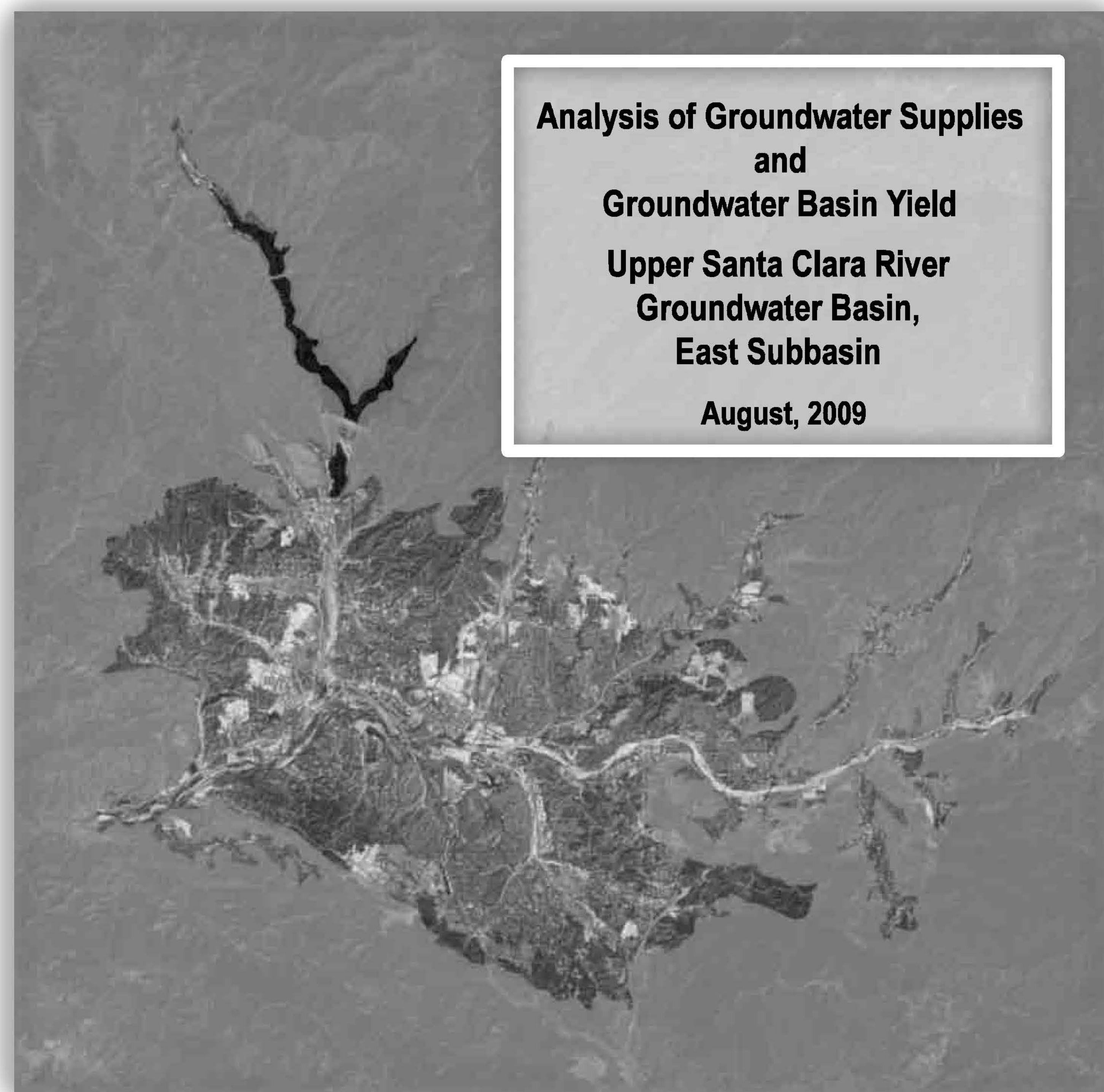
Luhdorff & Scalmanini and GSI Water Solutions, Inc.,
2009 Basin Yield Update

Analysis of Groundwater Supplies and Groundwater Basin Yield

Upper Santa Clara River Groundwater Basin, East Subbasin

August, 2009



prepared for

Santa Clarita Valley Municipal Water Purveyors

prepared by

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

GSI Water Solutions, Inc.

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Acronyms and Abbreviations

afy	acre-feet per year
AWRM	Alternative Water Resources Management program
CCCC	California Climate Change Center
CLWA	Castaic Lake Water Agency
CMIP3	Climate Model Intercomparison Project 3
DPH	California Department of Health Services
DTSC	California Department of Toxic Substances Control
DWR	California Department of Water Resources
ET	evapotranspiration
GCM	global climate model
GFDL	Geophysical Fluid Dynamics Laboratory
gpm	gallons per minute
in/yr	inches per year
IPCC	Intergovernmental Panel on Climate Change
LACFCD	Los Angeles County Flood Control District
LACSD	Los Angeles County Sanitation District
LARWQCB	Los Angeles Regional Water Quality Control Board
LLNL	Lawrence Livermore National Laboratory
LSCE	Luhdorff & Scalmanini Consulting Engineers
mg/L	milligrams per liter
mgd	million gallons per day
MOU	Memorandum of Understanding
NCAR	National Center for Atmospheric Research
NCWD	Newhall County Water District
NLF	Newhall Land & Farming Company
PCM1	Parallel Climate Model
Purveyors	Upper Basin Water Purveyors
RCS	Richard C. Slade and Associates, LLC
SCVSD	Santa Clarita Valley Sanitation District of Los Angeles County

SCWD	Santa Clarita Water Division of CLWA
SRES	Special Report on Emissions Scenarios
SWP	State Water Project
SWRM	Surface Water Routing Model
TMDL	Total Maximum Daily Loads
UWMP	Urban Water Management Plan
VWC	Valencia Water Company
WCRP	World Climate Research Programme
WHR	Wayside Honor Rancho
WRP	water reclamation plant
UCAR	University Corporation for Atmospheric Research
WRP	water reclamation plant

I. Introduction

In 2003, the retail water Purveyors in the Santa Clarita Valley (herein the Purveyors[1]) commissioned efforts to develop, calibrate and utilize a numerical groundwater model for purposes of analyzing the sustainability of local groundwater as a component of overall water supply in the Valley. At that time, the question of groundwater sustainability was complemented by a question about whether part of overall groundwater pumping could be employed to achieve containment and removal of perchlorate contamination in the deeper aquifer, the Saugus Formation, beneath the Valley. The results of those modeling efforts concluded that a certain groundwater operating plan (rates and distributions of groundwater pumping under varying local hydrologic conditions) would be expected to produce long-term sustainable groundwater conditions, and that a certain focused part of overall pumping would be expected to both extract perchlorate-contaminated groundwater (for use after treatment) and contain the migration of perchlorate-impacted groundwater. The development and calibration of the numerical groundwater flow model is described in *Regional Groundwater Flow Model for the Santa Clarita Valley, Model Development and Calibration* (CH2M Hill, April 2004). Application of the model for extraction and containment of perchlorate-impacted groundwater is described in *Analysis of Perchlorate Containment in Groundwater Near the Whittaker-Bermite Property* (CH2M Hill, December 2004). And application of the model for analysis of basin yield, including sustainability of groundwater pumping consistent with that employed in the perchlorate containment analysis, is documented in *Analysis of Groundwater Basin Yield, Upper Santa Clara River Groundwater Basin, East Subbasin, Los Angeles County, California* (CH2M Hill and LSCE, August 2005).

The groundwater system in the Santa Clarita Valley, located in northwestern Los Angeles County, is identified by the California Department of Water Resources (DWR) as the Santa Clara River Valley Groundwater Basin, East Subbasin (Basin No. 4-4.07) and lies within the DWR-designated Upper Santa Clara River Hydrologic Area [Figure 1-1]. Groundwater in the basin is pumped from a shallow Alluvial Aquifer and from deeper groundwater resources that are present in an older, underlying unit called the Saugus Formation. Most groundwater pumping is by the Purveyors for municipal uses (in the range of approximately 23,000 to 33,000 acre-feet per year (afy) in recent years), with some continuing pumping by private landowners, primarily for irrigation uses (approximately 13,000 to 17,000 afy in recent years). The Purveyors also have access to other sources of water to supplement groundwater for municipal supply, including imported State Water Project (SWP) water, groundwater banking outside the basin, recycled water, short-term water exchanges, and dry-year water purchase programs. Those sources are described in the Purveyors' current *2005 Urban Water Management Plan* (Black & Veatch, et al., November 2005) and in a series of annual *Santa Clarita Valley Water Reports*, most recently for 2007 (LSCE, April 2008).

The water supply and water resource management practices of the Purveyors call for maximizing the use of Alluvial Aquifer and imported water during years of normal or above-normal

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[1] The Santa Clarita Valley Purveyors are comprised of Los Angeles County Waterworks District 36, Newhall County Water District, Santa Clarita Water Division of the Castaic Lake Water Agency (formerly Santa Clarita Water Company, acquired by CLWA in 1999), and Valencia Water Company.

availability of these supplies, and limiting the use of the Saugus Formation during these periods, then temporarily increasing Saugus Formation pumping during years when supplemental imported water supplies are significantly reduced because of drought conditions. These local management practices have been called the local groundwater operating plan; that term has been adopted in this report to identify the previously analyzed operating plan (the 2004 Operating Plan) and subsequent iterations analyzed herein (the 2008 Operating Plan, the 2008 Operating Plan with Pumping Redistribution, and a Potential Operating Plan).

1.1 Background

The numerical groundwater model was originally developed as part of the work scope contained in an August 2001 Memorandum of Understanding (MOU) that was adopted by the Purveyors and the United Water Conservation District, located downstream in Ventura County. That MOU was a commitment by the Purveyors to expand on previous analyses of groundwater conditions such that the adequacy of the local groundwater supply could be better understood and questions about surface water and groundwater resources could be more readily addressed. The MOU initiated a collaborative and integrated approach to data collection; database management; evaluating groundwater conditions and the sustainability of the Purveyors' operating plan; groundwater flow modeling; annual reporting on basin conditions; and technical reporting focused on geologic and hydrologic aspects of the overall stream-aquifer system.

In 2003, subsequent to the MOU, Castaic Lake Water Agency (CLWA) prepared and adopted a formal Groundwater Management Plan (CLWA, 2003), which includes 14 elements intended to achieve four management objectives, or goals, for the groundwater basin. Those four management objectives include development of local groundwater for water supply; avoidance of overdraft and associated undesirable effects; preservation of groundwater quality; and preservation of interrelated surface water resources. The intent of the Groundwater Management Plan is to ensure that ongoing utilization of local groundwater continues to result in acceptable aquifer conditions, specifically avoidance of overdraft (Element 3 of the Plan), no degradation of quality (Element 6 of the Plan), and no adverse impacts to surface waters (Element 2 of the Plan). The Plan identified these objectives and elements as being accomplished via continued conjunctive use operations that have been ongoing since the initial importation of supplemental surface water in 1980 (Element 5 of the Plan) and via monitoring and interpretation of surface water and groundwater conditions on an ongoing basis (Elements 1 and 2 of the Plan).

The Purveyors initially agreed in the MOU, and the Purveyors subsequently committed in the Groundwater Management Plan, to develop and use a numerical groundwater flow model for the sustainability evaluation of the local groundwater operating plan. Prior to that, the available data showed that no long-term lowering of the water table or degradation of water quality had occurred during the 50 to 60 years of recorded historical groundwater development in the valley, and the various studies and water planning efforts performed up to that time had resulted in a local groundwater operating plan that placed future pumping of the Alluvial Aquifer in the same range as historical pumping. However, although the MOU recognized a need to formally analyze the Alluvial Aquifer, it identified that the primary question to be evaluated with the model would be the operational yield of the Saugus Formation, given that the Purveyors' operating plan called for dry-year pumping from that aquifer at rates higher than had historically been pumped. For that reason, the MOU identified that the model would evaluate the effect of the current groundwater operating plan on groundwater conditions in both the Alluvial Aquifer and the Saugus Formation over a multi-year wet/dry cycle. The operational yield was defined in the MOU as an operating plan for the local groundwater basin that would allow continued pumping from the Alluvial Aquifer and Saugus Formation while assuring that groundwater supplies would be adequately replenished from one wet/dry cycle to the next.

As introduced above, a groundwater operating plan was formally analyzed with the groundwater model as part of the perchlorate containment analysis in 2004, and then specifically as the focus of basin yield analysis in 2005. In summary, that plan was as follows:

- Pumping from the Alluvial Aquifer in a given year is governed by local hydrologic conditions in the basin. Under the operating plan, pumping ranges between 30,000 and 40,000 afy during normal and above-normal rainfall years but, because of operational constraints in the eastern part of the basin, is reduced to between 30,000 and 35,000 afy during locally dry years.

- Pumping from the Saugus Formation in a given year is tied directly to the availability of other water supplies, particularly imported water from the SWP system. For the Saugus Formation, the operating plan consists of pumping between 7,500 and 15,000 afy during average-year to wet-year conditions within the SWP system. Planned dry-year pumping from the Saugus Formation ranges between 15,000 and 25,000 afy during a dry year, and increases to between 21,000 and 25,000 afy if SWP deliveries are reduced for two consecutive years, and between 21,000 and 35,000 afy if SWP deliveries are reduced for three consecutive years. Such high pumping would be followed by periods of reduced (average-year) pumping, at rates between 7,500 and 15,000 afy, to further enhance the effectiveness of natural recharge processes that would recover water levels and groundwater storage volumes in the Saugus Formation, as has been historically experienced.

Simulated groundwater basin response to groundwater pumping in accordance with the 2004 Operating Plan, over a long-term period of varying hydrologic conditions, was concluded to be sustainable based on a two-part definition of sustainability, which is continued in the updated analysis reported herein, as follows:

- lack of chronic, or sustained, depletion of groundwater storage, as indicated by projected groundwater levels, over a reasonable range of wet, normal, and dry hydrologic conditions

- maintenance of surface water flows in the western portion of the basin (which are partially maintained by groundwater discharge) and surface water outflow to downstream basins over the same range of hydrologic conditions

The primary conclusion from the modeling analysis of the 2004 Operating Plan was that it would not cause detrimental short-or long-term effects to the groundwater and surface water resources in the Valley and was, therefore, sustainable. In summary, the groundwater basin could be expected to respond to the 2004 Operating Plan in a manner similar to what had been experienced over approximately the preceding 50 years: Use of water from the Alluvium, slightly decreased during locally drier periods, was projected to result in small to large fluctuations in Alluvial Aquifer groundwater levels from the middle to the eastern part of the basin, followed by full to near-full recovery in wet years or periods of years. Different from historically experienced conditions is in the Saugus Formation, where greater Saugus pumping during periods of significantly reduced imported water supplies was projected to cause larger fluctuations in groundwater levels during such pumping, with full to near-full recovery of Saugus water levels in subsequent years when the availability of imported water supplies was expected to return to normal.

After completion of the sustainability analysis, the 2004 Operating Plan was incorporated in the Purveyors' collective 2005 Urban Water Management Plan (UWMP) to reflect the groundwater component of overall water supplies available to meet current and projected water requirements over the planning horizon of the UWMP.

1.2 Scope of Updated Analysis

In 2008, partly in preparation for the next UWMP in 2010, and in part because of recent events that are expected to impact the future reliability of the principal supplemental water supply for Santa Clarita Valley, i.e., from the State Water Project, the Purveyors concluded that an updated analysis was needed to further assess groundwater development potential and possible augmentation of the groundwater operating plan. Near-term reductions in SWP water deliveries to CLWA are possible because of an August 2007 court ruling that is expected to reduce exports from the Bay-Delta by approximately 30 percent in the immediate future. Additionally, the National Marine Fisheries Service (NMFS) released its Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project on June 4, 2009. The proposed regulatory actions will further restrict Delta export operations of the State Water Project, however, studies have not been completed quantifying impacts on SWP reliability. The duration of reductions are unknown and depend on a number of factors, including whether DWR can construct alternative facilities in the future to make up for reductions. Additionally, DWR is evaluating the potential magnitude of longer-term future reductions in SWP deliveries because of potential effects of global climate change.

A second consideration in conducting an updated analysis of the basin is that global climate change could alter local rainfall and associated recharge patterns, thus affecting local groundwater supplies, i.e. the yield of the basin. Finally, the Los Angeles County Flood Control District (LACFCD) is planning a number of small flood control projects in the Santa Clarita Valley; estimated amounts of conservation/groundwater recharge potential are being included for each of the individual projects in the overall LACFCD planning, and the Purveyors have interest in whether that potential could appreciably augment the yield of the basin.

In light of the above, the scope of the updated basin yield analysis, reported herein, includes the following:

- consider potential increased utilization of groundwater for regular (wet/normal) and/or dry-year water supply, including distribution of the yield by reach of the Santa Clara River alluvium and its various tributaries;

- consider potential augmentation of basin yield via initiation of artificial groundwater recharge using stormwater runoff in selected areas of the basin as being planned by LACFCD; and

- quantitatively or qualitatively, depending on the availability of technical reference material, describe general impacts of climate change on the groundwater basin and its yield.

1.3 Report Organization

To address the scope of the updated basin yield analysis outlined above, the remainder of this report is organized as follows:

Chapter 2 discusses the extension of the numerical groundwater flow model from its previous calibration period of 1980 through 2004 to add three years and thus extend calibration through 2007; this section also describes some limited model recalibration after extension of the model through 2007.

Chapter 3 describes the operating plans that were developed for updated analysis of basin yield, and the process that was used to simulate basin response to those plans and to evaluate the results.

Chapter 4 discusses the results of the simulated basin response to the 2008 and Potential groundwater operating plans, including the sustainability and achievability of the plans.

Chapter 5 describes climate change considerations, the selection of a range of potential climate change impacts on local hydrologic conditions, and the simulated effects of those resultant hydrologic conditions on the sustainability and achievability of the 2008 groundwater operating plan.

Chapter 6 describes the potential groundwater recharge projects being planned by LACFCD and discusses the potential benefit to the yield of the basin.

Chapter 7 summarizes the conclusions derived from the overall updated basin yield analysis, and the implications of those conclusions for long-term groundwater supply and groundwater management in the Santa Clarita Valley.

References and Appendices follow Section 7. The Appendices include a description of the Santa Clarita Valley numerical groundwater flow model, description of the updated model calibration, hydrographs to illustrate simulated basin response to the operating plans, and discussion of climate projections and their incorporation in the analyses reported herein.

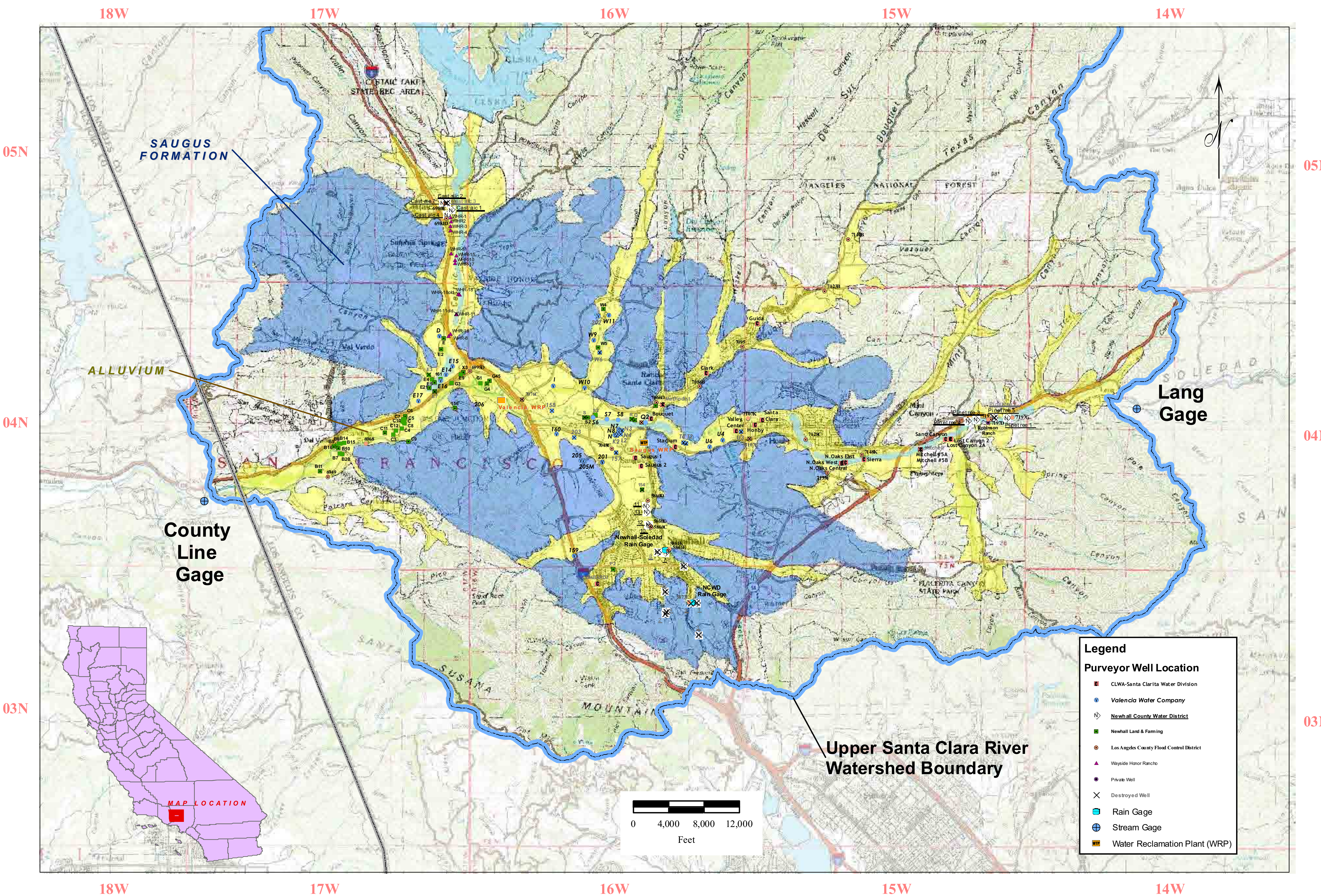

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Figure 1-1
Basin Location Map
Upper Santa Clara River Valley Groundwater Basin, East Subbasin

II. Updated Model Calibration

2.1 Model Description

The Santa Clarita Valley groundwater flow model is a three-dimensional, numerical model that uses the MicroFEM® finite-element software (Hemker and de Boer, 2003). The model covers the entire area underlain by the Saugus Formation, plus the portions of the Alluvial Aquifer that lie beyond the limits of the Saugus Formation (Figure 3-1). The model's construction and calibration are summarized in Appendix A and discussed in detail in *Regional Groundwater Flow Model for the Santa Clarita Valley: Model Development and Calibration* (CH2M HILL, 2004a).

The model simulates groundwater conditions within an area that largely coincides with the Santa Clara River Valley Groundwater Basin, East Subbasin, delineated by DWR. This area extends from the Lang stream gage at the eastern end of the valley to the County Line stream gage area in the west. The model is based on a finite-element mesh consisting of seven layers, with 17,103 nodes and 32,496 elements in each layer (Figure 2-1). The upper model layer simulates the Alluvial Aquifer and also the upper portion of the Saugus Formation where the Alluvial Aquifer is not present. The underlying layers simulate the underlying freshwater Saugus Formation and its Sunshine Ranch Member. Figure 2-2 shows the model layering in three cross-sectional views.

The boundary conditions in the model consist of the following:

- Specified flux boundaries for the following:
  - precipitation
  - irrigation
  - recharge from ephemeral streams
  - pumping
  - underflow from beneath Castaic Dam
- Head-dependent flux boundaries for the following:
  - groundwater discharges to the perennial reach of the Santa Clara River
  - residual drainage of groundwater to the Santa Clara River in the ephemeral reach under high water table conditions
  - evapotranspiration (ET) by phreatophyte plants, which extract groundwater from the shallow water table that lies along riparian river corridors
- Constant-head boundaries for the following:
  - subsurface inflow in the Alluvial Aquifer at the eastern end of the valley, at the Lang gage[1]

[1] A constant-head boundary was established in the groundwater model at this location using recent field conditions that were observed after the model calibration report (CH2M HILL, 2004a) was published. This change improved the groundwater model's calibration in the Alluvial Aquifer in the upper reaches of Soledad Canyon and did not appreciably change the calibration quality elsewhere. See CH2M HILL (2005) for further details.

- subsurface outflow in the Alluvial Aquifer at the western end of the valley, at the County Line gage

Groundwater recharge rates are estimated using precipitation records, streamflow records, watershed maps, topographic maps, and aerial photography. These recharge rates are calculated using a detailed Surface Water Routing Model (SWRM), which was written specifically to provide time-dependent, spatially varying recharge rates as input to the groundwater model. The SWRM relies on streamflow records at the Lang and County Line gages; historical records of rainfall data from the NCWD rain gage (see Figure 1-1), spatial variations in rainfall across the basin, the rates and locations of future WRP discharges to the Santa Clara River, and irrigation from agricultural and urban water uses.

The depths from which production wells obtain water are defined in the groundwater model from well construction records. The rates and locations of pumping are based on the Purveyors' operating plan for the basin and on the surveyed location of each production well.

2.2 Calibration Update Approach

The calibration update process consisted of transient modeling that simulated monthly variations in pumping from, and recharge to, the Alluvial Aquifer and the Saugus Formation during the period January 2005 through December 2007. As with the original calibration effort, simulation results were compared to measured fluctuations in groundwater elevations and streamflows in the Santa Clara River.

Hydrologic input data for the calibration update simulation are tabulated in Appendix B and were as follows:

- Groundwater pumping data were provided by the Purveyors for each production well. Appendix Tables B-1 and B-2 show annual pumping for the Alluvial Aquifer and Saugus Formation, respectively, from 1980 through 2007. As with the initial model calibration effort, the monthly distribution of pumping was defined from information on the monthly distribution of urban and agricultural water demands, as listed in Appendix Table B-3.
- Groundwater recharge was defined using the SWRM, which was written specifically for the groundwater model during the original model development effort (see Appendix C of CH2M HILL, 2004a). The SWRM defined recharge from applied water use (i.e., irrigation)[2]; direct precipitation within the model domain (see Appendix Table B-4); Santa Clara River flows into the valley as measured at the Lang stream gage (see Appendix Table B-5); SWRM-estimated stormwater inflows into the model domain along ephemeral streams that are tributaries to the Santa Clara River; measured volumes of treated water discharge into the Santa Clara River from two Los Angeles County Sanitation District (LACSD) water reclamation plants (WRPs) (see Appendix Tables B-6

[2] Infiltration of applied water was simulated in the same locations as in the original model calibration effort, and at the 1999 rates described in the model development report (CH2M HILL, 2004a). These rates were 24.7 inches per year (in/yr) for irrigated agricultural land, 2.2 in/yr for residential areas, and 1.0 in/yr for retail/industrial lands and golf courses.

and B-7); and water released from Castaic Lagoon into Castaic Creek by DWR (see Appendix Table B-8).

- Coefficients for the riverbed leakage term at each river node vary over time in the model. For the years 2005 through 2007, the calibration update process initially used the same values as used for 1992, 1996, and 1989, respectively. These values were then adjusted as necessary during the calibration update process.

The quality of the model's calibration was evaluated as follows:

- Simulated groundwater elevation trends were compared with data collected at production wells where long-term records of groundwater elevations are available. These wells are referred to herein as target wells. As discussed in the model development report (CH2M HILL, 2004a), the calibration goal at target wells was to simulate groundwater elevations that were higher than the pumping elevations and as close as possible to the static elevations. Therefore, the hydrographs show the model-simulated groundwater elevations, the measured static groundwater elevations, and, for production wells, the measured pumping groundwater elevations. Additionally, the comparison of time-varying simulated and measured groundwater elevations was equally focused on the slopes of the hydrographs, not just the absolute values of the groundwater elevations at any given time.
- The groundwater budget was evaluated to compare simulation results with measured flows in the Santa Clara River at the west end of the basin (at the County Line gage; see Appendix Table B-9); and estimated volumes of groundwater discharge to the Santa Clara River (see Appendix Table B-10).

2.3 Results from the Calibration Update Process

The initial simulation of conditions during 2005 through 2007 produced findings that were deemed to require adjustments to the model's calibration of portions of the Alluvial Aquifer prior to conducting the predictive modeling necessary for the basin yield update analysis. Specifically, the results from the initial calibration update indicated that, from 2005 through 2007, the model simulated:

- too much groundwater level recovery in Castaic Valley at NCWD's Castaic wellfield during the high streamflow event of early 2005

- too much decline in groundwater levels in lower San Francisquito Canyon (at VWC's W9 and W11 wells)

- groundwater levels that were too high in lower Bouquet Canyon (at SCWD's Clark well) and below the mouth of Bouquet Canyon (at VWC's S6, S7, and S8 wells)

It was also noted that, the model simulated too little groundwater level decline immediately prior to 2005 in the eastern-most portions of the Alluvial Aquifer along the Santa Clara River (at and east of the mouth of Mint Canyon). Additionally, it was determined that, for NCWD's Pinetree wellfield, the groundwater level database contained incorrect reference elevations, which are used to convert groundwater depths to groundwater elevations. As a result, it was concluded that the original calibration effort (during 2004) had compared simulation results with database-derived groundwater elevation values that were lower than the actual elevations of the water table throughout the entire simulation period (January 1980 to the present).

As a result of these findings, efforts were undertaken to improve the model's calibration quality in the eastern-most portion of the Alluvial Aquifer and in the tributary canyons noted above. This focused re-calibration process resulted in changes to the hydraulic conductivity in certain areas and riverbed leakage coefficients along certain reaches of Castaic Creek and the eastern reaches of the Santa Clara River. These changes were:

- increasing the hydraulic conductivity from 105 feet/day to between 250 and 500 feet/day in San Francisquito Canyon

- increasing the hydraulic conductivity from 245 feet/day to 300 feet/day in lower Bouquet Canyon

- introducing a zone of reduced hydraulic conductivity (250 feet/day) along the Santa Clara River at the mouth of Mint Canyon, to better simulate the hydraulic gradient between SCWD's Sierra and Mitchell wells

- reducing the hydraulic conductivity by 50 percent along the Santa Clara River from just east of NCWD's Pinetree wellfield upstream to the Lang gage at the eastern end of the valley (from 300 to 150 feet/day) and also in two nearby tributaries (Tick Canyon and Bee Canyon, from 150 to 75 feet/day)

- raising the Castaic Creek riverbed leakage coefficients during the high-flow events of 2001 and late 2004/early 2005

- raising the riverbed leakage coefficients in San Francisquito and Bouquet Canyons during and after the high-flow event of late 2004/early 2005

- raising the riverbed leakage coefficients for the reach of the Santa Clara River near SCWD's North Oaks and Sierra wells during the high-flow event of late 2004/early 2005

- revising the rainfall-runoff-recharge relationship for the basin. This relationship is based on a power-function equation developed by Turner (1986). As shown in Figure 2-3, the coefficients were revised slightly in a manner that, when compared with the original calibration (CH2M HILL, 2004a), generates slightly more recharge when annual precipitation is above normal. This increase in recharge ranges from about 0.25 inches to 1 inch for annual rainfall between 21 and 40 inches at the NCWD gage. For the wettest year on record at the NCWD gage (48.33 inches in calendar year 1983), annual recharge is 22.5 and 23.8 inches in the 2004 and 2008 calibrations, respectively, which is a difference of about 1.3 inches.

Appendix B contains groundwater elevation hydrographs comparing the model-simulated groundwater elevations with static and pumping groundwater elevations at the many production wells in the valley. Model simulation results are shown both for the original calibration (CH2M HILL, 2004a) and the updated calibration. The hydrographs are organized according to the primary subareas for the Alluvial Aquifer (see Figure 2-4 for the locations of these subareas) and by Purveyor for the Saugus Formation. The hydrographs show notable improvements in calibration quality in Castaic Valley, San Francisquito Canyon, and Bouquet Canyon. However, little improvement could be achieved at VWC's S-series wells without degrading the calibration quality in nearby wells (such as VWC's N-series wells). Along the Santa Clara River, substantial improvements to the model's simulation of drought periods in the Alluvial Aquifer were achieved at NCWD's Pinetree wellfield, and to a lesser extent at other wells further west (for example, SCWD's North Oaks, Sierra, and Honby wells).

In the Saugus Formation, the model simulates the trends in groundwater elevations quite well at each Saugus production well. The trends (hydrograph slopes) are particularly close in the NCWD wellfield (NCWD production wells 11, 12, and 13). Farther downgradient, the model tends to slightly over-predict groundwater elevations in SCWD's two production wells. However, the model closely simulates the groundwater elevation trends at these two wells, which is the primary consideration for evaluating the quality of the transient calibration process in the Saugus Formation. Groundwater elevations and trends are well-simulated at VWC's Saugus production wells (including the recently constructed VWC-206).

Appendix B also contains hydrographs comparing the simulated and measured values of 1) total river flow and 2) groundwater discharge to the river for the Santa Clara River at the County Line gage, where the river exits the valley and flows into Ventura County.[3] The hydrographs show that the model adequately replicates seasonal and year-to-year cycles of low and high river flows. Additionally, the model simulates temporal cycles in groundwater discharge to the river in a manner that is generally consistent with the cycles reflected in the estimates made from available stream gage data. As discussed in prior model development reports (CH2M HILL, 2004a and 2005), it is likely that differences between modeled and measured hydrographs for total river flow and groundwater discharges result from uncertainties in both the model and the County Line gage data, particularly during periods of low river flows.

[3] The "measured" groundwater discharges to the river are estimates that were derived from a hydrograph separation process, described by CH2M HILL (2004). This process estimated the monthly groundwater discharge to the river by examining the daily streamflow data at the County Line gage, the daily and monthly precipitation at local rain gages, monthly flows into Castaic Creek from Castaic Lagoon, and monthly flows into the Santa Clara River from the Saugus and Valencia WRPs.

III. Modeling Approach for Analyzing Basin Yield

3.1 Modeling Approach

The process of designing the modeling analysis to evaluate the sustainability and achievability of a given operating plan consisted of the following five activities:

- Selecting a period over which to simulate groundwater conditions under each operating plan, including:
  - defining a sequence of varying local hydrology (rainfall, streamflows, and groundwater recharge) on a month-to-month basis throughout the simulation period
  - defining a sequence of varying availability of imported water supplies, as defined from availability studies of the State Water Project (SWP), on a month-to-month basis throughout the simulation period
- Defining pumping rates and schedules for each production well in the valley, including consideration of the varying local hydrology and SWP water availability
- Running the model to calculate time-varying (monthly) groundwater elevations and groundwater discharge terms throughout the multi-year simulation period
- Evaluating the modeling results by examining forecasted time-series plots (hydrographs) of water budget terms and groundwater elevations to evaluate the effects of the operating plan in the Alluvial Aquifer, the Saugus Formation, and the Santa Clara River

These activities are described in further detail below.

3.2 Simulation Period

The locations and temporal variation in pumping from the Alluvial Aquifer were defined in the model from the operating plan and from historical records of the year-to-year variability in local hydrology. Simulated pumping from the Saugus Formation was defined from the operating plan, historical pumping records, and operational constraints and historical patterns of SWP water supply availability.

3.2.1 Original Simulation Period

Because the operating plan for the Saugus Formation is linked to the hydrology and operational constraints for the SWP system, the year-to-year variability in Saugus Formation pumping is, to a great extent, dependent on the hydrology outside the valley (i.e., in northern California). As discussed in the original basin yield analysis report (CH2M HILL and LSCE, 2005), local hydrology affects the availability of Alluvial Aquifer groundwater, but is not always a good indicator of local pumping conditions in the Saugus Formation, because local droughts and SWP droughts do not necessarily coincide with each other. Consequently, it was decided that the model would need to be run over several decades to capture the year-to-year differences between local hydrology and SWP hydrology and water availability, as well as the less frequent times when both systems experience similar hydrologic conditions (as occurred periodically during the 1960s and in 1994). Historical records were then analyzed to identify a simulation period that would be long enough to capture the variety of year-to-year and longer-term trends in local hydrology and imported water availability.

The original basin yield analysis was conducted using a synthetic 78-year period that replicated the historical hydrology from 1980 through 2003, followed by a replication of historical hydrology from 1950 through 2003. This synthetic time period simulated 24 years of reduced pumping from the Alluvial Aquifer, including two 3-year periods and one 4-year period of reduced pumping. For the Saugus Formation, this synthetic time period contained 18 "drought years" in which imported water volumes were sufficiently low to result in increased pumping from the Saugus Formation. These 18 years included two droughts lasting 2 years and two droughts lasting 3 years.

3.2.2 Current Simulation Period and Associated Hydrology

As introduced in Section 1.2, the update of the basin yield analysis was conducted in part because of the possibility of near-term reductions in SWP water deliveries to CLWA. The most recent analysis of the SWP's delivery reliability (DWR, 2008) includes year-to-year projections of delivery volumes under various development conditions, assuming both a repeat of historical climate and the potential effects of climate change. The analyses that are based on historical climate are reported for the climate that occurred from 1922 through 2003. These year-to-year projections had not been completed and published at the time of the original basin yield analysis in 2004 and 2005. Because these new analyses are now available, the basin yield update analysis simulated the historical record of climate and corresponding SWP delivery volumes for an 86-year period beginning in 1922 and ending in 2007, rather than using a synthetic time period. This 86-year period is characterized by:

- 14 years when deliveries are 35 percent or less of maximum Table A amounts, including 3 years when the deliveries do not exceed 10 percent of the Table A amounts

- Two droughts lasting 6 years (1929 through 1934, and 1987 through 1992)

Under the groundwater operating plan for the Santa Clarita Valley, the SWP delivery volume in any given year affects the amount of groundwater pumping that occurs from the Saugus Formation during that year. The amount of groundwater pumping from the Alluvial Aquifer is controlled by local hydrology, as determined by the amount of rainfall that occurs within the watershed during a given year. Figure 3-1 shows the historical pattern of annual rainfall on a calendar year basis from 1922 through 2007 at the Newhall-Soledad rain gage, which has the longest rainfall record of any location within the watershed. Values for 1922 through 1930 are estimated from RCS (2002). RCS personnel have since indicated that the source of data to 1931 is an unofficial record obtained in 2001 from a former California State Climatologist. The figure also shows the average and median values of rainfall for the period 1931 through 2007 (18.16 and 15.82 inches per year, respectively). The estimated rainfall values from 1922 through 1930 were not included in the calculations of the average and median values. The figure shows that annual rainfall at the Newhall-Soledad rain gage since 1922 has ranged from about 4.1 inches in the driest years (in 1947 and 1972) to as much as 42.1 inches in the wettest years (1941 and 1978). 52 of the 86 years of record were characterized by below-average rainfall, and 36 years were particularly dry years characterized by rainfall values below 13.5 inches/year, which is 85 percent of the long-term median rainfall.

For annual rainfall at the Newhall-Soledad rain gage, Figure 3-2 shows the cumulative departure since 1922 from the 1931-2007 average rainfall. The cumulative departure refers to the cumulative (accumulated) amount of rainfall deficit or rainfall surplus over time, compared with long-term average rainfall. The slope of the cumulative departure plot is indicative of whether a given time period is characterized by generally dry conditions (downward slope), near-normal conditions (flat), or wetter-than-normal conditions (upward slope). The figure shows the following patterns in the local rainfall cycle:

- Generally dry conditions (downward-trending slope) after 1922 and continuing through 1935

- Generally wet conditions (upward-trending slope) from 1938 through 1944

- Thirty years of generally dry conditions (downward-trending slope) from 1947 through 1976, except for modestly wet conditions from 1965 through 1970

- Generally wet conditions (upward-trending slope) from 1977 through 2005, interrupted by drought conditions from 1984 through 1991 and from 1999 through 2004

An additional noteworthy feature of the cumulative departure plot is the 48-inch rainfall deficit that occurred from 1947 through 1951, which was not fully captured in the original basin yield analysis, but is modeled in its entirety in this updated analysis. The total rainfall deficit from 1947 through 1976 was approximately 86 inches (from a cumulative 31 inches above average in 1946 to a cumulative 55 inches below average in 1976). After 1976, the cumulative departure returned to a slightly positive value because of significant rainfall events in 1978, 1980, and 1983.

Table 3-1 shows the sequence of normal-year versus dry-year pumping conditions for the Alluvial Aquifer, as derived from the local rainfall records, and for the Saugus Formation as derived from the availability of SWP water. For the Alluvial Aquifer, the pumping year type is assumed to lag the local hydrology by one year. An examination of historical rainfall data and Alluvial Aquifer pumping patterns shows such a lag occurred in several years during the past two decades. The table shows dry-year pumping occurring in 55 years from the Alluvial Aquifer and 15 years from the Saugus Formation. During the 86-year simulation period, there are nine periods when dry-year pumping from the Alluvial Aquifer lasts more than two consecutive years, and two periods have dry-year Saugus pumping lasting more than one year. The longest dry-year pumping periods last for 7 years in the Alluvial Aquifer and 4 years in the Saugus Formation.

During the predominantly dry period from 1922 through 1978, only 16 of these 57 years (28 percent) were years in which normal pumping would have occurred from the Alluvial Aquifer.

3.3 2008 Operating Plan

Following are a general description of the 2008 Operating Plan and discussions of how pumping is distributed spatially and over time in the Alluvial Aquifer and the Saugus Formation under this plan. This plan was analyzed for its long-term sustainability by using the groundwater flow model to simulate the plan under the historical hydrology dating back to 1922. Actual historical pumping at the operating plan rates and for the current basin-wide network of production wells dates back only to the mid-1990s. Prior to that time, less pumping occurred in some years, while in other years pumping was limited to the western portion of the valley. Consequently, the modeling analysis was conducted in a manner to allow evaluation of how the basin might respond to the current operating plan and the current network of production wells, as might occur if past multi-decadal cycles of local and SWP hydrology (such as those measured as far back as 1922) were to repeat themselves in the future.

3.3.1 General Description of 2008 Operating Plan

As discussed in Section 1.1, the 2008 Operating Plan for the local groundwater basin is as follows:

- Pumping from the Alluvial Aquifer ranges between 30,000 and 40,000 afy during normal and above-normal rainfall years but, because of operational constraints in the eastern part of the basin, is reduced to between 30,000 and 35,000 afy during locally dry years. Table 3-2 shows the sequence of historical rainfall cycles and associated pumping from the Alluvial Aquifer, based on this operating plan and the 86-year simulation period that reflects historical rainfall in the valley from 1922 through 2007.

- Pumping from the Saugus Formation ranges between 7,500 and 15,000 afy during average-year to wet-year conditions within the SWP system. Planned dry-year pumping from the Saugus Formation ranges between 15,000 and 25,000 afy during a dry year, and increases to between 21,000 and 25,000 afy if SWP allocation is reduced to about 35 percent or less of the maximum Table A amount for two consecutive years, and between 21,000 and 35,000 afy if SWP allocation is reduced to about 35 percent or less of the maximum Table A amount for three consecutive years. Table 3-3 shows the sequence of SWP water availability and associated pumping from the Saugus Formation, based on this operating plan and the 86-year simulation period that reflects historical hydrology in the SWP system from 1922 through 2007.

Pumping rates for Purveyor-owned wells were assigned in accordance with the groundwater operating plan for the Santa Clarita Valley, which defines ranges of valley-wide annual pumping, given the water supply needs of the Purveyors. Pumping rates at individual wells were also assigned using the recent and planned production schedules for each well, information on the depths and lengths of the intake sections (open intervals) of each well, and by incorporating current plans addressing two other specific issues affecting Purveyor pumping:

- The presence of ammonium perchlorate in parts of the Saugus Formation and the Alluvial Aquifer

- Intermittent planned pumping from the Saugus Formation for the purpose of meeting regulatory objectives for chloride concentrations in the Santa Clara River.

These two issues and the details of how pumping was specified in the modeling analysis of the current operating plan are discussed further in Sections 3.3.2 and 3.3.3 below.

3.3.2 Alluvial Aquifer Pumping

Simulated pumping rates under the 2008 Operating Plan for production wells completed in the Alluvial Aquifer are listed in Table 3-4. The table provides this information for 8 wells owned by NCWD, 13 wells owned by SCWD, 15 wells owned by VWC, 16 wells owned by NLF, and private wells owned by Robinson Ranch and Wayside Honor Rancho. Most Alluvial Aquifer wells were specified to operate at similar rates regardless of year type, except in the eastern portion of the basin. Wells in this area (the Robinson Ranch well, the four Pinetree wells owned by NCWD, and 11 wells owned by SCWD) were assumed to have lower pumping capacities during dry years than non-drought years because of historically experienced lower groundwater elevations during dry periods.

The 2008 Operating Plan for the Alluvial Aquifer accounts for historical perchlorate detections in two alluvial wells, as the result of contamination emanating from the former Whittaker-Bermite property.

- In 2002, an Alluvial production well owned by SCWD (SCWD-Stadium) was shut down because of the detection of perchlorate. SCWD has recently drilled a replacement well (Valley Center) further to the east, north-northeast of the Whittaker-Bermite property.

- In March 2005, an Alluvial production well owned by VWC (VWC-Q2) was shut down because of perchlorate detection. After returning the well to service with wellhead treatment in October 2005, followed by nearly two years of operation with wellhead treatment, during which there was no detection of perchlorate, Valencia was authorized by the California Department of Public Health (DPH) to discontinue treatment. Well Q2 has since been operated without treatment and there has been no detection of perchlorate since discontinuation of wellhead treatment. Consequently, Well Q2 is included in the 2008 Operating Plan.

The 2008 Operating Plan for the Alluvial Aquifer also accounts for known private pumping at wells owned by the Newhall Land & Farming Company (NLF) for agricultural water supply; wells owned by Los Angeles County Water District No. 36 that provide potable water to the Wayside Honor Rancho; and a well in eastern Soledad Canyon owned by Robinson Ranch that is used for golf course irrigation. In the future, portions of the current pumping by NLF are planned to be converted to pumping by Valencia Water Company to supply potable water to the future Newhall Ranch development. However, for the purposes of the groundwater modeling analysis, this pumping volume is indicated in Table 3-4 as continuing to be conducted by NLF, to reflect current ownership and current operating conditions. The planned change from agricultural to municipal supply is expected to result in only locally small changes in pumping locations (new municipal wells in close proximity to existing agricultural wells that will then be abandoned), resulting in practically similar spatial distribution of pumping and thus similar conditions as simulated in the 2008 Operating Plan.

The water management practices of the Purveyors also recognize ongoing Alluvial Aquifer pumping for other smaller private domestic and related pumping. For the last ten years of formal annual water report preparation in the Santa Clarita Valley, those reports have included estimates of the latter private pumping. Based on limited data provided by private well owners as part of the overall Groundwater Management Plan effort, it is estimated that small private pumping is within 500 afy, or approximately one percent of typical Alluvial Aquifer pumping by the Purveyors and other known private well owners (including agricultural pumpers) combined. However, the small private wells are not explicitly modeled in the basin yield analysis described herein because their locations and operations are not known, and their operation creates a pumping stress that is essentially negligible at the scale of the overall groundwater model. Ultimately, as discussed throughout this report, the intent is to maintain overall pumping, including private pumping, within the operating plan to result in sustainable groundwater conditions to support the combination of municipal (Purveyor), agricultural, and private groundwater use on an ongoing basis. Thus, private well owners in the basin, like the large municipal and agricultural pumpers, can expect groundwater supplies to continue to be available as they have been in the past, with some fluctuations in water levels through wet and dry periods, but no long-term depletion of supply.

3.3.3 Saugus Aquifer Pumping

Simulated pumping rates under the 2008 Operating Plan for production wells completed in the Saugus Formation are listed in Table 3-5. The table provides this information for two wells owned by NCWD, two wells owned by SCWD, six wells owned by VWC, and a private well at the Palmer golf course, located just north of Hasley Canyon. Pumping rates at specific Saugus Formation production wells were assigned for each type of year (normal, dry year 1, dry year 2, and dry year 3) using information on the capacity, recent and planned use, and location of each well[1]. Significant aspects of the pumping rate selection at each well are as follows:

- Pumping from most existing Saugus Formation production wells was based on recent and planned use of these wells, as defined by the Purveyors. The simulation included increased dry-year pumping from the Saugus Formation in the western portion of the basin, where it is anticipated that future wells will be installed.

- Each Saugus Formation production well has an intake section (open interval) that is significantly longer in vertical extent than the thicknesses of the individual layers that represent the Saugus Formation in the groundwater flow model. Consequently, the

[1] Table 3-5 only lists wells that are anticipated to be operating in the future. Existing wells that are not listed in this table (such as NCWD-7, NCWD-10, and NCWD-11) are currently not in service and, therefore, are not expected to provide significant quantities of water in the future.

Saugus pumping rates were assigned to multiple layers in the model by considering the depths of the intake section of each well and the transmissivity of each model layer. Table 3-6 shows the allocation of pumping in each model layer for each Saugus Formation production well, along with the intake sections of each well and the model-simulated transmissivity in each layer at each well location.

The 2008 Operating Plan for the Saugus Formation accounts for historical perchlorate detections and the resulting containment and remedial response activities that are being constructed at this time. In 1997, two Saugus Formation production wells owned by SCWD (wells SCWD-Saugus1 and SCWD-Saugus2), one Saugus Formation production well owned by NCWD (well NCWD-11), and one former Saugus Formation production well owned by VWC (well VWC-157) were removed from service because perchlorate was detected in groundwater at these wells[2]. Under oversight by the California Department of Toxic Substances Control (DTSC), and with ultimate approval by DPH, in accordance with its Policy 97-005 (for restoration of water supply from "severely impaired" water sources), the Purveyors developed a remedial strategy that will entail pumping of two impacted wells for containment of perchlorate migration; treatment and subsequent use of the pumped water for water supply; and installation of replacement wells in non-impacted portions of the basin to restore the remainder of groundwater supply impacted by perchlorate. A noteworthy detail of these activities is that the groundwater flow model was used to identify the design of a pumping scheme that would meet the Purveyors' objectives for perchlorate containment in the Saugus Formation (CH2M HILL, 2004b). The final containment plan specifies that wells SCWD-Saugus1 and SCWD-Saugus 2 operate at an instantaneous pumping rate of 1,200 gallons per minute (gpm) at each well (for a combined total of 2,400 gpm from the two wells). The annual pumping volume of 1,772 afy per well shown in Table 3-5 is based on this rate and also on the assumption that pumping will occur continuously, except for up to four weeks per year for maintenance purposes. Construction of facilities and pipelines necessary to implement the containment program and to restore inactivated well capacity, to be followed by operational start-up, are currently scheduled to occur in 2009.

The 2008 Operating Plan for the Saugus Formation also accounts for intermittent pumping from the Saugus Formation that is expected to occur for the purpose of meeting regulatory objectives for chloride in the Santa Clara River. This pumping program is one component of an Alternative Water Resources Management (AWRM) program to be implemented by the Santa Clarita Valley Sanitation District of Los Angeles County (SCVSD, a division of the Los Angeles County Sanitation District [LACSD]), the Purveyors, and other parties for the purpose of meeting Total Maximum Daily Loads (TMDLs) for chloride in the Santa Clara River in western Los Angeles County and eastern Ventura County. The AWRM program was finalized in the form of a Memorandum of Understanding (MOU) dated October 2008. Under the AWRM program, CLWA will develop a plan to provide imported water to replace Saugus Formation groundwater that will be pumped to provide supplemental water for the AWRM program. The supplemental pumped groundwater from the Saugus Formation will be released to the Santa Clara River near the Los Angeles County / Ventura County line to improve water quality conditions in the river

[2]As part of the ongoing implementation of perchlorate containment and restoration of impacted capacity, well VWC-157 was abandoned in January 2005 and replaced by new well VWC-206. Thus, this analysis includes planned pumping from replacement well VWC-206.

and to allow for attainment of the AWRM's stated water quality objectives for the river. Under the AWRM, the supplemental water will be directed to the river during years of extreme drought conditions in the SWP, defined as time periods when chloride concentrations equal or exceed 80 milligrams per liter (mg/L) in SWP water (Geomatrix, 2008; LARWQCB, 2008). Pumping under this program is planned to occur from well VWC-206 and from two future wells that will be drilled near VWC-206. This supplemental pumping is factored into the annual pumping volumes listed in Table 3-5. The pumping rates listed in Table 3-5 for the individual Saugus Formation wells will occur regardless of whether a portion of a given year's pumping is being directed to the AWRM program. Any volume of pumping directed to the AWRM program in a given year will be made up with imported water supplies, rather than from increased pumping of Alluvial or other Saugus groundwater. Technical analyses indicate that this pumping could occur in about 24 percent of all years, with total pumping occurring at rates ranging from less than 1 million gallons per day (mgd) to as much as 8 mgd (Geomatrix, 2008).

3.3.4 Monthly Allocation of Pumping

The model simulations that evaluated the operating plan were conducted by modeling groundwater recharge and pumping on a monthly basis. Consequently, the annual pumping volumes specified in the groundwater operating plan were converted to monthly values at each well for modeling purposes. The allocation of pumping, by month, for agricultural and urban production wells in both the Alluvial Aquifer and the Saugus Formation is listed in Table 3-7. Separate monthly distributions were used because agricultural demands are for exclusively outdoor uses, whereas urban demands are for both indoor and outdoor uses. As discussed in the model development report (CH2M HILL, 2004a), the monthly distribution of agricultural pumping was derived from crop consumptive use requirements published by the California Irrigation Management Information Service. The monthly distribution of urban demand was determined by examining historical monthly flow records for the two water reclamation plants (WRPs) that are present in the valley, and also by examining the distributions of monthly water consumption recorded by the Purveyors within their service areas during the past several years.

3.3.5 Total Available Potable Water Supply Under the 2008 Operating Plan

For the 2008 Operating Plan and the 1922-2007 simulation period, Table 3-8 lists the annual volumes of water available from each potable water source (Alluvial Aquifer, Saugus groundwater, and SWP imports), along with their combined total. The combined pumping from the Alluvial Aquifer and the Saugus Formation averages 51,400 afy and ranges between 47,335 and 73,577 under the 2008 Operating Plan. Year-by-year pumping from each aquifer is shown in Figure 3-3, along with total groundwater pumping.

Figure 3-4 compares total groundwater pumping with SWP water supply availability and the resulting total volume of water from a combination of local groundwater and imported SWP water (not including other water supplies, for example, purchased water, water banked in other groundwater basins, etc.). The total water supply from those two sources is as low as 64,858 afy during the driest years in the SWP system, when SWP deliveries are below 10,000 afy. For the 86-year simulation period, the total available supply from local groundwater and imported SWP water averages about 110,000 afy and can exceed 140,000 afy in the wettest years.

3.4 2008 Operating Plan with Pumping Redistribution

The 2008 Operating Plan with Pumping Redistribution was developed in response to model simulation results (discussed in Section 4 of this report) that identified a potential lack of achievability in maintaining alluvial pumping in the eastern portion of the basin, due to decline in groundwater levels below the intake sections of wells. The model simulations of the 2008 operating plan indicated that such declines, and the associated potential lack of achievability, could occur during periods which experience prolonged dry conditions, such as occurred from the mid-1940s through the mid-1970s, when there were few years of significantly greater-than-average rainfall. For this three-decade period, the model simulation found the 2008 Operating Plan to not be achievable in the most eastern part of the basin, the "Above Mint Canyon" subarea. However, it was also recognized that achievability might be accomplished by redistributing some pumping to other areas, specifically to reduce pumping stress in the far east and replace it with increased pumping farther west in the basin. This redistribution may not be necessary during other historical periods that were characterized by intermittent years of significant rainfall, streamflow, and associated groundwater recharge (such as occurred periodically from the late 1970s through 2005).

This variation of the 2008 Operating Plan was examined as follows. Recognizing that SCWD is in the midst of constructing new or replacement wells (e.g. to replace its perchlorate-impacted Stadium well) to the west of the "Above Mint Canyon" subarea, a redistribution of some SCWD pumping, as analyzed in the 2008 Operating Plan, was crafted whereby 1,600 afy of pumping was moved from three SCWD wells in the "Above Mint Canyon" subarea (near the mouth of Sand Canyon) to the replacement SCWD Santa Clara and Bouquet wells, located in the "Above Saugus WRP" and "Bouquet Canyon" subareas, respectively. Table 3-9 shows the resulting pumping plan for each Alluvial well under this redistribution scheme.

Besides the pumping redistribution in these Alluvial wells, all other aspects of Alluvial and Saugus pumping remains unchanged from the 2008 Operating Plan.

3.5 Potential Future Operating Plan

A third operating plan was analyzed at the request of the Purveyors. This plan is referred to herein as the Potential Operating Plan and contemplates increased utilization of groundwater during both regular (wet/normal) years and dry years. Target pumping volumes and locations under this plan were provided by the Purveyors and are summarized in Table 3-10 for the Alluvial Aquifer and Table 3-11 for the Saugus Formation. Under this plan, Alluvial Aquifer pumping would be on the order of 47,500 afy in normal/wet years and would be reduced to about 41,500 afy following two or more years of below-normal rainfall locally. Saugus Formation pumping would be on the order of 16,350 afy during years of normal SWP water availability and would increase to over 39,500 afy in the third year of reduced SWP water availability.

Consequently, total groundwater pumping under this plan would be almost 64,000 afy during normal years (compared with about 51,000 afy in the 2008 Operating Plan) and could be as high as about 87,000 afy during the highest pumping years (compared with about 73,500 afy in the 2008 Operating Plan). Figure 3-5 shows the fluctuation during the 86-year simulation period in total groundwater pumping under this Potential Operating Plan, as well as the fluctuations in total Alluvial pumping and total Saugus pumping. Figure 3-6 compares the year-to-year pumping volumes, as well as the 86-year total pumping, for the potential plan and the 2008 plan. Total groundwater pumping during the 86-year simulation period would be about 1 million acre-feet, or about 80 percent, higher under the Potential Operating Plan.

The Potential Operating Plan differs from the 2008 Operating Plan only in the amount of groundwater being extracted. Both plans assume the same amount of SWP water availability. As shown in Table 3-12 and Figure 3-7, under the Potential Operating Plan, the total contemplated volume of available potable water supply from a combination of local groundwater and imported SWP water (not including other water supplies, for example, purchased water, water banked in other groundwater basins, etc.) ranges between about 77,000 afy and 156,000 afy, and averages nearly 122,000 afy for the 86-year simulation period. This represents an approximate 10 percent increase in water supply from those two sources during average and wet years, compared with the 2008 Operating Plan. During years of reduced SWP imports, the Potential Operating Plan contemplates almost 20 percent more potable water availability from local groundwater and imported SWP water during the driest years, compared with the 2008 Operating Plan.

3.6 Simulation of Other Local Hydrologic Processes

In addition to groundwater pumping, infiltration from irrigation (from urban and agricultural lands), precipitation, and streamflows (stormwater and WRP discharges) were also modeled. These other local hydrologic processes were defined using the Surface Water Routing Model (SWRM), which is described in Appendix C to the model development and calibration report (CH2M HILL, 2004a). The procedures used to derive these terms were the same as in the original basin yield analysis (CH2M HILL and LSCE, 2005) and are described in the following sections.

3.6.1 Recharge from Urban Irrigation

Under existing land use and water use conditions, the estimated long-term infiltration rates of applied irrigation water beneath urban areas, under full build-out conditions in the valley, were estimated to be 1.0 in/yr for industrial and retail lands, 2.2 in/yr for residential developments and parks, and 4.6 in/yr for golf courses (CH2M HILL, 2004a; CH2M HILL and LSCE, 2005). These rates were applied during each year (and each month) of the 86-year simulation period. The areas over which these rates were applied were larger than under current conditions. The areas were defined from recent land use data and LACSD mapping of projected future land uses in the rest of the Santa Clarita Valley under full build-out conditions[3] (CH2M HILL and LSCE, 2005).

[3] LACSD land use mapping indicates that, including Newhall Ranch, approximately 14,000 acres of currently undeveloped land will be urbanized in the future within the model simulation area. Additional urbanization will also occur in areas that are within the watershed, but outside the model's boundaries.

3.6.2 Recharge from Agricultural Irrigation

As discussed in the *Newhall Ranch Updated Water Resources Impact Evaluation* (CH2M HILL, 2002), irrigation of lands owned by NLF results in existing agricultural return flows. The source of most irrigation water is groundwater pumping from the Alluvial Aquifer, with some limited pumping occurring from one Saugus Formation well (NLF-156) prior to 2008, when this well was taken out of service. Under full Valley build-out conditions, the currently irrigated lands will no longer be irrigated because their water source will be used as part of the water supply for Newhall Ranch. Therefore, under full build-out conditions, no agricultural irrigation will occur within the area simulated by the model.

3.6.3 Precipitation Recharge

Infiltration from direct precipitation within the model domain was defined using data from the Newhall-Soledad and NCWD rain gages, an isohyet map of rainfall throughout the watershed, and the Turner (1986) power-function equation that describes the relationship between annual rainfall and annual groundwater recharge within the valley. Details concerning the derivation of precipitation infiltration rates from these data are contained in Appendix C to the model development and calibration report (CH2M HILL, 2004a). Table 3-13 lists the simulated monthly precipitation at the NCWD rain gage for the 86-year model period[4].

3.6.4 Stormwater Flows and Recharge from Streams

For each month of the simulation, the SWRM calculated the amounts of stormwater flow and groundwater recharge in all streams, plus the amount of flow and groundwater recharge arising from projected future WRP discharges to the Santa Clara River (including from the future Newhall WRP, which will service the planned Newhall Ranch development). For the Santa Clara River, the volume of streamflow was defined from measured and estimated streamflow data at the Lang gage (Table 3-14). For Castaic Creek, the volume of streamflow was defined from historical DWR operations and consideration of the hydrologic year type (Table 3-15). For the remaining Santa Clara River tributaries, streamflow volumes were defined by the SWRM using monthly rainfall data and the Turner (1986) relationship between rainfall, ET, and the subsequent yield from each watershed.

3.6.5 WRP Discharges to the Santa Clara River

Treated water is discharged to the Santa Clara River from the two WRPs that are present in the Valley. The Saugus WRP discharges to the river immediately above the mouth of the South Fork Santa Clara River, and the Valencia WRP discharges to the river just west of Interstate 5. The planned Newhall WRP will discharge to the river just east of the Los Angeles / Ventura County line for limited durations in the winter months.

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[4]The simulated monthly precipitation was defined from measurements at the NCWD rain gage from 1979 through 2003, as well as by combining the isohyet map with measurements at the Newhall-Soledad rain gage from prior to 1979.

Under full Valley build-out conditions, future flows into and from WRPs will be higher than historical flows because of increased development and the associated increase in indoor water use volumes. Additionally, a portion of the future treated water will be reclaimed, as described in CLWA's recycled water master plan (Kennedy/Jenks Consultants, 2002). In the original basin yield analysis work (CH2M HILL and LSCE, 2005), future inflows to the Saugus and Valencia WRPs were estimated from projected future water demands and from comparisons of historical water use and measured inflows to both WRPs. Table 3-16 shows the derivation of urban water demands outside the Newhall Ranch development (which will be served by a new, separate WRP). Table 3-17 shows the total amount of treated water generated by the Saugus and Valencia WRPs, and the amount of this water that is reclaimed and discharged to the river, by month. These values are the same as were used in the original basin yield analysis work. The values in Table 3-17 assume that the reclaimed water volume will be no more than 16,000 afy, to maintain existing flow volumes in the Santa Clara River. For the Newhall Ranch WRP, discharges to the river will be 286 afy, occurring primarily in December and January, when demands for reclaimed water are at their seasonal low. The total combined volumes of treated water discharged to the Santa Clara River under full Valley build-out conditions (including Newhall Ranch) are summarized, by month, in Table 3-18. These rates, which were used in the original basin yield analysis, were carried forward and used in each year of the 86-year simulation for the basin yield update analysis.

3.6.6 Monthly Assignment and Tracking of Surface Water Budget

The month-by-month assignment of the rates and locations of surface water infiltration to the underlying Alluvial Aquifer system was performed by the SWRM using the procedures described in Section C.8.5 of Appendix C to the model development and calibration report (CH2M HILL, 2004a). Streambed infiltration capacities for the last 28 years of the 86-year simulation period (calendar years 1980 through 2007) were the same as those used in the calibrated model. For the prior 58 years (1922 through 1979), the monthly streambed infiltration capacity values for a given year were selected by using one of the calibration years as a prototype year. Rainfall and streamflow records were used to identify the best prototype year and to subsequently specify the corresponding streambed infiltration rates.

For each month of the 86-year simulation period, the SWRM also tracked the volume of surface water that does not infiltrate to groundwater from a given stream because of gaining stream conditions (i.e., rejected stream leakage). This rejected stream leakage was calculated to remain as surface water in the Santa Clara River and to eventually exit the model domain at the west end of the Valley, at the County Line gage.

3.7 Running the Model and Evaluating Results

As discussed in the previous sections, the modeling evaluations were performed by simulating conditions on a monthly basis for the 86-year simulation period. The first step in this process consisted of running the SWRM to calculate the monthly distribution of recharge to the Alluvial Aquifer system (from rainfall, streamflow, irrigation, and WRP discharges) and recharge to the Saugus Formation (from rainfall and irrigation) in areas where the Alluvial Aquifer is not present. The output from the SWRM consisted of monthly files that assigned recharge to each node in the model grid.

The model was then run using monthly time steps, in which pumping and recharge terms were varied each month. For each sub-interval of time, the model was run by solving the groundwater flow equations for a given month, using a convergence criterion of 0.005 foot for groundwater elevations and a water budget convergence criterion of 2 cubic feet per day. The model results were then evaluated by generating time-series plots (hydrographs) of water budget terms and groundwater elevations to evaluate the potential effects of the groundwater operating plan across the basin. The hydrographs were used to evaluate whether the operating plan is consistent with the objective of operating the basin in a manner that maintains long-term stability in groundwater levels and river flows. This analysis and its findings are presented in the following Chapter 4.

Table 3-1
Alluvial and Saugus Formation Pumping Patterns for the Simulation of 1922-2007 Historical Hydrology

Calendar Year	Local Rainfall (inches)[a]	SWP Water Availability[b]	Simulated Pumping Conditions	
			Alluvium	Saugus
1922	~ 32	89%	Normal	Normal
1923	~ 14	76%	Normal	Normal
1924	~ 8	10%	Dry Year 1	Dry Year 1
1925	~ 7	40%	Dry Year 2	Normal
1926	~ 26	53%	Dry Year 3	Normal
1927	~ 24	89%	Normal	Normal
1928	~ 10	50%	Normal	Normal
1929	~ 12	18%	Dry Year 1	Dry Year 1
1930	~ 12	49%	Dry Year 2	Normal
1931	24.41	27%	Dry Year 3	Dry Year 2
1932	13.73	32%	Normal	Dry Year 3
1933	20.52	48%	Dry Year 1	Dry Year 4
1934	18.05	32%	Dry Year 2	Dry Year 5
1935	12.21	81%	Dry Year 3	Normal
1936	20.47	76%	Dry Year 4	Normal
1937	17.92	78%	Dry Year 5	Normal
1938	32.75	82%	Dry Year 6	Normal
1939	11.27	79%	Normal	Normal
1940	21.37	77%	Dry Year 1	Normal
1941	42.14	61%	Dry Year 2	Normal
1942	7.10	77%	Normal	Normal
1943	37.03	76%	Dry Year 1	Normal
1944	24.63	71%	Normal	Normal
1945	14.56	75%	Normal	Normal
1946	21.71	77%	Normal	Normal
1947	4.16	56%	Normal	Normal
1948	9.13	63%	Dry Year 1	Normal
1949	9.93	31%	Dry Year 2	Dry Year 1
1950	6.84	60%	Dry Year 3	Normal
1951	12.42	85%	Dry Year 4	Normal
1952	34.19	63%	Dry Year 5	Normal
1953	4.88	80%	Normal	Normal
1954	15.82	77%	Dry Year 1	Normal
1955	13.91	28%	Dry Year 2	Dry Year 1
1956	14.21	87%	Dry Year 3	Normal
1957	22.85	62%	Dry Year 4	Normal
1958	23.14	73%	Dry Year 5	Normal
1959	9.81	84%	Normal	Normal
1960	11.64	35%	Dry Year 1	Dry Year 1
1961	8.82	57%	Dry Year 2	Normal
1962	21.22	72%	Dry Year 3	Normal
1963	12.79	82%	Dry Year 4	Normal
1964	10.09	53%	Dry Year 5	Normal
1965	32.28	69%	Dry Year 6	Normal
1966	14.57	79%	Normal	Normal
1967	23.23	72%	Dry Year 1	Normal
1968	6.90	80%	Dry Year 2	Normal
1969	32.42	64%	Dry Year 3	Normal
1970	23.19	79%	Normal	Normal
1971	13.75	80%	Normal	Normal
1972	4.15	41%	Dry Year 1	Normal
1973	19.79	75%	Dry Year 2	Normal
1974	18.04	77%	Dry Year 3	Normal
1975	10.92	78%	Dry Year 4	Normal
1976	14.02	63%	Dry Year 5	Normal
1977	20.87	6%	Dry Year 6	Dry Year 3
1978	42.17	87%	Dry Year 7	Normal
1979	21.47	76%	Normal	Normal
1980	27.00	66%	Normal	Normal
1981	13.42	76%	Normal	Normal
1982	20.20	71%	Dry Year 1	Normal
1983	39.07	60%	Normal	Normal
1984	12.86	78%	Normal	Normal
1985	8.37	77%	Dry Year 1	Normal
1986	18.02	56%	Dry Year 2	Normal
1987	14.45	68%	Normal	Normal
1988	16.92	12%	Dry Year 1	Dry Year 1
1989	7.56	76%	Dry Year 2	Normal
1990	6.98	9%	Dry Year 3	Dry Year 2
1991	17.21	18%	Dry Year 4	Dry Year 3
1992	32.03	26%	Dry Year 5	Dry Year 4
1993	32.72	90%	Normal	Normal
1994	10.27	51%	Normal	Normal
1995	29.15	72%	Dry Year 1	Normal
1996	15.88	83%	Normal	Normal
1997	13.35	75%	Normal	Normal
1998	30.73	73%	Normal	Normal
1999	8.96	83%	Normal	Normal
2000	14.04	84%	Normal	Normal
2001	22.24	28%	Dry Year 1	Dry Year 1
2002	7.90	52%	Dry Year 2	Normal
2003	15.70	71%	Dry Year 3	Normal
2004	22.79	65%	Dry Year 4	Normal
2005	37.15	90%	Normal	Normal
2006	13.89	100%	Normal	Normal
2007	5.78	60%	Dry Year 1	Normal

aFrom records at Newhall-Soledad rain gage (Station No. FC32CE). Pumping year type lags local rainfall by one year. Dry year pumping occurs when rainfall in prior year is 12.5 inches or less, and may continue until after a year with high rainfall (well above normal) has occurred.

[b]Values for 1922-2003 are from Table B.3 in DWR (2008) and are for SWP Table A Deliveries under current (2007) conditions. Values in 2004 through 2007 are actual historical deliveries during those years.

TABLE 3-2

Local Hydrology and 2008 Operating Plan for the Alluvial Aquifer

Calendar Year	Local Rainfall (inches)[a]	Year Type	Alluvial Aquifer Pumping under the Groundwater Operating Plan (afy)
1922	~ 32	Normal	35,000-40,000
1923	~ 14	Normal	35,000-40,000
1924	~ 8	Dry Year 1	30,000-35,000
1925	~ 7	Dry Year 2	30,000-35,000
1926	~ 26	Dry Year 3	30,000-35,000
1927	~ 24	Normal	35,000-40,000
1928	~ 10	Normal	35,000-40,000
1929	~ 12	Dry Year 1	30,000-35,000
1930	~ 12	Dry Year 2	30,000-35,000
1931	24.41	Dry Year 3	30,000-35,000
1932	13.73	Normal	35,000-40,000
1933	20.52	Dry Year 1	30,000-35,000
1934	18.05	Dry Year 2	30,000-35,000
1935	12.21	Dry Year 3	30,000-35,000
1936	20.47	Dry Year 4	30,000-35,000
1937	17.92	Dry Year 5	30,000-35,000
1938	32.75	Dry Year 6	30,000-35,000
1939	11.27	Normal	35,000-40,000
1940	21.37	Dry Year 1	30,000-35,000
1941	42.14	Dry Year 2	30,000-35,000
1942	7.10	Normal	35,000-40,000
1943	37.03	Dry Year 1	30,000-35,000
1944	24.63	Normal	35,000-40,000
1945	14.56	Normal	35,000-40,000
1946	21.71	Normal	35,000-40,000
1947	4.16	Normal	35,000-40,000
1948	9.13	Dry Year 1	30,000-35,000
1949	9.93	Dry Year 2	30,000-35,000
1950	6.84	Dry Year 3	30,000-35,000
1951	12.42	Dry Year 4	30,000-35,000
1952	34.19	Dry Year 5	30,000-35,000
1953	4.88	Normal	35,000-40,000
1954	15.82	Dry Year 1	30,000-35,000
1955	13.91	Dry Year 2	30,000-35,000
1956	14.21	Dry Year 3	30,000-35,000
1957	22.85	Dry Year 4	30,000-35,000
1958	23.14	Dry Year 5	30,000-35,000
1959	9.81	Normal	35,000-40,000
1960	11.64	Dry Year 1	30,000-35,000
1961	8.82	Dry Year 2	30,000-35,000
1962	21.22	Dry Year 3	30,000-35,000
1963	12.79	Dry Year 4	30,000-35,000
1964	10.09	Dry Year 5	30,000-35,000
1965	32.28	Dry Year 6	30,000-35,000
1966	14.57	Normal	35,000-40,000
1967	23.23	Dry Year 1	30,000-35,000
1968	6.90	Dry Year 2	30,000-35,000
1969	32.42	Dry Year 3	30,000-35,000
1970	23.19	Normal	35,000-40,000
1971	13.75	Normal	35,000-40,000
1972	4.15	Dry Year 1	30,000-35,000
1973	19.79	Dry Year 2	30,000-35,000
1974	18.04	Dry Year 3	30,000-35,000
1975	10.92	Dry Year 4	30,000-35,000
1976	14.02	Dry Year 5	30,000-35,000
1977	20.87	Dry Year 6	30,000-35,000
1978	42.17	Dry Year 7	30,000-35,000
1979	21.47	Normal	35,000-40,000
1980	27.00	Normal	35,000-40,000
1981	13.42	Normal	35,000-40,000
1982	20.20	Dry Year 1	30,000-35,000
1983	39.07	Normal	35,000-40,000
1984	12.86	Normal	35,000-40,000
1985	8.37	Dry Year 1	30,000-35,000
1986	18.02	Dry Year 2	30,000-35,000
1987	14.45	Normal	35,000-40,000
1988	16.92	Dry Year 1	30,000-35,000
1989	7.56	Dry Year 2	30,000-35,000
1990	6.98	Dry Year 3	30,000-35,000
1991	17.21	Dry Year 4	30,000-35,000
1992	32.03	Dry Year 5	30,000-35,000
1993	32.72	Normal	35,000-40,000
1994	10.27	Normal	35,000-40,000
1995	29.15	Dry Year 1	30,000-35,000
1996	15.88	Normal	35,000-40,000
1997	13.35	Normal	35,000-40,000
1998	30.73	Normal	35,000-40,000
1999	8.96	Normal	35,000-40,000
2000	14.04	Normal	35,000-40,000
2001	22.24	Dry Year 1	30,000-35,000
2002	7.90	Dry Year 2	30,000-35,000
2003	15.70	Dry Year 3	30,000-35,000
2004	22.79	Dry Year 4	30,000-35,000
2005	37.15	Normal	35,000-40,000
2006	13.89	Normal	35,000-40,000
2007	5.78	Dry Year 1	30,000-35,000

aFrom records at Newhall-Soledad rain gage (Station No. FC32CE). Pumping year type lags local rainfall by one year. Dry year pumping occurs when rainfall in prior year is 12.5 inches or less, and may continue until after a year with high rainfall (well above normal) has occurred.

afy = acre-feet per year

TABLE 3-3
SWP Deliveries and 2008 Operating Plan for the Saugus Formation

Calendar Year	Historical SWP Hydrology	SWP Water Delivery from the California Bay-Delta: Percent of Maximum Table A Deliveries (Current Conditions)	Design of Updated Basin Analysis: Saugus Pumping: Year Type	Design of Updated Basin Analysis: Saugus Operating Plan Pumping Volume (afy)	
1922	Above Normal	89%	Normal	11,000	
1923	Below Normal	76%	Normal	11,000	
1924	Critical	10%	Dry Year 1	15,000	Mild Single Dry Year
1925	Dry	40%	Normal	11,000	
1926	Dry	53%	Normal	11,000	
1927	Wet	89%	Normal	11,000	
1928	Above Normal	50%	Normal	11,000	
1929	Critical	18%	Dry Year 1	15,000	6-Year Drought (1929-1934) and 4-Year Drought (1931-1934)
1930	Dry	49%	Normal	11,000	
1931	Critical	27%	Dry Year 2	25,000	
1932	Dry	32%	Dry Year 3	35,000	
1933	Critical	48%	Dry Year 4	35,000	
1934	Critical	32%	Dry Year 5	35,000	
1935	Below Normal	81%	Normal	11,000	
1936	Below Normal	76%	Normal	11,000	
1937	Below Normal	78%	Normal	11,000	
1938	Wet	82%	Normal	11,000	
1939	Dry	79%	Normal	11,000	
1940	Above Normal	77%	Normal	11,000	
1941	Wet	61%	Normal	11,000	
1942	Wet	77%	Normal	11,000	
1943	Wet	76%	Normal	11,000	
1944	Dry	71%	Normal	11,000	
1945	Below Normal	75%	Normal	11,000	
1946	Below Normal	77%	Normal	11,000	
1947	Dry	56%	Normal	11,000	
1948	Below Normal	63%	Normal	11,000	
1949	Dry	31%	Dry Year 1	15,000	Mild Single Dry Year
1950	Below Normal	60%	Normal	11,000	
1951	Above Normal	85%	Normal	11,000	
1952	Wet	63%	Normal	11,000	
1953	Wet	80%	Normal	11,000	
1954	Above Normal	77%	Normal	11,000	
1955	Dry	28%	Dry Year 1	15,000	Mild Single Dry Year
1956	Wet	87%	Normal	11,000	
1957	Above Normal	62%	Normal	11,000	
1958	Wet	73%	Normal	11,000	
1959	Below Normal	84%	Normal	11,000	
1960	Dry	35%	Dry Year 1	15,000	Mild Single Dry Year
1961	Dry	57%	Normal	11,000	
1962	Below Normal	72%	Normal	11,000	
1963	Wet	82%	Normal	11,000	
1964	Dry	53%	Normal	11,000	
1965	Wet	69%	Normal	11,000	
1966	Below Normal	79%	Normal	11,000	
1967	Wet	72%	Normal	11,000	
1968	Below Normal	80%	Normal	11,000	
1969	Wet	64%	Normal	11,000	
1970	Wet	79%	Normal	11,000	
1971	Wet	80%	Normal	11,000	
1972	Below Normal	41%	Normal	11,000	
1973	Above Normal	75%	Normal	11,000	
1974	Wet	77%	Normal	11,000	
1975	Wet	78%	Normal	11,000	
1976	Critical	63%	Normal	11,000	2-year Drought (1976-1977); Single Critical Dry Year (1977)
1977	Critical	6%	Dry Year 3	35,000	
1978	Above Normal	87%	Normal	11,000	
1979	Below Normal	76%	Normal	11,000	
1980	Above Normal	66%	Normal	11,000	
1981	Dry	76%	Normal	11,000	
1982	Wet	71%	Normal	11,000	
1983	Wet	60%	Normal	11,000	
1984	Wet	78%	Normal	11,000	
1985	Dry	77%	Normal	11,000	
1986	Wet	56%	Normal	11,000	
1987	Dry	68%	Normal	11,000	6-Year Drought (1987-1992)
1988	Critical	12%	Dry Year 1	15,000	
1989	Dry	76%	Normal	11,000	
1990	Critical	9%	Dry Year 2	25,000	
1991	Critical	18%	Dry Year 3	35,000	
1992	Critical	26%	Dry Year 4	35,000	
1993	Above Normal	90%	Normal	11,000	
1994	Critical	51%	Normal	11,000	
1995	Wet	72%	Normal	11,000	
1996	Wet	83%	Normal	11,000	
1997	Wet	75%	Normal	11,000	
1998	Wet	73%	Normal	11,000	
1999	Wet	83%	Normal	11,000	
2000	Above Normal	84%	Normal	11,000	
2001	Dry	28%	Dry Year 1	15,000	Mild Single Dry Year
2002	Dry	52%	Normal	11,000	
2003	Above Normal	71%	Normal	11,000	
2004	Below Normal / Dry	65%	Normal	11,000	
2005	Wet / Above Normal	90%	Normal	11,000	
2006	Wet / Wet	100%	Normal	11,000	
2007	Dry / Critical	60%	Normal	11,000	

[b]Values for 1922-2003 are from Table B.3 in DWR (2008) and are for SWP Table A Deliveries under current (2007) conditions.
Values in 2004 through 2007 are actual historical deliveries during those years. afy = acre-feet per year

TABLE 3-4
Pumping Rates Simulated for Individual Alluvial Aquifer Wells under the 2008 Groundwater Operating Plan

		2005 Operating Plan		2008 Operating Plan			
Well Name	**Alluvial Subarea**	**Normal**	**Dry**	**Normal**	**Dry Yr 1**	**Dry Yr 2+**	**Comments**
NCWD-Castaic 1	Castaic Valley	385	345	350	300	250	
NCWD-Castaic 2	Castaic Valley	166	125	100	100	100	
NCWD-Castaic 4	Castaic Valley	100	45	100	0	0	
NCWD-Castaic 7	Castaic Valley			300	200	200	Assume similar pumping as at NCWD-Castaic3 during early 1980s
NCWD-Pinetree 1	Above Mint Canyon	164	0	150	0	0	
NCWD-Pinetree 3	Above Mint Canyon	545	525	350	300	300	
NCWD-Pinetree 4	Above Mint Canyon	300	0	300	200	200	
NCWD-Pinetree 5	Above Mint Canyon			300	200	200	
NCWD Total		**1,660**	**1,040**	**1,950**	**1,300**	**1,250**	
NLF-161	Below Valencia WRP	485	485	1,000	1,000	1,000	
NLF-B10	Below Valencia WRP	344	344	500	350	350	
NLF-B11	Below Valencia WRP	232	232	100	200	200	
NLF-B14	Below Valencia WRP			300	1,000	1,000	
NLF-B20	Below Valencia WRP	584	584	350	500	500	Pumping was assigned to former B7 well in 2005 analysis.
NLF-B5	Below Valencia WRP	1,582	1,582	2,400	1,900	1,900	
NLF-B6	Below Valencia WRP	1,766	1,766	1,100	1,100	1,100	
NLF-C	Below Valencia WRP	1,373	1,373	1,100	1,000	1,000	
NLF-C3	Below Valencia WRP	192	192	100	200	200	
NLF-C4	Below Valencia WRP	809	809	200	450	450	
NLF-C5	Below Valencia WRP	850	850	900	850	850	
NLF-C7	Below Valencia WRP	1,107	1,107	350	300	300	
NLF-C8	Below Valencia WRP	594	594	400	400	400	
NLF-E5	Below Valencia WRP	750	750	100	150	150	
NLF-E9	Below Valencia WRP	814	814	900	350	350	
NLF-G45	Below Valencia WRP	390	390	350	400	400	
NLF Total		**11,872**	**11,872**	**10,150**	**10,150**	**10,150**	
SCWD-Clark	Bouquet Canyon	782	700	700	700	700	
SCWD-Guida	Bouquet Canyon	1,320	1,230	1,300	1,250	1,200	
SCWD-Honby	Above Saugus WRP	696	870	1,000	850	700	
SCWD-Lost Canyon 2	Above Mint Canyon	741	640	700	700	650	
SCWD-Lost Canyon 2A	Above Mint Canyon	1,034	590	700	650	600	
SCWD-Mitchell #5A	Above Mint Canyon	0	0	500	350	200	
SCWD-Mitchell #5B	Above Mint Canyon	557	0	800	550	300	
SCWD-N. Oaks Central	Above Mint Canyon	822	1,640	850	800	700	
SCWD-N. Oaks East	Above Mint Canyon	1,234	485	800	750	700	
SCWD-N. Oaks West	Above Mint Canyon	898	0	800	750	700	
SCWD-Sand Canyon	Above Mint Canyon	930	195	1,000	600	200	
SCWD-Sierra	Above Mint Canyon	846	0	1,100	900	700	
SCWD-Valley Center	Above Saugus WRP	800	800	800	800	800	Pumping transferred from former well SCWD-Stadium
SCWD Total		**10,660**	**7,150**	**11,050**	**9,650**	**8,150**	
VWC-D	Castaic Valley	690	690	880	880	880	
VWC-E15	Below Valencia WRP			800	800	800	
VWC-N	Below Saugus WRP	620	620	650	650	650	
VWC-N7	Below Saugus WRP	1,160	1,160	1,160	1,160	1,160	
VWC-N8	Below Saugus WRP	1,160	1,160	1,160	1,160	1,160	
VWC-Q2	Below Saugus WRP	985	985	1,100	1,100	1,100	
VWC-S6	Below Saugus WRP	865	865	1,000	1,000	1,000	
VWC-S7	Below Saugus WRP	865	865	500	500	500	
VWC-S8	Below Saugus WRP	865	865	500	500	500	
VWC-T7	Above Saugus WRP	920	920	750	750	750	Pumping transferred from former wells VWC-T2 and VWC-T4
VWC-U4	Above Saugus WRP	935	935	800	800	800	
VWC-U6	Above Saugus WRP	825	825	800	800	800	Pumping transferred from former well VWC-U3
VWC-W10	San Francisquito Canyon	865	865	1,000	1,000	1,000	Pumping was assigned to former W6 well in 2005 analysis.
VWC-W11	San Francisquito Canyon	600	600	800	800	800	
VWC-W9	San Francisquito Canyon	350	350	950	950	950	
VWC Total		**11,705**	**11,705**	**12,850**	**12,850**	**12,850**	
Robinson Ranch	Above Mint Canyon	932	400	600	550	450	
WHR	Castaic Valley	1,600	1,600	2,000	2,000	2,000	
Purveyor Alluvial Usage		**24,025**	**19,895**	**25,850**	**23,800**	**22,250**	**2008 Operating Plan:**
Other Alluvial Usage		**14,404**	**13,872**	**12,750**	**12,700**	**12,600**	**35,000 to 40,000 AF/yr in normal and wet years**
Total Alluvial Pumping		**38,429**	**33,767**	**38,600**	**36,500**	**34,850**	**30,000 to 35,000 AF/yr in dry years**

Notes:

All pumping volumes are listed in units of acre-feet per year (afy).
Wells that are not listed are assumed to not be pumping in the future.
NLF = Newhall Land & Farming Company
NCWD = Newhall County Water District
SCWD = Santa Clarita Division of Castaic Lake Water Agency
VWC = Valencia Water Company
WHR = Wayside Honor Rancho, whose wells are owned by the Los Angeles County Waterworks District No. 36
"Other Alluvial Usage" consists of pumping by NLF, WHR, and Robinson Ranch. An additional 500 afy of pumping by other private well owners is not included in this table.

TABLE 3-

Pumping Rates Simulated for Individual Saugus ormation Wells under the 2008 Groundwater Operating Plan

Owner	Well Name	Non-Drought Years	Drought Year 1	Drought Year 2	Drought Year 3
NCWD	12	1,765	2,494	2,494	2,494
	13	1,765	2,494	2,494	2,494
Total Pumping (NCWD Wells)		**3,530**	**4,988**	**4,988**	**4,988**
SCWD	Saugus1	1,772	1,772	1,772	1,772
	Saugus2	1,772	1,772	1,772	1,772
Total Pumping (SCWD Wells)		**3,544**	**3,544**	**3,544**	**3,544**
Private	Palmer Golf Course	500	500	500	500
Total Pumping (Future Golf)		**500**	**500**	**500**	**500**
VWC	159	50	50	50	50
	160 (Municipal)	500	830	830	830
	160 (Val. Ctry Club)	500	500	500	500
	201	300	300	3,777	3,777
	205	1,211	2,945	4,038	4,038
	206	1,175	2,734	3,500	3,500
	207	1,175	2,734	3,500	3,500
Total Pumping (VWC Wells)		**4,911**	**10,093**	**16,195**	**16,195**
	Future #1	0	0	0	3,250
	Future #2	0	0	0	3,250
	Future #3	0	0	0	3,250
Total Pumping (Future Wells)		**0**	**0**	**0**	**9,750**
Total Pumping (All Saugus Wells)		**12,485**	**19,125**	**25,227**	**34,977**

Notes:

All pumping volumes are listed in units of acre-feet per year (afy).

Wells that are not listed are assumed to not be pumping in the future.

NLF = Newhall Land & Farming Company

SCWD = Santa Clarita Division of Castaic Lake Water Agency

NCWD = Newhall County Water District

VWC = Valencia Water Company

TABLE 3-6

Allocation of Pumping by Layer for Wells Completed in the Saugus Formation

Well Owner - Well Name	Model Layer	Depth to Open Interval (feet) Top	Bottom	Length of Open Interval in Model Layer (feet)	Kh (ft/day)	T in Open Interval (ft^2/day)	Percentage of Yield from Model Layer
NCWD-12	2	485	1,280	15	10	150	8.8
	3			500	2	1,000	58.5
	4			280	2	560	32.7
NCWD-13	2	420	750	80	10	800	61.5
	3			250	2	500	38.5
SCWD-Saugus1	2	490	1,620	10	10	100	1.8
	3			500	6.5	3,250	59.9
	4			500	4	2,000	36.8
	5			20	4	80	1.5
SCWD-Saugus2	2	490	1,591	10	10	100	1.7
	3			500	6.5	3,250	56.9
	4			500	4	2,000	35.0
	5			91	4	364	6.4
Palmer Golf Course	2			250	1	250	20.0
	3			500	1	500	40.0
	4			500	1	500	40.0
VWC-159	3	662	1,900	338	0.025	8.45	27.3
	4			500	0.025	12.5	40.4
	5			400	0.025	10	32.3
VWC-160	3	950	2,000	50	6.5	325	7.6
	4			500	4	2,000	46.2
	5			500	4	2,000	46.2
VWC-201	3	540	1,670	460	6.5	2,990	52.7
	4			500	4	2,000	35.3
	5			170	4	680	12.0
VWC-205	3	820	1,930	180	6.5	1,170	23.9
	4			500	4	2,000	40.9
	5			430	4	1,720	35.2
VWC-206	3	500	2,000	500	6.5	3,250	44.8
	4			500	4	2,000	27.6
	5			500	4	2,000	27.6
VWC-207*	3	500	2,000	500	6.5	3,250	44.8
	4			500	4	2,000	27.6
	5			500	4	2,000	27.6
Future Wells	3	500	2,000	500	6.5	3,250	44.8
Near VWC-206	4			500	4	2,000	27.6
(Assumed)	5			500	4	2,000	27.6

Notes:

* VWC-207 well construction information was not available at the time of this investigation and therefore the allocation of pumping was assumed to be similar to VWC-206.

Existing wells NCWD-7, NCWD-10, and NCWD-11 are assumed to no longer operate in the future.

Kh = horizontal hydraulic conductivity
ft/day = feet per day

T = transmissivity
ft^2/day = square feet per day

Ta le 3-

Allocation of umping, by onth, for Agricultural and rban roduction Wells

Month	Percent of Annual Water Use, Agricultural	Percent of Annual Water Use, Urban	Percent of May through October Water Use, Urban
January	3.75	5.2	
February	5.1	3.7	
March	6.6	5.2	
April	9.1	6.6	
May	10.55	8.7	13.2
June	11.4	10.4	15.8
July	14.1	13	19.7
August	12.95	13.6	20.6
September	10.2	10.9	16.6
October	7.5	9.3	14.1
November	5	7.1	
December	3.75	6.3	
Total	**100**	**100**	**100**

TABLE 3-8

Total Groundwater and SWP Supplies for 2008 Groundwater Operating Plan (Not Including Recycled Water and Other Water Supplies, e.g. Purchased or Banked Water)

Model Year	Based on Historical Year	SWP Hydrology [a]	SWP Allocations [b] (%)	SWP Deliveries (afy)	Simulated Pumping From Alluvial Aquifer (afy)	Simulated Pumping From Saugus Formation (afy)	Total Groundwater Pumping (afy)	SWP + Groundwater (afy)
1	1922	Above Normal	89%	82,227	38,600	12,485	51,085	133,312
2	1923	Below Normal	76%	70,699	38,600	12,485	51,085	121,784
3	1924	Critical	10%	8,960	36,500	19,125	55,625	64,585
4	1925	Dry	40%	36,784	34,850	12,485	47,335	84,119
5	1926	Dry	53%	48,929	34,850	12,485	47,335	96,264
6	1927	Wet	89%	82,786	38,600	12,485	51,085	133,871
7	1928	Above Normal	50%	46,079	38,600	12,485	51,085	97,164
8	1929	Critical	18%	16,858	36,500	19,125	55,625	72,483
9	1930	Dry	49%	45,379	34,850	12,485	47,335	92,714
10	1931	Critical	27%	24,732	34,850	25,227	60,077	84,809
11	1932	Dry	32%	29,204	38,600	34,977	73,577	102,781
12	1933	Critical	48%	44,339	36,500	34,977	71,477	115,816
13	1934	Critical	32%	29,424	34,850	34,977	69,827	99,251
14	1935	Below Normal	81%	74,625	34,850	12,485	47,335	121,960
15	1936	Below Normal	76%	69,911	34,850	12,485	47,335	117,246
16	1937	Below Normal	78%	72,037	34,850	12,485	47,335	119,372
17	1938	Wet	82%	75,970	34,850	12,485	47,335	123,305
18	1939	Dry	79%	72,883	38,600	12,485	51,085	123,968
19	1940	Above Normal	77%	70,837	36,500	12,485	48,985	119,822
20	1941	Wet	61%	56,535	34,850	12,485	47,335	103,870
21	1942	Wet	77%	70,890	38,600	12,485	51,085	121,975
22	1943	Wet	76%	70,599	36,500	12,485	48,985	119,584
23	1944	Dry	71%	65,569	38,600	12,485	51,085	116,654
24	1945	Below Normal	75%	69,041	38,600	12,485	51,085	120,126
25	1946	Below Normal	77%	71,596	38,600	12,485	51,085	122,681
26	1947	Dry	56%	51,794	38,600	12,485	51,085	102,879
27	1948	Below Normal	63%	58,403	36,500	12,485	48,985	107,388
28	1949	Dry	31%	28,443	34,850	19,125	53,975	82,418
29	1950	Below Normal	60%	55,099	34,850	12,485	47,335	102,434
30	1951	Above Normal	85%	78,272	34,850	12,485	47,335	125,607
31	1952	Wet	63%	57,855	34,850	12,485	47,335	105,190
32	1953	Wet	80%	74,381	38,600	12,485	51,085	125,466
33	1954	Above Normal	77%	71,652	36,500	12,485	48,985	120,637
34	1955	Dry	28%	25,439	34,850	19,125	53,975	79,414
35	1956	Wet	87%	80,155	34,850	12,485	47,335	127,490
36	1957	Above Normal	62%	56,957	34,850	12,485	47,335	104,292
37	1958	Wet	73%	67,806	34,850	12,485	47,335	115,141
38	1959	Below Normal	84%	77,554	38,600	12,485	51,085	128,639
39	1960	Dry	35%	32,679	36,500	19,125	55,625	88,304
40	1961	Dry	57%	52,756	34,850	12,485	47,335	100,091
41	1962	Below Normal	72%	66,287	34,850	12,485	47,335	113,622
42	1963	Wet	82%	76,230	34,850	12,485	47,335	123,565
43	1964	Dry	53%	49,474	34,850	12,485	47,335	96,809
44	1965	Wet	69%	64,021	34,850	12,485	47,335	111,356
45	1966	Below Normal	79%	73,083	38,600	12,485	51,085	124,168
46	1967	Wet	72%	66,920	36,500	12,485	48,985	115,905
47	1968	Below Normal	80%	73,794	34,850	12,485	47,335	121,129
48	1969	Wet	64%	58,766	34,850	12,485	47,335	106,101
49	1970	Wet	79%	72,904	38,600	12,485	51,085	123,989
50	1971	Wet	80%	74,236	38,600	12,485	51,085	125,321
51	1972	Below Normal	41%	38,213	36,500	12,485	48,985	87,198
52	1973	Above Normal	75%	69,052	34,850	12,485	47,335	116,387
53	1974	Wet	77%	71,257	34,850	12,485	47,335	118,592
54	1975	Wet	78%	72,018	34,850	12,485	47,335	119,353
55	1976	Critical	63%	58,273	34,850	12,485	47,335	105,608
56	1977	Critical	6%	5,428	34,850	34,977	69,827	75,255
57	1978	Above Normal	87%	80,556	34,850	12,485	47,335	127,891
58	1979	Below Normal	76%	70,013	38,600	12,485	51,085	121,098
59	1980	Above Normal	66%	60,652	38,600	12,485	51,085	111,737
60	1981	Dry	76%	69,997	38,600	12,485	51,085	121,082
61	1982	Wet	71%	65,809	36,500	12,485	48,985	114,794
62	1983	Wet	60%	55,886	38,600	12,485	51,085	106,971
63	1984	Wet	78%	72,233	38,600	12,485	51,085	123,318
64	1985	Dry	77%	71,579	36,500	12,485	48,985	120,564
65	1986	Wet	56%	51,344	34,850	12,485	47,335	98,679
66	1987	Dry	68%	63,232	38,600	12,485	51,085	114,317
67	1988	Critical	12%	10,665	36,500	19,125	55,625	66,290
68	1989	Dry	76%	70,061	34,850	12,485	47,335	117,396
69	1990	Critical	9%	8,056	34,850	25,227	60,077	68,133
70	1991	Critical	18%	16,313	34,850	34,977	69,827	86,140
71	1992	Critical	26%	24,330	34,850	34,977	69,827	94,157
72	1993	Above Normal	90%	83,055	38,600	12,485	51,085	134,140
73	1994	Critical	51%	47,101	38,600	12,485	51,085	98,186
74	1995	Wet	72%	66,992	36,500	12,485	48,985	115,977
75	1996	Wet	83%	76,979	38,600	12,485	51,085	128,064
76	1997	Wet	75%	69,401	38,600	12,485	51,085	120,486
77	1998	Wet	73%	67,316	38,600	12,485	51,085	118,401
78	1999	Wet	83%	76,976	38,600	12,485	51,085	128,061
79	2000	Above Normal	84%	77,238	38,600	12,485	51,085	128,323
80	2001	Dry	28%	26,050	36,500	19,125	55,625	81,675
81	2002	Dry	52%	48,382	34,850	12,485	47,335	95,717
82	2003	Above Normal	71%	65,873	34,850	12,485	47,335	113,208
83	2004	Below Normal / Dry	Actual was 65%	60,125	34,850	12,485	47,335	107,460
84	2005	Wet / Above Normal	Actual was 90%	83,250	38,600	12,485	51,085	134,335
85	2006	Wet / Wet	Actual was 100%	92,500	38,600	12,485	51,085	143,585
86	2007	Dry / Critical	Actual was 60%	55,500	36,500	12,485	48,985	104,485

[a]Defined by water year, using DWR's Sacramento Valley Unimpaired Runoff Index: wet = wettest; critical = driest

[b]From Table B.3 in *The State Water Project Delivery Reliability Report 2007* (DWR, August 2008). This is for current (2007) conditions as defined in the DWR report. In any given year, the allocation may be made up, in part, of carryover water from the prior year.

afy = acre-feet per year SWP = State Water Project

Ta le 3-

Pumping Rates Simulated for Individual Alluvial Aquifer Wells nder the Redistri uted 2008 Groundwater Operating Plan Listed B Alluvial Su area

		Original 2008 Operating Plan			Redistributed 2008 Operating Plan			
Well Name	**Alluvial Subarea**	**Normal**	**Dry Yr 1**	**Dry Yr 2+**	**Normal**	**Dry Yr 1**	**Dry Yr 2+**	**Comments**
NCWD-Pinetree 1	Above Mint Canyon	150	0	0	150	0	0	
NCWD-Pinetree 3	Above Mint Canyon	350	300	300	350	300	300	
NCWD-Pinetree 4	Above Mint Canyon	300	200	200	300	200	200	
NCWD-Pinetree 5	Above Mint Canyon	300	200	200	300	200	200	
Robinson Ranch	Above Mint Canyon	600	550	450	600	550	450	
SCWD-Sand Canyon	**Above Mint Canyon**	**1,000**	**600**	**200**	**200**	**150**	**0**	**Reduce these three wells by 1,600 afy in order to**
SCWD-Lost Canyon 2	**Above Mint Canyon**	**700**	**700**	**650**	**300**	**150**	**0**	**offset increased pumping at the SCWD-Santa Clara and**
SCWD-Lost Canyon 2A	**Above Mint Canyon**	**700**	**650**	**600**	**300**	**150**	**0**	**SCWD-Bouquet wells in the "Above Saugus WRP" area.**
SCWD-Mitchell #5A	Above Mint Canyon	500	350	200	500	350	200	
SCWD-Mitchell #5B	Above Mint Canyon	800	550	300	800	550	300	
SCWD-N. Oaks Central	Above Mint Canyon	850	800	700	850	800	700	
SCWD-N. Oaks East	Above Mint Canyon	800	750	700	800	750	700	
SCWD-N. Oaks West	Above Mint Canyon	800	750	700	800	750	700	
SCWD-Sierra	Above Mint Canyon	1,100	900	700	1,100	900	700	
Mint Canyon Total		**8,950**	**7,300**	**5,900**	**7,350**	**5,800**	**4,450**	
SCWD-Honby	Above Saugus WRP	1,000	850	700	1,000	850	700	
SCWD-Santa Clara	Above Saugus WRP	800	800	800	800	800	800	
SCWD-Valley Center	**Above Saugus WRP**	**0**	**0**	**0**	**800**	**800**	**800**	**Pumps 800 afy moved from the "Above Mint Canyon" area.**
SCWD-Bouquet	**Above Saugus WRP**	**0**	**0**	**0**	**800**	**800**	**800**	**Pumps 800 afy moved from the "Above Mint Canyon" area.**
VWC-T7	Above Saugus WRP	750	750	750	750	750	750	
VWC-U4	Above Saugus WRP	800	800	800	800	800	800	
VWC-U6	Above Saugus WRP	800	800	800	800	800	800	
Above Saugus WRP Total		**4,150**	**4,000**	**3,850**	**5,750**	**5,600**	**5,450**	
VWC-N	Below Saugus WRP	650	650	650	650	650	650	
VWC-N7	Below Saugus WRP	1,160	1,160	1,160	1,160	1,160	1,160	
VWC-N8	Below Saugus WRP	1,160	1,160	1,160	1,160	1,160	1,160	
VWC-Q2	Below Saugus WRP	1,100	1,100	1,100	1,100	1,100	1,100	
VWC-S6	Below Saugus WRP	1,000	1,000	1,000	1,000	1,000	1,000	
VWC-S7	Below Saugus WRP	500	500	500	500	500	500	
VWC-S8	Below Saugus WRP	500	500	500	500	500	500	
Below Saugus WRP Total		**6,070**	**6,070**	**6,070**	**6,070**	**6,070**	**6,070**	
NLF-161	Below Valencia WRP	1,000	1,000	1,000	1,000	1,000	1,000	
NLF-B10	Below Valencia WRP	500	350	350	500	350	350	
NLF-B11	Below Valencia WRP	100	200	200	100	200	200	
NLF-B14	Below Valencia WRP	300	1,000	1,000	300	1,000	1,000	
NLF-B20	Below Valencia WRP	350	500	500	350	500	500	
NLF-B5	Below Valencia WRP	2,400	1,900	1,900	2,400	1,900	1,900	
NLF-B6	Below Valencia WRP	1,100	1,100	1,100	1,100	1,100	1,100	
NLF-C	Below Valencia WRP	1,100	1,000	1,000	1,100	1,000	1,000	
NLF-C3	Below Valencia WRP	100	200	200	100	200	200	
NLF-C4	Below Valencia WRP	200	450	450	200	450	450	
NLF-C5	Below Valencia WRP	900	850	850	900	850	850	
NLF-C7	Below Valencia WRP	350	300	300	350	300	300	
NLF-C8	Below Valencia WRP	400	400	400	400	400	400	
NLF-E5	Below Valencia WRP	100	150	150	100	150	150	
NLF-E9	Below Valencia WRP	900	350	350	900	350	350	
NLF-G45	Below Valencia WRP	350	400	400	350	400	400	
VWC-E15	Below Valencia WRP	800	800	800	800	800	800	
Below Valencia WRP Total		**10,950**	**10,950**	**10,950**	**10,950**	**10,950**	**10,950**	
SCWD-Clark	Bouquet Canyon	700	700	700	700	700	700	
SCWD-Guida	Bouquet Canyon	1,300	1,250	1,200	1,300	1,250	1,200	
Bouquet Canyon Total		**2,000**	**1,950**	**1,900**	**2,000**	**1,950**	**1,900**	
VWC-W10	San Francisquito Canyon	1,000	1,000	1,000	1,000	1,000	1,000	
VWC-W11	San Francisquito Canyon	800	800	800	800	800	800	
VWC-W9	San Francisquito Canyon	950	950	950	950	950	950	
San Francisquito Canyon Total		**2,750**	**2,750**	**2,750**	**2,750**	**2,750**	**2,750**	
NCWD-Castaic 1	Castaic Valley	350	300	250	350	300	250	
NCWD-Castaic 2	Castaic Valley	100	100	100	100	100	100	
NCWD-Castaic 4	Castaic Valley	100	0	0	100	0	0	
NCWD-Castaic 7	Castaic Valley	300	200	200	300	200	200	
VWC-D	Castaic Valley	880	880	880	880	880	880	
WHR	Castaic Valley	2,000	2,000	2,000	2,000	2,000	2,000	
Castaic Valley Total:		**3,730**	**3,480**	**3,430**	**3,730**	**3,480**	**3,430**	
Total Alluvial Pumping		**38,600**	**36,500**	**34,850**	**38,600**	**36,600**	**35,000**	**Current Operating Plan:** **35,000 to 40,000 AF/yr in normal and wet years** **30,000 to 35,000 AF/yr in dry years**

Notes:

All pumping volumes are listed in acre-feet per year (afy).

Wells that are not listed are assumed to not be pumping in the future.

NLF = Newhall Land & Farming Company

NCWD = Newhall County Water District

SCWD = Santa Clarita Division of Castaic Lake Water Agency

VWC = Valencia Water Company

WHR = Wayside Honor Rancho, whose wells are owned by the Los Angeles County Waterworks District No. 36

TABLE 3- 0
Pumping Rates Simulated for Individual Alluvial Aquifer Wells under the Potential Groundwater Operating Plan

Well Name	Alluvial Subarea	Potential Operating Plan Normal	Dry Yr 1	Dry Yr 2+	Comments
NCWD-Castaic 1	Castaic Valley	450	400	400	100 to 150 afy more than 2008 operating plan.
NCWD-Castaic 2	Castaic Valley	300	200	100	0 to 200 afy more than 2008 operating plan.
NCWD-Castaic 4	Castaic Valley	150	100	50	50 to 100 afy more than 2008 operating plan.
NCWD-Castaic 7	Castaic Valley	1,800	1,800	1,800	1500 to 1600 afy more than 2008 operating plan.
NCWD-Pinetree 1	Above Mint Canyon	200	200	200	50 to 200 afy more than 2008 operating plan.
NCWD-Pinetree 3	Above Mint Canyon	450	450	450	100 to 150 afy more than 2008 operating plan.
NCWD-Pinetree 4	Above Mint Canyon	300	300	200	0 to 100 afy more than 2008 operating plan.
NCWD-Pinetree 5	Above Mint Canyon	300	300	200	0 to 100 afy more than 2008 operating plan.
NCWD Total		**3,950**	**3,750**	**3,400**	**Total is 2,000 to 2,450 afy more than in the 2008 operating plan.**
NLF-B14	Below Valencia WRP	650	650	650	Future agricultural supply for Newhall Land & Farming Co.
NLF-B15	Below Valencia WRP	650	650	650	Future agricultural supply for Newhall Land & Farming Co.
NLF-B16	Below Valencia WRP	650	650	650	Future agricultural supply for Newhall Land & Farming Co.
NLF-C10	Below Valencia WRP	650	650	650	Future agricultural supply for Newhall Land & Farming Co.
NLF-C11	Below Valencia WRP	650	650	650	Future agricultural supply for Newhall Land & Farming Co.
NLF-C12	Below Valencia WRP	650	650	650	Future agricultural supply for Newhall Land & Farming Co.
NLF-E21	Castaic Valley	650	650	650	Future agricultural supply for Newhall Land & Farming Co.
NLF Total		**4,550**	**4,550**	**4,550**	**Total is 5,600 afy less than in the 2008 operating plan.**
SCWD-Clark	Bouquet Canyon	800	750	700	0 to 100 afy more than 2008 operating plan.
SCWD-Guida	Bouquet Canyon	1,500	1,400	1,300	100 to 200 afy more than 2008 operating plan.
SCWD-Honby	Above Saugus WRP	1,200	1,000	700	0 to 200 afy more than 2008 operating plan.
SCWD-Lost Canyon 2	Above Mint Canyon	850	800	700	50 to 150 afy more than 2008 operating plan.
SCWD-Lost Canyon 2A	Above Mint Canyon	800	700	600	0 to 100 afy more than 2008 operating plan.
SCWD-Mitchell #5A	Above Mint Canyon	900	550	200	0 to 400 afy more than 2008 operating plan.
SCWD-Mitchell #5B	Above Mint Canyon	1,000	900	800	200 to 500 afy more than 2008 operating plan.
SCWD-N. Oaks Central	Above Mint Canyon	1,400	800	800	0 to 550 afy more than 2008 operating plan.
SCWD-N. Oaks East	Above Mint Canyon	1,000	800	600	50 to 200 afy more than 2008 operating plan.
SCWD-N. Oaks West	Above Mint Canyon	1,000	800	600	50 to 200 afy more than 2008 operating plan.
SCWD-Sand Canyon	Above Mint Canyon	1,300	1,000	600	300 to 400 afy more than 2008 operating plan.
SCWD-Sierra	Above Mint Canyon	1,400	1,100	800	100 to 300 afy more than 2008 operating plan.
SCWD-Santa Clara	Above Saugus WRP	950	950	950	Future well.
SCWD-Valley Center	Above Saugus WRP	1,200	1,000	800	800 gpm (2008 plan) + 0 to 400 afy additional pumping.
SCWD-Bouquet	Above Saugus WRP	1,200	1,100	1,100	Future well.
SCWD Total		**16,500**	**13,650**	**11,250**	**Total is 3,100 to 5,450 afy more than in the 2008 operating plan.**
VWC-D	Castaic Valley	880	880	880	Same as 2008 operating plan.
VWC-E14	Castaic Valley	1,175	1,175	1,175	Future operations for Newhall Ranch.
VWC-E15	Castaic Valley	800	800	800	Same as 2008 operating plan.
VWC-E16	Castaic Valley	1,175	1,175	1,175	Future operations for Newhall Ranch.
VWC-E17	Castaic Valley	1,175	1,175	1,175	Future operations for Newhall Ranch.
VWC-G1	Below Valencia WRP	1,175	1,175	1,175	Future operations for Newhall Ranch.
VWC-G3	Below Valencia WRP	1,175	1,175	1,175	Future operations for Newhall Ranch.
VWC-G4	Below Valencia WRP	1,175	1,175	1,175	Future operations for Newhall Ranch.
VWC-N	Below Saugus WRP	650	650	650	Same as 2008 operating plan.
VWC-N7	Below Saugus WRP	1,160	1,160	1,160	Same as 2008 operating plan.
VWC-N8	Below Saugus WRP	1,160	1,160	1,160	Same as 2008 operating plan.
VWC-Q2	Below Saugus WRP	1,100	1,100	1,100	Same as 2008 operating plan.
VWC-S6	Below Saugus WRP	1,000	1,000	1,000	Same as 2008 operating plan.
VWC-S7	Below Saugus WRP	500	500	500	Same as 2008 operating plan.
VWC-S8	Below Saugus WRP	500	500	500	Same as 2008 operating plan.
VWC-T7	Above Saugus WRP	750	750	750	Same as 2008 operating plan.
VWC-U4	Above Saugus WRP	800	800	800	Same as 2008 operating plan.
VWC-U6	Above Saugus WRP	800	800	800	Same as 2008 operating plan.
VWC-W10	San Francisquito Canyon	1,000	1,000	1,000	Same as 2008 operating plan.
VWC-W11	San Francisquito Canyon	800	800	800	Same as 2008 operating plan.
VWC-W9	San Francisquito Canyon	950	950	950	Same as 2008 operating plan.
VWC Total		**19,900**	**19,900**	**19,900**	**VWC and NLF total is 1,450 afy more than in the 2008 operating plan.**
Robinson Ranch	Above Mint Canyon	600	550	450	Same as 2008 operating plan.
WHR	Castaic Valley	2,000	2,000	2,000	Same as 2008 operating plan.
Purveyor Alluvial Usage		**40,350**	**37,300**	**34,550**	**2008 Operating Plan:**
Other Alluvial Usage		**7,150**	**7,100**	**7,000**	**35,000 to 40,000 afy in normal and wet years**
Total Alluvial Pumping		**47,500**	**44,400**	**41,550**	**30,000 to 35,000 afy in dry years**

Notes:
All pumping volumes are listed in units of acre-feet per year (afy).
Wells that are not listed are assumed to not be pumping in the future.
NLF = Newhall Land & Farming Company — NCWD = Newhall County Water District
SCWD = Santa Clarita Division of Castaic Lake Water Agency — VWC = Valencia Water Company
WHR = Wayside Honor Rancho, whose wells are owned by the Los Angeles County Waterworks District No. 36
"Other Alluvial Usage" consists of pumping by NLF, WHR, and Robinson Ranch. An additional 500 afy of pumping by other private well owners is not included in this table.

TABLE 3-

Pumping Rates Simulated for Individual Saugus ormation Wells under the Potential Groundwater Operating Plan

Owner	Well Name	Non-Drought Years	Drought Year 1	Drought Year 2	Drought Year 3
NCWD	12	1,765	2,494	2,494	2,494
	13	1,765	2,494	2,494	2,494
	Future well	1,765	2,494	2,494	2,494
Total Pumping (NCWD Wells)		**5,295**	**7,482**	**7,482**	**7,482**
SCWD	Saugus1	1,772	1,772	1,772	1,772
	Saugus2	1,772	1,772	1,772	1,772
	Future well	1,800	1,800	1,800	1,800
Total Pumping (SCWD Wells)		**5,344**	**5,344**	**5,344**	**5,344**
LA County Water District #36	Future well	300	300	300	300
Total Pumping (LACWD #36)		**300**	**300**	**300**	**300**
Private (Palmer)	Future Golf Course	500	500	500	500
Total Pumping (Future Golf)		**500**	**500**	**500**	**500**
VWC	159	50	50	50	50
	160 (Municipal)	500	830	830	830
	160 (Val. Ctry Club)	500	500	500	500
	201	300	300	3,777	3,777
	205	1,211	2,945	4,038	4,038
	206	1,175	2,734	3,500	3,500
	207	1,175	2,734	3,500	3,500
Total Pumping (VWC Wells)		**4,911**	**10,093**	**16,195**	**16,195**
	Future #1	0	0	0	3,250
	Future #2	0	0	0	3,250
	Future #3	0	0	0	3,250
Total Pumping (Future Wells)		**0**	**0**	**0**	**9,750**
Total Pumping (All Saugus Wells)		**16,350**	**23,719**	**29,821**	**39,571**

Notes:

All pumping volumes are listed in units of acre-feet per year (afy).

Wells that are not listed are assumed to not be pumping in the future.

NLF = Newhall Land & Farming Company

SCWD = Santa Clarita Division of Castaic Lake Water Agency

NCWD = Newhall County Water District

VWC = Valencia Water Company

TABLE 3-12

Total Groundwater and SWP Supplies for Potential Groundwater Operating Plan (Not Including Recycled Water and Other Water Supplies, e.g. Purchased or Banked Water)

Model Year	Based on Historical Year	SWP Hydrology [a]	SWP Allocations [b] (%)	SWP Deliveries (afy)	Simulated Pumping From Alluvial Aquifer (afy)	Simulated Pumping From Saugus Formation (afy)	Total Groundwater Pumping (afy)	SWP + Groundwater (afy)
1	1922	Above Normal	89%	82,227	47,500	16,350	63,850	146,077
2	1923	Below Normal	76%	70,699	47,500	16,350	63,850	134,549
3	1924	Critical	10%	8,960	44,400	23,719	68,119	77,079
4	1925	Dry	40%	36,784	41,550	16,350	57,900	94,684
5	1926	Dry	53%	48,929	41,550	16,350	57,900	106,829
6	1927	Wet	89%	82,786	47,500	16,350	63,850	146,636
7	1928	Above Normal	50%	46,079	47,500	16,350	63,850	109,929
8	1929	Critical	18%	16,858	44,400	23,719	68,119	84,977
9	1930	Dry	49%	45,379	41,550	16,350	57,900	103,279
10	1931	Critical	27%	24,732	41,550	29,821	71,371	96,103
11	1932	Dry	32%	29,204	47,500	39,571	87,071	116,275
12	1933	Critical	48%	44,339	44,400	39,571	83,971	128,310
13	1934	Critical	32%	29,424	41,550	39,571	81,121	110,545
14	1935	Below Normal	81%	74,625	41,550	16,350	57,900	132,525
15	1936	Below Normal	76%	69,911	41,550	16,350	57,900	127,811
16	1937	Below Normal	78%	72,037	41,550	16,350	57,900	129,937
17	1938	Wet	82%	75,970	41,550	16,350	57,900	133,870
18	1939	Dry	79%	72,883	47,500	16,350	63,850	136,733
19	1940	Above Normal	77%	70,837	44,400	16,350	60,750	131,587
20	1941	Wet	61%	56,535	41,550	16,350	57,900	114,435
21	1942	Wet	77%	70,890	47,500	16,350	63,850	134,740
22	1943	Wet	76%	70,599	44,400	16,350	60,750	131,349
23	1944	Dry	71%	65,569	47,500	16,350	63,850	129,419
24	1945	Below Normal	75%	69,041	47,500	16,350	63,850	132,891
25	1946	Below Normal	77%	71,596	47,500	16,350	63,850	135,446
26	1947	Dry	56%	51,794	47,500	16,350	63,850	115,644
27	1948	Below Normal	63%	58,403	44,400	16,350	60,750	119,153
28	1949	Dry	31%	28,443	41,550	23,719	65,269	93,712
29	1950	Below Normal	60%	55,099	41,550	16,350	57,900	112,999
30	1951	Above Normal	85%	78,272	41,550	16,350	57,900	136,172
31	1952	Wet	63%	57,855	41,550	16,350	57,900	115,755
32	1953	Wet	80%	74,381	47,500	16,350	63,850	138,231
33	1954	Above Normal	77%	71,652	44,400	16,350	60,750	132,402
34	1955	Dry	28%	25,439	41,550	23,719	65,269	90,708
35	1956	Wet	87%	80,155	41,550	16,350	57,900	138,055
36	1957	Above Normal	62%	56,957	41,550	16,350	57,900	114,857
37	1958	Wet	73%	67,806	41,550	16,350	57,900	125,706
38	1959	Below Normal	84%	77,554	47,500	16,350	63,850	141,404
39	1960	Dry	35%	32,679	44,400	23,719	68,119	100,798
40	1961	Dry	57%	52,756	41,550	16,350	57,900	110,656
41	1962	Below Normal	72%	66,287	41,550	16,350	57,900	124,187
42	1963	Wet	82%	76,230	41,550	16,350	57,900	134,130
43	1964	Dry	53%	49,474	41,550	16,350	57,900	107,374
44	1965	Wet	69%	64,021	41,550	16,350	57,900	121,921
45	1966	Below Normal	79%	73,083	47,500	16,350	63,850	136,933
46	1967	Wet	72%	66,920	44,400	16,350	60,750	127,670
47	1968	Below Normal	80%	73,794	41,550	16,350	57,900	131,694
48	1969	Wet	64%	58,766	41,550	16,350	57,900	116,666
49	1970	Wet	79%	72,904	47,500	16,350	63,850	136,754
50	1971	Wet	80%	74,236	47,500	16,350	63,850	138,086
51	1972	Below Normal	41%	38,213	44,400	16,350	60,750	98,963
52	1973	Above Normal	75%	69,052	41,550	16,350	57,900	126,952
53	1974	Wet	77%	71,257	41,550	16,350	57,900	129,157
54	1975	Wet	78%	72,018	41,550	16,350	57,900	129,918
55	1976	Critical	63%	58,273	41,550	16,350	57,900	116,173
56	1977	Critical	6%	5,428	41,550	39,571	81,121	86,549
57	1978	Above Normal	87%	80,556	41,550	16,350	57,900	138,456
58	1979	Below Normal	76%	70,013	47,500	16,350	63,850	133,863
59	1980	Above Normal	66%	60,652	47,500	16,350	63,850	124,502
60	1981	Dry	76%	69,997	47,500	16,350	63,850	133,847
61	1982	Wet	71%	65,809	44,400	16,350	60,750	126,559
62	1983	Wet	60%	55,886	47,500	16,350	63,850	119,736
63	1984	Wet	78%	72,233	47,500	16,350	63,850	136,083
64	1985	Dry	77%	71,579	44,400	16,350	60,750	132,329
65	1986	Wet	56%	51,344	41,550	16,350	57,900	109,244
66	1987	Dry	68%	63,232	47,500	16,350	63,850	127,082
67	1988	Critical	12%	10,665	44,400	23,719	68,119	78,784
68	1989	Dry	76%	70,061	41,550	16,350	57,900	127,961
69	1990	Critical	9%	8,056	41,550	29,821	71,371	79,427
70	1991	Critical	18%	16,313	41,550	39,571	81,121	97,434
71	1992	Critical	26%	24,330	41,550	39,571	81,121	105,451
72	1993	Above Normal	90%	83,055	47,500	16,350	63,850	146,905
73	1994	Critical	51%	47,101	47,500	16,350	63,850	110,951
74	1995	Wet	72%	66,992	44,400	16,350	60,750	127,742
75	1996	Wet	83%	76,979	47,500	16,350	63,850	140,829
76	1997	Wet	75%	69,401	47,500	16,350	63,850	133,251
77	1998	Wet	73%	67,316	47,500	16,350	63,850	131,166
78	1999	Wet	83%	76,976	47,500	16,350	63,850	140,826
79	2000	Above Normal	84%	77,238	47,500	16,350	63,850	141,088
80	2001	Dry	28%	26,050	44,400	23,719	68,119	94,169
81	2002	Dry	52%	48,382	41,550	16,350	57,900	106,282
82	2003	Above Normal	71%	65,873	41,550	16,350	57,900	123,773
83	2004	Below Normal / Dry	Actual was 65%	60,125	41,550	16,350	57,900	118,025
84	2005	Wet / Above Normal	Actual was 90%	83,250	47,500	16,350	63,850	147,100
85	2006	Wet / Wet	Actual was 100%	92,500	47,500	16,350	63,850	156,350
86	2007	Dry / Critical	Actual was 60%	55,500	44,400	16,350	60,750	116,250

[a]Defined by water year, using DWR's Sacramento Valley Unimpaired Runoff Index: wet = wettest; critical = driest

[b]From Table B.3 in *The State Water Project Delivery Reliability Report 2007* (DWR, August 2008). This is for current (2007) conditions as defined in the DWR report. In any given year, the allocation may be made up, in part, of carryover water from the prior year.

afy = acre-feet per year SWP = State Water Project

TABLE 3-13

Simulated onthly recipitation at the e hall County Water istrict ain Gage for the year Simulation

Model Year	Historical Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1	1922	3.28	16.64	9.73	0.15	0.34	0.00	0.30	0.00	0.00	1.55	0.00	7.25	39.24
2	1923	1.21	9.43	3.15	2.10	0.00	0.00	0.00	0.31	0.00	1.13	0.00	0.00	17.33
3	1924	2.89	4.23	0.22	0.48	0.88	0.00	0.00	0.00	0.00	0.00	0.63	0.01	9.34
4	1925	0.89	4.13	1.30	0.30	0.00	0.00	0.00	0.00	0.62	0.86	0.37	0.00	8.47
5	1926	10.36	14.63	4.84	0.36	0.40	0.00	0.00	0.00	0.00	0.00	0.00	1.36	31.95
6	1927	5.84	10.76	3.38	2.56	0.00	0.00	0.00	0.00	0.00	0.22	3.18	1.30	27.24
7	1928	1.55	0.51	0.38	0.05	0.12	0.01	0.00	0.00	0.02	0.00	3.01	5.85	11.50
8	1929	4.17	2.21	0.20	2.05	0.00	0.00	0.00	0.00	0.00	0.00	4.96	0.07	13.66
9	1930	4.17	2.21	0.20	2.05	0.00	0.00	0.00	0.00	0.00	0.00	4.96	0.07	13.66
10	1931	4.10	6.45	0.00	2.29	0.97	0.02	0.00	3.78	0.06	0.14	3.30	7.53	28.65
11	1932	4.81	9.42	0.18	0.46	0.21	0.00	0.00	0.00	0.08	0.06	0.00	0.89	16.11
12	1933	16.04	0.00	0.05	0.34	1.04	0.31	0.00	0.08	0.00	0.22	0.05	5.95	24.08
13	1934	6.54	2.93	0.11	0.00	0.02	0.59	0.00	0.00	0.01	2.17	2.25	6.56	21.18
14	1935	4.45	2.50	3.41	1.95	0.00	0.00	0.00	0.06	0.08	0.12	0.95	0.81	14.33
15	1936	0.06	8.40	1.84	0.36	0.00	0.00	0.06	0.00	0.01	2.45	0.01	10.82	24.02
16	1937	3.34	6.79	6.16	0.21	0.33	0.00	0.00	0.00	0.00	0.00	0.00	4.19	21.03
17	1938	0.62	12.79	11.37	0.84	0.05	0.12	0.00	0.00	0.15	0.07	0.01	12.40	38.43
18	1939	3.80	1.91	2.05	0.27	0.12	0.00	0.00	0.00	3.60	0.22	0.34	0.90	13.23
19	1940	3.29	6.25	1.43	2.12	0.00	0.00	0.00	0.00	0.00	1.29	0.07	10.62	25.08
20	1941	3.92	19.84	10.82	5.82	0.00	0.00	0.00	0.01	0.00	2.45	0.35	6.23	49.45
21	1942	0.14	0.88	1.64	2.73	0.00	0.00	0.00	0.68	0.00	0.93	0.23	1.09	8.33
22	1943	19.90	4.59	7.80	1.04	0.00	0.00	0.00	0.00	0.00	0.15	0.33	9.63	43.45
23	1944	1.20	16.38	3.76	0.54	0.01	0.00	0.00	0.00	0.00	0.00	5.82	1.20	28.90
24	1945	0.14	4.11	3.13	0.19	0.00	0.00	0.00	0.00	0.00	1.33	0.45	7.75	17.09
25	1946	0.19	2.42	5.95	0.61	0.00	0.00	0.00	0.00	0.00	0.75	10.87	4.69	25.48
26	1947	0.47	0.42	1.28	0.56	0.14	0.00	0.00	0.08	0.05	0.04	0.00	1.84	4.88
27	1948	0.00	1.87	3.49	1.56	0.00	0.09	0.00	0.00	0.00	0.14	0.00	3.57	10.71
28	1949	2.83	1.06	2.18	0.02	1.35	0.00	0.00	0.00	0.00	0.00	1.36	2.85	11.65
29	1950	2.58	1.69	1.27	0.86	0.01	0.00	0.00	0.00	0.32	0.36	0.73	0.21	8.03
30	1951	2.96	0.93	1.16	1.69	0.09	0.00	0.00	0.05	0.00	0.49	1.33	5.88	14.57
31	1952	17.68	0.61	10.30	1.80	0.00	0.00	0.00	0.00	0.12	0.00	4.52	5.09	40.12
32	1953	0.80	0.02	0.21	1.64	0.69	0.00	0.00	0.00	0.00	0.00	2.32	0.04	5.73
33	1954	6.38	3.36	4.86	0.12	0.00	0.00	0.00	0.00	0.00	0.00	2.38	1.47	18.56
34	1955	5.69	1.69	0.21	3.38	1.91	0.00	0.00	0.00	0.00	0.00	1.43	2.01	16.32
35	1956	7.55	1.00	0.00	5.90	1.82	0.00	0.11	0.00	0.00	0.15	0.00	0.15	16.68
36	1957	7.22	2.71	3.05	1.16	1.06	0.25	0.00	0.00	0.00	2.68	0.40	8.30	26.81
37	1958	2.11	10.42	5.82	7.18	0.00	0.00	0.00	0.00	0.04	1.35	0.23	0.00	27.15
38	1959	3.70	5.47	0.00	0.59	0.00	0.00	0.00	0.00	0.08	0.00	0.00	1.68	11.51
39	1960	4.17	2.21	0.20	2.05	0.00	0.00	0.00	0.00	0.00	0.00	4.96	0.07	13.66
40	1961	1.88	0.00	0.76	0.33	0.09	0.00	0.07	0.00	0.11	0.00	4.12	2.99	10.35
41	1962	3.86	19.44	1.53	0.00	0.02	0.00	0.00	0.00	0.00	0.05	0.00	0.00	24.90
42	1963	0.99	3.63	4.10	2.23	0.06	0.43	0.00	0.00	0.77	0.50	2.29	0.01	15.01
43	1964	2.95	0.00	1.88	2.41	0.04	0.12	0.00	0.00	0.00	0.52	1.47	2.48	11.84
44	1965	0.25	0.07	1.65	9.14	0.00	0.02	0.26	0.16	0.95	0.00	17.49	7.89	37.88
45	1966	1.42	1.55	0.33	0.00	0.09	0.00	0.00	0.00	0.09	0.11	7.56	5.95	17.10

TABLE 3-13
Simulated onthly recipitation at the e hall County Water istrict ain Gage for the year Simulation

Model Year	Historical Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
46	1967	6.76	0.22	3.23	5.41	0.19	0.00	0.00	0.00	0.50	0.00	9.36	1.58	27.26
47	1968	0.86	0.93	2.91	0.97	0.07	0.00	0.00	0.38	0.00	0.39	0.35	1.24	8.10
48	1969	19.53	13.89	0.82	1.16	0.05	0.05	0.18	0.00	0.00	0.00	2.32	0.05	38.04
49	1970	0.94	6.63	4.33	0.00	0.00	0.00	0.00	0.00	0.00	0.13	8.86	6.33	27.21
50	1971	1.23	1.41	0.48	0.94	0.15	0.00	0.00	0.00	0.47	0.50	0.38	10.57	16.14
51	1972	0.00	0.12	0.00	0.02	0.05	0.05	0.00	0.06	0.00	0.05	3.45	1.08	4.87
52	1973	5.19	11.74	3.29	0.00	0.00	0.00	0.00	0.00	0.00	0.15	1.83	1.03	23.22
53	1974	10.58	0.02	4.30	0.06	0.00	0.00	0.02	0.00	0.00	1.17	0.12	4.89	21.17
54	1975	0.28	3.02	6.04	2.96	0.00	0.00	0.00	0.00	0.00	0.39	0.04	0.09	12.81
55	1976	0.00	7.39	1.47	0.46	0.15	0.35	0.01	0.00	3.40	0.22	2.09	0.90	16.45
56	1977	5.75	0.12	2.15	0.00	5.27	0.00	0.00	2.68	0.02	0.05	0.06	8.40	24.49
57	1978	10.74	13.23	17.10	2.72	0.00	0.00	0.00	0.00	1.23	0.01	2.70	1.76	49.49
58	1979	12.44	3.20	6.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.89	1.19	23.75
59	1980	10.36	14.63	4.84	0.36	0.40	0.00	0.00	0.00	0.00	0.00	0.00	1.36	31.95
60	1981	4.76	1.66	5.50	0.46	0.00	0.00	0.00	0.00	0.00	0.58	3.62	0.22	16.80
61	1982	3.33	1.21	9.50	1.09	0.13	0.00	0.00	0.00	1.02	0.25	5.34	2.95	24.82
62	1983	8.67	6.85	13.07	4.61	0.20	0.00	0.00	1.17	1.85	1.74	5.04	5.13	48.33
63	1984	0.00	0.00	0.27	0.07	0.00	0.00	0.00	0.00	0.05	0.16	3.87	8.13	12.55
64	1985	0.78	1.20	1.04	0.14	0.07	0.00	0.06	0.00	0.12	0.54	5.11	0.70	9.76
65	1986	5.84	6.65	5.39	0.88	0.00	0.00	0.05	0.00	1.78	0.68	1.55	0.24	23.06
66	1987	2.10	0.61	1.69	0.14	0.00	0.00	0.09	0.02	0.00	3.47	3.84	4.80	16.76
67	1988	3.27	3.39	1.16	3.98	0.09	0.00	0.00	0.00	0.10	0.00	0.92	7.14	20.05
68	1989	0.89	4.13	1.30	0.30	0.00	0.00	0.00	0.00	0.62	0.86	0.37	0.00	8.47
69	1990	2.89	4.23	0.22	0.48	0.88	0.00	0.00	0.00	0.00	0.00	0.63	0.01	9.34
70	1991	1.11	5.72	11.33	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	5.95	24.61
71	1992	3.28	16.64	9.73	0.15	0.34	0.00	0.30	0.00	0.00	1.55	0.00	7.25	39.24
72	1993	17.11	11.73	4.27	0.00	0.00	0.65	0.00	0.00	0.00	0.57	0.75	1.00	36.08
73	1994	0.48	5.31	2.33	0.42	0.00	0.00	0.00	0.00	0.00	0.78	0.71	1.94	11.97
74	1995	21.98	1.93	8.30	0.72	0.26	0.76	0.00	0.00	0.00	0.00	0.00	2.33	36.28
75	1996	2.97	6.73	2.08	0.13	0.68	0.00	0.00	0.00	0.00	1.30	1.06	8.70	23.65
76	1997	6.67	0.23	0.00	0.00	0.00	0.00	0.05	0.00	0.53	0.00	3.73	6.72	17.93
77	1998	3.49	22.00	3.98	2.28	5.50	0.06	0.00	0.00	0.21	0.33	1.36	1.39	40.60
78	1999	2.08	0.65	3.00	3.78	0.00	0.48	0.00	0.00	0.01	0.00	0.00	0.05	10.05
79	2000	1.21	9.43	3.15	2.10	0.00	0.00	0.00	0.31	0.00	1.13	0.00	0.00	17.33
80	2001	5.84	10.76	3.38	2.56	0.00	0.00	0.00	0.00	0.00	0.22	3.18	1.30	27.24
81	2002	1.55	0.51	0.38	0.05	0.12	0.01	0.00	0.00	0.02	0.00	3.01	5.85	11.50
82	2003	0.00	9.03	2.38	2.35	1.70	0.00	0.02	0.00	0.00	1.10	0.63	2.57	19.78
83	2004	0.65	8.07	0.37	0.20	0.00	0.00	0.00	0.00	0.00	4.79	0.64	8.54	23.26
84	2005	17.06	16.69	2.70	1.42	0.45	0.00	0.00	0.00	0.17	1.91	0.59	0.14	41.13
85	2006	3.27	3.78	5.68	4.22	0.99	0.00	0.00	0.00	0.00	0.42	0.05	0.83	19.24
86	2007	1.66	1.38	0.17	0.71	0.00	0.00	0.00	0.00	1.32	0.25	0.50	2.67	8.66

All precipitation values are listed in units of inches.

TABLE 3-14
Simulated onthly Streamflo s in the Santa Clara i er at the Lang Gage for the year Simulation

Model Year	Historical Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Prototype Year
1	1922	336	534	429	398	117	84	16	5	108	144	498	1,446	4,115	1992
2	1923	117	117	65	31	12	0	0	0	0	0	258	516	1,116	2000
3	1924	212	276	230	46	46	5	0	0	0	27	36	147	1,025	1990
4	1925	50	111	60	25	6	0	0	0	102	94	34	18	499	1989
5	1926	1,310	7,449	1,213	568	218	78	6	0	37	274	467	553	12,175	1980
6	1927	333	1,420	785	283	238	0	0	0	0	95	178	855	4,188	2001
7	1928	50	111	60	25	6	0	0	0	102	94	34	18	499	2002
8	1929	68	67	70	69	70	68	65	65	60	58	316	164	1,140	1960
9	1930	68	67	70	69	70	68	65	65	60	58	316	164	1,140	1960
10	1931	333	1,420	785	283	238	0	0	0	0	95	178	855	4,188	2001
11	1932	117	117	65	31	12	0	0	0	0	0	258	516	1,116	1987
12	1933	0	30	0	0	0	0	0	0	0	25	0	1,652	1,707	2004
13	1934	222	209	506	117	77	68	0	0	0	0	12	25	1,236	1988
14	1935	1,211	1,421	954	802	268	156	62	8	6	1	27	189	5,104	1995
15	1936	0	30	0	0	0	0	0	0	0	25	0	1,652	1,707	2004
16	1937	222	209	506	117	77	68	0	0	0	0	12	25	1,236	1988
17	1938	1,211	1,421	954	802	268	156	62	8	6	1	27	189	5,104	1995
18	1939	7,355	2,668	597	265	120	55	27	5	32	73	132	141	11,468	Half of 1993
19	1940	0	30	0	0	0	0	0	0	0	25	0	1,652	1,707	2004
20	1941	13,686	11,359	11,699	2,378	1,458	721	322	120	77	128	179	206	42,333	2005
21	1942	50	111	60	25	6	0	0	0	102	94	34	18	499	1989
22	1943	18,997	8,508	3,837	961	667	347	81	91	70	139	190	186	34,074	1998
23	1944	1,211	1,421	954	802	268	156	62	8	6	1	27	189	5,104	1995
24	1945	517	346	140	85	33	5	4	50	66	240	566	809	2,859	1997
25	1946	1,211	1,421	954	802	268	156	62	8	6	1	27	189	5,104	1995
26	1947	332	250	131	90	50	22	32	6	0	0	11	58	983	1972
27	1948	50	111	60	25	6	0	0	0	102	94	34	18	499	2002
28	1949	50	111	60	25	6	0	0	0	102	94	34	18	499	2002
29	1950	83	198	184	126	105	83	51	54	56	53	43	42	1,078	1950
30	1951	49	40	66	91	98	84	79	72	57	71	47	53	807	1951
31	1952	9,629	636	7,091	2,114	895	326	153	138	86	97	178	313	21,656	1952
32	1953	300	282	271	237	165	134	102	86	85	83	74	68	1,888	1953
33	1954	145	278	404	356	181	108	110	99	91	90	80	75	2,017	1954
34	1955	103	156	157	128	153	99	78	76	74	68	66	62	1,220	1955
35	1956	69	85	130	137	139	98	86	80	77	76	67	69	1,113	1956
36	1957	67	55	78	90	93	80	78	78	76	79	66	71	910	1957
37	1958	66	329	743	4,550	825	283	130	108	95	145	146	116	7,536	1958
38	1959	246	351	189	127	111	92	84	86	83	69	68	68	1,575	1959
39	1960	68	67	70	69	70	68	65	65	60	58	316	164	1,140	1960
40	1961	124	91	38	38	36	32	28	33	22	19	19	119	597	1961
41	1962	139	1,904	791	449	329	169	97	82	80	84	82	82	4,287	1962
42	1963	85	142	145	131	104	86	79	74	66	65	62	58	1,096	1963
43	1964	69	50	51	62	66	54	53	53	54	45	43	41	640	1964
44	1965	30	23	25	46	43	36	31	34	37	35	1,305	3,300	4,944	1965
45	1966	1,765	1,014	778	450	308	115	68	54	45	63	91	523	5,274	1966

TABLE 3-14
Simulated onthly Streamflo s in the Santa Clara i er at the Lang Gage for the year Simulation

Model Year	Historical Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Prototype Year
46	1967	757	489	1,028	2,295	1,880	729	212	104	89	73	255	487	8,397	1967
47	1968	300	247	276	180	72	32	32	30	25	133	208	851	2,384	1968
48	1969	13,797	2,856	1,005	489	320	147	98	98	46	318	392	399	19,966	1969
49	1970	461	550	1,168	465	290	169	74	60	58	27	501	1,338	5,161	1970
50	1971	614	524	556	397	262	167	70	25	5	30	200	420	3,270	1971
51	1972	332	250	131	90	50	22	32	6	0	0	11	58	983	1972
52	1973	153	1,717	950	471	226	71	18	12	8	3	8	44	3,679	1973
53	1974	608	229	392	190	129	49	17	6	0	3	19	87	1,728	1974
54	1975	53	90	228	181	104	31	15	3	0	0	0	0	704	1975
55	1976	0	110	63	39	33	12	0	0	1	0	0	0	258	1976
56	1977	28	7	28	19	60	5	0	0	0	0	0	0	147	1977
57	1978	744	9,486	11,412	1,696	2,736	1,154	418	209	101	264	422	86	28,730	1978
58	1979	1,254	433	1,113	506	246	190	178	111	125	90	120	558	4,925	1979
59	1980	1,310	7,449	1,213	568	218	78	6	0	37	274	467	553	12,175	1980
60	1981	594	98	339	240	107	18	18	12	338	321	258	394	2,739	1981
61	1982	333	1,420	785	283	238	0	0	0	0	95	178	855	4,188	1982
62	1983	1,922	16,971	2,755	2,576	958	523	639	512	0	0	0	0	26,855	1983
63	1984	0	596	405	240	143	166	228	411	154	220	904	578	4,044	1984
64	1985	483	461	274	215	77	0	0	0	12	179	221	301	2,224	1985
65	1986	483	1,138	488	283	107	6	0	12	6	12	80	129	2,744	1986
66	1987	117	117	65	31	12	0	0	0	0	0	258	516	1,116	1987
67	1988	222	209	506	117	77	68	0	0	0	0	12	25	1,236	1988
68	1989	50	111	60	25	6	0	0	0	102	94	34	18	499	1989
69	1990	212	276	230	46	46	5	0	0	0	27	36	147	1,025	1990
70	1991	162	775	879	736	145	142	14	0	45	69	62	263	3,291	1991
71	1992	336	534	429	398	117	84	16	5	108	144	498	1,446	4,115	1992
72	1993	14,709	5,336	1,194	530	239	110	54	10	64	145	264	281	22,937	1993
73	1994	388	493	497	319	163	80	20	7	37	102	193	941	3,239	1994
74	1995	1,211	1,421	954	802	268	156	62	8	6	1	27	189	5,104	1995
75	1996	666	896	730	315	151	46	7	0	54	154	307	510	3,836	1996
76	1997	517	346	140	85	33	5	4	50	66	240	566	809	2,859	1997
77	1998	18,997	8,508	3,837	961	667	347	81	91	70	139	190	186	34,074	1998
78	1999	92	85	204	224	197	107	80	46	52	54	31	80	1,252	1999
79	2000	117	117	65	31	12	0	0	0	0	0	258	516	1,116	1987
80	2001	333	1,420	785	283	238	0	0	0	0	95	178	855	4,188	1982
81	2002	50	111	60	25	6	0	0	0	102	94	34	18	499	1989
82	2003	666	896	730	315	109	0	0	0	0	0	0	0	2,715	1996 and 2003
83	2004	0	30	0	0	0	0	0	0	0	25	0	1,652	1,707	2004
84	2005	13,686	11,359	11,699	2,378	1,458	721	322	120	77	128	179	206	42,333	2005
85	2006	418	352	510	920	381	69	0	0	0	0	0	0	2,650	2006
86	2007	1	57	30	20	0	0	0	0	0	3	8	6	125	2007

All simulated streamflow volumes are listed in units of acre-feet (af).

TABLE 3-15

Simulated onthly Water eleases from Castaic Lagoon to Castaic Cree for the year Simulation

Model Year	Historical Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Prototype Year
1	1922	0	0	580	3,052	667	127	24	0	0	0	0	0	4,450	1992
2	1923	0	660	855	0	2,087	3,484	0	0	0	0	0	0	7,086	2000
3	1924	0	0	0	0	0	0	0	0	0	0	0	0	0	1990
4	1925	0	0	0	0	0	0	0	0	0	0	0	0	0	1989
5	1926	0	0	0	0	0	834	1,052	919	0	0	0	0	2,805	1980
6	1927	0	389	1,218	0	0	0	0	0	0	0	0	0	1,607	2001
7	1928	0	0	0	0	0	0	0	0	0	0	0	0	0	2002
8	1929	0	0	0	0	0	0	0	0	0	0	0	0	0	2002
9	1930	0	0	0	0	0	0	0	0	0	0	0	0	0	1984
10	1931	0	389	1,218	0	0	0	0	0	0	0	0	0	1,607	2001
11	1932	105	0	0	1,490	46	0	0	0	0	0	0	0	1,641	1986
12	1933	0	59	1,004	0	0	0	0	0	0	0	0	60	1,123	2004
13	1934	0	0	809	341	900	0	0	0	0	0	0	0	2,050	1988
14	1935	0	0	0	0	0	1,668	2,104	1,839	0	0	0	0	5,611	1995
15	1936	0	59	1,004	0	0	0	0	0	0	0	0	60	1,123	2004
16	1937	0	0	809	341	900	0	0	0	0	0	0	0	2,050	1988
17	1938	0	0	0	0	0	1,668	2,104	1,839	0	0	0	0	5,611	1995
18	1939	0	70	93	1,516	951	318	171	169	407	0	0	171	3,863	Half of 1993
19	1940	0	59	1,004	0	0	0	0	0	0	0	0	60	1,123	2004
20	1941	32,391	37,514	12,993	3,613	2,891	90	1,657	32	0	0	0	0	91,181	2005
21	1942	0	0	0	0	0	0	0	0	0	0	0	0	0	1989
22	1943	1,186	19,545	10,747	4,566	7,561	47	1,370	436	464	302	652	926	47,802	1998
23	1944	0	0	0	0	0	1,668	2,104	1,839	0	0	0	0	5,611	1995
24	1945	0	0	8,701	873	0	0	0	0	0	0	0	310	9,884	1997
25	1946	0	0	0	0	0	1,668	2,104	1,839	0	0	0	0	5,611	1995
26	1947	0	0	0	0	0	0	0	0	0	0	0	0	0	1989
27	1948	0	0	0	0	0	0	0	0	0	0	0	0	0	2002
28	1949	0	0	0	0	0	0	0	0	0	0	0	0	0	2002
29	1950	0	0	0	0	0	0	0	0	0	0	0	0	0	2007
30	1951	0	0	0	0	0	0	0	0	0	0	0	0	0	1984
31	1952	0	140	186	3,031	1,901	635	341	337	813	0	0	341	7,725	1993
32	1953	0	0	0	0	0	0	0	0	0	0	0	0	0	1989
33	1954	0	0	0	4,961	671	0	0	0	0	0	0	0	5,632	1996
34	1955	105	0	0	1,490	46	0	0	0	0	0	0	0	1,641	1986
35	1956	105	0	0	1,490	46	0	0	0	0	0	212	0	1,853	1987
36	1957	0	0	0	0	0	667	842	735	0	0	0	0	2,244	1982
37	1958	0	0	0	0	0	667	842	735	0	0	0	0	2,244	1982
38	1959	210	0	0	2,979	93	0	0	0	0	0	0	0	3,282	1994
39	1960	0	0	0	0	0	0	0	0	0	0	0	0	0	1984
40	1961	612	691	0	3,187	1,191	149	0	0	0	0	0	0	5,830	1999
41	1962	0	0	0	0	0	667	842	735	0	0	0	0	2,244	1982
42	1963	0	0	0	0	0	0	0	0	0	0	0	0	0	1984
43	1964	210	0	0	2,979	93	0	0	0	0	0	0	0	3,282	1994
44	1965	0	0	580	3,052	667	127	24	0	0	0	0	0	4,450	1992
45	1966	105	0	0	1,490	46	0	0	0	0	0	212	0	1,853	1987

TABLE 3-15
Simulated onthly Water eleases from Castaic Lagoon to Castaic Cree for the year Simulation

Model Year	Historical Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Prototype Year
46	1967	0	0	0	0	0	667	842	735	0	0	0	0	2,244	1982
47	1968	0	0	0	0	0	0	0	0	0	0	0	0	0	2007
48	1969	0	140	186	3,031	1,901	635	341	337	813	0	0	341	7,725	1993
49	1970	0	0	0	0	0	667	842	735	0	0	0	0	2,244	1982
50	1971	105	0	0	1,490	46	0	0	0	0	0	0	0	1,641	1986
51	1972	0	0	0	0	0	0	0	0	0	0	0	0	0	1989
52	1973	0	0	0	0	0	667	842	735	0	0	0	0	2,244	1982
53	1974	105	0	0	1,490	46	0	0	0	0	0	0	0	1,641	1986
54	1975	210	0	0	2,979	93	0	0	0	0	0	0	0	3,282	1994
55	1976	105	0	0	1,490	46	0	0	0	0	0	212	0	1,853	1987
56	1977	0	0	0	0	0	667	842	735	0	0	0	0	2,244	1982
57	1978	0	0	0	0	0	1,168	1,473	1,287	0	0	0	0	3,928	1983
58	1979	0	0	0	0	0	667	842	735	0	0	0	0	2,244	1982
59	1980	0	0	0	0	0	834	1,052	919	0	0	0	0	2,805	1980
60	1981	105	0	0	1,490	46	0	0	0	0	0	0	0	1,641	1986
61	1982	0	0	0	0	0	667	842	735	0	0	0	0	2,244	1982
62	1983	0	0	0	0	0	1,168	1,473	1,287	0	0	0	0	3,928	1983
63	1984	0	0	0	0	0	0	0	0	0	0	0	0	0	1984
64	1985	0	0	0	0	0	0	0	0	0	0	0	0	0	1985
65	1986	105	0	0	1,490	46	0	0	0	0	0	0	0	1,641	1986
66	1987	105	0	0	1,490	46	0	0	0	0	0	212	0	1,853	1987
67	1988	0	0	809	341	900	0	0	0	0	0	0	0	2,050	1988
68	1989	0	0	0	0	0	0	0	0	0	0	0	0	0	1989
69	1990	0	0	0	0	0	0	0	0	0	0	0	0	0	1990
70	1991	0	0	0	0	0	0	0	0	0	0	0	66	66	1991
71	1992	0	0	580	3,052	667	127	24	0	0	0	0	0	4,450	1992
72	1993	0	140	186	3,031	1,901	635	341	337	813	0	0	341	7,725	1993
73	1994	210	0	0	2,979	93	0	0	0	0	0	0	0	3,282	1994
74	1995	0	0	0	0	0	1,668	2,104	1,839	0	0	0	0	5,611	1995
75	1996	0	0	0	4,961	671	0	0	0	0	0	0	0	5,632	1996
76	1997	0	0	8,701	873	0	0	0	0	0	0	0	310	9,884	1997
77	1998	1,186	19,545	10,747	4,566	7,561	47	1,370	436	464	302	652	926	47,802	1998
78	1999	612	691	0	3,187	1,191	149	0	0	0	0	0	0	5,830	1999
79	2000	0	660	855	0	2,087	3,484	0	0	0	0	0	0	7,086	2000
80	2001	0	389	1,218	0	0	0	0	0	0	0	0	0	1,607	2001
81	2002	0	0	0	0	0	0	0	0	0	0	0	0	0	2002
82	2003	0	0	0	2,286	418	315	0	0	0	0	0	0	3,019	2003
83	2004	0	59	1,004	0	0	0	0	0	0	0	0	60	1,123	2004
84	2005	32,391	37,514	12,993	3,613	2,891	90	1,657	32	0	0	0	0	91,181	2005
85	2006	1,403	2,185	2,648	5,906	3,395	2,307	0	0	0	0	0	0	17,844	2006
86	2007	0	0	0	0	0	0	0	0	0	0	0	0	0	2007

All simulated water releases are listed in units of acre-feet (af).

