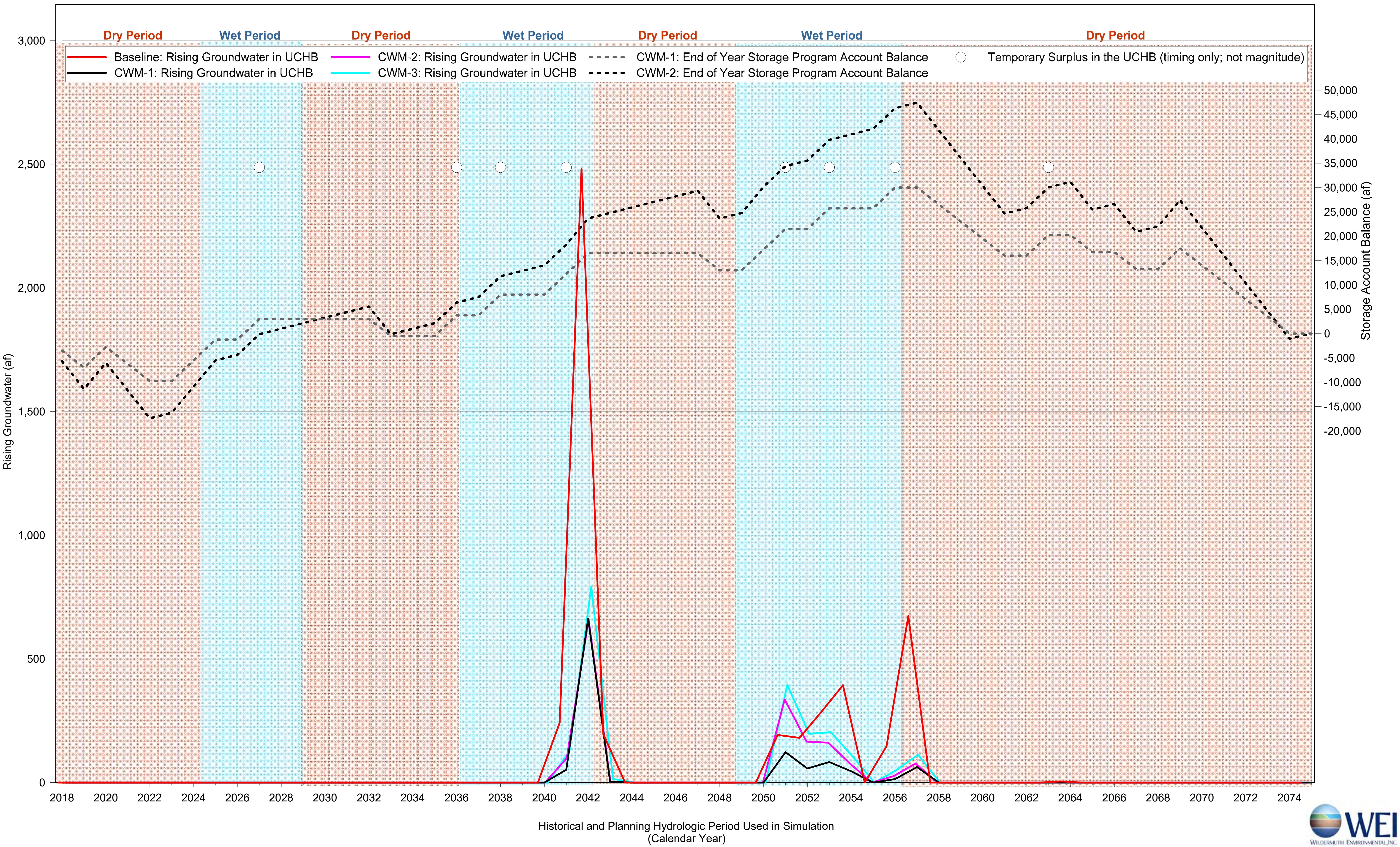


Figure 15b
Rising Groundwater in the Two Basins

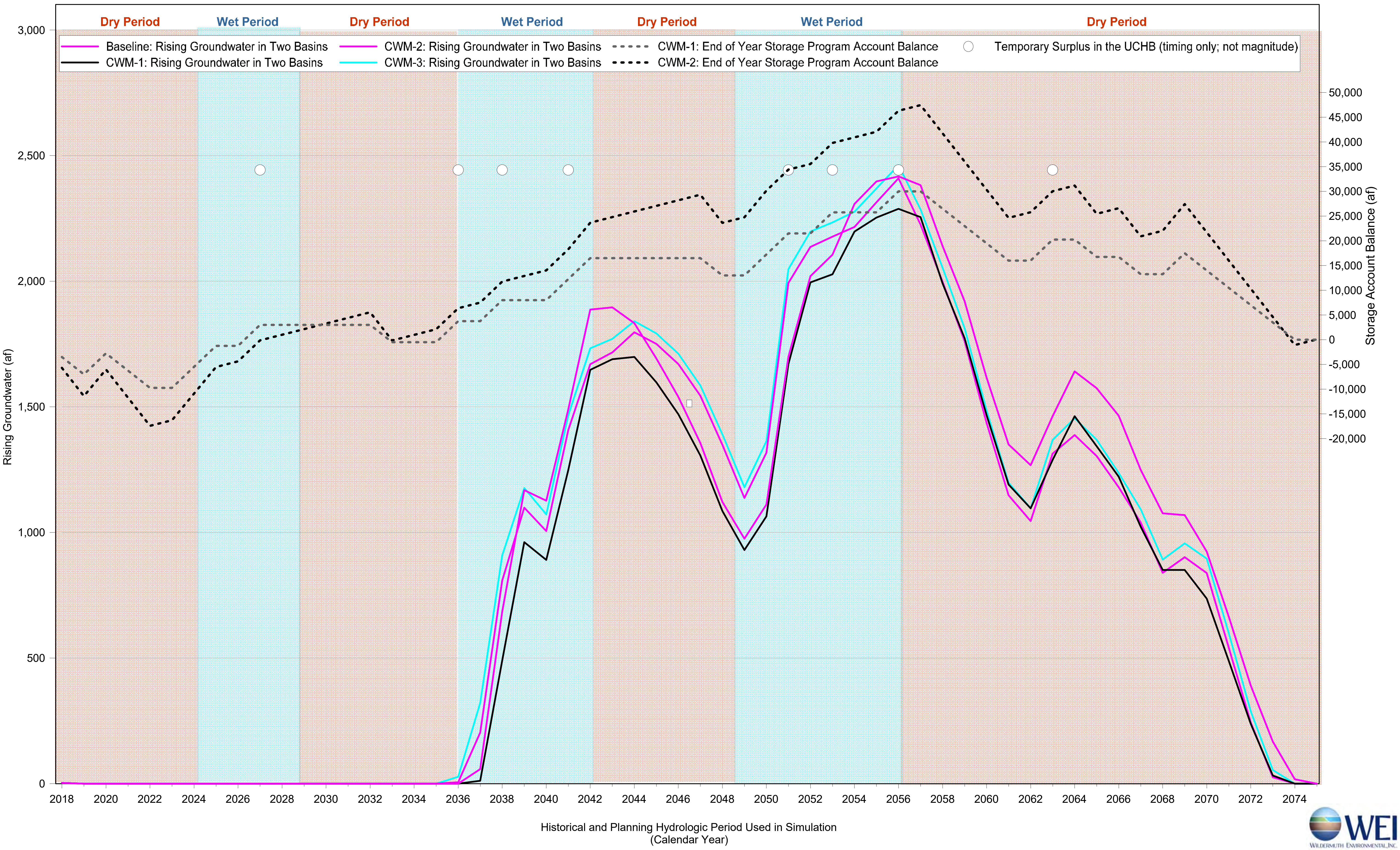
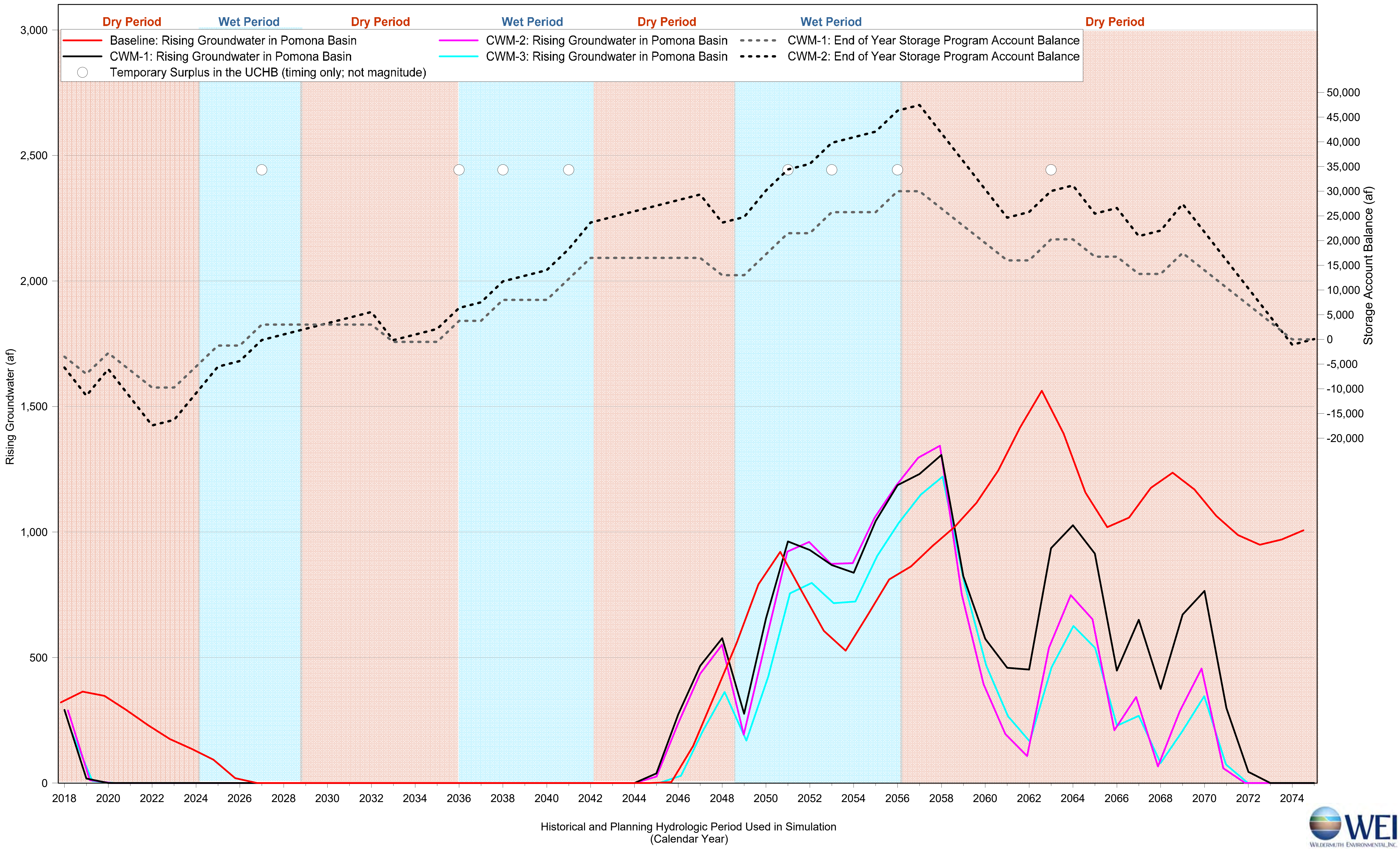
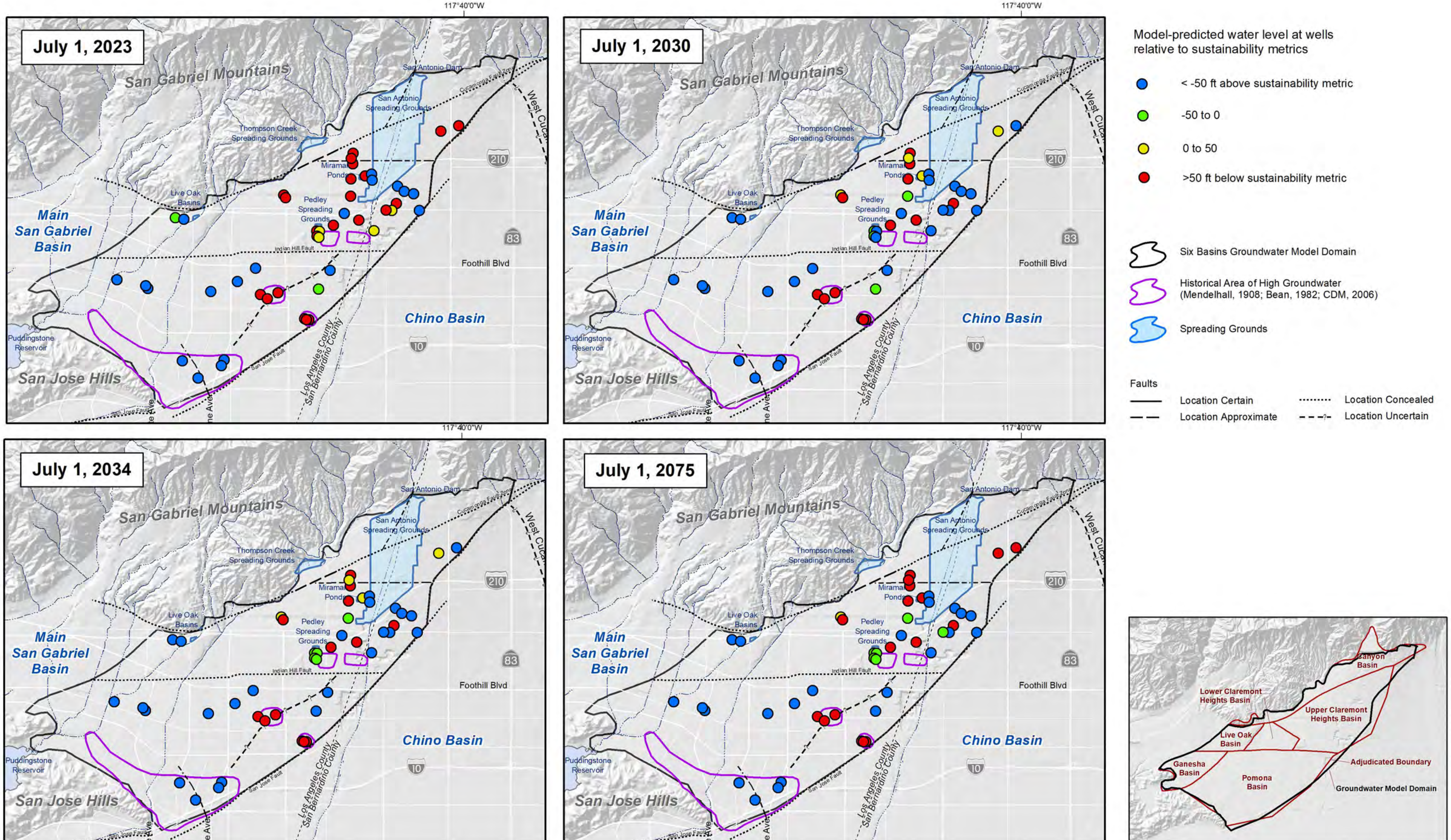


Figure 15c
Rising Groundwater in the Pomona Basin





Produced by:

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Wildermuth Environmental, Inc.

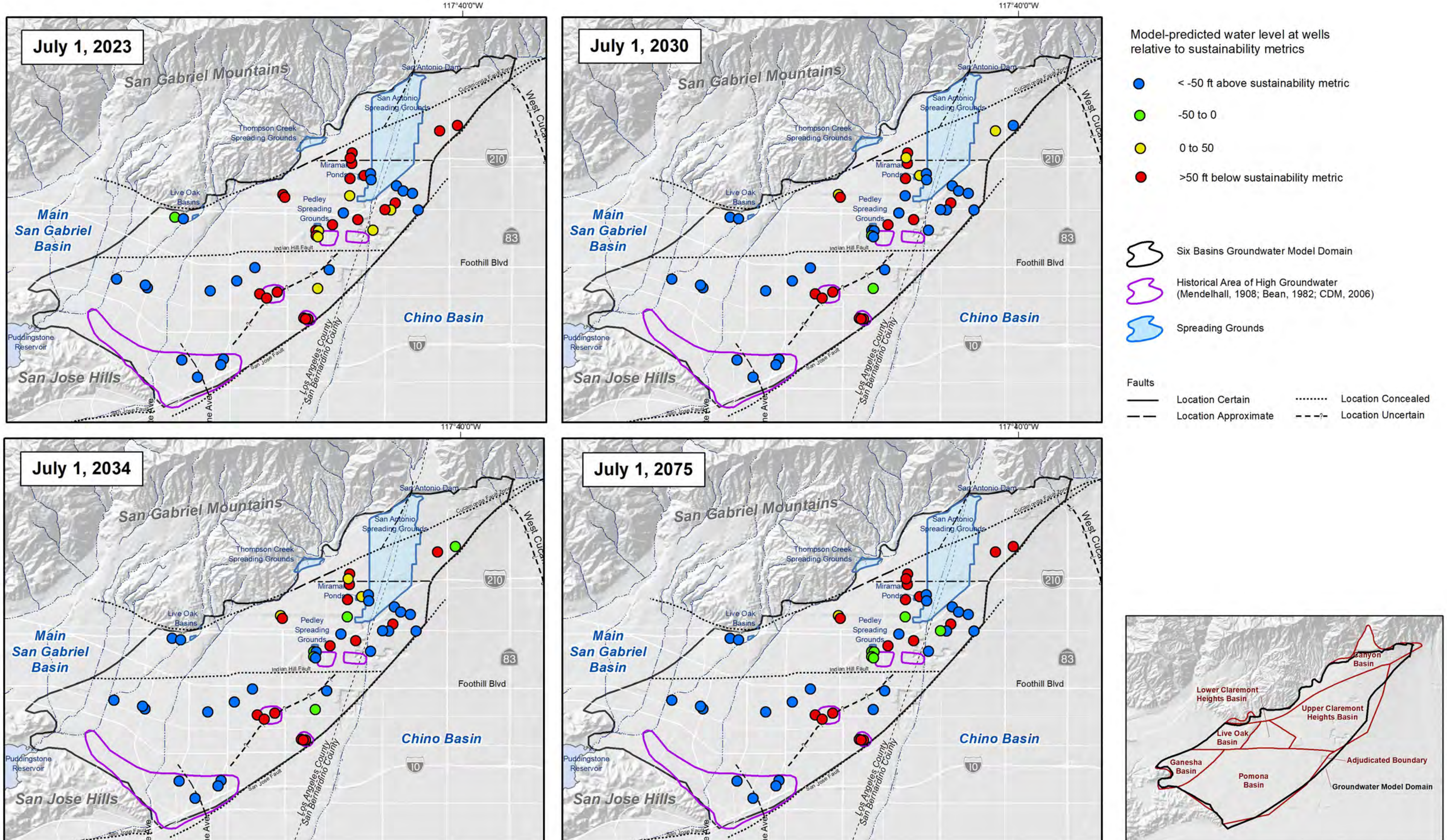
Author: RT
Date: 20200721

0 1 2 Miles
0 2 4 Kilometers

Six Basins Watermaster
Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Pumping Sustainability at Wells during Dry Periods
CWM1

Figure 16a



Produced by:

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Author: RT

Date: 20200828

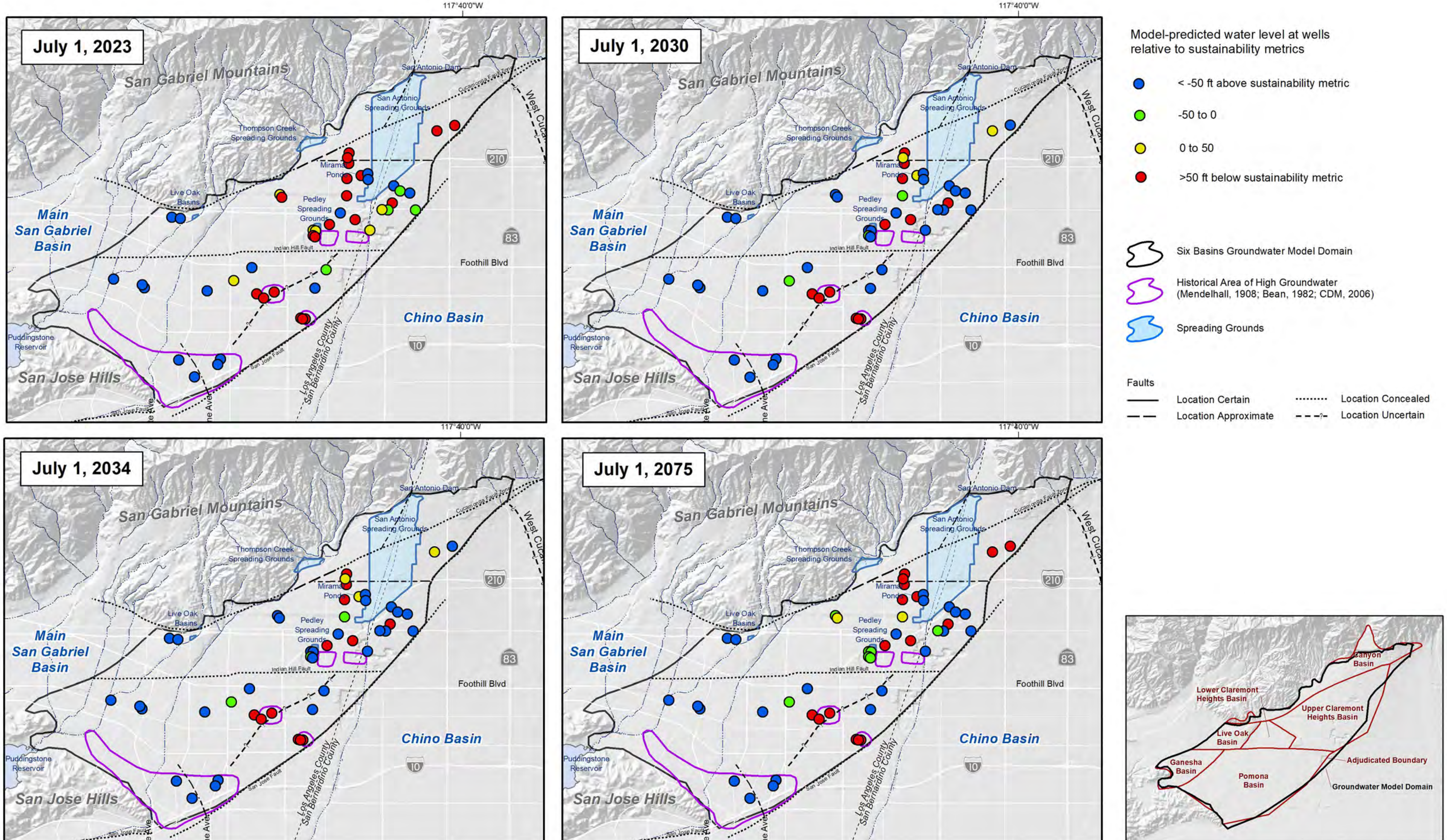
Six Basins Watermaster

Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Pumping Sustainability at Wells during Dry Periods

CWM2

Figure 16b



Produced by:

WEI
WILDERMUTH ENVIRONMENTAL, INC.

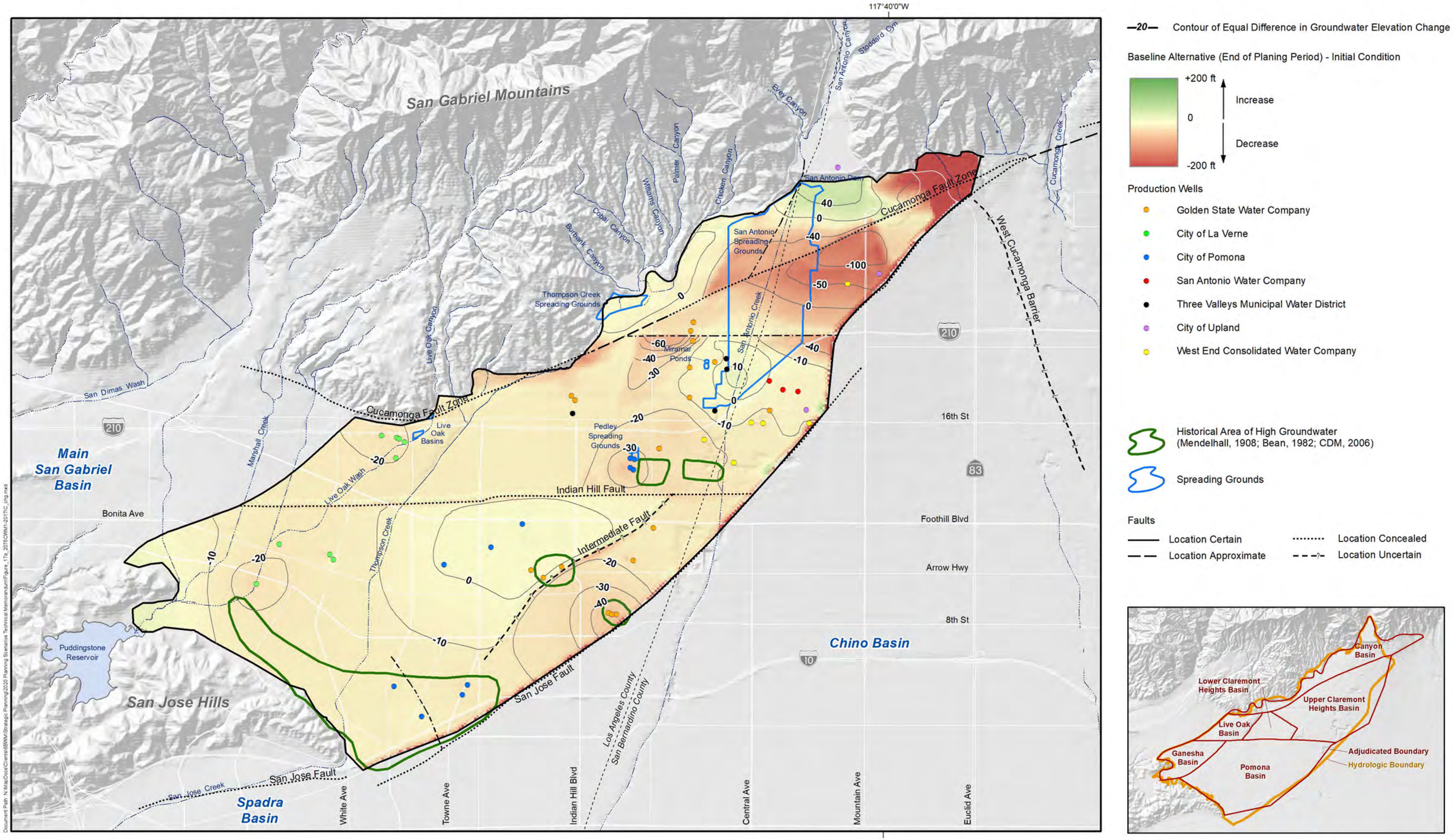
Author: RT
Date: 20200828

0 1 2 Miles
0 2 4 Kilometers

Six Basins Watermaster
Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Pumping Sustainability at Wells during Dry Periods
CWM3

Figure 16c



Produced by:

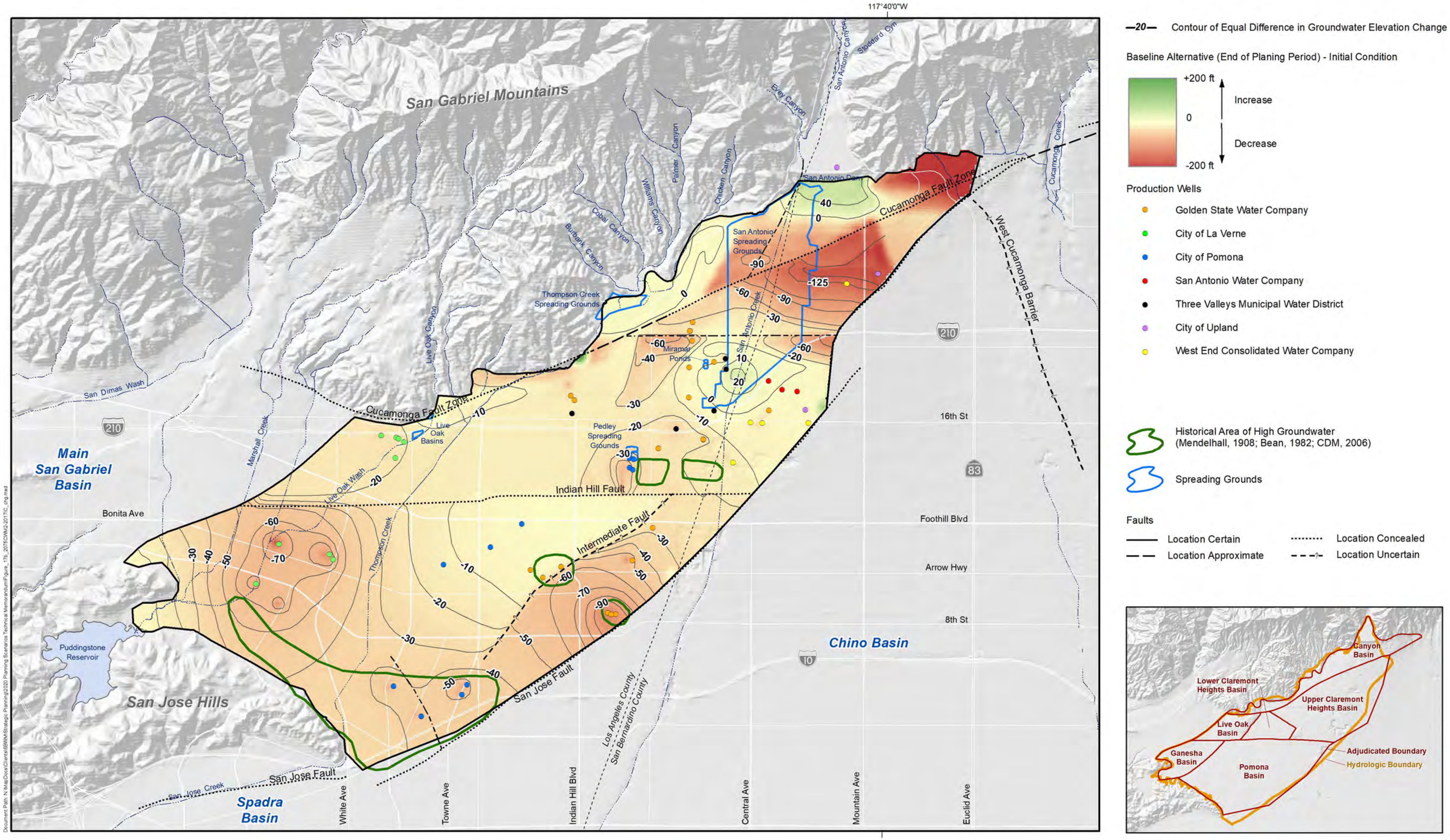
WEI
Wildermuth Environmental, Inc.

Author: RT
Date: 20200824

Six Basins Watermaster

Groundwater-Level Difference: CWM-1 End of Planning Period (2075) - Initial Conditions (2017)

Figure 17a



Produced by:

WEI
Wildermuth Environmental, Inc.

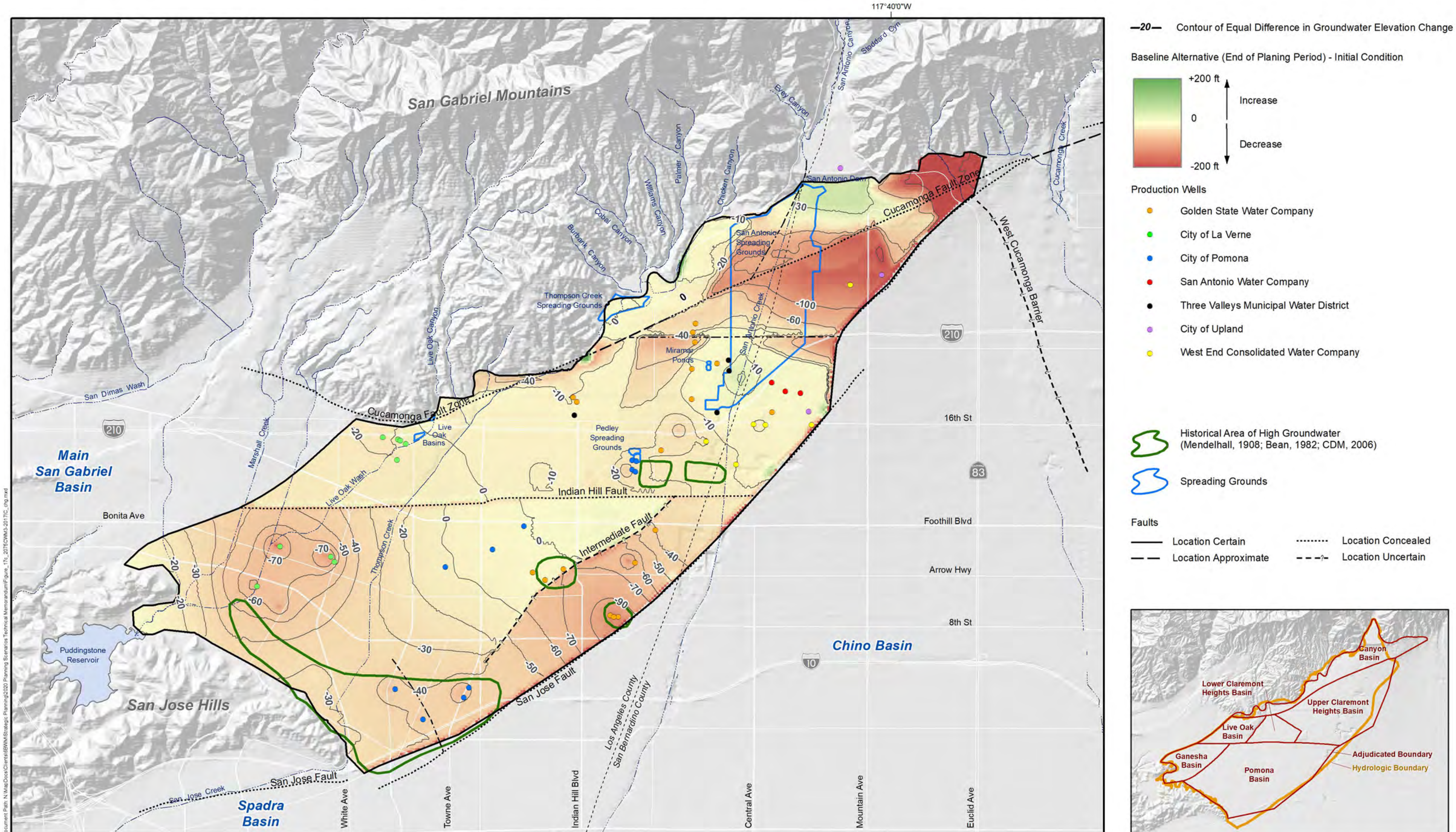
Author: RT
Date: 20200824

0 1 2 Miles
0 2 4 Kilometers

Six Basins Watermaster

Groundwater-Level Difference: CWM-2 End of Planning Period (2075) - Initial Conditions (2017)

Figure 17b



Produced by:

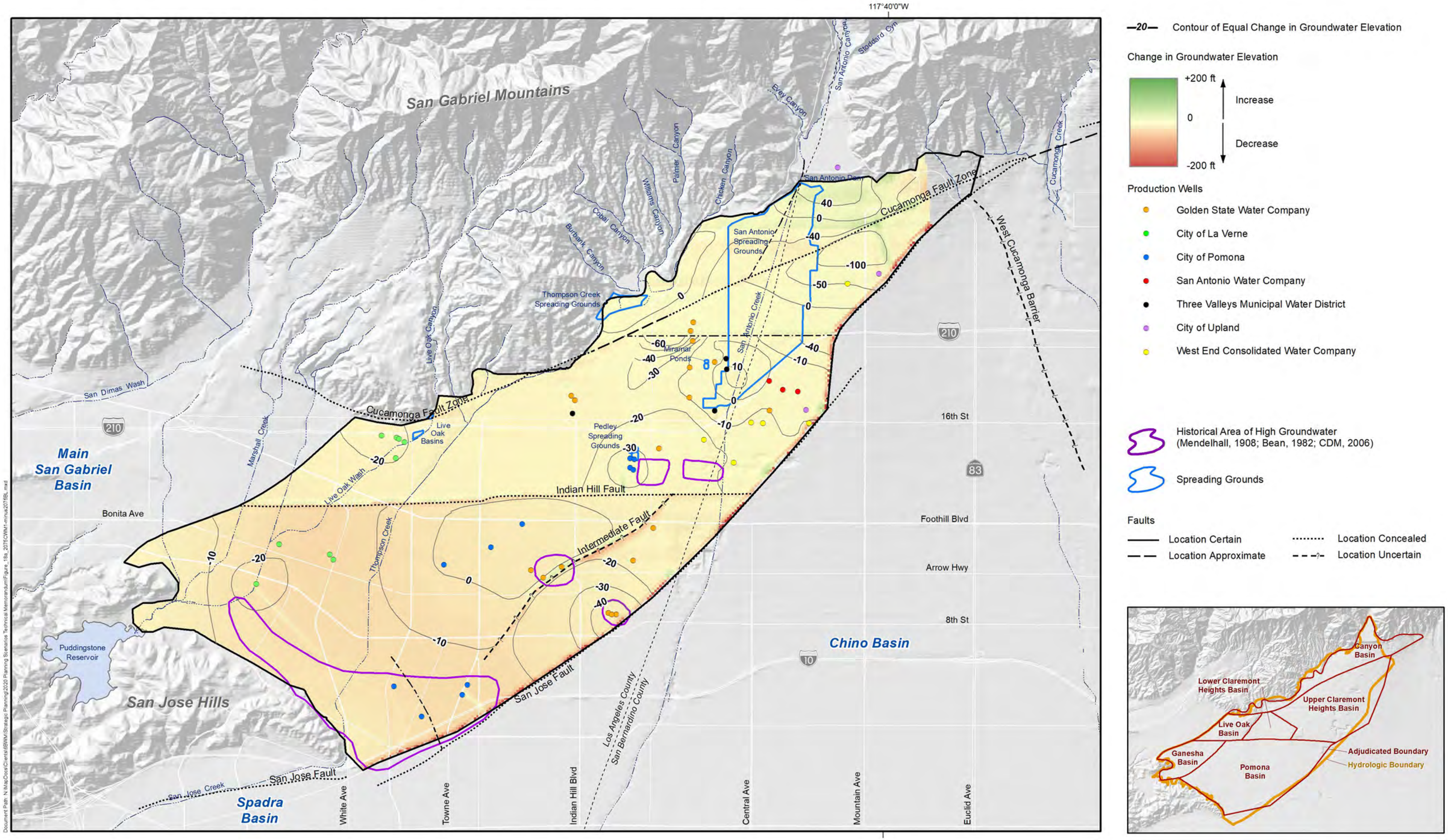
WEI
WILDERMUTH ENVIRONMENTAL, INC.

Author: RT
Date: 20200824

0 1 2 Miles
0 2 4 Kilometers

Groundwater-Level Difference: CWM-3 End of Planning Period (2075) - Initial Conditions (2017)

Figure 17c



Produced by:

WEI Wildermuth Environmental, Inc.

