APPENDICES

APPENDIX A

Preparation Checklist for Groundwater Sustainability Plan Submittal

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
§ 354.			**Introduction to Plan Contents**					
			This Article describes the required contents of Plans submitted to the Department for evaluation, including administrative information, a description of the basin setting, sustainable management criteria, description of the monitoring network, and projects and management actions.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
SubArticle 1.			**Administrative Information**					
§ 354.2.			**Introduction to Administrative Information**					
			This Subarticle describes information in the Plan relating to administrative and other general information about the Agency that has adopted the Plan and the area covered by the Plan.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.4.			**General Information**					
			Each Plan shall include the following general information:					
(a)			An executive summary written in plain language that provides an overview of the Plan and description of groundwater conditions in the basin.		ES			
(b)			A list of references and technical studies relied upon by the Agency in developing the Plan. Each Agency shall provide to the Department electronic copies of reports and other documents and materials cited as references that are not generally available to the public.		8			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10733.2 and 10733.4, Water Code.					
§ 354.6.			**Agency Information**					
			When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:					
(a)			The name and mailing address of the Agency.		2.6			
(b)			The organization and management structure of the Agency, identifying persons with management authority for implementation of the Plan.		2.7			
(c)			The name and contact information, including the phone number, mailing address and electronic mail address, of the plan manager.		2.7.1			
(d)			The legal authority of the Agency, with specific reference to citations setting forth the duties, powers, and responsibilities of the Agency, demonstrating that the Agency has the legal authority to implement the Plan.		2.7.2			
(e)			An estimate of the cost of implementing the Plan and a general description of how the Agency plans to meet those costs.		1.7.3, 7.7:7:8		7-1:7-2	
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.8, 10727.2, and 10733.2, Water Code.					

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§ 354.8.			**Description of Plan Area**					
			Each Plan shall include a description of the geographic areas covered, including the following information:					
(a)			One or more maps of the basin that depict the following, as applicable:					
	(1)		The area covered by the Plan, delineating areas managed by the Agency as an exclusive Agency and any areas for which the Agency is not an exclusive Agency, and the name and location of any adjacent basins.		2.8	2-1		
	(2)		Adjudicated areas, other Agencies within the basin, and areas covered by an Alternative.		2.8:2.8.1			
	(3)		Jurisdictional boundaries of federal or state land (including the identity of the agency with jurisdiction over that land), tribal land, cities, counties, agencies with water management responsibilities, and areas covered by relevant general plans.		2.8.1	2-1		
	(4)		Existing land use designations and the identification of water use sector and water source type.		2.8.1.1:2.8.1.3	2-2:2-4	2-1	
	(5)		The density of wells per square mile, by dasymetric or similar mapping techniques, showing the general distribution of agricultural, industrial, and domestic water supply wells in the basin, including de minimis extractors, and the location and extent of communities dependent upon groundwater, utilizing data provided by the Department, as specified in Section 353.2, or the best available information.		2.8.3.4	2-5:2-7		
(b)			A written description of the Plan area, including a summary of the jurisdictional areas and other features depicted on the map.		2.8:2.8.1	2-1		
(c)			Identification of existing water resource monitoring and management programs, and description of any such programs the Agency plans to incorporate in its monitoring network or in development of its Plan. The Agency may coordinate with existing water resource monitoring and management programs to incorporate and adopt that program as part of the Plan.		2.8.2			
(d)			A description of how existing water resource monitoring or management programs may limit operational flexibility in the basin, and how the Plan has been developed to adapt to those limits.		2.8.2			
(e)			A description of conjunctive use programs in the basin.		2.8.2.7			
(f)			A plain language description of the land use elements or topic categories of applicable general plans that includes the following:					
	(1)		A summary of general plans and other land use plans governing the basin.		2.8.3			
	(2)		A general description of how implementation of existing land use plans may change water demands within the basin or affect the ability of the Agency to achieve sustainable groundwater management over the planning and implementation horizon, and how the Plan addresses those potential effects		2.8.3.2			
	(3)		A general description of how implementation of the Plan may affect the water supply assumptions of relevant land use plans over the planning and implementation horizon.		2.8.3.3			

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				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(4)		A summary of the process for permitting new or replacement wells in the basin, including adopted standards in local well ordinances, zoning codes, and policies contained in adopted land use plans.		2.8.3.4			
	(5)		To the extent known, the Agency may include information regarding the implementation of land use plans outside the basin that could affect the ability of the Agency to achieve sustainable groundwater management.		2.8.3.5			
(g)			A description of any of the additional Plan elements included in Water Code Section 10727.4 that the Agency determines to be appropriate.		2.8.4			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10720.3, 10727.2, 10727.4, 10733, and 10733.2, Water Code.					
§ 354.10.			**Notice and Communication**					
			Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:					
(a)			A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties.		2.9.1			
(b)			A list of public meetings at which the Plan was discussed or considered by the Agency.		Appendix C			
(c)			Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.		Appendix I			
(d)			A communication section of the Plan that includes the following:					
	(1)		An explanation of the Agency's decision-making process.		Appendix C			
	(2)		Identification of opportunities for public engagement and a discussion of how public input and response will be used.		Appendix C			
	(3)		A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin.		Appendix C			
	(4)		The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.		Appendix C			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.8, 10728.4, and 10733.2, Water Code					

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SubArticle 2.			**Basin Setting**					
§ 354.12.			**Introduction to Basin Setting**					
			This Subarticle describes the information about the physical setting and characteristics of the basin and current conditions of the basin that shall be part of each Plan, including the identification of data gaps and levels of uncertainty, which comprise the basin setting that serves as the basis for defining and assessing reasonable sustainable management criteria and projects and management actions. Information provided pursuant to this Subarticle shall be prepared by or under the direction of a professional geologist or professional engineer.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.14.			**Hydrogeologic Conceptual Model**					
(a)			Each Plan shall include a descriptive hydrogeologic conceptual model of the basin based on technical studies and qualified maps that characterizes the physical components and interaction of the surface water and groundwater systems in the basin.		3.1, Appendix F			
(b)			The hydrogeologic conceptual model shall be summarized in a written description that includes the following:					
	(1)		The regional geologic and structural setting of the basin including the immediate surrounding area, as necessary for geologic consistency.		3.1.2			
	(2)		Lateral basin boundaries, including major geologic features that significantly affect groundwater flow.		3.1.3.1			
	(3)		The definable bottom of the basin.		3.1.3.1			
	(4)		Principal aquifers and aquitards, including the following information:					
		(A)	Formation names, if defined.		3.1.3			
		(B)	Physical properties of aquifers and aquitards, including the vertical and lateral extent, hydraulic conductivity, and storativity, which may be based on existing technical studies or other best available information.		3.1.3			
		(C)	Structural properties of the basin that restrict groundwater flow within the principal aquifers, including information regarding stratigraphic changes, truncation of units, or other features.		3.1.3			
		(D)	General water quality of the principal aquifers, which may be based on information derived from existing technical studies or regulatory programs.		3.1.3.3			
		(E)	Identification of the primary use or uses of each aquifer, such as domestic, irrigation, or municipal water supply.		3.1.3.4			
	(5)		Identification of data gaps and uncertainty within the hydrogeologic conceptual model		3.1.4			
(c)			The hydrogeologic conceptual model shall be represented graphically by at least two scaled cross-sections that display the information required by this section and are sufficient to depict major stratigraphic and structural features in the basin.		3.1	3-10:3-15		

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(d)			Physical characteristics of the basin shall be represented on one or more maps that depict the following:					
	(1)		Topographic information derived from the U.S. Geological Survey or another reliable source.		3.1.1	3-1		
	(2)		Surficial geology derived from a qualified map including the locations of cross-sections required by this Section.		3.1.2	3-4		
	(3)		Soil characteristics as described by the appropriate Natural Resources Conservation Service soil survey or other applicable studies.		3.1.2.1	3-6		
	(4)		Delineation of existing recharge areas that substantially contribute to the replenishment of the basin, potential recharge areas, and discharge areas, including significant active springs, seeps, and wetlands within or adjacent to the basin.		3.1.3.2	3-9		
	(5)		Surface water bodies that are significant to the management of the basin.		3.1.1.2	3-2		
	(6)		The source and point of delivery for imported water supplies.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2, 10733, and 10733.2, Water Code.					
§ 354.16.			**Groundwater Conditions**					
			Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:					
(a)			Groundwater elevation data demonstrating flow directions, lateral and vertical gradients, and regional pumping patterns, including:					
	(1)		Groundwater elevation contour maps depicting the groundwater table or potentiometric surface associated with the current seasonal high and seasonal low for each principal aquifer within the basin.		3.2.1	3-19:3-23		
	(2)		Hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers.		3.2.1	3-25:3-29, Appendix D		
(b)			A graph depicting estimates of the change in groundwater in storage, based on data, demonstrating the annual and cumulative change in the volume of groundwater in storage between seasonal high groundwater conditions, including the annual groundwater use and water year type.		3.2.2	3-30		
(c)			Seawater intrusion conditions in the basin, including maps and cross-sections of the seawater intrusion front for each principal aquifer.		3.2.3	3-32:3-40		
(d)			Groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes.		3.2.4	3-41		
(e)			The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or the best available information.		3.2.5	3-42		

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Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(f)			Identification of interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems, utilizing data available from the Department, as specified in Section 353.2, or the best available information.		3.2.6	3-43:3-45		
(g)			Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information.		3.2.7	3-46:3-52		
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10727.4, and 10733.2, Water Code.					
§ 354.18.			**Water Budget**					
(a)			Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored. Water budget information shall be reported in tabular and graphical form.		3.3			
(b)			The water budget shall quantify the following, either through direct measurements or estimates based on data:					
	(1)		Total surface water entering and leaving a basin by water source type.		3.3.2			
	(2)		Inflow to the groundwater system by water source type, including subsurface groundwater inflow and infiltration of precipitation, applied water, and surface water systems, such as lakes, streams, rivers, canals, springs and conveyance systems.		3.3.2			
	(3)		Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow.		3.3.2			
	(4)		The change in the annual volume of groundwater in storage between seasonal high conditions.		3.3.3:3.3.4			
	(5)		If overdraft conditions occur, as defined in Bulletin 118, the water budget shall include a quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions.		3.3.6			
	(6)		The water year type associated with the annual supply, demand, and change in groundwater stored.		3.3.3:3.3.4			
	(7)		An estimate of sustainable yield for the basin.		3.3.6			
(c)			Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:					
	(1)		Current water budget information shall quantify current inflows and outflows for the basin using the most recent hydrology, water supply, water demand, and land use information.		3.3.4			
	(2)		Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:					

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		(A)	A quantitative evaluation of the availability or reliability of historical surface water supply deliveries as a function of the historical planned versus actual annual surface water deliveries, by surface water source and water year type, and based on the most recent ten years of surface water supply information.		3.3.3.1			
		(B)	A quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon.		3.3.3			
		(C)	A description of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability of the Agency to operate the basin within sustainable yield. Basin hydrology may be characterized and evaluated using water year type.		3.3.3			
	(3)		Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:					
		(A)	Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.		3.3.5			
		(B)	Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.		3.3.5			
		(C)	Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section 354.18(c)(2)(A), and the projected changes in local land use planning, population growth, and climate.		3.3.5			
(d)			The Agency shall utilize the following information provided, as available, by the Department pursuant to Section 353.2, or other data of comparable quality, to develop the water budget:					

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	(1)		Historical water budget information for mean annual temperature, mean annual precipitation, water year type, and land use.		3.3.3			
	(2)		Current water budget information for temperature, water year type, evapotranspiration, and land use.		3.3.4			
	(3)		Projected water budget information for population, population growth, climate change, and sea level rise.		3.3.5			
(e)			Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow. If a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater, the Plan shall identify and describe an equally effective method, tool, or analytical model to evaluate projected water budget conditions.		3.3.1:3.3.2			
(f)			The Department shall provide the California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and the Integrated Water Flow Model (IWFM) for use by Agencies in developing the water budget. Each Agency may choose to use a different groundwater and surface water model, pursuant to Section 352.4.		3.3.1:3.3.2			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10721, 10723.2, 10727.2, 10727.6, 10729, and 10733.2, Water Code.					
§ 354.20.			**Management Areas**					
(a)			Each Agency may define one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin.		5.11			
(b)			A basin that includes one or more management areas shall describe the following in the Plan:					
	(1)		The reason for the creation of each management area.		5.11			
	(2)		The minimum thresholds and measurable objectives established for each management area, and an explanation of the rationale for selecting those values, if different from the basin at large.		5.11			
	(3)		The level of monitoring and analysis appropriate for each management area.		5.11			
	(4)		An explanation of how the management area can operate under different minimum thresholds and measurable objectives without causing undesirable results outside the management area, if applicable.		5.11			
(c)			If a Plan includes one or more management areas, the Plan shall include descriptions, maps, and other information required by this Subarticle sufficient to describe conditions in those areas.		5.11			
			Note: Authority cited: Section 10733.2, Water Code.					