Ta le 3-

Water emands and Indoor Water se under ull uild out Conditions E cluding e hall anch

Year 2000 Actual (afy)	Full Build-out Conditions (afy)	Comments
Annual Urban Water Use Outside Newhall Ranch		
60,988	123,038	Year 2000 value is retail purveyor demand plus other demands in Table II-6 of the *2004 Santa Clarita Valley Water Report* (LSCE, 2005a). Year 2045 value is from Table 2.5-4 of the *Newhall Ranch Draft Additional Analysis* (Impact Sciences, Inc., 2001). Consists of 89,805 AF/yr Development Monitoring System[a] demand, plus 55,995 AF/yr additional urban demand, minus 14,480 AF/yr conservation, minus 5,193 AF/yr agricultural uses and 3,089 AF/yr "other" uses. Does not include 4,500 AF/yr for aquifer storage and recovery or 17,680 AF/yr of demand for the Newhall Ranch Specific Plan.
Annual Indoor Water Use Outside Newhall Ranch (Equal to LACSD WRP Influent Volumes)		
18,723	40,313 (average year)	The year 2000 volume is from the Saugus and Valencia WRPs for the period January 2000 through December 2000. The long-term current generated effluent volume is based on the influent volume estimated from water balance calculations performed for the chloride mass balance analysis. The effluent volume is 32.8 percent of the total urban water production of 123,038 AF/yr, which includes other uses.

[a]Development Monitoring System water demands are demands associated with future build-out of developments identified in Los Angeles County's Development Monitoring System for the Santa Clarita Valley.

Ta le 3-

reated Water ischarges from the Saugus and alencia W s to the Santa Clara i er under ull uild out Conditions

Month	Treated Water Volume (2000)[a]	Treated Water Volume (Full Build-out Conditions)[b]	Percent of Annual Outdoor Demand	Reclaimed Volume under Full Build-out Conditions (Before Maintaining Existing Streamflows)	Reclaimed Volume under Full Build-out Conditions (After Maintaining Existing Streamflows)	WRP Discharges to River under Full Build-out Conditions[c]	Month
January	1,503	3,237	3.75	637	637	2,600	January
February	1,443	3,106	5.1	867	867	2,239	February
March	1,528	3,290	6.6	1,122	1,122	2,168	March
April	1,505	3,240	9.1	1,547	1,547	1,693	April
May	1,569	3,379	10.55	1,794	1,794	1,585	May
June	1,543	3,322	11.4	1,938	1,781	1,541	June
July	1,606	3,459	14.1	2,397	1,854	1,605	July
August	1,649	3,550	12.95	2,202	1,902	1,648	August
September	1,593	3,430	10.2	1,734	1,734	1,696	September
October	1,631	3,512	7.5	1,275	1,275	2,237	October
November	1,546	3,329	5	850	850	2,479	November
December	1,607	3,459	3.75	637	637	2,822	December
Total Annual	**18,723**	**40,313**	**100**	**17,000**	**16,000**	**24,313**	**Total Annual**

[a]Values shown are the actual volumes of treated water discharged to the Santa Clara River from the Saugus and Valencia WRPs during calendar year 2000. (See also Table 3-16.)

[b]Values shown are the combined treated water volumes estimated to be produced by the Saugus and Valencia WRPs for full build-out conditions in the Santa Clarita Valley. These values do not include the future Newhall Ranch WRP, which will be operated by LACSD.

[c]Values shown do not include discharges of treated water to the river from the future Newhall Ranch WRP. These volumes are 10 acre-feet in November, 138 acre-feet in December, and 138 acre-feet in January. During the other nine months of the year, this WRP will not discharge treated water to the river (see the *Newhall Ranch Draft Additional Analysis* [Impact Sciences, Inc., 2001] for further details). The combined total discharge from the Saugus, Valencia, and Newhall Ranch WRPs is summarized in Table 3-18.

Note: All volumes are in acre-feet.

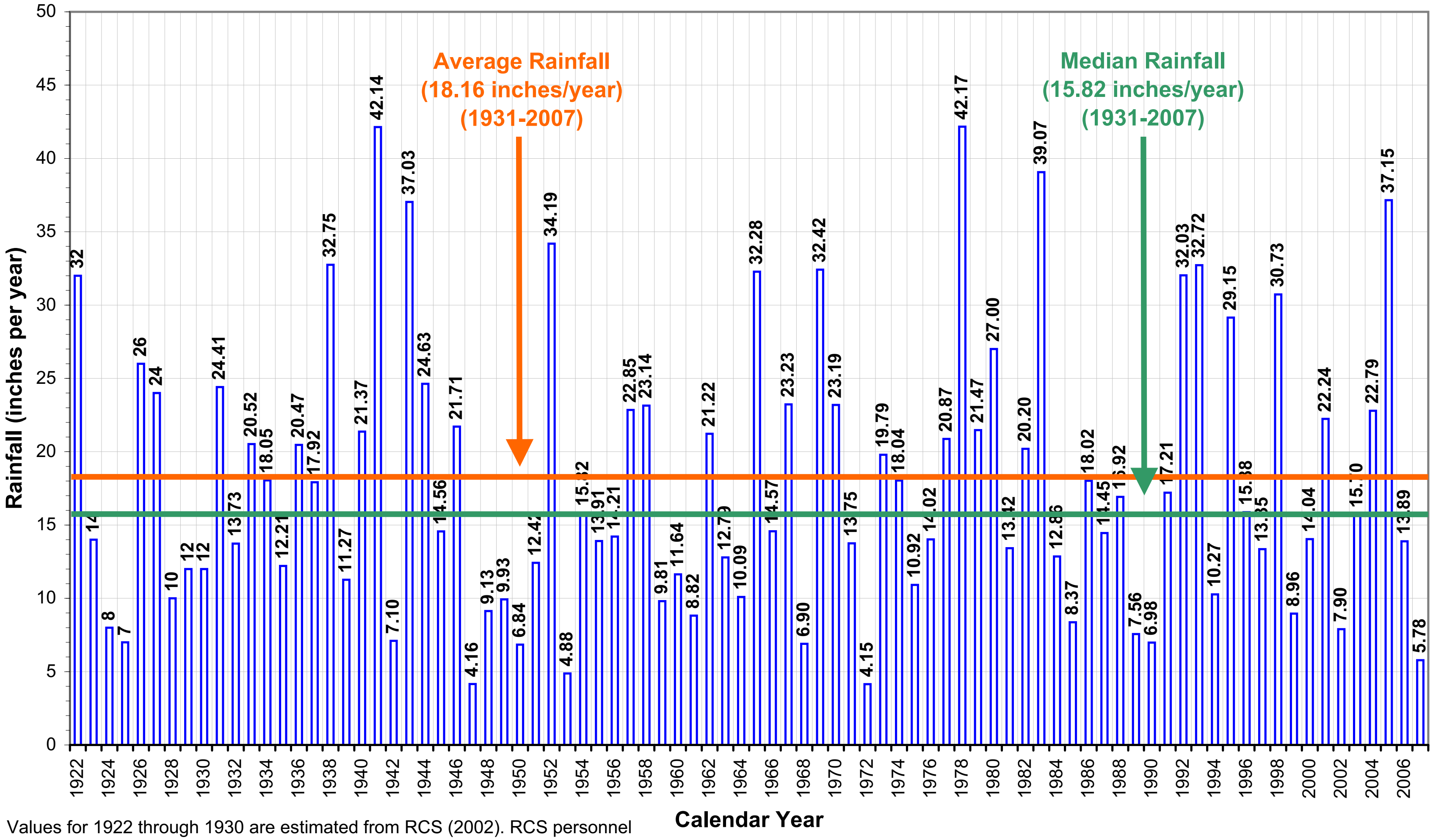
Ta le 3- 8

Simulated onthly reated Waste ater ischarges from Santa Clarita alley W s under ull uild out Conditions

WRP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Saugus	493	487	500	490	503	466	457	508	586	555	514	596	**6,155**
Valencia	2,107	1,752	1,668	1,203	1,082	1,075	1,148	1,140	1,110	1,682	1,965	2,226	**18,158**
Newhall	138	0	0	0	0	0	0	0	0	0	10	138	**286**
Total	**2,738**	**2,239**	**2,168**	**1,693**	**1,585**	**1,541**	**1,605**	**1,648**	**1,696**	**2,237**	**2,489**	**2,960**	**24,599**

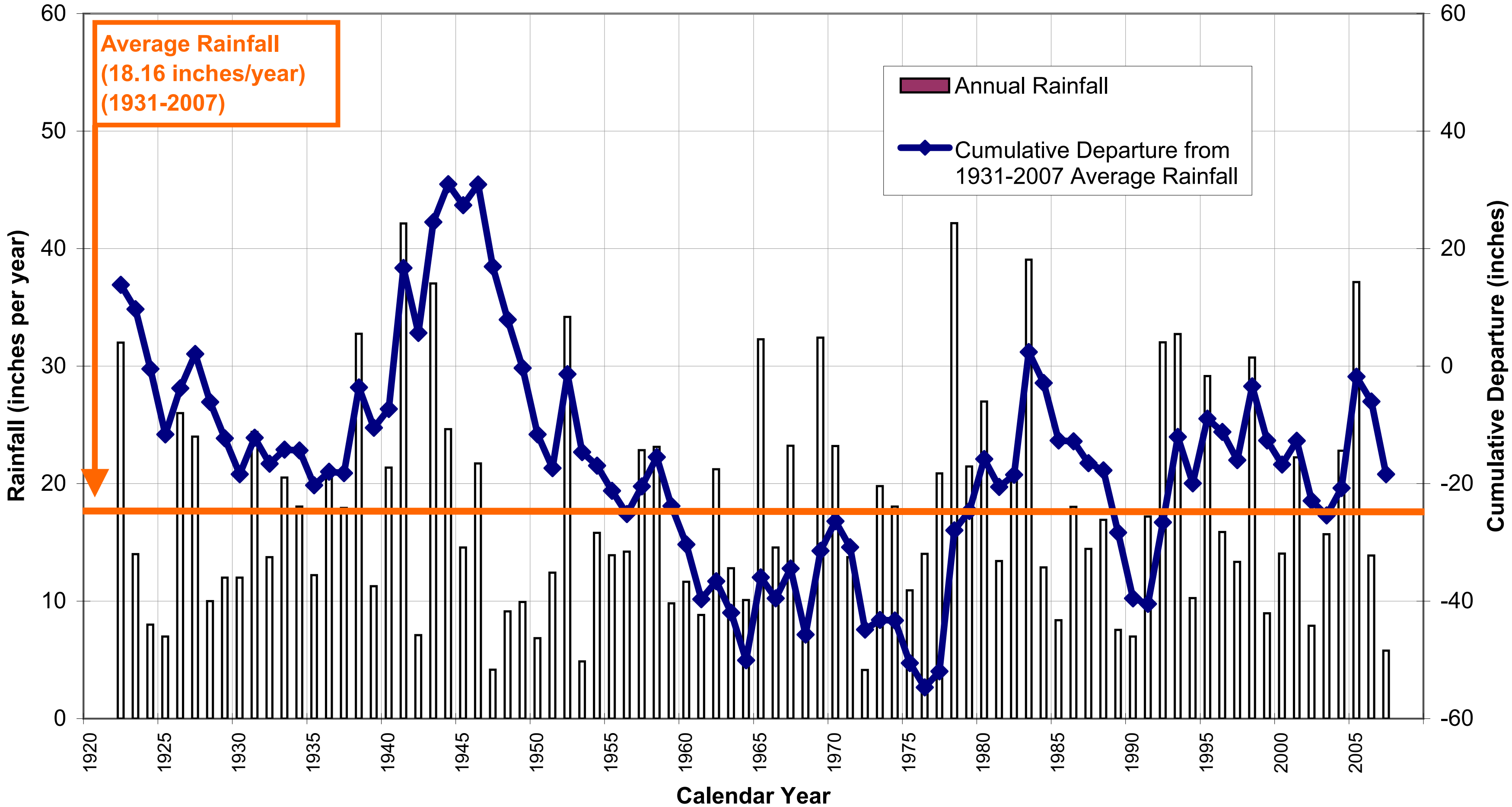
Note: All volumes are in acre-feet.

Figure 3-1
Annual Rainfall
(Newhall-Soledad Rain Gage)



Values for 1922 through 1930 are estimated from RCS (2002). RCS personnel have since indicated that the source of data to 1931 is an unofficial record obtained in 2001 from a former California State Climatologist.

Figure 3-2
Annual Rainfall and Cumulative Departure from Average Rainfall
(Newhall-Soledad Rain Gage)



Values of annual rainfall for 1922 through 1930 are estimated from RCS (2002).
RCS personnel have since indicated that the source of data to 1931 is an unofficial
record obtained in 2001 from a former California State Climatologist.

Figure 3-3
Simulated Groundwater Pumping for 2008 Groundwater Operating Plan

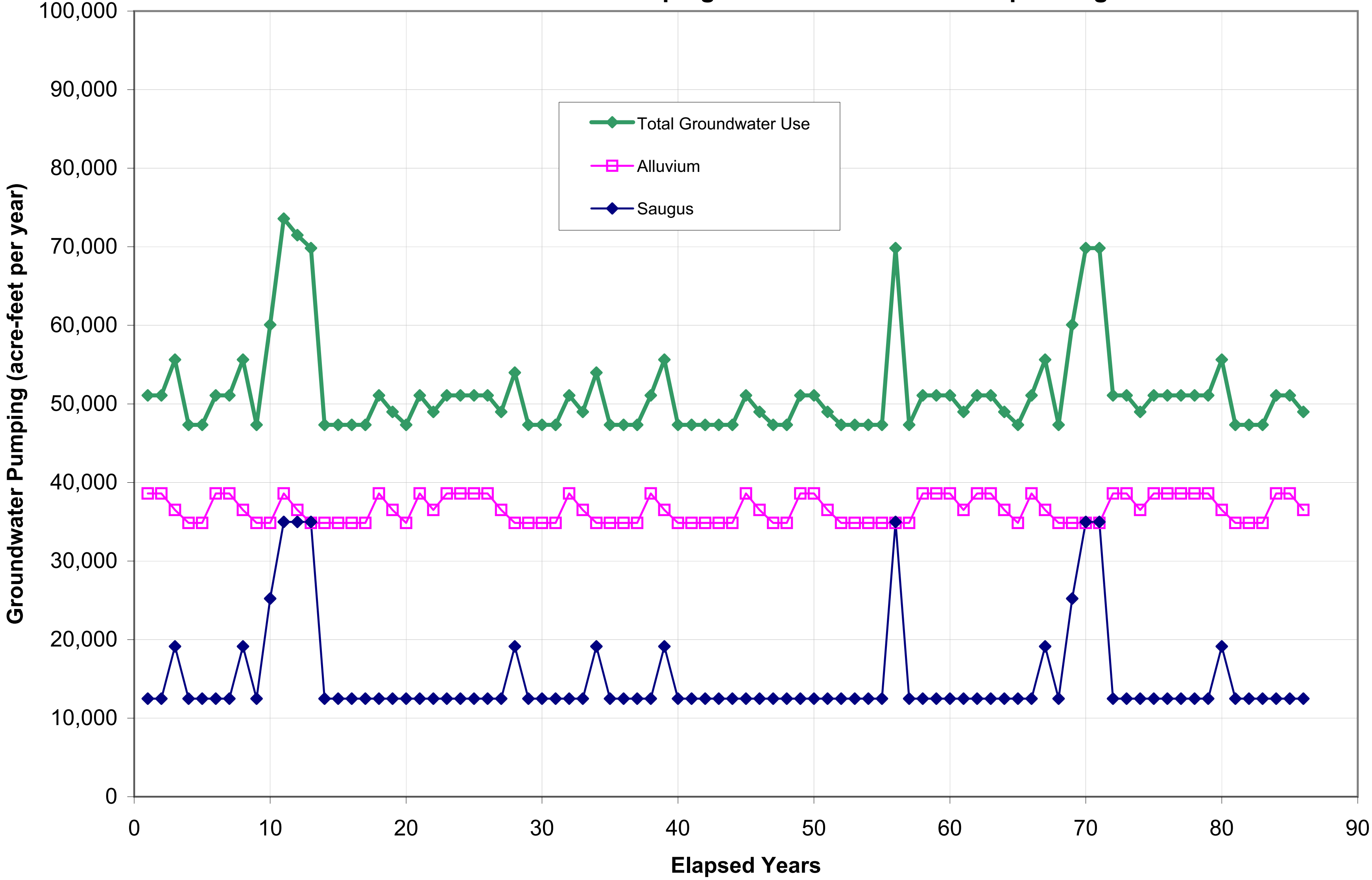


Figure 3-4
Simulated Water Supplies For 2008 Groundwater Operating Plan (Excluding Recycled Water)

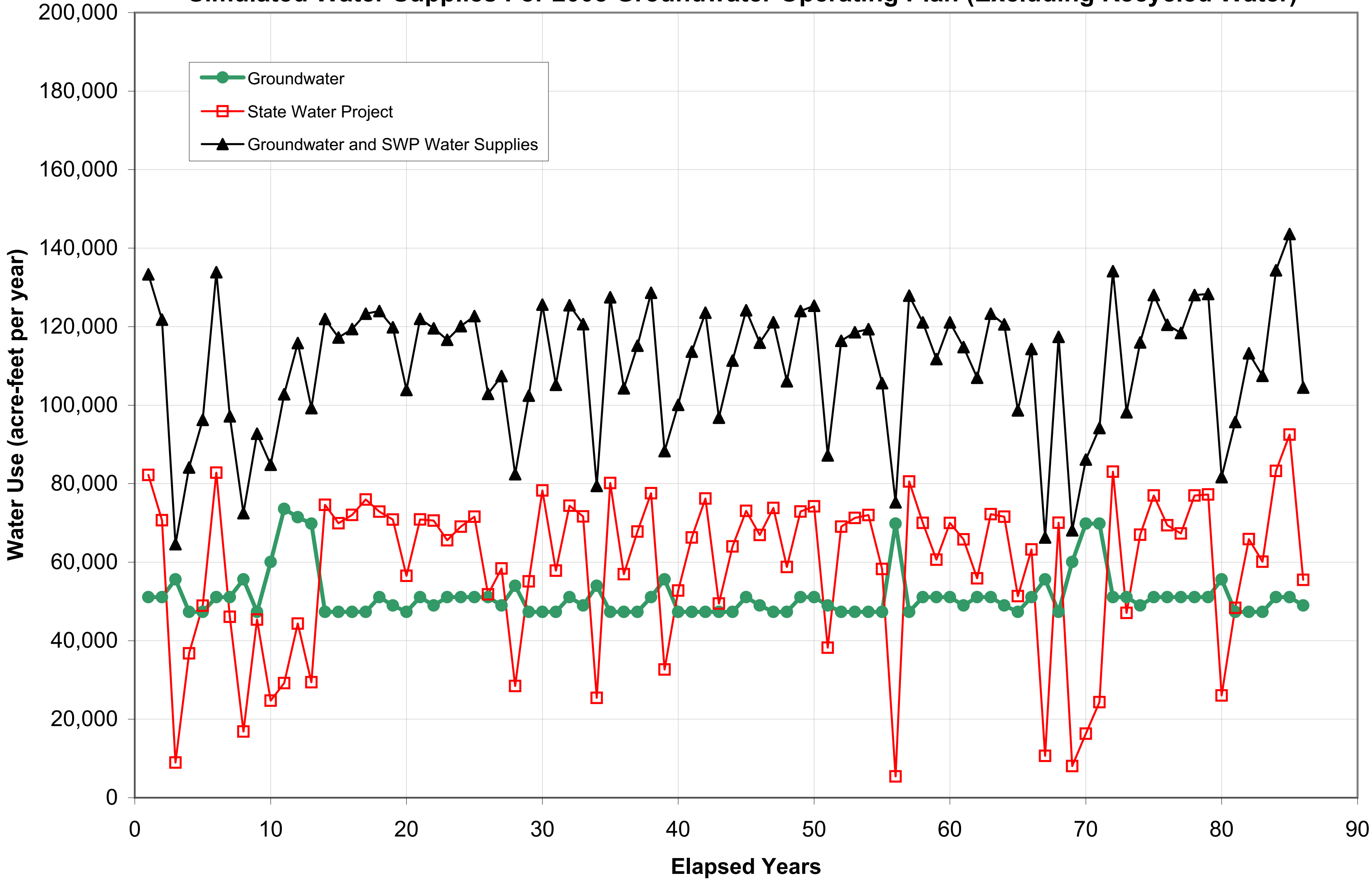


Figure 3-5
Simulated Groundwater Pumping For Potential Groundwater Operating Plan

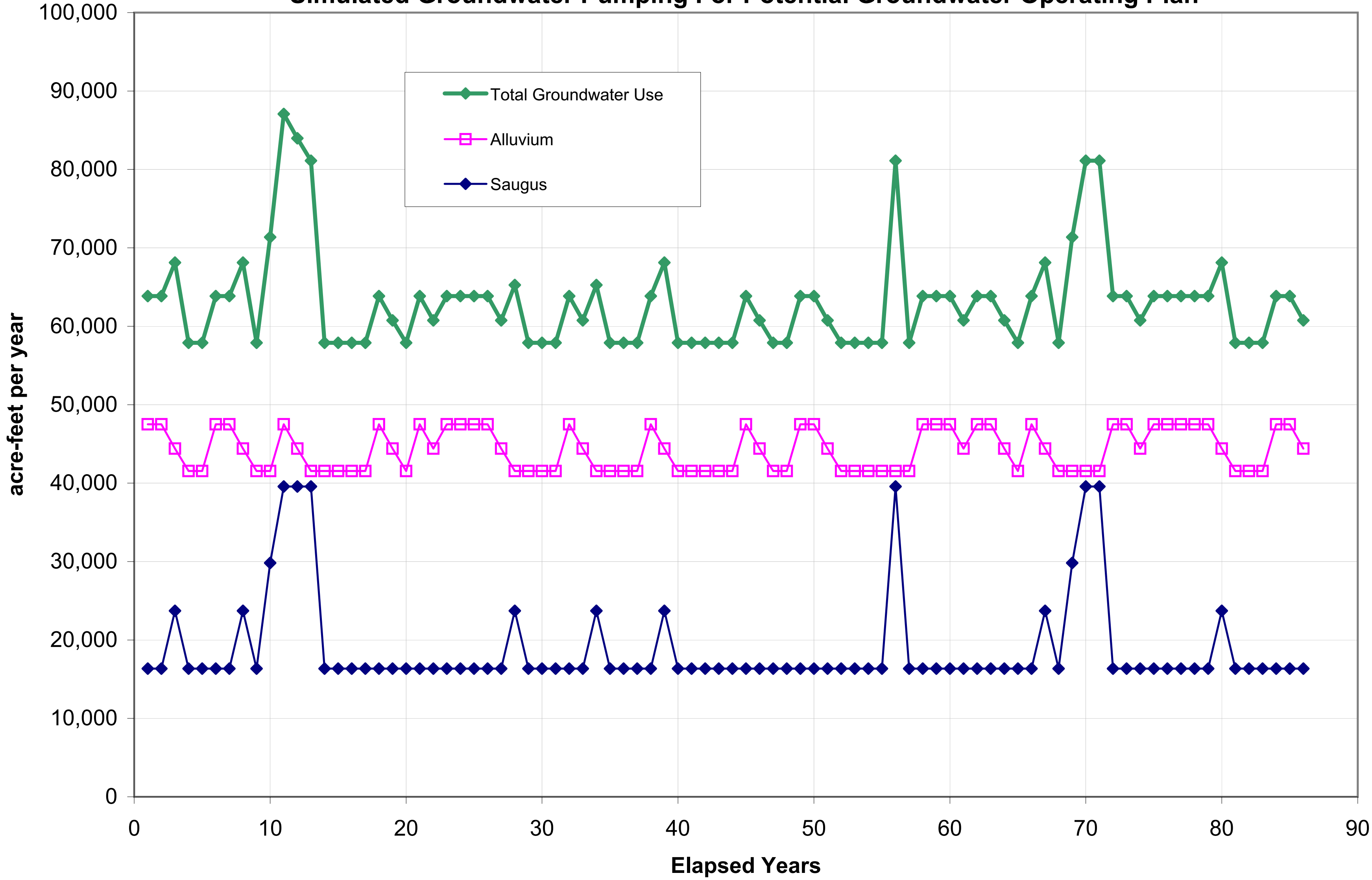


Figure 3-6
Simulated Groundwater Pumping For 2008 and Potential Groundwater Operating Plans

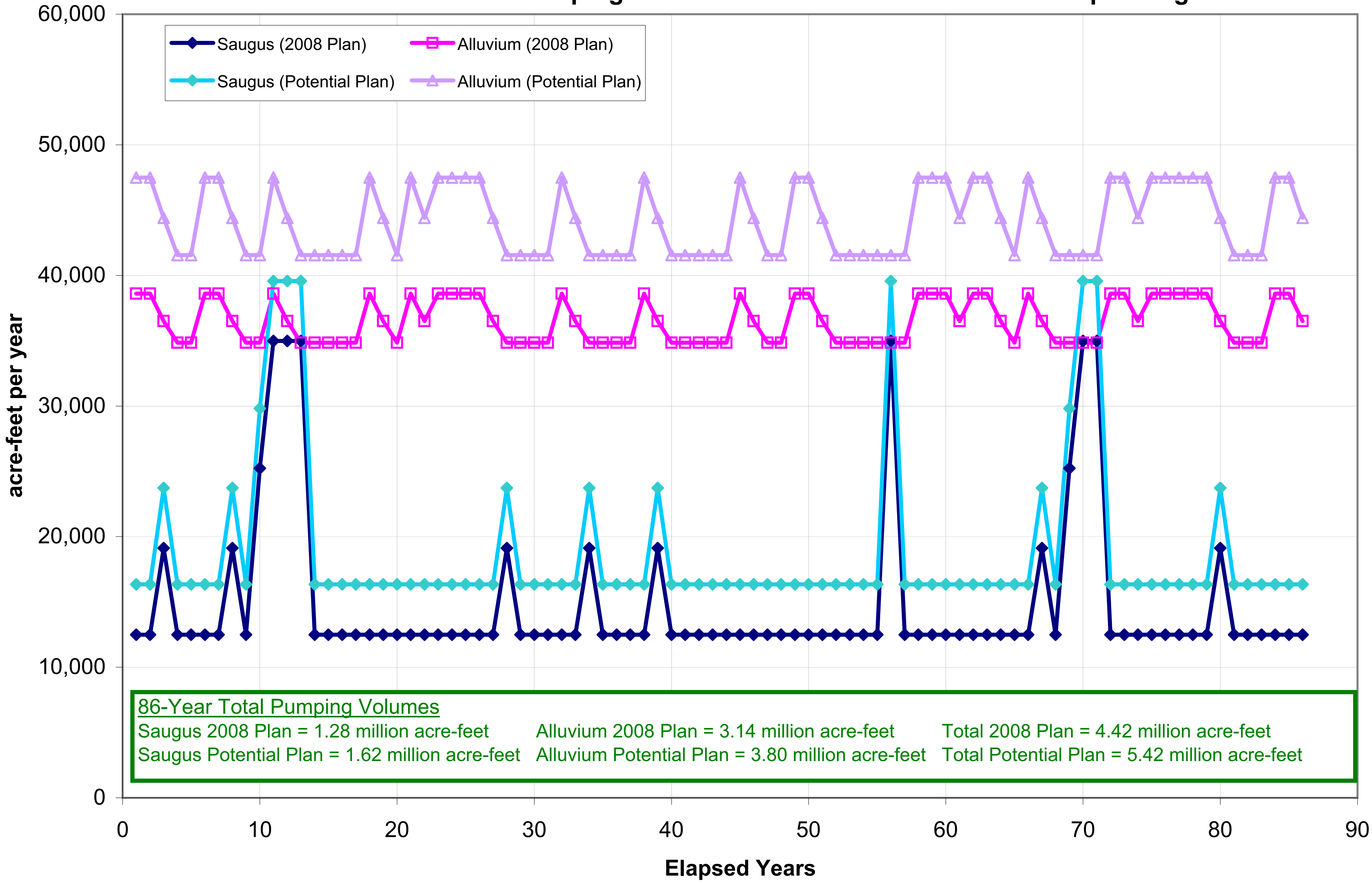
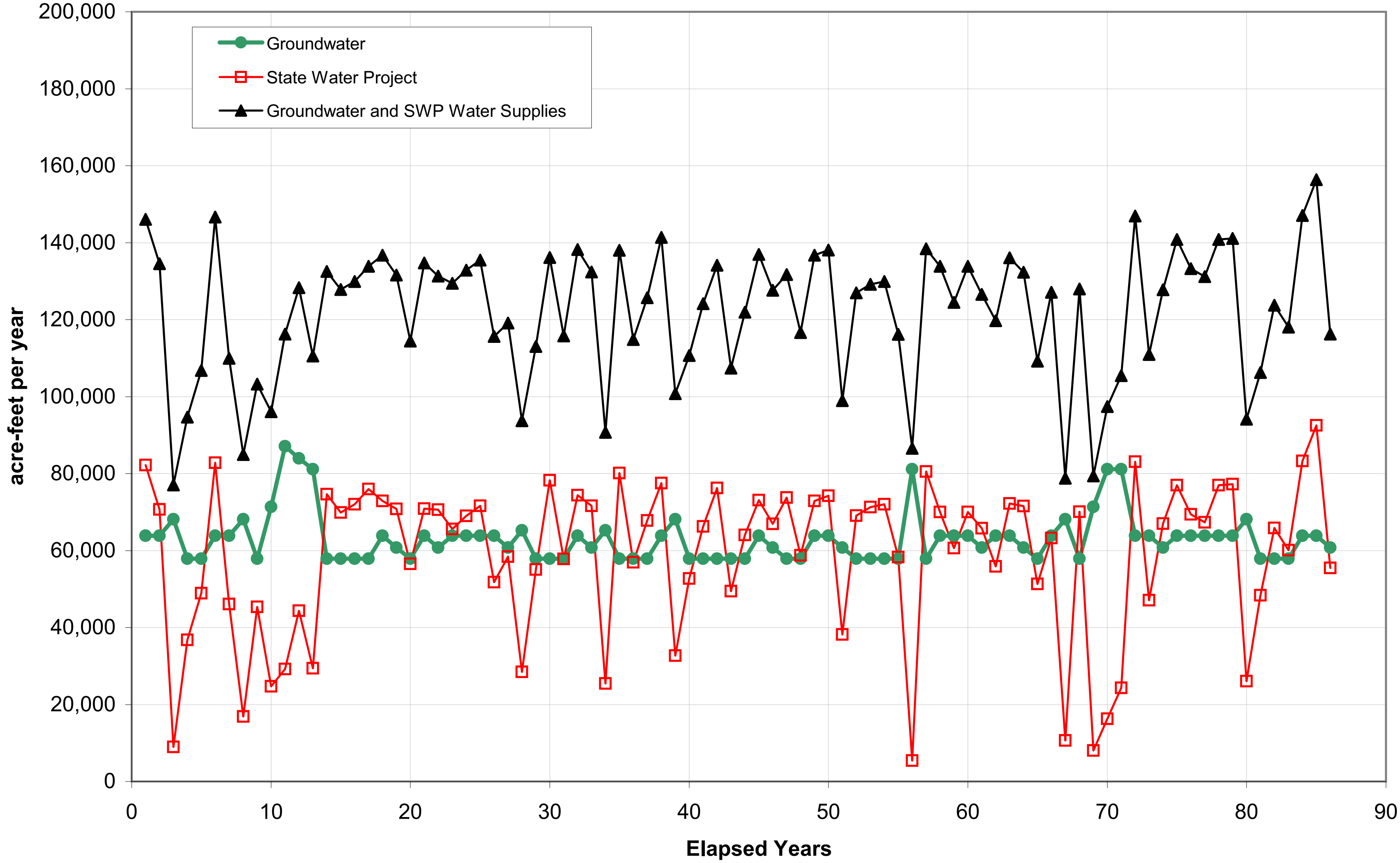


Figure 3-7
Simulated Water Supplies For Potential Groundwater Operating Plan
(Excluding Recycled Water)



IV. Sustainability of Operating Plans

This section of the report presents and discusses time-series plots (hydrographs) of simulated groundwater elevations, groundwater budget terms, and Santa Clara River flows for the 86-year modeling period. The results for the 2008 Operating Plan, the 2008 Operating Plan with Pumping Redistribution, and the future Potential Operating Plan are presented and discussed together.

4.1 Groundwater Elevations

As introduced above, groundwater elevation trends are considered to be the key indicator of long-term sustainability of an operating plan. A sustainable plan is characterized by the absence of long-term declines in groundwater levels or, if declines occur initially, subsequent long-term stabilization of groundwater levels. Concurrent with sustainability considerations, i.e. groundwater resource response to a certain level of pumping, is whether an operating plan is physically achievable. An achievable plan is one in which target pumping capacities and long-term (monthly and/or annual) target pumping volumes can be expected to be pumped without exceeding practical well and pump performance. Achievability of the plan at a given well can be evaluated by comparing groundwater elevations and trends against historical levels and against the depths in the aquifer to which the well is open (i.e., the depth interval for the well screen or the perforated steel casing).

Sections 4.1.1 through 4.1.3 discuss sustainability and achievability of the 2008 Operating Plan, the 2008 Operating Plan with Pumping Redistribution, and the Potential Operating Plan, respectively. Hydrographs illustrating basin response to each operating plan at each production well location in the Valley are contained in Appendix C.

4.1.1 2008 Operating Plan

Selected groundwater elevation hydrographs for different portions of the Alluvial Aquifer are presented on Figures 4-1 through 4-8. Each figure presents hydrographs for wells that are considered representative of conditions in the following alluvial subareas:

- Along the Santa Clara River, below the Valencia WRP (well VWC-E15)
- Along the Santa Clara River, below the Saugus WRP (well VWC-S8)
- Along the Santa Clara River, above the Saugus WRP (well VWC-T7)
- Along the Santa Clara River, at and above Mint Canyon (wells SCWD-Sierra and NCWD-Pinetree1)
- Castaic Valley (well NCWD-Castaic7)
- San Francisquito Canyon (well VWC-W11)
- Bouquet Canyon (well SCWD-Clark)

Each set of hydrographs in Figures 4-1 through 4-8 shows the simulated monthly groundwater elevations for both operating plans, as well as three sets of historical groundwater elevations from 1980-2007 (static [non-pumping] groundwater elevations, groundwater elevations measured during pumping, and the model's simulation of historical conditions from 1980-2007).

Key findings from the simulated hydrographs for the 2008 Operating Plan are as follows:

The model simulates distinct multi-year periods of overall declining or overall increasing groundwater elevations resulting from cycles of below-normal and above-normal rainfall periods. This variation is consistent with historical observations of the relationship between rainfall and groundwater level fluctuations (CH2M HILL, 2004a; CH2M HILL and LSCE, 2005) and is particularly pronounced in much of the Alluvial Aquifer.

The 2008 Operating Plan is sustainable, but not fully achievable, in the Alluvial Aquifer as configured. Specifically:

- Alluvial Aquifer wells in each subarea do not show sustained long-term declines in groundwater elevations. Groundwater elevations decline notably in some areas during drought periods, but eventually recover in response to significant rainfall/recharge events that occur periodically, marking the end of a given drought cycle.

- The 2008 plan is achievable in most Alluvial Aquifer subareas in that the groundwater elevations remain similar to historical groundwater elevations, do not drop appreciably into the open intervals of the wells or, at wells such as SCWD-Clark, where groundwater levels are already within the open interval, are only modestly below levels observed in recent years. This means that groundwater levels in most areas are not expected to pose operational difficulties that would significantly reduce the pumping capacities of individual wells.

- However, a notable exception is in the "Above Mint Canyon" subarea, where groundwater elevations are simulated to be within the open intervals of wells during most of the simulation period. In some instances, the simulated groundwater elevations are predicted to drop below the bottom of the well, meaning that the pumping rates programmed into the model at, and prior to, that time are not expected to be physically achievable. As shown by the hydrographs, the 2008 Operating Plan is predicted to not be fully achievable in the "Above Mint Canyon" subarea under the types of drought cycles such as were observed from the mid-1920s through the late 1930s and from the mid-1940s through the mid-1970s.

- It is important to note that, because the model simulates more pumping than can physically be achieved in the "Above Mint Canyon" alluvial subarea during drought periods, actual groundwater elevations will be higher at the ends of the drought cycles than predicted by the model (because actual pumping will have to be less than what is simulated by the model). This in turn means that the relatively low groundwater elevations depicted on the hydrographs between 1976 and the early 1990s are lower than will actually occur. It also means that, while pumping at the rates contemplated in the 2008 Operating Plan may not be achievable, some lower extraction rates can likely be achieved in the "Above Mint Canyon" area, with the possibility that reductions in this area could be offset by increased pumping in other parts of the basin. This idea is supported by a group of focused test simulations that were conducted during the course of evaluating the 2008 Operating Plan. Results are discussed in the following Section 4.1.2.

Figures 4-9 through 4-11 contain groundwater elevation hydrographs for three representative wells in the Saugus Formation (SCWD-Saugus1 just south of Bouquet Junction; NCWD-13 further to the south, along the South Fork Santa Clara River; and VWC-206 near the Valencia WRP). The principal observations from these hydrographs are:

- Groundwater elevations show long-term stability under the 2008 Operating Plan, with no sustained declines being evident. At each well, the groundwater elevations under this operating plan are slightly below the historical static elevations that were observed from 1980 through 2007, reflecting greater use of Saugus wells under the 2008 Operating Plan than has occurred historically (in particular, greater use of SCWD-Saugus1 and SCWD-Saugus2, which will begin pumping under the perchlorate containment plan described in Section 3.3.3). Nonetheless, the groundwater elevations are at or above historically recorded pumping elevations, and notably above the top of the open interval of each well, indicating that the 2008 Operating Plan should be achievable at each well and sustainable in the long-run.

4.1.2 2008 Operating Plan with Pumping Redistribution

During the prolonged dry period from the mid-1940s through the mid-1970s, when there were few years of significantly greater-than-average rainfall, the 2008 Operating Plan might have been achievable if pumping in the "Above Mint Canyon" alluvial subarea had been lower than the pumping volume contemplated in the 2008 Operating Plan. This reduction would not have been necessary during other historical periods that were characterized by intermittent years of significant rainfall, streamflow, and associated groundwater recharge (such as occurred periodically from the late 1970s through 2005).

This possibility was examined as follows. Recognizing that SCWD is in the midst of constructing new or replacement wells (e.g. to replace its perchlorate-impacted Stadium well) to the west of the "Above Mint Canyon" subarea, a potential redistribution of some SCWD pumping, as analyzed in the 2008 Operating Plan, was crafted whereby 1,600 afy of pumping was moved from three SCWD wells in the "Above Mint Canyon" subarea (near the mouth of Sand Canyon) to the replacement SCWD Santa Clara and Bouquet wells, located in the "Above Saugus WRP" and "Bouquet Canyon" subareas, respectively (Table 3-9). The resultant impact on groundwater levels to the west was nearly insignificant, indicating no adverse effect on either sustainability or achievability of groundwater at a higher pumping rate in those subareas (Figures 4-12 through 4-15). However, in the "Above Mint Canyon" area to the east, while there was appreciable improvement, in places up to 20 feet of higher groundwater levels through prolonged dry periods, the redistribution of 1,600 afy from this alluvial subarea is not predicted to significantly improve operating conditions at most of the production wells in this area, as groundwater levels are still predicted to decline close to, or below, the open intervals of many of the existing production wells under the historical hydrologic conditions observed from the mid-1940s through the mid-1970s (see Figures 4-12 through 4-15).

The preceding "redistribution" analysis suggests that the Purveyors can expect that the "Above Mint Canyon" subarea will suffer from significantly depressed groundwater levels through extended dry periods that will, in turn, physically limit the amount of groundwater pumping in that area, most notably from the SCWD wells in that subarea. The "redistribution" analysis indicates that increased pumping to the west, to offset reduced pumping in the "Above Mint Canyon" area, is both sustainable and achievable. The residual "Above Mint Canyon" pumping (a total of 4,450 afy in multiple dry years; 3,300 afy by SCWD, 700 afy by NCWD, and 450 afy by Robinson Ranch) in the 2008 Operating Plan does not appear to be fully achievable through those dry periods. Implications are likely to be in the following range of possibilities. One possibility is that additional redistribution can be achieved by further increasing pumping to the west; that would tend to keep the total groundwater supply near the upper end (35,000 afy) of the dry-year range in the Operating Plan (Section 3.3.1). Model results of limited redistribution above indicate the probability that such can be accomplished with small decreases in groundwater levels that will not have an adverse effect on overall sustainability and achievability. A second possibility is that pumping is not increased to the west, even if pumping is reduced in the "Above Mint Canyon" area; in that case, the total achievable pumping in dry periods would be near the lower end (30,000 afy) of the dry-year range in the Operating Plan. Additionally, in this second case, because of the absence of episodic recharge events during such a prolonged period, pumping during or after years of near-normal rainfall may also require reduction to this same low end of the range in the Operating Plan (30,000 afy).

In summary, the 2008 Operating Plan, as originally crafted, would utilize groundwater in a sustainable manner, but is not expected to be fully achievable due to depressed groundwater levels at the eastern end of the basin, i.e. in the "Above Mint Canyon" area, through extended dry periods. As pumping in that area declines due to depressed groundwater levels, total Alluvial pumping can be expected to remain within the overall dry-period range in the 2008 Operating Plan (30,000 to 35,000 afy). With redistribution of pumping to the west, Alluvial pumping can be achieved toward the upper end of that range. However, without pumping redistribution to the west, Alluvial pumping can be expected to decrease toward the lower end of that range during most years until an episodic rainfall and recharge event occurs that substantially recharges the aquifer in the "Above Mint Canyon" area.

4.1.3 Potential Operating Plan

The Potential Operating Plan is not sustainable or achievable in the Alluvial Aquifer as configured. Although there are local areas where groundwater conditions would appear sustainable, overall the Potential Operating Plan is not sustainable or achievable because several of the Alluvial Aquifer subareas show groundwater elevations that are distinctly lower during most of the 86-year simulation period than under the 2008 Operating Plan, and show a continued decline over time (Figures 4-1 through 4-8).

The Potential Operating Plan shows modest long-term declines in Saugus Formation groundwater elevations at each Saugus production well, as indicated by comparing the relatively high groundwater elevations in the mid-1940s (following the drought of the mid-1920s through late 1930s) with the relatively high, but slightly lower, groundwater elevations of the mid-1980s (following the drought of the mid-1940s through mid-1970s). The hydrographs in Figures 4-9 through 4-11 indicate that pumping during the next several decades from the Saugus Formation under the Potential Operating Plan would likely be achievable, but the long-term decline indicates that the Potential Operating Plan may not be sustainable beyond the next several decades.

4.2 Groundwater Recharge, Discharge, and Storage

The sustainability of each operating plan can also be evaluated by examining trends in groundwater recharge and groundwater discharge during the 86-year simulation period. The magnitudes of individual groundwater recharge mechanisms at any given time are the same for the 2008 Operating Plan and the Potential Operating Plan, because recharge is an input to the model and is not affected by groundwater pumping. However, the groundwater discharge terms are different for the two plans because of the different groundwater pumping rates and the corresponding differences between the two plans in how they affect groundwater levels and, therefore, the magnitudes of the various components of groundwater discharge.

Figure 4-16 compares the magnitudes and trends in groundwater recharge and groundwater discharge for the 2008 Operating Plan. The figure shows that groundwater recharge rates vary greatly from year to year because of year-to-year variations in precipitation and stormwater generation within the groundwater basin and in the contiguous upstream watersheds. In contrast, total groundwater discharge is much less variable from year to year, with variations arising from increased pumping during drought years and increased evapotranspiration and groundwater discharge to the Santa Clara River during wet years. The groundwater discharge plot shows no obvious downward trend over time in groundwater discharges to streams or other discharge terms, and total discharges are do not show a continued downward trend over time. This indicates that the 2008 Operating Plan is sustainable in the long-term, a conclusion that is consistent with the examination of the groundwater elevation hydrographs discussed previously in Section 4.1.1.

Figure 4-17 compares the groundwater discharge terms for the 2008 and Potential Operating Plans. The figure shows that total groundwater discharges and discharges to streams are lower under the Potential Operating Plan than under the 2008 Operating Plan. The discharges to streams appear to decline gradually over time under the Potential Operating Plan, whereas these discharges appear more stable under the 2008 plan after the 1940s and early 1950s. This difference in groundwater discharge trends between the two operating plans is also evident in a plot showing the cumulative change in groundwater storage over time during the 86-year simulation period (Figure 4-18). The cumulative change in groundwater storage is a measure of the longer-term trends in the amount of groundwater in storage, and is plotted on a monthly basis. The 2008 Operating Plan shows a recovery of groundwater storage volumes beginning in the late 1970s, after the droughts of prior years. While the Potential Operating Plan also shows some recovery in the late 1970s, the curve as a whole remains lower in value after the 1940s than during the first two decades of the simulation.

In summary, the differences between the two operating plans' groundwater discharge trends and groundwater storage trends during the 86-year simulation period is consistent with the observed trends in groundwater elevations and the associated conclusions about sustainability discussed above.

4.3 River Flows

Figure 4-19 shows the total flows estimated by the model for the Santa Clara River at the County Line gage, which is located at the western end of the Valley. The figure contains both a linear plot and a semi-logarithmic plot, to better illustrate the flows during low-flow periods. As shown by both plots, total flow in the river at the County Line varies considerably over time. This variation occurs because of temporal variations in rainfall, streamflow, and groundwater discharges to the river.

The influences of the local hydrology and the groundwater operating plans on the Santa Clara River are also shown by Figure 4-20, which displays the model-calculated volumes of monthly groundwater discharge to the river. Groundwater discharges to the river occur along the river reach lying downstream of the mouth of San Francisquito Canyon. The figure shows that the groundwater discharge rates to the river also vary over time, both seasonally and over multi-year periods. For the 2008 Operating Plan, the model simulates no groundwater discharge to the river at certain times during the droughts of the mid-1930s and the mid-1940s to mid-1970s. In contrast, the Potential Operating Plan not only results in smaller discharges to the river at most times, but also results in many more months of no groundwater discharge to the river compared with the 2008 Operating Plan.

As discussed by CH2M HILL (2004a), the river baseflow (flow other than from stormwater runoff) gage has increased at the County Line since water imports into the Valley began in 1980. Figure 4-21 shows the historically recorded monthly flow during the driest month of each year since 1950 and compares this flow with the driest-month flow predicted to occur each year under the 2008 and Potential Operating Plans. The plot shows that under the local, ambient hydrologic conditions observed from 1922 through 1979, the 2008 Operating Plan would have maintained river flows at levels higher than were actually recorded during those years (prior to the importation of water). The Potential Operating Plan also would have maintained higher river flow in most years, with a few years (1969, 1972, and 1975) showing similar driest-month river flows as were historically recorded. This indicates that both operating plans, and in particular the 2008 Operating Plan, will maintain river flows at higher levels than occurred prior to urbanization of the Valley.

4.4 Relationship of Simulation Results to Future Conditions

The curves presented on Figures 4-1 through 4-21 provide a general indication of the types of fluctuations in groundwater conditions that could be expected to occur in the future in the Santa Clarita Valley over a period of many years under the two operating plans. However, these curves have been derived using an assumed sequence of local hydrologic conditions that is based on the sequence of rainfall and streamflow volumes that were measured during the past several decades. In the future, the year-to-year volumes and trends in rainfall and streamflow could vary from those observed in the past because of 1) changes in the timing and magnitude of multi-decadal cycles of drought and wetter-than-normal conditions such as those that have been observed in the past; and/or 2) because of global-scale changes in climate. The latter topic and its potential effect on the sustainability of the 2008 Operating Plan are discussed in the following Chapter 5 of this report.

Ta le 4-

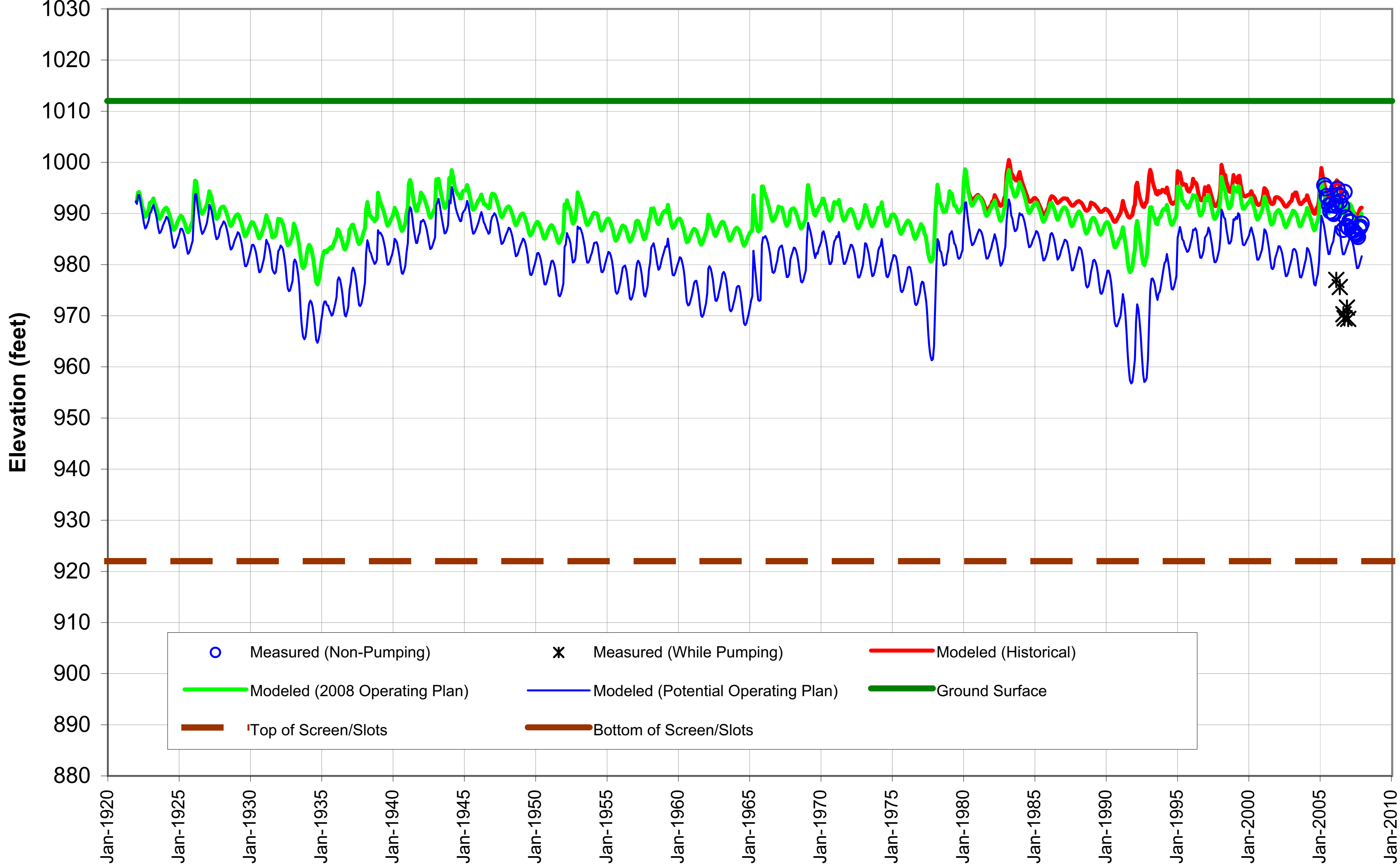
Pumping Rates Simulated for Individual Alluvial Aquifer Wells nder the Re- istri uted 2008 Groundwater Operating Plan Listed B Alluvial Su area
er Santa lara i er roun ater asin, ast Subbasin, os ngeles ount , alifornia

		Original 2008 Operating Plan			Re-Distributed 2008 Operating Plan			
Well Name	**Alluvial Subarea**	**Normal**	**Dry Yr 1**	**Dry Yr 2+**	**Normal**	**Dry Yr 1**	**Dry Yr 2+**	**Comments**
NCWD-Pinetree 1	Above Mint Canyon	150	0	0	150	0	0	
NCWD-Pinetree 3	Above Mint Canyon	350	300	300	350	300	300	
NCWD-Pinetree 4	Above Mint Canyon	300	200	200	300	200	200	
NCWD-Pinetree 5	Above Mint Canyon	300	200	200	300	200	200	
Robinson Ranch	Above Mint Canyon	600	550	450	600	550	450	
SCWD-Sand Canyon	**Above Mint Canyon**	**1,000**	**600**	**200**	**200**	**150**	**0**	**Reduce these three wells by 1,600 afy in order to**
SCWD-Lost Canyon 2	**Above Mint Canyon**	**700**	**700**	**650**	**300**	**150**	**0**	**offset increased pumping at the SCWD-Santa Clara and**
SCWD-Lost Canyon 2A	**Above Mint Canyon**	**700**	**650**	**600**	**300**	**150**	**0**	**SCWD-Bouquet wells in the "Above Saugus WRP" area.**
SCWD-Mitchell #5A	Above Mint Canyon	500	350	200	500	350	200	
SCWD-Mitchell #5B	Above Mint Canyon	800	550	300	800	550	300	
SCWD-N. Oaks Central	Above Mint Canyon	850	800	700	850	800	700	
SCWD-N. Oaks East	Above Mint Canyon	800	750	700	800	750	700	
SCWD-N. Oaks West	Above Mint Canyon	800	750	700	800	750	700	
SCWD-Sierra	Above Mint Canyon	1,100	900	700	1,100	900	700	
Mint Canyon Total		**8,950**	**7,300**	**5,900**	**7,350**	**5,800**	**4,450**	
SCWD-Honby	Above Saugus WRP	1,000	850	700	1,000	850	700	
SCWD-Santa Clara	Above Saugus WRP	800	800	800	800	800	800	
SCWD-Valley Center	**Above Saugus WRP**	**0**	**0**	**0**	**800**	**800**	**800**	**Pumps 800 afy moved from the "Above Mint Canyon" area.**
SCWD-Bouquet	**Above Saugus WRP**	**0**	**0**	**0**	**800**	**800**	**800**	**Pumps 800 afy moved from the "Above Mint Canyon" area.**
VWC-T7	Above Saugus WRP	750	750	750	750	750	750	
VWC-U4	Above Saugus WRP	800	800	800	800	800	800	
VWC-U6	Above Saugus WRP	800	800	800	800	800	800	
Above Saugus WRP Total		**4,150**	**4,000**	**3,850**	**5,750**	**5,600**	**5,450**	
VWC-N	Below Saugus WRP	650	650	650	650	650	650	
VWC-N7	Below Saugus WRP	1,160	1,160	1,160	1,160	1,160	1,160	
VWC-N8	Below Saugus WRP	1,160	1,160	1,160	1,160	1,160	1,160	
VWC-Q2	Below Saugus WRP	1,100	1,100	1,100	1,100	1,100	1,100	
VWC-S6	Below Saugus WRP	1,000	1,000	1,000	1,000	1,000	1,000	
VWC-S7	Below Saugus WRP	500	500	500	500	500	500	
VWC-S8	Below Saugus WRP	500	500	500	500	500	500	
Below Saugus WRP Total		**6,070**	**6,070**	**6,070**	**6,070**	**6,070**	**6,070**	
NLF-161	Below Valencia WRP	1,000	1,000	1,000	1,000	1,000	1,000	
NLF-B10	Below Valencia WRP	500	350	350	500	350	350	
NLF-B11	Below Valencia WRP	100	200	200	100	200	200	
NLF-B14	Below Valencia WRP	300	1,000	1,000	300	1,000	1,000	
NLF-B20	Below Valencia WRP	350	500	500	350	500	500	
NLF-B5	Below Valencia WRP	2,400	1,900	1,900	2,400	1,900	1,900	
NLF-B6	Below Valencia WRP	1,100	1,100	1,100	1,100	1,100	1,100	
NLF-C	Below Valencia WRP	1,100	1,000	1,000	1,100	1,000	1,000	
NLF-C3	Below Valencia WRP	100	200	200	100	200	200	
NLF-C4	Below Valencia WRP	200	450	450	200	450	450	
NLF-C5	Below Valencia WRP	900	850	850	900	850	850	
NLF-C7	Below Valencia WRP	350	300	300	350	300	300	
NLF-C8	Below Valencia WRP	400	400	400	400	400	400	
NLF-E5	Below Valencia WRP	100	150	150	100	150	150	
NLF-E9	Below Valencia WRP	900	350	350	900	350	350	
NLF-G45	Below Valencia WRP	350	400	400	350	400	400	
VWC-E15	Below Valencia WRP	800	800	800	800	800	800	
Below Valencia WRP Total		**10,950**	**10,950**	**10,950**	**10,950**	**10,950**	**10,950**	
SCWD-Clark	Bouquet Canyon	700	700	700	700	700	700	
SCWD-Guida	Bouquet Canyon	1,300	1,250	1,200	1,300	1,250	1,200	
Bouquet Canyon Total		**2,000**	**1,950**	**1,900**	**2,000**	**1,950**	**1,900**	
VWC-W10	San Francisquito Canyon	1,000	1,000	1,000	1,000	1,000	1,000	
VWC-W11	San Francisquito Canyon	800	800	800	800	800	800	
VWC-W9	San Francisquito Canyon	950	950	950	950	950	950	
San Francisquito Canyon Total		**2,750**	**2,750**	**2,750**	**2,750**	**2,750**	**2,750**	
NCWD-Castaic 1	Castaic Valley	350	300	250	350	300	250	
NCWD-Castaic 2	Castaic Valley	100	100	100	100	100	100	
NCWD-Castaic 4	Castaic Valley	100	0	0	100	0	0	
NCWD-Castaic 7	Castaic Valley	300	200	200	300	200	200	
VWC-D	Castaic Valley	880	880	880	880	880	880	
WHR	Castaic Valley	2,000	2,000	2,000	2,000	2,000	2,000	
Castaic Valley Total:		**3,730**	**3,480**	**3,430**	**3,730**	**3,480**	**3,430**	
Total Alluvial Pumping		**38,600**	**36,500**	**34,850**	**38,600**	**36,600**	**35,000**	**Current Operating Plan:** 35,000 to 40,000 AF/yr in normal and wet years; 30,000 to 35,000 AF/yr in dry years

Notes:

All pumping volumes are listed in acre-feet per year (afy).
Wells that are not listed are assumed to not be pumping in the future.
NLF = Newhall Land & Farming Company
NCWD = Newhall County Water District
SCWD = Santa Clarita Division of Castaic Lake Water Agency
VWC = Valencia Water Company
WHR = Wayside Honor Rancho, whose wells are owned by the Los Angeles County Waterworks District No. 36

Figure 4-1: VWC-E15 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Below Valencia WRP)



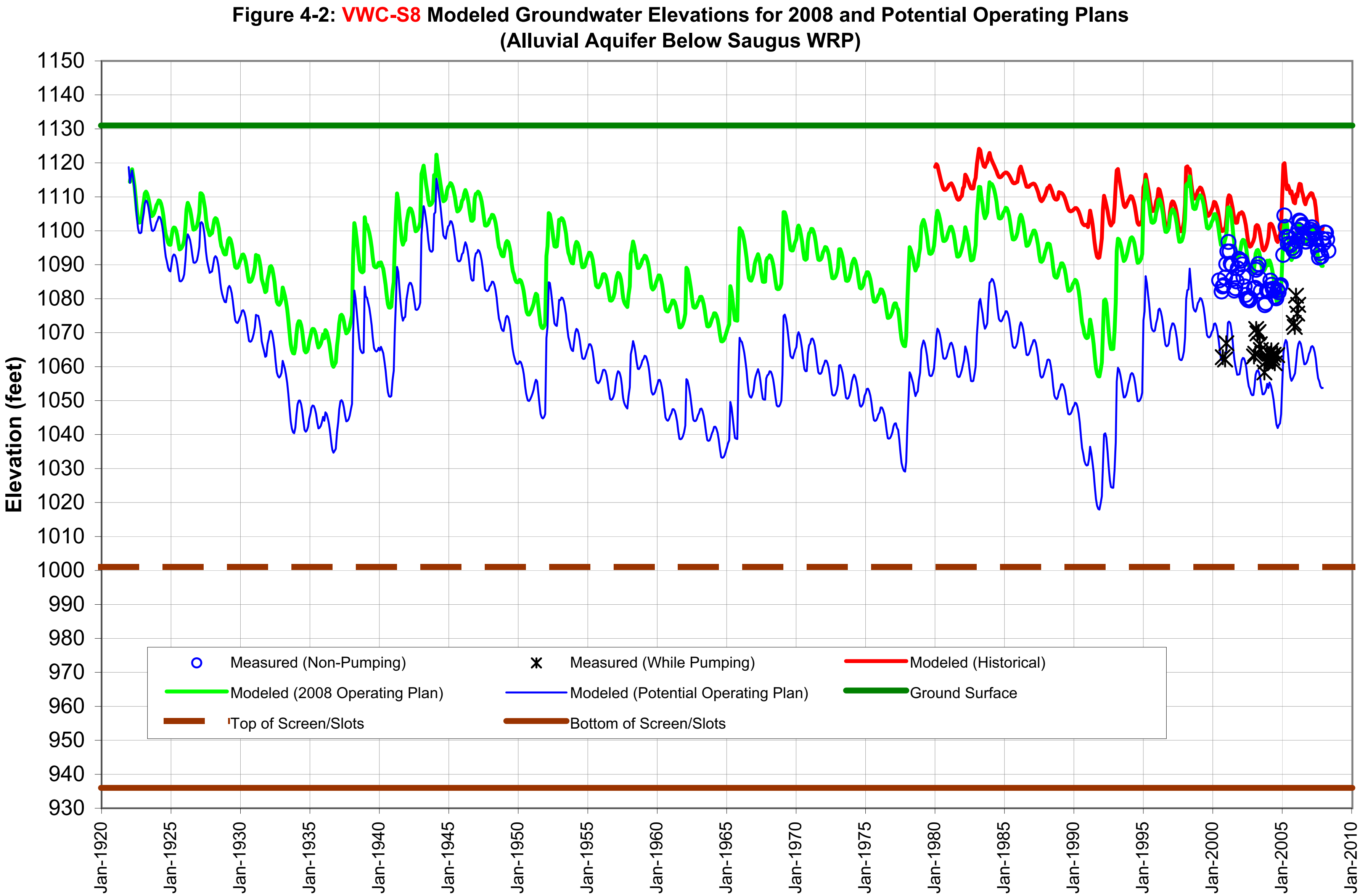
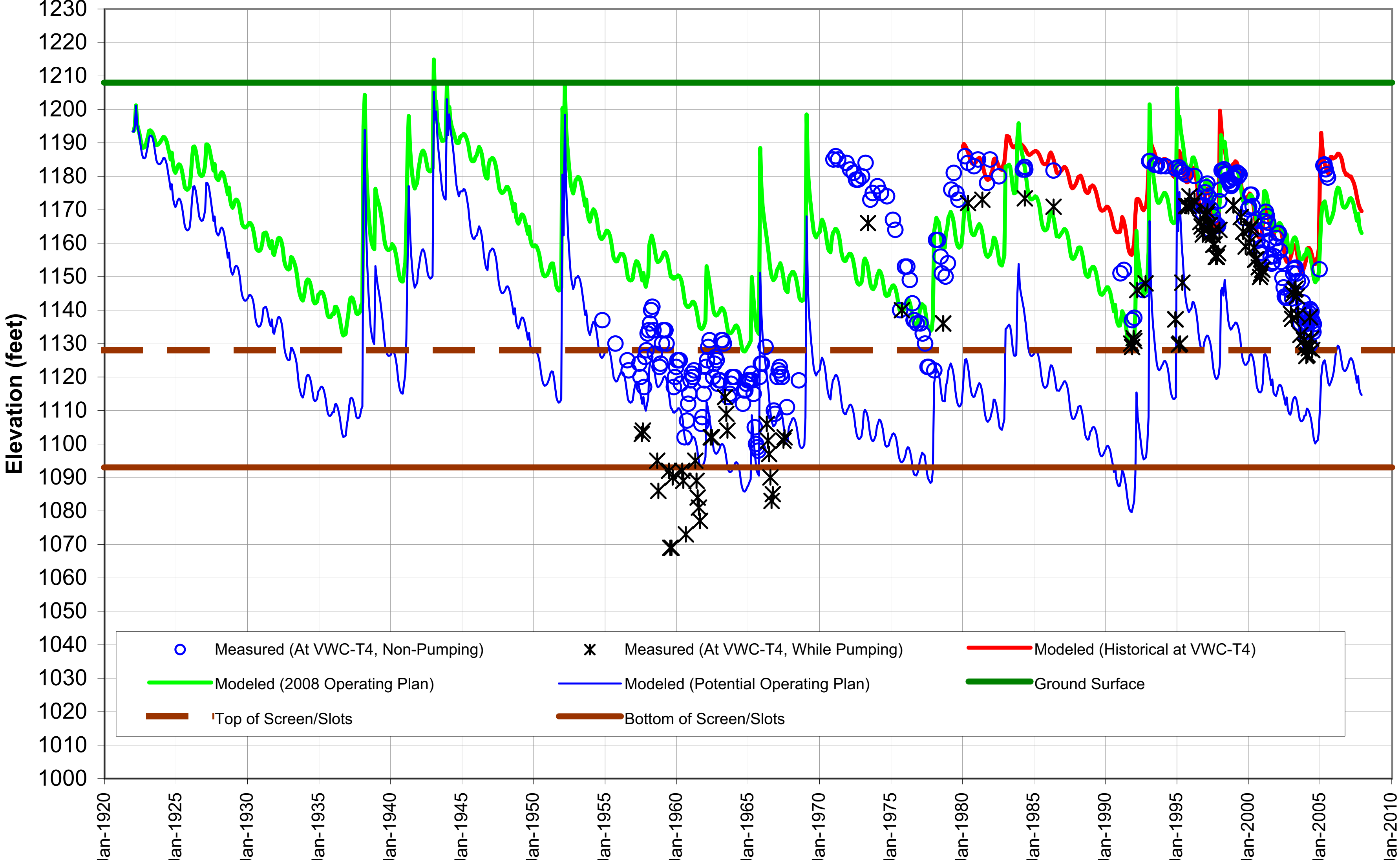


Figure 4-2: VWC-S8 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Below Saugus WRP)
Elevation (feet)
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

Figure 4-3: VWC-T7 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Above Saugus WRP)



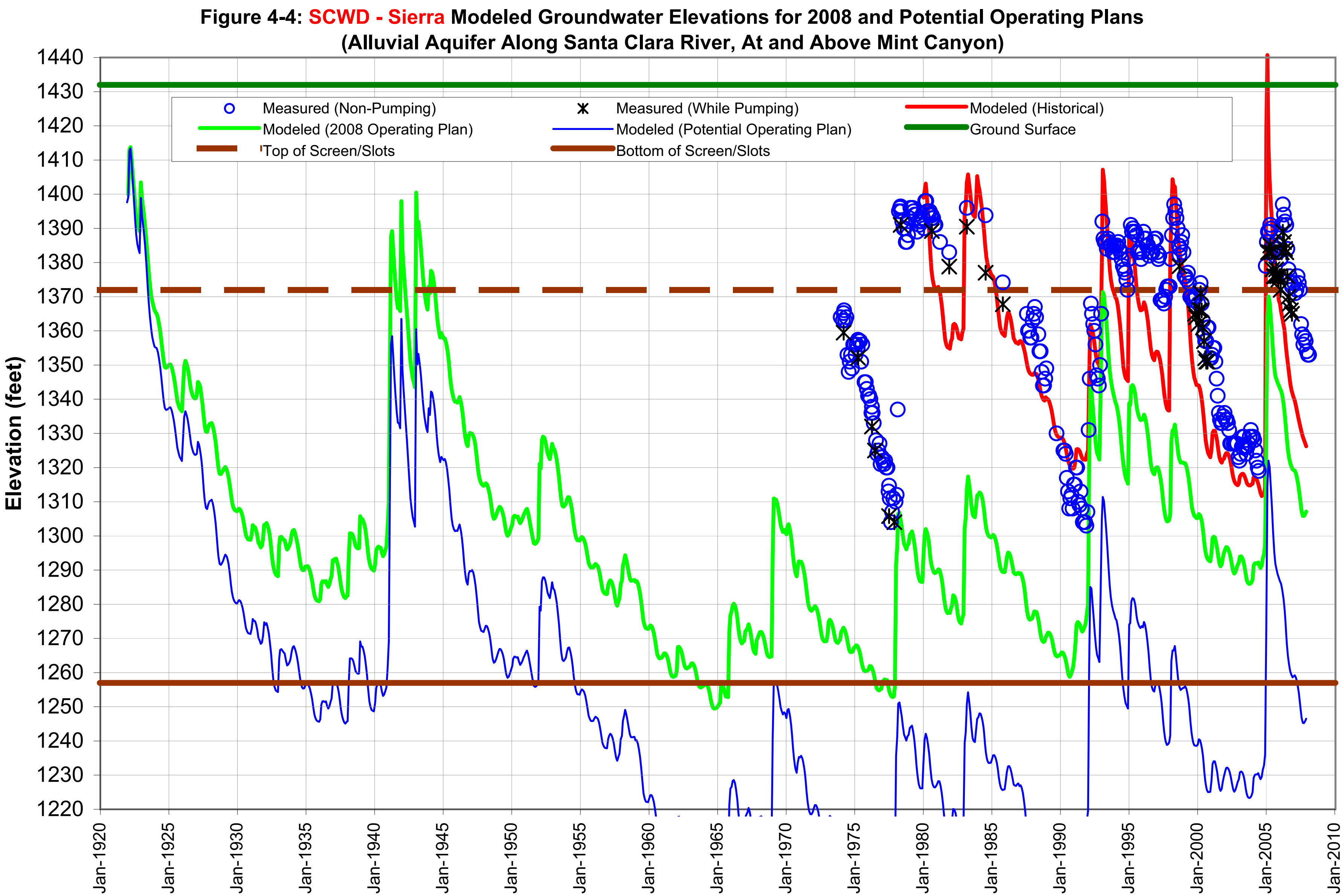


Figure 4-4: SCWD - Sierra Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots
Elevation (feet)
1440
1430
1420
1410
1400
1390
1380
1370
1360
1350
1340
1330
1320
1310
1300
1290
1280
1270
1260
1250
1240
1230
1220
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
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Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010

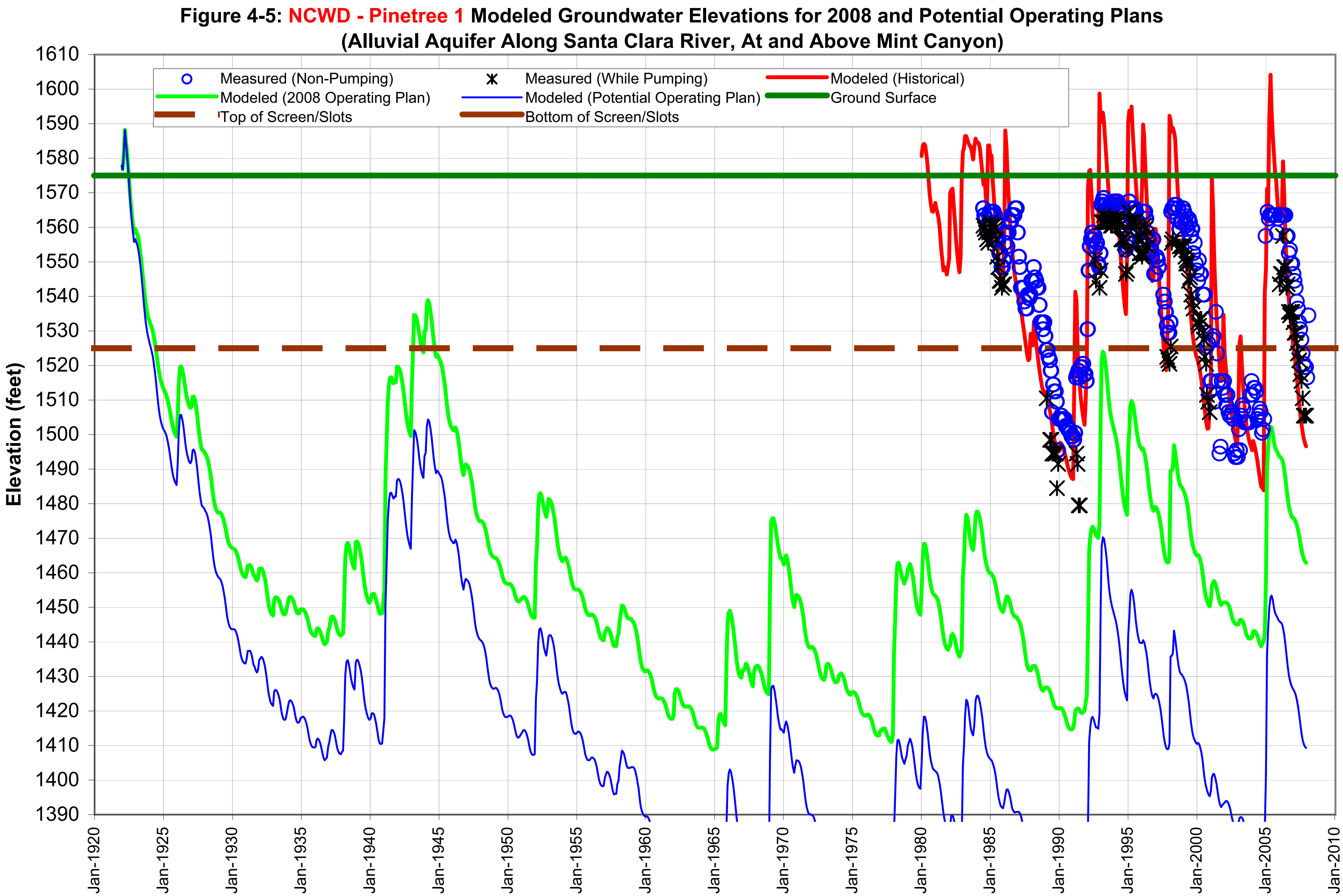


Figure 4-5: NCWD - Pinetree 1 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots
Elevation (feet)
1610
1600
1590
1580
1570
1560
1550
1540
1530
1520
1510
1500
1490
1480
1470
1460
1450
1440
1430
1420
1410
1400
1390
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010

Figure 4-6: NCWD - Castaic 7 Modeled Groundwater Elevations for 2008 and Potential Operating Plans (Alluvial Aquifer in Castaic Valley)

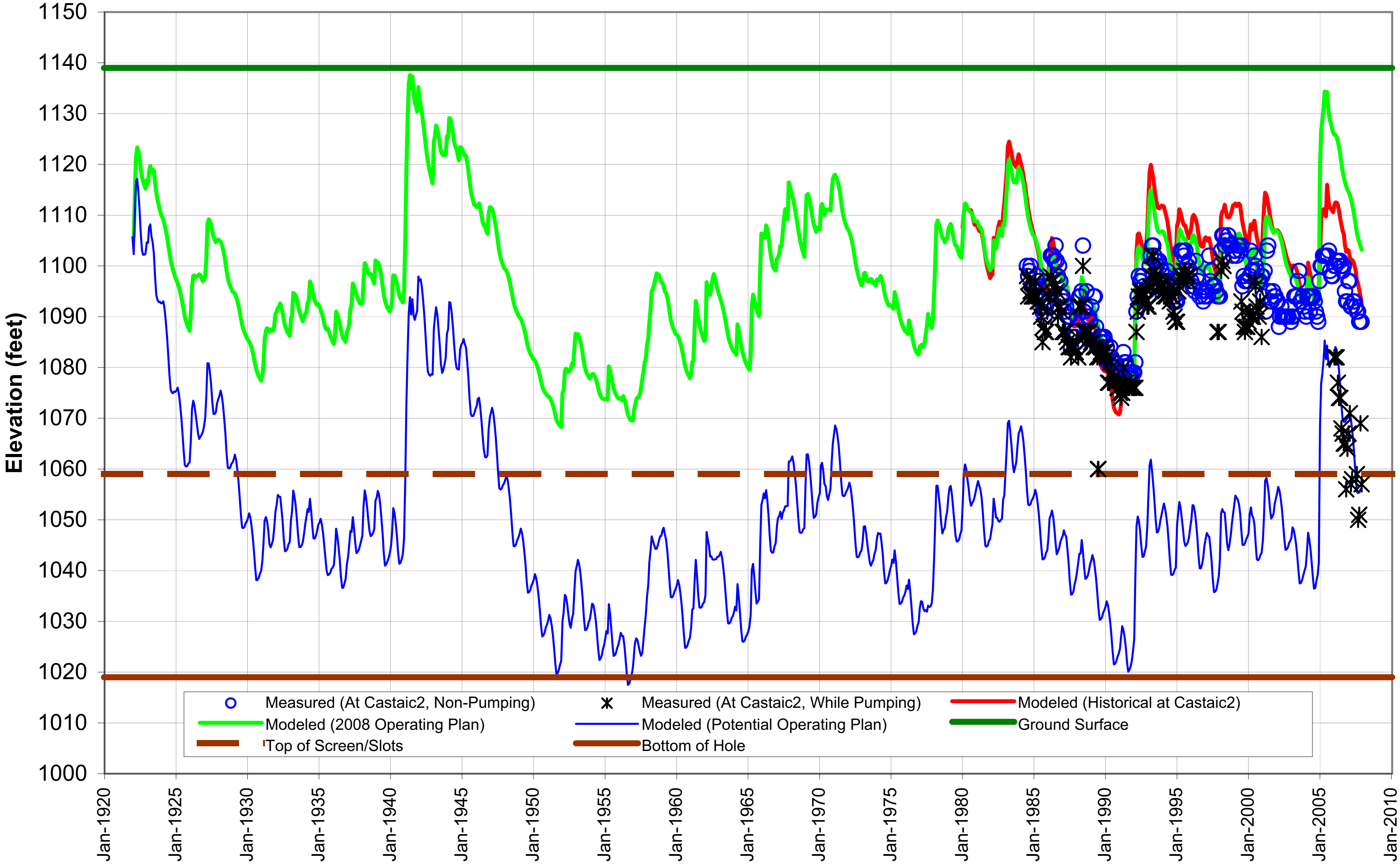


Figure 4-7: VWC-W11 Modeled Groundwater Elevations for 2008 and Potential Operating Plans (Alluvial Aquifer in San Francisquito Canyon)

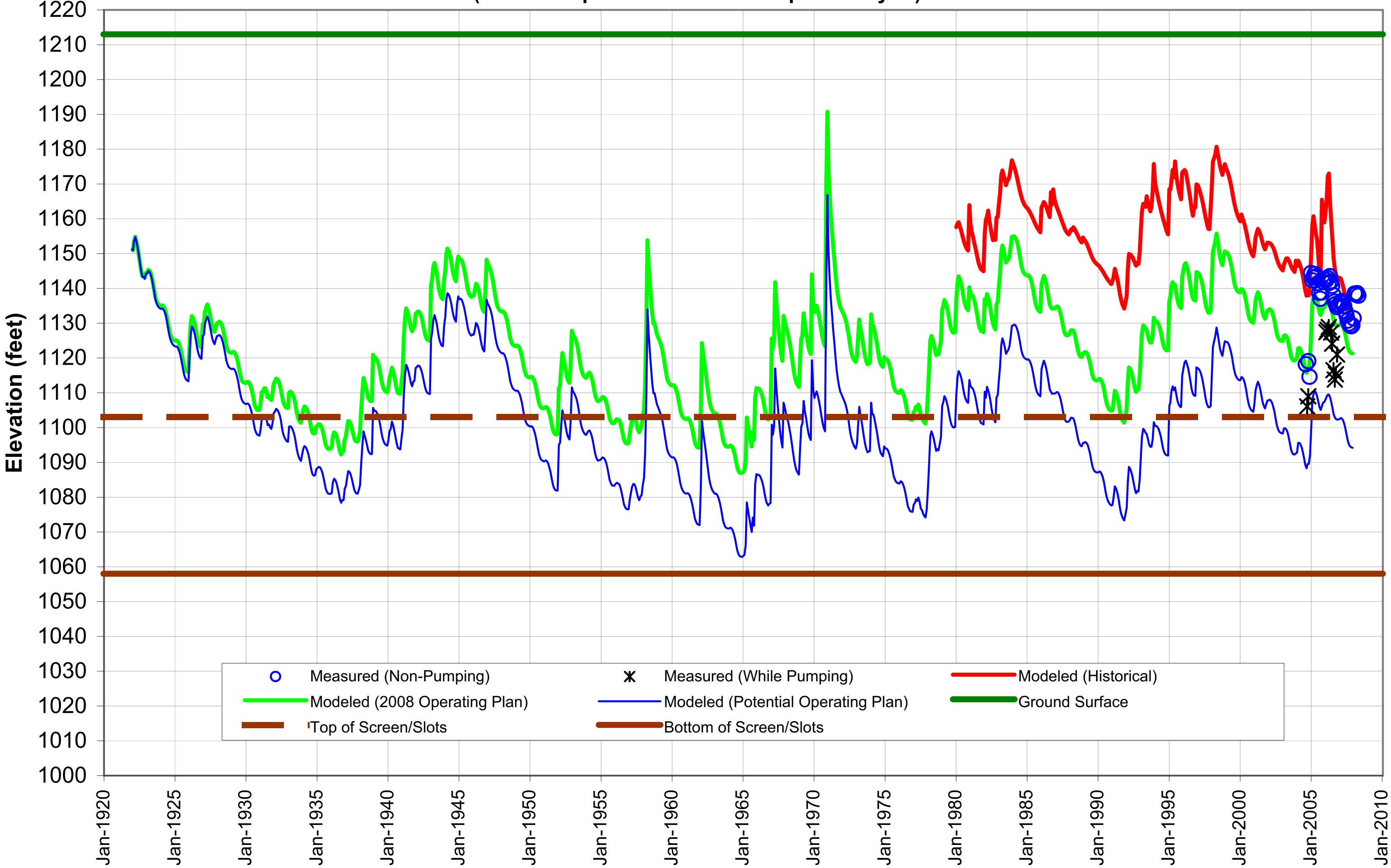


Figure 4-8: SCWD - Clark Modeled Groundwater Elevations for 2008 and Potential Operating Plans (Alluvial Aquifer in Bouquet Canyon)

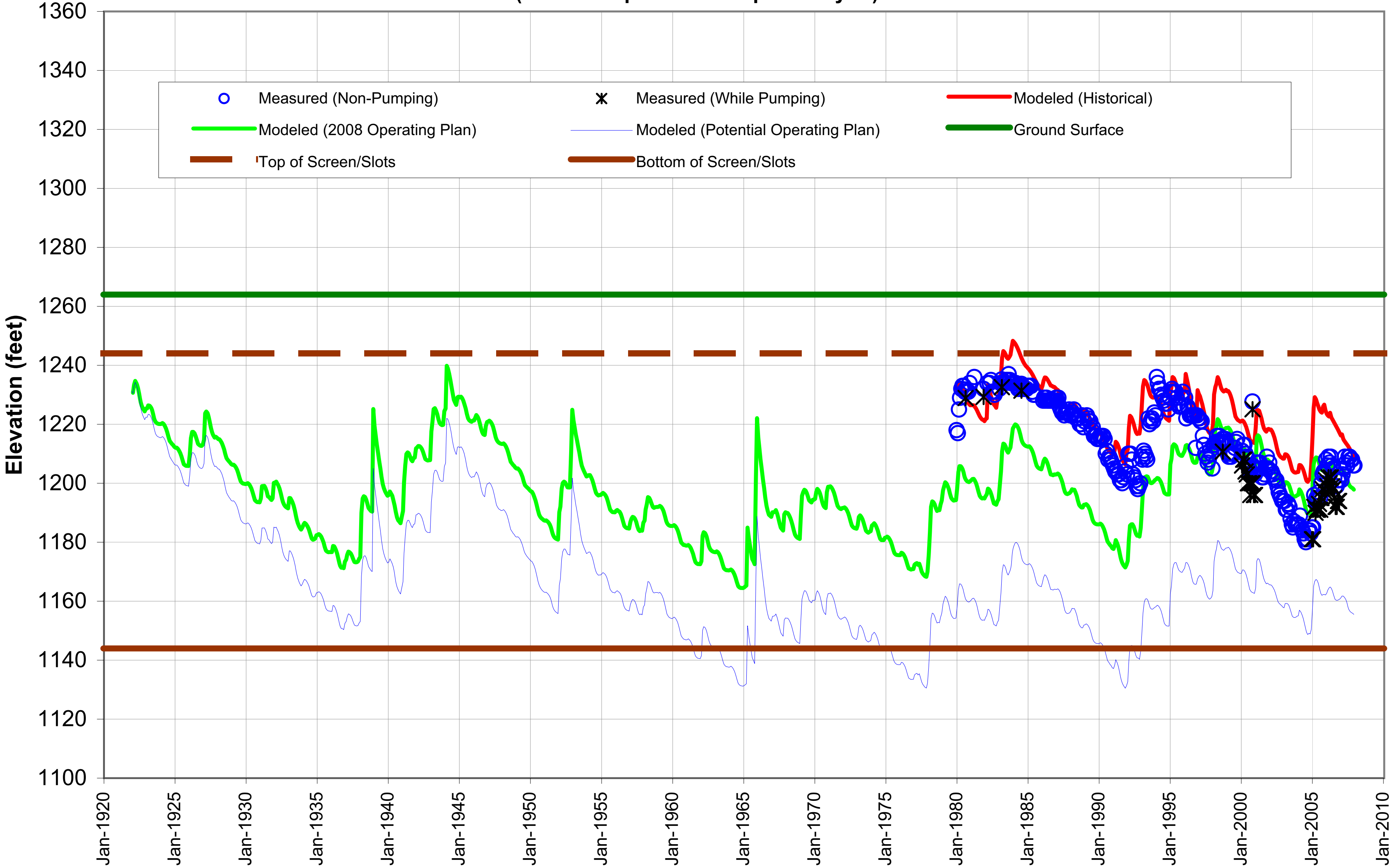


Figure 4-9: SCWD-Saugus1 Modeled Groundwater Elevations for 2008 and Potential Operating Plans (Saugus Formation)

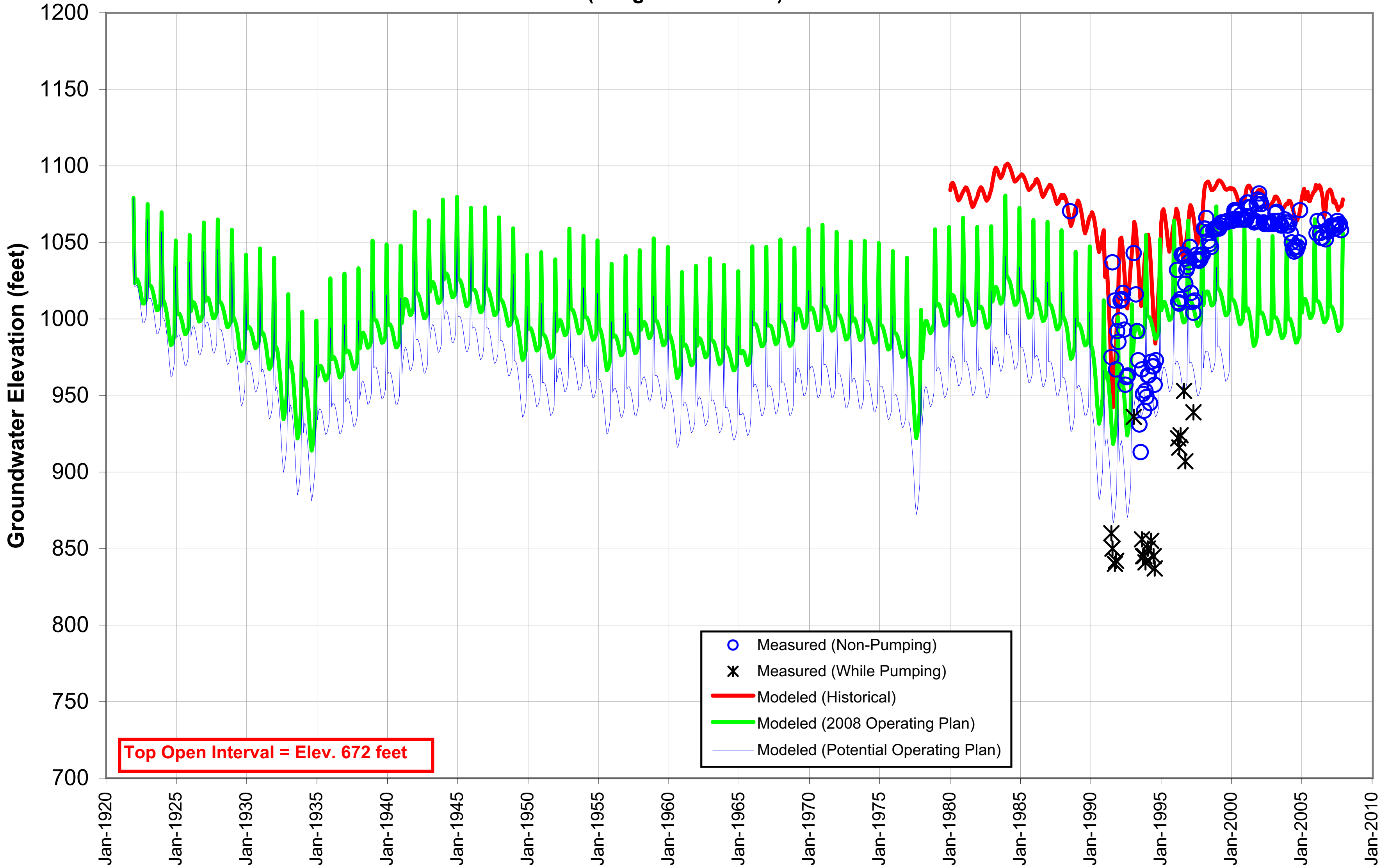


Figure 4-10: VWC-206 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Saugus Formation)

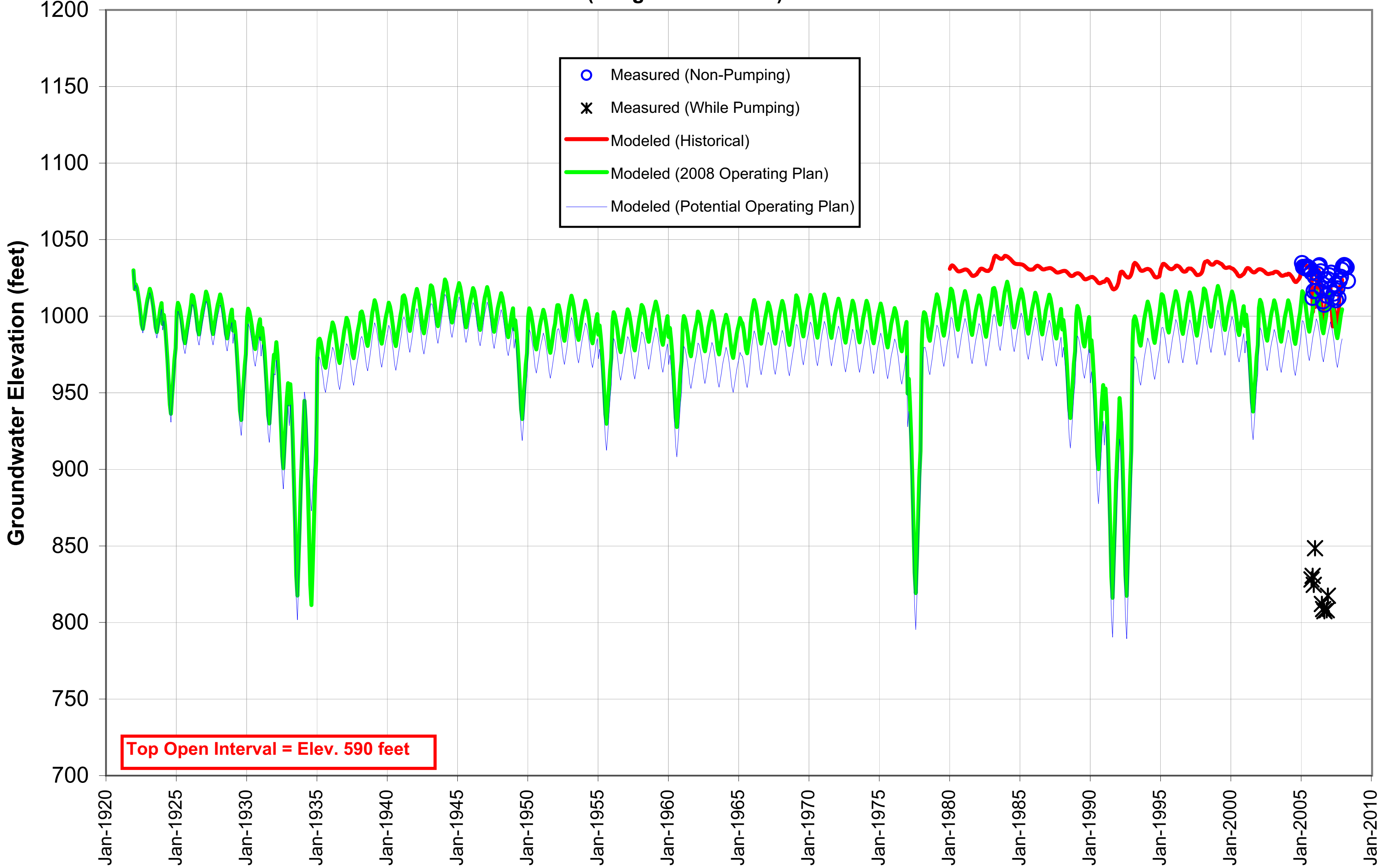


Figure 4-11: NCWD-13 Modeled Groundwater Elevations for 2008 and Potential Operating Plans (Saugus Formation)

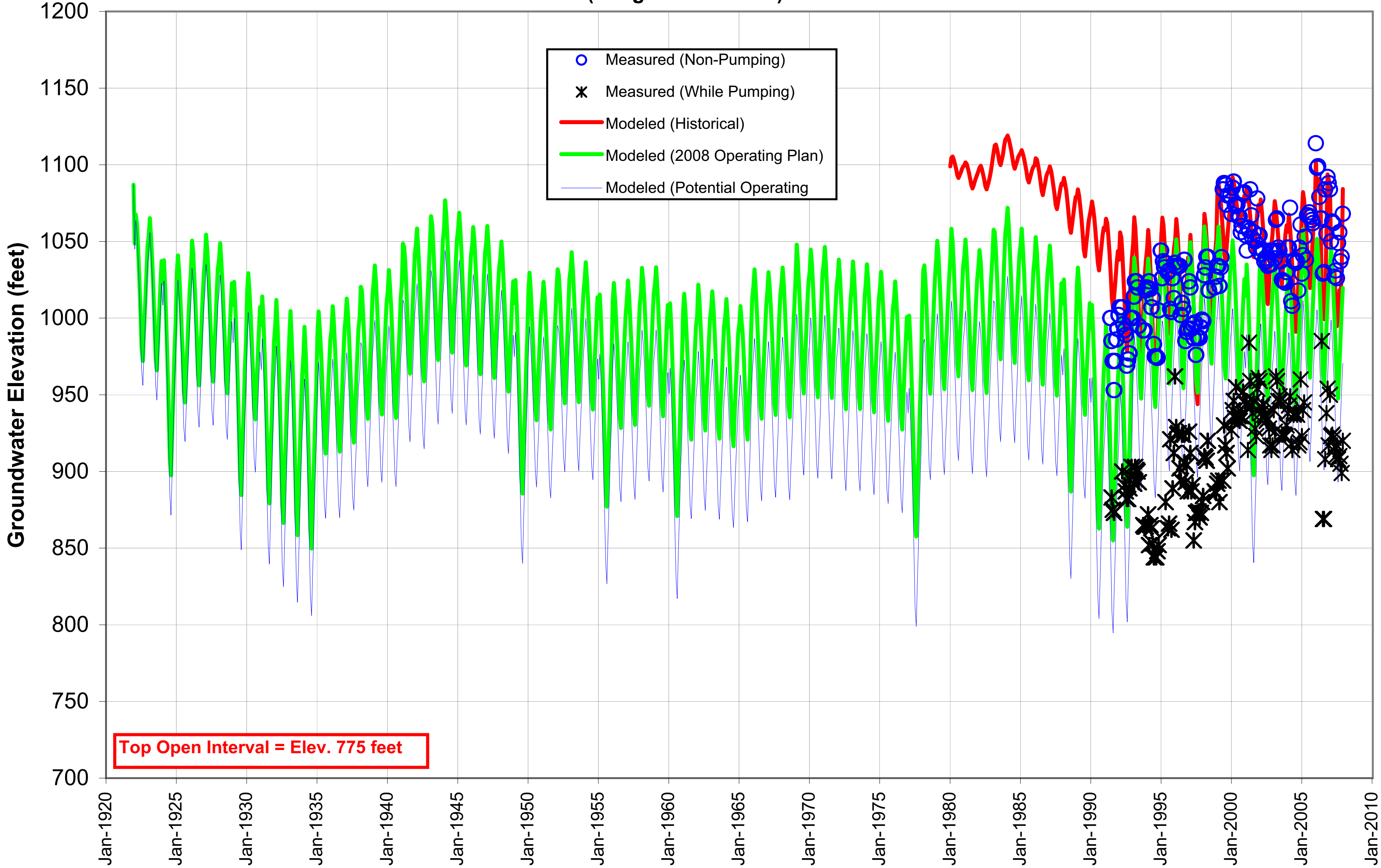


Figure 4-12: VWC-T7 Modeled Groundwater Elevations for Initial and Modified 2008 Operating Plans (Alluvial Aquifer Above Saugus WRP)

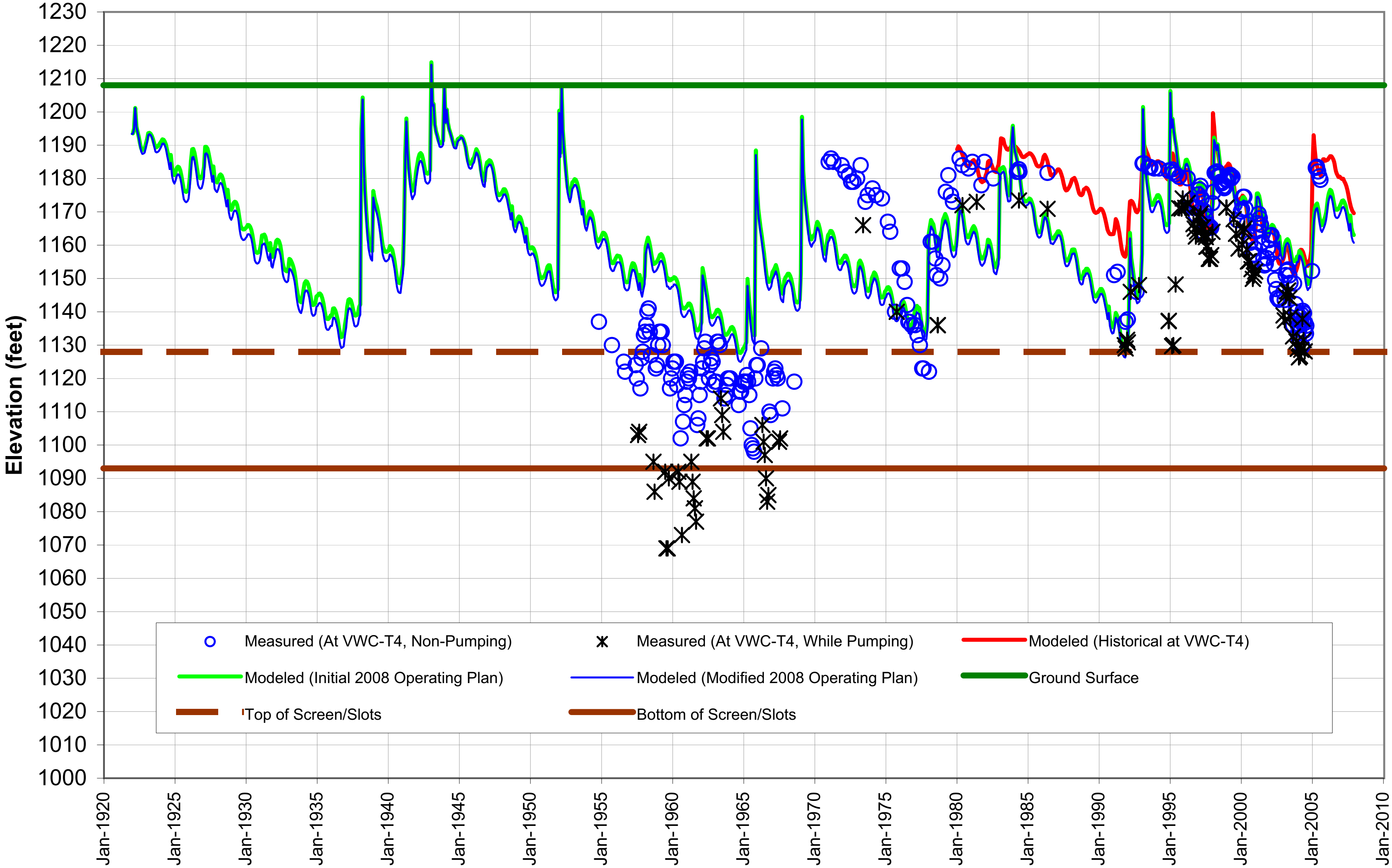


Figure 4-13: SCWD-Clark Modeled Groundwater Elevations for Initial and Modified 2008 Operating Plans (Alluvial Aquifer in Bouquet Canyon)

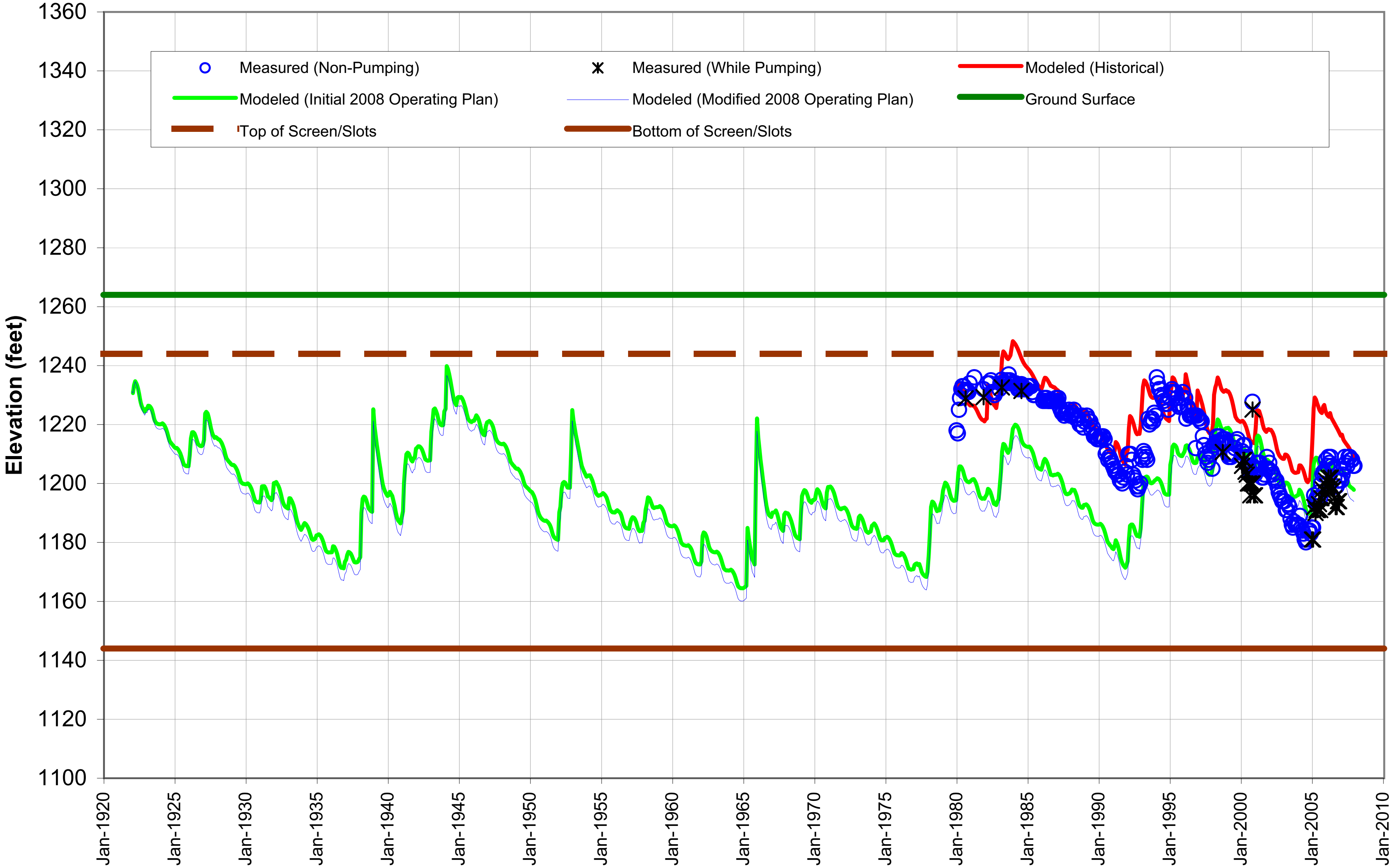


Figure 4-14: SCWD-Sierra Modeled Groundwater Elevations for Initial and Modified 2008 Operating Plans (Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)

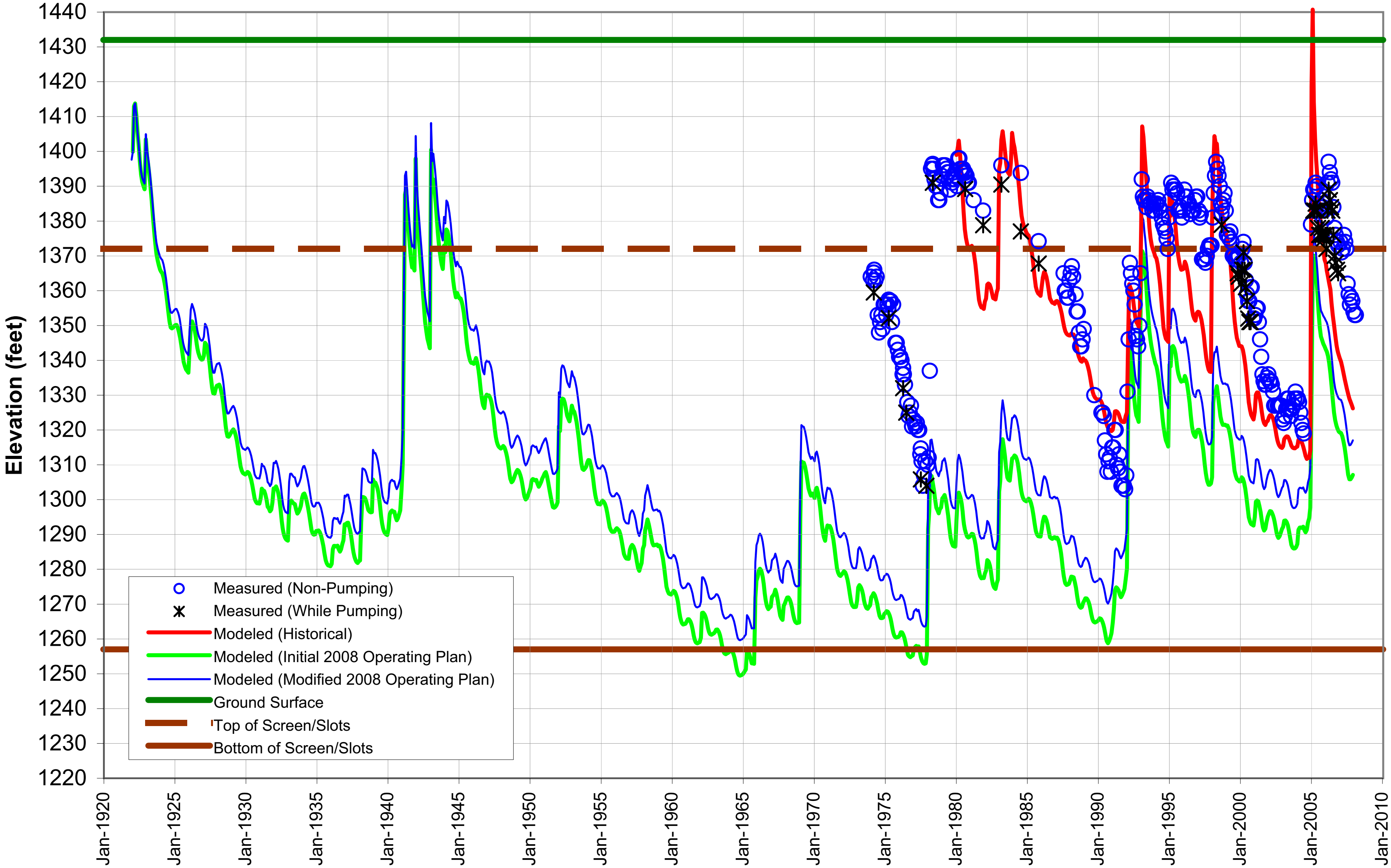


Figure 4-15: NCWD-Pinetree3 Modeled Groundwater Elevations for Initial and Modified 2008 Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)

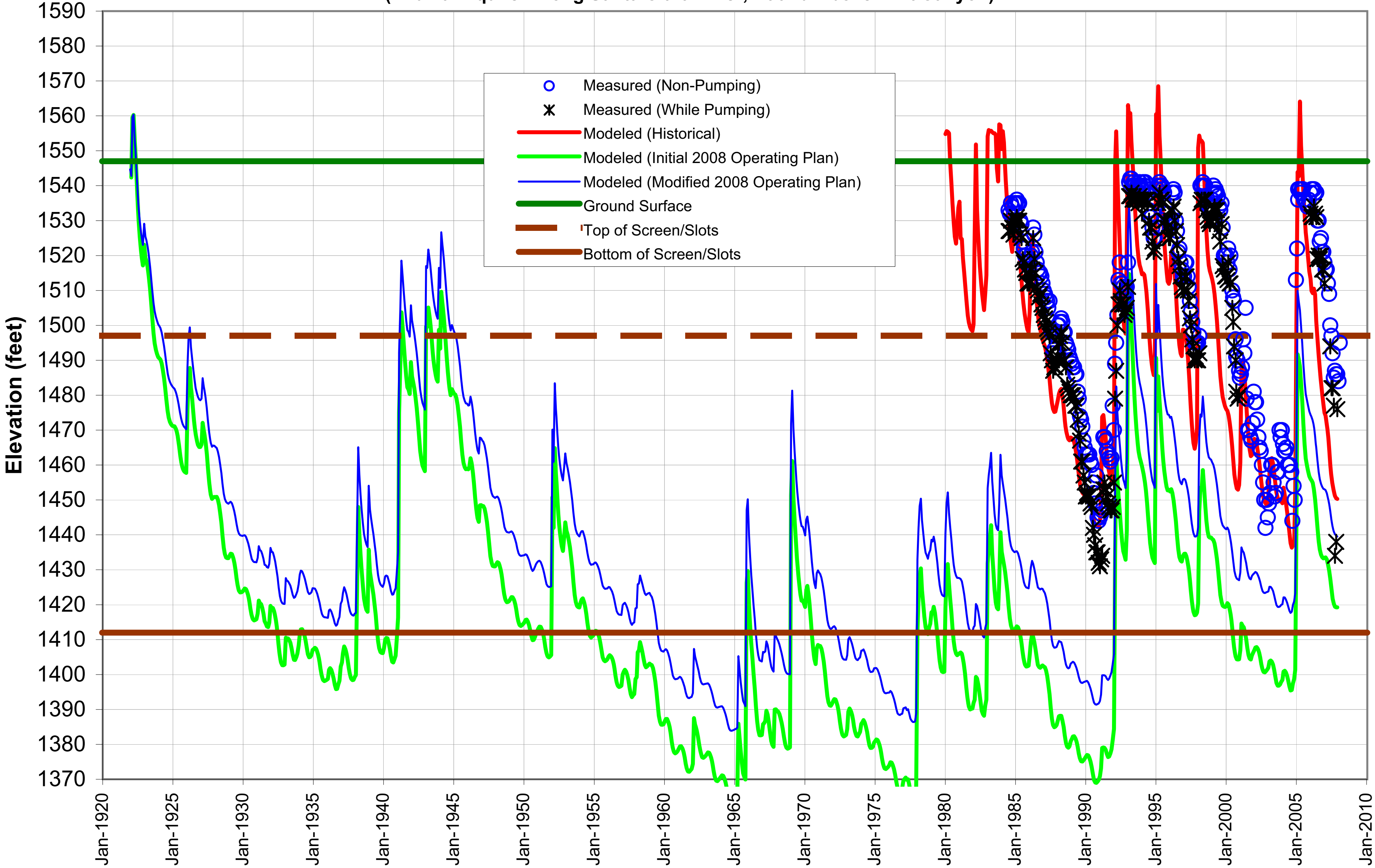
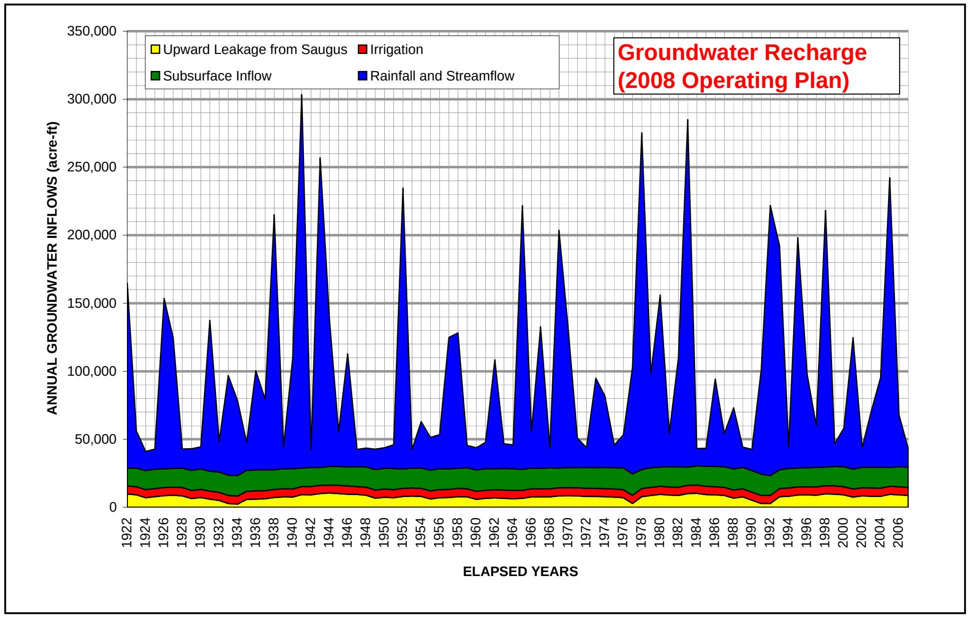


Figure 4-16: Comparison of Simulated Trends in Groundwater Recharge and Discharge Terms for the 2008 Operating Plan Under Historical Hydrology



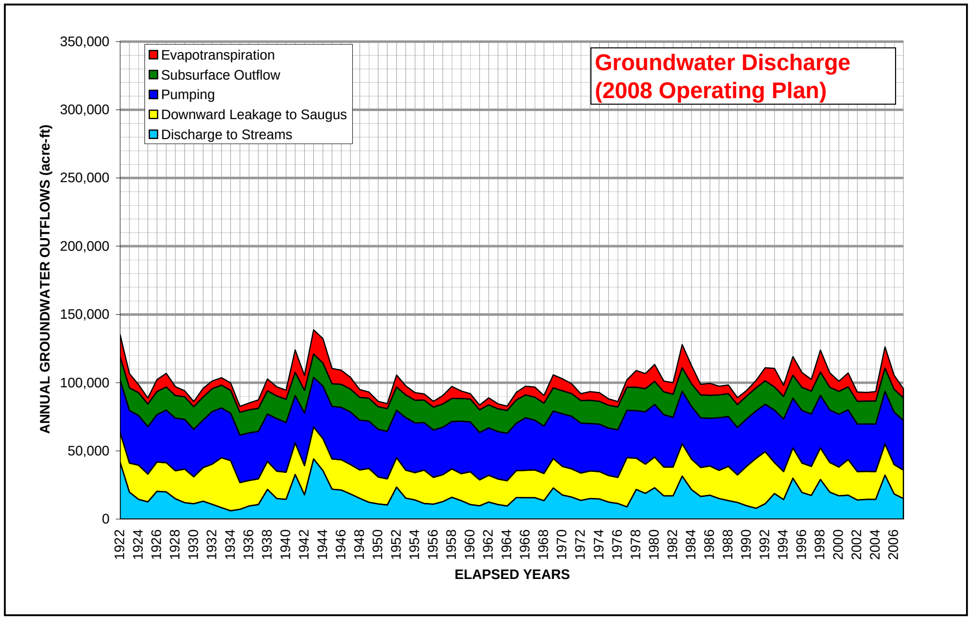
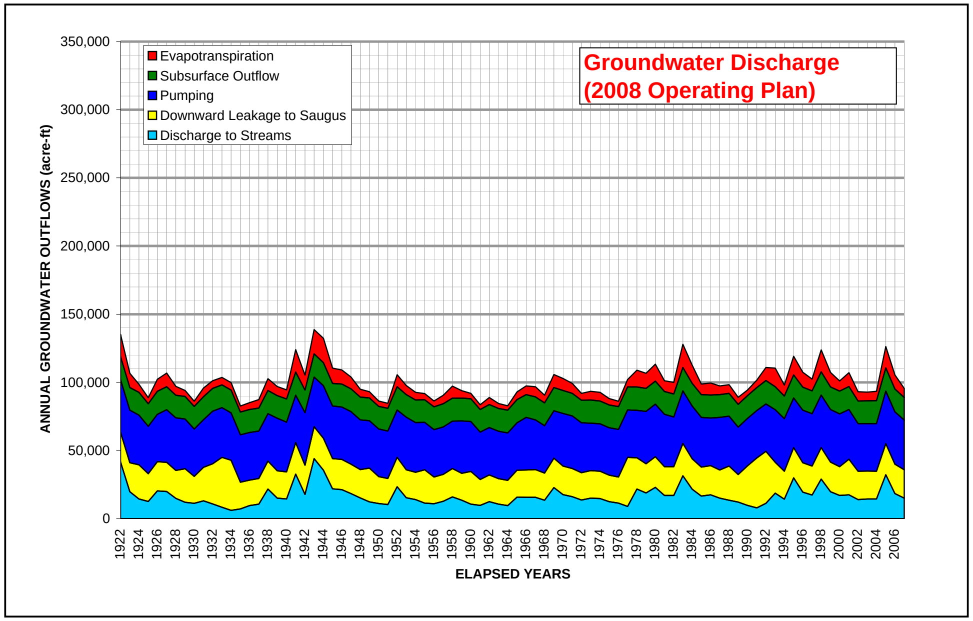
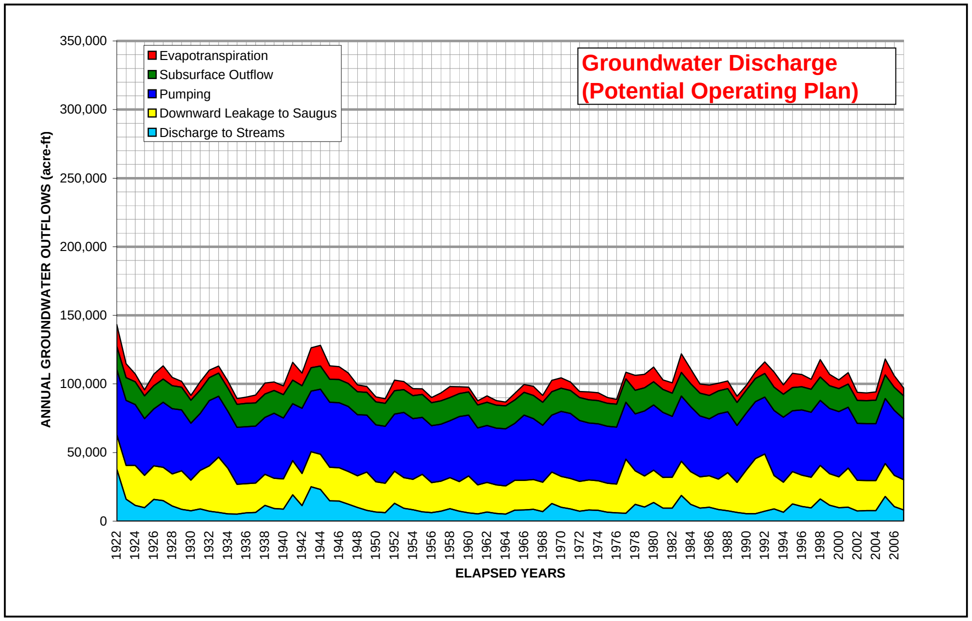


Figure 4-17: Comparison of Simulated Trends in Groundwater Discharge Terms for the 2008 and Potential Operating Plans Under Historical Hydrology





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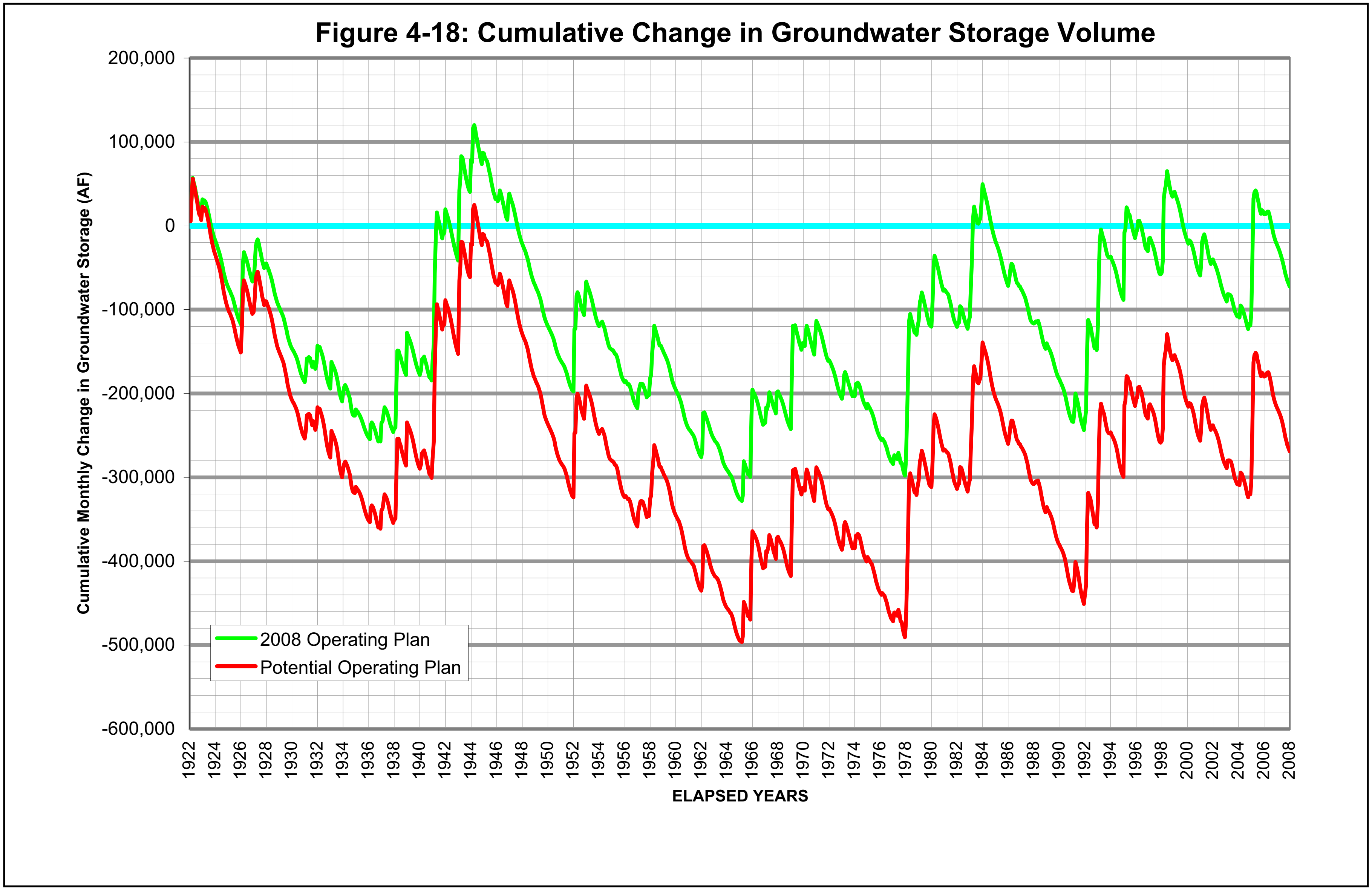
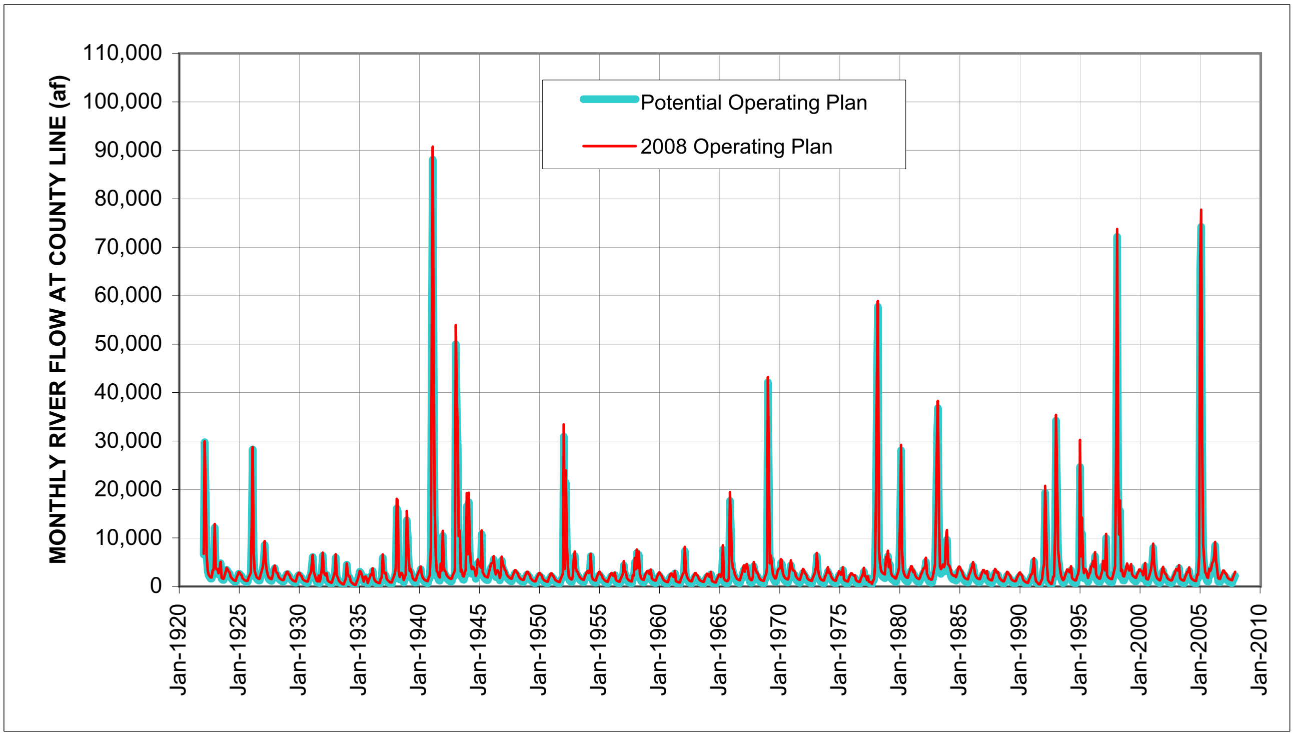


Figure 4-18: Cumulative Change in Groundwater Storage Volume
Cumulative Monthly Change in Groundwater Storage (AF)
200,000
100,000
0
-100,000
-200,000
-300,000
-400,000
-500,000
-600,000
1922
1924
1926
1928
1930
1932
1934
1936
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
ELAPSED YEARS
2008 Operating Plan
Potential Operating Plan

Figure 4-19
Simulated Monthly Flow in the Santa Clara River at the County Line
For the 2008 and Potential Operating Plans Under Historical Hydrology



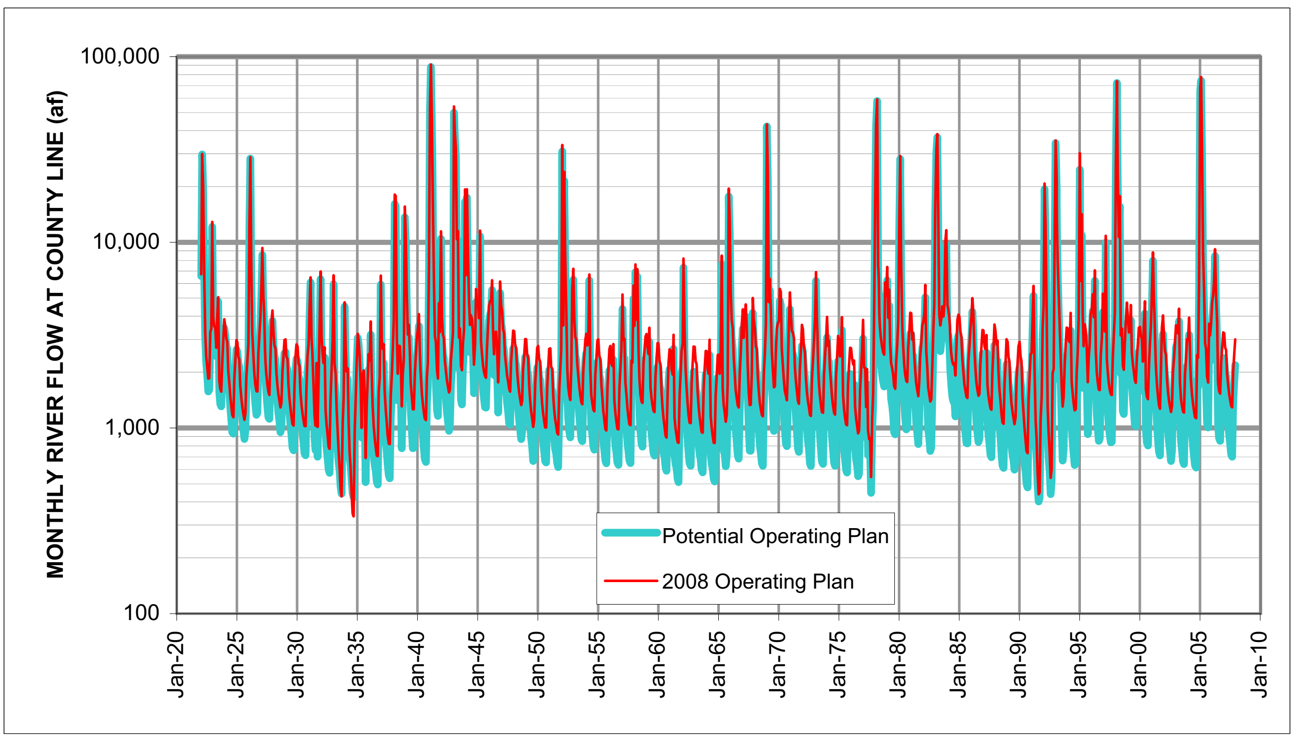


Figure 4-20
Modeled and Estimated Monthly Groundwater Discharges to the Perennial Reach of the Santa Clara River (from Round Mountain to Blue Cut)

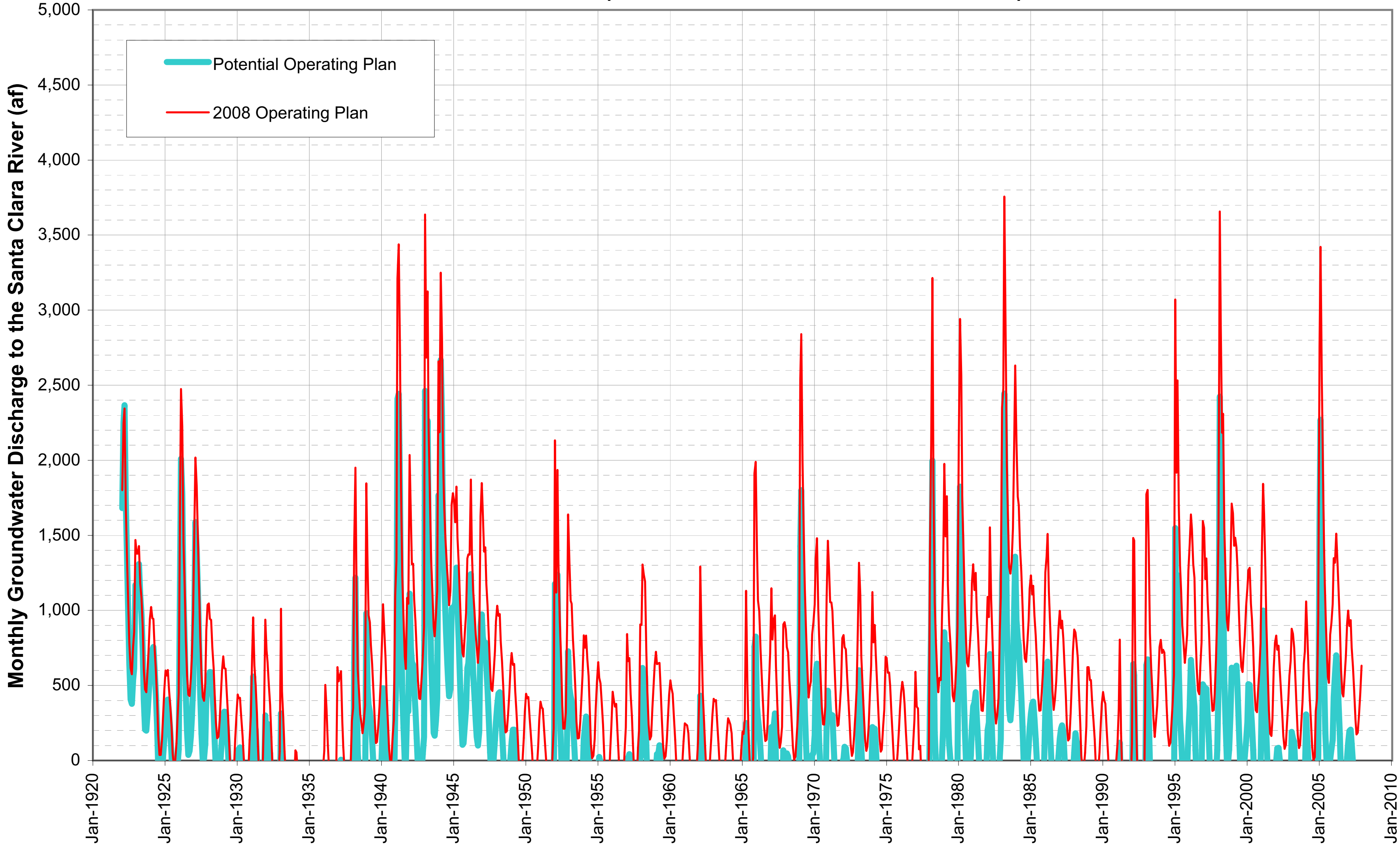
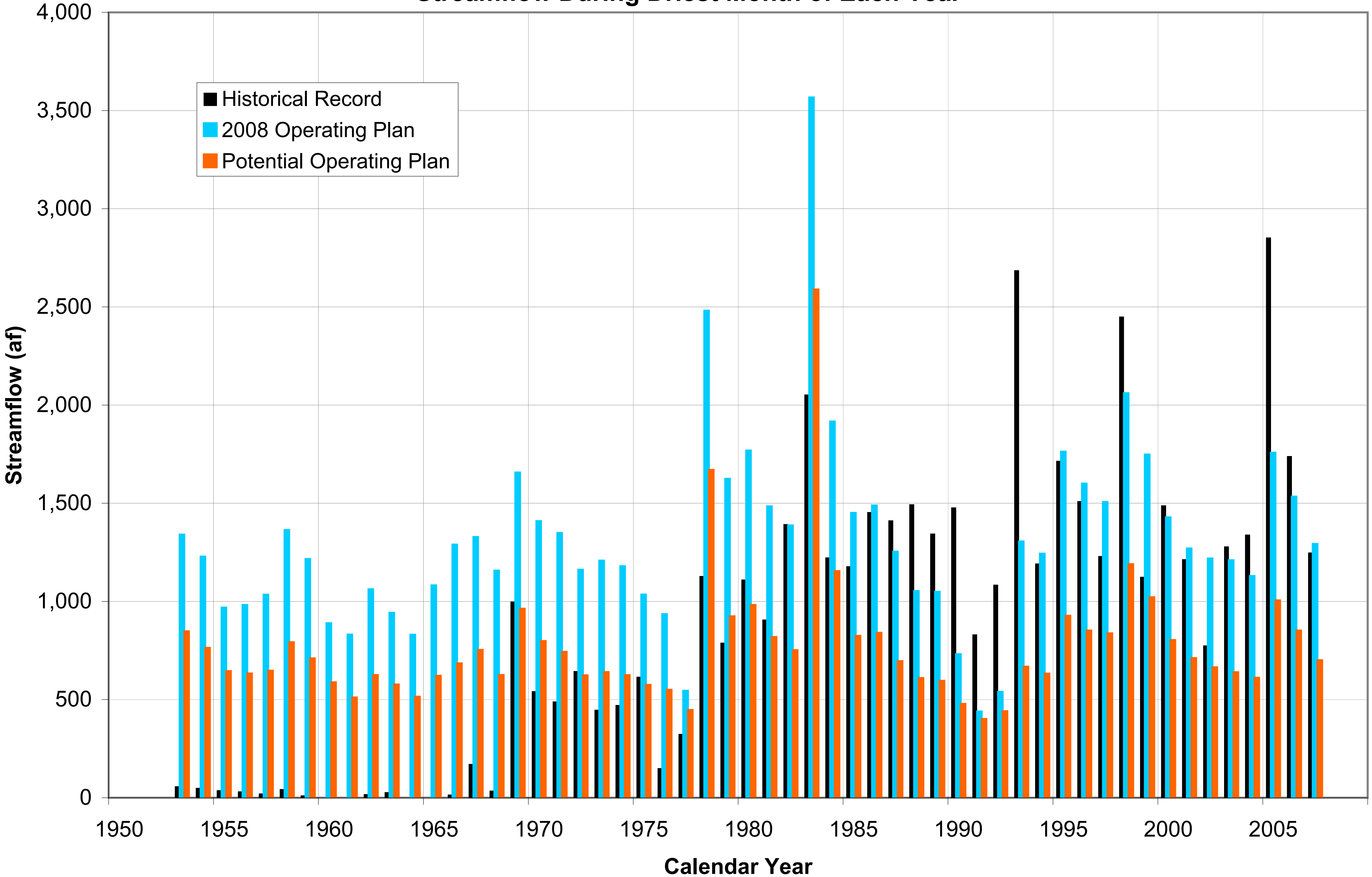


Figure 4-21
Streamflow During Driest Month of Each Year



V. Climate Change Considerations

This section of the report describes an analysis of the potential impacts of climate change on the 2008 Operating Plan for the Santa Clarita Valley. The analysis simulates a group of different potential future groundwater recharge events arising from a suite of published spatial-temporal distributions of future rainfall, as derived from global climate models that in turn have been scaled to watershed scales throughout California, including at the scale of the Santa Clarita Valley. The rainfall distributions, which are also known as rainfall projections, account for a variety of possible changes in global climate and have been published by climatologists conducting research and modeling of possible changes in climate arising from historic and potential future greenhouse gas emissions.

Following are discussions of the objectives of the analysis, a description of the technical approach that was used to simulate potential climate change effects on the local groundwater system in the Santa Clarita Valley, and the results of the modeling evaluation as they pertain to the 2008 Operating Plan. An overview of the current understanding regarding potential climate change in southern California is contained in Appendix D, along with details regarding the projections of future rainfall that were used in the groundwater model to evaluate potential climate change effects on local groundwater.

5.1 Objectives

As recently noted by California's state climatologist (Anderson, 2009), the scientific community's research on global climate processes "includes the expectation that climate will be changing over the course of the next century to an extent that these changes must be accounted for in the water resources planning process". The need to understand and plan for climate change was recognized in 2007 by the Purveyors who, in commissioning the updated basin yield analysis specified that this study should include an evaluation of the potential significance of climate change on local groundwater supplies.

As discussed below in Section 5.2, there are many different climate models, each with its own strengths and limitations. Additionally, the international scientific community has formally identified multiple scenarios for future greenhouse gas emissions. Each scenario has different assumptions about the magnitude and timing of these emissions. Consequently, absolute predictions regarding future climatic conditions and subsequent effect on local groundwater are not possible. Instead, the primary objective of the analysis reported herein is to quantitatively, or qualitatively, describe general impacts of climate change on the groundwater basin and its yield. As the work has progressed, this general objective has focused on understanding whether the yield of the basin, operated in accordance with the 2008 Operating Plan, might be different for future climate change scenarios than for the historical rainfall patterns under which the 2008 Operating Plan was evaluated in Chapter 4. The general objective and the more specific objective together seek to understand the sensitivity of the aquifer and the 2008 Operating Plan to climate change, rather than to make predictions about future climate and groundwater conditions.

5.2 Approach

The analysis was conducted by selecting a small number of published projections regarding possible future patterns of monthly rainfall over time between now and the year 2099. An 86-year time period from 2010 through 2095 was then simulated with the groundwater model, using monthly variations in groundwater recharge that were derived from the monthly projections of future rainfall patterns under a given climate change scenario. Details regarding this process are summarized below and described in greater detail in Appendix D.

5.2.1 Evaluation and Selection of Climate Change Scenarios

Nine of 112 published climate projections were studied for potential use in the Santa Clarita groundwater model. The nine projections that were studied are the same group of projections (models) that were evaluated by DWR in its most recent report on the reliability of State Water Project water deliveries (DWR, 2008).

The nine rainfall projections were studied for their ability to reasonably replicate recent historical rainfall at the Newhall-Soledad rain gage. More importantly, the projections were studied to ascertain the degree to which they show different or similar trends and magnitudes of rainfall at various times (during the Purveyor's UWMP planning time frame [20 to 25 years], and beyond that time frame); and the degree to which they project generally dry, wet, or average conditions over the long-term (through the next 86-year period). This trend evaluation was conducted by examining the cumulative departure of rainfall on a monthly basis for each projection, compared with the 1931-2007 long-term average rainfall. Figure 5-1 displays the cumulative departure from mean precipitation, beginning in 2010, for the nine projections that were studied and for the three projections that were selected for evaluating potential climate-change impacts on groundwater in the Santa Clarita Valley. The figure shows that the nine projections exhibit a broad range in the cumulative departure over time, with an increase in the range of predicted values as time goes on. This increase with time arises in part from differences between the emissions scenarios beginning in about the year 2030, as well as from the general increase in predictive uncertainty that exists in each climate model as it projects into the future the many physical processes that affect climate.

The three projections that were evaluated using the groundwater model were selected because they display a variety of rainfall cycles during the UWMP planning horizon and beyond. In particular:

- Over the course of the UWMP planning horizon, projection #1 shows considerable fluctuation and is generally wetter than normal, while projections #6 and #9 show less fluctuation and are generally drier than normal.

- Afterwards, the three projections show a variety of trends. Projection #1 shows a sustained long-term progressive drying of the climate, with rainfall generally below the historical average. Projection #9 shows the opposite trend: sustained long-term progressive wetting of the climate with more rainfall than the historical average.

Projection #6 shows wet conditions immediately after the UWMP planning horizon, then fluctuating cycles of below-normal and above-normal rainfall, with no net departure from historical average rainfall by the end of the projection time frame.

5.2.2 Simulation Period

An 86-year period beginning in 2010 and continuing through the year 2095 was evaluated with the model, using the local monthly rainfall projections specific to each of these years to define groundwater recharge terms and Alluvial Aquifer pumping patterns. The same pattern of Saugus Formation pumping that was used for the 2008 Operating Plan (representing SWP water availability from 1922 through 2007) was utilized in conjunction with the 2010-2095 simulation of conditions in the Alluvial Aquifer to assess the basin's response to a combination of pumping dictated by local and SWP hydrologic conditions plus runoff/recharge in the Valley resulting from local rainfall conditions.

5.2.3 Hydrologic Processes for Climate Change Scenarios

Four separate hydrologic processes were varied in the groundwater flow model for each climate change scenario. The four processes and the methods by which they were varied were as follows.

- **Groundwater pumping pattern -** Different approaches were taken for the Alluvium versus the Saugus.

  The sequence of normal-year versus dry-year pumping from the alluvium was defined from the prior year's rainfall, as contained in the particular climate projection being evaluated. Tables 5-1 through 5-3 list the alluvial year types for each of the three climate runs that were evaluated.

  The Saugus pumping pattern and pumping rates were specified to be the same as for the 1922-2007 period that was evaluated for the 2008 Operating Plan. Tables 5-4 through 5-6 compare the Saugus pumping pattern with the pumping pattern for the Alluvial Aquifer.

- **Infiltration of direct precipitation -** The month-by-month rainfall from a given climate projection was used by the SWRM to calculate this term for the uppermost layer in the model grid. This is calculated at each node in the grid.

- **Infiltration from stormwater generated within the watershed and from Santa Clara River flows entering the eastern end of the Valley (at the Lang gage) -** For a given future year, these terms were estimated by first identifying one or more similar rainfall years in the historic record, which were treated as prototypical years for the purpose of defining annual and monthly streamflow at each stream node. If more than one year was identified as a possible prototype for a given future year, then the prototypical year was selected by further considering whether hydrologic conditions were generally dry or generally wet. Infiltration from streamflow during a given year was then calculated by the SWRM model from the prototypical year's monthly flow rates and monthly riverbed infiltration rates.

- **Infiltration from water released by DWR from Castaic Lagoon to Castaic Creek -** The prototype-year method was used to identify this term, using the same general procedure as described above for Santa Clara River flows at the Lang gage.

5.3 2008 Operating Plan under Climate Change Scenarios

Hydrographs of simulated groundwater levels, at the locations of each production well, are included in Appendix E to show the simulated response of the groundwater system to the three modeled rainfall projections. Extracted from the complete set in Appendix E, Figures 5-2 through 5-9 are illustrative groundwater elevation hydrographs for each Alluvial Aquifer subarea, using the same set of representative wells as shown for the sustainability discussions in Chapter 4. Figures 5-10 through 5-12 are groundwater elevation hydrographs for the three representative Saugus Formation production wells discussed in Chapter 4.

Based on simulated aquifer response to a combination of pumping in accordance with the 2008 Operating Plan and the range of climate change hydrology, the potential effects of climate change on the yield of the local groundwater basin and the associated availability of groundwater as part of the Valley's overall water supply can be summarized as follows. In all cases, it should be noted that specific short-term patterns of precipitation, as projected by the climate models, significantly influence the potential sustainability of overall groundwater yield and/or the achievability, i.e. the physical ability to extract groundwater at the operating plan rates, of the operating plan in certain subareas of the overall basin.

5.3.1 Drying Climate Trend (Climate Scenario 1)

In the short term, i.e. through the horizon of current UWMP planning, a long-term drying trend in the local climate would not be expected to result in unsustainable groundwater conditions, but could result in unachievable pumping in the "Above Mint Canyon" area at the rates specified in the 2008 Operating Plan. Beyond that planning horizon, the prevailing trend of drier climate would be expected to result in a general long-term lowering of groundwater levels in most of the basin, indicative that pumping in accordance with the 2008 Operating Plan would not be considered sustainable. Directly related to the latter long-term lowering of groundwater levels, the prevailing trend of drier climate would be expected to result in groundwater levels sufficiently lowered in several parts of the basin (e.g. at and above Mint Canyon, below the Saugus WRP, and in Bouquet and San Francisquito Canyon) that the wells in those areas would no longer support the pumping rates in the 2008 Operating Plan. On a long-term basis, then, the drying climate trend analyzed herein would be expected to result in a smaller local groundwater supply over time.

5.3.2 Wetter Climate Trend (Climate Scenario 9)

A tendency toward wetter local hydrologic conditions would logically suggest that the 2008 Operating Plan, considered sustainable through historical hydrologic conditions, would continue to be sustainable. Simulated basin response supports that expectation. Ironically, however, primarily as a result of the specific patterns of precipitation as projected by this climate model, near-term conditions through the UWMP planning horizon, could appear to be unsustainable, i.e. general declining trend in groundwater levels. Subsequent wetter conditions ultimately lead to the long-term appearance of groundwater sustainability at the pumping rates in the 2008 Operating Plan.

Over both the short term (UWMP planning horizon) and the long term simulated herein, the wetter climate trend appears to result in local issues with regard to achievability of 2008 Operating Plan pumping, commonly in the eastern part of the basin at and above Mint Canyon, and also in San Francisquito Canyon in the near term.

For the most part, the wetter climate trend analyzed herein would be expected to result in a sustainable local groundwater supply at the rates in the 2008 Operating Plan, albeit with some short-term challenges to physically extracting full pumping rates in the eastern part of the basin.

5.3.3 Average Climate Trend (Climate Scenario 6)

A climate tendency toward general continuation of a climate similar, on average, to historically experienced conditions would logically suggest that the 2008 Operating Plan, considered sustainable through historical hydrologic conditions, would continue to be sustainable. Simulated basin response supports that expectation. Similar also to expected response under historical hydrologic conditions, there would be expected challenges to the achievability of the 2008 Operating Plan, notably in the near-term UWMP planning horizon, under a climate "change" that continues long-term average historical precipitation. In summary, a "climate change" that results in essential continuation of long-term average precipitation would be expected to result in a sustainable local groundwater supply at the rates in the 2008 Operating Plan, with basically the same local issues relative to actual pumping capability as derived from the analysis of that operating plan through historical hydrologic conditions.