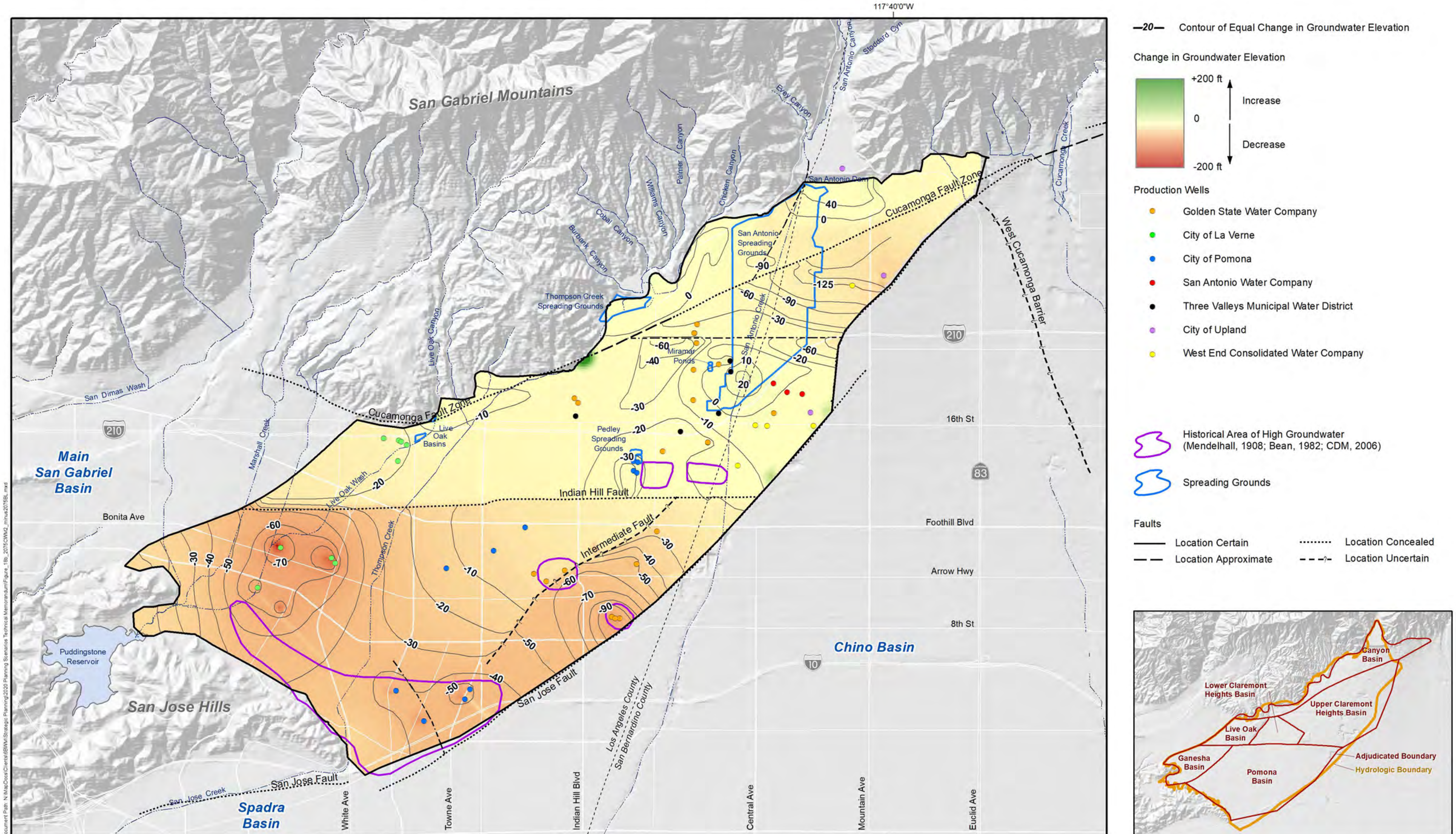
Author: AP
Date: 20201019

0 1 2 Miles
0 2 4 Kilometers

Six Basins Watermaster

Groundwater-Level Differece: CWM-1 - Baseline Alternative End of Planning Period (2075)

Figure 18a



Produced by:

WEI
Wildermuth Environmental, Inc.

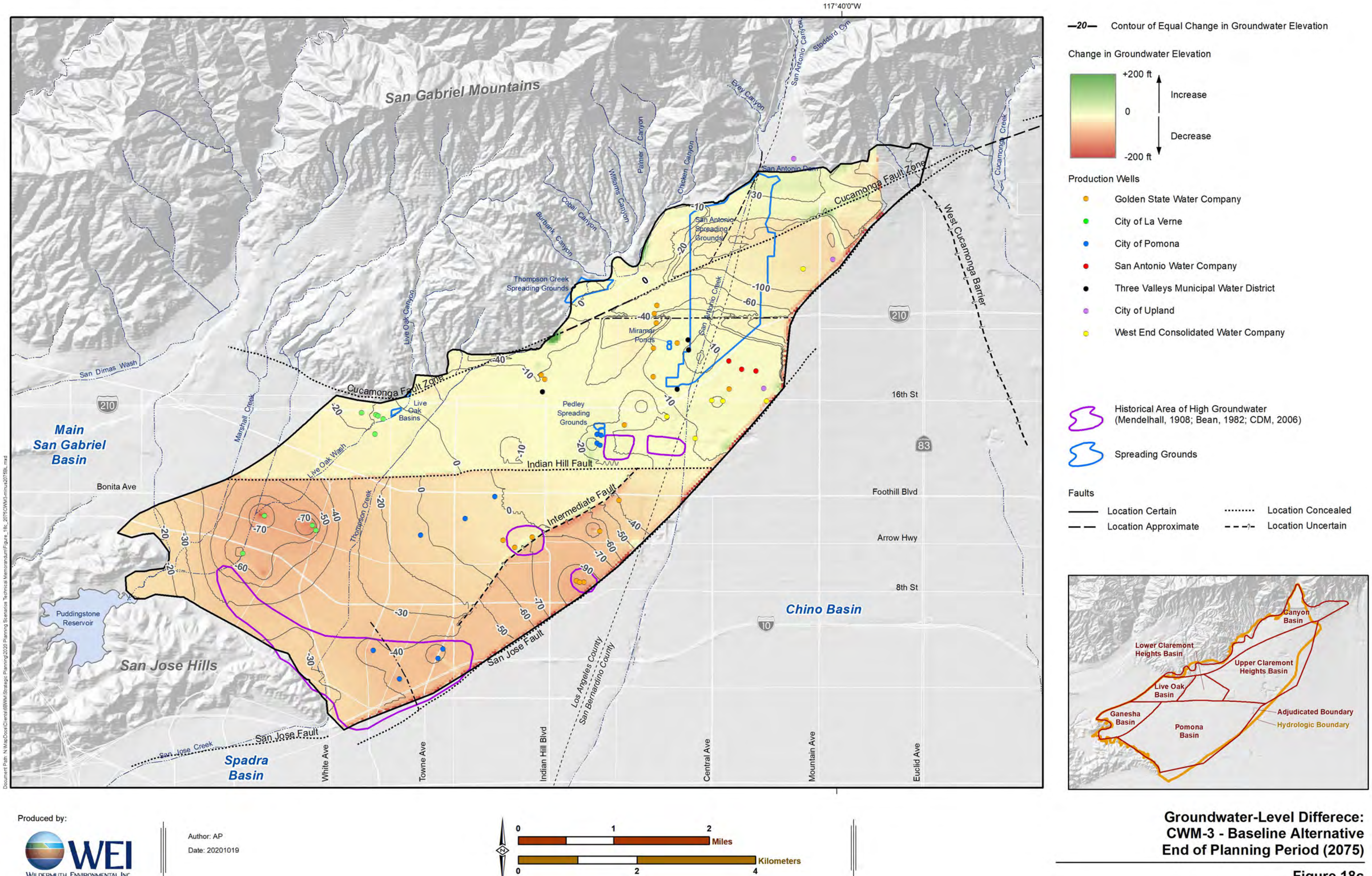
Author: AP
Date: 20201019

0 1 2 Miles
0 2 4 Kilometers

Six Basins Watermaster

Groundwater-Level Differece: CWM-2 - Baseline Alternative End of Planning Period (2075)

Figure 18b



Produced by:

WEI
Wildermuth Environmental, Inc.

Author: AP
Date: 20201019

Groundwater-Level Differece: CWM-3 - Baseline Alternative End of Planning Period (2075)

Figure 18c

Table 1
Water Budget for the Six Basins

Baseline from 2018 to 2075

Fiscal Year	Recharge								Discharge					Change in Storage		Annual Developed Yield
	Subsurface Boundary Inflow from the San Gabriel Mountains	Subsurface Boundary Inflow from the San Jose Hills	Deep Infiltration of Precipitation and Applied Water	Stormwater Infiltration at Spreading Grounds	Streambed Infiltration in Unlined Channels	Returns from Septic Systems	Imported Water Spreading	Total Inflow	Groundwater Production	ET	Rising Groundwater Outflow to Storm Drains	Subsurface Outflow to Chino Basin	Total Outflow	Annual	Cumulative	
2018	3,771	238	5,804	87	48	390	1,024	11,362	17,213	0	324	5,258	22,794	-11,432	-11,432	4,756
2019	1,387	238	7,930	40	32	390	2,500	12,517	17,213	0	364	5,007	22,584	-10,067	-21,499	4,646
2020	6,671	238	8,831	11,580	179	390	2,250	30,140	17,213	0	347	4,845	22,405	7,735	-13,764	22,698
2021	3,020	238	7,728	113	43	390	2,250	13,783	17,712	0	291	4,807	22,810	-9,027	-22,791	6,435
2022	2,624	238	8,797	126	63	390	774	13,012	17,712	0	230	4,657	22,599	-9,587	-32,378	7,351
2023	2,879	238	9,861	274	84	390	2,250	15,976	18,211	0	175	4,497	22,883	-6,907	-39,286	9,054
2024	10,626	238	12,216	13,789	155	390	2,500	39,914	17,213	0	136	4,524	21,873	18,041	-21,245	32,754
2025	10,353	238	11,645	10,982	218	390	2,500	36,327	19,709	0	93	4,723	24,526	11,801	-9,443	29,011
2026	6,846	238	12,306	257	62	390	2,500	22,600	22,557	0	20	4,868	27,444	-4,844	-14,288	15,212
2027	23,111	238	12,338	37,915	297	390	2,250	76,539	23,056	0	0	5,111	28,167	48,372	34,085	69,179
2028	7,084	238	9,354	2,421	68	390	2,250	21,806	26,521	0	0	5,650	32,171	-10,365	23,719	13,905
2029	8,107	238	8,920	331	82	390	774	18,842	25,050	0	0	5,563	30,612	-11,771	11,949	12,505
2030	4,482	238	10,556	189	48	390	2,250	18,154	24,554	0	0	5,396	29,950	-11,796	152	10,508
2031	7,534	238	11,286	6,853	185	390	2,250	28,736	17,712	0	0	5,341	23,053	5,684	5,836	21,146
2032	8,581	238	10,070	601	102	390	774	20,756	18,711	0	0	5,404	24,114	-3,359	2,477	14,578
2033	5,419	238	9,463	159	81	390	2,250	18,001	18,711	0	0	5,385	24,095	-6,094	-3,617	10,366
2034	4,301	238	9,950	3,827	51	390	2,250	21,007	18,711	0	0	5,341	24,052	-3,045	-6,662	13,416
2035	5,328	238	15,933	1,695	92	390	774	24,450	18,711	0	0	5,376	24,087	363	-6,298	18,300
2036	20,789	238	16,846	48,610	396	390	2,250	89,519	18,711	0	0	5,773	24,484	65,035	58,737	81,496
2037	7,754	238	15,050	5,529	177	390	2,500	31,637	26,031	0	58	6,521	32,610	-972	57,765	22,558
2038	18,439	238	12,531	27,549	291	390	2,500	61,939	27,005	0	685	6,624	34,314	27,625	85,390	52,130
2039	4,422	238	9,230	533	52	390	2,500	17,366	29,818	0	1,168	6,739	37,725	-20,359	65,031	6,959
2040	9,364	238	14,112	9,577	160	390	2,500	36,341	23,056	0	1,126	6,622	30,804	5,537	70,567	26,093
2041	18,122	238	13,193	41,552	401	390	2,500	76,396	23,555	0	1,732	6,920	32,207	44,188	114,755	65,244
2042	6,128	238	8,781	10,145	84	390	2,500	28,266	24,055	0	4,367	7,499	35,922	-7,656	107,099	13,899
2043	7,735	238	9,821	1,179	101	390	2,500	21,964	24,554	0	2,092	7,386	34,033	-12,069	95,031	9,986
2044	7,842	238	9,557	8,925	160	390	2,500	29,612	22,557	0	1,833	7,260	31,650	-2,038	92,993	18,019
2045	4,777	238	9,294	179	61	390	2,250	17,189	18,211	0	1,692	7,263	27,167	-9,978	83,015	5,983
2046	6,099	238	9,503	2,508	110	390	2,250	21,098	17,712	0	1,543	7,190	26,445	-5,347	77,668	10,115
2047	5,121	238	8,000	527	98	390	2,250	16,623	17,712	0	1,503	7,075	26,290	-9,667	68,001	5,795
2048	3,288	238	8,868	136	73	390	774	13,767	16,713	0	1,473	6,916	25,102	-11,335	56,666	4,604
2049	5,376	238	11,336	5,002	146	390	2,250	24,738	16,214	0	1,533	6,805	24,552	186	56,851	14,150
2050	9,323	238	15,286	17,949	218	390	2,250	45,654	16,713	0	1,902	6,900	25,515	20,138	76,990	34,602
2051	21,647	238	13,052	45,012	402	390	774	81,515	19,709	0	2,813	7,392	29,914	51,600	128,590	70,536
2052	5,791	238	10,644	252	87	390	2,500	19,902	27,479	0	2,963	7,740	38,182	-18,280	110,310	6,699
2053	13,512	238	11,542	31,817	311	390	2,500	60,311	26,521	0	2,996	7,620	37,138	23,173	133,483	47,194
2054	8,386	238	10,704	5,228	137	390	2,500	27,583	27,005	0	3,229	7,749	37,983	-10,399	123,084	14,106

Table 1
Water Budget for the Six Basins

Baseline from 2018 to 2075

Fiscal Year	Recharge: Subsurface Boundary Inflow from the San Gabriel Mountains	Recharge: Subsurface Boundary Inflow from the San Jose Hills	Recharge: Deep Infiltration of Precipitation and Applied Water	Recharge: Stormwater Infiltration at Spreading Grounds	Recharge: Streambed Infiltration in Unlined Channels	Recharge: Returns from Septic Systems	Recharge: Imported Water Spreading	Recharge: Total Inflow	Discharge: Groundwater Production	Discharge: ET	Discharge: Rising Groundwater Outflow to Storm Drains	Discharge: Subsurface Outflow to Chino Basin	Discharge: Total Outflow	Change in Storage: Annual	Change in Storage: Cumulative	Annual Developed Yield
2055	7,421	238	13,566	2,743	206	390	2,500	27,064	21,059	0	3,065	7,711	31,835	-4,770	118,314	13,789
2056	13,946	238	10,659	25,036	383	390	2,500	53,153	22,058	0	3,376	7,735	33,168	19,985	138,299	39,542
2057	3,786	238	7,615	3,082	63	390	2,500	17,674	21,558	0	3,919	7,902	33,379	-15,705	122,593	3,353
2058	6,250	238	9,129	270	122	390	2,500	18,899	21,059	0	3,086	7,693	31,837	-12,938	109,655	5,621
2059	4,622	238	7,384	399	144	390	2,500	15,676	19,210	0	2,941	7,448	29,599	-13,923	95,733	2,787
2060	2,398	238	8,013	35	34	390	2,250	13,359	16,214	0	2,732	7,248	26,194	-12,836	82,897	1,128
2061	4,021	238	9,217	380	129	390	2,250	16,624	15,715	0	2,595	7,074	25,383	-8,759	74,138	4,705
2062	3,147	238	12,644	534	75	390	2,250	19,278	15,715	0	2,683	6,946	25,344	-6,065	68,073	7,399
2063	15,170	238	13,164	48,303	318	390	2,250	79,834	16,214	0	3,025	7,197	26,436	53,398	121,470	67,362
2064	5,269	238	7,181	9,658	123	390	2,500	25,359	24,055	0	3,037	7,596	34,688	-9,329	112,142	12,226
2065	2,707	238	7,354	16	27	390	2,500	13,232	25,050	0	2,732	7,306	35,087	-21,855	90,287	695
2066	5,151	238	8,908	2,499	150	390	2,500	19,836	24,554	0	2,484	6,891	33,929	-14,093	76,193	7,961
2067	3,829	238	9,381	201	97	390	2,250	16,386	17,213	0	2,306	6,661	26,180	-9,794	66,399	5,169
2068	7,714	238	11,144	7,134	176	390	774	27,569	16,214	0	2,252	6,601	25,067	2,502	68,902	17,942
2069	9,305	238	9,554	21,058	193	390	2,250	42,988	17,712	0	2,305	6,706	26,724	16,264	85,166	31,726
2070	4,850	238	6,606	92	72	390	2,250	14,498	21,059	0	2,094	6,727	29,880	-15,382	69,784	3,427
2071	4,712	238	6,120	31	48	390	774	12,313	19,709	0	1,729	6,427	27,865	-15,552	54,232	3,383
2072	567	238	6,734	2	0	390	2,250	10,181	18,711	0	1,378	6,113	26,201	-16,020	38,212	441
2073	1,620	238	7,047	4	0	390	2,250	11,549	15,215	0	1,117	5,860	22,192	-10,643	27,569	2,322
2074	1,953	238	8,825	17	0	390	774	12,197	15,215	0	988	5,651	21,853	-9,656	17,913	4,785
2075	5,877	238	10,689	3,441	75	390	2,250	22,961	15,715	0	1,007	5,490	22,212	750	18,662	14,214
Statistics for the Baseline Planning Period 2018 through 2075																
Total	420,353	13,816	591,274	478,381	7,789	22,620	121,740	1,655,972	1,179,040	0	87,539	370,731	1,637,310	18,662		1,075,962
Average	7,247	238	10,194	8,248	134	390	2,099	28,551	20,328	0	1,509	6,392	28,229	322		18,551
Median	5,834	238	9,556	2,058	100	390	2,250	21,053	18,711	0	1,518	6,684	26,584	-7,282		12,366
Maximum	23,111	238	16,846	48,610	402	390	2,500	89,519	29,818	0	4,367	7,902	38,182	65,035		81,496
Minimum	567	238	5,804	2	0	390	774	10,181	15,215	0	0	4,497	21,853	-21,855		441

Table 2
Strategic Plan Projects - Capacity and New Facilities by Project Type

Project Name	New Facilities	Approximate Increase in Capacity
Pump and treat projects		
Pomona Reservoir 5	Treatment facilities	2,000 afy
La Verne Lincoln/Mills	Treatment facilities	1,000 afy
GSWC Del Monte 4	Treatment facilities	800 afy
La Verne Old Baldy	Treatment and conveyance facilities	800 afy
PBWA Durward 2	Well and treatment facilities	600 afy
Total pump and treat capacity		*5,200 afy of increased pumping*
Stormwater and supplemental-water recharge projects		
Stormwater at the SASG	Monitoring facilities	Unknown
Stormwater at the TCSG	Recharge and conveyance facilities	
Supplemental water at PSG	Conveyance facilities	
Stormwater and supplemental water at the Fairplex	Recharge and conveyance facilities	
MS4 recharge projects	Recharge and conveyance facilities	
Supplemental water at SASG	Conveyance facilities for recycled water. None for imported water.	
Supplemental water at TCSG	Conveyance facilities	
Total recharge capacity		*Unknown*
Temporary Surplus projects		
Existing unused pumping capacity	Conveyance facilities	< 500 af/month
P-20	None	80 af/month
New well(s)	Well(s) and conveyance facilities	< 125 af/month
Total Temporary Surplus capacity		*6,345 afy of increased pumping during wet periods (April to December)*

Table 3
Dry-Year Storage Program Accounting in Conjunctive Water Management - Scenario 1 (af)

Planning Period	Historical Hydrologic Period Used in Simulation	Stormwater Recharge at SASG	Take (by extra pumping in the Pomona Basin)	Put (by in-lieu recharge)		End of Year Storage Program Account Balance
				Temporary Surplus	Delivery of Treated Imported Water	
2018	1960	0	-3,500	0	0	-3,500
2019	1961	0	-3,500	0	0	-7,000
2020	1962	10,775	0	0	4,250	-2,750
2021	1963	0	-3,500	0	0	-6,250
2022	1964	0	-3,500	0	0	-9,750
2023	1965	8	0	0	0	-9,750
2024	1966	13,053	0	0	4,250	-5,500
2025	1967	10,044	0	0	4,250	-1,250
2026	1968	98	0	0	0	-1,250
2027	1969	36,442	0	4,250	0	3,000
2028	1970	2,215	0	0	0	3,000
2029	1971	125	0	0	0	3,000
2030	1972	84	0	0	0	3,000
2031	1973	6,206	0	0	0	3,000
2032	1974	252	0	0	0	3,000
2033	1975	0	-3,500	0	0	-500
2034	1976	3,724	0	0	0	-500
2035	1977	1,490	0	0	0	-500
2036	1978	46,762	0	4,250	0	3,750
2037	1979	4,854	0	0	0	3,750
2038	1980	26,169	0	4,250	0	8,000
2039	1981	439	0	0	0	8,000
2040	1982	9,018	0	0	0	8,000
2041	1983	39,815	0	4,250	0	12,250
2042	1984	9,911	0	0	4,250	16,500
2043	1985	990	0	0	0	16,500
2044	1986	8,529	0	0	0	16,500
2045	1987	54	0	0	0	16,500
2046	1988	2,242	0	0	0	16,500
2047	1989	303	0	0	0	16,500
2048	1990	0	-3,500	0	0	13,000
2049	1991	4,429	0	0	0	13,000
2050	1992	17,008	0	0	4,250	17,250
2051	1993	42,940	0	4,250	0	21,500
2052	1994	123	0	0	0	21,500
2053	1995	30,462	0	0	4,250	25,750
2054	1996	4,711	0	0	0	25,750
2055	1997	2,117	0	0	0	25,750
2056	1998	23,610	0	4,250	0	30,000
2057	1999	2,989	0	0	0	30,000
2058	2000	0	-3,500	0	0	26,500
2059	2001	0	-3,500	0	0	23,000
2060	2002	0	-3,500	0	0	19,500
2061	2003	0	-3,500	0	0	16,000
2062	2004	341	0	0	0	16,000
2063	2005	46,836	0	4,250	0	20,250
2064	2006	9,362	0	0	0	20,250
2065	2007	0	-3,500	0	0	16,750
2066	2008	2,055	0	0	0	16,750
2067	2009	0	-3,500	0	0	13,250
2068	2010	6,514	0	0	0	13,250
2069	2011	20,273	0	0	4,250	17,500
2070	2012	0	-3,500	0	0	14,000
2071	2013	0	-3,500	0	0	10,500
2072	2014	0	-3,500	0	0	7,000
2073	2015	0	-3,500	0	0	3,500
2074	2016	0	-3,500	0	0	0
2075	2017	3,432	0	0	0	0
Min		0	-3,500	0	0	-9,750
Max		46,836	0	4,250	4,250	30,000
Total		450,804	-59,500	29,750	29,750	

Table 4

Dry-Year Storage Porgram Accounting in Conjunctive Water Management - Scenario 2 and 3 (af)

Planning Period	Historical Hydrologic Period Used in Simulation	Stormwater Recharge at SASG	Take	Put				End of Year Storage Program Account Balance
				By In-lieu Recharge		By Wet Water Recharge	Total Puts	
				Temporary Surplus	Delivery of Imported Water			
2018	1960	0	-5,700	0	0	0	0	-5,700
2019	1961	0	-5,700	0	0	0	0	-11,400
2020	1962	10,775	0	0	4,250	1,135	1,135	-6,015
2021	1963	0	-5,700	0	0	0	0	-11,715
2022	1964	0	-5,700	0	0	0	0	-17,415
2023	1965	8	0	0	0	1,135	1,135	-16,280
2024	1966	13,053	0	0	4,250	1,135	1,135	-10,895
2025	1967	10,044	0	0	4,250	1,135	1,135	-5,510
2026	1968	98	0	0	0	1,135	1,135	-4,375
2027	1969	36,442	0	4,250	0	0	4,250	-125
2028	1970	2,215	0	0	0	1,135	1,135	1,010
2029	1971	125	0	0	0	1,135	1,135	2,145
2030	1972	84	0	0	0	1,135	1,135	3,280
2031	1973	6,206	0	0	0	1,135	1,135	4,415
2032	1974	252	0	0	0	1,135	1,135	5,550
2033	1975	0	-5,700	0	0	0	0	-150
2034	1976	3,724	0	0	0	1,135	1,135	985
2035	1977	1,490	0	0	0	1,135	1,135	2,120
2036	1978	46,762	0	4,250	0	0	4,250	6,370
2037	1979	4,854	0	0	0	1,135	1,135	7,505
2038	1980	26,169	0	4,250	0	0	4,250	11,755
2039	1981	439	0	0	0	1,135	1,135	12,890
2040	1982	9,018	0	0	0	1,135	1,135	14,025
2041	1983	39,815	0	4,250	0	0	4,250	18,275
2042	1984	9,911	0	0	4,250	1,135	1,135	23,660
2043	1985	990	0	0	0	1,135	1,135	24,795
2044	1986	8,529	0	0	0	1,135	1,135	25,930
2045	1987	54	0	0	0	1,135	1,135	27,065
2046	1988	2,242	0	0	0	1,135	1,135	28,200
2047	1989	303	0	0	0	1,135	1,135	29,335
2048	1990	0	-5,700	0	0	0	0	23,635
2049	1991	4,429	0	0	0	1,135	1,135	24,770
2050	1992	17,008	0	0	4,250	1,135	1,135	30,155
2051	1993	42,940	0	4,250	0	0	4,250	34,405
2052	1994	123	0	0	0	1,135	1,135	35,540
2053	1995	30,462	0	0	4,250	0	0	39,790
2054	1996	4,711	0	0	0	1,135	1,135	40,925
2055	1997	2,117	0	0	0	1,135	1,135	42,060
2056	1998	23,610	0	4,250	0	0	4,250	46,310
2057	1999	2,989	0	0	0	1,135	1,135	47,445
2058	2000	0	-5,700	0	0	0	0	41,745
2059	2001	0	-5,700	0	0	0	0	36,045
2060	2002	0	-5,700	0	0	0	0	30,345
2061	2003	0	-5,700	0	0	0	0	24,645
2062	2004	341	0	0	0	1,135	1,135	25,780
2063	2005	46,836	0	4,250	0	0	4,250	30,030
2064	2006	9,362	0	0	0	1,135	1,135	31,165
2065	2007	0	-5,700	0	0	0	0	25,465
2066	2008	2,055	0	0	0	1,135	1,135	26,600
2067	2009	0	-5,700	0	0	0	0	20,900
2068	2010	6,514	0	0	0	1,135	1,135	22,035
2069	2011	20,273	0	0	4,250	1,135	1,135	27,420
2070	2012	0	-5,700	0	0	0	0	21,720
2071	2013	0	-5,700	0	0	0	0	16,020
2072	2014	0	-5,700	0	0	0	0	10,320
2073	2015	0	-5,700	0	0	0	0	4,620
2074	2016	0	-5,700	0	0	0	0	-1,080
2075	2017	3,432	0	0	0	1,135	1,135	55
Min		0	-5,700	0	0	0	0	-17,415
Max		46,836	0	4,250	4,250	1,135	4,250	47,445
Total		450,804	-96,900	29,750	29,750	37,455	67,205	

Table 5
Assumed Recharge of MS-4 Projects[1]

Site ID	Site	Stormwater Recharge Benefit (afy)	Dry Weather Recharge Benefit (afy)
G-02	Las Flores Park	71	14
LO-01	Lutheran High School	14	4
P-25	Brackett Field	180	35
UCH-01	Rancho Santa Ana Botanical Gardens	69	20
UCH-02	La Puerta Sports Park	229	48
	Fairplex	336	53
	Pedley Spreading Grounds	192	53
	San Antonio Spreading Grounds	128	25
	Total	**1,219**	**251**

1 -- WEI and Stantec, 2020. *Reconnaissance-Level Recharge Study of the Six Basins.*

Table 6a
Water Budget for the Six Basins

CWM-1 from 2018 to 2075

Fiscal Year	Recharge								Discharge					Change in Storage		Annual Developed Yield
	Subsurface Boundary Inflow from the San Gabriel Mountains	Subsurface Boundary Inflow from the San Jose Hills	Deep Infiltration of Precipitation and Applied Water	Stormwater Infiltration at Spreading Grounds	Streambed Infiltration in Unlined Channels	Returns from Septic Systems	Imported Water Spreading	Total Inflow	Groundwater Production	ET	Rising Groundwater Outflow to Storm Drains	Subsurface Outflow to Chino Basin	Total Outflow	Annual	Cumulative	
2018	3,771	238	5,804	87	48	390	1,024	11,362	18,428	0	294	5,252	23,974	-12,612	-12,612	4,792
2019	1,387	238	7,930	40	32	390	2,500	12,517	20,636	0	18	4,928	25,582	-13,065	-25,676	5,071
2020	6,671	238	8,831	11,580	179	390	2,250	30,140	18,279	0	0	4,708	22,987	7,153	-18,524	23,182
2021	3,020	238	7,728	113	43	390	2,250	13,783	15,971	0	0	4,861	20,832	-7,049	-25,573	6,671
2022	2,624	238	8,797	126	63	390	774	13,012	21,231	0	0	4,644	25,875	-12,863	-38,436	7,594
2023	2,879	238	9,861	274	84	390	2,250	15,976	20,479	0	0	4,404	24,882	-8,906	-47,343	9,323
2024	10,626	238	12,216	13,789	155	390	2,500	39,914	16,034	0	0	4,446	20,480	19,434	-27,909	32,968
2025	10,353	238	11,645	10,982	218	390	2,500	36,327	15,439	0	0	4,816	20,256	16,071	-11,838	29,010
2026	6,846	238	12,306	257	62	390	2,500	22,600	19,505	0	0	5,106	24,612	-2,012	-13,850	14,993
2027	23,111	238	12,338	37,915	297	390	2,250	76,539	23,581	0	0	5,325	28,906	47,634	33,784	68,964
2028	7,084	238	9,354	2,421	68	390	2,250	21,806	26,027	0	0	5,879	31,906	-10,100	23,684	13,677
2029	8,107	238	8,920	331	82	390	774	18,842	25,054	0	0	5,762	30,815	-11,974	11,710	12,306
2030	4,482	238	10,556	189	48	390	2,250	18,154	24,554	0	0	5,547	30,101	-11,948	-237	10,357
2031	7,534	238	11,286	6,853	185	390	2,250	28,736	17,712	0	0	5,457	23,169	5,567	5,330	21,029
2032	8,581	238	10,070	601	102	390	774	20,756	18,711	0	0	5,494	24,204	-3,448	1,881	14,488
2033	5,419	238	9,463	159	81	390	2,250	18,001	19,933	0	0	5,447	25,379	-7,378	-5,497	10,304
2034	4,301	238	9,950	3,827	51	390	2,250	21,007	20,989	0	0	5,312	26,301	-5,294	-10,791	13,445
2035	5,328	238	15,933	1,695	92	390	774	24,450	18,711	0	0	5,342	24,052	398	-10,393	18,334
2036	20,789	238	16,846	48,610	396	390	2,250	89,519	18,713	0	0	5,739	24,452	65,067	54,674	81,530
2037	7,754	238	15,050	5,529	177	390	2,500	31,637	26,050	0	11	6,555	32,616	-979	53,696	22,571
2038	18,439	238	12,531	27,549	291	390	2,500	61,939	27,595	0	490	6,653	34,738	27,201	80,897	52,296
2039	4,422	238	9,230	533	52	390	2,500	17,366	29,503	0	961	6,837	37,301	-19,935	60,962	7,068
2040	9,364	238	14,112	9,577	160	390	2,500	36,341	23,056	0	891	6,702	30,649	5,692	66,654	26,248
2041	18,122	238	13,193	41,552	401	390	2,500	76,396	23,761	0	1,300	6,960	32,020	44,375	111,029	65,636
2042	6,128	238	8,781	10,145	84	390	2,500	28,266	22,534	0	2,310	7,629	32,474	-4,208	106,821	15,826
2043	7,735	238	9,821	1,179	101	390	2,500	21,964	21,619	0	1,693	7,669	30,981	-9,016	97,804	10,103
2044	7,842	238	9,557	8,925	160	390	2,500	29,612	22,557	0	1,699	7,498	31,753	-2,141	95,663	17,916
2045	4,777	238	9,294	179	61	390	2,250	17,189	18,211	0	1,636	7,440	27,288	-10,099	85,565	5,862
2046	6,099	238	9,503	2,508	110	390	2,250	21,098	17,712	0	1,745	7,319	26,775	-5,677	79,887	9,785
2047	5,121	238	8,000	527	98	390	2,250	16,623	17,712	0	1,774	7,162	26,647	-10,024	69,863	5,438
2048	3,288	238	8,868	136	73	390	774	13,767	17,900	0	1,662	6,968	26,530	-12,763	57,100	4,363
2049	5,376	238	11,336	5,002	146	390	2,250	24,738	18,527	0	1,206	6,768	26,501	-1,763	55,337	14,514
2050	9,323	238	15,286	17,949	218	390	2,250	45,654	15,568	0	1,720	6,885	24,172	21,481	76,818	34,799
2051	21,647	238	13,052	45,012	402	390	774	81,515	16,647	0	2,756	7,582	26,985	54,530	131,348	70,403
2052	5,791	238	10,644	252	87	390	2,500	19,902	27,508	0	2,980	7,999	38,487	-18,585	112,762	6,423
2053	13,512	238	11,542	31,817	311	390	2,500	60,311	26,794	0	2,979	7,827	37,599	22,711	135,474	47,005
2054	8,386	238	10,704	5,228	137	390	2,500	27,583	26,809	0	3,081	8,001	37,891	-10,307	125,167	14,002

Table 6a
Water Budget for the Six Basins

CWM-1 from 2018 to 2075

Fiscal Year	Recharge								Discharge					Change in Storage		Annual Developed Yield
	Subsurface Boundary Inflow from the San Gabriel Mountains	Subsurface Boundary Inflow from the San Jose Hills	Deep Infiltration of Precipitation and Applied Water	Stormwater Infiltration at Spreading Grounds	Streambed Infiltration in Unlined Channels	Returns from Septic Systems	Imported Water Spreading	Total Inflow	Groundwater Production	ET	Rising Groundwater Outflow to Storm Drains	Subsurface Outflow to Chino Basin	Total Outflow	Annual	Cumulative	
2055	7,421	238	13,566	2,743	206	390	2,500	27,064	21,059	0	3,297	7,909	32,265	-5,200	119,967	13,359
2056	13,946	238	10,659	25,036	383	390	2,500	53,153	22,145	0	3,489	7,867	33,501	19,651	139,618	39,296
2057	3,786	238	7,615	3,082	63	390	2,500	17,674	21,470	0	3,549	8,107	33,126	-15,453	124,165	3,518
2058	6,250	238	9,129	270	122	390	2,500	18,899	22,534	0	3,298	7,835	33,667	-14,768	109,397	5,266
2059	4,622	238	7,384	399	144	390	2,500	15,676	22,353	0	2,597	7,440	32,391	-16,714	92,683	3,139
2060	2,398	238	8,013	35	34	390	2,250	13,359	19,781	0	2,042	7,153	28,975	-15,616	77,067	1,914
2061	4,021	238	9,217	380	129	390	2,250	16,624	19,233	0	1,650	6,914	27,797	-11,173	65,894	5,810
2062	3,147	238	12,644	534	75	390	2,250	19,278	18,011	0	1,548	6,743	26,302	-7,023	58,871	8,738
2063	15,170	238	13,164	48,303	318	390	2,250	79,834	16,293	0	2,224	7,037	25,554	54,280	113,151	68,323
2064	5,269	238	7,181	9,658	123	390	2,500	25,359	23,976	0	2,490	7,566	34,032	-8,673	104,478	12,803
2065	2,707	238	7,354	16	27	390	2,500	13,232	26,272	0	2,257	7,265	35,794	-22,562	81,916	1,210
2066	5,151	238	8,908	2,499	150	390	2,500	19,836	26,836	0	1,670	6,719	35,224	-15,388	66,528	8,947
2067	3,829	238	9,381	201	97	390	2,250	16,386	18,385	0	1,673	6,483	26,541	-10,155	56,373	5,980
2068	7,714	238	11,144	7,134	176	390	774	27,569	18,541	0	1,226	6,369	26,135	1,434	57,807	19,201
2069	9,305	238	9,554	21,058	193	390	2,250	42,988	16,556	0	1,522	6,521	24,598	18,390	76,197	32,696
2070	4,850	238	6,606	92	72	390	2,250	14,498	19,461	0	1,502	6,735	27,698	-13,200	62,997	4,011
2071	4,712	238	6,120	31	48	390	774	12,313	22,906	0	787	6,352	30,045	-17,732	45,265	4,400
2072	567	238	6,734	2	0	390	2,250	10,181	22,116	0	282	5,966	28,364	-18,183	27,082	1,683
2073	1,620	238	7,047	4	0	390	2,250	11,549	18,822	0	32	5,654	24,508	-12,960	14,123	3,612
2074	1,953	238	8,825	17	0	390	774	12,197	18,733	0	0	5,391	24,124	-11,927	2,196	6,032
2075	5,877	238	10,689	3,441	75	390	2,250	22,961	17,993	0	0	5,192	23,184	-223	1,972	15,520
Total	420,353	13,816	591,274	478,381	7,789	22,620	121,740	1,655,972	1,213,522	0	68,340	372,138	1,653,999	1,972		1,093,754
Average	7,247	238	10,194	8,248	134	390	2,099	28,551	20,923	0	1,178	6,416	28,517	34		18,858
Median	5,834	238	9,556	2,058	100	390	2,250	21,053	20,206	0	1,216	6,678	27,136	-7,214		12,555
Maximum	23,111	238	16,846	48,610	402	390	2,500	89,519	29,503	0	3,549	8,107	38,487	65,067		81,530
Minimum	567	238	5,804	2	0	390	774	10,181	15,439	0	0	4,404	20,256	-22,562		1,210

Table 6b
Water Budget for the Six Basins

CWM-2 from 2018 to 2075

Fiscal Year	Recharge								Discharge					Change in Storage		Annual Developed Yield
	Subsurface Boundary Inflow from the San Gabriel Mountains	Subsurface Boundary Inflow from the San Jose Hills	Deep Infiltration of Precipitation and Applied Water	Stormwater Infiltration at Spreading Grounds	Streambed Infiltration in Unlined Channels	Returns from Septic Systems	Imported Water Spreading	Total Inflow	Groundwater Production	ET	Rising Groundwater Outflow to Storm Drains	Subsurface Outflow to Chino Basin	Total Outflow	Annual	Cumulative	
2018	3,771	238	5,804	87	48	390	1,024	11,362	19,183	0	292	5,239	24,714	-13,352	-13,352	4,807
2019	1,387	238	7,930	40	32	390	2,500	12,517	22,801	0	12	4,814	27,627	-15,109	-28,461	5,191
2020	6,671	238	8,831	11,580	179	390	2,628	30,518	17,717	0	0	4,534	22,251	8,267	-20,195	23,356
2021	3,020	238	7,728	113	43	390	3,007	14,539	17,016	0	0	4,716	21,732	-7,193	-27,387	6,816
2022	2,624	238	8,797	126	63	390	774	13,012	23,440	0	0	4,463	27,903	-14,891	-42,278	7,775
2023	2,879	238	9,861	274	84	390	2,628	16,355	21,916	0	0	4,174	26,090	-9,735	-52,013	9,552
2024	10,626	238	12,216	13,789	155	390	3,635	41,049	16,006	0	0	4,257	20,263	20,786	-31,227	33,157
2025	10,353	238	11,645	10,982	218	390	3,635	37,462	15,529	0	0	4,678	20,207	17,255	-13,972	29,149
2026	6,846	238	12,306	257	62	390	3,635	23,735	19,723	0	0	5,032	24,756	-1,021	-14,993	15,068
2027	23,111	238	12,338	37,915	297	390	3,007	77,296	23,456	0	0	5,303	28,759	48,537	33,544	68,987
2028	7,084	238	9,354	2,421	68	390	2,628	22,184	27,352	0	0	5,894	33,245	-11,061	22,483	13,662
2029	8,107	238	8,920	331	82	390	1,909	19,977	25,054	0	0	5,770	30,824	-10,847	11,636	12,298
2030	4,482	238	10,556	189	48	390	3,385	19,289	24,554	0	0	5,563	30,117	-10,829	807	10,341
2031	7,534	238	11,286	6,853	185	390	3,385	29,871	17,712	0	0	5,478	23,190	6,681	7,488	21,008
2032	8,581	238	10,070	601	102	390	1,909	21,891	18,711	0	0	5,525	24,236	-2,345	5,143	14,457
2033	5,419	238	9,463	159	81	390	3,007	18,758	20,691	0	0	5,484	26,176	-7,418	-2,275	10,266
2034	4,301	238	9,950	3,827	51	390	2,628	21,385	22,430	0	0	5,277	27,707	-6,321	-8,596	13,480
2035	5,328	238	15,933	1,695	92	390	1,909	25,585	18,711	0	0	5,313	24,024	1,561	-7,035	18,363
2036	20,789	238	16,846	48,610	396	390	3,007	90,276	19,236	0	6	5,746	24,988	65,288	58,253	81,517
2037	7,754	238	15,050	5,529	177	390	2,878	32,016	26,852	0	203	6,607	33,663	-1,647	56,606	22,327
2038	18,439	238	12,531	27,549	291	390	3,257	62,696	28,085	0	808	6,710	35,604	27,092	83,697	51,920
2039	4,422	238	9,230	533	52	390	2,878	17,744	31,213	0	1,099	6,881	39,193	-21,448	62,249	6,886
2040	9,364	238	14,112	9,577	160	390	3,635	37,476	23,056	0	1,005	6,744	30,805	6,671	68,920	26,092
2041	18,122	238	13,193	41,552	401	390	3,257	77,152	24,590	0	1,506	7,015	33,111	44,041	112,961	65,375
2042	6,128	238	8,781	10,145	84	390	2,878	28,644	23,804	0	2,329	7,699	33,832	-5,188	107,773	15,737
2043	7,735	238	9,821	1,179	101	390	3,635	23,099	21,721	0	1,720	7,762	31,203	-8,103	99,670	9,983
2044	7,842	238	9,557	8,925	160	390	3,635	30,747	22,557	0	1,797	7,587	31,941	-1,193	98,477	17,728
2045	4,777	238	9,294	179	61	390	3,385	18,324	18,211	0	1,777	7,521	27,509	-9,185	89,292	5,642
2046	6,099	238	9,503	2,508	110	390	3,385	22,233	17,712	0	1,910	7,402	27,024	-4,791	84,501	9,536
2047	5,121	238	8,000	527	98	390	3,385	17,758	17,712	0	1,979	7,254	26,945	-9,187	75,314	5,140
2048	3,288	238	8,868	136	73	390	1,531	14,524	18,643	0	1,899	7,063	27,604	-13,081	62,233	4,031
2049	5,376	238	11,336	5,002	146	390	2,628	25,116	19,985	0	1,330	6,793	28,107	-2,991	59,242	14,365
2050	9,323	238	15,286	17,949	218	390	3,385	46,789	15,543	0	1,878	6,932	24,353	22,435	81,677	34,593
2051	21,647	238	13,052	45,012	402	390	1,531	82,271	17,980	0	3,251	7,652	28,884	53,388	135,065	69,837
2052	5,791	238	10,644	252	87	390	2,878	20,280	28,716	0	3,263	8,088	40,066	-19,786	115,279	6,052
2053	13,512	238	11,542	31,817	311	390	3,257	61,067	27,586	0	3,212	7,908	38,706	22,361	137,640	46,691
2054	8,386	238	10,704	5,228	137	390	2,878	27,962	28,216	0	3,168	8,073	39,457	-11,495	126,145	13,843