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			Reference: Sections 10733.2 and 10733.4, Water Code.					
SubArticle 3.			**Sustainable Management Criteria**					
§ 354.22.			**Introduction to Sustainable Management Criteria**					
			This Subarticle describes criteria by which an Agency defines conditions in its Plan that constitute sustainable groundwater management for the basin, including the process by which the Agency shall characterize undesirable results, and establish minimum thresholds and measurable objectives for each applicable sustainability indicator.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.24.			**Sustainability Goal**					
			Each Agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The Plan shall include a description of the sustainability goal, including information from the basin setting used to establish the sustainability goal, a discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield, and an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and implementation horizon.		5.3			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10721, 10727, 10727.2, 10733.2, and 10733.8, Water Code.					
§ 354.26.			**Undesirable Results**					
(a)			Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.		5.4.2			
(b)			The description of undesirable results shall include the following:					
	(1)		The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.		5.5.1, 5.6.1, 5.7.1, 5.8.1, 5.9.1			
	(2)		The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.		5.5.1, 5.6.1, 5.7.1, 5.8.1, 5.9.1			
	(3)		Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.		5.5.1, 5.6.1, 5.7.1, 5.8.1, 5.9.1			

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(c)			The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.		5.5.2, 5.6.2, 5.7.2, 5.8.2, 5.9.2			
(d)			An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.		5.10			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10721, 10723.2, 10727.2, 10733.2, and 10733.8, Water Code.					
§ 354.28.			**Minimum Thresholds**					
(a)			Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.		5.5.2, 5.6.2, 5.7.2, 5.8.2, 5.9.2			
(b)			The description of minimum thresholds shall include the following:					
	(1)		The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting.		5.5.2, 5.6.2, 5.7.2, 5.8.2, 5.9.2			
	(2)		The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.		5.5.2, 5.6.2, 5.7.2, 5.8.2, 5.9.2			
	(3)		How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.		5.5.2, 5.6.2, 5.7.2, 5.8.2, 5.9.2			
	(4)		How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.		5.5.2, 5.6.2, 5.7.2, 5.8.2, 5.9.2			

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	(5)		How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.		5.5.2, 5.6.2, 5.7.2, 5.8.2, 5.9.2			
	(6)		How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.		5.5.2, 5.6.2, 5.7.2, 5.8.2, 5.9.2			
(c)			Minimum thresholds for each sustainability indicator shall be defined as follows:					
	(1)		Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:					
		(A)	The rate of groundwater elevation decline based on historical trends, water year type, and projected water use in the basin.		5.5.2			
		(B)	Potential effects on other sustainability indicators.		5.5.2			
	(2)		Reduction of Groundwater Storage. The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin.		5.6.2			
	(3)		Seawater Intrusion. The minimum threshold for seawater intrusion shall be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results. Minimum thresholds for seawater intrusion shall be supported by the following:					
		(A)	Maps and cross-sections of the chloride concentration isocontour that defines the minimum threshold and measurable objective for each principal aquifer.		5.7.2	5-10		
		(B)	A description of how the seawater intrusion minimum threshold considers the effects of current and projected sea levels.		5.7.2			
	(4)		Degraded Water Quality. The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.		5.8.2			

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	(5)		Land Subsidence. The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results. Minimum thresholds for land subsidence shall be supported by the following:					
		(A)	Identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including an explanation of how the Agency has determined and considered those uses and interests, and the Agency's rationale for establishing minimum thresholds in light of those effects.		5.9.2			
		(B)	Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives.		5.9.2			
	(6)		Depletions of Interconnected Surface Water. The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results. The minimum threshold established for depletions of interconnected surface water shall be supported by the following:					
		(A)	The location, quantity, and timing of depletions of interconnected surface water.		5.10			
		(B)	A description of the groundwater and surface water model used to quantify surface water depletion. If a numerical groundwater and surface water model is not used to quantify surface water depletion, the Plan shall identify and describe an equally effective method, tool, or analytical model to accomplish the requirements of this Paragraph.		5.10			
(d)			An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.		5.6.1			
(e)			An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.		5.10			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10733, 10733.2, and 10733.8, Water Code.					
§ 354.30.			**Measurable Objectives**					
(a)			Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.		5.5.3, 5.6.3, 5.7.3, 5.8.3, 5.9.3			

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Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(b)			Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.		5.5.3, 5.6.3, 5.7.3, 5.8.3, 5.9.3			
(c)			Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.		5.5.3, 5.6.3, 5.7.3, 5.8.3, 5.9.3			
(d)			An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.		5.6.3			
(e)			Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.		5.5.3, 5.6.3, 5.7.3, 5.8.3, 5.9.3			
(f)			Each Plan may include measurable objectives and interim milestones for additional Plan elements described in Water Code Section 10727.4 where the Agency determines such measures are appropriate for sustainable groundwater management in the basin.		N/A			No additional Plan elements.
(g)			An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.		N/A			Measurable objectives do not exceed the reasonable margin of operational flexibility.
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2, 10727.4, and 10733.2, Water Code.					
SubArticle 4.			**Monitoring Networks**					
§ 354.32.			**Introduction to Monitoring Networks**					
			This Subarticle describes the monitoring network that shall be developed for each basin, including monitoring objectives, monitoring protocols, and data reporting requirements. The monitoring network shall promote the collection of data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions that occur through implementation of the Plan.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					

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				GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
§ 354.34.			**Monitoring Network**					
(a)			Each Agency shall develop a monitoring network capable of collecting sufficient data to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, and yield representative information about groundwater conditions as necessary to evaluate Plan implementation.		4.1:4.2			
(b)			Each Plan shall include a description of the monitoring network objectives for the basin, including an explanation of how the network will be developed and implemented to monitor groundwater and related surface conditions, and the interconnection of surface water and groundwater, with sufficient temporal frequency and spatial density to evaluate the affects and effectiveness of Plan implementation. The monitoring network objectives shall be implemented to accomplish the following:					
	(1)		Demonstrate progress toward achieving measurable objectives described in the Plan.		4.2			
	(2)		Monitor impacts to the beneficial uses or users of groundwater.		4.2			
	(3)		Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.		4.2			
	(4)		Quantify annual changes in water budget components.		4.2			
(c)			Each monitoring network shall be designed to accomplish the following for each sustainability indicator:					
	(1)		Chronic Lowering of Groundwater Levels. Demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features by the following methods:					
		(A)	A sufficient density of monitoring wells to collect representative measurements through depth-discrete perforated intervals to characterize the groundwater table or potentiometric surface for each principal aquifer.		4.4.1	4-3		
		(B)	Static groundwater elevation measurements shall be collected at least two times per year, to represent seasonal low and seasonal high groundwater conditions.		4.4.1			
	(2)		Reduction of Groundwater Storage. Provide an estimate of the change in annual groundwater in storage.		4.4.2			
	(3)		Seawater Intrusion. Monitor seawater intrusion using chloride concentrations, or other measurements convertible to chloride concentrations, so that the current and projected rate and extent of seawater intrusion for each applicable principal aquifer may be calculated.		4.4.3	4-4		
	(4)		Degraded Water Quality. Collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues.		4.4.4	4-5		
	(5)		Land Subsidence. Identify the rate and extent of land subsidence, which may be measured by extensometers, surveying, remote sensing technology, or other appropriate method.		4.4.5			

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Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(6)		Depletions of Interconnected Surface Water. Monitor surface water and groundwater, where interconnected surface water conditions exist, to characterize the spatial and temporal exchanges between surface water and groundwater, and to calibrate and apply the tools and methods necessary to calculate depletions of surface water caused by groundwater extractions. The monitoring network shall be able to characterize the following:					
		(A)	Flow conditions including surface water discharge, surface water head, and baseflow contribution.		4.4.6			
		(B)	Identifying the approximate date and location where ephemeral or intermittent flowing streams and rivers cease to flow, if applicable.		4.4.6			
		(C)	Temporal change in conditions due to variations in stream discharge and regional groundwater extraction.		4.4.6			
		(D)	Other factors that may be necessary to identify adverse impacts on beneficial uses of the surface water.		4.4.6			
(d)			The monitoring network shall be designed to ensure adequate coverage of sustainability indicators. If management areas are established, the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the basin setting and sustainable management criteria specific to that area.		4.2			
(e)			A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.		4.3			
(f)			The Agency shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the following factors:					
	(1)		Amount of current and projected groundwater use.		4.2			
	(2)		Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.		4.2			
	(3)		Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal.		4.2			
	(4)		Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.		4.2:4.3			
(g)			Each Plan shall describe the following information about the monitoring network:					
	(1)		Scientific rationale for the monitoring site selection process.		4.2			
	(2)		Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.		4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5			

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Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(3)		For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.		4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5			
(h)			The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.		4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5	4-3, 4-4, 4-5	4-2, 4-3, 4-4	
(i)			The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.		4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5			
(j)			An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish a monitoring network related to those sustainability indicators.		4.4.6			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10727.4, 10728, 10733, 10733.2, and 10733.8, Water Code					
§ 354.36.			**Representative Monitoring**					
			Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin, as follows:					
(a)			Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.		4.4.1, 4.4.3, 4.4.4			
(b)			(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following:					
	(1)		Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.		4.4.2			
	(2)		Measurable objectives established for groundwater elevation shall include a reasonable margin of operational flexibility taking into consideration the basin setting to avoid undesirable results for the sustainability indicators for which groundwater elevation measurements serve as a proxy.		4.4.2			
(c)			The designation of a representative monitoring site shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area.		4.4.1, 4.4.3, 4.4.4			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2 and 10733.2, Water Code					

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				GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
§ 354.38.			Assessment and Improvement of Monitoring Network					
(a)			Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.		4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5			
(b)			Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.		4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5			
(c)			If the monitoring network contains data gaps, the Plan shall include a description of the following:					
	(1)		The location and reason for data gaps in the monitoring network.		4.4.1, 4.4.2, 4.4.3			
	(2)		Local issues and circumstances that limit or prevent monitoring.		4.4.1, 4.4.2, 4.4.3			
(d)			Each Agency shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.		4.4.1, 4.4.2, 4.4.3			
(e)			Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:					
	(1)		Minimum threshold exceedances.		4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5			
	(2)		Highly variable spatial or temporal conditions.		4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5			
	(3)		Adverse impacts to beneficial uses and users of groundwater.		4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5			