5.4 Climate Change Summary

Examination of the three simulated climate change scenarios was undertaken to provide a level of quantification to the possible impact of climate change on local groundwater basin yield and availability of groundwater as part of overall water supply to the Valley. In light of the range of global climate model output that was considered for development of the local scenarios analyzed herein, it is obvious that there is neither a unique result that can be expected to become a representative hydrologic condition in the Valley, nor is there a unique result that can be expected in terms of basin yield and associated sustainable groundwater supply as an outcome of climate change. Obviously, the Valley does not get to "choose" a future climate scenario, but rather will have to manage within whatever future patterns of rainfall actually occur over time, whether the future rainfall exhibit wet-dry cycles that are similar to or different from historically recorded conditions. Perhaps most useful in the consideration of climate change effects analyzed herein is with respect to results over the UWMP planning horizon of 20 to 25 years. For the range of relatively wet to relatively dry conditions analyzed herein, all three scenarios suggest that the 2008 Operating Plan can be considered sustainable and, with the same local exceptions as simulated through a repetition of historical hydrology (e.g. mainly at and above Mint Canyon), achievable over the UWMP planning horizon. Beyond that horizon, greater uncertainty exists because the global climate models use different emissions scenarios and also become increasingly uncertain over time because of predictive uncertainty pertaining to the forward-looking representation of the many physical processes that affect climate into the future. As a result, for time periods beyond the UWMP planning horizon, some models predict long-term drying and subsequent sustained declines in groundwater levels, which would result in a smaller local groundwater supply over time, while other models predict hydrologic conditions similar to or wetter than those that have been historically observed, in which case the 2008 Operating Plan can be considered sustainable, albeit with some local issues relative to actual pumping capability at certain times (mainly in the Alluvium at the eastern end of the Valley).

Table 5-1

Climate Projection #1 (Global Climate Model GFDL_cm2_0.1_sresB1)

Local Hydrology and Corresponding Pumping from the Alluvial Aquifer for the 86-year Simulation

Model Year	Calendar Year	Local Rainfall (inches)[a]	Year Type	Alluvial Aquifer Pumping under the Groundwater Operating Plan (AF/yr)
1	2010	18.27	Normal	35,000-40,000
2	2011	19.17	Normal	35,000-40,000
3	2012	43.26	Normal	35,000-40,000
4	2013	20.63	Normal	35,000-40,000
5	2014	13.96	Normal	35,000-40,000
6	2015	11.24	Normal	35,000-40,000
7	2016	13.80	Dry Year 1	30,000-35,000
8	2017	22.80	Dry Year 2	30,000-35,000
9	2018	15.37	Normal	35,000-40,000
10	2019	23.75	Normal	35,000-40,000
11	2020	45.78	Normal	35,000-40,000
12	2021	38.53	Normal	35,000-40,000
13	2022	43.23	Normal	35,000-40,000
14	2023	25.37	Normal	35,000-40,000
15	2024	24.15	Normal	35,000-40,000
16	2025	9.65	Normal	35,000-40,000
17	2026	20.35	Dry Year 1	30,000-35,000
18	2027	15.10	Normal	35,000-40,000
19	2028	17.37	Normal	35,000-40,000
20	2029	22.37	Normal	35,000-40,000
21	2030	14.77	Normal	35,000-40,000
22	2031	14.56	Normal	35,000-40,000
23	2032	9.17	Dry Year 1	30,000-35,000
24	2033	31.25	Dry Year 2	30,000-35,000
25	2034	31.80	Normal	35,000-40,000
26	2035	10.36	Normal	35,000-40,000
27	2036	12.98	Dry Year 1	30,000-35,000
28	2037	13.51	Dry Year 2	30,000-35,000
29	2038	28.59	Dry Year 3	30,000-35,000
30	2039	16.63	Normal	35,000-40,000
31	2040	12.83	Normal	35,000-40,000
32	2041	20.67	Dry Year 1	30,000-35,000
33	2042	16.41	Normal	35,000-40,000
34	2043	9.38	Normal	35,000-40,000
35	2044	24.67	Dry Year 1	30,000-35,000
36	2045	29.24	Normal	35,000-40,000
37	2046	17.91	Normal	35,000-40,000
38	2047	10.47	Normal	35,000-40,000
39	2048	15.97	Dry Year 1	30,000-35,000
40	2049	19.69	Dry Year 2	30,000-35,000
41	2050	27.84	Dry Year 3	30,000-35,000
42	2051	12.19	Normal	35,000-40,000
43	2052	20.08	Dry Year 1	30,000-35,000
44	2053	14.02	Normal	35,000-40,000
45	2054	33.91	Dry Year 1	30,000-35,000
46	2055	19.94	Normal	35,000-40,000
47	2056	14.32	Normal	35,000-40,000
48	2057	14.01	Normal	35,000-40,000
49	2058	28.83	Dry Year 1	30,000-35,000
50	2059	35.10	Normal	35,000-40,000
51	2060	11.01	Normal	35,000-40,000
52	2061	9.40	Dry Year 1	30,000-35,000
53	2062	20.34	Dry Year 2	30,000-35,000
54	2063	10.66	Dry Year 3	30,000-35,000
55	2064	9.63	Dry Year 4	30,000-35,000
56	2065	17.94	Dry Year 5	30,000-35,000
57	2066	18.07	Dry Year 6	30,000-35,000
58	2067	13.68	Dry Year 7	30,000-35,000
59	2068	7.10	Dry Year 8	30,000-35,000
60	2069	20.97	Dry Year 9	30,000-35,000
61	2070	14.49	Dry Year 10	30,000-35,000
62	2071	17.87	Dry Year 11	30,000-35,000
63	2072	20.27	Dry Year 12	30,000-35,000
64	2073	11.02	Dry Year 13	30,000-35,000
65	2074	23.74	Dry Year 14	30,000-35,000
66	2075	20.98	Normal	35,000-40,000
67	2076	8.79	Normal	35,000-40,000
68	2077	12.56	Dry Year 1	30,000-35,000
69	2078	21.59	Dry Year 2	30,000-35,000
70	2079	30.22	Dry Year 3	30,000-35,000
71	2080	12.53	Normal	35,000-40,000
72	2081	21.67	Dry Year 1	30,000-35,000
73	2082	17.97	Normal	35,000-40,000
74	2083	36.13	Normal	35,000-40,000
75	2084	32.25	Normal	35,000-40,000
76	2085	18.51	Normal	35,000-40,000
77	2086	20.78	Normal	35,000-40,000
78	2087	30.97	Normal	35,000-40,000
79	2088	8.45	Normal	35,000-40,000
80	2089	32.79	Dry Year 1	30,000-35,000
81	2090	34.48	Normal	35,000-40,000
82	2091	18.49	Normal	35,000-40,000
83	2092	7.60	Normal	35,000-40,000
84	2093	21.56	Dry Year 1	30,000-35,000
85	2094	16.99	Normal	35,000-40,000
86	2095	21.56	Normal	35,000-40,000

aThe values from the global climate model were extrapolated to the location of the Newhall County Water District Rain Gage.

Table 5-2

Climate Projection #6 (Global Climate Model NCAR_PCM1.3_sresA2)

Local Hydrology and Corresponding Pumping from the Alluvial Aquifer for the 86-year Simulation

Model Year	Calendar Year	Local Rainfall (inches)[a]	Year Type	Alluvial Aquifer Pumping under the Groundwater Operating Plan (AF/yr)
1	2010	17.22	Normal	35,000-40,000
2	2011	13.37	Normal	35,000-40,000
3	2012	16.14	Dry Year 1	30,000-35,000
4	2013	16.53	Dry Year 2	30,000-35,000
5	2014	15.33	Dry Year 3	30,000-35,000
6	2015	40.92	Dry Year 4	30,000-35,000
7	2016	20.24	Normal	35,000-40,000
8	2017	19.50	Normal	35,000-40,000
9	2018	10.68	Normal	35,000-40,000
10	2019	15.15	Dry Year 1	30,000-35,000
11	2020	24.58	Dry Year 2	30,000-35,000
12	2021	16.38	Normal	35,000-40,000
13	2022	22.64	Normal	35,000-40,000
14	2023	21.29	Normal	35,000-40,000
15	2024	13.37	Normal	35,000-40,000
16	2025	19.50	Dry Year 1	30,000-35,000
17	2026	12.05	Dry Year 2	30,000-35,000
18	2027	18.89	Dry Year 3	30,000-35,000
19	2028	11.56	Dry Year 4	30,000-35,000
20	2029	8.46	Dry Year 5	30,000-35,000
21	2030	16.41	Dry Year 6	30,000-35,000
22	2031	19.44	Dry Year 7	30,000-35,000
23	2032	18.66	Dry Year 8	30,000-35,000
24	2033	30.29	Dry Year 9	30,000-35,000
25	2034	42.86	Normal	35,000-40,000
26	2035	16.39	Normal	35,000-40,000
27	2036	17.74	Dry Year 1	30,000-35,000
28	2037	50.04	Dry Year 2	30,000-35,000
29	2038	35.50	Normal	35,000-40,000
30	2039	39.98	Normal	35,000-40,000
31	2040	28.83	Normal	35,000-40,000
32	2041	23.15	Normal	35,000-40,000
33	2042	22.57	Normal	35,000-40,000
34	2043	22.20	Normal	35,000-40,000
35	2044	16.25	Normal	35,000-40,000
36	2045	34.88	Normal	35,000-40,000
37	2046	20.82	Normal	35,000-40,000
38	2047	14.35	Normal	35,000-40,000
39	2048	12.06	Dry Year 1	30,000-35,000
40	2049	12.16	Dry Year 2	30,000-35,000
41	2050	11.37	Dry Year 3	30,000-35,000
42	2051	28.47	Dry Year 4	30,000-35,000
43	2052	26.84	Normal	35,000-40,000
44	2053	25.59	Normal	35,000-40,000
45	2054	15.97	Normal	35,000-40,000
46	2055	21.26	Normal	35,000-40,000
47	2056	23.32	Normal	35,000-40,000
48	2057	13.55	Normal	35,000-40,000
49	2058	23.32	Dry Year 1	30,000-35,000
50	2059	13.04	Normal	35,000-40,000
51	2060	22.71	Dry Year 1	30,000-35,000
52	2061	10.15	Normal	35,000-40,000
53	2062	20.52	Dry Year 1	30,000-35,000
54	2063	71.95	Dry Year 2	30,000-35,000
55	2064	33.61	Normal	35,000-40,000
56	2065	13.39	Normal	35,000-40,000
57	2066	25.96	Dry Year 1	30,000-35,000
58	2067	28.69	Normal	35,000-40,000
59	2068	18.22	Normal	35,000-40,000
60	2069	11.17	Normal	35,000-40,000
61	2070	18.25	Dry Year 1	30,000-35,000
62	2071	17.85	Dry Year 2	30,000-35,000
63	2072	19.30	Dry Year 3	30,000-35,000
64	2073	14.70	Normal	35,000-40,000
65	2074	9.82	Dry Year 1	30,000-35,000
66	2075	14.96	Dry Year 2	30,000-35,000
67	2076	29.84	Dry Year 3	30,000-35,000
68	2077	19.05	Normal	35,000-40,000
69	2078	45.70	Normal	35,000-40,000
70	2079	25.20	Normal	35,000-40,000
71	2080	31.12	Normal	35,000-40,000
72	2081	29.50	Normal	35,000-40,000
73	2082	27.59	Normal	35,000-40,000
74	2083	15.50	Normal	35,000-40,000
75	2084	8.74	Normal	35,000-40,000
76	2085	18.76	Dry Year 1	30,000-35,000
77	2086	13.07	Dry Year 2	30,000-35,000
78	2087	22.89	Dry Year 3	30,000-35,000
79	2088	50.06	Normal	35,000-40,000
80	2089	27.24	Normal	35,000-40,000
81	2090	12.53	Normal	35,000-40,000
82	2091	9.14	Dry Year 1	30,000-35,000
83	2092	10.81	Dry Year 2	30,000-35,000
84	2093	23.07	Dry Year 3	30,000-35,000
85	2094	12.91	Dry Year 4	30,000-35,000
86	2095	26.47	Dry Year 5	30,000-35,000

aThe values from the global climate model were extrapolated to the location of the Newhall County Water District Rain Gage.

Table 5-3

Climate Projection #9 (Global Climate Model NCAR_PCM1.3_sresB1)

Local Hydrology and Corresponding Pumping from the Alluvial Aquifer for the 86-year Simulation

Model Year	Calendar Year	Local Rainfall (inches)[a]	Year Type	Alluvial Aquifer Pumping under the Groundwater Operating Plan (AF/yr)
1	2010	22.14	Normal	35,000-40,000
2	2011	28.62	Normal	35,000-40,000
3	2012	18.21	Normal	35,000-40,000
4	2013	18.42	Normal	35,000-40,000
5	2014	17.85	Normal	35,000-40,000
6	2015	22.34	Normal	35,000-40,000
7	2016	17.51	Normal	35,000-40,000
8	2017	16.21	Normal	35,000-40,000
9	2018	11.56	Dry Year 1	30,000-35,000
10	2019	11.83	Dry Year 2	30,000-35,000
11	2020	37.62	Dry Year 3	30,000-35,000
12	2021	16.56	Normal	35,000-40,000
13	2022	15.17	Normal	35,000-40,000
14	2023	22.88	Normal	35,000-40,000
15	2024	13.18	Normal	35,000-40,000
16	2025	20.34	Dry Year 1	30,000-35,000
17	2026	26.96	Dry Year 2	30,000-35,000
18	2027	26.47	Normal	35,000-40,000
19	2028	18.04	Normal	35,000-40,000
20	2029	18.04	Normal	35,000-40,000
21	2030	16.49	Normal	35,000-40,000
22	2031	22.51	Dry Year 1	30,000-35,000
23	2032	22.84	Normal	35,000-40,000
24	2033	15.01	Normal	35,000-40,000
25	2034	13.40	Dry Year 1	30,000-35,000
26	2035	18.72	Dry Year 2	30,000-35,000
27	2036	26.43	Dry Year 3	30,000-35,000
28	2037	11.11	Normal	35,000-40,000
29	2038	12.97	Dry Year 1	30,000-35,000
30	2039	41.47	Dry Year 2	30,000-35,000
31	2040	18.62	Normal	35,000-40,000
32	2041	39.65	Normal	35,000-40,000
33	2042	33.75	Normal	35,000-40,000
34	2043	57.56	Normal	35,000-40,000
35	2044	14.63	Normal	35,000-40,000
36	2045	15.63	Dry Year 1	30,000-35,000
37	2046	15.41	Dry Year 2	30,000-35,000
38	2047	24.66	Dry Year 3	30,000-35,000
39	2048	53.80	Normal	35,000-40,000
40	2049	14.70	Normal	35,000-40,000
41	2050	9.79	Dry Year 1	30,000-35,000
42	2051	38.49	Dry Year 2	30,000-35,000
43	2052	19.57	Normal	35,000-40,000
44	2053	20.65	Normal	35,000-40,000
45	2054	10.40	Normal	35,000-40,000
46	2055	12.58	Dry Year 1	30,000-35,000
47	2056	17.80	Dry Year 2	30,000-35,000
48	2057	15.56	Dry Year 3	30,000-35,000
49	2058	45.18	Dry Year 4	30,000-35,000
50	2059	26.78	Normal	35,000-40,000
51	2060	23.78	Normal	35,000-40,000
52	2061	47.61	Normal	35,000-40,000
53	2062	28.90	Normal	35,000-40,000
54	2063	30.43	Normal	35,000-40,000
55	2064	18.15	Normal	35,000-40,000
56	2065	30.15	Normal	35,000-40,000
57	2066	13.65	Normal	35,000-40,000
58	2067	16.34	Dry Year 1	30,000-35,000
59	2068	10.60	Dry Year 2	30,000-35,000
60	2069	60.56	Dry Year 3	30,000-35,000
61	2070	20.56	Normal	35,000-40,000
62	2071	15.31	Normal	35,000-40,000
63	2072	33.67	Normal	35,000-40,000
64	2073	46.34	Normal	35,000-40,000
65	2074	33.69	Normal	35,000-40,000
66	2075	15.71	Normal	35,000-40,000
67	2076	14.36	Normal	35,000-40,000
68	2077	21.25	Dry Year 1	30,000-35,000
69	2078	37.14	Normal	35,000-40,000
70	2079	31.87	Normal	35,000-40,000
71	2080	8.14	Normal	35,000-40,000
72	2081	25.22	Dry Year 1	30,000-35,000
73	2082	32.82	Normal	35,000-40,000
74	2083	28.25	Normal	35,000-40,000
75	2084	7.23	Normal	35,000-40,000
76	2085	11.37	Dry Year 1	30,000-35,000
77	2086	27.47	Dry Year 2	30,000-35,000
78	2087	20.97	Normal	35,000-40,000
79	2088	16.12	Normal	35,000-40,000
80	2089	64.70	Normal	35,000-40,000
81	2090	21.30	Normal	35,000-40,000
82	2091	12.38	Normal	35,000-40,000
83	2092	22.06	Dry Year 1	30,000-35,000
84	2093	19.32	Normal	35,000-40,000
85	2094	20.91	Normal	35,000-40,000
86	2095	21.05	Normal	35,000-40,000

aThe values from the global climate model were extrapolated to the location of the Newhall County Water District Rain Gage.

Ta le -4
Climate Projection #1 (Global Climate Model GFDL_cm2_0.1_sresB1)
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Model Year	Alluvium Year	Saugus Year	Year Name for Model Run	Simulated Pumping Conditions	
				Alluvium	Saugus
1	2010	1922	1922	Normal	Normal
2	2011	1923	1923	Normal	Normal
3	2012	1924	1924	Normal	Dry Year 1
4	2013	1925	1925	Normal	Normal
5	2014	1926	1926	Normal	Normal
6	2015	1927	1927	Normal	Normal
7	2016	1928	1928	Dry Year 1	Normal
8	2017	1929	1929	Dry Year 2	Dry Year 1
9	2018	1930	1930	Normal	Normal
10	2019	1931	1931	Normal	Dry Year 1
11	2020	1932	1932	Normal	Dry Year 2
12	2021	1933	1933	Normal	Dry Year 3
13	2022	1934	1934	Normal	Dry Year 4
14	2023	1935	1935	Normal	Normal
15	2024	1936	1936	Normal	Normal
16	2025	1937	1937	Normal	Normal
17	2026	1938	1938	Dry Year 1	Normal
18	2027	1939	1939	Normal	Normal
19	2028	1940	1940	Normal	Normal
20	2029	1941	1941	Normal	Normal
21	2030	1942	1942	Normal	Normal
22	2031	1943	1943	Normal	Normal
23	2032	1944	1944	Dry Year 1	Normal
24	2033	1945	1945	Dry Year 2	Normal
25	2034	1946	1946	Normal	Normal
26	2035	1947	1947	Normal	Normal
27	2036	1948	1948	Dry Year 1	Normal
28	2037	1949	1949	Dry Year 2	Dry Year 1
29	2038	1950	1950	Dry Year 3	Normal
30	2039	1951	1951	Normal	Normal
31	2040	1952	1952	Normal	Normal
32	2041	1953	1953	Dry Year 1	Normal
33	2042	1954	1954	Normal	Normal
34	2043	1955	1955	Normal	Dry Year 1
35	2044	1956	1956	Dry Year 1	Normal
36	2045	1957	1957	Normal	Normal
37	2046	1958	1958	Normal	Normal
38	2047	1959	1959	Normal	Normal
39	2048	1960	1960	Dry Year 1	Dry Year 1
40	2049	1961	1961	Dry Year 2	Normal
41	2050	1962	1962	Dry Year 3	Normal
42	2051	1963	1963	Normal	Normal
43	2052	1964	1964	Dry Year 1	Normal
44	2053	1965	1965	Normal	Normal
45	2054	1966	1966	Dry Year 1	Normal
46	2055	1967	1967	Normal	Normal
47	2056	1968	1968	Normal	Normal
48	2057	1969	1969	Normal	Normal
49	2058	1970	1970	Dry Year 1	Normal
50	2059	1971	1971	Normal	Normal
51	2060	1972	1972	Normal	Normal
52	2061	1973	1973	Dry Year 1	Normal
53	2062	1974	1974	Dry Year 2	Normal
54	2063	1975	1975	Dry Year 3	Normal
55	2064	1976	1976	Dry Year 4	Normal
56	2065	1977	1977	Dry Year 5	Dry Year 1
57	2066	1978	1978	Dry Year 6	Normal
58	2067	1979	1979	Dry Year 7	Normal
59	2068	1980	1980	Dry Year 8	Normal
60	2069	1981	1981	Dry Year 9	Normal
61	2070	1982	1982	Dry Year 10	Normal
62	2071	1983	1983	Dry Year 11	Normal
63	2072	1984	1984	Dry Year 12	Normal
64	2073	1985	1985	Dry Year 13	Normal
65	2074	1986	1986	Dry Year 14	Normal
66	2075	1987	1987	Normal	Normal
67	2076	1988	1988	Normal	Dry Year 1
68	2077	1989	1989	Dry Year 1	Normal
69	2078	1990	1990	Dry Year 2	Dry Year 2
70	2079	1991	1991	Dry Year 3	Dry Year 3
71	2080	1992	1992	Normal	Dry Year 4
72	2081	1993	1993	Dry Year 1	Normal
73	2082	1994	1994	Normal	Normal
74	2083	1995	1995	Normal	Normal
75	2084	1996	1996	Normal	Normal
76	2085	1997	1997	Normal	Normal
77	2086	1998	1998	Normal	Normal
78	2087	1999	1999	Normal	Normal
79	2088	2000	2000	Normal	Normal
80	2089	2001	2001	Dry Year 1	Dry Year 1
81	2090	2002	2002	Normal	Normal
82	2091	2003	2003	Normal	Normal
83	2092	2004	2004	Normal	Normal
84	2093	2005	2005	Dry Year 1	Normal
85	2094	2006	2006	Normal	Normal
86	2095	2007	2007	Normal	Normal

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Climate Projection #6 (Global Climate Model NCAR_PCM1.3_sresA2)

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Model Year	Alluvium Year	Saugus Year	Year Name for Model Run	Simulated Pumping Conditions	
				Alluvium	Saugus
1	2010	1922	1922	Normal	Normal
2	2011	1923	1923	Normal	Normal
3	2012	1924	1924	Dry Year 1	Dry Year 1
4	2013	1925	1925	Dry Year 2	Normal
5	2014	1926	1926	Dry Year 3	Normal
6	2015	1927	1927	Dry Year 4	Normal
7	2016	1928	1928	Normal	Normal
8	2017	1929	1929	Normal	Dry Year 1
9	2018	1930	1930	Normal	Normal
10	2019	1931	1931	Dry Year 1	Dry Year 1
11	2020	1932	1932	Dry Year 2	Dry Year 2
12	2021	1933	1933	Normal	Dry Year 3
13	2022	1934	1934	Normal	Dry Year 4
14	2023	1935	1935	Normal	Normal
15	2024	1936	1936	Normal	Normal
16	2025	1937	1937	Dry Year 1	Normal
17	2026	1938	1938	Dry Year 2	Normal
18	2027	1939	1939	Dry Year 3	Normal
19	2028	1940	1940	Dry Year 4	Normal
20	2029	1941	1941	Dry Year 5	Normal
21	2030	1942	1942	Dry Year 6	Normal
22	2031	1943	1943	Dry Year 7	Normal
23	2032	1944	1944	Dry Year 8	Normal
24	2033	1945	1945	Dry Year 9	Normal
25	2034	1946	1946	Normal	Normal
26	2035	1947	1947	Normal	Normal
27	2036	1948	1948	Dry Year 1	Normal
28	2037	1949	1949	Dry Year 2	Dry Year 1
29	2038	1950	1950	Normal	Normal
30	2039	1951	1951	Normal	Normal
31	2040	1952	1952	Normal	Normal
32	2041	1953	1953	Normal	Normal
33	2042	1954	1954	Normal	Normal
34	2043	1955	1955	Normal	Dry Year 1
35	2044	1956	1956	Normal	Normal
36	2045	1957	1957	Normal	Normal
37	2046	1958	1958	Normal	Normal
38	2047	1959	1959	Normal	Normal
39	2048	1960	1960	Dry Year 1	Dry Year 1
40	2049	1961	1961	Dry Year 2	Normal
41	2050	1962	1962	Dry Year 3	Normal
42	2051	1963	1963	Dry Year 4	Normal
43	2052	1964	1964	Normal	Normal
44	2053	1965	1965	Normal	Normal
45	2054	1966	1966	Normal	Normal
46	2055	1967	1967	Normal	Normal
47	2056	1968	1968	Normal	Normal
48	2057	1969	1969	Normal	Normal
49	2058	1970	1970	Dry Year 1	Normal
50	2059	1971	1971	Normal	Normal
51	2060	1972	1972	Dry Year 1	Normal
52	2061	1973	1973	Normal	Normal
53	2062	1974	1974	Dry Year 1	Normal
54	2063	1975	1975	Dry Year 2	Normal
55	2064	1976	1976	Normal	Normal
56	2065	1977	1977	Normal	Dry Year 1
57	2066	1978	1978	Dry Year 1	Normal
58	2067	1979	1979	Normal	Normal
59	2068	1980	1980	Normal	Normal
60	2069	1981	1981	Normal	Normal
61	2070	1982	1982	Dry Year 1	Normal
62	2071	1983	1983	Dry Year 2	Normal
63	2072	1984	1984	Dry Year 3	Normal
64	2073	1985	1985	Normal	Normal
65	2074	1986	1986	Dry Year 1	Normal
66	2075	1987	1987	Dry Year 2	Normal
67	2076	1988	1988	Dry Year 3	Dry Year 1
68	2077	1989	1989	Normal	Normal
69	2078	1990	1990	Normal	Dry Year 2
70	2079	1991	1991	Normal	Dry Year 3
71	2080	1992	1992	Normal	Dry Year 4
72	2081	1993	1993	Normal	Normal
73	2082	1994	1994	Normal	Normal
74	2083	1995	1995	Normal	Normal
75	2084	1996	1996	Normal	Normal
76	2085	1997	1997	Dry Year 1	Normal
77	2086	1998	1998	Dry Year 2	Normal
78	2087	1999	1999	Dry Year 3	Normal
79	2088	2000	2000	Normal	Normal
80	2089	2001	2001	Normal	Dry Year 1
81	2090	2002	2002	Normal	Normal
82	2091	2003	2003	Dry Year 1	Normal
83	2092	2004	2004	Dry Year 2	Normal
84	2093	2005	2005	Dry Year 3	Normal
85	2094	2006	2006	Dry Year 4	Normal
86	2095	2007	2007	Dry Year 5	Normal

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Climate Projection #9 (Global Climate Model NCAR_PCM1.3_sresB1)

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Model Year	Alluvium Year	Saugus Year	Year Name for Model Run	Simulated Pumping Conditions	
				Alluvium	Saugus
1	2010	1922	1922	Normal	Normal
2	2011	1923	1923	Normal	Normal
3	2012	1924	1924	Normal	Dry Year 1
4	2013	1925	1925	Normal	Normal
5	2014	1926	1926	Normal	Normal
6	2015	1927	1927	Normal	Normal
7	2016	1928	1928	Normal	Normal
8	2017	1929	1929	Normal	Dry Year 1
9	2018	1930	1930	Dry Year 1	Normal
10	2019	1931	1931	Dry Year 2	Dry Year 1
11	2020	1932	1932	Dry Year 3	Dry Year 2
12	2021	1933	1933	Normal	Dry Year 3
13	2022	1934	1934	Normal	Dry Year 4
14	2023	1935	1935	Normal	Normal
15	2024	1936	1936	Normal	Normal
16	2025	1937	1937	Dry Year 1	Normal
17	2026	1938	1938	Dry Year 2	Normal
18	2027	1939	1939	Normal	Normal
19	2028	1940	1940	Normal	Normal
20	2029	1941	1941	Normal	Normal
21	2030	1942	1942	Normal	Normal
22	2031	1943	1943	Dry Year 1	Normal
23	2032	1944	1944	Normal	Normal
24	2033	1945	1945	Normal	Normal
25	2034	1946	1946	Dry Year 1	Normal
26	2035	1947	1947	Dry Year 2	Normal
27	2036	1948	1948	Dry Year 3	Normal
28	2037	1949	1949	Normal	Dry Year 1
29	2038	1950	1950	Dry Year 1	Normal
30	2039	1951	1951	Dry Year 2	Normal
31	2040	1952	1952	Normal	Normal
32	2041	1953	1953	Normal	Normal
33	2042	1954	1954	Normal	Normal
34	2043	1955	1955	Normal	Dry Year 1
35	2044	1956	1956	Normal	Normal
36	2045	1957	1957	Dry Year 1	Normal
37	2046	1958	1958	Dry Year 2	Normal
38	2047	1959	1959	Dry Year 3	Normal
39	2048	1960	1960	Normal	Dry Year 1
40	2049	1961	1961	Normal	Normal
41	2050	1962	1962	Dry Year 1	Normal
42	2051	1963	1963	Dry Year 2	Normal
43	2052	1964	1964	Normal	Normal
44	2053	1965	1965	Normal	Normal
45	2054	1966	1966	Normal	Normal
46	2055	1967	1967	Dry Year 1	Normal
47	2056	1968	1968	Dry Year 2	Normal
48	2057	1969	1969	Dry Year 3	Normal
49	2058	1970	1970	Dry Year 4	Normal
50	2059	1971	1971	Normal	Normal
51	2060	1972	1972	Normal	Normal
52	2061	1973	1973	Normal	Normal
53	2062	1974	1974	Normal	Normal
54	2063	1975	1975	Normal	Normal
55	2064	1976	1976	Normal	Normal
56	2065	1977	1977	Normal	Dry Year 1
57	2066	1978	1978	Normal	Normal
58	2067	1979	1979	Dry Year 1	Normal
59	2068	1980	1980	Dry Year 2	Normal
60	2069	1981	1981	Dry Year 3	Normal
61	2070	1982	1982	Normal	Normal
62	2071	1983	1983	Normal	Normal
63	2072	1984	1984	Normal	Normal
64	2073	1985	1985	Normal	Normal
65	2074	1986	1986	Normal	Normal
66	2075	1987	1987	Normal	Normal
67	2076	1988	1988	Normal	Dry Year 1
68	2077	1989	1989	Dry Year 1	Normal
69	2078	1990	1990	Normal	Dry Year 2
70	2079	1991	1991	Normal	Dry Year 3
71	2080	1992	1992	Normal	Dry Year 4
72	2081	1993	1993	Dry Year 1	Normal
73	2082	1994	1994	Normal	Normal
74	2083	1995	1995	Normal	Normal
75	2084	1996	1996	Normal	Normal
76	2085	1997	1997	Dry Year 1	Normal
77	2086	1998	1998	Dry Year 2	Normal
78	2087	1999	1999	Normal	Normal
79	2088	2000	2000	Normal	Normal
80	2089	2001	2001	Normal	Dry Year 1
81	2090	2002	2002	Normal	Normal
82	2091	2003	2003	Normal	Normal
83	2092	2004	2004	Dry Year 1	Normal
84	2093	2005	2005	Normal	Normal
85	2094	2006	2006	Normal	Normal
86	2095	2007	2007	Normal	Normal

Figure 5-1: 2010-2098 Cumulative Departure from Average Annual Rainfall at Newhall-Soledad Rain Gage

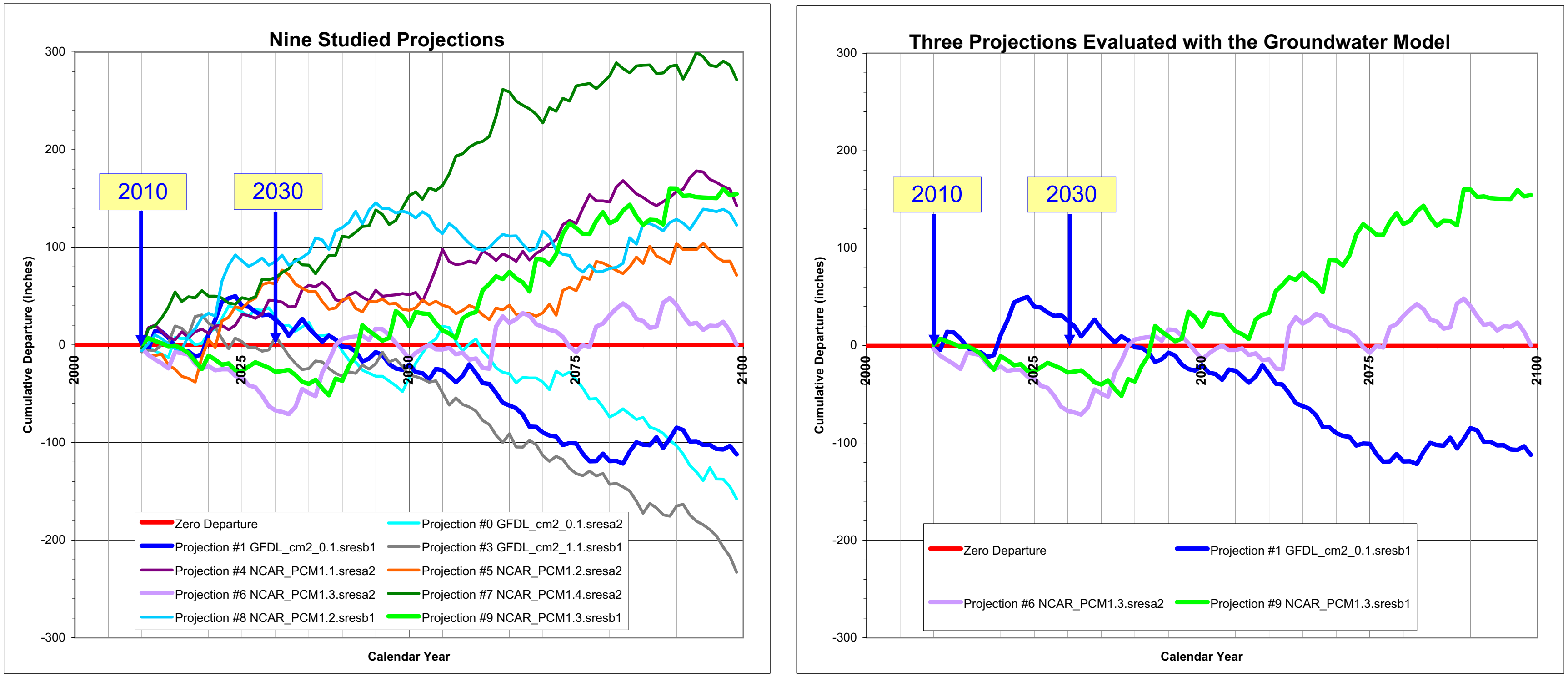


Figure 5-2: VWC-E15 Modeled Groundwater Elevations For Various Climate Projections (Alluvial Aquifer Below Valencia WRP)

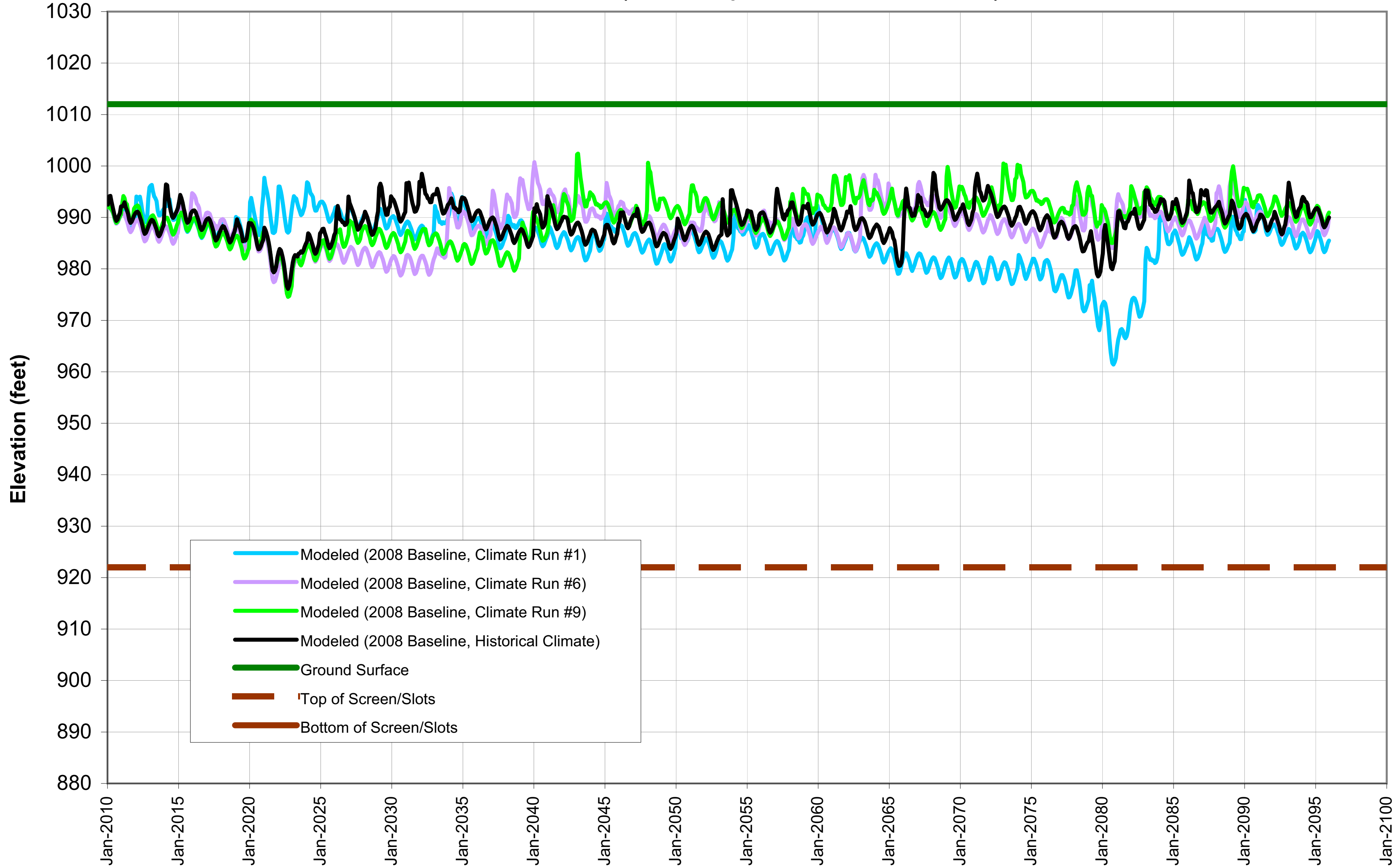
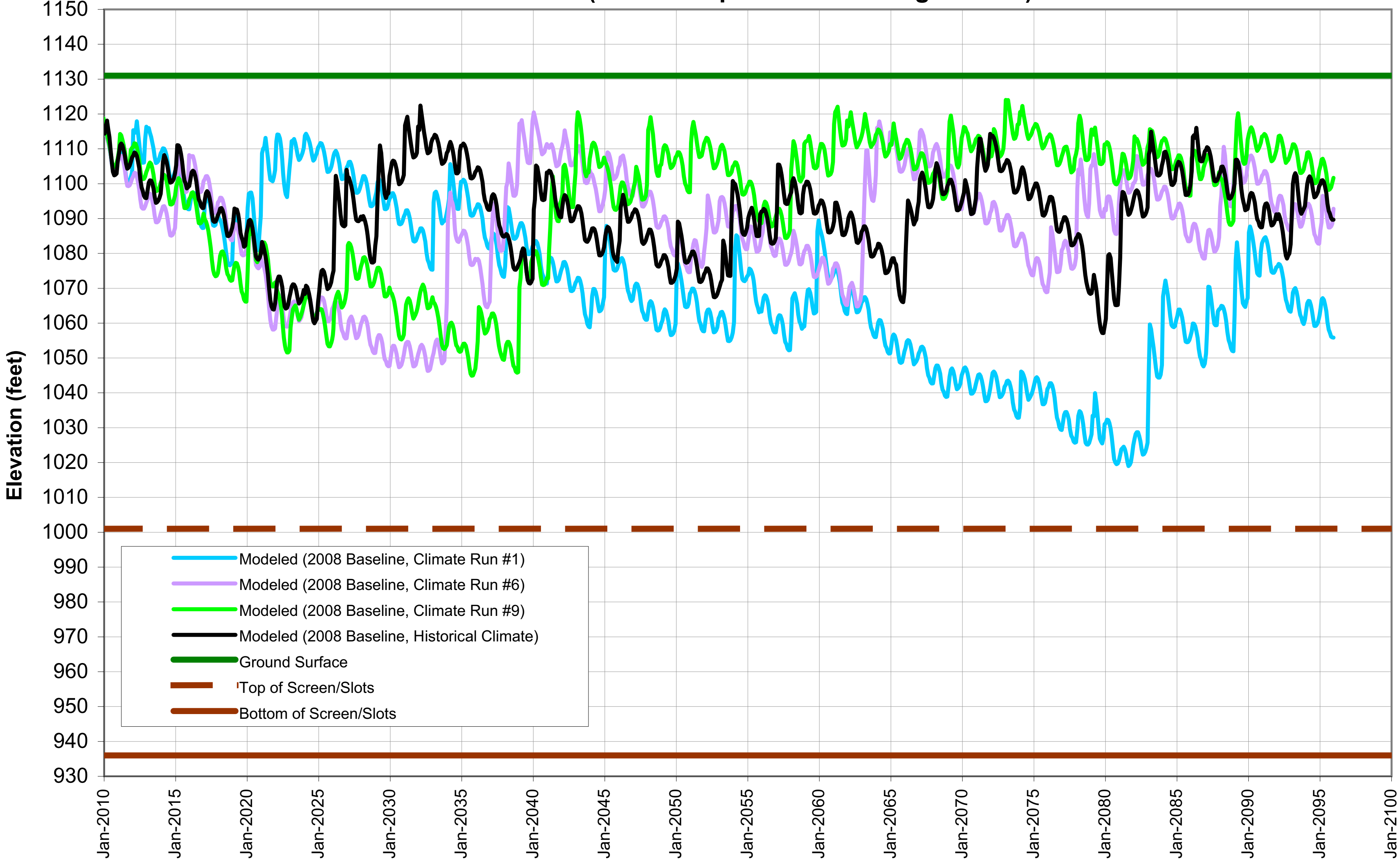


Figure 5-3: VWC-S8 Modeled Groundwater Elevations For Various Climate Projections (Alluvial Aquifer Below Saugus WRP)



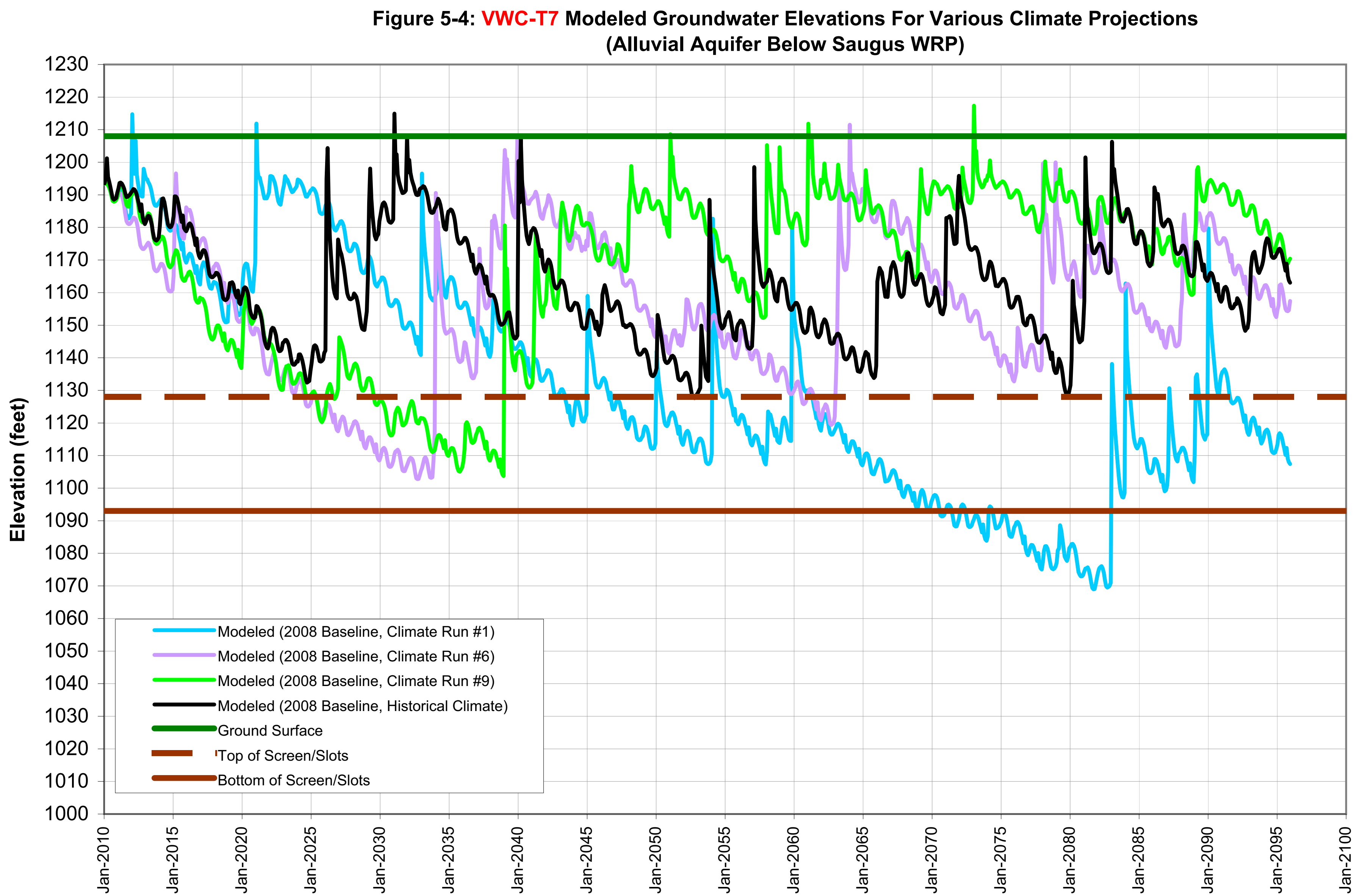


Figure 5-4: VWC-T7 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Below Saugus WRP)
Elevation (feet)
1230
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Baseline, Climate Run #1)
Modeled (2008 Baseline, Climate Run #6)
Modeled (2008 Baseline, Climate Run #9)
Modeled (2008 Baseline, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

Figure 5-5: SCWD-Sierra Modeled Groundwater Elevations for Various Climate Projections (Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)

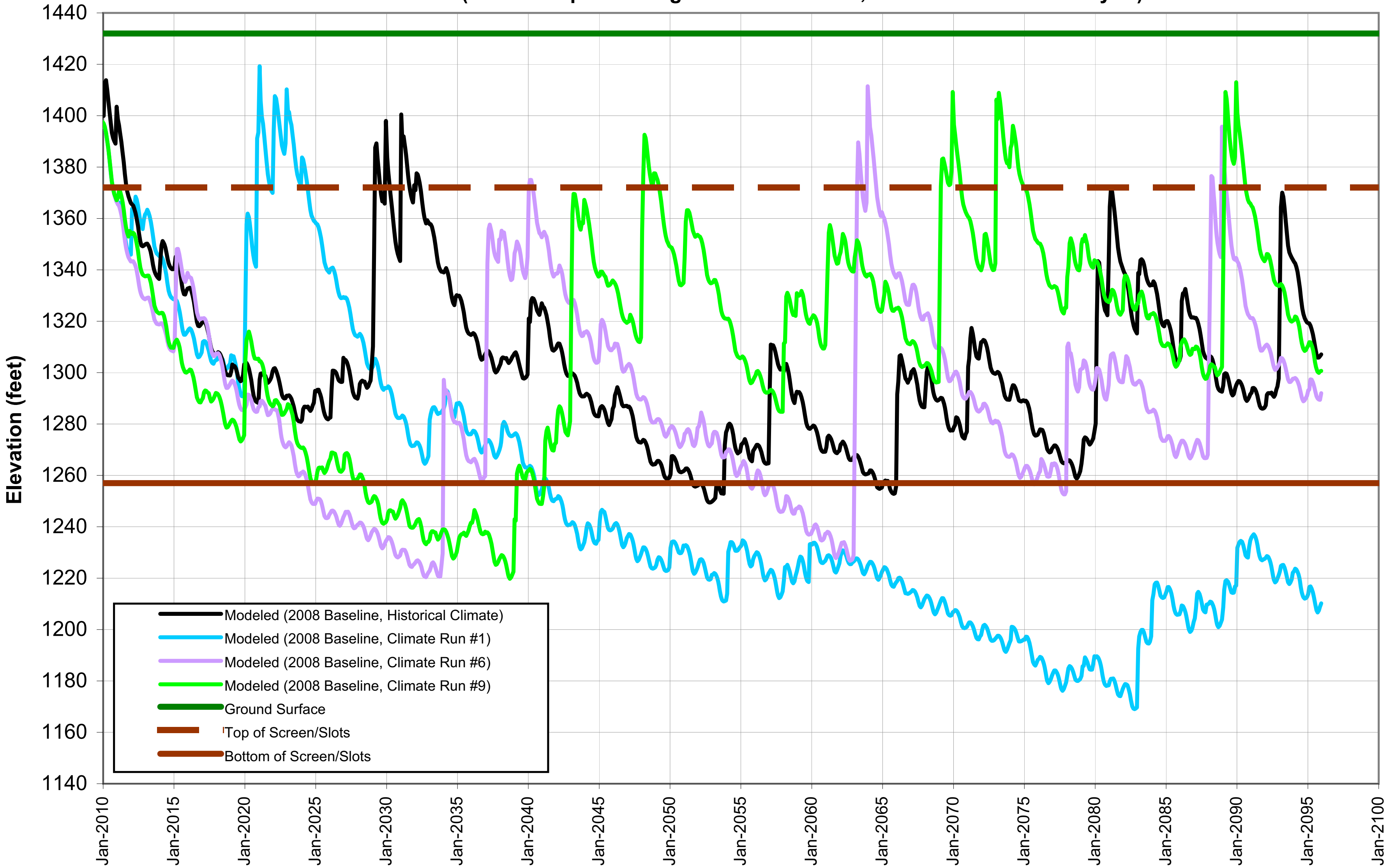


Figure 5-6: NCWD-Pinetree1 Modeled Groundwater Elevations For Various Climate Projections (Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)

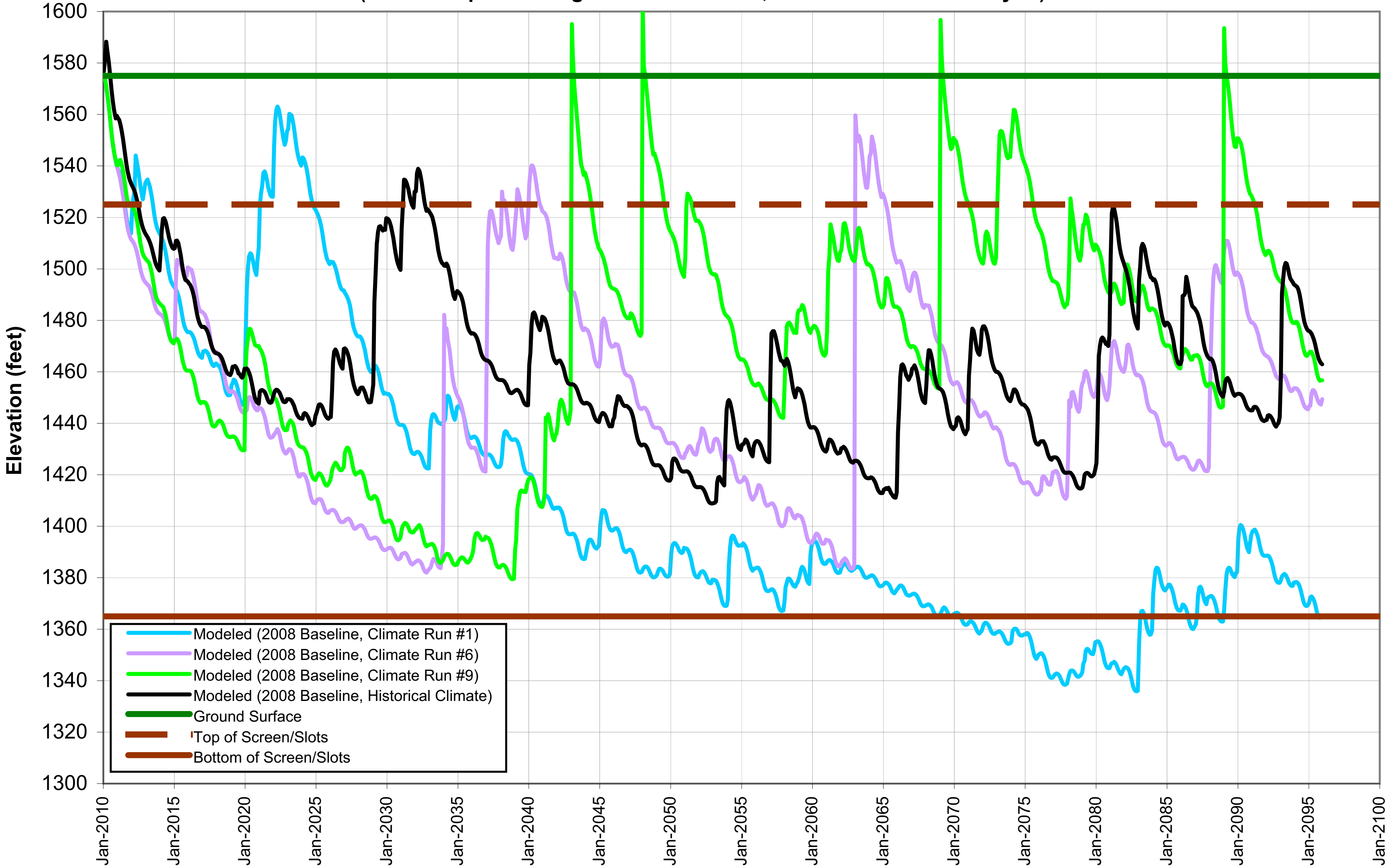


Figure 5-7: NCWD-Castaic7 Modeled Groundwater Elevations For Various Climate Projections (Alluvial Aquifer in Castaic Valley)

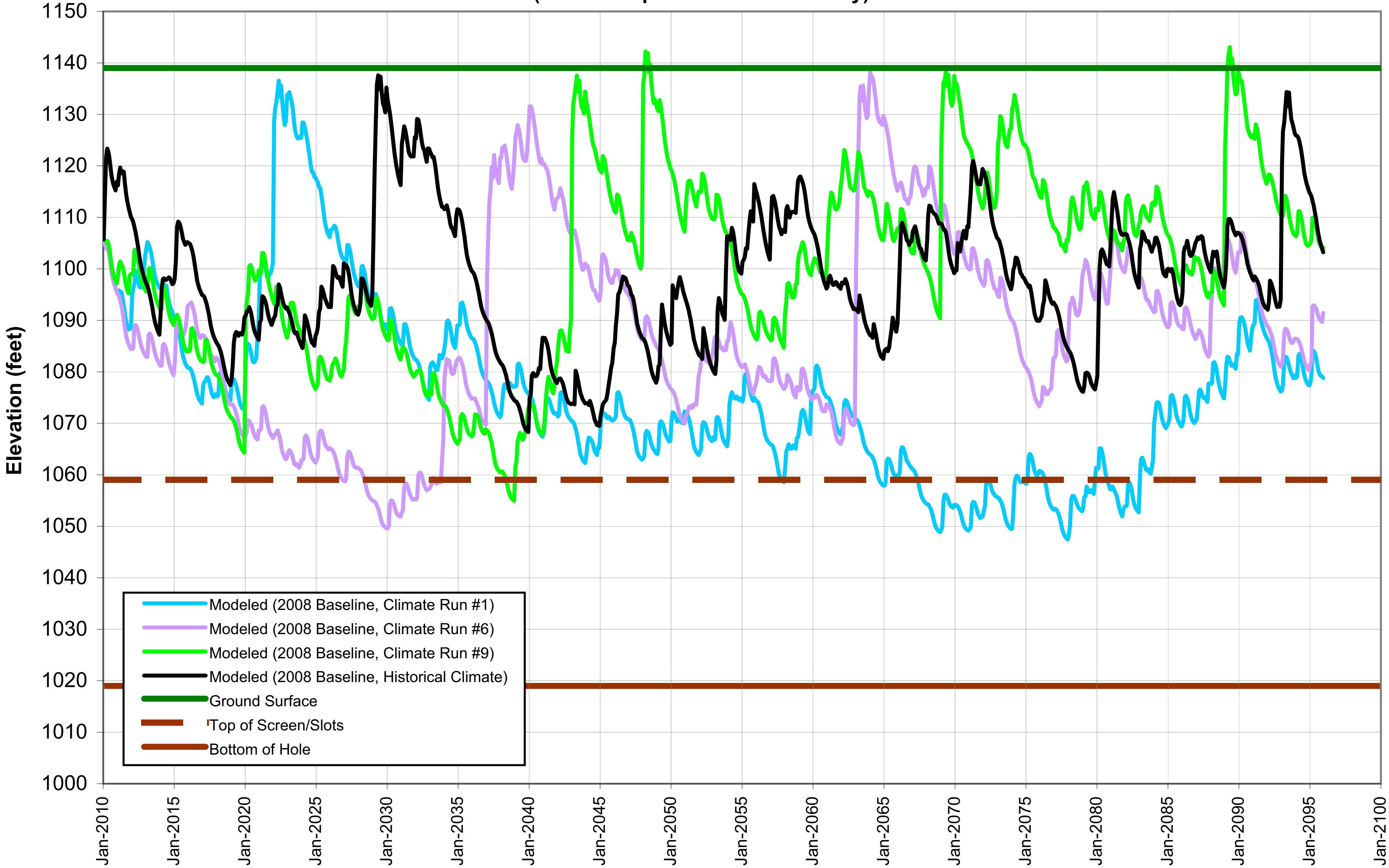


Figure 5-8: VWC-W11 Modeled Groundwater Elevations For Various Climate Projections (Alluvial Aquifer in San Francisquito Canyon)

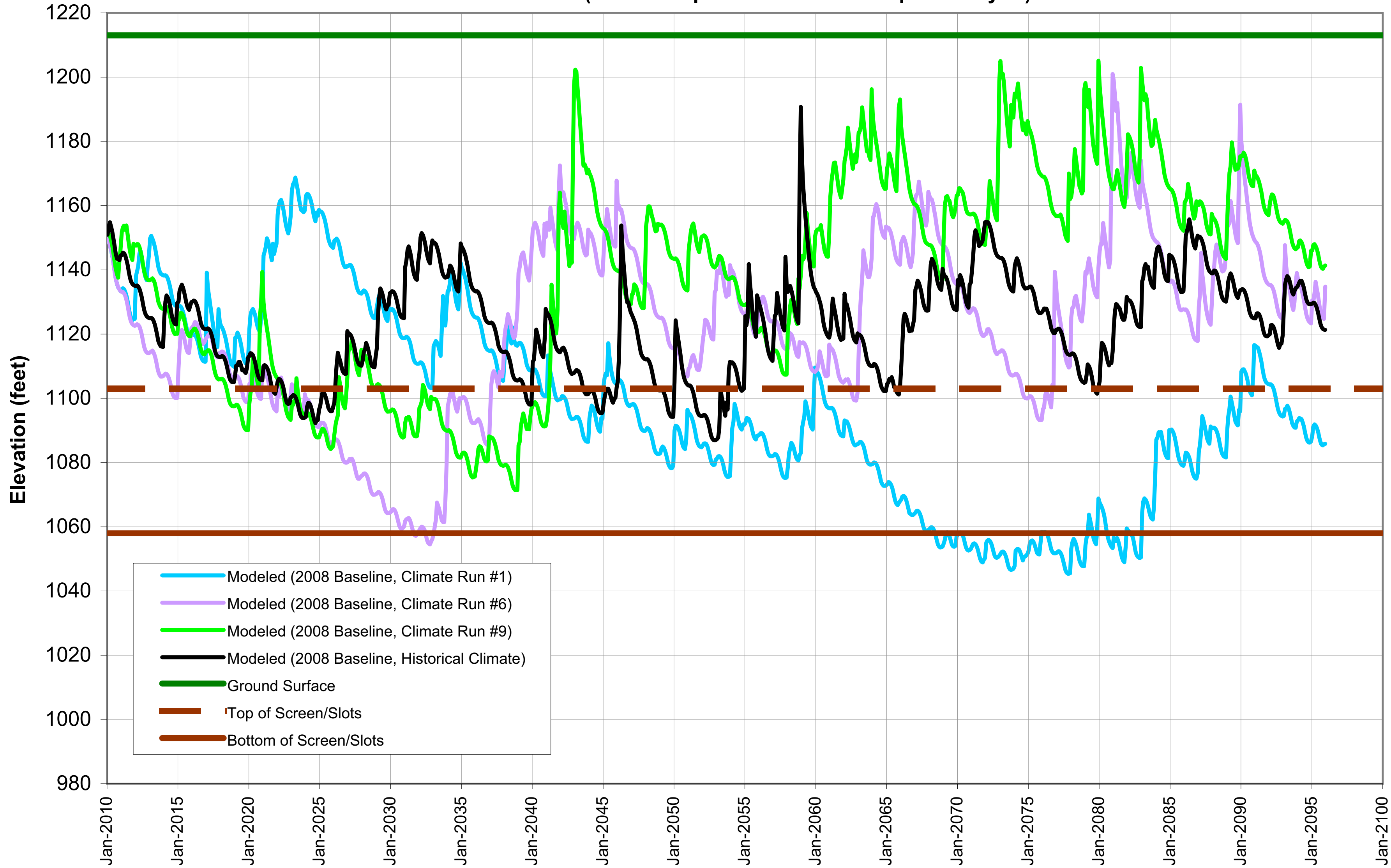


Figure 5-9: SCWD-Clark Modeled Groundwater Elevations for Various Climate Projections (Alluvial Aquifer in Bouquet Canyon)

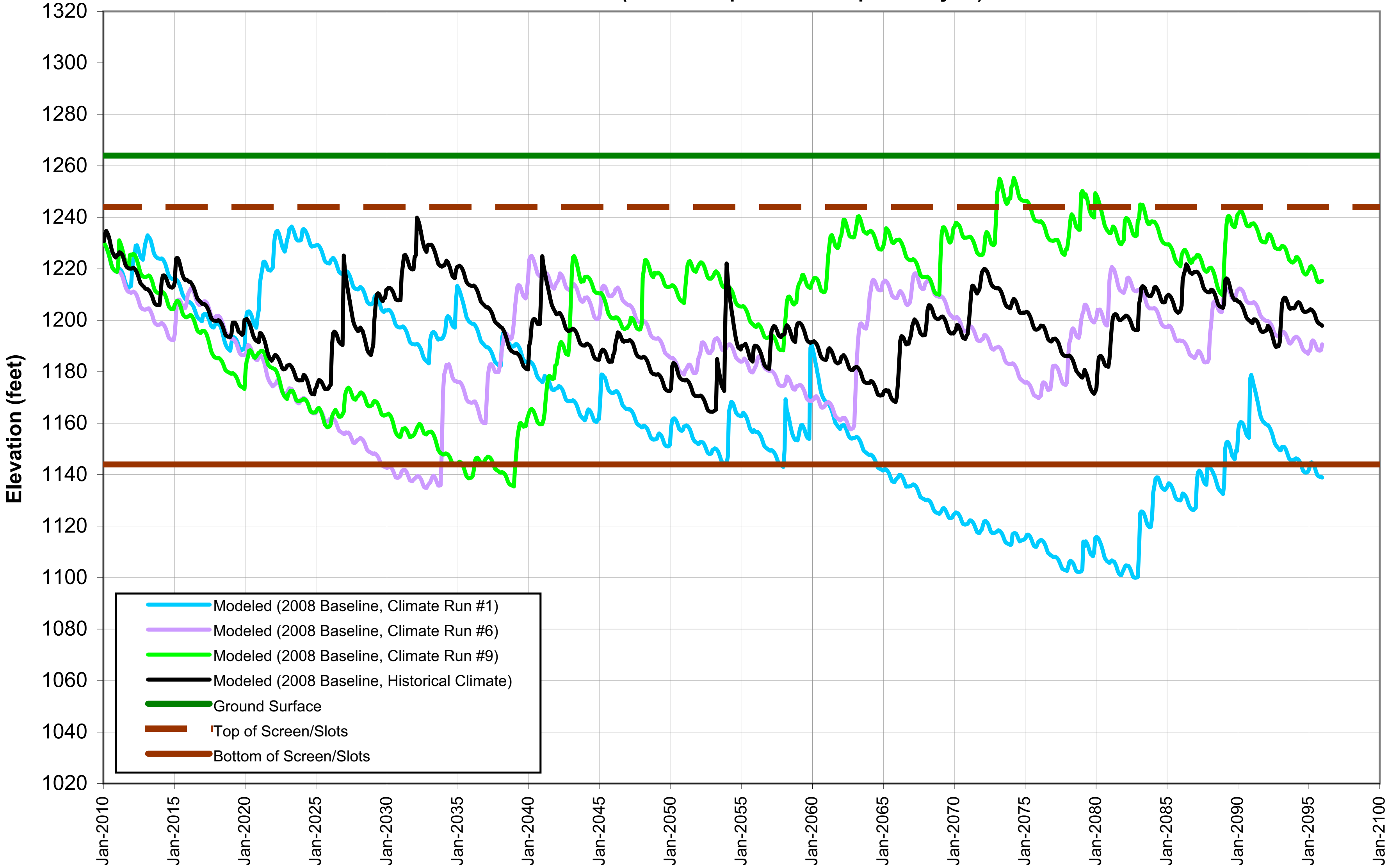
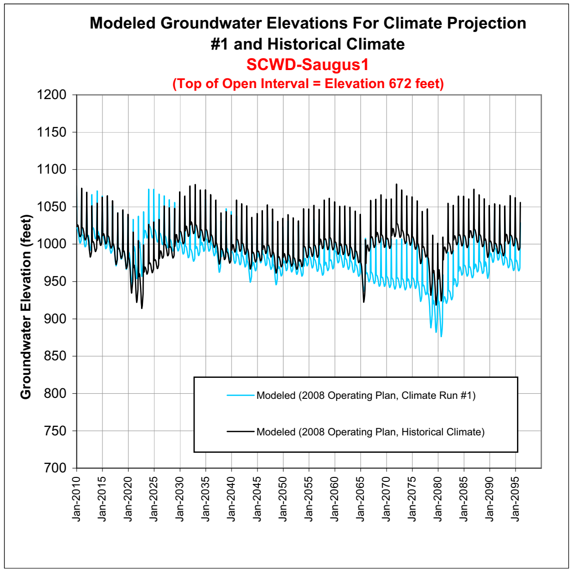
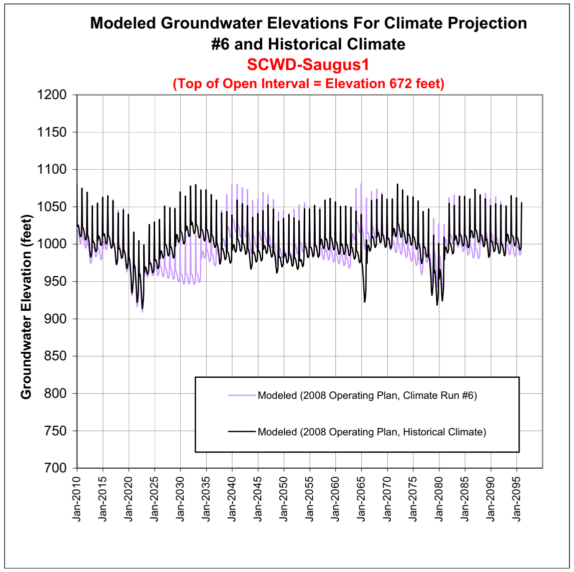


Figure 5-10: Groundwater Elevation Trends at SCWD-Saugus1 for the 2008 Operating Plan Under Historical Climate and Climate Projections #1, #6, and #9





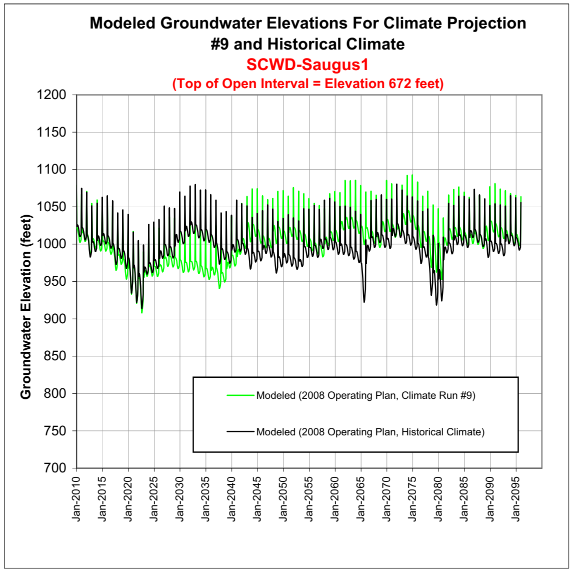
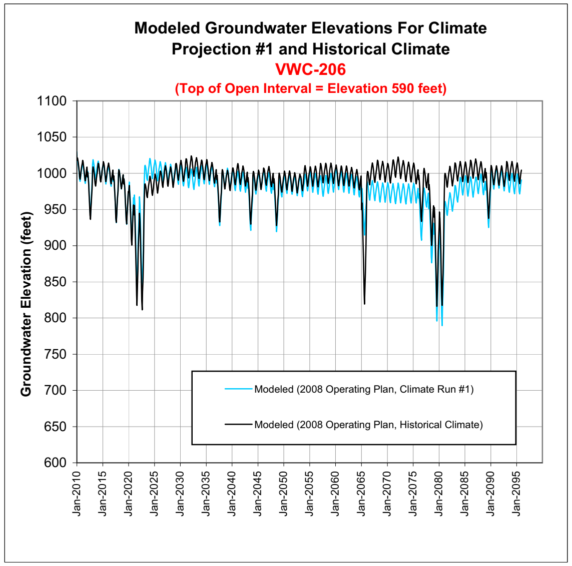
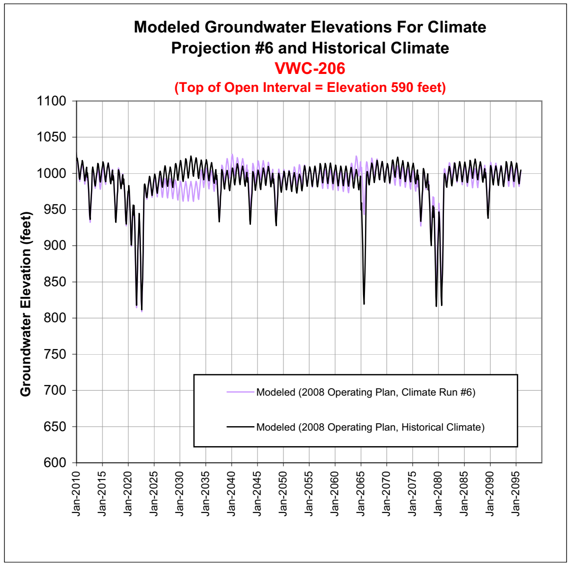


Figure 5-11: Groundwater Elevation Trends at VWC-206 for the 2008 Operating Plan Under Historical Climate and Climate Projections #1, #6, and #9





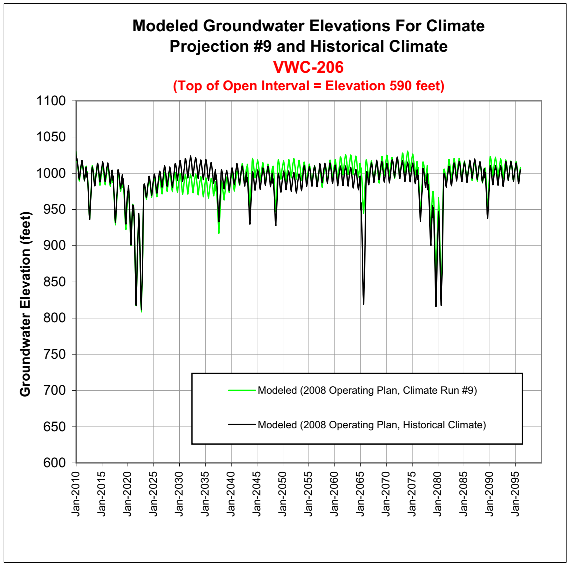
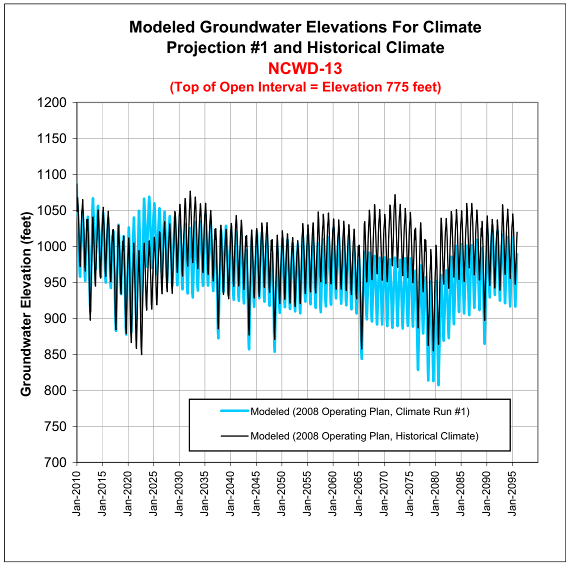
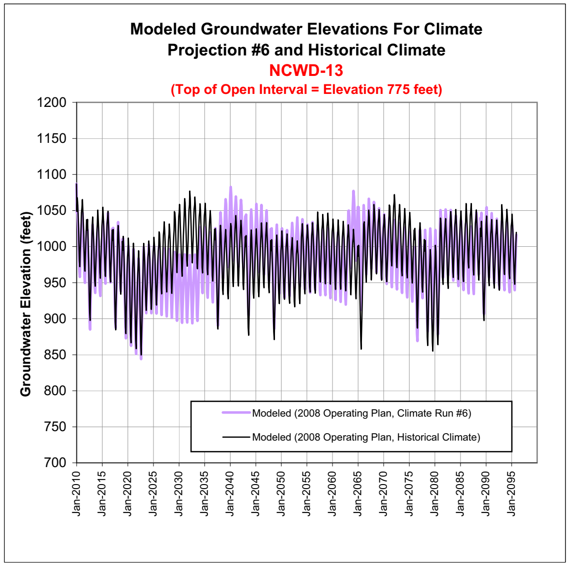
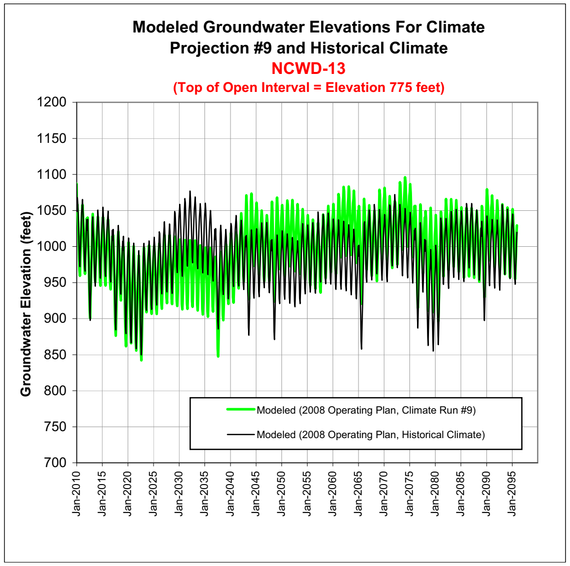


Figure 5-12: Groundwater Elevation Trends at NCWD-13 for the 2008 Operating Plan Under Historical Climate and Climate Projections #1, #6, and #9







VI. Local Artificial Recharge Projects

6.1 Los Angeles County Flood Control District Study

The Los Angeles County Flood Control District (LACFCD) prepared an unpublished water conservation plan that proposes constructing thirteen separate artificial recharge projects in the upper Santa Clara River Watershed. The focus of the plan is to capture or impede stormwater runoff to promote percolation to groundwater, specifically to the Alluvium located along the Santa Clara River. Although the plan acknowledged that there is a lack of runoff data to accurately predict the water conservation benefits of the projects, LACFCD estimated that, on average, a given year could be expected to have three storms that would be capable of producing enough stormwater runoff to fill the estimated storage capacities of each of the thirteen proposed projects. Therefore, to estimate the total water conservation benefit, LACFCD multiplied the total storage capacity of the thirteen projects by three. The total storage capacity and water conservation benefit of the thirteen projects combined were thus estimated to be 1,816 acre feet and 5,455 acre feet per year, respectively.

The plan subdivided the thirteen projects into three separate areas of the basin (Figure 6-1):

- six projects on the south fork of the Santa Clara River
- two projects in San Francisquito Canyon
- five projects on the main Santa Clara River System

Table 6-1 lists each project by subarea along with the LACFCD estimate of project capacity and water conservation benefit. The project locations relative to the Alluvial aquifer system by subarea are described below.

6.2 Project Locations Relative to Aquifer System

The six projects that would be located along the south fork of the Santa Clara River, as illustrated in Figure 6-1, consist of three rubber dam projects; two projects that divert water into spreading grounds; and a project that backs up flows behind a rubber dam for diversion into adjoining spreading grounds. The total capacity and estimated water conservation benefit of these six facilities are 496 acre feet and 1,475 acre feet per year, respectively. The riverbed of the south fork of the Santa Clara River lies along the eastern margin of the alluvial valley that the river occupies. In this area, the alluvium is thin and the Saugus Formation outcrops in the hills adjoining the river valley. Projects 1 through 5 are located in areas where groundwater pumping occurs from the Saugus Formation, but no Alluvial production wells are present because of the limited saturated thickness of the alluvium throughout this area. Project no. 6 is the furthest north (or downgradient) of the south fork projects and is located south of VWC's N7 and N8 Alluvial production wells in an area where the saturated thickness of the alluvium is much greater than further upstream where the other projects are located.

The two projects (no. 7 and 8 on Figure 6-1) proposed by LACFCD in San Francisquito Canyon would consist of spreading grounds along the unnamed ephemeral stream, tributary to the Santa

Clara River. The total capacity of the spreading grounds would be about 420 acre feet with a combined estimated water conservation benefit of 1,270 acre feet per year. The locations of the two spreading grounds are along the margins of the Alluvium north of Decoro Drive and Cooper Hill Drive where the alluvium is thin.

The five projects (no. 9 through 13 on Figure 6-1) proposed by LACFCD along the Santa Clara River extend from near the Saugus wastewater treatment plant eastward to areas just east of Newhall County Water District's Pinetree wells. These projects would include one rubber dam and four spreading grounds that are located along the margins of the Alluvium near outcrops of Saugus and bedrock formations in the hills adjoining the alluvial river valley. The five projects would have combined capacity of about 900 acre feet and an estimated total annual water conservation benefit of about 2,710 acre feet per year.

6.3 Conceptual Project Operation and Impacts

The purpose of the planned projects would be to capture stormwater runoff using inflatable rubber dams and to divert excess runoff into spreading grounds in order to recharge groundwater in the Alluvium in the immediate vicinity of each project site. The ability and related impact of the projects to effectively increase groundwater recharge in the Alluvium rather than to simply redistribute groundwater recharge is discussed in further detail below.

- **South Fork of the Santa Clara River.** Recharge projects in the South Fork of the Santa Clara River would be located primarily along the margins of the river valley where the Alluvium where this unit is thin. These project locations (nos. 1 through 5 on Figure 6-1) may not have sufficient alluvial thickness and available storage capacity during storm events to allow excess runoff captured by these projects to recharge groundwater at each project location. As a result, the excess stormwater runoff may not readily recharge groundwater and may be rejected due to the lack of available storage capacity in the vicinity of each project. Excess runoff captured by these projects would likely recharge groundwater elsewhere in the south fork of the Santa Clara River or near its mouth. Project locations 1 through 5 are proposed to be located in areas where groundwater production wells pump groundwater from the underlying Saugus Formation, rather than from the Alluvium. Consequently, even if some additional water were introduced to storage, little if any of the benefit would be able to be pumped at those project locations (again, there are no existing Alluvial production wells in the area and there is no likelihood of new production wells being constructed, all due to the lack of sufficient thickness of the Alluvium). Project location no. 6, the northernmost project in this area may have the potential to provide additional recharge to groundwater. However, due to the low storage capacity and estimated water conservation benefit, it would be difficult to differentiate between recharge from this project as compared to recharge under existing conditions, which already maintains sustainable groundwater conditions.

- **San Francisquito Canyon.** Project locations in San Francisquito Canyon would intercept stormwater runoff that would likely continue to recharge the Alluvium further downstream of the project locations; in essence, the projects would potentially only redistribute stormwater recharge that currently has recharged the Alluvial aquifer in areas upstream of the Valencia waste water treatment plant (again, existing recharge already supports sustainable groundwater conditions in San Francisquito Canyon and immediately downstream in the main River area).

- **Santa Clara River** The project locations in the Santa Clara River area are very spread out with the easternmost project (no. 12) having the largest estimated capacity. However, Project no. 12 is located more than a mile east of Newhall County Water Districts Pinetree wells, and any stormwater runoff captured by this project would likely result in two different outcomes. One outcome is that the project would likely recharge groundwater in an area which currently has no production wells, and the water that is recharged would likely have recharged groundwater further downstream in the absence of the project. The second outcome is that the available storage in the alluvium in the area of the project would fill rapidly during a large stormwater runoff event, thereby limiting the amount of infiltration that can occur afterwards from the stormwater runoff captured by the project's spreading grounds. Three of the other four remaining projects (no. 10, 11, and 13) will likely encounter similar obstacles to Project no. 12 because of the similar surface and groundwater conditions that are present along the Santa Clara River between the Bouquet Canyon Bridge and the Lang gage (the eastern margin of the watershed). Project no. 9 (at the Bouquet Canyon Bridge) is similar in nature to Project no. 6 described above in that any benefit derived from the project might not be discernible from the conditions that would otherwise occur naturally in the absence of this and the other projects that are proposed along the Santa Clara River.

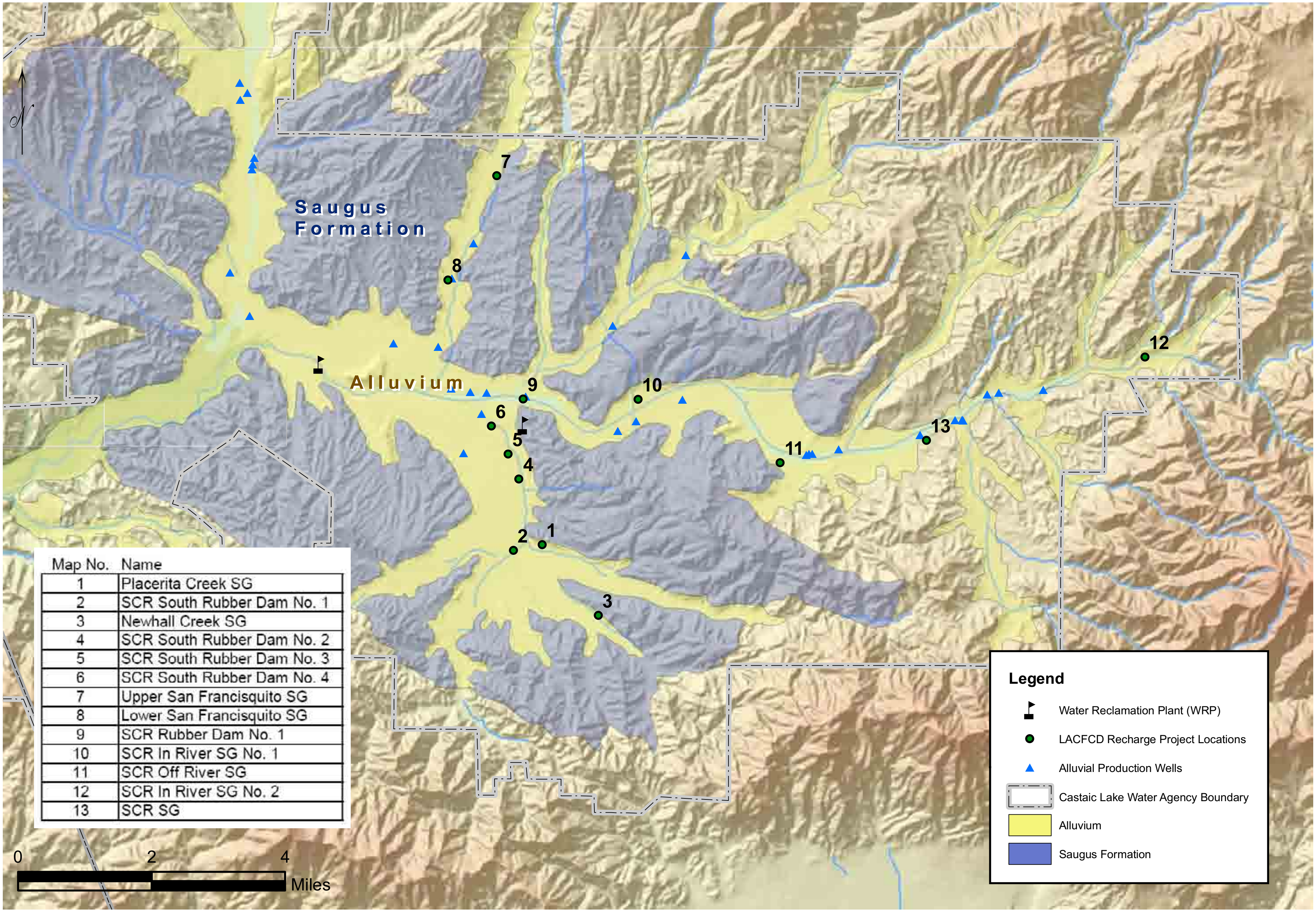
The overarching consideration with regard to the planned artificial recharge projects is that they might capture and "artificially recharge" water that already recharges the Alluvial aquifer system where it is of sufficient thickness to be developed as a groundwater supply. As evident from empirical observations and the simulations reported herein, the system "naturally" recharges to the point of sustaining groundwater pumping and, in the westerly end of the basin, to the point that stream recharge is rejected (and groundwater discharges to the stream). The small volumes of the various planned artificial recharge projects, and the arbitrarily estimated filling of those three times per year, do not represent "new" recharge; they likely represent some potential minor relocation of existing recharge.

Even if it were desirable to purposely relocate some existing recharge to one or more of the planned (LACFCD) locations, it would be difficult (possible but challenging) to redistribute the small amount of stream recharge and to then track the corresponding small effect of intercepting that water and removing it as a source of recharge as now occurs downstream. The results of the rest of the work reported herein, most notably that dealing with achievability of the 2008 Operating Plan, clearly suggest that artificial recharge could locally benefit certain areas, notably at and above Mint Canyon. However, such benefits would more logically develop from other water sources that would supplement natural recharge rather than simply redistribute it. The model used to simulate the basin response to the operating plans, under historic and potential climate change conditions, can readily simulate the effects and benefits of artificial recharge at selected locations using supplemental water.

Ta le -

Los Angeles ount lood ontrol istri t
Stormwater Runoff Re harge Pro e ts

Re harge Pro e t	Storage apa it a re-feet	Annual Water onservation Benefit a re-feet ear
Santa lara River South or		
	09	0
2		220
	2	0
	0	0
		0
Su total	4	4
San ran isquito an on		
	2 0	00
	90	0
Su total	420	2 0
Santa lara River		
9	0	2 0
0	0	0
	220	0
2	0	220
	0	0 0
Su total	00	2 0
Grand Total	8	4



LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Figure 6-1
Locations of LACFCD Planned Recharge Projects
Upper Santa Clara River Valley Groundwater Basin, East Subbasin

VII. Conclusions

The primary objective of the updated analysis of groundwater basin yield in the Santa Clarita Valley was to evaluate the planned utilization of groundwater by the Purveyors, after their consideration of potential impacts on traditional supplemental water supplies from the State Water Project (SWP), and with recognition of ongoing pumping by others for agricultural and other private water supply, for sustainability of the groundwater resource and for physical ability to extract groundwater at desired rates. As has previously been utilized in this basin, consistent with groundwater management in other settings, sustainability is defined in terms of renewability (recharge) of groundwater as reflected by the following indicators:

- lack of chronic, or sustained, depletion of groundwater storage, as indicated by projected groundwater levels, over a reasonable range of wet, normal, and dry hydrologic conditions

- maintenance of surface water flows in the western portion of the basin (which are partially maintained by groundwater discharge) and surface water outflow to downstream basins over the same range of hydrologic conditions

Regarding maintenance of surface water flows, although the development and use of groundwater in a sustainable manner necessitates the inducement of recharge from surface water, sustainability in this case does not rely on inducing groundwater recharge by eliminating surface water flows. Rather, sustainability retains surface water outflows and may even increase them with the importation of supplemental water when contrasted to pre-SWP conditions. Regarding both indicators of sustainability, the range of analyzed hydrologic conditions is a long-term period that includes anticipated occurrences of the types of years and groups of year types that have historically occurred in the basin.

A second objective of the updated groundwater basin yield analysis was to investigate and describe potential impacts of expected climate change on the groundwater basin and its yield. A third objective was to consider potential augmentation of basin yield via potential artificial groundwater recharge using storm water runoff in selected areas of the basin as being planned by the Los Angeles County Flood Control District.

The primary objective was investigated by analyzing, with the numerical groundwater flow model of the basin, two groundwater operating plans: a 2008 Operating Plan to reflect currently envisioned pumping rates and distribution throughout the Valley, including fluctuations through wet/normal and dry years, to achieve a desired amount of water supply that, in combination with anticipated supplemental water supplies, can meet existing and projected water requirements in the Valley; and a Potential Operating Plan that envisions potentially increased utilization of groundwater during both wet/normal and dry years.

With regard to the respective operating plans, a first conclusion is that the 2008 Operating Plan will not cause detrimental short- or long-term effects to the groundwater and surface water resources in the Valley and is, therefore, sustainable. Consistent with actual operating experience and empirical observations of historical basin response to groundwater pumping, the

2008 Operating Plan can be expected to have local difficulty, in the Alluvium at the eastern end of the basin during locally dry periods, with achievement of all the Alluvial pumping in the 2008 Operating Plan. This condition is particularly evident if several decades of predominantly below-normal rainfall years were to occur in the future such as occurred during much of the five decades from the mid-1920s through the mid-1970s. In other words, while the basin as a whole can sustain the pumping embedded in the 2008 Operating Plan, local conditions in the Alluvium in the eastern end of the basin can be expected to repeat historical groundwater level declines during dry periods, necessitating a reduction in desired Alluvial aquifer pumping due to decreased well yield and associated actual pumping capacity. The modeling analysis conducted to date suggests that those reductions in pumping from the Alluvial aquifer can be made up by an equivalent amount of increased pumping in other parts of the basin without disrupting basin-wide sustainability or local pumping capacity in those other areas. For the Saugus Formation, the modeling analysis indicates that this aquifer can sustain the pumping from this unit that is imbedded the 2008 Operating Plan.

Simulation of the 2008 Operating Plan with Pumping Redistribution indicates that westerly redistribution of 1,600 afy of alluvial pumping from the eastern end of the basin would help, but not eliminate, the lack of achievability. The residual unachievable pumping in the east end of the basin, about 4,500 afy, could be redistributed to other areas of the basin with minimal impact on groundwater levels. In this case, total Alluvial pumping in the basin could remain near the upper end of the 2008 Operating Plan range of 30,000 to 35,000 afy. Conversely, absent any additional efforts to redistribute pumping, the total Alluvial pumping capacity during extended dry periods would likely shrink toward the lower end of the 2008 Operating Plan range, toward 30,000 afy.

Another conclusion with regard to the respective operating plans is that the Potential Operating Plan would result in lower groundwater levels, failure of the basin to fully recover (during wet hydrologic cycles) from depressed storage that occurs during dry periods, and generally declining trends in groundwater levels and storage. This conclusion is strongly suggested for the Alluvial aquifer by the modeling results, but the model also indicates that long-term lowering of groundwater levels could also occur in the Saugus Formation, with only partial water level recovery occurring in the Saugus. Thus, the Potential Operating Plan would not be sustainable over a long-term period. The simulated combination of lower and declining groundwater levels under the Potential Operating Plan also leads to a conclusion that such an operating plan could not be physically achieved in several areas within the basin.

Conclusions with regard to another of the objectives of the updated groundwater basin yield analysis include a recognition that the runoff conservation/groundwater recharge projects being planned by the Los Angeles County Flood Control District are a combination of individually small projects that are not yet fully analyzed in terms of potential new yield, are but unlikely to provide any substantial recharge that does not already occur. Additionally, these proposed projects are mostly located in areas of the basin where the alluvial aquifer is of insufficient thickness and storage (and is thus not developed for water supply) or where the alluvial aquifer already fully recharges when stream flows are naturally present.

Final conclusions related to the overall objectives of the updated groundwater basin yield analysis all relate to the potential impacts of climate change on the yield of the basin and the related groundwater supply from the basin. While “conclusions” would probably be an inappropriate term to describe future conditions that cannot be projected with any degree of certainty, the results of simulating basin response to the 2008 Operating Plan, under a range of potential climate change result in two important observations.

- for the broad range of climate change possibilities that was analyzed, the 2008 Operating Plan would appear to be both sustainable and, with the same physical constraints to full pumping in the eastern part of the basin as have otherwise been experienced, achievable through the shorter term horizon associated with UWMP planning.

- the range of potential climate change impacts extends from a possible wet trend to a possible dry trend over the long term. The trends that range from an approximate continuation of historical average precipitation, to something wetter than that, would appear to result in continued sustainability of the 2008 Operating Plan, again with intermittent constraints on full pumping in the eastern part of the basin. The potential long-term dry trend arising out of climate change would be expected to decrease local recharge to the point that lower and declining groundwater levels would render the 2008 Operating Plan unsustainable.

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Appendi A

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APPENDIX A

pdated es ription of the Santa larita alle Groundwater low odel

A Introdu tion

The Santa Clarita Valley Groundwater Flow Model is a three-dimensional, numerical model of groundwater flow that covers the entire area underlain by the Saugus Formation, plus the portions of the Alluvial Aquifer that lie beyond the limits of the Saugus Formation. A Surface Water Routing Model (SWRM) was also developed specifically for this basin as a pre- and post-processor for the groundwater model.

The approach to developing the groundwater model included the following steps:

1. Compiling information on the geology and hydrogeology of the valley and developing a conceptual understanding of the groundwater flow system
2. Creating a variety of data sets to conduct steady-state and transient calibrations
3. Constructing the model using the MicroFEM® finite-element groundwater flow code (Hemker and de Boer, 2003), and also using the available database and geographic information system (GIS) information for the Santa Clarita Valley
4. Calibrating the model
5. Performing sensitivity tests on the model

This appendix provides an overview of the groundwater model's construction and calibration. The initial construction and calibration of the model and the SWRM are described in detail in the *Regional Groundwater Flow Model for the Santa Clarita Valley, Santa Clarita, California* (CH2M HILL, 2004a). Subsequent checks of, and minor updates to, the model's calibration were performed in early 2005 (CH2M HILL, 2005) and again in 2008 (see Section 2 of this report) as hydrologic and water use data became available for years subsequent to 1999.

A 2 odel onstru tion

A 2 Software

The groundwater model was constructed using the three-dimensional, finite-element groundwater modeling software MicroFEM® (Hemker and de Boer, 2003). MicroFEM® operates in a Windows™ environment and can be used to solve groundwater flow problems for unconfined, semi-confined, or confined aquifer systems. This software simulates steady-state or transient flow conditions in up to a 20-layer aquifer system; the finite-element mesh may contain as many as 50,000 nodes in each model layer. The software contains several different methods for simulating groundwater/surface water interactions. MicroFEM® is based on software developed in the Netherlands during the 1980s for use in evaluating the effects of groundwater pumping in areas with complicated meandering rivers. Further details regarding this software's design, capabilities, and functionality can be found on the Internet at www.microfem.com and in two reviews of the software by Diodato (1997, 2000).

A 2 2 odel Grid

The groundwater flow model is based on a finite-element mesh consisting of 7 layers, with 17,103 nodes and 32,496 elements in each layer. The nodes are spaced 500 feet apart in the majority of the modeled area. However, a finer node spacing (150 feet) was used along the Santa Clara River and its tributaries to allow a more exact simulation of surface water/ groundwater exchanges. Additionally, specific nodes were placed within this regional grid at the locations of production and monitoring wells.

A 2 3 La ering

The upper model layer simulates the Alluvial Aquifer, or the upper portion of the Saugus Formation wherever the Alluvial Aquifer is not present. The six underlying layers simulate the underlying freshwater Saugus Formation and the Sunshine Ranch Member. The northern and southern edges of the model domain are defined by the geologic contacts mapped by Richard C. Slade and Associates, LLC (2002), formerly known as Richard C. Slade, Consulting Groundwater Geologist (both hereafter referred to as RCS), for the Alluvial Aquifer and the Saugus Formation.

The saturated thickness of the Alluvial Aquifer was defined from the average base elevation of the aquifer and the water level elevations measured during the fall of 1985 and the spring of 2000, as described by RCS (1986 and 2002). Along the Santa Clara River, the typical saturated thickness of the Alluvial Aquifer is as much as 130 feet in the western (down-gradient) portion of the basin and between 80 and 90 feet in the eastern (upgradient) portion of the basin, though it can be notably less in this area during droughts. Saturated thicknesses can be less than 60 feet in some tributary canyons, particularly along the South Fork Santa Clara River, where all production wells are constructed in the Saugus Formation, rather than the alluvium (RCS, 2002).

The Saugus Formation is generally a bowl-shaped structure that thins at its margins and has its greatest thickness (about 5,500 feet) in the center of the basin. The upper, freshwater-bearing portion of the Saugus Formation was simulated using 500-foot-thick model layers to depths as great as 2,500 feet in the center of the basin (RCS, 1988 and 2002). The deepest active model layer at any given location represented the Sunshine Ranch Member of the Saugus Formation, which is of marine origin and, therefore, is more saline and thought to have lower water-bearing potential than the overlying Saugus Formation deposits that are terrestrial in origin.

A 2 4 Boundar onditions

The following boundary conditions were used in the model:

1. **Specified flux for precipitation within the model grid.** Deep percolation of precipitation was simulated using the precipitation top-system package contained in MicroFEM®.

2. **Specified flux for irrigation.** Deep percolation of agricultural irrigation and urban irrigation in developed areas was simulated using the precipitation top-system package contained in MicroFEM®.
3. **Specified flux and head-dependent flux along ephemeral streams**. With respect to groundwater discharges to streams, the Santa Clara River was modeled as an ephemeral, predominantly losing stream at and upstream of the mouth of San Francisquito Canyon, and as a perennial, predominantly gaining stream downstream of San Francisquito Canyon. The tributaries to the Santa Clara River were modeled as ephemeral streams, using the precipitation top-system package to specify stream leakage to groundwater. For these tributaries and the ephemeral reach of the Santa Clara River, groundwater recharge rates were estimated from precipitation records, stream-flow records, watershed maps, topographic maps, and aerial photography using the SWRM, which was developed specifically to calculate time-varying recharge at each stream node from these data. Aerial photos and historical observations indicated that under high water table conditions, groundwater can locally discharge into Castaic Creek and the ephemeral reach of the Santa Clara River wherever Alluvial groundwater levels rise above the riverbed elevation. Consequently, the drain package in MicroFEM® was used in these streams to allow for drainage of any groundwater that was calculated by MicroFEM® to be above the riverbed elevation in any given river node at any given time step.
4. **Specified flux and head-dependent flux along perennial Santa Clara River**. The perennial reach of the Santa Clara River was modeled using the wadi top-system package contained in MicroFEM®. The wadi package allows groundwater to discharge to the river whenever groundwater elevations are higher than the specified river stage. When groundwater levels are below the river stage, the river recharges the Alluvial Aquifer. The rate of recharge is proportional to the difference between the river stage elevation and the model-calculated groundwater elevation. However, after the groundwater elevation drops below the streambed sediments, the rate of leakage from the stream is constant (i.e., does not vary as the groundwater elevation fluctuates). For the Santa Clarita Valley groundwater flow model, each node along the perennial reach of the Santa Clara River was assigned a river stage 1 foot higher than the mapped bed elevation of the river. The riverbed permeability, or conductance, which helps control the model-calculated groundwater/surface water exchange rates, was adjusted during model calibration by calibrating to streamflow data collected at the County Line gage.
5. **Specified flux for pumping**. Pumping rates and locations for wells completed in the Alluvial Aquifer and the Saugus Formation were directly imported into the model from the Upper Santa Clara River Groundwater Basin database. For model calibration, pumping rates were assigned from water use records maintained by the Upper Basin Water Purveyors; estimates of monthly water demand for urban water use and agricultural water use; and well construction records, which were needed to determine which model layers at each individual well should be assigned pumping
6. **Specified flux at upgradient Alluvial Aquifer boundaries.** Where there is Alluvial groundwater flow into the study area from beneath Castaic Dam, the magnitude of the

specified flux was adjusted during the model calibration process using groundwater elevations and gradients published by RCS (1986 and 2002).

7. **Specified groundwater elevation in the Alluvial Aquifer at the county line.** The groundwater elevation (805 feet) was obtained from water level contour maps for the Alluvial Aquifer prepared by RCS (1986, 2002). (See also CH2M HILL [2004a].)

8. **Specified groundwater elevation in the Alluvial Aquifer at the Lang gage.** The groundwater elevation (1,746 feet) was derived from topographic maps of the elevation of the Santa Clara River bed. As discussed in *Final Report: Analysis of Perchlorate Containment in Groundwater Near the Whittaker-Bermite Property* (CH2M HILL, 2004b), the boundary condition at this location was converted to a constant-head boundary shortly after completion of the model development report. This change was made based on results from field reconnaissance that was performed in April and May of 2004, when the Santa Clara River was dry at the Lang gage. At that time, groundwater was locally discharging from the bed of the Santa Clara River in isolated locations where the riverbed intersects the water table, then seeping back into the riverbed nearby. Significant phreatophyte growth was also present along the riverbed in this same area (just downstream of the Lang gage). Additionally, water was present and actively flowing in the river east (upstream) of the Santa Clarita Valley (in the area between the Santa Clarita Valley and the upstream Acton Basin). Based on these observations, a specified groundwater elevation of 1,746 feet was established in the Alluvial Aquifer at the eastern boundary of the model to simulate subsurface flow beneath the channel of the Santa Clara River at the Lang gage. This specified elevation was held constant throughout the simulation period.

9. **Head-dependent flux for evapotranspiration (ET).** ET from the water table by riparian vegetation was simulated using the evaporation top-system package contained in MicroFEM®. This package requires specification of the maximum rooting depth for the riparian vegetation, the maximum potential ET rate, and the ground surface elevation.

10. **No-flow boundaries**. In general, the outermost line of nodes that form the model boundary and the bottom of the model are no-flow boundaries. The exceptions are the western model boundary (specified head) and the specified-flux nodes representing underflow into the Alluvial Aquifer from beneath Castaic Dam. Also, all nodes on the model boundary are assigned specified fluxes due to precipitation and, in some cases, ephemeral streamflow.

A 2 Aquifer Parameters

The selection of the aquifer parameter values (horizontal and vertical hydraulic conductivity, storage coefficients, streambed conductance, and ET parameters) is described in detail in Sections 4 and 5 of the model development report (CH2M HILL, 2004a). Initial estimates of, and ranges of values for, these parameters were defined during initial model development and adjusted on an as-needed basis, and within certain limits, during model calibration. Additionally, the calibration process adjusted the coefficients for an empirical power-function equation (Turner, 1986) that was used in the SWRM to define the relationship between precipitation, stormwater flow, and the amount of stormwater flow available for potential infiltration to groundwater. Adjustments to some of the parameters have been made during recent calibration update efforts, as described in Section 2 of this report.

A 3 odel ali ration

A 3 ali ration Pro ess

Calibration of the groundwater flow model involved matching both steady-state and transient conditions in the Alluvial Aquifer and the Saugus Formation. The steady-state calibration was performed for calendar years 1980 through 1985, and the initial transient calibration effort was performed for calendar years 1980 through 1999, as described by CH2M HILL (2004a). Subsequent checks of, and minor updates to, the model's calibration were performed in early 2005 (CH2M HILL, 2005) and again in 2008 (see Section 2 of this report) as hydrologic and water use data became available for years subsequent to 1999.

The goals of the calibration process have been generally to match groundwater flow directions, groundwater gradients, and groundwater elevations that were measured throughout the period of historical record at wells across the valley. An additional calibration goal has been to match the patterns of total flow in the Santa Clara River and estimated groundwater discharge rates to the river. The Alluvial Aquifer and the Saugus Formation were each subdivided into zones to facilitate parameter selection and model calibration. Model variables are adjusted in a manner that seeks to honor independent estimates of parameter values while resulting in the best possible calibration.

A 3 2 ali ration ualit

The calibrated version of the model meets most of the qualitative and quantitative goals that were established for the calibration process. For the steady-state model, statistical goals for the head residuals, which are equal to the modeled minus measured groundwater elevations, were easily met for the Alluvial Aquifer and adequately met for the Saugus Formation. For the transient model, trends in groundwater elevations were generally well matched, and groundwater discharges to the river were simulated well for both the steady-state and transient models. However, during the middle and late 1990s, the model tended to simulate too much decline in Alluvial Aquifer groundwater elevations in the eastern-most portion of the valley. This is the area where local droughts have the greatest effect on the Upper Basin Water Purveyors' ability to pump groundwater, so this deviation is acceptable because predictive simulations of various groundwater pumping strategies will not overestimate the degree to which groundwater can be pumped from the Alluvial Aquifer in this area during periods of below-normal rainfall.

The groundwater budget for the initial 20-year transient calibration period 1980 through 1999 showed that recharge from precipitation and streamflows varied considerably from year to year, ranging from less than 15,000 acre-feet per year (AF/yr) in the driest years to as much as 270,000 AF/yr in the wettest years. In contrast, total groundwater discharges were less variable, ranging from approximately 61,000 AF/yr at the end of the late 1980s/early 1990s drought to 116,000 AF/yr during 1998. This variability in groundwater discharge did not follow the year-to-year pumping patterns, but instead was caused by year-to-year fluctuations in ET and groundwater discharges to the river. These fluctuations, in turn, correlated well with groundwater recharge patterns. During the initial 20-year transient calibration period, changes in the volume of groundwater stored in the combined Alluvial-Saugus aquifer system varied primarily according to year-to-year variations in regional rainfall. No long-term decline in groundwater storage was observed in the field or simulated by the model during this initial 20-year calibration period.

A 4 odel Sensitivit

Sensitivity analyses were performed during the model's initial calibration (CH2M HILL, 2004a) to evaluate whether further changes in the values of key model parameters would improve the model's calibration quality. Variables that were tested were the hydraulic properties (horizontal and vertical hydraulic conductivities and storage coefficients) for the Alluvial Aquifer and the Saugus Formation, the riverbed leakage terms for the Santa Clara River and Castaic Creek, and the ET parameters. The sensitivity analysis indicated that the model is sensitive to the choices of horizontal hydraulic conductivity in both aquifers and the vertical hydraulic conductivity values in the Saugus Formation. The model is also sensitive to the surface water parameters, specifically the choice of empirical coefficients used by the Turner (1986) equation to estimate stormwater flows from rainfall data and the riverbed leakage terms in both the eastern (groundwater recharge) and western (groundwater discharge) portions of the basin. The model is relatively insensitive to the choice of ET parameters.

A odel Appli a ilit

The process of developing the conceptual model of the local groundwater basin, developing a detailed numerical model, and calibrating the model to more than 20 years of groundwater elevation and streamflow data, has resulted in a groundwater flow model that is suitable for its intended applications, which are evaluating groundwater management strategies, groundwater sustainability, artificial recharge options, and restoration of contaminated water supplies. The primary design and calibration attributes that make the model appropriate for its intended uses are as follows:

1. Its ability to simulate historical trends in groundwater elevations and river flows during a nearly 3-decade period that reflects increased urbanization, increased State Water Project water imports (from outside the valley), and associated changes in land use and water use
2. Its ability to simulate trends in smaller geographic areas of interest within the valley (for example, near the Whittaker-Bermite property)
3. Its use of an integrated model of the watershed to define the amount of rainfall and stormwater that is potentially available to recharge the groundwater system

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Appendi B

pdated Santa larita alle Groundwater low odel ali ration Ta les and drographs

TABLE B-1

Annual Groundwater Pumping from the Alluvial Aquifer

Upper Santa Clara River Groundwater Basin, East Subbasin, Los Angeles County, California

Owner	Well Name	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
NCWD	Castaic1	244	257	253	189	251	274	295	450	520	478	444	561	515	458	496	401	385	535	166	426	118	345	385	561	456	360	557	392
	Castaic2	124	48	0	0	0	0	380	535	324	678	0	0	0	477	518	380	327	268	257	331	289	166	0	123	403	288	310	162
	Castaic3	0	108	136	172	240	301	0	0	324	0	660	532	488	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Castaic4	0	0	0	0	0	0	0	0	0	39	0	0	0	0	0	0	0	95	57	6	7	100	47	56	80	66	198	38
	Pinetree1	346	326	355	242	148	273	8	0	2	152	0	47	16	247	154	79	64	89	227	403	245	164	0	0	0	131	242	343
	Pinetree2	58	84	209	112	154	113	206	309	351	348	31	0	283	326	218	165	70	0	0	0	0	0	0	0	0	0	0	0
	Pinetree3	398	527	225	432	753	655	719	756	758	672	801	724	682	450	607	595	624	812	716	505	494	566	544	525	643	335	427	473
	Pinetree4	0	0	0	0	3	28	234	77	4	0	0	0	10	19	232	55	333	510	338	5	355	300	5	0	0	208	415	399
NLF	161	317	370	271	223	314	220	170	0	0	0	120	82	401	753	791	0	0	0	0	123	328	496	485	2,021	1,834	986	1,069	645
	B10	0	0	0	0	0	0	0	0	0	0	0	291	1,225	452	1,406	894	1,045	930	1,244	1,155	1,446	1,240	534	344	589	592	466	140
	B11	186	217	159	133	184	138	60	0	0	127	445	311	0	136	51	127	151	30	250	212	87	205	232	271	338	81	30	34
	B5	1,218	1,423	1,041	858	1,208	772	1,178	1,002	1,481	1,928	1,893	1,880	860	989	1,950	1,921	1,649	1,756	1,273	1,748	2,008	1,680	2,280	1,582	2,166	2,129	2,673	1,730
	B6	858	1,002	733	604	850	543	946	788	165	96	137	263	615	283	808	1,359	1,421	1,602	1,572	2,133	870	1,312	2,175	1,766	1,356	1,090	1,216	834
	B7	0	0	0	0	0	0	60	0	0	127	0	0	400	180	581	373	56	286	176	444	461	474	584	402	71	0	0	0
	B14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	239	1,125
	B20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	347	483
	C	723	845	618	510	717	575	660	387	418	557	338	226	756	1,024	417	1,324	715	1,126	598	716	1,034	1,319	1,720	1,373	1,202	1,091	1,197	817
	C3	196	229	168	138	195	140	254	63	130	71	134	48	197	259	582	333	397	355	378	619	441	93	192	186	59	0	124	362
	C4	260	304	222	183	258	196	137	25	30	7	213	225	166	12	108	150	293	483	609	819	1,078	1,028	809	764	274	0	358	663
	C5	459	536	392	323	455	359	328	191	198	154	147	250	428	414	394	472	676	894	628	685	605	680	850	622	649	864	896	1,027
	C6	203	237	174	143	201	166	161	103	117	77	59	123	0	0	0	360	229	226	128	154	164	231	241	108	119	1	0	0
	C7	575	671	491	405	570	354	195	192	318	337	339	220	427	279	625	778	582	779	779	1,167	503	741	866	443	369	366	336	905
	C8	0	0	0	0	0	0	0	0	0	0	0	0	126	254	166	199	458	432	179	236	241	286	593	408	390	316	463	192
	C11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	271	355
	E	2,067	2,416	1,767	1,457	2,051	3,342	1,842	1,180	812	624	965	498	1,325	1,513	1,022	1,366	2,542	1,949	1,522	2,506	2,084	1,691	16	28	0	0	0	0
	E2	174	203	149	123	173	138	103	0	0	251	1,284	830	560	584	555	115	669	525	426	138	125	141	55	14	463	107	0	0
	E3	0	0	0	0	0	0	0	0	0	0	0	0	0	15	138	0	0	0	0	0	0	0	0	0	0	0	0	0
	E4	1,011	1,181	864	712	1,003	639	716	83	566	392	553	284	376	16	0	381	140	339	80	281	66	0	0	0	0	0	0	0
	E5	0	0	0	0	0	0	0	0	0	0	0	0	65	274	0	142	514	598	42	0	47	172	679	537	284	157	92	17
	E7	0	0	0	0	0	0	0	0	0	0	0	0	116	80	105	88	79	2	0	0	0	0	0	0	0	0	0	0
	E9	96	113	82	68	96	78	117	288	476	411	339	596	252	187	435	319	12	142	170	42	38	238	814	47	609	842	992	42
	G45	324	378	277	228	321	179	153	98	123	99	143	146	165	82	144	137	159	180	144	231	197	291	283	60	0	26	690	597
	Q	441	515	377	311	438	159	360	382	312	185	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	R	0	0	0	0	0	0	0	205	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	R2	159	186	136	112	158	71	104	47	0	0	0	87	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S2	293	342	250	206	290	95	0	958	0	0	503	0	0	0	0	0	0	0	0	276	237	0	0	0	0	0	0	0
	S3	655	765	560	461	649	327	124	0	0	0	29	37	52	99	87	109	97	55	10	3	0	0	0	0	0	0	0	0
	Topco 1	0	0	0	0	0	0	0	0	0	0	0	0	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Topco 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	W4	303	354	259	213	300	138	60	1	0	300	157	252	1	0	36	5	128	29	20	3	0	46	1	0	0	0	0	0
	W5	553	646	472	389	548	191	315	205	308	192	0	175	0	0	0	0	0	0	0	21	17	276	104	23	0	0	18	0
	X3	260	304	222	183	258	508	244	314	497	308	412	215	350	135	205	222	8	108	22	112	10	12	0	0	6	0	0	0
SCWD	Clark	303	228	131	137	194	200	208	342	248	301	407	542	662	635	572	662	1,027	873	697	878	747	696	782	712	728	694	777	795
	Guida	1,058	795	457	477	677	698	221	569	158	530	676	801	978	895	942	744	1,252	1,479	1,274	1,556	853	1,047	1,320	1,230	1,432	1,487	1,479	1,384
	Honby	594	447	257	268	381	392	193	391	462	216	930	893	731	1,393	476	553	352	814	532	1,162	815	721	696	874	707	1,289	886	1,291
	Lost Canyon 2	1,083	814	468	489	693	714	765	923	787	588	601	404	465	692	669	773	678	792	757	946	708	741	730	644	785	853	837	802
	Lost Canyon 2A	0	0	0	0	0	0	0	0	0	0	293	832	1,284	1,080	1,383	1,230	1,370	1,055	973	890	998	1,034	905	593	756	738	799	554
	Methodist	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mitchell	1,189	893	515	537	761	785	444	582	485	435	264	3	474	663	564	610	598	633	482	913	439	407	293	19	54	1,158	1,996	1,728
	N.Oaks Central	488	367	211	220	313	322	304	361	153	329	525	704	701	1,403	1,313	965	851	870	1,490	1,682	1,145	822	1,646	1,641	669	1,700	1,024	14
	N.Oaks East	601	451	260	271	385	396	863	972	776	914	454	194	588	1,233	1,473	1,295	900	1,033	1,407	695	1,483	1,234	448	485	595	941	987	1,028
	N.Oaks West	643	483	278	290	412	424	874	465	842	413	275	78	634	866	972	795	663	952	934	1,894	1,663	898	1,123	31	858	904	1,143	30
	Sand Canyon	721	542	312	325	461	477	514	466	498	1,115	458	49	661	918	781	842	1,211	1,533	1,622	1,629	1,317	930	705	195	562	1,260	1,557	1,408
	Sierra	2,780	2,089	1,202	1,255	1,780	1,834	856	220	459	730	772	719	1,050	1,413	1,433	1,092	1,034	597	814	1,158	640	846	87	0	0	1,384	1,671	1,652
	Stadium	0	0	0	0	0	0	167	291	211	214	328	374	60	825	418	656	509	637	444	338	721	565	778	0	0	0	0	0

TABLE B-1
Annual Groundwater Pumping from the Alluvial Aquifer
Upper Santa Clara River Groundwater Basin, East Subbasin, Los Angeles County, California

Owner	Well Name	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
VWC	D	289	269	164	163	240	41	0	305	588	614	510	680	239	173	494	403	454	1,134	1,209	921	880	646	772	687	833	1,178	1,048	870
	E15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	838	1,263
	I	214	200	122	121	177	181	95	0	91	132	73	108	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	K2	0	0	0	0	0	0	0	0	0	0	0	982	1,134	1,708	2,089	1,155	1,305	1,076	1,489	1,420	861	669	954	364	0	0	0	0
	L2	9	8	5	5	7	91	0	0	0	0	0	838	526	996	1,236	818	961	308	190	532	494	349	490	71	0	0	0	0
	N	1,475	1,376	840	833	1,223	1,093	1,472	1,420	1,473	1,177	792	976	697	66	0	24	263	808	768	1,036	935	591	700	622	587	282	1,054	849
	N3	0	0	0	0	0	0	0	0	0	0	0	10	999	1,536	29	943	1,325	1,034	1,093	1,057	778	226	857	255	0	0	0	0
	N4	5	5	3	3	4	65	0	0	0	0	0	847	248	133	911	1,329	1,328	1,185	772	894	710	458	909	248	0	0	0	0
	N7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	486
	N8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	539
	Q2	440	411	251	248	367	461	838	893	512	1,483	1,398	1,783	335	548	1,348	1,126	1,385	1,462	1,655	1,288	1,387	923	1,167	1,451	1,096	404	1,280	1,116
	S6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	515	1,490	1,320	2,134	2,301	1,694	1,579	1,751
	S7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	111	564	419	1,095	471	186	766	675
	S8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79	327	190	409	153	2,095	437	422
	T2	621	580	354	351	515	704	894	913	1,007	1,030	643	662	379	0	3	280	733	837	941	726	984	700	696	1,014	822	724	0	0
	T4	160	150	91	91	133	54	167	0	0	0	0	163	687	3	1	975	1,258	804	523	892	625	690	831	799	747	823	0	0
	U3	1,476	1,378	841	834	1,225	1,278	1,033	638	323	823	1,254	1,199	369	1	2	765	987	851	560	702	1,126	956	572	823	0	0	0	0
	U4	1,306	1,220	744	738	1,084	665	668	606	696	567	551	584	42	3	2	7	742	789	529	828	1,073	942	796	934	625	1,049	750	790
	U6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	636	1,323
	W6	0	0	0	0	0	0	0	146	145	0	0	217	260	204	224	365	615	493	355	416	445	182	0	0	0	0	0	0
	W9	0	0	0	0	0	0	0	0	0	0	11	902	699	444	507	508	1,077	915	627	1,111	1,176	806	939	764	566	995	951	931
	W10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	1,537	1,674	990	1,244
	W11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	123	1,123	1,556	881
WHR	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10	1,842	1,842	1,842	1,842	1,842	1,842	1,842	1,842	1,842	1,842	1,229	1,376	772	1,104	1,204	1,352	760	614	1,229	1,131	1,010	1,000	1,000	1,000	2,000	2,000	2,000	2,000
	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	15	137	137	137	137	137	137	137	137	137	137	91	102	57	82	89	100	56	46	91	84	75	74	72	173	74	0	0	0
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	17	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021	1,021	680	762	427	612	666	748	421	340	680	627	559	530	530	1,100	1,031	842	1,026	85
	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Pumping (NCWD)		1,170	1,350	1,178	1,147	1,549	1,644	1,842	2,127	2,283	2,367	1,936	1,864	1,994	1,977	2,225	1,675	1,803	2,309	1,761	1,676	1,508	1,641	981	1,265	1,582	1,389	2,149	1,806
Total Pumping (SCWC)		9,460	7,109	4,091	4,269	6,057	6,242	5,409	5,582	5,079	5,785	5,983	5,593	8,288	12,016	10,996	10,217	10,445	11,268	11,426	13,741	11,529	9,941	9,513	6,424	7,146	12,408	13,156	10,686
Total Pumping (VWC)		5,995	5,597	3,415	3,387	4,975	4,633	5,167	4,921	4,835	5,826	5,232	9,951	6,615	5,815	6,847	8,698	12,433	11,696	10,711	11,823	12,179	10,519	11,612	11,706	9,861	12,227	11,884	13,140
Total Pumping (All Purveyors)		16,625	14,056	8,684	8,803	12,581	12,519	12,418	12,630	12,197	13,978	13,151	17,408	16,897	19,808	20,068	20,590	24,681	25,273	23,898	27,240	25,216	22,101	22,106	19,395	18,589	26,024	27,189	25,632
Total Pumping (NLF)		11,331	13,237	9,684	7,983	11,237	9,328	8,287	6,512	5,951	6,243	8,225	7,039	8,938	8,020	10,606	11,174	12,020	12,826	10,250	13,824	12,087	12,652	13,513	10,999	10,778	8,648	11,477	9,968
Total Pumping (WHR)		3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	2,000	2,240	1,256	1,798	1,959	2,200	1,237	1,000	2,000	1,842	1,644	1,604	1,602	2,273	3,105	2,842	3,026	2,085
Total Pumping (Others)		500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	932	932	932	932	953	890	909	1,071	633	869	588
Total Alluvial Aquifer Pumping		31,456	30,793	21,868	20,286	27,318	25,347	24,205	22,642	21,648	23,721	23,876	27,187	27,591	30,126	33,133	34,464	38,438	40,031	37,080	43,838	39,879	37,310	38,111	33,576	33,543	38,147	42,560	38,273

Notes:

All pumping volumes are listed in acre-feet and are from records maintained by the Upper Basin Water Purveyors.

NCWD = Newhall County Water District
NLF= Newhall Land & Farming Company
VWC = Valencia Water Company
SCWD = Santa Clarita Water Division of Castaic Lake Water Agency
WHR = Wayside Honor Rancho / Los Angeles County Waterworks District 36

TABLE B-2

Annual Groundwater Pumping from the Saugus Formation

Upper Santa Clara River Groundwater Basin, East Subbasin, Los Angeles County, California

Owner	Well Name	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
NCWD	7	404	396	350	348	355	384	271	260	332	242	242	274	180	268	321	364	332	288	280	172	0	0	0	0	0	0	0	0
	4	440	449	319	385	315	369	222	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	119	227	115	138	1	0	5	1	1	0	4	1	1	0	1	0	0	0	0	0	0	0	0	0
	10	790	906	1,287	1,300	1,007	997	731	888	613	453	644	343	351	61	0	1	0	0	2	0	0	0	0	0	0	0	0	0
	11	729	870	716	754	1,159	1,278	2,209	2,371	1,265	1,280	1,252	1,034	428	730	614	522	353	81	14	0	0	0	0	0	0	0	0	0
	12	0	0	0	0	0	0	0	0	1,830	2,713	2,603	3,342	2,807	1,956	1,918	2,264	2,140	1,798	1,909	1,155	1,767	1,242	1,758	1,013	1,833	1,878	2,305	1,397
	13	0	0	0	0	0	0	0	0	0	0	0	0	1,393	2,053	2,246	1,623	2,045	3,001	2,351	1,295	419	1,190	1,637	1,500	1,906	1,558	1,118	2,294
NLF	156	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	266	445	426	479	374	300	211	122	268	6	934	971
SCWC	Saugus1	0	0	0	0	0	0	0	0	31	0	0	1,690	437	1,226	1,333	0	410	451	0	0	0	0	0	0	0	0	0	0
	Saugus2	0	0	0	0	0	0	0	0	32	0	40	3,091	2,476	1,675	2,530	1,726	1,766	617	0	0	0	0	0	0	0	0	0	0
VWC	157	635	604	529	239	387	314	581	483	1,223	1,146	635	1,005	570	436	616	403	46	80	0	0	0	0	0	0	0	0	0	0
	159	0	0	0	0	0	0	0	0	0	0	3	63	65	74	147	68	3	0	0	0	0	91	0	30	9	25	1	41
	160	1,571	1,725	368	372	467	571	846	822	1,077	1,326	839	1,325	580	920	957	585	206	401	133	95	1,332	707	347	864	1,526	846	583	681
	201	0	0	0	0	0	0	0	0	0	57	2,039	2,249	1,170	752	845	530	71	35	16	11	295	128	495	168	148	299	396	133
	205	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	101	0	123	511	813	1,478	613	771
	206	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	366	1,362	1,397
Total Pumping (NCWD)		2,363	2,621	2,672	2,787	2,955	3,255	3,548	3,657	4,041	4,688	4,746	4,994	5,160	5,068	5,103	4,775	4,871	5,168	4,557	2,622	2,186	2,432	3,395	2,513	3,739	3,435	3,423	3,691
Total Pumping (SCWC)		0	0	0	0	0	0	0	0	63	0	40	4,781	2,913	2,901	3,863	1,726	2,176	1,068	0	0	0	0	0	0	0	0	0	0
Total Pumping (VWC)		2,206	2,329	897	611	854	885	1,427	1,305	2,300	2,529	3,516	4,642	2,385	2,182	2,565	1,586	326	516	149	106	1,728	926	965	1,573	2,496	3,014	2,955	3,023
Total Pumping (All Purveyors)		4,569	4,950	3,569	3,398	3,809	4,140	4,975	4,962	6,404	7,217	8,302	14,417	10,458	10,151	11,531	8,087	7,373	6,752	4,706	2,728	3,914	3,358	4,360	4,086	6,235	6,449	6,378	6,713
Total Pumping (NLF)		20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	266	445	426	479	374	300	211	122	268	6	934	971
Total Pumping (Others)		0	0	501	434	620	555	490	579	504	522	539	480	446	439	474	453	547	548	423	509	513	513	513	513	513			
Total Saugus Formation Pumping		4,589	4,970	4,090	3,852	4,449	4,715	5,485	5,561	6,928	7,759	8,861	14,917	10,924	10,610	12,025	8,560	8,186	7,745	5,555	3,716	4,801	4,171	5,084	4,721	7,016	6,455	7,312	7,684

Note:

All pumping volumes are listed in acre-feet and are from records maintained by the Upper Basin Water Purveyors.

NCWD = Newhall County Water District

NLF= Newhall Land & Farming Company

VWC = Valencia Water Company

SCWD = Santa Clarita Water Division of Castaic Lake Water Agency

WHR = Wayside Honor Rancho / Los Angeles County Waterworks District 36

TABLE B-3
Allocation of umping, by onth, for Agricultural and rban roduction Wells
pper Santa Clara i er Ground ater asin, East Subbasin, Los Angeles County, California

Month	% of Annual Water Use, Agricultural	% of Annual Water Use, Urban	% of May through October Water Use, Urban
January	3.8	5.2	
February	5.1	3.7	
March	6.6	5.2	
April	9.1	6.6	
May	10.6	8.7	13.2
June	11.4	10.4	15.8
July	14.1	13.0	19.7
August	12.9	13.6	20.6
September	10.2	10.9	16.5
October	7.5	9.3	14.1
November	5.0	7.1	
December	3.8	6.3	
Total	**100.0**	**100.0**	**100.0**

TABLE B-4

onthly recipitation easured at the e hall County Water istrict ain Gage

pper Santa Clara i er Ground ater asin, East Subbasin, Los Angeles County, California

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1980	10.36	14.63	4.84	0.36	0.40	0.00	0.00	0.00	0.00	0.00	0.00	1.36	31.95
1981	4.76	1.66	5.50	0.46	0.00	0.00	0.00	0.00	0.00	0.58	3.62	0.22	16.80
1982	3.33	1.21	9.50	1.09	0.13	0.00	0.00	0.00	1.02	0.25	5.34	2.95	24.82
1983	8.67	6.85	13.07	4.61	0.20	0.00	0.00	1.17	1.85	1.74	5.04	5.13	48.33
1984	0.00	0.00	0.27	0.07	0.00	0.00	0.00	0.00	0.05	0.16	3.87	8.13	12.55
1985	0.78	1.20	1.04	0.14	0.07	0.00	0.06	0.00	0.12	0.54	5.11	0.70	9.76
1986	5.84	6.65	5.39	0.88	0.00	0.00	0.05	0.00	1.78	0.68	1.55	0.24	23.06
1987	2.10	0.61	1.69	0.14	0.00	0.00	0.09	0.02	0.00	3.47	3.84	4.80	16.76
1988	3.27	3.39	1.16	3.98	0.09	0.00	0.00	0.00	0.10	0.00	0.92	7.14	20.05
1989	0.89	4.13	1.30	0.30	0.00	0.00	0.00	0.00	0.62	0.86	0.37	0.00	8.47
1990	2.89	4.23	0.22	0.48	0.88	0.00	0.00	0.00	0.00	0.00	0.63	0.01	9.34
1991	1.11	5.72	11.33	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	5.95	24.61
1992	3.28	16.64	9.73	0.15	0.34	0.00	0.30	0.00	0.00	1.55	0.00	7.25	39.24
1993	17.11	11.73	4.27	0.00	0.00	0.65	0.00	0.00	0.00	0.57	0.75	1.00	36.08
1994	0.48	5.31	2.33	0.42	0.00	0.00	0.00	0.00	0.00	0.78	0.71	1.94	11.97
1995	21.98	1.93	8.30	0.72	0.26	0.76	0.00	0.00	0.00	0.00	0.00	2.33	36.28
1996	2.97	6.73	2.08	0.13	0.68	0.00	0.00	0.00	0.00	1.30	1.06	8.70	23.65
1997	6.67	0.23	0.00	0.00	0.00	0.00	0.05	0.00	0.53	0.00	3.73	6.72	17.93
1998	3.49	22.00	3.98	2.28	5.50	0.06	0.00	0.00	0.21	0.33	1.36	1.39	40.60
1999	2.08	0.65	3.00	3.78	0.00	0.48	0.00	0.00	0.01	0.00	0.00	0.05	10.05
2000	1.21	9.43	3.15	2.10	0.00	0.00	0.00	0.31	0.00	1.13	0.00	0.00	17.33
2001	5.84	10.76	3.38	2.56	0.00	0.00	0.00	0.00	0.00	0.22	3.18	1.30	27.24
2002	1.55	0.51	0.38	0.05	0.12	0.01	0.00	0.00	0.02	0.00	3.01	5.85	11.50
2003	0.00	9.03	2.38	2.35	1.70	0.00	0.02	0.00	0.00	1.10	0.63	2.57	19.78
2004	0.65	8.07	0.37	0.20	0.00	0.00	0.00	0.00	0.00	4.79	0.64	8.54	23.26
2005	17.06	16.69	2.70	1.42	0.45	0.00	0.00	0.00	0.17	1.91	0.59	0.14	41.13
2006	3.27	3.78	5.68	4.22	0.99	0.00	0.00	0.00	0.00	0.42	0.05	0.83	19.24
2007	1.66	1.38	0.17	0.71	0.00	0.00	0.00	0.00	1.32	0.25	0.50	2.67	8.66

Note:
All precipitation values are measured in inches.

TABLE B-5
easured and Estimated onthly Streamflo s in the Santa Clara i er at the Lang Gage
pper Santa Clara i er Ground ater asin, East Subbasin, Los Angeles County, California

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1980	1,310	7,449	1,213	568	218	78	6	0	37	274	467	553	12,175
1981	594	98	339	240	107	18	18	12	338	321	258	394	2,739
1982	333	1,420	785	283	238	0	0	0	0	95	178	855	4,188
1983	1,922	16,971	2,755	2,576	958	523	639	512	0	0	0	0	26,855
1984	0	596	405	240	143	166	228	411	154	220	904	578	4,044
1985	483	461	274	215	77	0	0	0	12	179	221	301	2,224
1986	483	1,138	488	283	107	6	0	12	6	12	80	129	2,744
1987	117	117	65	31	12	0	0	0	0	0	258	516	1,116
1988	222	209	506	117	77	68	0	0	0	0	12	25	1,236
1989	50	111	60	25	6	0	0	0	102	94	***34***	***18***	***499***
1990	***212***	***276***	***230***	***46***	***46***	***5***	***0***	***0***	***0***	***27***	***36***	***147***	***1,025***
1991	***162***	***775***	***879***	***736***	***145***	***142***	***14***	***0***	***45***	***69***	***62***	***263***	***3,291***
1992	***336***	***534***	***429***	***398***	***117***	***84***	***16***	***5***	***108***	***144***	***498***	***1,446***	***4,115***
1993	***14,709***	***5,336***	***1,194***	***530***	***239***	***110***	***54***	***10***	***64***	***145***	***264***	***281***	***22,937***
1994	***388***	***493***	***497***	***319***	***163***	***80***	***20***	***7***	***37***	***102***	***193***	***941***	***3,239***
1995	***1,211***	***1,421***	***954***	***802***	***268***	***156***	***62***	***8***	***6***	***1***	***27***	***189***	***5,104***
1996	***666***	***896***	***730***	***315***	***151***	***46***	***7***	***0***	***54***	***154***	***307***	***510***	***3,836***
1997	***517***	***346***	***140***	***85***	***33***	***5***	***4***	***50***	***66***	***240***	***566***	***809***	***2,859***
1998	***18,997***	***8,508***	***3,837***	***961***	***667***	***347***	***81***	***91***	***70***	***139***	***190***	***186***	***34,074***
1999	***92***	***85***	***204***	***224***	***197***	***107***	***80***	***46***	***52***	***54***	***31***	***80***	***1,252***
2000	***394***	***581***	***613***	***354***	***234***	***59***	***53***	***34***	***42***	***28***	***24***	***4***	***2,419***
2001	***333***	***1,420***	***785***	***283***	***238***	***0***	***0***	***0***	***0***	***95***	***178***	***855***	***4,188***
2002	***50***	***111***	***60***	***25***	***6***	***0***	***0***	***0***	***102***	***94***	***34***	***18***	***499***
2003	***666***	***896***	***730***	***315***	109	0	0	0	0	0	0	0	2,715
2004	0	30	0	0	0	0	0	0	0	25	0	1,652	1,707
2005	***13,686***	***11,359***	***6,046***	***3,000***	***1,750***	***1,000***	***500***	***400***	***300***	***239***	179	206	***38,665***
2006	418	352	510	920	381	69	0	0	0	0	0	0	2,650
2007	1	57	30	20	0	0	0	0	0	3	8	6	125

Note:
All monthly streamflows are measured in acre-feet. Values in bold italicized font are estimated from regression techniques and from estimates by LA County, because (1) the Lang gage was out of service from November 1989 through April 2003 and (2) the gage was flooded during several days in January 2005 and February 2005.

TABLE B-6

onthly reated Water ischarges easured at the alencia Water eclamation lant

pper Santa Clara i er Ground ater asin, East Subbasin, Los Angeles County, California

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1980	266	258	257	239	247	212	219	219	212	228	239	247	2,844
1981	248	220	249	235	244	237	253	255	248	263	285	270	3,006
1982	275	247	284	271	277	269	275	268	254	266	271	284	3,241
1983	286	261	301	288	296	277	287	296	282	286	276	295	3,432
1984	303	281	304	294	321	315	320	317	314	322	315	319	3,723
1985	309	283	316	316	333	331	354	359	348	361	357	341	4,006
1986	350	341	374	359	377	380	415	454	446	440	421	445	4,801
1987	455	415	472	489	550	567	603	594	579	633	600	624	6,582
1988	622	557	588	587	603	537	575	606	587	608	600	602	7,072
1989	622	593	695	666	671	708	714	731	668	678	673	676	8,095
1990	698	644	725	695	666	693	725	714	692	700	658	680	8,290
1991	715	662	702	627	668	646	647	691	709	743	717	748	8,276
1992	777	777	819	813	824	800	853	869	818	828	811	786	9,775
1993	778	733	863	858	869	925	910	846	816	834	818	858	10,107
1994	722	729	809	776	802	761	771	764	739	763	735	760	9,132
1995	889	777	935	887	884	848	853	814	826	834	823	855	10,225
1996	893	838	935	890	902	876	903	891	886	817	810	816	10,456
1997	815	713	866	829	852	879	860	851	824	826	778	775	9,867
1998	778	787	955	955	984	965	1,136	1,139	1,020	993	911	906	11,529
1999	930	868	962	953	985	968	1,003	1,018	961	1,020	1,040	987	11,695
2000	1,010	956	1,027	1,015	1,066	1,076	1,149	1,140	1,008	1,076	1,032	1,011	12,566
2001	964	916	1,044	1,013	1,082	1,049	1,120	1,105	1,059	1,107	1,053	1,064	12,575
2002	1,107	1,001	1,120	1,100	1,186	1,164	1,211	1,246	1,213	1,200	1,141	1,154	13,843
2003	1,159	1,083	1,205	1,311	1,367	1,339	1,416	1,423	1,374	1,346	1,316	1,321	15,660
2004	1,315	1,263	1,345	1,296	1,342	1,331	1,371	1,414	1,284	1,415	1,370	1,396	16,142
2005	1,519	1,467	1,597	1,533	1,629	1,541	1,577	1,587	1,505	1,599	1,522	1,476	18,552
2006	1,491	1,330	1,545	1,522	1,525	1,456	1,485	1,488	1,400	1,427	1,382	1,432	17,482
2007	1,429	1,325	1,440	1,425	1,455	1,418	1,461	1,497	1,461	1,530	1,470	1,486	17,398

Note:
All discharge values are measured in acre-feet.

TABLE B-7

onthly reated Water ischarges easured at the Saugus Water eclamation lant
pper Santa Clara i er Ground ater asin, East Subbasin, Los Angeles County, California

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1980	362	365	419	414	419	387	362	362	350	362	359	371	4,529
1981	382	337	390	398	444	412	417	429	431	434	412	460	4,945
1982	445	399	456	444	446	434	434	421	415	434	431	438	5,196
1983	460	421	514	541	562	545	520	477	458	481	477	534	5,990
1984	558	505	499	485	476	443	458	456	451	467	474	519	5,791
1985	503	461	505	458	448	444	452	459	452	470	460	498	5,610
1986	498	475	528	501	499	483	481	476	500	511	518	552	6,023
1987	524	475	542	487	425	383	391	403	395	397	411	430	5,264
1988	443	411	439	434	440	430	445	457	435	464	436	460	5,294
1989	462	410	441	450	464	436	476	479	462	471	451	466	5,468
1990	463	403	432	426	483	492	513	504	489	493	508	512	5,718
1991	495	423	479	427	491	516	557	525	486	474	470	493	5,835
1992	488	507	530	472	489	476	493	521	492	498	452	514	5,931
1993	595	534	616	581	615	587	622	604	578	609	567	567	7,075
1994	601	606	694	677	687	644	642	645	619	663	655	685	7,817
1995	657	578	676	705	699	631	641	635	617	613	568	581	7,602
1996	532	504	525	501	517	506	511	525	532	579	558	583	6,375
1997	564	516	515	461	469	417	442	474	475	503	521	553	5,911
1998	529	541	544	511	617	587	426	399	457	501	521	533	6,166
1999	542	485	551	391	544	512	547	532	521	527	487	514	6,153
2000	493	487	501	490	503	466	457	509	585	555	514	596	6,157
2001	592	531	572	510	500	490	485	519	510	527	553	560	6,350
2002	520	459	518	493	491	526	564	551	518	552	556	567	6,315
2003	551	500	528	343	352	332	328	335	325	326	325	352	4,596
2004	360	359	384	372	376	362	378	373	397	406	370	396	4,534
2005	409	359	379	359	387	371	383	409	397	407	394	439	4,693
2006	450	383	433	426	462	451	458	450	449	499	485	486	5,430
2007	472	429	476	454	474	468	475	483	463	434	437	468	5,533

Note:
All discharge values are measured in acre-feet.

TABLE B-8
onthly eleases of Water from Castaic Lagoon to Castaic Cree
pper Santa Clara i er Ground ater asin, East Subbasin, Los Angeles County, California

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1980	0	0	0	0	0	834	1,052	919	0	0	0	0	2,805
1981	105	0	0	1,490	46	0	0	0	0	0	0	0	1,641
1982	0	0	0	0	0	667	842	735	0	0	0	0	2,244
1983	0	0	0	0	0	1,168	1,473	1,287	0	0	0	0	3,928
1984	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	105	0	0	1,490	46	0	0	0	0	0	0	0	1,641
1987	105	0	0	1,490	46	0	0	0	0	0	212	0	1,853
1988	0	0	809	341	900	0	0	0	0	0	0	0	2,050
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	66	66
1992	0	0	580	3,052	667	127	24	0	0	0	0	0	4,450
1993	0	140	186	3,031	1,901	635	341	337	813	0	0	341	7,725
1994	210	0	0	2,979	93	0	0	0	0	0	0	0	3,282
1995	0	0	0	0	0	1,668	2,104	1,839	0	0	0	0	5,611
1996	0	0	0	4,961	671	0	0	0	0	0	0	0	5,632
1997	0	0	8,701	873	0	0	0	0	0	0	0	310	9,884
1998	1,186	19,545	10,747	4,566	7,561	47	1,370	436	464	302	652	926	47,802
1999	612	691	0	3,187	1,191	149	0	0	0	0	0	0	5,830
2000	0	660	855	0	2,087	3,484	0	0	0	0	0	0	7,086
2001	0	389	1,218	0	0	0	0	0	0	0	0	0	1,607
2002	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	2,286	418	315	0	0	0	0	0	0	3,019
2004	0	59	1,004	0	0	0	0	0	0	0	0	60	1,123
2005	32,391	37,514	12,993	3,613	2,891	90	1,657	32	0	0	0	0	91,181
2006	1,403	2,185	2,648	5,906	3,395	2,307	0	0	0	0	0	0	17,844
2007	0	0	0	0	0	0	0	0	0	0	0	0	0

Note:
All monthly releases are measured in acre-feet.

TABLE B-9

onthly Streamflo s easured in the Santa Clara i er at the County Line Gage

pper Santa Clara i er Ground ater asin, East Subbasin, Los Angeles County, California

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1980	8,428	43,565	18,125	8,551	3,792	3,963	1,202	1,111	1,668	1,470	1,452	1,884	95,211
1981	3,376	1,533	5,415	1,815	1,662	1,279	942	906	1,139	1,488	2,138	2,539	24,232
1982	2,826	2,358	5,572	7,091	3,909	1,749	1,694	1,392	1,597	1,621	3,449	3,229	36,487
1983	7,787	9,122	67,712	11,240	10,320	3,828	2,102	2,678	2,053	3,443	5,040	5,911	131,236
1984	5,691	3,931	4,084	4,530	2,309	1,607	1,224	1,511	1,464	1,624	3,237	8,067	39,279
1985	3,116	2,561	2,852	1,974	1,694	1,365	1,178	1,365	1,551	1,880	2,102	2,828	24,466
1986	3,955	13,991	10,616	3,328	2,612	1,622	1,454	1,482	1,870	1,896	2,606	2,590	48,022
1987	2,485	2,325	2,575	1,841	1,908	1,710	1,650	1,470	1,412	2,309	2,057	4,457	26,199
1988	3,421	2,981	3,025	3,172	2,636	2,231	1,734	1,494	1,605	1,904	2,027	10,381	36,611
1989	2,644	3,340	2,584	2,055	1,740	1,920	1,732	1,345	1,535	2,146	1,964	1,795	24,800
1990	2,709	3,247	2,269	1,898	1,730	1,545	1,478	1,751	1,668	1,660	1,924	1,593	23,472
1991	2,051	3,219	15,981	1,837	1,519	1,113	1,144	831	912	948	1,014	4,332	34,901
1992	3,737	37,636	9,576	4,439	1,964	1,533	1,377	1,085	1,129	1,329	1,496	3,277	68,578
1993	47,199	44,749	25,738	9,459	4,860	3,324	2,797	2,771	2,949	3,005	2,686	3,247	152,784
1994	3,281	3,437	3,501	3,533	3,519	2,200	1,640	1,400	1,192	1,855	2,263	4,219	32,040
1995	31,125	3,828	19,662	8,452	3,901	2,527	1,843	2,192	1,855	1,716	2,075	3,235	82,411
1996	3,604	10,669	7,678	6,073	3,584	1,678	1,640	1,579	1,509	2,625	1,590	5,701	47,930
1997	5,375	3,913	7,884	3,370	1,680	1,240	1,571	1,371	1,230	1,662	2,636	4,848	36,780
1998	5,875	104,388	25,377	9,378	34,992	5,312	3,935	3,537	2,579	2,450	2,890	4,427	205,140
1999	4,328	4,128	4,322	6,526	4,760	3,590	1,125	1,439	2,164	1,888	2,243	2,434	38,947
2000	2,470	12,210	6,400	2,910	3,610	5,250	1,890	1,490	1,560	1,950	1,890	2,290	43,920
2001	3,680	5,430	7,370	2,970	2,650	1,890	1,520	1,100	970	1,510	2,310	3,220	34,620
2002	2,980	2,060	2,610	2,390	1,730	1,680	1,600	772	1,010	1,440	2,490	4,330	25,092
2003	2,690	5,540	3,910	5,470	2,810	2,150	1,670	1,280	1,600	2,491	2,688	3,816	36,115
2004	4,046	7,202	4,261	2,005	1,851	1,851	1,340	1,648	1,440	5,909	2,636	15,679	49,868
2005	82,455	98,467	40,416	9,057	6,561	3,903	3,197	2,853	3,178	4,525	3,856	3,794	262,262
2006	9,156	9,713	9,660	11,800	6,665	5,314	2,324	1,740	1,797	2,380	2,547	2,742	65,837
2007	3,406	3,332	2,669	2,630	1,986	1,535	1,248	1,488	1,785	2,340	2,295	3,517	28,232

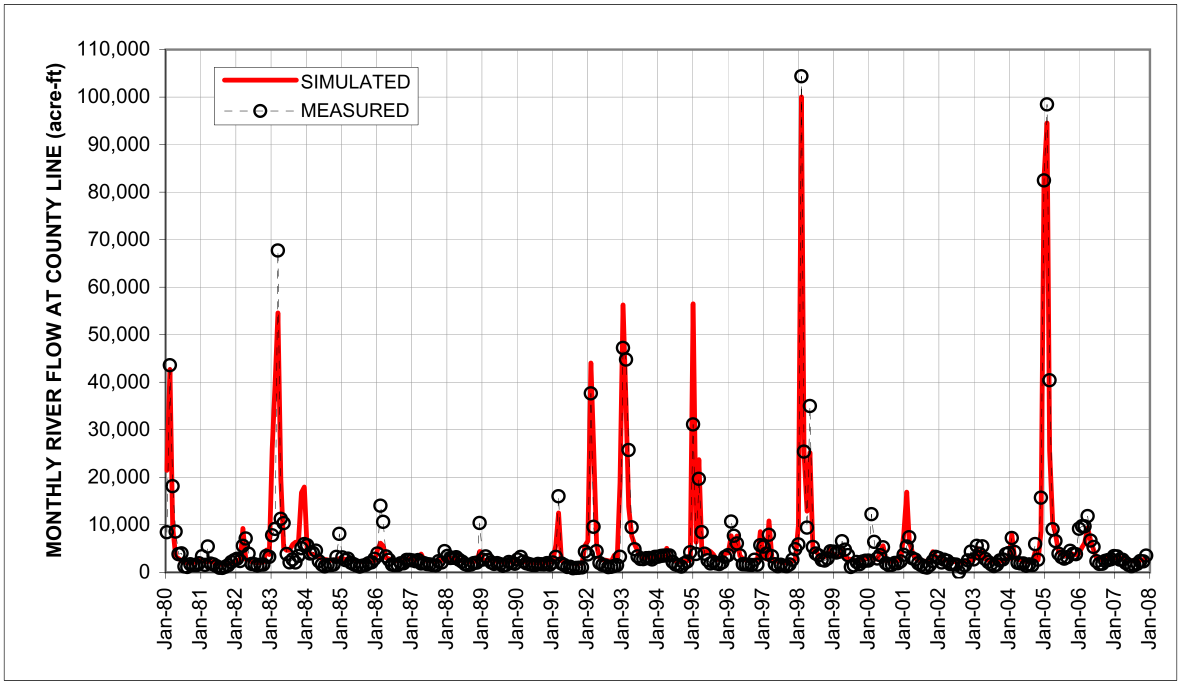
Note:
All monthly streamflows are measured in acre-feet.