Table 6b
Water Budget for the Six Basins

CWM-2 from 2018 to 2075

Fiscal Year	Recharge								Discharge					Change in Storage		Annual Developed Yield
	Subsurface Boundary Inflow from the San Gabriel Mountains	Subsurface Boundary Inflow from the San Jose Hills	Deep Infiltration of Precipitation and Applied Water	Stormwater Infiltration at Spreading Grounds	Streambed Infiltration in Unlined Channels	Returns from Septic Systems	Imported Water Spreading	Total Inflow	Groundwater Production	ET	Rising Groundwater Outflow to Storm Drains	Subsurface Outflow to Chino Basin	Total Outflow	Annual	Cumulative	
2055	7,421	238	13,566	2,743	206	390	3,635	28,199	21,059	0	3,371	7,969	32,399	-4,199	121,946	13,225
2056	13,946	238	10,659	25,036	383	390	3,257	53,909	23,092	0	3,621	7,931	34,645	19,265	141,210	39,100
2057	3,786	238	7,615	3,082	63	390	2,878	18,052	22,724	0	3,598	8,159	34,480	-16,429	124,782	3,417
2058	6,250	238	9,129	270	122	390	3,257	19,656	23,408	0	3,342	7,866	34,616	-14,960	109,822	5,192
2059	4,622	238	7,384	399	144	390	2,500	15,676	24,390	0	2,513	7,391	34,294	-18,617	91,205	3,273
2060	2,398	238	8,013	35	34	390	2,250	13,359	22,011	0	1,830	7,021	30,863	-17,504	73,700	2,257
2061	4,021	238	9,217	380	129	390	2,250	16,624	21,442	0	1,343	6,723	29,508	-12,884	60,817	6,308
2062	3,147	238	12,644	534	75	390	2,628	19,657	19,461	0	1,153	6,522	27,135	-7,478	53,338	9,354
2063	15,170	238	13,164	48,303	318	390	3,007	80,590	17,179	0	1,852	6,876	25,907	54,684	108,022	68,856
2064	5,269	238	7,181	9,658	123	390	2,878	25,738	24,601	0	2,136	7,461	34,198	-8,460	99,562	13,262
2065	2,707	238	7,354	16	27	390	3,257	13,989	27,039	0	1,956	7,179	36,174	-22,185	77,377	1,597
2066	5,151	238	8,908	2,499	150	390	2,878	20,214	28,269	0	1,390	6,619	36,278	-16,063	61,314	9,327
2067	3,829	238	9,381	201	97	390	3,007	17,143	19,121	0	1,382	6,388	26,891	-9,748	51,566	6,367
2068	7,714	238	11,144	7,134	176	390	1,152	27,948	20,005	0	905	6,222	27,133	815	52,381	19,668
2069	9,305	238	9,554	21,058	193	390	3,385	44,123	16,477	0	1,187	6,408	24,073	20,050	72,431	33,142
2070	4,850	238	6,606	92	72	390	3,007	15,255	20,597	0	1,295	6,662	28,554	-13,299	59,132	4,291
2071	4,712	238	6,120	31	48	390	774	12,313	24,975	0	600	6,231	31,805	-19,492	39,640	4,708
2072	567	238	6,734	2	0	390	2,250	10,181	24,272	0	243	5,764	30,279	-20,098	19,542	1,924
2073	1,620	238	7,047	4	0	390	2,250	11,549	21,071	0	26	5,393	26,489	-14,940	4,602	3,880
2074	1,953	238	8,825	17	0	390	774	12,197	20,941	0	0	5,091	26,032	-13,835	-9,233	6,332
2075	5,877	238	10,689	3,441	75	390	2,628	23,340	21,334	0	0	4,858	26,193	-2,853	-12,086	15,853
Total	420,353	13,816	591,274	478,381	7,789	22,620	158,438	1,692,670	1,266,885	0	68,185	369,686	1,704,756	-12,086		1,096,361
Average	7,247	238	10,194	8,248	134	390	2,732	29,184	21,843	0	1,176	6,374	29,392	-208		18,903
Median	5,834	238	9,556	2,058	100	390	2,878	22,037	21,581	0	1,126	6,613	28,330	-7,448		12,761
Maximum	23,111	238	16,846	48,610	402	390	3,635	90,276	31,213	0	3,621	8,159	40,066	65,288		81,517
Minimum	567	238	5,804	2	0	390	774	10,181	15,529	0	0	4,174	20,207	-22,185		1,597

Table 6c
Water Budget for the Six Basins

CWM3 from 2018 to 2075

Fiscal Year	Recharge								Discharge					Change in Storage		Annual Developed Yield
	Subsurface Boundary Inflow from the San Gabriel Mountains	Subsurface Boundary Inflow from the San Jose Hills	Deep Infiltration of Precipitation and Applied Water	Stormwater Infiltration at Spreading Grounds	Streambed Infiltration in Unlined Channels	Returns from Septic Systems	Imported Water Spreading	Total Inflow	Groundwater Production	ET	Rising Groundwater Outflow to Storm Drains	Subsurface Outflow to Chino Basin	Total Outflow	Annual	Cumulative	
2018	3,771	238	5,804	1,557	48	390	1,024	12,832	20,643	0	216	5,232	26,092	-13,260	-13,260	6,360
2019	1,387	238	7,930	1,510	32	390	2,500	13,987	24,261	0	8	4,805	29,073	-15,086	-28,346	6,675
2020	6,671	238	8,831	13,050	179	390	2,628	31,988	17,836	0	0	4,523	22,358	9,630	-18,716	24,837
2021	3,020	238	7,728	1,583	43	390	3,007	16,009	18,426	0	0	4,693	23,119	-7,110	-25,826	8,309
2022	2,624	238	8,797	1,596	63	390	774	14,482	24,899	0	0	4,428	29,328	-14,846	-40,672	9,280
2023	2,879	238	9,861	1,744	84	390	2,628	17,825	23,376	0	0	4,128	27,503	-9,679	-50,351	11,068
2024	10,626	238	12,216	15,259	155	390	3,635	42,519	17,361	0	0	4,207	21,568	20,951	-29,400	34,677
2025	10,353	238	11,645	12,452	218	390	3,635	38,932	16,954	0	0	4,627	21,582	17,350	-12,050	30,669
2026	6,846	238	12,306	1,727	62	390	3,635	25,205	21,183	0	0	4,984	26,167	-962	-13,012	16,586
2027	23,111	238	12,338	39,385	297	390	3,007	78,766	24,916	0	0	5,258	30,174	48,592	35,580	70,502
2028	7,084	238	9,354	3,891	68	390	2,628	23,654	28,812	0	0	5,849	34,660	-11,006	24,574	15,177
2029	8,107	238	8,920	1,801	82	390	1,909	21,447	26,514	0	0	5,726	32,240	-10,793	13,781	13,812
2030	4,482	238	10,556	1,659	48	390	3,385	20,759	26,014	0	0	5,520	31,534	-10,775	3,005	11,854
2031	7,534	238	11,286	8,323	185	390	3,385	31,341	19,172	0	0	5,435	24,607	6,735	9,740	22,522
2032	8,581	238	10,070	2,071	102	390	1,909	23,361	20,171	0	0	5,482	25,653	-2,292	7,449	15,970
2033	5,419	238	9,463	1,629	81	390	3,007	20,227	22,306	0	0	5,442	27,748	-7,521	-72	11,779
2034	4,301	238	9,950	5,297	51	390	2,628	22,855	23,890	0	0	5,229	29,119	-6,263	-6,335	14,999
2035	5,328	238	15,933	3,165	92	390	1,909	27,055	20,171	0	0	5,263	25,434	1,621	-4,714	19,883
2036	20,789	238	16,846	50,080	396	390	3,007	91,746	20,634	0	27	5,697	26,358	65,388	60,674	83,015
2037	7,754	238	15,050	6,999	177	390	2,878	33,486	28,312	0	322	6,560	35,194	-1,708	58,966	23,726
2038	18,439	238	12,531	29,019	291	390	3,257	64,166	29,545	0	909	6,669	37,123	27,043	86,009	53,331
2039	4,422	238	9,230	2,003	52	390	2,878	19,214	32,764	0	1,177	6,843	40,784	-21,569	64,439	8,316
2040	9,364	238	14,112	11,047	160	390	3,635	38,946	24,516	0	1,072	6,709	32,297	6,649	71,088	27,530
2041	18,122	238	13,193	43,022	401	390	3,257	78,622	26,050	0	1,593	6,982	34,625	43,997	115,085	66,790
2042	6,128	238	8,781	11,615	84	390	2,878	30,114	25,264	0	2,525	7,663	35,452	-5,338	109,747	17,047
2043	7,735	238	9,821	2,649	101	390	3,635	24,569	23,181	0	1,785	7,726	32,692	-8,123	101,624	11,423
2044	7,842	238	9,557	10,395	160	390	3,635	32,217	24,017	0	1,841	7,553	33,411	-1,194	100,430	19,188
2045	4,777	238	9,294	1,649	61	390	3,385	19,794	19,671	0	1,792	7,487	28,951	-9,157	91,273	7,129
2046	6,099	238	9,503	3,978	110	390	3,385	23,703	19,172	0	1,740	7,375	28,288	-4,584	86,689	11,202
2047	5,121	238	8,000	1,996	98	390	3,385	19,228	19,172	0	1,792	7,236	28,200	-8,972	77,717	6,815
2048	3,288	238	8,868	1,606	73	390	1,531	15,994	20,102	0	1,753	7,049	28,905	-12,911	64,806	5,661
2049	5,376	238	11,336	6,472	146	390	2,628	26,586	21,445	0	1,349	6,769	29,563	-2,977	61,829	15,839
2050	9,323	238	15,286	19,419	218	390	3,385	48,259	16,880	0	1,787	6,908	25,575	22,683	84,512	36,178
2051	21,647	238	13,052	46,481	402	390	1,531	83,741	19,405	0	3,199	7,634	30,238	53,503	138,016	71,378
2052	5,791	238	10,644	1,722	87	390	2,878	21,750	30,176	0	3,192	8,072	41,440	-19,690	118,326	7,608
2053	13,512	238	11,542	33,287	311	390	3,257	62,537	29,046	0	3,154	7,898	40,099	22,438	140,764	48,228
2054	8,386	238	10,704	6,698	137	390	2,878	29,432	29,677	0	3,105	8,064	40,846	-11,414	129,350	15,384

Table 6c
Water Budget for the Six Basins

CWM3 from 2018 to 2075

Fiscal Year	Recharge								Discharge					Change in Storage		Annual Developed Yield
	Subsurface Boundary Inflow from the San Gabriel Mountains	Subsurface Boundary Inflow from the San Jose Hills	Deep Infiltration of Precipitation and Applied Water	Stormwater Infiltration at Spreading Grounds	Streambed Infiltration in Unlined Channels	Returns from Septic Systems	Imported Water Spreading	Total Inflow	Groundwater Production	ET	Rising Groundwater Outflow to Storm Drains	Subsurface Outflow to Chino Basin	Total Outflow	Annual	Cumulative	
2055	7,421	238	13,566	4,213	206	390	3,635	29,669	22,519	0	3,274	7,964	33,757	-4,088	125,262	14,796
2056	13,946	238	10,659	26,506	383	390	3,257	55,379	24,552	0	3,550	7,930	36,032	19,348	144,610	40,642
2057	3,786	238	7,615	4,552	63	390	2,878	19,522	24,184	0	3,547	8,158	35,888	-16,366	128,244	4,939
2058	6,250	238	9,129	1,740	122	390	3,257	21,126	24,868	0	3,274	7,867	36,010	-14,884	113,360	6,728
2059	4,622	238	7,384	1,868	144	390	2,500	17,146	25,850	0	2,608	7,385	35,843	-18,696	94,664	4,653
2060	2,398	238	8,013	1,505	34	390	2,250	14,829	23,471	0	1,955	6,998	32,424	-17,596	77,068	3,626
2061	4,021	238	9,217	1,850	129	390	2,250	18,094	22,902	0	1,464	6,691	31,057	-12,963	64,105	7,688
2062	3,147	238	12,644	2,004	75	390	2,628	21,127	20,921	0	1,262	6,485	28,668	-7,541	56,564	10,751
2063	15,170	238	13,164	49,773	318	390	3,007	82,060	18,483	0	1,829	6,844	27,157	54,904	111,468	70,381
2064	5,269	238	7,181	11,128	123	390	2,878	27,208	26,060	0	2,080	7,437	35,577	-8,369	103,098	14,813
2065	2,707	238	7,354	1,486	27	390	3,257	15,459	28,499	0	1,907	7,164	37,569	-22,110	80,988	3,132
2066	5,151	238	8,908	3,969	150	390	2,878	21,684	29,729	0	1,465	6,612	37,807	-16,123	64,865	10,728
2067	3,829	238	9,381	1,671	97	390	3,007	18,613	20,581	0	1,360	6,383	28,325	-9,712	55,154	7,863
2068	7,714	238	11,144	8,604	176	390	1,152	29,418	21,465	0	971	6,207	28,644	774	55,927	21,086
2069	9,305	238	9,554	22,528	193	390	3,385	45,593	17,846	0	1,163	6,391	25,400	20,192	76,120	34,653
2070	4,850	238	6,606	1,562	72	390	3,007	16,725	22,057	0	1,242	6,649	29,948	-13,223	62,896	5,827
2071	4,712	238	6,120	1,501	48	390	774	13,783	26,435	0	672	6,216	33,324	-19,540	43,356	6,120
2072	567	238	6,734	1,472	0	390	2,250	11,651	25,732	0	287	5,739	31,759	-20,108	23,248	3,375
2073	1,620	238	7,047	1,474	0	390	2,250	13,019	22,531	0	55	5,361	27,946	-14,927	8,321	5,353
2074	1,953	238	8,825	1,487	0	390	774	13,667	22,401	0	0	5,060	27,461	-13,794	-5,474	7,833
2075	5,877	238	10,689	4,911	75	390	2,628	24,810	22,794	0	0	4,827	27,622	-2,812	-8,286	17,354
Total	420,353	13,816	591,274	563,638	7,789	22,620	158,438	1,777,928	1,349,813	0	68,304	368,097	1,786,214	-8,286		1,183,089
Average	7,247	238	10,194	9,718	134	390	2,732	30,654	23,273	0	1,178	6,346	30,797	-143		20,398
Median	5,834	238	9,556	3,528	100	390	2,878	23,507	23,041	0	1,170	6,586	29,755	-7,531		14,304
Maximum	23,111	238	16,846	50,080	402	390	3,635	91,746	32,764	0	3,550	8,158	41,440	65,388		83,015
Minimum	567	238	5,804	1,472	0	390	774	11,651	16,880	0	0	4,128	21,568	-22,110		3,132

TECHNICAL MEMORANDUM

November 6, 2020

To: Six Basins Watermaster

From: Carolina Sanchez and Andy Malone, WEI

Re: Six Basins Groundwater Flow Model Recalibration

Background and Objectives

At the July 26, 2017 Board meeting, the Six Basins Watermaster Board received and filed the final Planning Proposal for Strategic Plan Implementation (Planning Proposal). The Planning Proposal describes the next steps for Watermaster and the individual project proponents to implement the Strategic Plan as a programmatic water-resources management plan for the Six Basins. A recommendation from the Planning Proposal was to prepare a Programmatic Impact Report (PEIR) for the Six Basins Strategic Plan. To support the PEIR, Watermaster elected to recalibrate the Six Basin groundwater model so that it could be used to evaluate the hydrologic impacts to the Six Basins with and without the implementation of the Strategic Plan.

This technical memorandum (TM) describes the model recalibration. Specifically, it describes updates to the *Development and Use of a Numerical Groundwater- Flow Model of the Six Basins*[1] report completed in 2015 (Numerical Model Report). Below are the sections of the Numerical Model Report that were updated.

- Section 2.3.3 – Internal Barriers to Groundwater Flow
- Section 3 – Water Budget
- Section 5.3 – Initial Aquifer Properties and Parameter Zonation
- Section 5.6 – Model Calibration

Internal Barriers to Groundwater Flow (Section 2.3.3)

The Six Basins Strategic Plan Report[2] identified internal barriers to the Six Basins groundwater basin, including:

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[1] WEI, 2017. *Strategic Plan for the Six Basins*. November 2017.

[2] WEI, 2015. *Development and Use of a Numerical Groundwater- Flow Model of the Six Basins*. December 2015.

- The Indian Hill Fault, which separates the northern forebay areas of the Six Basins from the southern areas of groundwater discharge.
- The Intermediate Fault in the Pomona Basin which parallels the San Jose Fault
- Other faults mapped in the Six Basins in the past and that have been used to delineate the sub-basins as defined in the Judgment, including the Cucamonga Fault, the Claremont Heights Barrier, the Thompson Wash Barrier, and the San Antonio Fault.

In 2017, WEI identified two additional internal barriers in the Six Basins:

- **Pomona Barrier**. Figure 1 shows the location of the Pomona Barrier as an inferred geologic fault trace in the southern portion of the Pomona Basin that parallels the trend of the San Jose Hills. The location and existence of the Pomona Barrier is evidenced by (i) differential vertical ground motion as measured by Interferometric Synthetic Aperture Radar (InSAR) and (ii) groundwater-level data collected at wells.

  The InSAR estimates of vertical ground motion on Figure 1 show a relatively steep gradient of downward ground motion between City of Pomona wells P-32B/P-33 and P-01A/P-07. The gradient slopes to the west with maximum downward ground motion focused in the vicinity of wells P-32B and P-33. Steep gradients of vertical ground motion in groundwater basins can be indicators of the existence of internal barriers to groundwater flow. This is because pumping on one side of the barrier can focus head declines, aquifer-system compression, and downward ground motion in the vicinity of the pumping wells. This is the likely case here, where Figure 1 shows that wells P-32B and P-33 experience a higher magnitude of drawdown due to pumping compared to wells P-01A and P-07.

  Further evidence for the existence of the Pomona Barrier can be seen in the groundwater-level data on Figure 1. The wells shown on this chart have wells screens depth intervals of approximately 300-1,000 ft-bgs.[3] Without the Pomona Barrier, one would expect drawdown and recovery cycles at these nearby wells to mimic each other closely. This is not the case. Figure 1 shows that shows that wells P-32B and P-33 experience drawdown and recovery at different times compared to wells P-01A and P-07. This is likely due to the Pomona Barrier that hydraulically isolates wells P-32B and P-33 from P-01A and P-07.

- **Claremont Barrier**. Figure 2 shows the location of the Claremont Barrier as an inferred, east/west-trending, geologic fault trace in the Upper Claremont Heights Basin. The location and existence of the Claremont Barrier is evidenced by groundwater-elevation data collected at wells on either side of the barrier.

  Figure 2 indicates that groundwater flows southward from the higher groundwater elevations at well MW-1 (an area of groundwater recharge within the San Antonio Spreading Grounds) toward lower groundwater elevations at wells Pomello-1 and Pomello-4. The Pomello wells are located about 4,000 feet southwest of MW-1 and have

[3] Depth of well screens for P-33 is unknown.

groundwater elevations about 115 feet lower. However, groundwater elevations at well Alamosa-2, located only about 400 feet south of Pomello-4, are up to 100 feet lower than groundwater elevations at the Pomello wells. This abrupt offset of groundwater elevations across a relatively short horizontal distance indicates the existence of a hydraulic barrier to the southward flow of groundwater.

The time-series of groundwater elevations on Figure 1 also show the transient effects of a recharge event at the San Antonio Spreading Grounds during the spring of 2017. Groundwater levels increase first at MW-1 due to the recharge of surface water runoff at the spreading grounds. About 30 days later, groundwater levels begin to increase due to the recharge event at the Pomello wells. However, groundwater levels do not increase at Alamosa-2 until another 30 to 60 days later, and the increase in groundwater levels occurs more gradually over time. These observations indicate the existence of a partial barrier to groundwater flow between the Pomello wells and Alamosa-2 that is delaying the influence of the recharge event on groundwater levels at Alamosa-2.

Water Budget (Section 3)

The water budget is an accounting of recharge to and discharge from the groundwater system and the resultant changes of groundwater in storage. This section discusses the water budget of the Six Basins for the calibration period (fiscal year 1977/78 through 2016/17). It was derived from measured and estimated values and is shown in Table 3-1. The initial water budget was used in the model-calibration process: components of recharge and estimates of groundwater production were used as boundary conditions during model calibration. Model calibration generated the final estimates of the aquifer and fault properties for the groundwater-flow model.

The model used to estimate the components of the water budget remain the same as those described in Section 3.1 of the Numerical Model Report. Changes to the water budget terms are describe below.

Recharge Components (Section 3.2)

Stormwater infiltration at the spreading grounds was the only recharge term that changed compared to what is described in Section 3.2 of the Numerical Model Report.

Stormwater infiltration at spreading grounds. The spreading of stormwater runoff is performed by various parties at the San Antonio Spreading Grounds (SASG), Thompson Creek Spreading Grounds (TCSG), Live Oak Spreading Grounds (LOSG), and Pedley Spreading Grounds (PSG). The spreading of stormwater runoff during the calibration period was estimated based on historical records provided by the PVPA (at the SASG, TCSG, and PSG), the City of Pomona (at the PSG and SASG), SAWCO (at the SASG), and the Los Angeles County Flood Control District (at the LOSG).

In a preliminary run during calibration, it was concluded that although the preliminary calibration statistics suggested that the model is well calibrated, the model was incapable of matching the measured groundwater-level peaks at wells in the Upper Claremont Heights Basin (UCHB) during very wet years. The ability of the model to simulate high-groundwater conditions in the UCHB is important because the model will be used to analyze different management strategies to avoid high-groundwater conditions in the Six Basins. To improve the model, the subsequent work consisted of conducting a sensitivity model run to analyze how the spatial distribution of recharge at the SASG could improve the model calibration, and specifically the model estimates of groundwater-levels in the UCHB during wet years.

WEI performed three runs with different estimates for the spatial distribution of recharge at the SASG. After performing this work, and carefully reviewing all available historical information, WEI concluded that the PVPA's SASG recharge estimates for very wet years are generally too low, especially in the southern portion of the SASG. For example, WEI reviewed the recharge data for WY 2011 – a year of very poor matches between model-simulated and measured groundwater levels – and concluded that the recharge estimates provided by PVPA appeared to be too low. Upon further analysis and review of aerial imagery from March 2011, WEI noticed that the Lower San Bernardino turnout off the San Antonio Creek channel was open, and because this turnout is not metered, any diversions were not accounted for in PVPA's recharge estimates. Because the recharge at the SASG is a significant boundary condition for the model (about 25 percent of the total average recharge to the Six Basins), inaccurate historical recharge data at the SASG can inhibit model calibration, and hence, the ability of the model to simulate future groundwater conditions with confidence. Thus, the historical records of recharge at the SASG provided by the PVPA were adjusted based on estimate San Antonio dam outflow data from the United States Army Corps of Engineers.

Initial Aquifer Properties and Parameter Zonation (Section 5.3)

Parameter zones were delineated in each model layer to speed the calibration process. Figure 5-2 shows the parameter zones for Layers 1, 2, and 3. Note that a new layer was added to better represent the new barriers added to the model (see updates to Section 2.3.3). The parameter zones were delineated based on hydrogeology and the locations of calibration wells. Each parameter zone was assigned an initial zone coefficient based on past modeling efforts, pumping-test results, and professional judgment. Table 5-1 provided the parameter-zone coefficients.

Boundary Conditions (Section 5.5)

Boundary conditions are necessary in solving numerical groundwater-flow problems. Ideally, in groundwater investigations, the study area is bounded by identifiable hydrogeologic features that can be quantified relative to the groundwater system. These boundaries can also occur within the active model domain (e.g. a stream). Figure 5-4 shows the locations and types of boundary conditions incorporated into the Six Basins Model.

Model Calibration (Section 5.6)

Selection of Calibration Data (Section 5.6.3)

The transient calibration period is July 1, 1977 through June 30, 2017. This period was primarily chosen based on the availability of groundwater-elevation and groundwater-production records.

The model was calibrated by comparing observed and model-simulated groundwater elevations at wells. Groundwater-elevation measurements were selected based on the following criteria:

- Measurement locations with time-series data should have sufficient parameter sensitivities.
- Calibration wells should be geographically distributed across the domain.
- Calibration wells should be distributed vertically in model layers, if possible.
- Measurements should be evenly distributed over time, if possible.

For this model, over 5,100 groundwater-elevation measurements from 33 wells were used in calibration. Table 5-4 lists the calibration wells and describes their attributes. Figure 5-5 shows the calibration well locations.

Model Calibration (Section 5.6.4)

The final calibration-based estimates for the aquifer parameters are listed in Table 5-5 for the parameter-zone coefficients, in Table 5-6 for the aquifer properties, and in Table 5-7 for the fault properties.

Table 3-1 shows the calibrated water budget for the Six Basins, which is an accounting of recharge to and discharge from the groundwater system and the resultant changes of groundwater in storage over the calibration period. This table also shows the annual "Developed Yield" of the Six Basins. Developed Yield is equal to groundwater production plus the change in groundwater storage minus the recharge of imported water. Developed Yield is an estimate of net inflow to a basin. Over a representative hydrologic period and under similar conditions of overlying land and water uses, Developed Yield is an estimate of the sustainable yield from a groundwater basin. The average Developed Yield over the calibration period was about equal to what was actually pumped from the Six Basins, suggesting that current production rates are sustainable within the Six Basins.

Evaluation of Model Calibration Performance at Wells (Section 5.6.5)

The evaluation of model calibration is described below by qualitative and quantitative measures:

General Qualitative Observations of Model Calibration. In model calibration, groundwater elevations were set only for the initial condition (July 1977 conditions), and the boundary inflows were not adjusted. Figure 5-6 is a scatter plot that shows simulated versus observed groundwater elevations for all calibration wells. The points are distributed along the diagonal "best fit" line, which indicates that the calibrated model generally duplicated the observed groundwater elevations across the Six Basins.

Figure 5-7a, 5-7b, and 5-7c show observed versus simulated groundwater elevations at various times during the calibration period—fall 2011, fall 1999, and fall 1983, respectively. On each map, the general shape of observed and simulated groundwater-elevation contours and associated hydraulic gradients are similar, indicating that the model was able to duplicate the groundwater-flow systems of the Six Basins over the calibration period.

Both observations demonstrate a qualitative validation of model calibration and indicate good inverse modeling performance.

Quantitative Measures of Model Calibration. The three statistics methods used to determine if the calibration was "good" in the 2015 Numerical Model Report were also used for this calibration: the coefficient of determination (R2), the Nash-Sutcliffe efficiency (NSE) index normalized, and the root-mean-square error (NRMSE). The table below compared the 2015 and 2020 calibration statistics.

Model Calibration Evaluation

Statistical Method	2015 Results	2020 Results
R^2	95%	96%
NSE	0.95	0.96
NRMSE	4.4%	3.6%

Spatial Evaluation of Model Calibration. Appendix C contains the individual time-history charts of observed versus simulated groundwater elevations for the 33 calibration wells during the calibration period. Figures 5-8a, 5-8b, and 5-8c are scatter plots that show observed versus simulated groundwater elevations for all calibration wells in various areas of the Six Basins. These scatter plots indicate that the calibrated model contains some areas with systemic error and bias. For example, in Figure 5-8a the calibration wells located in the northern part of the Upper Claremont Heights Basin (SAWC-33 and MW-1) display a vertical trend across the best-fit line. This indicates a systematic error where the model is overly sensitive to aquifer stresses.

The maps of observed versus simulated groundwater elevations at various times during the calibration period (Figures 5-7a, 5-7b, and 5-7c) show that some areas in the model domain have a consistent bias over time, which indicates that the model is estimating consistently higher or lower groundwater elevations compared to observed groundwater elevations. These areas include: south of the Cucamonga Fault near the SASG (where measured levels are consistently lower than simulated levels); and the Live Oak Basin (where measured levels are consistently higher than simulated levels). The biases are typically located in areas near fault barriers.

Residual Analysis (Section 5.6.6)

Figure 5-9 shows the frequency residual distribution in the model domain, and the following table shows the groundwater-elevation residual statistics.

Residual Statistics

Statistic	2015 Value	2020 Value
Mean	-6.63	-2.17
Standard Error	1.00	0.75
Median	0.68	3.67
Standard Deviation	57.70	53.82
Sample Variance	3,329.82	2,896.82
Kurtosis	1.27	1.34
Skewness	-0.74	-0.26
Range	478.91	514.24
Minimum	-264.77	-259.44
Maximum	214.14	254.80

The mean of the residuals is around -2.17, which is close to zero, with a standard deviation of about 54 feet. The value of skewness is -0.26 indicating that the residual distribution is nearly symmetrically distributed. The Kurtosis is 1.34, indicating that the residual distribution is normally distributed.

The residual distribution shown in Figure 5-9 is statistically random with normal distribution and shows little geographical trend.

Figure 5-10 shows each calibration well and its mean residual. As the figure shows, the greatest mean residuals occur in the Two Basins and near faults, suggesting that these areas of the basin require additional field information and understanding to improve model calibration in the future.

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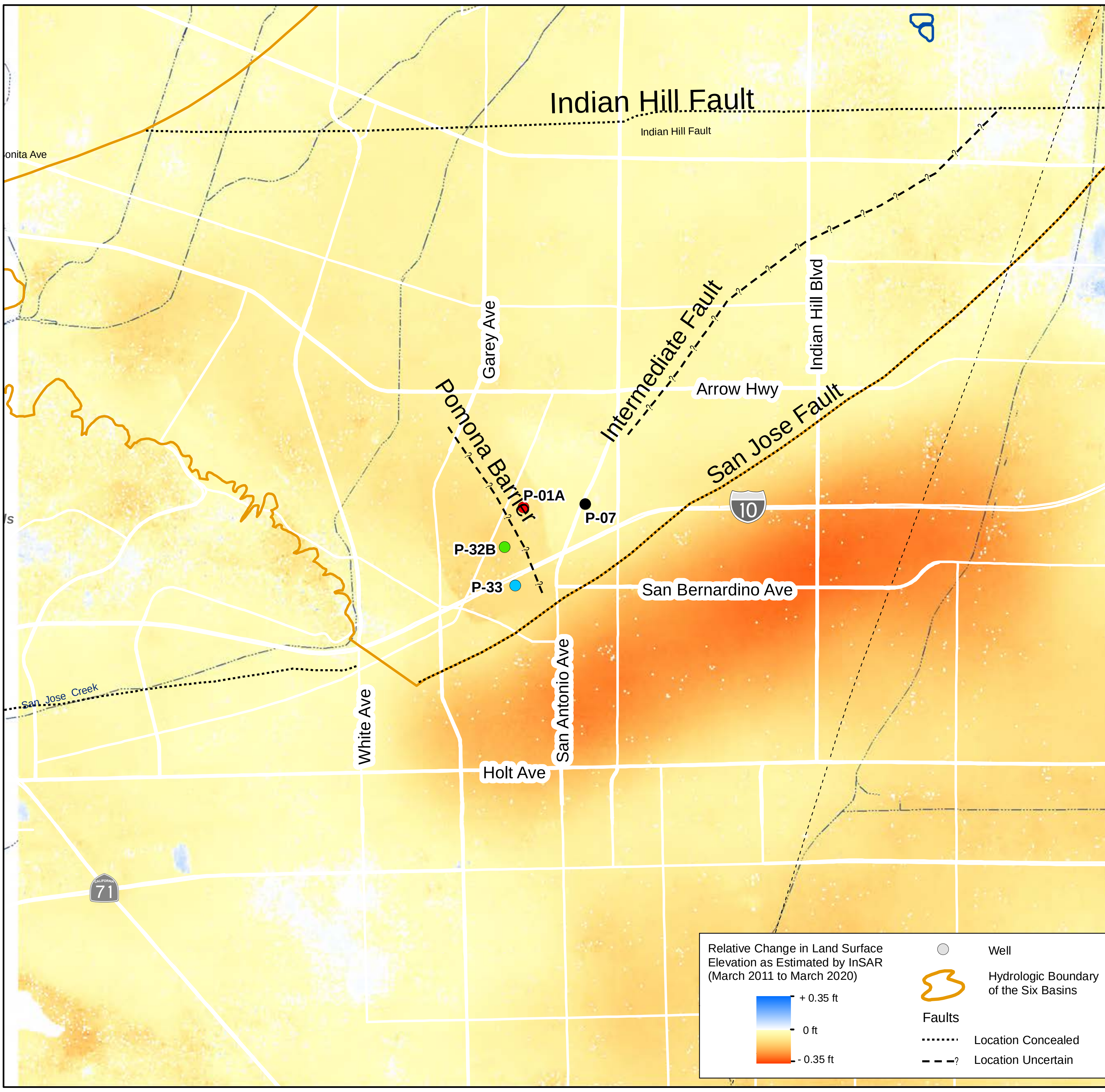
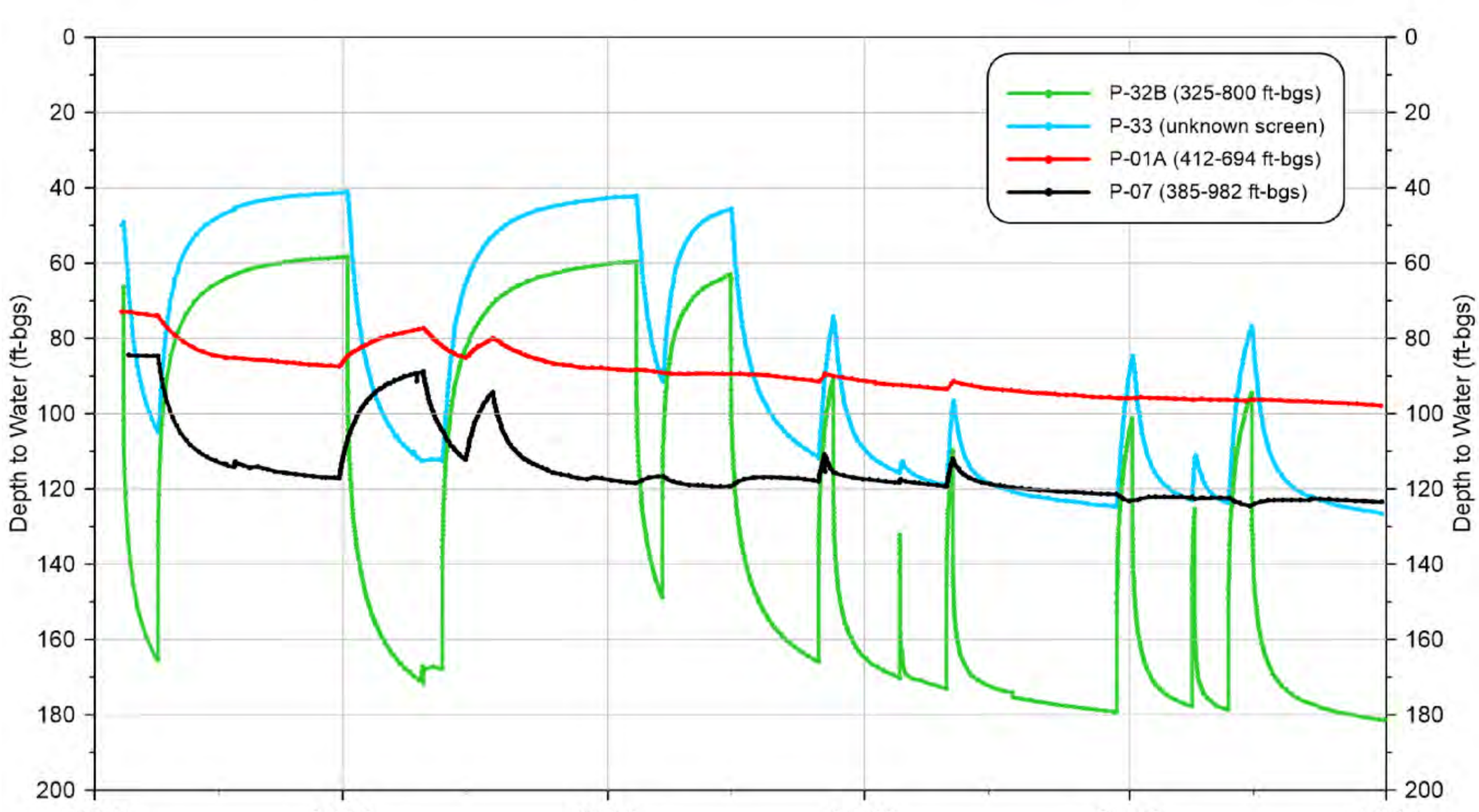


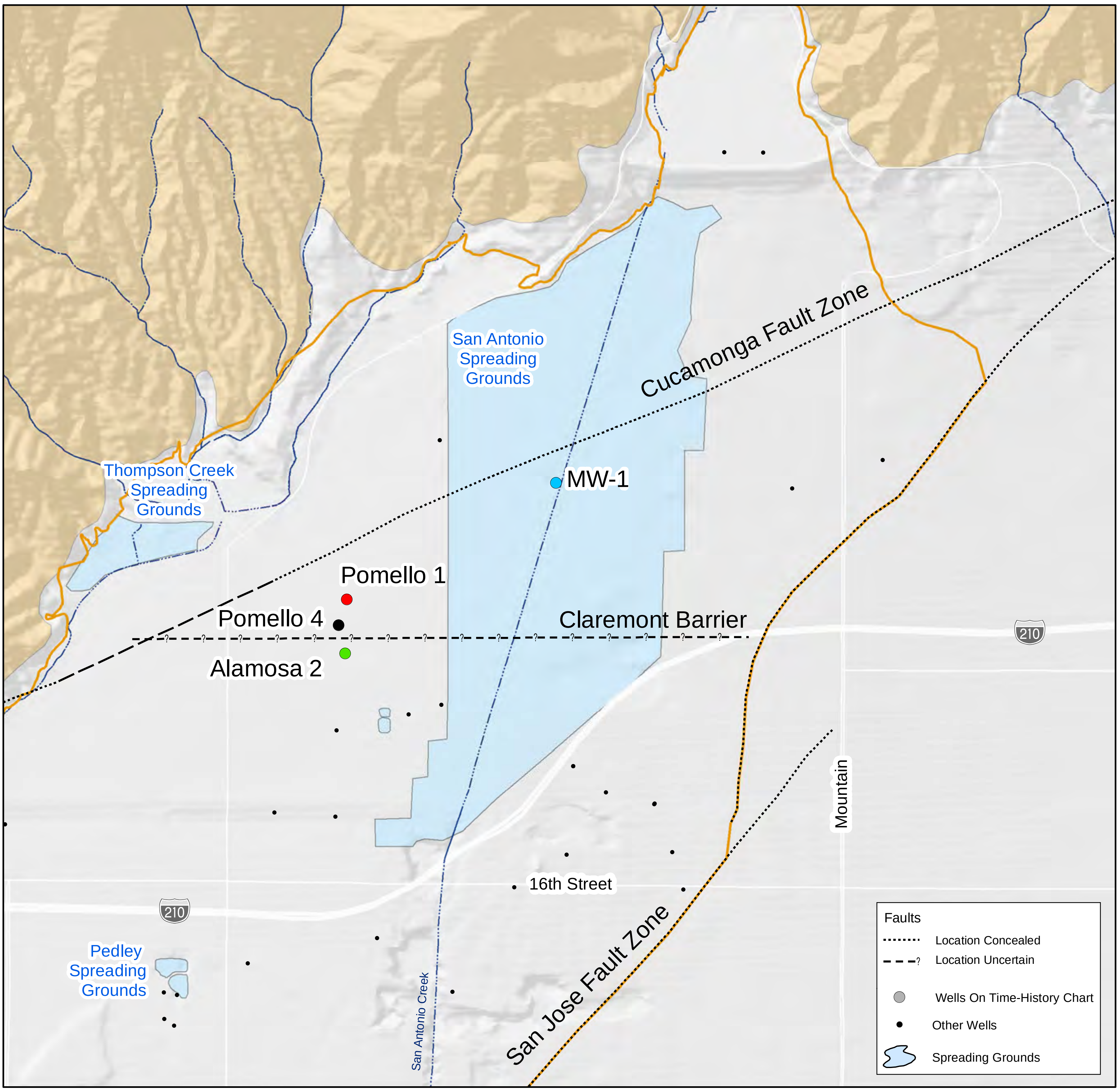


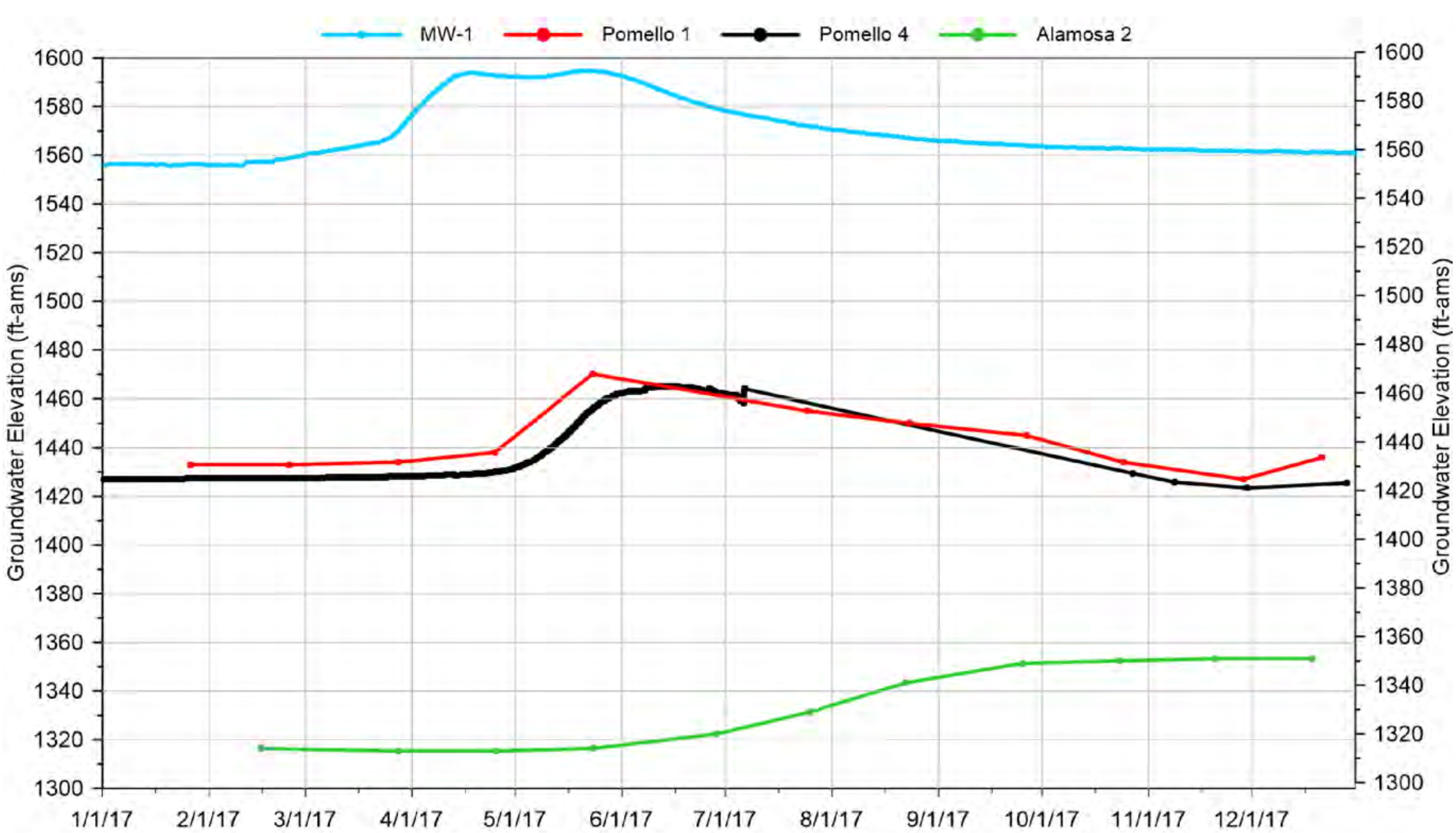
Prepared by:
WEI
Wildermuth Environmental, Inc.