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Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(4)		The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.		4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10728.2, 10733, 10733.2, and 10733.8, Water Code					
§ 354.40.			**Reporting Monitoring Data to the Department**					
			Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10728, 10728.2, 10733.2, and 10733.8, Water Code.					
SubArticle 5.			**Projects and Management Actions**					
§ 354.42.			**Introduction to Projects and Management Actions**					
			This Subarticle describes the criteria for projects and management actions to be included in a Plan to meet the sustainability goal for the basin in a manner that can be maintained over the planning and implementation horizon.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.44.			**Projects and Management Actions**					
(a)			Each Plan shall include a description of the projects and management actions the Agency has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the basin.		6			
(b)			Each Plan shall include a description of the projects and management actions that include the following:					
	(1)		A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent. The Plan shall include the following:					

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Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
		(A)	A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management actions, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.		6.2, 6.3.3, 6.4.3, 6.5.3, 6.6.3, 6.7.3, 6.8.3, 6.9.3, 6.10.3, 6.11.3, 6.12.3, 6.13.3			
		(B)	The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.		6.3.4, 6.4.4, 6.5.4, 6.6.4, 6.7.4, 6.8.4, 6.9.4, 6.10.4, 6.11.4, 6.12.4, 6.13.4			
	(2)		If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.		N/A			Overdraft conditions are not identified.
	(3)		A summary of the permitting and regulatory process required for each project and management action.		6.3.5, 6.4.5, 6.5.5, 6.6.5, 6.7.5, 6.8.5, 6.9.5, 6.10.5, 6.11.5, 6.12.5, 6.13.5			

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Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(4)		The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.		6.3.6, 6.4.6, 6.5.6, 6.6.6, 6.7.6, 6.8.6, 6.9.6, 6.10.6, 6.11.6, 6.12.6, 6.13.6			
	(5)		An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.		6.3.7, 6.4.7, 6.5.7, 6.6.7, 6.7.7, 6.8.7, 6.9.7, 6.10.7, 6.11.7, 6.12.7, 6.13.7			
	(6)		An explanation of how the project or management action will be accomplished. If the projects or management actions rely on water from outside the jurisdiction of the Agency, an explanation of the source and reliability of that water shall be included.		6.3.1, 6.4.1, 6.5.1, 6.6.1, 6.7.1, 6.8.1, 6.9.1, 6.10.1, 6.11.1, 6.12.1, 6.13.1			
	(7)		A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.		6.3.8, 6.4.8, 6.5.8, 6.6.8, 6.7.8, 6.8.8, 6.9.8, 6.10.8, 6.11.8, 6.12.8, 6.13.8			

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Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(8)		A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.		6.3.9, 6.4.9, 6.5.9, 6.6.9, 6.7.9, 6.8.9, 6.9.9, 6.10.9, 6.11.9, 6.12.9, 6.13.9			
	(9)		A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.		6.2, 6.6, 6.7, 6.10			
(c)			Projects and management actions shall be supported by best available information and best available science.		6.2			
(d)			An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.		6.2			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2, 10727.4, and 10733.2, Water Code.					

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APPENDIX B

Carpinteria Groundwater Sustainability Agency Governance Documents

JOINT EXERCISE OF POWERS AGREEMENT

by and among

THE CARPINTERIA VALLEY WATER DISTRICT

THE CITY OF CARPINTERIA

THE SANTA BARBARA COUNTY WATER AGENCY

and

THE COUNTY OF VENTURA

creating

CARPINTERIA GROUNDWATER SUSTAINABILITY AGENCY

January 2020

JOINT EXERCISE OF POWERS AGREEMENT
THE CARPINTERIA GROUNDWATER SUSTAINABILITY AGENCY

This **Joint Exercise of Powers Agreement ("Agreement")** is made and effective on the last date executed ("**Effective Date**"), by and among the Carpinteria Valley Water District, the City of Carpinteria, the Santa Barbara County Water Agency and the County of Ventura, sometimes referred to herein individually as a "**Member**" and collectively as the "**Members,**" for purposes of forming the Carpinteria Groundwater Sustainability Agency ("**Agency**") and setting forth the terms pursuant to which the Agency shall operate. Capitalized terms used herein shall have the meanings given to them in Article 1 of this Agreement.

RECITALS

A. Each of the Members is a local agency, as defined by the Sustainable Groundwater Management Act of 2014 ("**SGMA**"), duly organized and existing under and by virtue of the laws of the State of California, and each Member can exercise powers related to groundwater management.

B. For groundwater basins designated by the California Department of Water Resources ("**DWR**") as medium- and high-priority, SGMA requires establishment of a groundwater sustainability agency ("**GSA**") within 2 years from the date in which the basin was designated medium or high priority, and adoption of a groundwater sustainability plan ("**GSP**") within 5 years of the date of said designation.

C. The Carpinteria Groundwater Basin (designated basin number 3-18 in the DWR's Bulletin No. 118) ("**Basin**") has been designated as a high-priority basin by DWR.

D. Under SGMA, a combination of local agencies may form a GSA through a joint exercise of powers agreement.

E. The Members have determined that the sustainable management of the Carpinteria Groundwater Basin pursuant to SGMA may best be achieved through the cooperation of the Members operating through a joint powers authority. In accordance with Water Code section 10732, subdivision (b), all Members have held a public hearing regarding entering into this Agreement and complied with the noticing provisions in SGMA.

F. The Joint Exercise of Powers Act ("**Act**") codified in Government Code section 6500, et seq., authorizes the Members to create a joint powers authority, and to jointly exercise any power common to the Members and to exercise additional powers granted under the Act.

G. The Act, including the Marks-Roos Local Bond Pooling Act of 1985 (Government Code section 6584, et seq.), authorizes an entity created pursuant to the Act to issue bonds, and under certain circumstances, to purchase bonds issued by, or to make loans to, the Members for financing public capital improvements, working capital, liability and other insurance needs or projects whenever doing so would result in significant public benefits, as determined by the Members. The Act further authorizes and empowers a joint powers authority to sell bonds so issued or purchased to public or private purchasers at public or negotiated sales.

H. Based on the foregoing legal authority, the Members desire to create a joint powers authority for the purpose of taking all actions deemed necessary by the joint powers authority to ensure sustainable management of the Basin as required by SGMA.

I. The governing board of each Member has determined it to be in the Member's best interest and in the public interest that this Agreement be executed.

TERMS OF AGREEMENT

In consideration of the mutual promises and covenants herein contained, the Members agree as follows:

ARTICLE 1
DEFINITIONS

The following terms have the following meanings for purposes of this Agreement:

1.1 "Act" means the Joint Exercise of Powers Act, set forth in Chapter 5 of Division 7 of Title 1 of the Government Code section 6500, et seq., including all laws supplemental thereto.

1.2 "Agreement" has the meaning assigned thereto in the Preamble.

1.3 "Auditor" means the auditor of the financial affairs of the Agency appointed by the Board of Directors pursuant to Section 13.3 of this Agreement.

1.4 "Agency" has the meaning assigned thereto in the Preamble.

1.5 "Basin" has the meaning assigned thereto in Recital C and shall be further defined as consistent with the most current definition of Carpinteria Groundwater Basin in DWR Bulletin 118.

1.6 "Board of Directors" or "Board" means the governing body of the Agency as established by Article 6 of this Agreement.

1.7 "Bylaws" means the bylaws adopted by the Board of Directors pursuant to Article 11 of this Agreement to govern the day-to-day operations of the Agency.

1.8 "Director" and "Alternate Director" shall mean a director or alternate director appointed to the Board of Directors for the Agency by a Member pursuant to Article 6 of this Agreement.

1.9 "DWR" has the meaning assigned thereto in Recital B.

1.10 "Effective Date" has the meaning assigned thereto in the Preamble.

1.11 “Executive Director” means the chief administrative officer of the Agency to be appointed by the Board of Directors pursuant to Article 10 of this Agreement.

1.12 “GSA” has the meaning assigned thereto in Recital B.

1.13 “GSP” has the meaning assigned thereto in Recital B.

1.14 “Member” has the meaning assigned thereto in the Preamble and further means each party to this Agreement that satisfies the requirements of Section 5.1 of this Agreement, including any new members as may be authorized by the Board, pursuant to Section 5.2 of this Agreement.

1.15 “Officer(s)” means the chair, vice chair, secretary, or treasurer of the Agency to be appointed by the Board of Directors pursuant to Section 7.1 of this Agreement.

1.16 “Principal Office” means the physical location at which Agency and GSA business is conducted, GSA staff is officed, official Agency and GSA documents will be stored, and GSA equipment will be stored. The Principal Office may be co-located at a member agency office, but Agency property and documents must be segregated into its own space.

1.17 “Quorum” shall have the meaning assigned to it in Section 9.1 of this Agreement.

1.18 “SGMA” has the meaning assigned thereto in Recital A.

1.19 “Special Projects” shall mean a project undertaken pursuant to Article 17 of this Agreement.

1.20 “State” means the State of California.

1.21 “Supermajority” shall mean the following:

1.21.1 If five (5) Directors are eligible to vote, a supermajority shall mean three (3) affirmative votes.

1.21.2 If six (6) Directors are eligible to vote, a supermajority vote shall mean four (4) affirmative votes.

1.21.3 If seven (7) Directors are eligible to vote, a supermajority vote shall mean five (5) affirmative votes.

1.21.4 If eight (8) Directors are eligible to vote, a supermajority vote shall mean six (6) affirmative votes.

1.22 A “unanimous” vote by the Board of Directors shall mean one of all Directors in attendance and eligible to vote.

ARTICLE 2
CREATION OF THE AGENCY

2.1 Creation of the Agency. There is hereby created pursuant to the Act, a joint powers authority, which will be a public entity separate from the Members to this Agreement and shall be known as the Carpinteria Groundwater Sustainability Agency ("**Agency**"). Within thirty (30) days after the Effective Date of this Agreement and after any amendment to this Agreement, the Agency shall cause a notice of this Agreement or amendment to be prepared and filed with the office of the California Secretary of State containing the information required by Government Code section 6503.5. Within seventy (70) days after the Effective Date of this Agreement, the Agency shall cause a statement of the information concerning the Agency, required by Government Code section 53051, to be filed with the office of the California Secretary of State and with the Clerk for the County of Santa Barbara for the County of Ventura, setting forth the facts required to be stated pursuant to Government Code section 53051, subdivision (a). The jurisdictional boundary of Agency shall be coterminous with the boundaries of the Basin.

2.2 Purpose of the Agency. Each Member to this Agreement has in common the power to study, plan, develop, finance, acquire, construct, maintain, repair, manage, operate, control, and govern water supply projects and/or exercise groundwater management authority within the Basin either alone or in cooperation with other public or private non-member entities, and each is a local agency eligible to serve as the GSA in the Basin, either alone or jointly through a joint powers agreement as provided for by SGMA. This Agreement is being entered into in order to jointly exercise some or all of the foregoing common powers, as appropriate, and for the exercise of such additional powers as may be authorized by law in the manner herein set forth, in order to effectuate the purposes of this Agreement. The purpose of the Agency is to form a GSA to manage groundwater in the Basin and to develop, adopt, and implement the GSP for the Basin pursuant to SGMA and other applicable provisions of law.