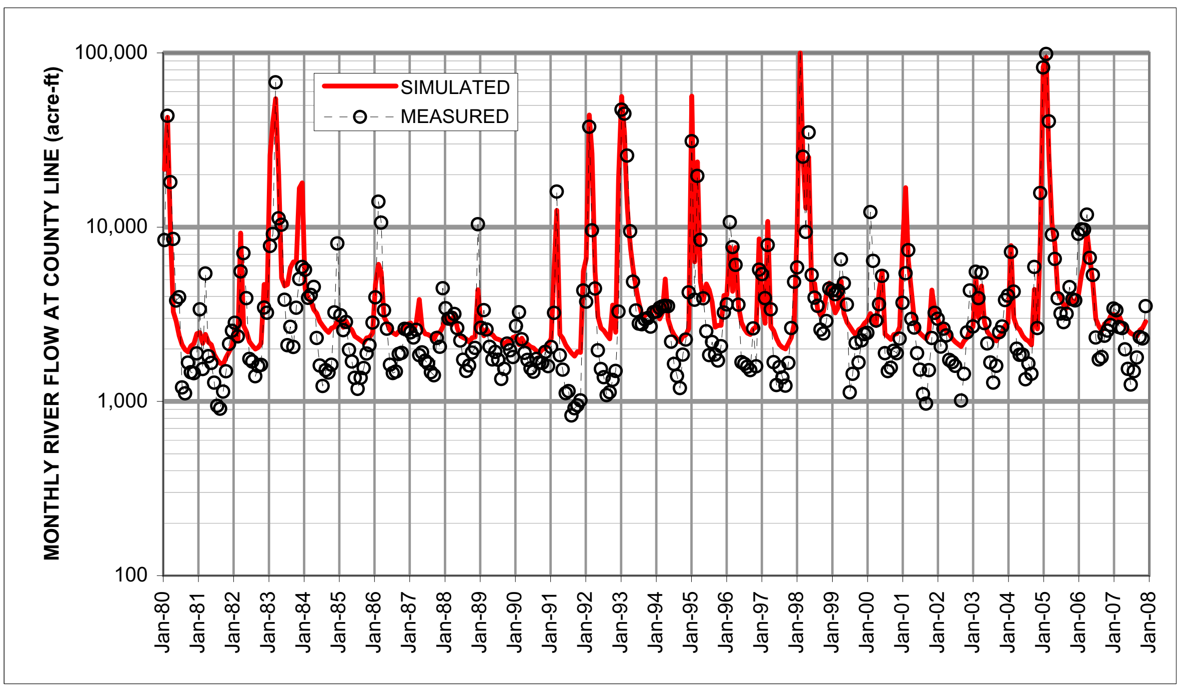
Table B-10

Estimated Annual Ground ater ischarge to the Santa Clara i er
pper Santa Clara i er Ground ater asin, East Subbasin, Los Angeles County, California

Calendar Year	Flow in Castaic Creek (acre-feet)	Flow at County Line (acre-feet)	Estimated Non-Storm Flow at County Line (acre-feet)	WRP Flows (acre-feet)	Estimated Groundwater Discharge to River (acre-feet)
1980	16,785	95,211	57,593	7,374	50,219
1981	6,519	24,232	21,172	7,950	13,222
1982	9,102	36,487	32,531	8,438	24,093
1983	67,058	131,236	55,878	9,422	46,456
1984	13,787	39,279	35,215	9,514	25,701
1985	2,619	24,466	24,089	9,616	14,473
1986	4,945	48,022	31,327	10,824	20,503
1987	911	26,199	23,663	11,846	11,817
1988	2,415	36,611	24,934	12,366	12,568
1989	Unavailable	24,800	23,453	13,563	9,890
1990	0	23,472	21,772	14,009	7,763
1991	65	34,901	18,702	14,111	4,591
1992	4,450	68,578	23,601	15,706	7,895
1993	7,725	152,784	65,054	17,182	47,872
1994	Unavailable	32,040	31,239	16,949	14,290
1995	5,611	82,411	51,001	17,827	33,174
1996	5,632	47,930	36,366	16,831	19,535
1997	9,885	36,780	27,521	15,778	11,743
1998	47,803	205,140	81,744	17,695	64,049
1999	5,830	38,947	27,176	17,847	9,329
2000	7,007	43,920	30,131	18,723	11,408
2001	1,607	34,620	27,900	18,925	8,975
2002	0	25,092	23,243	20,158	3,085
2003	3,019	36,115	28,835	20,257	8,578
2004	1,123	49,868	28,957	20,676	8,281
2005	91,181	262,262	57,378	23,245	34,133
2006	17,844	65,837	33,261	22,913	10,348
2007	0	28,232	26,152	22,931	3,221

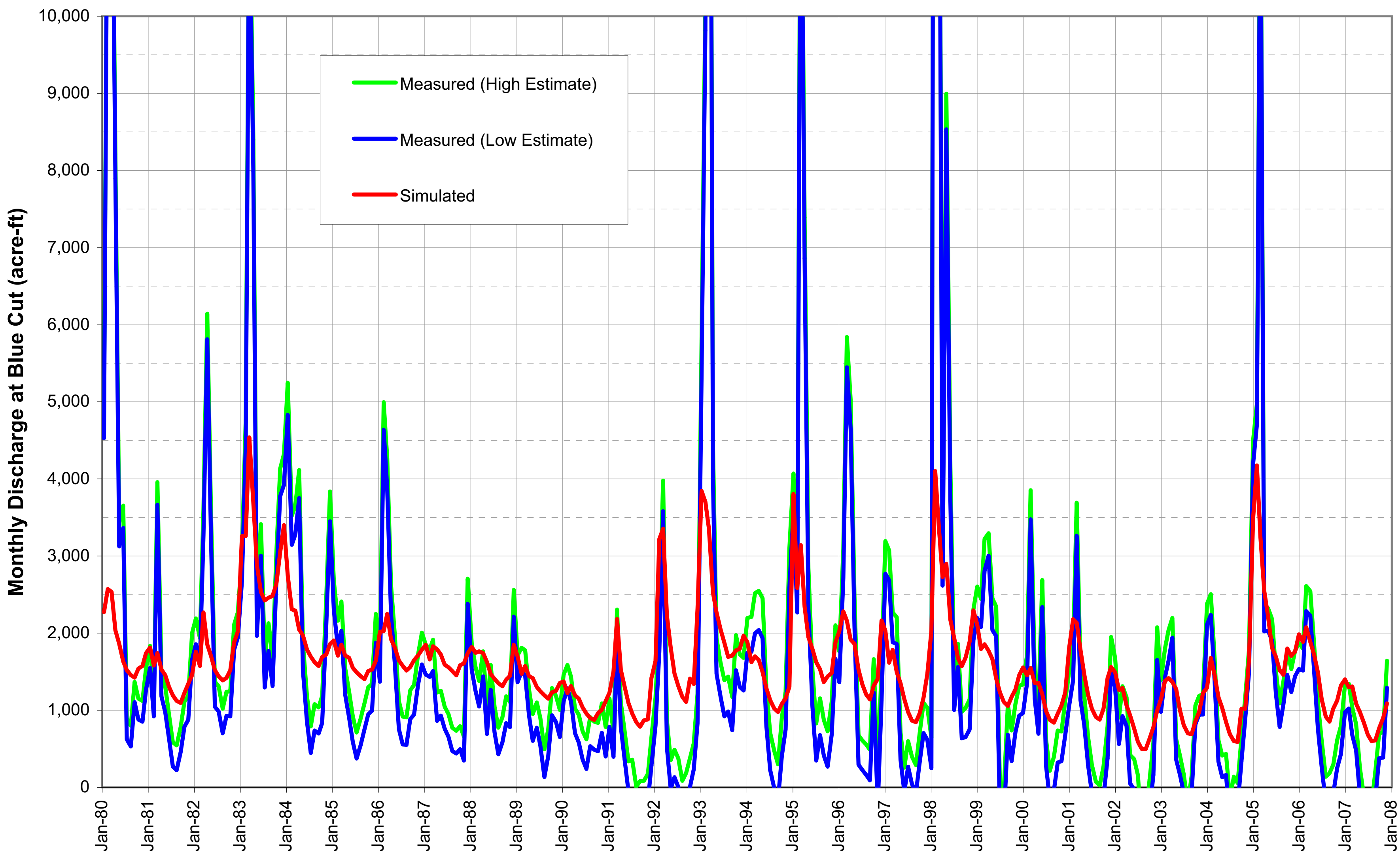
Modeled and Measured Monthly Flow in the Santa Clara River at the County Line





File "Figures_AppendixB_RiverFlows.xls",
Sheet "RiverPlot1"

Modeled and Estimated Monthly Groundwater Discharges to the Perennial Reach of the Santa Clara River (from Round Mountain to Blue Cut)



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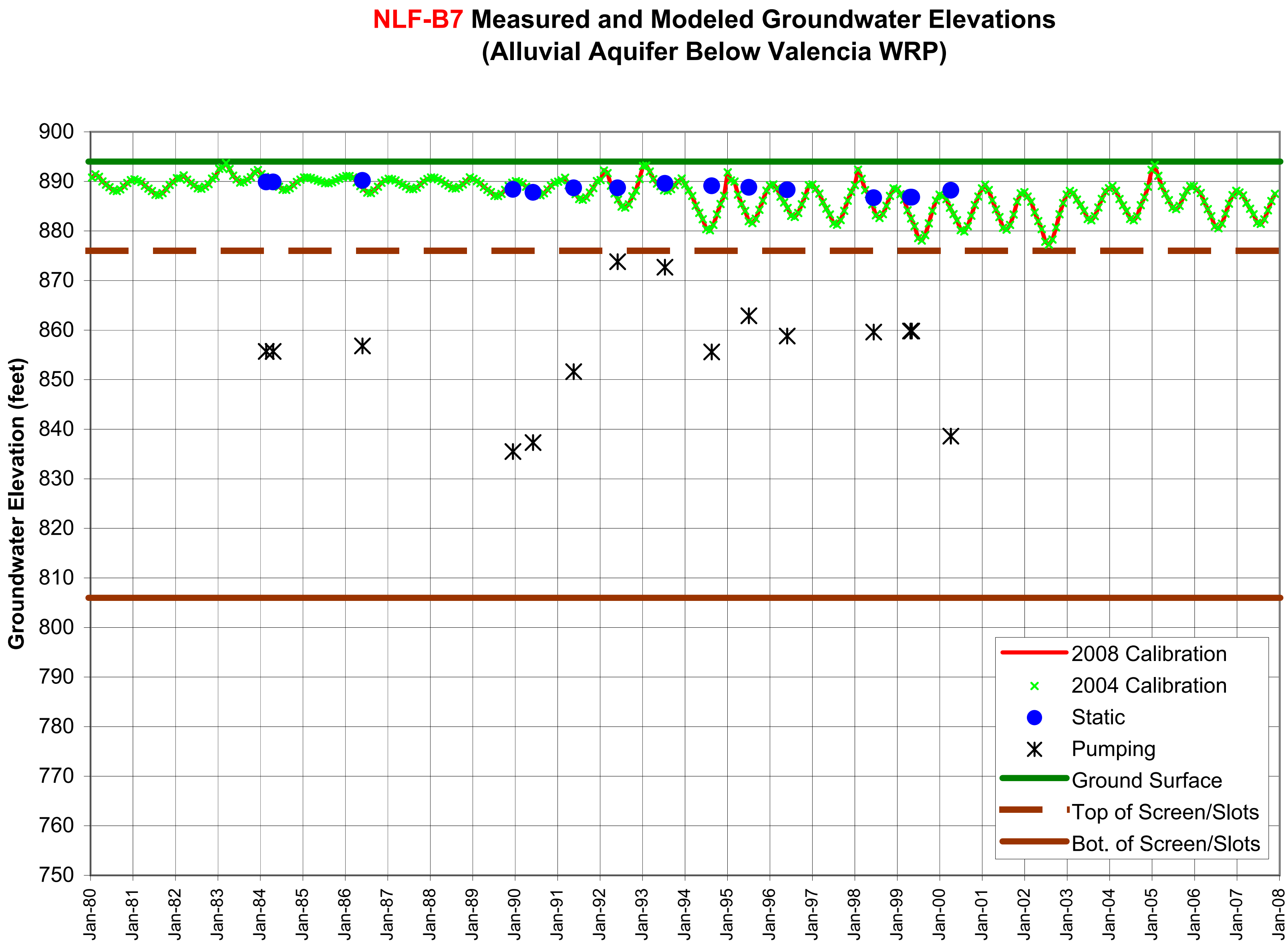
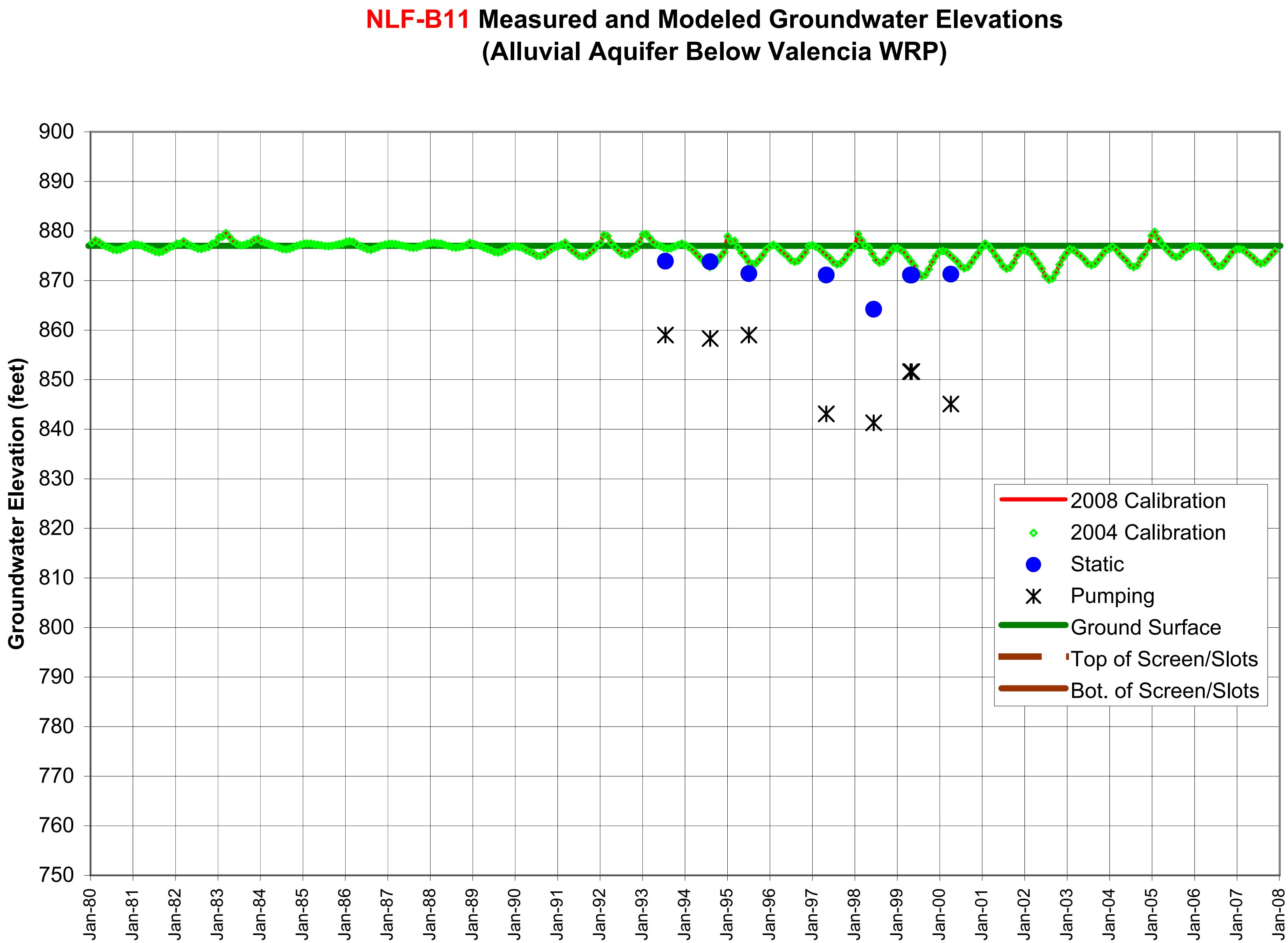
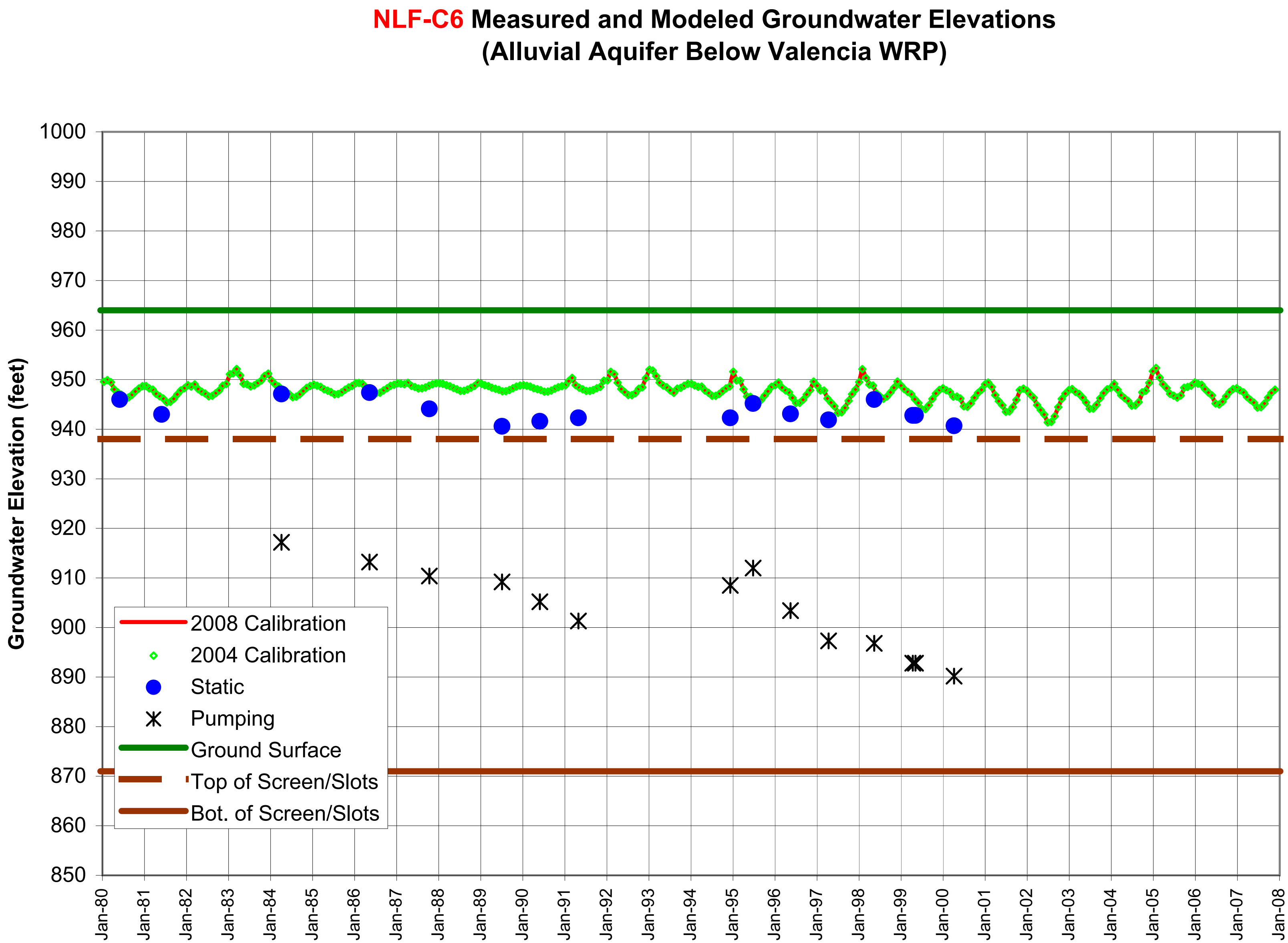
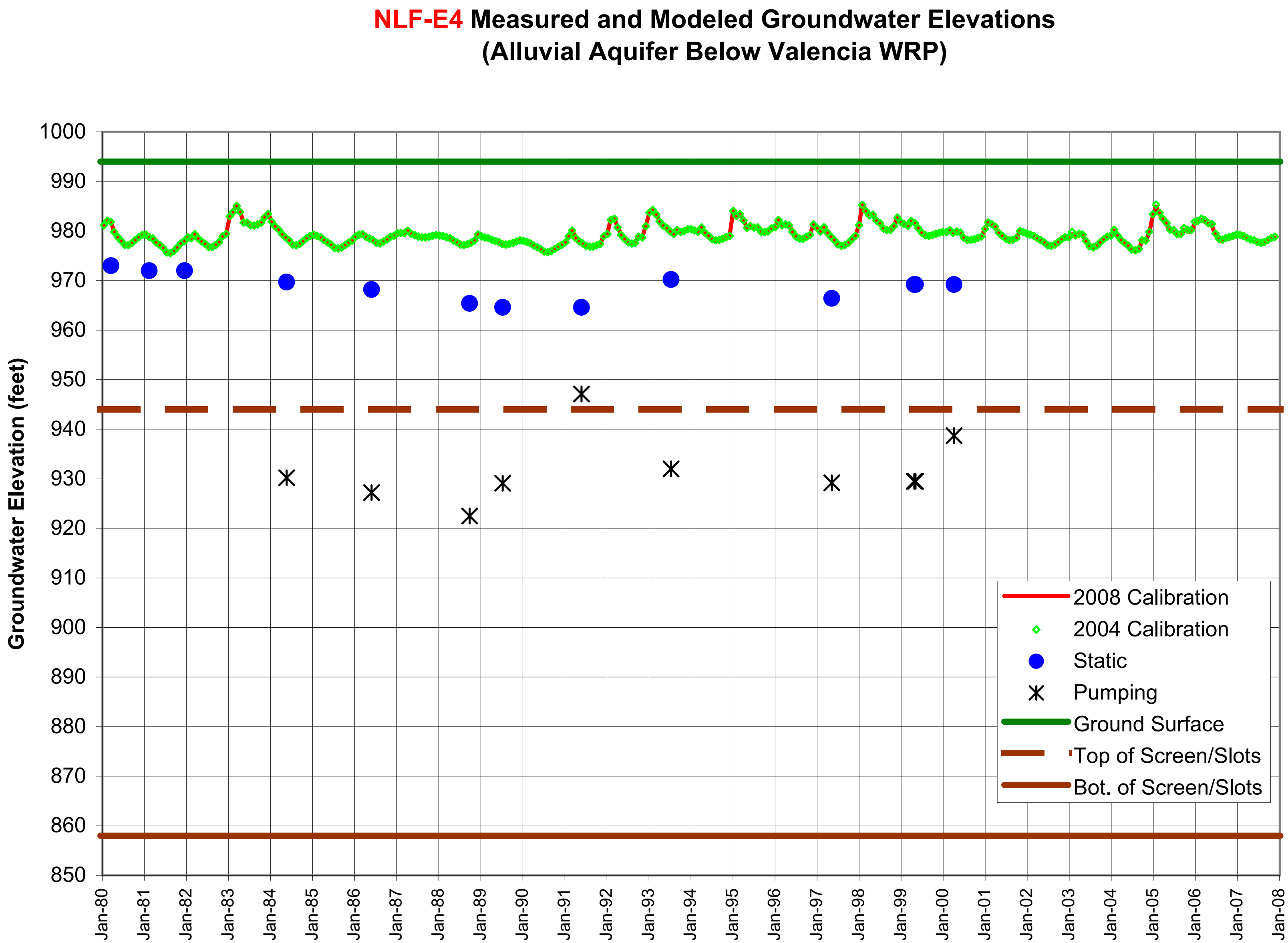

NLF-B7 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Below Valencia WRP)
Groundwater Elevation (feet)
900
890
880
870
860
850
840
830
820
810
800
790
780
770
760
750
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2008 Calibration
2004 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots



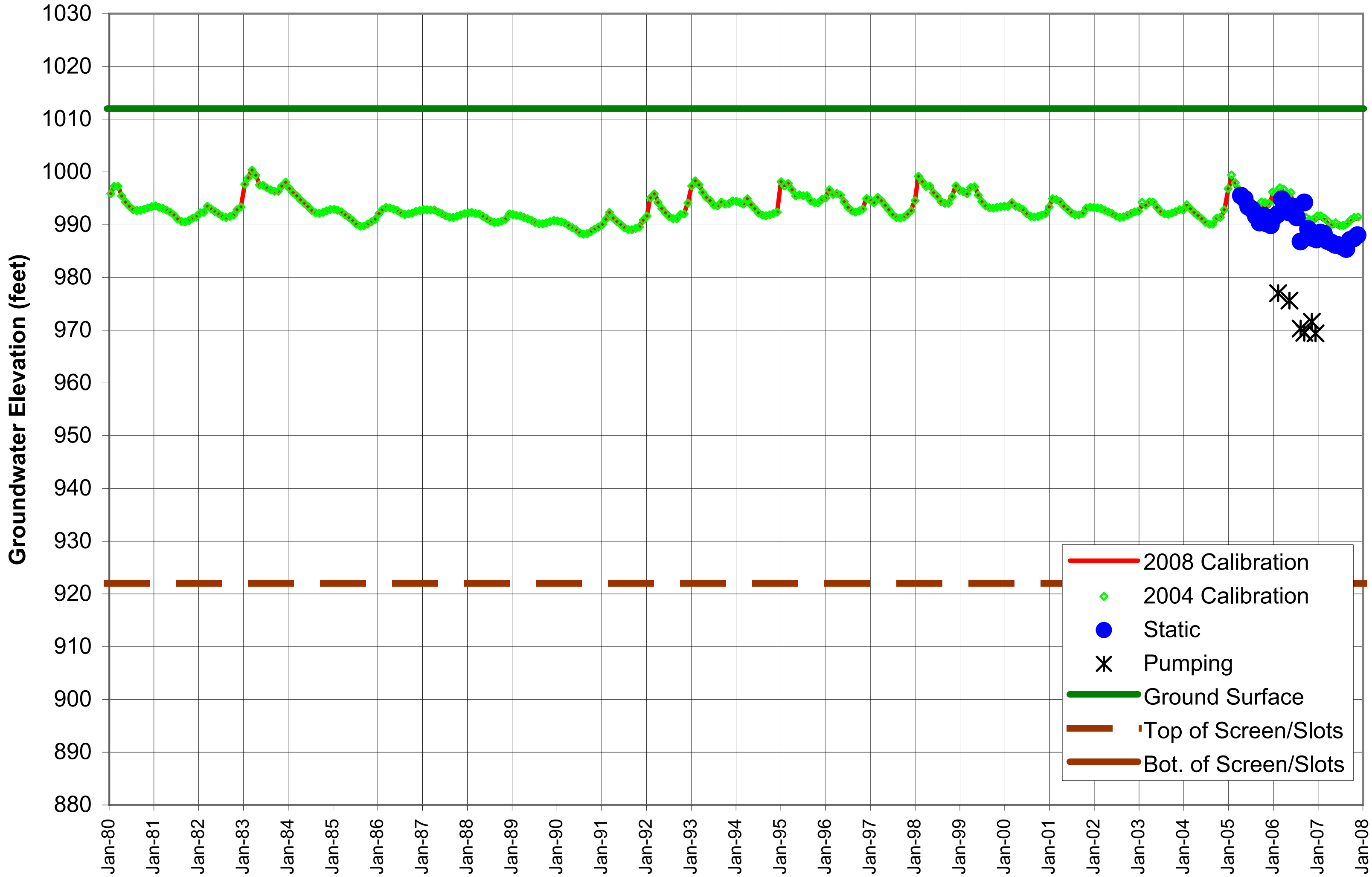
NLF-B11 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Below Valencia WRP)
Groundwater Elevation (feet)
900
890
880
870
860
850
840
830
820
810
800
790
780
770
760
750
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2008 Calibration
2004 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

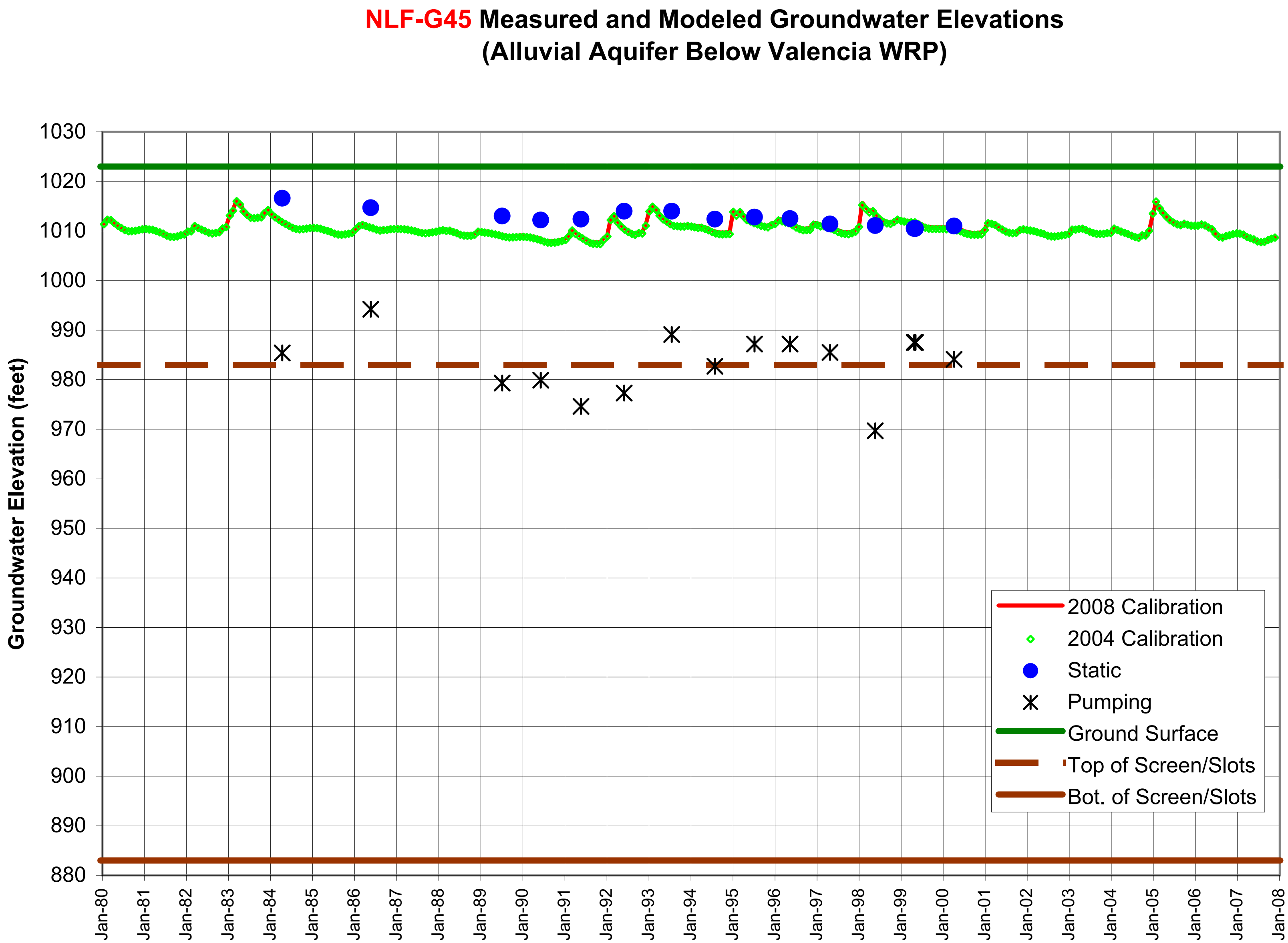

NLF-C6 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Below Valencia WRP)
Groundwater Elevation (feet)
1000
990
980
970
960
950
940
930
920
910
900
890
880
870
860
850
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2008 Calibration
2004 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

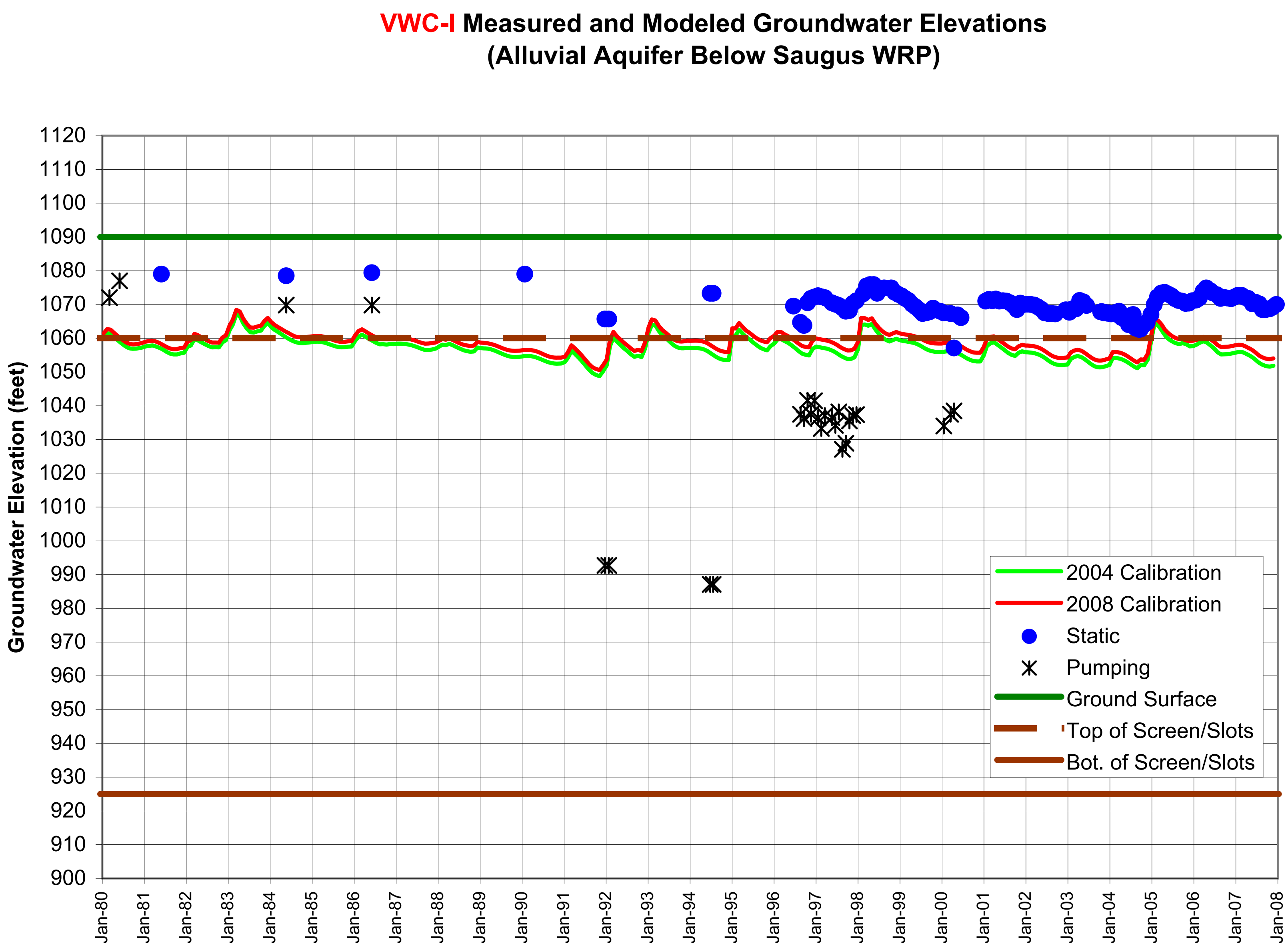


NLF-E4 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Below Valencia WRP)
Groundwater Elevation (feet)
1000
990
980
970
960
950
940
930
920
910
900
890
880
870
860
850
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2008 Calibration
2004 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

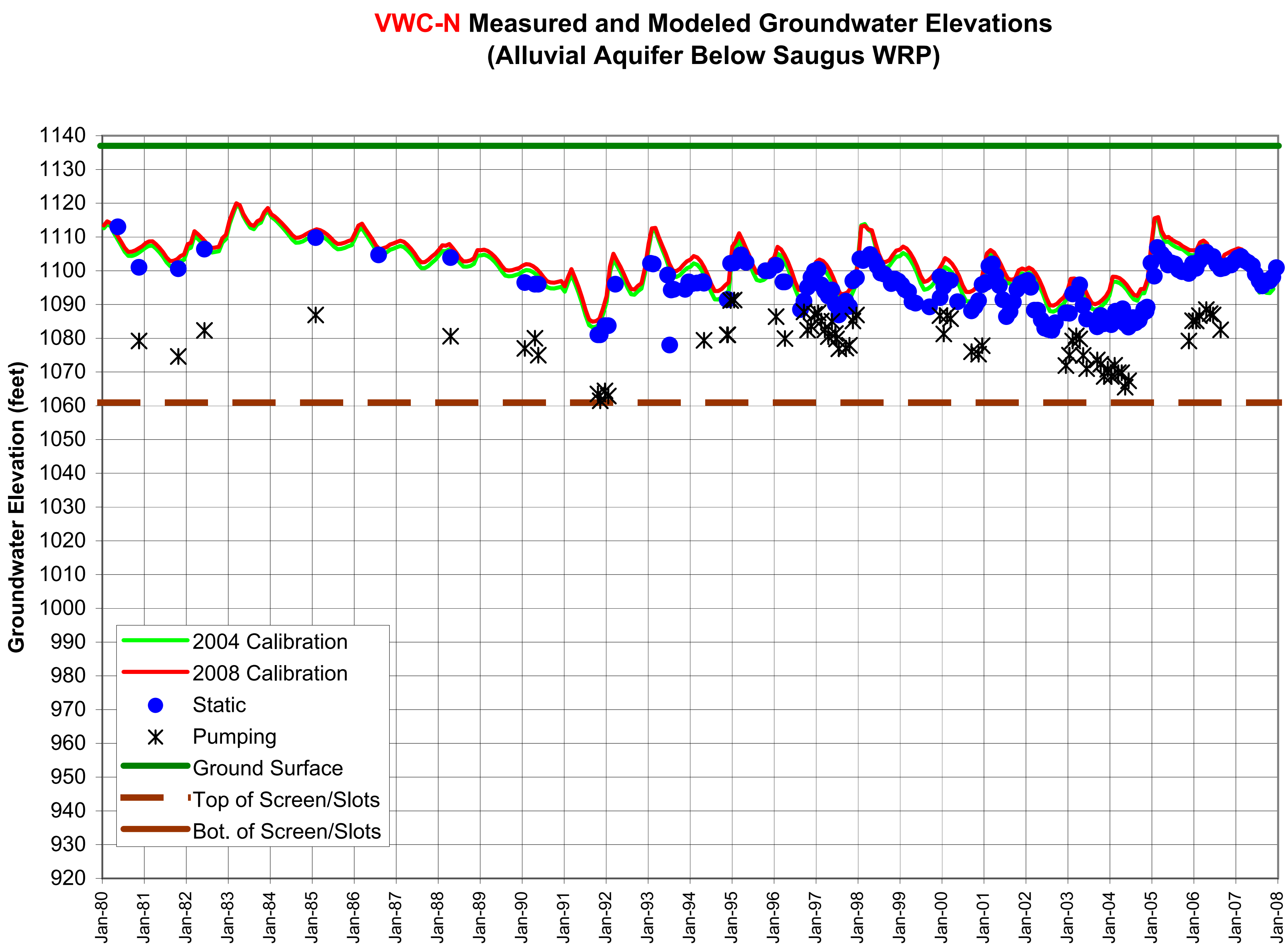
VWC-E15 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Below Valencia WRP)

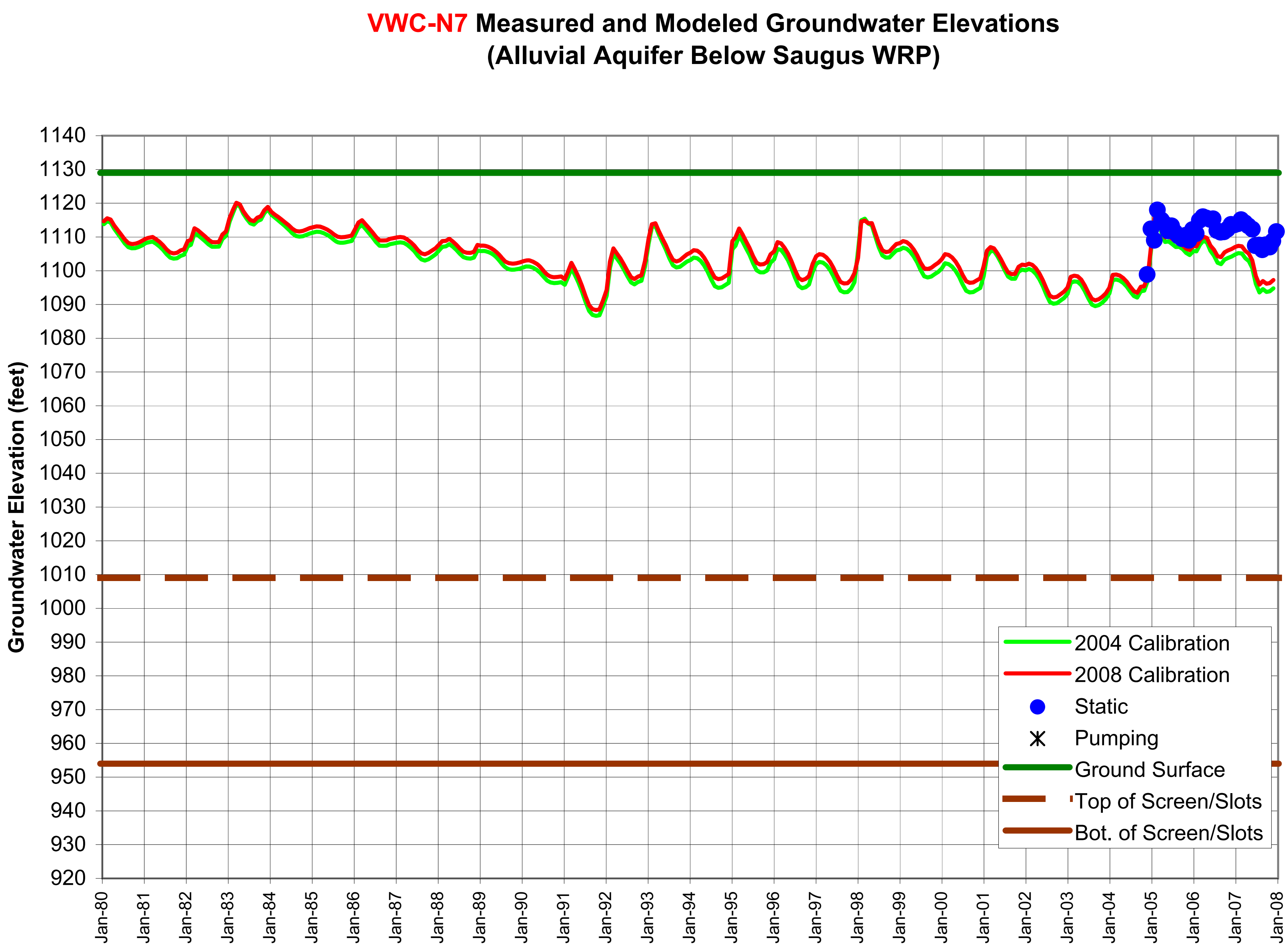



NLF-G45 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Below Valencia WRP)
Groundwater Elevation (feet)
1030
1020
1010
1000
990
980
970
960
950
940
930
920
910
900
890
880
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2008 Calibration
2004 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

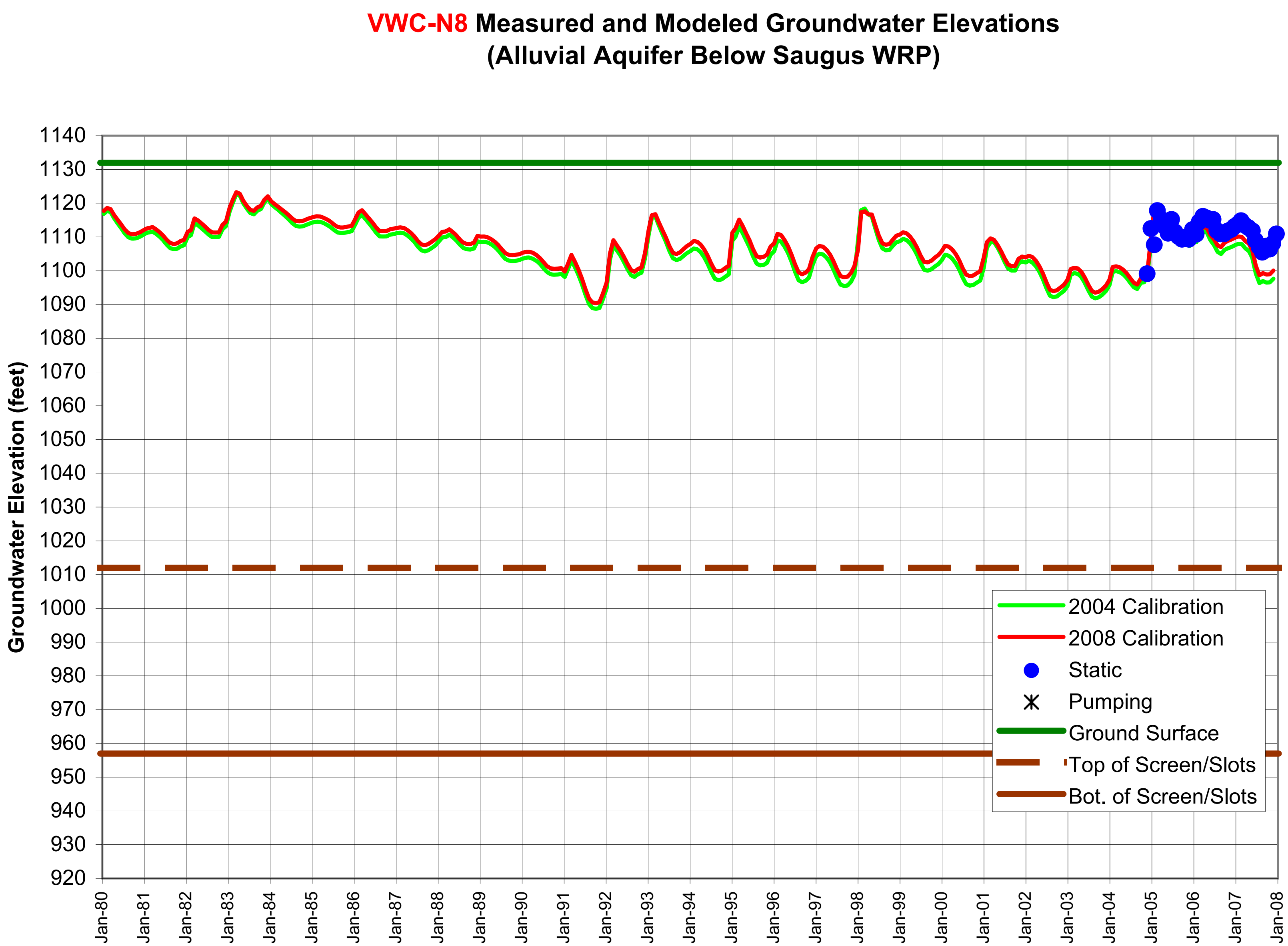


VWC-I Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Below Saugus WRP)
Groundwater Elevation (feet)
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
910
900
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

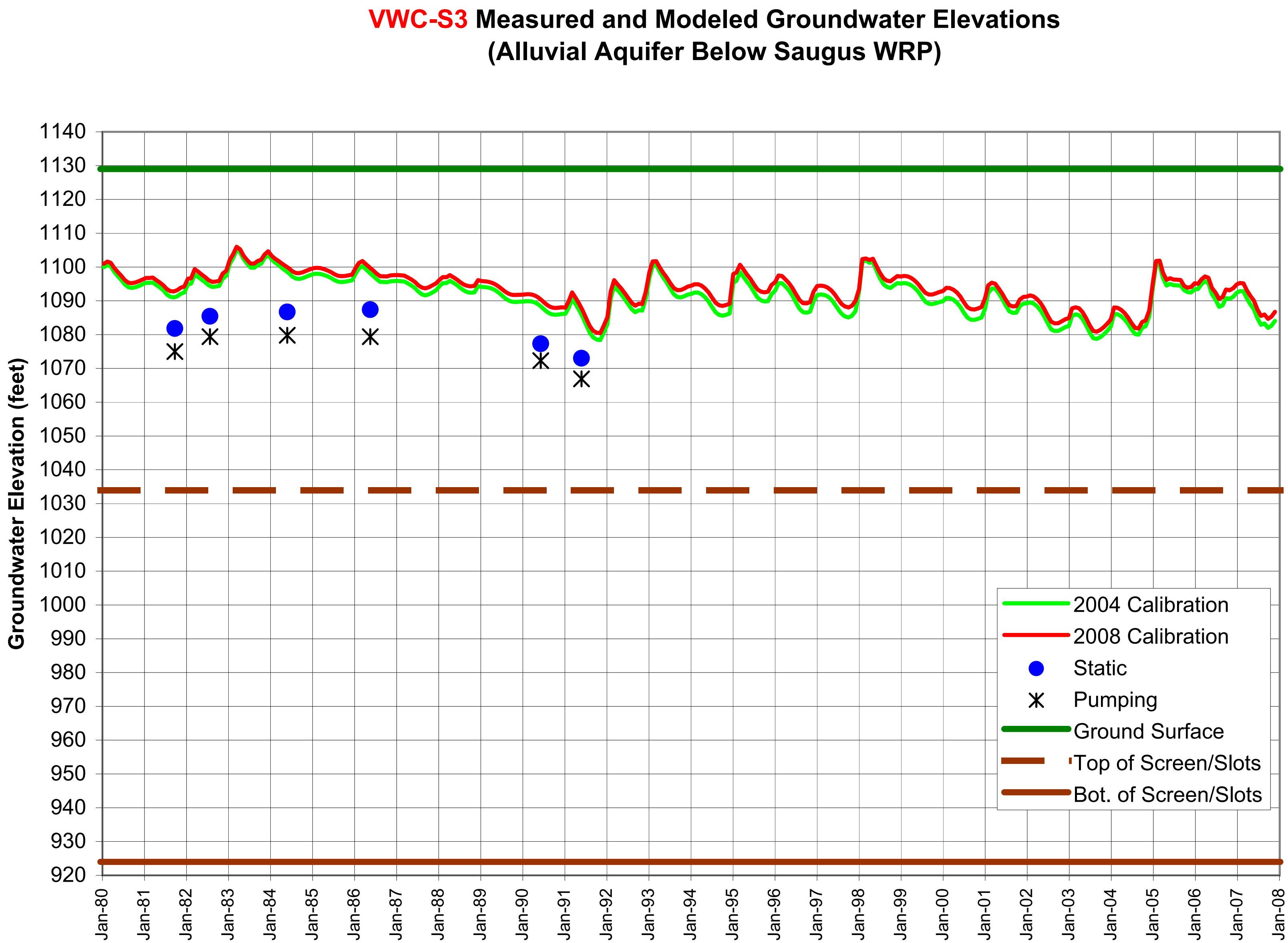

VWC-N Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Below Saugus WRP)
Groundwater Elevation (feet)
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

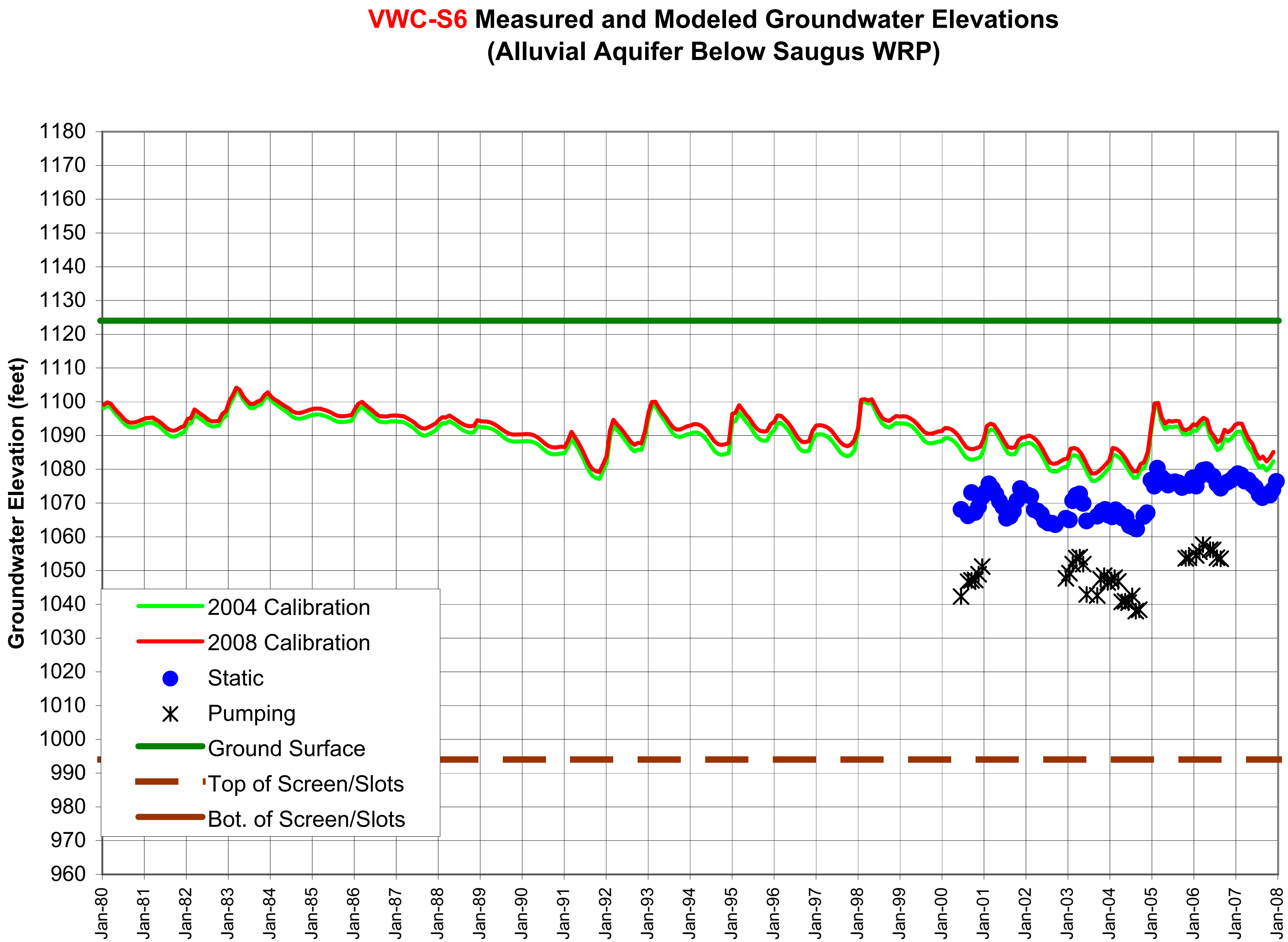


VWC-N7 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Below Saugus WRP)
Groundwater Elevation (feet)
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

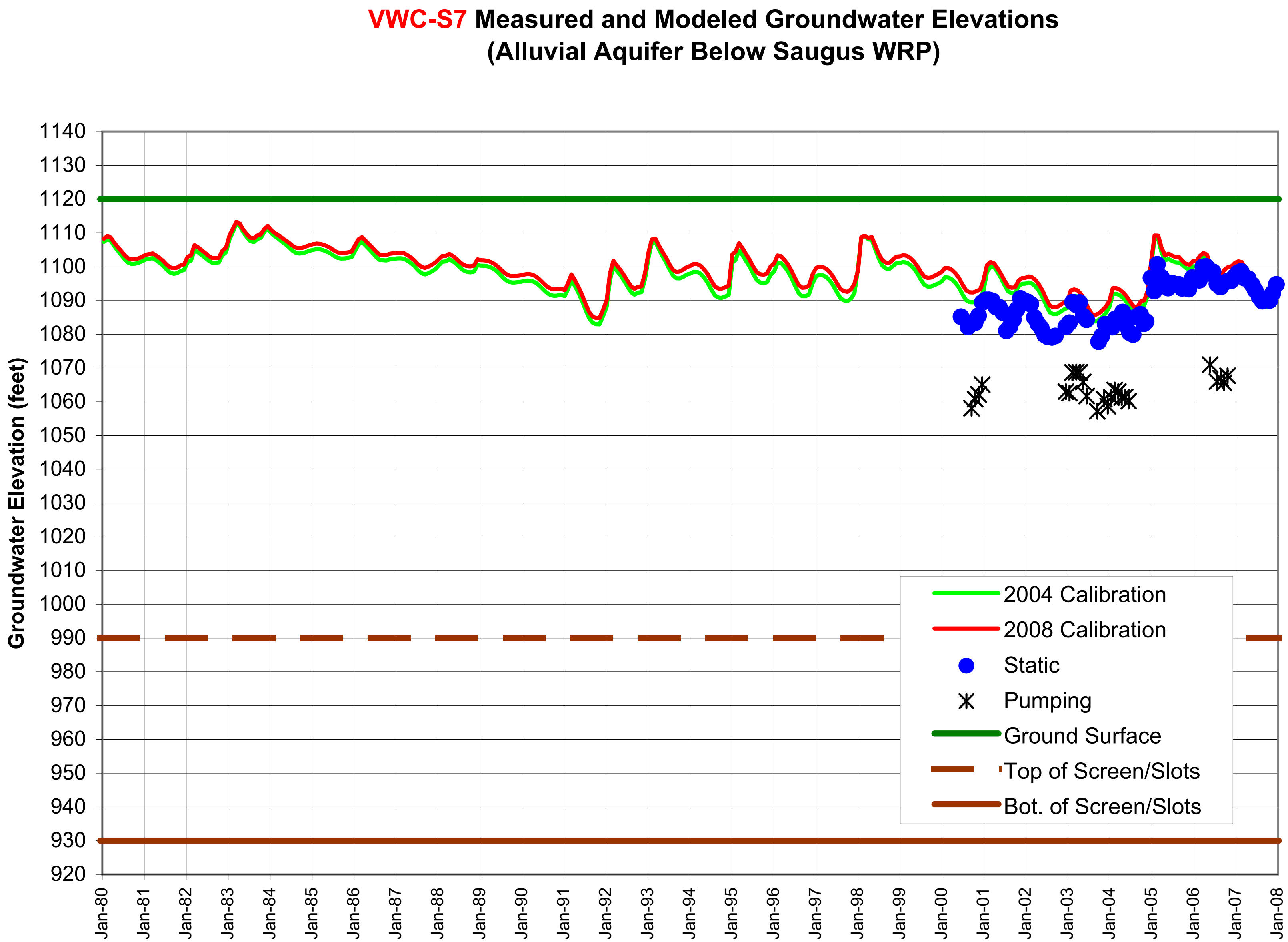


VWC-N8 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Below Saugus WRP)
Groundwater Elevation (feet)
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

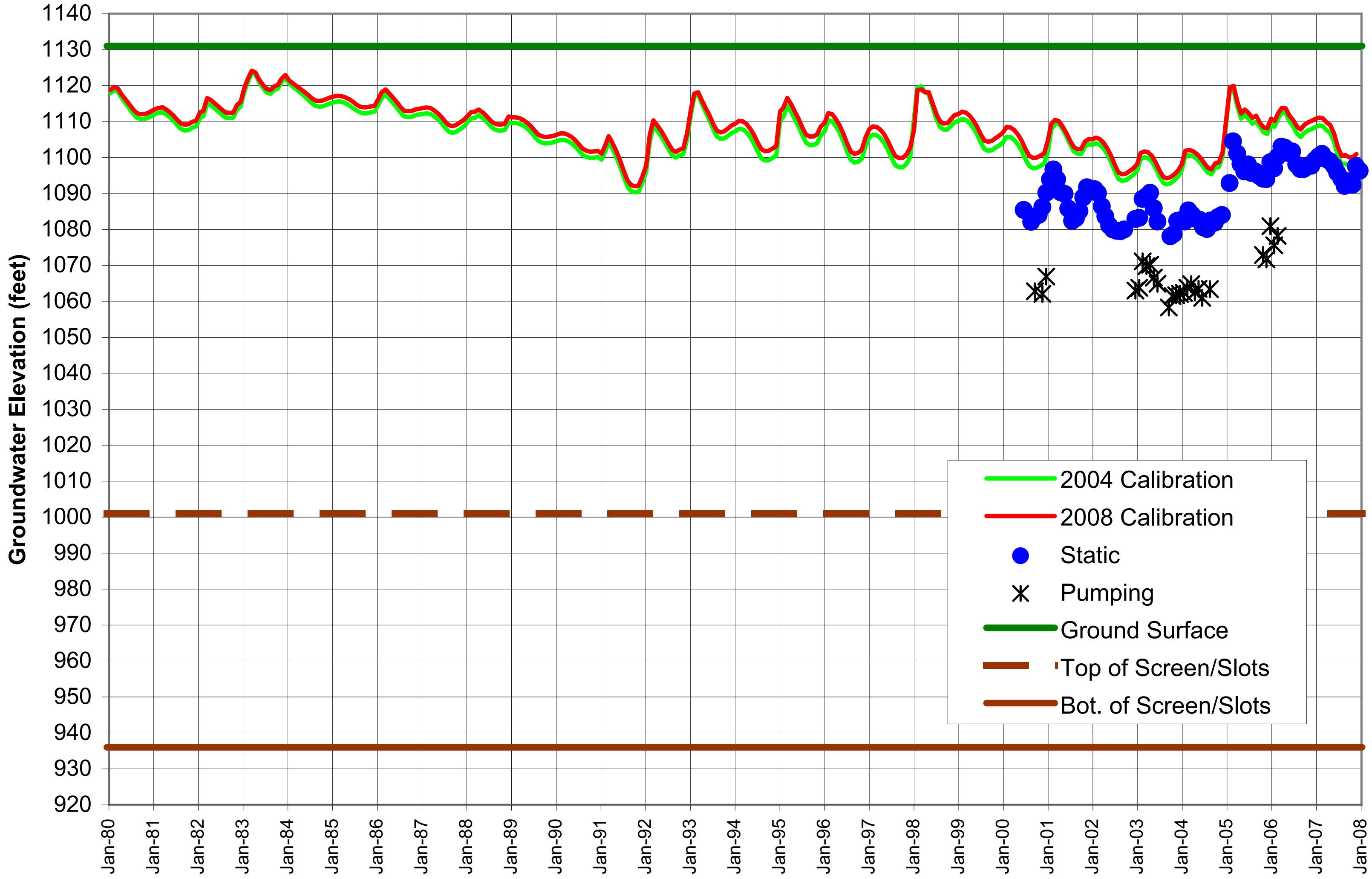

VWC-S3 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Below Saugus WRP)
Groundwater Elevation (feet)
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots



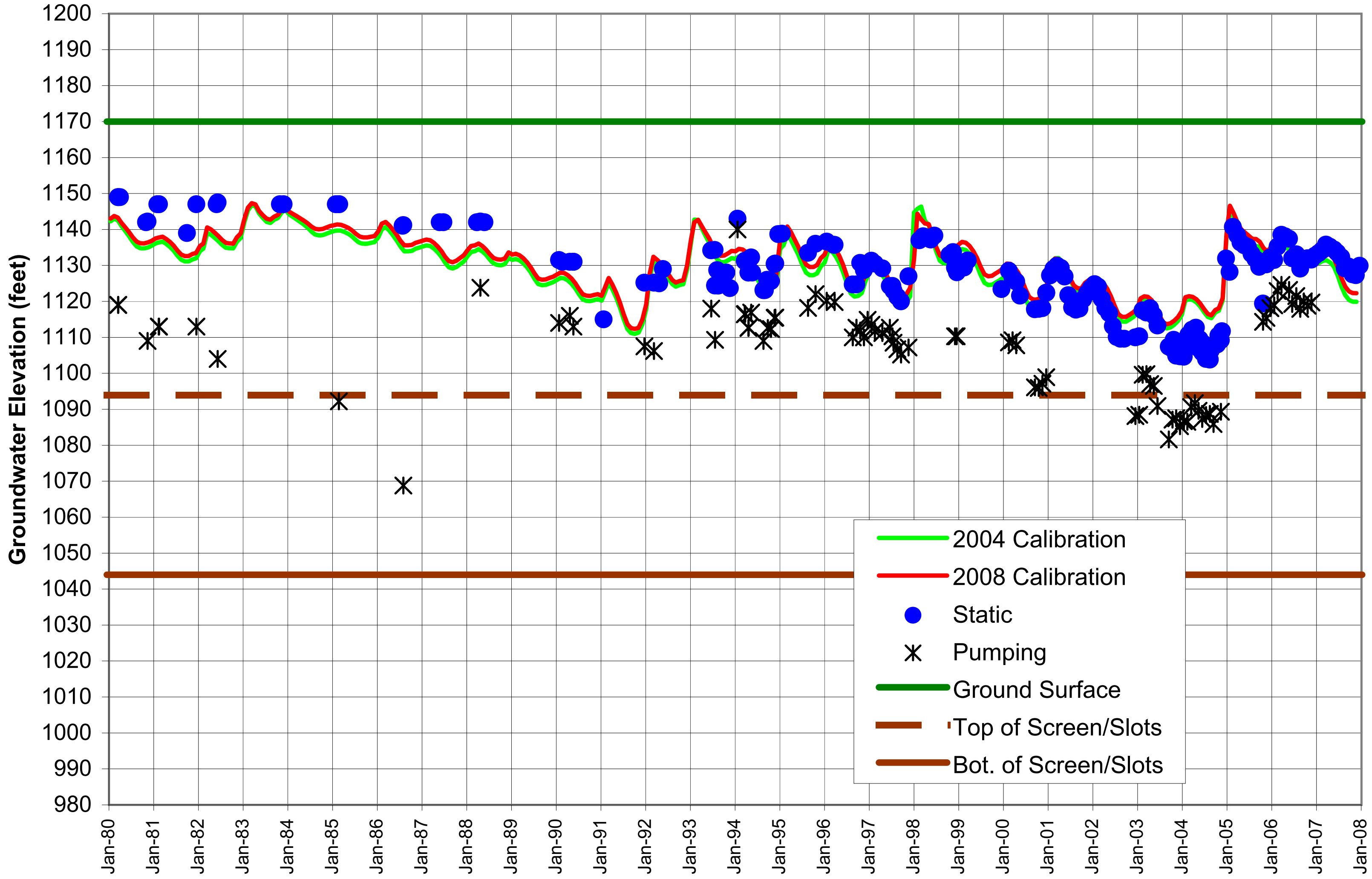
VWC-S6 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Below Saugus WRP)
Groundwater Elevation (feet)
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots


VWC-S7 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Below Saugus WRP)
Groundwater Elevation (feet)
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

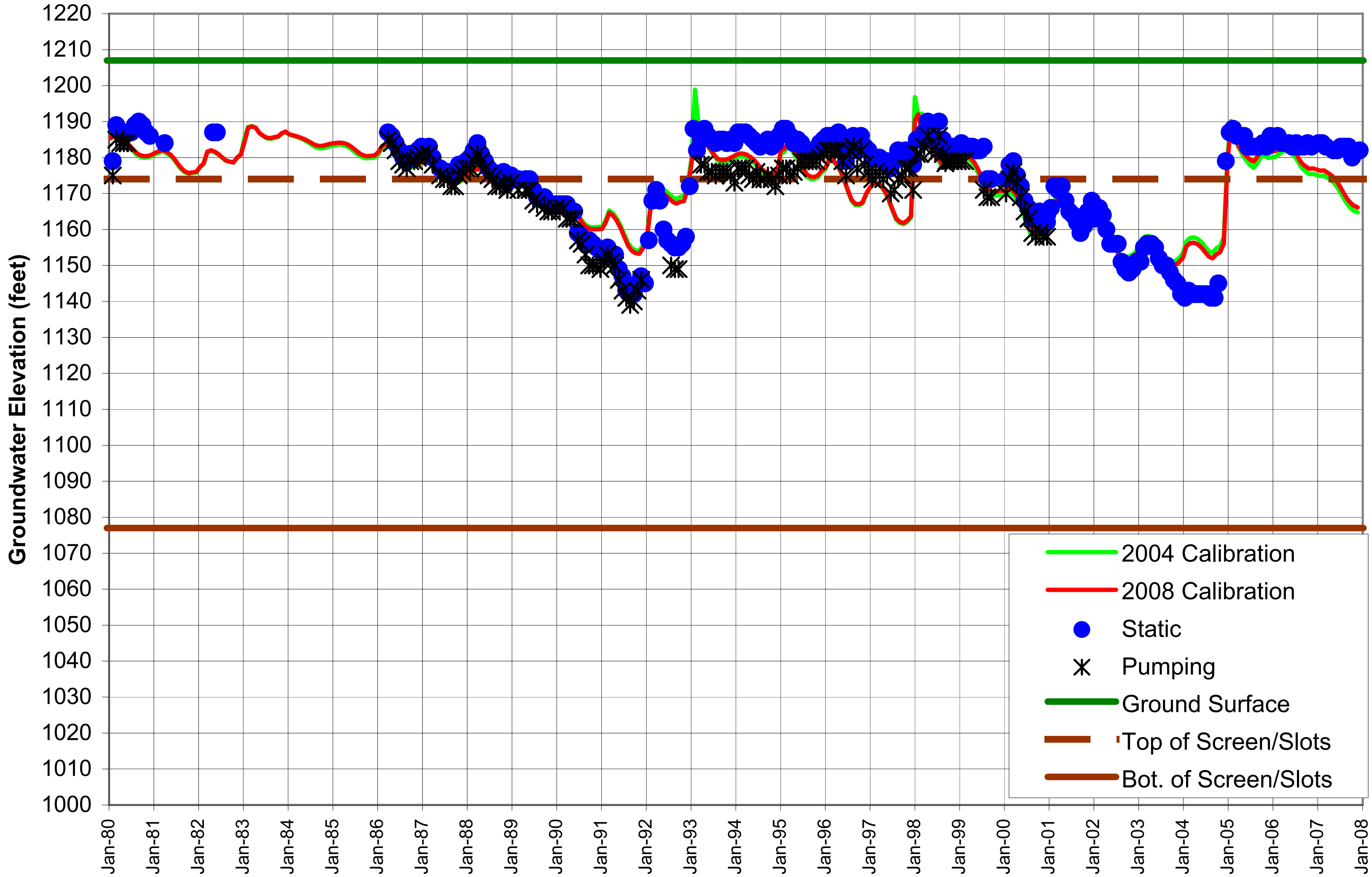
VWC-S8 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Below Saugus WRP)



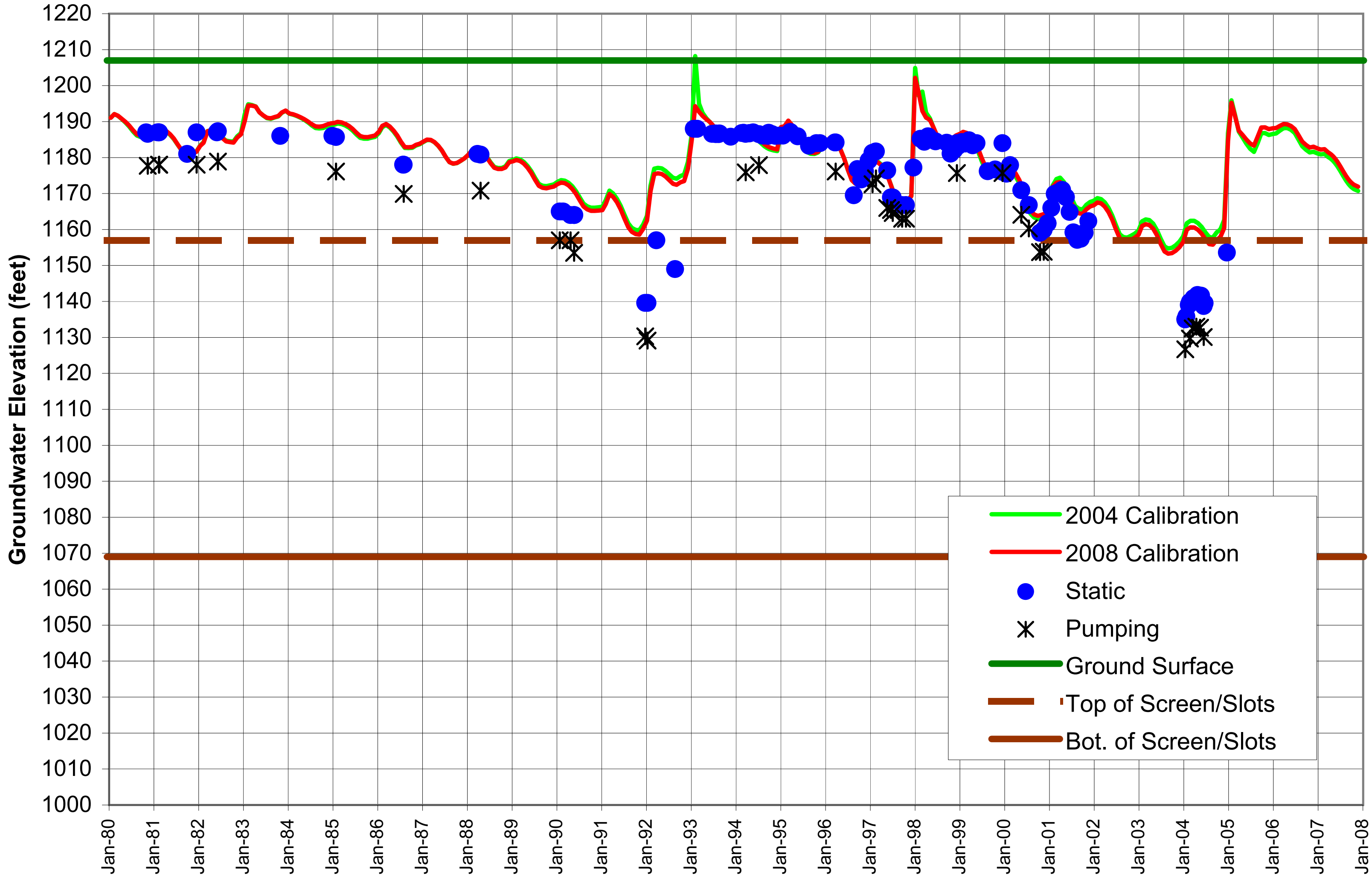
VWC-Q2 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Above Saugus WRP)

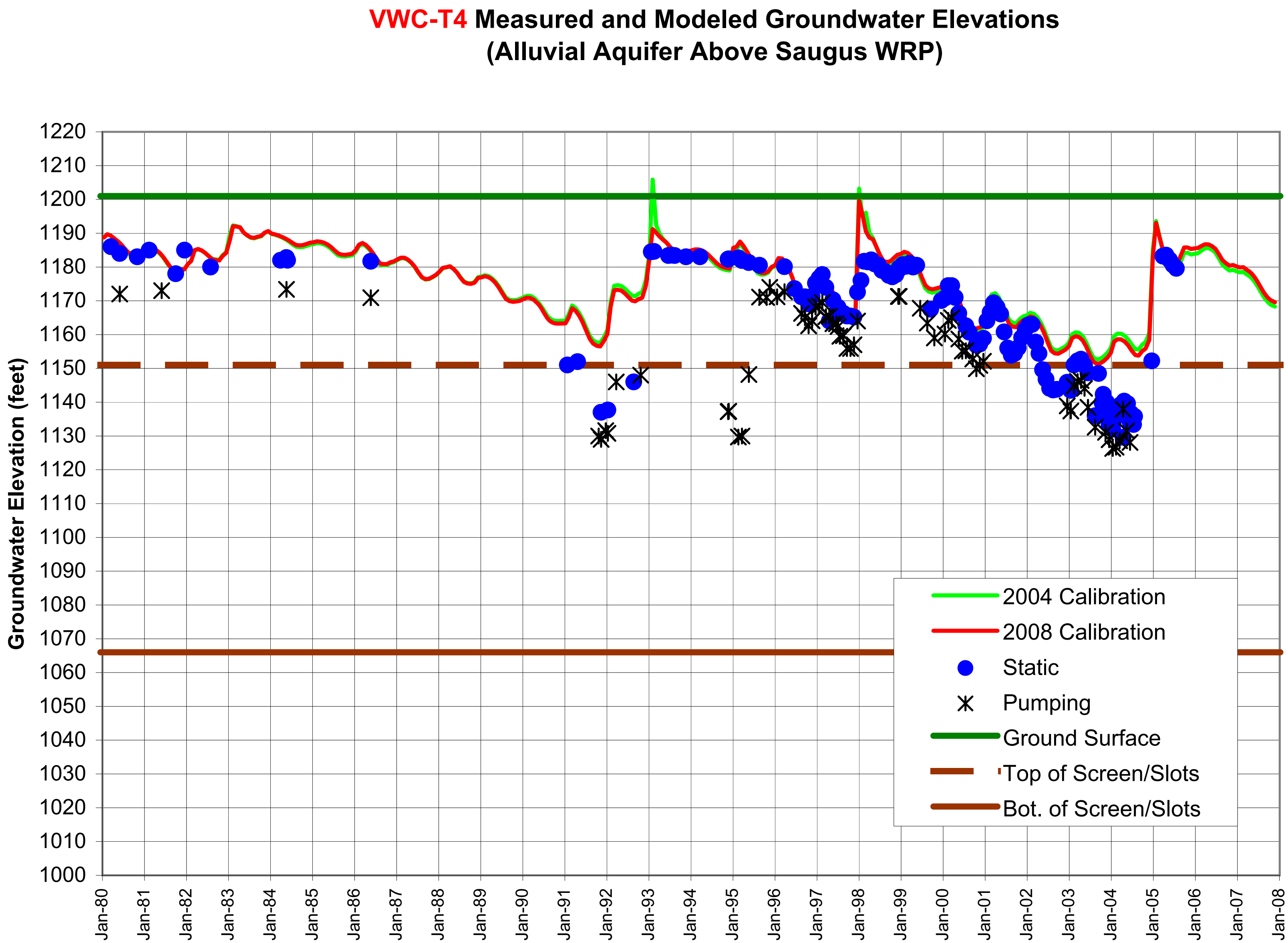


SCWD-Stadium Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Above Saugus WRP)

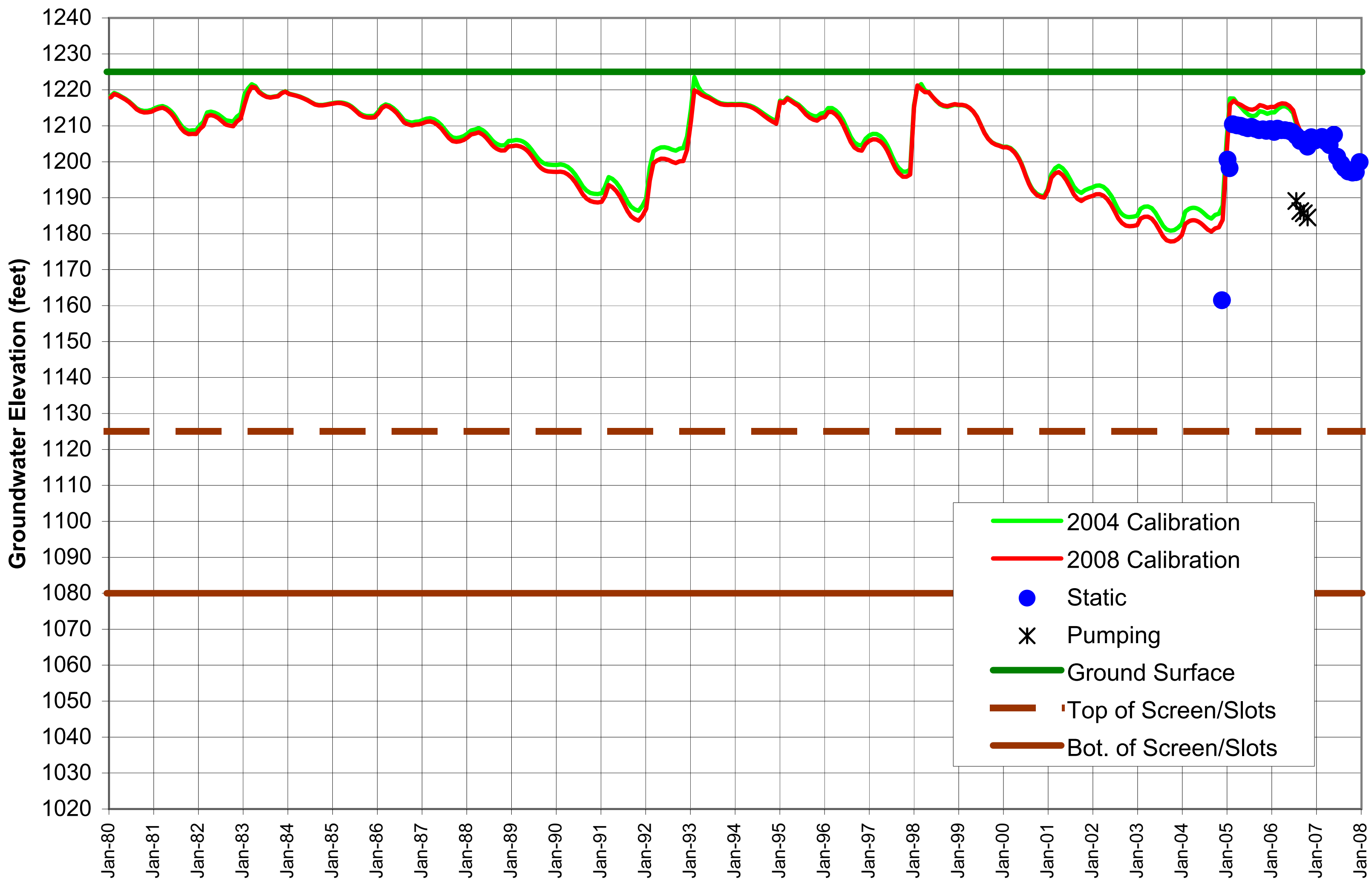


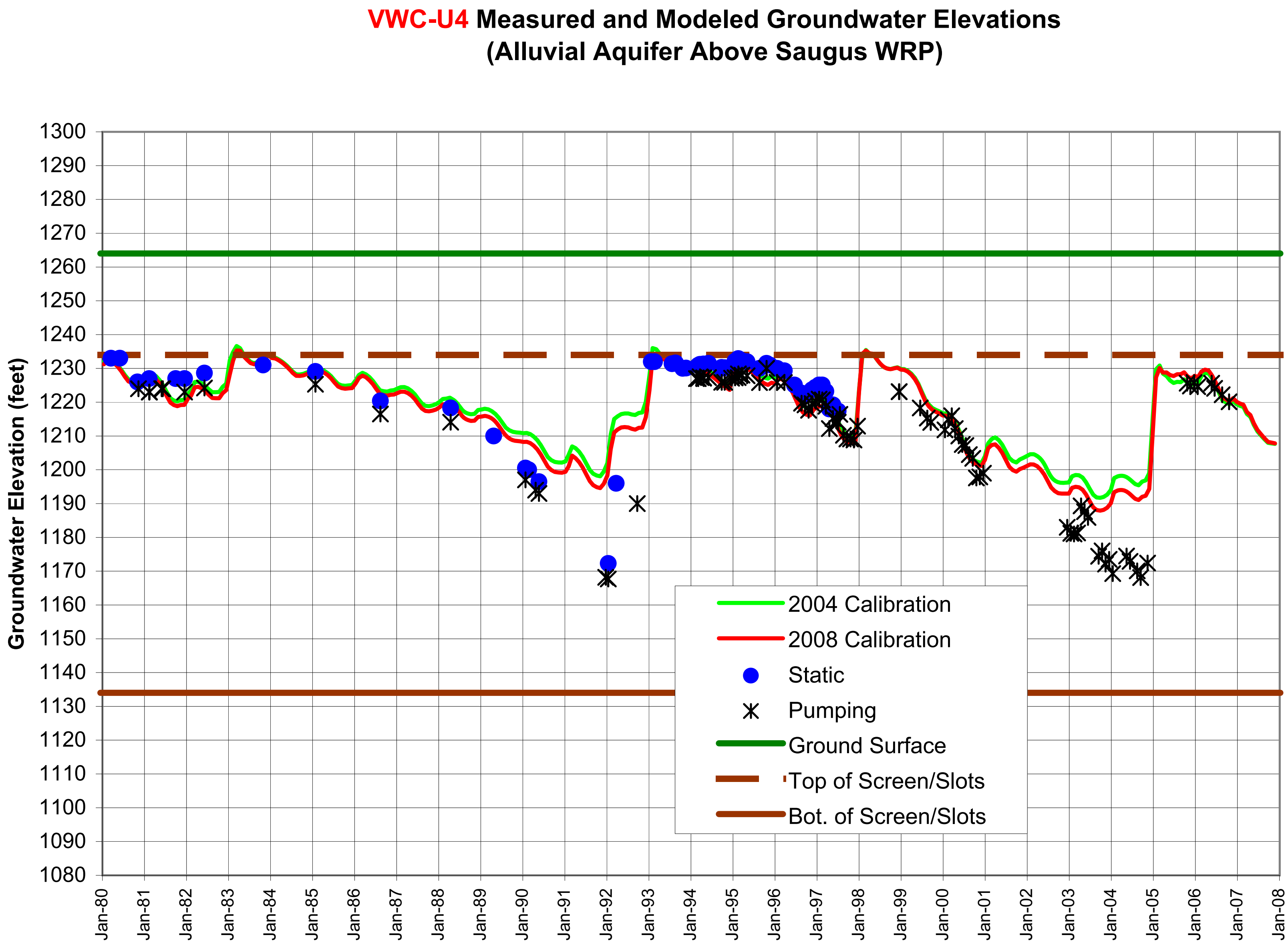
VWC-T2 Measured and Modeled Groundwater Elevations (Alluvial Aquifer Above Saugus WRP)

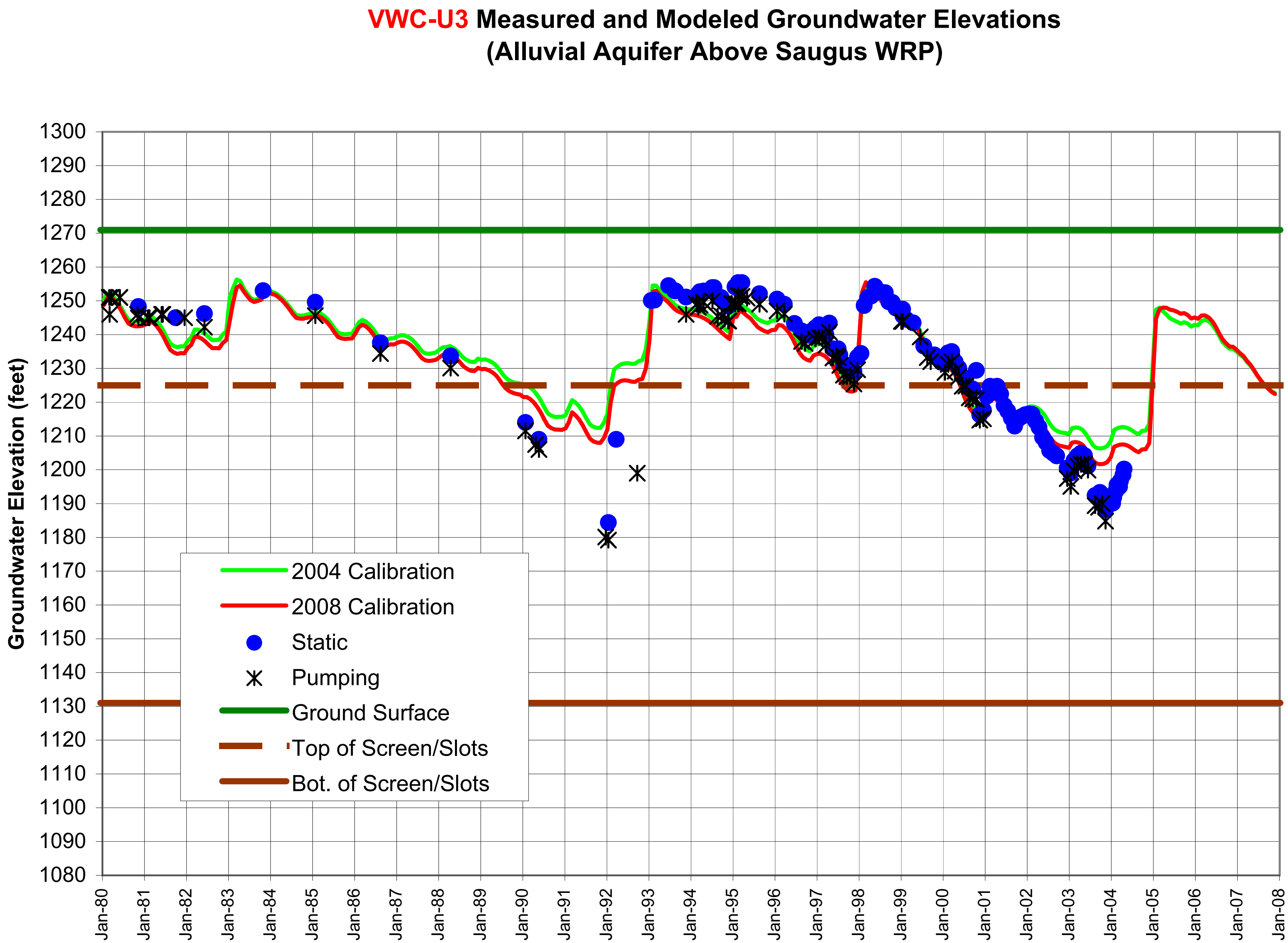


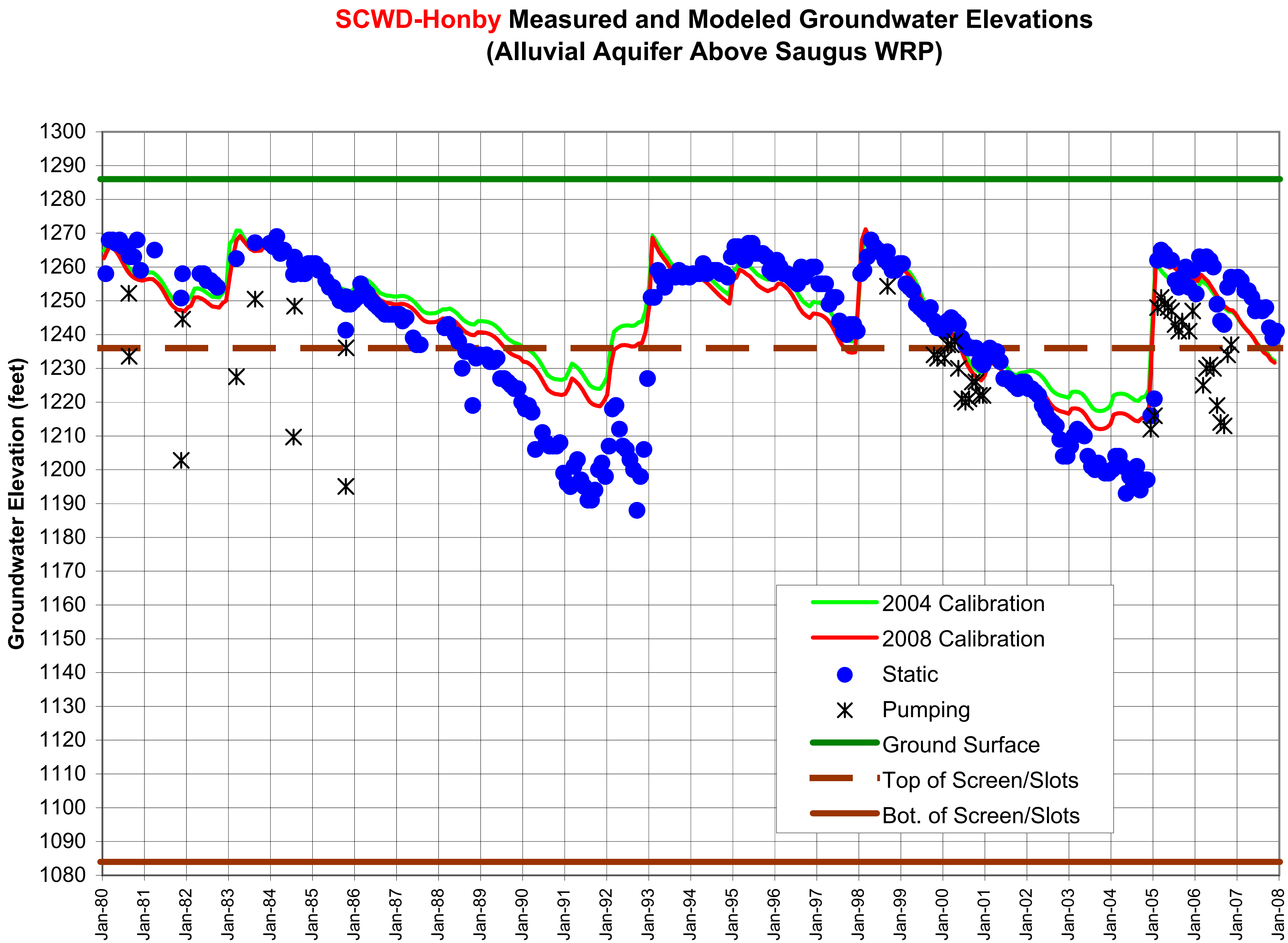

VWC-T4 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Above Saugus WRP)
Groundwater Elevation (feet)
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

VWC-U6 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Above Saugus WRP)



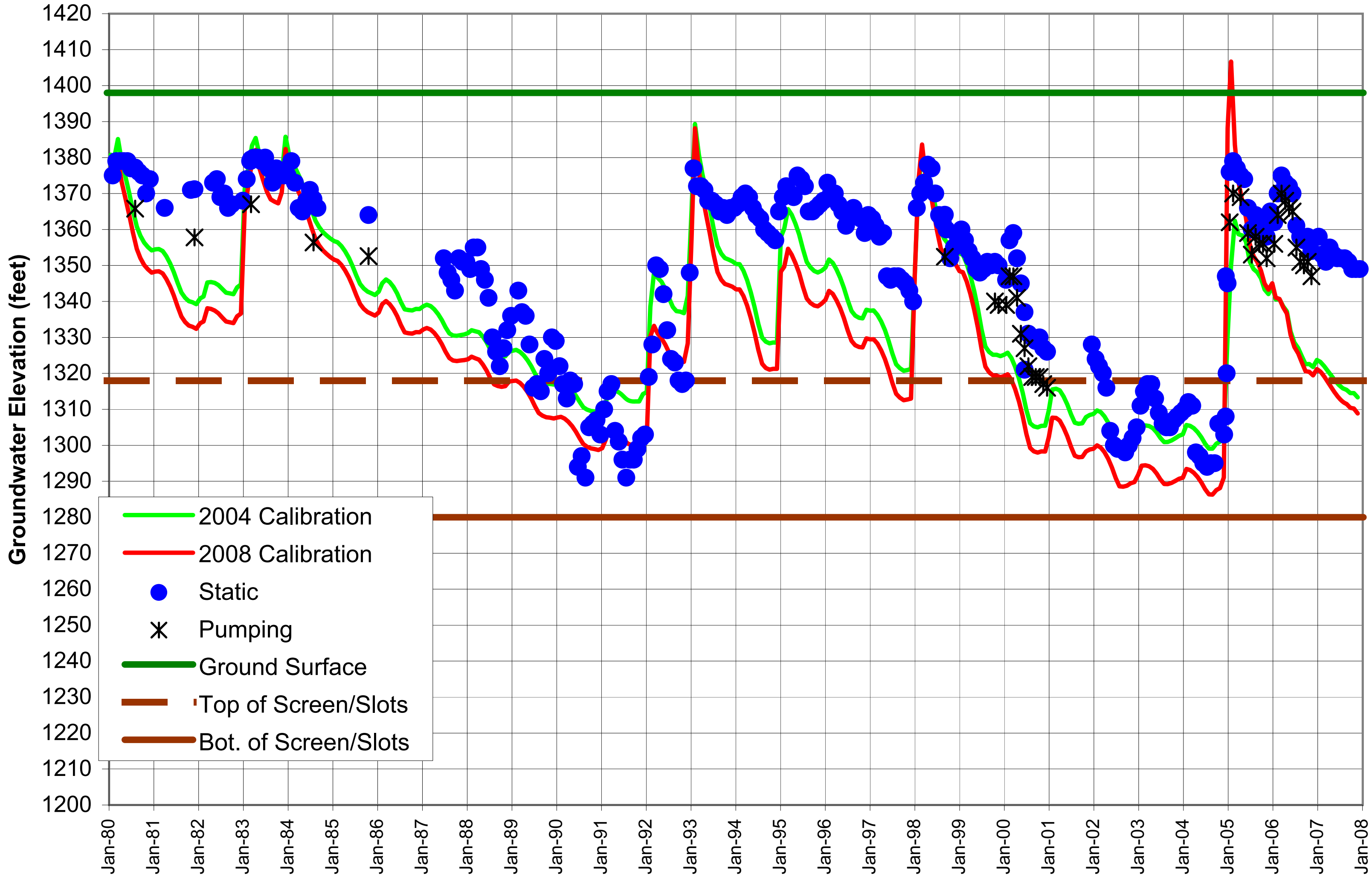

VWC-U4 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Above Saugus WRP)
Groundwater Elevation (feet)
1300
1290
1280
1270
1260
1250
1240
1230
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots


VWC-U3 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Above Saugus WRP)
Groundwater Elevation (feet)
1300
1290
1280
1270
1260
1250
1240
1230
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

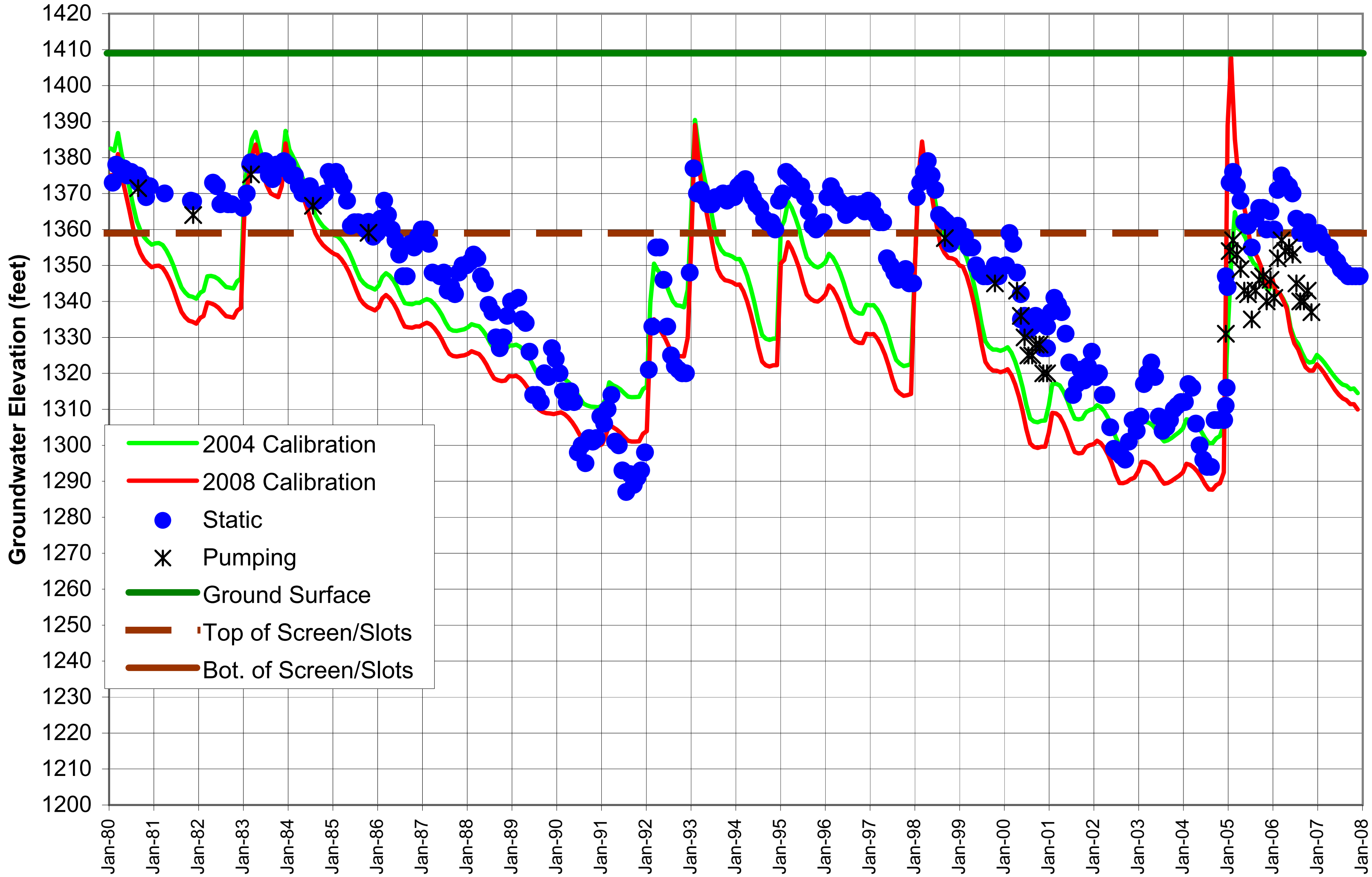


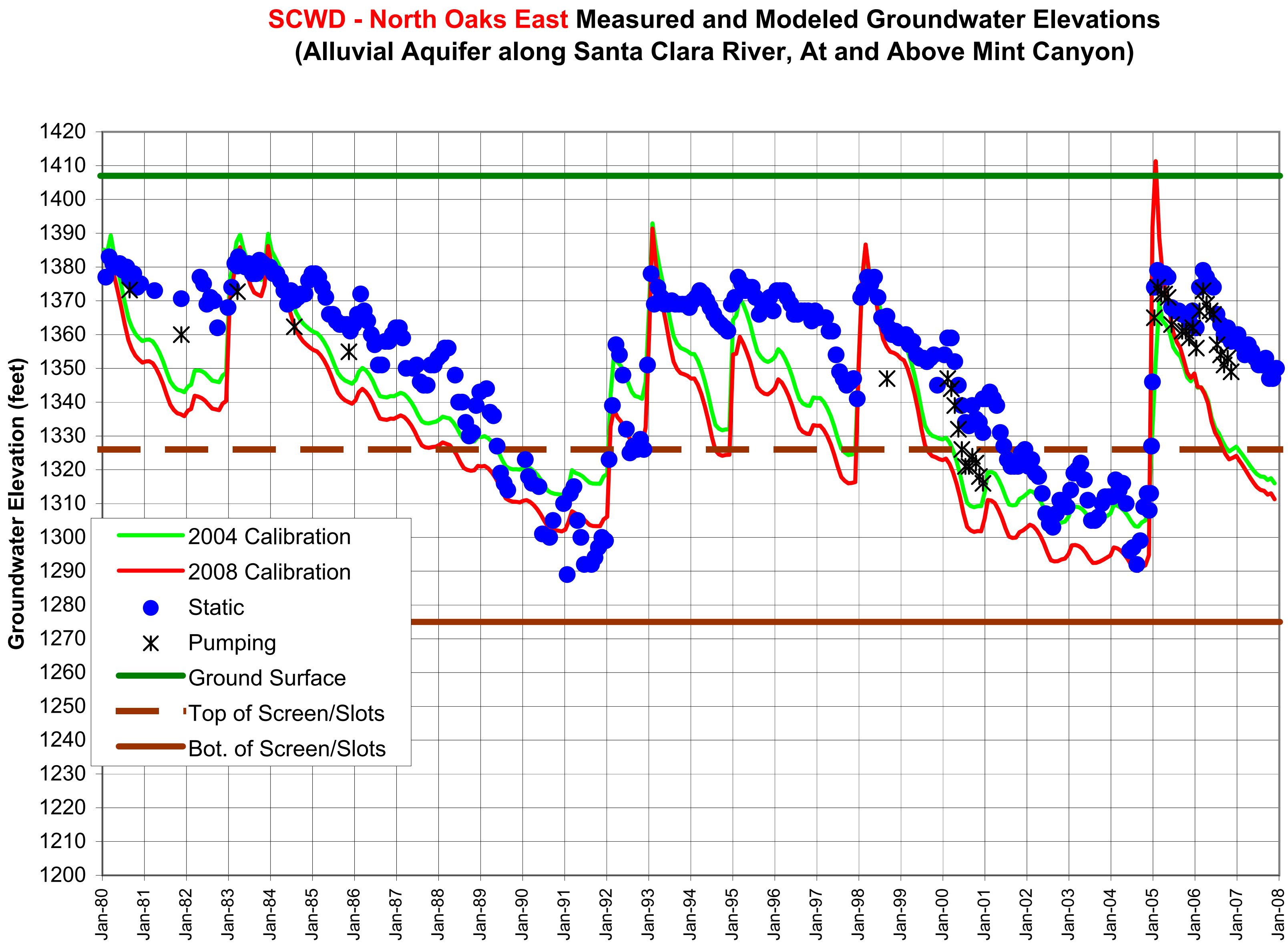
SCWD-Honby Measured and Modeled Groundwater Elevations
(Alluvial Aquifer Above Saugus WRP)
Groundwater Elevation (feet)
1300
1290
1280
1270
1260
1250
1240
1230
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

SCWD - North Oaks West Measured and Modeled Groundwater Elevations
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)

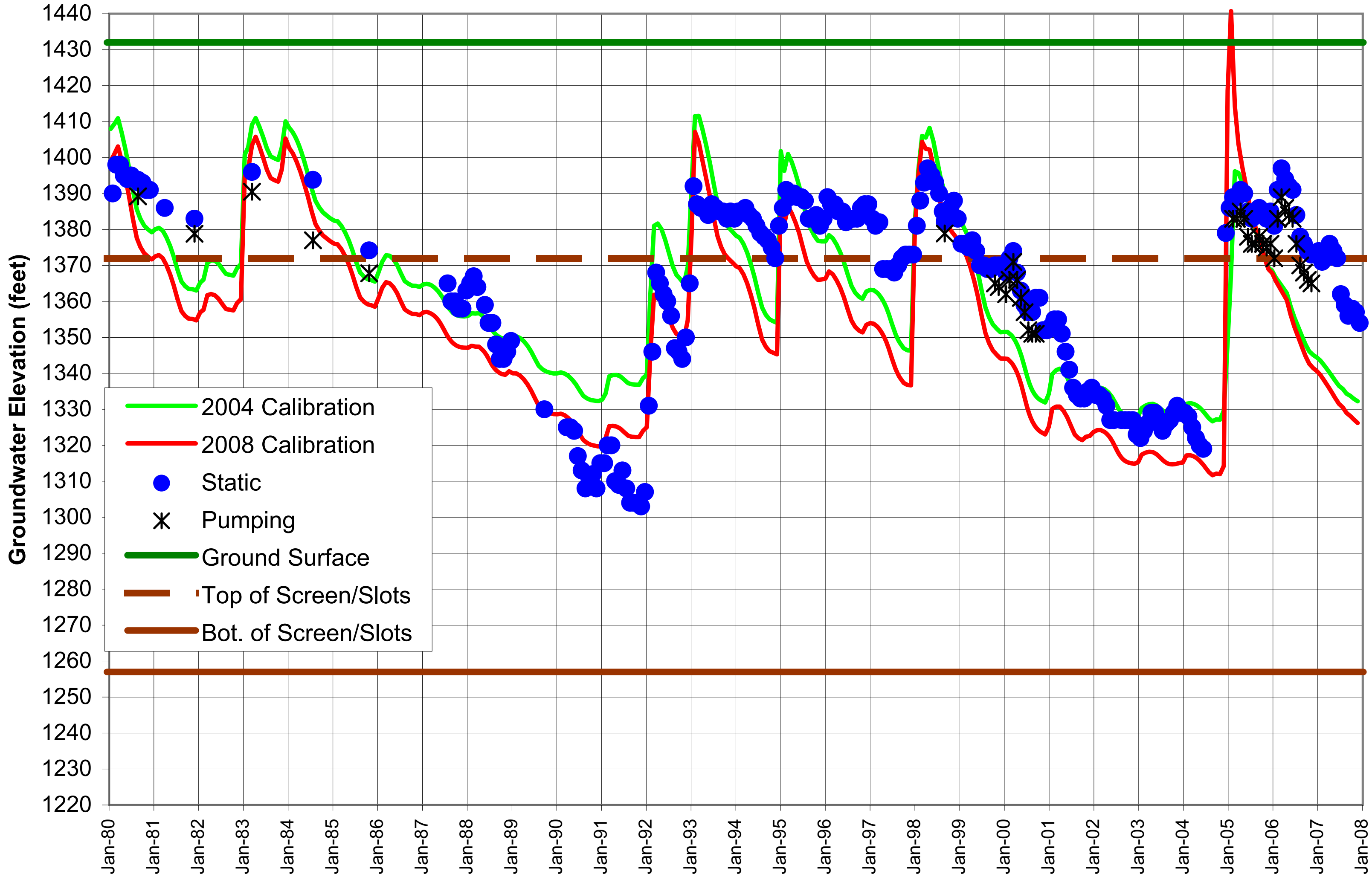


SCWD - North Oaks Central Measured and Modeled Groundwater Elevations
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)

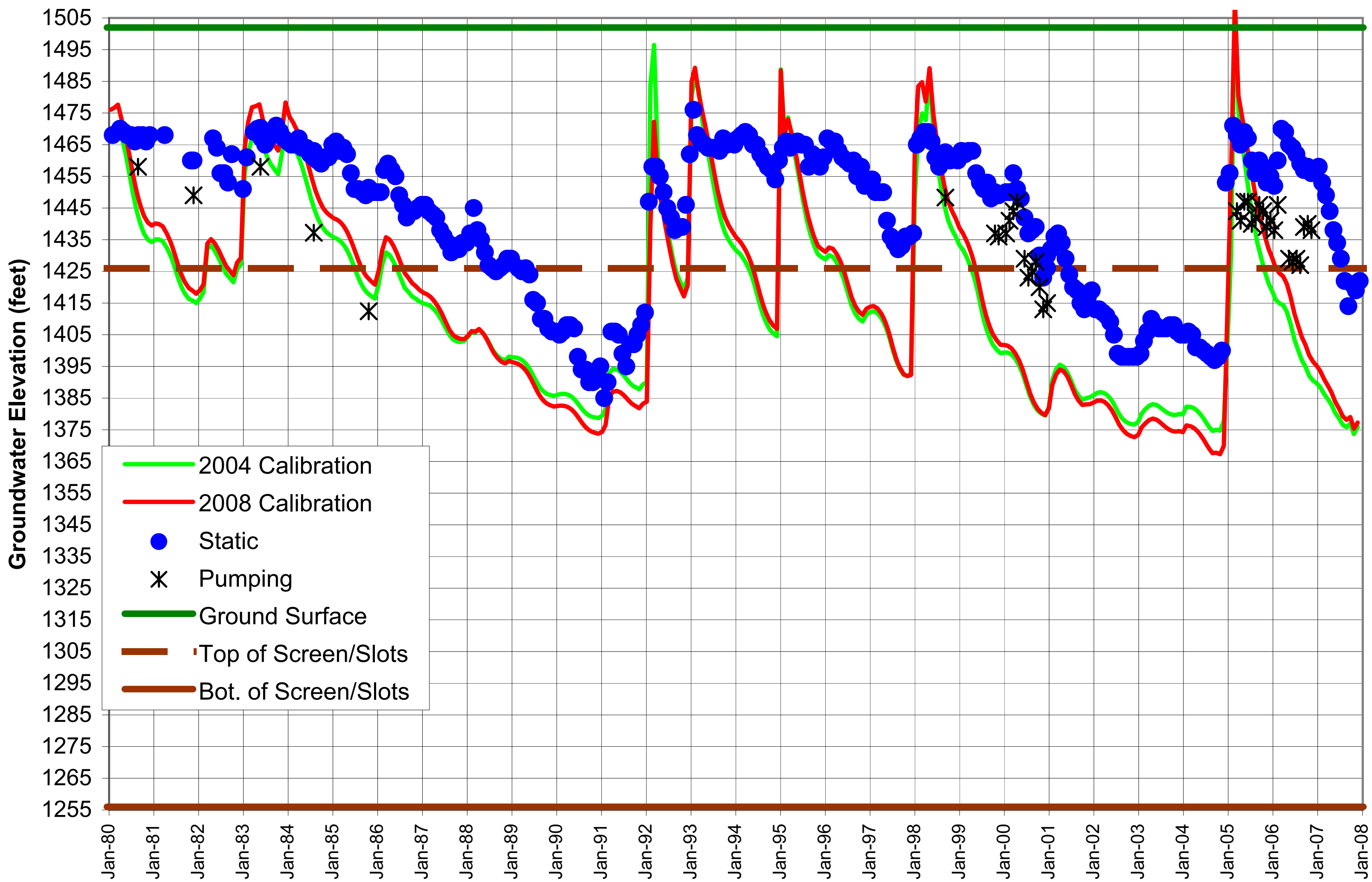



SCWD - North Oaks East Measured and Modeled Groundwater Elevations
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)
Groundwater Elevation (feet)
1420
1410
1400
1390
1380
1370
1360
1350
1340
1330
1320
1310
1300
1290
1280
1270
1260
1250
1240
1230
1220
1210
1200
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

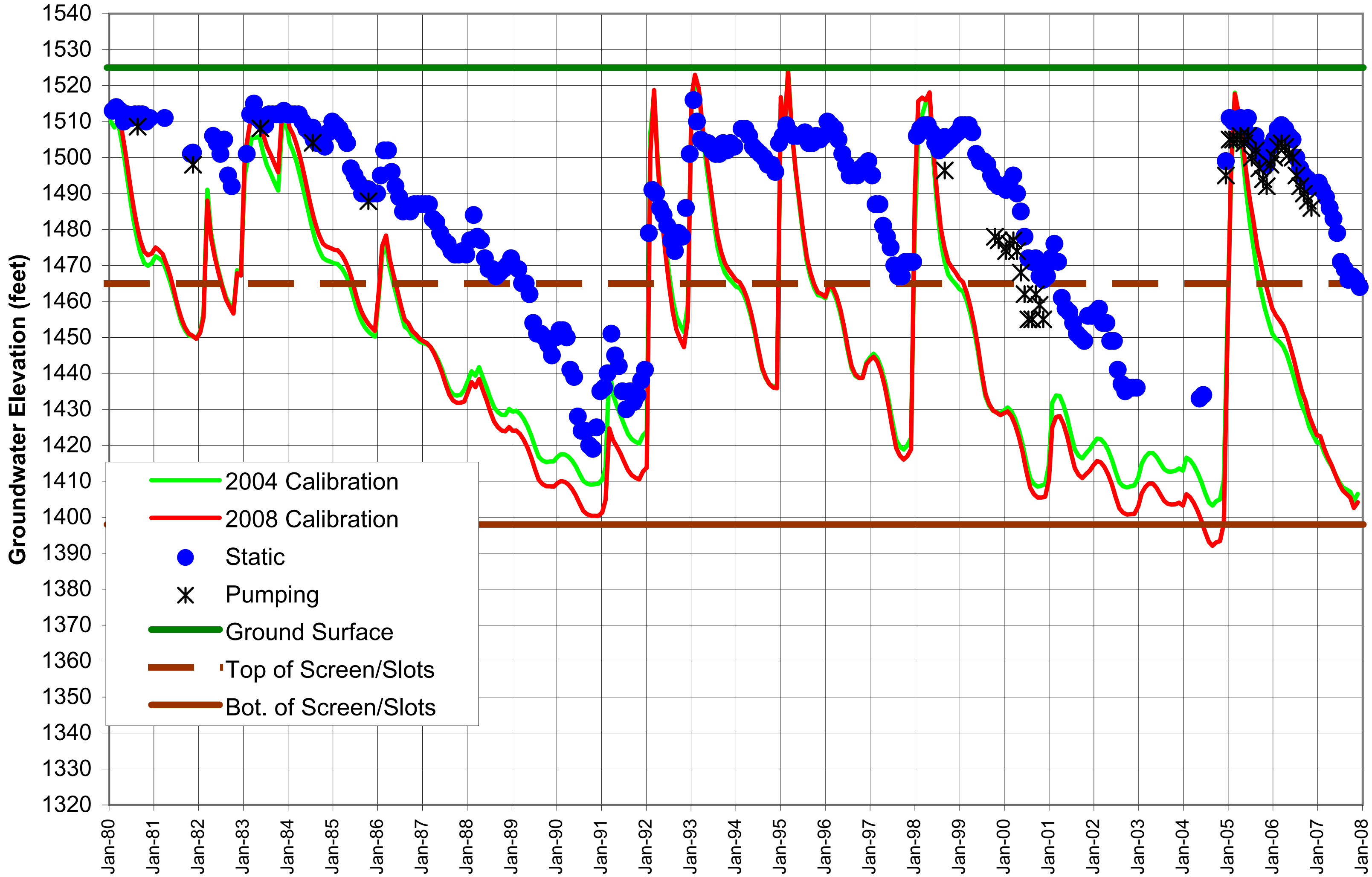
SCWD - Sierra Measured and Modeled Groundwater Elevations
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)

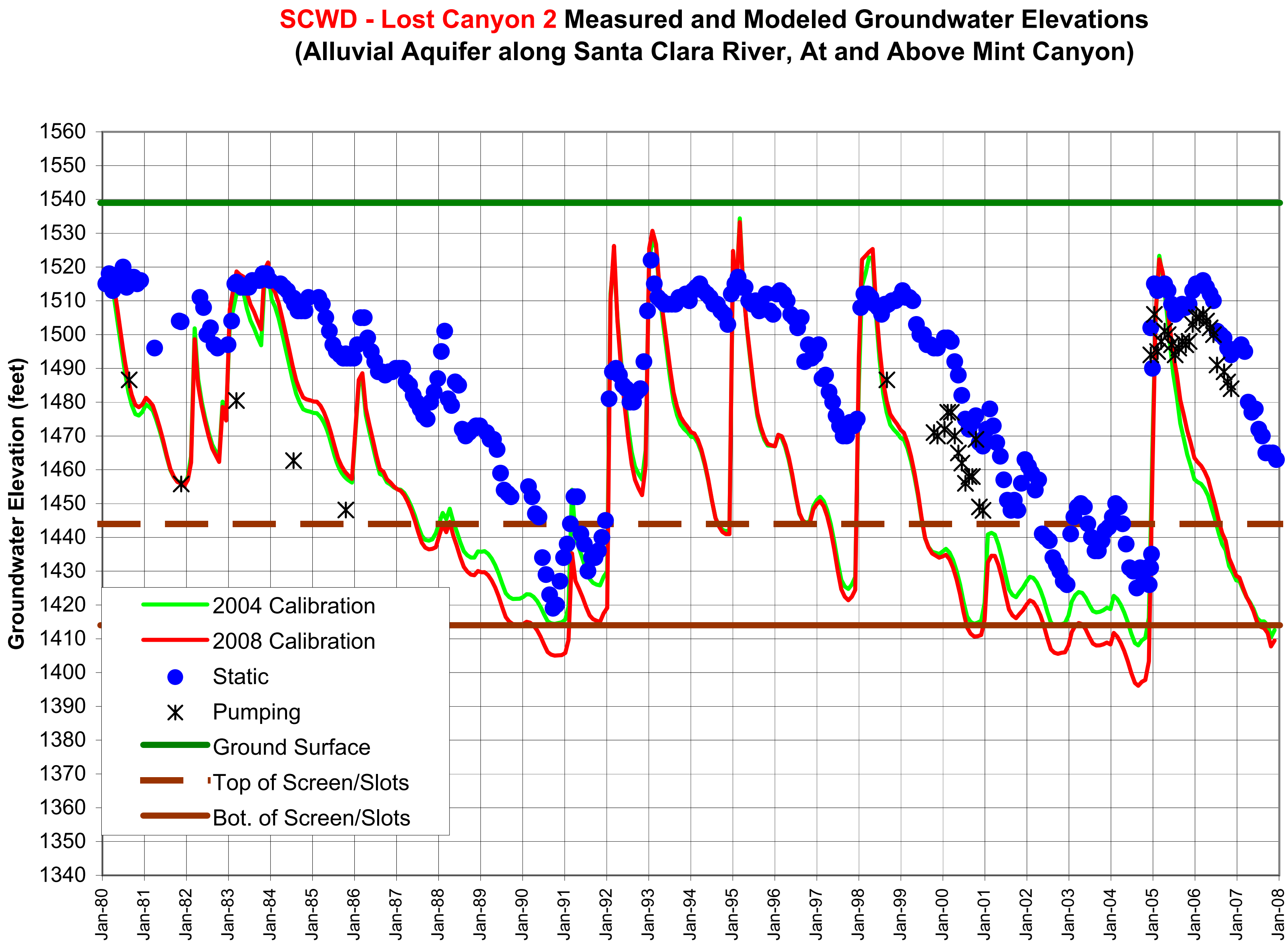


SCWD - Mitchell Measured and Modeled Groundwater Elevations
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)

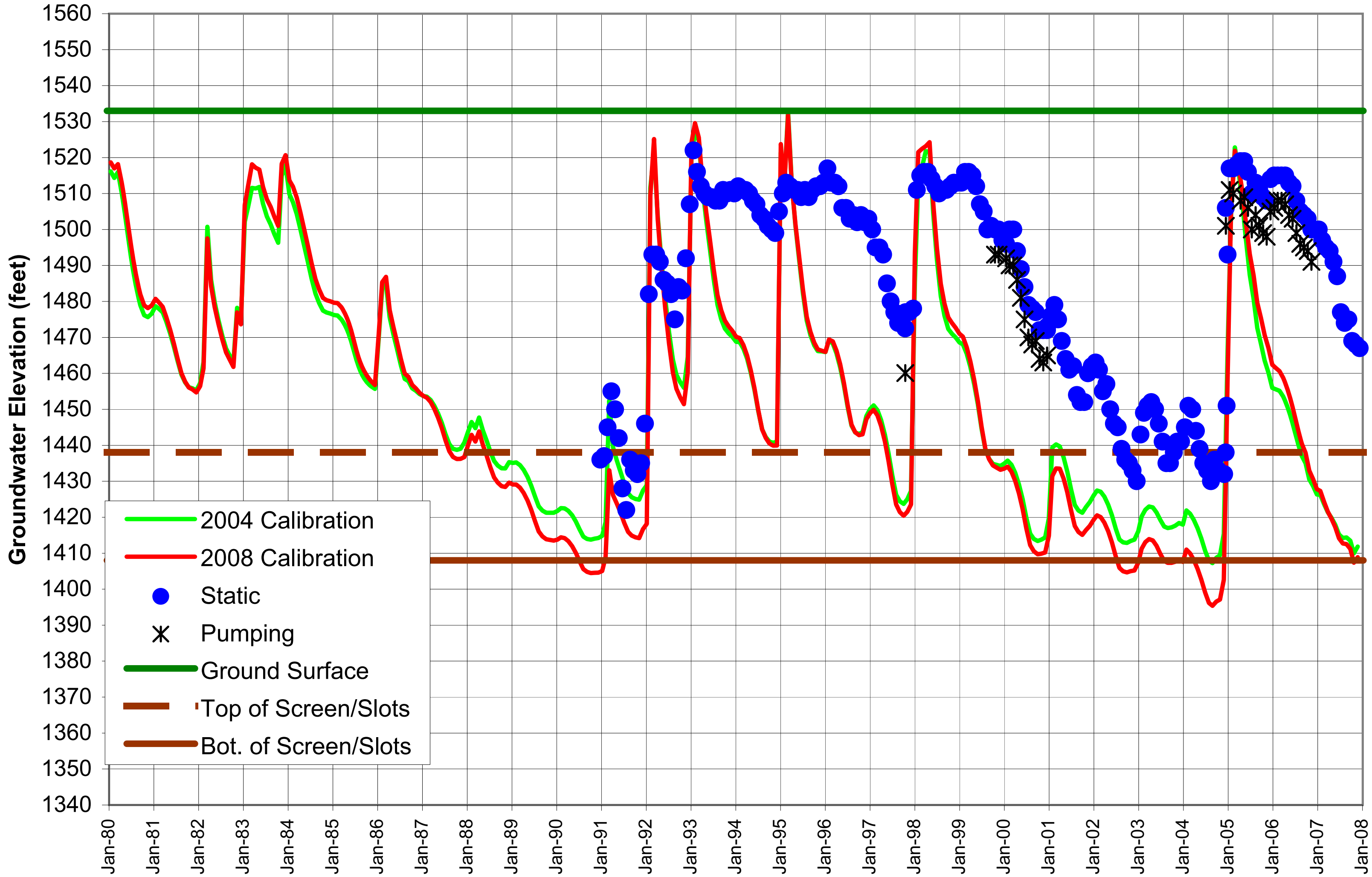


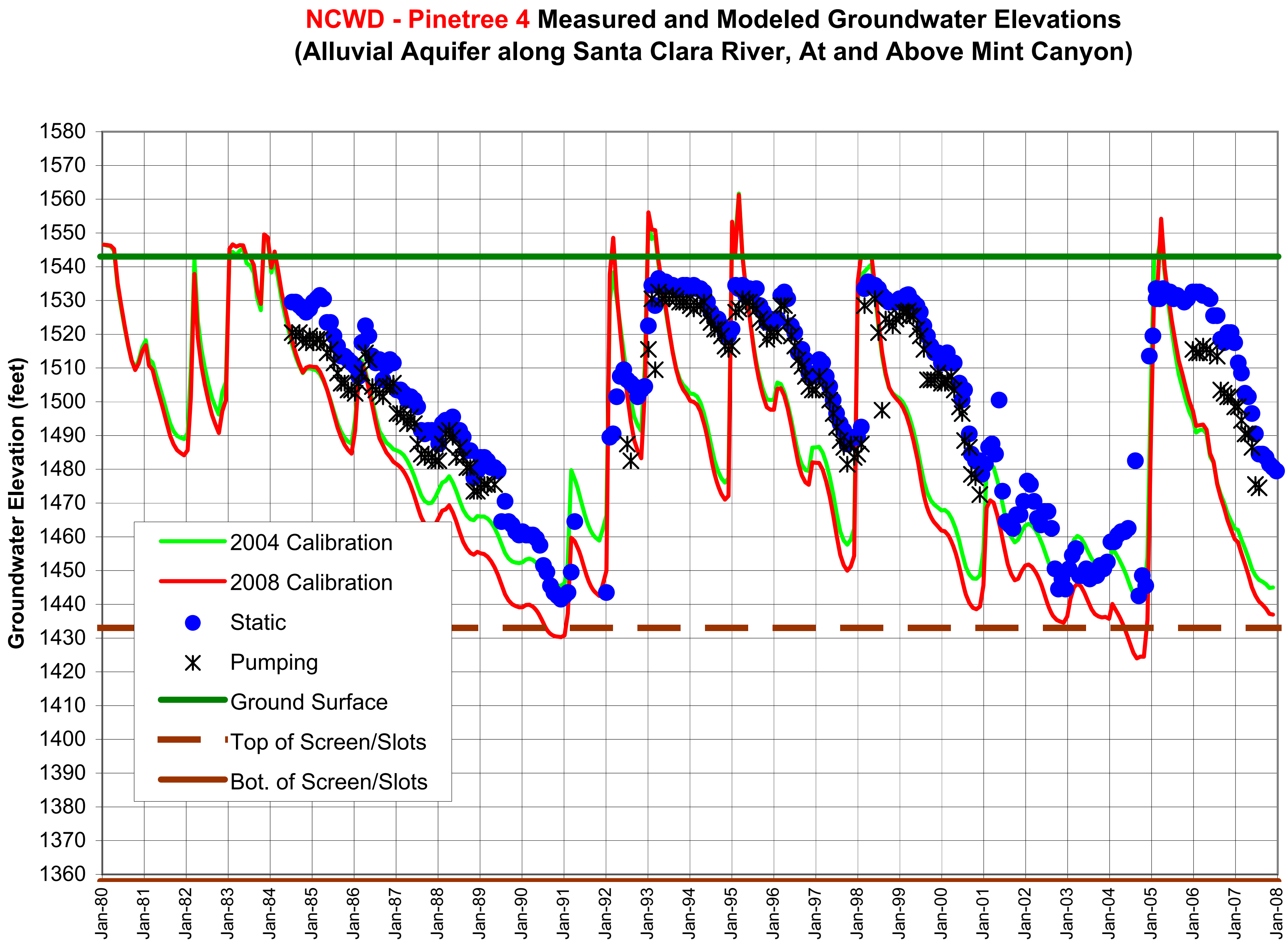
SCWD - Sand Canyon Measured and Modeled Groundwater Elevations
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)



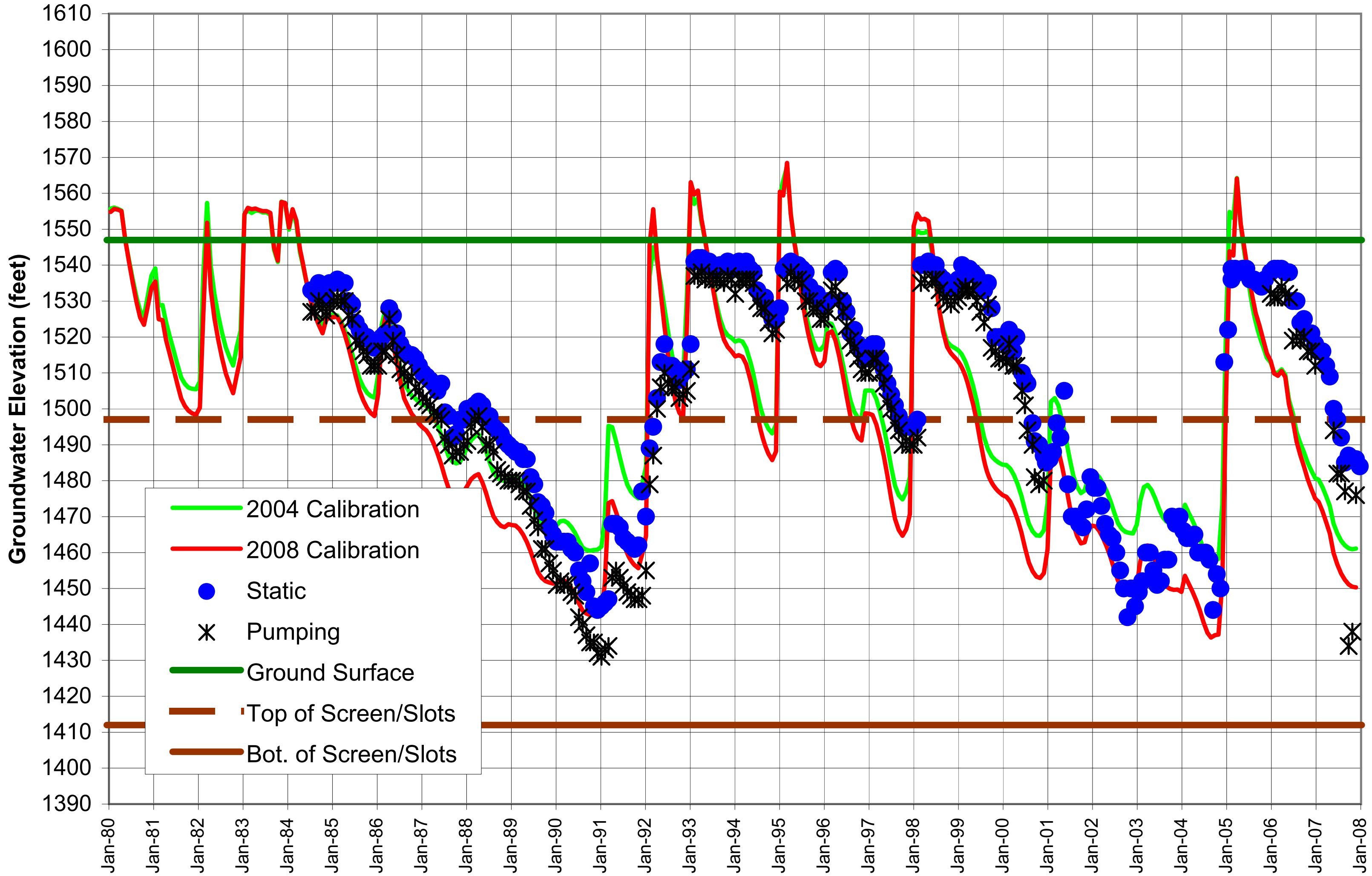

SCWD - Lost Canyon 2 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)
Groundwater Elevation (feet)
1560
1550
1540
1530
1520
1510
1500
1490
1480
1470
1460
1450
1440
1430
1420
1410
1400
1390
1380
1370
1360
1350
1340
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08

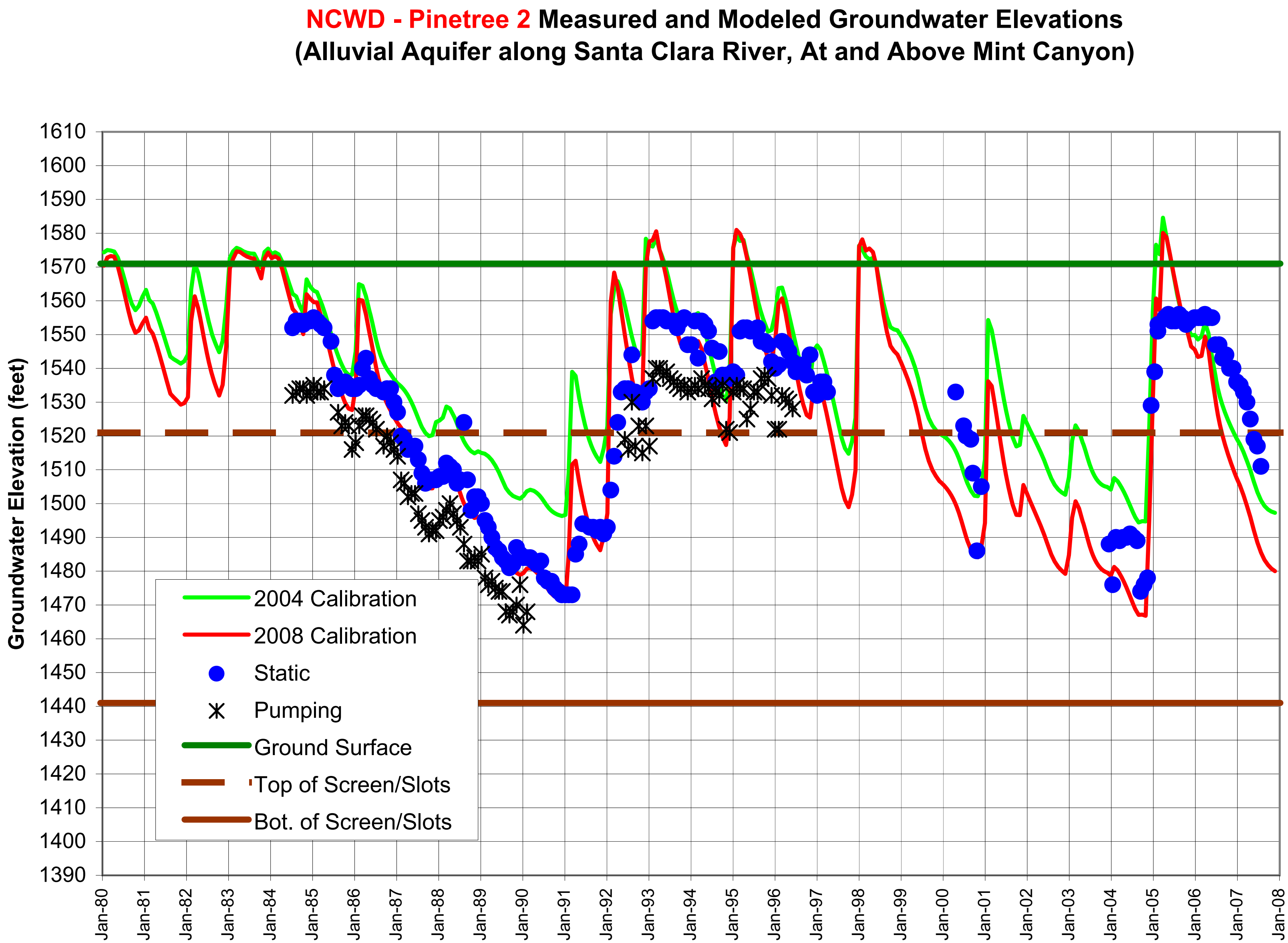
SCWD - Lost Canyon 2A Measured and Modeled Groundwater Elevations
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)



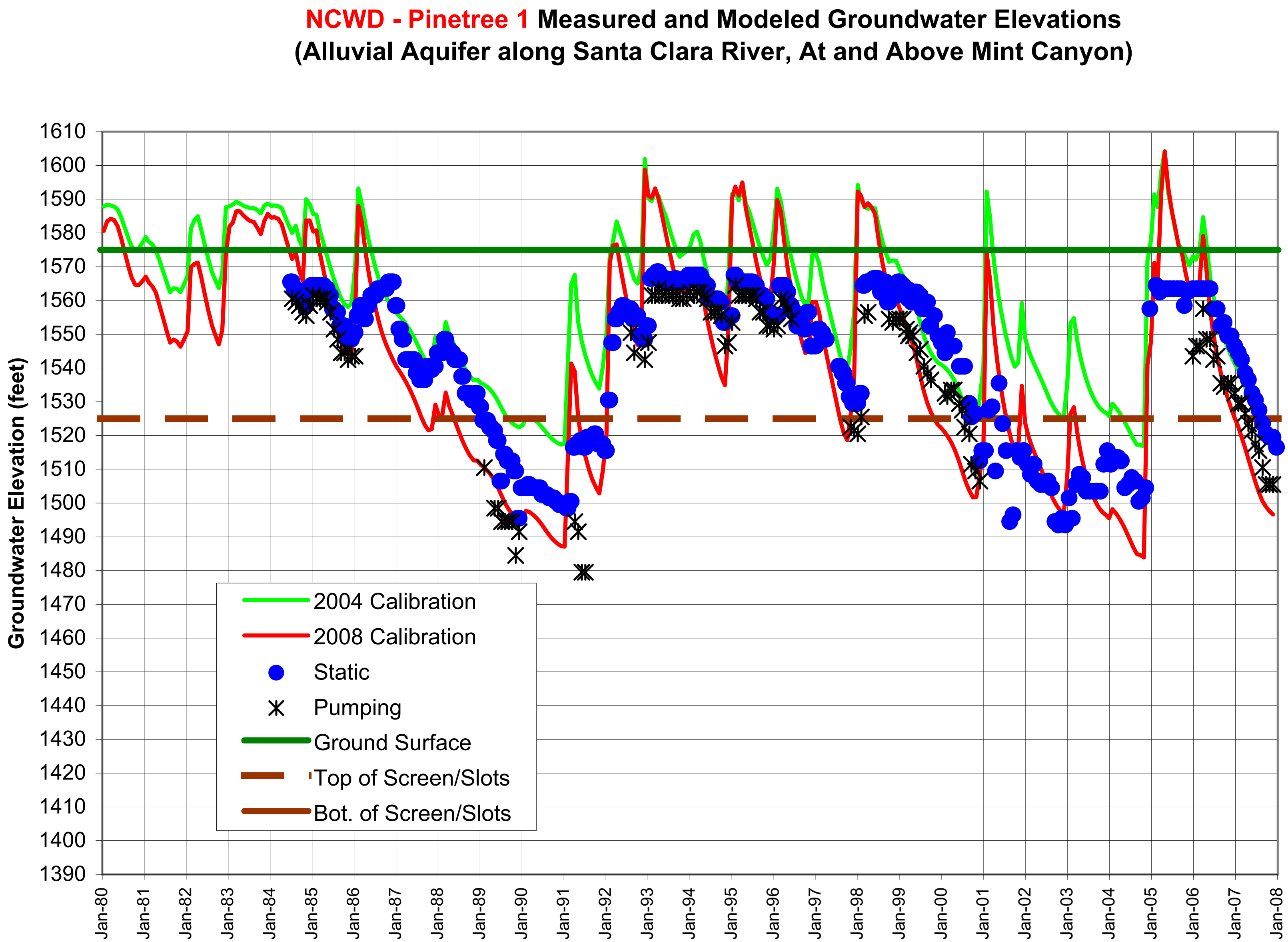

NCWD - Pinetree 4 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)
Groundwater Elevation (feet)
1580
1570
1560
1550
1540
1530
1520
1510
1500
1490
1480
1470
1460
1450
1440
1430
1420
1410
1400
1390
1380
1370
1360
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

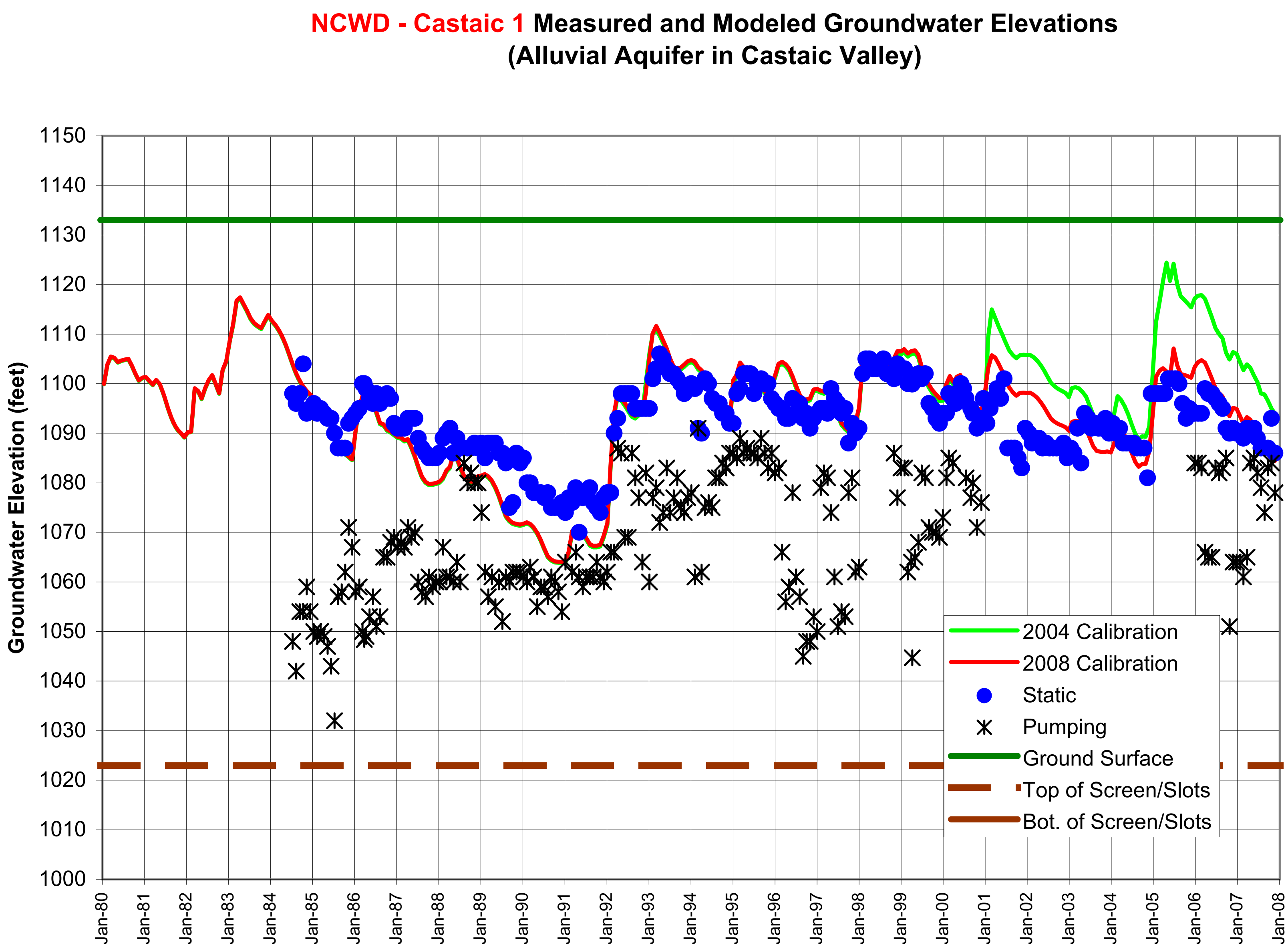
NCWD - Pinetree 3 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)



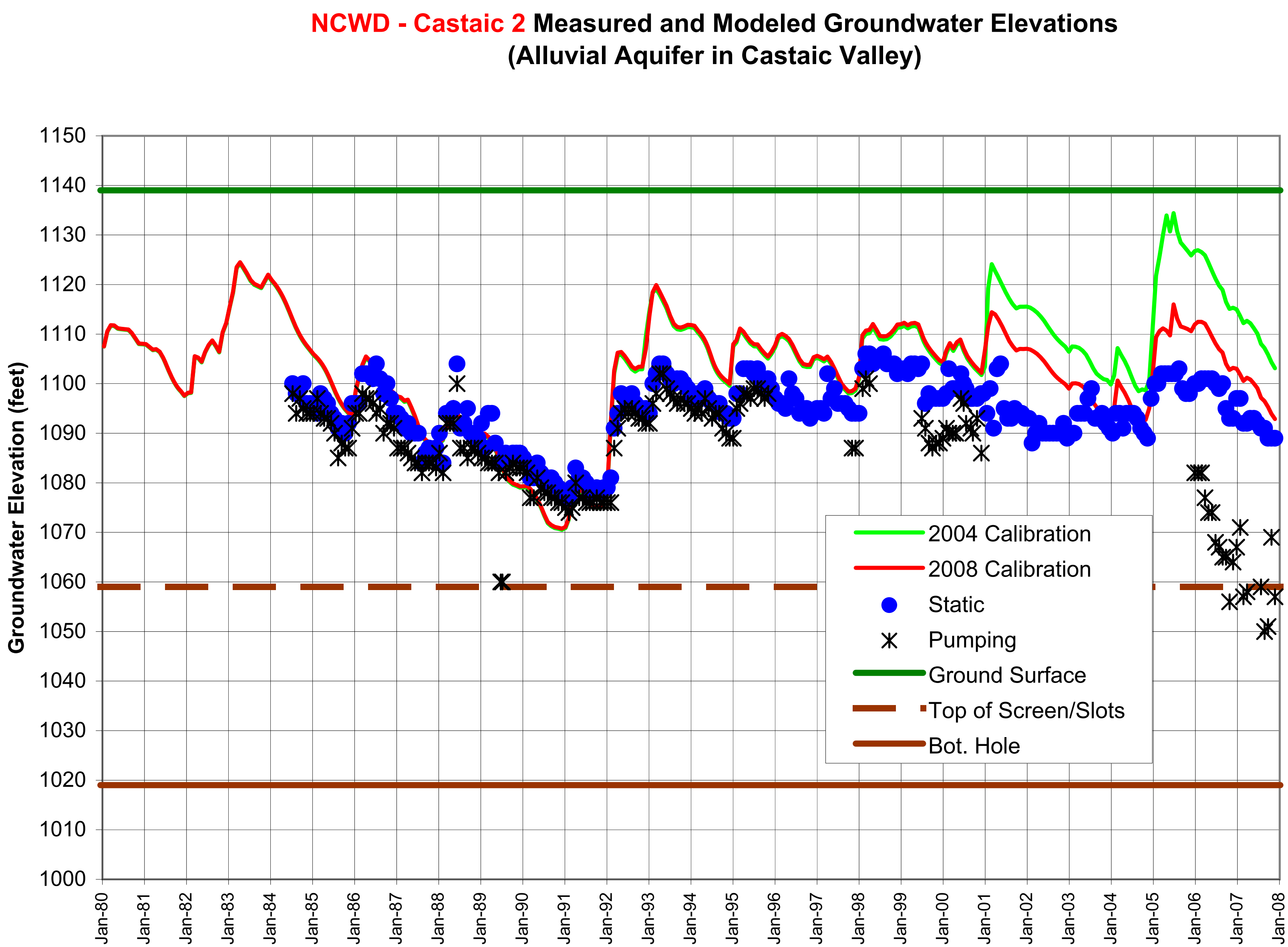


NCWD - Pinetree 2 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)
Groundwater Elevation (feet)
1610
1600
1590
1580
1570
1560
1550
1540
1530
1520
1510
1500
1490
1480
1470
1460
1450
1440
1430
1420
1410
1400
1390
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots


NCWD - Pinetree 1 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)
Groundwater Elevation (feet)
1610
1600
1590
1580
1570
1560
1550
1540
1530
1520
1510
1500
1490
1480
1470
1460
1450
1440
1430
1420
1410
1400
1390
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

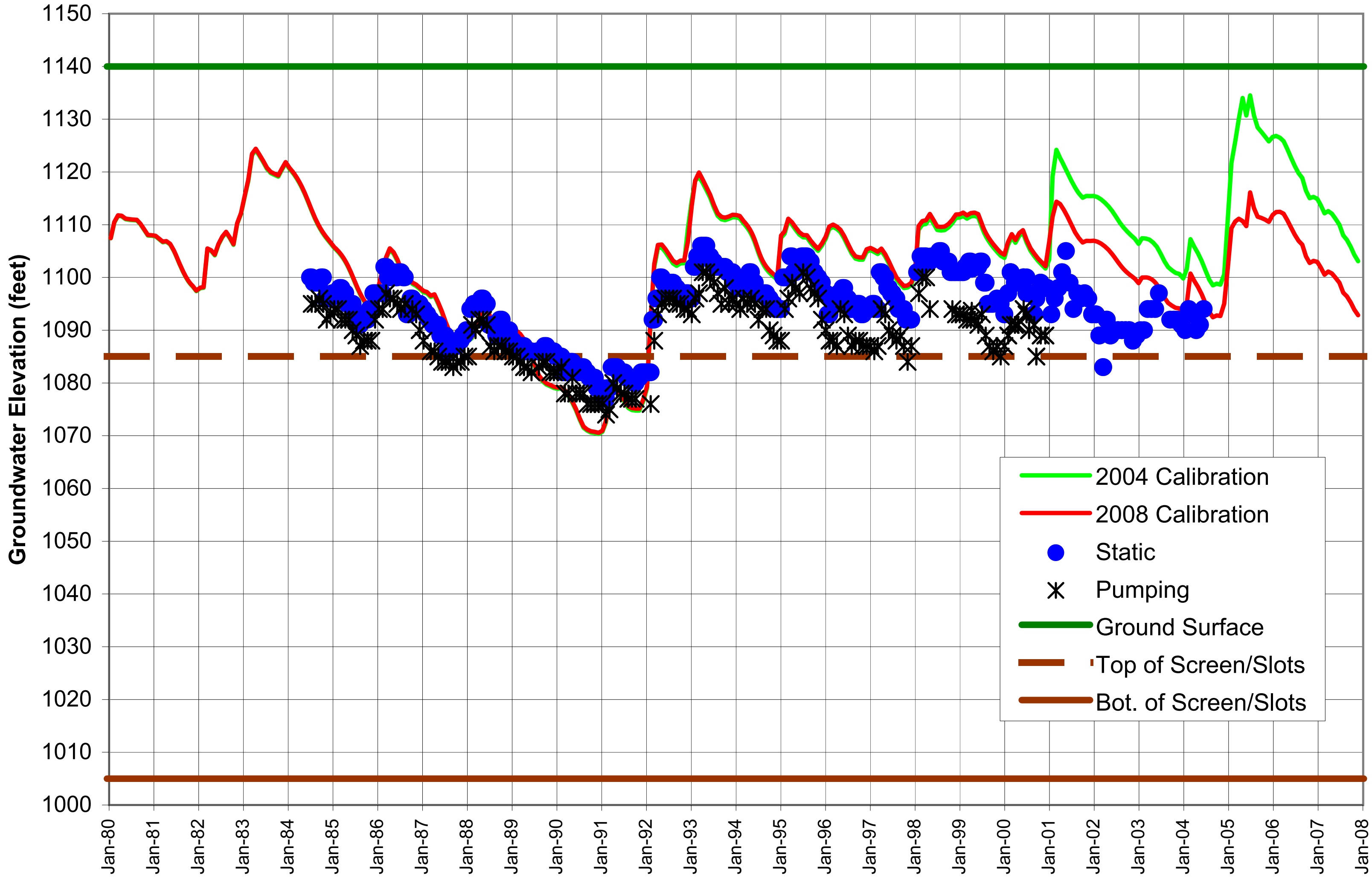


NCWD - Castaic 1 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer in Castaic Valley)
Groundwater Elevation (feet)
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