Six Basins Watermaster
Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Evidence for the Existence of the Pomona Barrier

Figure 1





Prepared by: WEI

Six Basins Watermaster
Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Evidence for the Existence of the Claremont Barrier

Figure 2

Table 3-1
Water Budget for the Six Basins
Calibration 1978 - 2017

Fiscal Year	Recharge									Discharge				Change in Storage		Annual Developed Yield
	Subsurface Boundary Inflow from the San Gabriel Mountains	Subsurface Boundary Inflow from the San Jose Hills	Deep Infiltration of Precipitation and Applied Water	Stormwater Infiltration at Spreading Grounds	Streambed Infiltration in Unlined Channels	Returns from Septic Systems	Artificial Recharge of Native Water	Imported Water Spreading	Total Inflow	Groundwater Production	Rising Groundwater Outflow to Storm Drains	Subsurface Outflow to Chino Basin	Total Outflow	Annual Total Inflow minus Total Outflow	Cumulative Total Inflow minus Total Outflow	
1978	9,822	458	17,198	48,537	396	836	0	0	77,247	13,915	1,612	7,056	22,582	54,665	54,665	68,579
1979	14,869	386	17,661	5,288	177	876	0	0	39,256	15,858	6,271	7,657	29,786	9,469	64,134	25,327
1980	12,877	398	15,337	27,417	291	916	0	0	57,236	17,869	7,536	7,687	33,092	24,145	88,279	42,013
1981	11,066	302	12,505	778	52	1,013	0	0	25,716	19,920	7,147	7,831	34,897	-9,181	79,097	10,738
1982	6,026	327	8,985	9,824	160	664	0	0	25,985	17,431	2,805	7,748	27,984	-2,000	77,098	15,431
1983	14,017	398	14,082	42,519	401	399	0	0	71,816	16,971	9,172	8,056	34,199	37,617	114,715	54,588
1984	12,987	340	12,999	10,644	84	394	0	0	37,447	20,930	16,036	8,311	45,277	-7,830	106,885	13,100
1985	6,762	335	8,258	1,650	101	389	0	0	17,496	20,807	4,258	8,119	33,184	-15,689	91,196	5,119
1986	7,664	360	9,265	8,867	160	393	0	0	26,708	19,001	2,030	7,917	28,948	-2,240	88,956	16,761
1987	6,508	299	8,978	273	61	396	0	0	16,514	21,285	1,781	7,687	30,754	-14,240	74,717	7,045
1988	4,828	331	8,702	2,545	110	397	0	0	16,912	18,548	1,483	7,470	27,501	-10,589	64,128	7,960
1989	5,834	309	8,956	452	98	418	0	0	16,068	16,856	1,289	7,444	25,590	-9,522	54,607	7,335
1990	4,125	257	7,447	62	73	413	0	0	12,377	16,833	893	7,174	24,900	-12,523	42,083	4,310
1991	3,821	302	8,330	4,954	146	401	0	0	17,954	15,656	543	6,835	23,034	-5,080	37,004	10,576
1992	7,229	313	10,820	17,288	218	393	0	0	36,261	17,222	437	6,688	24,347	11,914	48,918	29,136
1993	16,370	443	14,753	44,489	402	391	0	0	76,847	18,997	867	6,968	26,832	50,015	98,933	69,012
1994	12,591	294	12,491	507	87	389	0	0	26,359	21,065	1,579	7,278	29,922	-3,564	95,369	17,502
1995	9,758	343	10,071	32,259	311	389	0	0	53,132	21,377	1,536	7,533	30,445	22,687	118,056	44,064
1996	10,581	279	11,001	5,424	137	388	0	0	27,810	24,971	1,800	7,671	34,442	-6,632	111,424	18,339
1997	8,530	359	10,202	3,690	206	385	0	0	23,373	22,779	1,791	7,575	32,144	-8,772	102,653	14,007
1998	10,243	380	13,083	25,335	383	375	0	0	49,800	17,828	1,775	7,545	27,148	22,652	125,305	40,479
1999	7,396	225	10,169	3,266	63	374	626	0	22,120	21,056	1,991	7,567	30,614	-8,494	116,811	11,936
2000	5,591	270	7,098	166	122	372	643	0	14,261	19,361	1,839	7,467	28,666	-14,405	102,406	4,313
2001	5,576	229	8,597	241	144	365	1,003	0	16,154	13,819	1,700	7,095	22,614	-6,460	95,946	6,357
2002	3,982	210	6,855	138	34	375	142	0	11,737	15,047	1,827	6,889	23,763	-12,027	83,920	2,878
2003	2,193	234	7,475	171	129	384	1,573	0	12,157	12,527	1,820	6,866	21,213	-9,056	74,864	1,899
2004	3,893	207	8,660	507	75	394	1,076	0	14,814	13,744	1,856	6,781	22,381	-7,567	67,297	5,101
2005	10,402	338	12,006	47,622	318	402	923	0	72,010	13,729	2,371	7,093	23,193	48,816	116,113	61,623
2006	10,244	249	12,516	9,817	123	402	716	0	34,067	21,532	3,180	7,614	32,325	1,741	117,854	22,557
2007	4,948	208	6,638	137	27	400	4	0	12,360	23,984	2,624	7,403	34,011	-21,651	96,204	2,329
2008	2,967	221	6,812	2,396	150	400	446	1	13,393	18,703	2,120	7,045	27,868	-14,476	81,728	3,781
2009	4,787	213	8,346	447	97	401	480	742	15,513	18,234	1,907	6,703	26,845	-11,332	70,396	5,680
2010	4,816	217	8,819	6,849	176	393	978	1,005	23,253	17,982	1,695	6,530	26,207	-2,954	67,443	13,046
2011	9,017	251	10,543	20,741	193	389	1,292	1,509	43,935	18,609	1,677	6,826	27,111	16,823	84,266	32,631
2012	7,461	230	8,977	318	72	389	1,793	19	19,259	19,011	1,807	6,858	27,675	-8,417	75,849	8,781
2013	3,768	63	6,082	143	48	389	573	3	11,070	17,802	1,655	7,002	26,460	-15,391	60,458	1,835
2014	2,012	40	5,594	146	26	389	276	17	8,501	15,733	1,142	6,787	23,662	-15,162	45,296	278

Table 3-1
Water Budget for the Six Basins
Calibration 1978 - 2017

Fiscal Year	Recharge									Discharge				Change in Storage		Annual Developed Yield
	Subsurface Boundary Inflow from the San Gabriel Mountains	Subsurface Boundary Inflow from the San Jose Hills	Deep Infiltration of Precipitation and Applied Water	Stormwater Infiltration at Spreading Grounds	Streambed Infiltration in Unlined Channels	Returns from Septic Systems	Artificial Recharge of Native Water	Imported Water Spreading	Total Inflow	Groundwater Production	Rising Groundwater Outflow to Storm Drains	Subsurface Outflow to Chino Basin	Total Outflow	Annual	Cumulative	
														Total Inflow minus Total Outflow	Total Inflow minus Total Outflow	
2015	918	32	6,203	153	26	389	525	318	8,563	14,326	719	6,553	21,598	-13,035	32,262	448
2016	1,725	28	6,515	159	26	389	700	60	9,602	12,436	639	6,406	19,482	-9,880	22,381	1,795
2017	3,605	39	8,598	3,589	81	389	2,109	5	18,414	11,400	579	6,233	18,211	203	22,584	9,488
Statistics for the Calibration Period 1978 through 2017																
Total	291,810	10,719	397,626	389,806	5,980	17,995	15,879	3,679	1,133,494	715,153	105,789	289,967	1,110,910	22,584		718,179
Average	7,295	268	9,941	9,745	149	450	397	92	28,337	17,879	2,645	7,249	27,773	565		17,954
Median	6,635	286	8,978	2,906	122	393	0	0	20,689	17,925	1,795	7,226	27,325	-7,699		10,657
Maximum	16,370	458	17,661	48,537	402	1,013	2,109	1,509	77,247	24,971	16,036	8,311	45,277	54,665		69,012
Minimum	918	28	5,594	62	26	365	0	0	8,501	11,400	437	6,233	18,211	-21,651		278

Table 5-1
Model Parameter Zonation

Layer	Aquifer Property Type	Parameter Zone	Composite Parameter Zone	Initial Parameter - Zone Coefficient
1	HK	12	HK1Z12	6.98E-02
		13	HK1Z13	1.24E-01
		14	HK1Z14	2.95E-02
		15	HK1Z15	3.08E-01
		16	HK1Z16	2.39E-01
		17,25	HK1Z17	1.38E-02
		18	HK1Z18	7.08E-01
		23	HK1Z23	9.64E-02
		24	HK1Z24	1.89E-02
		26	HK1Z26	3.28E-01
	SY	12, 13, 24	SY1Z12	1.90E-02
		14	SY1Z14	3.10E-01
		15,16,17,25	SY1Z15	4.36E-01
		18	SY1Z18	4.63E-02
		23	SY1Z23	1.02E-02
		26	SY1Z26	1.16E-01
	VK	12, 13, 14, 24	VK1Z12	6.00E-01
		15, 16, 17,25,26	VK1Z15	5.00E-01
		18, 23	VK1Z18	5.00E-01
2	HK	12	HK2Z12	2.76E-01
		13	HK2Z13	2.55E-03
		14	HK2Z14	8.88E-02
		15	HK2Z15	1.14E-01
		16	HK2Z16	5.54E-01
		17,25	HK2Z17	9.15E-02
		18	HK2Z18	2.41E-01
		23	HK2Z23	3.13E-02
		24	HK2Z24	2.22E-03
		26	HK2Z26	5.71E-02
	SY	12, 13, 24	SY2Z12	6.81E-02
		14	SY2Z14	3.74E-03
		15,16,17,25	SY2Z15	8.10E-02
		18	SY2Z18	1.26E-03
		23	SY2Z23	4.89E-03
		26	SY2Z26	2.63E-03
	VK	12, 13, 14, 24	VK2Z12	6.00E-01
		15, 16, 17,25,26	VK2Z15	5.00E-01
		18, 23	VK1Z18	9.00E-01
3	HK	12, 13, 14, 23, 24	HKZ12	1.36E-02
		15,16,18,26	HKZ15	2.32E-02
		17,25	HKZ23	1.00E-02
	SS	12, 13, 24	SY1Z12	5.33E-06
		16, 17	SY1Z16	5.26E-05
	VK	12, 13, 14, 24	VK1Z12	8.16E-01
		18, 23	VK1Z18	1.00E-01

Abbreviations:

HK	Horizontal Hydraulic Conductivity, ft/day
SY	Specific Yield
VK	Vertical Hydraulic Conductivity, ft/day
SS	Specific Storage, 1/ft

Table 5-4
Calibration Wells

Well ID	Owner	Well Name	Screened Layer	Model Location		Latitude[1]	Longitude[1]
				Row	Column		
1207955	San Antonio Water Company	SAWC 33	2	260	69	34.151443	-117.679433
1224766	Six Basins Watermaster	MW-1	2	281	73	34.141619	-117.687619
1000621	West End Consolidated Water Co.	Upland Foothill #3	2	266	89	34.141417	-117.673451
1000672	San Antonio Water Company	SAWC 28	2	282	88	34.135856	-117.680726
1000651	Golden State Water Company	Pomello #1	2	303	67	34.135724	-117.700128
1002723	Golden State Water Company	Alamosa #2	2	306	70	34.133026	-117.700199
1000639	San Antonio Water Company	SAWC 26	1	298	96	34.126178	-117.684500
1002386	West End Consolidated Water Co.	Lemon Heights 4	1	300	108	34.121361	-117.679809
1224767	Six Basins Watermaster	MW-2	1	319	87	34.121903	-117.698024
1002395	West End Consolidated Water Co.	Mountain View 4	1	321	99	34.116188	-117.693625
1208151	Golden State Water Company	Mills #1	1	333	84	34.117516	-117.705916
1000647	Golden State Water Company	Indian Hill North #3	1 and 2	340	59	34.124383	-117.720515
1208146	Golden State Water Company	Campbell #1	1	356	57	34.118872	-117.729250
1002432	City of Pomona	P-20	1 and 2	359	67	34.114208	-117.725846
1002448	Unknown	NA_1002448	2	380	39	34.116444	-117.748081
1224790	City of La Verne	La Verne Heights #2	1	380	33	34.118612	-117.750924
1002494	City of Pomona	P-13	1 and 2	373	73	34.106467	-117.729469
1002489	City of Pomona	P-09B	1	383	71	34.103132	-117.734907
1002507	Golden State Water Company	Dreher #1	1	380	83	34.099871	-117.727939
1208148	Golden State Water Company	College #2	1 and 2	359	100	34.101371	-117.710254
1002517	Golden State Water Company	Del Monte #1	1	373	106	34.093781	-117.714488
1201224	City of Pomona	P-07	1 and 2	416	94	34.081852	-117.739654
1002594	City of Pomona	P-01A	1 and 2	422	88	34.081569	-117.745039
1002604	City of Pomona	P-03	1 and 2	428	79	34.082989	-117.751515
1201189	City of La Verne	Cartwright	1	409	48	34.101940	-117.757674
1224787	City of La Verne	Old Baldy	2	422	31	34.103332	-117.771541
1224789	City of La Verne	Walnut	2	434	34	34.097594	-117.775426
1000629	Adams And Garner	NA_1000629	2	289	53	34.146253	-117.700150
1002505	Unknown	NA_1002505	2	380	87	34.098441	-117.725850
1002784	Unknown	NA_1002784	2	447	29	34.094450	-117.783801
1002794	Unknown	NA_1002794	1	437	48	34.091099	-117.770502
1224293	Xerox Corporation	MW-14Y	1	399	81	34.093159	-117.737685
1230774	Victor Graphics	MW-2	2	443	18	34.100311	-117.786713

Notes:

1. Geographic Coordinate System: WGS 1984

Table 5-5

Final Calibrated Parameter-Zone Coefficients

Layer	Aquifer Property Type	Parameter Zone	Composite Parameter Zone	Initial Parameter - Zone Coefficient	Lower Bound	Upper Bound	Calibrated Value	Parameter Activity[a]
1	HK	12	HK1Z12	6.98E-02	1.00E-02	5.00E+00	8.59E-02	1
		13	HK1Z13	1.24E-01	1.00E-02	5.00E+00	1.06E-01	1
		14	HK1Z14	2.95E-02	1.00E-02	5.00E+00	2.67E-02	1
		15	HK1Z15	3.08E-01	1.00E-02	5.00E+00	3.08E-01	1
		16	HK1Z16	2.39E-01	1.00E-02	5.00E+00	2.39E-01	1
		17,25	HK1Z17	1.38E-02	1.00E-02	5.00E+00	1.45E-02	1
		18	HK1Z18	7.08E-01	1.00E-02	5.00E+00	7.41E-01	1
		23	HK1Z23	9.64E-02	1.00E-02	5.00E+00	3.87E-02	1
		24	HK1Z24	1.89E-02	1.00E-02	5.00E+00	1.64E-01	1
		26	HK1Z26	3.28E-01	1.00E-02	5.00E+00	3.08E-01	1
	SY	12, 13, 24	SY1Z12	1.90E-02	1.00E-02	1.30E+00	9.26E-02	1
		14	SY1Z14	3.10E-01	1.00E-02	1.30E+00	3.25E-01	1
		15,16,17,25	SY1Z15	4.36E-01	1.00E-02	1.30E+00	4.52E-01	1
		18	SY1Z18	4.63E-02	1.00E-02	1.30E+00	9.14E-02	1
		23	SY1Z23	1.02E-02	1.00E-02	1.30E+00	4.98E-03	1
		26	SY1Z26	1.16E-01	1.00E-02	1.30E+00	7.72E-02	1
	VK	12, 13, 14, 24	VK1Z12	6.00E-01	1.00E-02	1.00E+01	6.00E-01	2
		15, 16, 17,25,26	VK1Z15	5.00E-01	1.00E-02	1.00E+01	5.00E-01	2
		18, 23	VK1Z18	5.00E-01	1.00E-02	1.00E+01	5.00E-01	2
2	HK	12	HK2Z12	2.76E-01	1.00E-03	5.00E+00	2.99E-01	1
		13	HK2Z13	2.55E-03	1.00E-03	5.00E+00	1.28E-03	1
		14	HK2Z14	8.88E-02	1.00E-03	5.00E+00	9.27E-02	1
		15	HK2Z15	1.14E-01	1.00E-03	5.00E+00	1.17E-01	1
		16	HK2Z16	5.54E-01	1.00E-03	5.00E+00	5.58E-01	1
		17,25	HK2Z17	9.15E-02	1.00E-03	5.00E+00	8.77E-02	1
		18	HK2Z18	2.41E-01	1.00E-03	5.00E+00	2.61E-01	1
		23	HK2Z23	3.13E-02	1.00E-03	5.00E+00	3.06E-02	1
		24	HK2Z24	2.22E-03	1.00E-03	5.00E+00	1.81E-02	1
		26	HK2Z26	5.71E-02	1.00E-03	5.00E+00	5.50E-02	1
	SY	12, 13, 24	SY2Z12	6.81E-02	1.00E-05	1.00E-01	7.31E-02	1
		14	SY2Z14	3.74E-03	1.00E-05	1.00E-01	2.11E-03	1
		15,16,17,25	SY2Z15	8.10E-02	1.00E-05	1.00E-01	8.10E-01	1
		18	SY2Z18	1.26E-03	1.00E-05	1.00E-01	2.14E-03	1
		23	SY2Z23	4.89E-03	1.00E-05	1.00E-01	4.08E-03	1
		26	SY2Z26	2.63E-03	1.00E-05	1.00E-01	2.89E-03	1
	VK	12, 13, 14, 24	VK2Z12	6.00E-01	1.00E-02	1.00E+00	6.00E-01	2
		15, 16, 17,25,26	VK2Z15	5.00E-01	1.00E-02	1.00E+00	5.00E-01	2
		18, 23	VK1Z18	5.00E-01	1.00E-02	1.00E+00	5.00E-01	2
3	HK	12, 13, 14, 23, 24	HKZ12	1.36E-02	1.00E-03	5.00E+00	2.22E-02	1
		15,16,18,26	HKZ15	2.32E-02	1.00E-03	5.00E+00	2.42E-02	1
		17,25	HKZ23	1.00E-02	1.00E-03	5.00E+00	1.00E-02	2
	SS	12, 13, 24	SY1Z12	5.33E-06	5.00E-06	5.00E-04	6.51E-06	1
		16, 17	SY1Z16	5.26E-05	5.00E-06	5.00E-04	6.28E-05	1
	VK	12, 13, 14, 24	VK1Z12	8.16E-01	1.00E-02	1.00E+00	8.16E-01	2
		18, 23	VK1Z18	1.00E-01	1.00E-02	1.00E+00	1.00E-01	2

Notes

a) 1=Parameter was adjusted in PEST; 2= parameter was not adjusted in PEST

Abbreviations:

HK Horizontal Hydraulic Conductivity, ft/day

SY Specific Yield

VK Vertical Hydraulic Conductivity, ft/day

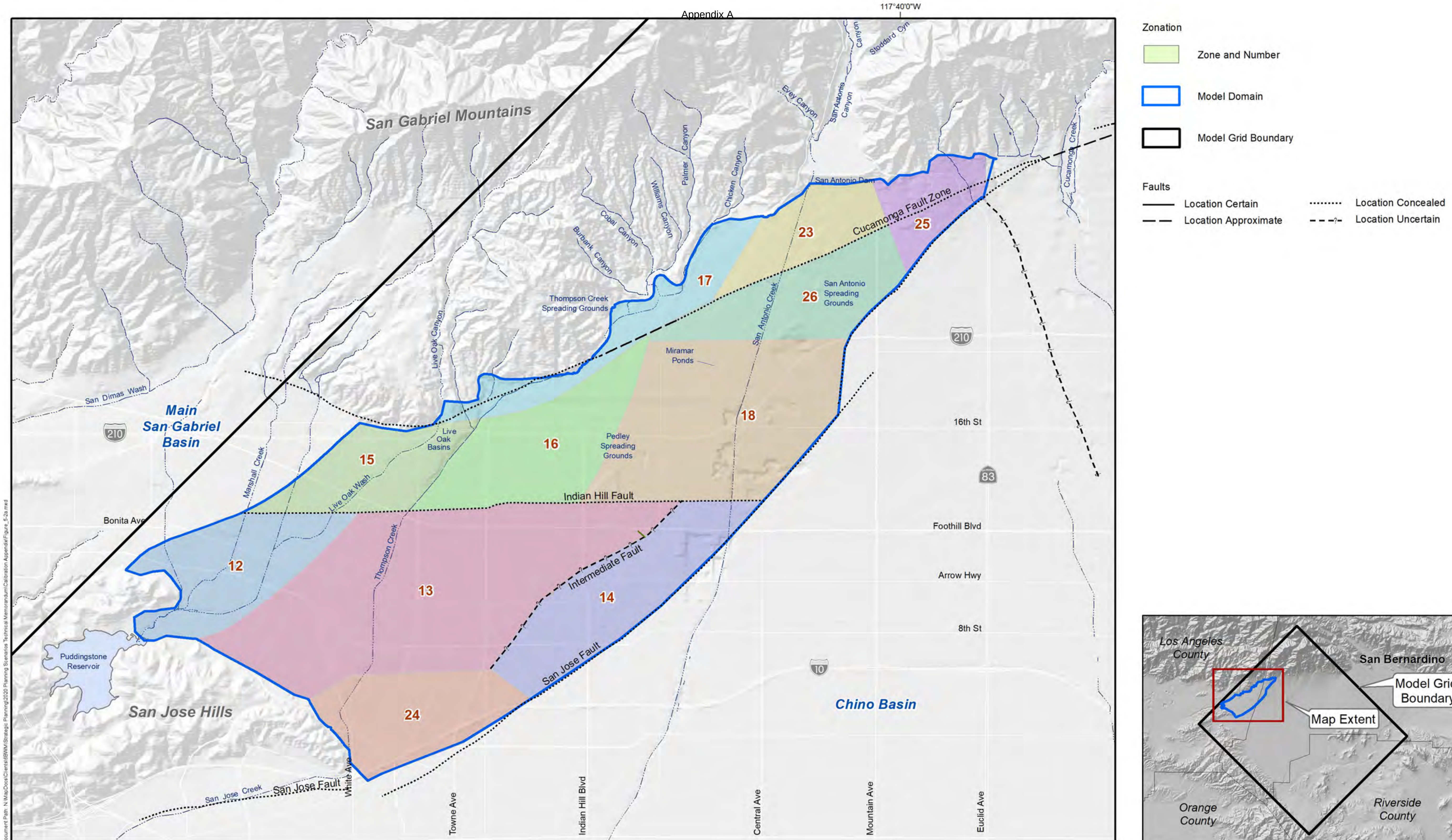
SS Specific Storage, 1/ft

Table 5-7
Final Calibrated Fault Properties

Composite Parameter Zone	Aquifer Property Type[1]	Parameter Activity	Layer	Fault Name	Calibrated Value (ft/day)
HFB1	HFB	1	1	Indian Hill Fault	1.61E-04
HFB12				West Indian Hill Fault	1.24E-04
HFB2				East Indian Hill Fault	3.90E-03
HFB3				Intermediate Fault	4.36E-07
HFB4				South San Jose Fault	8.39E-05
HFB5				North San Jose Fault	1.32E-05
HFB11				Cucamonga Fault	7.28E-02
HFB13				Claremont Barrier East to West	4.35E-02
HFB14				Pomona Barrier	4.51E-01
HFB21			2	Indian Hill Fault	1.35E-04
HFB22				West Indian Hill Fault	2.39E-04
HFB23				East Indian Hill Fault	4.33E-03
HFB24				North San Jose Fault	1.34E-04
HFB26		2	2 and 3	Cucamonga Fault and Claremont Barrier East to West	3.30E-06

[1] HFB = Horizontal Flow Barrier

[2] 1=Parameter was adjusted in PEST; 0= parameter was not adjusted in PEST



Prepared by:

WEI
WILDERMUTH ENVIRONMENTAL, INC.

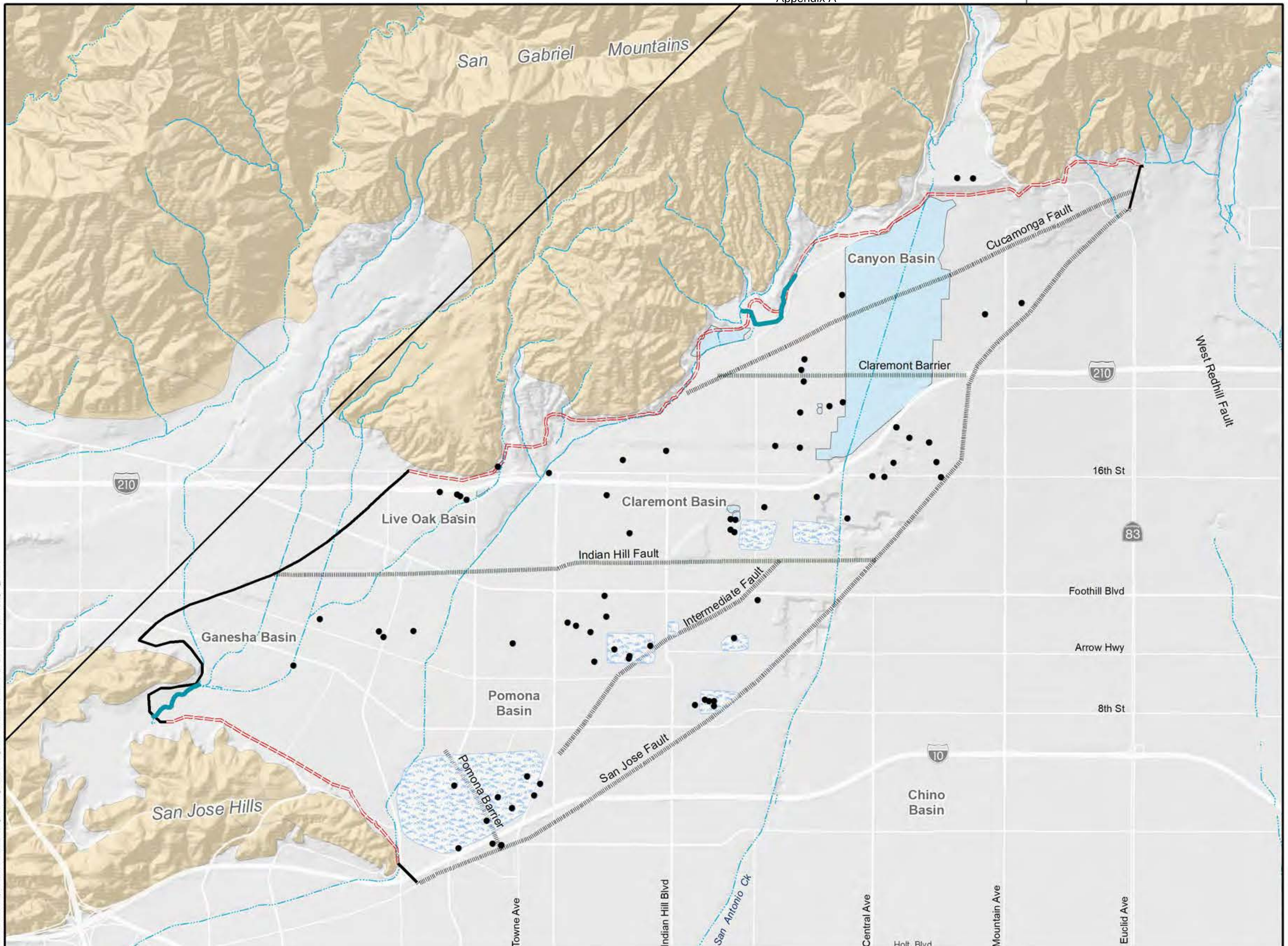
Author: APP
Date: 20201022

0 2 Miles
0 2 4 Kilometers

Six Basins Watermaster
Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Model Zonation
All Layers

Figure 5-2



Boundary Condition

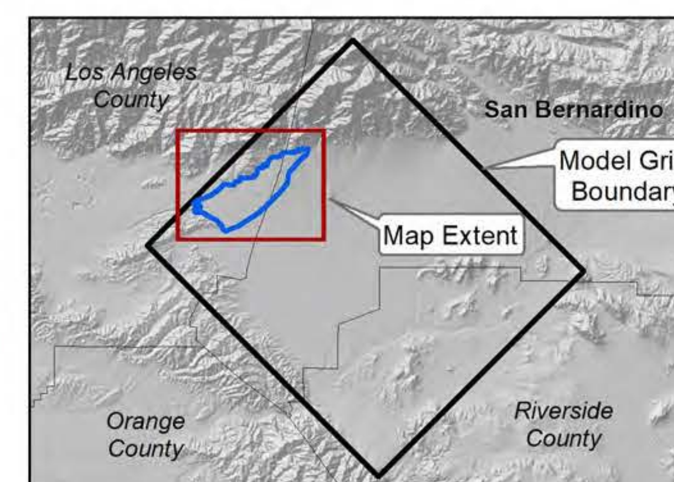
- Internal Hydraulic Barrier
- No Flow
- Variable Flux
- Historical Cienegas Area (Head dependant Boundary)
- Unlined Stream Channel
- Production Well
- Model Grid Boundary
- Spreading Grounds

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks



Prepared by:

WEI
WILDERMUTH ENVIRONMENTAL, INC.

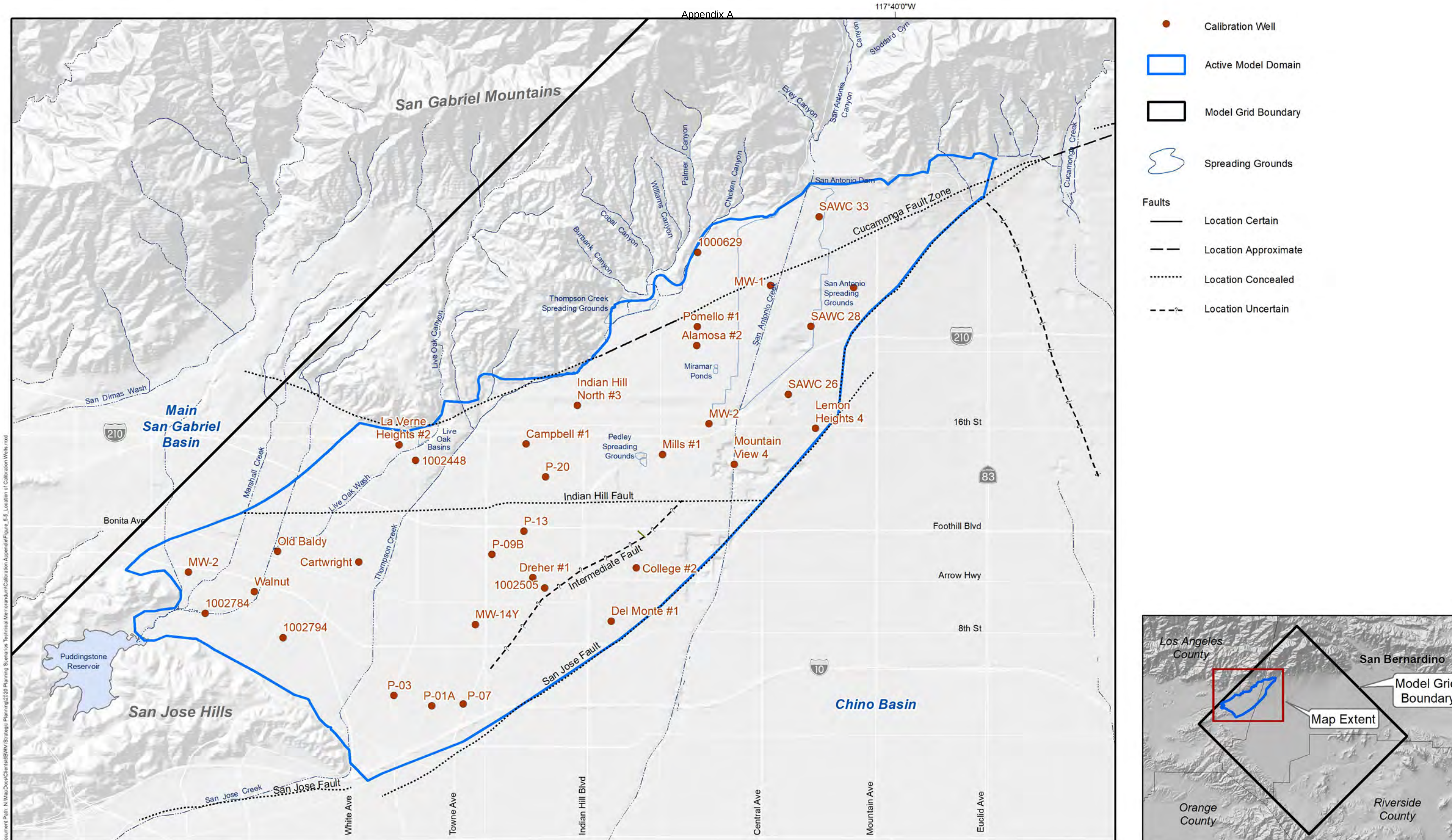
Author: APP
Date: 20201022

0 2 Miles
0 2 4 Kilometers

Six Basins Watermaster
Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Groundwater Model Boundary Conditions

Figure 5-4



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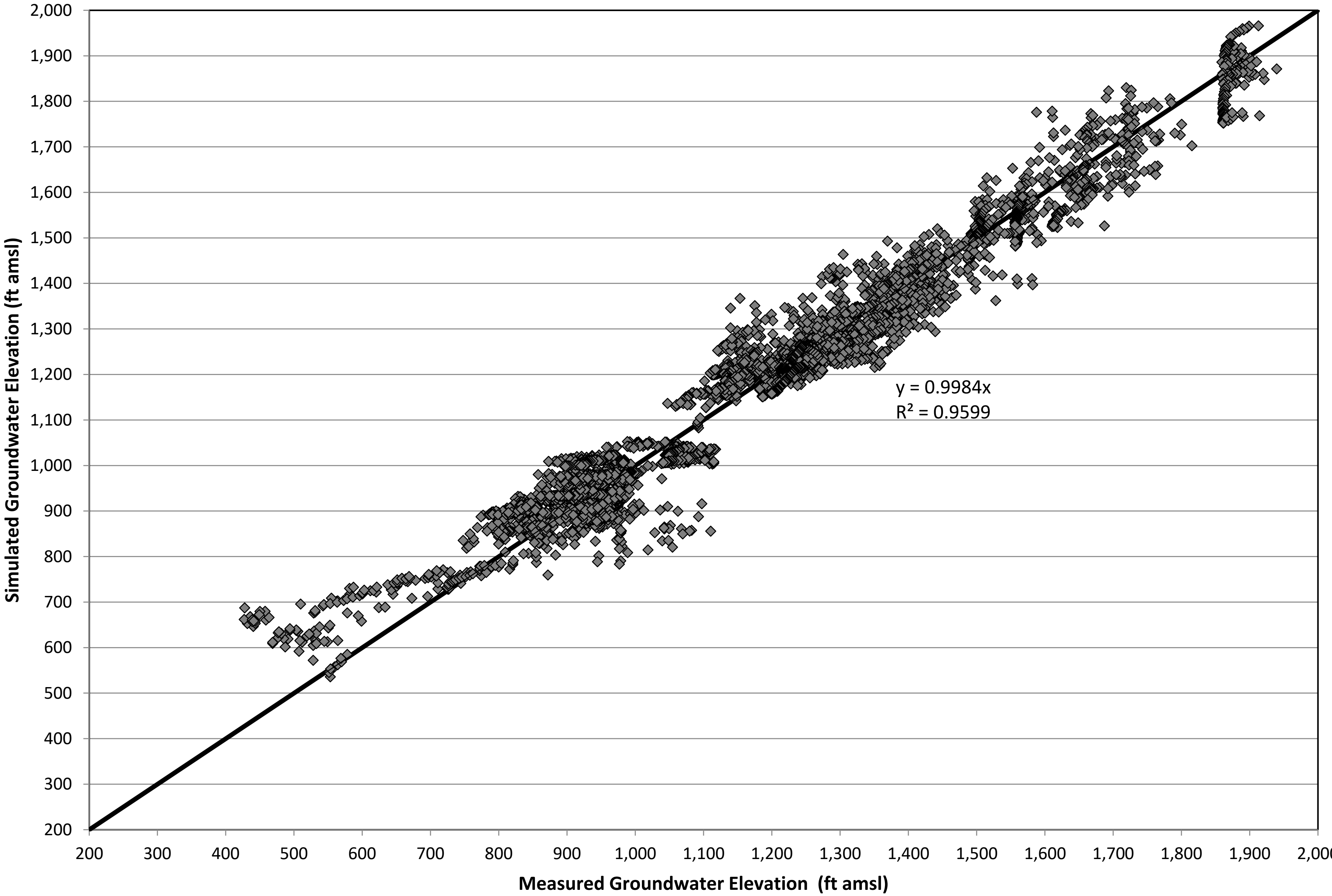
Author: APP
Date: 20200928

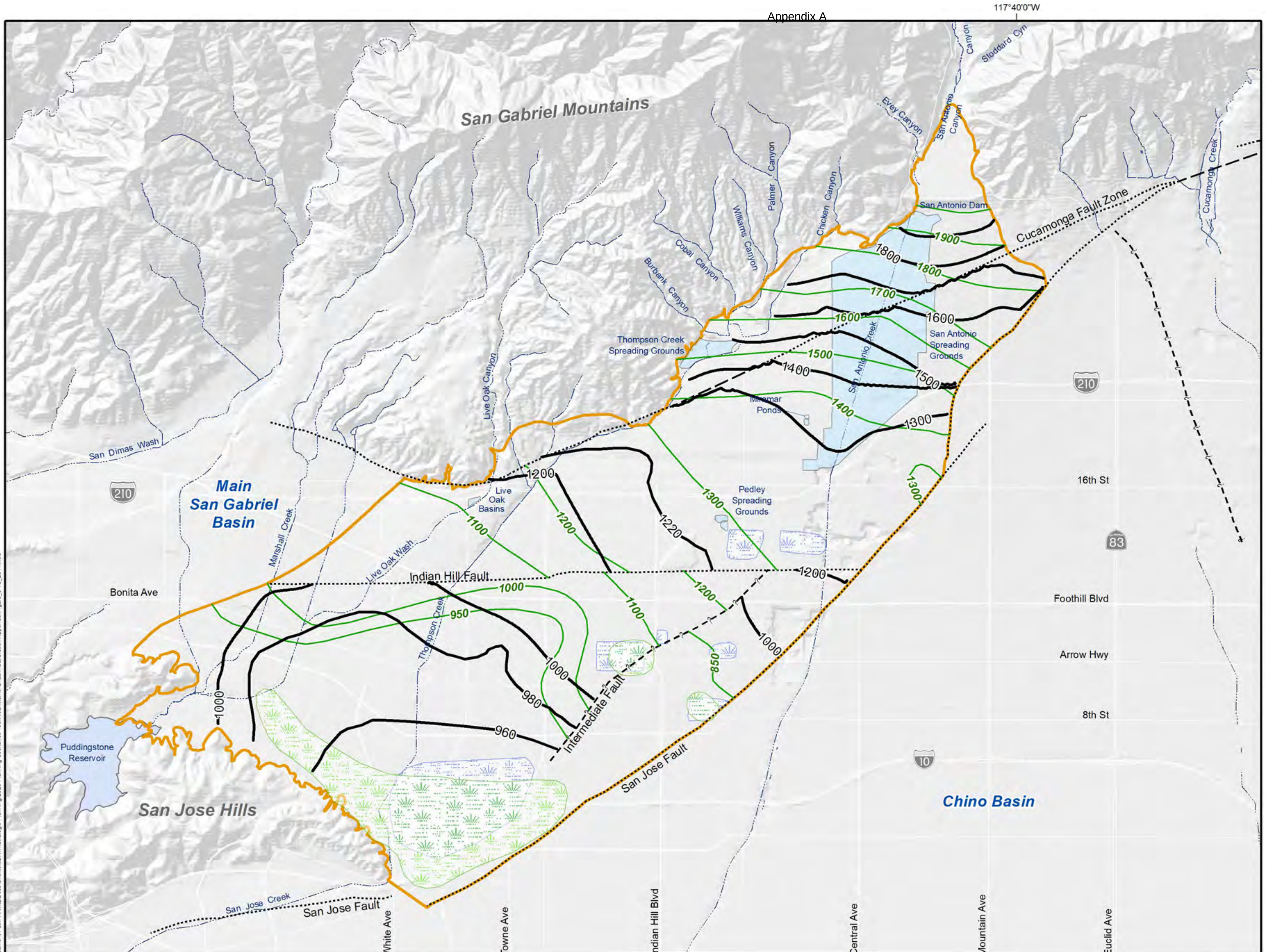
Six Basins Watermaster
Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Location of Calibration Wells

Figure 5-5

Figure 5-6
Comparison of Simulated and Measured Groundwater Elevations at Calibration Wells of the Six Basins

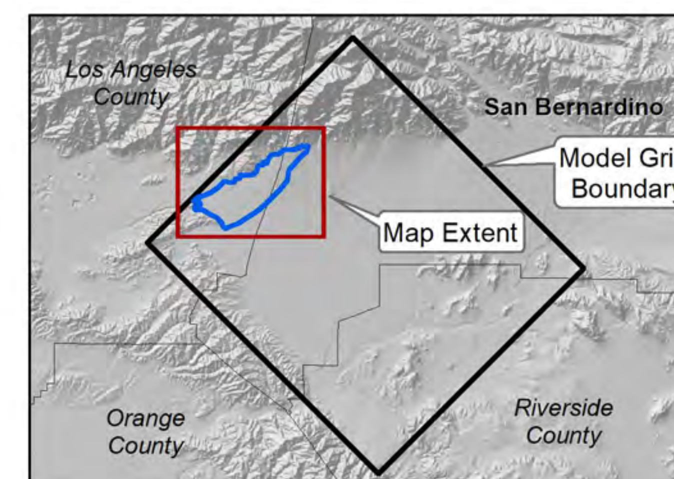




- —1000— Measured Groundwater Elevation Contours (ft-msl)
- —1000— Simulated Groundwater Elevation Contours (ft-msl)
- Artesian Areas as Mapped by Mendenhall (1908)
- Cienegas as Mapped by Bean (1982); CDM (2006)
- Spreading Grounds
- Hydrologic Boundary of the Six Basins

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain



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WEI
WILDERMUTH ENVIRONMENTAL, INC.