ARTICLE 3
TERM

This Agreement shall become effective upon its execution by each of the Members and shall remain in effect until terminated pursuant to the provisions of Article 16 of this Agreement.

ARTICLE 4
POWERS

The Agency shall possess the power in its own name to exercise any and all common powers of its Members reasonably necessary for the Agency to implement the purposes of SGMA and for no other purpose, together with such other powers as are expressly set forth in the Joint Exercise of Powers Act and in SGMA subject to the limitations set forth therein.

SGMA expressly reserves certain powers and authorities to and preserves certain powers and authorities of cities and counties, including, without limitation, the issuance of permits for the construction, modification or abandonment of groundwater wells, land use planning and groundwater management pursuant to city and county police powers in a manner that is not in conflict with the GSP. Directors representing a county or city of the Agency do not have the ability to authorize the Agency to exercise or infringe upon any such reserved powers and authorities, without the Agency first seeking and receiving authorization by formal action respectively from the Board of Supervisors or City Council. Furthermore, this agreement shall not be interpreted as limiting or ceding any such reserved or preserved powers and authorities. In addition, to the extent that a Member, other than a county or city, independently possesses any of the powers or authorities expressly preserved by SGMA, the Agency does not have the ability or authority to exercise or infringe on such preserved powers and/or authorities of such Member without the Agency first seeking and receiving authorization from such Member’s governing board, unless specifically enumerated in this Agreement.

For purposes of Government Code section 6509, the powers of the Agency shall be exercised subject to the restrictions upon the manner of exercising such powers as are imposed on the Carpinteria Valley Water District, and in the event of the withdrawal of the Carpinteria Valley Water District as a Member under this Agreement, then the manner of exercising; the Agency's powers shall be exercised subject to those restrictions imposed on the Santa Barbara County Water Agency.

As required by Water Code section 10723.2, the Agency shall consider the interests of all beneficial uses and users of groundwater in the Basin, as well as those responsible for implementing the GSP. Additionally, as set forth in Water Code section 10720.5, subdivision (a), any GSP adopted pursuant to this Agreement shall be consistent with Section 2 of Article X of the California Constitution. Nothing in this Agreement modifies the rights or priorities to use or store groundwater consistent with Section 2 of Article X of the California Constitution, with the exception that no extraction of groundwater between January 1, 2015 and the date of adoption of the GSP may be used as evidence of or to establish or defend against a claim for prescription. Likewise, as set forth in Water Code section 10720.5, subdivision (b), nothing in this agreement or any GSP adopted pursuant to this agreement determines or alters surface water rights or groundwater rights under common law or any provision of law that determines or grants water rights.

4.1 GSA Formation. Pursuant to Section 2.2 of this Agreement the Agency will serve as the GSA for the purposes of sustainably managing groundwater in the Basin under SGMA. After GSA formation, the Agency will have the authority to exercise all powers afforded to the Agency under SGMA, including without limitation:

4.1.1 To adopt rules, regulations, policies, bylaws and procedures governing the operation of the Agency.

4.1.2 To develop, adopt and implement a GSP for the Basin, and to exercise jointly the common powers of the Members in doing so.

4.1.3 To obtain rights, permits and other authorizations for, or pertaining to, implementation of a GSP for the Basin.

4.1.4 To collect and monitor data on the extraction of groundwater from, and the quality of groundwater in, the Basin.

4.1.5 To acquire property and other assets by grant, lease, purchase, bequest, devise, gift, or eminent domain, and to hold, enjoy, lease or sell, or otherwise dispose of, property, including real property, water rights, and personal property, necessary for the full exercise of the Agency's powers.

4.1.6 To establish and administer a conjunctive use program for the purposes of maintaining sustainable yields in the Basin consistent with the requirements of SGMA.

4.1.7 To regulate groundwater extractions as permitted by SGMA.

4.1.8 To spread, sink and inject water into the Basin.

4.1.9 To store, transport, recapture, recycle, purify, treat or otherwise manage and control water for beneficial use.

4.1.10 To develop and facilitate market-based solutions between Basin stakeholders for the use and management of water rights.

4.1.11 To impose assessments, groundwater extraction fees or other charges, and to undertake other means of financing the Agency as authorized by Chapter 8 of SGMA, commencing at section 10730 of the Water Code.

4.1.12 To perform other ancillary tasks relating to the operation of the Agency pursuant to SGMA, including without limitation, environmental review, engineering, and design.

4.1.13 To apply for, accept and receive licenses, permits, water rights, approvals, agreements, grants, loans, contributions, donations or other aid from any agency of the United States, the State of California or other public agencies or private persons or entities necessary for the Agency's purposes.

4.1.14 To develop, collect, provide, and disseminate information that furthers the purposes of the Agency.

4.1.15 To make and enter contracts necessary to the full exercise of the Agency's power.

4.1.16 To employ, designate, or otherwise contract for the services of, agents, officers, employees, attorneys, engineers, planners, financial consultants, technical specialists, advisors, and independent contractors.

4.1.17 To incur debts, liabilities or obligations, to issue bonds, notes, certificates of participation, guarantees, equipment leases, reimbursement obligations and other indebtedness, as authorized by the Act.

4.1.18 To cooperate, act in conjunction and contract with the United States, the State of California, or any agency thereof, counties, municipalities, public and private corporations of any kind (including without limitation, investor-owned utilities), and individuals, or any of them, for any and all purposes necessary or convenient for the full exercise of the powers of the Agency.

4.1.19 To sue and be sued in the Agency's own name.

4.1.20 To provide for the prosecution of, defense of, or other participation in, actions or proceedings at law or in public hearings in which the Members, pursuant to this Agreement, have an interest and employ counsel and other expert assistance for these purposes.

4.1.21 To accumulate operating and reserve funds for the purposes herein stated.

4.1.22 To invest money that is not required for the immediate necessities of the Agency, as the Agency determines is advisable, in the same manner and upon the same conditions as Members, pursuant to Government Code section 53601, as that section now exists or may hereafter be amended.

4.1.23 To undertake any investigations, studies, and matters of general administration.

4.1.24 To undertake Special Projects, as set forth in Article 17.

4.1.25 To perform all other acts necessary or proper to carry out fully the purposes of this Agreement.

ARTICLE 5
MEMBERSHIP

5.1 Members. The Members of the Agency shall be the Carpinteria Valley Water District, the City of Carpinteria, Santa Barbara County Water Agency and the County of Ventura as long as they have not, pursuant to the provisions hereof, withdrawn from this Agreement.

5.2 New Members. It is recognized that a public agency that is not a Member on the Effective Date of this Agreement may wish to participate in the Agency. Non-member eligible public agencies may become members of the Agency upon such terms and conditions as established by the Board of Directors and upon the unanimous consent of the existing Members, evidenced by the execution of a written amendment to this Agreement signed by all of the Members, including the non-member eligible public agency. The addition of new Members shall not affect any rights of existing Members without the consent of all affected Members.

ARTICLE 6
BOARD OF DIRECTORS AND OFFICERS

6.1 Formation of the Board of Directors. The Agency shall be governed by a Board of Directors ("**Board of Directors**" or "**Board**") consisting of representatives appointed in the manner set forth in Section 6.3 of this Agreement. The Board shall be composed of five (5) "**Regular Directors**" and up to three (3) "**Optional Directors**" as follows:

6.1.1 Five (5) Regular Directors shall be appointed to the Board within 30 days of the Effective Date of the Agreement in the manner set forth in Section 6.3.1 below.

6.1.2 Three (3) Optional Directors may be appointed after the first publicly held meeting of the Agency up to the time of adoption of the GSP by the Board in the manner set forth in Sections 6.3.2 through 6.3.4 below. After the GSP has been adopted by the Board, if a Member has not appointed an Optional Director to the Board, and the seat has not been filled pursuant to Section 6.3.5 below, a Member may elect to appoint its Optional Director but subject to the Board of Directors' approval.

6.2 Duties of the Board of Directors. The business and affairs of the Agency, and all of the powers of the Agency, including without limitation all powers set forth in Article 4, are reserved to and shall be exercised by and through the Board of Directors, except as may be expressly delegated to the Executive Director or others pursuant to this Agreement, Bylaws, or by specific action of the Board of Directors.

6.3 Appointment of Directors. The Directors shall be appointed as follows:

6.3.1 Five (5) Regular Directors from the Carpinteria Valley Water District shall be appointed to the Board of Directors by resolution of the Carpinteria Valley Water District board of directors.

6.3.2 One (1) Optional Director from the City of Carpinteria may be appointed by resolution of the City of Carpinteria City Council pursuant to Section 6.1.2 above.

6.3.3 One (1) Optional Director from the Santa Barbara County Water Agency may be appointed by resolution of the Santa Barbara County Water Agency board of directors pursuant to Section 6.1.2 above.

6.3.4 One (1) Optional Director from the County of Ventura may be appointed by resolution of the Ventura County Board of Supervisors pursuant to Section 6.1.2 above.

6.3.5 If the Members named in Sections 6.3.2, 6.3.3, or 6.3.4 fail to exercise the option to appoint an Optional Director up to the adoption of the GSP by the Board, or if a Member provides written notice to the Board Chair and to all other Members named in Sections 6.3.2, 6.3.3, or 6.3.4 that it declines to exercise its option to appoint an Optional Director, any other Member named in these Sections may choose to exercise the option to name another Optional Director from their respective agency within thirty (30) days after adoption of the GSP by the Board. The option under this Section may be exercised by providing the GSA Board Chair with written notice of the Member's election to name another Optional Director. If more than one eligible Member exercises the option under this section, the Member who first provided written notice to the GSA Board Chair will be the Member authorized to exercise the appointment option. This option shall be limited to allow the Members named in Sections 6.3.2, 6.3.3 and 6.3.4 to appoint a maximum of two Optional Directors.

6.4 Alternate Directors. Each Member may appoint one Alternate Director to act in the place of a Director in case of absence or inability to act. Alternate Directors shall be appointed in the same manner as set forth in Section 6.3. Unless appearing as a substitute for a Director due to absence or conflict of interest, Alternate Directors shall have no vote, and shall not participate in any discussions or deliberations of the Board. If the Director is not present, or if the Director has a conflict of interest which precludes participation by the Director in any decision-making process of the Board, the Alternate Director appointed to act in his/her place shall assume all rights of the Director, and shall have the authority to act in his/her absence, including casting votes on matters before the Board. Each Alternate Director shall be appointed prior to the meeting of the Board in which the Alternate Director is participating Board deliberations. Alternate Directors are encouraged to attend Board meetings and stay informed on current issues before the Board.

6.5 Term, Reappointment, and Removal.

6.5.1 Directors and Alternate Directors shall serve for terms of four (4) years. A Director or Alternate Director may be removed during his or her term or reappointed for multiple terms at the pleasure of the Member that appointed him or her.

6.5.2 A Director shall be a member of the appointing agency's legislative body and shall cease to be a Member Director or Alternate Director when no longer a member of the appointing agency's legislative body.

6.5.3 An Alternate Director shall be a member of the appointing agency's legislative body or in a senior management staff position and shall cease to be an Alternate Director when no longer a member of the appointing agency's staff or legislative body.