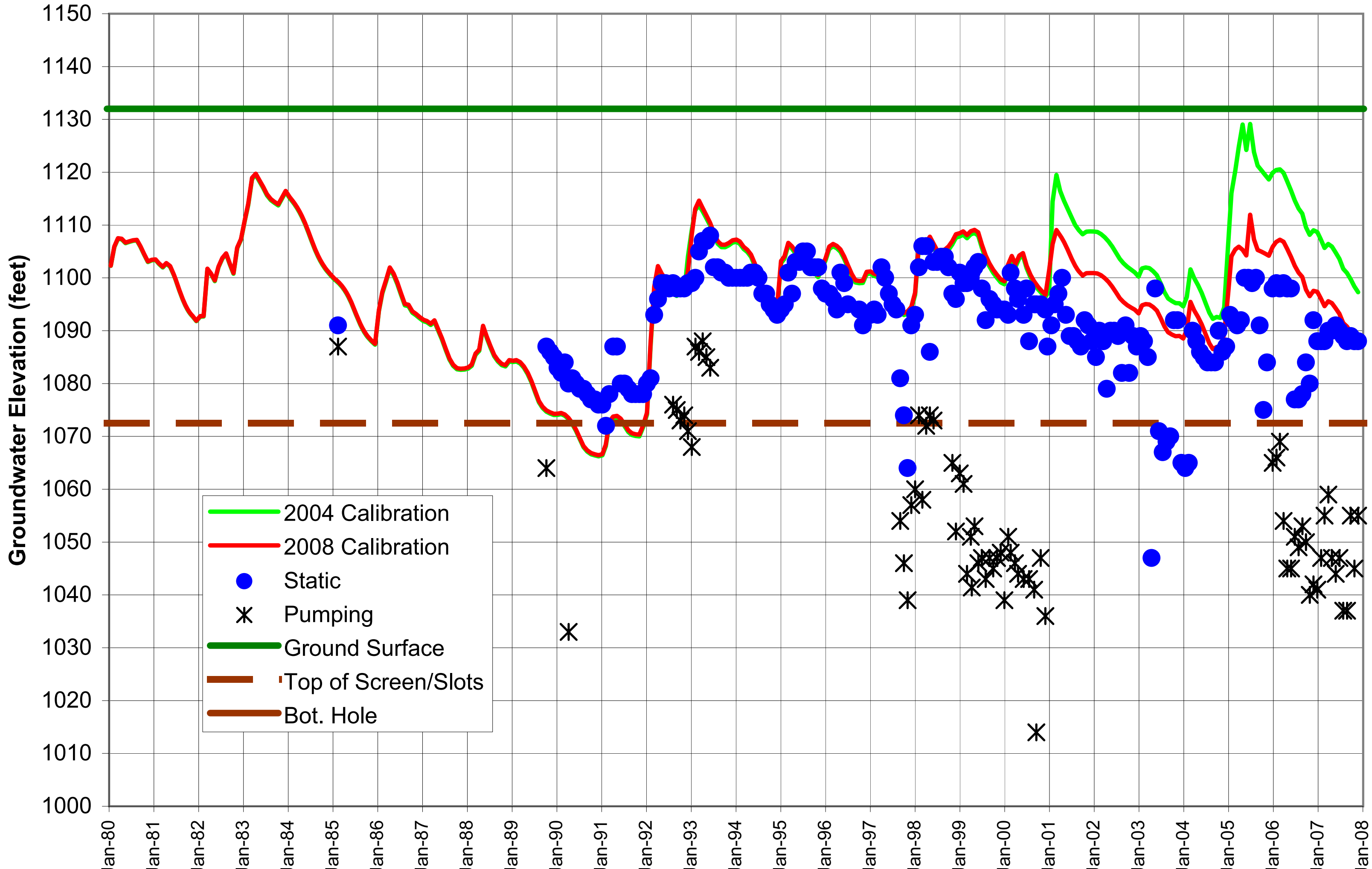


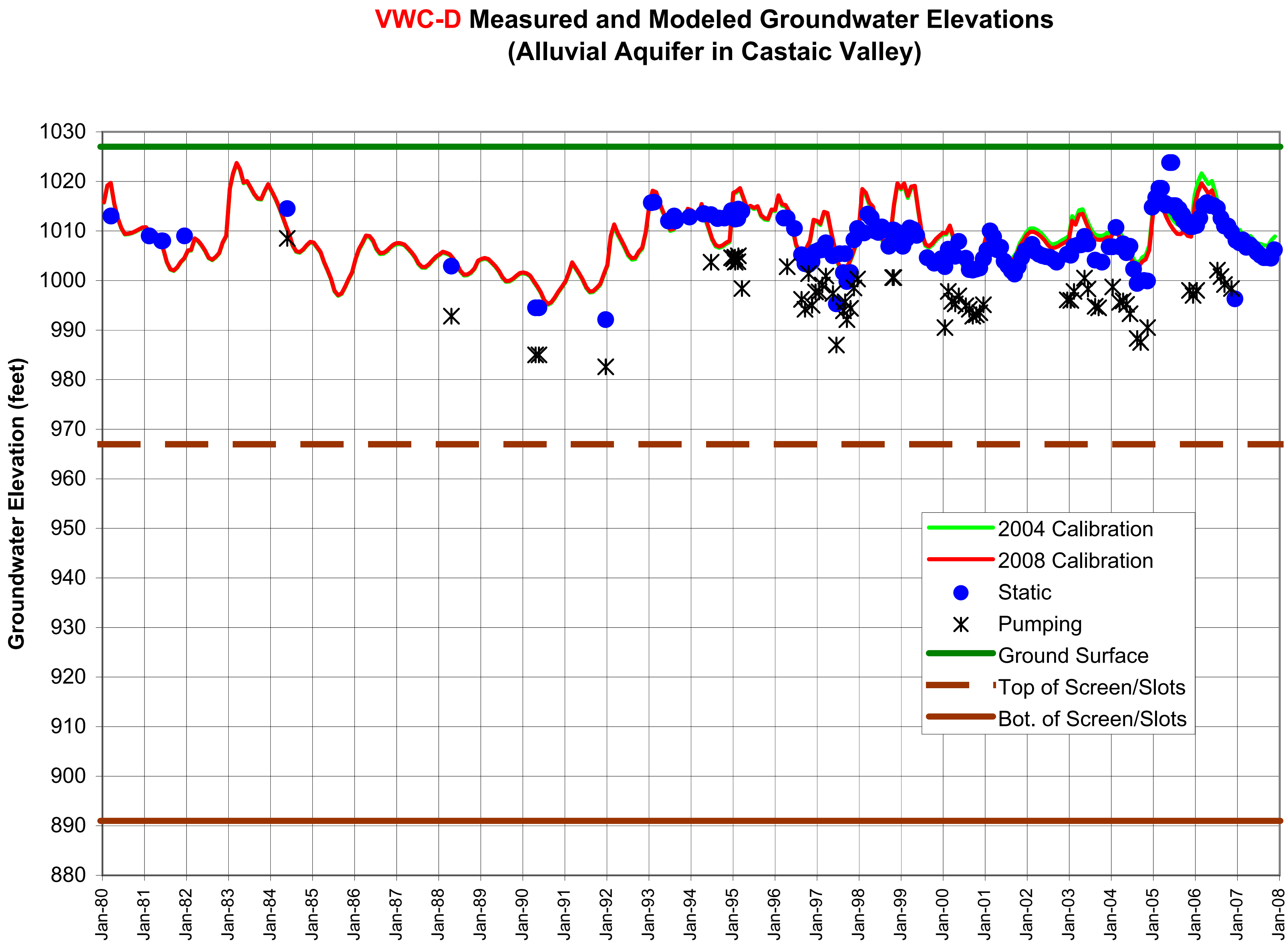
NCWD - Castaic 2 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer in Castaic Valley)
Groundwater Elevation (feet)
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. Hole

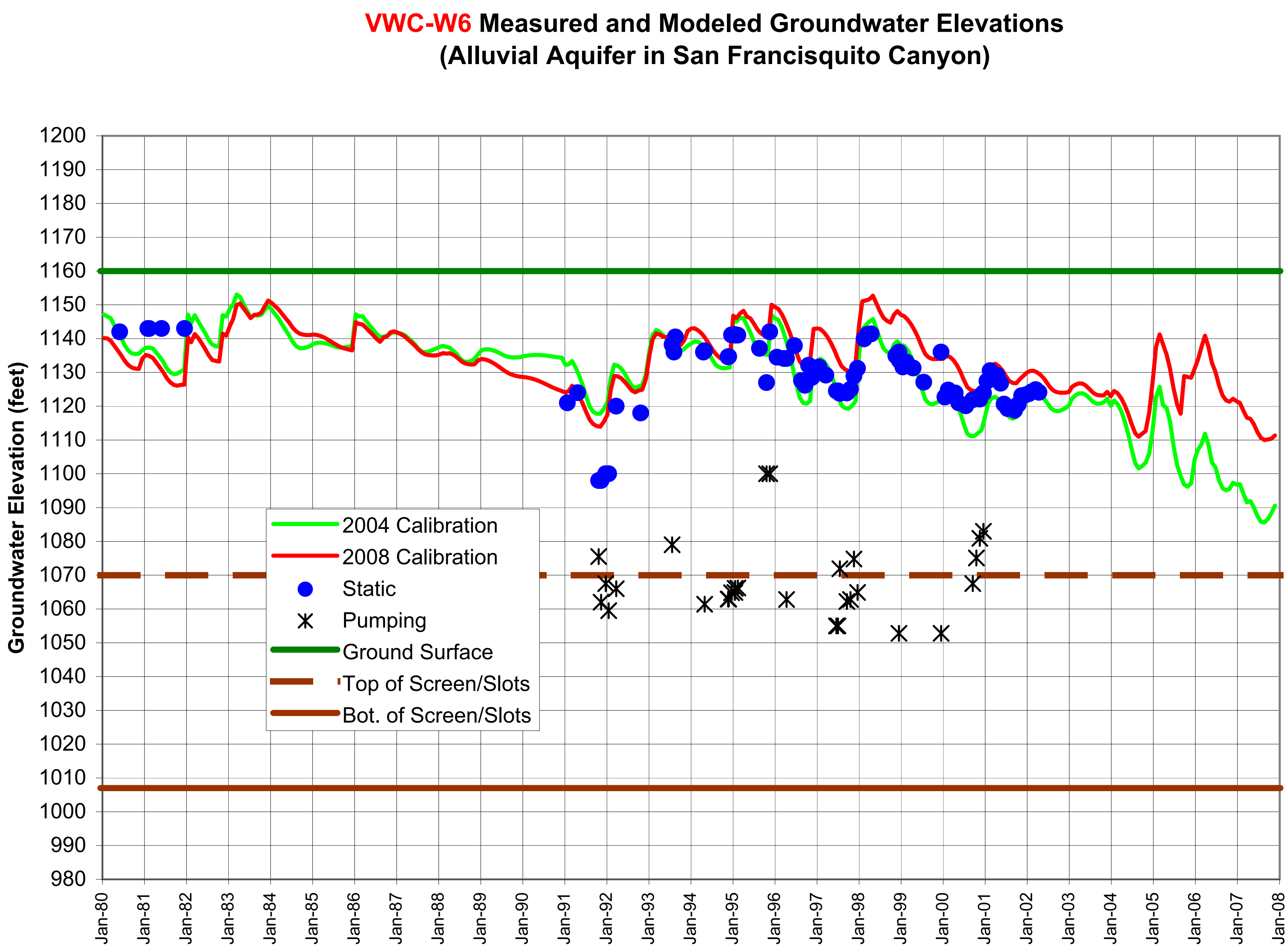
NCWD - Castaic 3 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer in Castaic Valley)

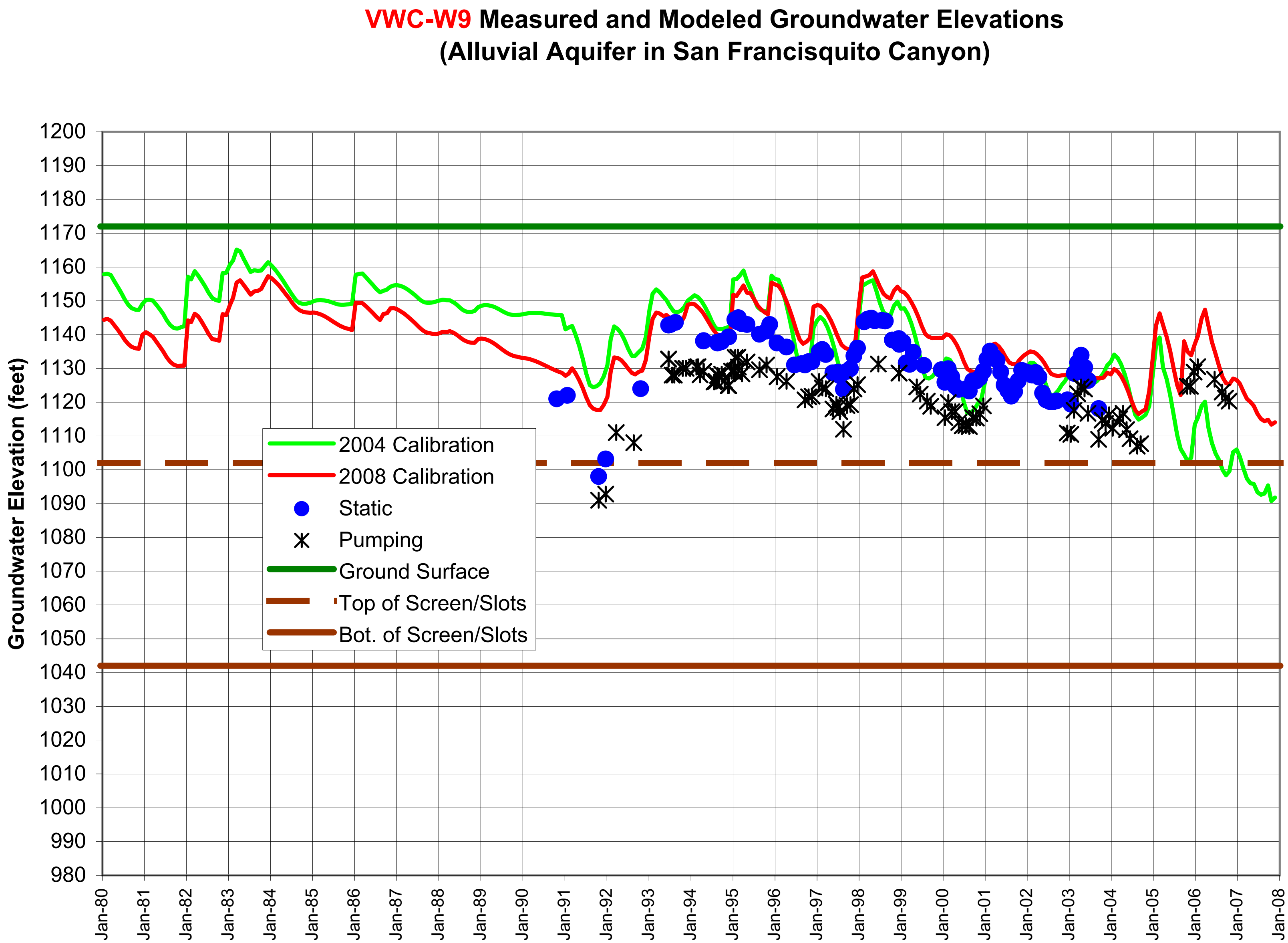


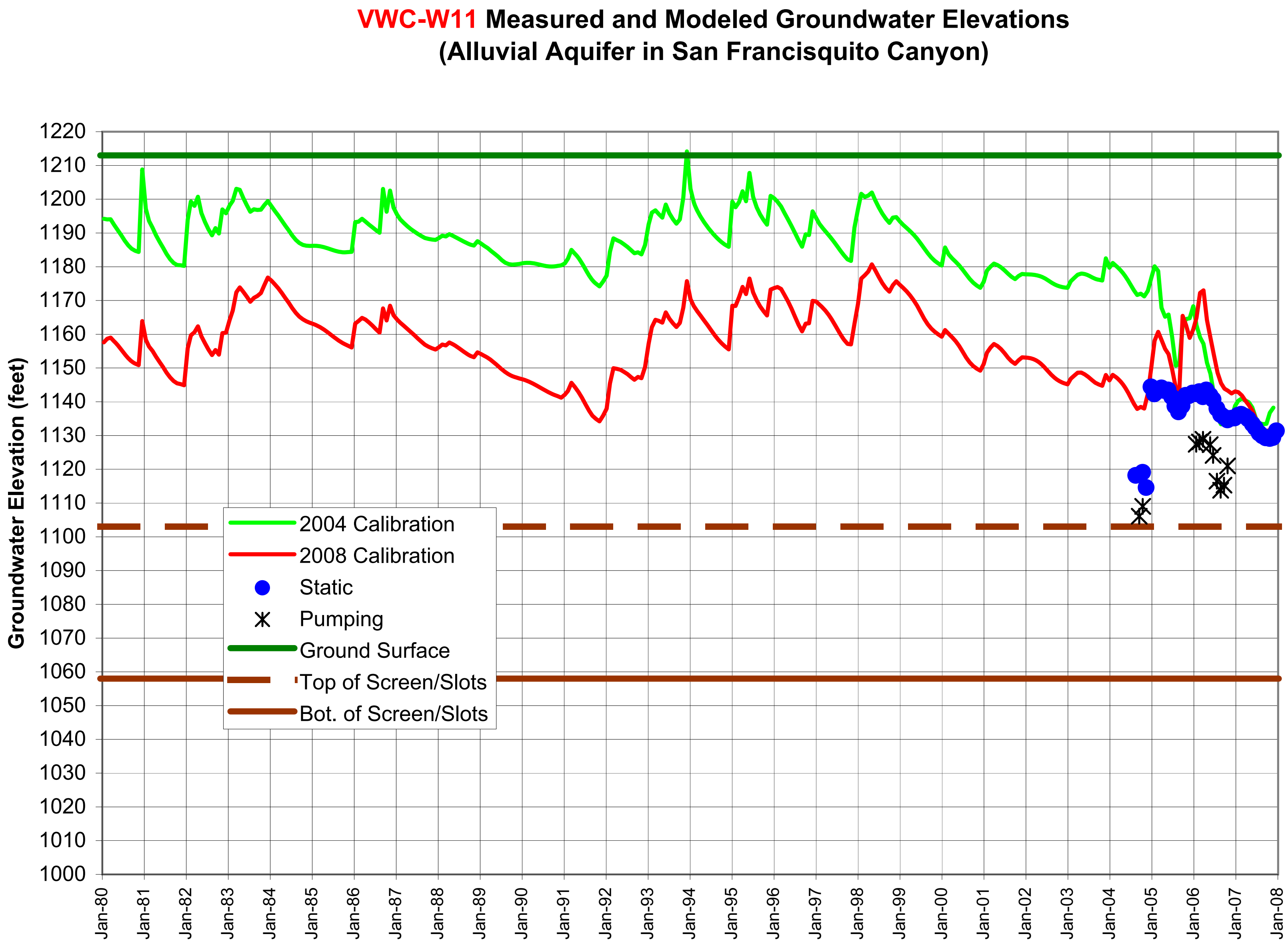
NCWD - Castaic 4 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer in Castaic Valley)




VWC-D Measured and Modeled Groundwater Elevations
(Alluvial Aquifer in Castaic Valley)
Groundwater Elevation (feet)
1030
1020
1010
1000
990
980
970
960
950
940
930
920
910
900
890
880
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

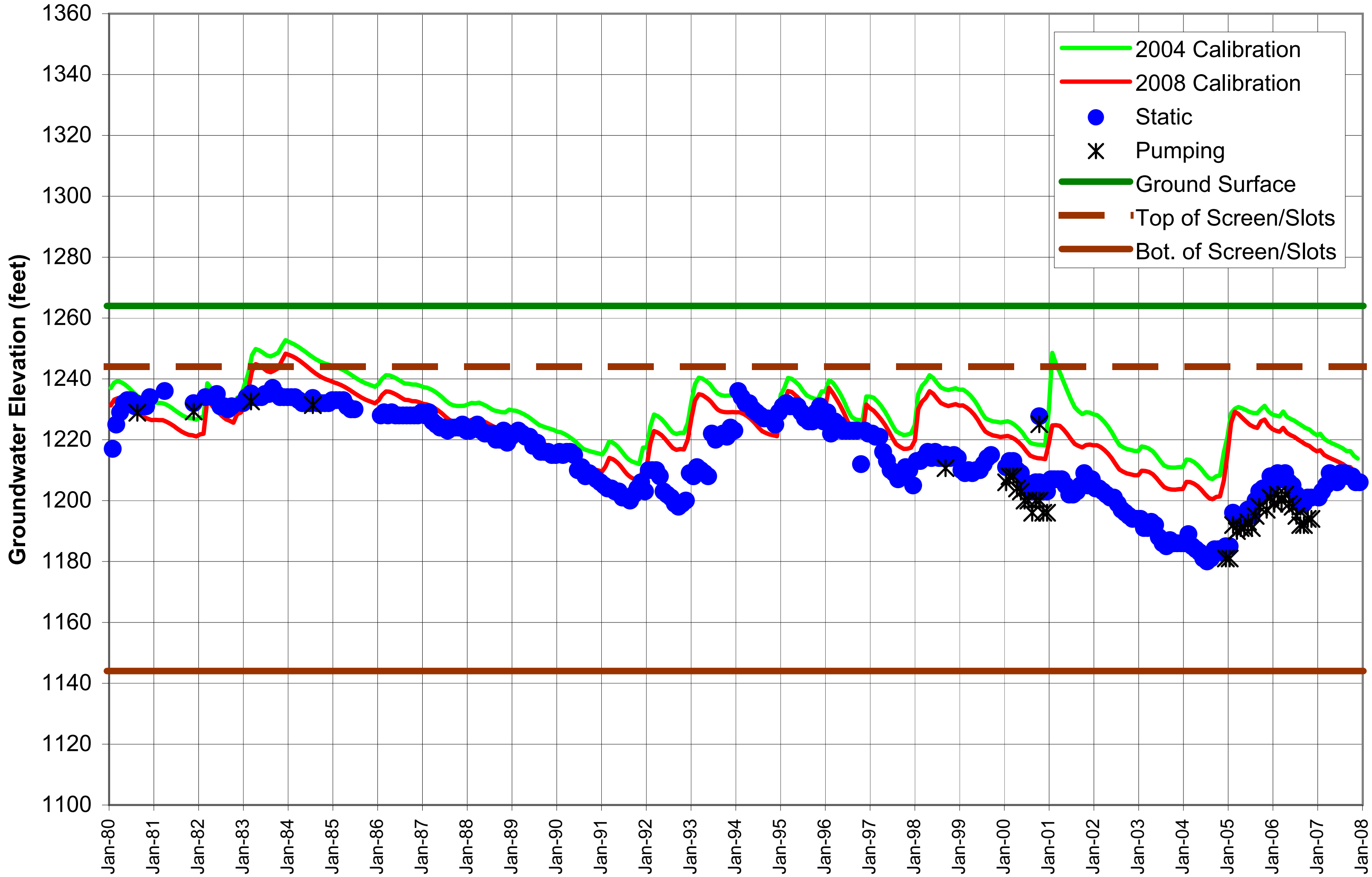

VWC-W6 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer in San Francisquito Canyon)
Groundwater Elevation (feet)
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

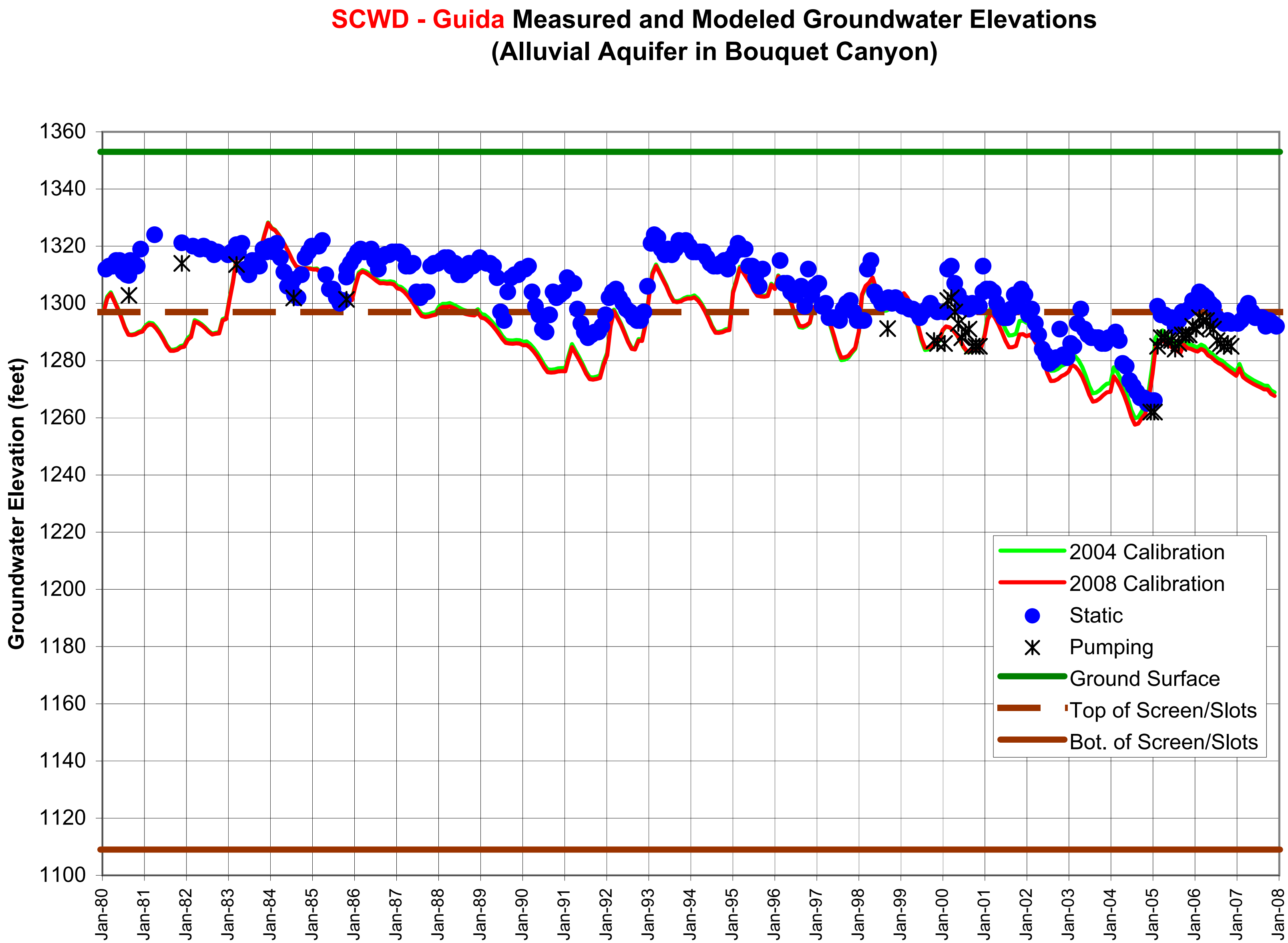

VWC-W9 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer in San Francisquito Canyon)
Groundwater Elevation (feet)
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots



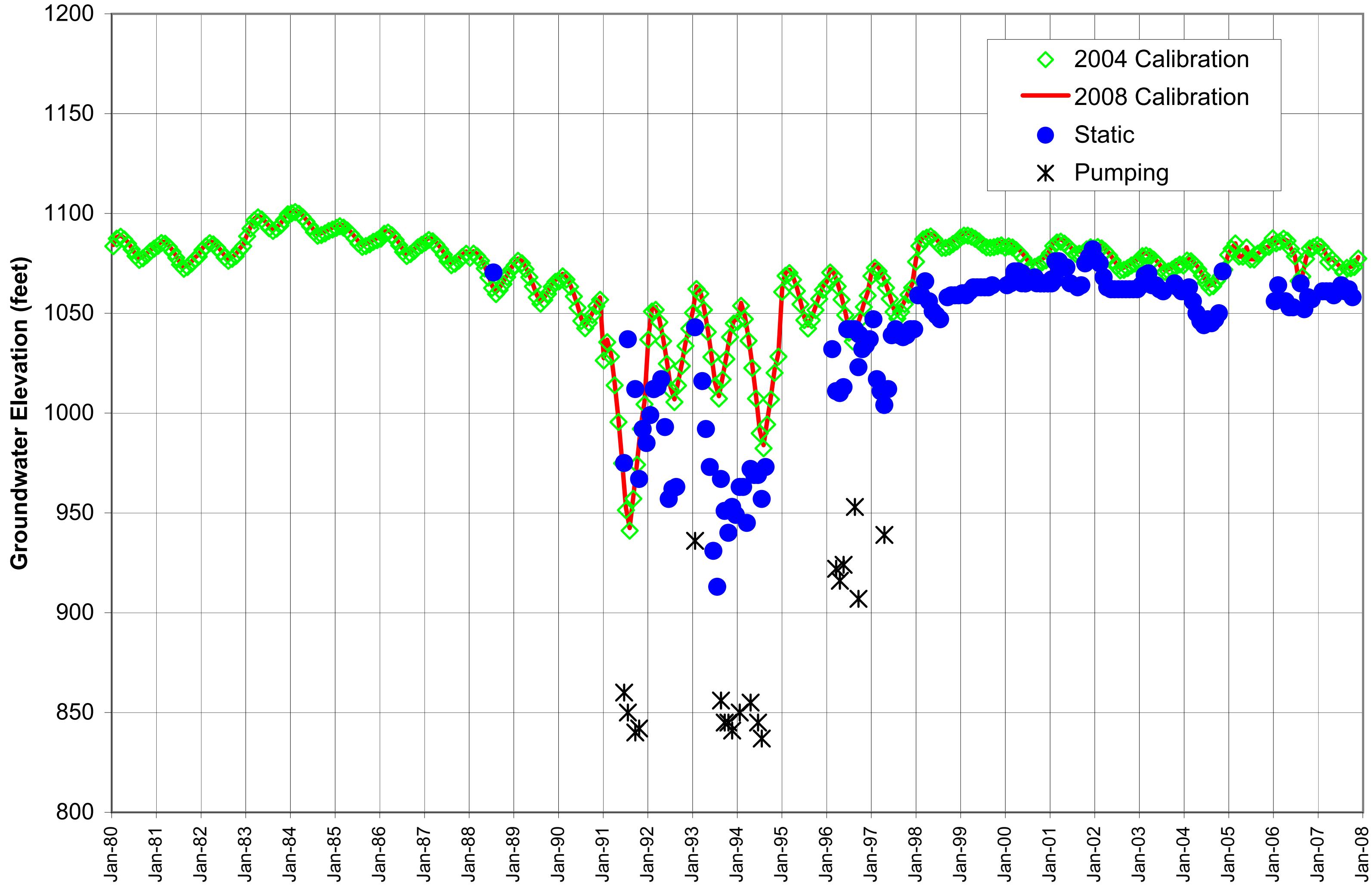
VWC-W11 Measured and Modeled Groundwater Elevations
(Alluvial Aquifer in San Francisquito Canyon)
Groundwater Elevation (feet)
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

SCWD - Clark Measured and Modeled Groundwater Elevations
(Alluvial Aquifer in Bouquet Canyon)

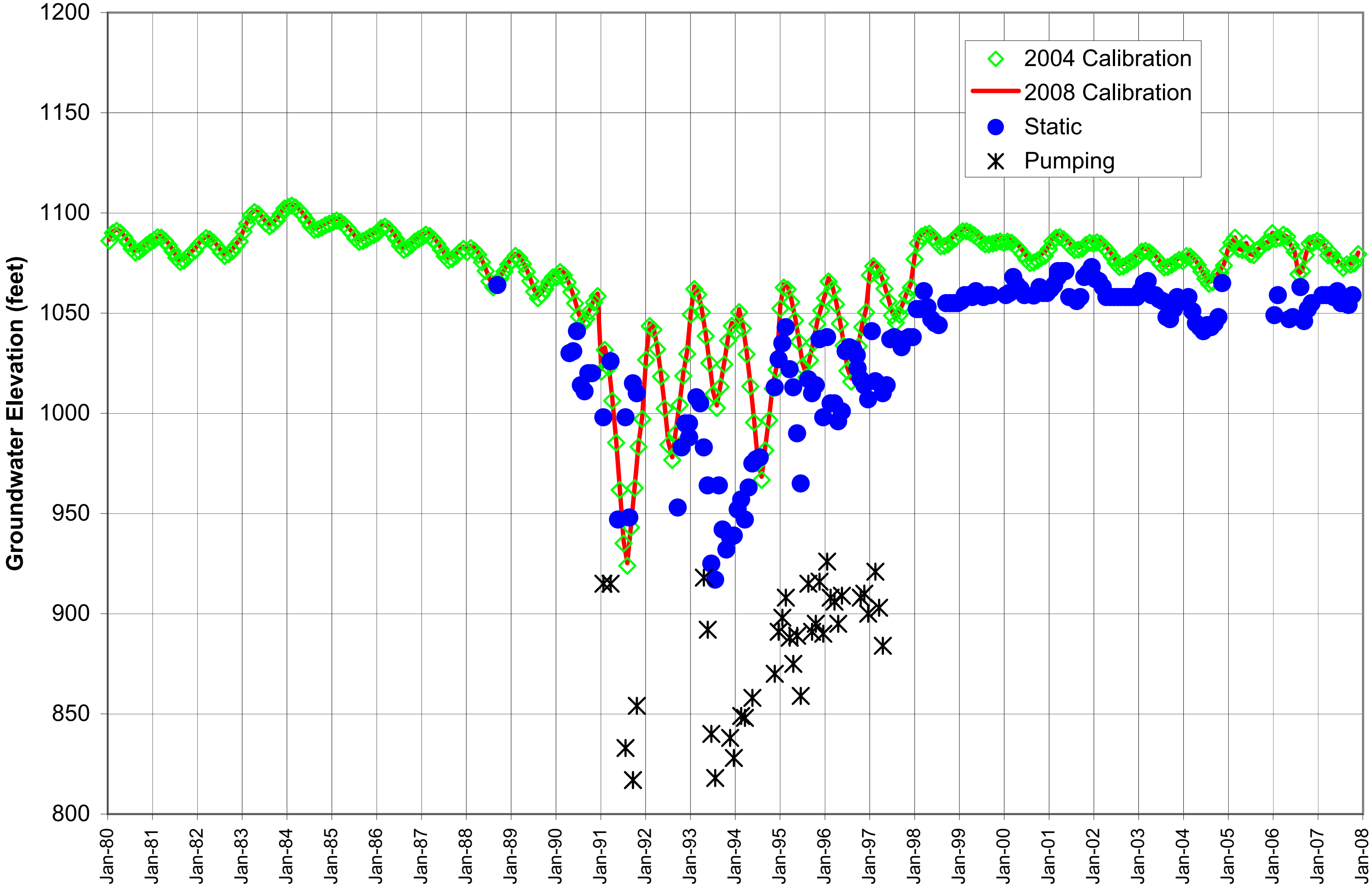



SCWD - Guida Measured and Modeled Groundwater Elevations
(Alluvial Aquifer in Bouquet Canyon)
Groundwater Elevation (feet)
1360
1340
1320
1300
1280
1260
1240
1220
1200
1180
1160
1140
1120
1100
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping
Ground Surface
Top of Screen/Slots
Bot. of Screen/Slots

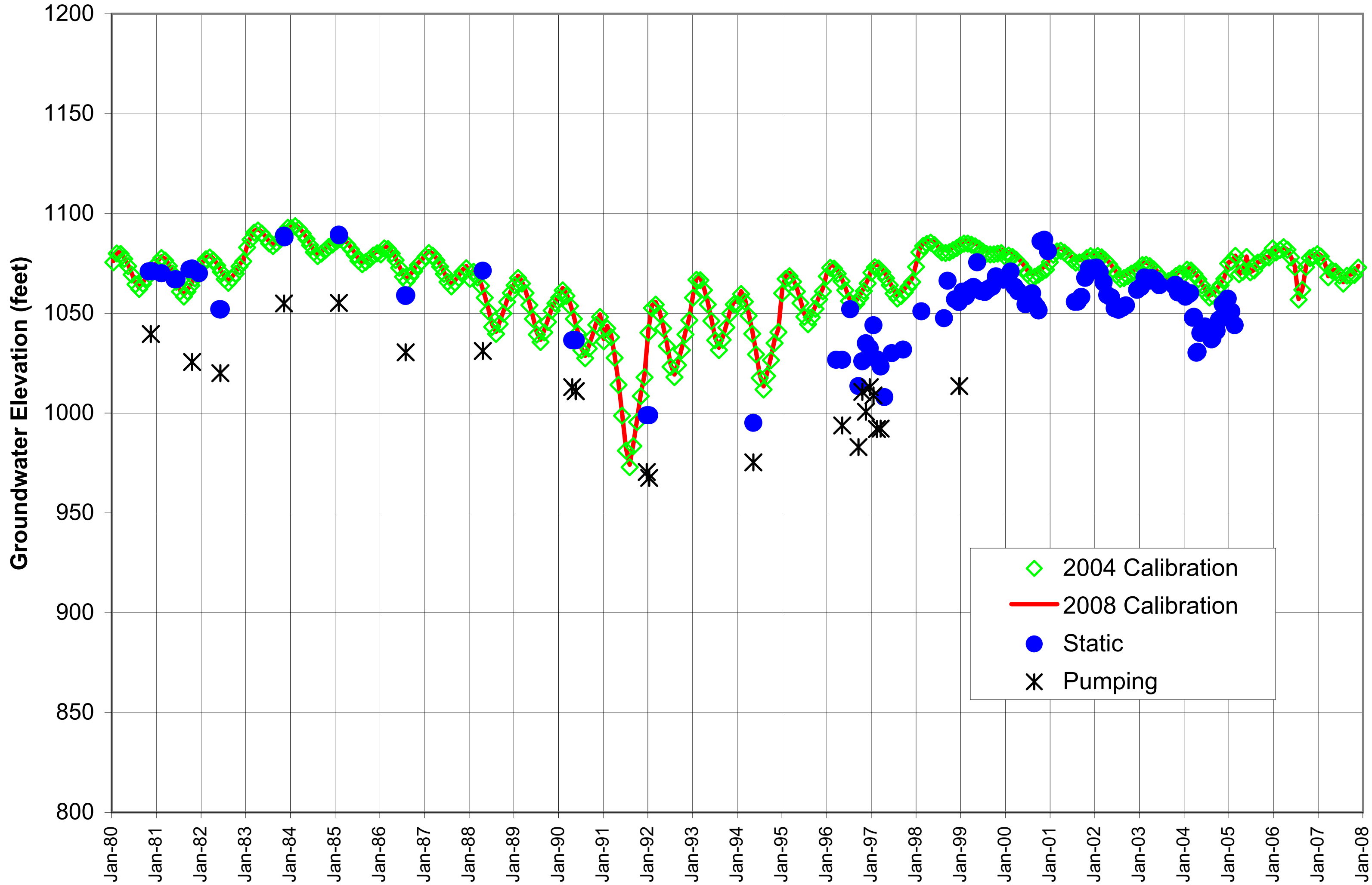
SCWD-Saugus1 Measured and Modeled Groundwater Elevations (Saugus Formation)



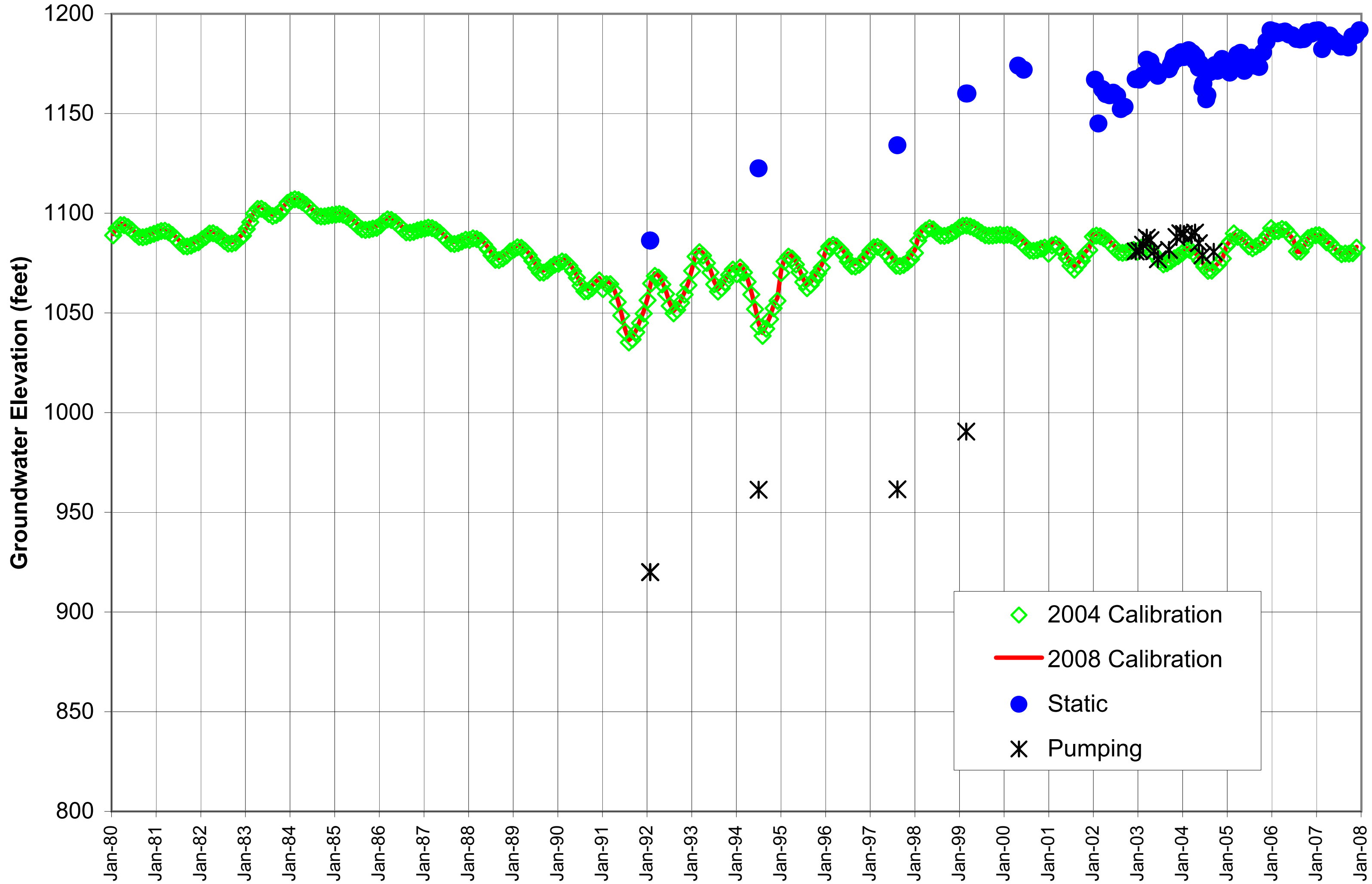
SCWD-Saugus2 Measured and Modeled Groundwater Elevations
(Saugus Formation)



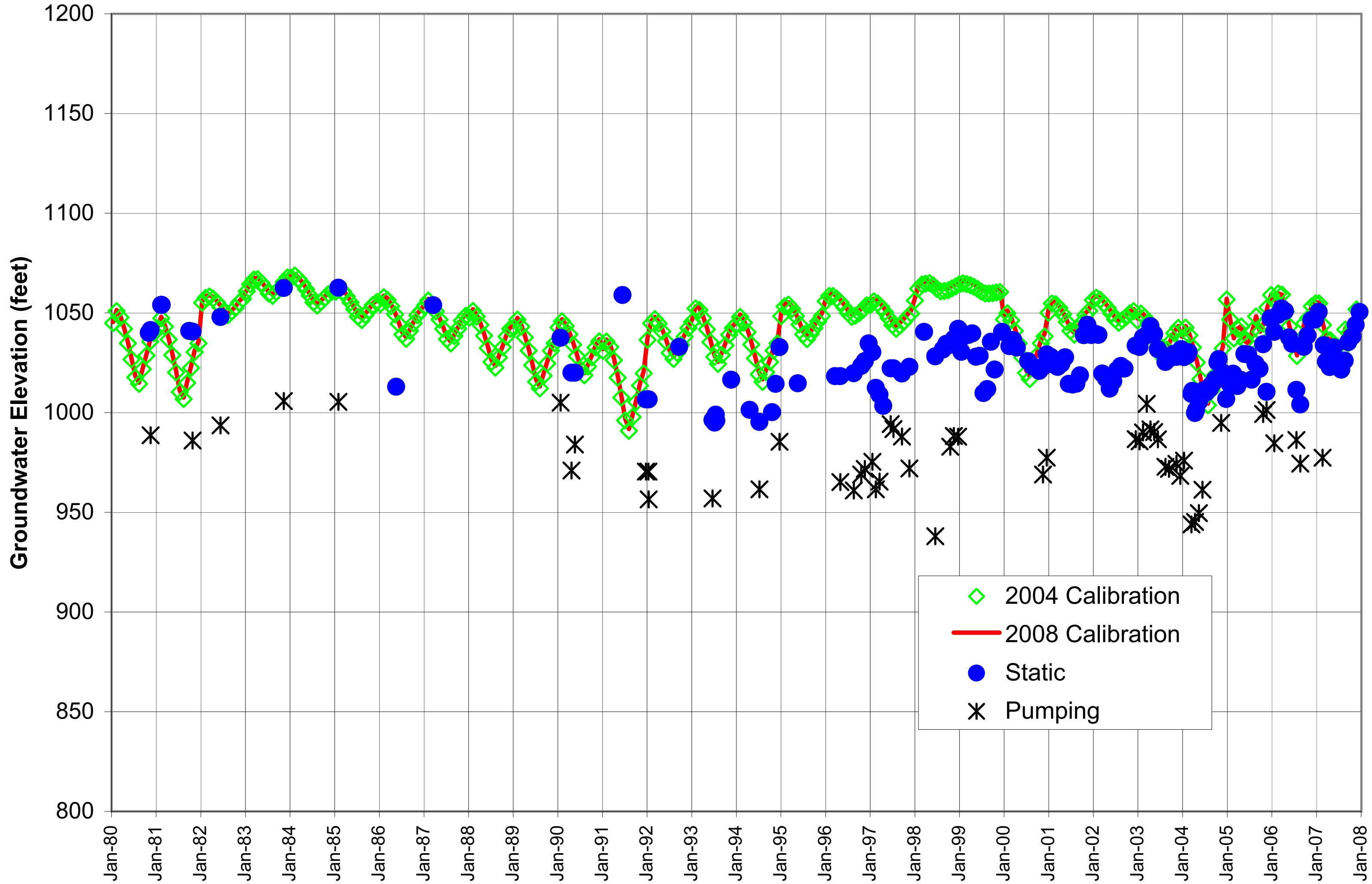
VWC-157 Measured and Modeled Groundwater Elevations
(Saugus Formation)

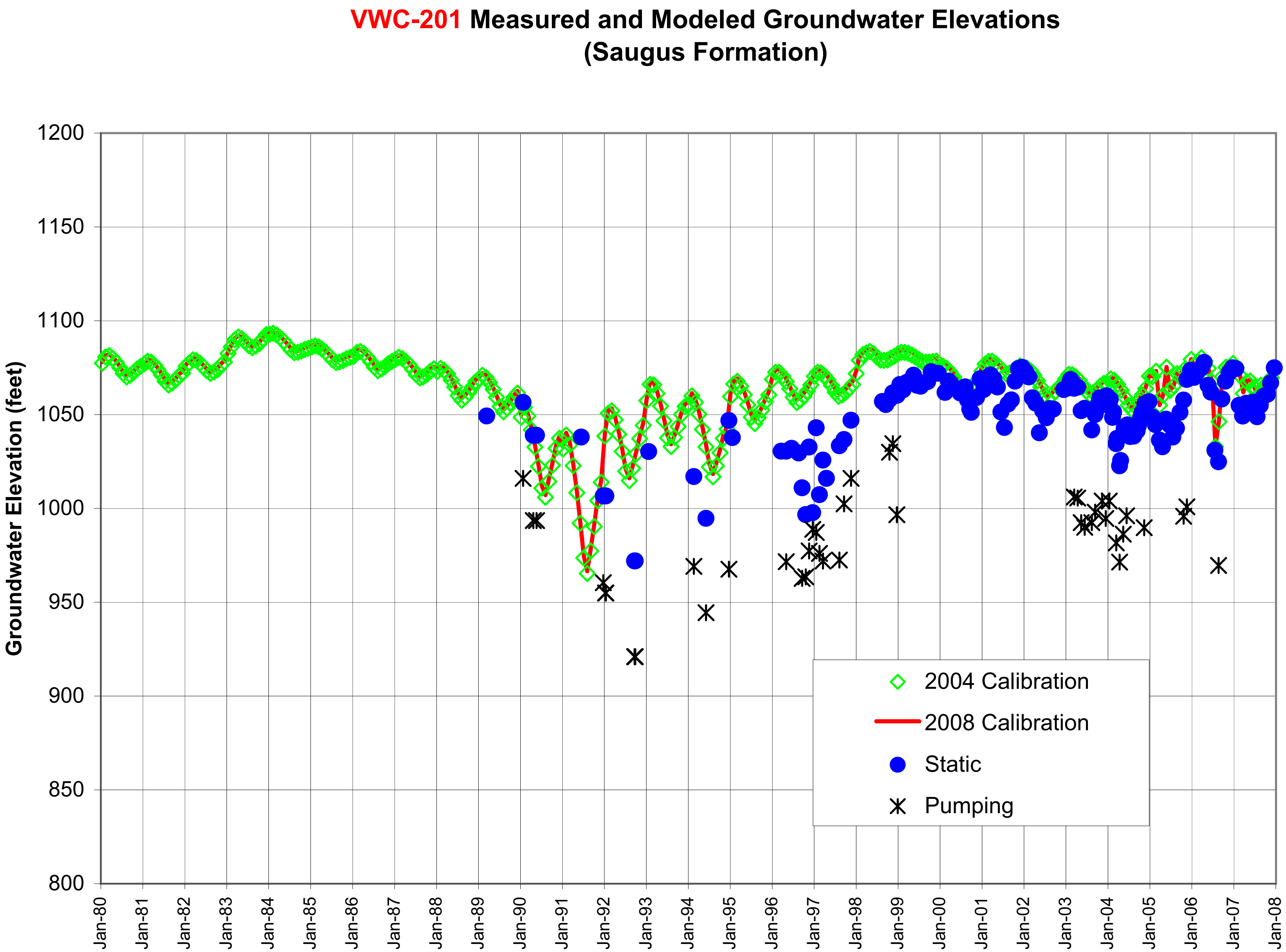


VWC-159 Measured and Modeled Groundwater Elevations (Saugus Formation)

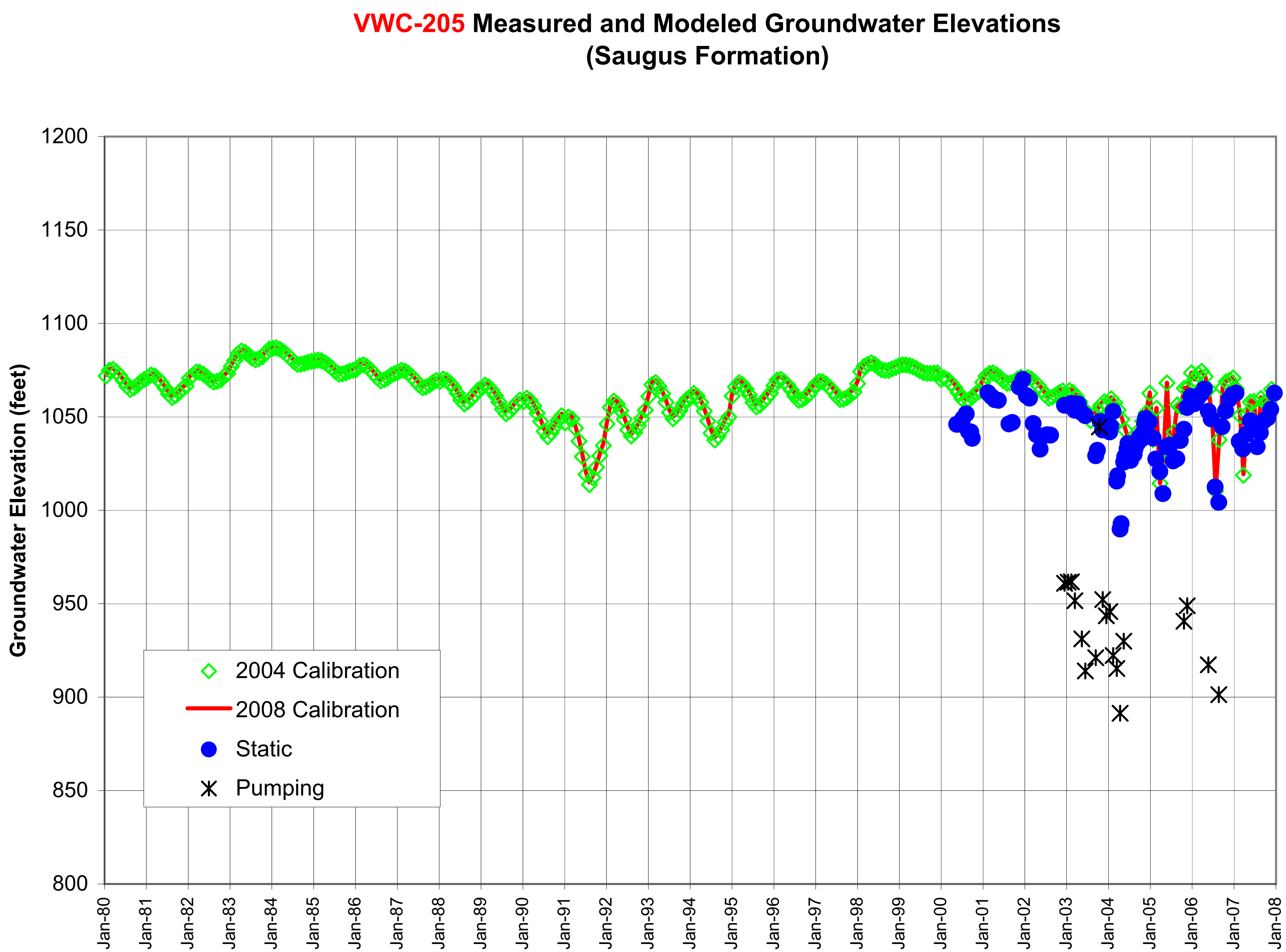


VWC-160 Measured and Modeled Groundwater Elevations (Saugus Formation)



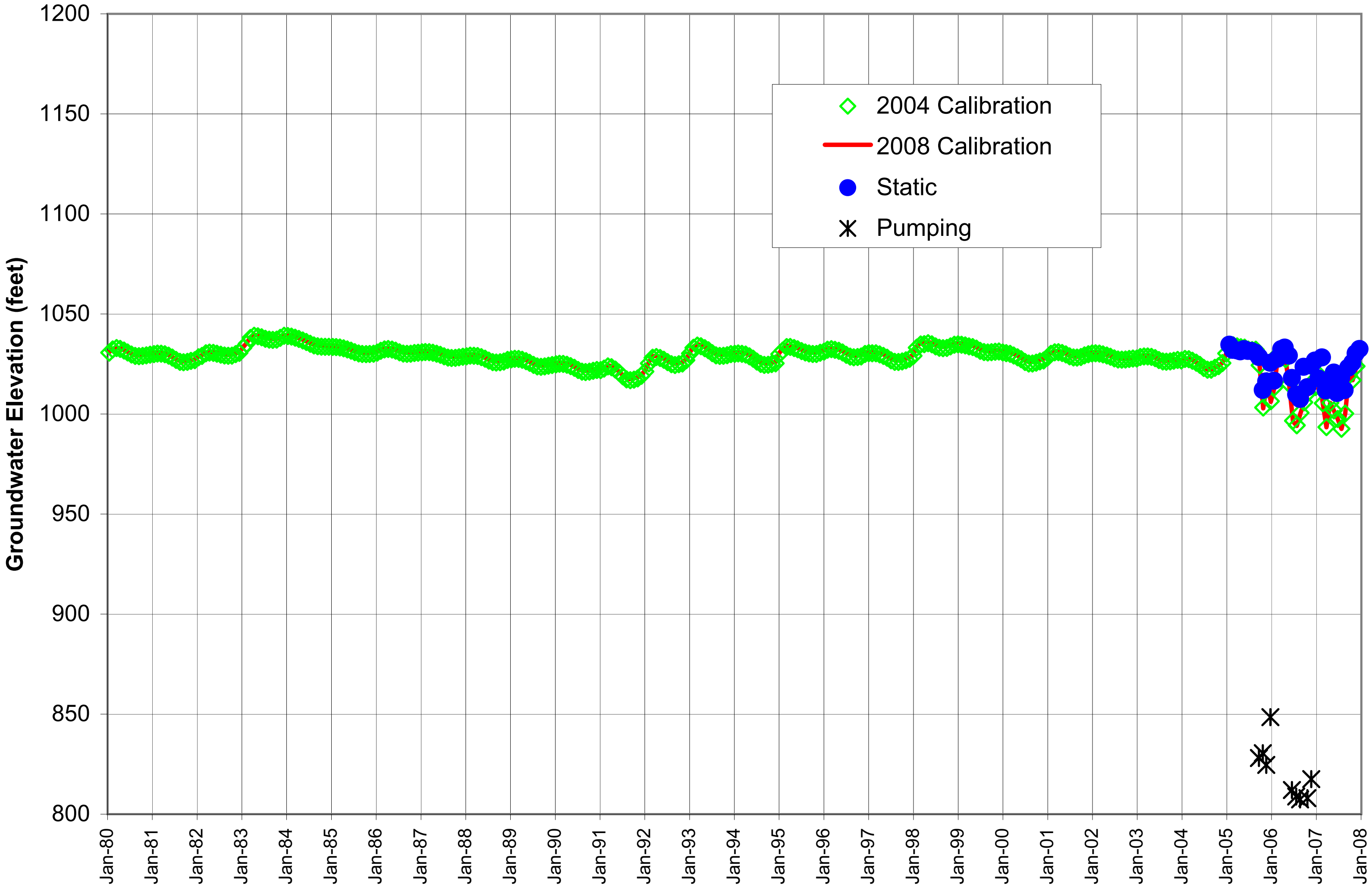


VWC-201 Measured and Modeled Groundwater Elevations
(Saugus Formation)
Groundwater Elevation (feet)
1200
1150
1100
1050
1000
950
900
850
800
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping

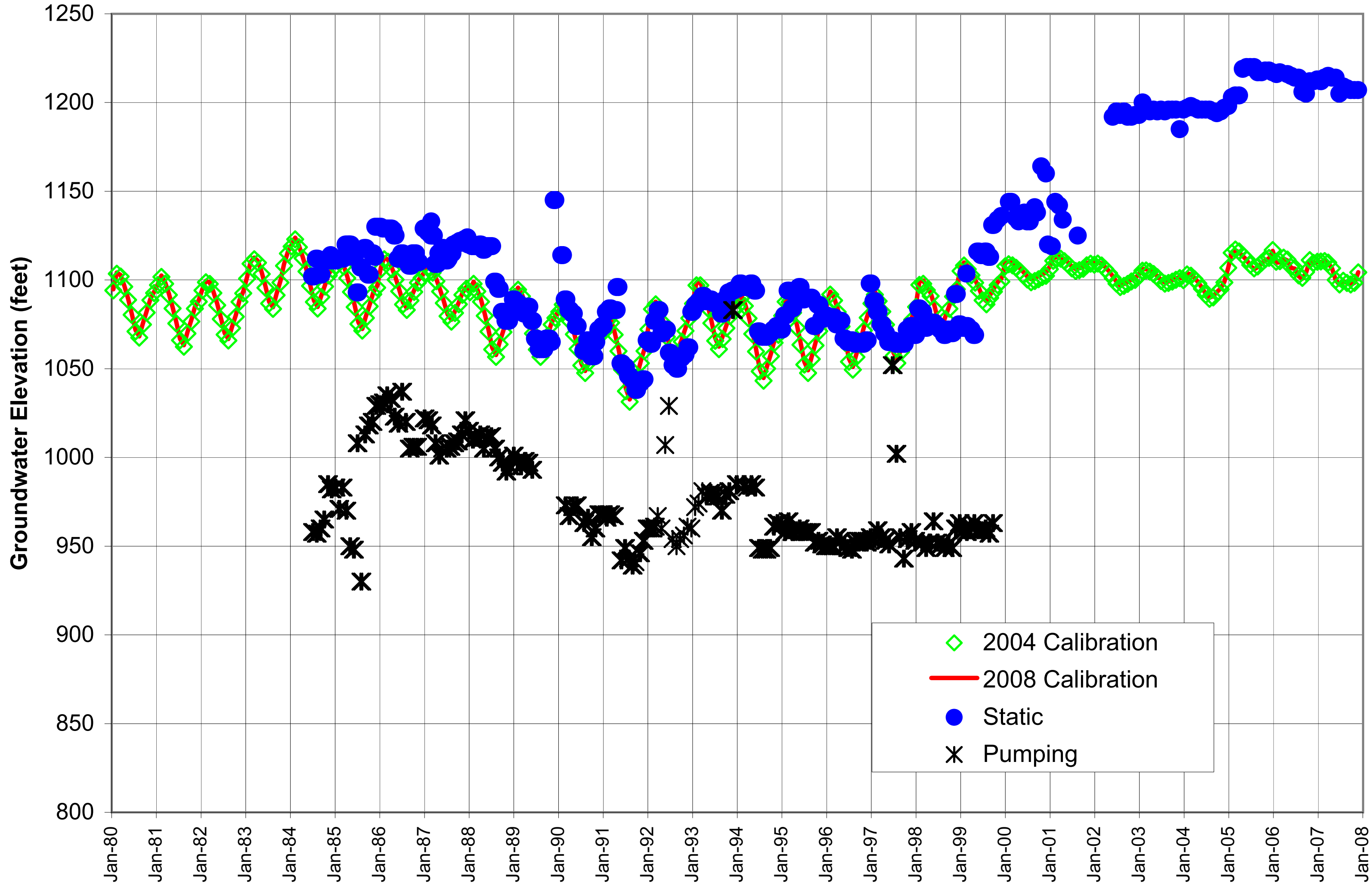


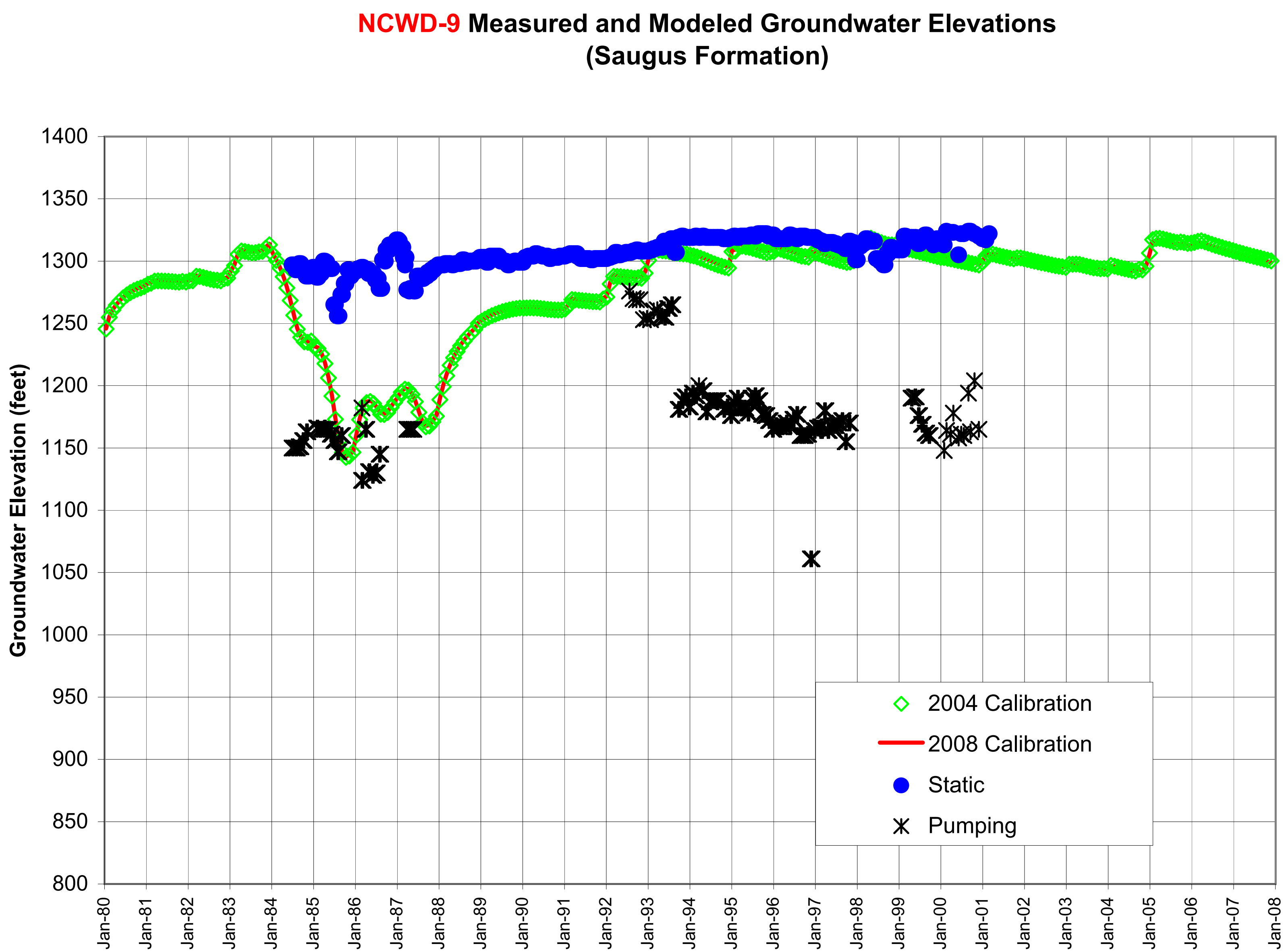
VWC-205 Measured and Modeled Groundwater Elevations
(Saugus Formation)
Groundwater Elevation (feet)
1200
1150
1100
1050
1000
950
900
850
800
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping

VWC-206 Measured and Modeled Groundwater Elevations (Saugus Formation)

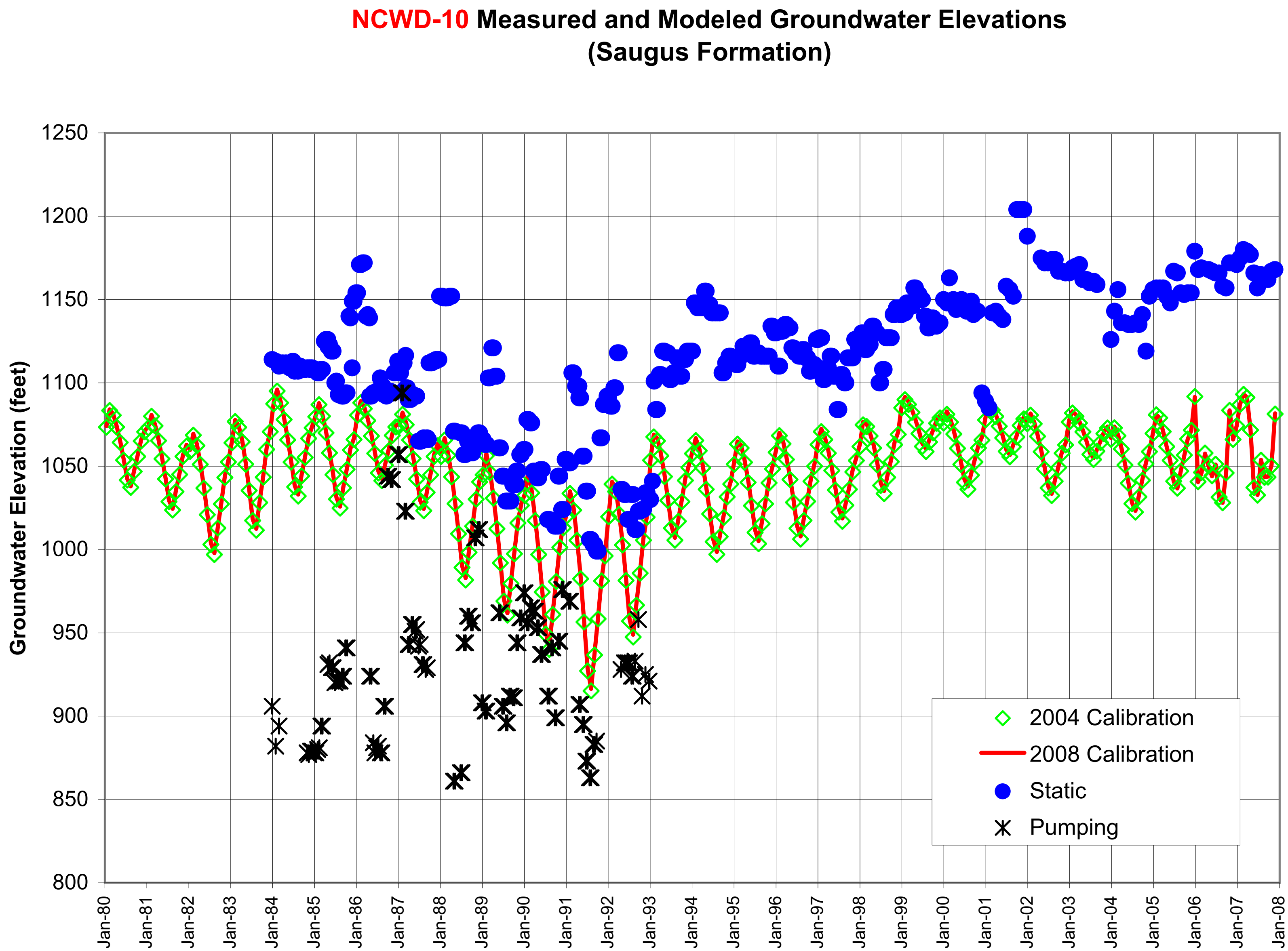


NCWD-7 Measured and Modeled Groundwater Elevations
(Saugus Formation)

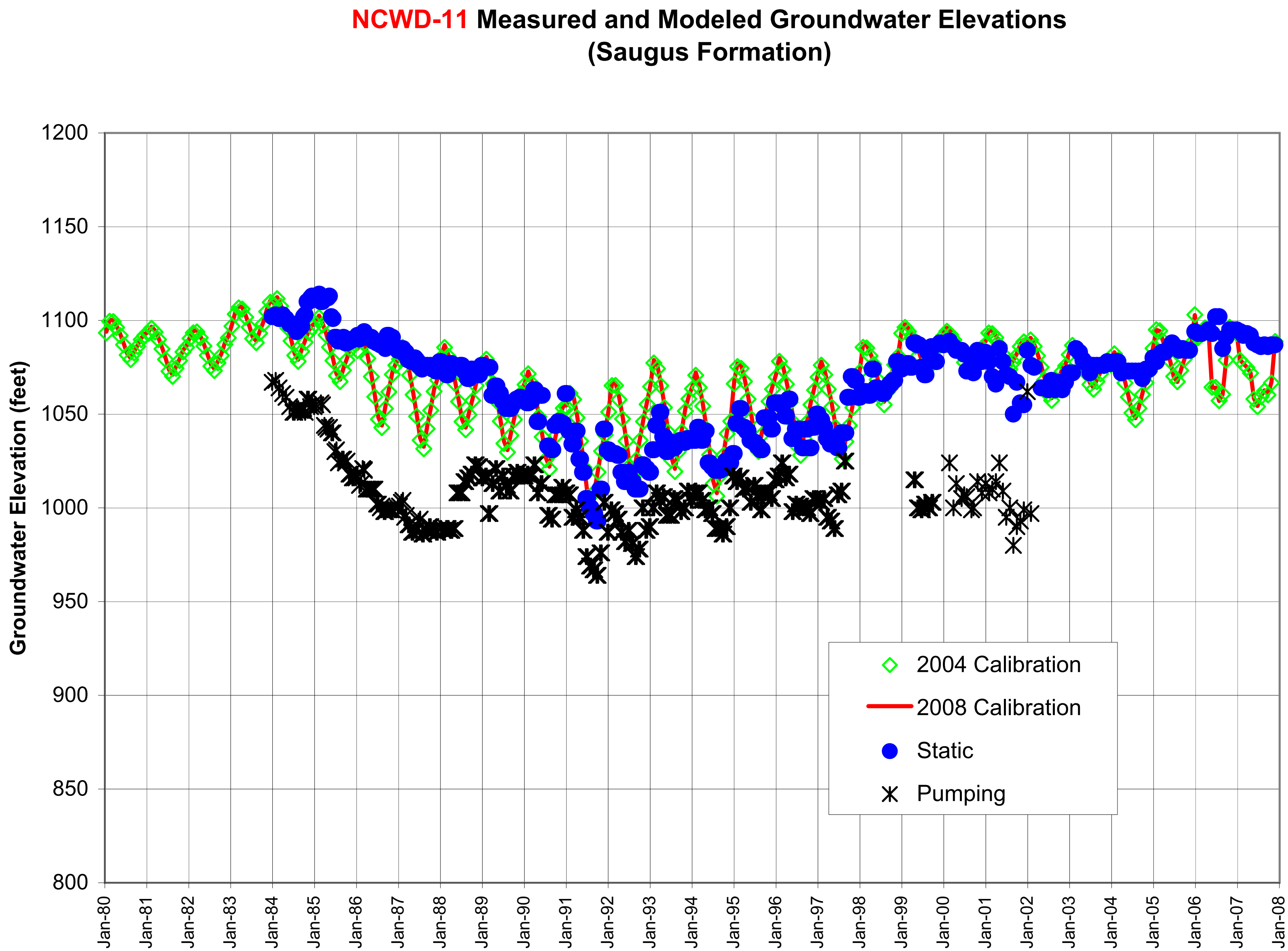




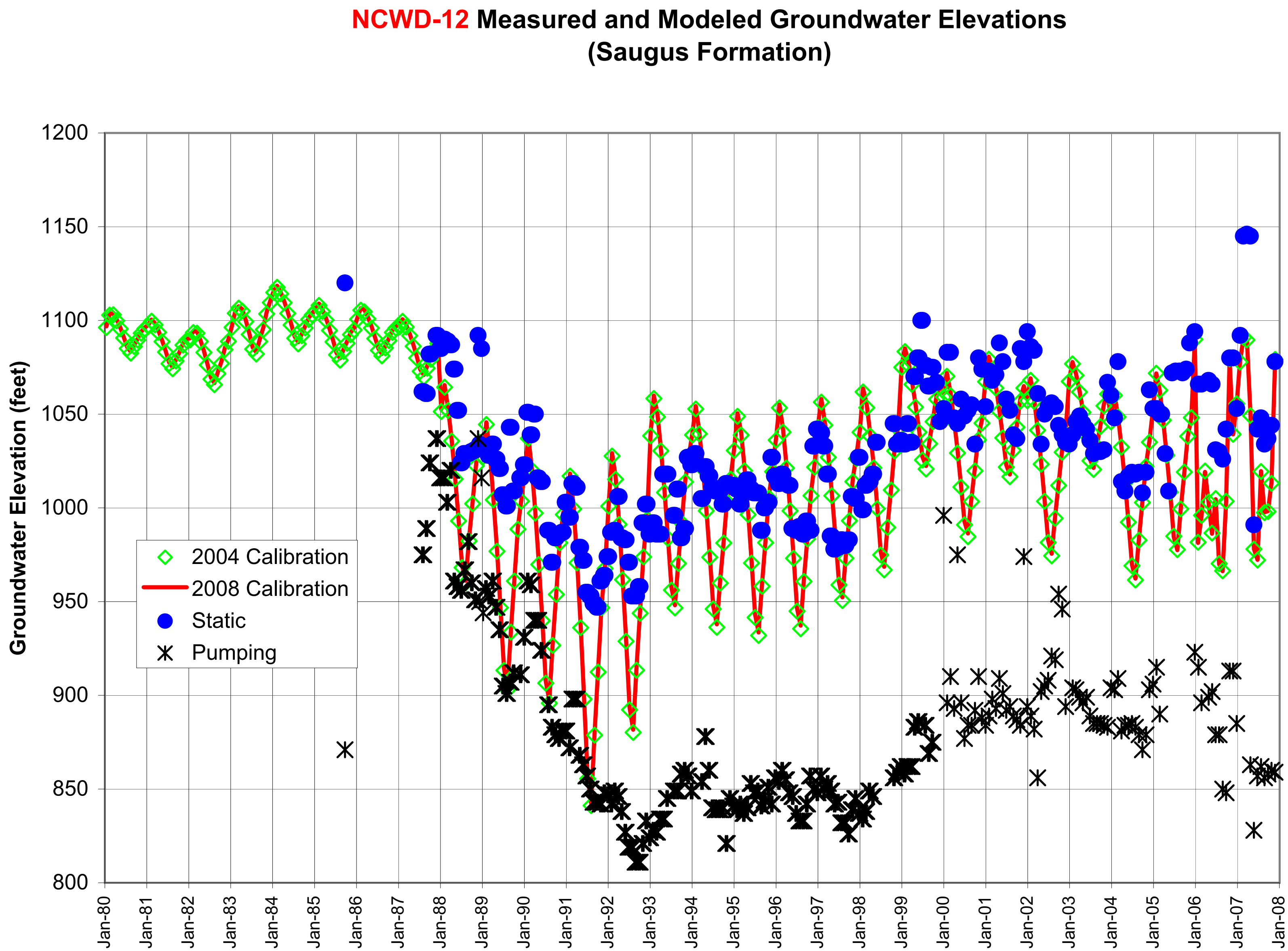
NCWD-9 Measured and Modeled Groundwater Elevations
(Saugus Formation)
Groundwater Elevation (feet)
1400
1350
1300
1250
1200
1150
1100
1050
1000
950
900
850
800
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping

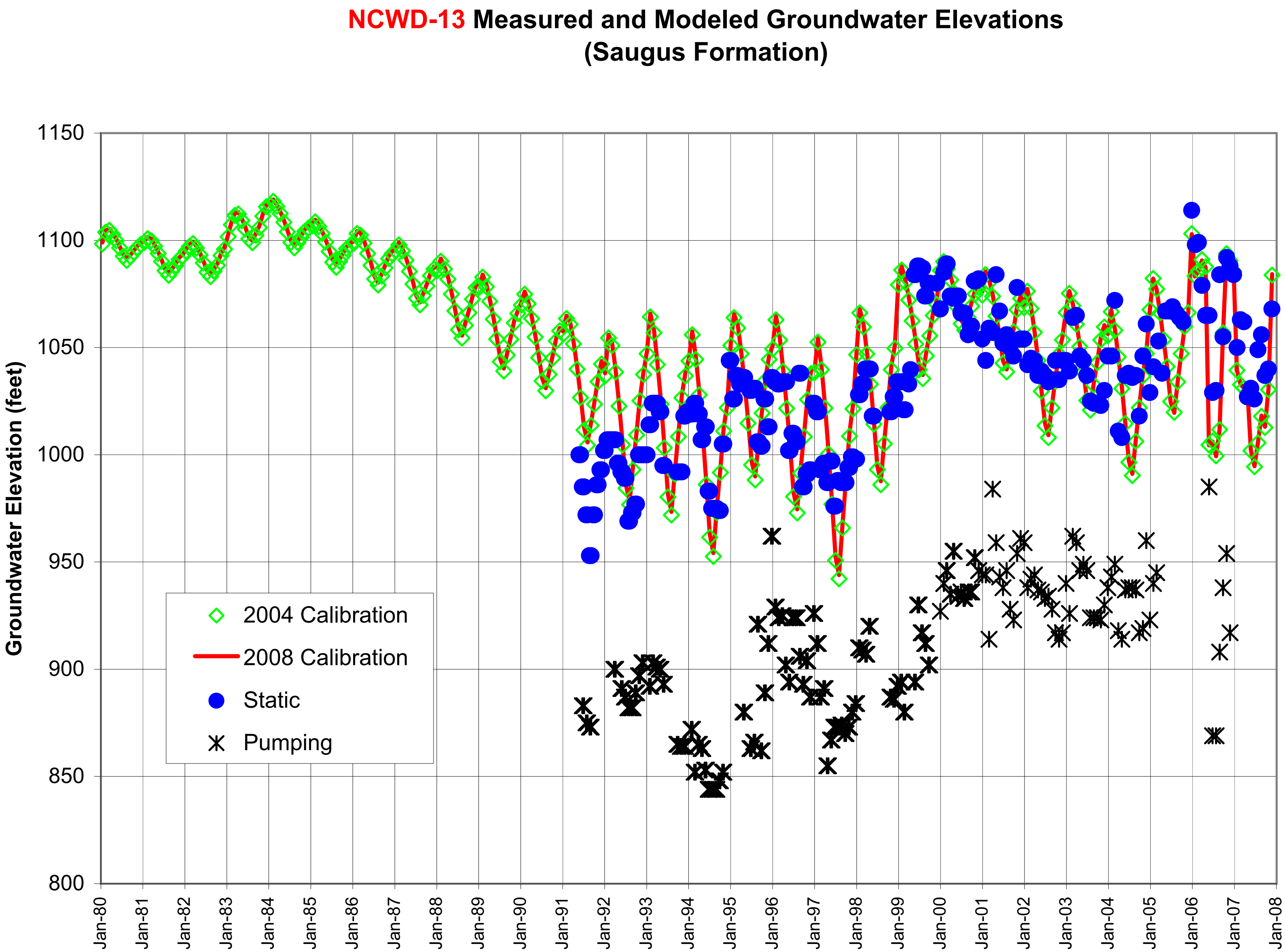


NCWD-10 Measured and Modeled Groundwater Elevations
(Saugus Formation)
Groundwater Elevation (feet)
1250
1200
1150
1100
1050
1000
950
900
850
800
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping



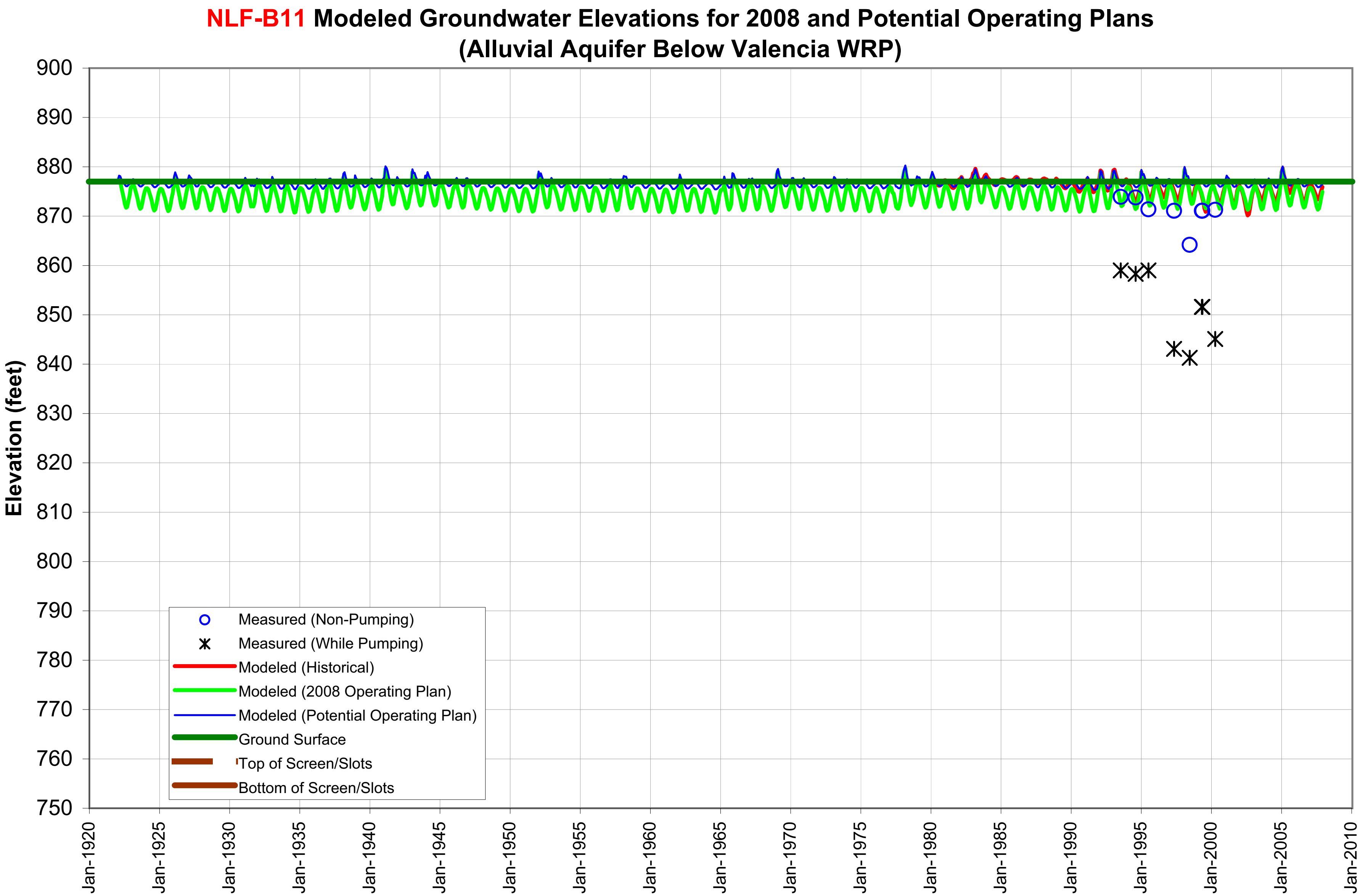
NCWD-11 Measured and Modeled Groundwater Elevations
(Saugus Formation)
Groundwater Elevation (feet)
1200
1150
1100
1050
1000
950
900
850
800
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping

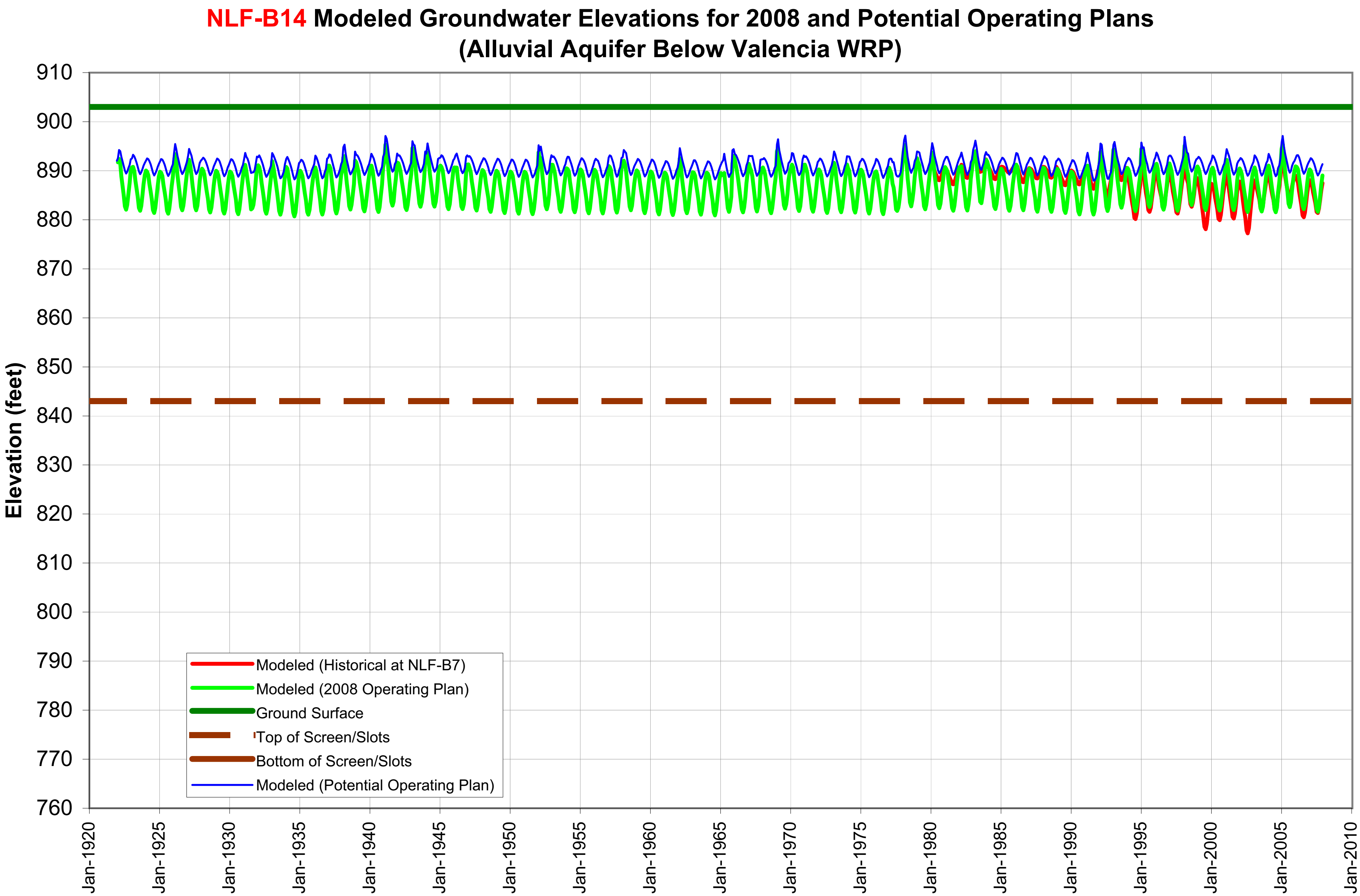

NCWD-12 Measured and Modeled Groundwater Elevations
(Saugus Formation)
Groundwater Elevation (feet)
1200
1150
1100
1050
1000
950
900
850
800
2004 Calibration
2008 Calibration
Static
Pumping
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08

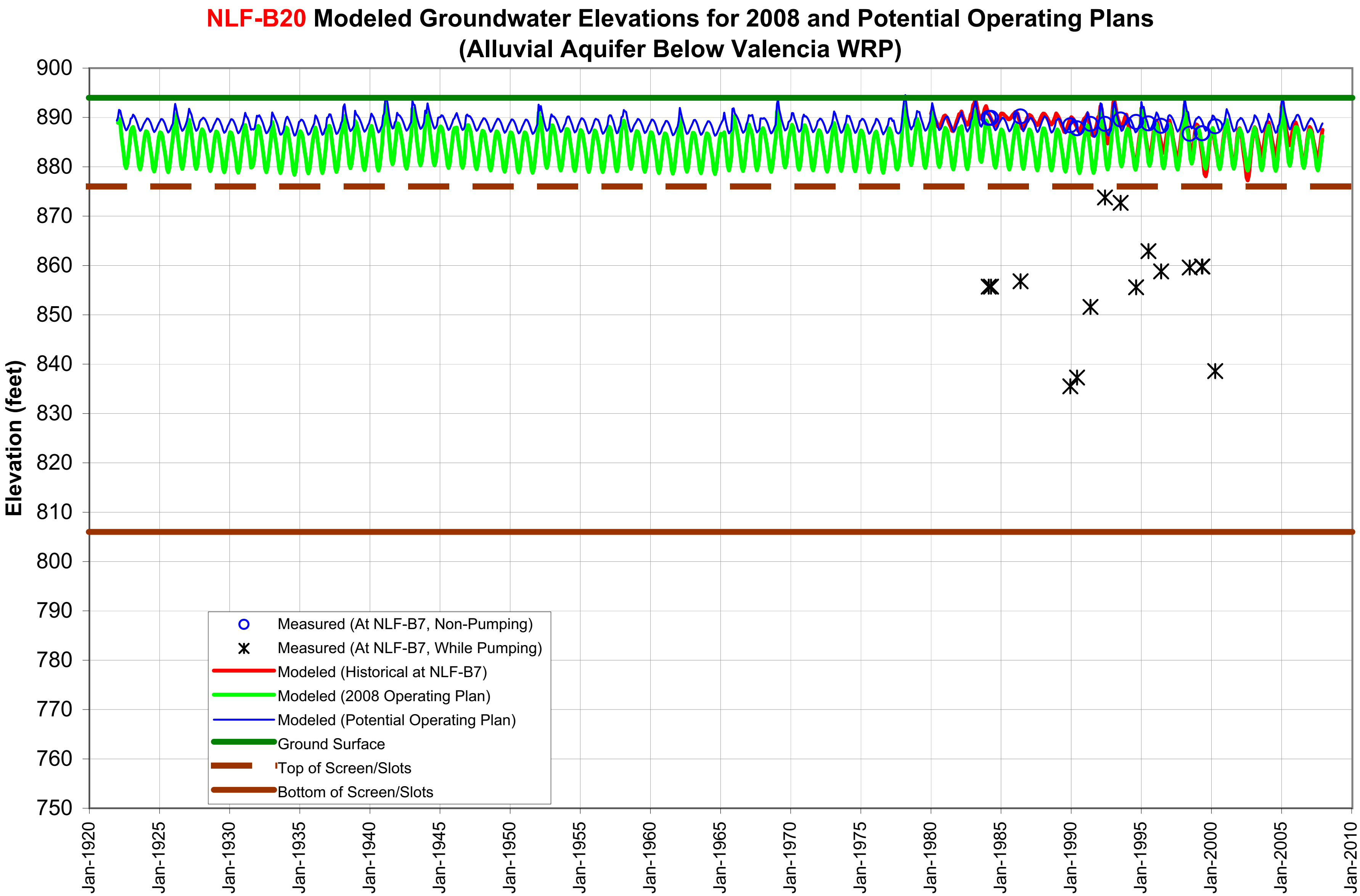

NCWD-13 Measured and Modeled Groundwater Elevations
(Saugus Formation)
Groundwater Elevation (feet)
1150
1100
1050
1000
950
900
850
800
Jan-80
Jan-81
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
2004 Calibration
2008 Calibration
Static
Pumping

Appendi

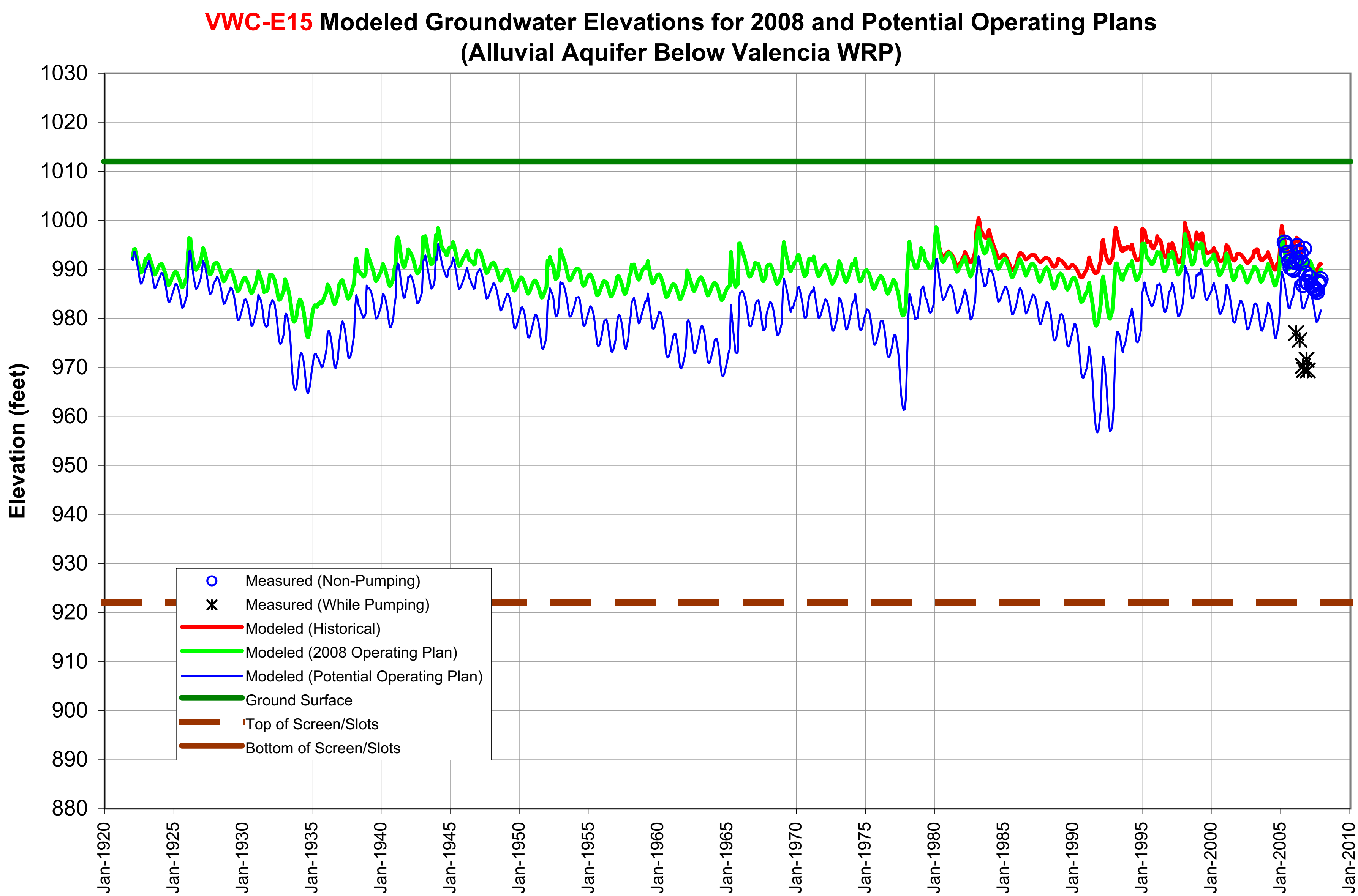
odeled Groundwater Elevation drographs 2008 and Potential Operating Plans

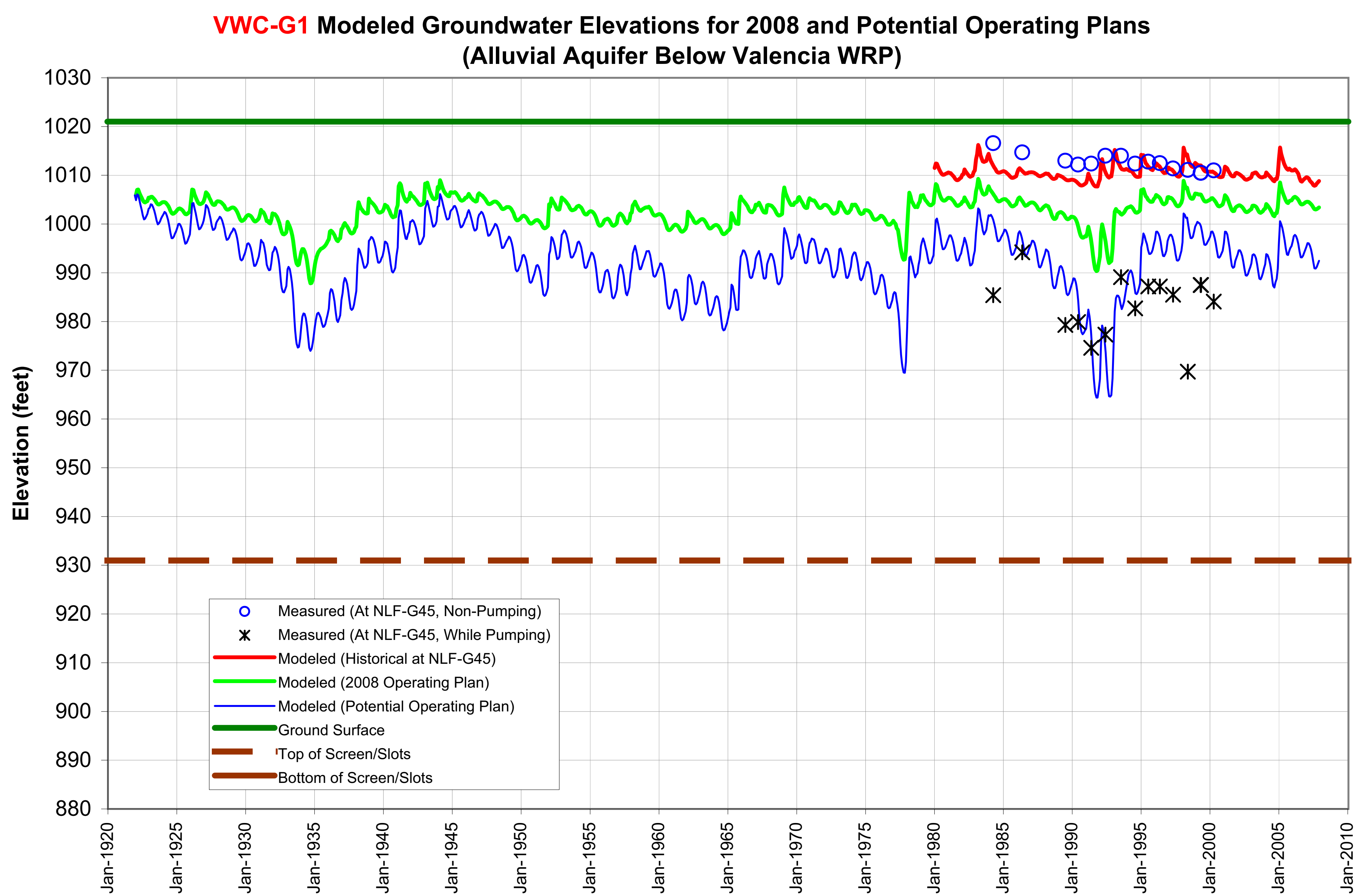

NLF-B11 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Below Valencia WRP)
Elevation (feet)
900
890
880
870
860
850
840
830
820
810
800
790
780
770
760
750
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

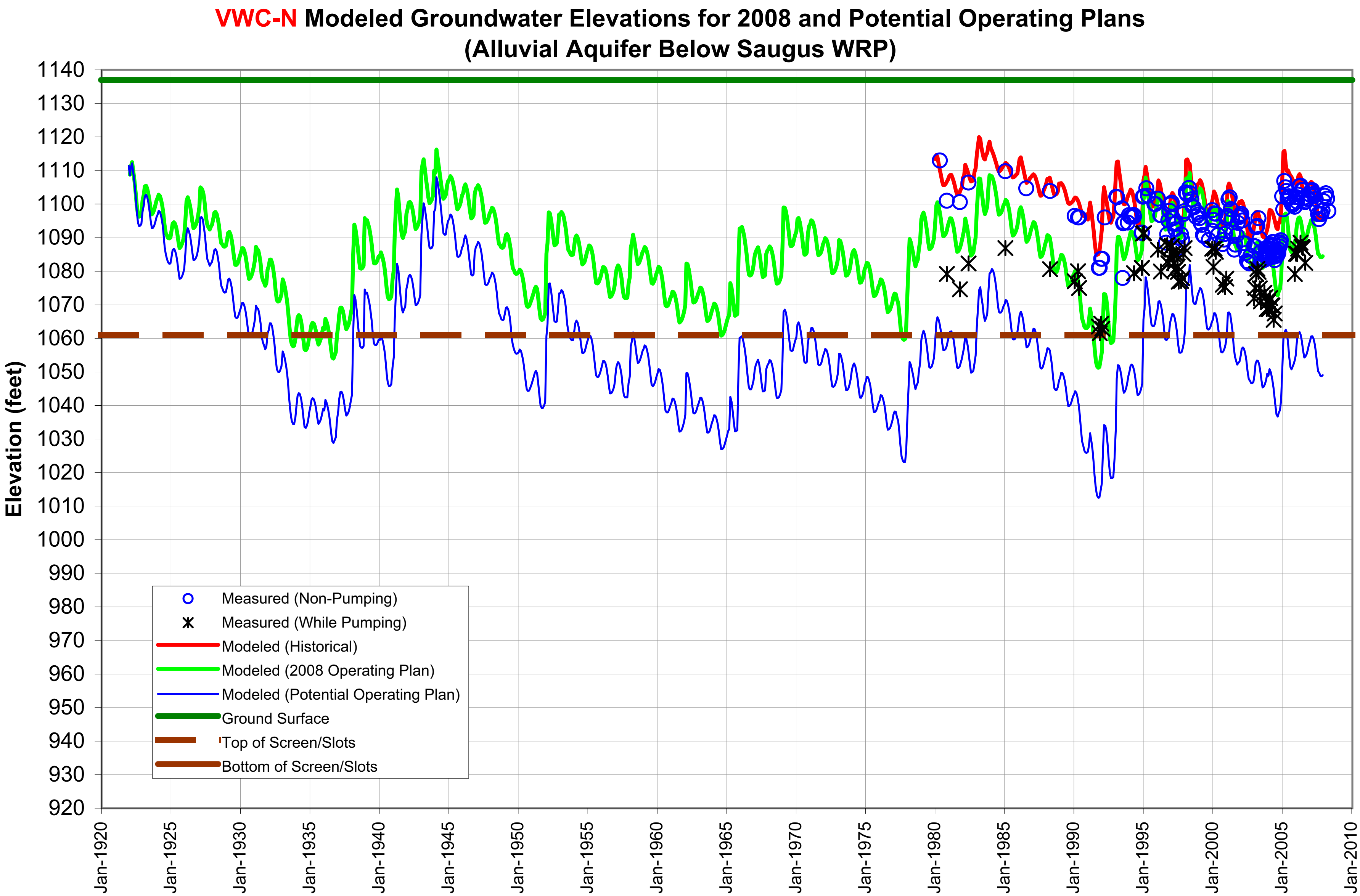

NLF-B14 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Below Valencia WRP)
Elevation (feet)
910
900
890
880
870
860
850
840
830
820
810
800
790
780
770
760
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Modeled (Historical at NLF-B7)
Modeled (2008 Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots
Modeled (Potential Operating Plan)

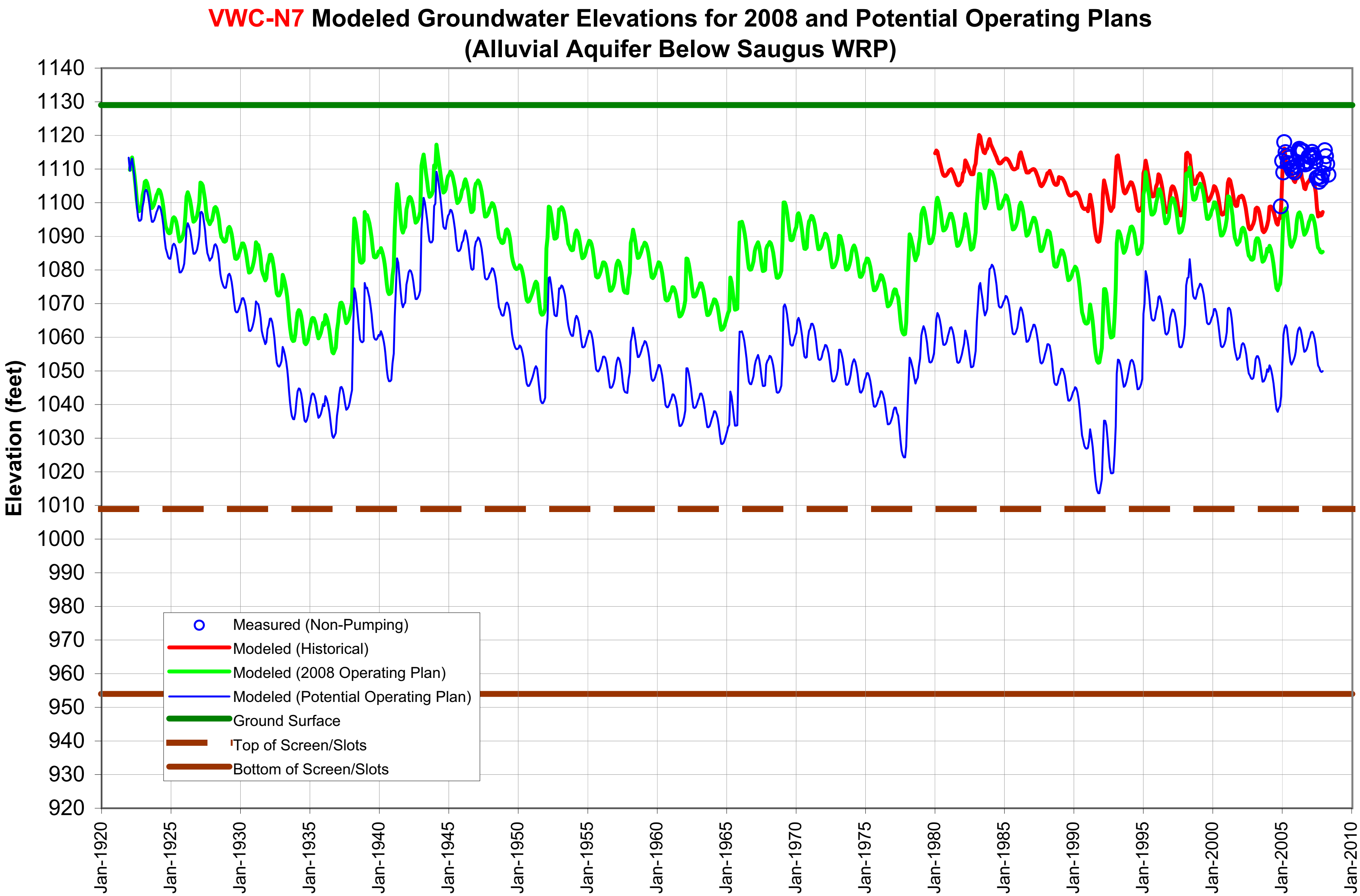


NLF-B20 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Below Valencia WRP)
Elevation (feet)
900
890
880
870
860
850
840
830
820
810
800
790
780
770
760
750
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (At NLF-B7, Non-Pumping)
Measured (At NLF-B7, While Pumping)
Modeled (Historical at NLF-B7)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

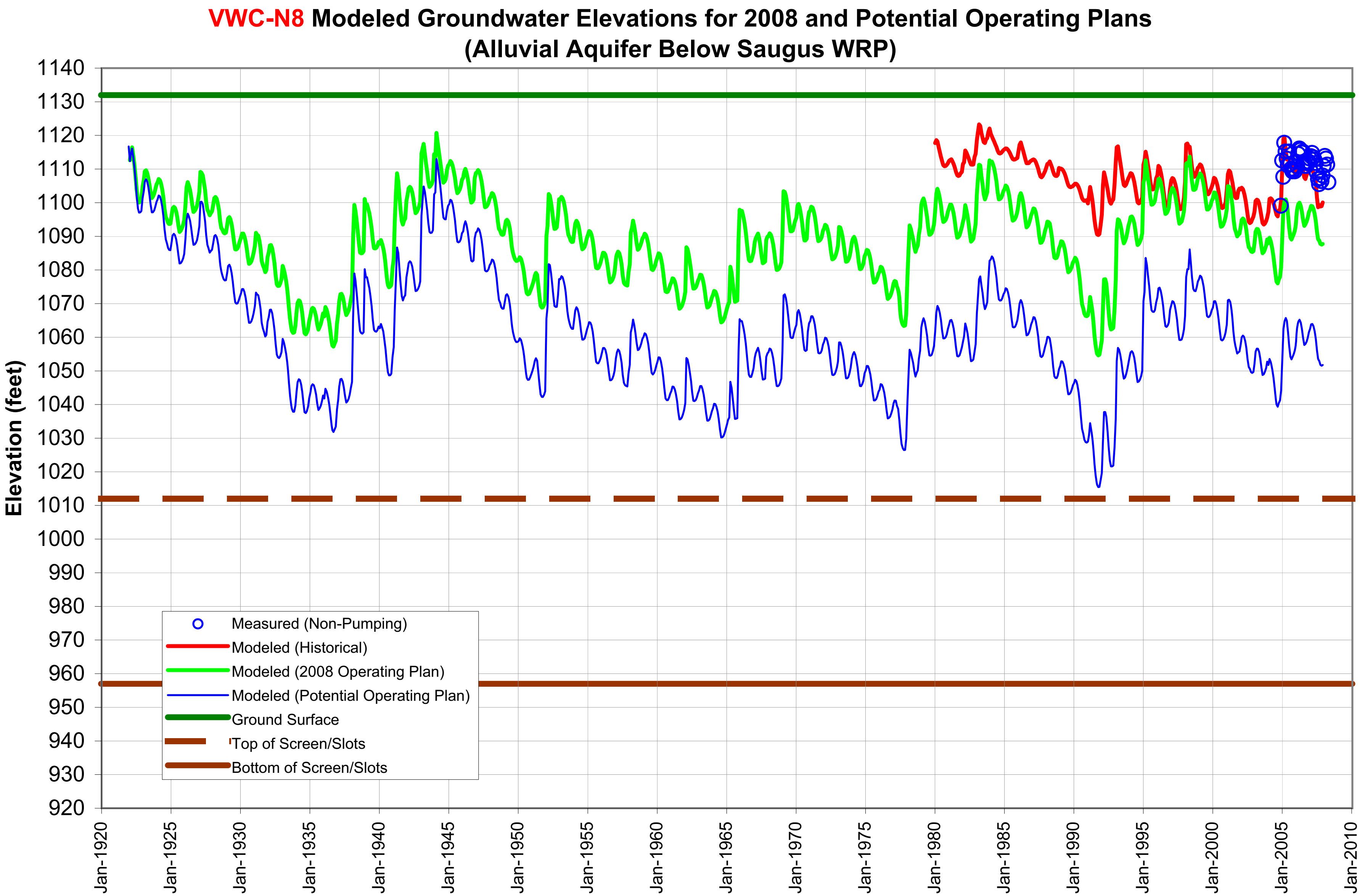

VWC-E15 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Below Valencia WRP)
Elevation (feet)
1030
1020
1010
1000
990
980
970
960
950
940
930
920
910
900
890
880
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots


VWC-G1 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Below Valencia WRP)
Elevation (feet)
1030
1020
1010
1000
990
980
970
960
950
940
930
920
910
900
890
880
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (At NLF-G45, Non-Pumping)
Measured (At NLF-G45, While Pumping)
Modeled (Historical at NLF-G45)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

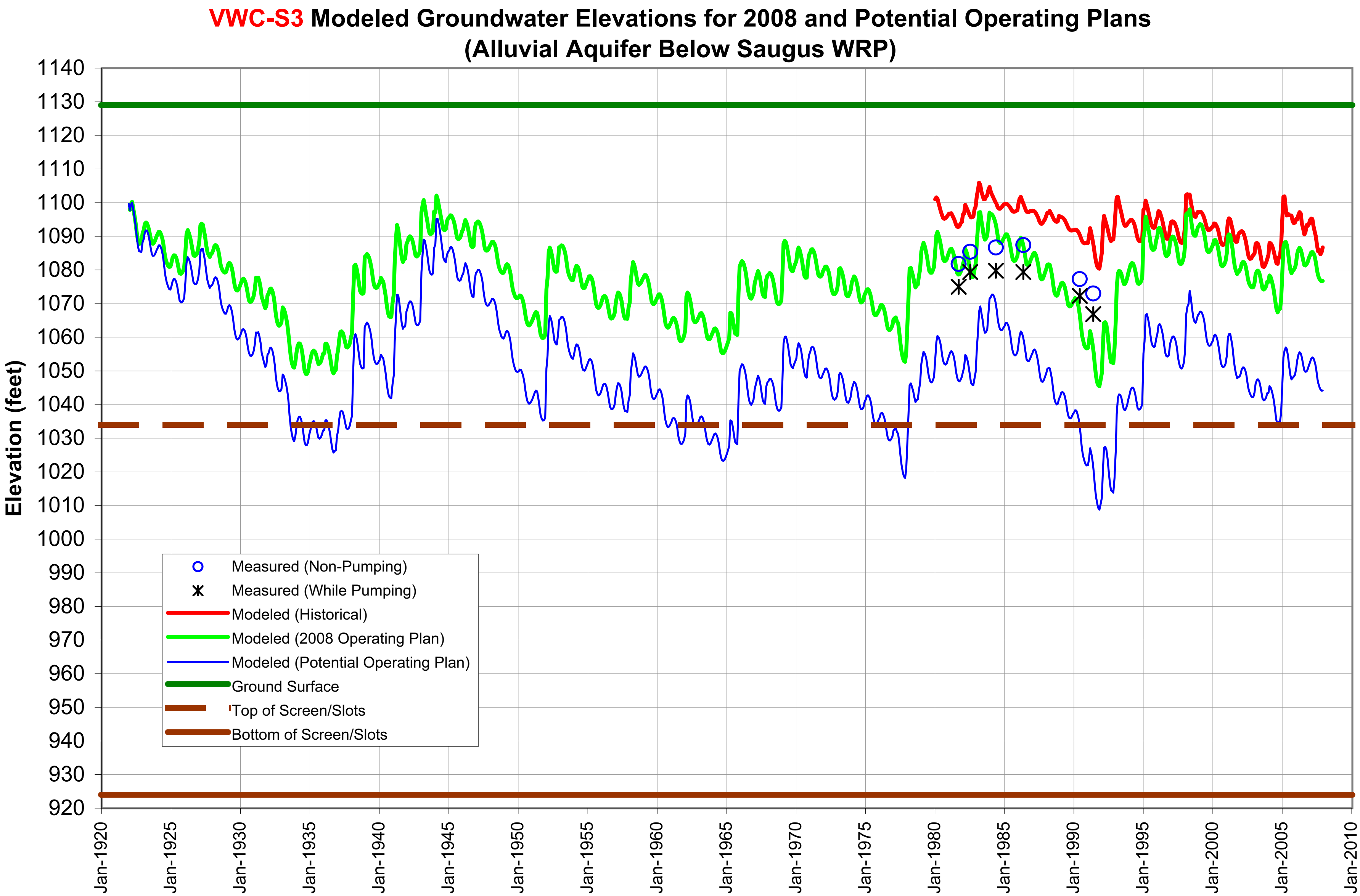

VWC-N Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Below Saugus WRP)
Elevation (feet)
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots



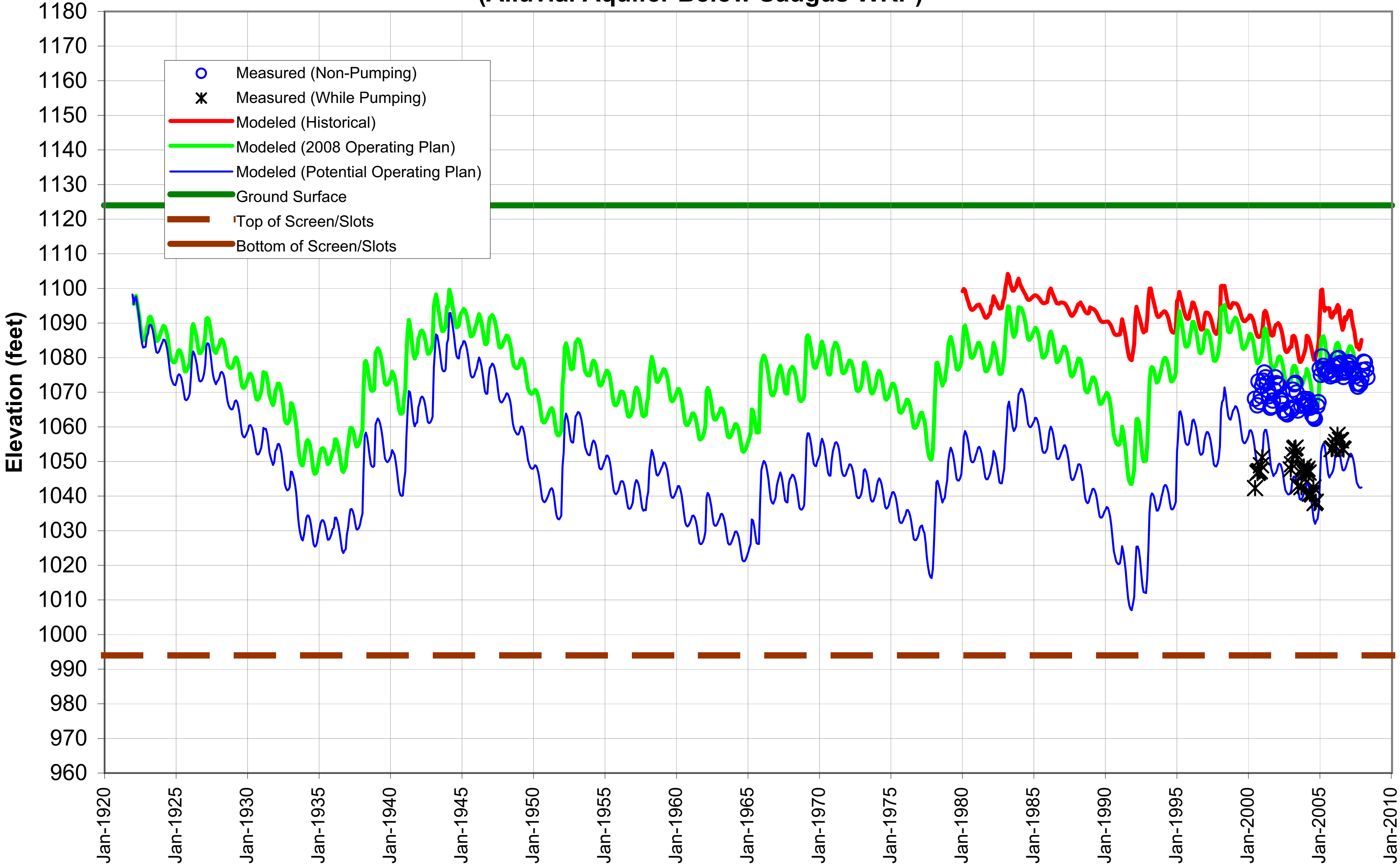
VWC-N7 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Below Saugus WRP)
Elevation (feet)
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

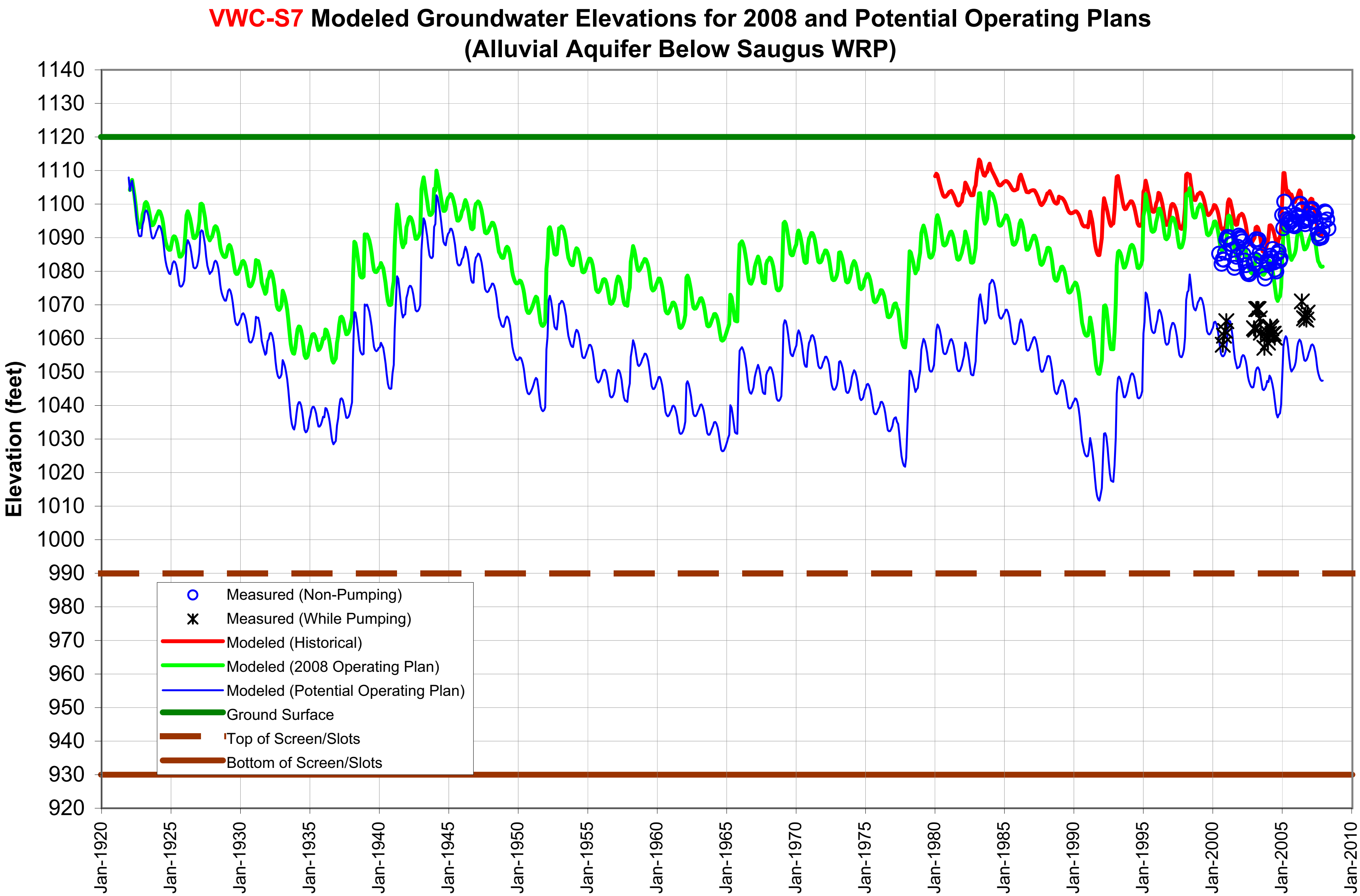


VWC-N8 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Below Saugus WRP)
Elevation (feet)
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

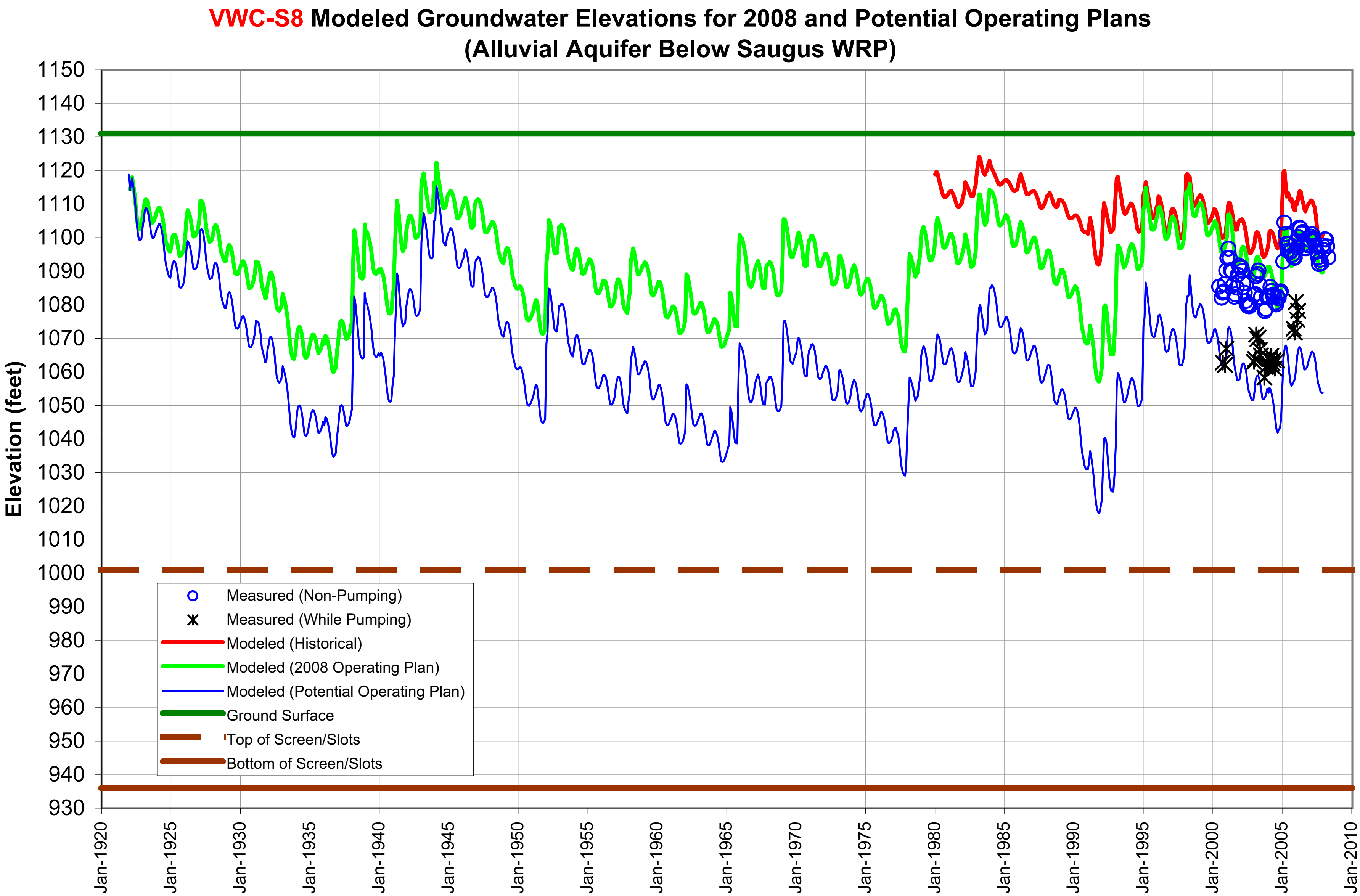

VWC-S3 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Below Saugus WRP)
Elevation (feet)
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

VWC-S6 Modeled Groundwater Elevations for 2008 and Potential Operating Plans (Alluvial Aquifer Below Saugus WRP)

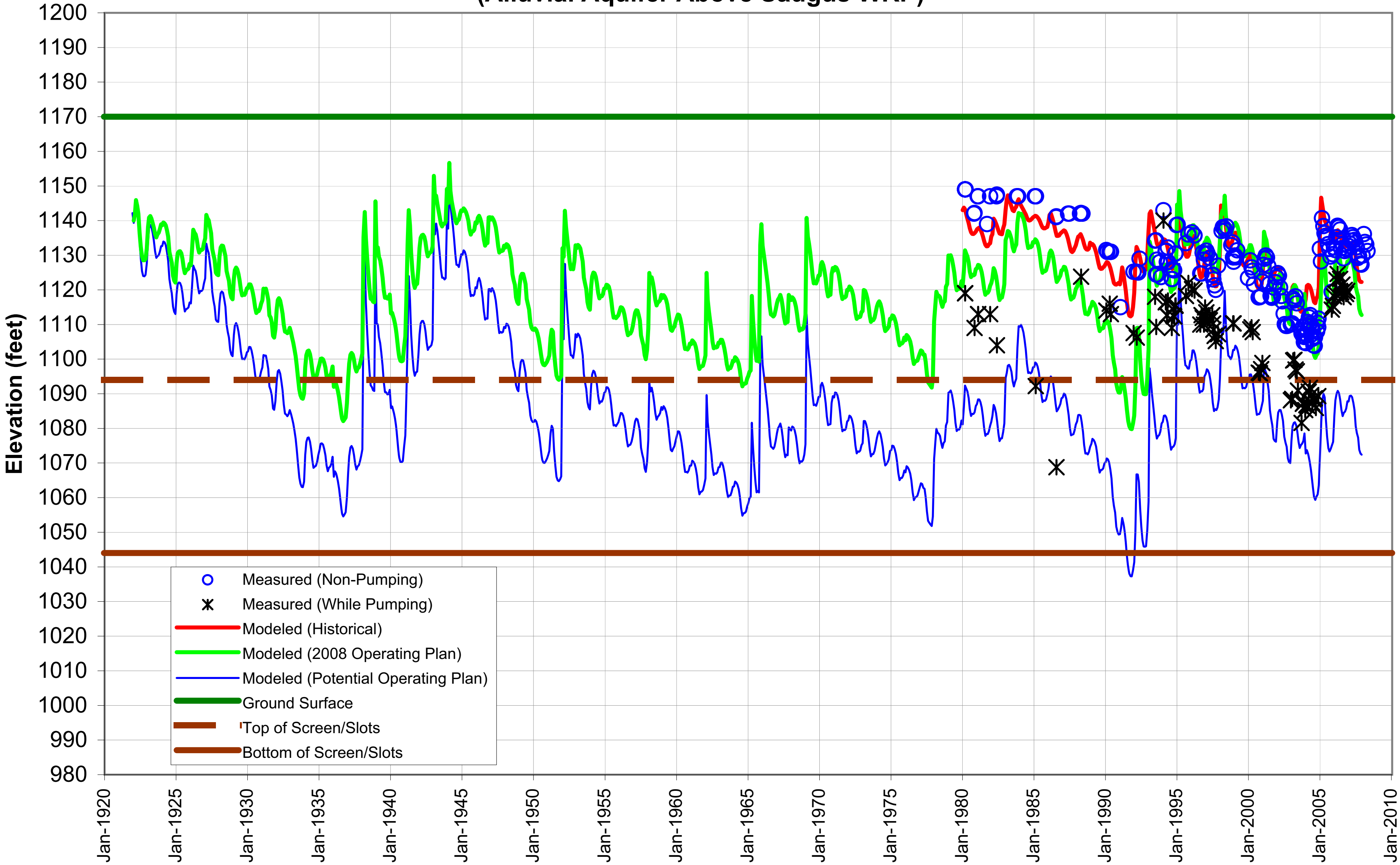


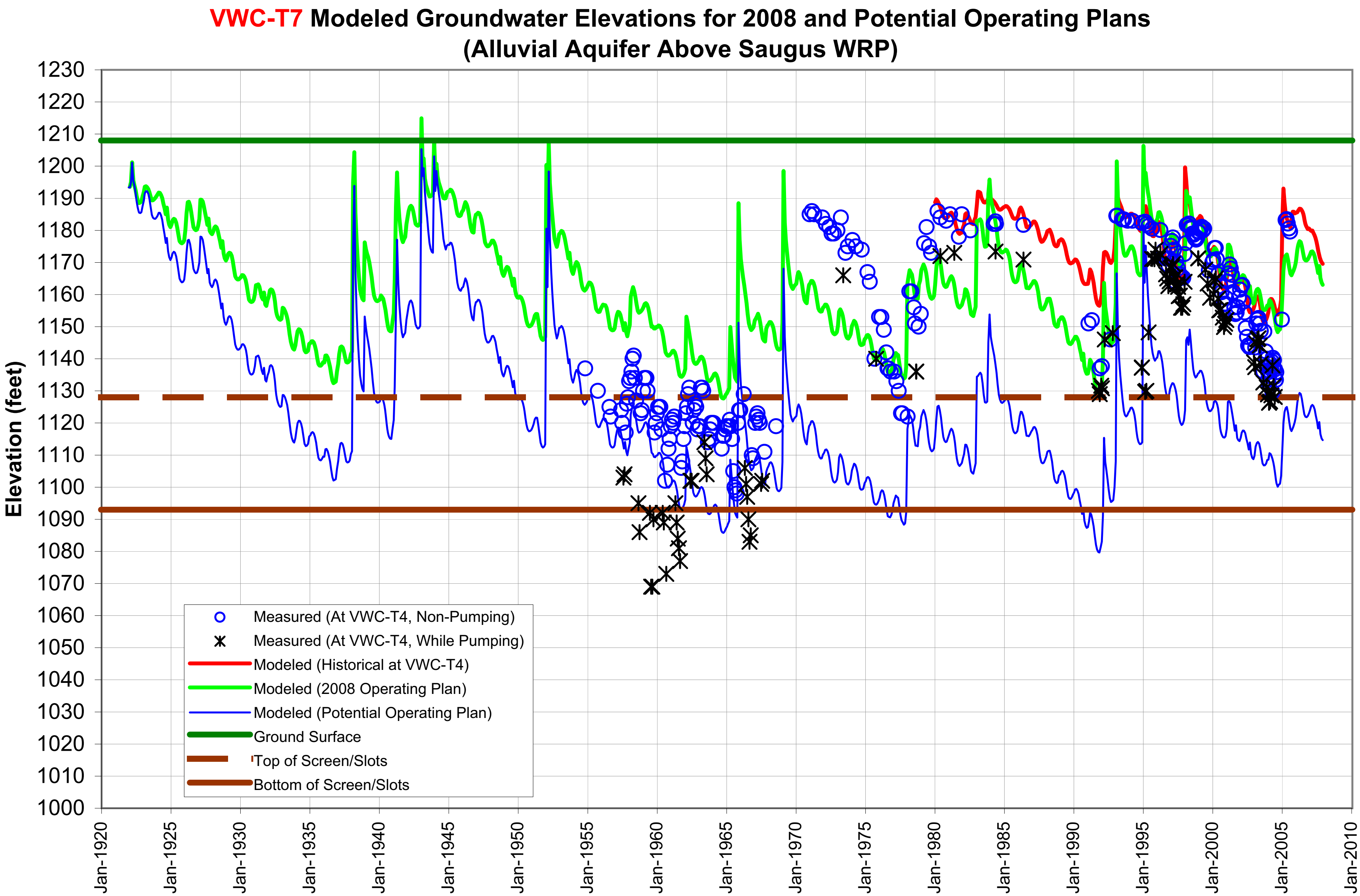


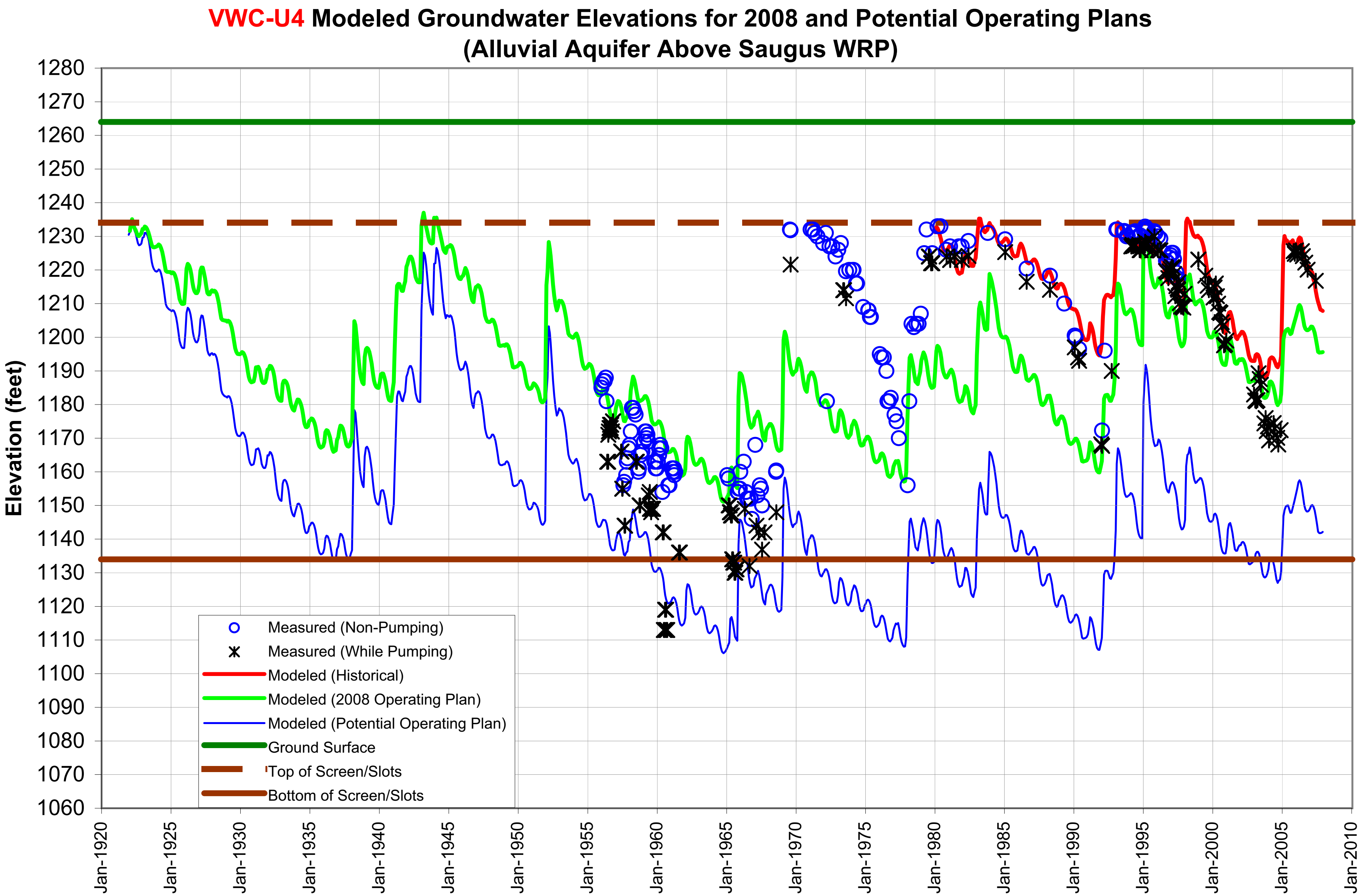
VWC-S7 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Below Saugus WRP)
Elevation (feet)
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots


VWC-S8 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Below Saugus WRP)
Elevation (feet)
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

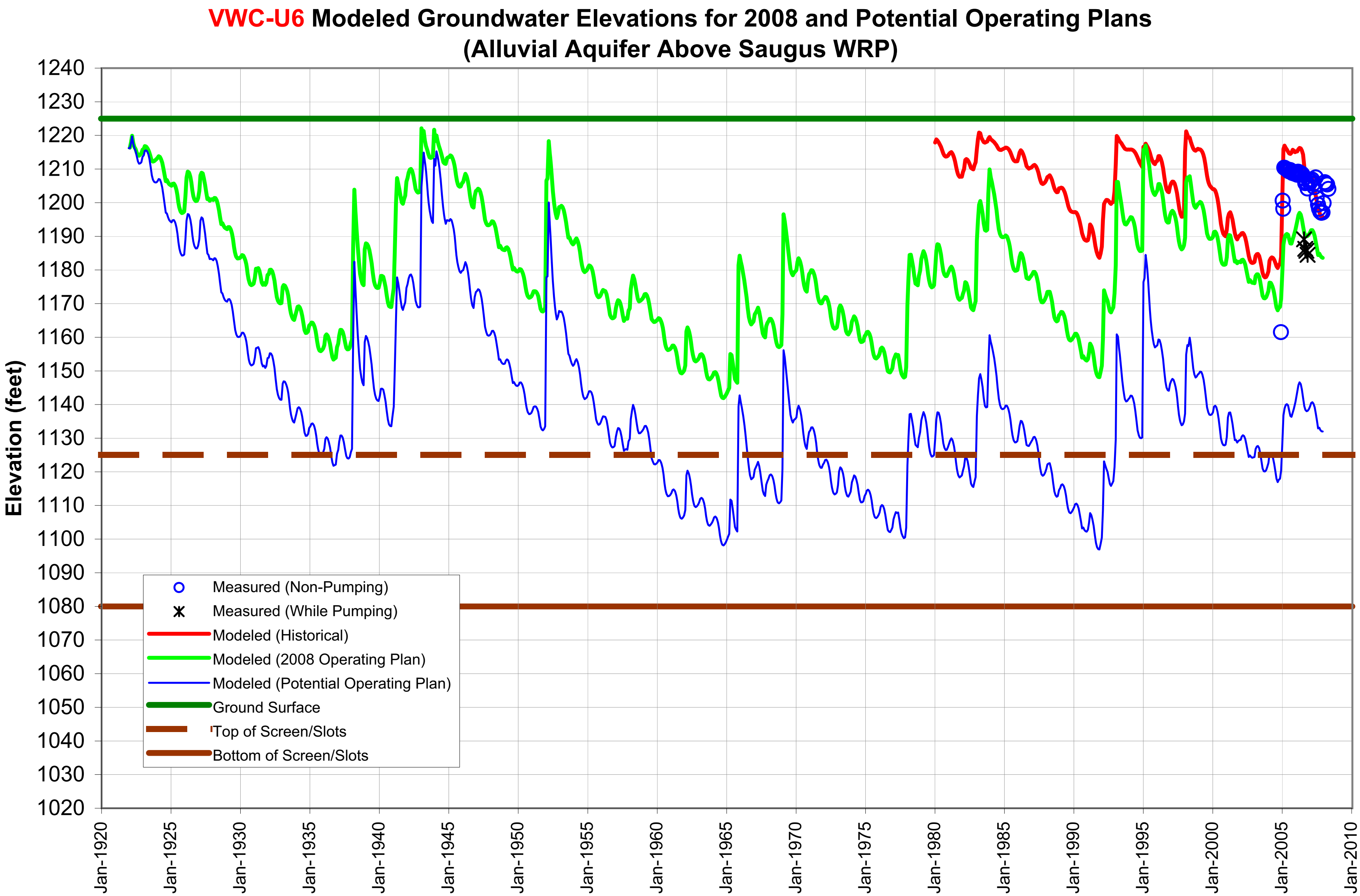
VWC-Q2 Modeled Groundwater Elevations for 2008 and Potential Operating Plans (Alluvial Aquifer Above Saugus WRP)

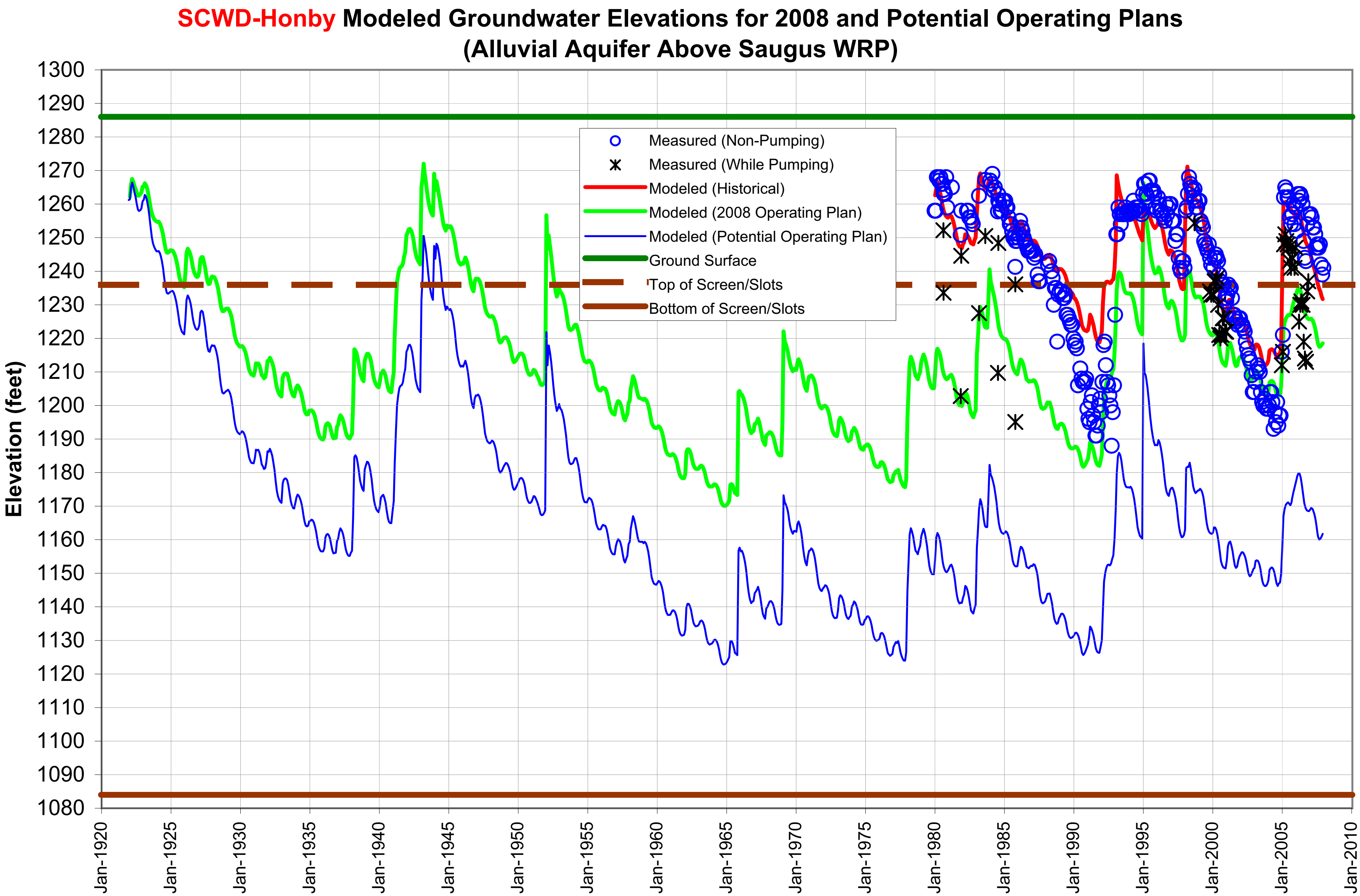



VWC-T7 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Above Saugus WRP)
Elevation (feet)
1230
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (At VWC-T4, Non-Pumping)
Measured (At VWC-T4, While Pumping)
Modeled (Historical at VWC-T4)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

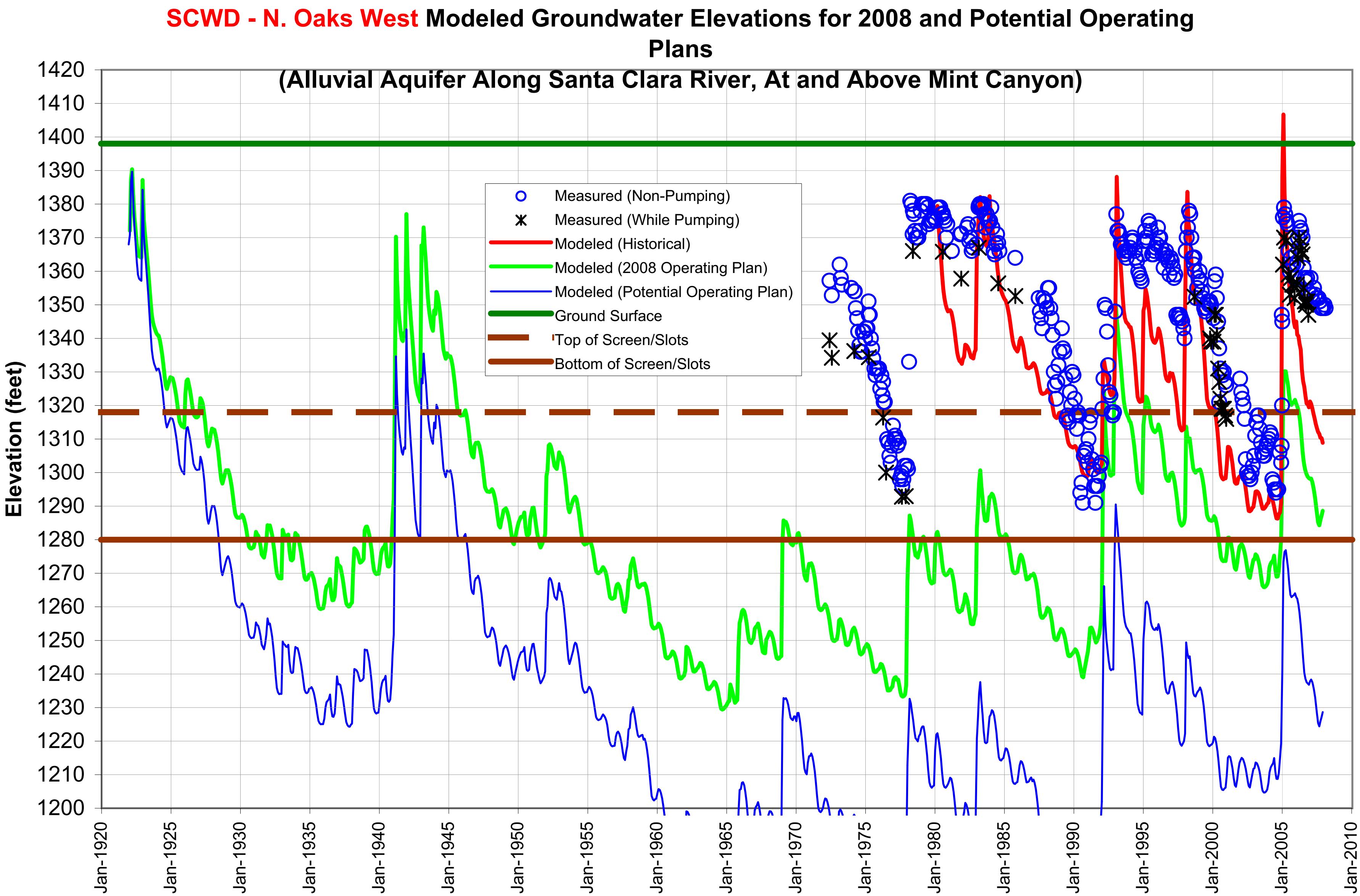


VWC-U4 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Above Saugus WRP)
Elevation (feet)
1280
1270
1260
1250
1240
1230
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