Author: APP
Date: 20201022

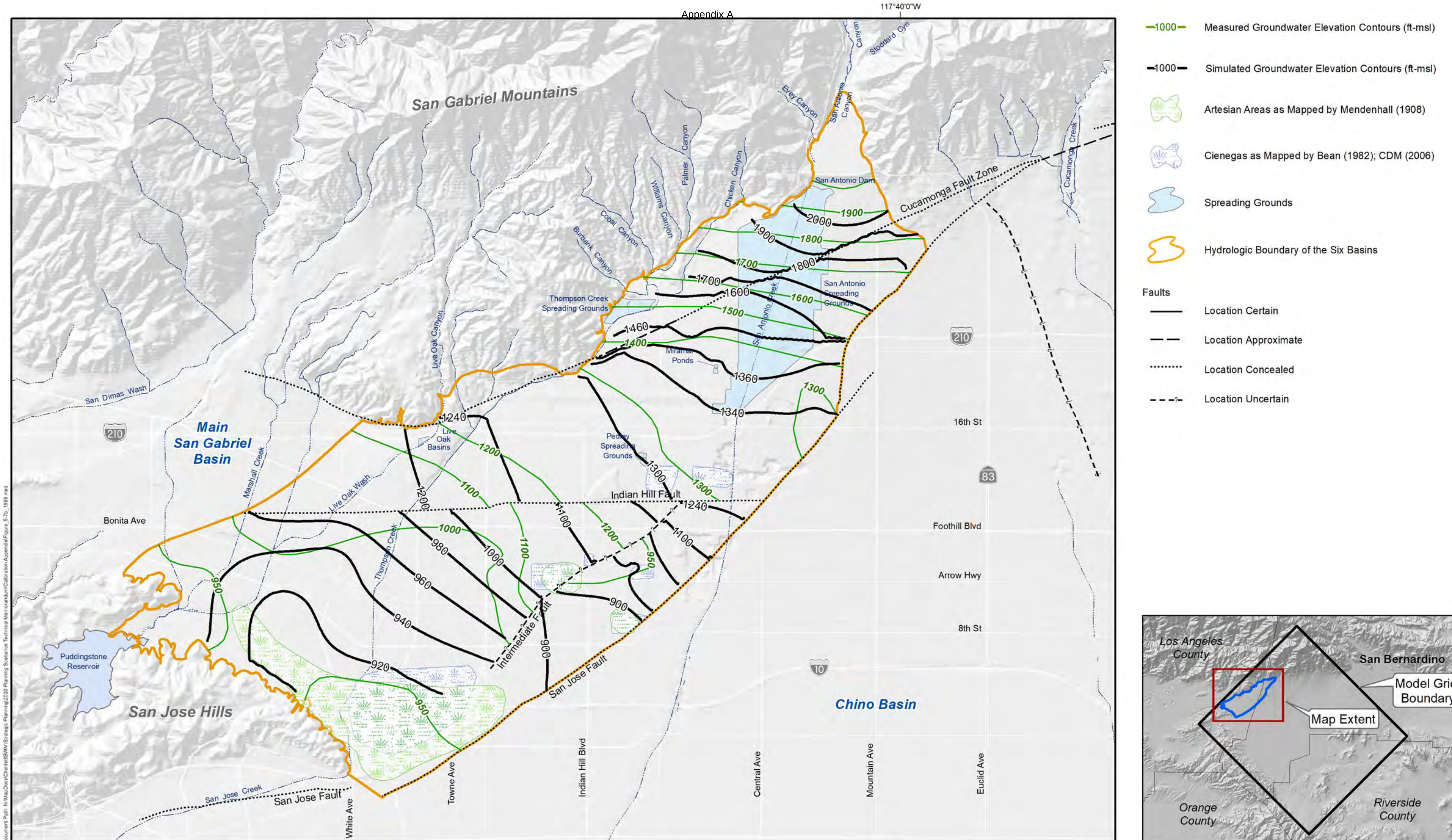
0 2 Miles
0 2 4 Kilometers

Six Basins Watermaster
Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Comparison of Simulated and Measured Groundwater Elevations at Calibration Wells of the Six Basins

Fall 2011

Figure 5-7a



Prepared by:

WEI WILDERMUTH ENVIRONMENTAL, INC.

Author: CS

Date: 20201022

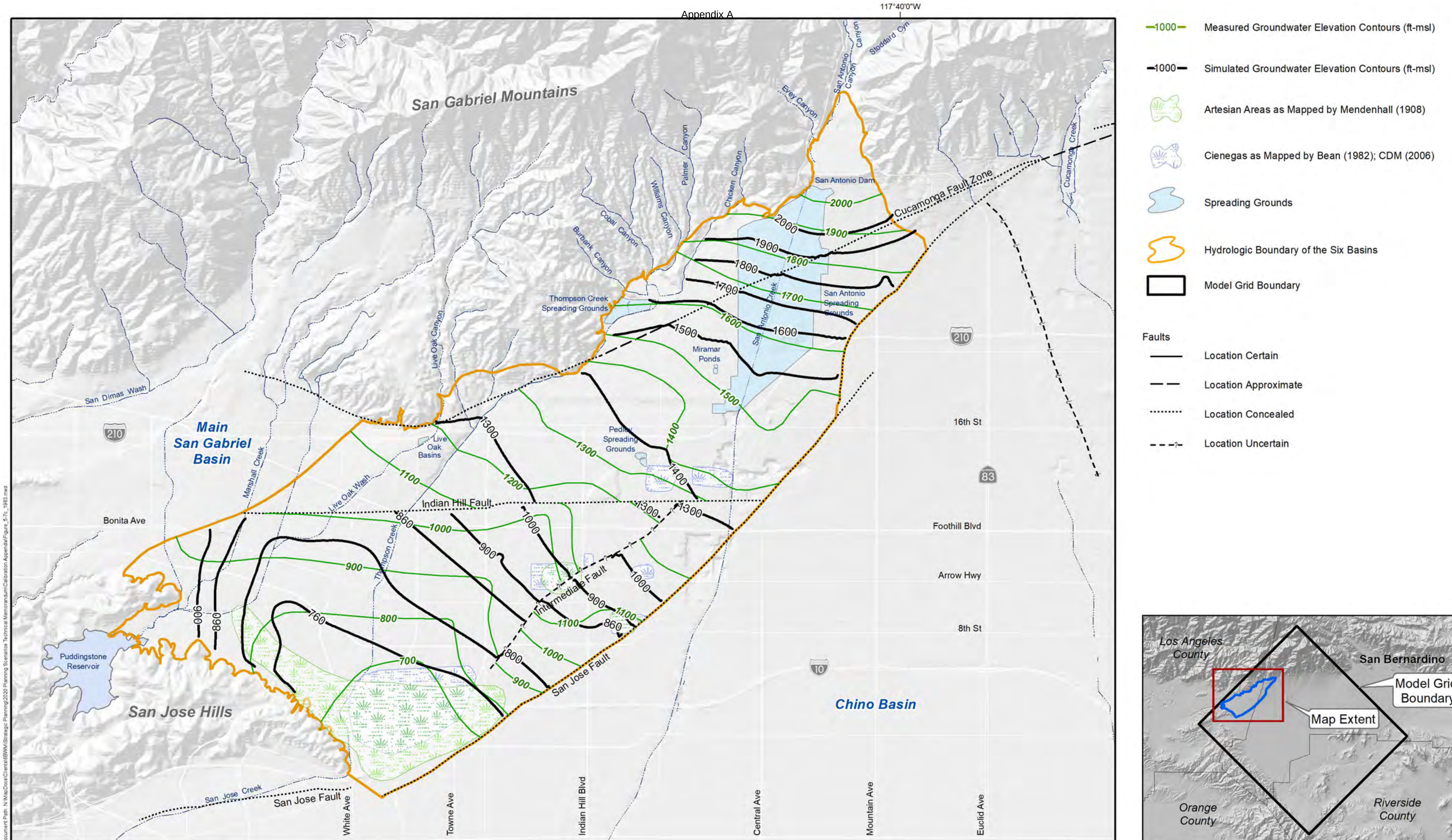
Six Basins Watermaster

Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Comparison of Simulated and Measured Groundwater Elevations at Calibration Wells of the Six Basins

Fall 1999 (Start of the Adjudication)

Figure 5-7b



Prepared by:

WEI Wildermuth Environmental, Inc.

Author: APP

Date: 20201022

Six Basins Watermaster

Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Comparison of Simulated and Measured Groundwater Elevations at Calibration Wells of the Six Basins

Fall 1983 (Period of High Groundwater)

Figure 5-7c

Figure 5-8a
Comparison of Simulated and Measured Groundwater Elevations at Calibration Wells within the Upper and Lower Claremont Heights and Canyon Basins

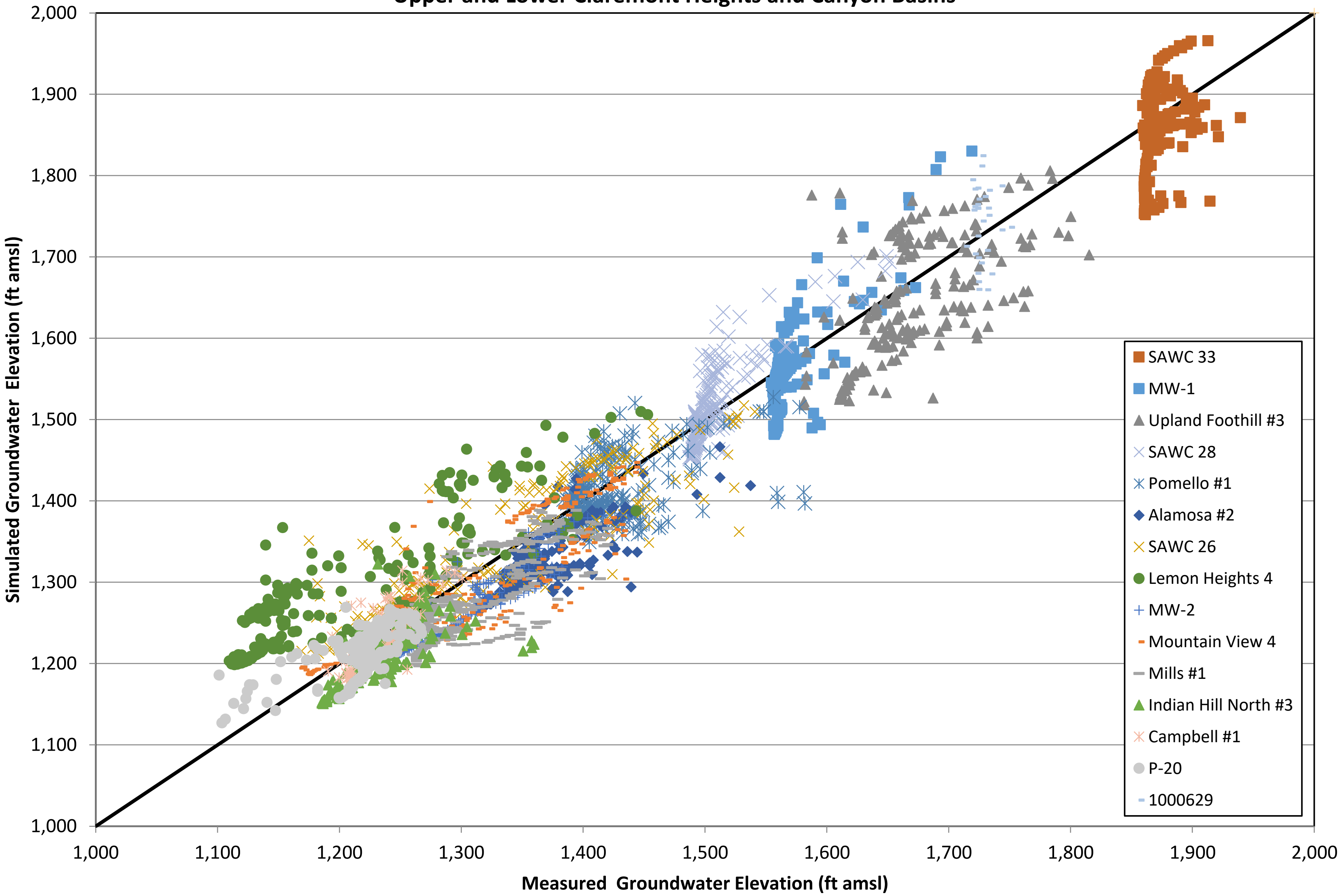


Figure 5-8b
Comparison of Simulated and Measured Groundwater Elevations at Calibration Wells within the Pomona Basin

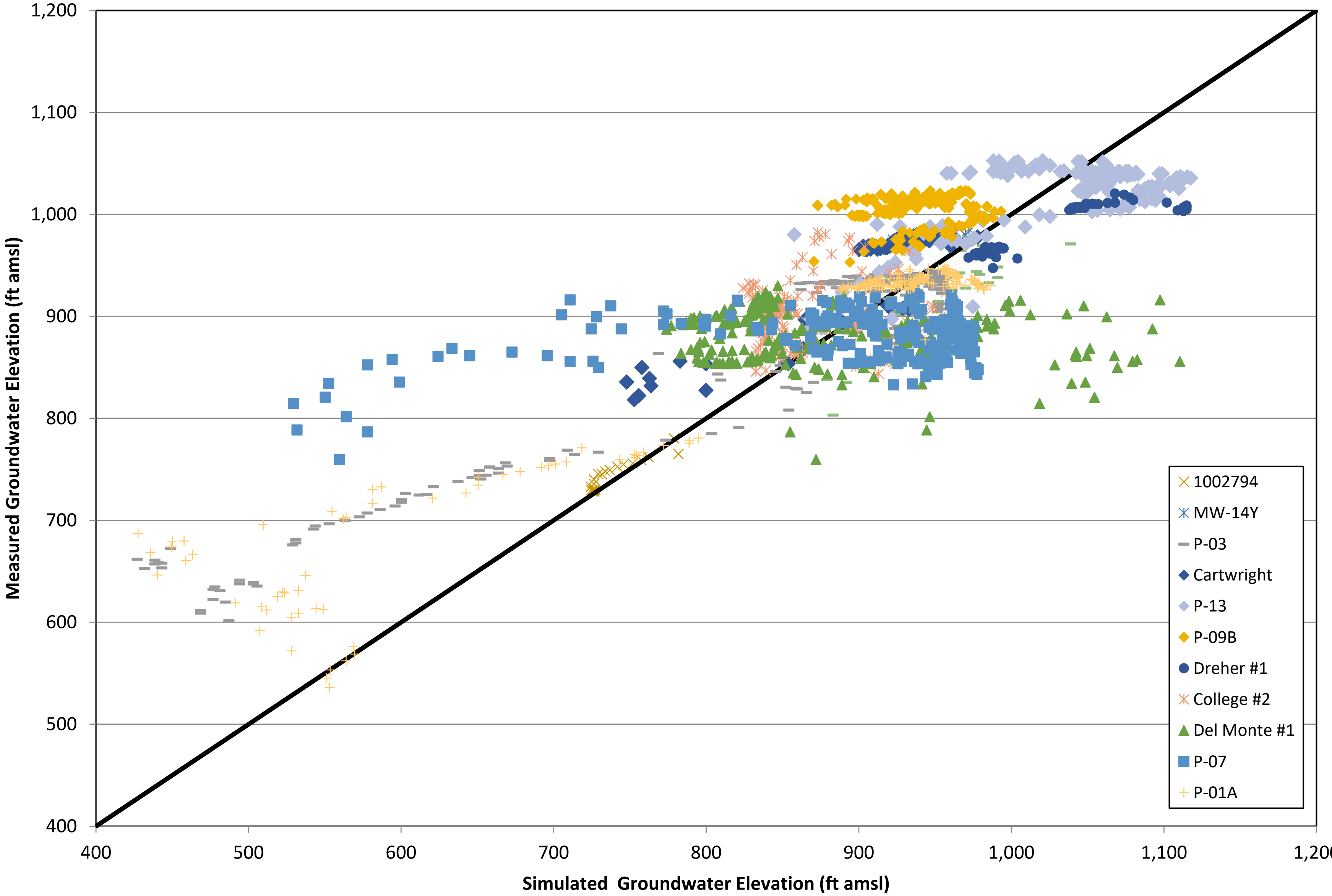


Figure 5_6_ 5-8a-c_5-9_Scatter_plots_Hist.xlsx--Figure_5-8b
10/22/2020

Figure 5-8c
Comparison of Simulated and Measured Groundwater Elevations at Calibration Wells within the Two Basins

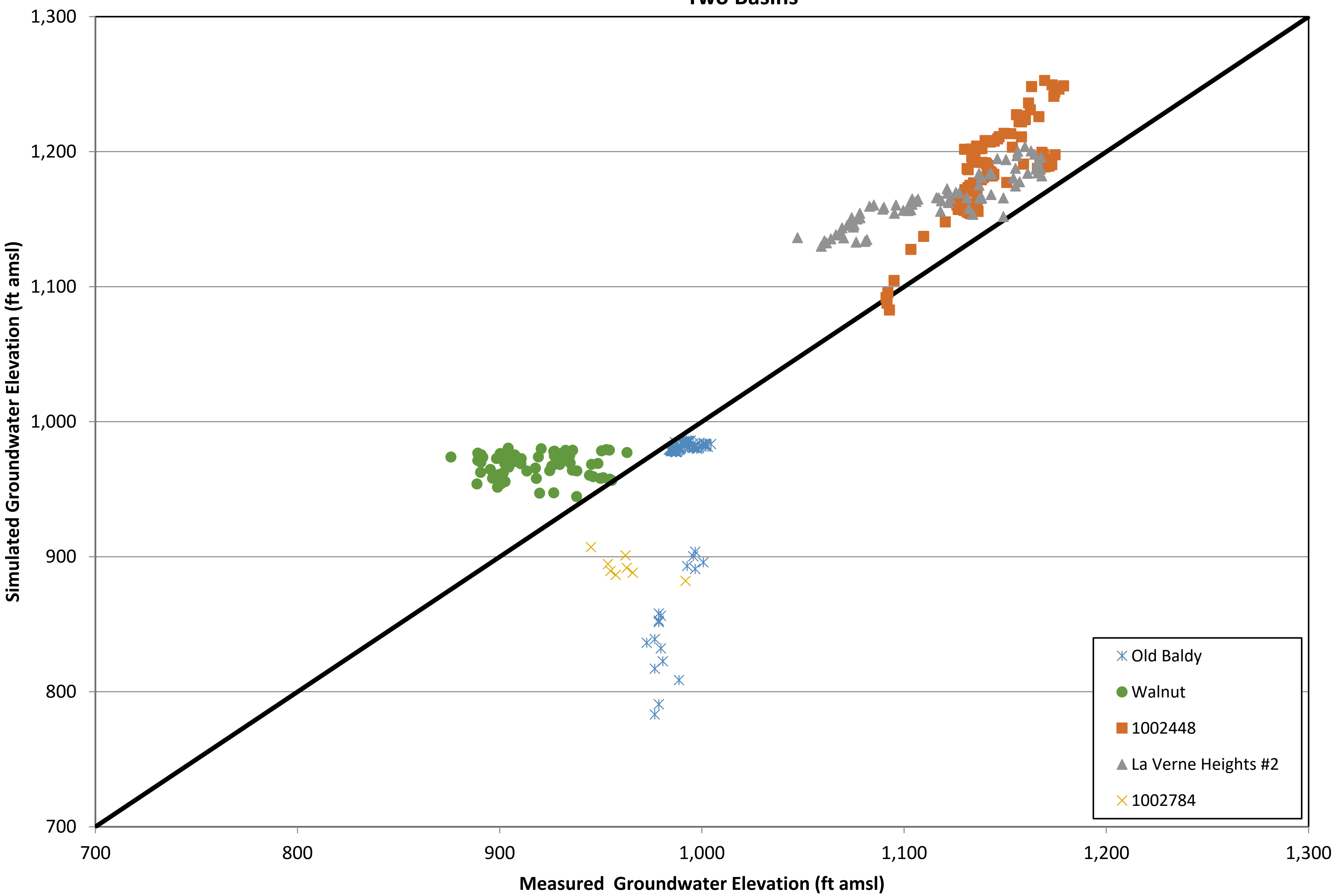


Figure 5-9
Residual Relative Frequency Histogram in Six Basins

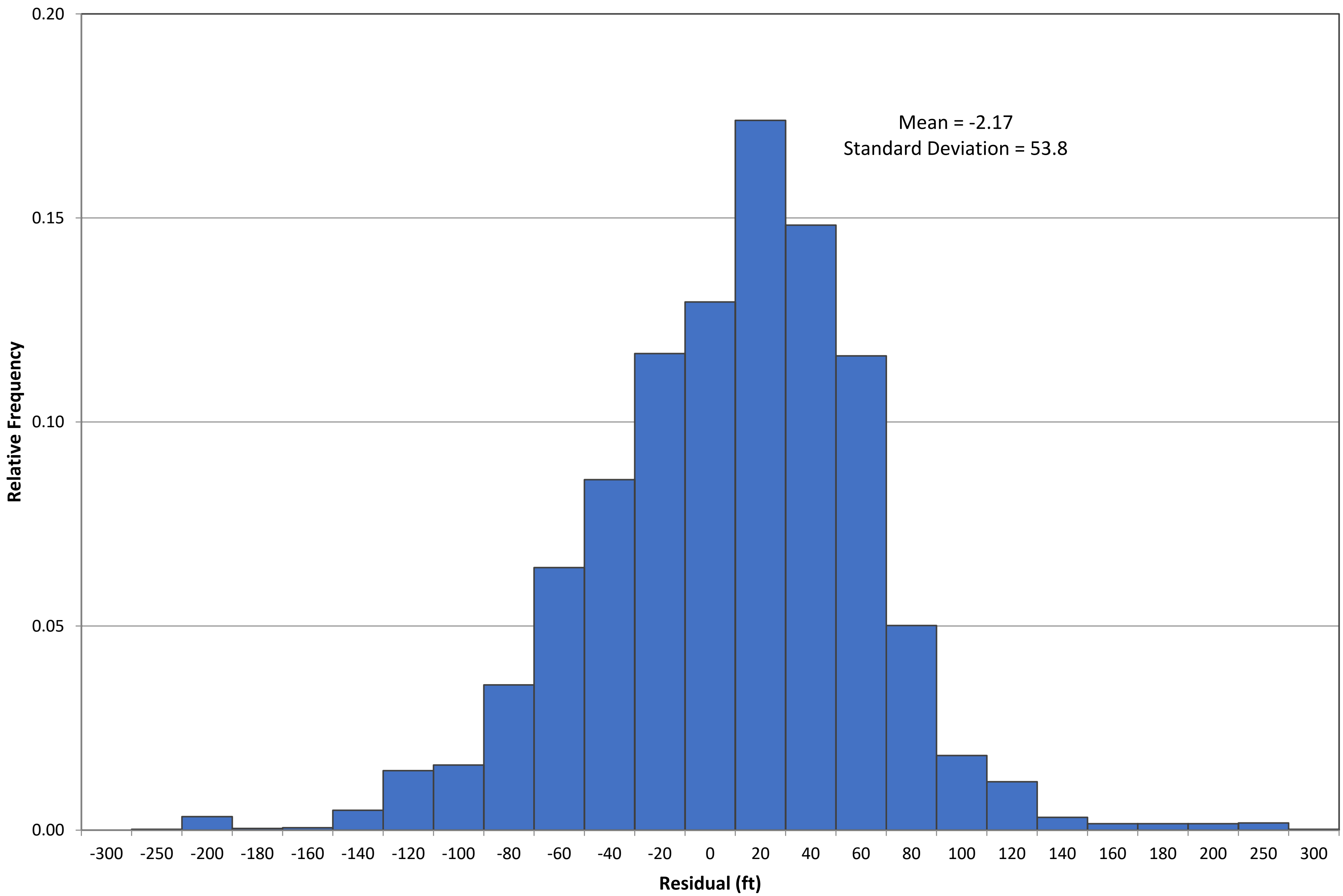
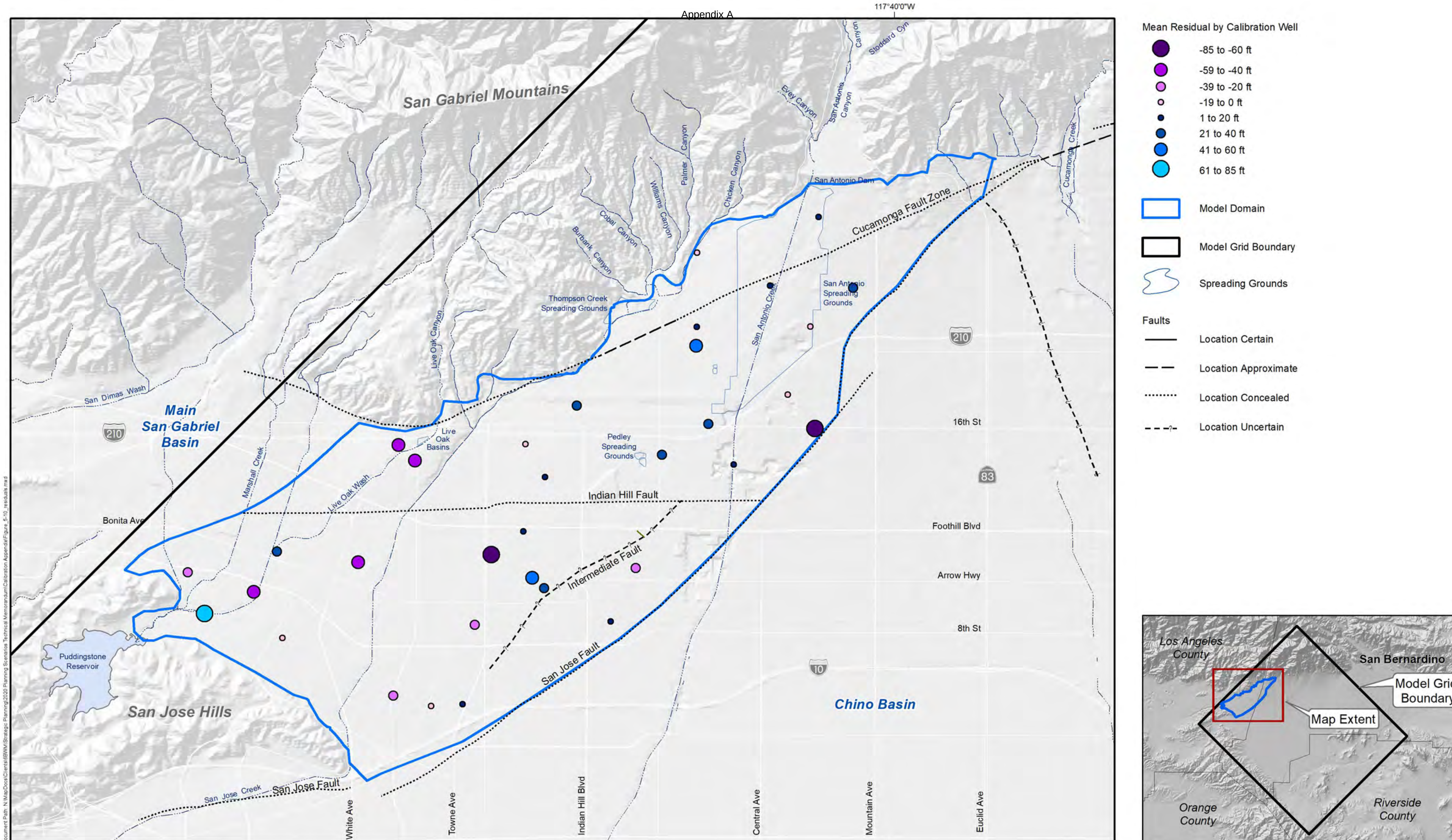


Figure 5_6_ 5-8a-c_5-9_Scatter_plots_Hist.xlsx--Figure_5-9_Histogram
10/22/2020



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Wildermuth Environmental, Inc.

Author: APP
Date: 20201026

Six Basins Watermaster
Development and Use of a Numerical Groundwater Flow Model of the Six Basins

Mean Residual Error by Calibration Well

Figure 5-10

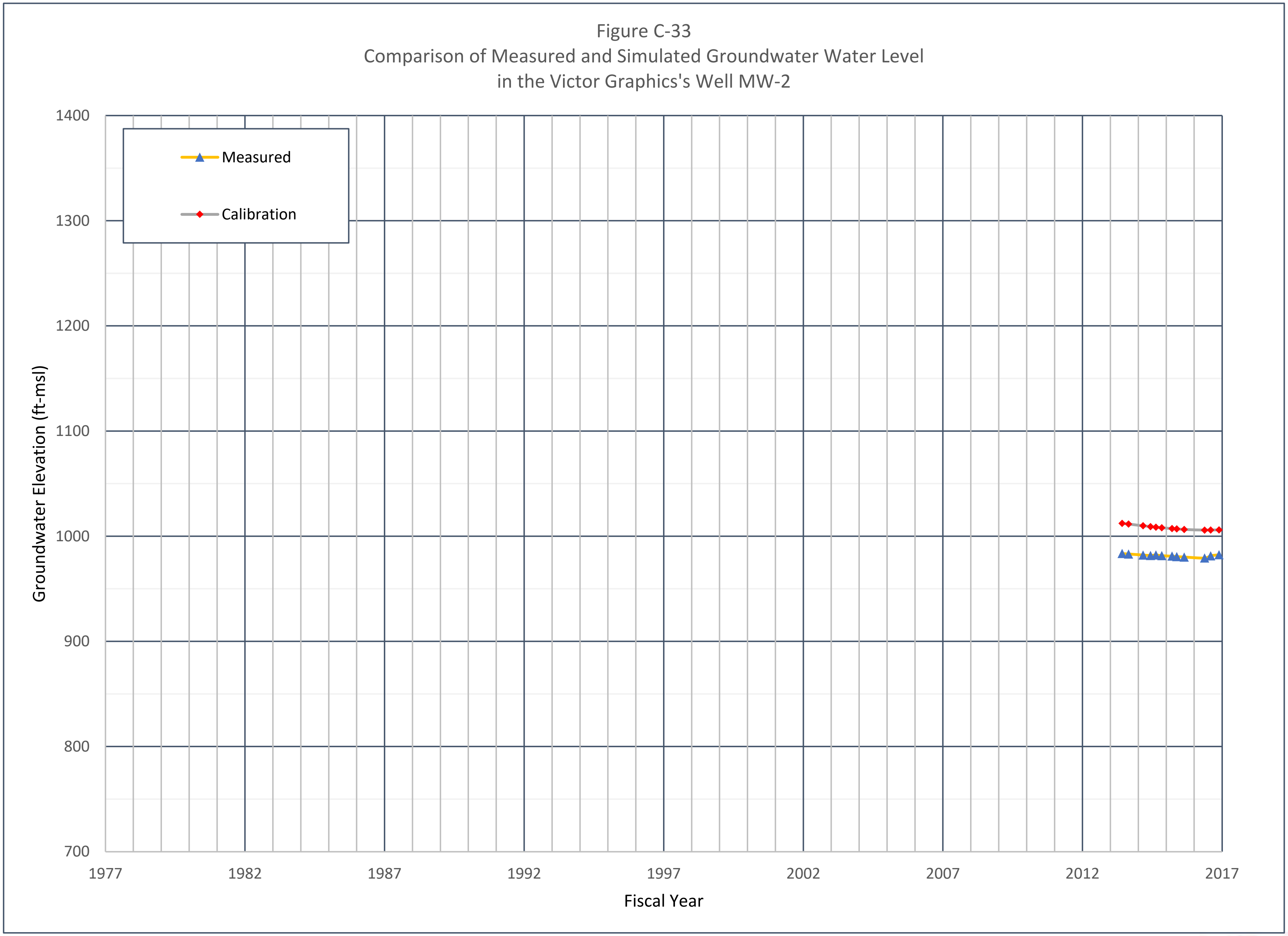


Figure C-33
Comparison of Measured and Simulated Groundwater Water Level
in the Victor Graphics's Well MW-2
Measured
Calibration
Groundwater Elevation (ft-msl)
1400
1300
1200
1100
1000
900
800
700
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

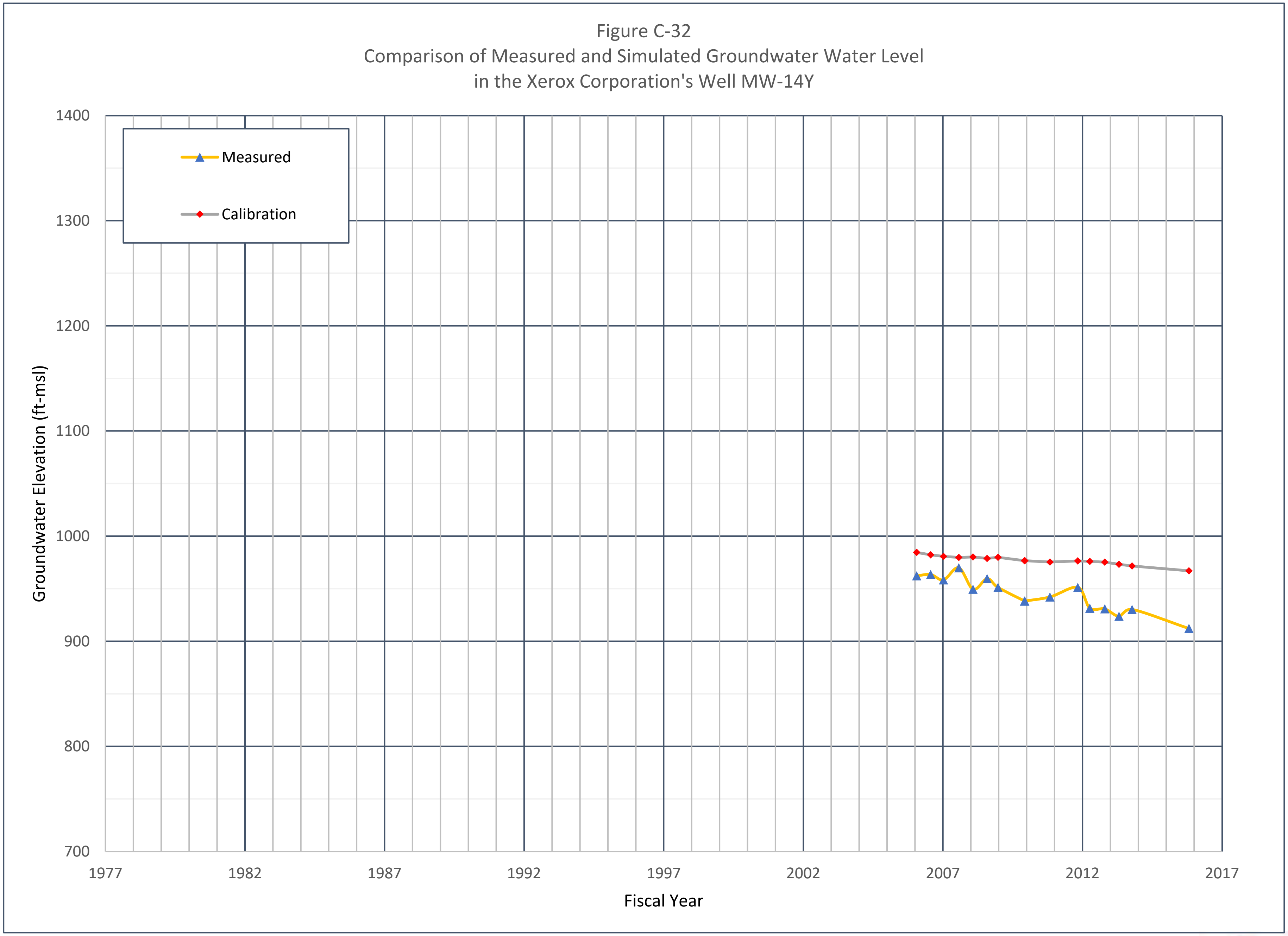
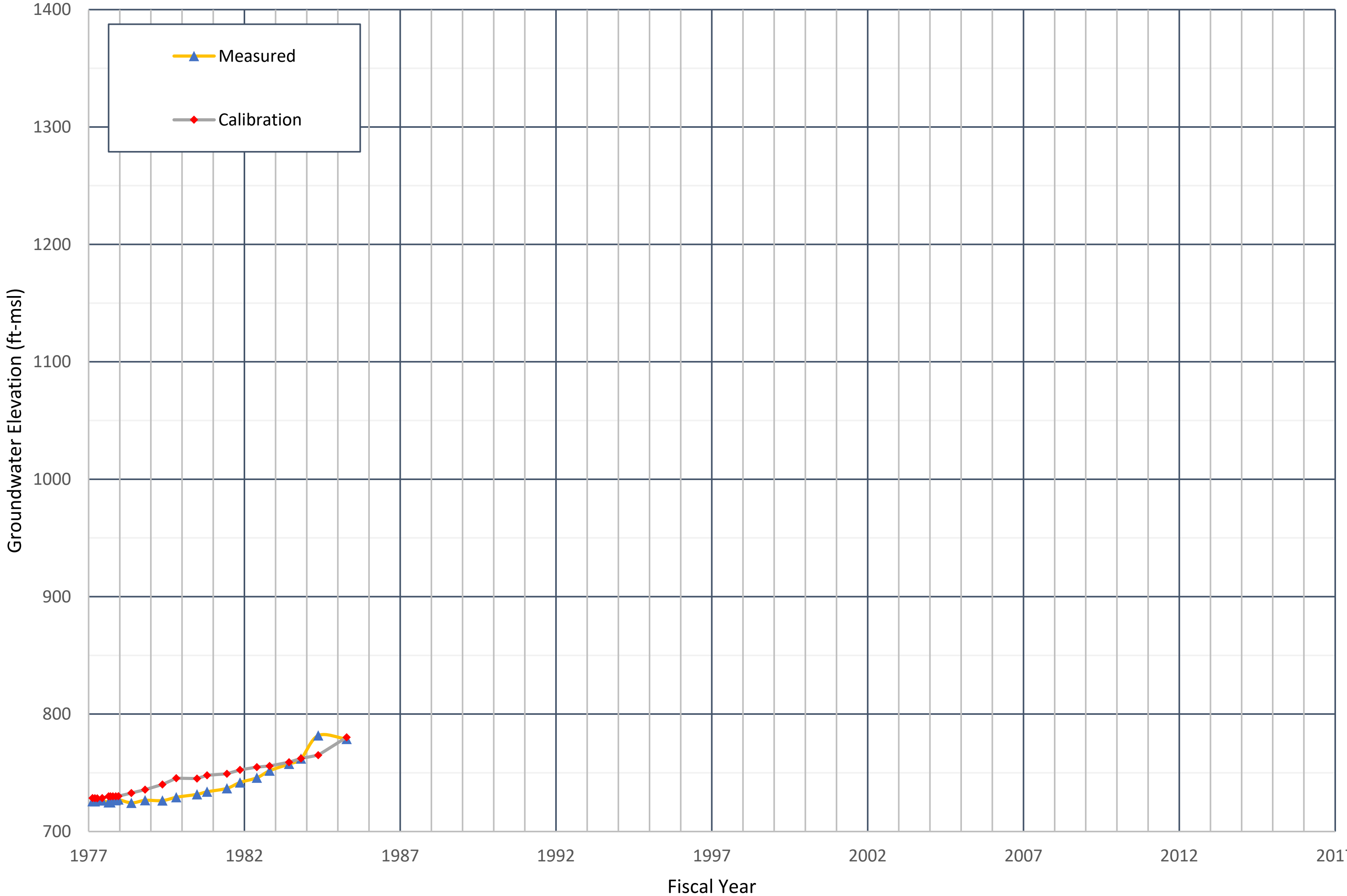