6.6 Vacancies. A vacancy on the Board of Directors shall occur when a Director resigns or reaches the end of that Director's term, as set forth in Section 6.5. A vacancy shall also occur when a Director is removed by his or her appointing Member. Upon the vacancy of a Director, the Alternate Director shall serve as Director until a new Director is appointed as set forth in Section 6.3 unless the Alternate Director is already serving as an Alternate Director in the event of a prior vacancy, in which case, the seat shall remain vacant until a replacement Director is appointed as set forth in Section 6.3. Members shall submit any changes in Director or Alternate Director positions to the Executive Director by written notice signed by an authorized representative of the Member's agency. The written notice shall include a resolution of the governing board of the Member directing such change in the Director or Alternative Director position.

6.7 Conflicts of Interest. No Director shall be allowed to participate in any matter before the Board in which he or she has a conflict of interest. A Director is also deemed to have a conflict of interest and disqualified from participating in related matters before the Board if that Director (i) is personally, or (ii) was appointed by a Member that is, named as an adverse party in any litigation in which the Agency is a party. In such an event, the Director shall be deemed disqualified in all matters related to the issue being litigated, shall not be eligible to receive confidential information relating to the litigation from the Agency or its legal counsel, and shall not be eligible to attend any closed session where the litigation is discussed. In the event a Director deemed to have conflict of interest refuses to withdraw from matters related to the conflict, the other Directors shall jointly seek a court order preventing the conflicted Director from participating in those related matters.

ARTICLE 7
OFFICERS

7.1 Officers. The officers of the Agency shall be a chair and vice chair, selected from among the Directors. The Agency shall also appoint a treasurer/auditor consistent with the provisions of Section 13.3. In the absence of the chair the vice chair, or in the vice chair's absence, the next senior Director, shall exercise all powers of the chair in the chair's absence or inability to act.

7.2 Appointment of Officers. Officers shall be elected by, and serve at the pleasure of, the Board of Directors, in accordance with the Bylaws.

7.3 Principal Office. The Principal Office of the Agency shall be established by the Board of Directors and may thereafter be changed by a vote of the Board.

ARTICLE 8
DIRECTOR MEETINGS

8.1 Initial Meeting. The initial meeting of the Board of Directors shall be held in Carpinteria, California, within thirty (30) days of the Effective Date of this Agreement.

8.2 Time and Place. The Board of Directors shall meet at least quarterly, at a date, time and place set by the Board, within the jurisdictional boundaries of one or more of the Members, and at such times as may be determined by the Board.

8.3 Special Meetings. Special meetings of the Board of Directors may be called by the Chair or by a vote of the Directors in accordance with the provisions of Government Code section 54956.

8.4 Conduct. All meetings of the Board of Directors, including special meetings, shall be noticed, held, and conducted in accordance with the Ralph M. Brown Act (Government Code, § 54950, et seq.). The Board may use teleconferencing in connection with any meeting in conformance with and to the extent authorized by applicable law.

8.5 Local Conflict of Interest Code. The Board of Directors shall adopt a local conflict of interest code pursuant to the provisions of the Political Reform Act of 1974 (Government Code, § 81000, et seq.) within six (6) months of the first meeting of the Board of Directors of the Agency.

ARTICLE 9
MEMBER VOTING

9.1 Quorum. A quorum of any meeting of the Board of Directors shall consist of a majority of the total number of Directors plus one Director ("**Quorum**"). In the absence of a Quorum, a meeting of the Directors may be adjourned for lack of a Quorum. If there is not a Quorum at a meeting of the Directors, no business may be transacted at the meeting. For purposes of this Article, a Director shall be deemed present if the Director appears at the meeting in person or participates telephonically, provided the telephone appearance is consistent with the requirements of the Ralph M. Brown Act (Government Code, § 54950, et seq.).

9.2 Director Votes. Voting by the Board of Directors shall be made on the basis of one vote for each Director. A Director, or an Alternate Director when acting in the absence of his or her Director, may vote on all matters of Agency business unless disqualified because of a conflict of interest pursuant to California law or the local conflict of interest code adopted by the Board of Directors.

9.3 Affirmative Decisions of the Board of Directors. The structure of voting and the determination of affirmative decisions of the Board of Directors, as set forth herein, are designed to encourage and facilitate consensus, pursuant to the following procedure:

9.3.1 First Hearing. A matter may be approved on the first hearing of the matter pursuant to a unanimous vote of all Directors.

9.3.2 Second Hearing. If unanimity is not obtained on the first hearing of a matter, the Board shall continue a final vote on the matter for a second hearing. The second hearing shall occur at the next regular meeting of the Board, unless the Board votes to continue the second hearing of the matter to another regular or special meeting of the Board.

(a) Matters Requiring Supermajority Vote on Second Hearing. Decisions concerning the following matters shall require a supermajority vote in order to pass on the Second Hearing: (i) any capital expenditure of $250,000 or more; (ii) the Agency's annual budget and amendments thereto; (iii) adoption or amendment of the GSP for the Basin; (iv) adoption of groundwater extraction fees; (v) the Agency's adoption of any taxes, fees, or assessments that are subject to Proposition 26 or 218; (vi) any stipulation to resolve litigation concerning groundwater rights within, or groundwater management for, the Basin. A supermajority vote shall be calculated pursuant to Section 1.21.

(b) Simple Majority Vote for All Other Matters on Second Hearing. Unless otherwise specified in this Agreement, for all matters not specified in Section 9.3.2(a), an affirmative decision of the Board on the second hearing shall require a simple majority of all Directors present at the meeting and eligible to vote on the matter.

ARTICLE 10
EXECUTIVE DIRECTOR AND STAFF

10.1 Appointment. The Board of Directors shall appoint an Executive Director, who may be, though need not be, an officer, employee, or representative of one of the Members. The Executive Director's compensation, if any, shall be determined by the Board of Directors.

10.2 Duties. If appointed, the Executive Director shall be the chief administrative officer of the Agency, shall serve at the pleasure of the Board of Directors, and shall be responsible to the Board for the proper and efficient administration of the Agency. The Executive Director shall have the powers designated by the Board, or otherwise as set forth in the Bylaws.

10.3 Term and Termination. The Executive Director shall serve until he/she resigns, or the Board of Directors terminates his/her appointment.

10.4 Staff and Services. The Executive Director may employ such additional full-time and/or part-time employees, assistants and independent contractors who may be necessary from time to time to accomplish the purposes of the Agency, subject to the approval of the Board of Directors. The Agency may contract with a Member or other public agency or private entity for various services, including without limitation, those related to the Agency's finances, purchasing, risk management, information technology and human resources. A written agreement shall be entered between the Agency and the Member or other public agency or private entity contracting to provide such service, and that agreement shall specify the terms on which such services shall be provided, including without limitation, the compensation, if any, that shall be made for the provision of such services.

ARTICLE 11
BYLAWS

The Board of Directors shall cause to be drafted, approve, and amend Bylaws of the Agency to govern the day-to-day operations of the Agency. The Bylaws shall be adopted at or before the first anniversary of the Board's first meeting.

ARTICLE 12
ADVISORY COMMITTEES

The Board of Directors may from time to time appoint one or more advisory committees or establish standing or ad hoc committees to assist in carrying out the purposes and objectives of the Agency. The Board shall determine the purpose and need for such committees and the necessary qualifications for individuals appointed to them. Each committee shall include a Director as the chair thereof. Other members of each committee may be composed of those individuals approved by the Board of Directors for participation on the committee. However, no committee or participant on such committee shall have any authority to act on behalf of the Agency.

ARTICLE 13 ACCOUNTING
PRACTICES

13.1 General. The Board of Directors shall establish and maintain such funds and accounts as may be required by generally accepted public agency accounting practices. The Agency shall maintain strict accountability of all funds and report all receipts and disbursements of the Agency.

13.2 Fiscal Year. Unless the Board of Directors decides otherwise, the fiscal year for the Agency shall run from July 1 to June 30.

13.3 Appointment of Treasurer and Auditor; Duties. The treasurer and Auditor shall be appointed and/or retained in the manner, and shall perform such duties and responsibilities, specified in sections 6505, 6505.5 and 6505.6 of the Act. The treasurer shall be bonded in accordance with the provisions of Government Code section 6505.1. Until such appointment of treasurer/Auditor, the duties of the office shall be carried out by the treasurer/auditor of the Carpinteria Valley Water District.

13.4 Records. The books and records of the Agency shall be open to inspection by the Members at reasonable times upon reasonable notice, provided, however, that nothing in this Agreement shall be interpreted as requiring the Agency to disclose confidential materials, or materials privileged from disclosure, under California law. Nothing in this Agreement shall be interpreted as negating an exemption from, or prohibition of, disclosure in the Public Records Act (Government Code, § 6250, et seq.).

ARTICLE 14
BUDGET AND EXPENSES

14.1 Budget. Within one hundred and twenty (120) days after the first meeting of the Board of Directors, and thereafter prior to the commencement of each fiscal year, the Board shall adopt a budget for the Agency for the ensuing fiscal year. In the event that a budget is not so approved, the prior year's budget shall be deemed approved for the ensuing fiscal year, and any groundwater extraction fee or contributions by Members, or both, approved by the Board during the prior fiscal year shall again be assessed in the same amount and terms for the ensuing fiscal year until amended.

14.2 Agency Funding and Contributions. For the purpose of funding the expenses and ongoing operations of the Agency, the Board of Directors shall maintain a funding account in connection with the annual budget process. The Board of Directors may fund the Agency and the GSP for the Basin as provided in Chapter 8 of SGMA (commencing with section 10730 of the Water Code), and through voluntary contributions from Members, with the intent that the Agency will reimburse each Member at a later date.

14.3 Return of Contributions. The Agency may reimburse Members for all or any part of any contributions made by Members, and any revenues by the Agency may be distributed by the Board of Directors at such time and upon such terms as the Board of Directors may decide; provided that (i) any distributions shall be made in proportion to the contributions paid by each Member to the Agency, and (ii) any capital contribution paid by a Member voluntarily, and without obligation to make such capital contribution pursuant to Section 14.2 above, shall be returned to the contributing Member, together with accrued interest at the annual rate published as the yield of the Local Agency Investment Fund administered by the California State Treasurer, before any other return of contributions to the Members is made. The Agency shall hold title to all funds and property acquired by the Agency during the term of this Agreement.

14.4 Issuance of Indebtedness. The Agency may issue bonds, notes or other forms of indebtedness, as permitted under Section 4.6 of this Agreement, provided such issuance is approved by a unanimous vote of the Directors.

14.5 Revenue. The Agency may assess fees or taxes from Basin users in order to fund its groundwater management activities. Revenues generated from Basin users may be subject to Proposition 26 or 218. Assessment of fees requires a Supermajority Vote of the Board pursuant to Section 9.3.2(a) of this Agreement.

ARTICLE 15
LIABILITIES

15.1 Liability. In accordance with Government Code section 6507, the debt, liabilities and obligations of the Agency shall be the debts, liabilities and obligations of the Agency alone, and not the individual Members.

15.2 Indemnity. Funds of the Agency may be used to defend, indemnify, and hold harmless the Agency, each Member, each Director, and any officers, agents and employees of the Agency for their actions taken within the course and scope of their duties while acting on behalf of the Agency. To the fullest extent permitted by law, the Agency agrees to save, indemnify, defend and hold harmless each Member from any liability, claims, suits, actions, arbitration proceedings, administrative proceedings, regulatory proceedings, losses, expenses or costs of any kind, whether actual, alleged or threatened, including attorney's fees and costs, court costs, interest, defense costs, and expert witness fees, where the same arise out of, or are in any way attributable in whole or in part to: (i) this Agreement; (ii) the acts or omissions of the Agency or its employees, officers or agents; or (iii) the negligent acts or omissions (not including gross negligence or wrongful conduct) of the employees, officers or agents of any Member arising out of or attributable to the Agency or this Agreement.