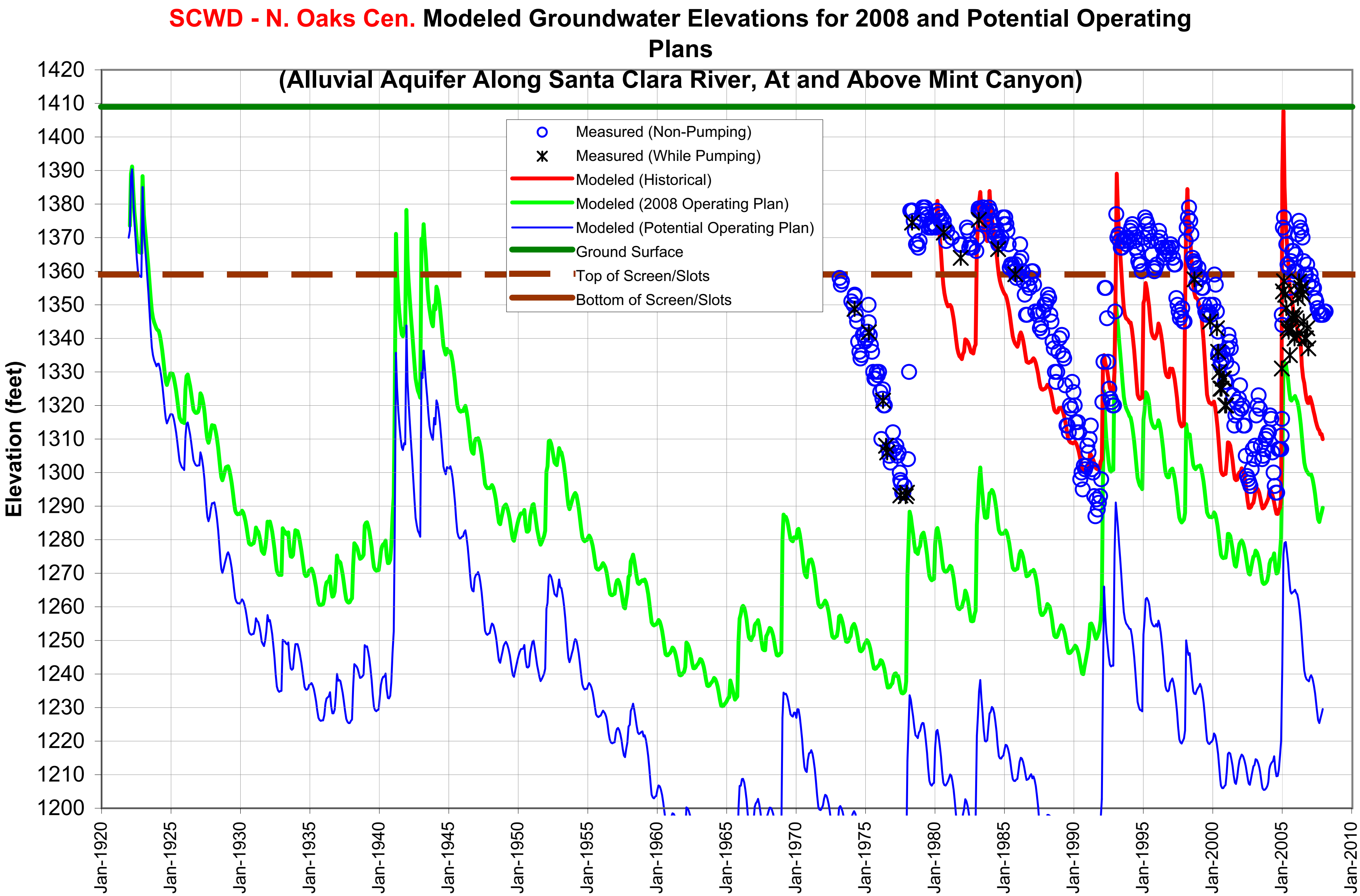

VWC-U6 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Above Saugus WRP)
Elevation (feet)
1240
1230
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

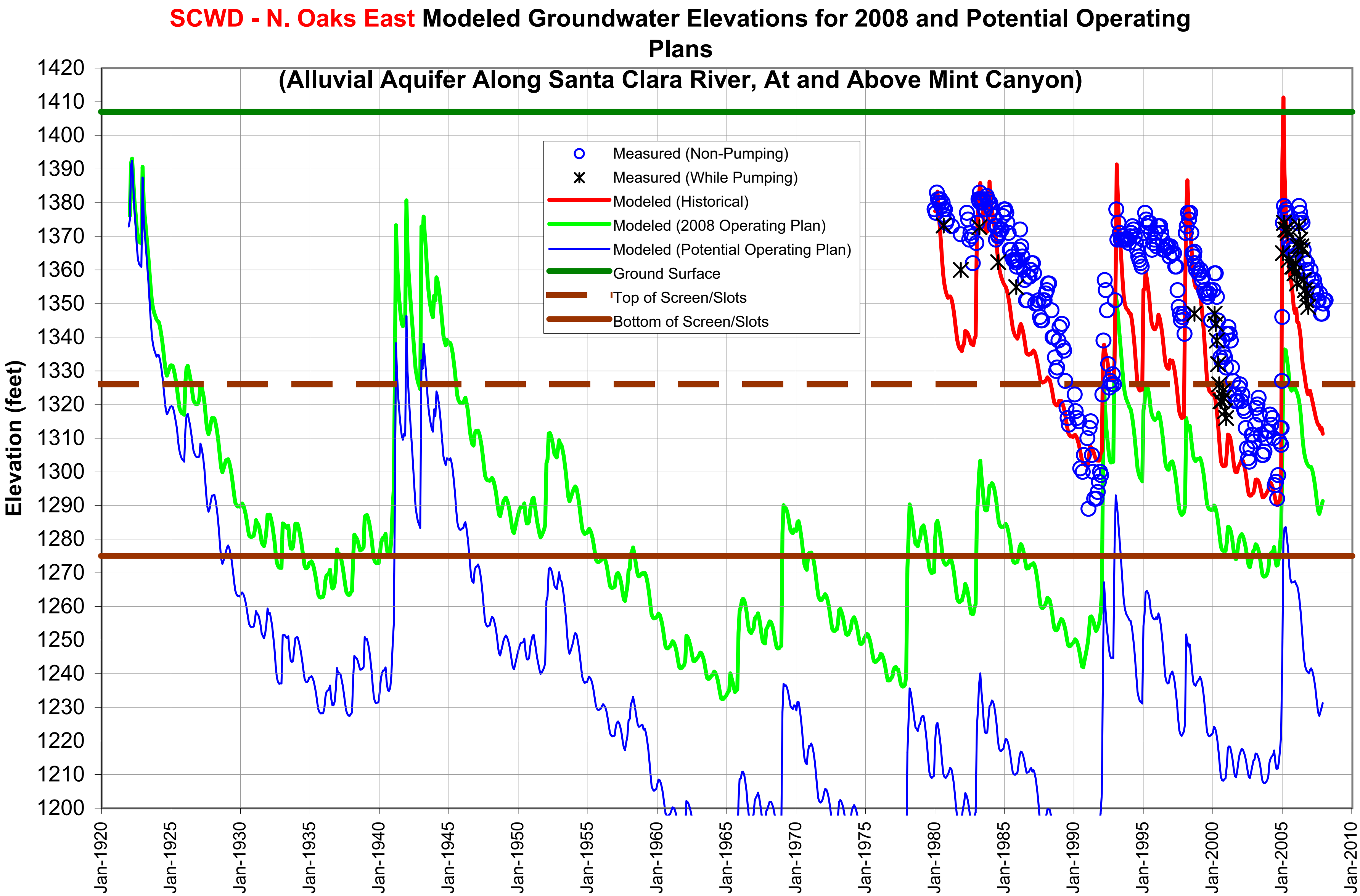


SCWD-Honby Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Above Saugus WRP)
Elevation (feet)
1300
1290
1280
1270
1260
1250
1240
1230
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

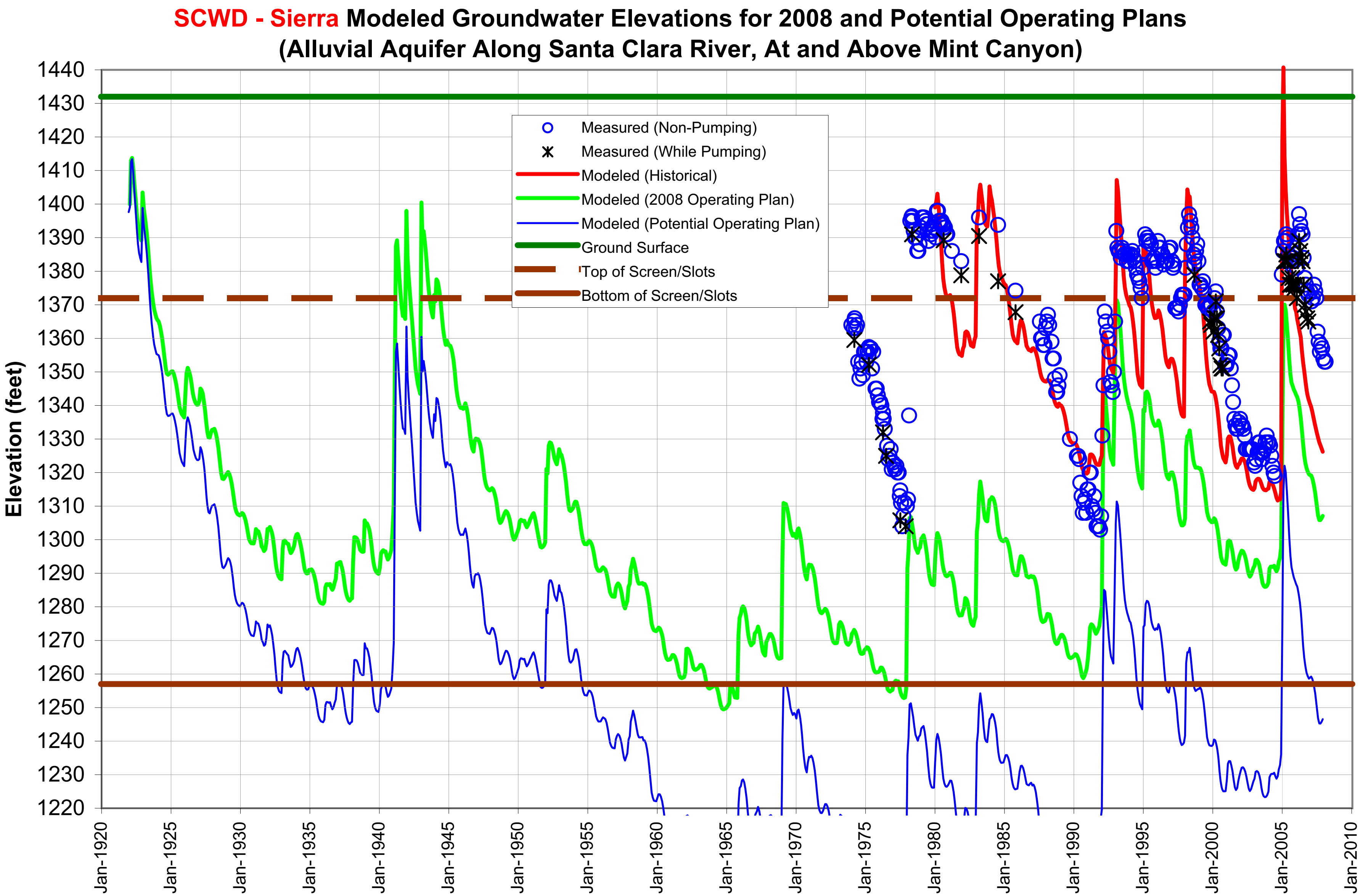


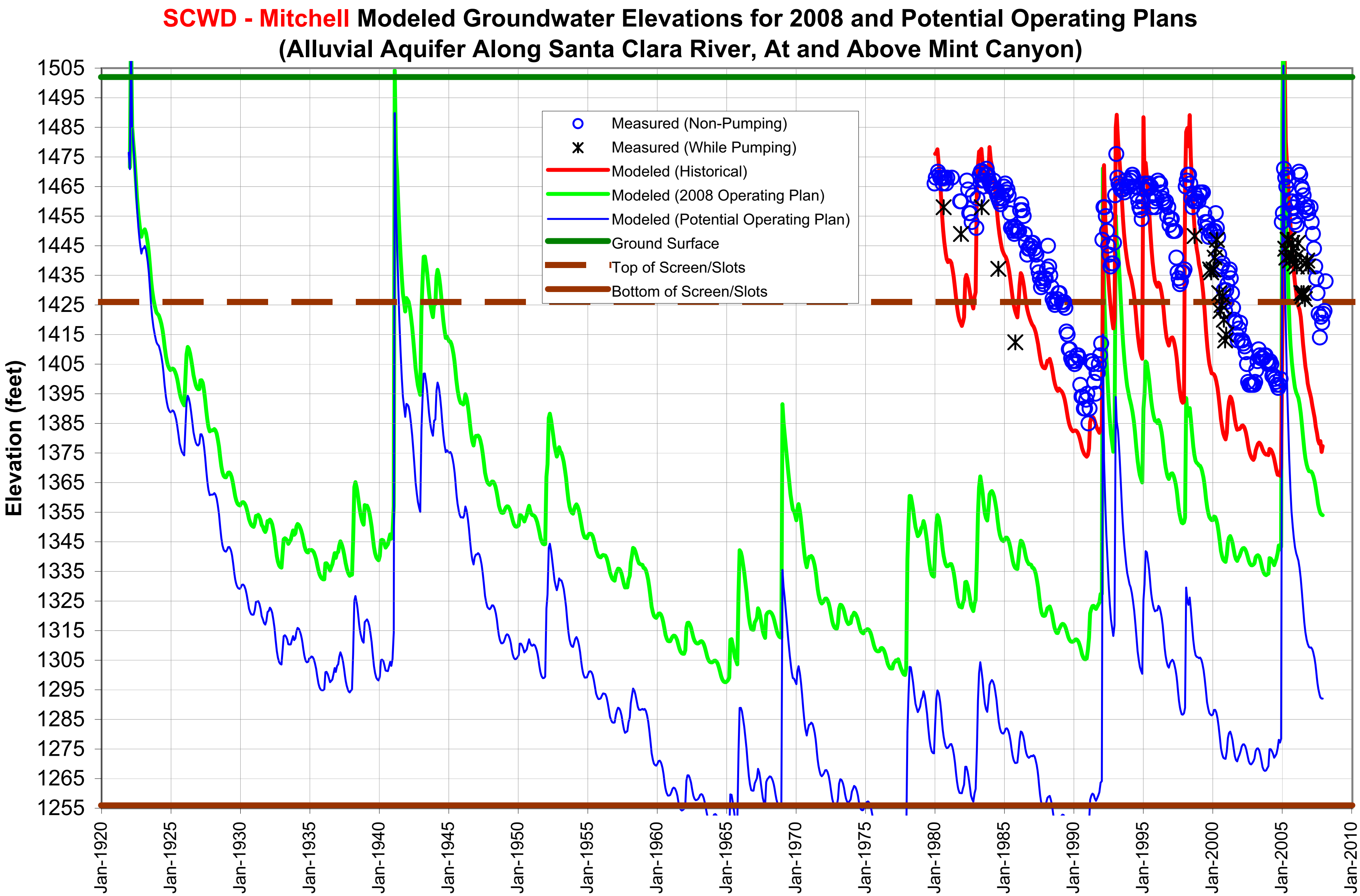
SCWD - N. Oaks West Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1420
1410
1400
1390
1380
1370
1360
1350
1340
1330
1320
1310
1300
1290
1280
1270
1260
1250
1240
1230
1220
1210
1200
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010

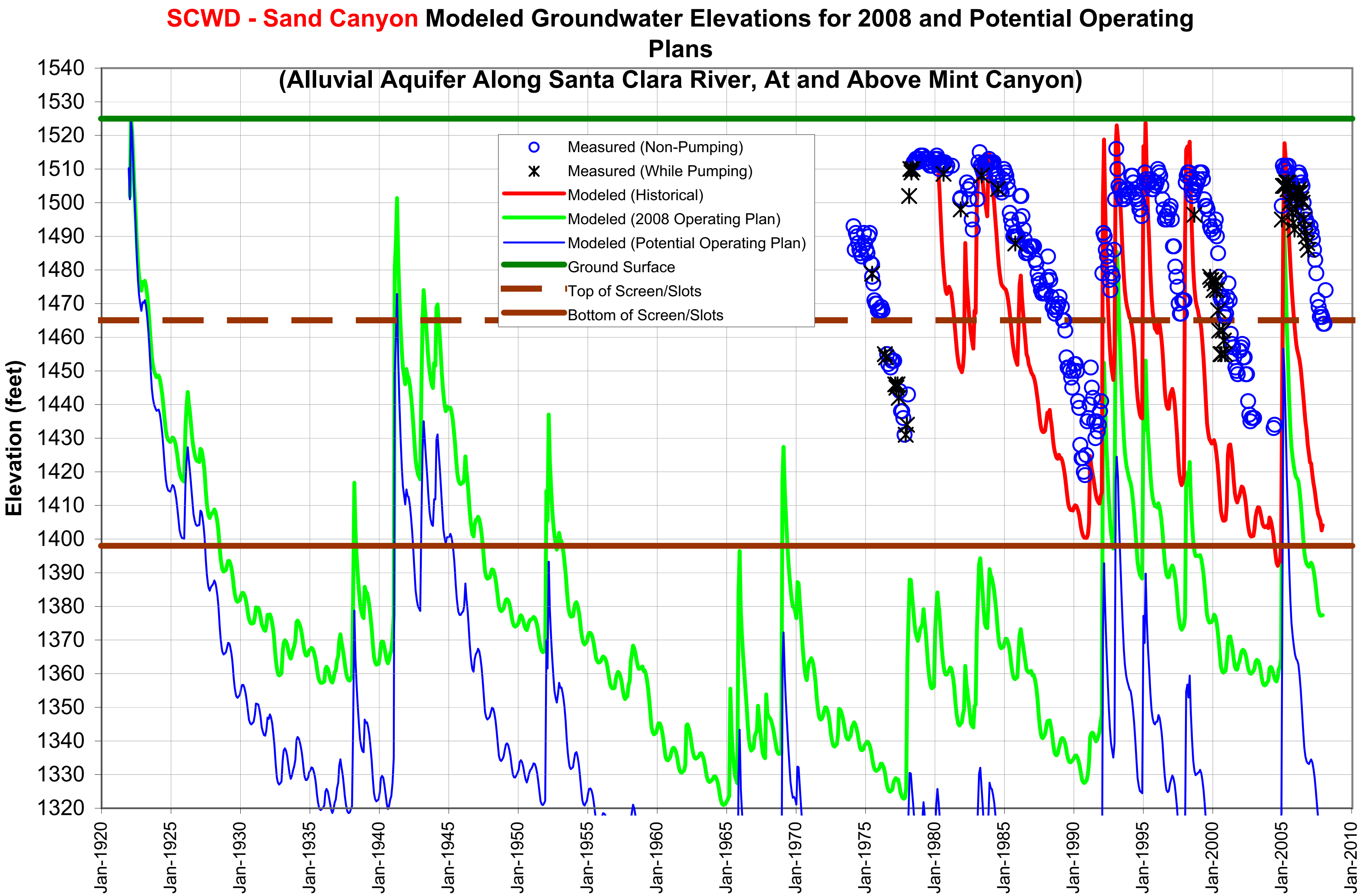

SCWD - N. Oaks Cen. Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1420
1410
1400
1390
1380
1370
1360
1350
1340
1330
1320
1310
1300
1290
1280
1270
1260
1250
1240
1230
1220
1210
1200
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010

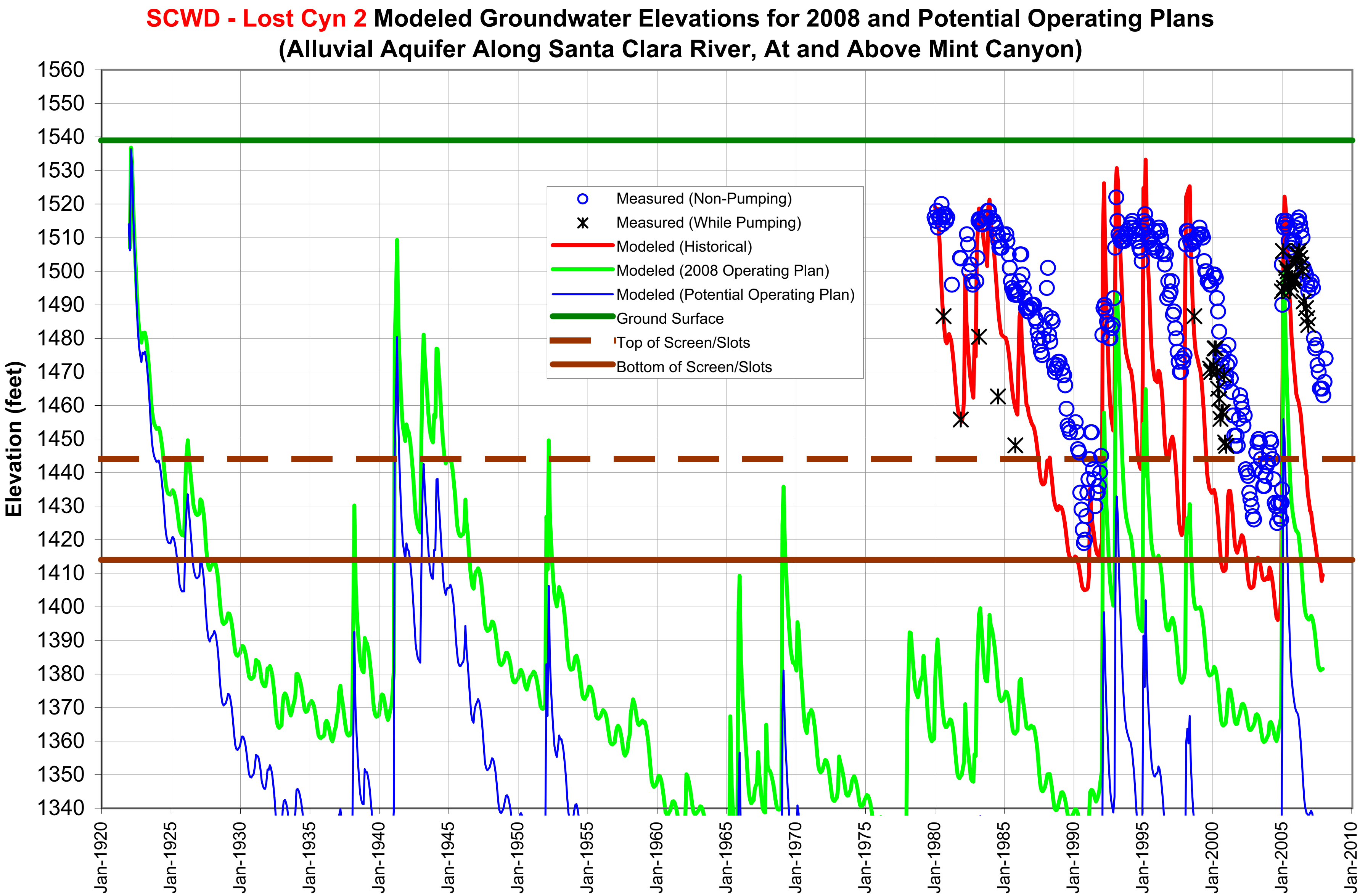


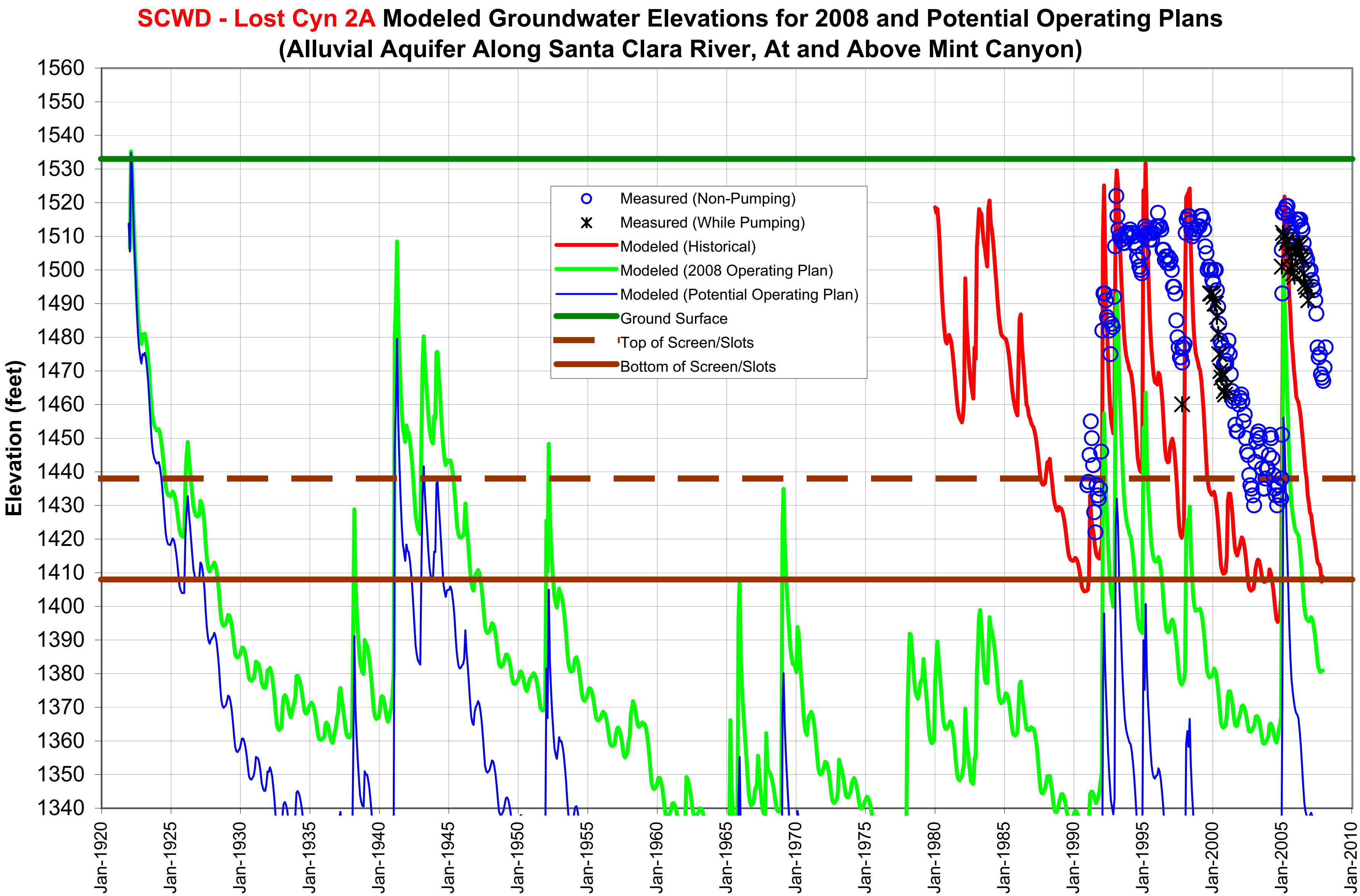
SCWD - N. Oaks East Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1420
1410
1400
1390
1380
1370
1360
1350
1340
1330
1320
1310
1300
1290
1280
1270
1260
1250
1240
1230
1220
1210
1200
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

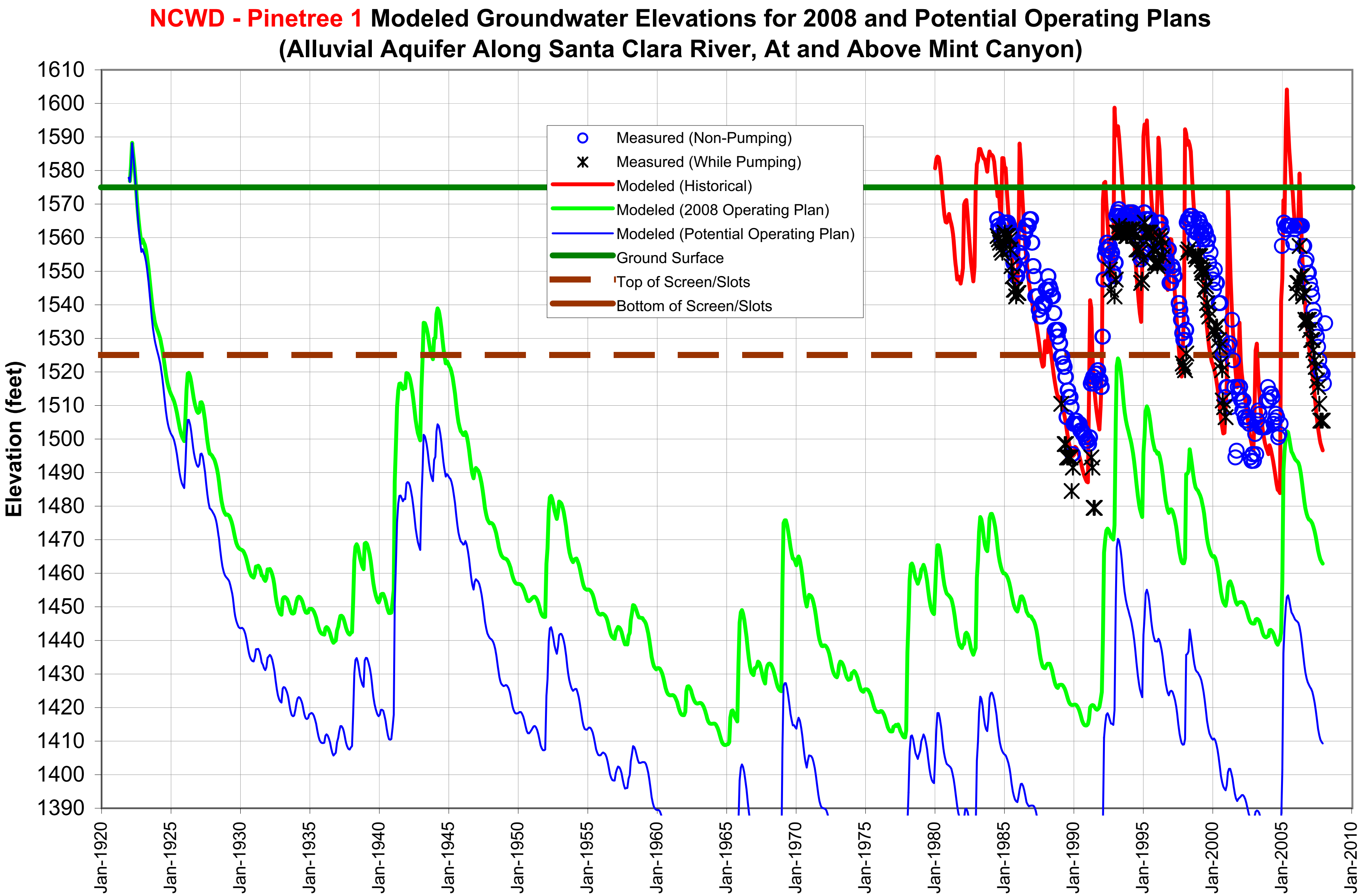

SCWD - Sierra Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1440
1430
1420
1410
1400
1390
1380
1370
1360
1350
1340
1330
1320
1310
1300
1290
1280
1270
1260
1250
1240
1230
1220
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

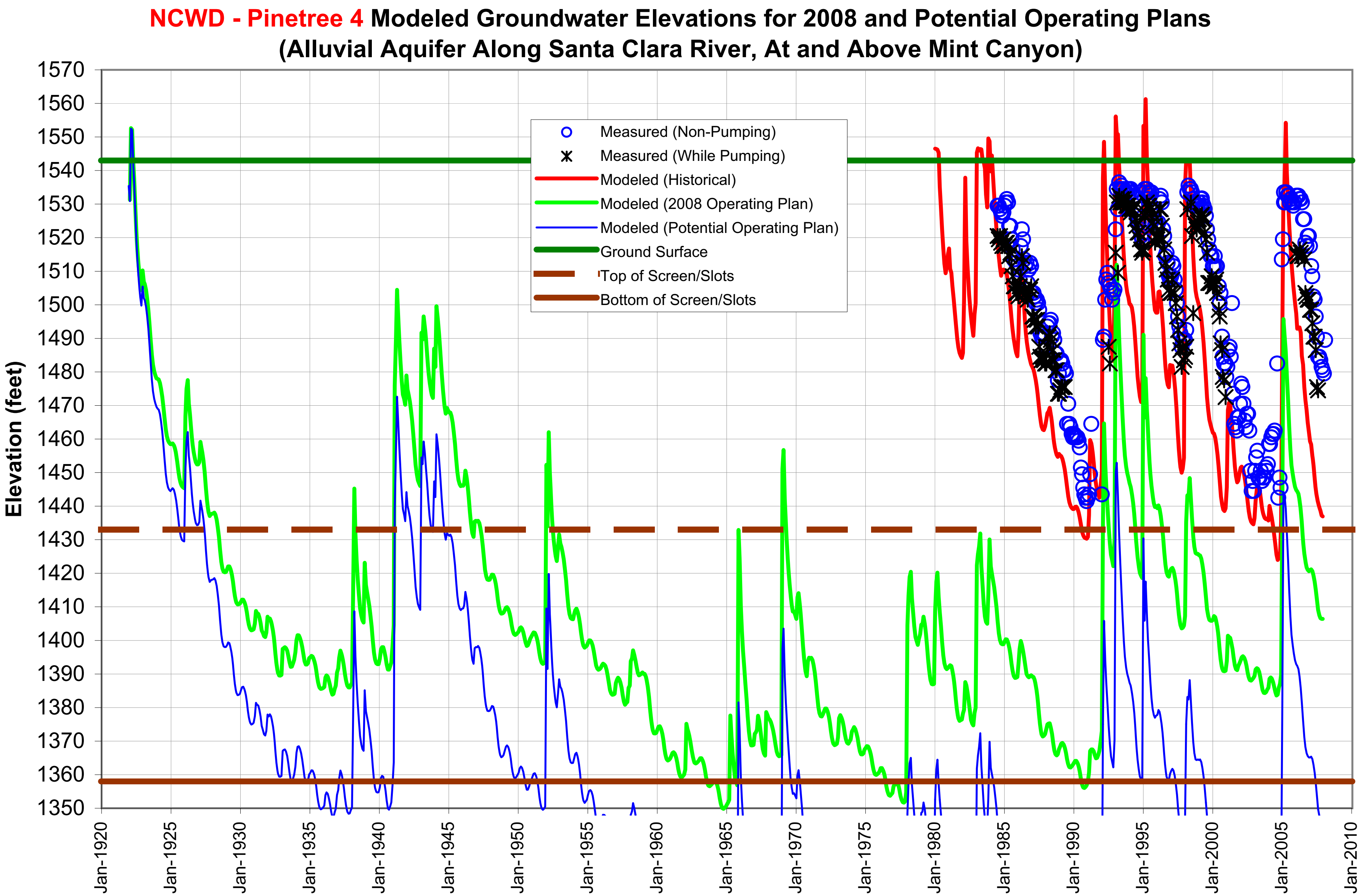

SCWD - Mitchell Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots
Elevation (feet)
1505
1495
1485
1475
1465
1455
1445
1435
1425
1415
1405
1395
1385
1375
1365
1355
1345
1335
1325
1315
1305
1295
1285
1275
1265
1255
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010

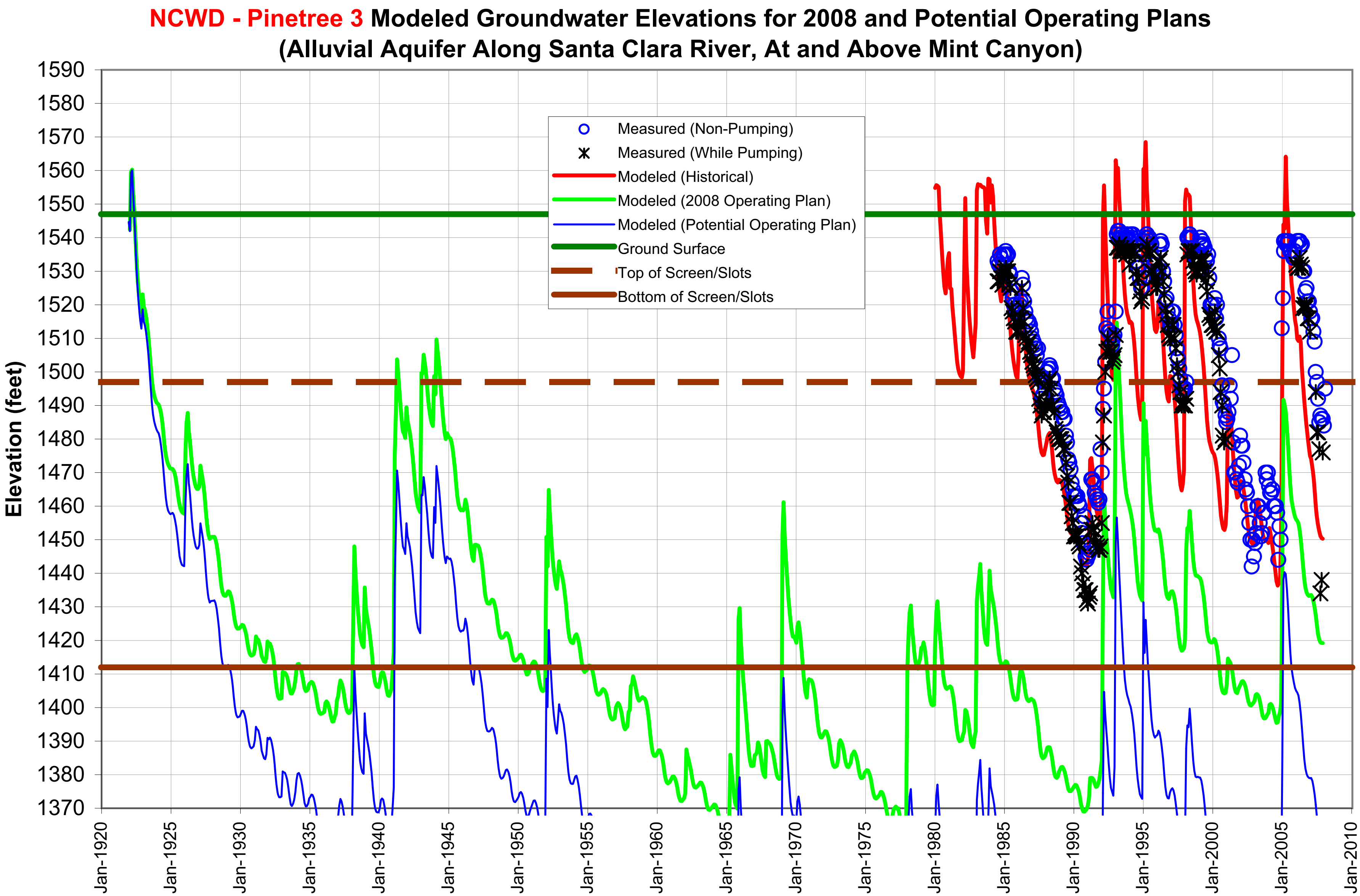

SCWD - Sand Canyon Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1540
1530
1520
1510
1500
1490
1480
1470
1460
1450
1440
1430
1420
1410
1400
1390
1380
1370
1360
1350
1340
1330
1320
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010


SCWD - Lost Cyn 2 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1560
1550
1540
1530
1520
1510
1500
1490
1480
1470
1460
1450
1440
1430
1420
1410
1400
1390
1380
1370
1360
1350
1340
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010

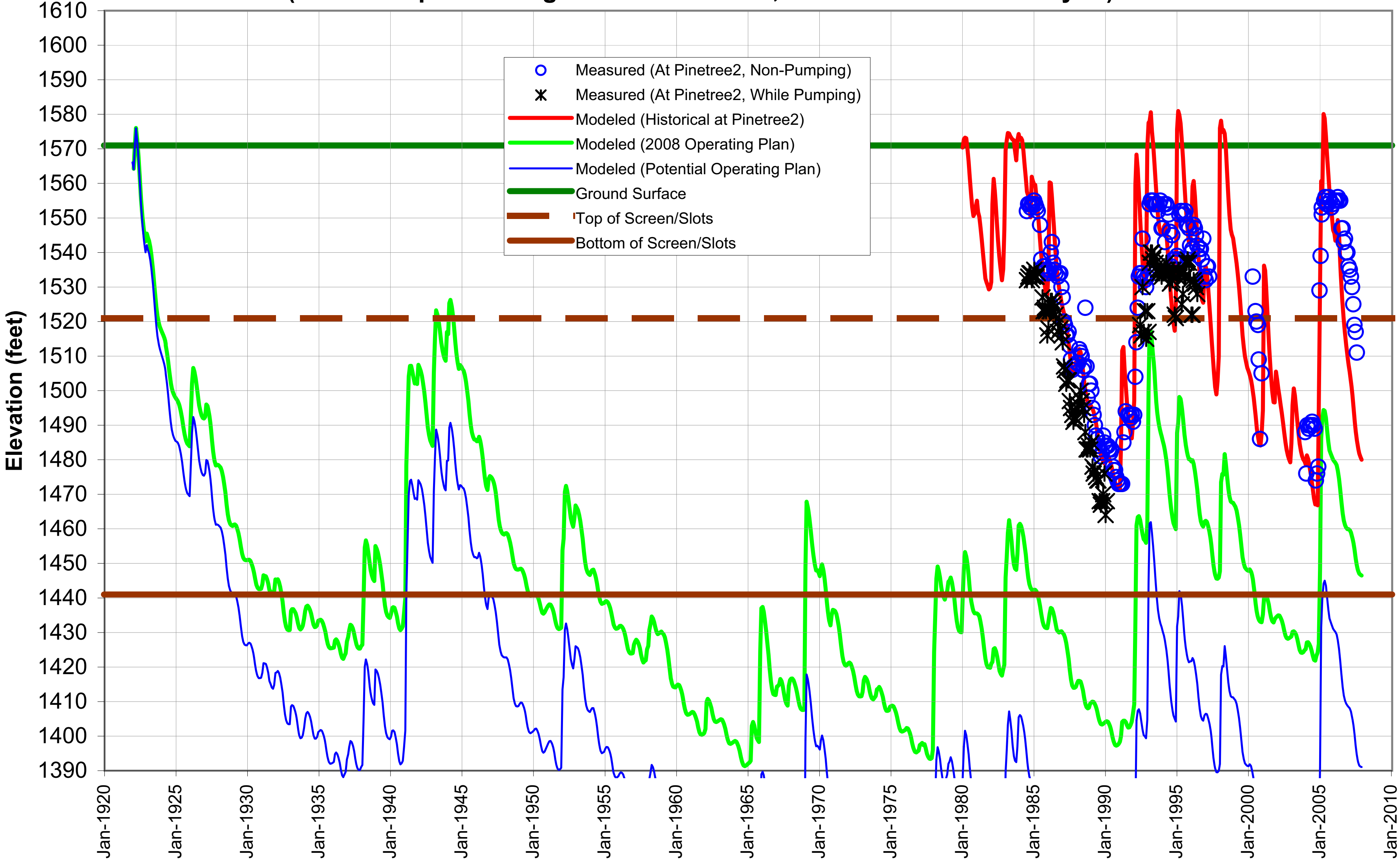

SCWD - Lost Cyn 2A Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1560
1550
1540
1530
1520
1510
1500
1490
1480
1470
1460
1450
1440
1430
1420
1410
1400
1390
1380
1370
1360
1350
1340
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

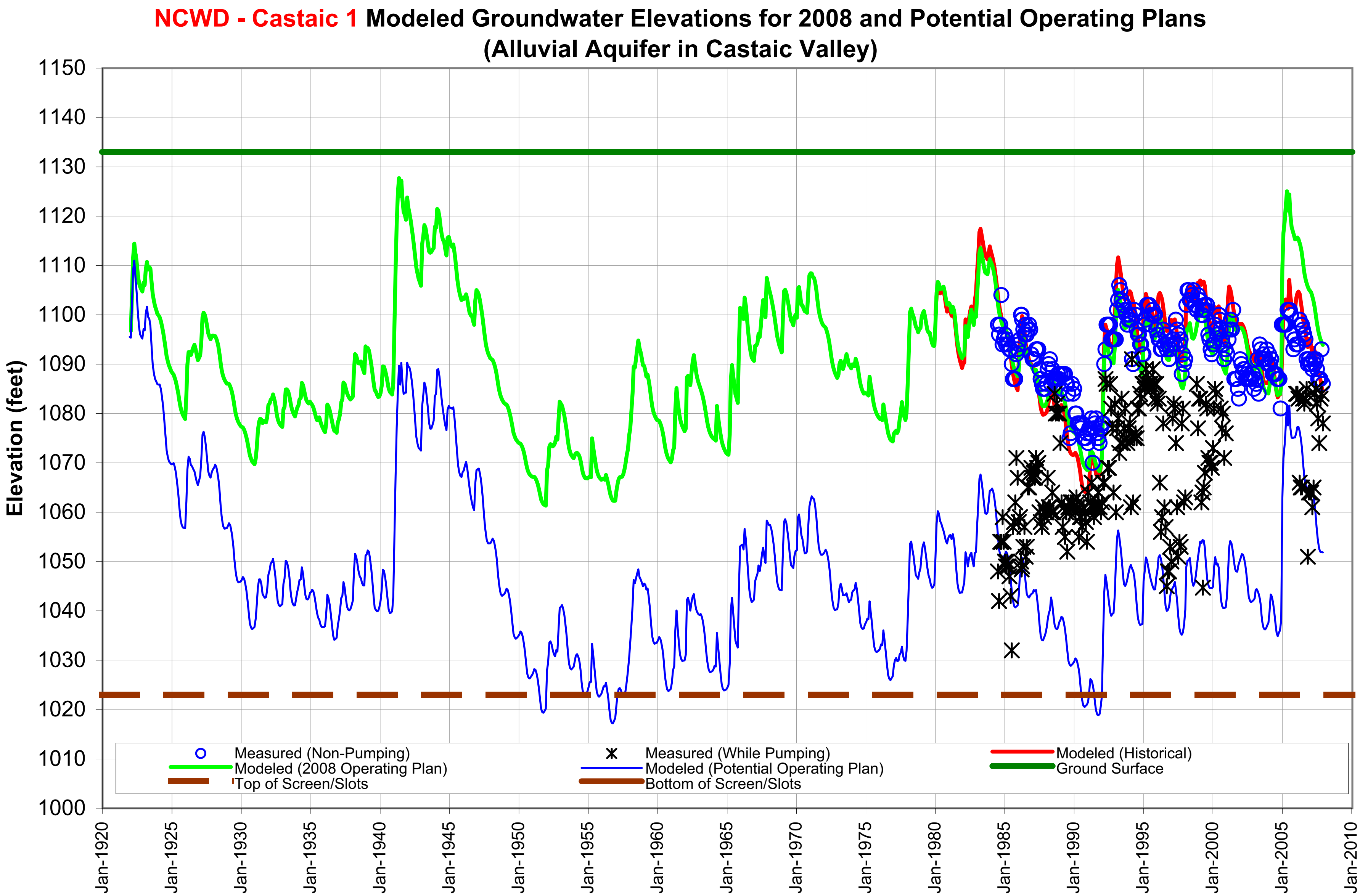

NCWD - Pinetree 1 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1610
1600
1590
1580
1570
1560
1550
1540
1530
1520
1510
1500
1490
1480
1470
1460
1450
1440
1430
1420
1410
1400
1390
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots


NCWD - Pinetree 4 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots
1570
1560
1550
1540
1530
1520
1510
1500
1490
1480
1470
1460
1450
1440
1430
1420
1410
1400
1390
1380
1370
1360
1350
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010

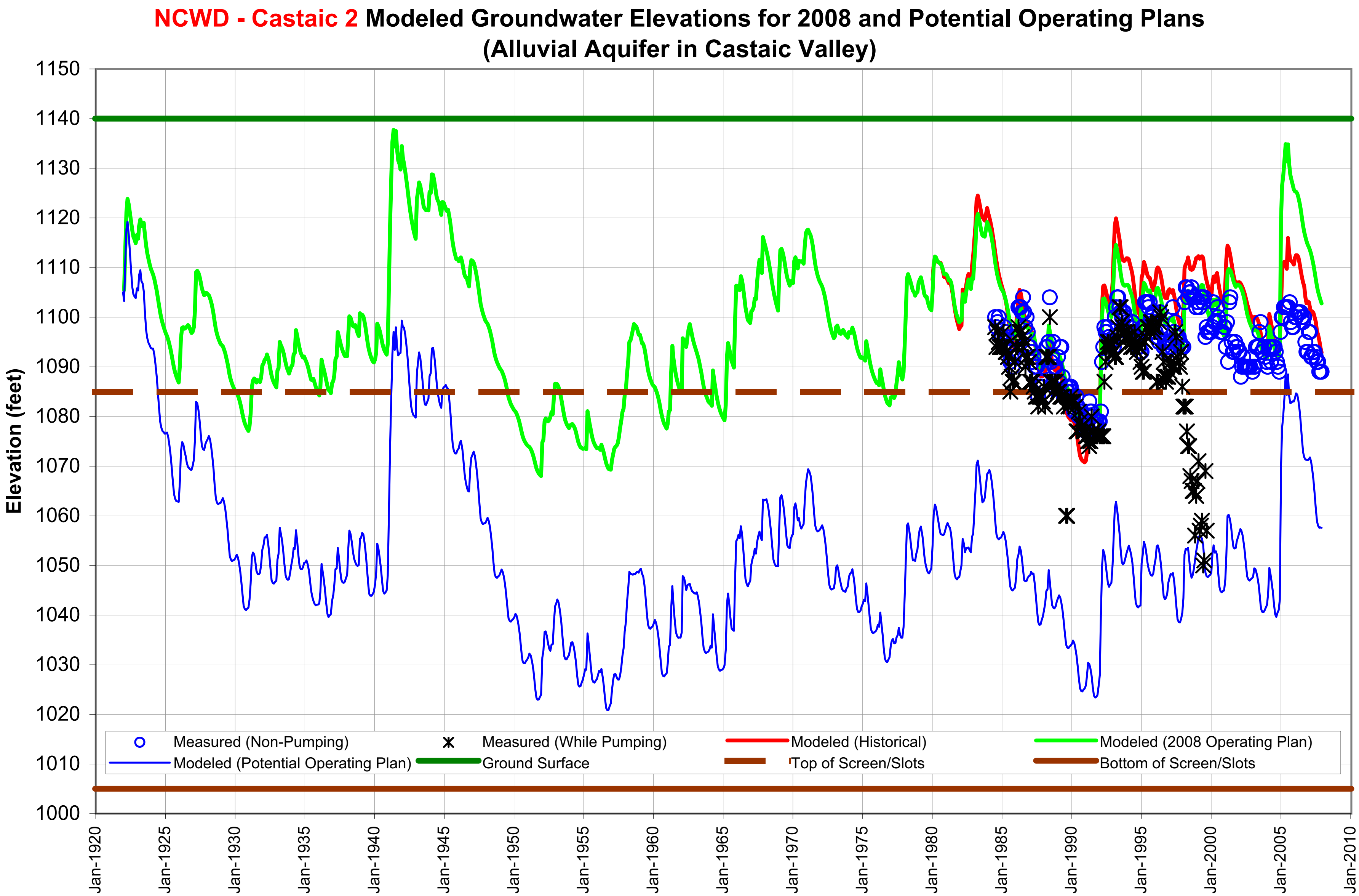

NCWD - Pinetree 3 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1590
1580
1570
1560
1550
1540
1530
1520
1510
1500
1490
1480
1470
1460
1450
1440
1430
1420
1410
1400
1390
1380
1370
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

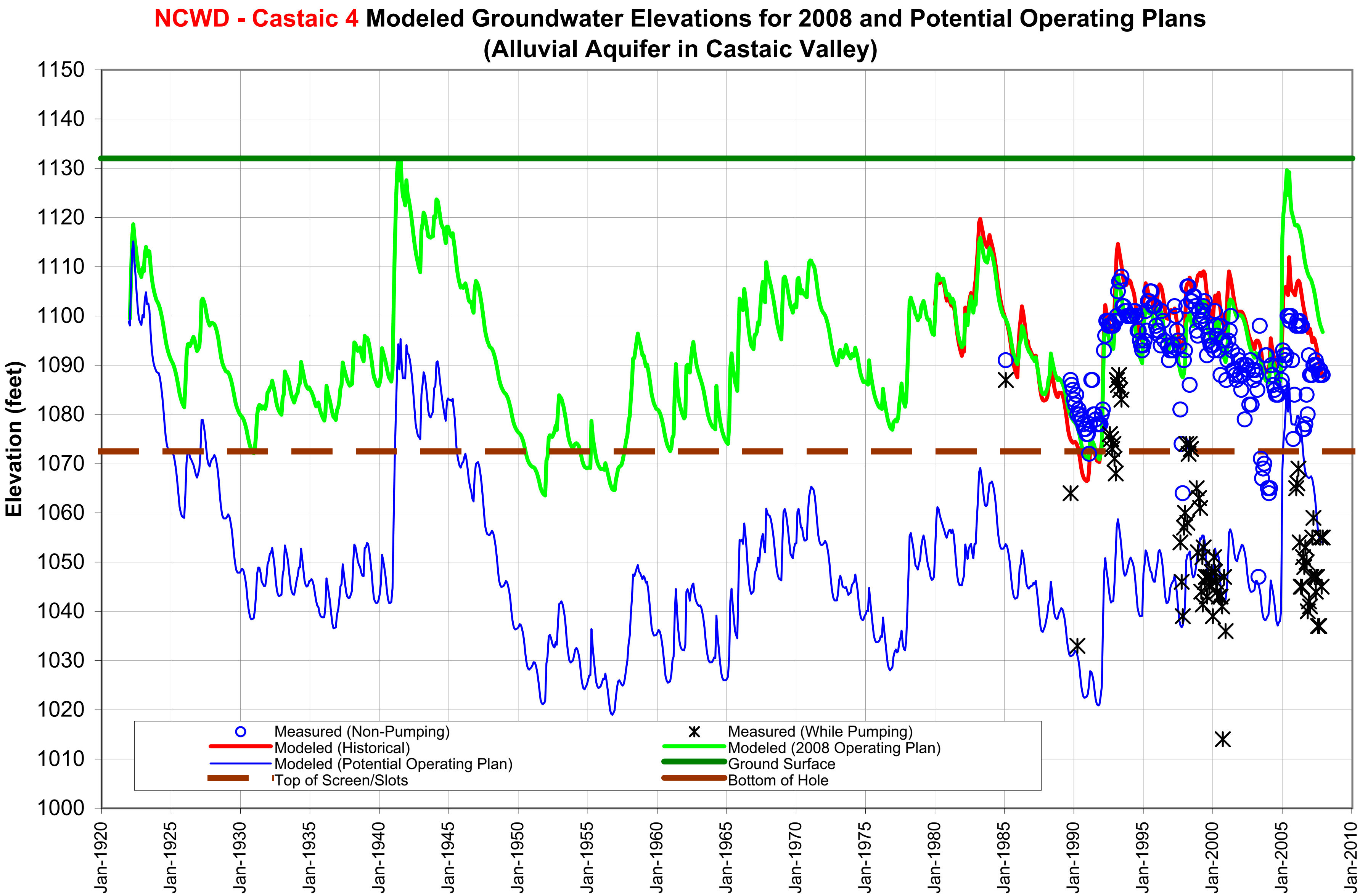
NCWD - Pinetree 5 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)

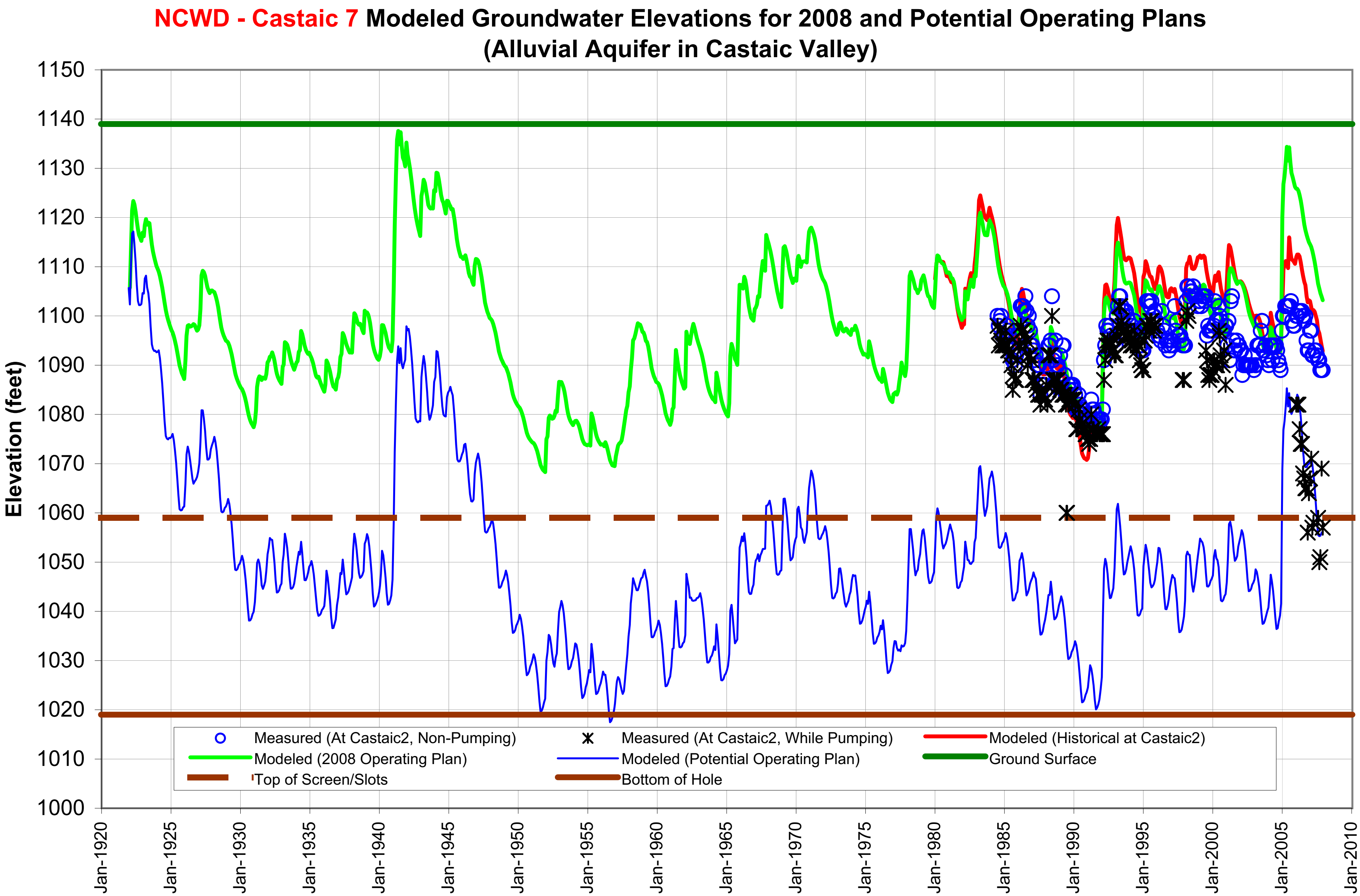


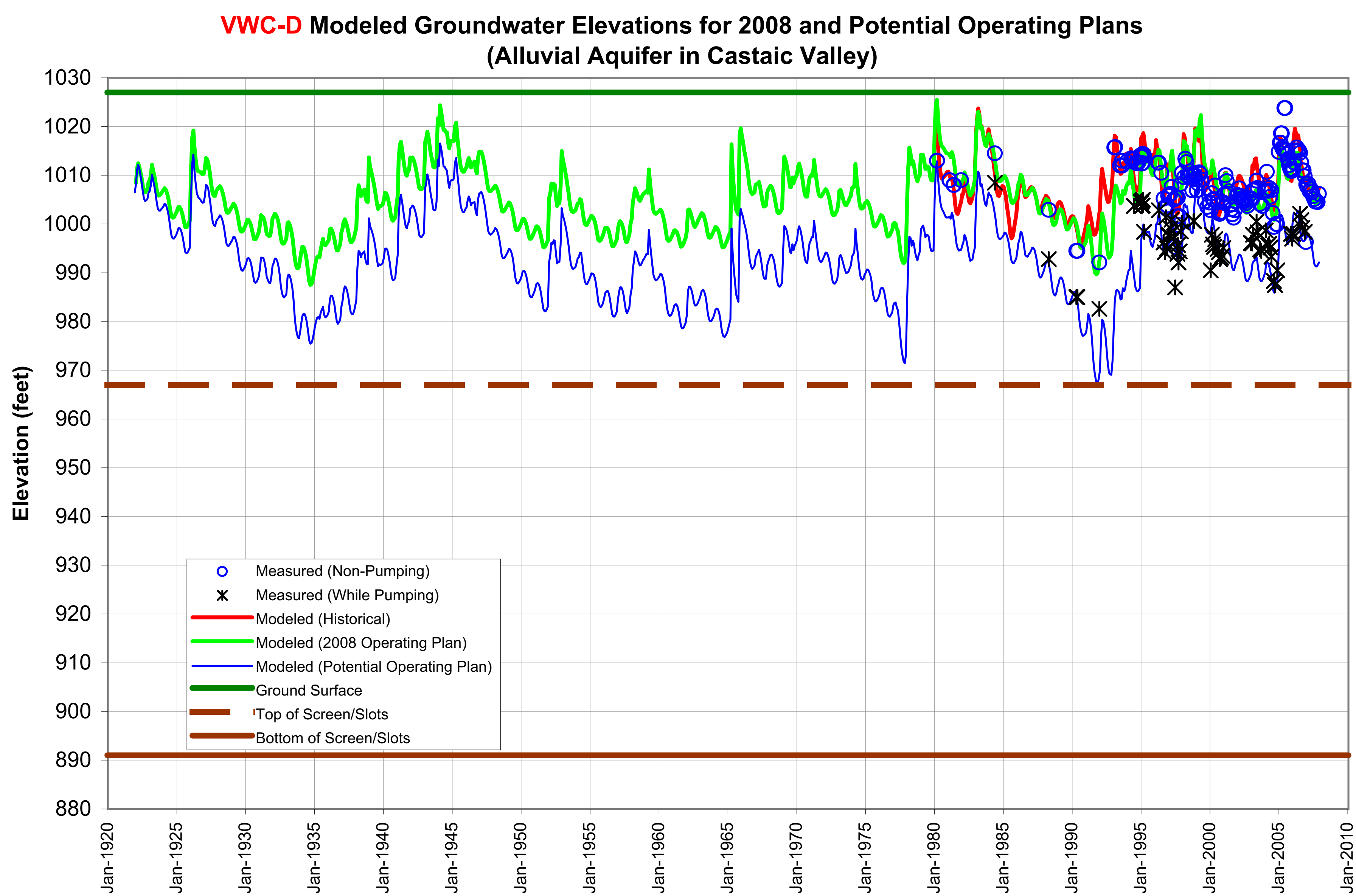


NCWD - Castaic 1 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer in Castaic Valley)
Elevation (feet)
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Modeled (2008 Operating Plan)
Top of Screen/Slots
Measured (While Pumping)
Modeled (Potential Operating Plan)
Bottom of Screen/Slots
Modeled (Historical)
Ground Surface

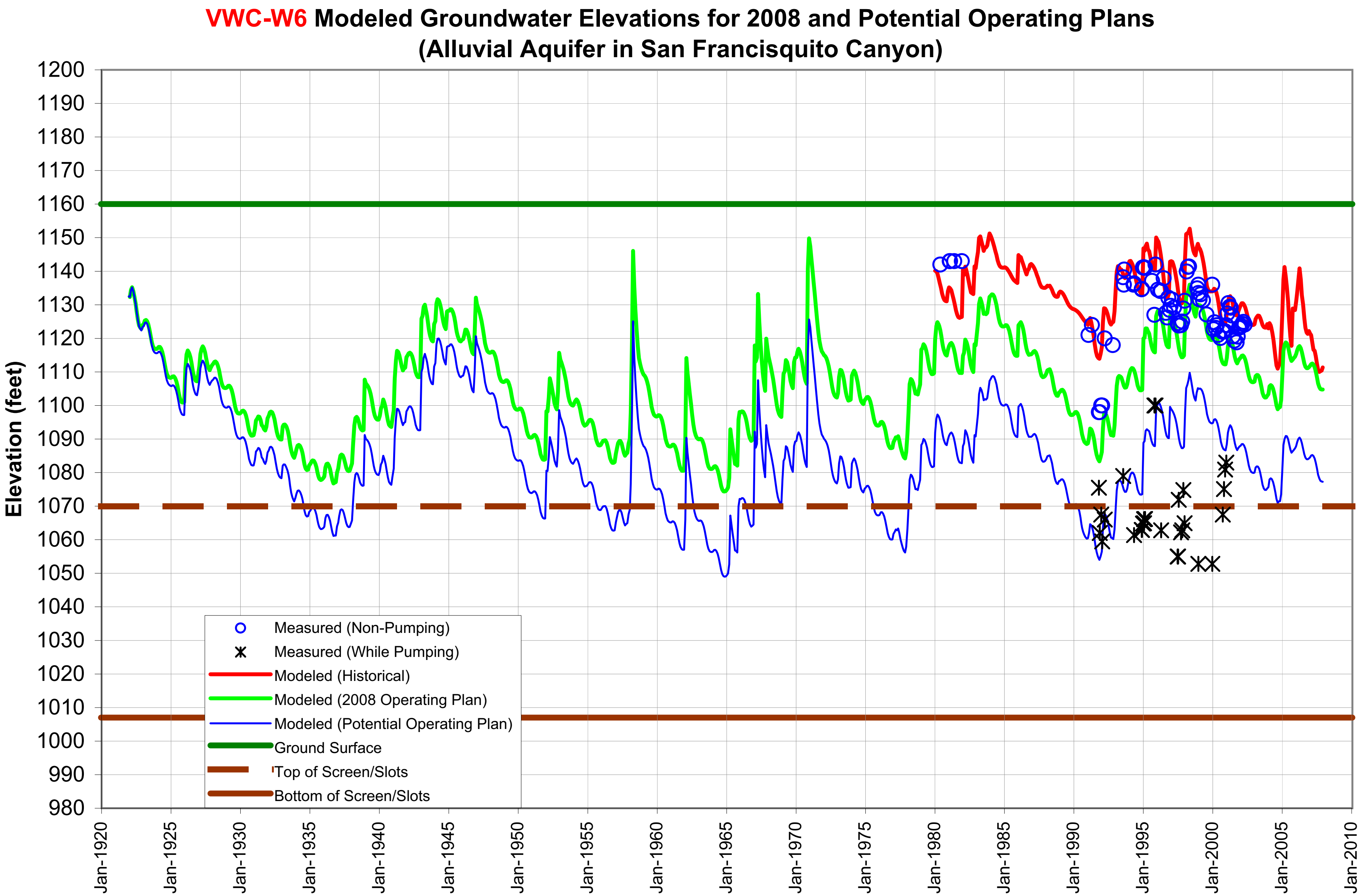

NCWD - Castaic 2 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer in Castaic Valley)
Elevation (feet)
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots


NCWD - Castaic 4 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer in Castaic Valley)
Elevation (feet)
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Modeled (Historical)
Modeled (Potential Operating Plan)
Top of Screen/Slots
Measured (While Pumping)
Modeled (2008 Operating Plan)
Ground Surface
Bottom of Hole

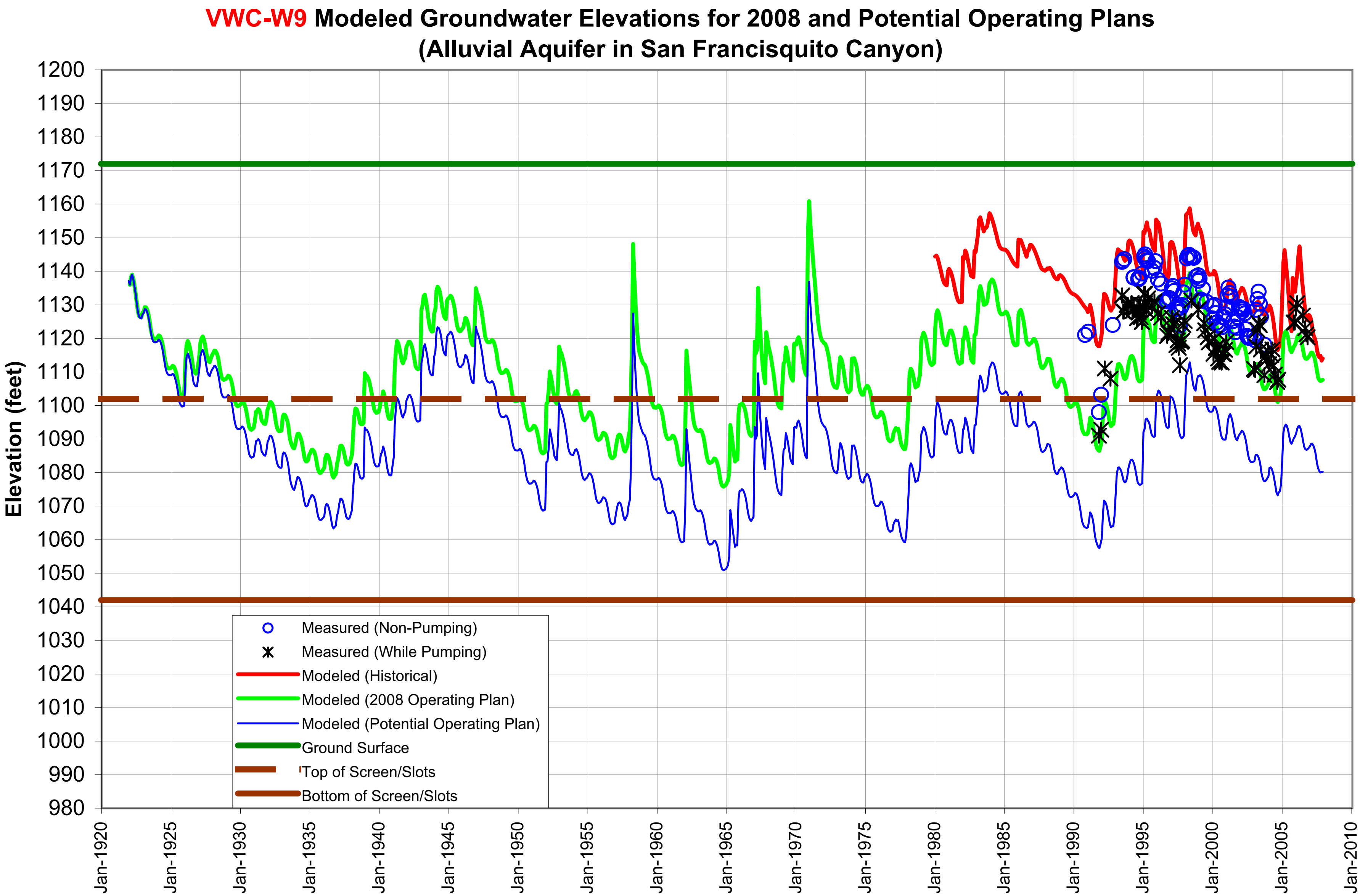

NCWD - Castaic 7 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer in Castaic Valley)
Elevation (feet)
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (At Castaic2, Non-Pumping)
Measured (At Castaic2, While Pumping)
Modeled (Historical at Castaic2)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Hole

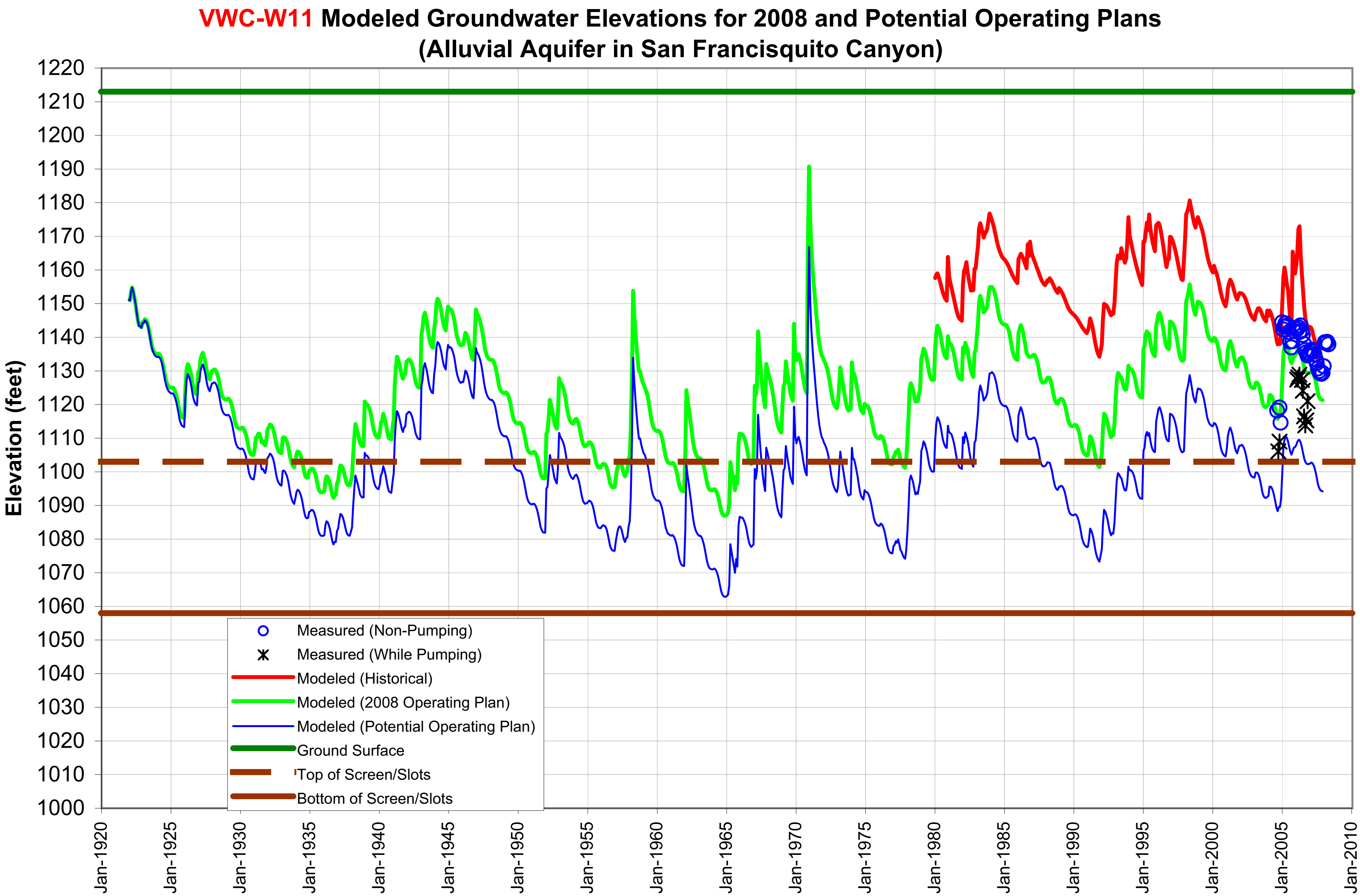


VWC-D Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer in Castaic Valley)
Elevation (feet)
1030
1020
1010
1000
990
980
970
960
950
940
930
920
910
900
890
880
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots



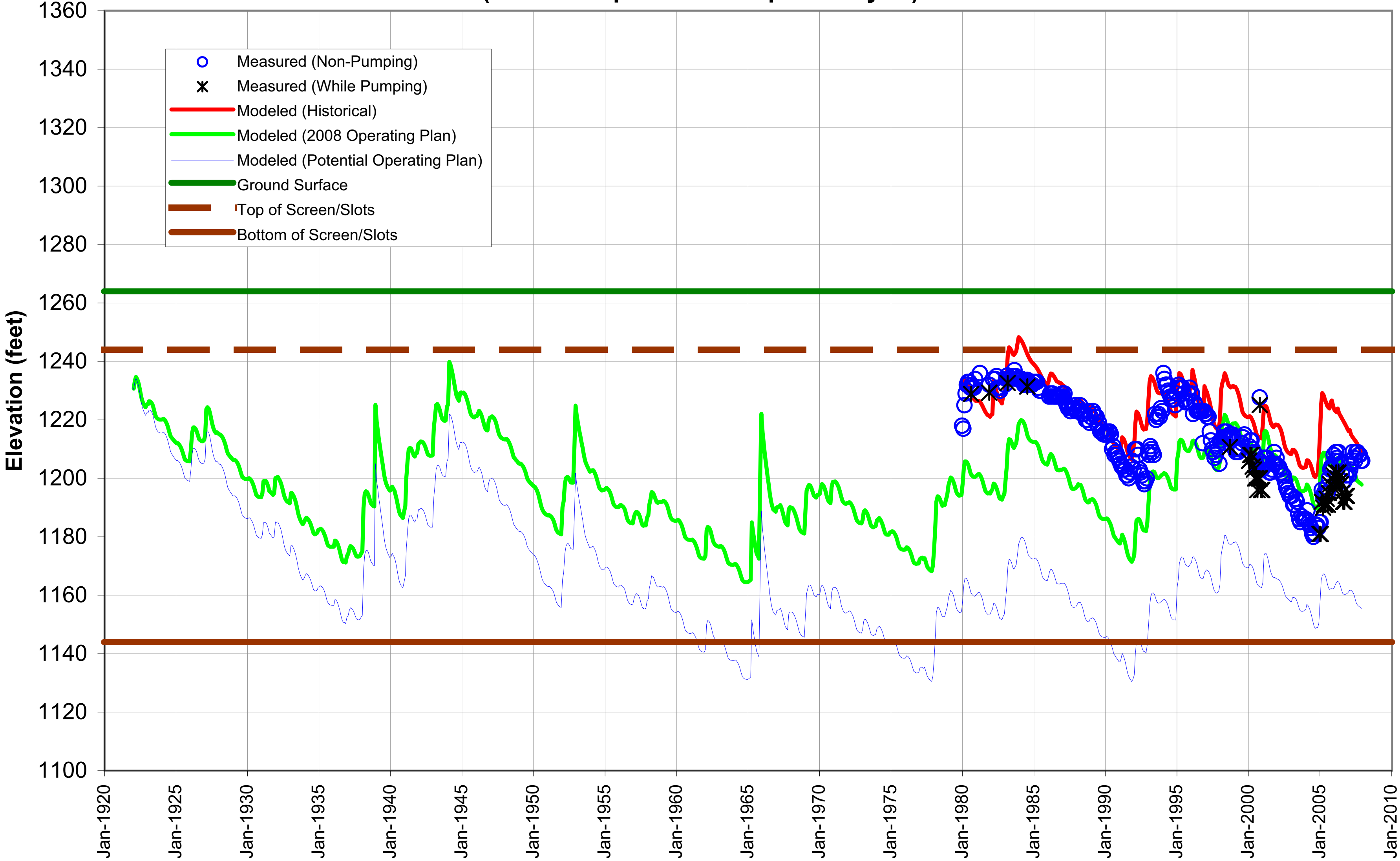
VWC-W6 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer in San Francisquito Canyon)
Elevation (feet)
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

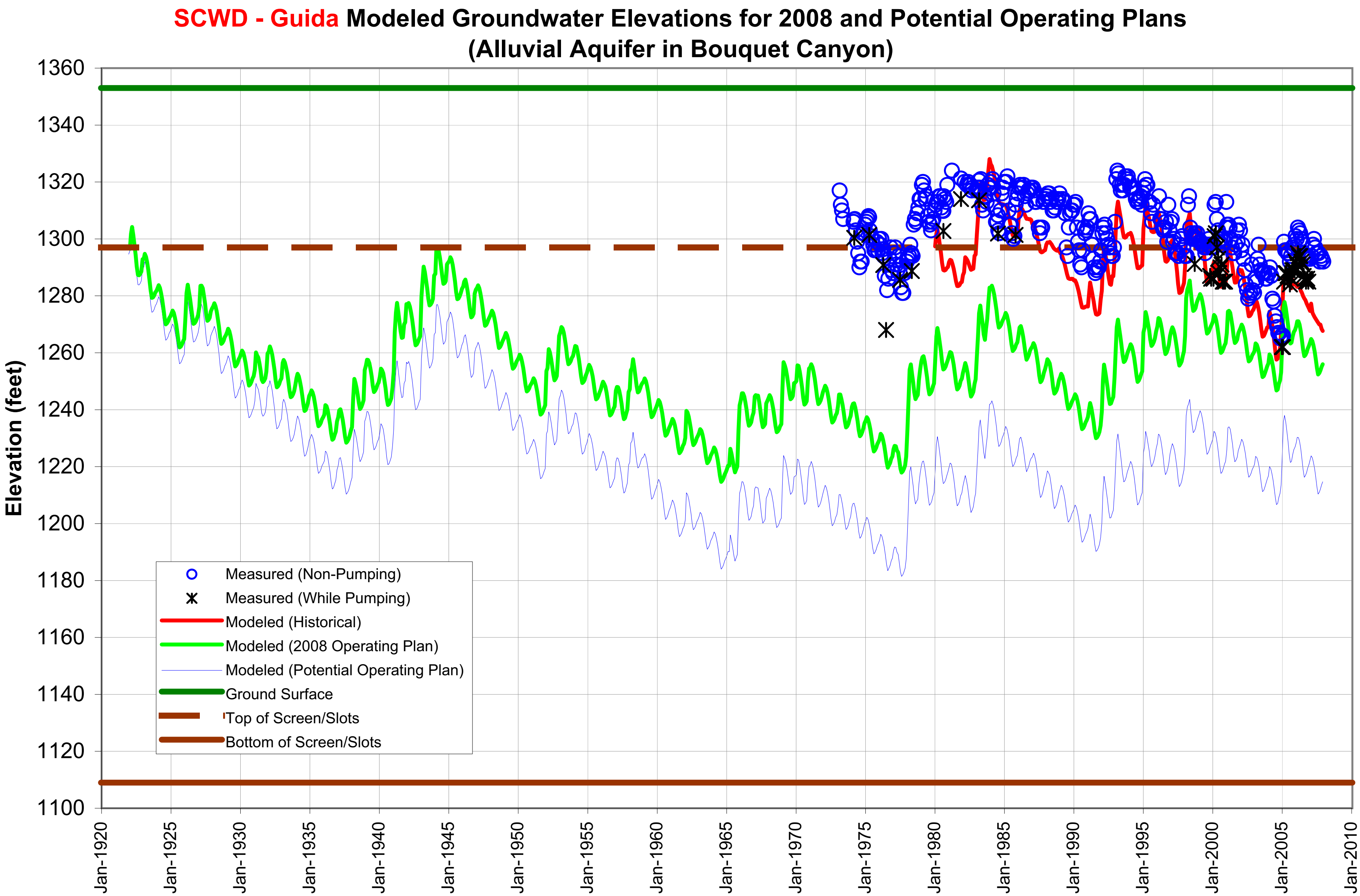

VWC-W9 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer in San Francisquito Canyon)
Elevation (feet)
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

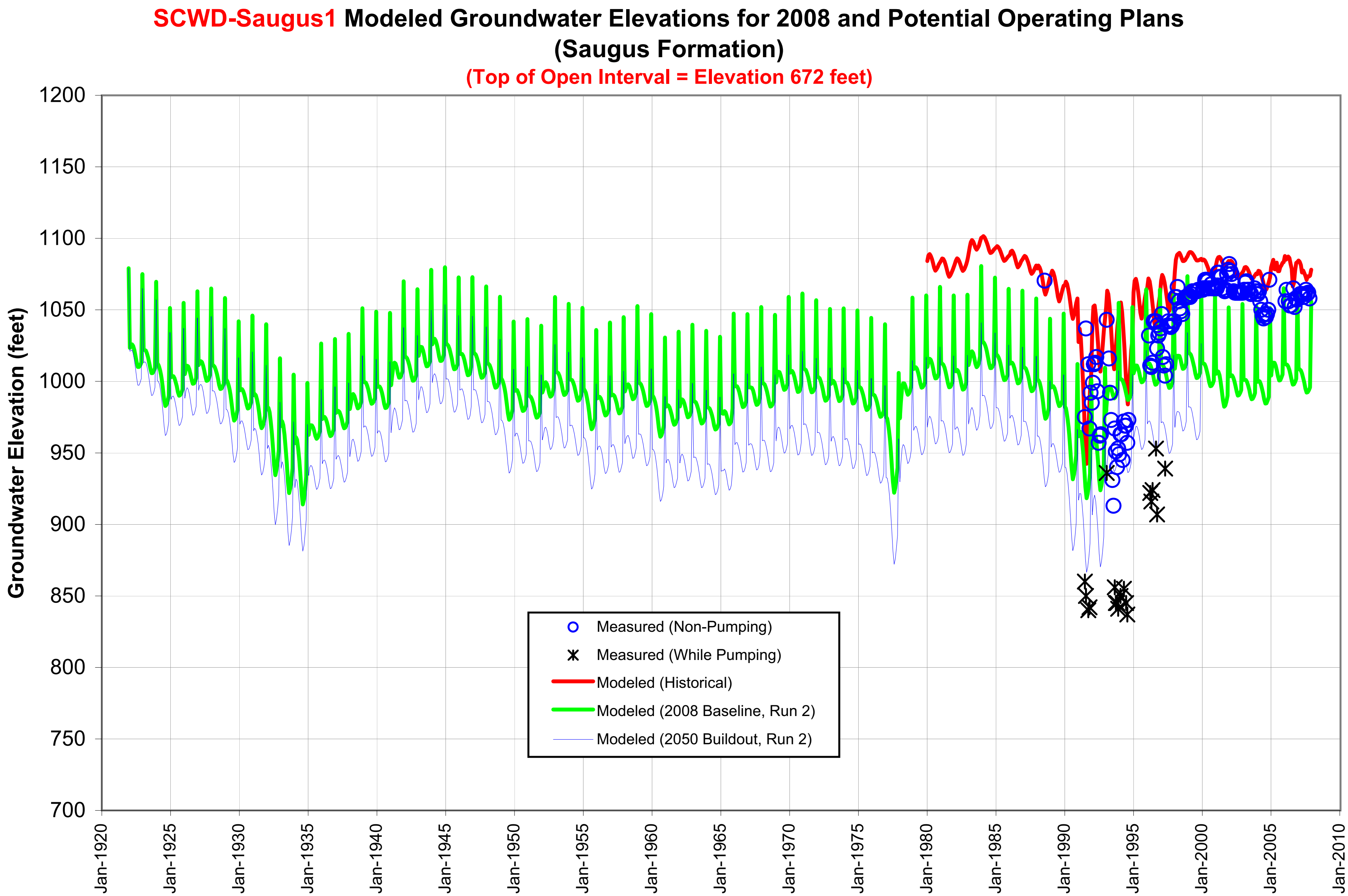


VWC-W11 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer in San Francisquito Canyon)
Elevation (feet)
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

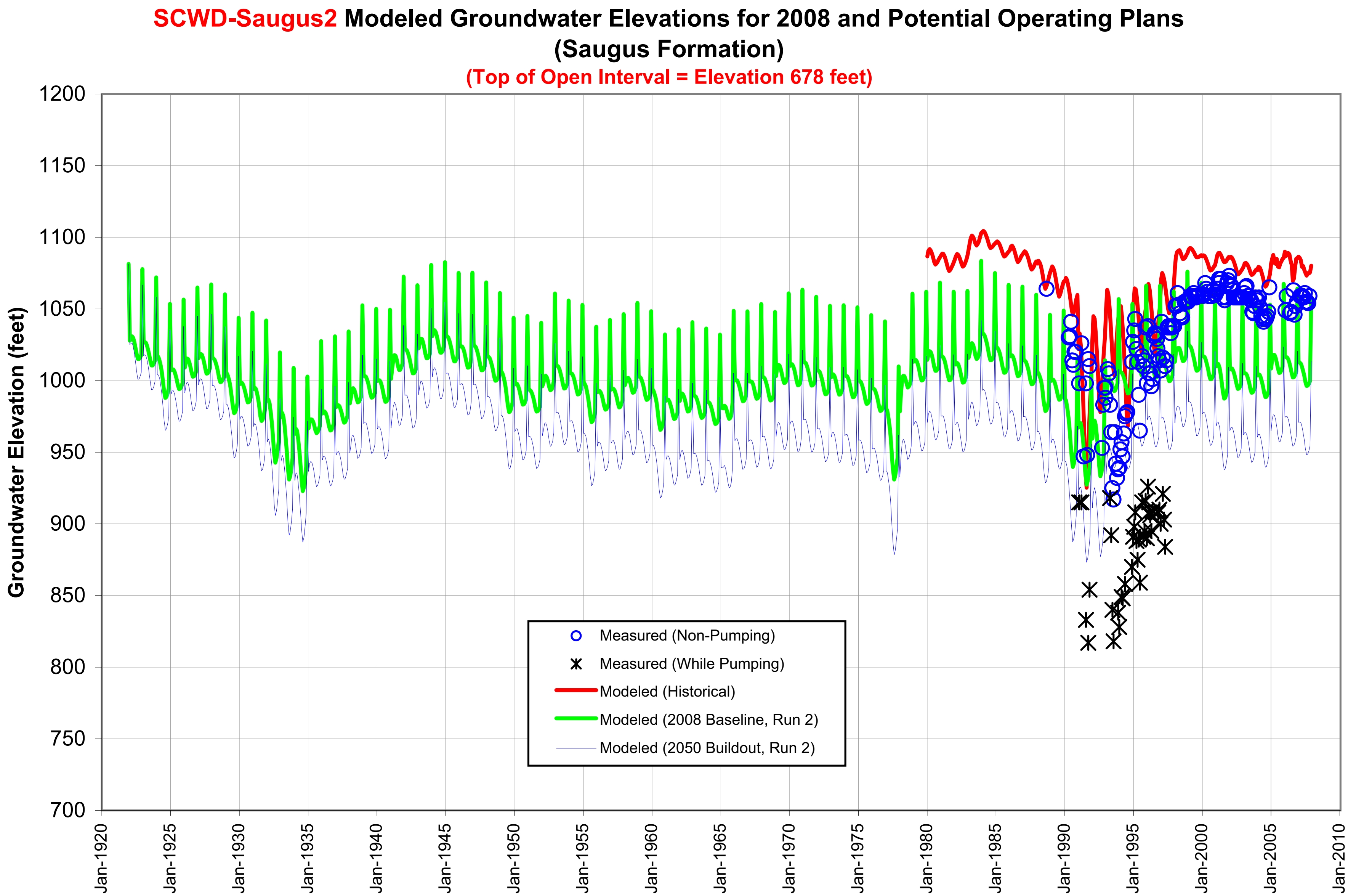
SCWD - Clark Modeled Groundwater Elevations for 2008 and Potential Operating Plans (Alluvial Aquifer in Bouquet Canyon)



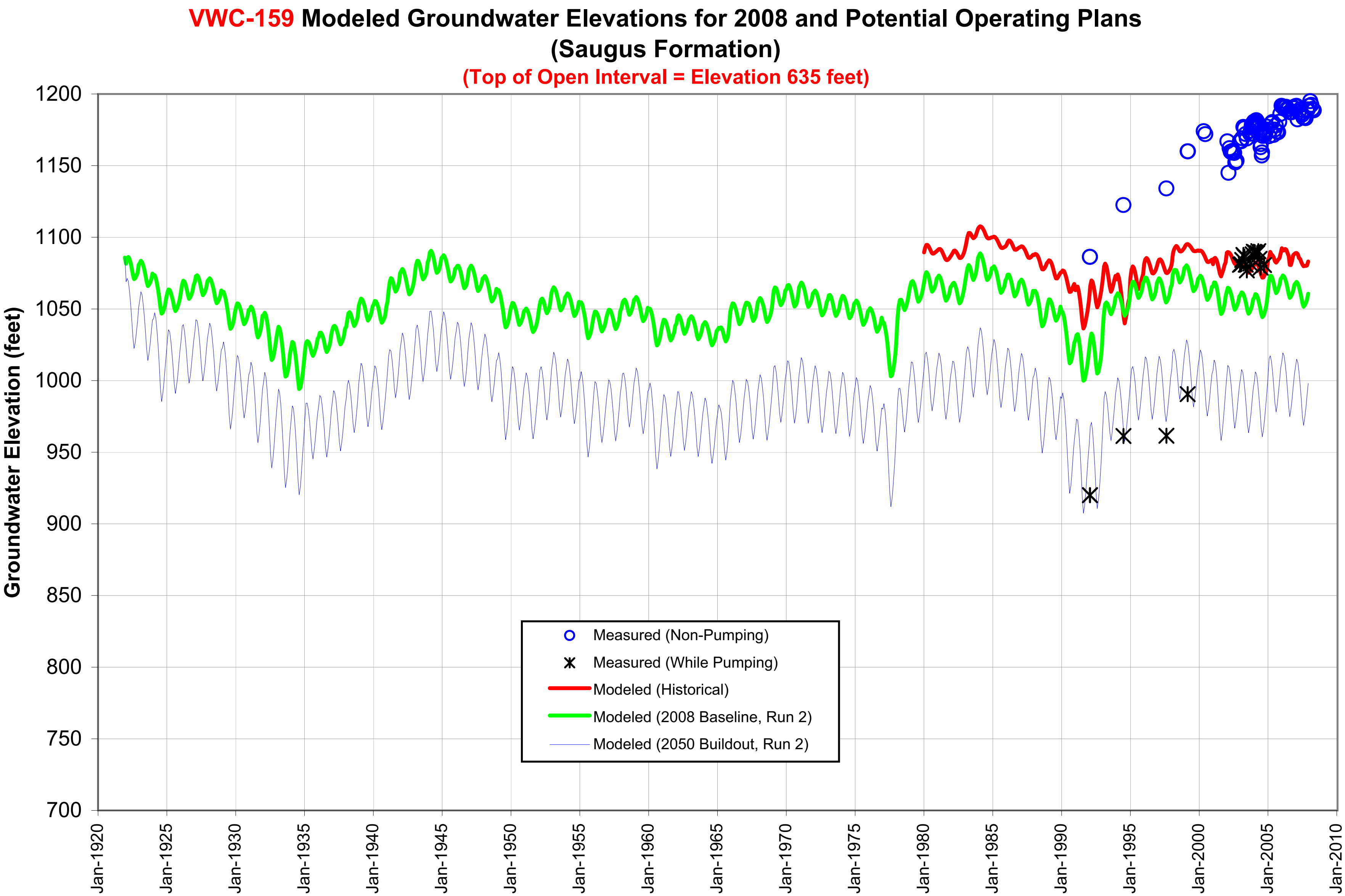

SCWD - Guida Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Alluvial Aquifer in Bouquet Canyon)
Elevation (feet)
1360
1340
1320
1300
1280
1260
1240
1220
1200
1180
1160
1140
1120
1100
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Operating Plan)
Modeled (Potential Operating Plan)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots



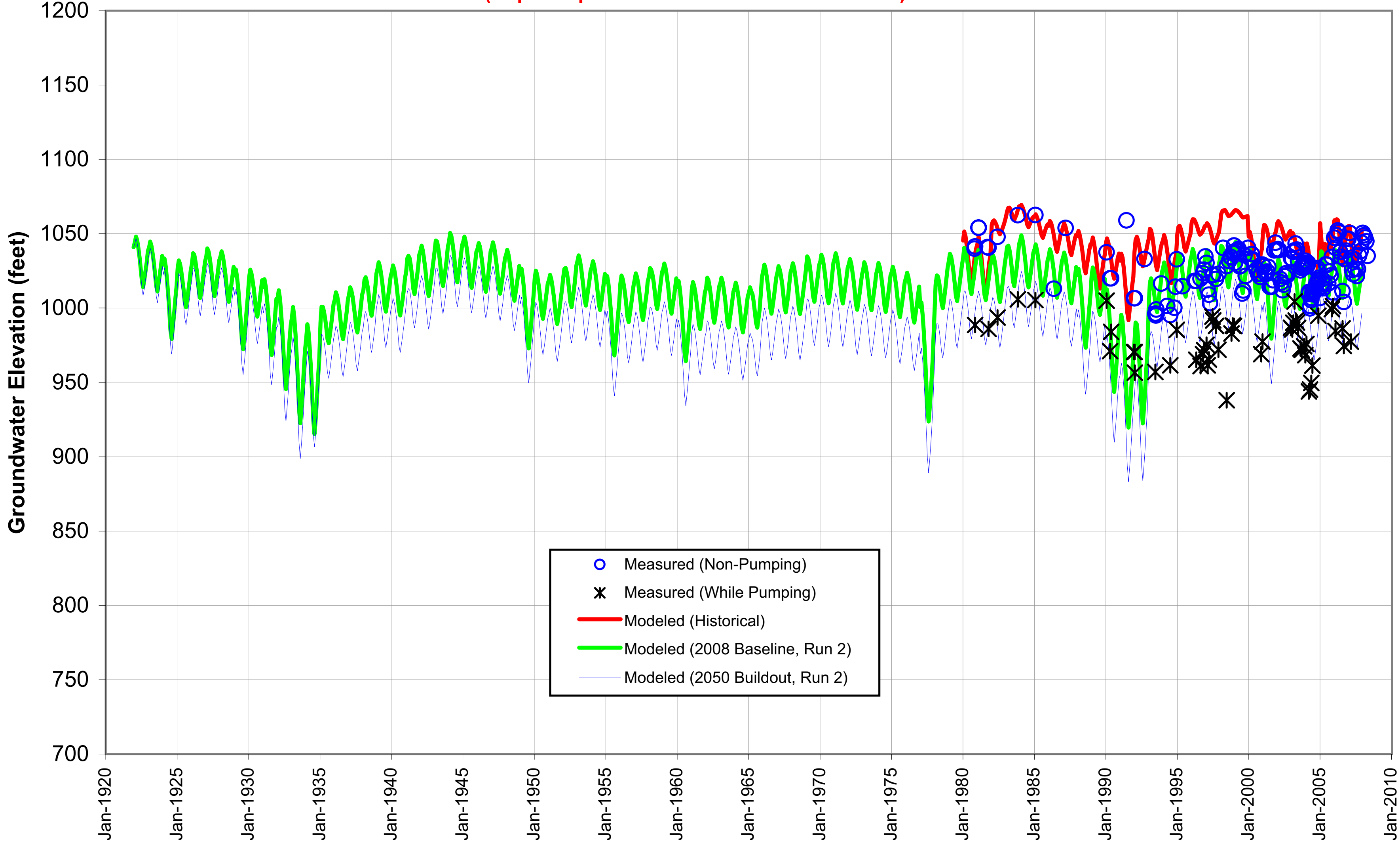
SCWD-Saugus1 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Saugus Formation)
(Top of Open Interval = Elevation 672 feet)
Groundwater Elevation (feet)
1200
1150
1100
1050
1000
950
900
850
800
750
700
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Baseline, Run 2)
Modeled (2050 Buildout, Run 2)

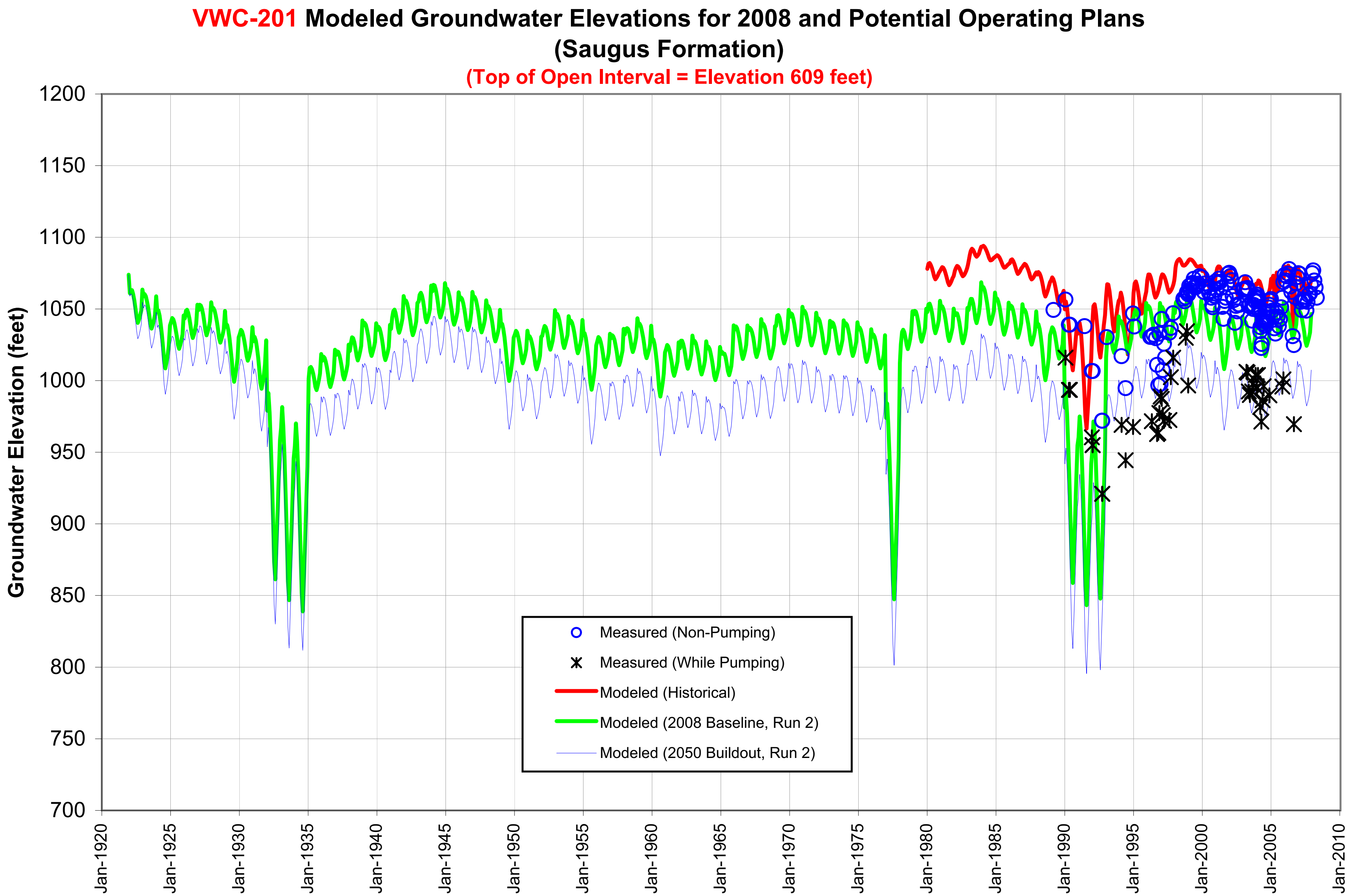


SCWD-Saugus2 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Saugus Formation)
(Top of Open Interval = Elevation 678 feet)
Groundwater Elevation (feet)
1200
1150
1100
1050
1000
950
900
850
800
750
700
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Baseline, Run 2)
Modeled (2050 Buildout, Run 2)

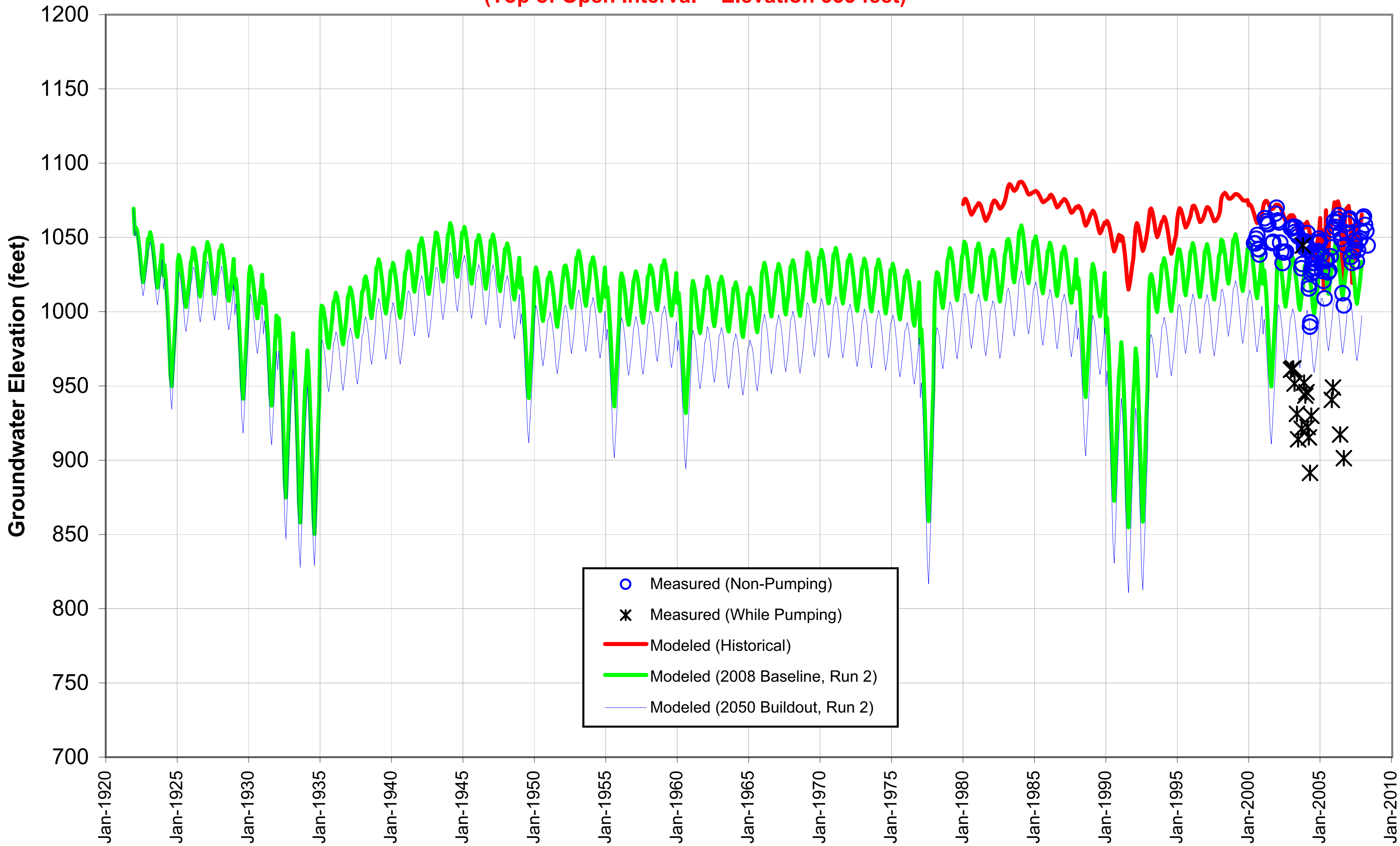

VWC-159 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Saugus Formation)
(Top of Open Interval = Elevation 635 feet)
Groundwater Elevation (feet)
1200
1150
1100
1050
1000
950
900
850
800
750
700
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Baseline, Run 2)
Modeled (2050 Buildout, Run 2)

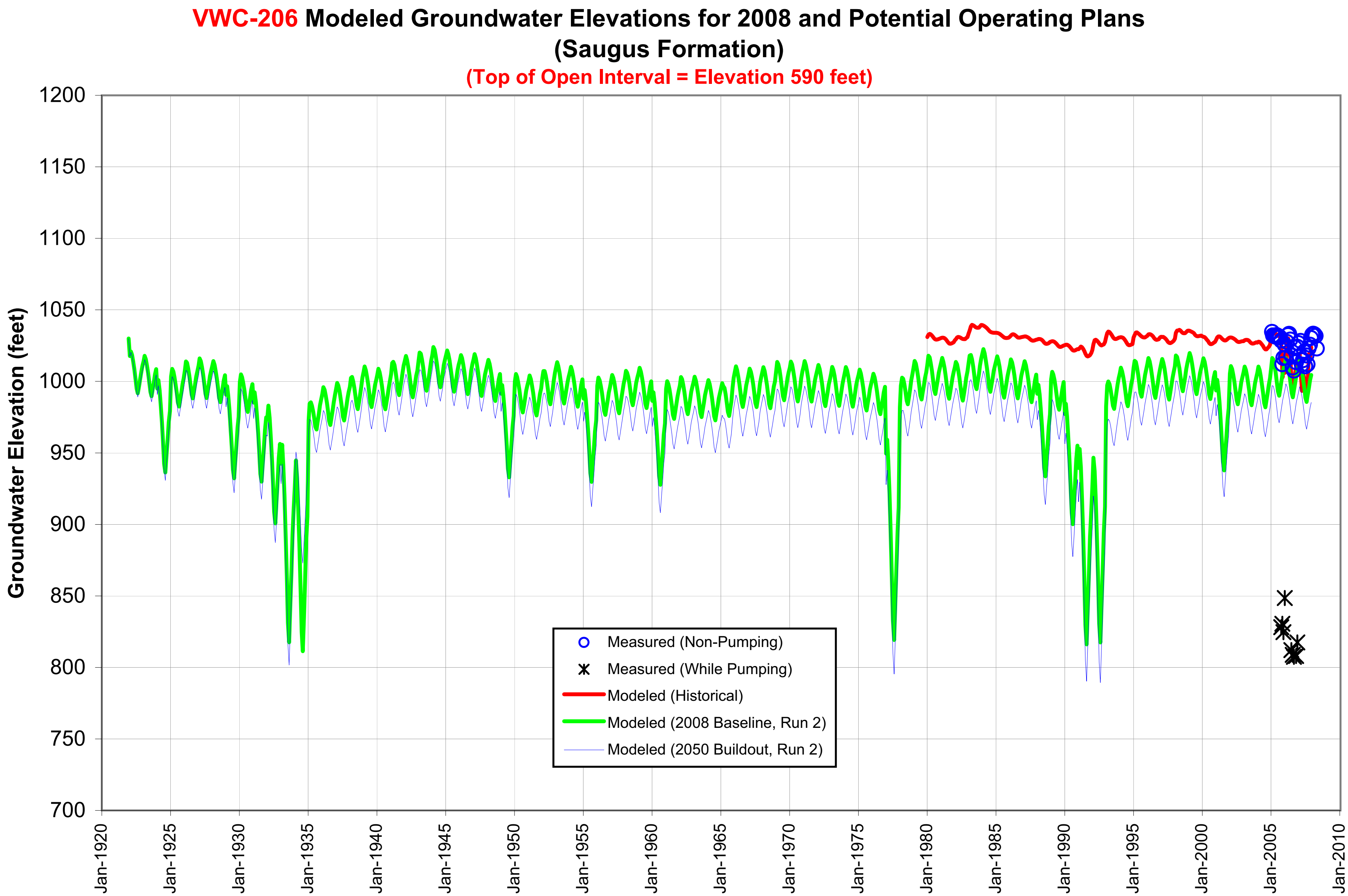
VWC-160 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Saugus Formation)
(Top of Open Interval = Elevation 152 feet)

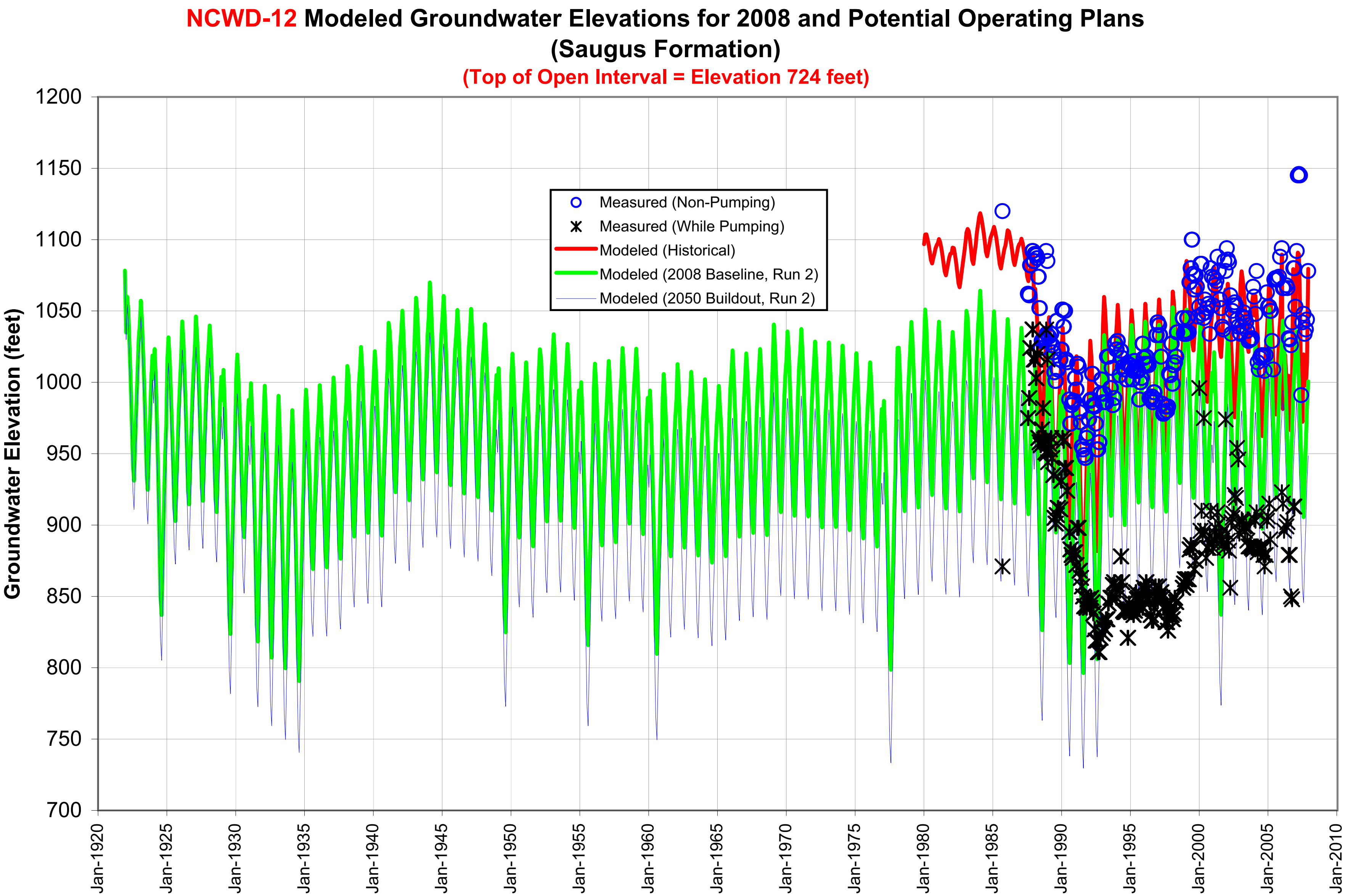



VWC-201 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Saugus Formation)
(Top of Open Interval = Elevation 609 feet)
Groundwater Elevation (feet)
1200
1150
1100
1050
1000
950
900
850
800
750
700
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Baseline, Run 2)
Modeled (2050 Buildout, Run 2)

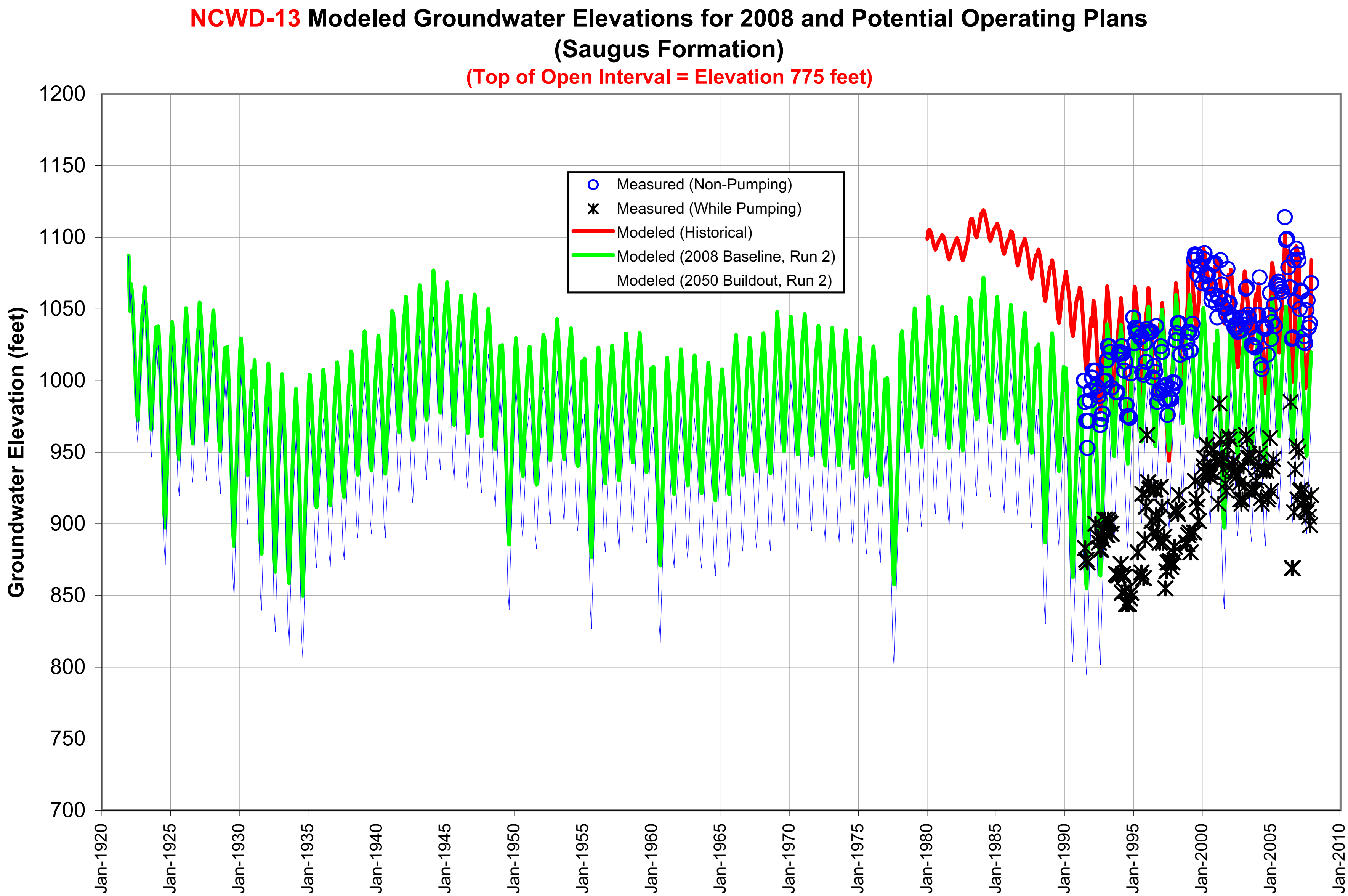
VWC-205 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Saugus Formation)
(Top of Open Interval = Elevation 333 feet)




VWC-206 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Saugus Formation)
(Top of Open Interval = Elevation 590 feet)
Groundwater Elevation (feet)
1200
1150
1100
1050
1000
950
900
850
800
750
700
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Baseline, Run 2)
Modeled (2050 Buildout, Run 2)



NCWD-12 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Saugus Formation)
(Top of Open Interval = Elevation 724 feet)
Groundwater Elevation (feet)
1200
1150
1100
1050
1000
950
900
850
800
750
700
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Baseline, Run 2)
Modeled (2050 Buildout, Run 2)



NCWD-13 Modeled Groundwater Elevations for 2008 and Potential Operating Plans
(Saugus Formation)
(Top of Open Interval = Elevation 775 feet)
Measured (Non-Pumping)
Measured (While Pumping)
Modeled (Historical)
Modeled (2008 Baseline, Run 2)
Modeled (2050 Buildout, Run 2)
Groundwater Elevation (feet)
1200
1150
1100
1050
1000
950
900
850
800
750
700
Jan-1920
Jan-1925
Jan-1930
Jan-1935
Jan-1940
Jan-1945
Jan-1950
Jan-1955
Jan-1960
Jan-1965
Jan-1970
Jan-1975
Jan-1980
Jan-1985
Jan-1990
Jan-1995
Jan-2000
Jan-2005
Jan-2010

Appendi

limate hange Literature Review and odel Simulations

Appendix D: Literature Review and Translation into Numerical Groundwater Model

This appendix presents an overview of the current understanding regarding potential climate change in southern California, as described in the professional literature. This is followed by a description of the technical approach that was used to simulate potential climate change effects on the local groundwater system in the Santa Clarita Valley, including selecting which rainfall projections to simulate from a large group of global climate models that have been made available to the general public. The appendix concludes with a description of how the rainfall projections were translated into monthly recharge terms for use in the numerical groundwater flow model.

D.1 Overview of Climate Change

As discussed by Anderson (2009), there are many sources of information on climate change. Information is available from scientific groups and public agencies at the international, national, regional, and state levels. A variety of publications are available that discuss not only the science of climate change, but also how the science can be used to evaluate climate impacts on natural resources and how to develop mitigation and adaptation strategies. At this time, the body of scientific knowledge that most directly pertains to understanding climate change in southern California is rooted in internationally-developed global-scale climate models and translations of those models by national and state researchers to better reflect local-scale climatic and watershed conditions in California. Section D.1.1 describes the global-scale climate models and the general interpretations that have been recently drawn from these models by the scientific community, as described in the professional literature. Section D.1.2 describes the translation of the global-scale rainfall projections to the local watershed scale.

D.1.1 Global Projections of Future Climate Conditions

Considerable research and predictive modeling work have been performed by climatologists and other scientists to understand the nature of the historical climate record, prehistoric climate, and future climate changes on a global scale. The largest body of this global-scale research and modeling work has been conducted under the auspices of the Intergovernmental Panel on Climate Change (IPCC), which has published four comprehensive assessment reports since 1990, with the most recent reports issued in 2007 (IPCC, 2007a and 2007b). The IPCC is a panel of international scientists that releases assessment reports every five years; these reports update the IPCC members' collective projections of climate change and perceived impacts.

Hundreds of simulations of past and future climate have been prepared by multiple climate modeling groups to support the work of the IPCC. Coordination of these modeling activities has been performed by the World Climate Research Programme's (WCRP's) Working Group on Coupled Modeling (Meehl et al., 2007). The WCRP's study containing the ensemble of simulations is called the Climate Model Intercomparison Project 3 (CMIP3), and the multi-model dataset of simulation results from this study is housed at Lawrence Livermore National Laboratory (LLNL).

The various GCMs that have been developed by the research community and incorporated into the IPCC assessments vary in terms of their design and the ways in which they simulate and couple the four major components of the climate system (atmosphere, ocean, land surface, and sea ice) that govern the time trends and spatial distributions of temperature and rainfall on a global scale. Despite these differences, the GCMs generally agree that temperatures will continue to rise globally for the next several decades and that longer-term temperature trends will depend on the magnitude of future greenhouse gas emissions (IPCC, 2007a). The GCMs also predict that precipitation increases are very likely in high latitudes, while decreases are likely in most subtropical regions. However, there is less agreement among the GCMs regarding future precipitation changes, mainly because of uncertainties about the "feedbacks" that might amplify or lessen global warming (California Climate Change Center [CCCC], 2006a; Westerling and Bryant, 2008). For example, as heat-trapping emissions cause temperatures to rise, the atmosphere can hold more water vapor, which traps heat and raises temperatures further—a positive feedback. Clouds created by this water vapor could absorb and re-radiate outgoing infrared radiation from Earth's surface (another positive feedback) or reflect more incoming shortwave radiation from the sun before it reaches Earth's surface (a negative feedback). Because many of these processes and their feedbacks are not yet fully understood, they are represented somewhat differently in each GCM. A review of the GCMs by the California Climate Change Center concluded that there is no clear trend in total precipitation amounts over the 21st century, with most of the models showing little change in total precipitation, but a trend towards slightly greater winter precipitation and lower spring precipitation (CCCC, 2006b; California Climate Action Team, 2006).

In addition to simulating the physical processes and their inter-relationships in differing manners, the GCMs also incorporate different assumptions about future green-house gas emissions. In its Special Report on Emissions Scenarios (SRES) (IPCC, 2000) and its third assessment report (IPCC, 2001), the IPCC defined 40 scenarios that each are a variation of one of four major storylines. A group of scenarios that is based on a single storyline is known as a scenario family (Anderson, 2009). The CMIP3 dataset is based on three scenario families (A1b, A2, and B1), two of which (A2 and B1) are used by the California Department of Water Resources (DWR) for studies across California. The major characteristics of the A2 and B1 scenario families are as follows (IPCC, 2001; Anderson, 2009):

- The A2 scenario family envisions rapid growth of greenhouse-gas emissions throughout the 21st Century, arising from large population increases, economic coordination that occurs regionally rather than globally, and a strong degree of self-reliance by the world's nations. The A2 scenario family can be thought of as a "high-emissions" scenario family.

- The B1 scenario family envisions population stabilization and global economic coordination, with a stronger emphasis on environmental sustainability. Under this scenario, greenhouse gas emissions after about 2050 are lower than under the A2 scenario, but similar until then. The B1 scenario family can be thought of as a "lower-emissions" scenario family.

The GCMs therefore provide different results regarding the potential magnitude of future changes in rainfall and temperature in various parts of the world (including southern California). Consequently, no one GCM is sufficient by itself for use in conducting hydrologic analyses regionally or within a local watershed.

D.1.2 Local-Scale Projections of Future Climate Trends

The GCMs describe continental water fluxes and processes at very large scales and do not account for elevation-related differences in rainfall and recharge patterns that are important at the local scale (i.e., at the scale of DWR-designated hydrologic regions and individual watersheds). For example, the rectangular cells that comprise the spatial grids of the various GCMs are 137 to 186 miles long on a side (Cayan et al., 2008).

As a result, a significant body of research is ongoing to develop statistical and other methods that "down-scale" the GCMs to provide the detail and spatial resolution needed for water resources planning and management. Statistically-downscaled climate projections (consisting of both temperature and rainfall projections) are now available across California and the United States, as developed from several GCMs and emissions scenarios. A total of 112 downscaled climate projections derived from the WCRP's CMIP3 multimodel dataset have been developed by LLNL, Santa Clara University, and the U.S. Bureau of Reclamation (USBR) Technical Service Center, with support from the USBR Research and Development Office, the U.S. Department of Energy National Energy Technology Laboratory, and the Institute for Research on Climate Change and its Societal Impacts. These downscaled projections are stored and served at the LLNL Green Data Oasis, which is available on the Internet at the following web address: http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/dcpInterface.html#Welcome. The CMIP3 data sets were down-scaled using statistical techniques and local, physically-based hydrologic models to translate the GCM results to a finer spatial resolution. Locally, this procedure "distributed" the GCM predictions over the complex landscape of California and produced multiple projections of future climate trends that can be evaluated together to understand the potential sensitivity of local water resources to climate change.

Ten of the 112 climate projections were downloaded and studied for potential use in the Santa Clarita groundwater model. The ten projections that were studied are the same group of projections (models) that were evaluated by DWR in its most recent report on the reliability of State Water Project water deliveries (DWR, 2008). The ten projections are derived from three groups of GCMs: the "cm2_0" and "cm2_1" model groups developed by the National Oceanic and Atmospheric Administration's Geophysical Fluid Dynamics Laboratory (GFDL), and the "PCM1" (Parallel Climate Model) group of models developed by the National Center for Atmospheric Research (NCAR), a division of the University Corporation for Atmospheric Research (UCAR). The ten downloaded projections are comprised of the models and emissions scenarios shown in Table D-1.

Table D-1
Global Climate Models and Emissions Scenarios

Climate Model	Emissions Scenario	Projection Name	Projection Number
GFDL_cm2_0.1	A2	GFDL _cm2_0.1_sresA2	0
GFDL _cm2_0.1	B1	GFDL _cm2_0.1_sresB1	1
GFDL _cm2_1.1	A2	GFDL _cm2_1.1_sresA2	2
GFDL _cm2_1.1	B1	GFDL _cm2_1.1_sresB1	3
NCAR_pcm1.1	A2	NCAR _pcm1.1_sresA2	4
NCAR _pcm1.2	A2	NCAR _pcm1.2_sresA2	5
NCAR _pcm1.3	A2	NCAR _pcm1.3_sresA2	6
NCAR _pcm1.4	A2	NCAR _pcm1.4_sresA2	7
NCAR _pcm1.2	B1	NCAR _pcm1.2_sresB1	8
NCAR _pcm1.3	B1	NCAR _pcm1.3_sresB1	9

For each climate projection, the precipitation information consists of the average daily rate of precipitation for a given month, in units of millimeters per day. This average rate is provided 1) for each month during the period January 1950 through January 2099 and for point locations spaced 1/8 of a latitude / longitude degree apart from each other.

For the purposes of providing an input rainfall record to the groundwater model, the precipitation projections were processed as follows:

- The average precipitation rate for a given month was calculated for the location of the Newhall-Soledad rain gage by extrapolating between the four nearest locations where downscaled rainfall projections were available.

- The average precipitation rate at the Newhall-Soledad gage was then converted to a value of inches per month by multiplying the average daily rate by the number of days in the month, and also converting from millimeters to inches.

- The monthly rainfall at the Newhall-Soledad gage location was then multiplied by 1.1735 to create a corresponding synthetic rainfall record at the location of the NCWD rain gage. This conversion factor has been derived from a comparison of the records from the two rain gages during the period January 1979 through September 2003. The NCWD gage location is used by the Surface Water Routing Model (SWRM; see Appendix C of CH2M HILL, 2004) to extrapolate rainfall across the basin on a monthly basis and subsequently compute monthly recharge rates at all nodes in the model grid.

These procedures were applied to all ten rainfall projections to produce projections at the Newhall-Soledad and NCWD rain gages. These gage-specific projections were then studied as described below for the purposes of selecting a subset to use in the groundwater flow model.

D.2 Evaluation and Selection of Rainfall Projections to Simulate with the Groundwater Model

Three aspects of each rainfall projection were considered in evaluating whether the projection should be chosen for use in the groundwater model:

- The ability to replicate historical rainfall trends as measured at the Newhall-Soledad and Newhall County Water District (NCWD) rain gages
- The specific trends shown by the projection, and how these trends compares with the trends from other projections during the following time frames:
  - Long-term (through the entire 21st century)
  - The near-term (the next 20 to 25 years, which is planning horizon being used by the Purveyors as part of the Urban Water Management Plan process)
- Selecting projections that encompass both sets of climate models (GFDL and PCM1) and both sets of emissions scenarios (A2 and B1).

Projection number 2 was eliminated from further consideration at the beginning of the evaluation because its historic rainfall record since 1950 was significantly greater than measured at the Newhall-Soledad rain gage. Following is a discussion of the methods by which a subset of the remaining nine rainfall projections was selected for use in the Santa Clarita groundwater model.

D.2.1 Replication of Historical Rainfall Trends

Preference was given to models that could reasonably replicate general historical trends in rainfall, as defined by a 30-year moving average. The 30-year moving average is the year-by-year change in the value of the average rainfall during the prior 30 years. For example, the values of the 30-year moving average during the years 1980, 1981, and 1982 are equal to the average during 1951 through 1980, 1952 through 1981, and 1953 through 1982, respectively.

Figure D-1 shows the 30-year moving average rainfall at the Newhall-Soledad rain gage location for the period 1950 through 2007. The 30-year moving averages for the 9 downscaled rainfall projections are compared with the moving average calculated from the actual historical record at this gage. As shown in this plot, 1979 is the first year in which the 30-year moving average is shown for the 9 projections because the projections begin in 1950.

In 1979, the historical record shows that the moving average was returning back to near-normal, after more than 30 years of being below the 1931-2007 long-term average. Beginning in 1979, the historical record shows a gradual increase in the 30-year moving average, with declines during the 1984-1991 drought and the 1999-2004 drought. The 9 climate projections generally reflect this same trend, though three notable exceptions are projection 3, which declines markedly after 1996, unlike the historical record; and projections 4 and 7, which rise too steeply beginning in 1996.

Figure D-2 compares the 30-year moving averages for all 9 rainfall projections (left-hand plot) with the moving averages for the three projections (1, 6, and 9) that were selected for evaluation with the groundwater flow model (right-hand plot). The three selected projections reasonably replicate the drought of the late 1980s and the subsequent increase in rainfall, and in later years they deviate less from the historical moving average than most of the other projections. One other projection (number 8) also replicated the historical moving average well, but was not evaluated with the groundwater flow model because it has similar future trends as those from other selected projections, as discussed further in Section D.2.2 below.

D.2.2 Future Trends

The three projections that were chosen for use in the groundwater model were selected in part because they reflect a reasonable range of possible hydrologic conditions looking forward in time. The 9 projections predict a significant range of possible future rainfall conditions through the 21st century, ranging from notably wetter to notably drier, and including some projections that show very little long-term trend. Because the objective of the groundwater modeling analysis of the Purveyors’ 2008 operating plan is to study the sensitivity of groundwater resources to potential climate change, the selection process sought to identify one relatively wet run, one relatively dry run, and one projection showing little long-term change, while also eliminating runs that do not adequately simulate historical trends.

The future trends for the 9 rainfall projections were evaluated by examining two statistics for the 86-year groundwater model simulation period of 2010 through 2095. These statistics were the 30-year moving average and the cumulative departure from historical average rainfall.

Future Trends in the 30-Year Moving Average

For the 9 projections, Figure D-3 shows the 30-year moving average rainfall for the period 2010 through 2095. The figure shows all 9 projections on the left plot and the three selected projections on the right plot. As shown in the figure, the selected projections reasonably capture the range of conditions after 2070, and also reasonably capture the average and dry conditions indicated by other projections prior to that time.

Projections 4, 5, and 7 are generally wetter between 2025 and 2050; however, these three projections are not used because they do not reasonably replicate the historical moving average in recent years. Projections 0 and 3 are generally drier during the latter 21st century; however, they were not selected because projection 3 poorly replicates the moving average in recent years, and projection 0 has a shorter drought period than projection 1.

Future Trends in the Cumulative Departure Curves

For the 9 projections, Figure D-4 shows the cumulative departure from the 1931-2007 long-term average rainfall, for the period 2010 through 2095. The figure shows that the 9 projections exhibit a broad range in the cumulative departure over time, with an increase in the range of predicted values as time goes on. This increase with time arises in part from differences between the two emissions scenarios (A2 and B1) beginning in about the year 2030, as well as from the general increase in predictive uncertainty that exists in each climate model as it projects into the future the many physical processes that affect climate.

Projections 0, 1, 6, 8, and 9 reasonably capture the ranges over time in the cumulative departure curve, including the timing of predominantly dry versus predominantly wet periods. Projection 0 was eliminated because its cumulative departure curve was equal to or higher in value than projection 1 during much of the 21st century. Projection 6 was retained because of the cyclic nature of its fluctuation around the long-term average, and because it ends with a cumulative departure value close to zero, indicating very little long-term departure from the historical average. Projections 1 and 9 were retained because they are nearly mirror images of each other, in part because of their long periods of relatively dry conditions (projection 1) and relatively wet conditions (projection 9) during the latter part of the 21st century. Projection 8 was not used because it is very wet between 2010 and 2025, and then fluctuates much like projection 6 after 2025.

Tables D-2 through D-4 present the monthly and annual rainfall values for rainfall projections 1, 6, and 9 during the period 2010 through 2095. The rainfall values in these tables are for the NCWD rain gage location. Characteristics of all nine projections and the three selected rainfall projections are discussed below for the period 2010 through 2095.

D.2.3 Characteristics of the Rainfall Projections from 2010 through 2095

A key difference between the GFDL and PCM1 models is the degree to which future greenhouse gas emissions change future temperature trends. The GFDL group of models has high temperature sensitivity to future emissions, while future emissions result in less change in simulated temperatures in the case of the PCM1 model group. Figure D-5 compares the 30-year moving averages for the GFDL model projections against those for the PCM1 model projections during the period 2010 through 2095. Figure D-6 compares the cumulative departure curves for the GFDL and PCM1 model projections. Both figures show that the GFDL models have predominantly drying trends, whereas the PCM1 models show some fluctuation with a general trend towards conditions that are wetter than historically observed. On each plot, the different emissions scenarios create comparatively smaller differences in the projections, with the choice of the climate model being more significant.

This is further illustrated by the 30-year moving averages in Figure D-7 and the cumulative departure curves in Figure D-8. Both figures compare the projections from the two emissions scenarios rather than from the choice of the climate model. The moving-average curves for the A2 scenario are only modestly different from the curves for the B1 scenario prior to 2050. After

2050, the A2 moving-average curves fluctuate considerably in the case of the PCM1 models, the lone GFDL model shows considerable drying, and the B1 moving-average curves are quite variable. For the cumulative departure curves (Figure D-8), three of the A2 scenarios have increasing trends under the PCM1 model; a fourth A2 scenario has no long-term trend under the PCM1 model; and the fifth A2 scenario has a long-term decline under the GFDL model. The cumulative departure curves for the B1 scenario also have two sets of trends, with the differences being related to the choice of the climate model.

D.3 Derivation of Groundwater Recharge Terms from Individual Rainfall Projections

Infiltration of direct precipitation and stormwater flows is calculated using the approaches that are described in Sections 3.6.3 and 3.6.4 of this report and in Appendix C to the model development and calibration report (CH2M HILL, 2004). Table D-5 summarizes the annual rainfall and the annual infiltration rate at the NCWD rain gage, along with statistics for each projection.

Tables D-6 through D-8 show the streamflow values at the location of the Lang stream gage that were assigned for each year during the 2010-2095 simulation period. The choice of the annual streamflow was made by matching a given year's rainfall to a historical year's similar rainfall, with additional consideration to whether the future year lies in a period of generally dry, normal, or wet conditions under the climate projection being evaluated. The tables assign qualitative descriptors (dry, wet, near normal) to each year based on how the year's rainfall compares with the long-term median. A given year is considered dry or wet if annual rainfall is less than 85 percent of, or greater than 115 percent of, respectively, the 1950-2000 median rainfall of 17.10 in/yr at the NCWD gage. Flows recorded during the years 1980 through 2007 were used in selecting flows during most years in the 2010-2095 period.

A year-matching process was also used to select the amount of water released into Castaic Creek from Castaic Lagoon during a given year in the 2010-2095 simulation period. Tables D-9 through D-11 show the selections. Releases recorded during the years 1980 through 2007 were used in selecting flows during the 2010-2095 period.