Figure C-32
Comparison of Measured and Simulated Groundwater Water Level
in the Xerox Corporation's Well MW-14Y
Measured
Calibration
Groundwater Elevation (ft-msl)
1400
1300
1200
1100
1000
900
800
700
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

Figure C-31
Comparison of Measured and Simulated Groundwater Water Level
in the Unknown's Well NA_1002794



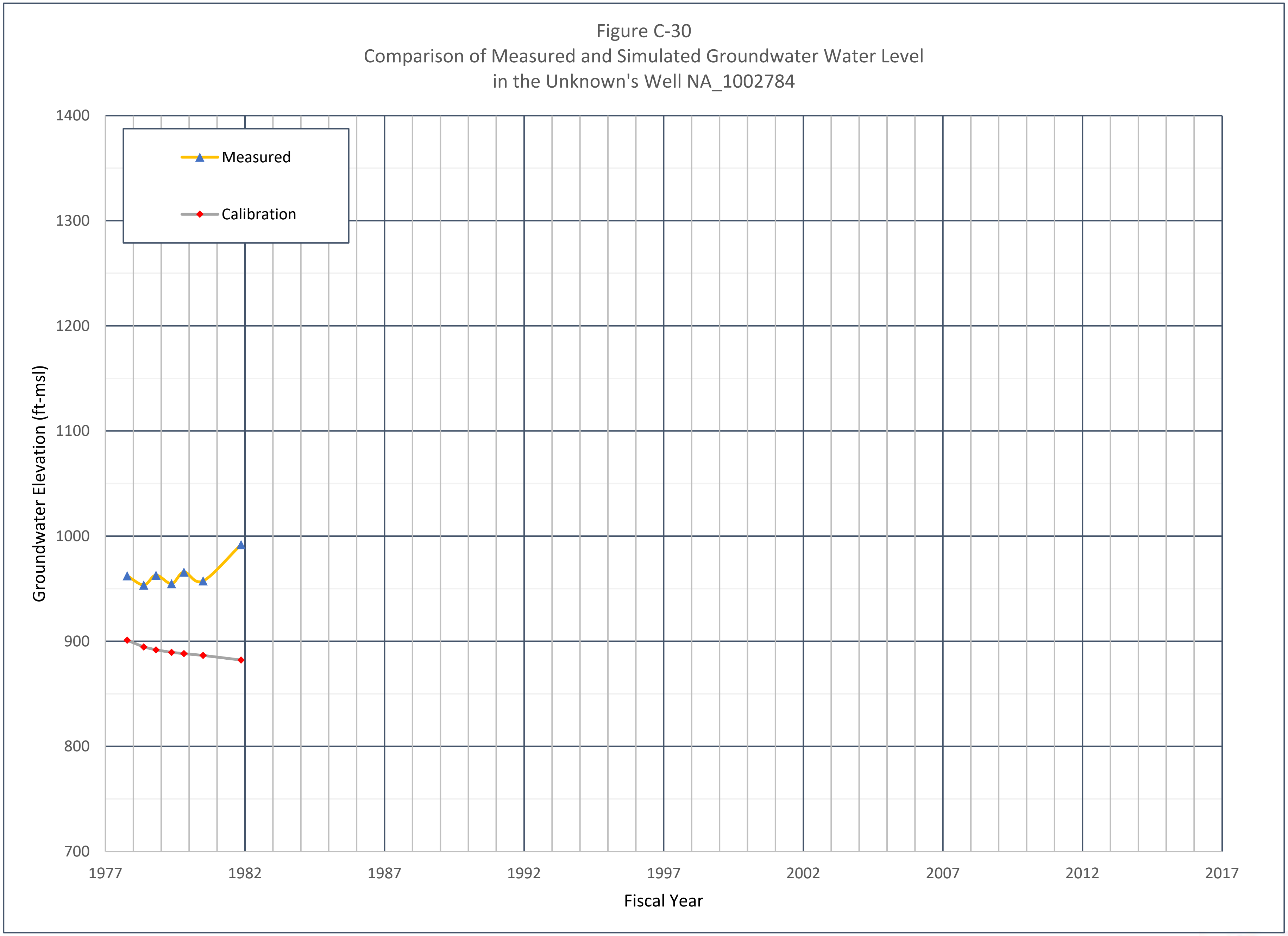


Figure C-30
Comparison of Measured and Simulated Groundwater Water Level
in the Unknown's Well NA_1002784
Measured
Calibration
Groundwater Elevation (ft-msl)
1400
1300
1200
1100
1000
900
800
700
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

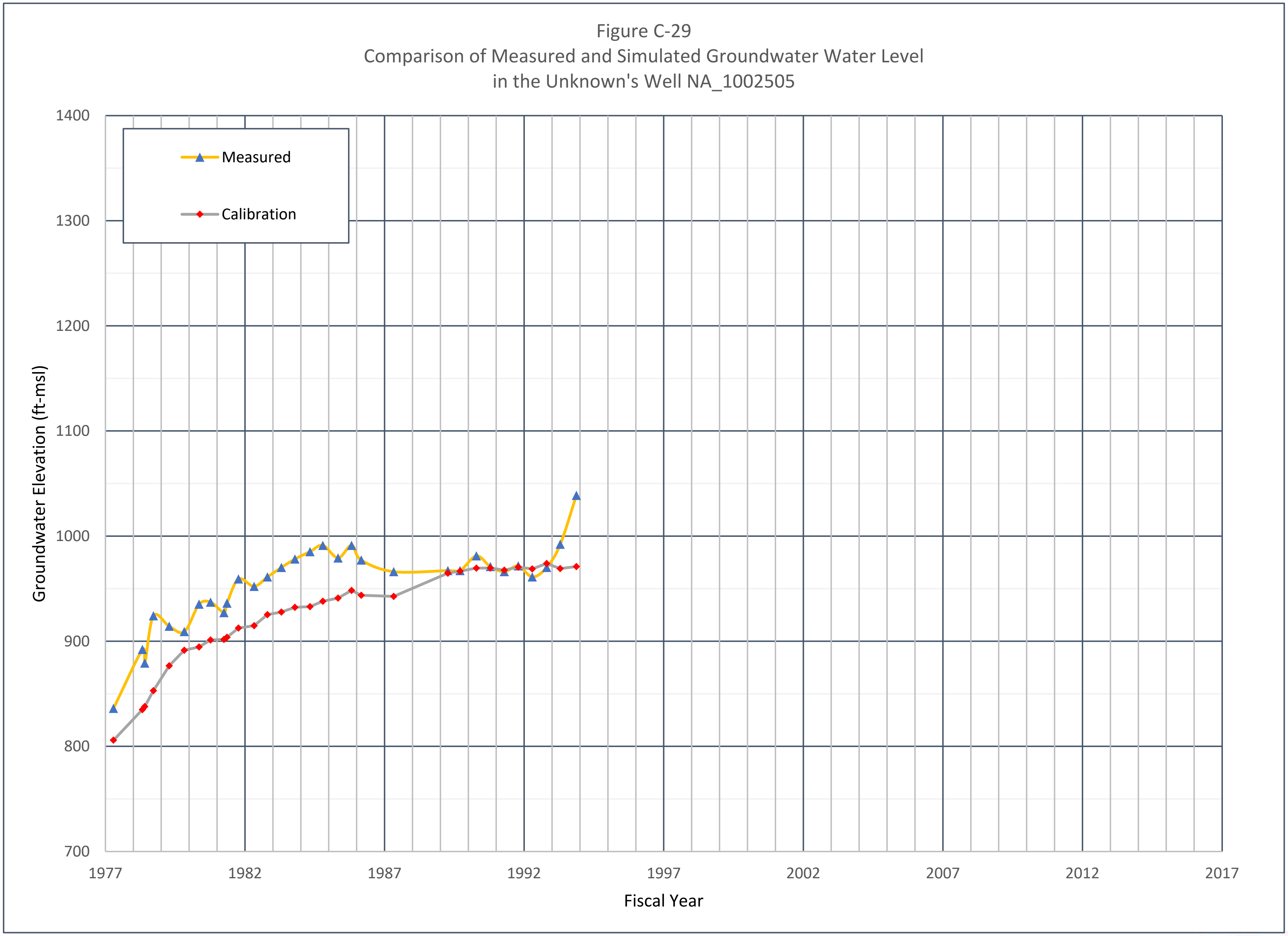


Figure C-29
Comparison of Measured and Simulated Groundwater Water Level
in the Unknown's Well NA_1002505
Measured
Calibration
Groundwater Elevation (ft-msl)
1400
1300
1200
1100
1000
900
800
700
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

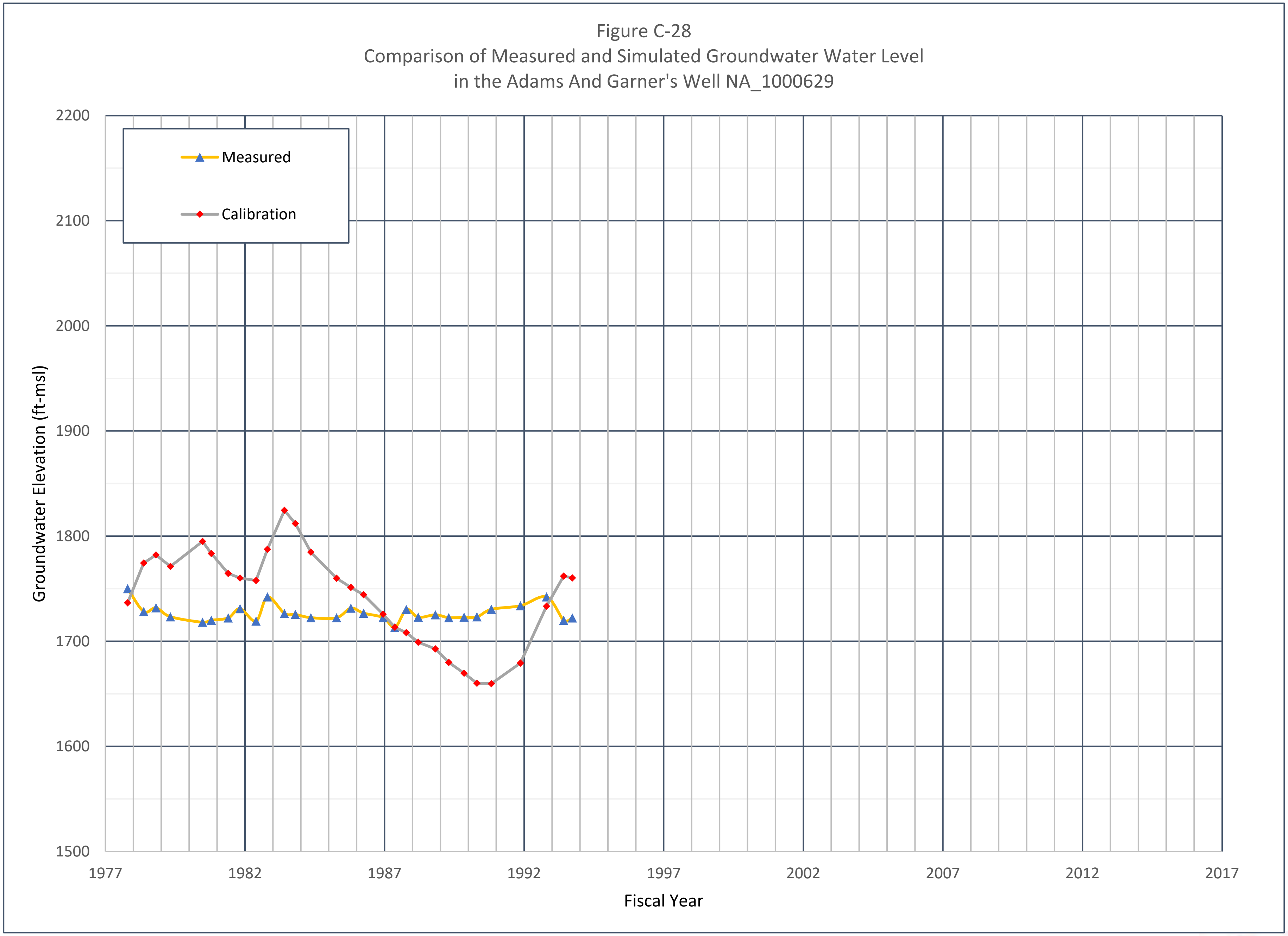


Figure C-28
Comparison of Measured and Simulated Groundwater Water Level
in the Adams And Garner's Well NA_1000629
Measured
Calibration
Groundwater Elevation (ft-msl)
2200
2100
2000
1900
1800
1700
1600
1500
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

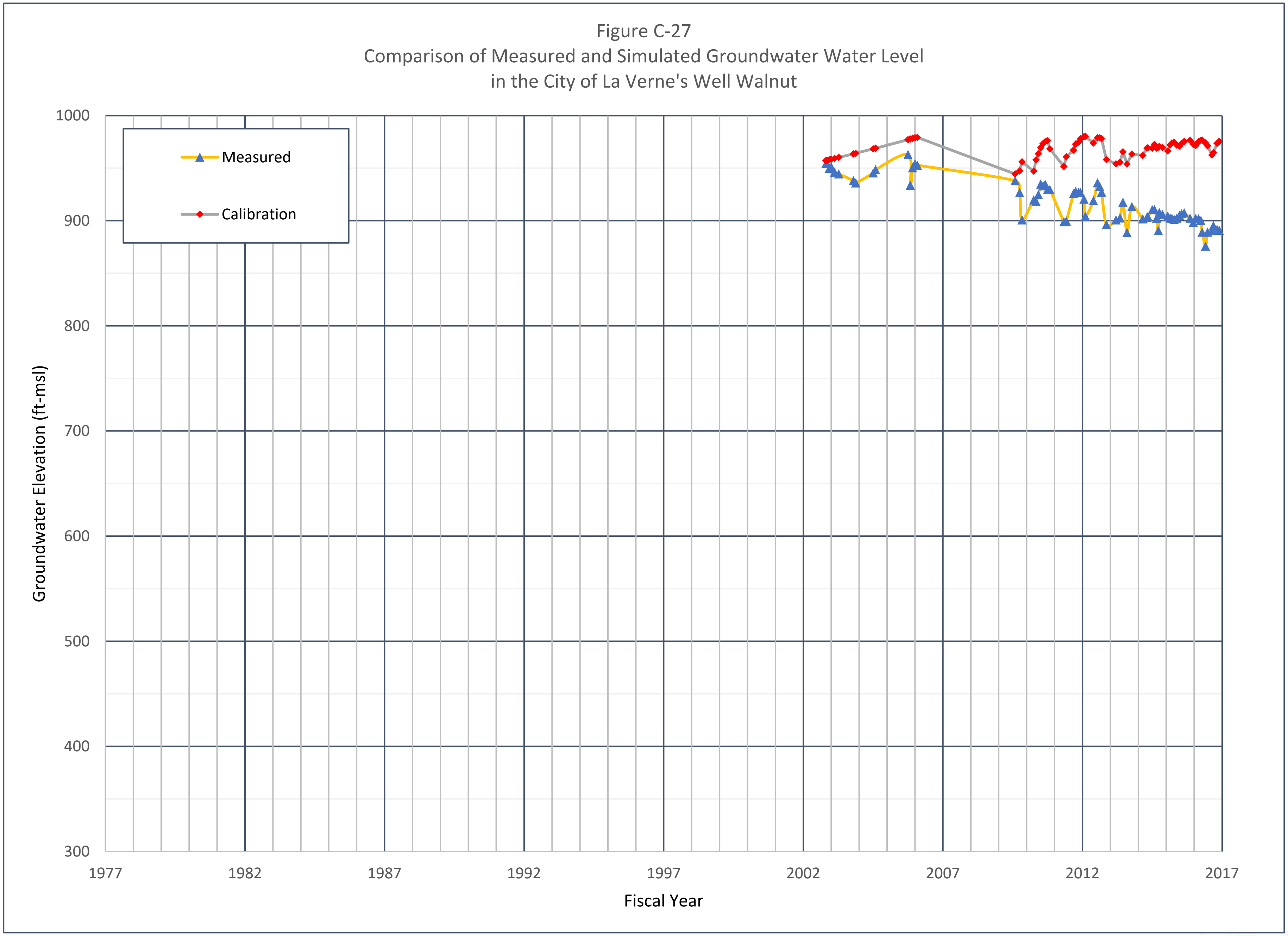


Figure C-27
Comparison of Measured and Simulated Groundwater Water Level
in the City of La Verne's Well Walnut
Measured
Calibration
Groundwater Elevation (ft-msl)
1000
900
800
700
600
500
400
300
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

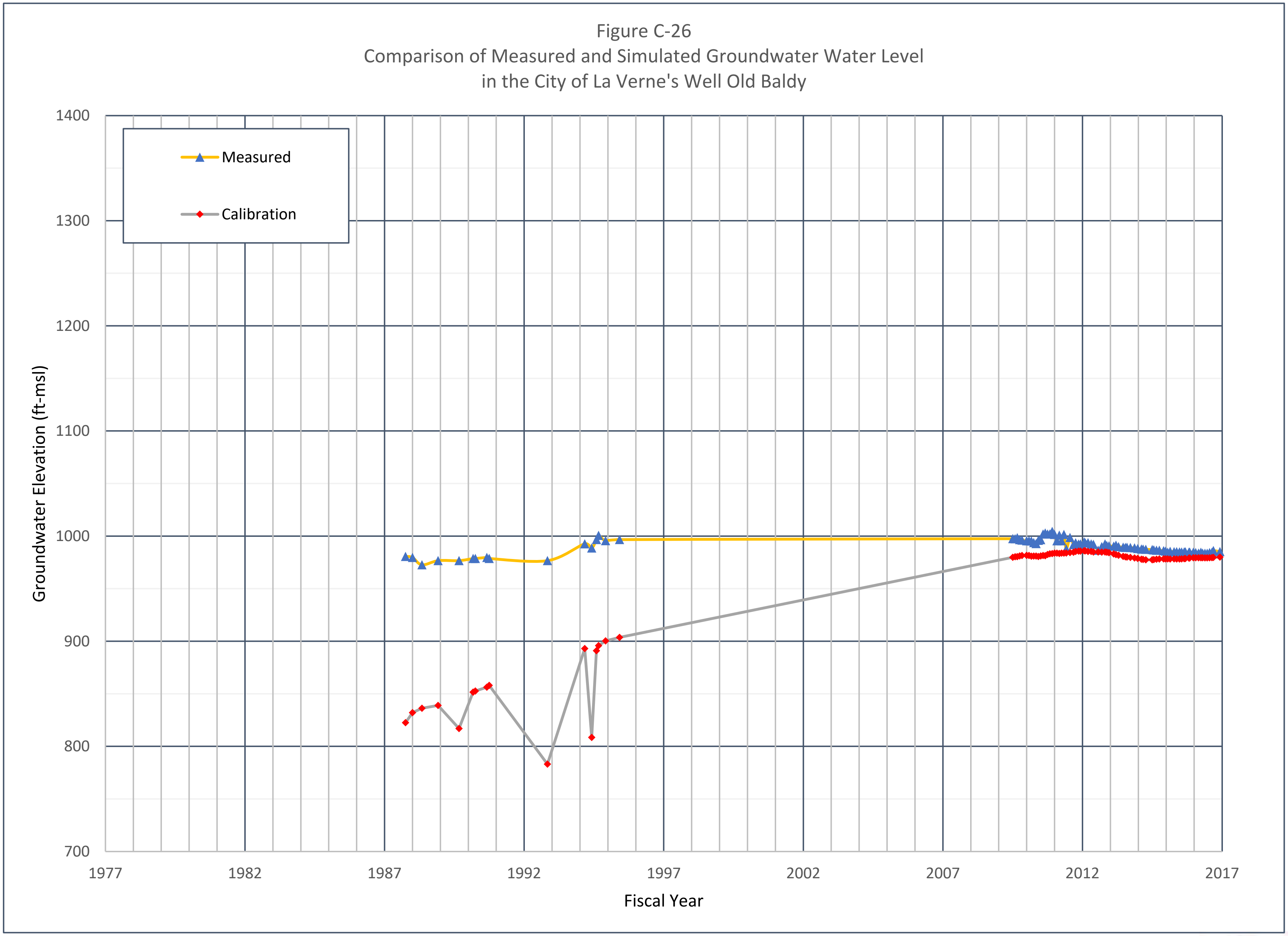


Figure C-26
Comparison of Measured and Simulated Groundwater Water Level
in the City of La Verne's Well Old Baldy
Measured
Calibration
Groundwater Elevation (ft-msl)
1400
1300
1200
1100
1000
900
800
700
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

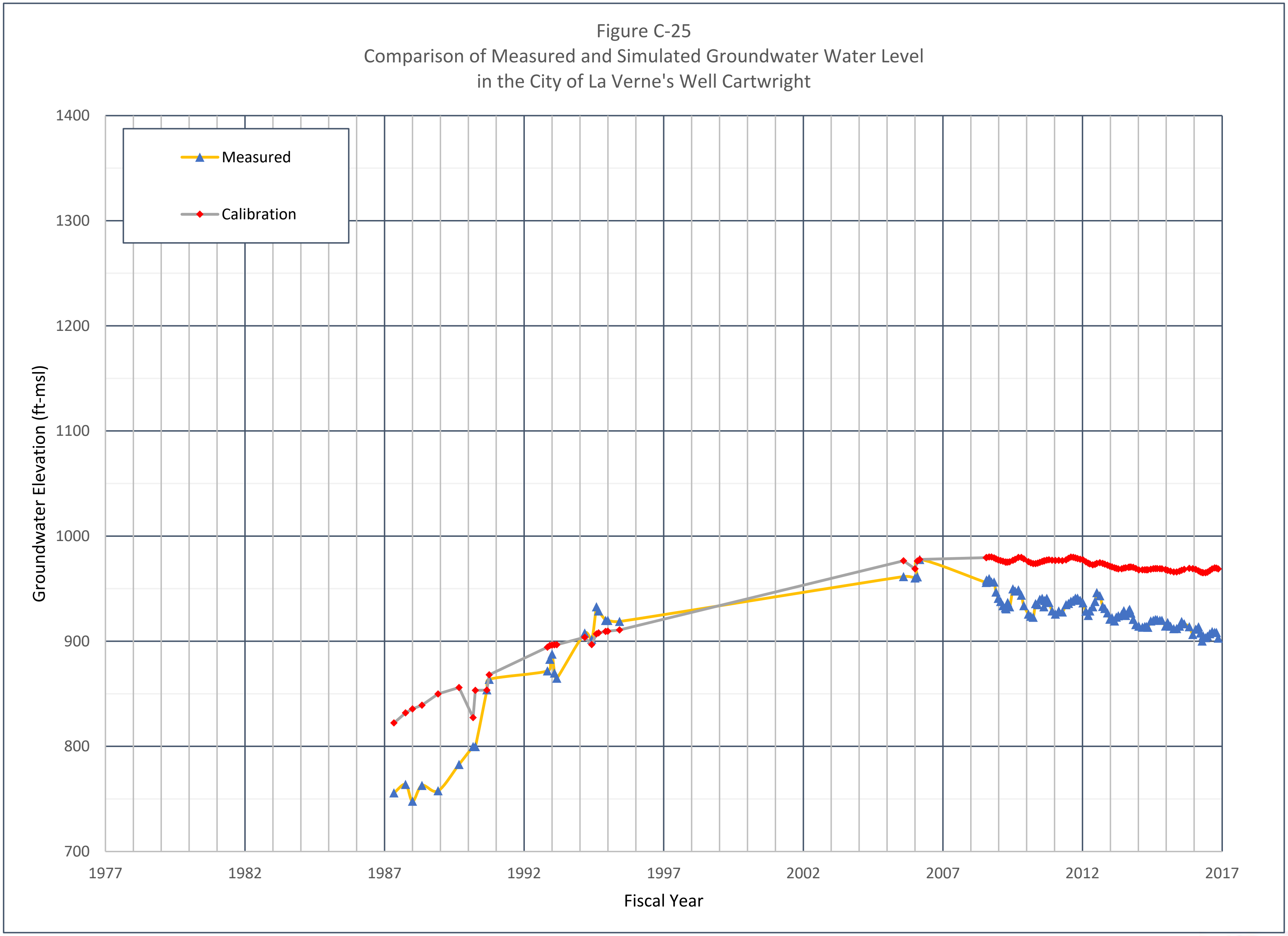


Figure C-25
Comparison of Measured and Simulated Groundwater Water Level
in the City of La Verne's Well Cartwright
Measured
Calibration
Groundwater Elevation (ft-msl)
1400
1300
1200
1100
1000
900
800
700
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

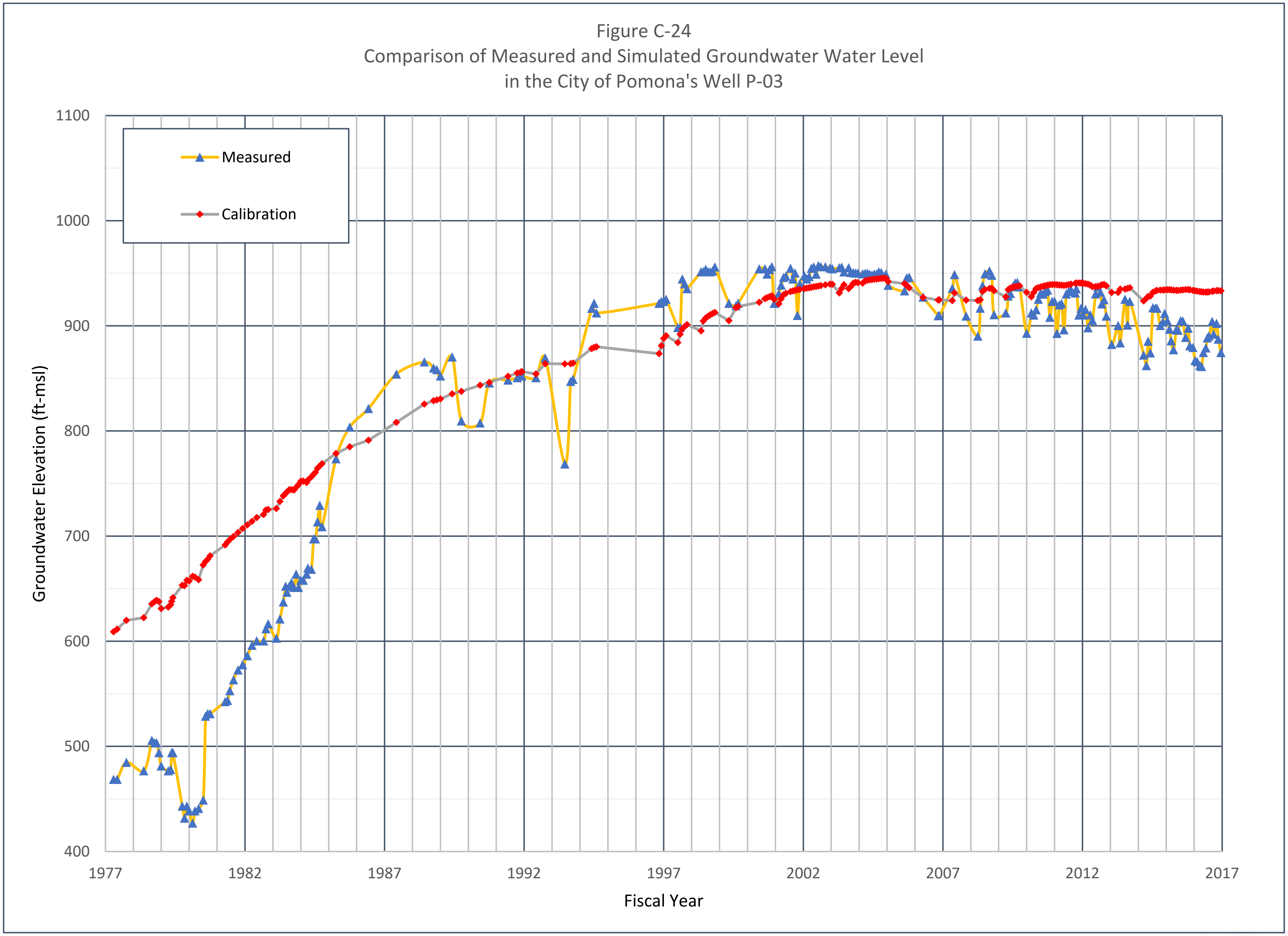


Figure C-24
Comparison of Measured and Simulated Groundwater Water Level
in the City of Pomona's Well P-03
Measured
Calibration
Groundwater Elevation (ft-msl)
1100
1000
900
800
700
600
500
400
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

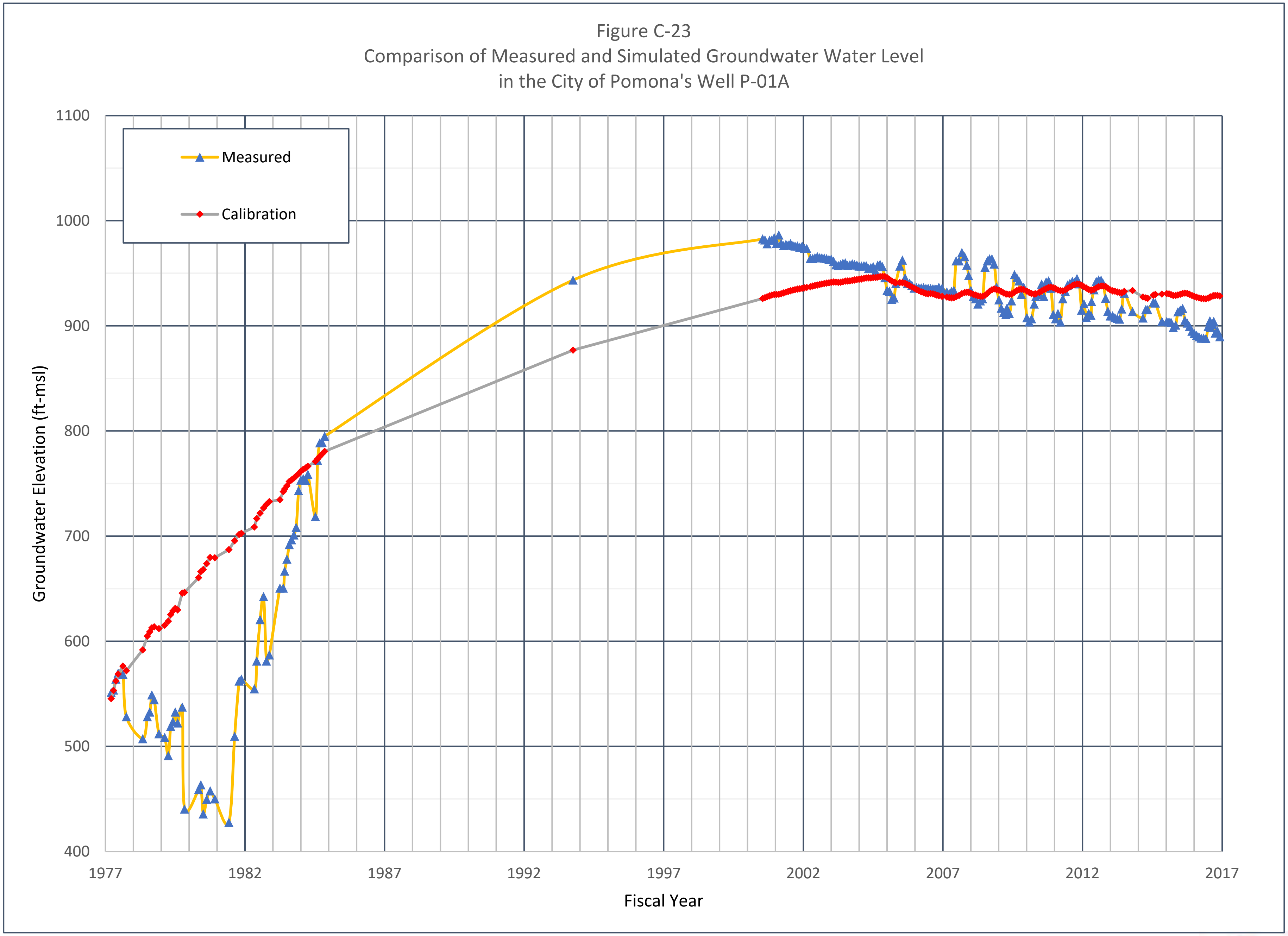


Figure C-23
Comparison of Measured and Simulated Groundwater Water Level
in the City of Pomona's Well P-01A
Measured
Calibration
Groundwater Elevation (ft-msl)
1100
1000
900
800
700
600
500
400
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

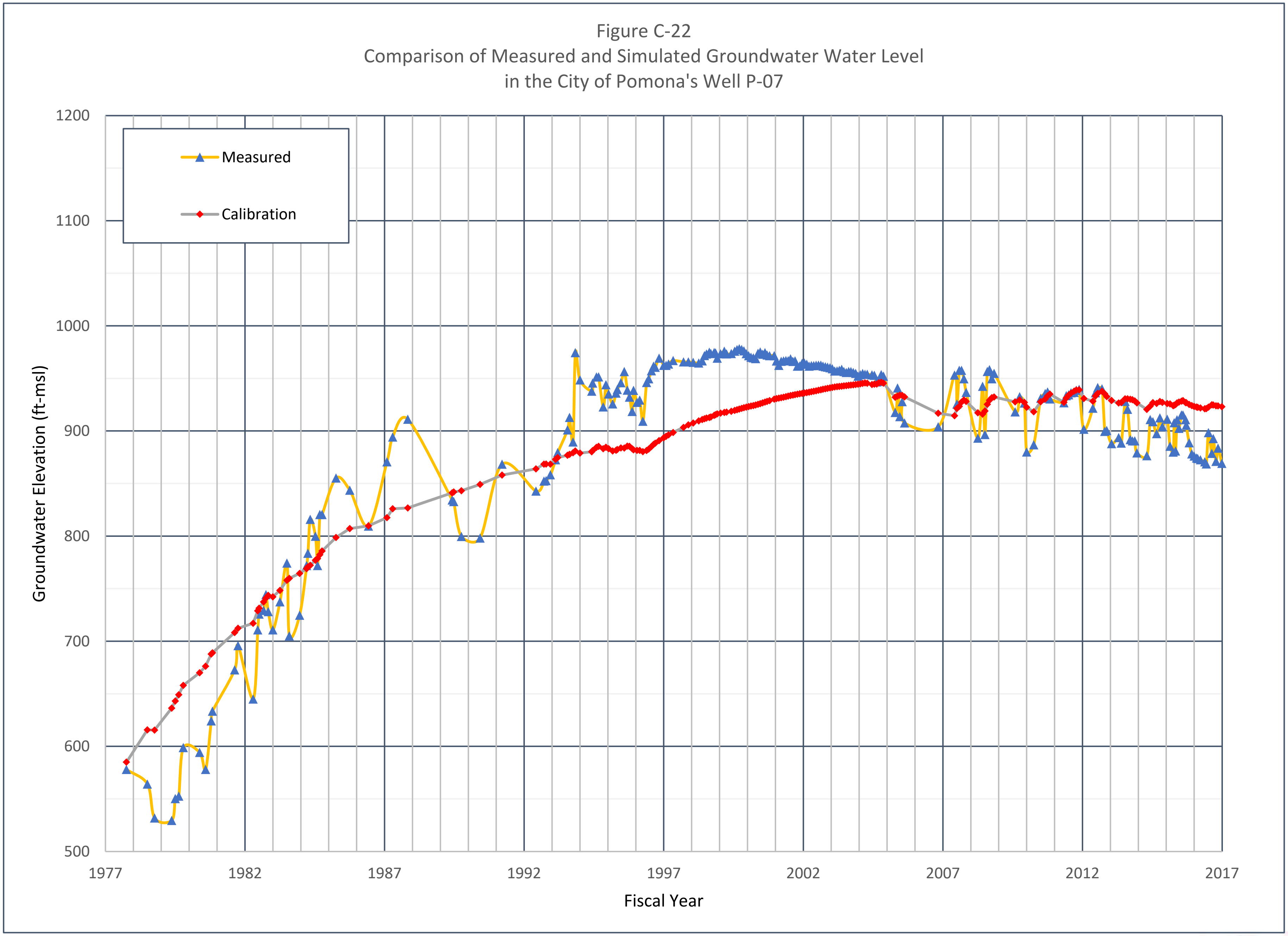


Figure C-22
Comparison of Measured and Simulated Groundwater Water Level
in the City of Pomona's Well P-07
Measured
Calibration
Groundwater Elevation (ft-msl)
1200
1100
1000
900
800
700
600
500
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