15.3 Hazardous Materials. The Agency shall not handle, receive, use, or dispose of hazardous materials unless first amending this Agreement to provide indemnification by the Agency of all of Members in relation to the Agency's handling, receipt, use or disposal of hazardous materials.

15.4 Liability Insurance. The Board of Directors shall obtain, and maintain in effect, appropriate liability insurance to cover the activities of the Agency's Directors and staff in the ordinary course of their duties.

15.5 Privileges and Immunities. All of the privileges and immunities from liability, exemption from laws, ordinances and rules, all pension, relief, disability, workers compensation, and other benefits which apply to the activity of officers, agents, or employees of any of the Members when performing their respective functions shall apply to them to the same degree and extent while engaged in the performance of any of the functions and other duties under this Agreement. None of the officers, agents, or employees appointed by the Board of Directors shall be deemed, by reason of their employment by the Board of Directors, to be employed by any of the Members or, by reason of their employment by the Board of Directors to be subject to any of the requirements of such Members.

ARTICLE 16
WITHDRAWAL OF MEMBERS

16.1 Unilateral Withdrawal. Subject to the Dispute Resolution provisions set forth in Section 18.9 of this Agreement, a Member may unilaterally withdraw from this Agreement without causing or requiring termination of this Agreement, effective upon sixty (60) days written notice to the Executive Director and all Members.

16.2 Rescission or Termination of Agency. This Agreement may be rescinded and the Agency terminated by unanimous written consent of all Members, except during the outstanding term of any Agency indebtedness.

16.3 Effect of Withdrawal or Termination. Upon termination of this Agreement or unilateral withdrawal, a Member shall remain obligated to pay its share of all debts, liabilities and obligations of the Agency required of the Member pursuant to the terms of this Agreement which were incurred or accrued prior to the date of such termination or withdrawal, including, without limitation, those debts, liabilities and obligations pursuant to Sections 4.6 and 14.4 of this Agreement. Any Member that withdraws from the Agency shall have no right to participate in the business and affairs of the Agency or to exercise any rights of a Member under this Agreement or the Act, but shall continue to share in distributions from the Agency on the same basis as if such Member had not withdrawn, provided that a Member that has withdrawn from the Agency shall not receive distributions in excess of the contributions made to the Agency while a Member. The right to share in distributions granted under this Section shall be in lieu of any right the withdrawn Member may have to receive a distribution or payment of the fair value of the Member's interest in the Agency.

16.4 Return of Contribution. Upon termination of this Agreement, any surplus money on-hand shall be returned to the Members in proportion to their contributions made. The Board of Directors shall first offer any property, works, rights and interests of the Agency for sale to the Members on terms and conditions determined by the Board of Directors. If no such sale to Members is consummated, the Board of Directors shall offer the property, works, rights, and interest of the Agency for sale to any non-member for good and adequate consideration. The net proceeds from any sale shall be distributed among the Members in proportion to their contributions made.

ARTICLE 17
SPECIAL PROJECTS

17.1 Special Projects. In addition to the general activities undertaken by all Members of the Agency, the Agency may initiate Special Projects that involve fewer than all Members. No Member shall be required to be involved in a Special Project that involves fewer than all Members.

17.2 Special Project Agreement. With the unanimous approval of Directors, Members may undertake Special Projects in the name of the Agency. Prior to undertaking a Special Project, the Members electing to participate in the Special Project shall enter into an activity agreement. Such activity agreement shall provide that: (i) no Special Project undertaken pursuant to such agreement shall conflict with the terms of this Agreement; and (ii) the Members to the activity agreement shall indemnify, defend and hold the Agency, and the Agency's other Members, harmless from and against any liabilities, costs or expenses of any kind resulting from the Special Project described in the activity agreement. All assets, rights, benefits, debts, liabilities and obligations attributable to a Special Project shall be assets, rights, benefits, debts, liabilities and obligations solely of the Members that have entered into the activity agreement for that Special Project, in accordance with the terms of the activity agreement, and shall not be the assets, rights, benefits, debts, liabilities and obligations of those Members that have not executed the activity agreement. Members not electing to participate in the Special Project shall have no rights, benefits, debts, liabilities or obligations attributable to such Special Project.

ARTICLE 18
MISCELLANEOUS PROVISIONS

18.1 No Predetermination or Irretrievable Commitment of Resources. Nothing in this Agreement shall constitute a determination by the Agency or any of its Members that any action shall be undertaken or that any unconditional or irretrievable commitment of resources shall be made, until such time as the required compliance with all local, state, or federal laws, including without limitation the California Environmental Quality Act (Public Resources Code, § 21000, et seq.), National Environmental Policy Act (42 U.S.C. § 4321, et seq.), or permit requirements, as applicable, has been completed.

18.2 Notices. Notices to a Director or Member hereunder shall be sufficient if delivered to the City Clerk, Board Clerk, or Board Secretary of the respective Director or Member and addressed to the Director or Member. Delivery may be accomplished by U.S. Postal Service, private mail service or electronic mail.

18.3 Amendments to Agreement. This Agreement may be amended or modified at any time only by subsequent written agreement approved and executed by all of the Members.

18.4 Agreement Complete. This Agreement constitutes the full and complete agreement of the Members. This Agreement supersedes all prior agreements and understandings, whether in writing or oral, related to the subject matter of this Agreement that are not set forth in writing herein.

18.5 Severability. Should any part, term or provision of this Agreement be decided by a court of competent jurisdiction to be illegal or in conflict with any applicable federal law or any law of the State of California, or otherwise be rendered unenforceable or ineffectual, the validity of the remaining parts, terms, or provisions of this Agreement shall not be affected thereby, provided however, that if the remaining parts, terms, or provisions do not comply with the Act, this Agreement shall terminate.

18.6 Withdrawal by Operation of Law. Should the participation of any Member to this Agreement be decided by the courts to be illegal or in excess of that Member's authority or in conflict with any law, the validity of this Agreement as to the remaining Members shall not be affected thereby.

18.7 Assignment. The rights and duties of the Members may not be assigned or delegated without the written consent of all other Members. Any attempt to assign or delegate such rights or duties in contravention of this Agreement shall be null and void.

18.8 Binding on Successors. This Agreement shall inure to the benefit of, and be binding upon, the successors or assigns of the Members.

18.9 Dispute Resolution. In the event that any dispute arises among the Members relating to (i) this Agreement, (ii) the rights and obligations arising from this Agreement, (iii) a Member proposing to withdraw from membership in the Agency, or (iv) a Member proposing to initiate litigation in relation to legal rights to groundwater within the Basin or the management of the Basin, the aggrieved Member or Members proposing to withdraw from membership shall provide written notice to the other Members of the controversy or proposal to withdraw from membership. Within forty-five (45) days after such written notice, the Members shall attempt in good faith to resolve the controversy through informal means. If the Members cannot agree upon a resolution of the controversy within forty-five (45) days from the providing of written notice specified above, the dispute shall be submitted to mediation prior to commencement of any legal action or prior to withdrawal of a Member proposing to withdraw from membership. The mediation shall be no less than a full day (unless agreed otherwise among the Members) and the cost of mediation shall be paid in equal proportion among the Members. The mediator shall be either voluntarily agreed to or appointed by the Superior Court upon a suit and motion for appointment of a neutral mediator. Upon completion of mediation, if the controversy has not been resolved, any Member may exercise all rights to bring a legal action relating to the controversy or withdraw from membership as otherwise authorized pursuant to this Agreement.

18.10 Counterparts. This Agreement may be executed in counterparts, each of which shall be deemed an original.

18.11 Singular Includes Plural. Whenever used in this Agreement, the singular form of any term includes the plural form and the plural form includes the singular form.

18.12 No Third-Party Rights. Nothing in this Agreement, whether express or implied, is intended to confer any rights or remedies under, or by reason of, this Agreement on any person other than the Members and their respective successors and assigns, nor is anything in this Agreement intended to relieve or discharge the obligations or liability of any third person to any Member, nor shall any provision give any third person any right of subrogation or action over or against any Member.

18.13 Member Authorization. The legislative bodies of the Members have each authorized execution of this Agreement, as evidenced by the signatures below.

IN WITNESS WHEREOF, the Members hereto have executed this Agreement by authorized officials thereof on the dates indicated below, which Agreement may be executed in counterparts.

CARPINTERIA VALLEY WATER DISTRICT

APPROVED AND ACCEPTED BY THE BOARD OF DIRECTORS:

By: Matthew Roberts ____________________ DATE 1-31-2020 ____________________
MATTHEW ROBERTS
PRESIDENT, BOARD OF DIRECTORS

ATTEST:

Ursula Santana ____________________ DATE 1.31.2020 ____________________
URSULA SANTANA, BOARD CLERK

APPROVED AS TO FORM:

By: J. Roger Myers ____________________ DATE 1-31-2020 ____________________
J. ROGER MYERS, GENERAL COUNSEL

CITY OF CARPINTERIA

Mayor, City of Carpinteria

ATTEST:

City Clerk, City of Carpinteria

APPROVED AS TO FORM:

Valerie Kincaid
O' Laughlin and Paris, acting as
Special Council of the City of Carpinteria

COUNTY OF VENTURA

APPROVED AND ACCEPTED BY THE BOARD OF SUPERVISORS:

By: ______________________________
CHAIR, BOARD OF SUPERVISORS

ATTEST: Michael Powers, Clerk of the Board of Supervisors

by: ~~BOARD CLERK~~ Deputy Clerk of the Board

APPROVED AS TO FORM:

By: ______________________________
COUNTY COUNSEL

SANTA BARBARA COUNTY WATER AGENCY

ATTEST:
MONA MIYASATO,
COUNTY EXECUTIVE OFFICER
Ex Officio Clerk of the Board Directors
of the Santa Barbara County Water Agency

By: Sheila dlaGuerra
Deputy

SANTA BARBARA COUNTY WATER AGENCY

By: ______________________
Gregg Hart, Chair, Board of Directors

APPROVED AS TO FORM:
MICHAEL C. GHIZZONI
COUNTY COUNSEL

By: ______________________
Deputy

APPROVED AS TO FORM:
RAY AROMATORIO, ARM, AIC
RISK MANAGER

By: ______________________

RECOMMENDED FOR APPROVAL:
SCOTT D. MCGOLPIN
PUBLIC WORKS DIRECTOR

By: ______________________
Deputy Public Works Director

APPENDIX C

Stakeholder Communications and Engagement Plan

Carpinteria Groundwater Sustainability Agency

Stakeholder Communications and Engagement Plan

Updated October 2023

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1. Sustainable Groundwater Management Act

SGMA is the California Sustainable Groundwater Management Act (SGMA) that was enacted in 2014 and became effective January 1, 2015. SGMA is important because it requires the regulation of groundwater for the first time in California's history and provides new authority to local agencies to implement these requirements. The intent of SGMA is to strengthen local management of specified groundwater basins that are most critical to the state's water needs by regulating groundwater use. The California Department of Water Resources and the State Water Resources Control Board (State Water Board) are the state agencies in charge of ensuring that SGMA is implemented.

California passed the Sustainable Groundwater Management Act to protect and regulate groundwater supplies. Groundwater basins designated as a high or medium priority by the California Department of Water Resources are required to form a Groundwater Sustainability Agency (GSA) to develop and implement a Groundwater Sustainability Plan (GSP), which is a detailed roadmap for how each groundwater basin will reach and maintain long-term sustainability.