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Table D-2
Rainfall at the NCWD Rain Gage for Climate Projection 1 (Climate Model GFDL_cm2_0.1_sresB1)

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2010	1.02	0.24	0.00	5.19	0.14	0.04	0.04	1.60	0.05	1.51	2.81	5.63	18.27
2011	3.81	5.31	1.63	0.67	0.03	0.13	0.03	0.01	0.20	0.14	5.62	1.60	19.17
2012	14.51	3.76	3.30	8.02	1.61	0.01	0.02	0.10	0.02	0.07	6.68	5.14	43.26
2013	8.27	8.67	0.11	1.44	0.18	0.10	0.01	0.01	0.01	0.23	1.20	0.40	20.63
2014	2.28	0.99	4.69	0.37	0.26	0.00	0.04	0.05	0.23	0.51	2.60	1.94	13.96
2015	3.85	4.72	0.47	0.16	0.11	0.04	0.05	0.04	0.42	0.31	0.50	0.58	11.24
2016	4.23	0.55	2.13	0.80	0.73	0.14	0.03	0.08	0.97	0.14	0.03	3.97	13.80
2017	12.77	0.23	1.48	0.04	0.06	0.15	0.09	0.01	0.06	0.80	4.94	2.18	22.80
2018	5.97	4.30	1.81	0.36	0.13	0.01	0.03	0.06	0.14	0.67	1.73	0.16	15.37
2019	14.01	1.68	5.30	0.11	0.07	0.02	0.01	0.10	0.02	0.00	1.88	0.52	23.75
2020	19.75	8.33	1.21	0.88	0.16	0.30	0.04	0.06	0.12	0.11	9.03	5.79	45.78
2021	22.06	3.03	3.33	5.02	0.56	0.01	0.01	0.01	0.97	0.00	1.56	1.96	38.53
2022	20.85	6.14	2.92	1.59	0.16	0.01	0.02	0.07	0.04	0.02	4.71	6.70	43.23
2023	4.10	10.00	2.48	5.01	0.10	0.25	0.24	0.26	0.04	1.34	0.16	1.39	25.37
2024	16.49	1.38	0.79	0.25	0.24	0.57	0.07	0.06	0.05	2.22	0.05	1.98	24.15
2025	3.83	0.27	1.43	2.24	0.10	0.21	0.03	0.26	0.01	0.91	0.29	0.07	9.65
2026	7.83	0.82	5.13	0.61	0.00	0.01	0.03	0.08	0.10	0.32	2.03	3.40	20.35
2027	1.45	3.38	6.63	0.45	0.21	0.56	0.03	0.03	0.58	0.22	0.66	0.92	15.10
2028	6.37	2.41	0.00	1.62	0.08	0.04	0.09	1.65	0.08	0.47	0.64	3.92	17.37
2029	3.17	8.47	5.65	0.04	0.46	0.15	0.15	0.11	0.01	0.06	3.97	0.13	22.37
2030	0.27	4.71	1.18	4.10	0.03	0.01	0.01	0.05	0.04	0.38	0.03	3.97	14.77
2031	5.03	4.30	0.00	0.40	0.12	0.00	0.01	0.03	0.06	0.69	3.27	0.65	14.56
2032	1.16	1.57	5.03	0.07	0.32	0.01	0.03	0.06	0.24	0.14	0.36	0.18	9.17
2033	21.68	1.49	1.51	0.27	0.23	0.06	0.01	1.68	2.14	0.44	0.02	1.71	31.25
2034	2.95	3.57	10.66	1.57	0.06	0.01	0.02	0.02	0.02	0.25	6.80	5.86	31.80
2035	2.35	0.60	0.12	2.53	2.35	0.00	0.03	0.03	0.43	0.01	1.26	0.65	10.36
2036	9.64	0.37	0.36	0.34	0.57	0.03	0.07	0.01	0.12	0.55	0.03	0.91	12.98
2037	4.24	1.14	2.42	0.64	0.31	0.01	0.12	0.09	0.04	0.03	3.03	1.43	13.51
2038	2.12	8.71	10.50	4.02	0.39	0.21	0.01	1.69	0.02	0.00	0.07	0.81	28.59
2039	11.85	0.47	1.05	0.86	0.08	0.03	0.03	0.01	0.46	0.01	0.47	1.31	16.63
2040	3.24	3.74	1.92	0.44	0.11	0.03	0.05	0.04	0.53	0.20	0.58	1.95	12.83
2041	5.28	10.49	0.08	0.08	0.33	0.14	0.03	0.04	0.01	0.78	2.86	0.57	20.67
2042	2.17	6.70	0.37	0.36	3.36	0.00	0.03	0.03	0.46	0.22	2.64	0.06	16.41
2043	1.86	0.61	0.55	1.04	0.33	0.00	0.01	0.06	3.25	1.09	0.03	0.55	9.38
2044	5.43	8.19	5.85	0.72	0.15	0.00	0.02	0.17	0.05	0.15	3.32	0.61	24.67
2045	15.45	7.04	2.88	0.10	2.39	0.05	0.01	0.05	0.25	0.20	0.10	0.73	29.24
2046	4.62	0.74	4.22	1.72	0.79	0.32	0.01	0.01	0.05	0.08	0.03	5.32	17.91
2047	0.12	5.84	1.51	0.50	0.00	0.01	0.15	0.14	0.34	0.24	0.45	1.17	10.47
2048	4.61	7.72	0.18	1.13	0.30	0.01	0.12	0.37	0.03	0.00	0.09	1.42	15.97
2049	0.70	7.99	5.23	0.57	0.10	0.03	0.03	0.87	0.08	0.16	0.00	3.94	19.69
2050	16.22	4.34	0.07	0.33	0.00	0.02	0.30	0.01	0.14	0.14	1.33	4.93	27.84
2051	5.48	3.71	1.61	0.12	0.19	0.01	0.01	0.01	0.01	0.07	0.03	0.94	12.19
2052	3.62	2.30	1.51	2.13	0.57	0.01	0.35	0.01	0.01	0.56	0.54	8.46	20.08
2053	3.27	1.58	0.90	0.03	0.00	0.01	0.01	0.09	0.07	0.00	2.58	5.48	14.02
2054	3.97	20.03	4.74	3.59	0.07	0.07	0.01	0.01	0.37	0.23	0.78	0.04	33.91
2055	2.26	7.98	0.00	1.09	0.16	0.01	0.15	0.03	0.04	0.32	7.78	0.13	19.94
2056	5.06	1.17	3.36	0.10	0.00	0.00	0.01	0.03	0.01	0.39	2.08	2.10	14.32
2057	4.12	2.86	1.02	0.87	0.12	0.01	0.01	0.03	0.13	0.20	0.87	3.77	14.01
2058	7.76	11.05	1.89	4.10	0.20	0.04	0.04	0.01	0.02	0.01	2.89	0.83	28.83
2059	3.51	3.17	3.69	1.48	0.09	0.01	0.01	0.02	0.09	0.13	18.52	4.38	35.10
2060	1.82	1.06	1.32	2.40	0.09	0.08	0.03	0.01	0.13	0.31	1.64	2.11	11.01
2061	4.33	1.19	0.00	1.75	0.11	0.01	0.06	0.19	0.28	0.48	0.14	0.86	9.40
2062	9.70	1.40	4.20	0.16	0.11	0.01	0.11	1.99	0.04	0.44	1.94	0.23	20.34
2063	5.61	3.79	0.47	0.04	0.07	0.03	0.11	0.07	0.03	0.00	0.03	0.42	10.66
2064	1.94	3.93	1.54	0.03	0.16	0.10	0.07	0.05	0.11	0.14	0.30	1.26	9.63
2065	1.72	3.26	0.00	0.08	0.11	0.01	0.01	0.03	0.04	0.22	7.09	5.37	17.94
2066	1.82	5.43	2.57	1.78	0.13	0.04	0.09	0.03	4.54	0.31	0.03	1.31	18.07
2067	4.06	0.26	1.74	1.52	0.41	0.01	0.24	0.09	0.01	0.68	4.00	0.67	13.68
2068	2.69	0.06	1.51	0.09	0.54	0.04	0.22	0.18	0.03	0.13	0.03	1.58	7.10
2069	3.53	2.49	5.84	2.78	0.16	0.01	0.23	0.03	0.03	0.21	0.40	5.26	20.97
2070	4.24	0.71	1.00	1.38	0.16	0.12	0.32	0.04	0.09	0.00	0.00	6.43	14.49
2071	5.61	0.94	0.14	0.06	0.04	0.06	0.01	0.03	0.04	0.03	7.29	3.63	17.87
2072	9.87	5.32	1.93	0.28	0.28	0.03	0.13	0.05	0.06	0.58	0.00	1.74	20.27
2073	0.61	0.28	0.50	3.11	0.11	0.01	0.24	0.03	0.11	1.55	0.94	3.54	11.02
2074	1.58	15.49	0.82	1.02	0.92	0.01	0.29	0.16	1.91	1.01	0.06	0.45	23.74
2075	1.41	4.36	1.90	1.20	0.24	0.01	0.24	0.03	0.30	0.34	5.45	5.51	20.98
2076	2.22	3.03	1.19	0.03	0.00	0.01	0.04	0.03	0.04	0.00	2.15	0.04	8.79
2077	5.76	0.24	2.89	0.56	0.89	0.38	0.38	0.05	0.04	0.00	0.42	0.94	12.56
2078	7.75	9.19	3.75	0.18	0.00	0.01	0.03	0.05	0.01	0.03	0.05	0.55	21.59
2079	1.93	7.18	1.05	8.15	0.32	0.02	0.02	0.06	0.69	0.04	4.42	6.34	30.22
2080	3.37	0.54	3.89	0.22	0.41	0.01	0.01	0.04	0.04	0.03	3.90	0.07	12.53
2081	4.02	1.14	0.16	3.35	0.26	0.01	0.03	1.24	0.01	0.31	6.02	5.11	21.67
2082	8.44	1.18	0.85	4.10	0.24	0.03	0.29	0.05	0.01	1.10	0.09	1.58	17.97
2083	21.23	8.21	1.50	0.04	0.16	0.04	0.06	0.06	0.09	0.06	1.03	3.66	36.13
2084	20.54	2.66	5.35	0.28	0.94	0.02	0.06	0.02	0.05	0.01	0.09	2.21	32.25
2085	6.92	8.61	2.11	0.04	0.25	0.03	0.09	0.18	0.03	0.04	0.09	0.13	18.51
2086	5.74	8.19	0.00	0.10	0.09	0.06	0.24	0.14	0.04	0.06	0.67	5.45	20.78
2087	1.81	6.93	11.68	3.00	0.58	0.15	0.14	0.01	0.01	0.14	6.37	0.16	30.97
2088	3.38	0.72	1.30	0.51	0.14	0.03	0.04	0.01	0.04	0.17	1.08	1.03	8.45
2089	7.33	11.99	6.61	1.15	0.18	0.13	0.01	0.04	0.67	0.20	4.33	0.13	32.79
2090	18.27	1.68	0.69	0.20	0.48	0.16	0.15	0.11	0.10	0.04	7.49	5.14	34.48
2091	8.54	0.36	5.98	0.42	1.09	0.00	0.05	0.03	0.01	0.28	1.30	0.44	18.49
2092	3.02	2.52	0.00	0.09	0.09	0.01	0.03	0.07	0.06	0.04	0.52	1.15	7.60
2093	1.36	7.18	2.06	3.42	0.60	0.01	0.21	0.04	0.01	0.05	0.04	6.58	21.56
2094	1.96	4.44	0.67	3.70	0.00	0.01	0.03	0.01	0.03	0.01	1.11	5.03	16.99
2095	4.52	10.19	2.62	0.16	0.00	0.01	0.10	0.11	0.05	1.42	2.08	0.28	21.56

Table D-3
Rainfall at the NCWD Rain Gage for Climate Projection 6 (Climate Model NCAR_PCM1.3_sresA2)

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2010	1.90	7.48	2.03	0.35	0.14	0.01	0.09	0.17	0.45	0.31	0.03	4.27	17.22
2011	0.70	3.21	1.40	1.74	0.46	0.03	0.01	0.05	0.08	2.48	0.83	2.37	13.37
2012	4.29	1.89	1.70	3.02	0.51	0.00	0.03	0.01	0.53	0.27	1.57	2.31	16.14
2013	3.90	0.10	8.40	0.06	0.08	0.01	0.01	0.00	0.05	0.00	1.63	2.28	16.53
2014	9.63	2.56	2.13	0.08	0.54	0.00	0.01	0.00	0.06	0.19	0.03	0.09	15.33
2015	4.23	14.01	11.36	0.83	0.28	0.17	0.04	0.13	0.44	0.47	3.39	5.57	40.92
2016	1.21	0.96	6.13	1.32	0.34	0.01	0.01	0.16	0.01	0.55	3.82	5.70	20.24
2017	1.77	0.56	2.73	1.82	0.39	0.03	0.09	0.11	0.01	0.06	2.74	9.18	19.50
2018	1.72	2.42	3.35	1.70	0.14	0.42	0.01	0.08	0.09	0.65	0.03	0.07	10.68
2019	3.76	1.86	0.80	0.49	0.01	0.04	0.03	0.01	0.23	0.05	3.71	4.14	15.15
2020	2.51	2.12	11.63	0.96	0.02	0.11	0.01	0.01	0.29	0.10	0.55	6.27	24.58
2021	5.64	3.40	0.91	1.23	0.48	0.01	0.05	0.05	0.06	0.27	2.99	1.28	16.38
2022	3.95	1.16	5.01	7.30	0.30	0.01	0.03	0.01	0.99	0.18	0.04	3.67	22.64
2023	5.58	2.54	1.43	2.43	0.11	0.01	0.03	0.01	0.00	0.05	2.83	6.27	21.29
2024	2.49	5.40	2.85	1.95	0.39	0.01	0.01	0.00	0.09	0.03	0.07	0.07	13.37
2025	3.92	1.58	0.66	2.95	2.95	0.00	0.03	0.01	0.13	1.24	0.05	6.00	19.50
2026	0.08	0.12	3.83	2.38	0.52	0.16	0.03	1.02	1.46	0.12	0.07	2.27	12.05
2027	1.39	3.01	0.04	5.01	0.49	0.01	0.01	0.01	0.05	2.49	3.94	2.43	18.89
2028	1.56	0.36	3.88	1.48	0.09	0.17	0.20	0.05	1.20	0.84	1.46	0.25	11.56
2029	1.18	0.10	1.46	2.41	0.11	0.03	0.01	0.06	0.01	0.35	2.37	0.37	8.46
2030	0.37	3.53	1.66	2.08	0.00	0.01	0.01	0.01	0.01	0.05	3.26	5.40	16.41
2031	9.45	0.00	0.77	3.53	0.33	0.03	0.01	0.01	0.01	0.05	3.54	1.71	19.44
2032	2.15	0.44	2.30	0.60	1.51	0.00	0.08	0.01	0.50	0.41	5.97	4.71	18.66
2033	0.94	1.86	4.07	2.47	0.18	0.02	0.02	0.05	0.70	0.55	8.64	10.77	30.29
2034	27.62	4.64	5.27	0.25	2.74	0.02	0.02	0.07	0.06	0.66	1.44	0.06	42.86
2035	5.46	2.07	3.89	1.48	0.01	0.01	0.00	0.01	0.00	0.72	2.57	0.18	16.39
2036	1.82	2.08	5.39	0.19	0.05	0.00	0.13	0.09	1.30	0.60	4.78	1.31	17.74
2037	20.93	15.49	5.35	1.35	0.01	0.01	0.02	0.16	0.72	1.12	0.36	4.50	50.04
2038	5.03	7.98	3.02	5.56	0.23	0.10	0.12	0.01	0.13	0.72	3.43	9.15	35.50
2039	10.55	4.50	6.82	1.33	1.02	0.02	0.04	0.17	0.10	0.04	5.70	9.69	39.98
2040	21.21	2.23	2.42	0.20	0.06	0.01	0.25	0.01	0.38	0.05	1.96	0.05	28.83
2041	3.59	1.07	1.39	4.80	0.94	0.02	0.01	0.05	0.01	0.00	5.89	5.39	23.15
2042	1.94	3.79	12.20	0.74	1.80	0.08	0.05	0.01	0.11	0.01	0.03	1.80	22.57
2043	4.08	2.66	4.16	0.25	0.38	0.04	0.05	0.01	0.03	0.43	2.47	7.66	22.20
2044	0.87	3.16	1.18	0.03	1.03	0.01	0.01	0.00	0.17	0.10	1.88	7.81	16.25
2045	5.12	19.52	4.34	1.21	0.53	0.01	0.01	0.04	0.73	0.44	0.57	2.35	34.88
2046	1.36	7.80	2.53	6.44	0.29	0.01	0.01	0.05	0.69	0.40	0.16	1.06	20.82
2047	0.14	1.78	2.58	0.94	0.03	0.30	0.03	0.01	0.21	1.08	0.66	6.60	14.35
2048	6.43	0.61	2.87	0.21	0.05	0.03	0.01	0.01	0.13	1.18	0.03	0.49	12.06
2049	0.60	2.14	4.34	2.64	0.03	0.01	0.04	0.01	0.09	0.20	0.80	1.26	12.16
2050	1.92	1.46	2.05	1.26	0.08	0.01	0.01	0.01	0.13	2.09	2.28	0.07	11.37
2051	5.48	0.00	4.19	3.54	2.02	0.01	0.02	0.01	0.90	0.81	4.30	7.17	28.47
2052	3.21	5.29	11.39	0.48	0.22	0.17	0.10	0.06	0.05	0.84	2.85	2.17	26.84
2053	10.08	2.25	1.70	2.26	0.62	0.50	0.05	0.01	0.02	1.70	0.51	5.89	25.59
2054	1.44	3.54	4.27	0.53	0.40	0.08	0.26	0.01	0.00	0.66	0.49	4.30	15.97
2055	1.51	0.70	6.96	0.26	0.08	0.23	0.01	0.05	0.93	0.01	4.26	6.26	21.26
2056	3.27	8.29	6.53	2.22	1.06	0.01	0.01	0.01	0.00	0.00	0.71	1.19	23.32
2057	2.70	4.20	0.00	4.77	0.13	0.01	0.14	0.09	1.09	0.26	0.03	0.13	13.55
2058	0.90	2.76	11.83	0.34	0.11	0.01	0.01	0.01	0.00	0.85	5.82	0.67	23.32
2059	1.72	6.54	2.84	0.39	0.95	0.17	0.01	0.04	0.01	0.16	0.03	0.17	13.04
2060	1.64	0.05	5.84	3.13	0.99	0.08	0.04	0.18	1.16	1.86	1.46	6.28	22.71
2061	4.63	0.60	1.81	0.42	0.15	0.01	0.01	0.01	0.49	0.01	1.65	0.34	10.15
2062	3.11	2.76	0.00	4.91	0.03	0.25	0.01	0.01	0.05	2.20	0.38	6.80	20.52
2063	20.93	19.73	11.93	7.41	2.12	0.07	0.12	0.01	0.20	0.47	2.92	6.03	71.95
2064	16.07	1.65	6.48	2.29	0.62	0.00	0.01	0.04	0.05	0.06	0.02	6.31	33.61
2065	3.40	0.92	2.60	1.94	0.10	0.01	0.01	0.03	0.03	2.78	1.25	0.33	13.39
2066	3.85	3.41	3.62	0.32	0.43	0.05	0.17	0.16	0.45	2.95	1.75	8.78	25.96
2067	9.90	5.66	3.37	2.21	0.36	0.06	0.01	0.02	0.28	0.09	1.17	5.55	28.69
2068	3.62	1.51	9.16	0.67	0.10	0.08	0.01	0.52	0.10	0.71	1.64	0.09	18.22
2069	1.56	2.16	0.34	1.76	0.66	0.12	0.07	0.07	0.28	2.20	0.03	1.93	11.17
2070	1.35	3.54	4.51	0.66	0.45	0.01	0.01	0.06	0.46	0.36	0.20	6.64	18.25
2071	3.73	3.83	1.40	0.08	0.20	0.01	0.10	0.08	0.01	0.04	1.89	6.47	17.85
2072	0.22	8.44	2.13	0.62	0.77	0.01	0.06	0.01	0.03	0.43	4.43	2.15	19.30
2073	1.62	2.27	3.01	2.31	0.60	0.04	0.08	0.04	1.26	0.92	1.39	1.17	14.70
2074	2.07	1.47	0.81	1.12	1.95	0.01	0.01	0.01	0.34	1.23	0.45	0.34	9.82
2075	4.96	4.81	1.26	0.21	0.08	0.01	0.01	0.03	0.62	0.76	0.22	1.99	14.96
2076	2.32	0.48	11.04	1.19	0.02	0.20	0.06	0.30	1.60	1.08	5.32	6.23	29.84
2077	0.32	3.98	3.24	1.81	0.51	0.01	0.11	0.01	0.06	0.79	0.08	8.12	19.05
2078	18.45	7.63	0.79	5.00	1.00	0.01	0.04	0.04	0.01	0.50	3.49	8.74	45.70
2079	4.86	0.66	10.33	1.79	0.01	0.07	0.02	0.06	0.10	0.60	0.52	6.17	25.20
2080	3.69	8.28	1.56	2.30	0.28	0.00	0.01	0.01	0.01	1.17	5.86	7.94	31.12
2081	13.79	7.91	2.70	3.44	0.07	0.01	0.01	0.12	0.11	0.87	0.00	0.46	29.50
2082	5.39	4.46	11.39	2.09	0.04	0.20	0.02	0.07	0.00	0.77	0.33	2.82	27.59
2083	1.45	0.21	0.89	2.17	0.83	0.01	0.03	0.00	0.00	0.30	6.20	3.43	15.50
2084	1.12	2.74	0.08	0.21	0.01	0.07	0.01	0.00	0.00	0.07	2.36	2.06	8.74
2085	0.27	3.54	1.60	0.43	0.09	0.01	0.19	0.62	0.47	3.24	4.90	3.41	18.76
2086	1.42	1.34	0.66	2.34	0.01	0.01	0.01	0.01	0.25	2.21	2.96	1.84	13.07
2087	4.40	3.59	6.31	2.06	0.24	0.00	0.03	0.01	0.24	1.06	0.03	4.93	22.89
2088	18.69	6.22	10.37	4.90	0.07	0.01	0.02	0.00	0.00	0.62	0.65	8.50	50.06
2089	9.54	2.08	1.71	2.56	0.41	0.02	0.01	0.01	0.04	0.64	3.95	6.26	27.24
2090	0.79	3.90	4.94	1.76	0.13	0.03	0.03	0.01	0.00	0.63	0.03	0.28	12.53
2091	0.35	1.51	1.14	1.62	0.15	0.01	0.03	0.01	0.04	3.14	0.03	1.11	9.14
2092	4.64	1.19	1.13	0.74	0.09	0.01	0.01	0.01	0.01	2.17	0.03	0.76	10.81
2093	3.56	6.17	1.66	1.62	0.02	0.04	0.01	0.04	0.06	2.67	3.36	3.84	23.07
2094	2.53	0.70	2.21	0.07	0.32	0.01	0.05	0.05	0.01	2.81	2.23	1.92	12.91
2095	5.22	0.09	10.76	1.85	0.07	0.07	0.02	0.01	0.02	0.33	0.24	7.78	26.47

Table D-4
Rainfall at the NCWD Rain Gage for Climate Projection 9 (Climate Model NCAR_PCM1.3_sresB1)

Calendar Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2010	6.07	0.05	4.22	0.80	0.29	0.03	0.03	0.01	0.03	1.08	4.44	5.10	22.14
2011	5.29	8.37	4.35	0.61	1.28	0.10	0.03	0.01	0.01	0.25	7.44	0.89	28.62
2012	1.43	5.42	5.13	1.17	0.64	0.05	0.01	0.26	0.29	0.03	1.31	2.48	18.21
2013	2.49	1.66	6.94	3.40	2.02	0.01	0.12	0.03	0.83	0.08	0.36	0.48	18.42
2014	2.47	0.08	6.28	2.94	1.11	0.35	0.04	0.00	0.04	0.00	3.88	0.66	17.85
2015	8.79	1.87	6.24	1.75	0.61	0.01	0.03	0.05	0.00	0.05	0.28	2.66	22.34
2016	1.30	2.31	3.44	0.03	0.03	0.01	0.03	0.08	0.04	0.26	0.09	9.89	17.51
2017	0.33	2.61	4.03	1.79	0.17	0.13	0.01	0.09	0.03	0.04	0.46	6.52	16.21
2018	1.61	4.44	2.05	1.34	0.11	0.01	0.01	0.06	1.09	0.42	0.01	0.40	11.56
2019	0.76	8.00	1.23	0.03	0.11	0.01	0.11	0.01	0.15	1.23	0.01	0.18	11.83
2020	19.03	5.91	1.87	4.70	0.20	0.06	0.05	0.06	0.22	2.27	1.40	1.85	37.62
2021	1.23	4.92	4.95	2.18	1.25	0.01	0.01	0.08	0.67	0.00	0.81	0.43	16.56
2022	0.17	1.13	1.31	2.14	0.84	0.01	0.03	0.04	0.03	0.04	2.73	6.70	15.17
2023	10.76	1.72	4.75	0.71	4.21	0.01	0.03	0.08	0.01	0.55	0.03	0.04	22.88
2024	0.26	4.01	2.28	3.74	0.57	0.01	0.01	0.01	0.00	0.64	0.03	1.63	13.18
2025	4.55	3.60	4.91	1.07	0.10	0.66	0.01	0.04	0.06	0.18	2.94	2.22	20.34
2026	3.50	7.17	3.41	3.24	4.36	0.01	0.03	0.06	0.03	0.83	1.58	2.74	26.96
2027	15.21	1.48	2.39	1.76	0.04	0.06	0.01	0.01	0.03	0.26	3.48	1.73	26.47
2028	3.94	4.03	2.60	1.11	0.46	0.13	0.03	0.01	0.03	1.55	1.76	2.41	18.04
2029	9.66	0.94	0.60	1.82	0.13	0.04	0.01	0.01	0.16	0.69	2.28	1.70	18.04
2030	2.06	3.03	2.15	2.13	0.37	0.00	0.07	0.01	0.05	0.64	0.03	5.94	16.49
2031	9.56	4.04	0.64	2.36	0.03	0.01	0.03	0.05	1.59	1.40	0.03	2.79	22.51
2032	4.07	3.01	4.08	5.49	2.15	0.01	0.04	0.01	0.42	0.03	3.48	0.04	22.84
2033	1.12	0.00	6.69	2.96	0.31	0.01	0.04	0.01	0.01	0.55	2.42	0.89	15.01
2034	2.78	0.78	1.81	0.68	0.61	0.01	0.01	0.01	1.00	0.04	0.00	5.66	13.40
2035	7.99	1.62	1.81	2.24	0.05	0.03	0.01	0.01	0.01	0.53	2.49	1.92	18.72
2036	1.46	6.10	11.70	1.61	1.07	0.11	0.01	0.04	0.11	0.59	0.58	3.04	26.43
2037	0.26	2.91	4.98	0.39	1.66	0.01	0.03	0.00	0.07	0.01	0.71	0.07	11.11
2038	3.96	0.10	0.29	1.71	0.01	0.01	0.07	0.04	0.58	1.93	2.25	2.01	12.97
2039	15.61	2.23	10.67	2.49	3.27	0.01	0.01	0.05	0.59	0.17	4.33	2.03	41.47
2040	7.62	3.89	2.95	0.66	0.30	0.03	0.08	0.03	0.69	0.18	0.78	1.43	18.62
2041	3.06	4.95	11.29	7.18	5.58	0.05	0.02	0.21	0.01	1.15	4.59	1.56	39.65
2042	6.67	6.61	4.62	1.92	0.01	0.09	0.11	0.10	1.37	0.28	5.68	6.28	33.75
2043	32.82	13.24	2.78	0.48	0.22	0.02	0.23	0.02	0.56	2.94	0.16	4.08	57.56
2044	0.99	3.01	5.68	3.13	0.05	0.00	0.01	0.07	0.03	0.63	0.71	0.32	14.63
2045	2.37	0.45	0.87	0.03	0.61	0.08	0.01	0.03	0.70	0.26	1.65	8.57	15.63
2046	1.59	5.38	2.73	0.21	0.03	0.01	0.01	0.01	0.05	0.03	5.06	0.29	15.41
2047	3.17	0.64	10.50	1.05	0.81	0.03	0.06	0.62	0.13	0.04	0.64	6.96	24.66
2048	36.20	5.00	6.70	0.52	0.12	0.13	0.47	0.01	0.01	0.79	3.79	0.06	53.80
2049	1.75	3.32	1.21	0.35	0.45	0.04	0.07	0.01	0.01	0.05	1.63	5.81	14.70
2050	4.19	0.66	1.14	0.06	0.03	0.00	0.04	0.01	0.36	2.23	0.33	0.73	9.79
2051	12.33	9.58	7.50	2.58	1.60	0.04	0.10	0.02	0.12	0.01	2.45	2.15	38.49
2052	4.59	1.92	2.19	1.42	0.01	0.06	0.08	0.04	0.43	2.55	0.92	5.36	19.57
2053	3.84	5.38	5.02	1.00	2.39	0.03	0.01	0.08	0.08	0.50	0.03	2.32	20.65
2054	1.96	0.25	0.23	0.27	0.37	0.00	0.27	0.06	0.01	0.21	6.70	0.07	10.40
2055	1.42	0.25	1.17	0.26	0.11	0.10	0.05	0.10	0.03	0.64	2.61	5.85	12.58
2056	0.74	7.89	4.70	0.07	0.34	0.05	0.03	0.12	0.10	0.90	0.86	2.01	17.80
2057	9.00	0.11	1.77	1.88	0.08	0.03	0.03	0.04	0.03	1.65	0.89	0.07	15.56
2058	16.00	5.04	9.99	2.12	0.16	0.01	0.07	0.02	0.01	1.82	0.17	9.76	45.18
2059	3.82	0.43	4.27	7.57	2.88	0.01	0.49	0.01	0.00	0.01	0.45	6.83	26.78
2060	3.85	3.55	1.93	2.15	2.26	0.03	0.01	0.01	1.43	0.72	1.43	6.40	23.78
2061	10.98	12.11	8.01	6.62	1.86	0.12	0.18	0.09	0.26	0.18	1.90	5.30	47.61
2062	2.95	7.57	11.41	2.22	0.06	0.00	0.05	0.01	1.36	1.42	0.25	1.59	28.90
2063	6.19	6.50	10.23	2.54	0.41	0.00	0.02	0.01	1.00	0.09	0.09	3.35	30.43
2064	0.73	3.39	1.62	1.00	0.74	0.19	0.06	0.09	0.06	2.79	0.58	6.87	18.15
2065	4.41	6.07	11.50	0.02	0.47	0.01	0.05	0.07	0.66	2.29	2.58	1.99	30.15
2066	0.36	5.36	1.54	1.47	0.19	0.01	0.01	0.08	0.03	0.36	0.43	3.80	13.65
2067	4.91	1.04	0.09	2.50	0.33	0.01	0.03	0.01	0.04	1.26	4.68	1.43	16.34
2068	0.13	2.96	2.55	1.90	0.17	0.00	0.11	0.01	0.03	0.06	1.25	1.44	10.60
2069	28.56	14.60	4.93	0.62	0.21	0.44	0.05	0.01	0.37	1.69	3.73	5.35	60.56
2070	1.46	7.48	1.77	0.03	4.70	0.03	0.03	0.03	0.82	2.28	0.65	1.28	20.56
2071	4.27	1.75	3.82	0.09	1.86	0.01	0.01	0.09	0.05	0.61	0.00	2.74	15.31
2072	1.34	4.59	14.59	3.57	0.52	0.01	0.01	0.05	0.26	0.37	2.11	6.25	33.67
2073	21.59	4.60	11.72	1.89	0.17	0.05	0.21	0.02	0.12	2.01	3.53	0.43	46.34
2074	14.00	3.28	11.16	1.23	0.56	0.52	0.01	0.02	1.02	0.19	0.58	1.13	33.69
2075	0.57	5.21	4.82	1.16	0.17	0.08	0.07	0.03	0.01	0.01	2.75	0.83	15.71
2076	1.15	1.93	1.82	3.65	0.32	0.05	0.15	0.04	0.49	0.59	2.92	1.26	14.36
2077	0.60	0.72	1.60	3.93	0.09	0.01	0.01	0.06	0.59	0.45	11.69	1.50	21.25
2078	6.34	8.02	11.16	4.37	0.17	0.05	0.01	0.05	0.63	0.01	0.70	5.62	37.14
2079	12.11	3.09	0.00	7.51	0.12	0.01	0.01	0.12	0.72	0.45	0.58	7.13	31.87
2080	2.17	2.75	0.69	0.09	0.25	0.13	0.04	0.01	0.04	0.03	0.03	1.89	8.14
2081	1.36	5.15	8.17	1.77	0.13	0.01	0.03	0.08	0.01	0.79	3.87	3.85	25.22
2082	21.22	2.22	1.20	0.72	0.10	0.06	0.05	0.02	0.01	0.53	1.44	5.25	32.82
2083	1.66	7.37	4.15	5.06	1.30	0.01	0.03	0.03	0.64	2.10	4.21	1.69	28.25
2084	0.29	3.15	0.96	0.81	0.62	0.02	0.02	0.22	0.20	0.26	0.29	0.39	7.23
2085	7.94	0.00	1.58	0.04	0.31	0.29	0.01	0.10	0.12	0.56	0.07	0.35	11.37
2086	11.32	2.22	3.46	2.43	0.06	0.50	0.03	0.01	0.01	1.92	5.44	0.06	27.47
2087	1.83	4.38	2.15	2.36	0.01	0.15	0.01	0.01	0.41	0.06	1.82	7.76	20.97
2088	4.48	4.15	3.06	0.04	0.13	0.01	0.07	0.78	0.24	1.25	0.03	1.90	16.12
2089	22.38	13.98	12.94	4.38	1.15	0.40	0.08	0.01	0.52	0.70	2.80	5.36	64.70
2090	3.26	1.01	6.08	2.00	0.17	0.15	0.03	0.01	0.64	0.91	1.55	5.50	21.30
2091	1.37	2.07	3.06	0.26	0.36	0.10	0.01	0.01	0.03	0.08	0.31	4.72	12.38
2092	5.11	8.30	3.61	2.16	0.34	0.09	0.11	0.05	1.44	0.27	0.54	0.04	22.06
2093	4.76	3.15	1.89	2.67	1.94	0.22	0.10	0.06	0.03	0.00	0.03	4.47	19.32
2094	2.19	6.28	2.32	0.72	0.01	0.01	0.01	0.04	0.01	0.15	2.72	6.45	20.91
2095	4.28	5.07	2.77	0.08	0.32	0.09	0.03	0.12	1.37	1.70	3.78	1.46	21.05

Table D-5
Rate of Direct Infiltration from Precipitation at NCWD Rain Gage Location

Climate Change Projection #1 (GFDL_CM2_0.1_sresB1)		
Year	Rainfall (inches) NCWD Gage	Infiltration at NCWD Gage Location (inches)
2010	18.27	1.65
2011	19.17	2.23
2012	43.26	19.79
2013	20.63	3.18
2014	13.96	0
2015	11.24	0
2016	13.80	0
2017	22.80	4.64
2018	15.37	0
2019	23.75	5.29
2020	45.78	21.78
2021	38.53	16.12
2022	43.23	19.77
2023	25.37	6.42
2024	24.15	5.57
2025	9.65	0
2026	20.35	2.99
2027	15.10	0
2028	17.37	1.08
2029	22.37	4.34
2030	14.77	0
2031	14.56	0
2032	9.17	0
2033	31.25	10.65
2034	31.80	11.05
2035	10.36	0
2036	12.98	0
2037	13.51	0
2038	28.59	8.70
2039	16.63	0.62
2040	12.83	0
2041	20.67	3.20
2042	16.41	0.48
2043	9.38	0
2044	24.67	5.92
2045	29.24	9.18
2046	17.91	1.42
2047	10.47	0
2048	15.97	0.22
2049	19.69	2.56
2050	27.84	8.16
2051	12.19	0
2052	20.08	2.82
2053	14.02	0
2054	33.91	12.63
2055	19.94	2.72
2056	14.32	0

Climate Change Projection #6 (NCAR_PCM1.3_sresA2)		
Year	Rainfall (inches) NCWD Gage	Infiltration at NCWD Gage Location (inches)
2010	17.22	0.98
2011	13.37	0
2012	16.14	0.32
2013	16.53	0.56
2014	15.33	0
2015	40.92	17.97
2016	20.24	2.92
2017	19.50	2.44
2018	10.68	0
2019	15.15	0
2020	24.58	5.87
2021	16.38	0.47
2022	22.64	4.53
2023	21.29	3.62
2024	13.37	0.00
2025	19.50	2.44
2026	12.05	0
2027	18.89	2.05
2028	11.56	0
2029	8.46	0
2030	16.41	0.48
2031	19.44	2.40
2032	18.66	1.90
2033	30.29	9.94
2034	42.86	19.48
2035	16.39	0.48
2036	17.74	1.31
2037	50.04	25.17
2038	35.50	13.82
2039	39.98	17.24
2040	28.83	8.88
2041	23.15	4.88
2042	22.57	4.48
2043	22.20	4.23
2044	16.25	0.39
2045	34.88	13.35
2046	20.82	3.30
2047	14.35	0
2048	12.06	0
2049	12.16	0
2050	11.37	0
2051	28.47	8.62
2052	26.84	7.45
2053	25.59	6.57
2054	15.97	0.22
2055	21.26	3.60
2056	23.32	4.99

Climate Change Projection #9 (NCAR_PCM1.3_sresB1)		
Year	Rainfall (inches) NCWD Gage	Infiltration at NCWD Gage Location (inches)
2010	22.14	4.19
2011	28.62	8.73
2012	18.21	1.61
2013	18.42	1.75
2014	17.85	1.38
2015	22.34	4.33
2016	17.51	1.17
2017	16.21	0.36
2018	11.56	0
2019	11.83	0
2020	37.62	15.43
2021	16.56	0.58
2022	15.17	0
2023	22.88	4.69
2024	13.18	0
2025	20.34	2.99
2026	26.96	7.53
2027	26.47	7.19
2028	18.04	1.50
2029	18.04	1.50
2030	16.49	0.53
2031	22.51	4.44
2032	22.84	4.66
2033	15.01	0
2034	13.40	0
2035	18.72	1.93
2036	26.43	7.16
2037	11.11	0
2038	12.97	0
2039	41.47	18.40
2040	18.62	1.87
2041	39.65	16.99
2042	33.75	12.50
2043	57.56	31.25
2044	14.63	0
2045	15.63	0.01
2046	15.41	0
2047	24.66	5.92
2048	53.80	28.20
2049	14.70	0
2050	9.79	0
2051	38.49	16.10
2052	19.57	2.49
2053	20.65	3.20
2054	10.40	0
2055	12.58	0
2056	17.80	1.35

Table D-5
Rate of Direct Infiltration from Precipitation at NCWD Rain Gage Location

Climate Change Projection #1 (GFDL_CM2_0.1_sresB1)			Climate Change Projection #6 (NCAR_PCM1.3_sresA2)			Climate Change Projection #9 (NCAR_PCM1.3_sresB1)		
Year	Rainfall (inches) NCWD Gage	Infiltration at NCWD Gage Location (inches)	Year	Rainfall (inches) NCWD Gage	Infiltration at NCWD Gage Location (inches)	Year	Rainfall (inches) NCWD Gage	Infiltration at NCWD Gage Location (inches)
2057	14.01	0	2057	13.55	0	2057	15.56	0.00
2058	28.83	8.88	2058	23.32	4.99	2058	45.18	21.30
2059	35.10	13.52	2059	13.04	0	2059	26.78	7.41
2060	11.01	0	2060	22.71	4.57	2060	23.78	5.31
2061	9.40	0	2061	10.15	0	2061	47.61	23.23
2062	20.34	2.99	2062	20.52	3.11	2062	28.90	8.93
2063	10.66	0	2063	71.95	43.19	2063	30.43	10.04
2064	9.63	0	2064	33.61	12.40	2064	18.15	1.57
2065	17.94	1.44	2065	13.39	0	2065	30.15	9.84
2066	18.07	1.52	2066	25.96	6.83	2066	13.65	0
2067	13.68	0	2067	28.69	8.78	2067	16.34	0.44
2068	7.10	0	2068	18.22	1.62	2068	10.60	0
2069	20.97	3.41	2069	11.17	0	2069	60.56	33.72
2070	14.49	0	2070	18.25	1.63	2070	20.56	3.13
2071	17.87	1.40	2071	17.85	1.38	2071	15.31	0
2072	20.27	2.94	2072	19.30	2.31	2072	33.67	12.44
2073	11.02	0	2073	14.70	0	2073	46.34	22.22
2074	23.74	5.28	2074	9.82	0	2074	33.69	12.46
2075	20.98	3.41	2075	14.96	0	2075	15.71	0.06
2076	8.79	0	2076	29.84	9.61	2076	14.36	0
2077	12.56	0	2077	19.05	2.14	2077	21.25	3.59
2078	21.59	3.82	2078	45.70	21.71	2078	37.14	15.06
2079	30.22	9.89	2079	25.20	6.29	2079	31.87	11.11
2080	12.53	0	2080	31.12	10.55	2080	8.14	0
2081	21.67	3.88	2081	29.50	9.37	2081	25.22	6.31
2082	17.97	1.45	2082	27.59	7.99	2082	32.82	11.81
2083	36.13	14.30	2083	15.50	0	2083	28.25	8.46
2084	32.25	11.38	2084	8.74	0	2084	7.23	0
2085	18.51	1.80	2085	18.76	1.96	2085	11.37	0
2086	20.78	3.28	2086	13.07	0	2086	27.47	7.90
2087	30.97	10.44	2087	22.89	4.70	2087	20.97	3.41
2088	8.45	0	2088	50.06	25.18	2088	16.12	0.31
2089	32.79	11.78	2089	27.24	7.74	2089	64.70	37.13
2090	34.48	13.05	2090	12.53	0	2090	21.30	3.62
2091	18.49	1.79	2091	9.14	0	2091	12.38	0
2092	7.60	0	2092	10.81	0	2092	22.06	4.14
2093	21.56	3.80	2093	23.07	4.82	2093	19.32	2.32
2094	16.99	0.84	2094	12.91	0	2094	20.91	3.37
2095	21.56	3.80	2095	26.47	7.19	2095	21.05	3.46
Total	**1,718.30**	**335.27**	**Total**	**1,861.58**	**417.43**	**Total**	**2,015.51**	**516.04**
Min	**7.10**	**0**	**Min**	**8.46**	**0**	**Min**	**7.23**	**0**
Max	**45.78**	**21.78**	**Max**	**71.95**	**43.19**	**Max**	**64.70**	**37.13**
Average	**19.98**	**3.90**	**Average**	**21.65**	**4.85**	**Average**	**23.44**	**6.00**

For the period 1922 through 1978, rainfall at the NCWD gage is calculated from the formula NCWD = 1.1735 * Newhall-Soledad gage rainfall.
This relationship is based on a regression analysis for the period 1979-2000.
Annual Infiltration = Annual Rainfall - (5.2 * [Annual Rainfall ^ 0.4])

Table D-6
Lang Gage Streamflows (AF) for Historical Record and Climate Change Projection #1 (GFDL_CM2_0.1_sresB1)

Historical Conditions						Climate Change Projection #1					
Cal. Year	**Rainfall (inches) NCWD Gage**	**Local Year Type**	**Lang Gage Streamflows (AF)**	**Prototype Year for Lang Gage**	**Prototype Year for Riverbed Leakage**	**Year**	**Rainfall (inches) NCWD Gage**	**Local Year Type**	**Lang Gage Streamflows (AF)**	**Prototype Year for Lang Gage**	**Prototype Year for Riverbed Leakage**
1922	37.55	**Wet**	4,115	1922	1992	2010	18.27	Near Normal	2,744	1986	1986
1923	16.43	Near Normal	1,116	1923	2000	2011	19.17	Near Normal	1,116	1987	1987
1924	9.39	**Dry**	1,025	1924	1990	2012	43.26	**Wet**	34,074	1998	1998
1925	8.21	**Dry**	499	1925	1989	2013	20.63	**Wet**	2,650	2006	2006
1926	30.51	**Wet**	12,175	1926	1980	2014	13.96	Near Normal	1,252	1999	1999
1927	28.16	**Wet**	4,188	1927	2001	2015	11.24	**Dry**	499	2002	2002
1928	11.74	**Dry**	499	1928	2002	2016	13.80	**Dry**	125	2007	2007
1929	14.08	**Dry**	1,140	1929	1960	2017	22.80	**Wet**	2,739	1981	1981
1930	14.08	**Dry**	1,140	1930	1960	2018	15.37	Near Normal	1,707	2004	2004
1931	28.65	**Wet**	4,188	1931	2001	2019	23.75	**Wet**	2,715	2003	2003
1932	16.11	Near Normal	1,116	1932	1987	2020	45.78	**Wet**	42,333	2005	2005
1933	24.08	**Wet**	1,707	1933	2004	2021	38.53	**Wet**	34,074	1998	1998
1934	21.18	**Wet**	1,236	1934	1988	2022	43.23	**Wet**	42,333	2005	2005
1935	14.33	**Dry**	5,104	1935	1995	2023	25.37	**Wet**	34,074	1998	1998
1936	24.02	**Wet**	1,707	1936	2004	2024	24.15	**Wet**	22,937	1993	1993
1937	21.03	**Wet**	1,236	1937	1988	2025	9.65	**Dry**	1,116	1987	1987
1938	38.43	**Wet**	5,104	1938	1995	2026	20.35	Near Normal	2,739	1981	1981
1939	13.23	**Dry**	11,468	1939	Assume flows are half of 1993	2027	15.10	Near Normal	1,116	2000	2000
1940	25.08	**Wet**	1,707	1940	2004	2028	17.37	Near Normal	1,116	2000	2000
1941	49.45	**Wet**	42,333	1941	2005	2029	22.37	**Wet**	2,715	2003	2003
1942	8.33	**Dry**	499	1942	1989	2030	14.77	Near Normal	1,116	2000	2000
1943	43.45	**Wet**	34,074	1943	1998	2031	14.56	Near Normal	1,116	2000	2000
1944	28.90	**Wet**	5,104	1944	1995	2032	9.17	**Dry**	499	2002	2002
1945	17.09	Near Normal	2,859	1945	1997	2033	31.25	**Wet**	5,104	1995	1995
1946	25.48	**Wet**	5,104	1946	1995	2034	31.80	**Wet**	5,104	1995	1995
1947	4.88	**Dry**	983	1947	1972	2035	10.36	**Dry**	1,116	2000	2000
1948	10.71	**Dry**	499	1948	2002	2036	12.98	**Dry**	499	2002	2002
1949	11.65	**Dry**	499	1949	2002	2037	13.51	**Dry**	125	2007	2007
1950	8.03	**Dry**	1,078	1950	1987	2038	28.59	**Wet**	5,104	1995	1995
1951	14.57	Near Normal	807	1951	Average of 1988 and 1989	2039	16.63	**Dry**	1,116	2000	2000
1952	40.12	**Wet**	21,656	1952	1993	2040	12.83	**Dry**	499	2002	2002
1953	5.73	**Dry**	1,888	1953	1985	2041	20.67	Near Normal	1,116	2000	2000
1954	18.56	Near Normal	2,017	1954	1985	2042	16.41	Near Normal	1,116	2000	2000
1955	16.32	Near Normal	1,220	1955	1988	2043	9.38	**Dry**	499	2002	2002
1956	16.68	Near Normal	1,113	1956	1987	2044	24.67	**Wet**	2,715	2003	2003
1957	26.81	**Wet**	910	1957	1990	2045	29.24	**Wet**	5,104	1995	1995
1958	27.15	**Wet**	7,536	1958	Multiply 1984 cfs/mile by 2.0	2046	17.91	Near Normal	4,188	2001	2001
1959	11.51	**Dry**	1,575	1959	Multiply 1986 cfs/mile by 0.5	2047	10.47	**Dry**	499	2002	2002
1960	13.66	**Dry**	1,140	1960	1987	2048	15.97	Near Normal	1,116	2000	2000
1961	10.35	**Dry**	597	1961	1989	2049	19.69	Near Normal	1,116	2000	2000
1962	24.90	**Wet**	4,287	1962	1982	2050	27.84	**Wet**	5,104	1995	1995
1963	15.01	Near Normal	1,096	1963	1987	2051	12.19	**Dry**	499	2002	2002
1964	11.84	**Dry**	640	1964	1989	2052	20.08	Near Normal	2,715	2003	2003
1965	37.88	**Wet**	4,944	1965	1982	2053	14.02	Near Normal	1,116	2000	2000
1966	17.10	Near Normal	5,274	1966	Multiply 1986 leakage by 2.0	2054	33.91	**Wet**	5,104	1995	1995
1967	27.26	**Wet**	8,397	1967	Multiply 1982 leakage by 2.0	2055	19.94	Near Normal	4,188	2001	2001
1968	8.10	**Dry**	2,384	1968	1985	2056	14.32	Near Normal	499	2002	2002
1969	38.04	**Wet**	19,966	1969	1993	2057	14.01	**Dry**	499	2002	2002

Table D-6
Lang Gage Streamflows (AF) for Historical Record and Climate Change Projection #1 (GFDL_CM2_0.1_sresB1)

Historical Conditions						Climate Change Projection #1					
Cal. Year	Rainfall (inches) NCWD Gage	Local Year Type	Lang Gage Streamflows (AF)	Prototype Year for Lang Gage	Prototype Year for Riverbed Leakage	Year	Rainfall (inches) NCWD Gage	Local Year Type	Lang Gage Streamflows (AF)	Prototype Year for Lang Gage	Prototype Year for Riverbed Leakage
1970	27.21	Wet	5,161	1970	Multiply 1986 leakage by 2.0	2058	28.83	Wet	4,188	2001	2001
1971	16.14	Near Normal	3,270	1971	Average of 1984 and 1985	2059	35.10	Wet	5,104	1995	1995
1972	4.87	Dry	983	1972	Multiply 1989 leakage by 2.0	2060	11.01	Dry	1,252	1999	1999
1973	23.22	Wet	3,679	1973	1984	2061	9.40	Dry	499	2002	2002
1974	21.17	Wet	1,728	1974	Average of 1986 and 1987	2062	20.34	Near Normal	2,715	2003	2003
1975	12.81	Dry	704	1975	Average of 1987 and 1989	2063	10.66	Dry	499	2002	2002
1976	16.45	Near Normal	258	1976	Multiply 1989 leakage by 0.5	2064	9.63	Dry	125	2007	2007
1977	24.49	Wet	147	1977	Multiply 1989 leakage by 0.3	2065	17.94	Near Normal	1,116	2000	2000
1978	49.49	Wet	28,730	1978	1983	2066	18.07	Near Normal	1,252	1999	1999
1979	23.75	Wet	4,925	1979	1995	2067	13.68	Dry	499	2002	2002
1980	31.95	Wet	12,175	1980	1980	2068	7.10	Dry	125	2007	2007
1981	16.80	Near Normal	2,739	1981	1981	2069	20.97	Near Normal	2,715	2003	2003
1982	24.82	Wet	4,188	1982	1982	2070	14.49	Near Normal	1,116	2000	2000
1983	48.33	Wet	26,855	1983	1983	2071	17.87	Near Normal	1,116	2000	2000
1984	12.55	Dry	4,044	1984	1984	2072	20.27	Near Normal	2,715	2003	2003
1985	9.76	Dry	2,224	1985	1985	2073	11.02	Dry	499	2002	2002
1986	23.06	Wet	2,744	1986	1986	2074	23.74	Wet	2,715	2003	2003
1987	16.76	Near Normal	1,116	1987	1987	2075	20.98	Wet	1,116	2000	2000
1988	20.05	Wet	1,236	1988	1988	2076	8.79	Dry	499	2002	2002
1989	8.47	Dry	499	1989	1989	2077	12.56	Dry	125	2007	2007
1990	9.34	Dry	1,025	1990	1990	2078	21.59	Wet	2,715	2003	2003
1991	24.61	Wet	3,291	1991	1991	2079	30.22	Wet	5,104	1995	1995
1992	39.24	Wet	4,115	1992	1992	2080	12.53	Dry	1,252	1999	1999
1993	36.08	Wet	22,937	1993	1993	2081	21.67	Wet	2,715	2003	2003
1994	11.97	Dry	3,239	1994	1994	2082	17.97	Near Normal	1,116	2000	2000
1995	36.28	Wet	5,104	1995	1995	2083	36.13	Wet	5,104	1995	1995
1996	23.65	Wet	3,836	1996	1996	2084	32.25	Wet	5,104	1995	1995
1997	17.93	Near Normal	2,859	1997	1997	2085	18.51	Near Normal	2,715	2003	2003
1998	40.60	Wet	34,074	1998	1998	2086	20.78	Wet	4,188	2001	2001
1999	10.05	Dry	1,252	1999	1999	2087	30.97	Wet	5,104	1995	1995
2000	17.33	Near Normal	1,116	2000	1987	2088	8.45	Dry	499	2002	2002
2001	27.24	Wet	4,188	2001	1982	2089	32.79	Wet	5,104	1995	1995
2002	11.50	Dry	499	2002	1989	2090	34.48	Wet	5,104	1995	1995
2003	19.78	Near Normal	2,715	2003	1996 and 2003	2091	18.49	Near Normal	2,715	2003	2003
2004	23.26	Wet	1,707	2004	2004	2092	7.60	Dry	499	2002	2002
2005	41.13	Wet	42,333	2005	2005	2093	21.56	Wet	4,188	2001	2001
2006	19.24	Near Normal	2,650	2006	2006	2094	16.99	Near Normal	1,116	2000	2000
2007	8.66	Dry	125	2007	2007	2095	21.56	Wet	4,188	2001	2001

For the period 1922 through 1978, rainfall at the NCWD gage is calculated from the formula NCWD = 1.1735 * Newhall-Soledad gage rainfall. This relationship is based on a regression analysis for the period 1979-2000.

The median for the Newhall-Soledad rain gage is 14.57 in/yr (1950-2000); the equivalent median is 17.10 in/yr at NCWD. Wet years have rainfall > 115% of median rainfall (greater than 16.75 in/yr at Newhall-Soledad, or 19.66 in/yr or ~ 20 in/yr at NCWD). Dry years have rainfall < 85% of median (less than 12.38 in/yr at Newhall-Soledad, or 14.53 in/yr or ~ 14 in/yr at NCWD).

Table D-7

Lang Gage Streamflows (AF) for Historical Record and Climate Change Projection #6 (NCAR_PCM1.3_sresA2)

Historical Conditions						Climate Change Projection #6					
Cal. Year	Rainfall (inches) NCWD Gage	Local Year Type	Lang Gage Streamflows (AF)	Prototype Year for Lang Gage	Prototype Year for Riverbed Leakage	Year	Rainfall (inches) NCWD Gage	Local Year Type	Lang Gage Streamflows (AF)	Prototype Year for Lang Gage	Prototype Year for Riverbed Leakage
1922	37.55	Wet	4,115	1922	1992	2010	17.22	Near Normal	2,744	1986	1986
1923	16.43	Near Normal	1,116	1923	2000	2011	13.37	Dry	1,252	1999	1999
1924	9.39	Dry	1,025	1924	1990	2012	16.14	Near Normal	1,116	1987	1987
1925	8.21	Dry	499	1925	1989	2013	16.53	Near Normal	1,116	1987	1987
1926	30.51	Wet	12,175	1926	1980	2014	15.33	Near Normal	1,116	1987	1987
1927	28.16	Wet	4,188	1927	2001	2015	40.92	Wet	34,074	1998	1998
1928	11.74	Dry	499	1928	2002	2016	20.24	Wet	2,650	2006	2006
1929	14.08	Dry	1,140	1929	1960	2017	19.50	Near Normal	1,252	1999	1999
1930	14.08	Dry	1,140	1930	1960	2018	10.68	Dry	499	2002	2002
1931	28.65	Wet	4,188	1931	2001	2019	15.15	Near Normal	1,116	1987	1987
1932	16.11	Near Normal	1,116	1932	1987	2020	24.58	Wet	2,715	2003	2003
1933	24.08	Wet	1,707	1933	2004	2021	16.38	Near Normal	1,707	2004	2004
1934	21.18	Wet	1,236	1934	1988	2022	22.64	Wet	2,715	2003	2003
1935	14.33	Dry	5,104	1935	1995	2023	21.29	Wet	2,650	2006	2006
1936	24.02	Wet	1,707	1936	2004	2024	13.37	Dry	1,252	1999	1999
1937	21.03	Wet	1,236	1937	1988	2025	19.50	Near Normal	1,116	1987	1987
1938	38.43	Wet	5,104	1938	1995	2026	12.05	Dry	499	2002	2002
1939	13.23	Dry	11,468	1939	Assume flows are half of 1993	2027	18.89	Near Normal	1,116	2000	2000
1940	25.08	Wet	1,707	1940	2004	2028	11.56	Dry	499	2002	2002
1941	49.45	Wet	42,333	1941	2005	2029	8.46	Dry	125	2007	2007
1942	8.33	Dry	499	1942	1989	2030	16.41	Near Normal	1,116	2000	2000
1943	43.45	Wet	34,074	1943	1998	2031	19.44	Near Normal	1,116	2000	2000
1944	28.90	Wet	5,104	1944	1995	2032	18.66	Near Normal	1,116	2000	2000
1945	17.09	Near Normal	2,859	1945	1997	2033	30.29	Wet	5,104	1995	1995
1946	25.48	Wet	5,104	1946	1995	2034	42.86	Wet	34,074	1998	1998
1947	4.88	Dry	983	1947	1972	2035	16.39	Near Normal	2,650	2006	2006
1948	10.71	Dry	499	1948	2002	2036	17.74	Near Normal	1,116	2000	2000
1949	11.65	Dry	499	1949	2002	2037	50.04	Wet	42,333	2005	2005
1950	8.03	Dry	1,078	1950	1987	2038	35.50	Wet	34,074	1998	1998
1951	14.57	Near Normal	807	1951	Average of 1988 and 1989	2039	39.98	Wet	34,074	1998	1998
1952	40.12	Wet	21,656	1952	1993	2040	28.83	Wet	22,937	1993	1993
1953	5.73	Dry	1,888	1953	1985	2041	23.15	Wet	12,175	1980	1980
1954	18.56	Near Normal	2,017	1954	1985	2042	22.57	Wet	5,104	1995	1995
1955	16.32	Near Normal	1,220	1955	1988	2043	22.20	Wet	3,836	1996	1996
1956	16.68	Near Normal	1,113	1956	1987	2044	16.25	Near Normal	2,715	2003	2003
1957	26.81	Wet	910	1957	1990	2045	34.88	Wet	12,175	1980	1980
1958	27.15	Wet	7,536	1958	Multiply 1984 cfs/mile by 2.0	2046	20.82	Wet	4,188	2001	2001
1959	11.51	Dry	1,575	1959	Multiply 1986 cfs/mile by 0.5	2047	14.35	Near Normal	2,744	1986	1986
1960	13.66	Dry	1,140	1960	1987	2048	12.06	Dry	1,116	2000	2000
1961	10.35	Dry	597	1961	1989	2049	12.16	Dry	499	2002	2002
1962	24.90	Wet	4,287	1962	1982	2050	11.37	Dry	125	2007	2007
1963	15.01	Near Normal	1,096	1963	1987	2051	28.47	Wet	4,188	2001	2001
1964	11.84	Dry	640	1964	1989	2052	26.84	Wet	3,836	1996	1996
1965	37.88	Wet	4,944	1965	1982	2053	25.59	Wet	2,715	2003	2003
1966	17.10	Near Normal	5,274	1966	Multiply 1986 leakage by 2.0	2054	15.97	Near Normal	1,116	2000	2000
1967	27.26	Wet	8,397	1967	Multiply 1982 leakage by 2.0	2055	21.26	Wet	2,715	2003	2003
1968	8.10	Dry	2,384	1968	1985	2056	23.32	Wet	4,188	2001	2001
1969	38.04	Wet	19,966	1969	1993	2057	13.55	Dry	1,116	2000	2000

Table D-7

Lang Gage Streamflows (AF) for Historical Record and Climate Change Projection #6 (NCAR_PCM1.3_sresA2)

Historical Conditions						Climate Change Projection #6					
Cal. Year	Rainfall (inches) NCWD Gage	Local Year Type	Lang Gage Streamflows (AF)	Prototype Year for Lang Gage	Prototype Year for Riverbed Leakage	Year	Rainfall (inches) NCWD Gage	Local Year Type	Lang Gage Streamflows (AF)	Prototype Year for Lang Gage	Prototype Year for Riverbed Leakage
1970	27.21	Wet	5,161	1970	Multiply 1986 leakage by 2.0	2058	23.32	Wet	2,715	2003	2003
1971	16.14	Near Normal	3,270	1971	Average of 1984 and 1985	2059	13.04	Dry	1,116	2000	2000
1972	4.87	Dry	983	1972	Multiply 1989 leakage by 2.0	2060	22.71	Wet	2,715	2003	2003
1973	23.22	Wet	3,679	1973	1984	2061	10.15	Dry	499	2002	2002
1974	21.17	Wet	1,728	1974	Average of 1986 and 1987	2062	20.52	Near Normal	1,116	2000	2000
1975	12.81	Dry	704	1975	Average of 1987 and 1989	2063	71.95	Wet	42,333	2005	2005
1976	16.45	Near Normal	258	1976	Multiply 1989 leakage by 0.5	2064	33.61	Wet	34,074	1998	1998
1977	24.49	Wet	147	1977	Multiply 1989 leakage by 0.3	2065	13.39	Dry	5,104	1995	1995
1978	49.49	Wet	28,730	1978	1983	2066	25.96	Wet	5,104	1995	1995
1979	23.75	Wet	4,925	1979	1995	2067	28.69	Wet	5,104	1995	1995
1980	31.95	Wet	12,175	1980	1980	2068	18.22	Near Normal	2,715	2003	2003
1981	16.80	Near Normal	2,739	1981	1981	2069	11.17	Dry	499	2002	2002
1982	24.82	Wet	4,188	1982	1982	2070	18.25	Near Normal	1,116	2000	2000
1983	48.33	Wet	26,855	1983	1983	2071	17.85	Near Normal	1,116	2000	2000
1984	12.55	Dry	4,044	1984	1984	2072	19.30	Near Normal	2,715	2003	2003
1985	9.76	Dry	2,224	1985	1985	2073	14.70	Near Normal	1,116	2000	2000
1986	23.06	Wet	2,744	1986	1986	2074	9.82	Dry	499	2002	2002
1987	16.76	Near Normal	1,116	1987	1987	2075	14.96	Near Normal	499	2002	2002
1988	20.05	Wet	1,236	1988	1988	2076	29.84	Wet	3,836	1996	1996
1989	8.47	Dry	499	1989	1989	2077	19.05	Near Normal	1,116	2000	2000
1990	9.34	Dry	1,025	1990	1990	2078	45.70	Wet	34,074	1998	1998
1991	24.61	Wet	3,291	1991	1991	2079	25.20	Wet	5,104	1995	1995
1992	39.24	Wet	4,115	1992	1992	2080	31.12	Wet	12,175	1980	1980
1993	36.08	Wet	22,937	1993	1993	2081	29.50	Wet	12,175	1980	1980
1994	11.97	Dry	3,239	1994	1994	2082	27.59	Wet	12,175	1980	1980
1995	36.28	Wet	5,104	1995	1995	2083	15.50	Near Normal	3,836	1996	1996
1996	23.65	Wet	3,836	1996	1996	2084	8.74	Dry	1,116	2000	2000
1997	17.93	Near Normal	2,859	1997	1997	2085	18.76	Near Normal	499	2002	2002
1998	40.60	Wet	34,074	1998	1998	2086	13.07	Dry	125	2007	2007
1999	10.05	Dry	1,252	1999	1999	2087	22.89	Wet	1,116	2000	2000
2000	17.33	Near Normal	1,116	2000	1987	2088	50.06	Wet	42,333	2005	2005
2001	27.24	Wet	4,188	2001	1982	2089	27.24	Wet	12,175	1980	1980
2002	11.50	Dry	499	2002	1989	2090	12.53	Dry	2,715	2003	2003
2003	19.78	Near Normal	2,715	2003	1996 and 2003	2091	9.14	Dry	499	2002	2002
2004	23.26	Wet	1,707	2004	2004	2092	10.81	Dry	125	2007	2007
2005	41.13	Wet	42,333	2005	2005	2093	23.07	Wet	1,116	2000	2000
2006	19.24	Near Normal	2,650	2006	2006	2094	12.91	Dry	499	2002	2002
2007	8.66	Dry	125	2007	2007	2095	26.47	Wet	2,715	2003	2003

For the period 1922 through 1978, rainfall at the NCWD gage is calculated from the formula NCWD = 1.1735 * Newhall-Soledad gage rainfall. This relationship is based on a regression analysis for the period 1979-2000.

The median for the Newhall-Soledad rain gage is 14.57 in/yr (1950-2000); the equivalent median is 17.10 in/yr at NCWD. Wet years have rainfall > 115% of median rainfall (greater than 16.75 in/yr at Newhall-Soledad, or 19.66 in/yr or ~ 20 in/yr at NCWD). Dry years have rainfall < 85% of median (less than 12.38 in/yr at Newhall-Soledad, or 14.53 in/yr or ~ 14 in/yr at NCWD).

Table D-8
Lang Gage Streamflows (AF) for Historical Record and Climate Change Projection #9 (NCAR_PCM1.3_sresB1)

Historical Conditions						Climate Change Projection #9					
Cal. Year	Rainfall (inches) NCWD Gage	Local Year Type	Lang Gage Streamflows (AF)	Prototype Year for Lang Gage	Prototype Year for Riverbed Leakage	Year	Rainfall (inches) NCWD Gage	Local Year Type	Lang Gage Streamflows (AF)	Prototype Year for Lang Gage	Prototype Year for Riverbed Leakage
1922	37.55	Wet	4,115	1922	1992	2010	22.14	Wet	3,836	1996	1996
1923	16.43	Near Normal	1,116	1923	2000	2011	28.62	Wet	5,104	1995	1995
1924	9.39	Dry	1,025	1924	1990	2012	18.21	Near Normal	2,715	2003	2003
1925	8.21	Dry	499	1925	1989	2013	18.42	Near Normal	2,715	2003	2003
1926	30.51	Wet	12,175	1926	1980	2014	17.85	Near Normal	2,650	2006	2006
1927	28.16	Wet	4,188	1927	2001	2015	22.34	Wet	3,836	1996	1996
1928	11.74	Dry	499	1928	2002	2016	17.51	Near Normal	2,715	2003	2003
1929	14.08	Dry	1,140	1929	1960	2017	16.21	Near Normal	1,707	2004	2004
1930	14.08	Dry	1,140	1930	1960	2018	11.56	Dry	499	2002	2002
1931	28.65	Wet	4,188	1931	2001	2019	11.83	Dry	125	2007	2007
1932	16.11	Near Normal	1,116	1932	1987	2020	37.62	Wet	22,937	1993	1993
1933	24.08	Wet	1,707	1933	2004	2021	16.56	Near Normal	2,715	2003	2003
1934	21.18	Wet	1,236	1934	1988	2022	15.17	Near Normal	1,707	2004	2004
1935	14.33	Dry	5,104	1935	1995	2023	22.88	Wet	3,836	1996	1996
1936	24.02	Wet	1,707	1936	2004	2024	13.18	Dry	1,116	1987	1987
1937	21.03	Wet	1,236	1937	1988	2025	20.34	Near Normal	1,707	2004	2004
1938	38.43	Wet	5,104	1938	1995	2026	26.96	Wet	3,836	1996	1996
1939	13.23	Dry	11,468	1939	Assume flows are half of 1993	2027	26.47	Wet	5,104	1995	1995
1940	25.08	Wet	1,707	1940	2004	2028	18.04	Near Normal	2,715	2003	2003
1941	49.45	Wet	42,333	1941	2005	2029	18.04	Near Normal	2,715	2003	2003
1942	8.33	Dry	499	1942	1989	2030	16.49	Near Normal	1,707	2004	2004
1943	43.45	Wet	34,074	1943	1998	2031	22.51	Wet	3,836	1996	1996
1944	28.90	Wet	5,104	1944	1995	2032	22.84	Wet	5,104	1995	1995
1945	17.09	Near Normal	2,859	1945	1997	2033	15.01	Near Normal	1,707	2004	2004
1946	25.48	Wet	5,104	1946	1995	2034	13.40	Dry	499	2002	2002
1947	4.88	Dry	983	1947	1972	2035	18.72	Near Normal	1,707	2004	2004
1948	10.71	Dry	499	1948	2002	2036	26.43	Wet	3,836	1996	1996
1949	11.65	Dry	499	1949	2002	2037	11.11	Dry	499	2002	2002
1950	8.03	Dry	1,078	1950	1987	2038	12.97	Dry	125	2007	2007
1951	14.57	Near Normal	807	1951	Average of 1988 and 1989	2039	41.47	Wet	34,074	1998	1998
1952	40.12	Wet	21,656	1952	1993	2040	18.62	Near Normal	2,650	2006	2006
1953	5.73	Dry	1,888	1953	1985	2041	39.65	Wet	22,937	1993	1993
1954	18.56	Near Normal	2,017	1954	1985	2042	33.75	Wet	19,966	1969	1969
1955	16.32	Near Normal	1,220	1955	1988	2043	57.56	Wet	42,333	2005	2005
1956	16.68	Near Normal	1,113	1956	1987	2044	14.63	Near Normal	2,715	2003	2003
1957	26.81	Wet	910	1957	1990	2045	15.63	Near Normal	1,707	2004	2004
1958	27.15	Wet	7,536	1958	Multiply 1984 cfs/mile by 2.0	2046	15.41	Near Normal	1,116	2000	2000
1959	11.51	Dry	1,575	1959	Multiply 1986 cfs/mile by 0.5	2047	24.66	Wet	3,836	1996	1996
1960	13.66	Dry	1,140	1960	1987	2048	53.80	Wet	42,333	2005	2005
1961	10.35	Dry	597	1961	1989	2049	14.70	Near Normal	2,715	2003	2003
1962	24.90	Wet	4,287	1962	1982	2050	9.79	Dry	499	2002	2002
1963	15.01	Near Normal	1,096	1963	1987	2051	38.49	Wet	34,074	1998	1998
1964	11.84	Dry	640	1964	1989	2052	19.57	Near Normal	2,715	2003	2003
1965	37.88	Wet	4,944	1965	1982	2053	20.65	Wet	3,836	1996	1996
1966	17.10	Near Normal	5,274	1966	Multiply 1986 leakage by 2.0	2054	10.40	Dry	1,116	2000	2000
1967	27.26	Wet	8,397	1967	Multiply 1982 leakage by 2.0	2055	12.58	Dry	499	2002	2002
1968	8.10	Dry	2,384	1968	1985	2056	17.80	Near Normal	1,116	2000	2000
1969	38.04	Wet	19,966	1969	1993	2057	15.56	Near Normal	1,116	2000	2000

Table D-8
Lang Gage Streamflows (AF) for Historical Record and Climate Change Projection #9 (NCAR_PCM1.3_sresB1)

Historical Conditions						Climate Change Projection #9					
Cal. Year	Rainfall (inches) NCWD Gage	Local Year Type	Lang Gage Streamflows (AF)	Prototype Year for Lang Gage	Prototype Year for Riverbed Leakage	Year	Rainfall (inches) NCWD Gage	Local Year Type	Lang Gage Streamflows (AF)	Prototype Year for Lang Gage	Prototype Year for Riverbed Leakage
1970	27.21	Wet	5,161	1970	Multiply 1986 leakage by 2.0	2058	45.18	Wet	34,074	1998	1998
1971	16.14	Near Normal	3,270	1971	Average of 1984 and 1985	2059	26.78	Wet	5,104	1995	1995
1972	4.87	Dry	983	1972	Multiply 1989 leakage by 2.0	2060	23.78	Wet	3,836	1996	1996
1973	23.22	Wet	3,679	1973	1984	2061	47.61	Wet	34,074	1998	1998
1974	21.17	Wet	1,728	1974	Average of 1986 and 1987	2062	28.90	Wet	12,175	1980	1980
1975	12.81	Dry	704	1975	Average of 1987 and 1989	2063	30.43	Wet	12,175	1980	1980
1976	16.45	Near Normal	258	1976	Multiply 1989 leakage by 0.5	2064	18.15	Near Normal	3,836	1996	1996
1977	24.49	Wet	147	1977	Multiply 1989 leakage by 0.3	2065	30.15	Wet	12,175	1980	1980
1978	49.49	Wet	28,730	1978	1983	2066	13.65	Dry	1,116	2000	2000
1979	23.75	Wet	4,925	1979	1995	2067	16.34	Near Normal	3,836	1996	1996
1980	31.95	Wet	12,175	1980	1980	2068	10.60	Dry	1,116	2000	2000
1981	16.80	Near Normal	2,739	1981	1981	2069	60.56	Wet	42,333	2005	2005
1982	24.82	Wet	4,188	1982	1982	2070	20.56	Wet	3,836	1996	1996
1983	48.33	Wet	26,855	1983	1983	2071	15.31	Near Normal	1,116	2000	2000
1984	12.55	Dry	4,044	1984	1984	2072	33.67	Wet	12,175	1980	1980
1985	9.76	Dry	2,224	1985	1985	2073	46.34	Wet	34,074	1998	1998
1986	23.06	Wet	2,744	1986	1986	2074	33.69	Wet	12,175	1980	1980
1987	16.76	Near Normal	1,116	1987	1987	2075	15.71	Near Normal	3,836	1996	1996
1988	20.05	Wet	1,236	1988	1988	2076	14.36	Near Normal	1,116	2000	2000
1989	8.47	Dry	499	1989	1989	2077	21.25	Wet	3,836	1996	1996
1990	9.34	Dry	1,025	1990	1990	2078	37.14	Wet	22,937	1993	1993
1991	24.61	Wet	3,291	1991	1991	2079	31.87	Wet	12,175	1980	1980
1992	39.24	Wet	4,115	1992	1992	2080	8.14	Dry	1,116	2000	2000
1993	36.08	Wet	22,937	1993	1993	2081	25.22	Wet	5,104	1995	1995
1994	11.97	Dry	3,239	1994	1994	2082	32.82	Wet	12,175	1980	1980
1995	36.28	Wet	5,104	1995	1995	2083	28.25	Wet	5,104	1995	1995
1996	23.65	Wet	3,836	1996	1996	2084	7.23	Dry	1,116	2000	2000
1997	17.93	Near Normal	2,859	1997	1997	2085	11.37	Dry	499	2002	2002
1998	40.60	Wet	34,074	1998	1998	2086	27.47	Wet	5,104	1995	1995
1999	10.05	Dry	1,252	1999	1999	2087	20.97	Wet	3,836	1996	1996
2000	17.33	Near Normal	1,116	2000	1987	2088	16.12	Near Normal	1,707	2004	2004
2001	27.24	Wet	4,188	2001	1982	2089	64.70	Wet	42,333	2005	2005
2002	11.50	Dry	499	2002	1989	2090	21.30	Wet	3,836	1996	1996
2003	19.78	Near Normal	2,715	2003	1996 and 2003	2091	12.38	Dry	1,116	2000	2000
2004	23.26	Wet	1,707	2004	2004	2092	22.06	Wet	3,836	1996	1996
2005	41.13	Wet	42,333	2005	2005	2093	19.32	Near Normal	2,715	2003	2003
2006	19.24	Near Normal	2,650	2006	2006	2094	20.91	Wet	2,715	2003	2003
2007	8.66	Dry	125	2007	2007	2095	21.05	Wet	2,715	2003	2003

For the period 1922 through 1978, rainfall at the NCWD gage is calculated from the formula NCWD = 1.1735 * Newhall-Soledad gage rainfall. This relationship is based on a regression analysis for the period 1979-2000.

The median for the Newhall-Soledad rain gage is 14.57 in/yr (1950-2000); the equivalent median is 17.10 in/yr at NCWD. Wet years have rainfall > 115% of median rainfall (greater than 16.75 in/yr at Newhall-Soledad, or 19.66 in/yr or ~ 20 in/yr at NCWD). Dry years have rainfall < 85% of median (less than 12.38 in/yr at Newhall-Soledad, or 14.53 in/yr or ~ 14 in/yr at NCWD).

Table D-9
Castaic Release Volumes (AF) for Historical Record and Climate Change Projection #1 (GFDL_CM2_0.1_sresB1)

Historical Conditions					Climate Change Projection #1				
Cal. Year	Rainfall (inches) NCWD Gage	Local Year Type	Castaic Release Volume (AF)	Prototype Year for Castaic Releases	Year	Rainfall (inches) NCWD Gage	Local Year Type	Castaic Release Volume (AF)	Prototype Year for Castaic Releases
1922	37.55	**Wet**	4,450	1992	2010	18.27	Near Normal	1,641	1981
1923	16.43	Near Normal	7,086	2000	2011	19.17	Near Normal	1,853	1987
1924	9.39	**Dry**	0	1990	2012	43.26	**Wet**	47,802	1998
1925	8.21	**Dry**	0	1989	2013	20.63	**Wet**	17,844	2006
1926	30.51	**Wet**	2,805	1980	2014	13.96	Near Normal	5,830	1999
1927	28.16	**Wet**	1,607	2001	2015	11.24	**Dry**	0	2002
1928	11.74	**Dry**	0	2002	2016	13.80	**Dry**	0	2002
1929	14.08	**Dry**	0	1960	2017	22.80	**Wet**	1,641	1981
1930	14.08	**Dry**	0	1960	2018	15.37	Near Normal	1,607	2001
1931	28.65	**Wet**	1,607	2001	2019	23.75	**Wet**	3,019	2003
1932	16.11	Near Normal	1,641	1987	2020	45.78	**Wet**	47,802	1998
1933	24.08	**Wet**	1,123	2004	2021	38.53	**Wet**	47,802	1998
1934	21.18	**Wet**	2,050	1988	2022	43.23	**Wet**	91,181	2005
1935	14.33	**Dry**	5,611	1995	2023	25.37	**Wet**	47,802	1998
1936	24.02	**Wet**	1,123	2004	2024	24.15	**Wet**	17,844	2006
1937	21.03	**Wet**	2,050	1988	2025	9.65	**Dry**	1,853	1987
1938	38.43	**Wet**	5,611	1995	2026	20.35	Near Normal	1,641	1981
1939	13.23	**Dry**	3,863	1993	2027	15.10	Near Normal	1,607	2001
1940	25.08	**Wet**	1,123	2004	2028	17.37	Near Normal	1,607	2001
1941	49.45	**Wet**	91,181	2005	2029	22.37	**Wet**	3,019	2003
1942	8.33	**Dry**	0	1989	2030	14.77	Near Normal	1,607	2001
1943	43.45	**Wet**	47,802	1998	2031	14.56	Near Normal	1,607	2001
1944	28.90	**Wet**	5,611	1995	2032	9.17	**Dry**	0	2002
1945	17.09	Near Normal	9,884	1997	2033	31.25	**Wet**	5,611	1995
1946	25.48	**Wet**	5,611	1995	2034	31.80	**Wet**	5,632	1996
1947	4.88	**Dry**	0	1972	2035	10.36	**Dry**	1,607	2001
1948	10.71	**Dry**	0	2002	2036	12.98	**Dry**	0	2002
1949	11.65	**Dry**	0	2002	2037	13.51	**Dry**	0	2002
1950	8.03	**Dry**	0	1989	2038	28.59	**Wet**	5,611	1995
1951	14.57	Near Normal	0	1984	2039	16.63	**Dry**	1,607	2001
1952	40.12	**Wet**	7,725	1993	2040	12.83	**Dry**	0	2002
1953	5.73	**Dry**	0	1989	2041	20.67	Near Normal	1,607	2001
1954	18.56	Near Normal	5,632	1996	2042	16.41	Near Normal	1,607	2001
1955	16.32	Near Normal	1,641	1986	2043	9.38	**Dry**	0	2002
1956	16.68	Near Normal	1,853	1987	2044	24.67	**Wet**	3,019	2003
1957	26.81	**Wet**	2,244	1982	2045	29.24	**Wet**	5,611	1995
1958	27.15	**Wet**	2,244	1982	2046	17.91	Near Normal	1,607	2001
1959	11.51	**Dry**	3,282	1994	2047	10.47	**Dry**	0	2002
1960	13.66	**Dry**	0	1984	2048	15.97	Near Normal	1,607	2001
1961	10.35	**Dry**	5,830	1999	2049	19.69	Near Normal	1,607	2001
1962	24.90	**Wet**	2,244	1982	2050	27.84	**Wet**	5,611	1995
1963	15.01	Near Normal	0	2002	2051	12.19	**Dry**	0	2002
1964	11.84	**Dry**	3,282	1994	2052	20.08	Near Normal	1,607	2001
1965	37.88	**Wet**	4,450	1992	2053	14.02	Near Normal	1,607	2001
1966	17.10	Near Normal	1,853	1987	2054	33.91	**Wet**	5,611	1995
1967	27.26	**Wet**	2,244	1982	2055	19.94	Near Normal	1,607	2001

Table D-9
Castaic Release Volumes (AF) for Historical Record and Climate Change Projection #1 (GFDL_CM2_0.1_sresB1)

Historical Conditions					Climate Change Projection #1				
Cal. Year	Rainfall (inches) NCWD Gage	Local Year Type	Castaic Release Volume (AF)	Prototype Year for Castaic Releases	Year	Rainfall (inches) NCWD Gage	Local Year Type	Castaic Release Volume (AF)	Prototype Year for Castaic Releases
1968	8.10	Dry	0	1989	2056	14.32	Near Normal	0	2002
1969	38.04	Wet	7,725	1993	2057	14.01	Dry	0	1990
1970	27.21	Wet	2,244	1982	2058	28.83	Wet	5,611	1995
1971	16.14	Near Normal	1,641	1986	2059	35.10	Wet	5,632	1996
1972	4.87	Dry	0	1989	2060	11.01	Dry	1,607	2001
1973	23.22	Wet	2,244	1982	2061	9.40	Dry	0	2002
1974	21.17	Wet	1,641	1986	2062	20.34	Near Normal	1,607	2001
1975	12.81	Dry	3,282	1994	2063	10.66	Dry	0	2002
1976	16.45	Near Normal	1,853	1987	2064	9.63	Dry	0	2002
1977	24.49	Wet	2,244	1982	2065	17.94	Near Normal	1,607	2001
1978	49.49	Wet	3,928	1983	2066	18.07	Near Normal	1,607	2001
1979	23.75	Wet	2,244	1982	2067	13.68	Dry	0	2002
1980	31.95	Wet	2,805	1980	2068	7.10	Dry	0	2002
1981	16.80	Near Normal	1,641	1986	2069	20.97	Near Normal	1,607	2001
1982	24.82	Wet	2,244	1982	2070	14.49	Near Normal	0	2002
1983	48.33	Wet	3,928	1983	2071	17.87	Near Normal	1,607	2001
1984	12.55	Dry	0	1984	2072	20.27	Near Normal	1,607	2001
1985	9.76	Dry	0	1985	2073	11.02	Dry	0	2002
1986	23.06	Wet	1,641	1986	2074	23.74	Wet	1,607	2001
1987	16.76	Near Normal	1,853	1987	2075	20.98	Wet	1,607	2001
1988	20.05	Wet	2,050	1988	2076	8.79	Dry	0	2002
1989	8.47	Dry	0	1989	2077	12.56	Dry	0	2002
1990	9.34	Dry	0	1990	2078	21.59	Wet	1,607	2001
1991	24.61	Wet	66	1991	2079	30.22	Wet	5,611	1995
1992	39.24	Wet	4,450	1992	2080	12.53	Dry	1,607	2001
1993	36.08	Wet	7,725	1993	2081	21.67	Wet	3,019	2003
1994	11.97	Dry	3,282	1994	2082	17.97	Near Normal	1,607	2001
1995	36.28	Wet	5,611	1995	2083	36.13	Wet	5,611	1995
1996	23.65	Wet	5,632	1996	2084	32.25	Wet	5,632	1996
1997	17.93	Near Normal	9,884	1997	2085	18.51	Near Normal	1,607	2001
1998	40.60	Wet	47,802	1998	2086	20.78	Wet	1,607	2001
1999	10.05	Dry	5,830	1999	2087	30.97	Wet	5,611	1995
2000	17.33	Near Normal	7,086	2000	2088	8.45	Dry	1,607	2001
2001	27.24	Wet	1,607	2001	2089	32.79	Wet	5,611	1995
2002	11.50	Dry	0	2002	2090	34.48	Wet	5,632	1996
2003	19.78	Near Normal	3,019	2003	2091	18.49	Near Normal	1,607	2001
2004	23.26	Wet	1,123	2004	2092	7.60	Dry	0	2002
2005	41.13	Wet	91,181	2005	2093	21.56	Wet	1,607	2001
2006	19.24	Near Normal	17,844	2006	2094	16.99	Near Normal	1,607	2001
2007	8.66	Dry	0	2007	2095	21.56	Wet	1,607	2001

For the period 1922 through 1978, rainfall at the NCWD gage is calculated from the formula NCWD = 1.1735 * Newhall-Soledad gage rainfall. This relationship is based on a regression analysis for the period 1979-2000.

The median for the Newhall-Soledad rain gage is 14.57 in/yr (1950-2000); the equivalent median is 17.10 in/yr at NCWD. Wet years have rainfall > 115% of median rainfall (greater than 16.75 in/yr at Newhall-Soledad, or 19.66 in/yr or ~ 20 in/yr at NCWD). Dry years have rainfall < 85% of median (less than 12.38 in/yr at Newhall-Soledad, or 14.53 in/yr or ~ 14 in/yr at NCWD).

Table D-10

Castaic Release Volumes (AF) for Historical Record and Climate Change Projection #6 (NCAR_PCM1.3_sresA2)

Historical Conditions					Climate Change Projection #6				
Cal. Year	Rainfall (inches) NCWD Gage	Local Year Type	Castaic Release Volume (AF)	Prototype Year for Castaic Releases	Year	Rainfall (inches) NCWD Gage	Local Year Type	Castaic Release Volume (AF)	Prototype Year for Castaic Releases
1922	37.55	Wet	4,450	1992	2010	17.22	Near Normal	1,641	1981
1923	16.43	Near Normal	7,086	2000	2011	13.37	Dry	0	2002
1924	9.39	Dry	0	1990	2012	16.14	Near Normal	1,607	2001
1925	8.21	Dry	0	1989	2013	16.53	Near Normal	1,607	2001
1926	30.51	Wet	2,805	1980	2014	15.33	Near Normal	1,607	2001
1927	28.16	Wet	1,607	2001	2015	40.92	Wet	47,802	1998
1928	11.74	Dry	0	2002	2016	20.24	Wet	17,844	2006
1929	14.08	Dry	0	1960	2017	19.50	Near Normal	5,611	1995
1930	14.08	Dry	0	1960	2018	10.68	Dry	0	2002
1931	28.65	Wet	1,607	2001	2019	15.15	Near Normal	0	2002
1932	16.11	Near Normal	1,641	1987	2020	24.58	Wet	3,019	2003
1933	24.08	Wet	1,123	2004	2021	16.38	Near Normal	1,607	2001
1934	21.18	Wet	2,050	1988	2022	22.64	Wet	3,019	2003
1935	14.33	Dry	5,611	1995	2023	21.29	Wet	5,611	1995
1936	24.02	Wet	1,123	2004	2024	13.37	Dry	1,607	2001
1937	21.03	Wet	2,050	1988	2025	19.50	Near Normal	1,607	2001
1938	38.43	Wet	5,611	1995	2026	12.05	Dry	0	2002
1939	13.23	Dry	3,863	1993	2027	18.89	Near Normal	1,607	2001
1940	25.08	Wet	1,123	2004	2028	11.56	Dry	0	2002
1941	49.45	Wet	91,181	2005	2029	8.46	Dry	0	2002
1942	8.33	Dry	0	1989	2030	16.41	Near Normal	1,607	2001
1943	43.45	Wet	47,802	1998	2031	19.44	Near Normal	1,607	2001
1944	28.90	Wet	5,611	1995	2032	18.66	Near Normal	1,607	2001
1945	17.09	Near Normal	9,884	1997	2033	30.29	Wet	5,611	1995
1946	25.48	Wet	5,611	1995	2034	42.86	Wet	47,802	1998
1947	4.88	Dry	0	1972	2035	16.39	Near Normal	3,019	2003
1948	10.71	Dry	0	2002	2036	17.74	Near Normal	3,019	2003
1949	11.65	Dry	0	2002	2037	50.04	Wet	91,181	2005
1950	8.03	Dry	0	1989	2038	35.50	Wet	17,844	2006
1951	14.57	Near Normal	0	1984	2039	39.98	Wet	47,802	1998
1952	40.12	Wet	7,725	1993	2040	28.83	Wet	17,844	2006
1953	5.73	Dry	0	1989	2041	23.15	Wet	17,844	2006
1954	18.56	Near Normal	5,632	1996	2042	22.57	Wet	17,844	2006
1955	16.32	Near Normal	1,641	1986	2043	22.20	Wet	17,844	2006
1956	16.68	Near Normal	1,853	1987	2044	16.25	Near Normal	5,611	1995
1957	26.81	Wet	2,244	1982	2045	34.88	Wet	17,844	2006
1958	27.15	Wet	2,244	1982	2046	20.82	Wet	5,611	1995
1959	11.51	Dry	3,282	1994	2047	14.35	Near Normal	3,019	2003
1960	13.66	Dry	0	1984	2048	12.06	Dry	1,607	2001
1961	10.35	Dry	5,830	1999	2049	12.16	Dry	0	2002
1962	24.90	Wet	2,244	1982	2050	11.37	Dry	0	2002
1963	15.01	Near Normal	0	2002	2051	28.47	Wet	5,611	1995
1964	11.84	Dry	3,282	1994	2052	26.84	Wet	5,611	1995
1965	37.88	Wet	4,450	1992	2053	25.59	Wet	5,611	1995
1966	17.10	Near Normal	1,853	1987	2054	15.97	Near Normal	1,607	2001
1967	27.26	Wet	2,244	1982	2055	21.26	Wet	3,019	2003

Table D-10
Castaic Release Volumes (AF) for Historical Record and Climate Change Projection #6 (NCAR_PCM1.3_sresA2)

Historical Conditions					Climate Change Projection #6				
Cal. Year	Rainfall (inches) NCWD Gage	Local Year Type	Castaic Release Volume (AF)	Prototype Year for Castaic Releases	Year	Rainfall (inches) NCWD Gage	Local Year Type	Castaic Release Volume (AF)	Prototype Year for Castaic Releases
1968	8.10	Dry	0	1989	2056	23.32	Wet	5,611	1995
1969	38.04	Wet	7,725	1993	2057	13.55	Dry	1,607	2001
1970	27.21	Wet	2,244	1982	2058	23.32	Wet	3,019	2003
1971	16.14	Near Normal	1,641	1986	2059	13.04	Dry	1,607	2001
1972	4.87	Dry	0	1989	2060	22.71	Wet	3,019	2003
1973	23.22	Wet	2,244	1982	2061	10.15	Dry	0	2002
1974	21.17	Wet	1,641	1986	2062	20.52	Near Normal	1,607	2001
1975	12.81	Dry	3,282	1994	2063	71.95	Wet	91,181	2005
1976	16.45	Near Normal	1,853	1987	2064	33.61	Wet	47,802	1998
1977	24.49	Wet	2,244	1982	2065	13.39	Dry	3,019	2003
1978	49.49	Wet	3,928	1983	2066	25.96	Wet	5,611	1995
1979	23.75	Wet	2,244	1982	2067	28.69	Wet	5,611	1995
1980	31.95	Wet	2,805	1980	2068	18.22	Near Normal	1,607	2001
1981	16.80	Near Normal	1,641	1986	2069	11.17	Dry	1,607	2001
1982	24.82	Wet	2,244	1982	2070	18.25	Near Normal	1,607	2001
1983	48.33	Wet	3,928	1983	2071	17.85	Near Normal	1,607	2001
1984	12.55	Dry	0	1984	2072	19.30	Near Normal	1,607	2001
1985	9.76	Dry	0	1985	2073	14.70	Near Normal	1,607	2001
1986	23.06	Wet	1,641	1986	2074	9.82	Dry	0	2002
1987	16.76	Near Normal	1,853	1987	2075	14.96	Near Normal	0	2002
1988	20.05	Wet	2,050	1988	2076	29.84	Wet	5,611	1995
1989	8.47	Dry	0	1989	2077	19.05	Near Normal	1,607	2001
1990	9.34	Dry	0	1990	2078	45.70	Wet	47,802	1998
1991	24.61	Wet	66	1991	2079	25.20	Wet	17,844	2006
1992	39.24	Wet	4,450	1992	2080	31.12	Wet	17,844	2006
1993	36.08	Wet	7,725	1993	2081	29.50	Wet	17,844	2006
1994	11.97	Dry	3,282	1994	2082	27.59	Wet	17,844	2006
1995	36.28	Wet	5,611	1995	2083	15.50	Near Normal	5,611	1995
1996	23.65	Wet	5,632	1996	2084	8.74	Dry	1,607	2001
1997	17.93	Near Normal	9,884	1997	2085	18.76	Near Normal	1,607	2001
1998	40.60	Wet	47,802	1998	2086	13.07	Dry	1,607	2001
1999	10.05	Dry	5,830	1999	2087	22.89	Wet	3,019	2003
2000	17.33	Near Normal	7,086	2000	2088	50.06	Wet	47,802	1998
2001	27.24	Wet	1,607	2001	2089	27.24	Wet	17,844	2006
2002	11.50	Dry	0	2002	2090	12.53	Dry	1,607	2001
2003	19.78	Near Normal	3,019	2003	2091	9.14	Dry	0	2002
2004	23.26	Wet	1,123	2004	2092	10.81	Dry	0	2002
2005	41.13	Wet	91,181	2005	2093	23.07	Wet	1,607	2001
2006	19.24	Near Normal	17,844	2006	2094	12.91	Dry	0	2002
2007	8.66	Dry	0	2007	2095	26.47	Wet	1,607	2001

For the period 1922 through 1978, rainfall at the NCWD gage is calculated from the formula NCWD = 1.1735 * Newhall-Soledad gage rainfall. This relationship is based on a regression analysis for the period 1979-2000.

The median for the Newhall-Soledad rain gage is 14.57 in/yr (1950-2000); the equivalent median is 17.10 in/yr at NCWD. Wet years have rainfall > 115% of median rainfall (greater than 16.75 in/yr at Newhall-Soledad, or 19.66 in/yr or ~ 20 in/yr at NCWD). Dry years have rainfall < 85% of median (less than 12.38 in/yr at Newhall-Soledad, or 14.53 in/yr or ~ 14 in/yr at NCWD).

Table D-11
Castaic Release Volumes (AF) for Historical Record and Climate Change Projection #9 (NCAR_PCM1.3_sresB1)

Historical Conditions					Climate Change Projection #9				
Cal. Year	Rainfall (inches) NCWD Gage	Local Year Type	Castaic Release Volume (AF)	Prototype Year for Castaic Releases	Year	Rainfall (inches) NCWD Gage	Local Year Type	Castaic Release Volume (AF)	Prototype Year for Castaic Releases
1922	37.55	Wet	4,450	1992	2010	22.14	Wet	1,641	1981
1923	16.43	Near Normal	7,086	2000	2011	28.62	Wet	3,019	2003
1924	9.39	Dry	0	1990	2012	18.21	Near Normal	1,607	2001
1925	8.21	Dry	0	1989	2013	18.42	Near Normal	1,607	2001
1926	30.51	Wet	2,805	1980	2014	17.85	Near Normal	1,607	2001
1927	28.16	Wet	1,607	2001	2015	22.34	Wet	3,019	2003
1928	11.74	Dry	0	2002	2016	17.51	Near Normal	1,607	2001
1929	14.08	Dry	0	1960	2017	16.21	Near Normal	1,607	2001
1930	14.08	Dry	0	1960	2018	11.56	Dry	0	2002
1931	28.65	Wet	1,607	2001	2019	11.83	Dry	0	2002
1932	16.11	Near Normal	1,641	1987	2020	37.62	Wet	4,450	1992
1933	24.08	Wet	1,123	2004	2021	16.56	Near Normal	1,607	2001
1934	21.18	Wet	2,050	1988	2022	15.17	Near Normal	1,607	2001
1935	14.33	Dry	5,611	1995	2023	22.88	Wet	1,607	2001
1936	24.02	Wet	1,123	2004	2024	13.18	Dry	0	2002
1937	21.03	Wet	2,050	1988	2025	20.34	Near Normal	1,607	2001
1938	38.43	Wet	5,611	1995	2026	26.96	Wet	3,019	2003
1939	13.23	Dry	3,863	1993	2027	26.47	Wet	4,450	1992
1940	25.08	Wet	1,123	2004	2028	18.04	Near Normal	1,607	2001
1941	49.45	Wet	91,181	2005	2029	18.04	Near Normal	1,607	2001
1942	8.33	Dry	0	1989	2030	16.49	Near Normal	1,607	2001
1943	43.45	Wet	47,802	1998	2031	22.51	Wet	3,019	2003
1944	28.90	Wet	5,611	1995	2032	22.84	Wet	3,019	2003
1945	17.09	Near Normal	9,884	1997	2033	15.01	Near Normal	1,607	2001
1946	25.48	Wet	5,611	1995	2034	13.40	Dry	0	2002
1947	4.88	Dry	0	1972	2035	18.72	Near Normal	1,607	2001
1948	10.71	Dry	0	2002	2036	26.43	Wet	3,019	2003
1949	11.65	Dry	0	2002	2037	11.11	Dry	0	2002
1950	8.03	Dry	0	1989	2038	12.97	Dry	0	2002
1951	14.57	Near Normal	0	1984	2039	41.47	Wet	47,802	1998
1952	40.12	Wet	7,725	1993	2040	18.62	Near Normal	3,019	2003
1953	5.73	Dry	0	1989	2041	39.65	Wet	17,844	2006
1954	18.56	Near Normal	5,632	1996	2042	33.75	Wet	17,844	2006
1955	16.32	Near Normal	1,641	1986	2043	57.56	Wet	91,181	2005
1956	16.68	Near Normal	1,853	1987	2044	14.63	Near Normal	5,611	1995
1957	26.81	Wet	2,244	1982	2045	15.63	Near Normal	1,607	2001
1958	27.15	Wet	2,244	1982	2046	15.41	Near Normal	1,607	2001
1959	11.51	Dry	3,282	1994	2047	24.66	Wet	3,019	2003
1960	13.66	Dry	0	1984	2048	53.80	Wet	91,181	2005
1961	10.35	Dry	5,830	1999	2049	14.70	Near Normal	1,607	2001
1962	24.90	Wet	2,244	1982	2050	9.79	Dry	0	2002
1963	15.01	Near Normal	0	2002	2051	38.49	Wet	17,844	2006
1964	11.84	Dry	3,282	1994	2052	19.57	Near Normal	1,607	2001
1965	37.88	Wet	4,450	1992	2053	20.65	Wet	1,607	2001
1966	17.10	Near Normal	1,853	1987	2054	10.40	Dry	0	2002
1967	27.26	Wet	2,244	1982	2055	12.58	Dry	0	2002

Table D-11
Castaic Release Volumes (AF) for Historical Record and Climate Change Projection #9 (NCAR_PCM1.3_sresB1)

Historical Conditions					Climate Change Projection #9				
Cal. Year	Rainfall (inches) NCWD Gage	Local Year Type	Castaic Release Volume (AF)	Prototype Year for Castaic Releases	Year	Rainfall (inches) NCWD Gage	Local Year Type	Castaic Release Volume (AF)	Prototype Year for Castaic Releases
1968	8.10	Dry	0	1989	2056	17.80	Near Normal	1,607	2001
1969	38.04	Wet	7,725	1993	2057	15.56	Near Normal	1,607	2001
1970	27.21	Wet	2,244	1982	2058	45.18	Wet	47,802	1998
1971	16.14	Near Normal	1,641	1986	2059	26.78	Wet	7,725	1993
1972	4.87	Dry	0	1989	2060	23.78	Wet	5,611	1995
1973	23.22	Wet	2,244	1982	2061	47.61	Wet	47,802	1998
1974	21.17	Wet	1,641	1986	2062	28.90	Wet	7,725	1993
1975	12.81	Dry	3,282	1994	2063	30.43	Wet	7,725	1993
1976	16.45	Near Normal	1,853	1987	2064	18.15	Near Normal	3,019	2003
1977	24.49	Wet	2,244	1982	2065	30.15	Wet	7,725	1993
1978	49.49	Wet	3,928	1983	2066	13.65	Dry	1,607	2001
1979	23.75	Wet	2,244	1982	2067	16.34	Near Normal	1,607	2001
1980	31.95	Wet	2,805	1980	2068	10.60	Dry	0	2002
1981	16.80	Near Normal	1,641	1986	2069	60.56	Wet	91,181	2005
1982	24.82	Wet	2,244	1982	2070	20.56	Wet	7,725	1993
1983	48.33	Wet	3,928	1983	2071	15.31	Near Normal	3,019	2003
1984	12.55	Dry	0	1984	2072	33.67	Wet	7,725	1993
1985	9.76	Dry	0	1985	2073	46.34	Wet	47,802	1998
1986	23.06	Wet	1,641	1986	2074	33.69	Wet	17,844	2006
1987	16.76	Near Normal	1,853	1987	2075	15.71	Near Normal	5,611	1995
1988	20.05	Wet	2,050	1988	2076	14.36	Near Normal	1,607	2001
1989	8.47	Dry	0	1989	2077	21.25	Wet	5,611	1995
1990	9.34	Dry	0	1990	2078	37.14	Wet	17,844	2006
1991	24.61	Wet	66	1991	2079	31.87	Wet	7,725	1993
1992	39.24	Wet	4,450	1992	2080	8.14	Dry	1,607	2001
1993	36.08	Wet	7,725	1993	2081	25.22	Wet	5,611	1995
1994	11.97	Dry	3,282	1994	2082	32.82	Wet	7,725	1993
1995	36.28	Wet	5,611	1995	2083	28.25	Wet	5,611	1995
1996	23.65	Wet	5,632	1996	2084	7.23	Dry	1,607	2001
1997	17.93	Near Normal	9,884	1997	2085	11.37	Dry	0	2002
1998	40.60	Wet	47,802	1998	2086	27.47	Wet	5,611	1995
1999	10.05	Dry	5,830	1999	2087	20.97	Wet	3,019	2003
2000	17.33	Near Normal	7,086	2000	2088	16.12	Near Normal	1,607	2001
2001	27.24	Wet	1,607	2001	2089	64.70	Wet	91,181	2005
2002	11.50	Dry	0	2002	2090	21.30	Wet	7,725	1993
2003	19.78	Near Normal	3,019	2003	2091	12.38	Dry	1,607	2001
2004	23.26	Wet	1,123	2004	2092	22.06	Wet	3,019	2003
2005	41.13	Wet	91,181	2005	2093	19.32	Near Normal	1,607	2001
2006	19.24	Near Normal	17,844	2006	2094	20.91	Wet	1,607	2001
2007	8.66	Dry	0	2007	2095	21.05	Wet	1,607	2001

For the period 1922 through 1978, rainfall at the NCWD gage is calculated from the formula NCWD = 1.1735 * Newhall-Soledad gage rainfall. This relationship is based on a regression analysis for the period 1979-2000.

The median for the Newhall-Soledad rain gage is 14.57 in/yr (1950-2000); the equivalent median is 17.10 in/yr at NCWD. Wet years have rainfall > 115% of median rainfall (greater than 16.75 in/yr at Newhall-Soledad, or 19.66 in/yr or ~ 20 in/yr at NCWD). Dry years have rainfall < 85% of median (less than 12.38 in/yr at Newhall-Soledad, or 14.53 in/yr or ~ 14 in/yr at NCWD).

Figure D-1: 30-Year Moving Average Rainfall Projections at Newhall-Soledad Rain Gage
(For Nine Studied Projections)

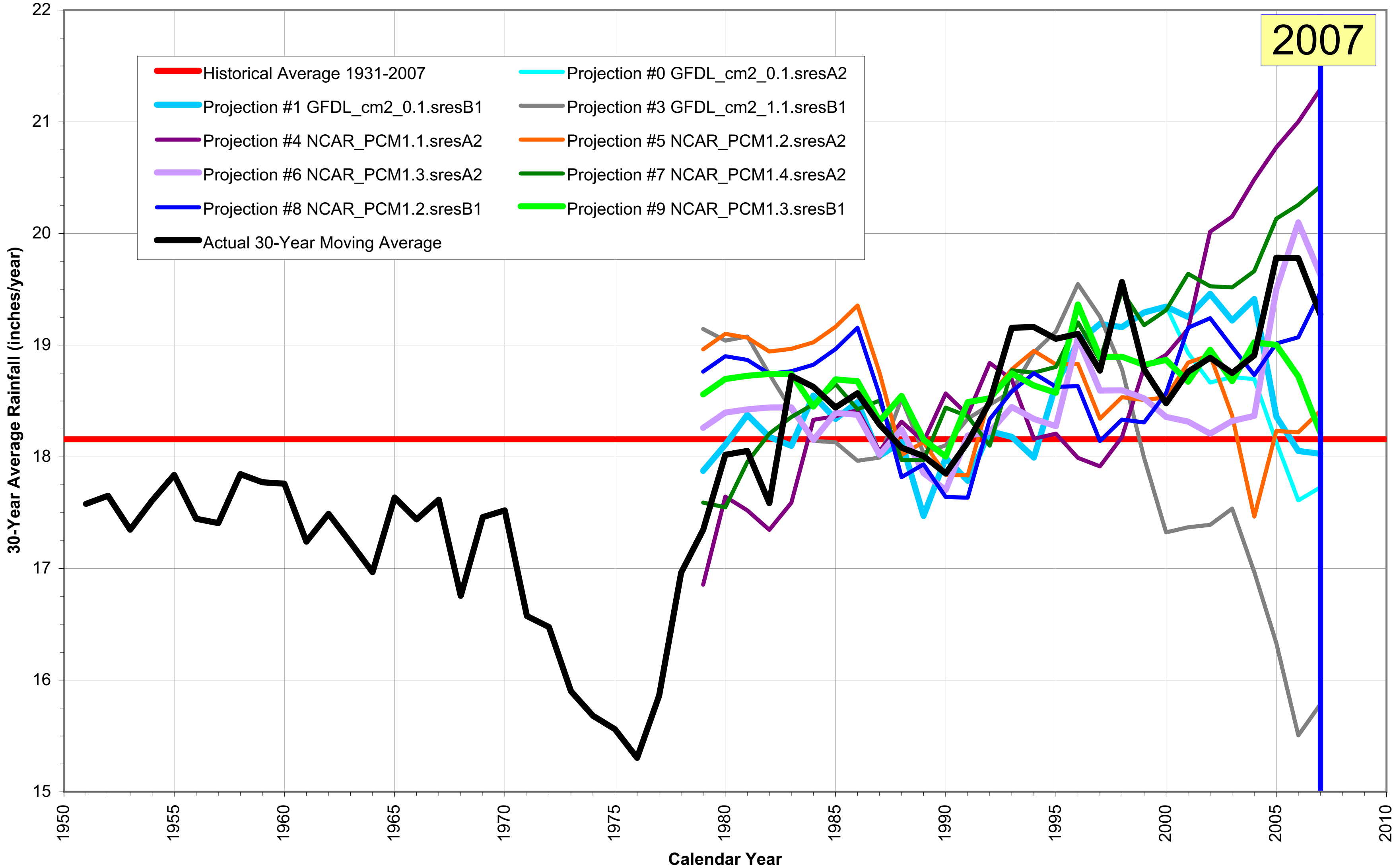


Figure D-2: 30-Year Moving Average Annual Rainfall at Newhall-Soledad Rain Gage (1950 - 2007)

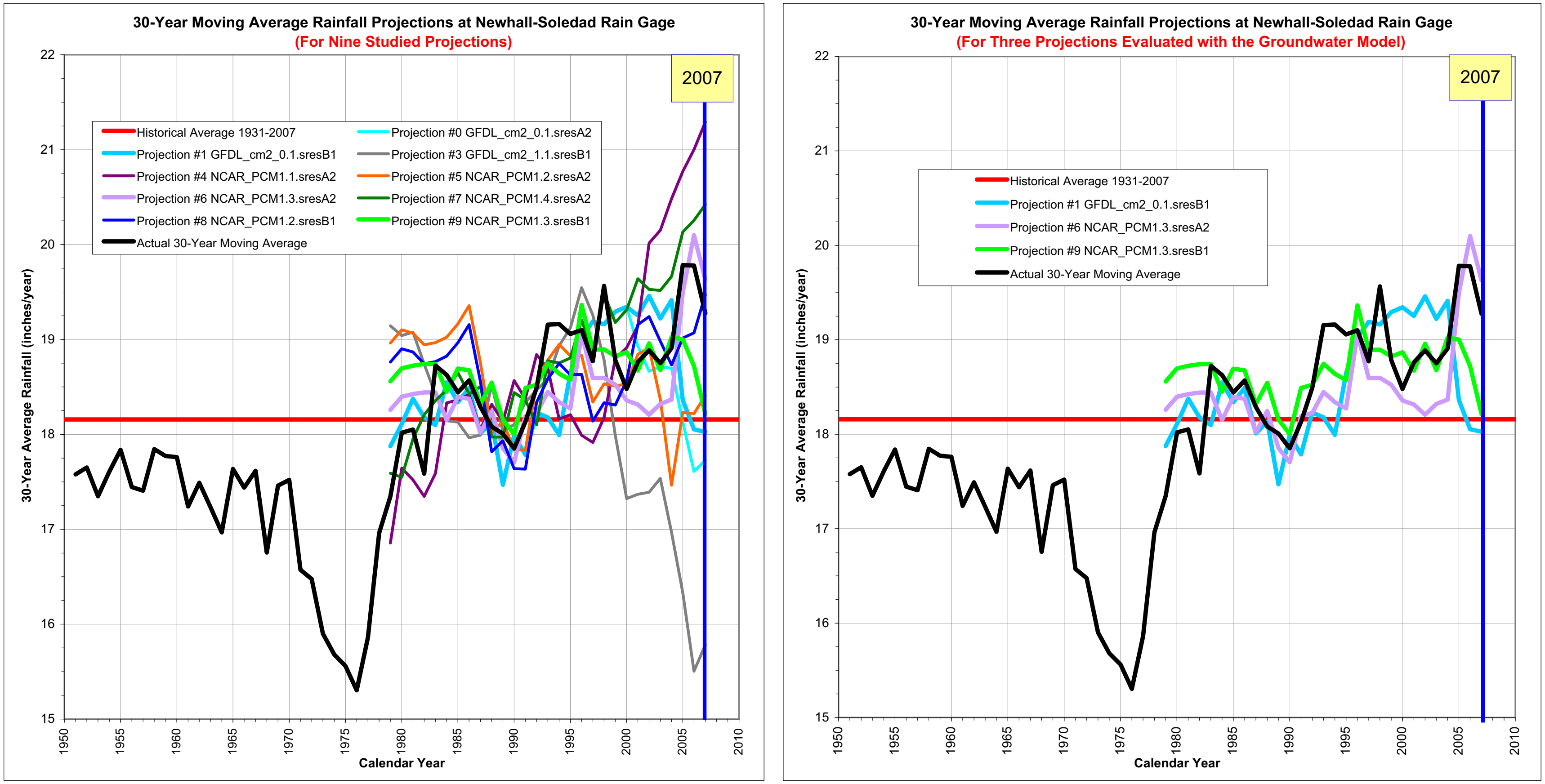
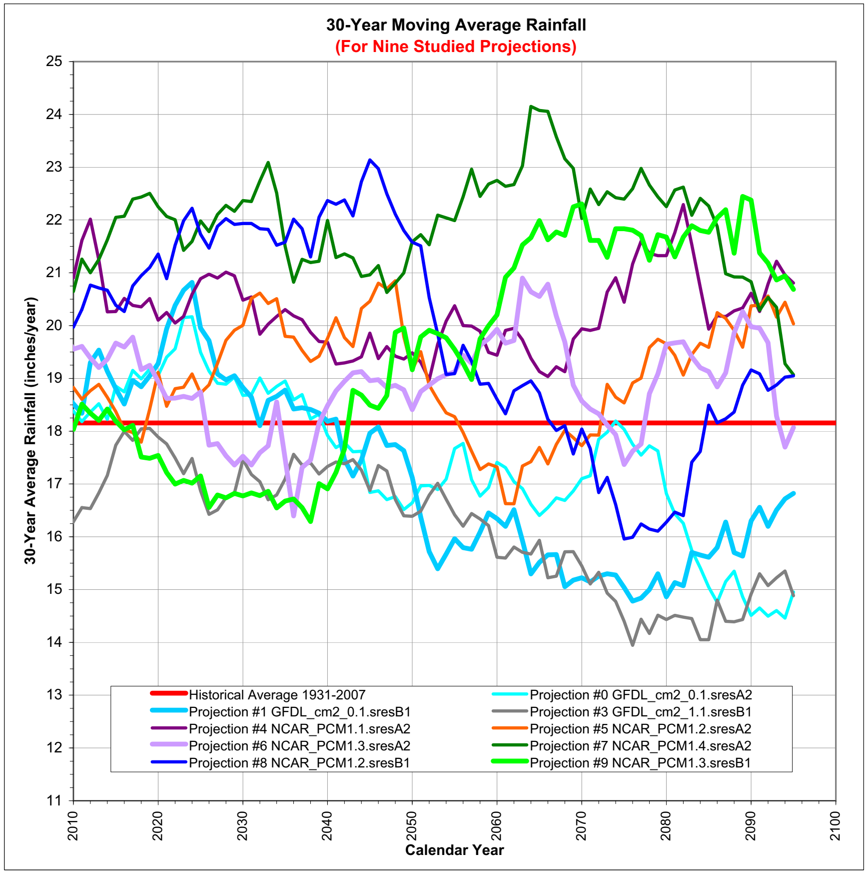


Figure D-3: 30-Year Moving Average Annual Rainfall at Newhall-Soledad Rain Gage (2010 - 2095)



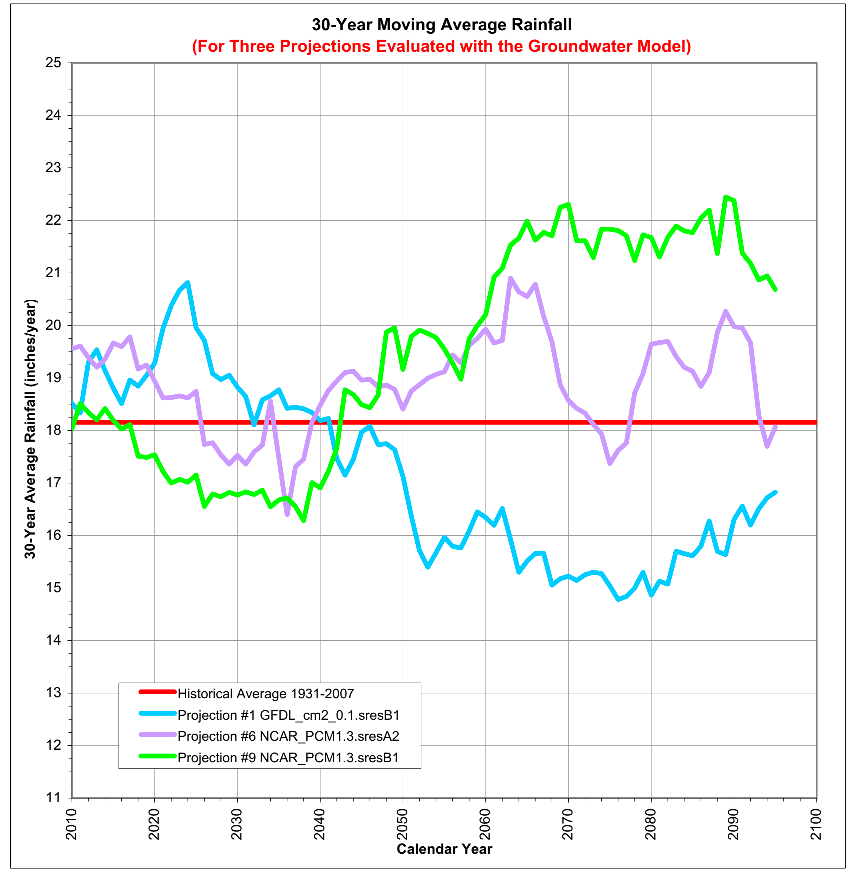
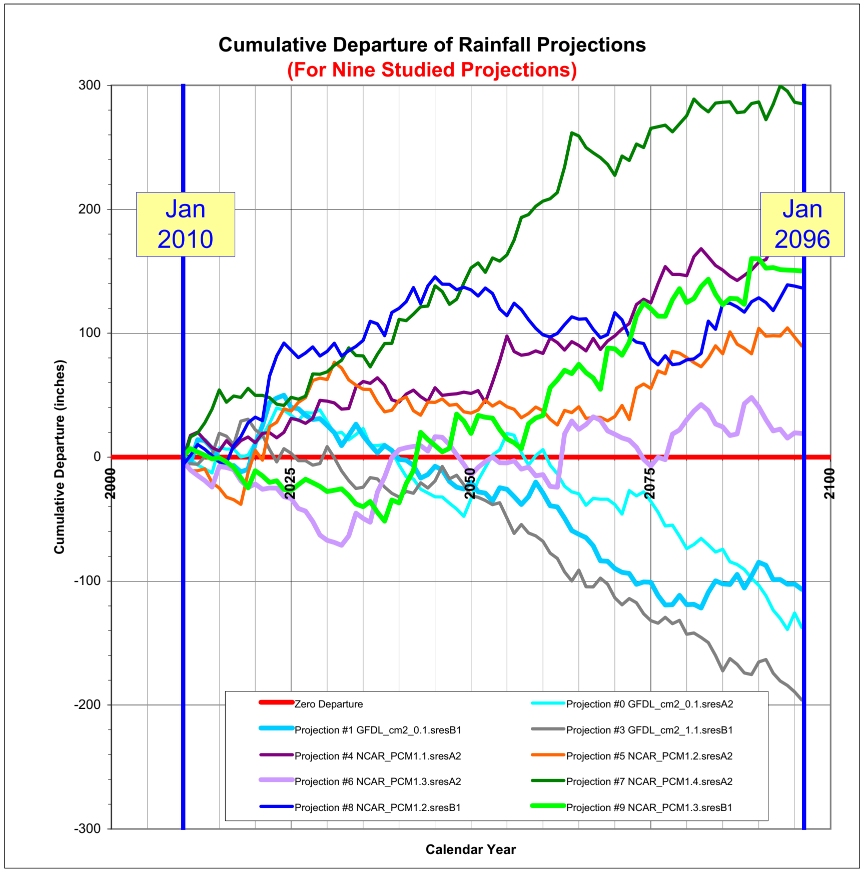


Figure D-4: Cumulative Departure from Average Annual Rainfall at Newhall-Soledad Rain Gage (2010-2095)



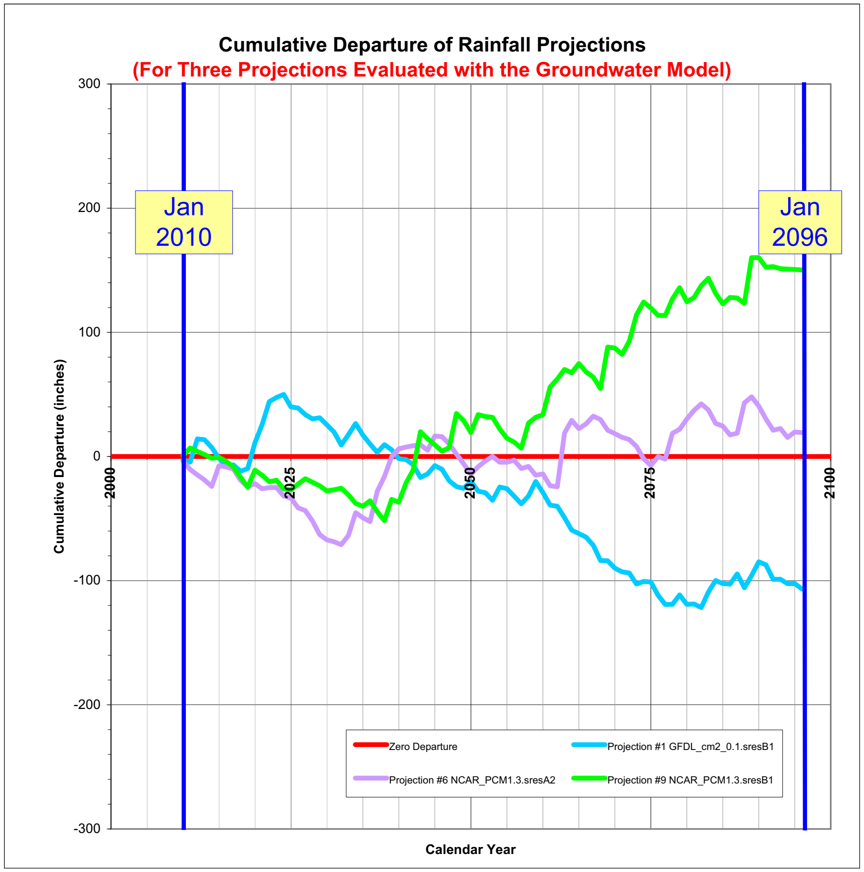
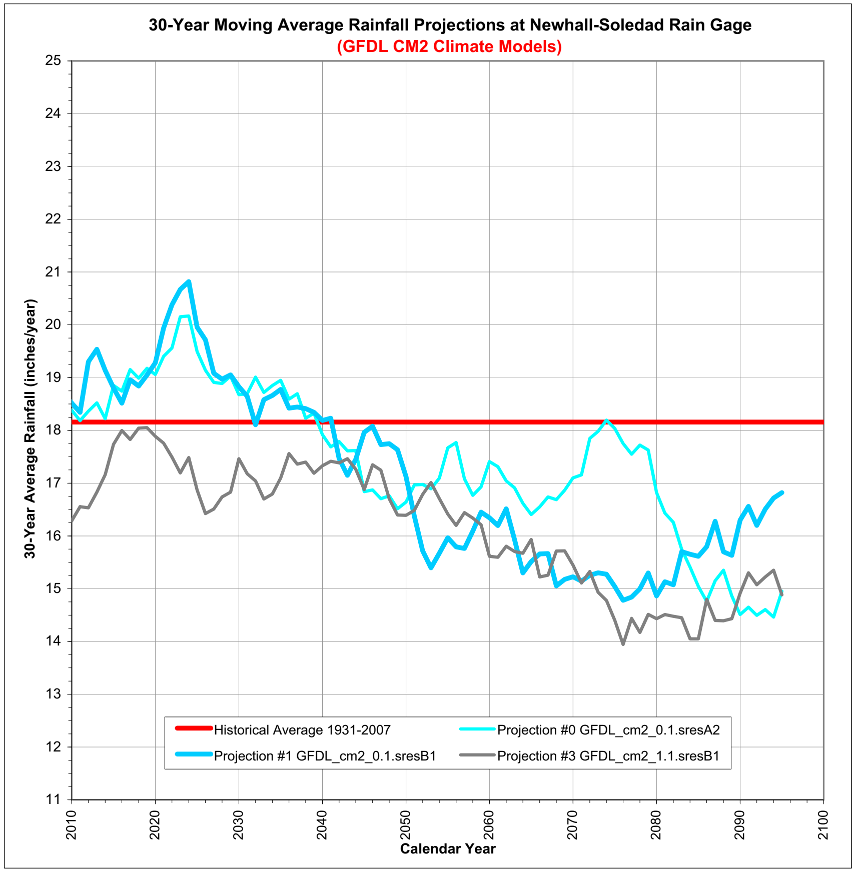


Figure D-5: 30-Year Moving Average Annual Rainfall at Newhall-Soledad Rain Gage (2010 - 2095)



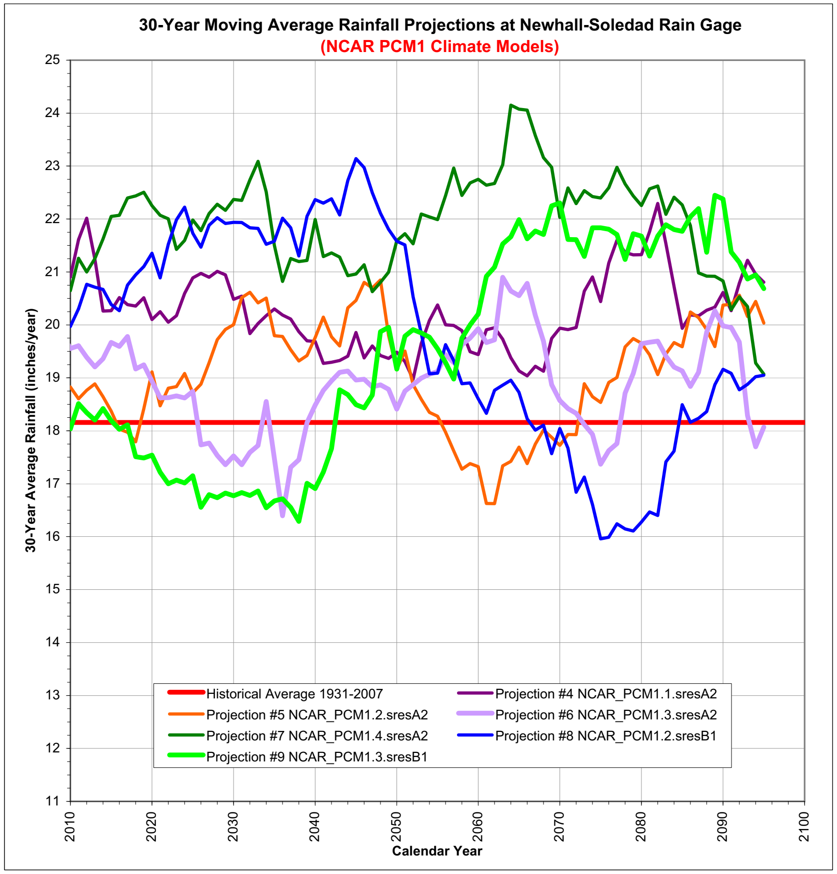
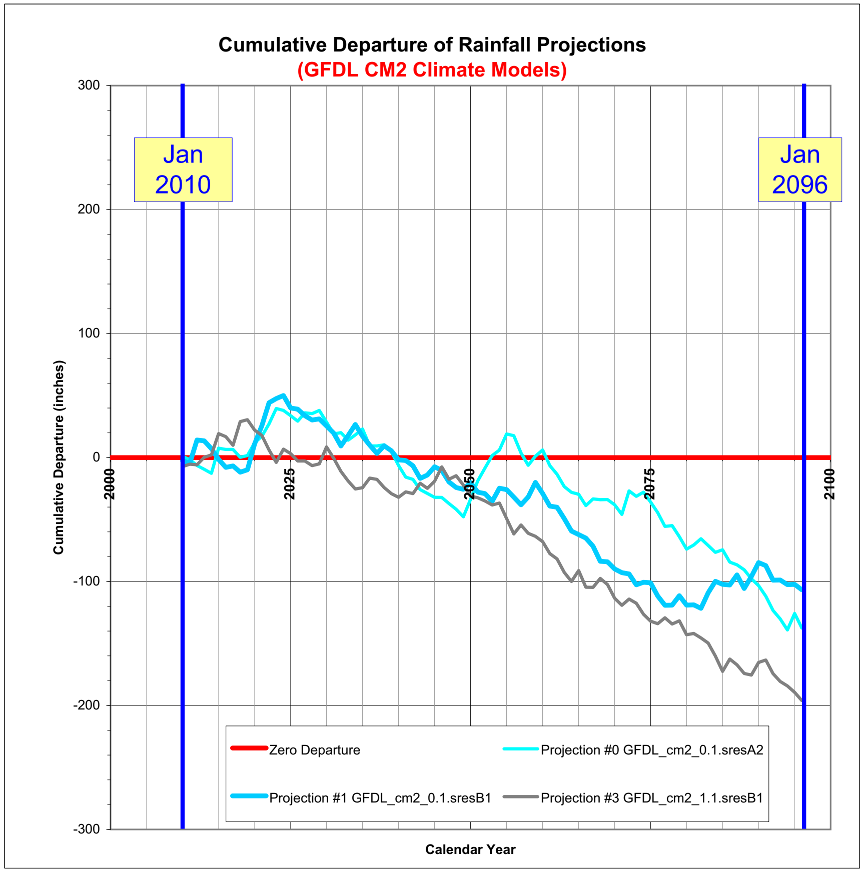


Figure D-6: Cumulative Departure from Average Annual Rainfall at Newhall-Soledad Rain Gage (2010-2095)



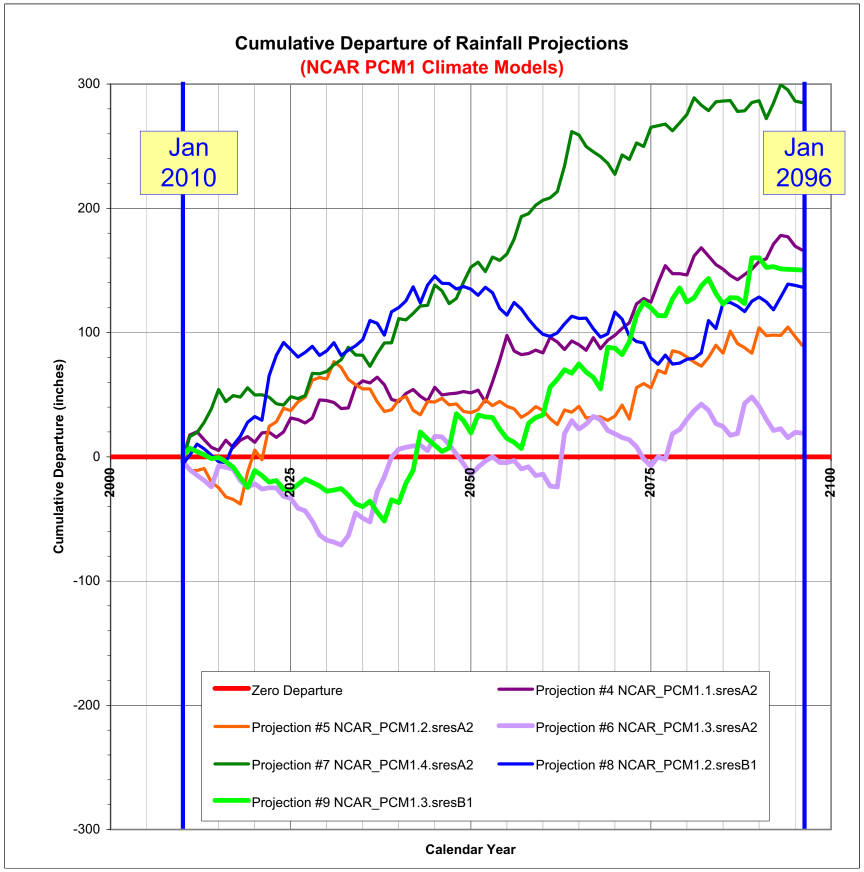


Figure D-7: 30-Year Moving Average Annual Rainfall at Newhall-Soledad Rain Gage (2010 - 2095)

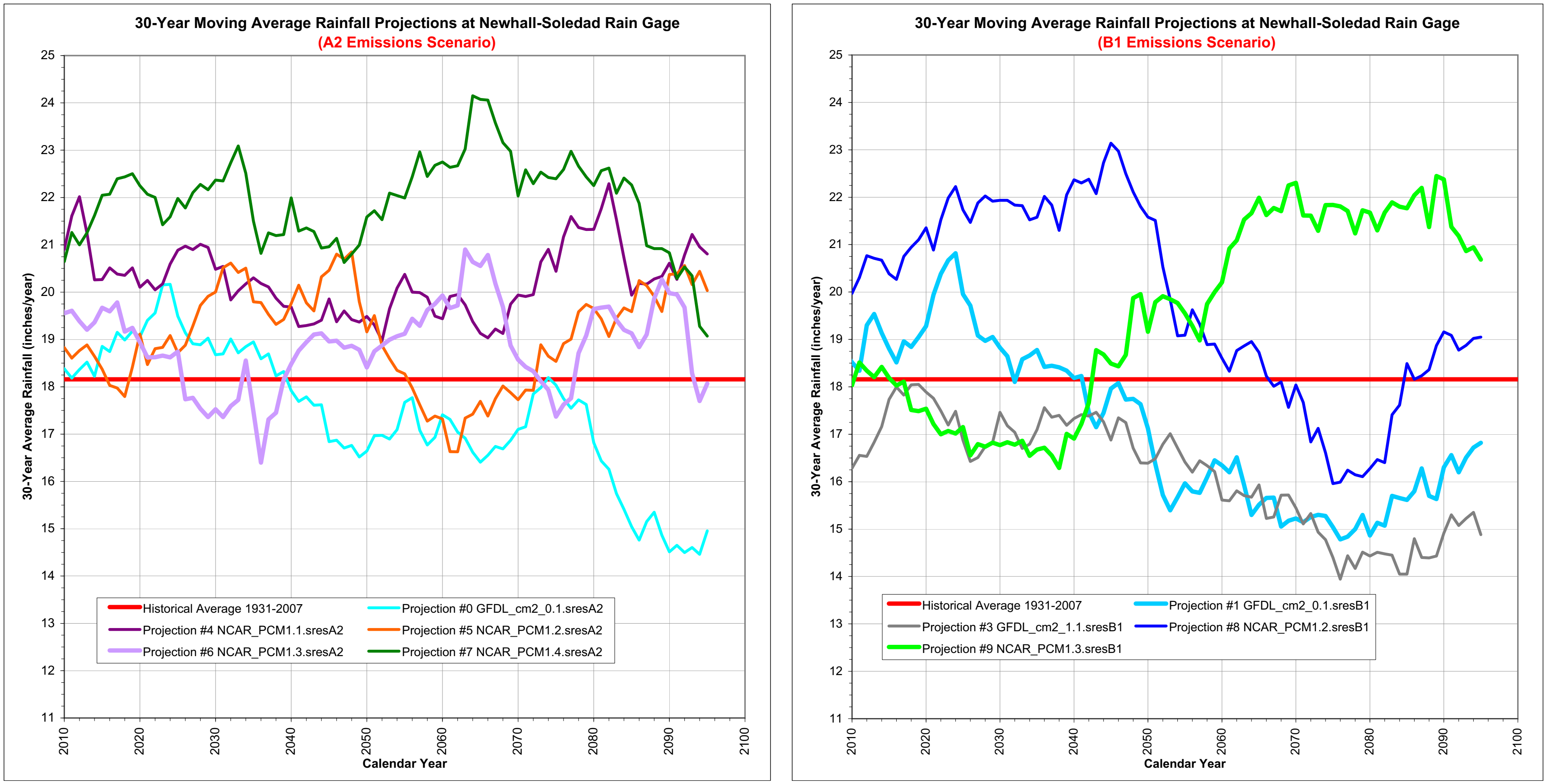
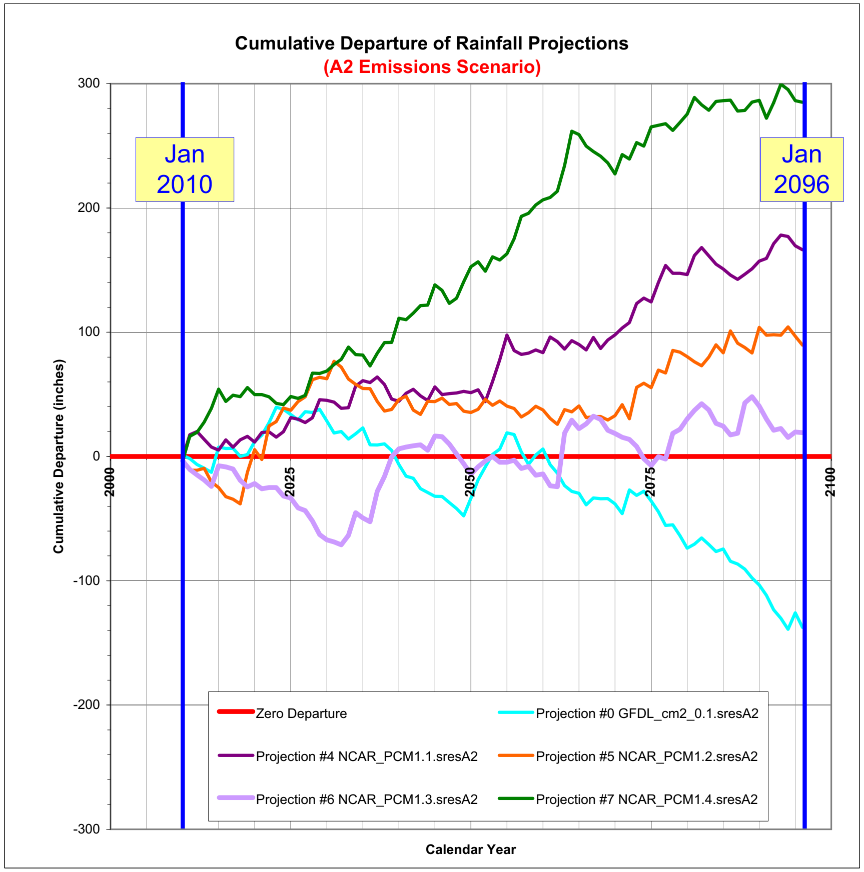
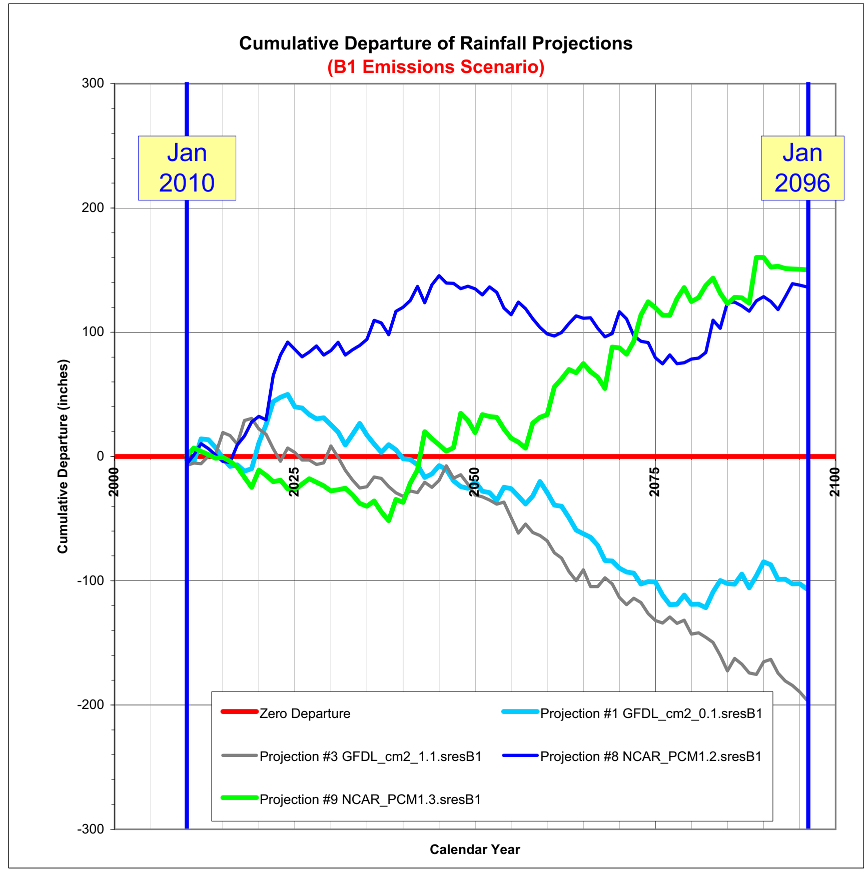


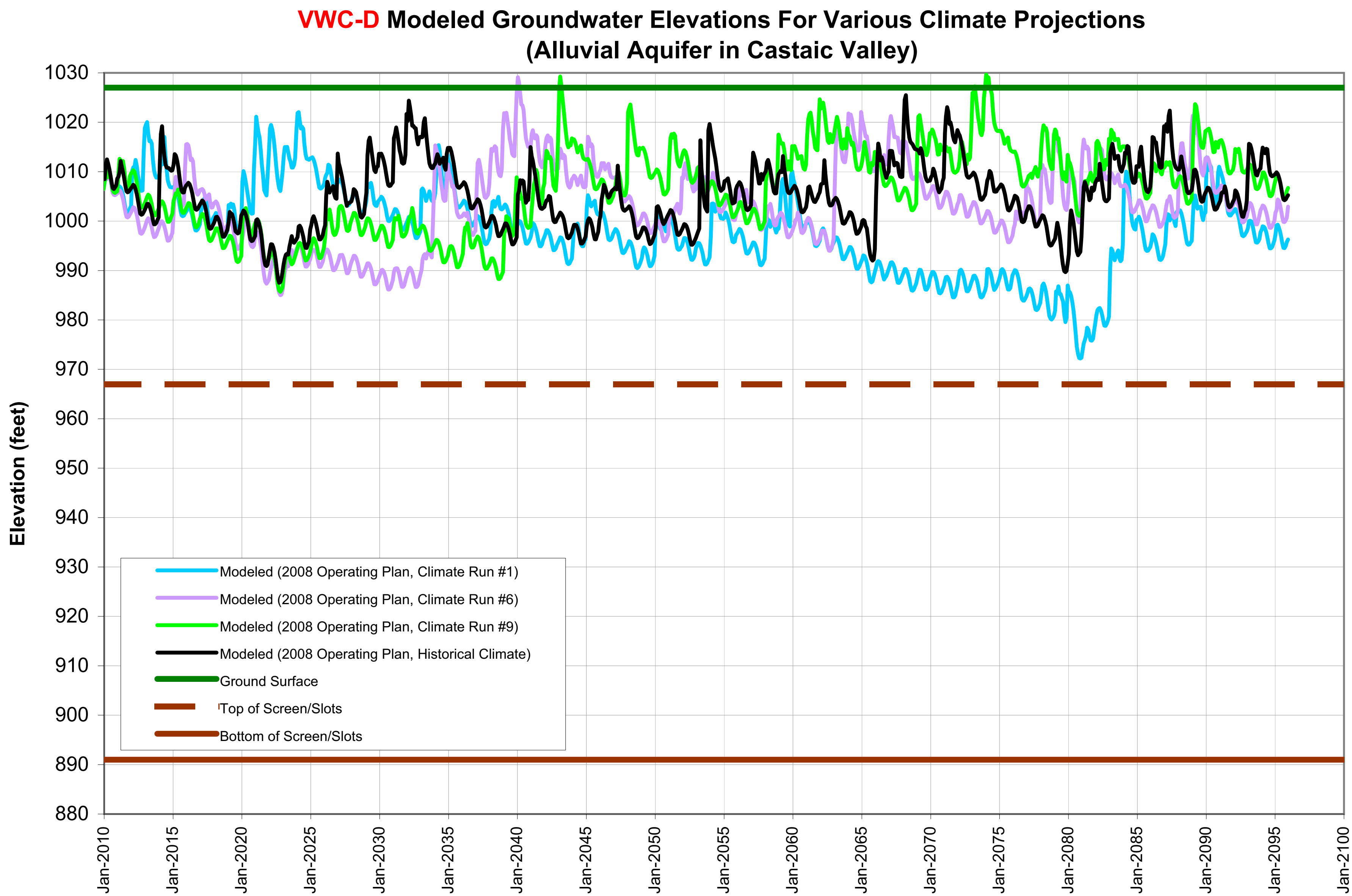
Figure D-8: Cumulative Departure from Average Annual Rainfall at Newhall-Soledad Rain Gage (2010-2095)

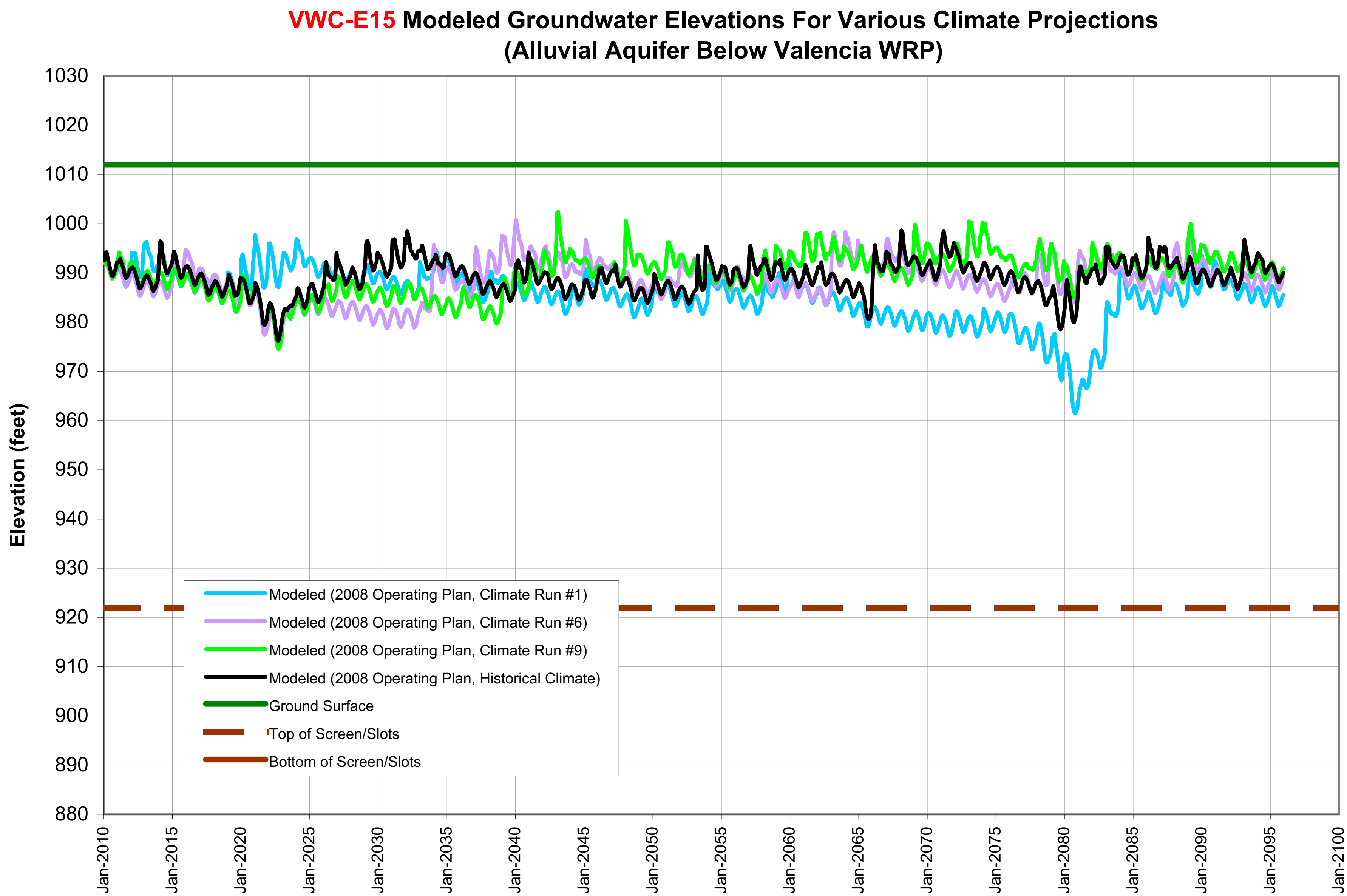




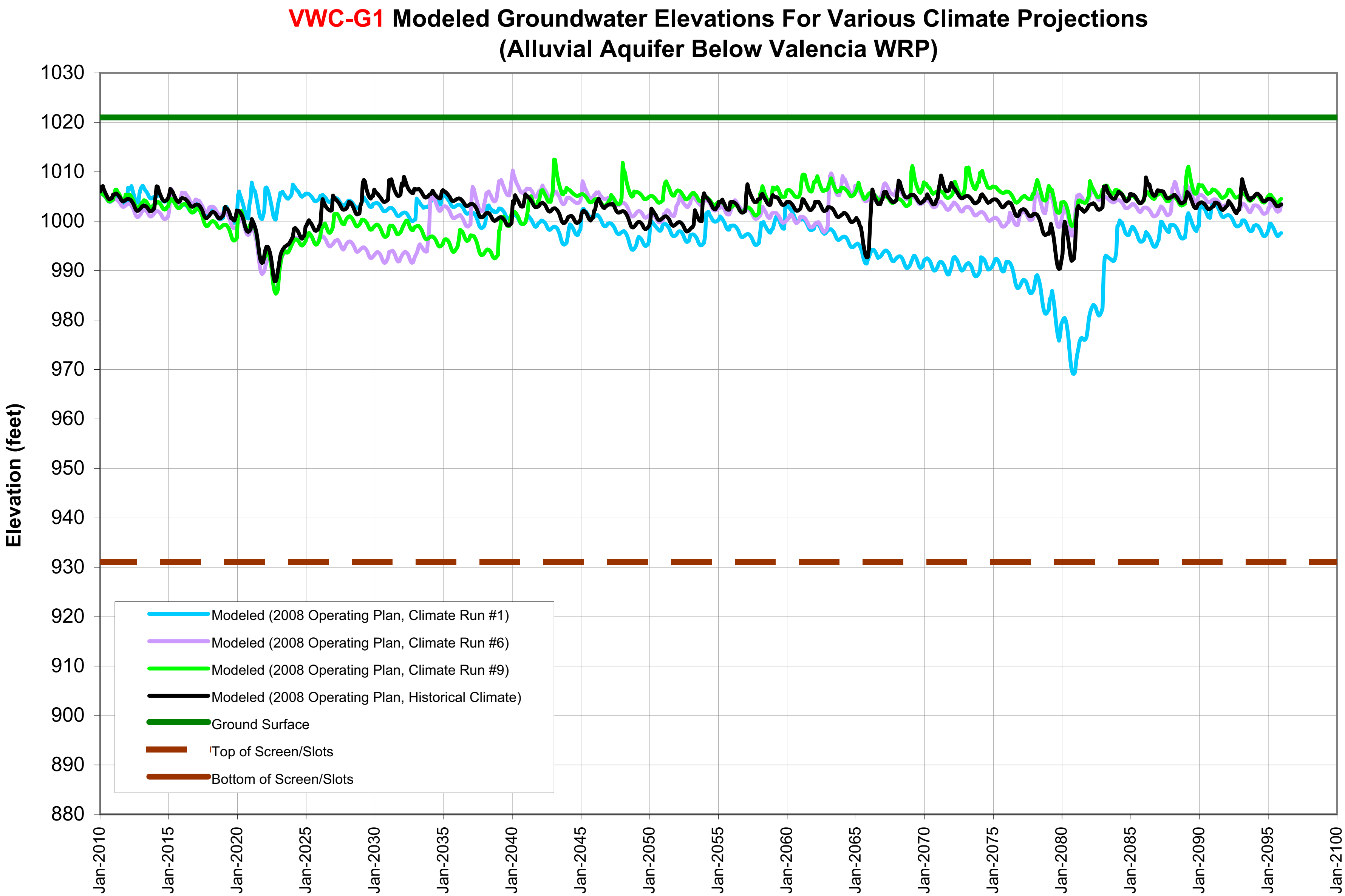
Appendi E

Simulated limate hange Groundwater Elevation drographs

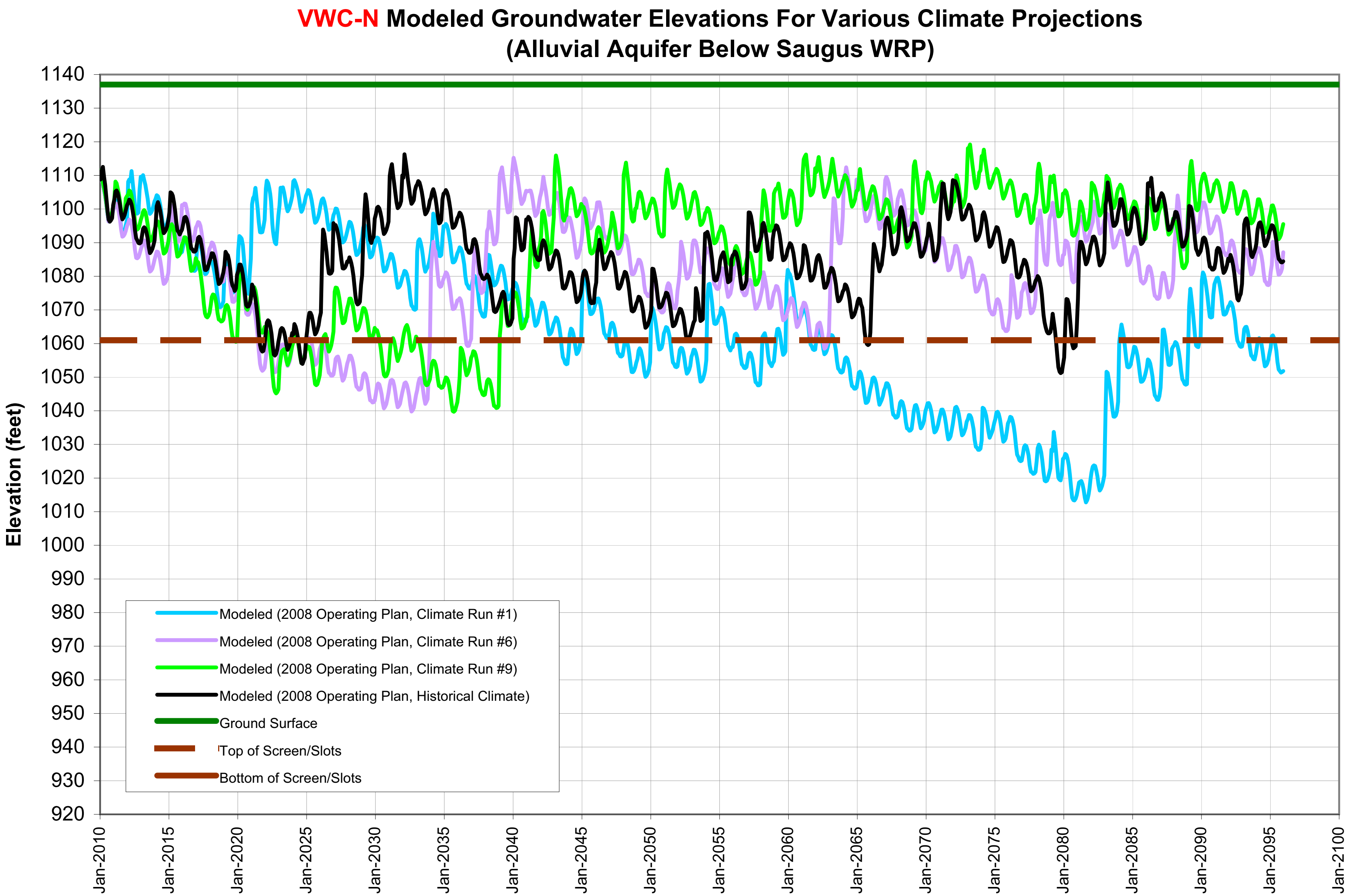

VWC-D Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer in Castaic Valley)
Elevation (feet)
1030
1020
1010
1000
990
980
970
960
950
940
930
920
910
900
890
880
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots



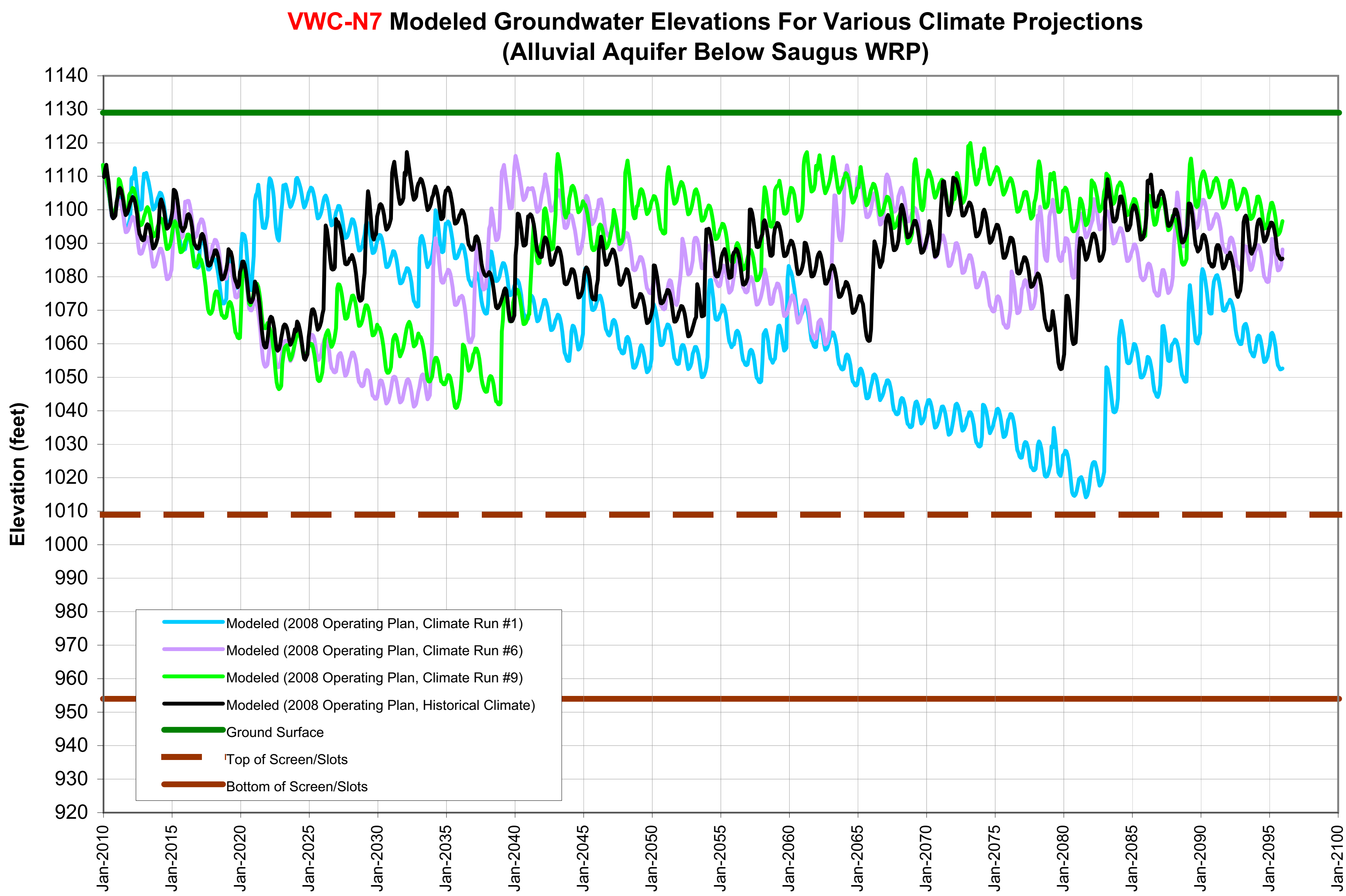
VWC-E15 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Below Valencia WRP)
Elevation (feet)
1030
1020
1010
1000
990
980
970
960
950
940
930
920
910
900
890
880
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

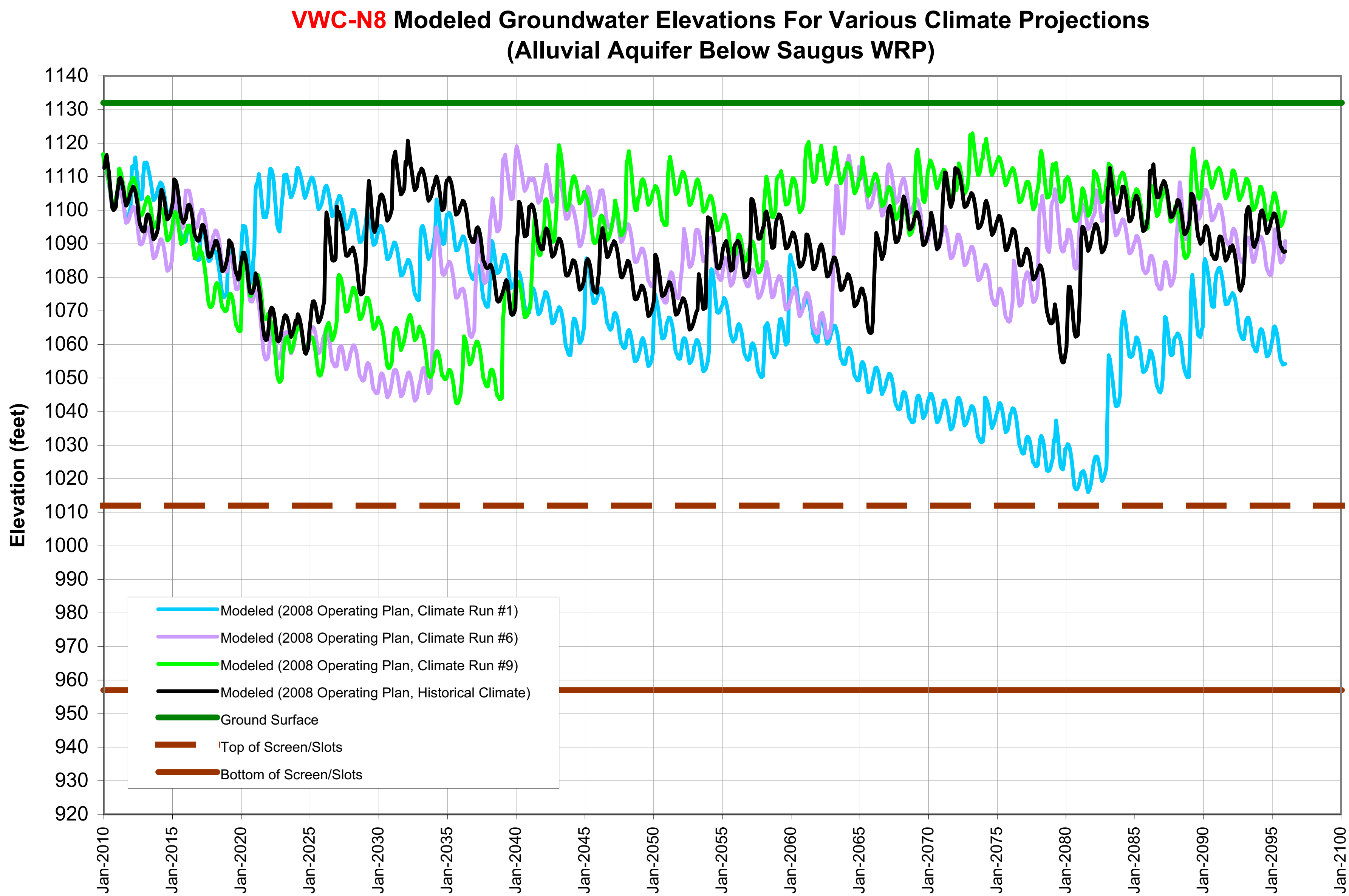


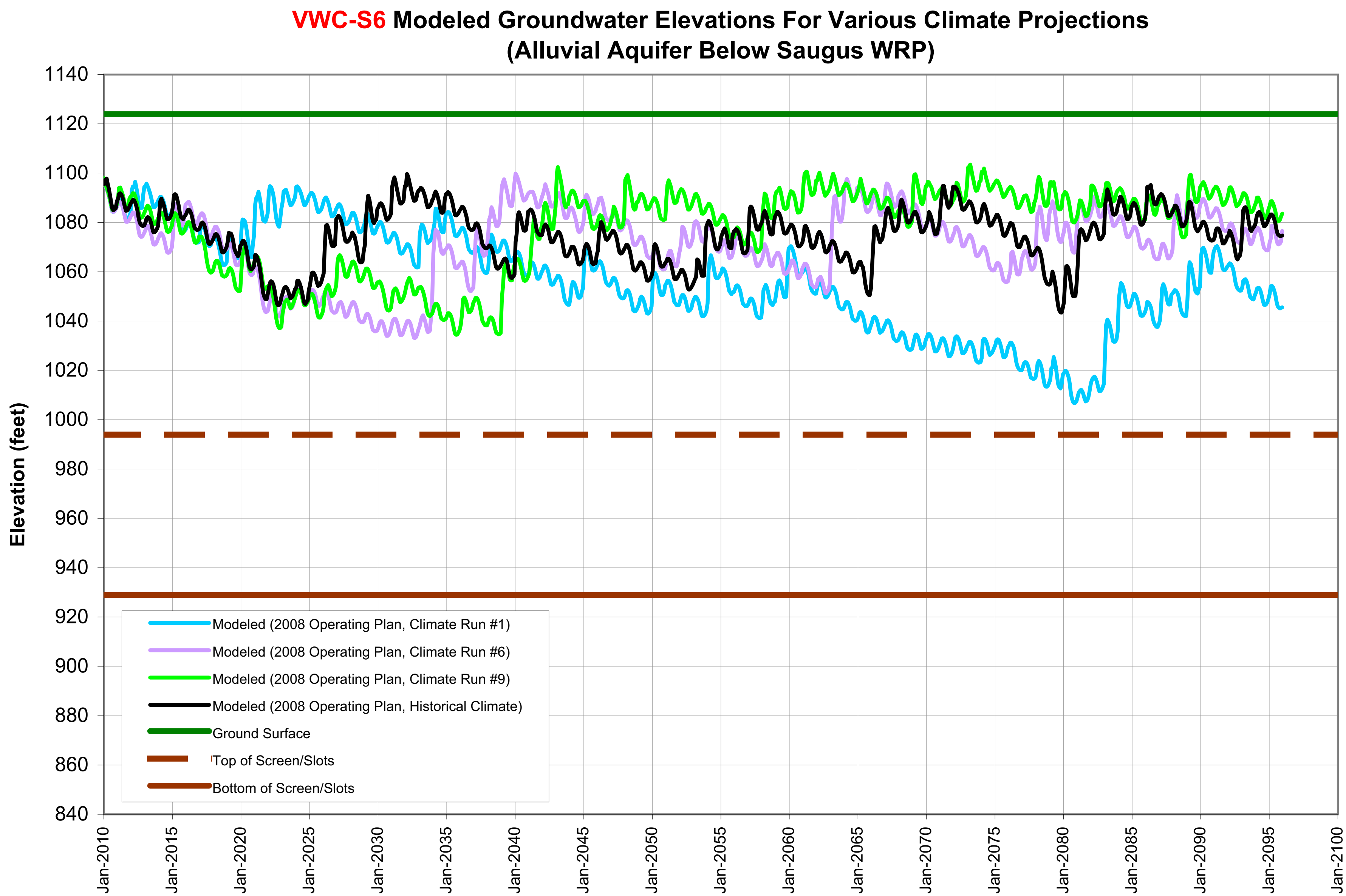
VWC-G1 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Below Valencia WRP)
Elevation (feet)
1030
1020
1010
1000
990
980
970
960
950
940
930
920
910
900
890
880
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots