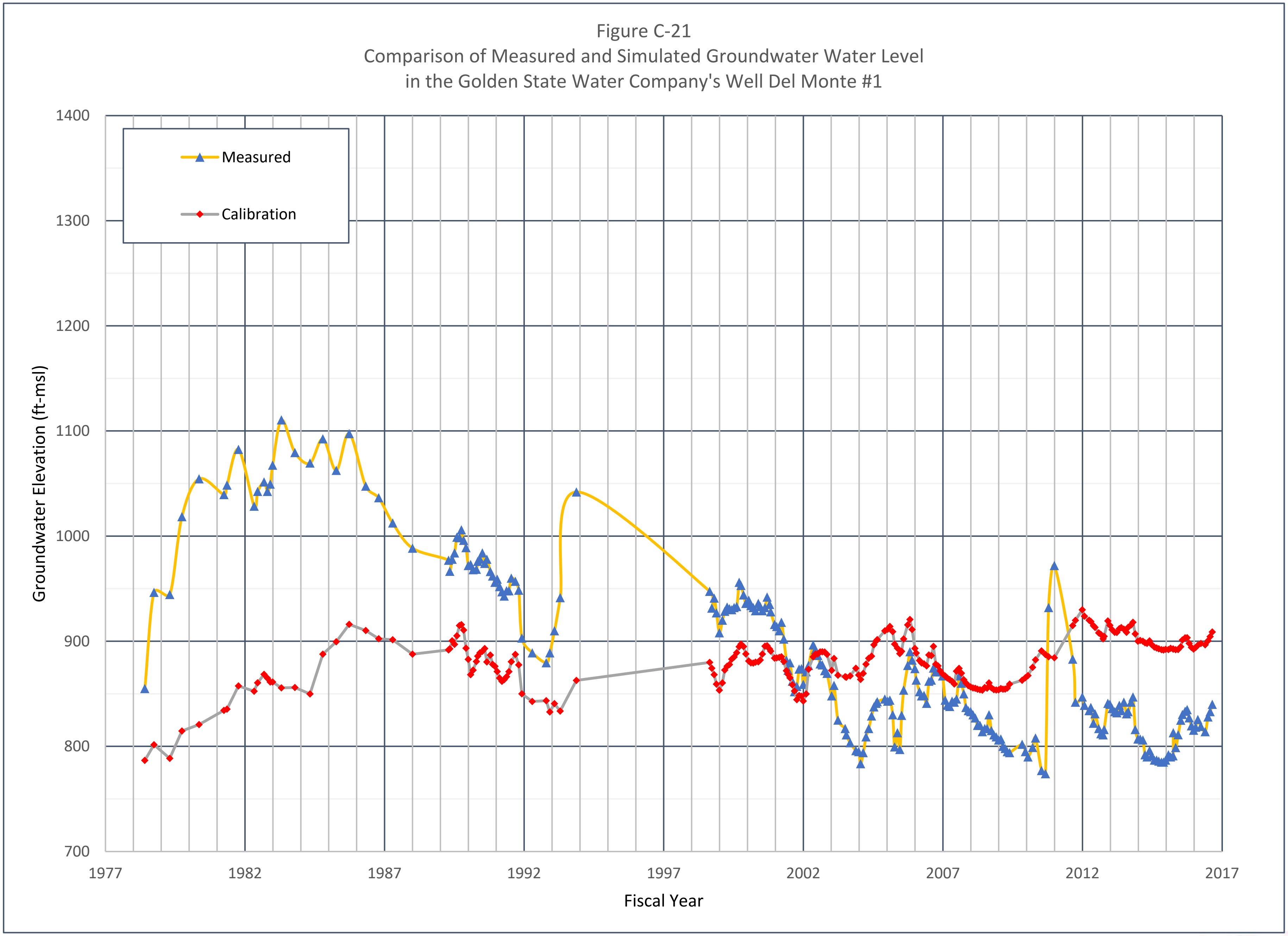


Figure C-21
Comparison of Measured and Simulated Groundwater Water Level
in the Golden State Water Company's Well Del Monte #1
Measured
Calibration
Groundwater Elevation (ft-msl)
1400
1300
1200
1100
1000
900
800
700
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

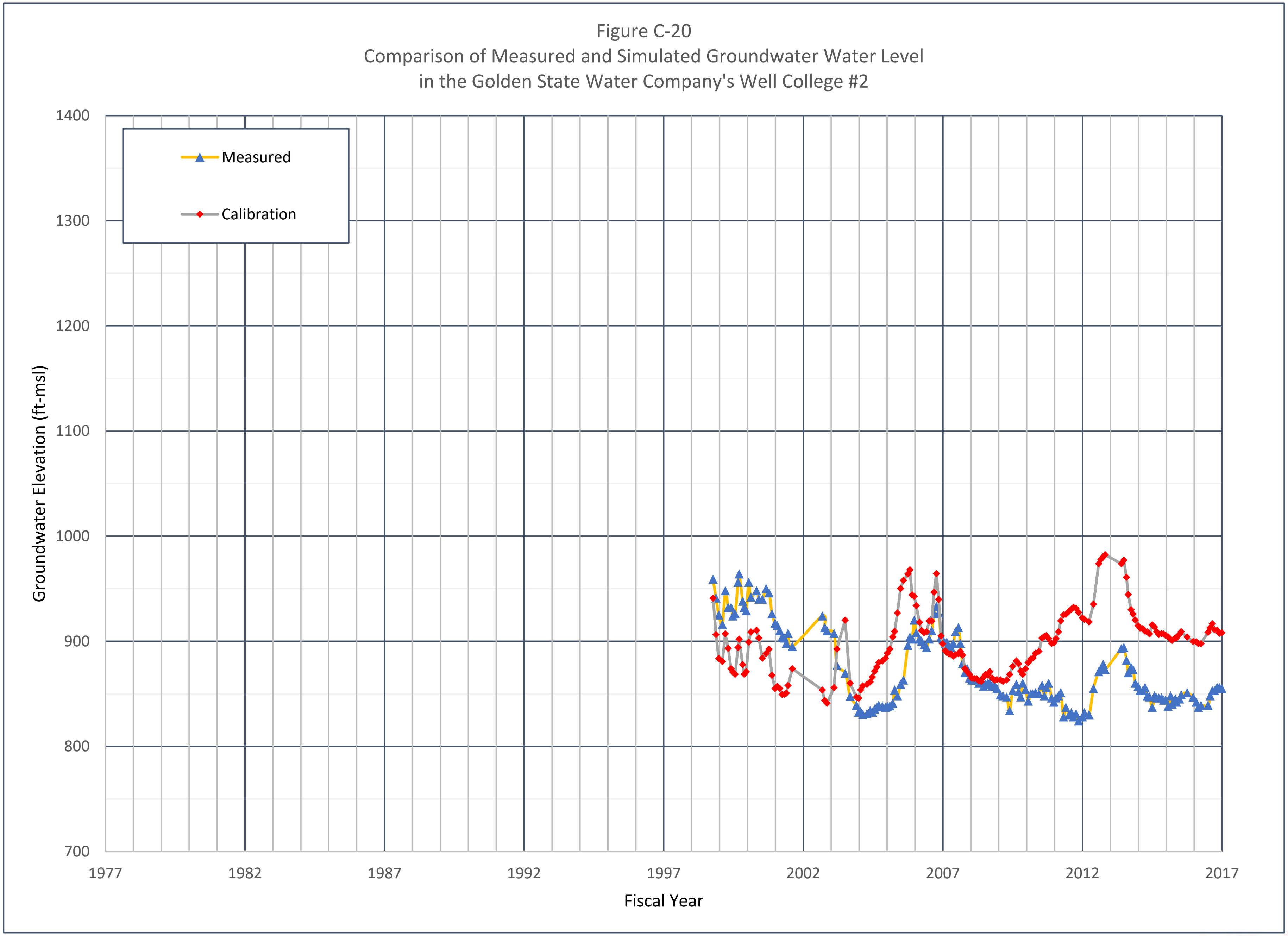


Figure C-20
Comparison of Measured and Simulated Groundwater Water Level
in the Golden State Water Company's Well College #2
Measured
Calibration
Groundwater Elevation (ft-msl)
1400
1300
1200
1100
1000
900
800
700
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

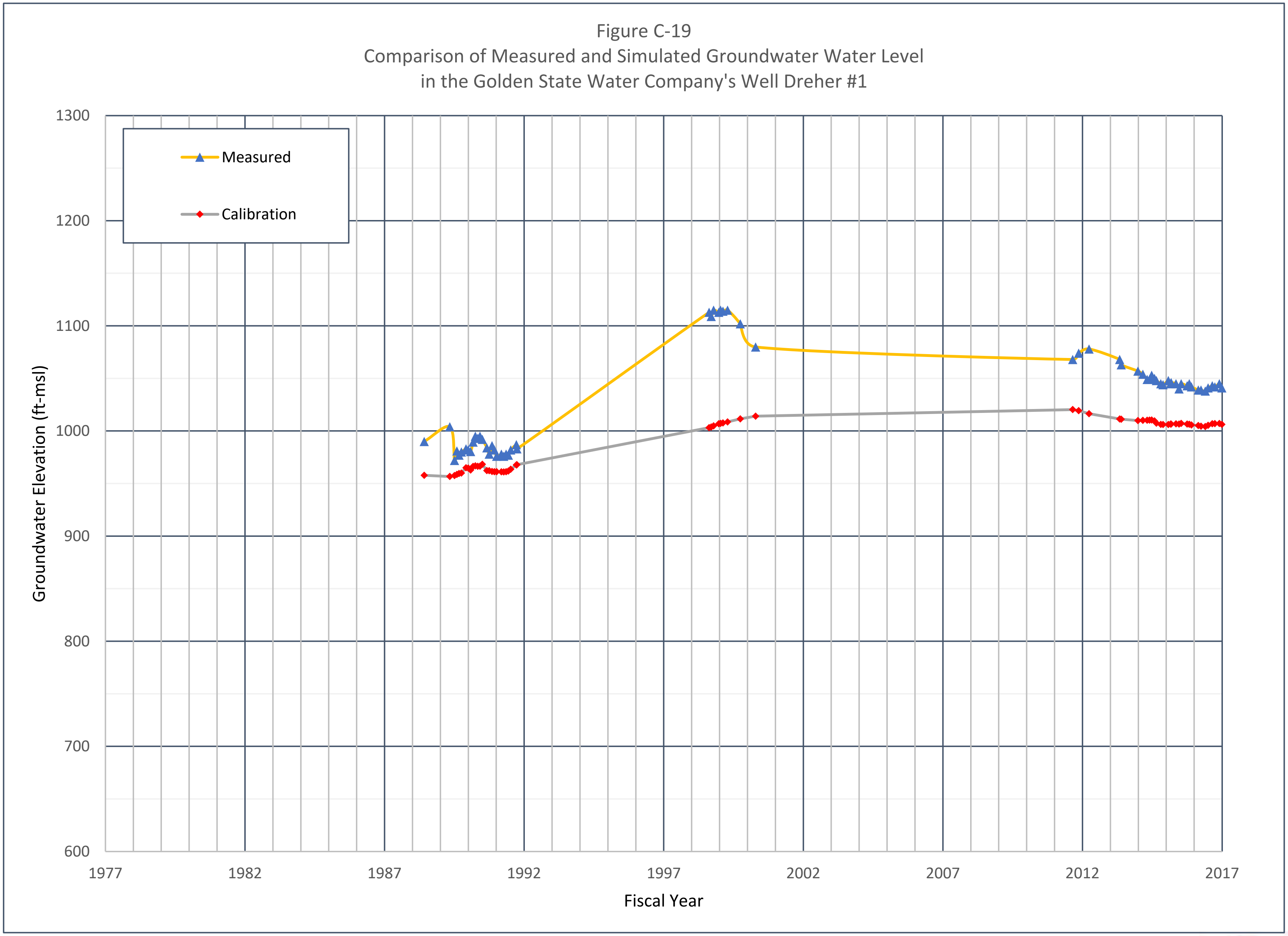


Figure C-19
Comparison of Measured and Simulated Groundwater Water Level
in the Golden State Water Company's Well Dreher #1
Measured
Calibration
Groundwater Elevation (ft-msl)
1300
1200
1100
1000
900
800
700
600
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

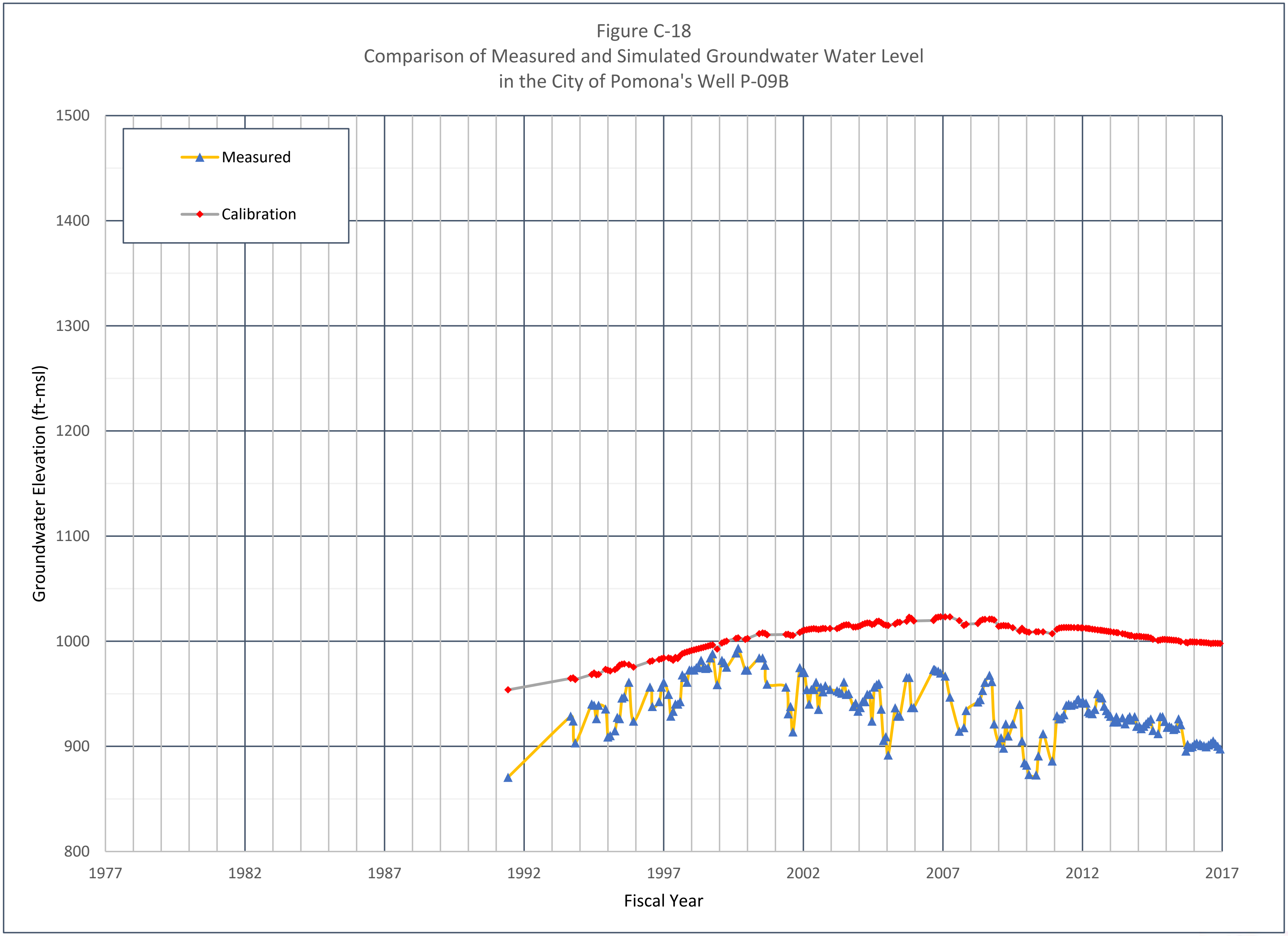


Figure C-18
Comparison of Measured and Simulated Groundwater Water Level
in the City of Pomona's Well P-09B
Measured
Calibration
Groundwater Elevation (ft-msl)
1500
1400
1300
1200
1100
1000
900
800
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

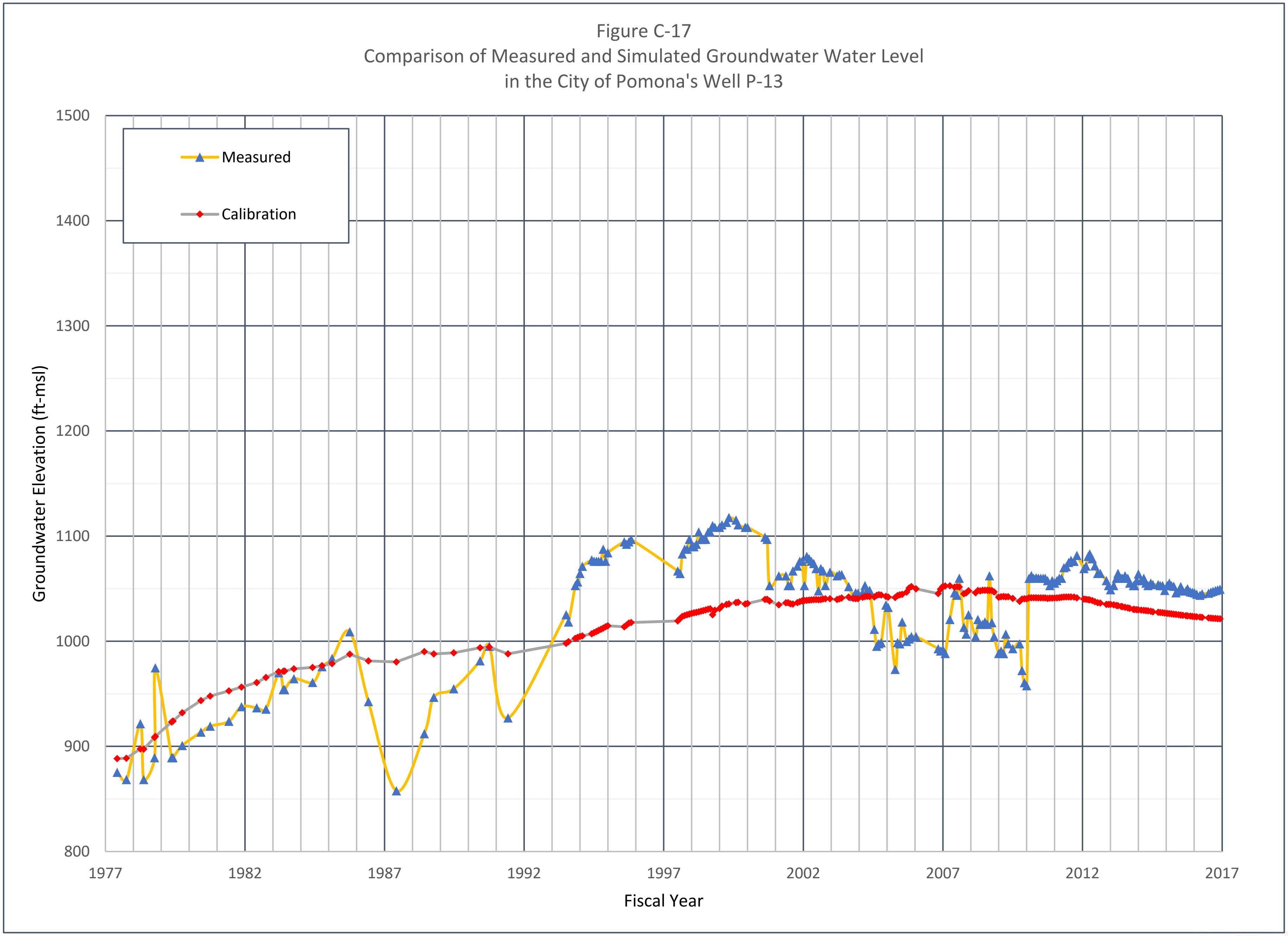


Figure C-17
Comparison of Measured and Simulated Groundwater Water Level
in the City of Pomona's Well P-13
Measured
Calibration
Groundwater Elevation (ft-msl)
1500
1400
1300
1200
1100
1000
900
800
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

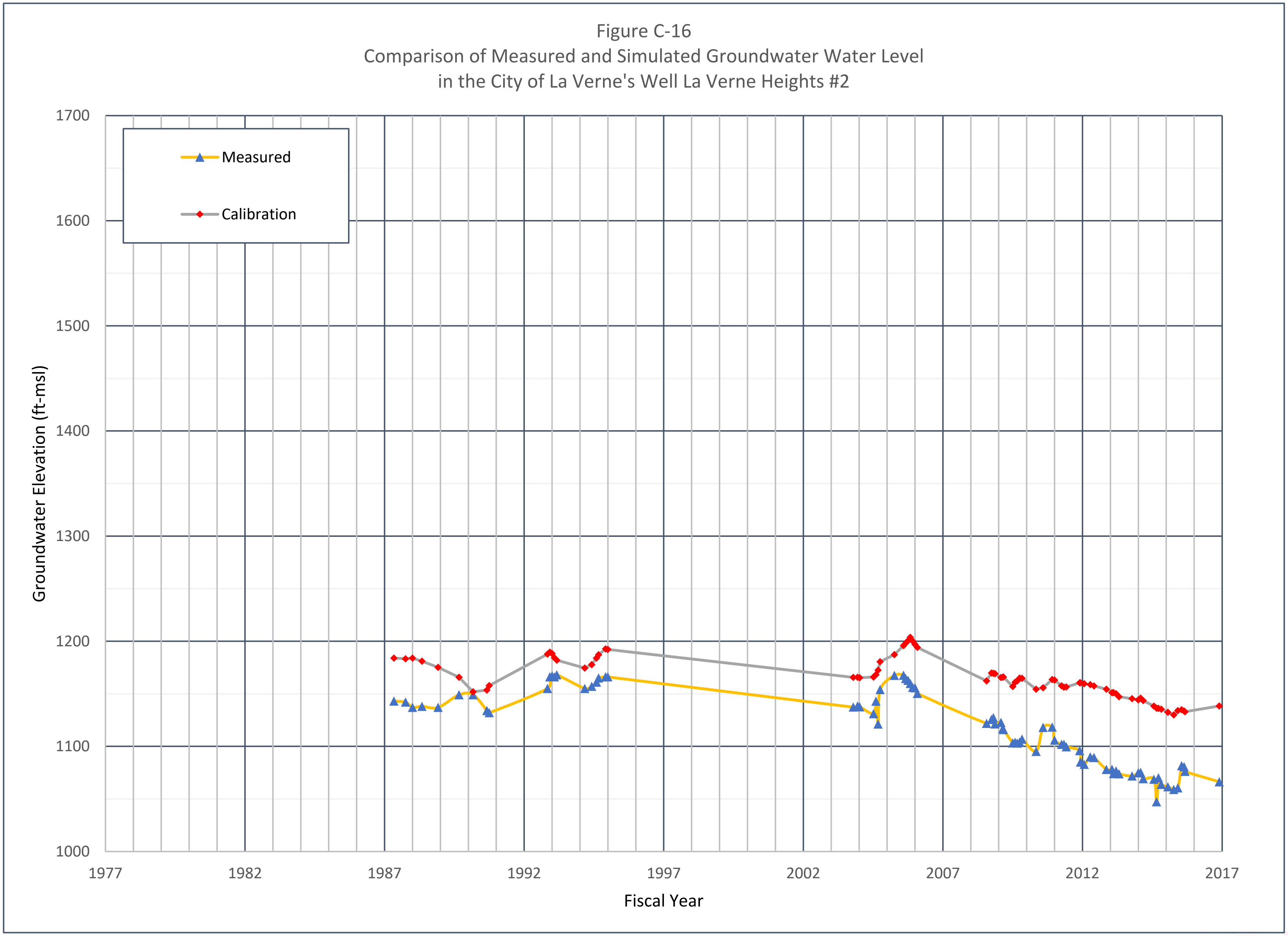
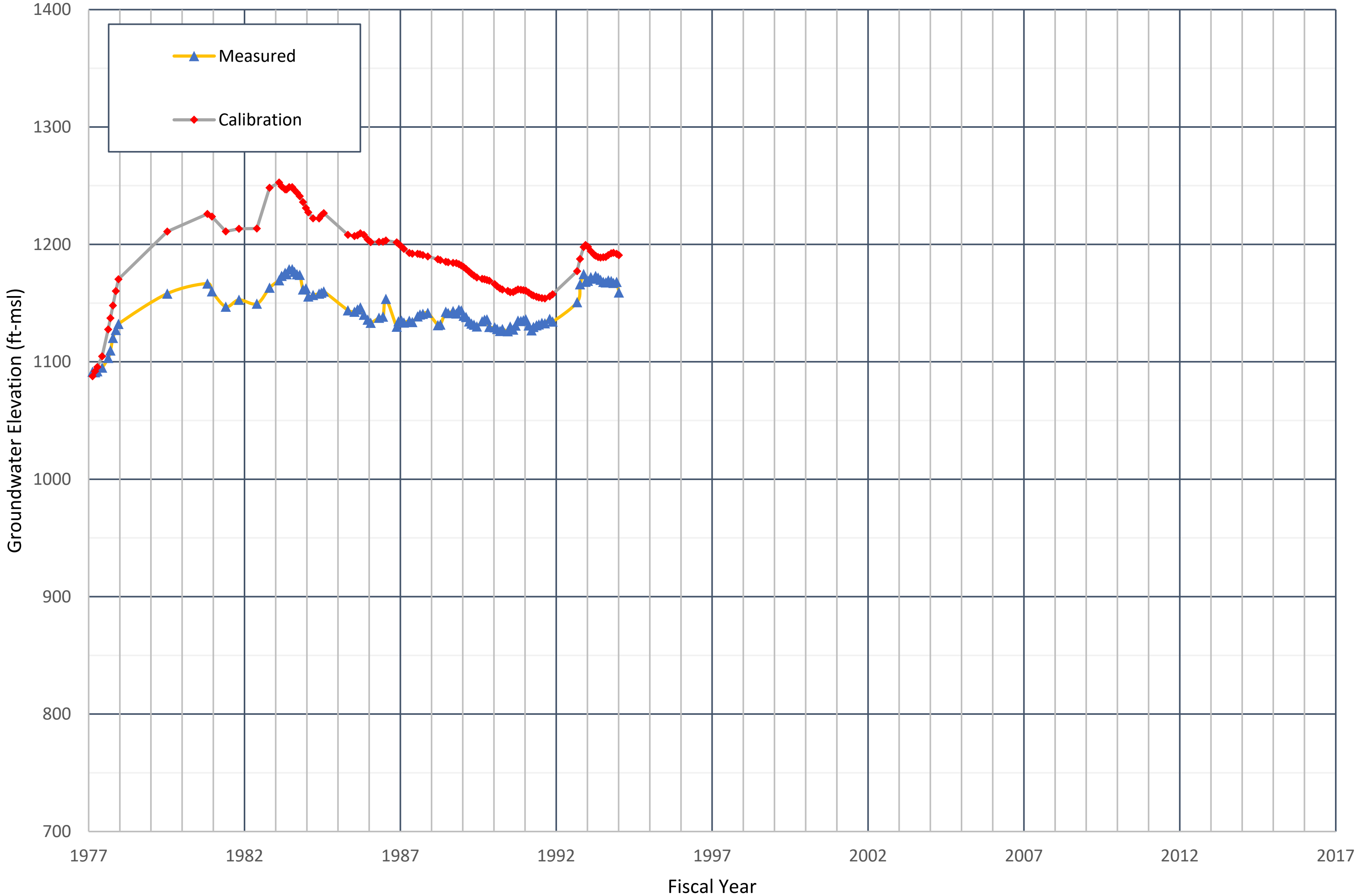


Figure C-16
Comparison of Measured and Simulated Groundwater Water Level
in the City of La Verne's Well La Verne Heights #2
Measured
Calibration
Groundwater Elevation (ft-msl)
1700
1600
1500
1400
1300
1200
1100
1000
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

Figure C-15
Comparison of Measured and Simulated Groundwater Water Level
in the Unknown's Well NA_1002448



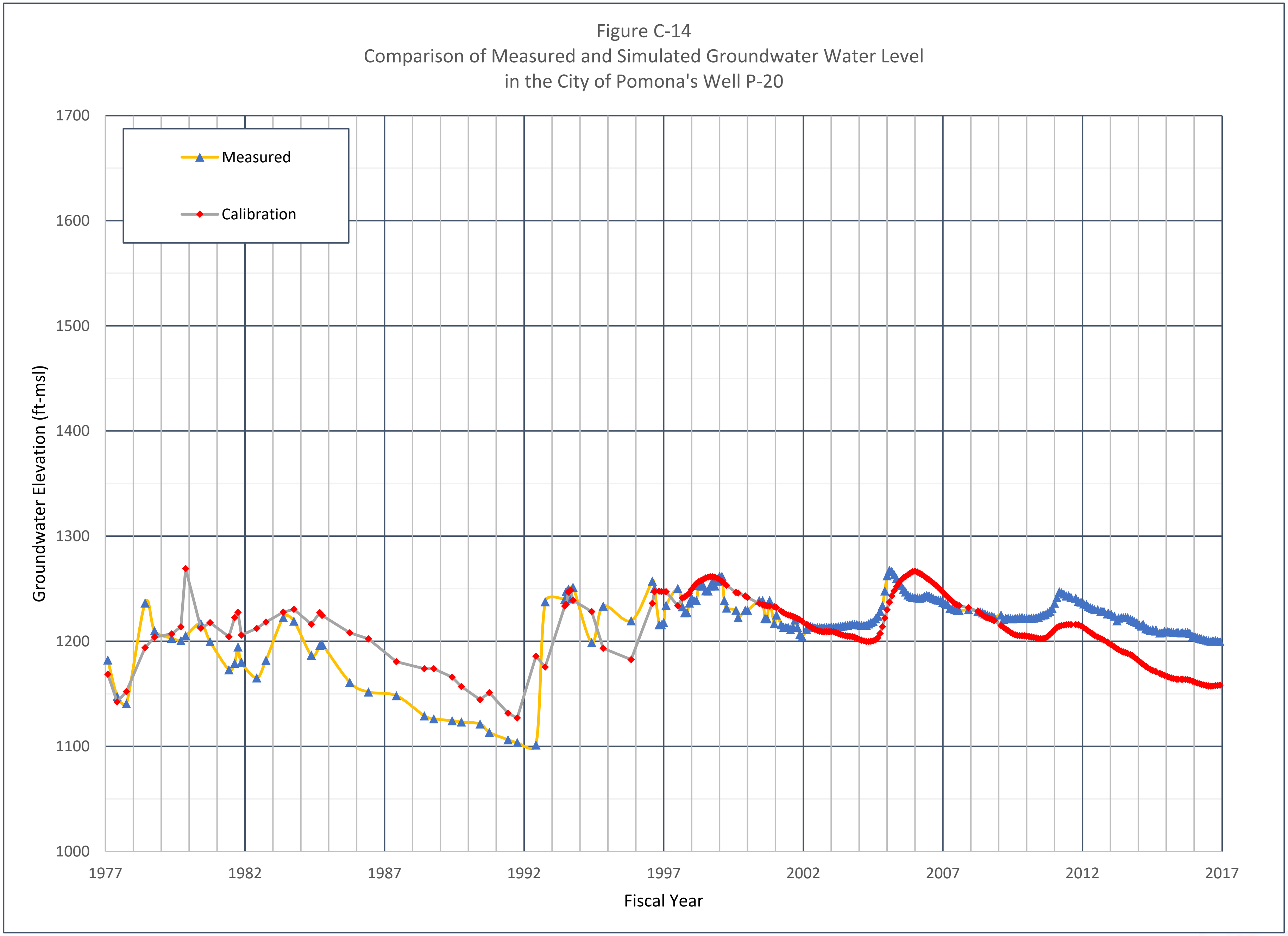


Figure C-14
Comparison of Measured and Simulated Groundwater Water Level
in the City of Pomona's Well P-20
Measured
Calibration
Groundwater Elevation (ft-msl)
1700
1600
1500
1400
1300
1200
1100
1000
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

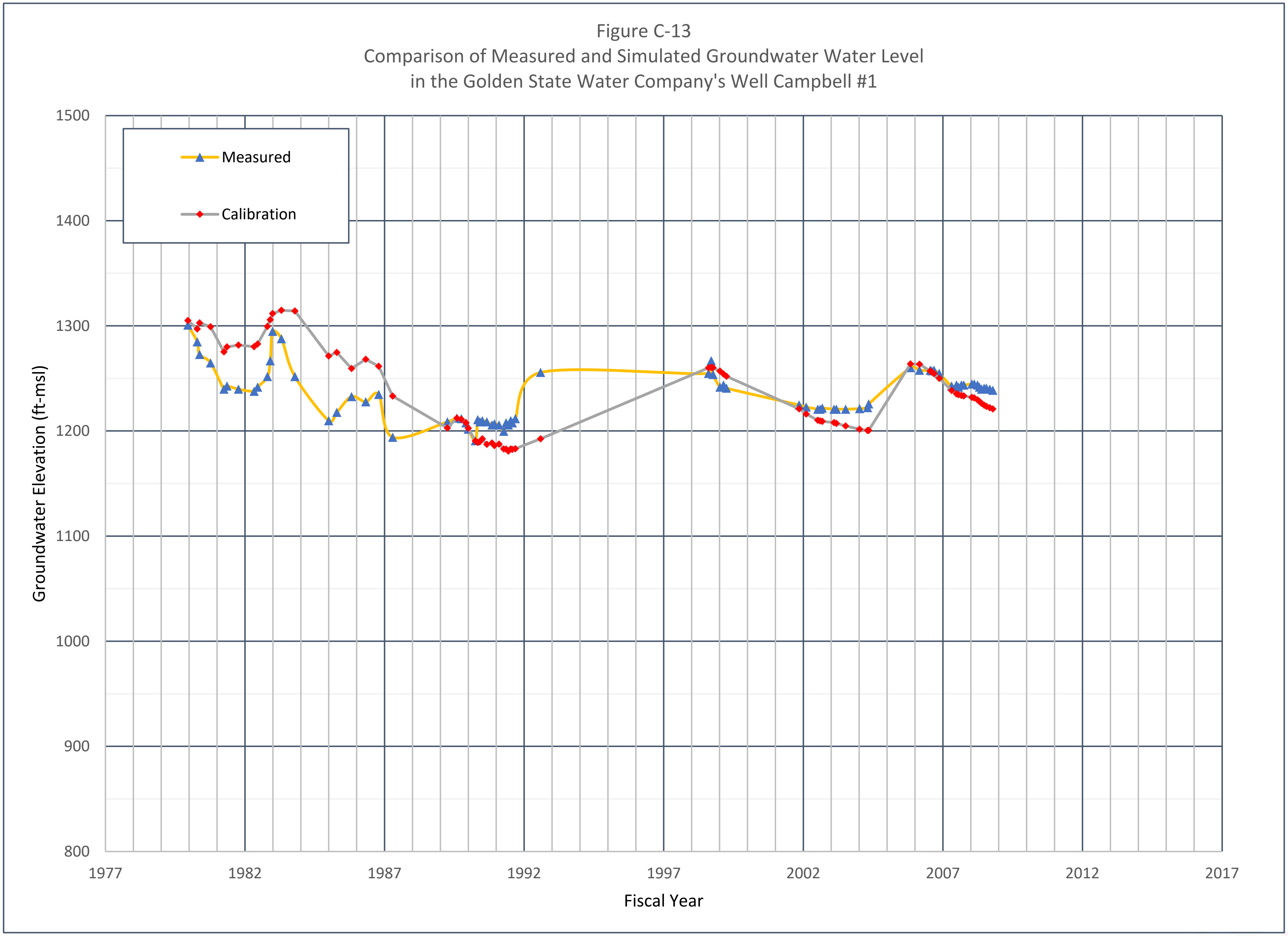


Figure C-13
Comparison of Measured and Simulated Groundwater Water Level
in the Golden State Water Company's Well Campbell #1
Measured
Calibration
Groundwater Elevation (ft-msl)
1500
1400
1300
1200
1100
1000
900
800
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

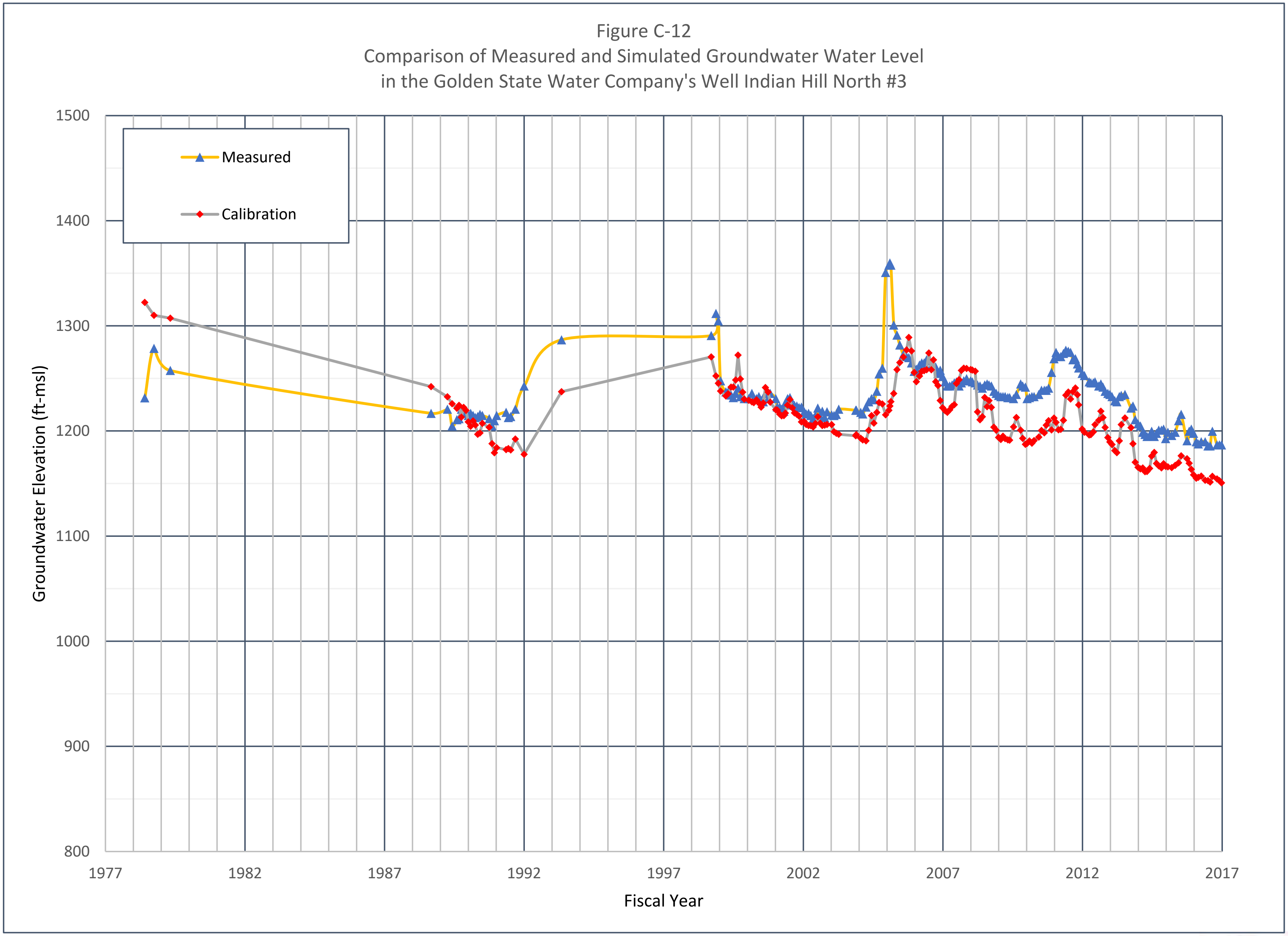


Figure C-12
Comparison of Measured and Simulated Groundwater Water Level
in the Golden State Water Company's Well Indian Hill North #3
Measured
Calibration
Groundwater Elevation (ft-msl)
1500
1400
1300
1200
1100
1000
900
800
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

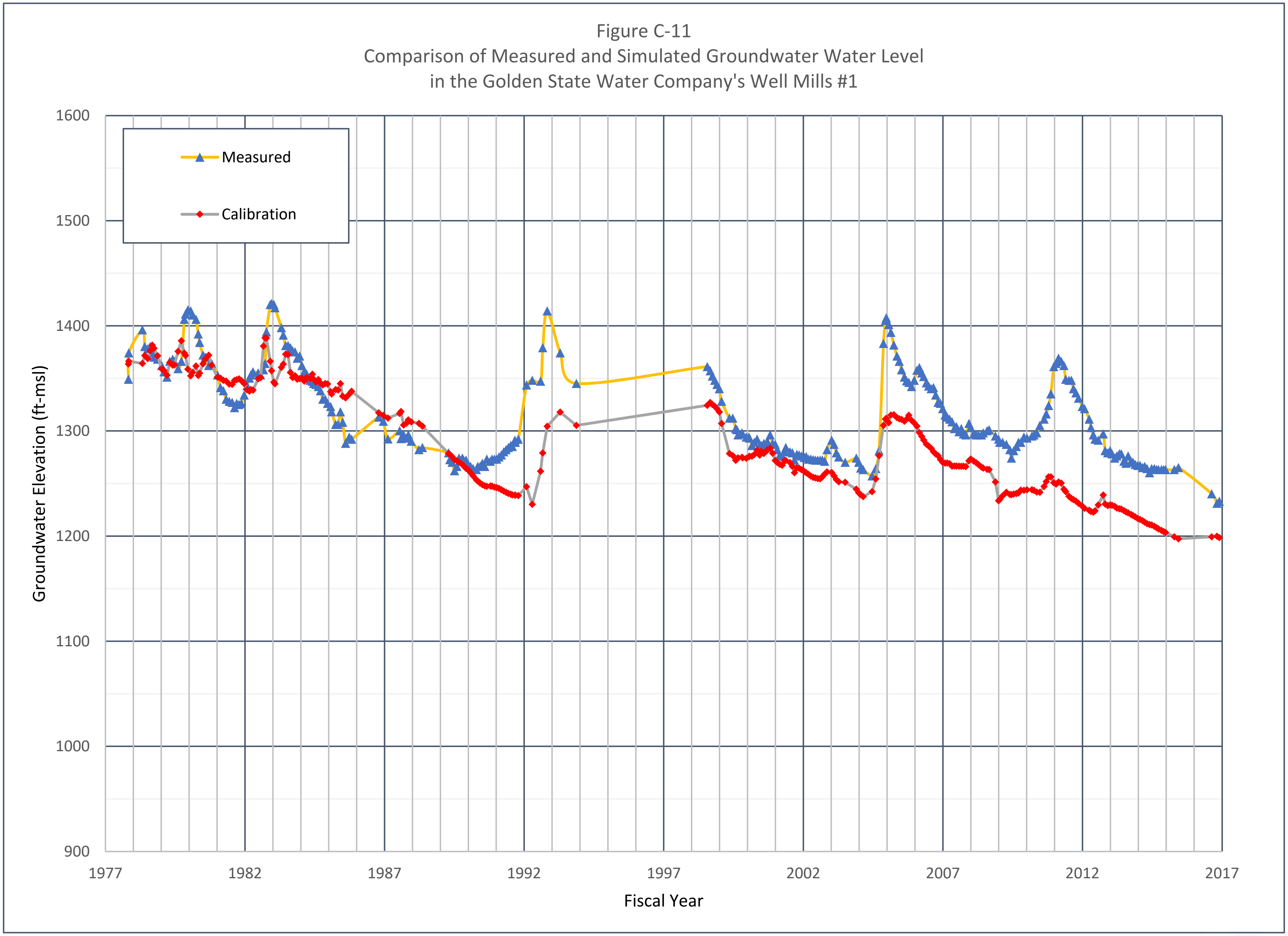


Figure C-11
Comparison of Measured and Simulated Groundwater Water Level
in the Golden State Water Company's Well Mills #1
Measured
Calibration
Groundwater Elevation (ft-msl)
1600
1500
1400
1300
1200
1100
1000
900
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