2. Carpinteria Groundwater Sustainability Agency

In 2019, the Carpinteria Groundwater Basin was re-evaluated and designated as "high priority" by the state Department of Water Resources, requiring formation of a GSA to develop and implement a GSP by 2024. As a result, the Carpinteria Groundwater Sustainability Agency (CGSA) was formed in 2020 by a Joint Powers Agreement (JPA) between the Carpinteria Valley Water District (CVWD), City of Carpinteria, Santa Barbara County Water Agency, and County of Ventura. The purpose of the GSA is to ensure long-term sustainable water use through monitoring, planning, and oversight of the Carpinteria Groundwater Basin.

The CGSA Board currently holds up to six regular meetings per year. Meeting agendas, minutes, and video recordings are posted on the CGSA website at https://carpgsa.org/public-info/meeting-agendas/. In 2021, the CGSA initiated a fee study designed to recover agency costs while ensuring that the benefit received from sustainable management of the basin is proportional to the fees paid. On June 29, 2022 and June 28, 2023, the CGSA Board of Directors approved a groundwater fee to be assessed for Fiscal Years 2022-2023 and 2023-2024 respectively as recommended in the Fee Study Report developed by Raftelis and based on stakeholder input through a public participation process including outreach, community meetings, and public hearings.

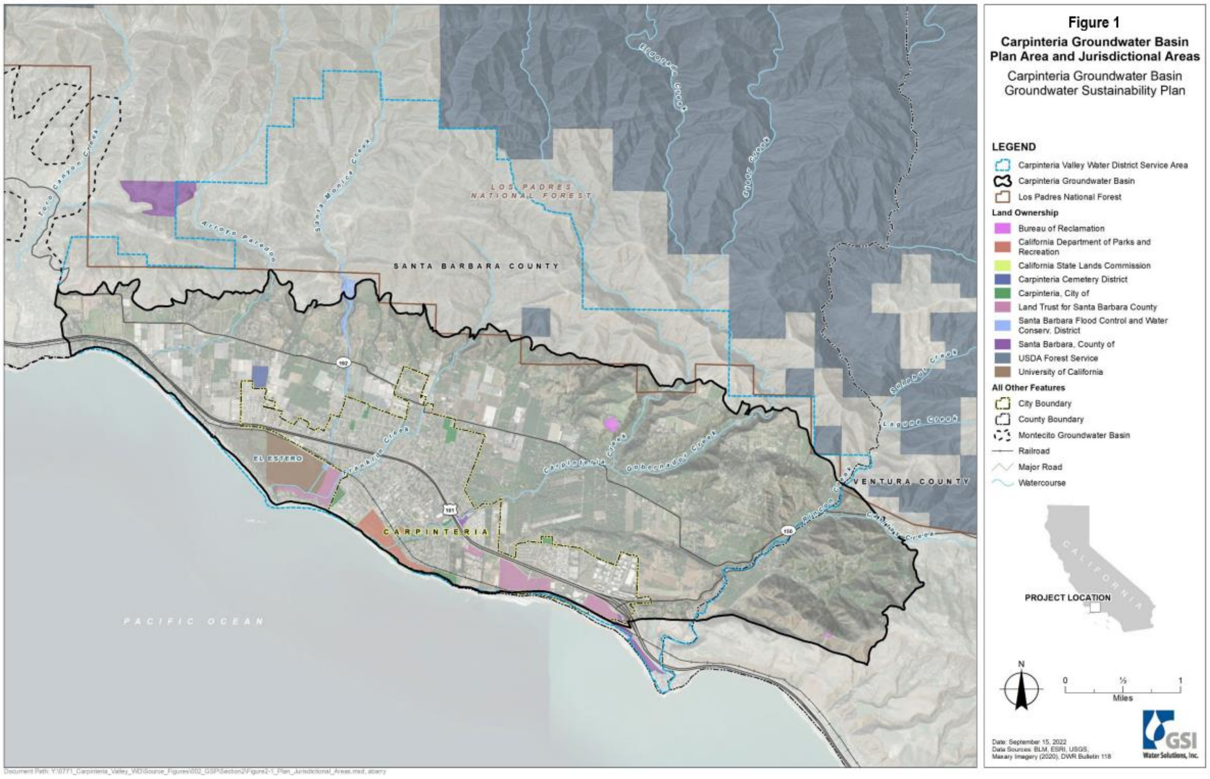

Figure 1. The Carpinteria Groundwater Basin is bounded on the north by the Santa Ynez Mountains and on the south by the Pacific Ocean. The eastern boundary is located near Laguna Ridge in Ventura County, and the western boundary is contiguous with the service area of the Carpinteria Valley Water District adjacent to the Montecito groundwater basin.

3. Carpinteria Groundwater Sustainability Plan

The GSP is the roadmap or framework to achieve sustainable groundwater management within 20 years. The framework for the GSP has several requirements, including:

- A description of the physical setting and characteristics of the aquifer system.
- Current and historical data for groundwater levels, groundwater quality, subsidence and groundwater/surface water interaction, and a discussion of historical and projected water demands and supplies.
- Maps that include details of the basin and its boundaries and identify existing and potential recharge areas.
- A succinctly stated sustainability goal for a desired condition that is applicable to the entire basin, how the basin will get to that desired condition, and why the measures planned will lead to success.
- Minimum thresholds, measurable objectives, as well as interim milestones in increments of five years, to achieve the sustainability goal in the basin within 20 years.
- A monitoring plan that will measure progress over time.
- A prioritized list of management actions and projects that will be implemented if necessary to achieve the sustainability goal.

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- A description of other applicable local government plans and how the GSP may affect those plans.

As the CGSA and its technical experts assemble the technical data to inform GSP development, stakeholder involvement will be embedded throughout, with updates to CGSA materials and information channels, and focused workshops at key plan development milestones.

GSP Development Schedule

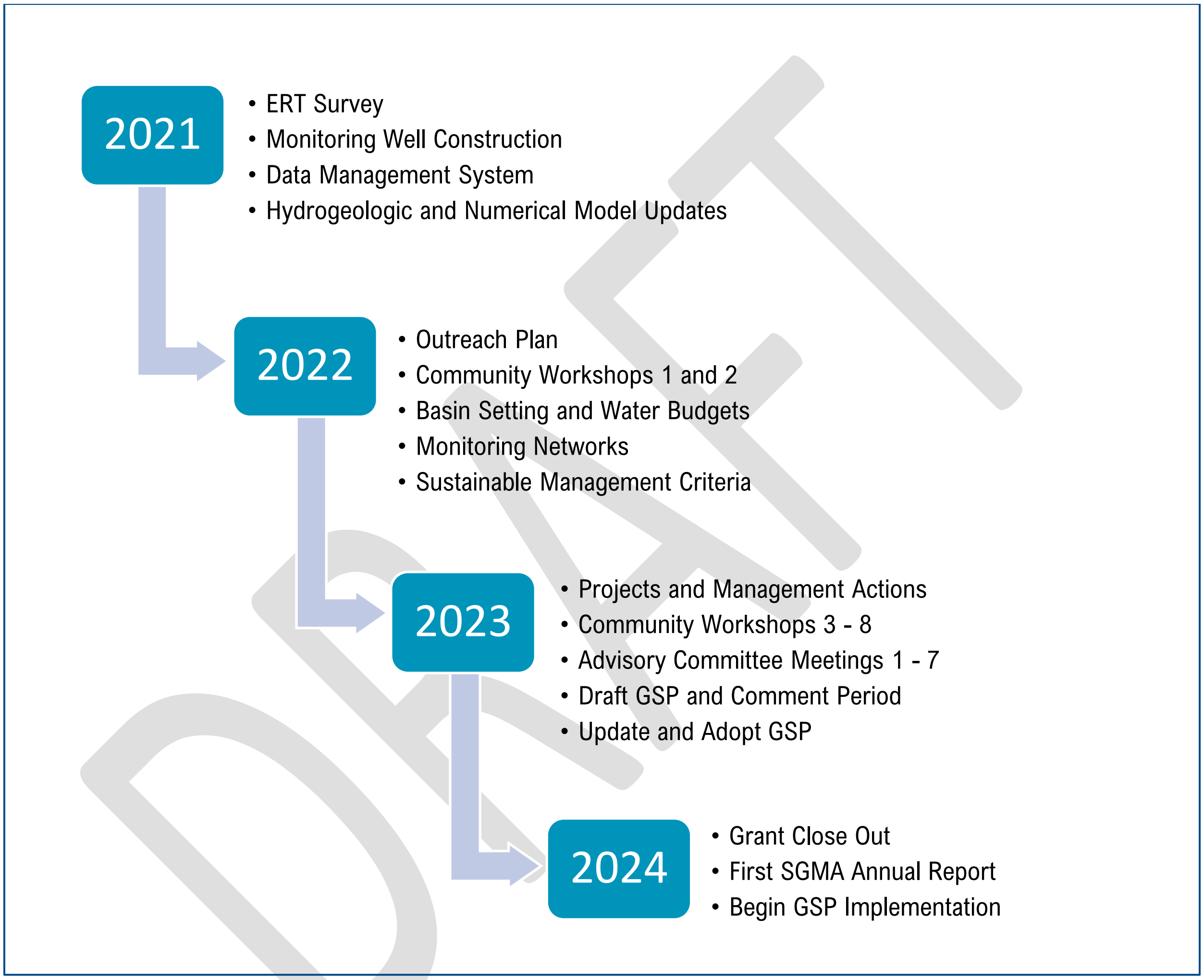

Figure 2

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4. CGSA Decision Making Process

The direction, funding, and approval for the CGSA groundwater sustainability planning process and work products are the responsibility of the CGSA governing Board.

Following an extensive stakeholder engagement process, including consideration of and response to all stakeholder input, the final GSP will be adopted by the Board. Meetings of the Board of Directors are currently and will continue to be noticed, posted on the CGSA website, and open to the public.

5. Communications and Engagement

Ensuring long-term groundwater sustainability is important to everyone: from homeowners to business owners to those involved in agriculture, and many others. Stakeholder involvement is critical to the development and implementation of an effective and successful GSP.

According to the California Department of Water Resources *GSP Stakeholder Communication and Engagement Guidance Document (Jan. 2018),* "Under the requirements of SGMA, GSAs must consider interests of all beneficial uses and users of groundwater. As a result, the GSP development needs to consider effects to other stakeholder groups in or around the groundwater basin with overlapping interests. These interests include, but are not limited to, holders of overlying groundwater rights (including agriculture users and domestic well owners), public water systems, local land use planning agencies, environmental users, surface water users, federal government, California Native American tribes, and disadvantaged communities (Water Code 10723.2). Furthermore, the GSP Regulations require that GSAs document in a communication section of the GSP the opportunities for public engagement and active involvement of diverse social, cultural, and economic elements of the population within the basin. Expertise of stakeholders may increase the chance that the GSAs are using best available information and best available science for GSP development."

This CGSA Stakeholder Communications and Engagement Plan outlines the strategies, tactics, and measures to reach diverse stakeholders, raise understanding and awareness of the issues and process, invite stakeholder input, and create a transparent and inclusive engagement process toward development of the CGSA GSP.