VWC-N Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Below Saugus WRP)
Elevation (feet)
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

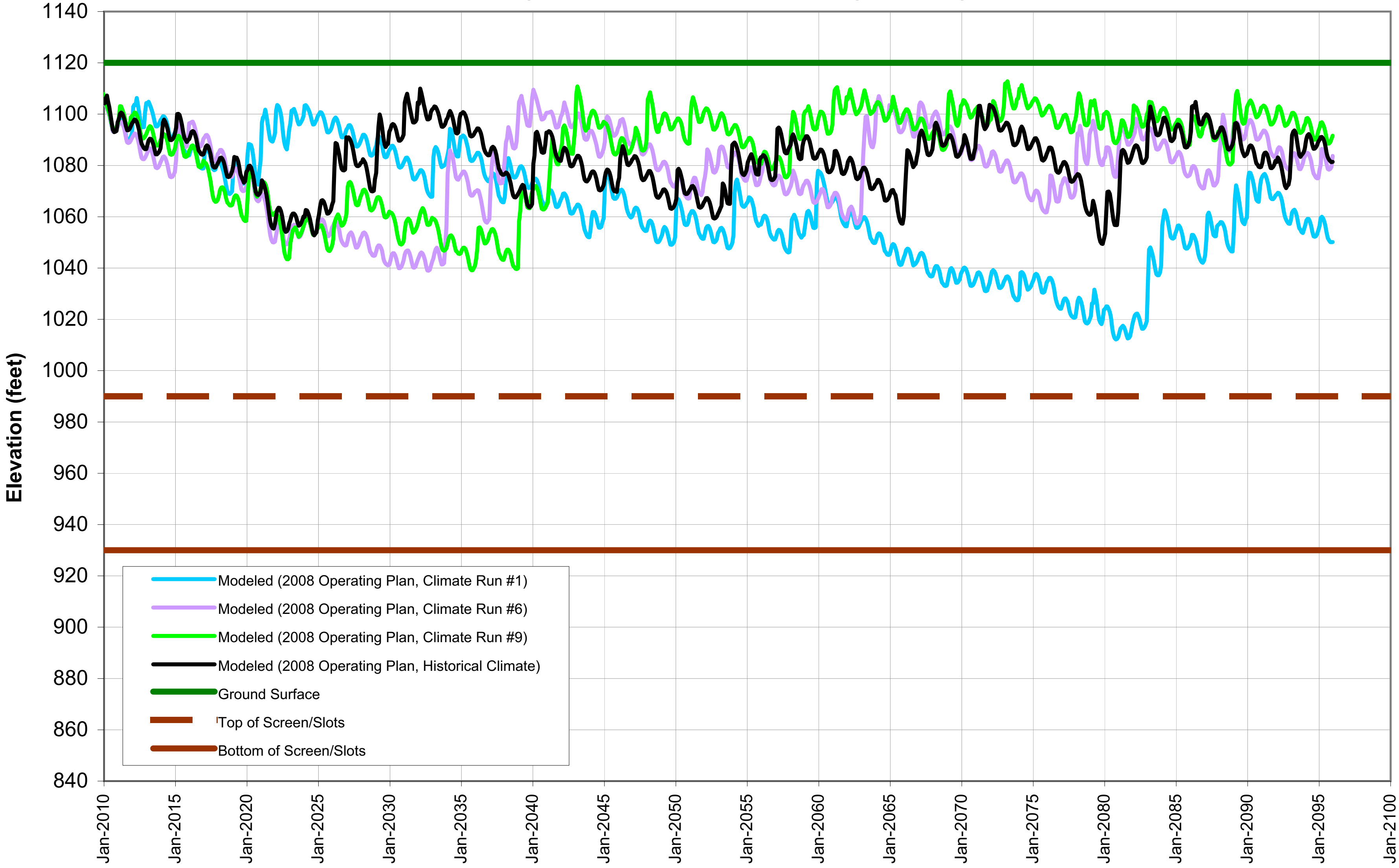

VWC-N7 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Below Saugus WRP)
Elevation (feet)
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

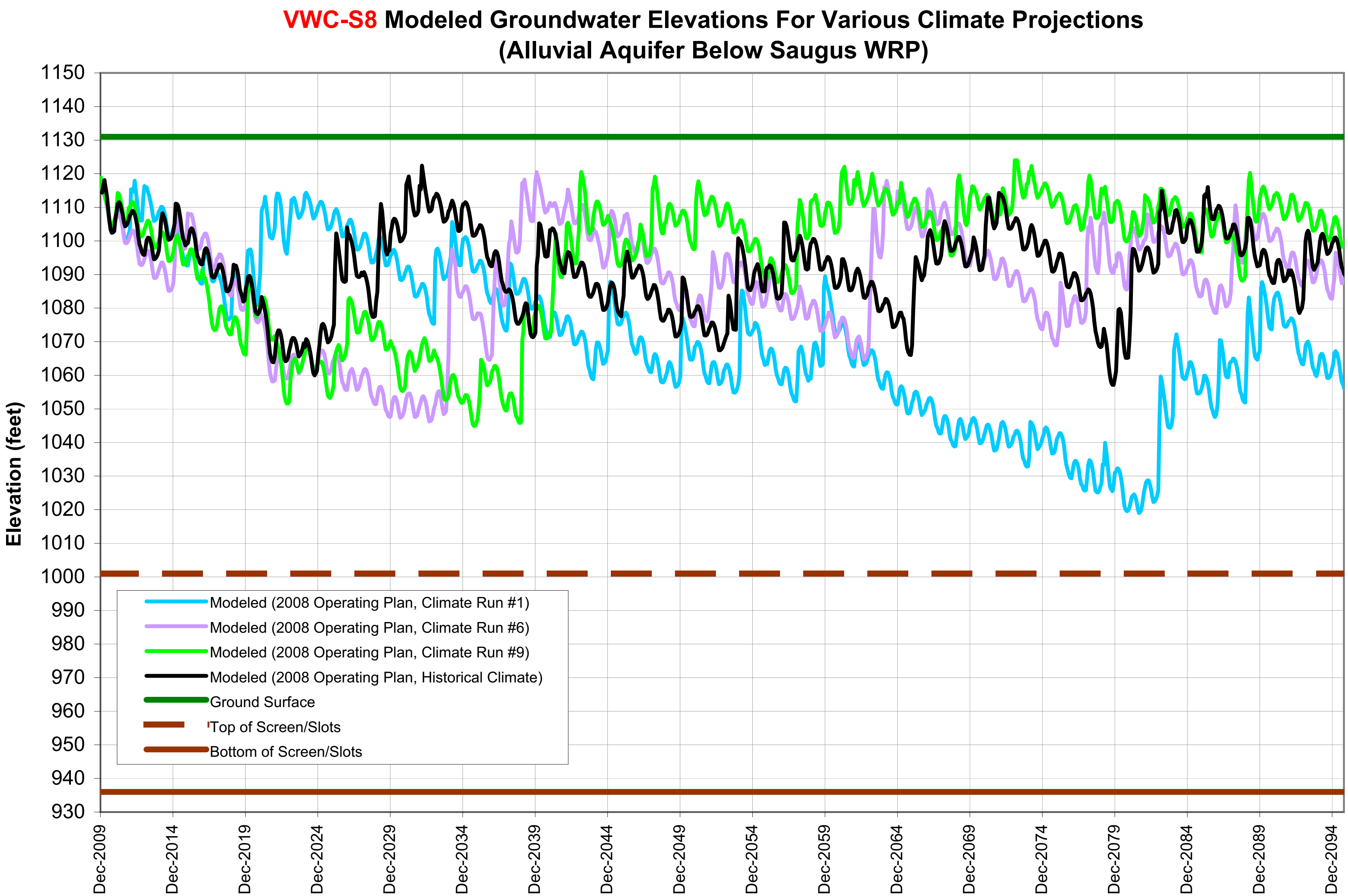

VWC-N8 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Below Saugus WRP)
Elevation (feet)
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

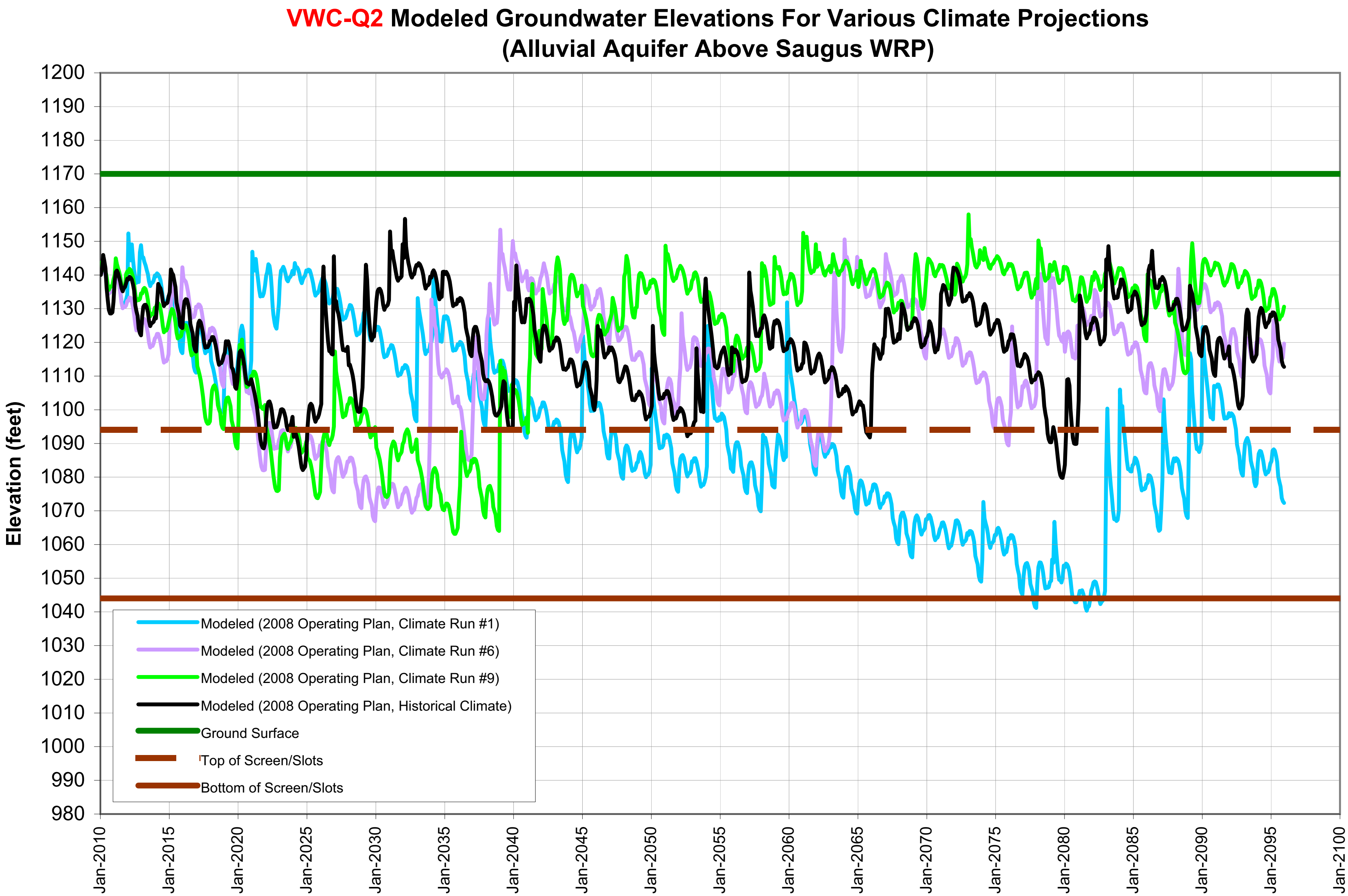


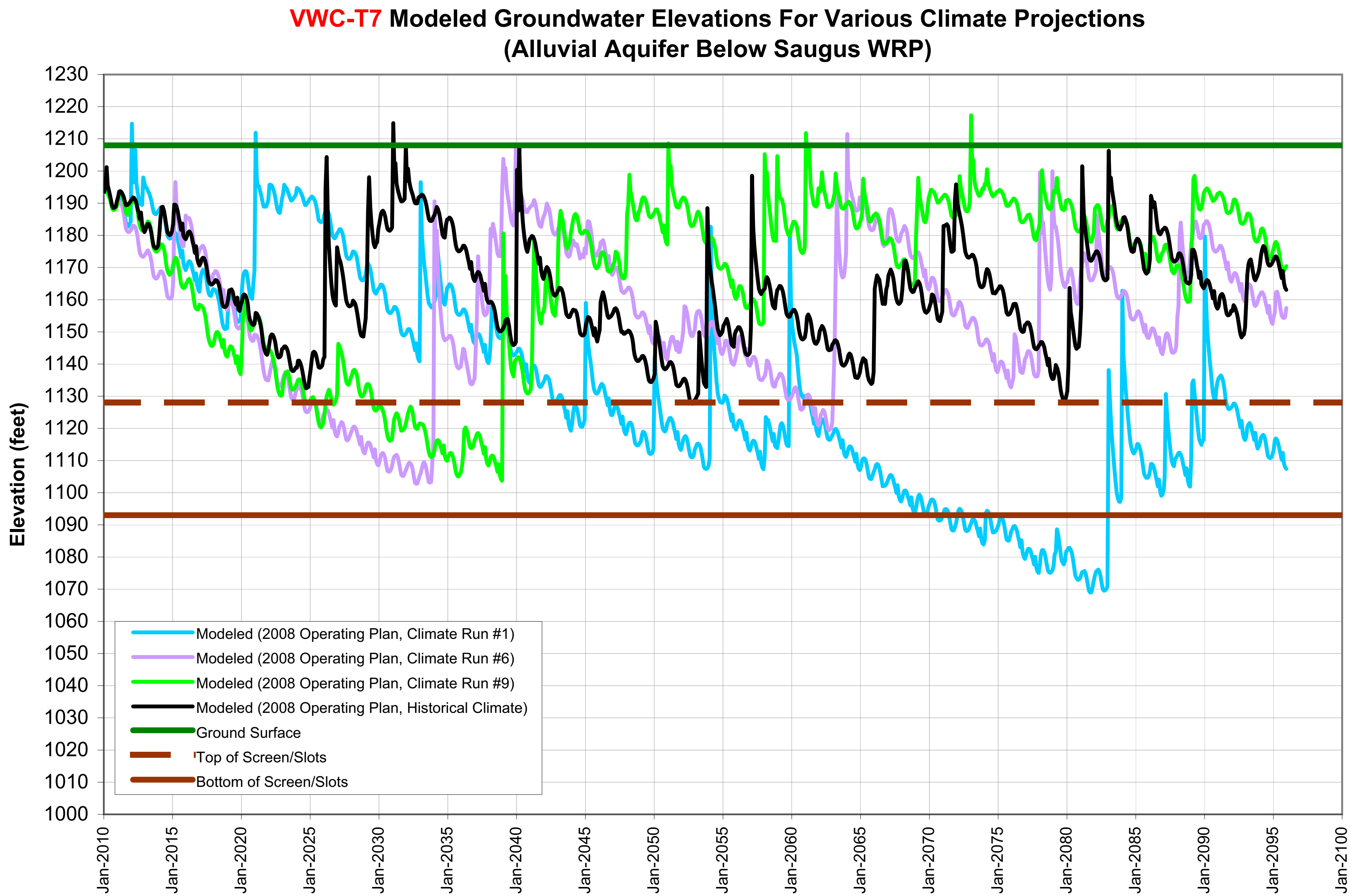
VWC-S6 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Below Saugus WRP)
Elevation (feet)
1140
1120
1100
1080
1060
1040
1020
1000
980
960
940
920
900
880
860
840
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100

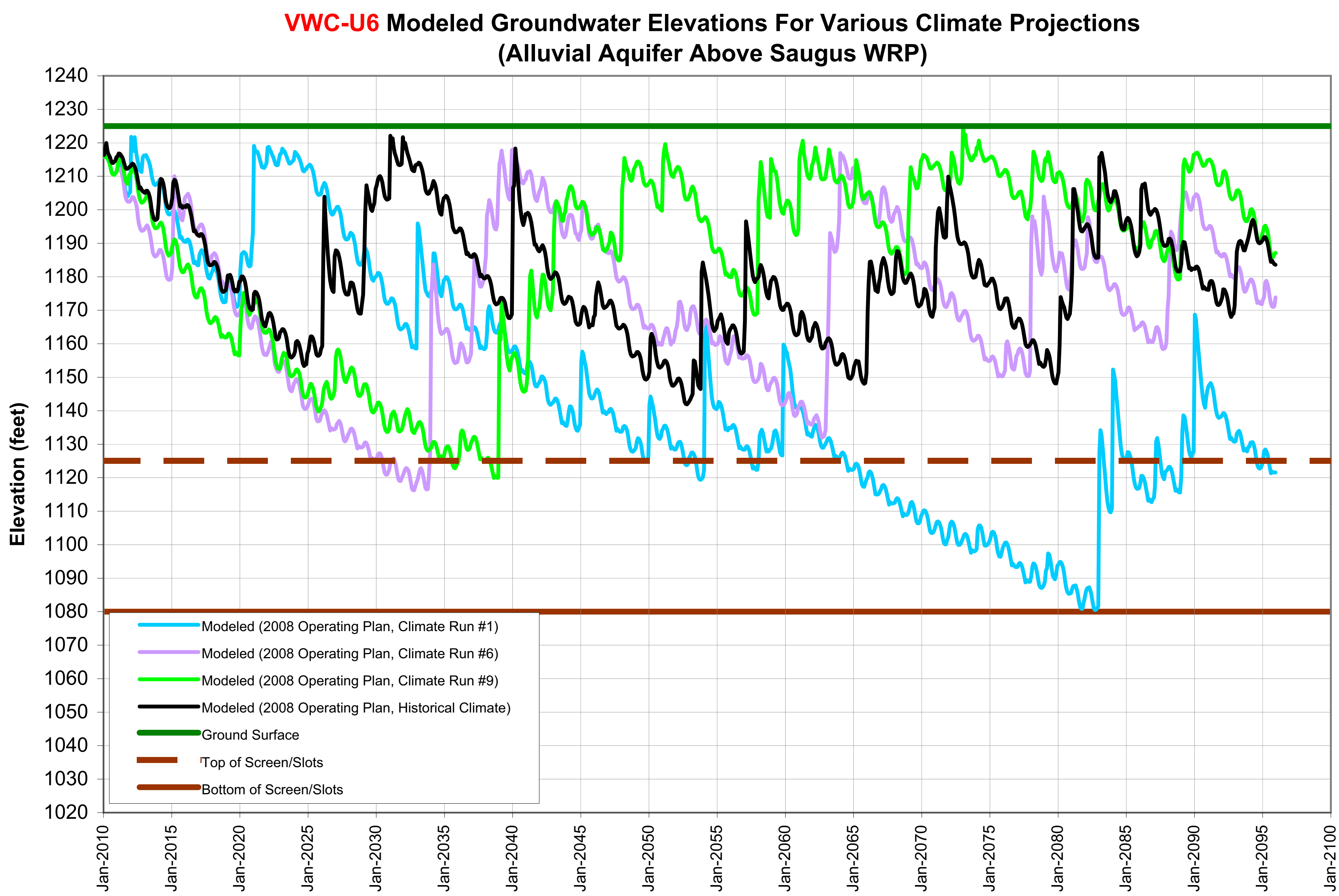
VWC-S7 Modeled Groundwater Elevations For Various Climate Projections (Alluvial Aquifer Below Saugus WRP)

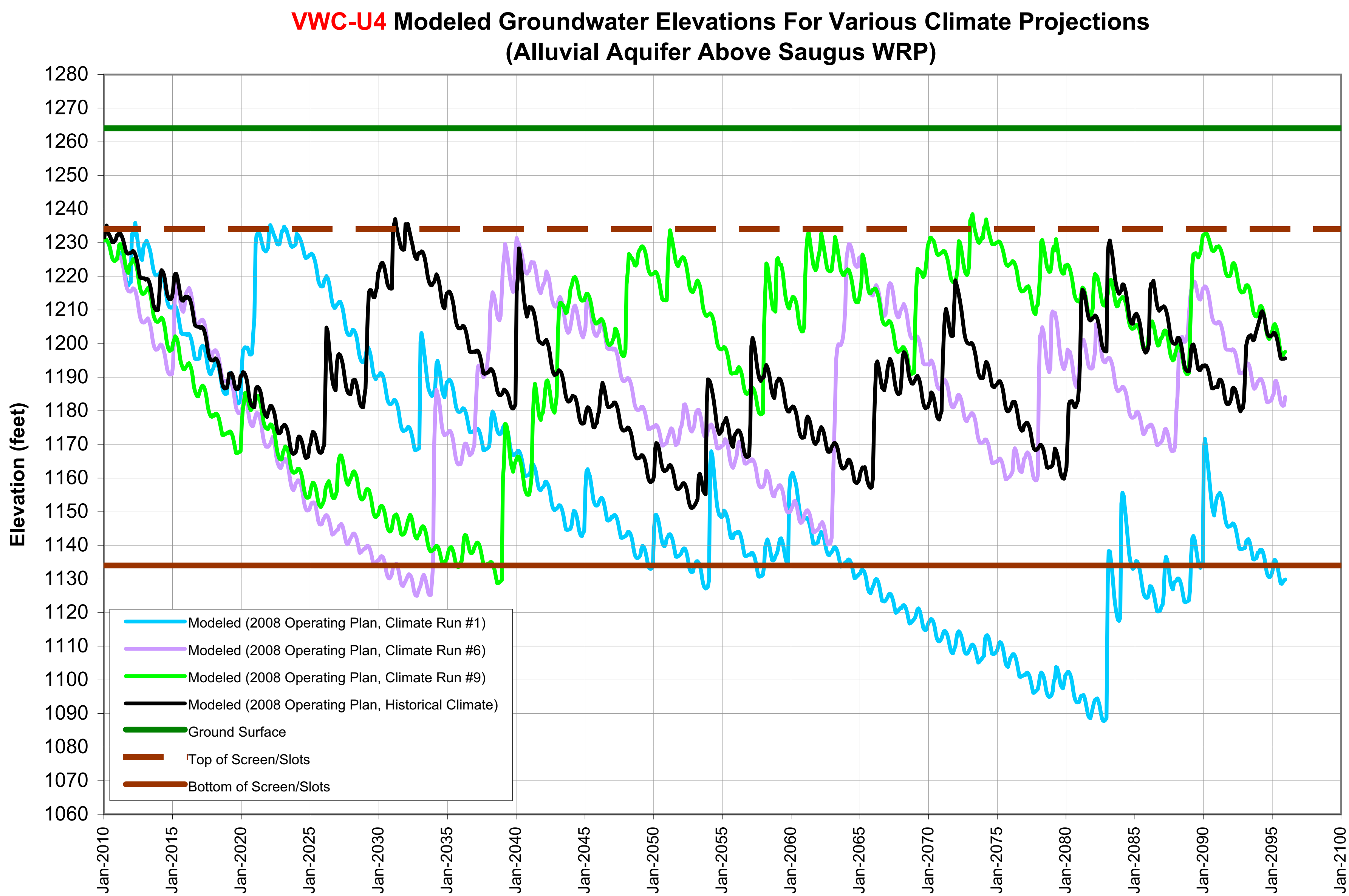



VWC-S8 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Below Saugus WRP)
Elevation (feet)
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
Dec-2009
Dec-2014
Dec-2019
Dec-2024
Dec-2029
Dec-2034
Dec-2039
Dec-2044
Dec-2049
Dec-2054
Dec-2059
Dec-2064
Dec-2069
Dec-2074
Dec-2079
Dec-2084
Dec-2089
Dec-2094
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

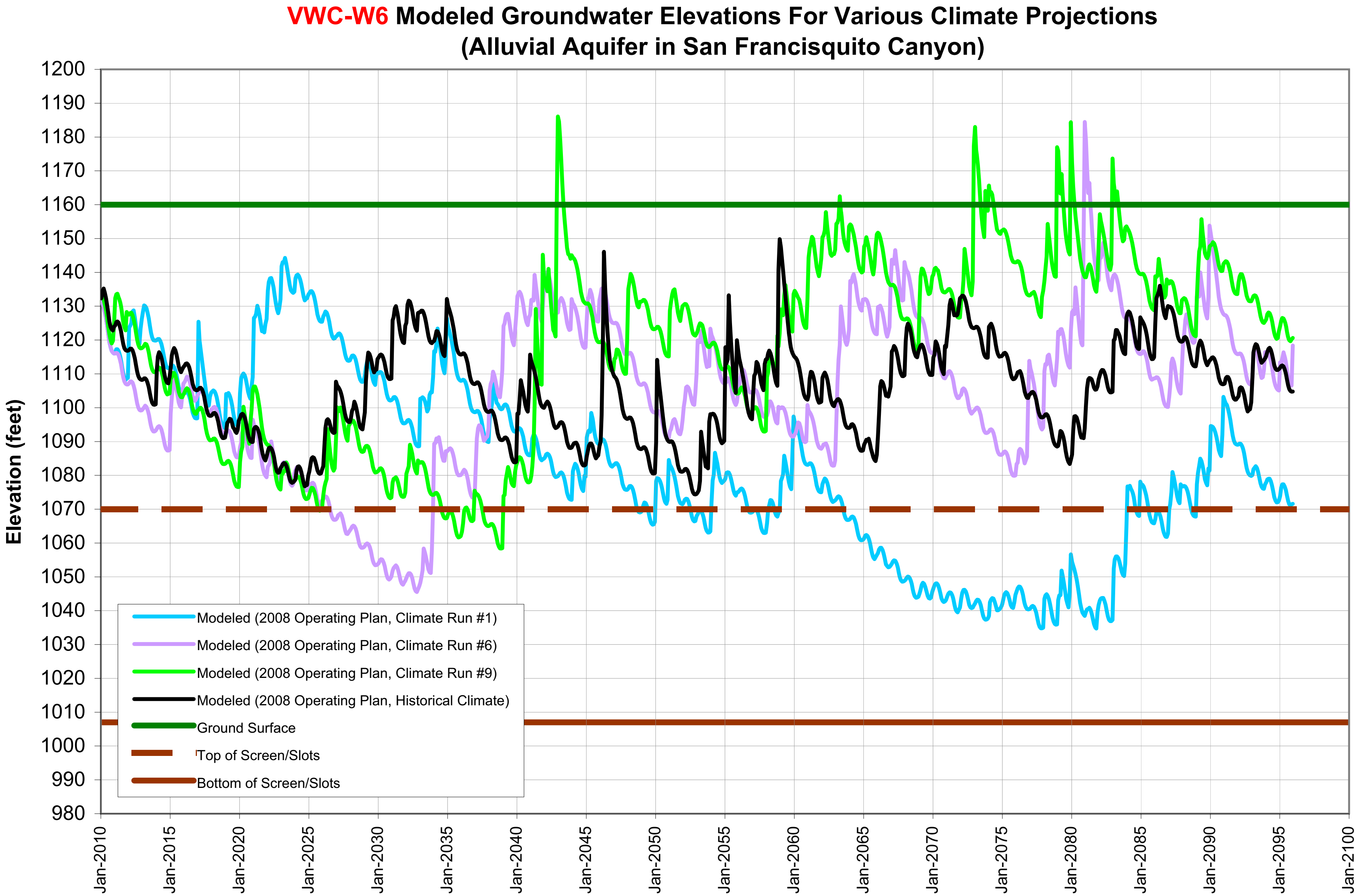

VWC-Q2 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Above Saugus WRP)
Elevation (feet)
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

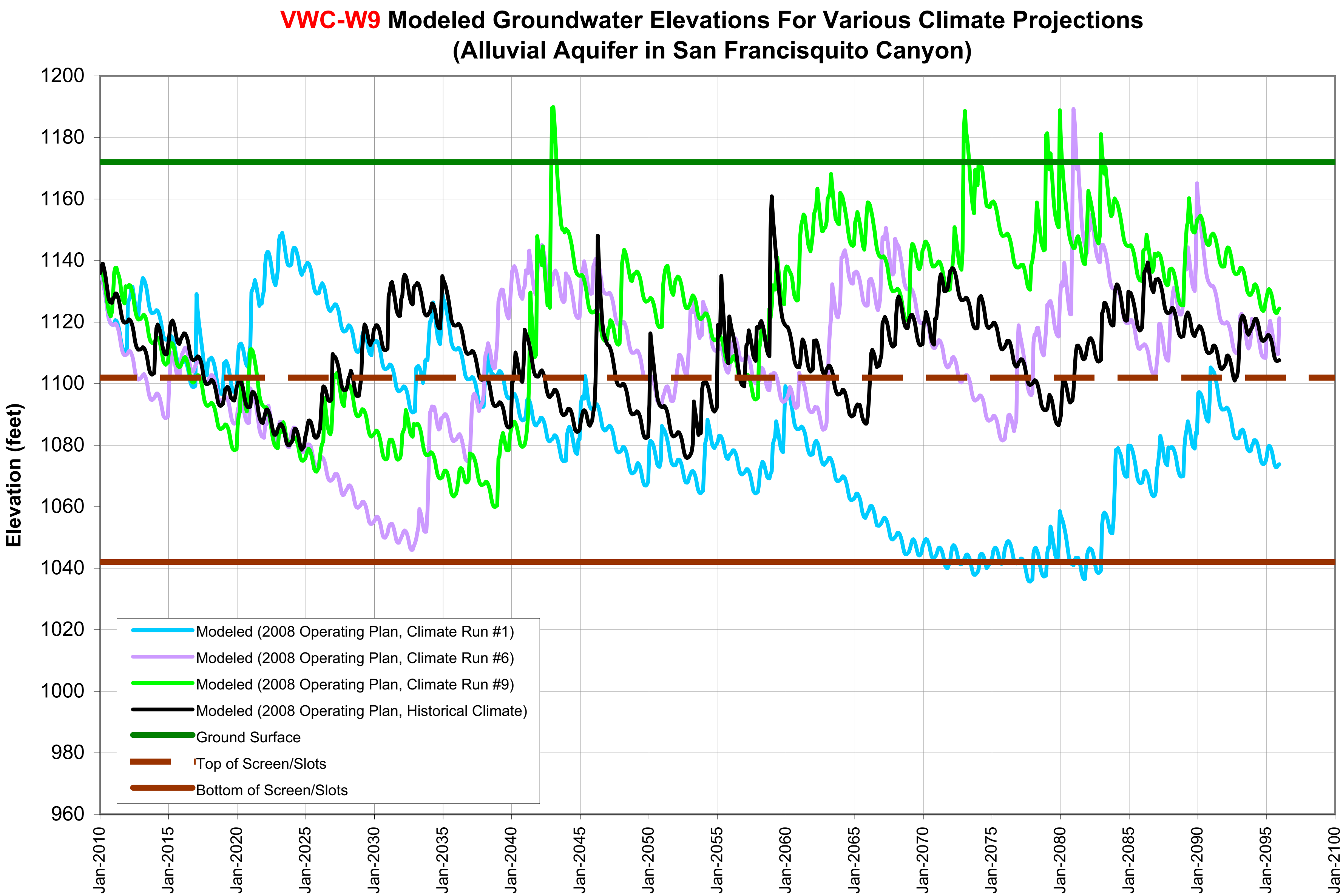

VWC-T7 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Below Saugus WRP)
Elevation (feet)
1230
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

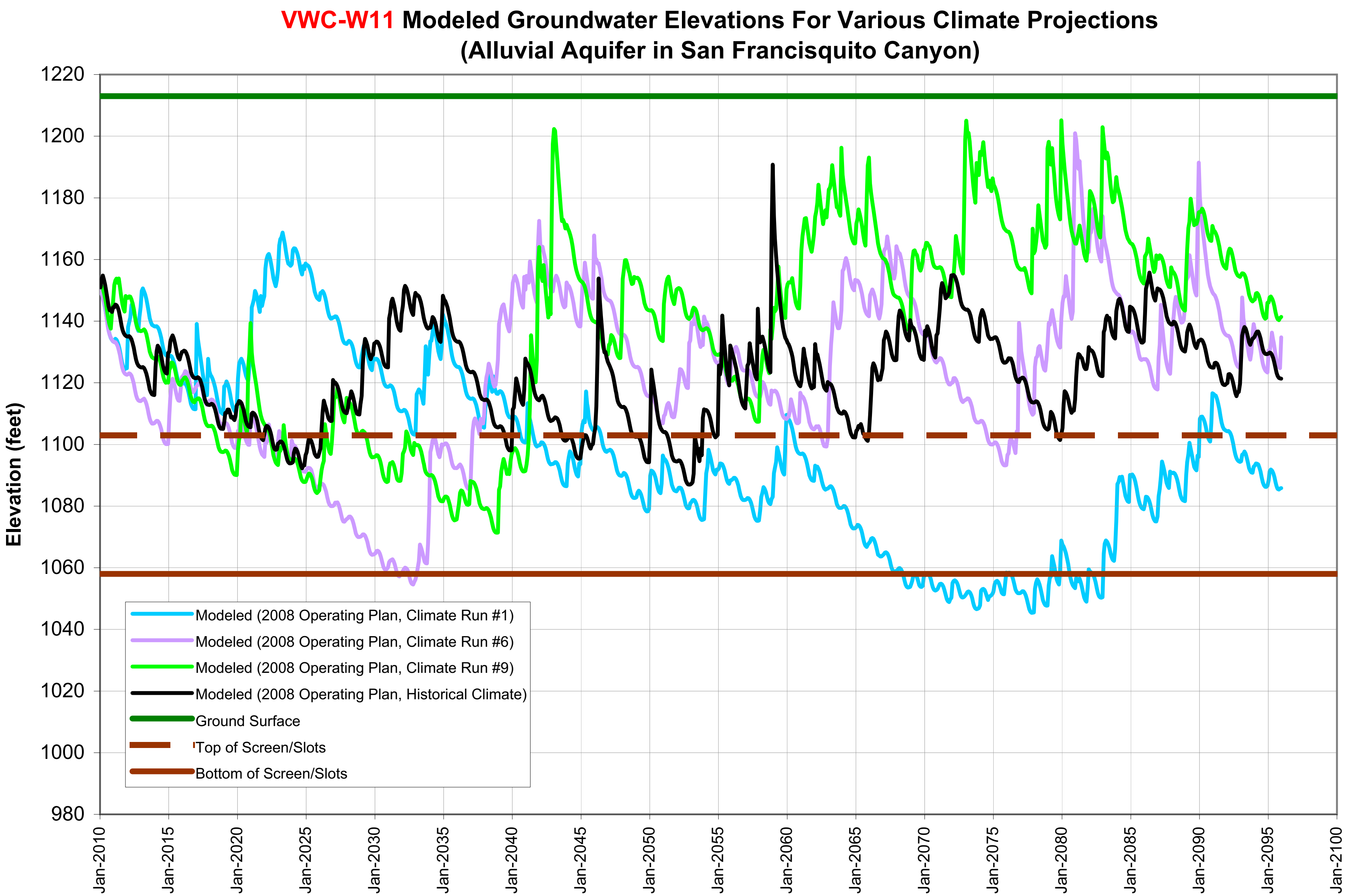

VWC-U6 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Above Saugus WRP)
Elevation (feet)
1240
1230
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

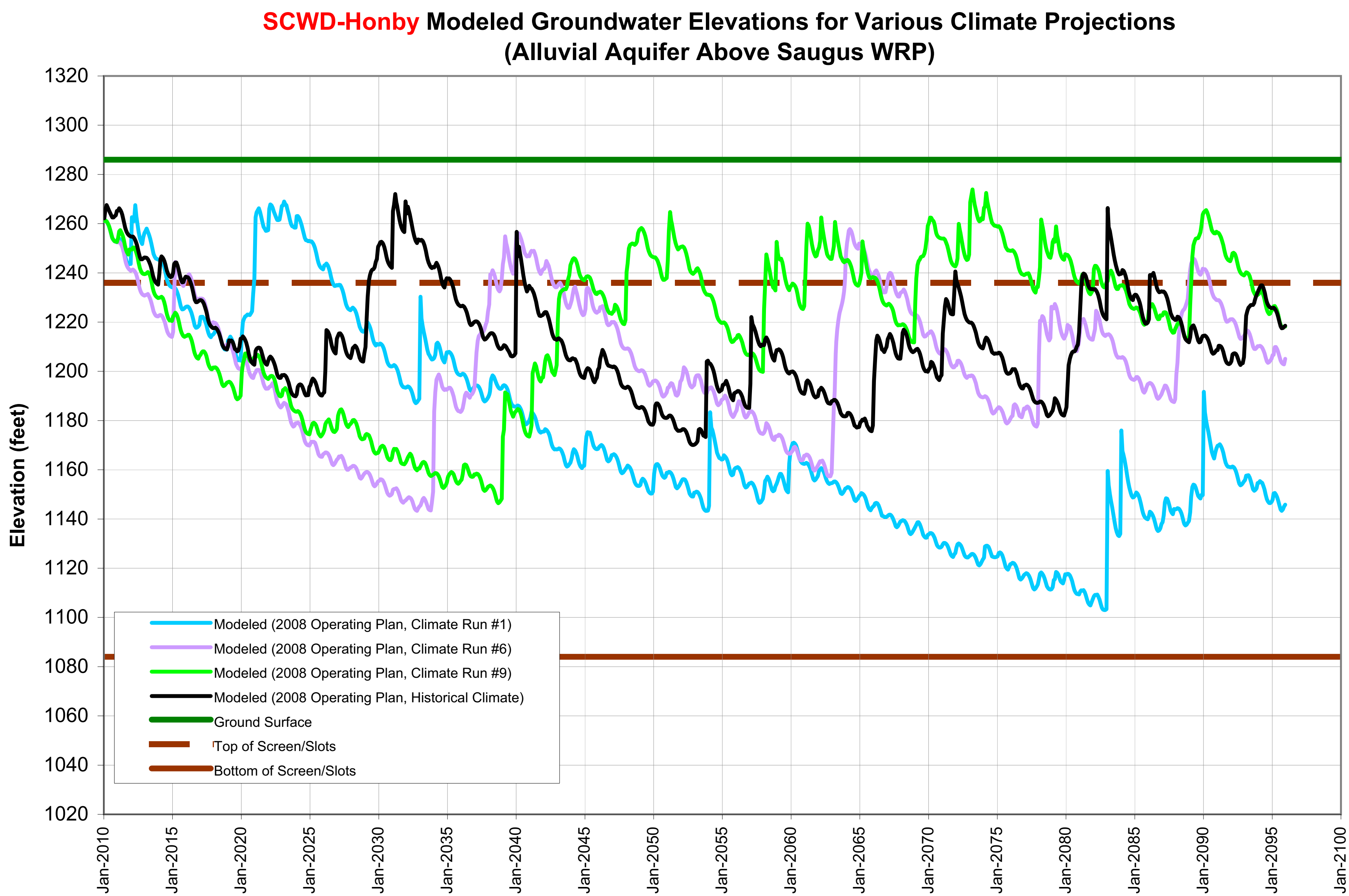


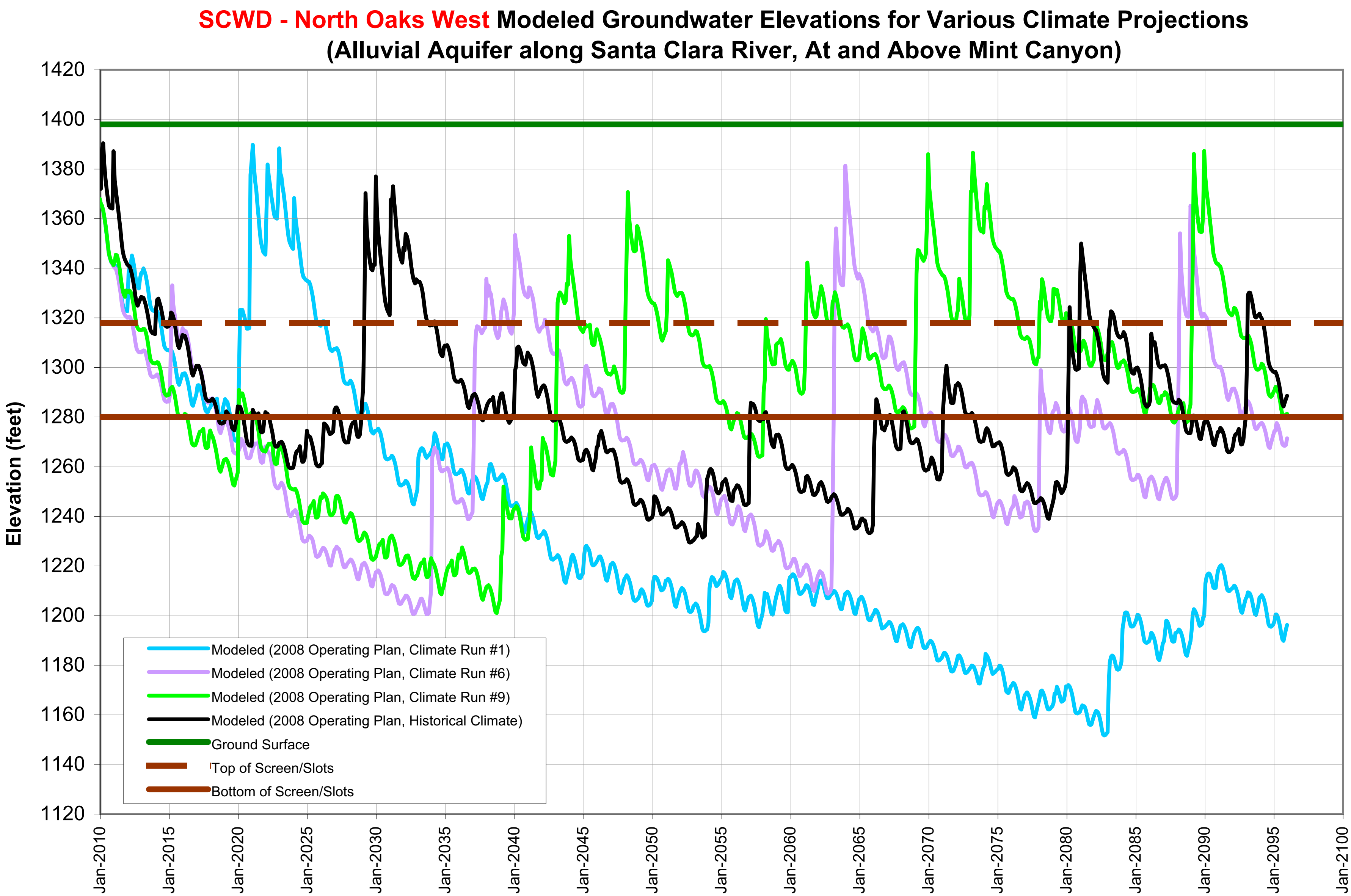
VWC-U4 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Above Saugus WRP)
Elevation (feet)
1280
1270
1260
1250
1240
1230
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

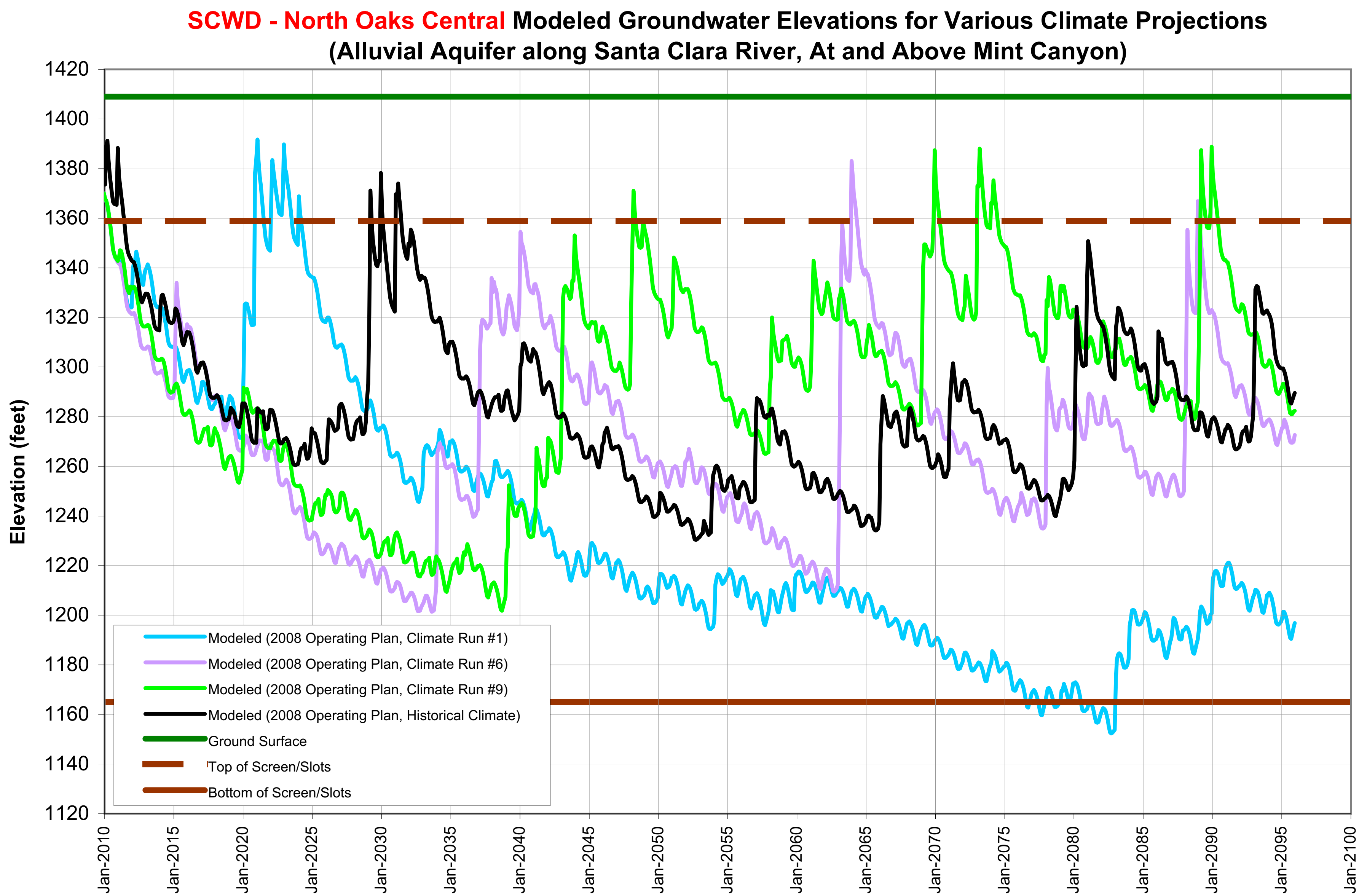

VWC-W6 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer in San Francisquito Canyon)
Elevation (feet)
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots


VWC-W9 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer in San Francisquito Canyon)
Elevation (feet)
1200
1180
1160
1140
1120
1100
1080
1060
1040
1020
1000
980
960
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

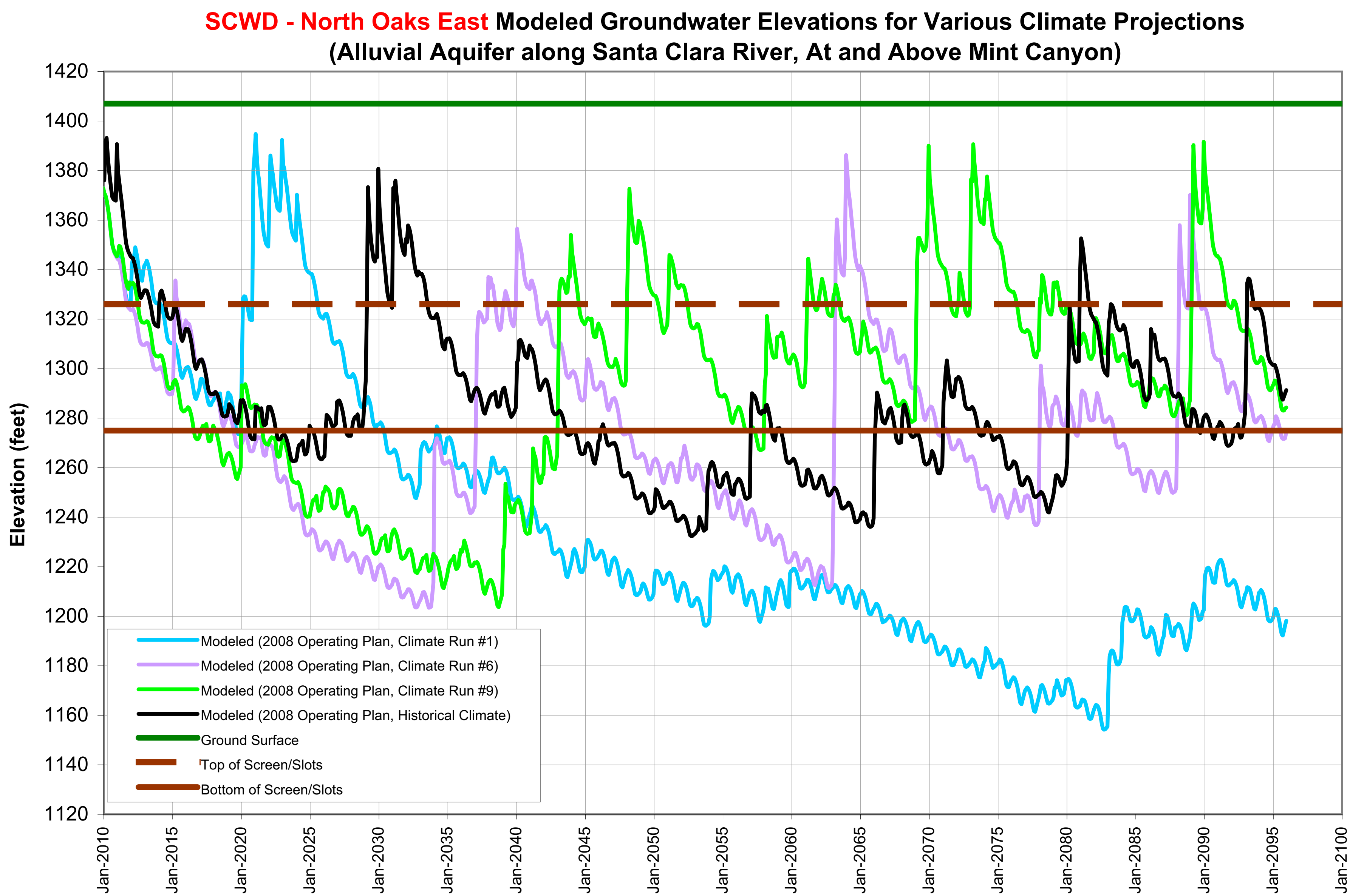

VWC-W11 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer in San Francisquito Canyon)
Elevation (feet)
1220
1200
1180
1160
1140
1120
1100
1080
1060
1040
1020
1000
980
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots


SCWD-Honby Modeled Groundwater Elevations for Various Climate Projections
(Alluvial Aquifer Above Saugus WRP)
Elevation (feet)
1320
1300
1280
1260
1240
1220
1200
1180
1160
1140
1120
1100
1080
1060
1040
1020
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

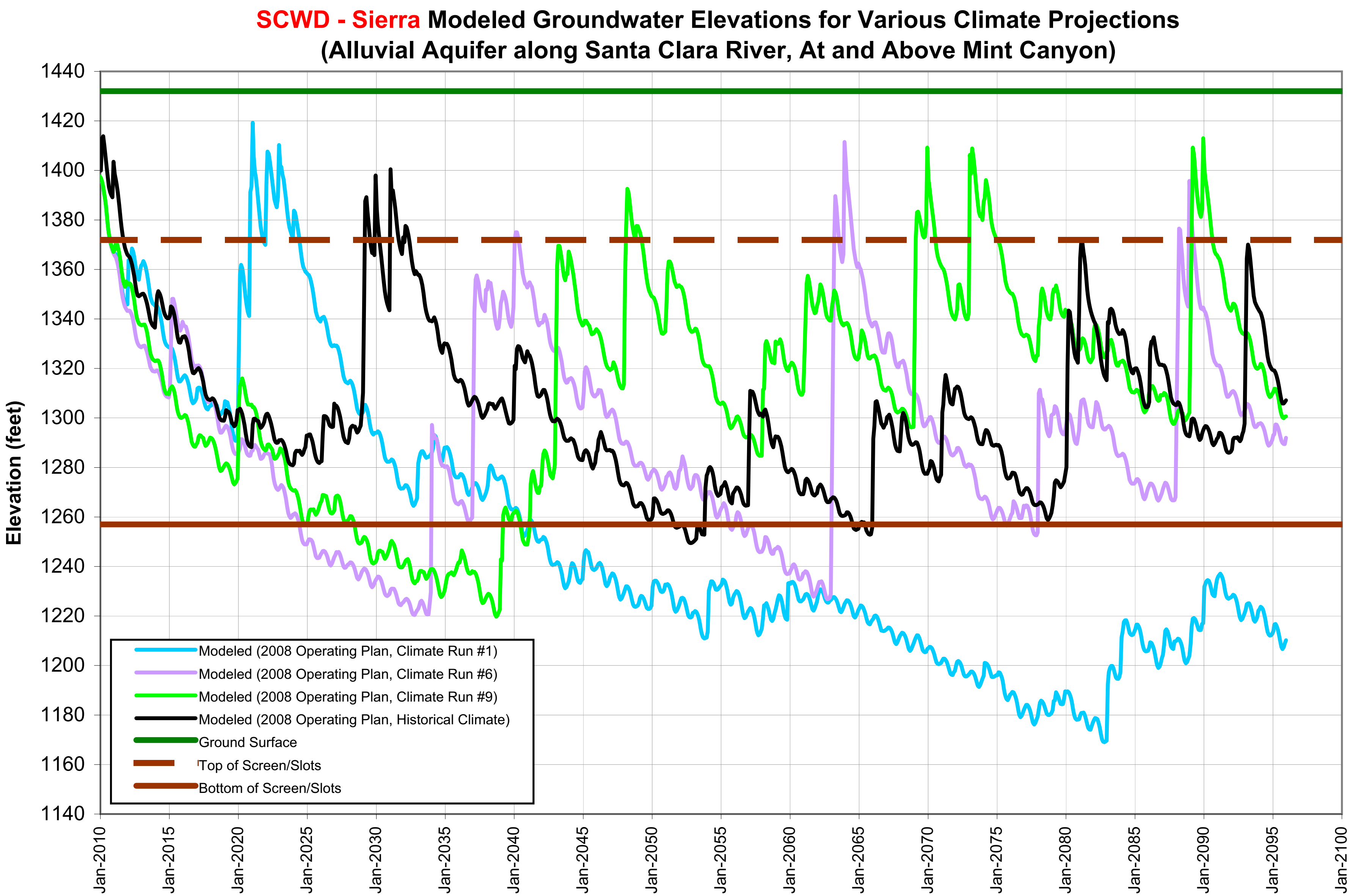

SCWD - North Oaks West Modeled Groundwater Elevations for Various Climate Projections
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1420
1400
1380
1360
1340
1320
1300
1280
1260
1240
1220
1200
1180
1160
1140
1120
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots



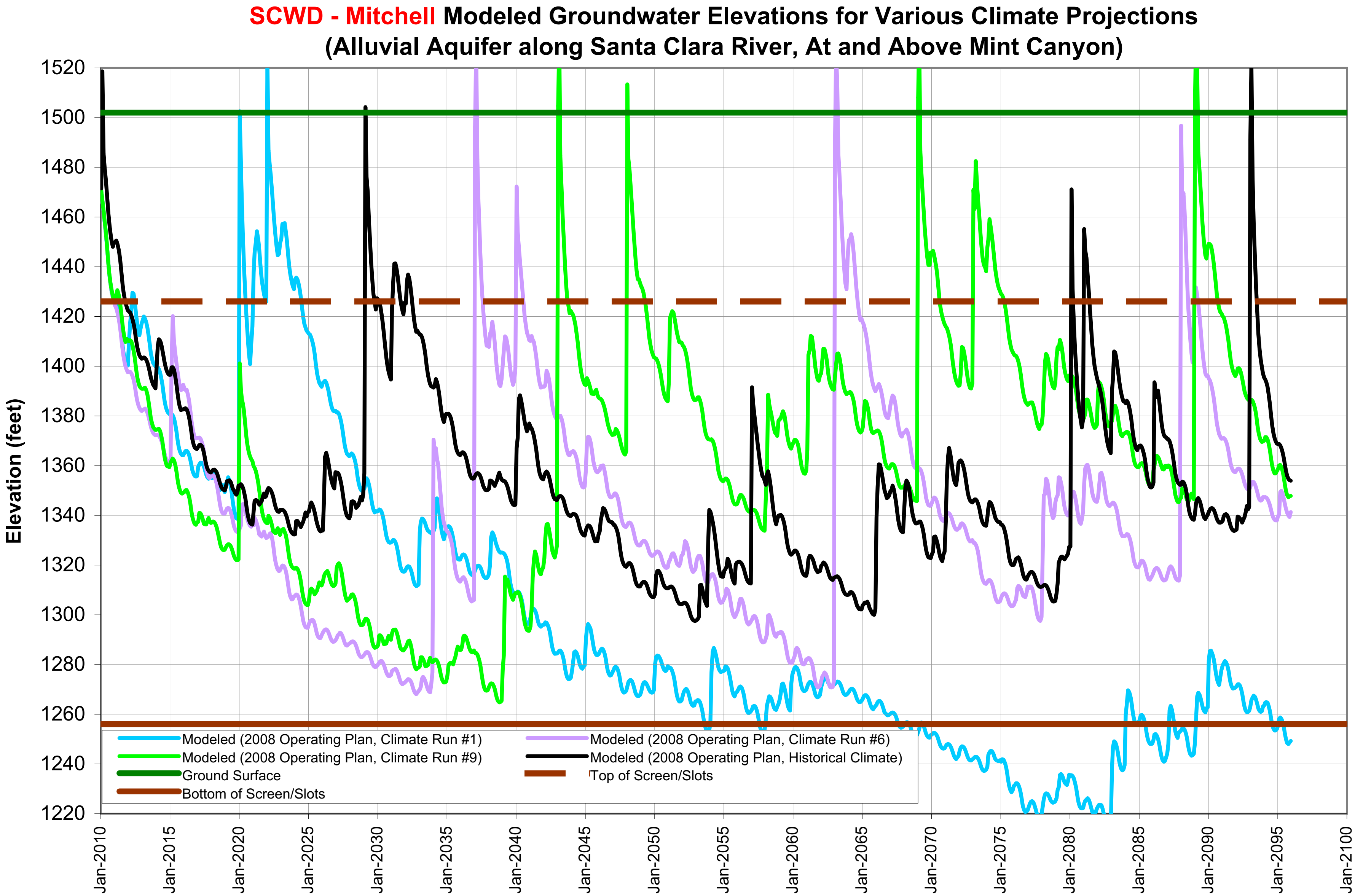
SCWD - North Oaks Central Modeled Groundwater Elevations for Various Climate Projections
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1420
1400
1380
1360
1340
1320
1300
1280
1260
1240
1220
1200
1180
1160
1140
1120
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots



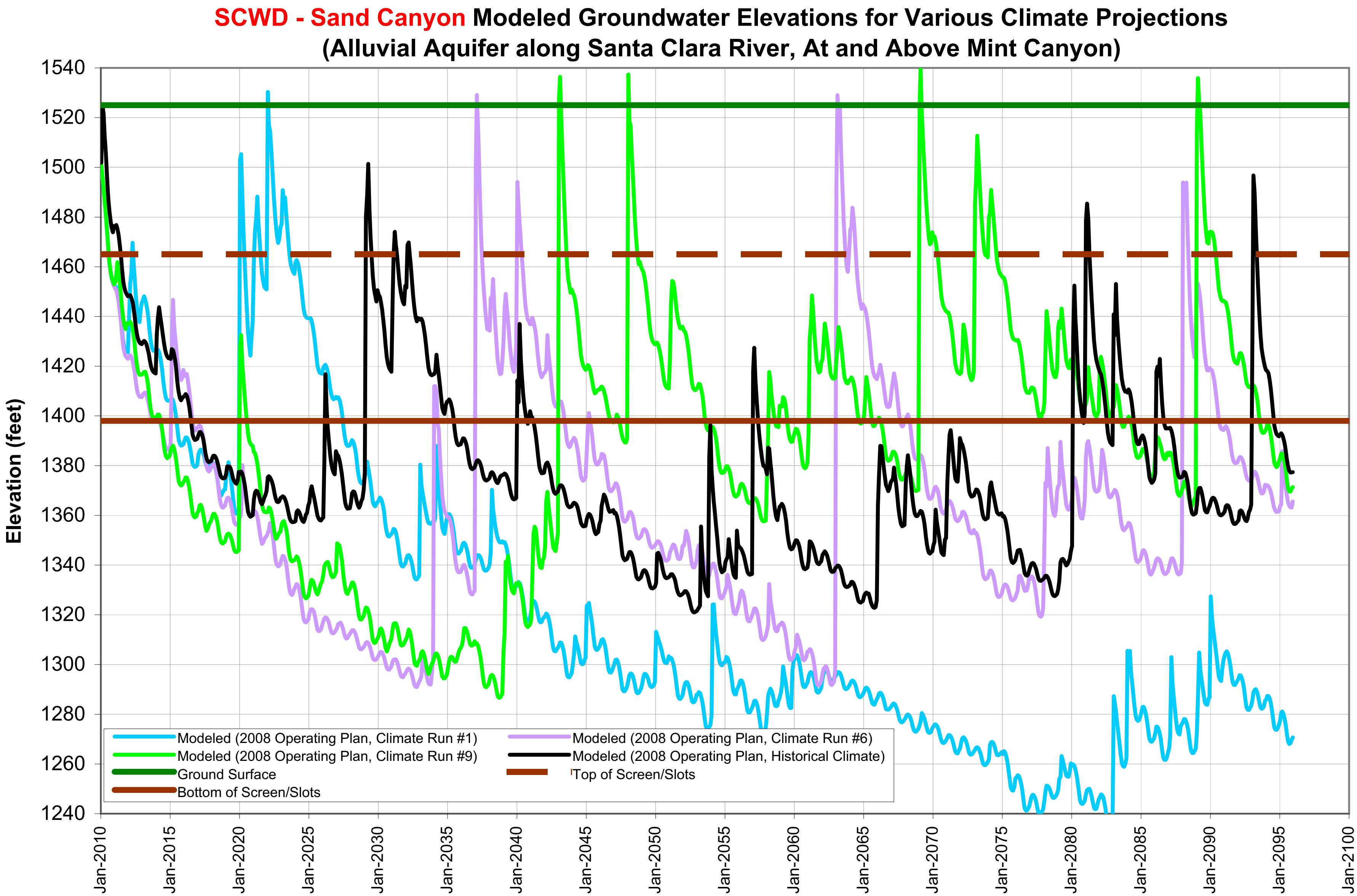
SCWD - North Oaks East Modeled Groundwater Elevations for Various Climate Projections
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1420
1400
1380
1360
1340
1320
1300
1280
1260
1240
1220
1200
1180
1160
1140
1120
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots



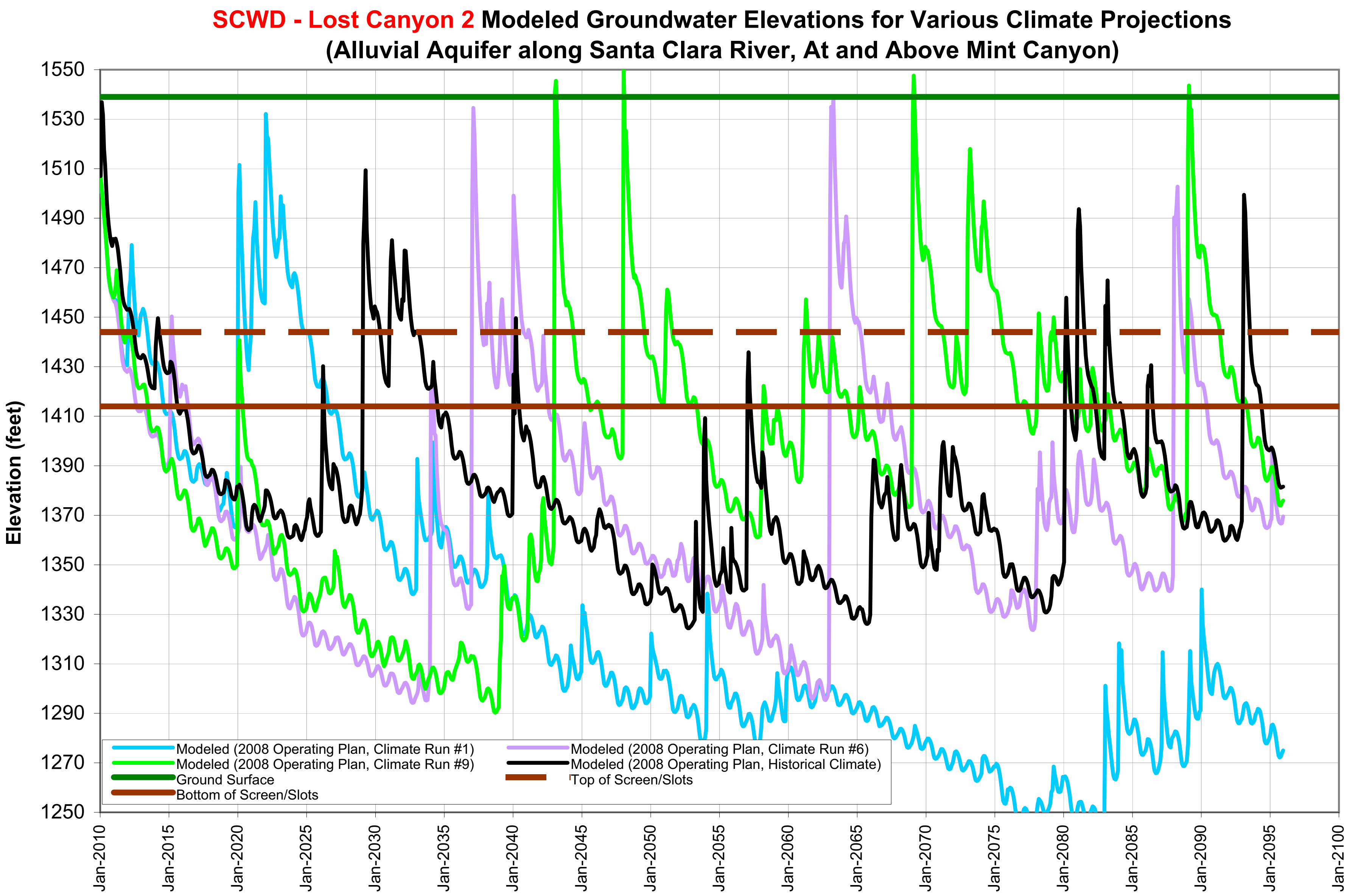
SCWD - Sierra Modeled Groundwater Elevations for Various Climate Projections
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1440
1420
1400
1380
1360
1340
1320
1300
1280
1260
1240
1220
1200
1180
1160
1140
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

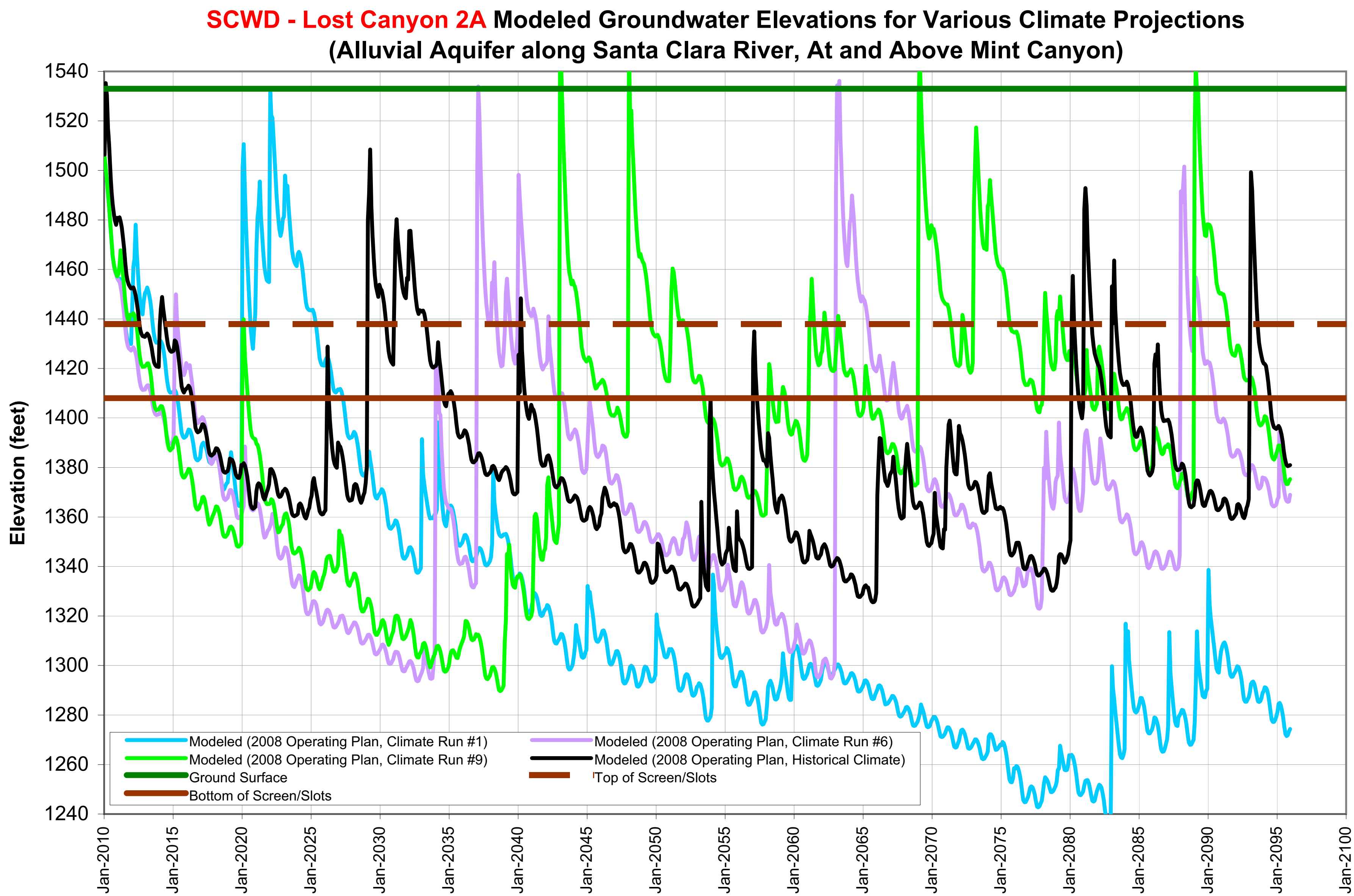


SCWD - Mitchell Modeled Groundwater Elevations for Various Climate Projections
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1520
1500
1480
1460
1440
1420
1400
1380
1360
1340
1320
1300
1280
1260
1240
1220
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots



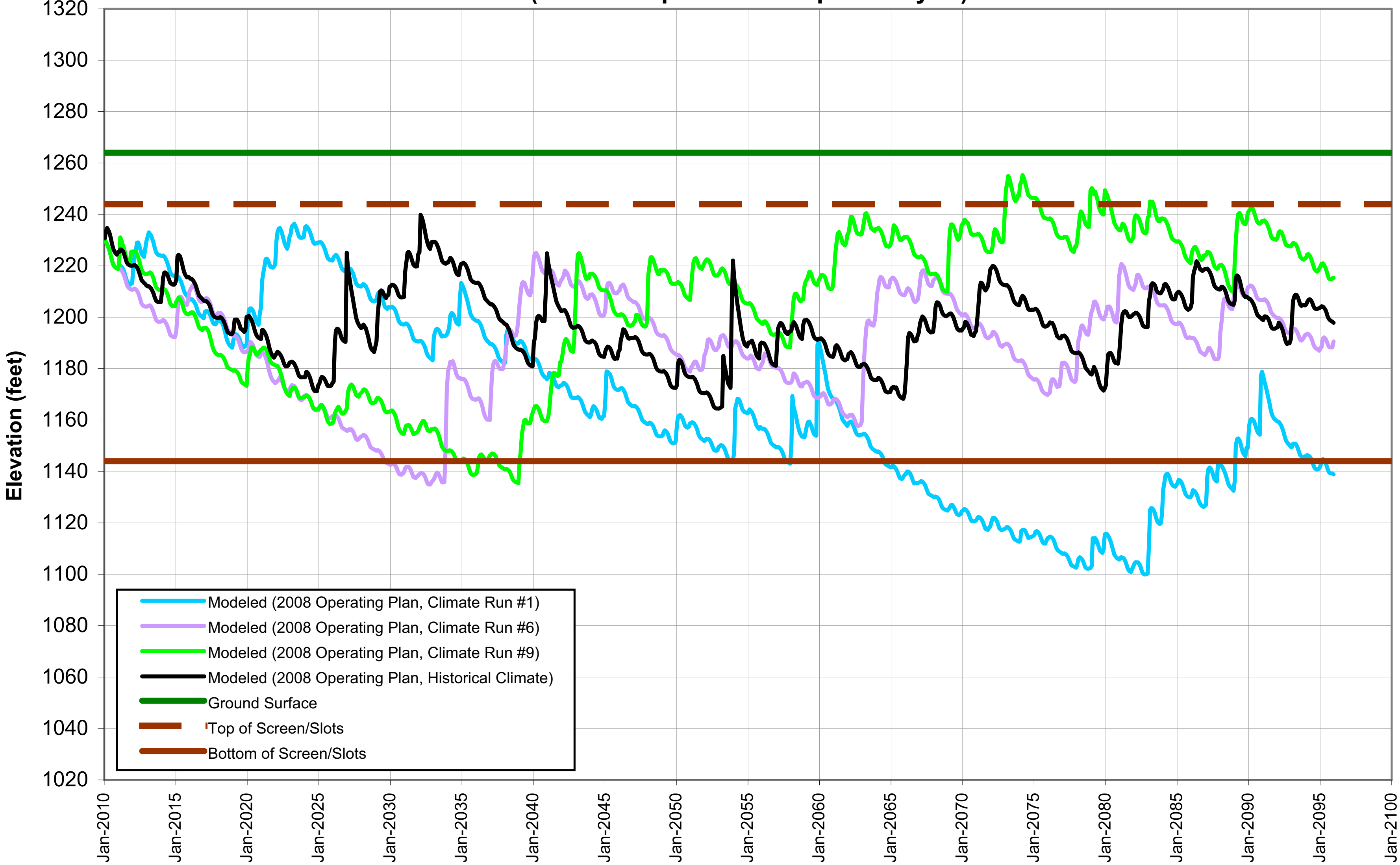
SCWD - Sand Canyon Modeled Groundwater Elevations for Various Climate Projections
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1540
1520
1500
1480
1460
1440
1420
1400
1380
1360
1340
1320
1300
1280
1260
1240
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

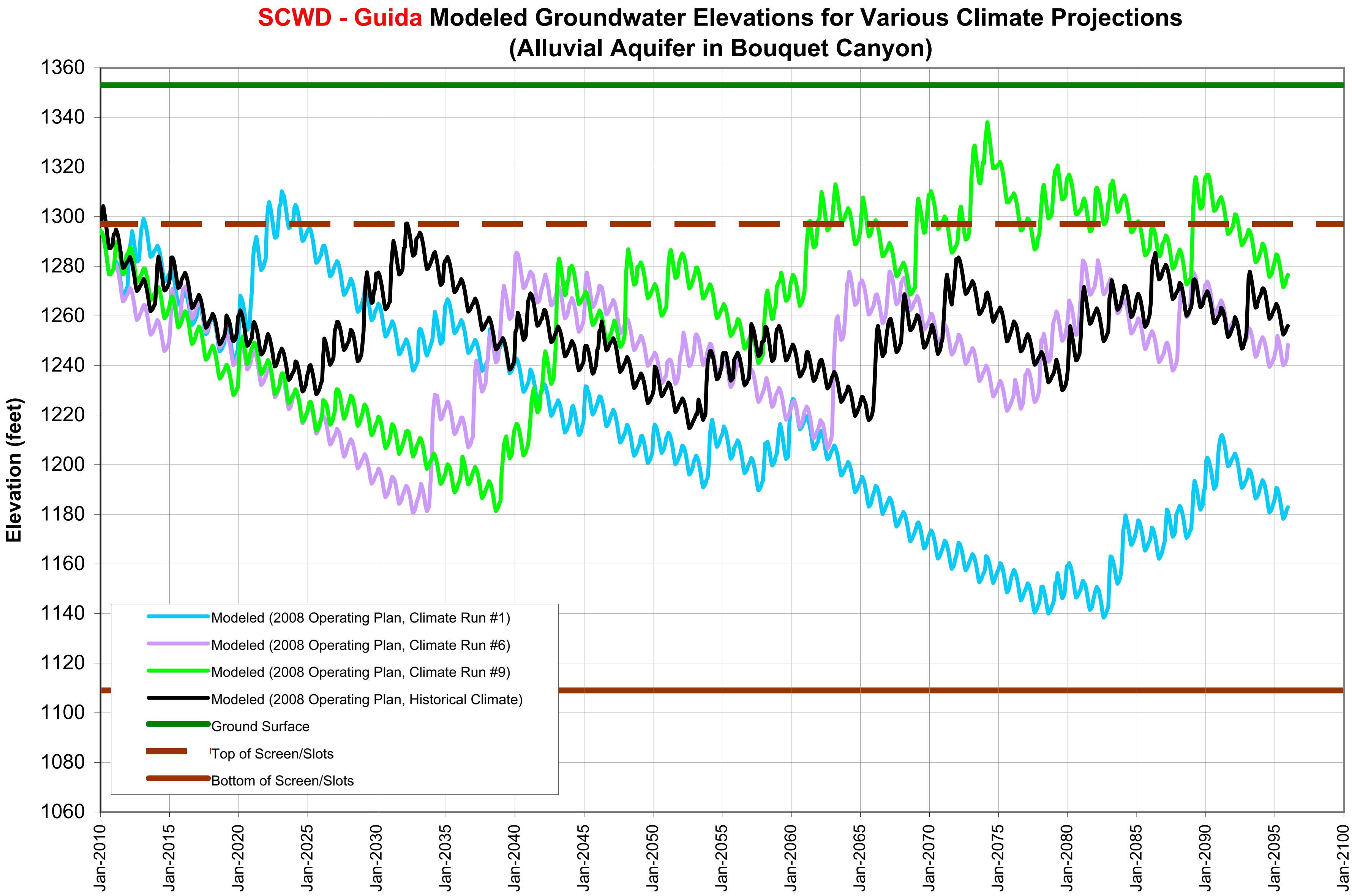

SCWD - Lost Canyon 2 Modeled Groundwater Elevations for Various Climate Projections
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1550
1530
1510
1490
1470
1450
1430
1410
1390
1370
1350
1330
1310
1290
1270
1250
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #9)
Ground Surface
Bottom of Screen/Slots
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Historical Climate)
Top of Screen/Slots

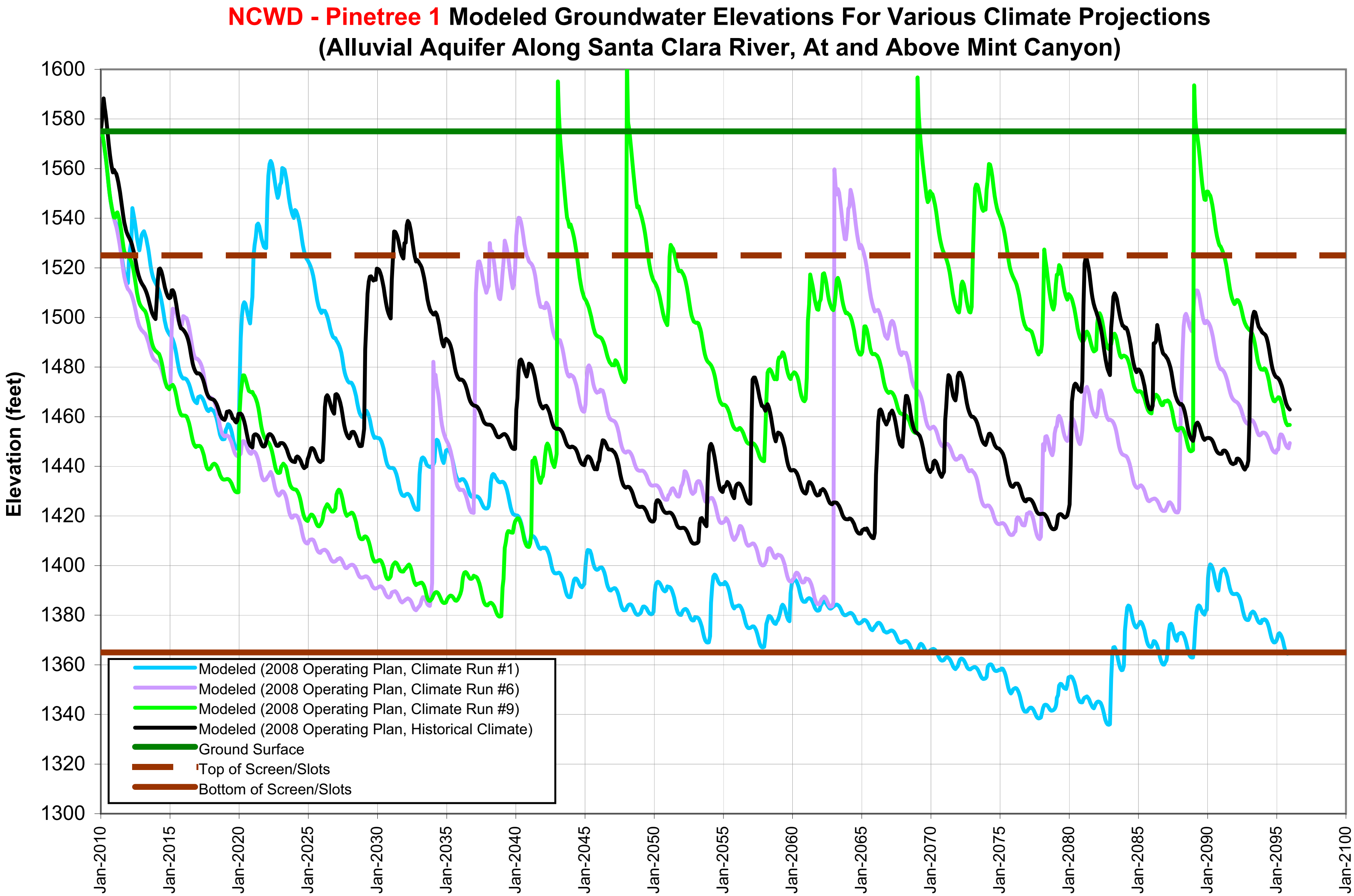


SCWD - Lost Canyon 2A Modeled Groundwater Elevations for Various Climate Projections
(Alluvial Aquifer along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1540
1520
1500
1480
1460
1440
1420
1400
1380
1360
1340
1320
1300
1280
1260
1240
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

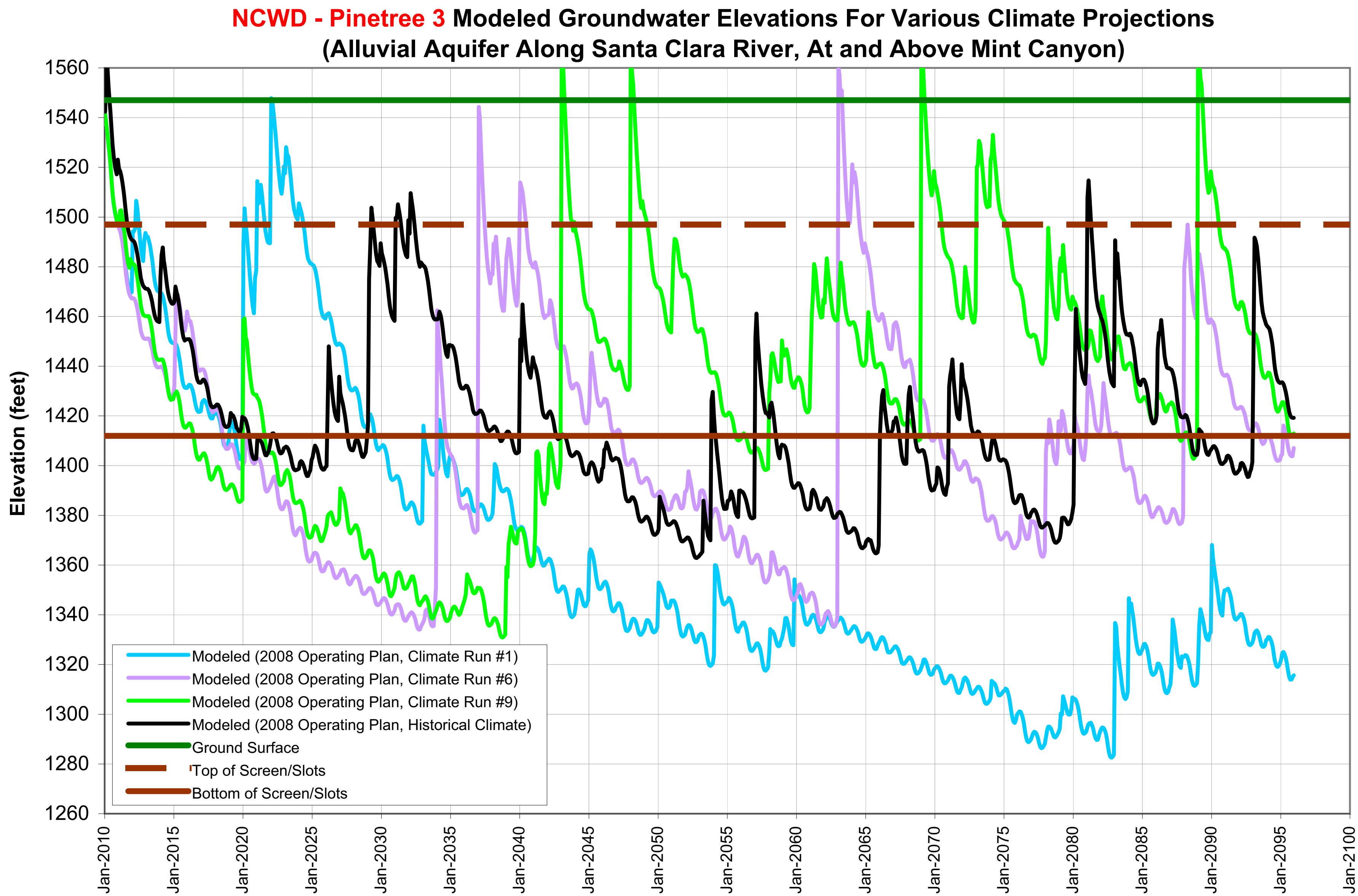
SCWD - Clark Modeled Groundwater Elevations for Various Climate Projections
(Alluvial Aquifer in Bouquet Canyon)



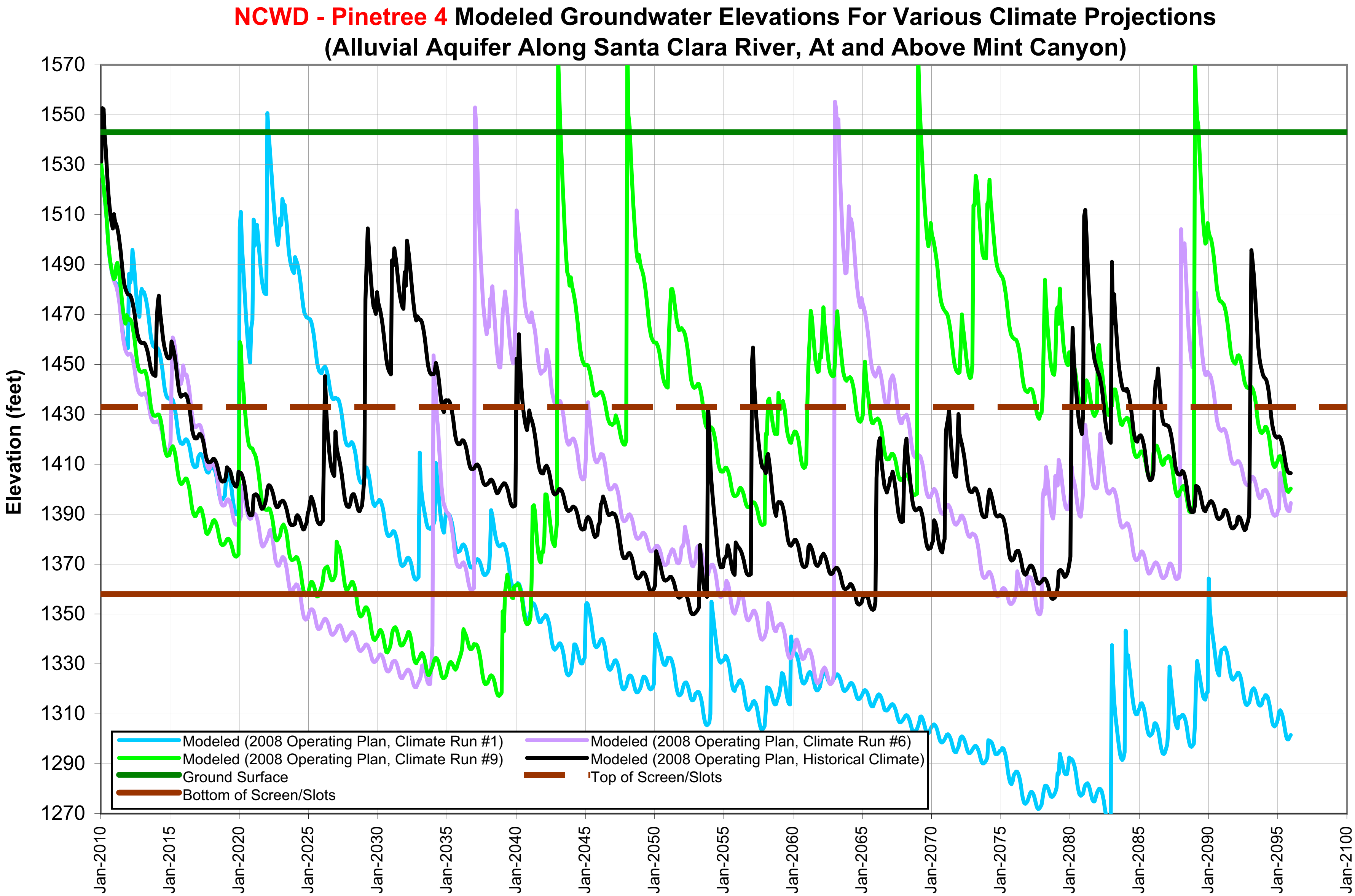

SCWD - Guida Modeled Groundwater Elevations for Various Climate Projections
(Alluvial Aquifer in Bouquet Canyon)
Elevation (feet)
1360
1340
1320
1300
1280
1260
1240
1220
1200
1180
1160
1140
1120
1100
1080
1060
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

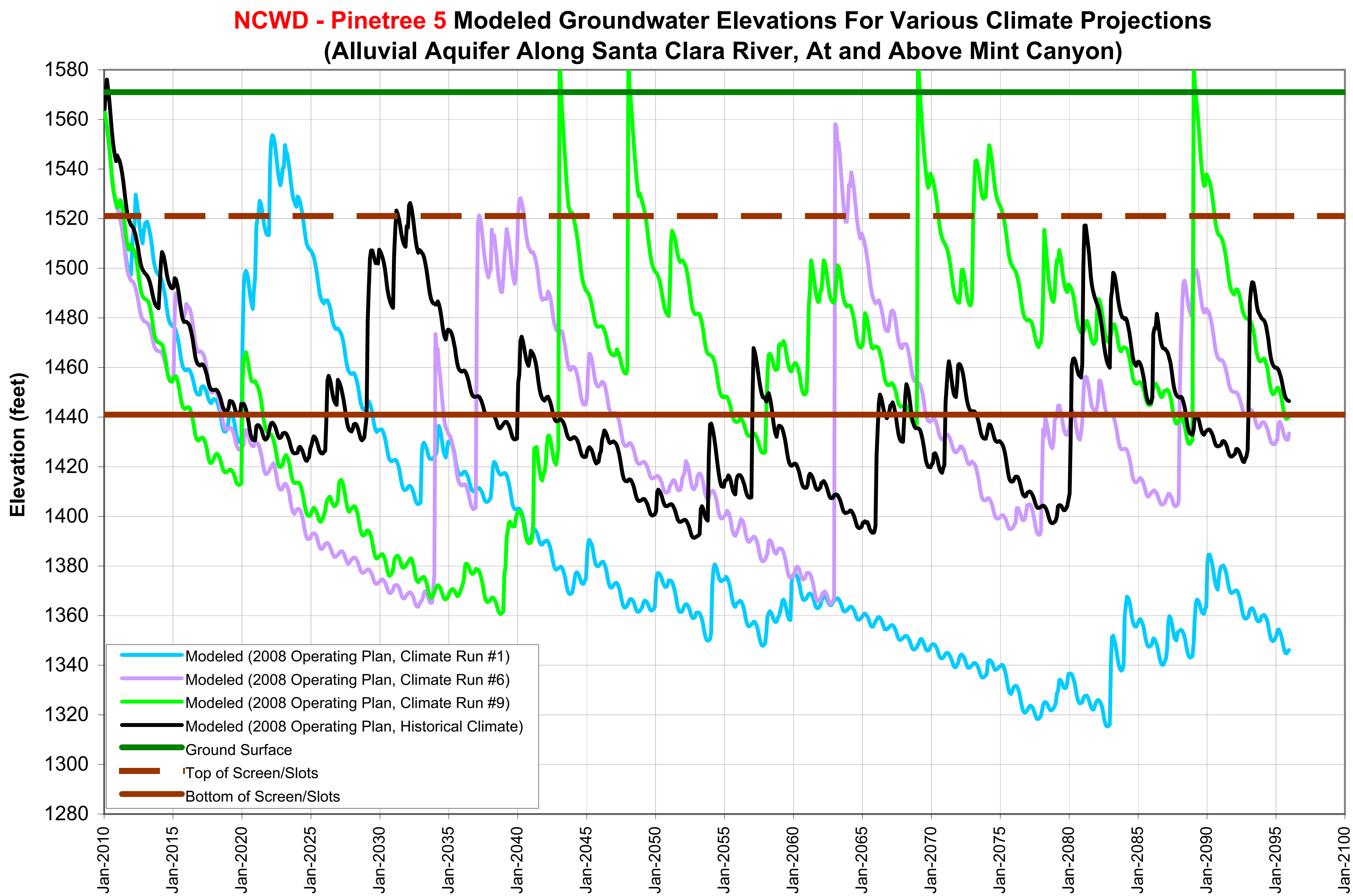


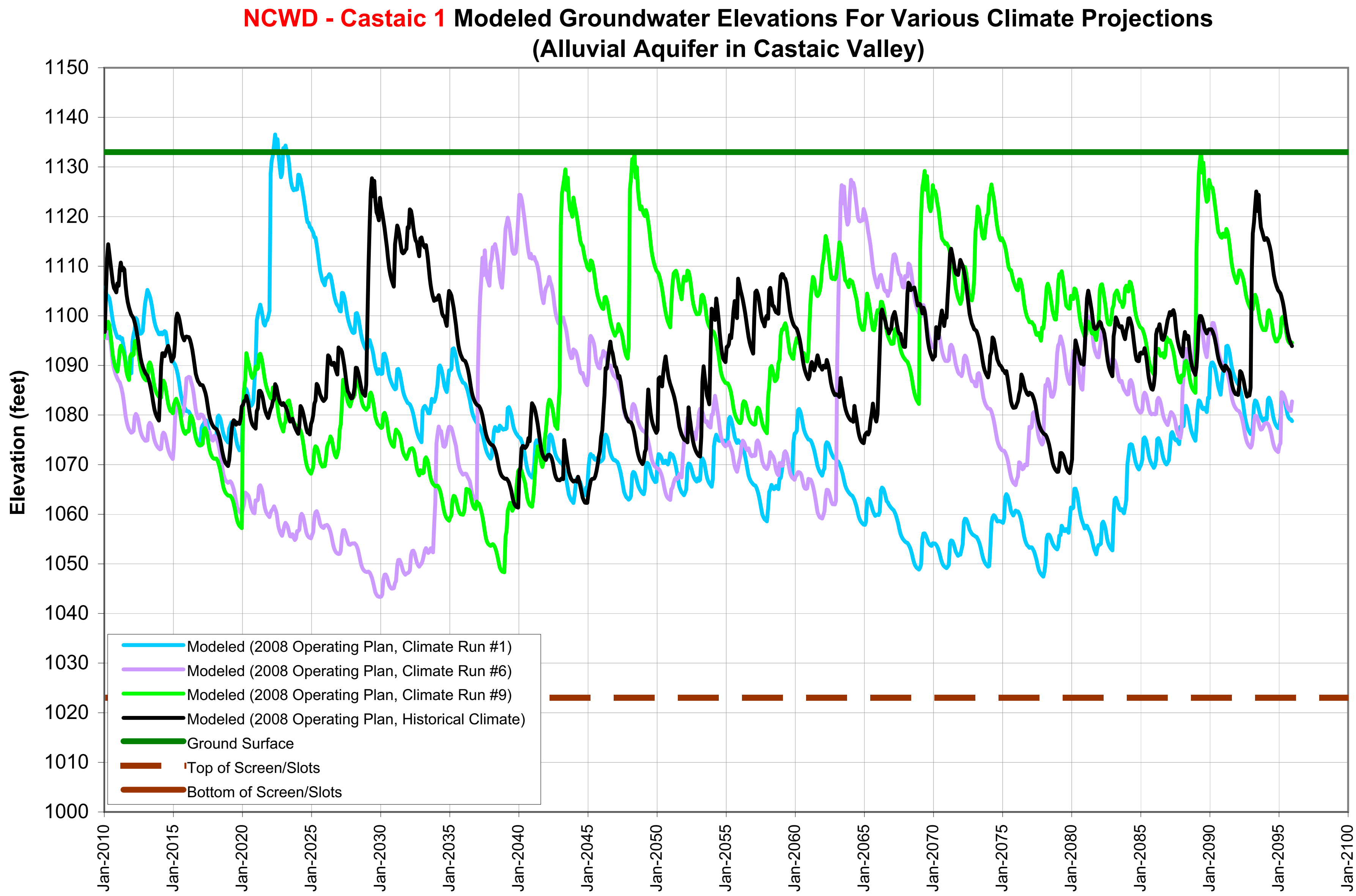
NCWD - Pinetree 1 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1600
1580
1560
1540
1520
1500
1480
1460
1440
1420
1400
1380
1360
1340
1320
1300
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

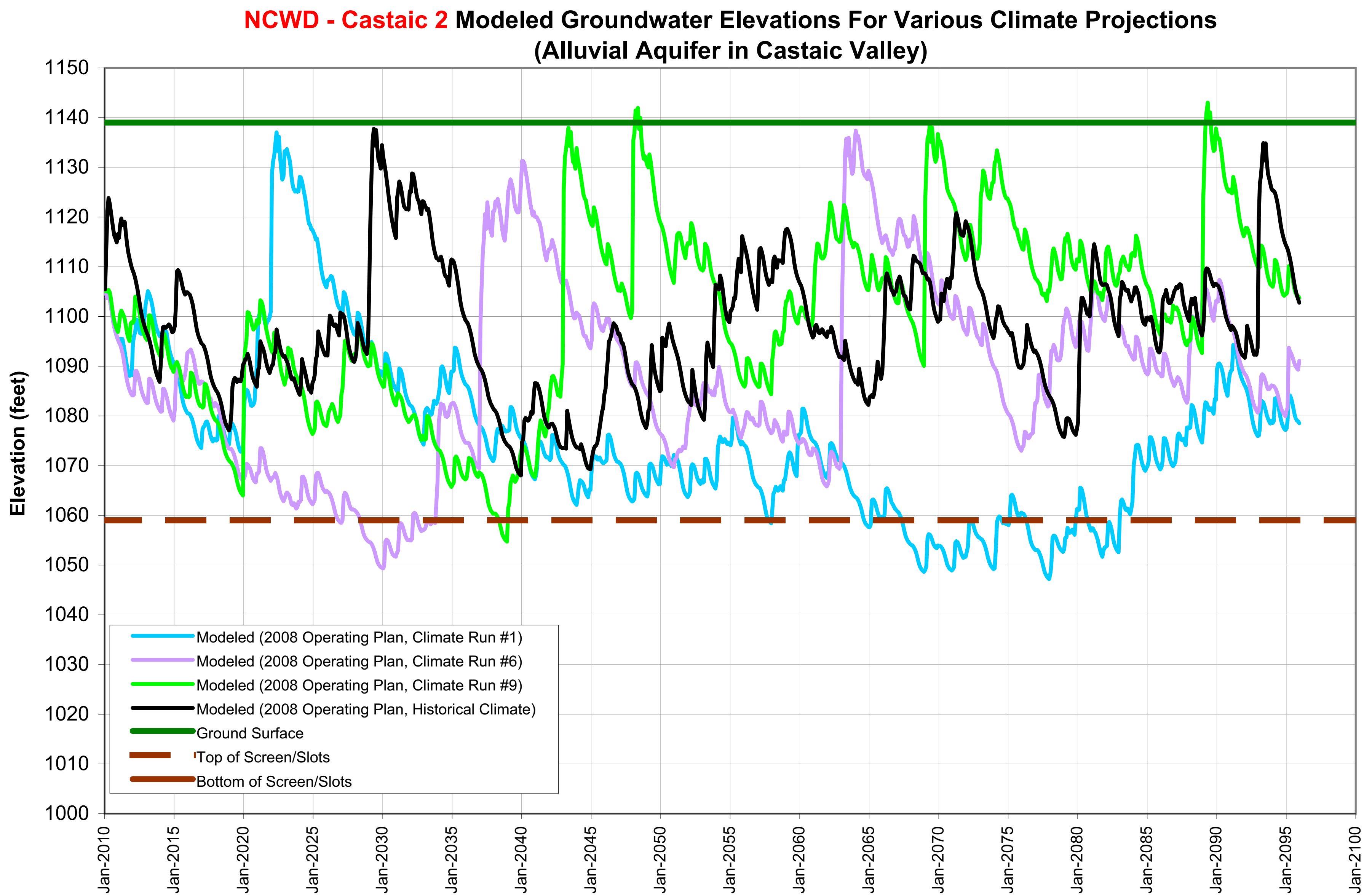


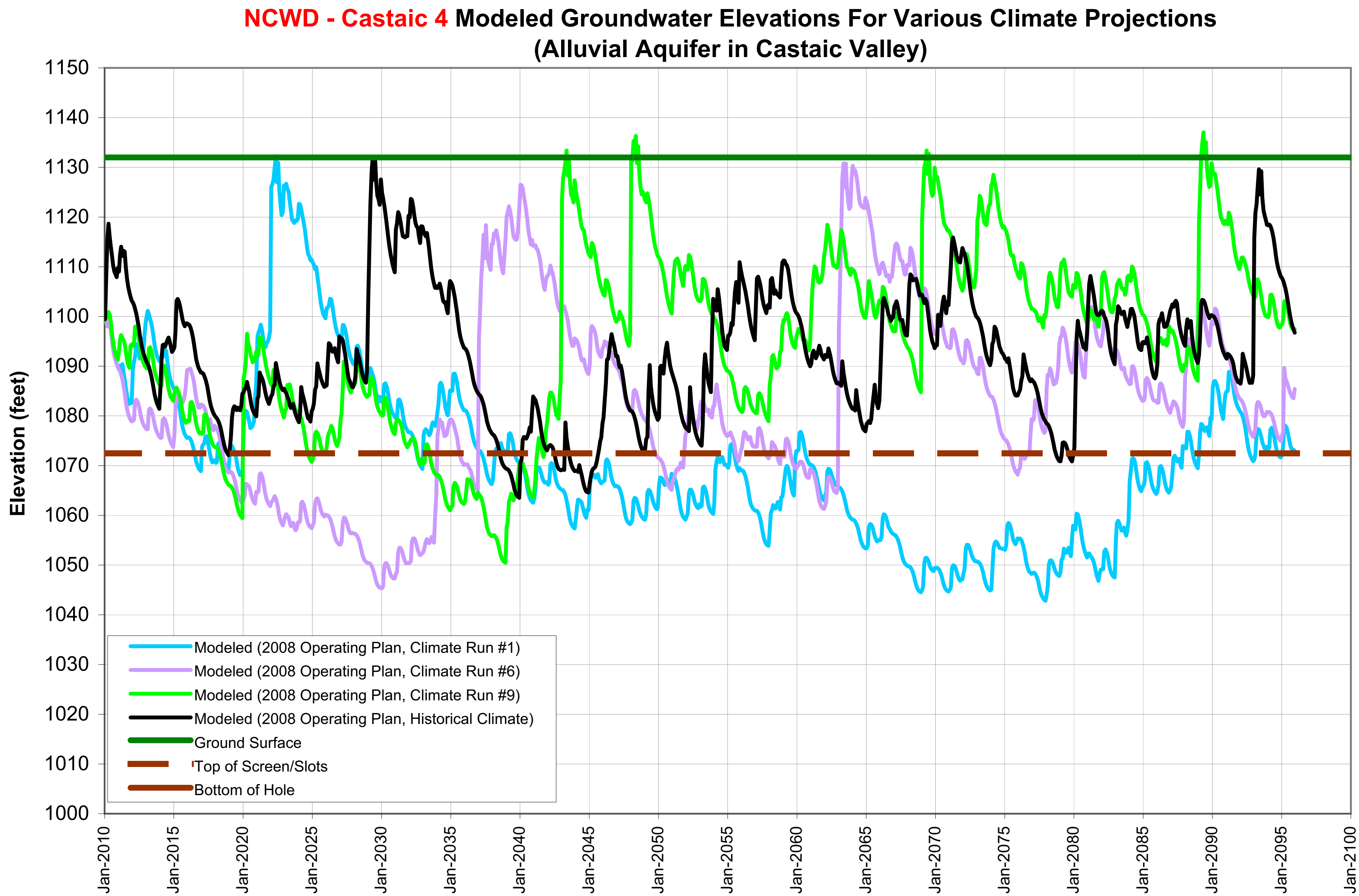
NCWD - Pinetree 3 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1560
1540
1520
1500
1480
1460
1440
1420
1400
1380
1360
1340
1320
1300
1280
1260
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots


NCWD - Pinetree 4 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1570
1550
1530
1510
1490
1470
1450
1430
1410
1390
1370
1350
1330
1310
1290
1270
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

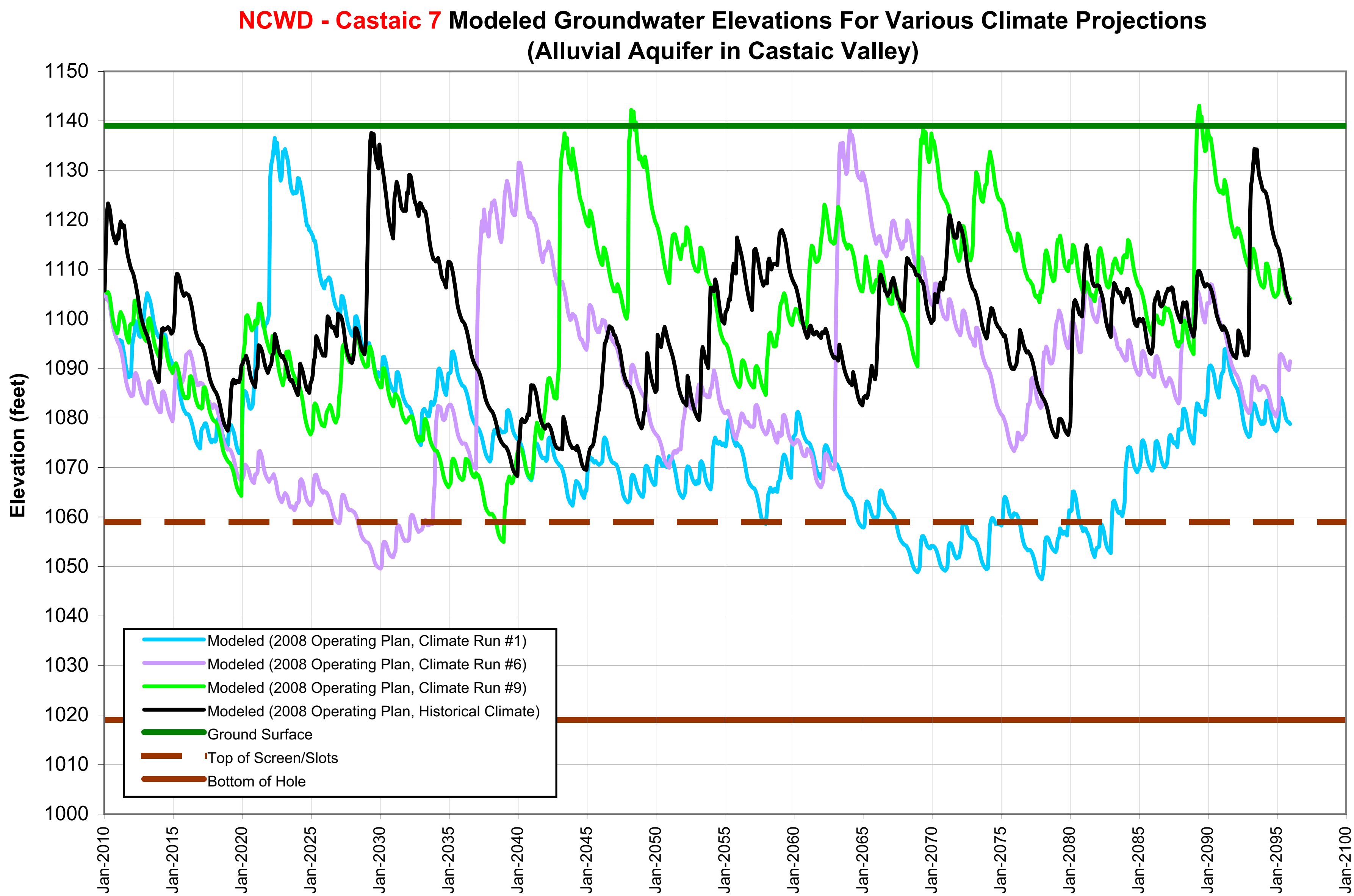

NCWD - Pinetree 5 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer Along Santa Clara River, At and Above Mint Canyon)
Elevation (feet)
1580
1560
1540
1520
1500
1480
1460
1440
1420
1400
1380
1360
1340
1320
1300
1280
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

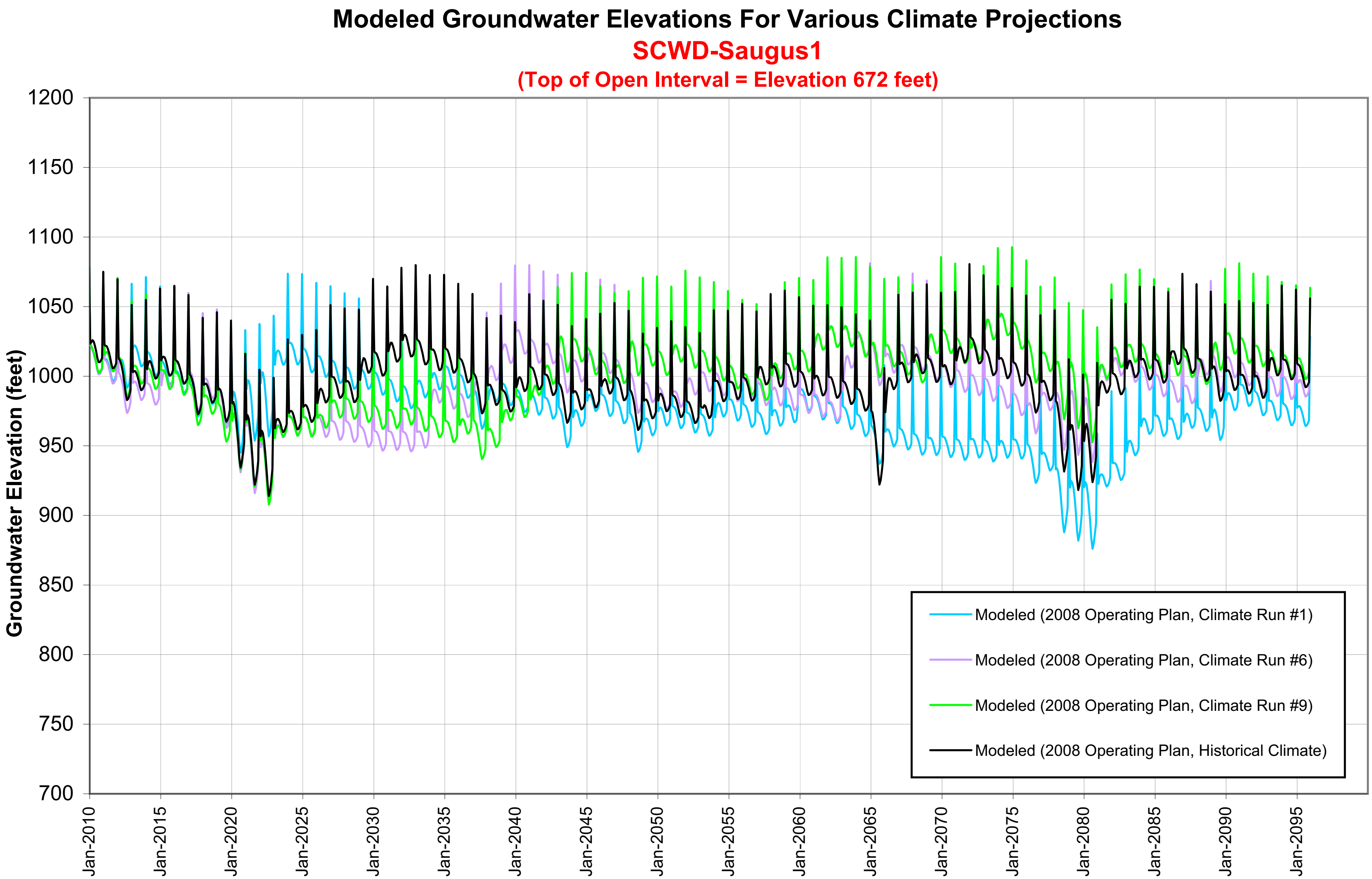

NCWD - Castaic 1 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer in Castaic Valley)
Elevation (feet)
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots


NCWD - Castaic 2 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer in Castaic Valley)
Elevation (feet)
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Screen/Slots

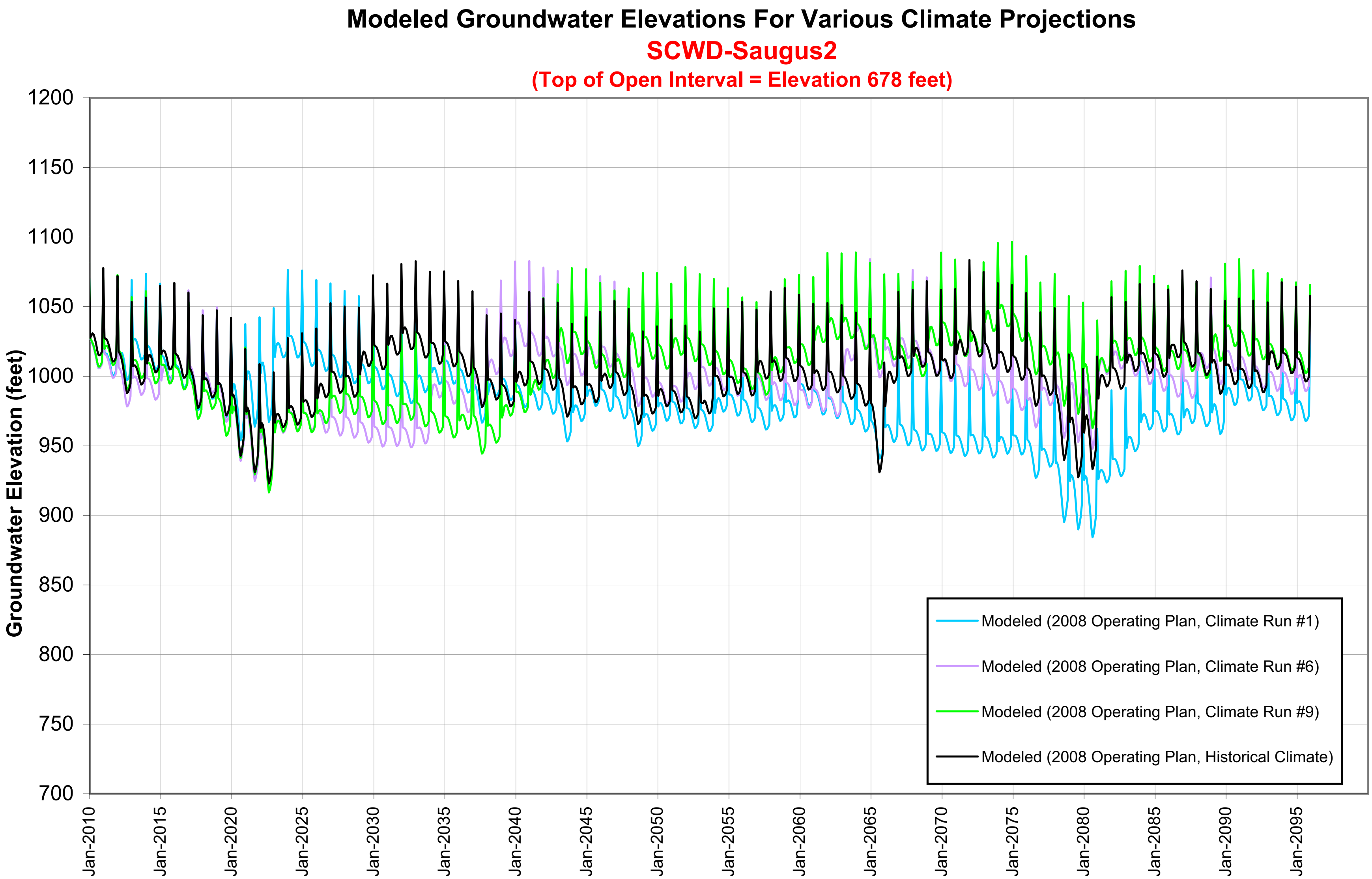


NCWD - Castaic 4 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer in Castaic Valley)
Elevation (feet)
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Hole

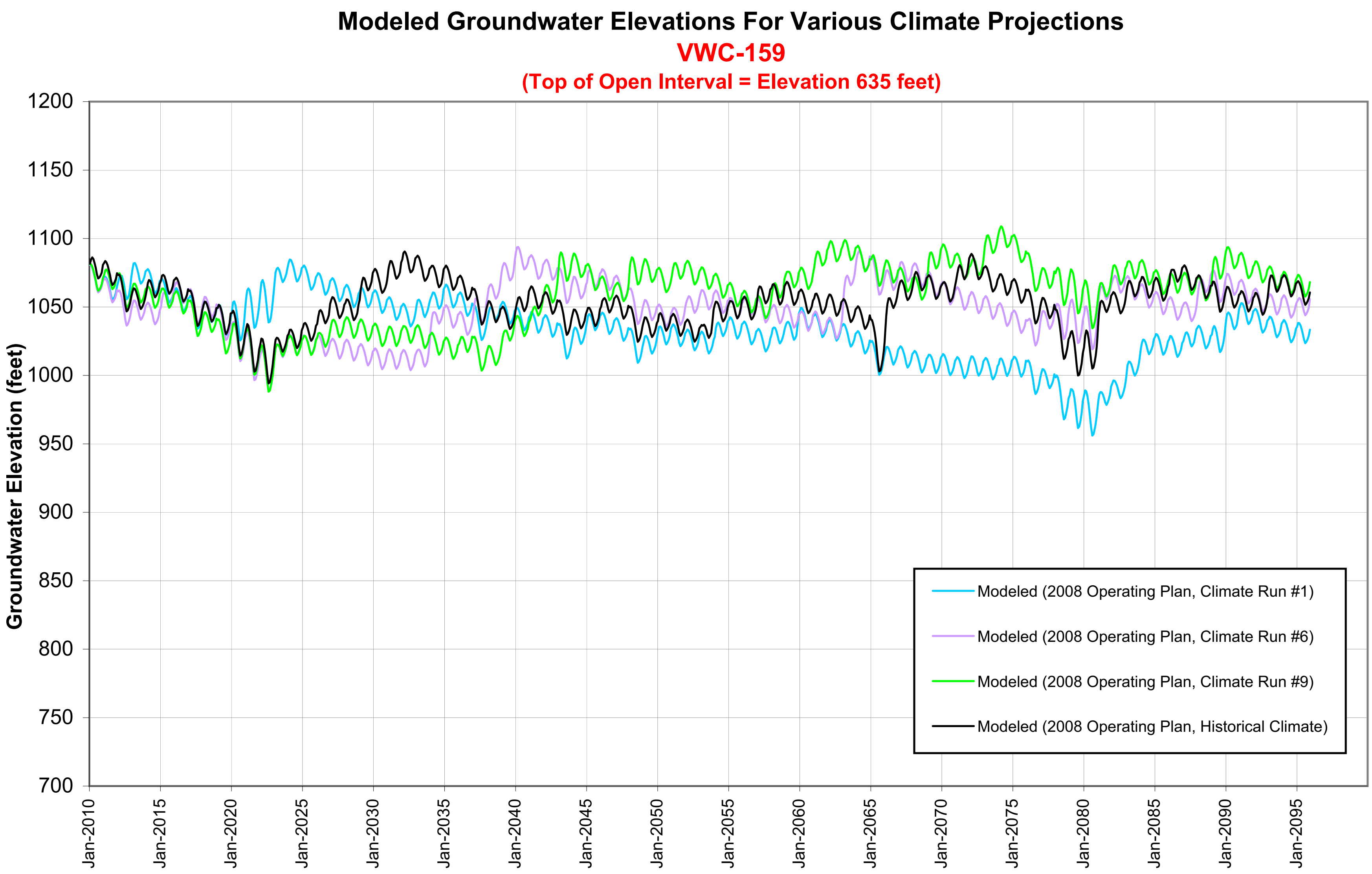

NCWD - Castaic 7 Modeled Groundwater Elevations For Various Climate Projections
(Alluvial Aquifer in Castaic Valley)
Elevation (feet)
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Jan-2100
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)
Ground Surface
Top of Screen/Slots
Bottom of Hole



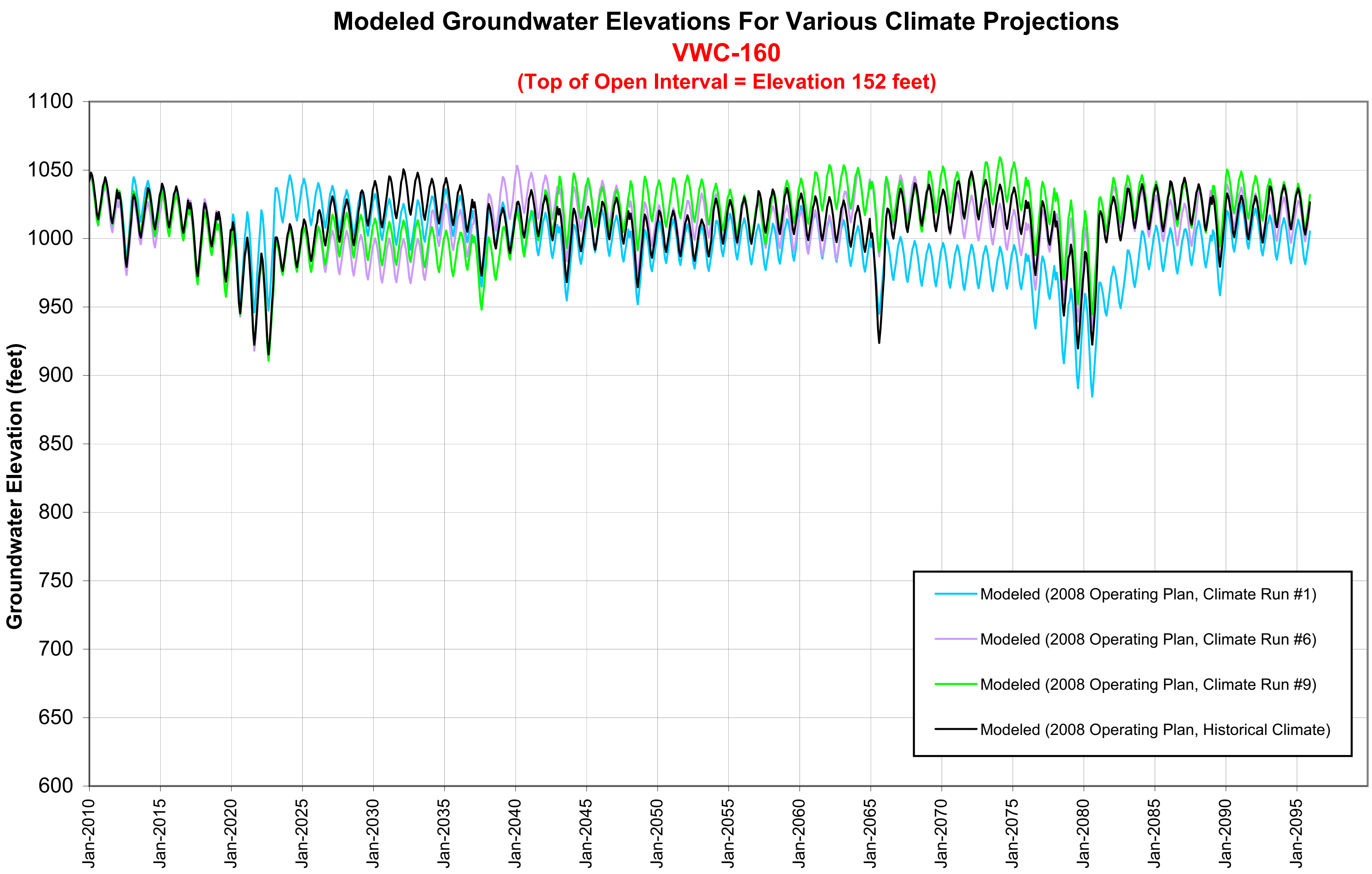
Modeled Groundwater Elevations For Various Climate Projections
SCWD-Saugus1
(Top of Open Interval = Elevation 672 feet)
Groundwater Elevation (feet)
1200
1150
1100
1050
1000
950
900
850
800
750
700
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)



Modeled Groundwater Elevations For Various Climate Projections
SCWD-Saugus2
(Top of Open Interval = Elevation 678 feet)
Groundwater Elevation (feet)
1200
1150
1100
1050
1000
950
900
850
800
750
700
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)



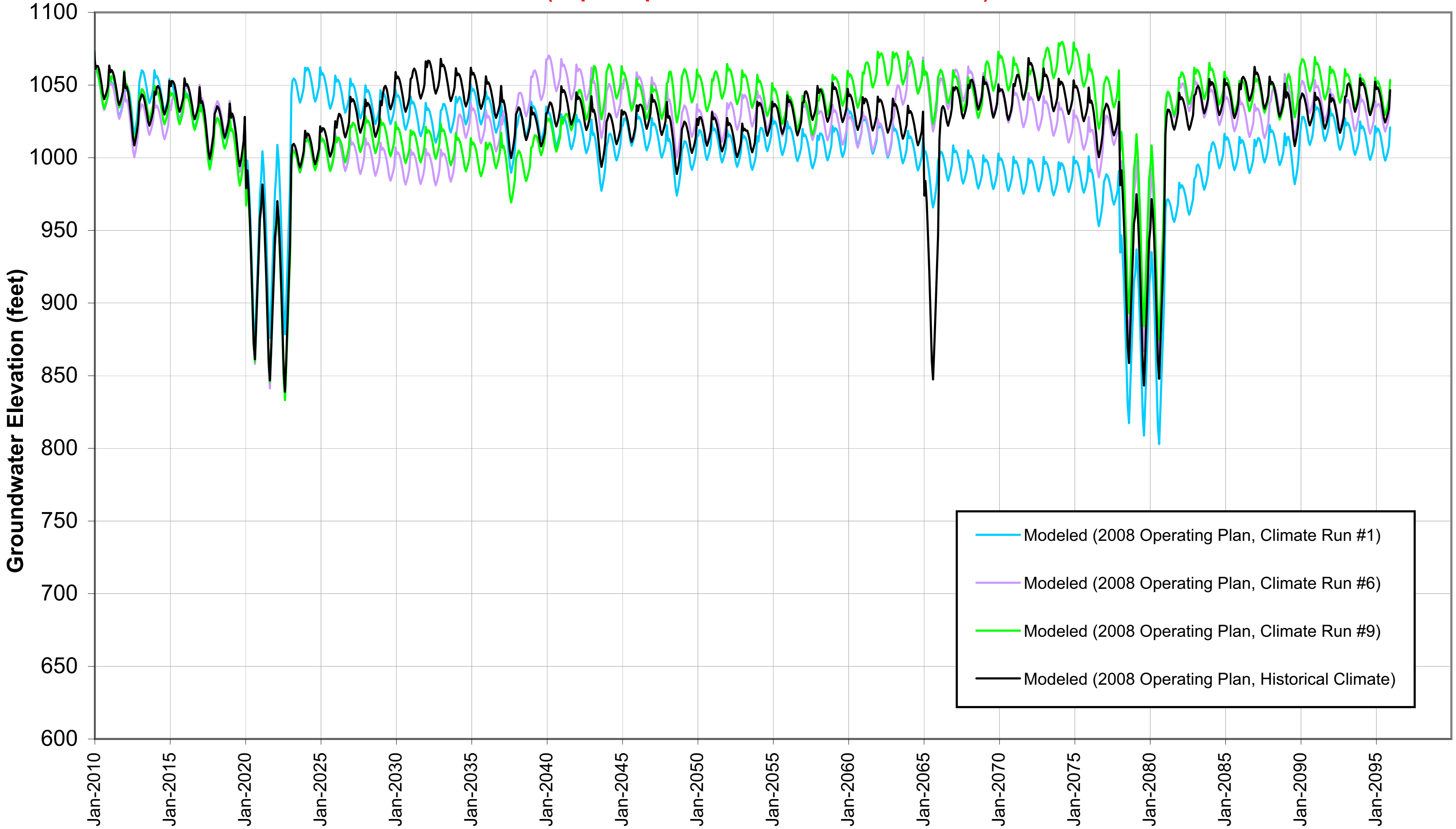
Modeled Groundwater Elevations For Various Climate Projections
VWC-159
(Top of Open Interval = Elevation 635 feet)
Groundwater Elevation (feet)
1200
1150
1100
1050
1000
950
900
850
800
750
700
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)

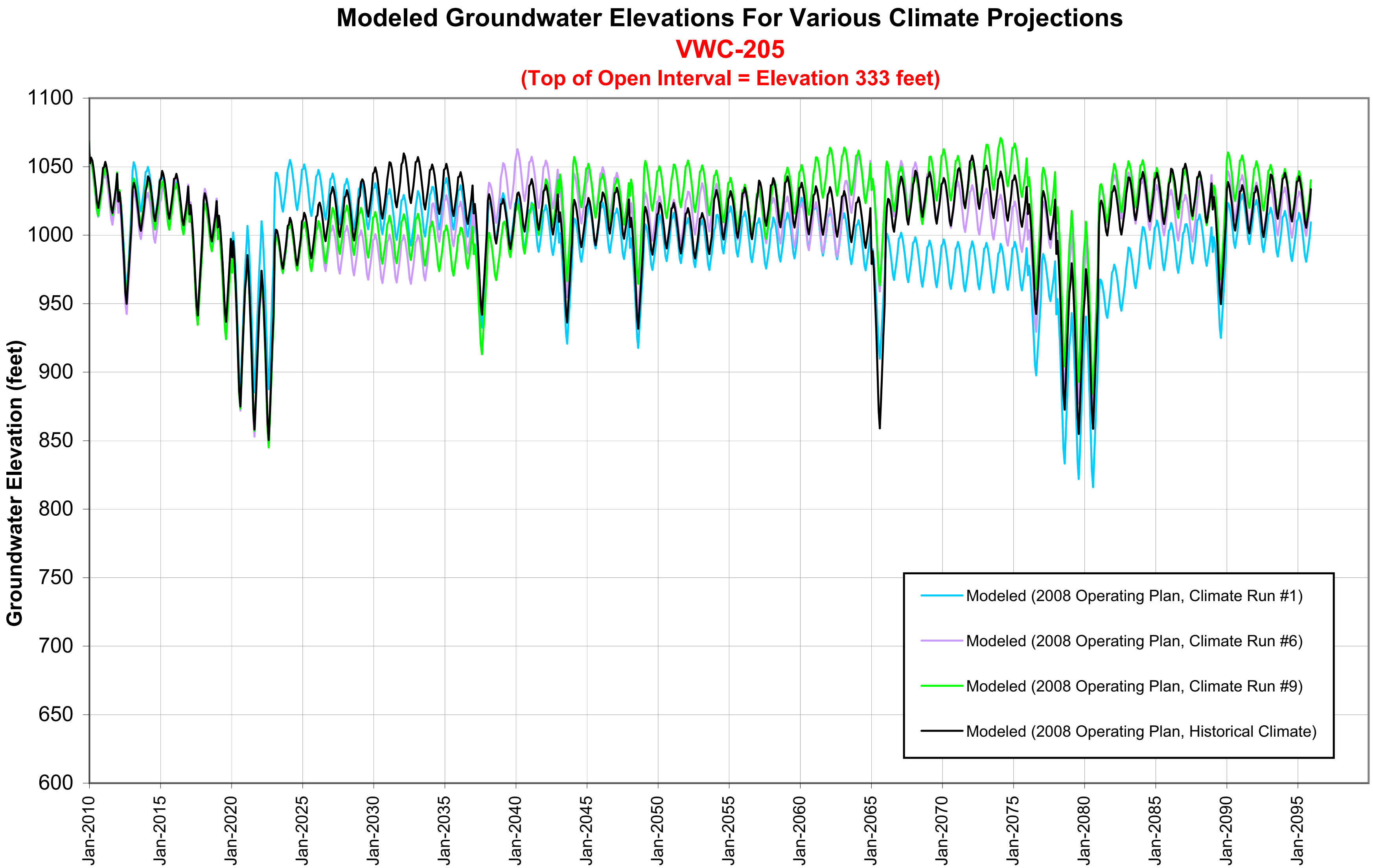

Modeled Groundwater Elevations For Various Climate Projections
VWC-160
(Top of Open Interval = Elevation 152 feet)
Groundwater Elevation (feet)
1100
1050
1000
950
900
850
800
750
700
650
600
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)

Modeled Groundwater Elevations For Various Climate Projections

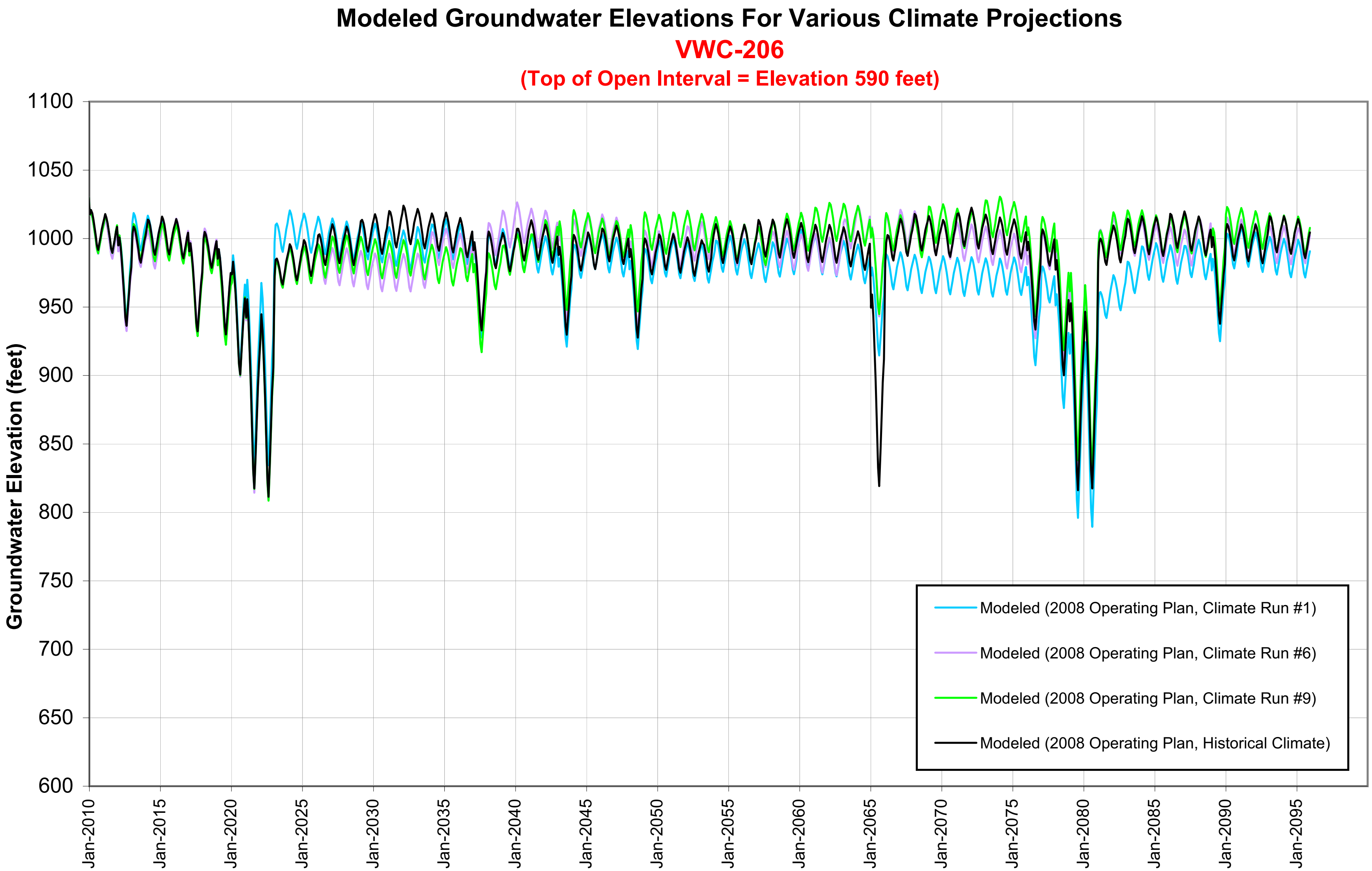
VWC-201

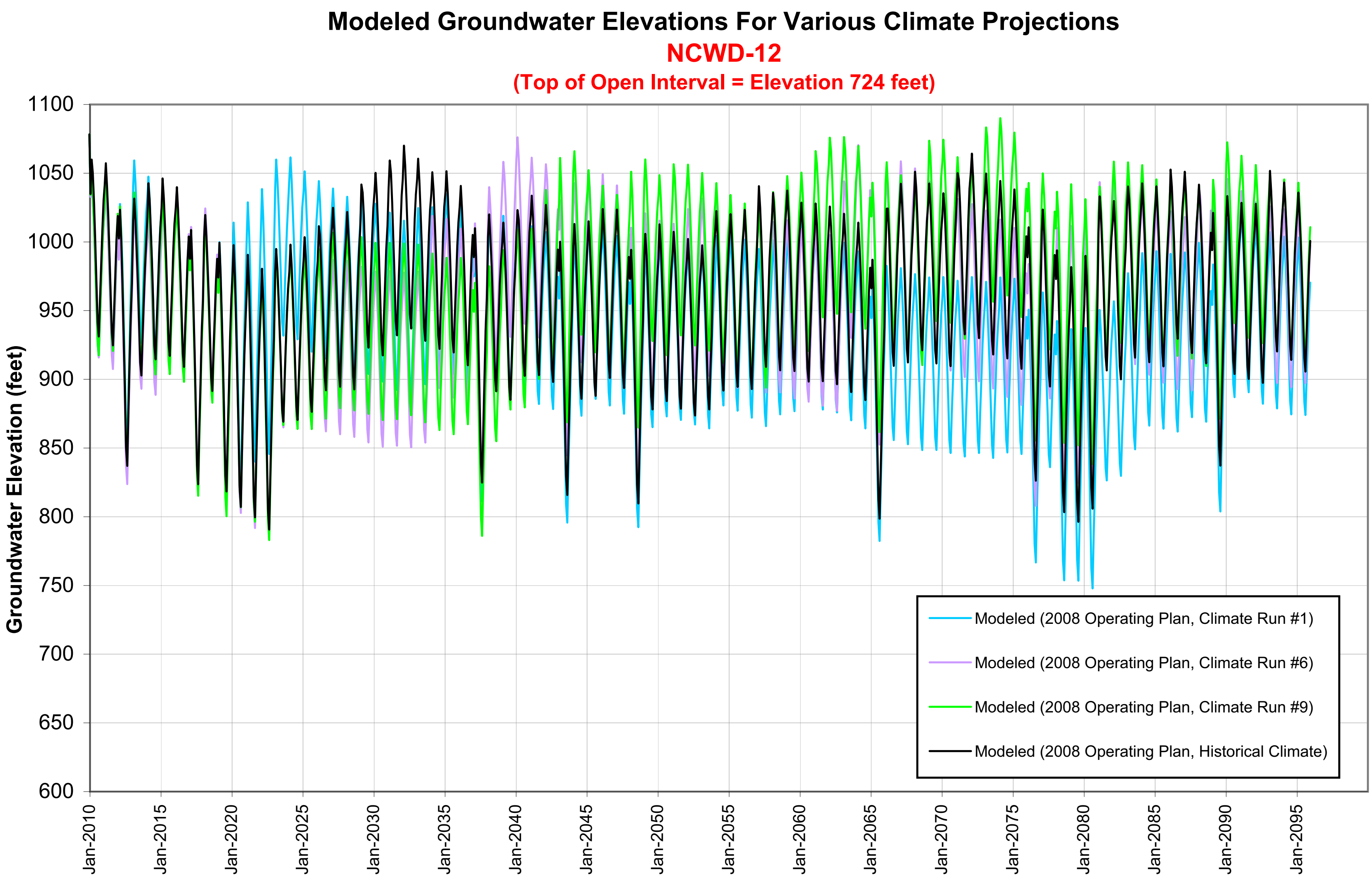
(Top of Open Interval = Elevation 609 feet)



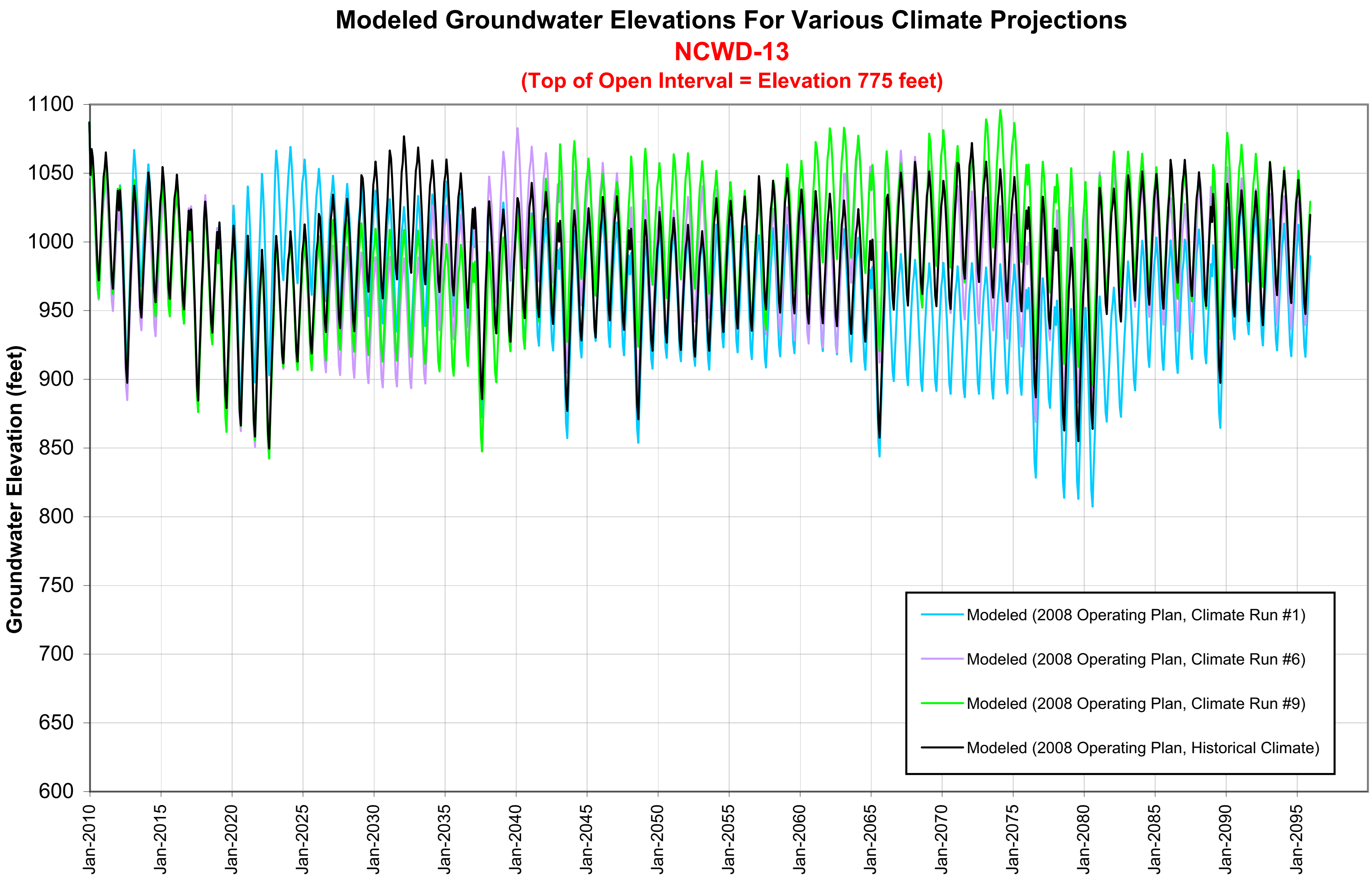


Modeled Groundwater Elevations For Various Climate Projections
VWC-205
(Top of Open Interval = Elevation 333 feet)
Groundwater Elevation (feet)
1100
1050
1000
950
900
850
800
750
700
650
600
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)


Modeled Groundwater Elevations For Various Climate Projections
VWC-206
(Top of Open Interval = Elevation 590 feet)
Groundwater Elevation (feet)
1100
1050
1000
950
900
850
800
750
700
650
600
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)



Modeled Groundwater Elevations For Various Climate Projections
NCWD-12
(Top of Open Interval = Elevation 724 feet)
Groundwater Elevation (feet)
1100
1050
1000
950
900
850
800
750
700
650
600
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)



Modeled Groundwater Elevations For Various Climate Projections
NCWD-13
(Top of Open Interval = Elevation 775 feet)
Groundwater Elevation (feet)
1100
1050
1000
950
900
850
800
750
700
650
600
Jan-2010
Jan-2015
Jan-2020
Jan-2025
Jan-2030
Jan-2035
Jan-2040
Jan-2045
Jan-2050
Jan-2055
Jan-2060
Jan-2065
Jan-2070
Jan-2075
Jan-2080
Jan-2085
Jan-2090
Jan-2095
Modeled (2008 Operating Plan, Climate Run #1)
Modeled (2008 Operating Plan, Climate Run #6)
Modeled (2008 Operating Plan, Climate Run #9)
Modeled (2008 Operating Plan, Historical Climate)