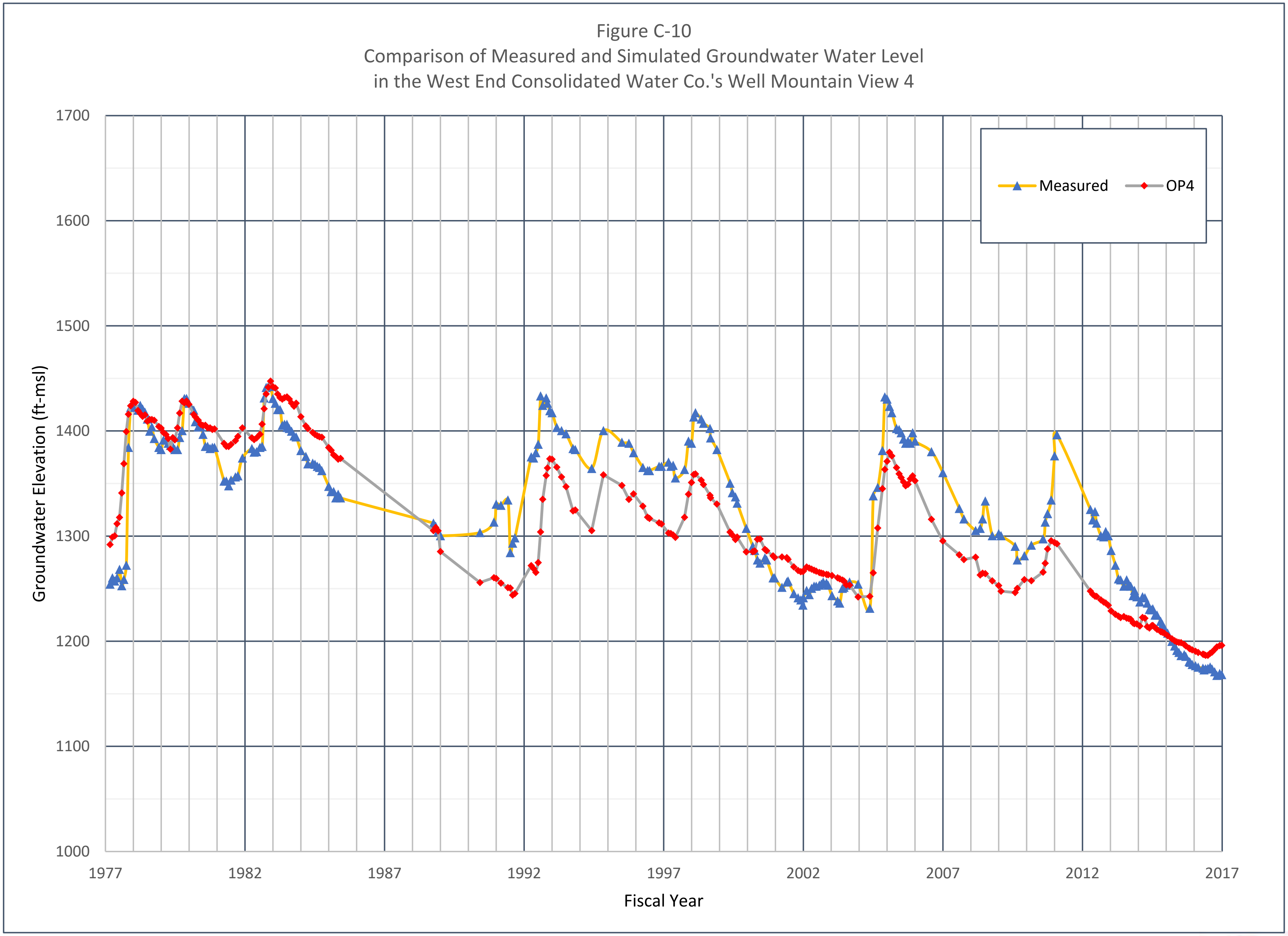


Figure C-10
Comparison of Measured and Simulated Groundwater Water Level
in the West End Consolidated Water Co.'s Well Mountain View 4
1700
1600
1500
1400
1300
1200
1100
1000
Groundwater Elevation (ft-msl)
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year
Measured
OP4

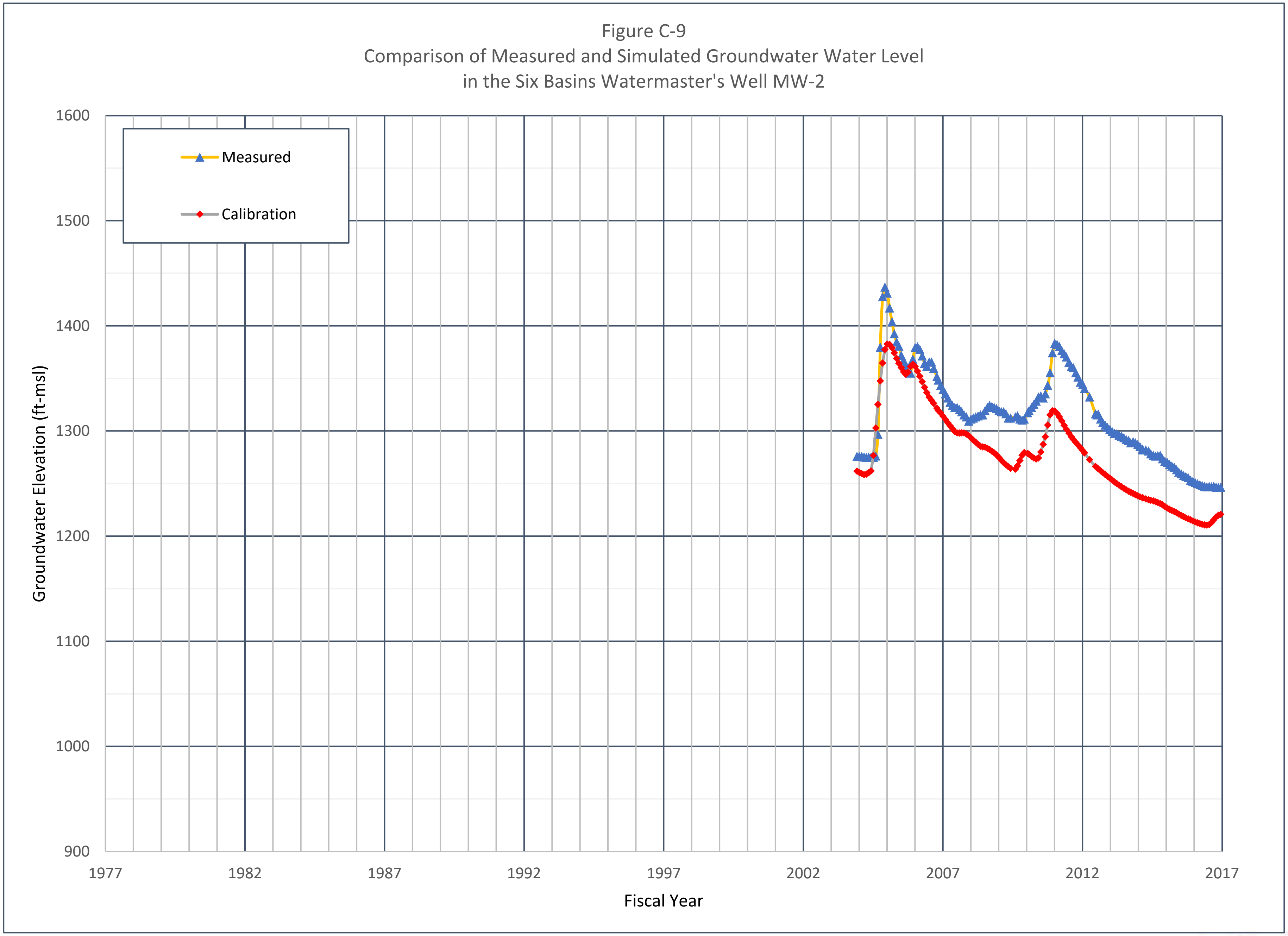


Figure C-9
Comparison of Measured and Simulated Groundwater Water Level
in the Six Basins Watermaster's Well MW-2
Measured
Calibration
Groundwater Elevation (ft-msl)
1600
1500
1400
1300
1200
1100
1000
900
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

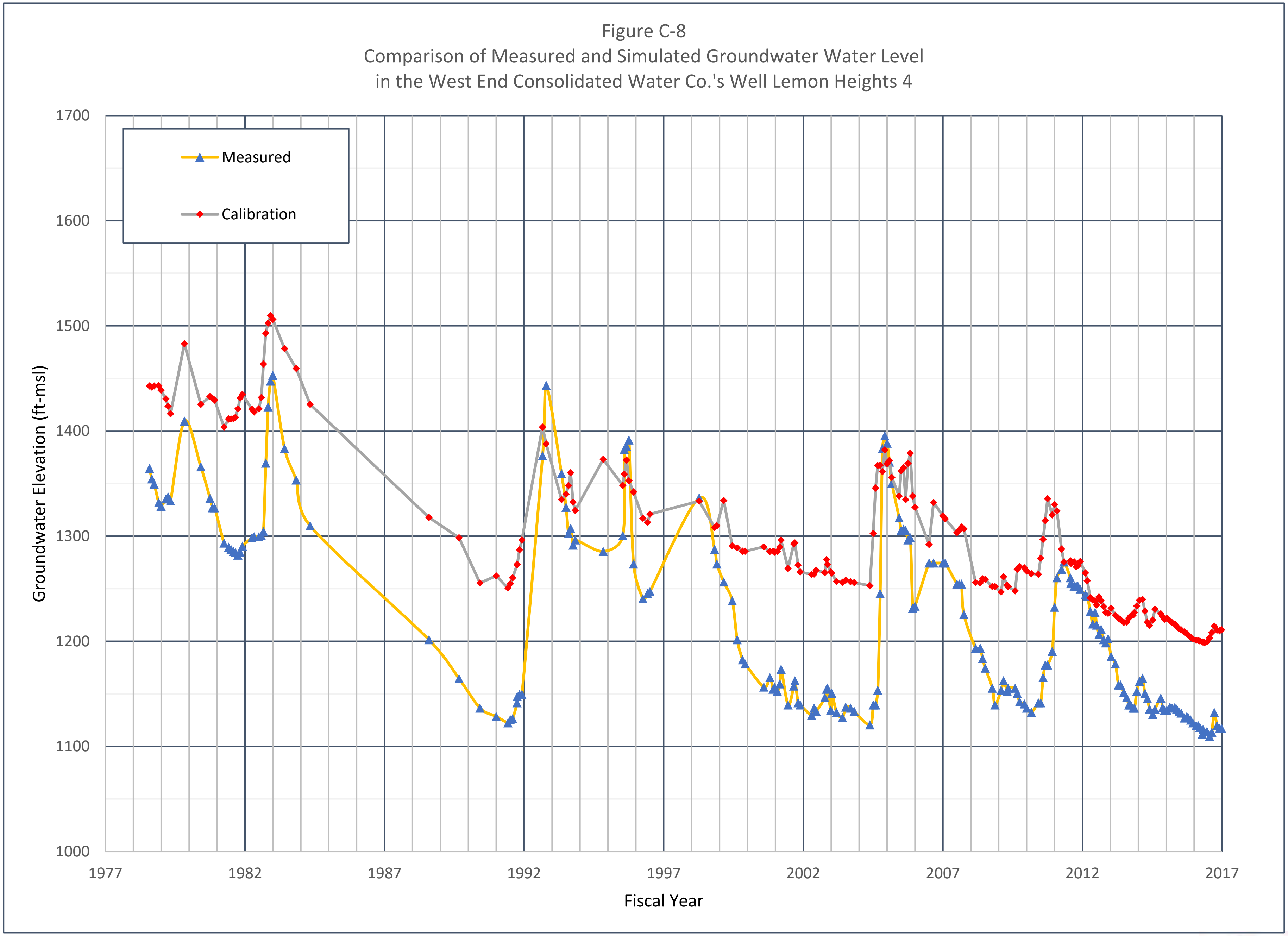


Figure C-8
Comparison of Measured and Simulated Groundwater Water Level
in the West End Consolidated Water Co.'s Well Lemon Heights 4
Measured
Calibration
Groundwater Elevation (ft-msl)
1700
1600
1500
1400
1300
1200
1100
1000
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

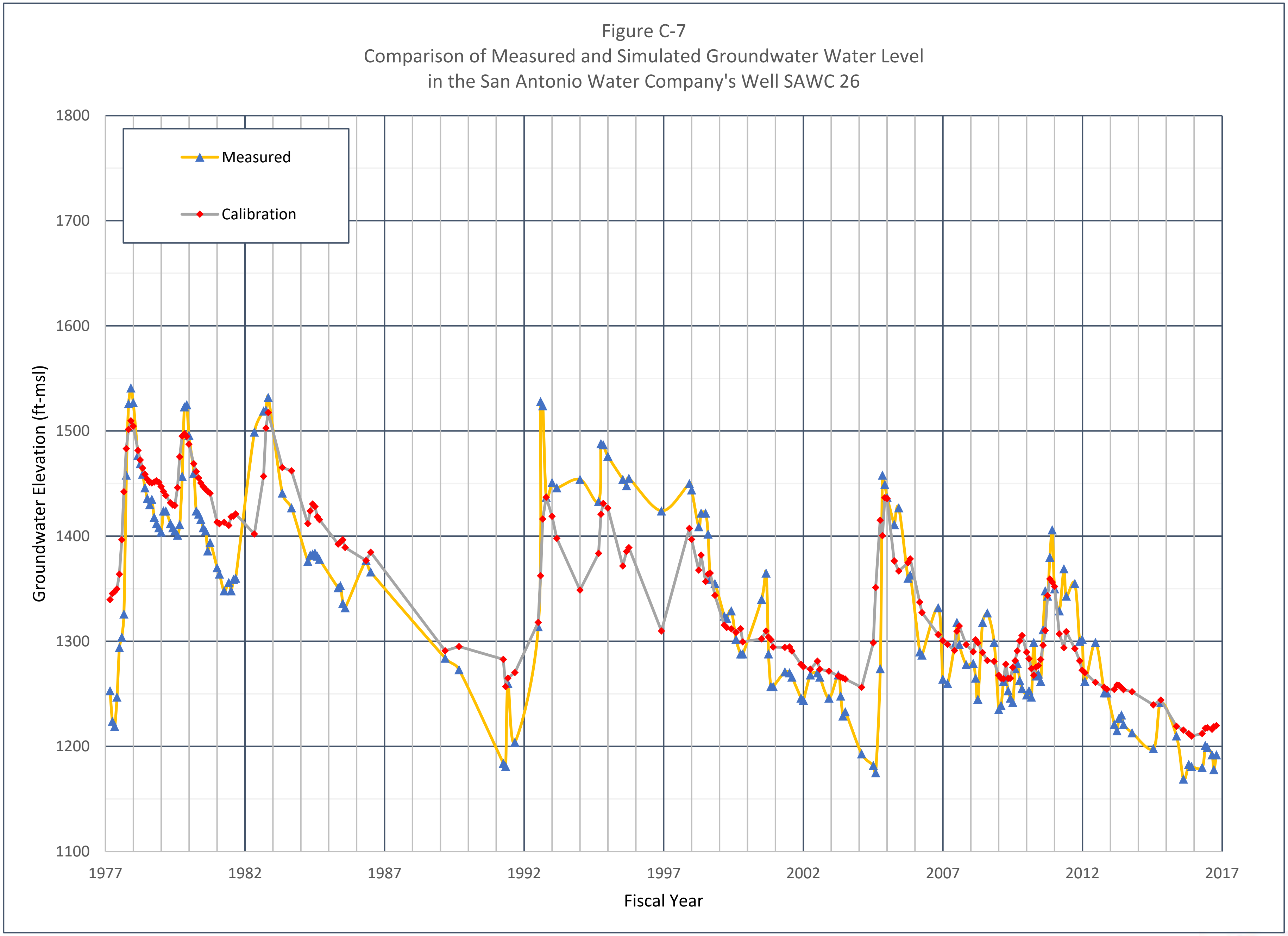


Figure C-7
Comparison of Measured and Simulated Groundwater Water Level
in the San Antonio Water Company's Well SAWC 26
Measured
Calibration
Groundwater Elevation (ft-msl)
1800
1700
1600
1500
1400
1300
1200
1100
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

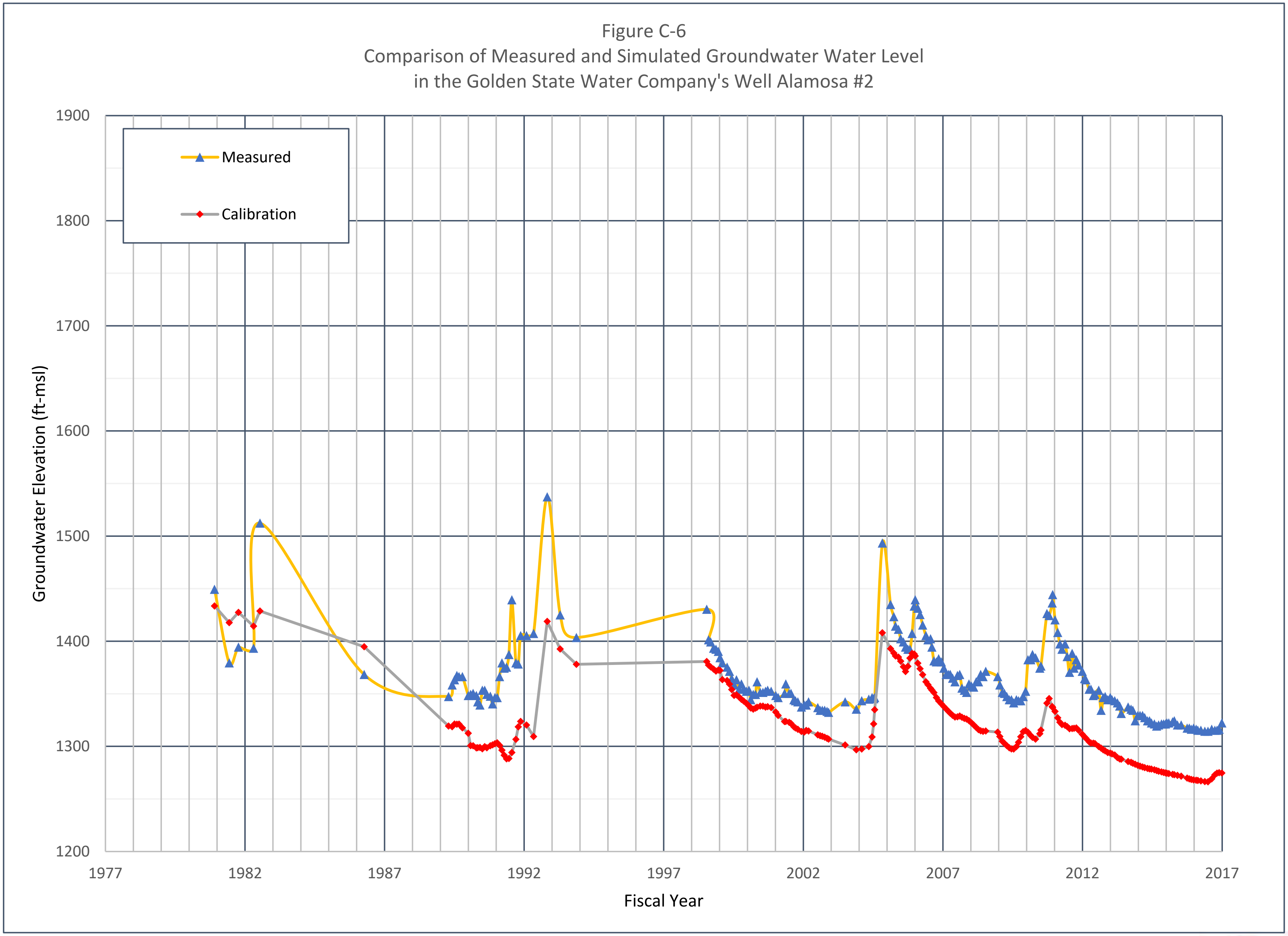


Figure C-6
Comparison of Measured and Simulated Groundwater Water Level
in the Golden State Water Company's Well Alamosa #2
Measured
Calibration
Groundwater Elevation (ft-msl)
1900
1800
1700
1600
1500
1400
1300
1200
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

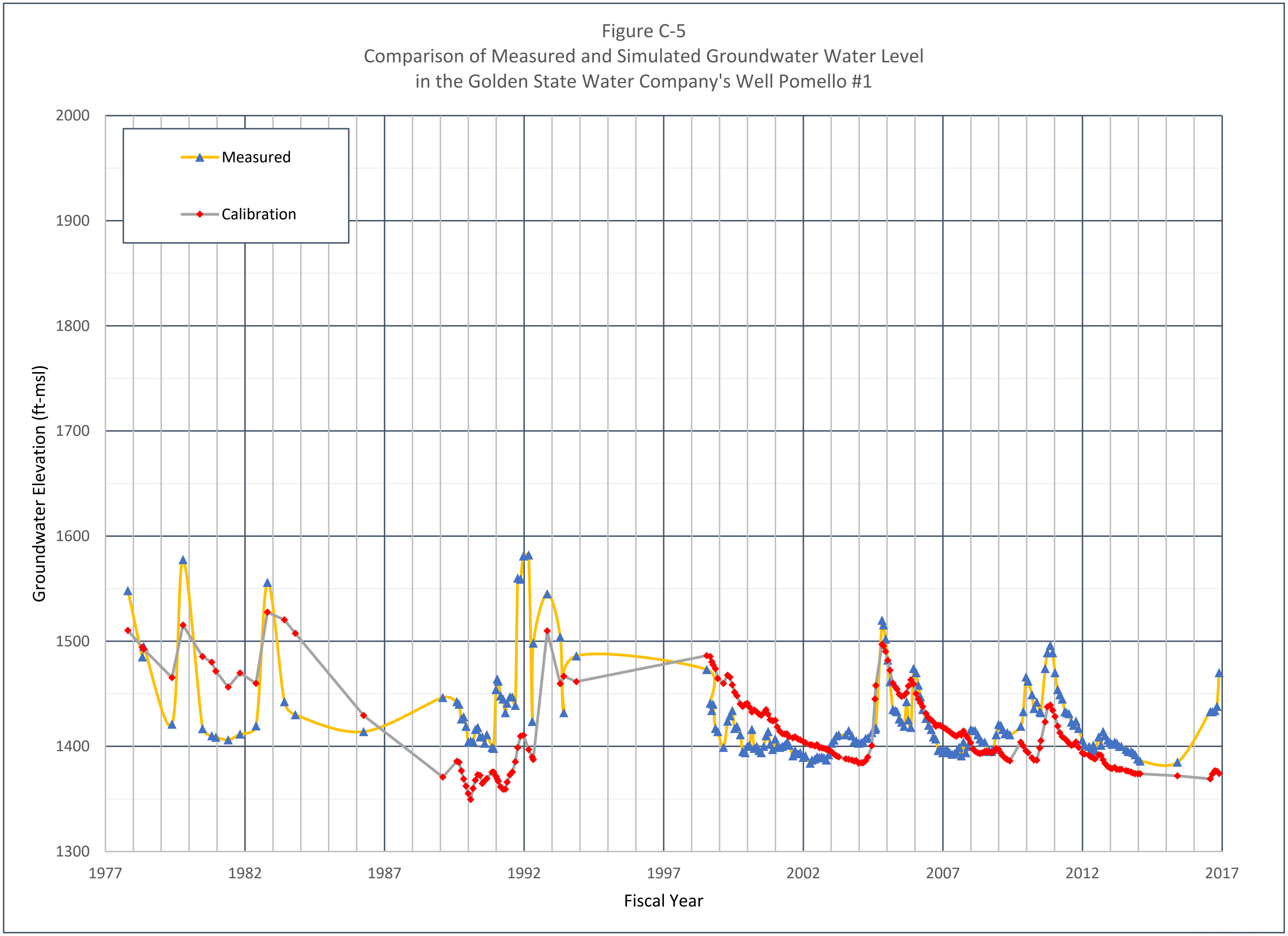


Figure C-5
Comparison of Measured and Simulated Groundwater Water Level
in the Golden State Water Company's Well Pomello #1
Measured
Calibration
Groundwater Elevation (ft-msl)
2000
1900
1800
1700
1600
1500
1400
1300
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

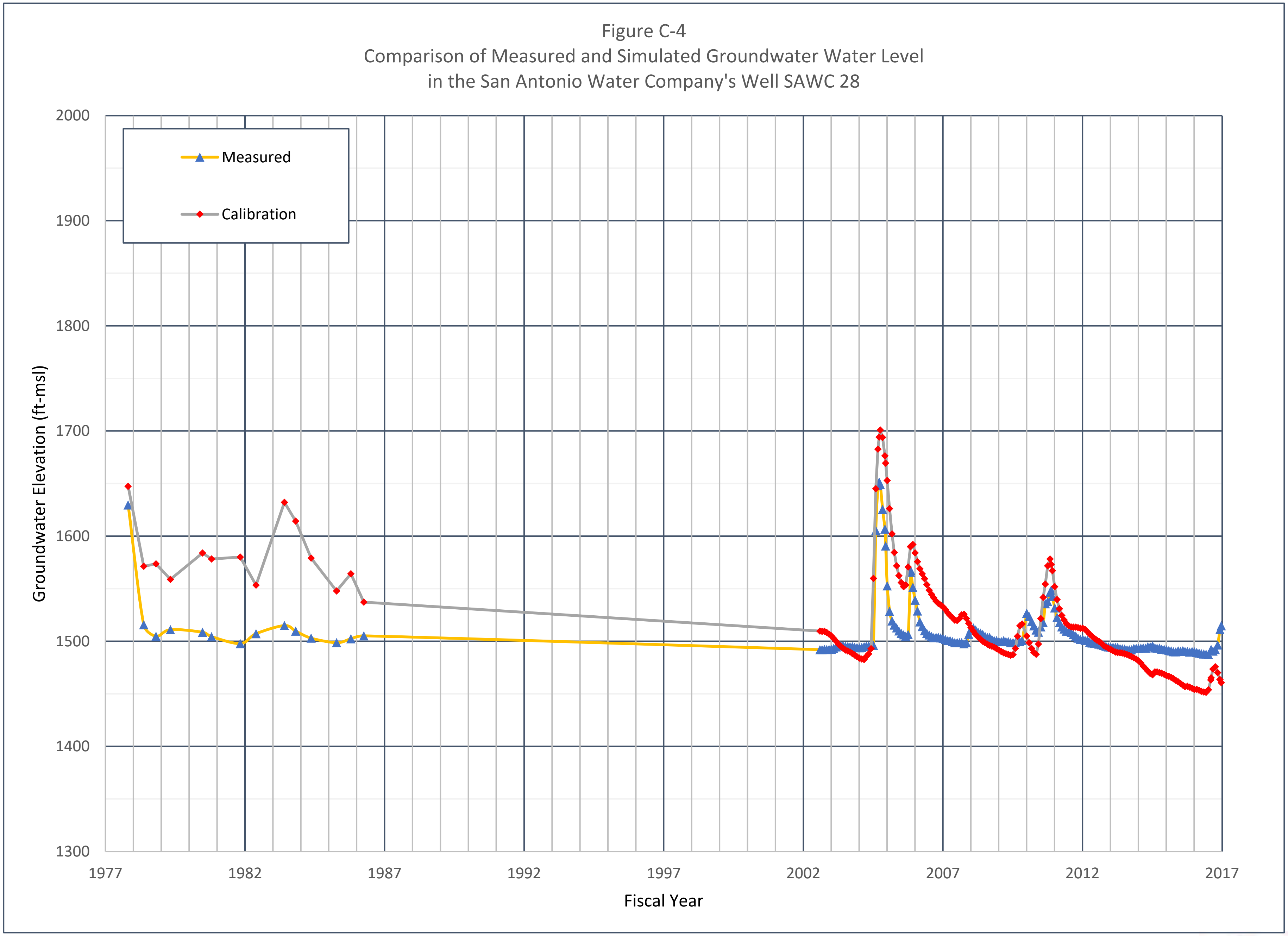


Figure C-4
Comparison of Measured and Simulated Groundwater Water Level
in the San Antonio Water Company's Well SAWC 28
Measured
Calibration
Groundwater Elevation (ft-msl)
2000
1900
1800
1700
1600
1500
1400
1300
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

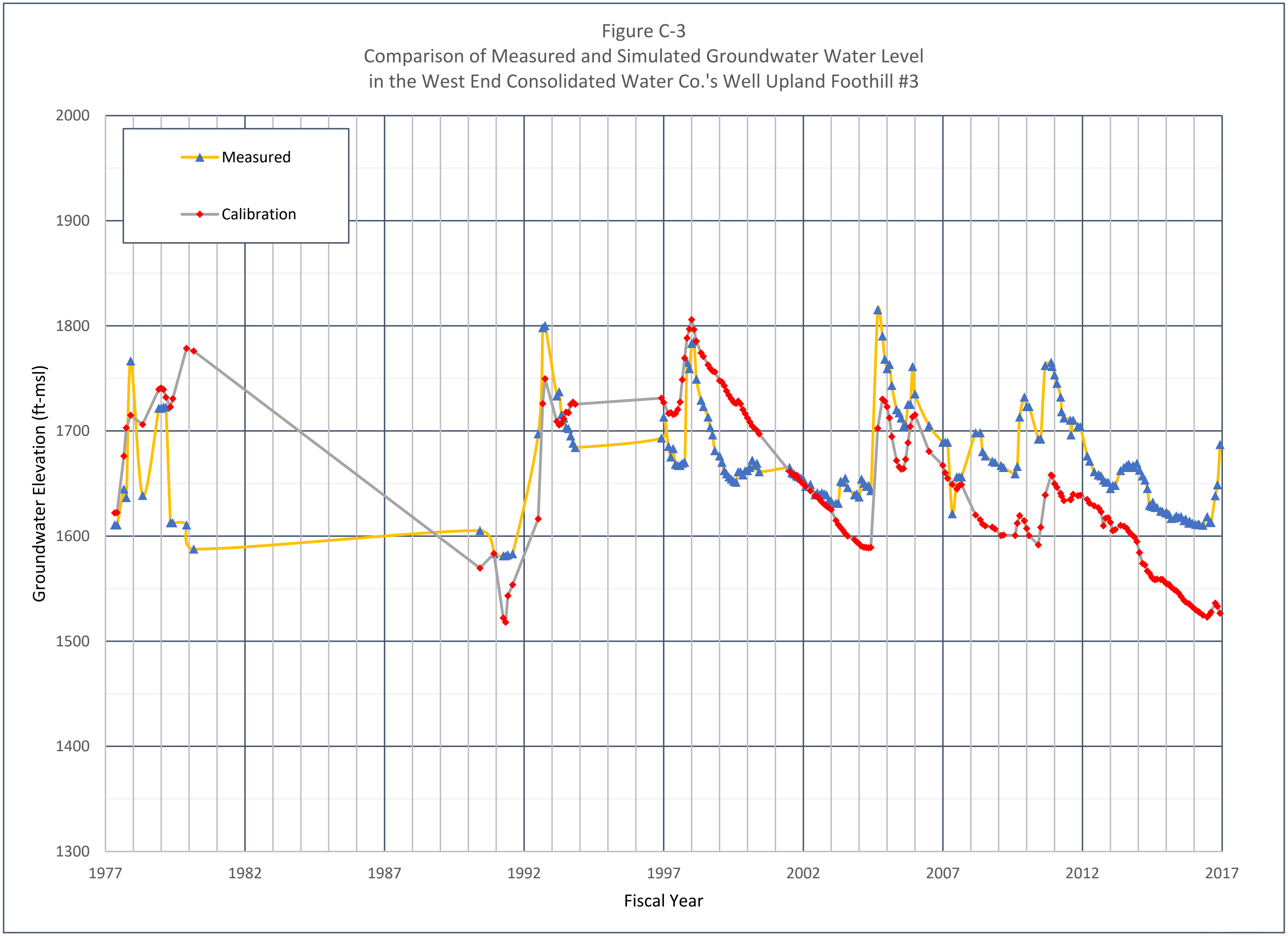


Figure C-3
Comparison of Measured and Simulated Groundwater Water Level
in the West End Consolidated Water Co.'s Well Upland Foothill #3
Measured
Calibration
Groundwater Elevation (ft-msl)
2000
1900
1800
1700
1600
1500
1400
1300
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

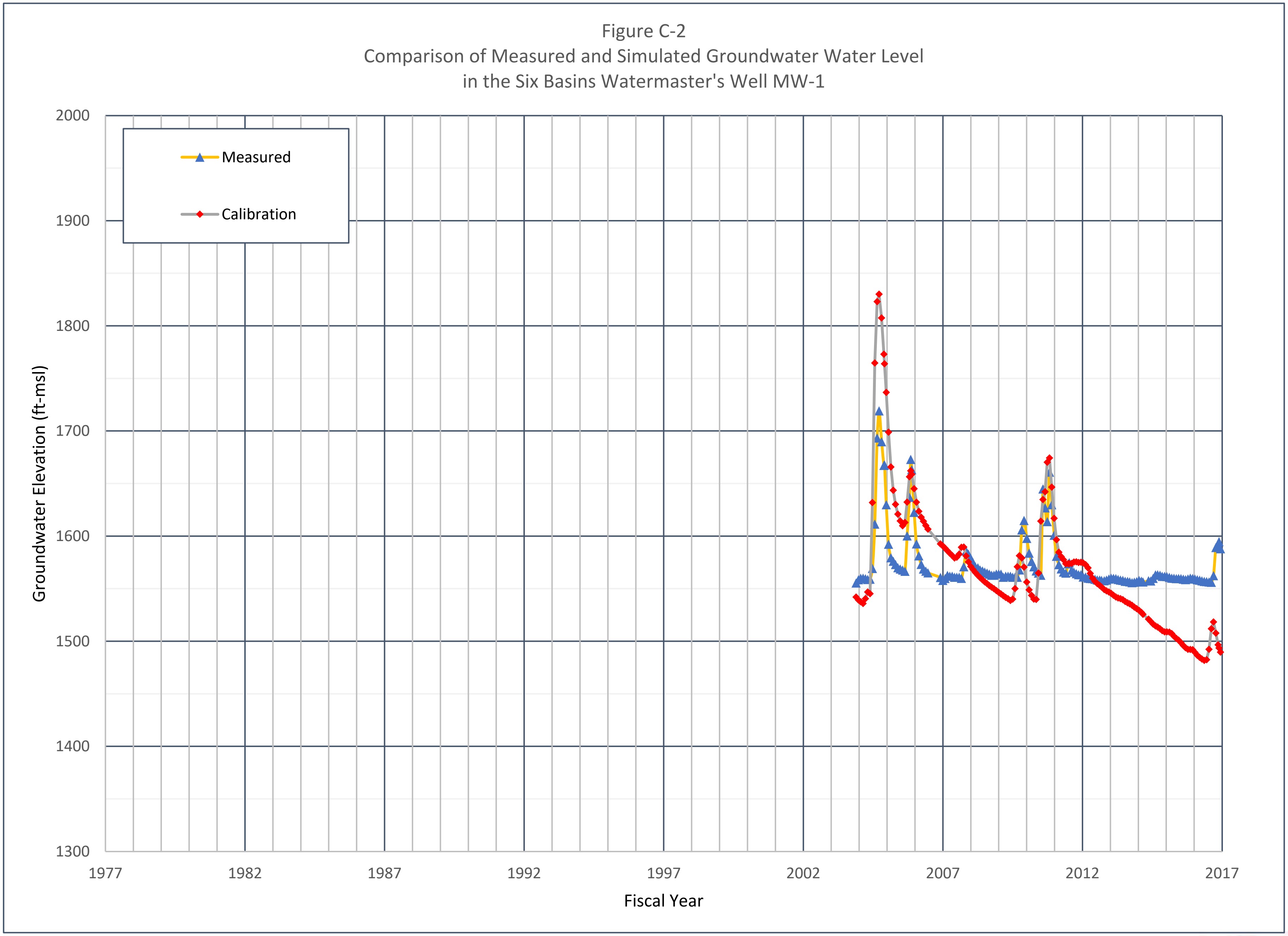


Figure C-2
Comparison of Measured and Simulated Groundwater Water Level
in the Six Basins Watermaster's Well MW-1
Measured
Calibration
Groundwater Elevation (ft-msl)
2000
1900
1800
1700
1600
1500
1400
1300
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year

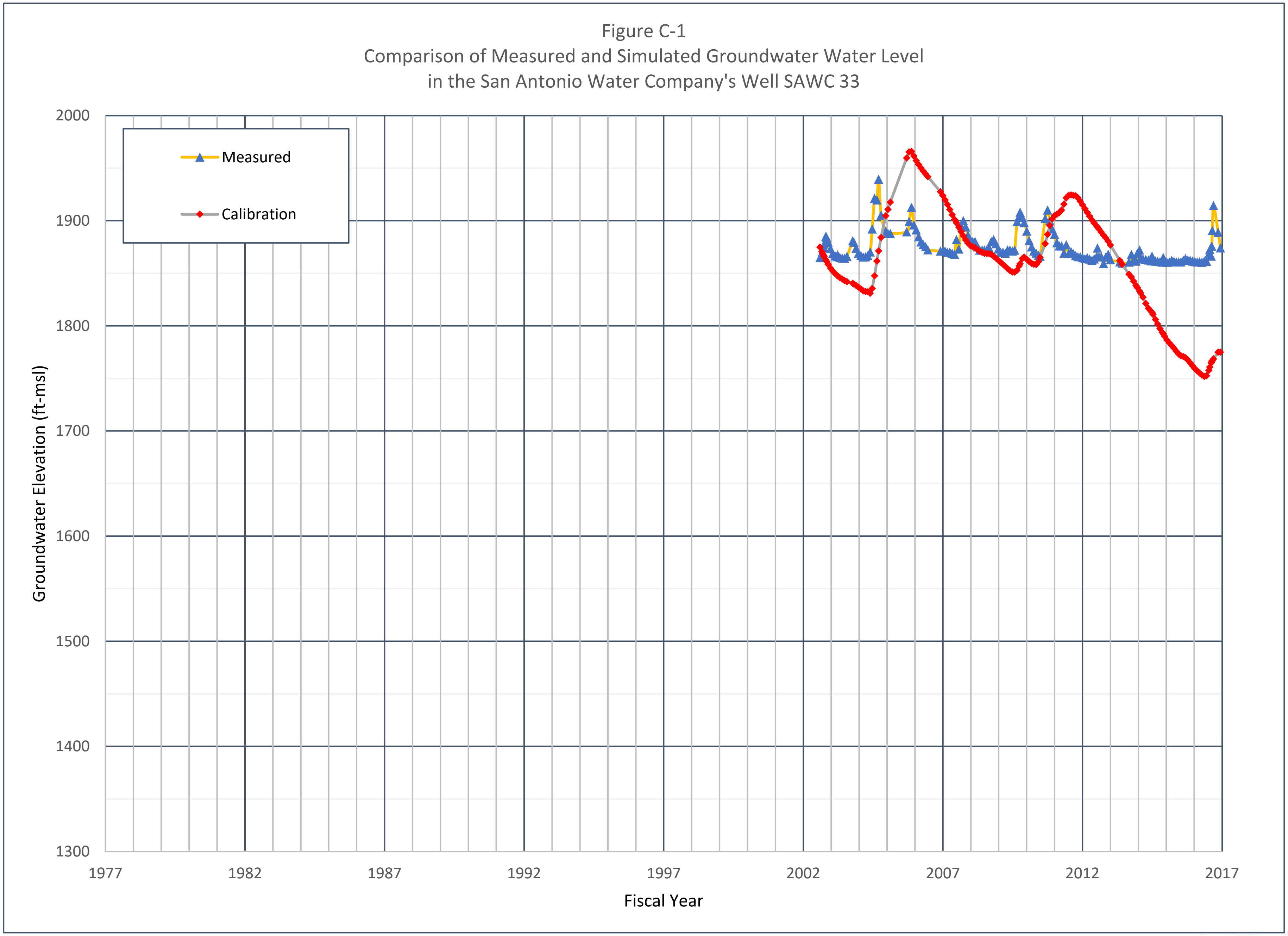


Figure C-1
Comparison of Measured and Simulated Groundwater Water Level
in the San Antonio Water Company's Well SAWC 33
Measured
Calibration
Groundwater Elevation (ft-msl)
2000
1900
1800
1700
1600
1500
1400
1300
1977
1982
1987
1992
1997
2002
2007
2012
2017
Fiscal Year