5.1. Stakeholder Identification

As part of ongoing outreach associated with water projects and programs managed by the CVWD, GSA formation and meetings (including recent public meetings regarding CGSA's proposed groundwater fee), and email sign-up options, the CGSA has developed an extensive stakeholder list reflecting:

- All groundwater users
- Holders of overlying water rights (agriculture and domestic)
- Municipal well operators and public water systems
- State and federal government contacts
- County and City leaders, staff, and planning/land use departments
- Local landowners
- Surface water users
- Regional water management groups
- Business and civic organizations
- Disadvantaged communities
- Tribes
- Environmental interests
- NGOs

Based on several datasets, two disadvantaged communities (DACs) were identified in the basin. The California Department of Water Resources' DACs online mapping tool shows the Ventura County portion of the basin and one census block group in the City of Carpinteria as DACs.[1] The Casitas Municipal Water District's Urban Water Management Plan shows the Ventura County portion of the basin as a DAC (Casitas Municipal Water District, 2020).

A detailed stakeholder database will continue to be updated and maintained to ensure timely updates and access to information including invitations to all formal engagement opportunities.

5.2. Situation Analysis

There has already been considerable stakeholder interest in water issues generally, and sustainable groundwater management specifically as part of the GSA development process and outreach associated with other regional water projects. As outreach continues through GSP development, anticipated questions or challenges to be addressed through engagement include:

- Seawater intrusion
- Water availability
- Geographic differences/diverse basin characteristics
- Perceived competition for water
- Diverse stakeholder opinions and perspectives
- Multiple municipalities/government structures
- Concerns about fairness
- Cost implications

5.3. Communications Goals for GSP Development

The overarching communications goal associated with GSP development is to create a transparent, inclusive, and responsive communications and stakeholder engagement process that leads to broad stakeholder understanding of the basin groundwater system, understanding of the key issues, and broad stakeholder acceptance of the GSP that reflects input received and creates a roadmap for basin sustainability.

5.4. Communications Objectives

- **Awareness:** Raise awareness about the purpose and need for a comprehensive plan for Carpinteria Groundwater Basin sustainability among multiple and varied basin stakeholders.
- **Engagement:** Establish inclusive opportunities for stakeholders to access information, provide productive input, and receive timely responses to questions or concerns.
- **Measurement:** Continually monitor and gauge the effectiveness of activities and implement course corrections or new activities to ensure transparency, broad stakeholder reach, and effectiveness.

[1] Available at https://gis.water.ca.gov/app/dacs/. (Accessed July 20, 2022.)

5.5. Key Messages

1. **We're required to take action and it's the right thing to do for our collective future.** The Carpinteria groundwater basin is designated a high priority basin in California – this means our vital groundwater resources are critical as a public water supply and, by law, we must develop a plan to manage and use our groundwater to ensure a sustainable future supply for our community.

2. **Our way of life depends on sustainable groundwater.** Groundwater is a vital component of our local water supply, especially as resources are becoming limited due to drought, climate fluctuations, and increased competition for all water resources. We've got to plan now to ensure a future supply and the Groundwater Sustainability Plan will create our roadmap.

3. **We need your input.** It takes all of us to create a plan for our water future – businesses, citizens, farmers, tribes, water users of all kinds – You have the opportunity to help shape our water future in the Carpinteria groundwater basin.

6. Communications and Engagement Implementation

Other than what is required by statute or regulation, GSAs have discretion on how to communicate and engage with the beneficial uses and users of groundwater within a basin. The CGSA began stakeholder engagement in the earliest parts of GSA development and is committed to maintaining open lines of communication throughout GSP completion and into implementation.

The CGSA intends to inform the public, including the key stakeholder groups mentioned above, about the purpose and need for a GSA and GSP, and progress toward implementing the GSP, including monitoring results and the status of projects and actions. Multifaceted communication tools will be disseminated through several means to ensure access to up-to-date information. These include, but are not limited to the following:

- The CGSA website (which includes an option to sign up for GSA and GSP updates).
- CGSA Board meetings, where information will be presented, and the public will be invited to comment.
- Workshops that will present information on key topics (e.g., water budgets, sustainable management criteria) and encourage input from basin stakeholders.
- Workshop video posting for stakeholder access at any time.
- Annual reports describing monitoring results and progress toward implementing the plan and meeting sustainability goals established with stakeholder input.
- CGSA email updates to stakeholder list including private well owners and NGOs who represent DACs (with ongoing effort to collect updated email addresses).
- GSP updates submitted to the California Department of Water Resources every 5 years. Basin stakeholders will be asked to review and comment on the update report.
- Outreach to organizations representing DACs and stakeholders within the basin, and direct communication to customers included in CVWD's Low-Income Household Water Assistance Program (LIHWAP).

- Engagement and presentations via the GSP Advisory Committee assembled for this GSP development.
- In addition, the CGSA will conduct public outreach and engagement throughout the implementation period to provide timely information to stakeholders about GSP implementation progress as well as monitored and modeled groundwater basin conditions.

6.1. Tactical Approach

Create Base Information

- Create base content, for varied levels of technical understanding, that identifies the problem, the variables, the opportunities, and the decision-making process.
- Identify key stakeholders including the locations of designated DACs. Identify need for bilingual translation and specific outreach efforts.
- Use visuals to communicate complex topics.
- Provide translation and interpretation of technical jargon to increase understanding and allow for input.
- Create base collateral materials, while leveraging existing content:
    - Updated fact sheet
    - Updated FAQ
    - Updated presentation with modules developed for focused workshops
    - Meeting materials and visuals

6.2. Make Information Accessible

- **Website**
    - The CGSA website will be maintained as a communication tool for posting data, including reports, meeting information and agendas, technical updates, and data analyses. The CGSA website will be updated regularly to reflect calendar changes and newly-available content and information.
- **Fliers**
    - Regularly scheduled meetings and informational materials will be posted, as appropriate, in City/County/Utility public spaces.
- **Social Media**
    - Disseminating key events and dates, updates, and media mentions through existing platforms including City/County social channels.
- **Media**
    - CVWD regularly engages local media, in particular the Coastal View, and will use the regularly developed water-focused Coastal View column to provide key GSP updates.
    - Additional opportunities for paid and earned media coverage, press releases and one-on-one interviews will be pursued as appropriate.
- **Information Repositories**

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- As GSP sections are released, they will be made available at member agency offices and at the Carpinteria Community Library as space is available.

- **Newsletters/Articles**
  - At key GSP development milestones, a standard article will be developed for CVWD and other CGSA agencies and partner newsletter to broaden information reach.
- **Eblasts**
  - Disseminating GSP updates and key events and dates through eblasts to the CGSA stakeholder list to keep interested parties engaged.

6.3. Conduct Focused Workshops and Meetings

- **Advisory Group**
  - The CGSA will create a GSP Stakeholder Advisory Committee made up of representatives of the region's diverse stakeholder groups and interest areas in order to provide focused input for CGSA consideration on GSP elements, in particular sustainable management criteria and management actions. Advisory Committee bylaws and chartering documents will be developed to provide greater definition around roles and responsibilities. Attachment A includes a list of Advisory Committee meetings and topics covered.
- **Fee Study Development/Public Workshops**
  - Prior to development of this Stakeholder Communication and Engagement Plan, the CGSA had already embarked on an extensive public education and participation process as part of its Groundwater Assessment Fee approval. CGSA will build upon these efforts, continuing to engage the stakeholders who participated in this early process, and building upon input received to inform GSP development.
- **GSP Key Milestone Workshops**
  - The CGSA will conduct workshops around focused topics associated with GSP development. Attachment A includes a list of workshops and topics covered. The hybrid meetings will be conducted in-person and via Zoom link shared through eblasts and social media. Workshops will also be recorded and posted to the CGSA website for access by those unable to attend the live meeting. During the meeting, ample opportunity will be provided for stakeholder questions or comments, orally and in writing and interpretation services will be provided upon request.

6.4. Meet Stakeholders Where They Are

- **Presentations**
  - CGSA leadership already participates in numerous presentations to community partners including civic, business, and community groups. Key talking points and updates related to GSP development will be included in these ongoing interactions.

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- **Briefings**
    - To ensure CGSA and community leaders have up-to-date information about GSP development and technical details, periodic briefings will be scheduled with appropriate leadership, including, but not limited to:
        - Board member presentations
        - Government-to-government communication
        - Focused stakeholder briefings
- **Community Events**
    - CGSA partner agencies participate in a host of community events providing valuable water-focused information. Where possible, CGSA materials (fact sheets, FAQs) will be made available and distributed at these heavily attended events.

6.5. Collect and Respond to Input

- Multiple opportunities to provide input and ask questions will be provided throughout GSP development, including through the engagement tactics identified previously. Questions and comments received and recorded during meetings, and collected through comment forms that will be available in meetings, at events, and online. Written comment forms will request name, address, phone, GSP section associated with comment, along with written comment.
- The CGSA website will continue to be a focal point for information sharing and will provide opportunities for stakeholder input through a comment/inquiry portal formatted to align with the comment form described above.
- GSP preparers will consider all comments and questions received, and will provide a written response to each written comment received, also identifying how and where in the GSP the comment was addressed.
- A tracking form will be prepared identifying written comments received (in person, via mail, and online), GSP section each comment pertains to, and how and where in the GSP the comment was addressed.

7. Conclusion

Public input is an important tool to support the work of the CGSA. This Plan identifies strategies to engage stakeholders to inform a GSP for groundwater management that reflects local needs and conditions and prioritizes and preserves local control over water resources. Including numerous voices and perspectives in the process will foster trust and support and result in reduced conflict and a better outcome.

By employing the strategies identified in this document, and by updated this plan to adjust to changing information and stakeholder needs, the CGSA will include the public and stakeholders in formulating a plan that will ensure the long-term sustainability of locally managed groundwater resources in the groundwater basin now and into the future.

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Attachment A

GSP Advisory Committee Meetings		
Meeting	**Date**	**Topic**
Meeting #1	February 28, 2023	SGMA 101 Overview, Basin Conditions, Introduction to Sustainable Management Criteria
Meeting #2	March 28, 2023	Groundwater Model History, Housing Impacts on Groundwater Sustainability, Agricultural Stakeholder Interviews regarding Undesirable Results, Seawater Intrusion Sustainability Management Criteria
Meeting #3	April 25, 2023	Sustainable Management Criteria, Introduction to Projects and Management Actions
Meeting #4	May 23, 2023	Flood Control Facilities, Groundwater Dependent Ecosystems and SGMA, Water Level and Groundwater Storage, Projects and Management Actions
Meeting #5	June 27, 2023	Projects and Management Actions, Implementation Plan, Agricultural Representative Interviews
Meeting #6	July 25, 2023	Review of Draft GSP Chapters 1 - 3
Meeting #7	August 22, 2023	Review of Draft GSP Chapters 4 - 7

GSP Workshops		
Workshop	**Date**	**Topic**
Workshop #1	October 19, 2022	SGMA 101 Overview, Hydrogeologic Conceptual Model, Groundwater Conditions, Historical/Current Water Budget
Workshop #2	November 16, 2022	Groundwater Model, Monitoring Network
Workshop #3	January 18, 2023	Introduction to Sustainable Management Criteria
Workshop #4	February 15, 2023	Future Water Budget, Seawater Intrusion Sustainability Management Criteria
Workshop #5	March 15, 2023	Sustainable Groundwater Management Act, Sustainable Management Criteria
Workshop #6	April 19, 2023	Sustainable Groundwater Management Act, Sustainable Management Criteria
Workshop #7	May 17, 2023	Sustainable Management Criteria, Introduction to Projects and Management Actions
Workshop #8	August 16, 2023	Projects and Management Actions, GSP Implementation

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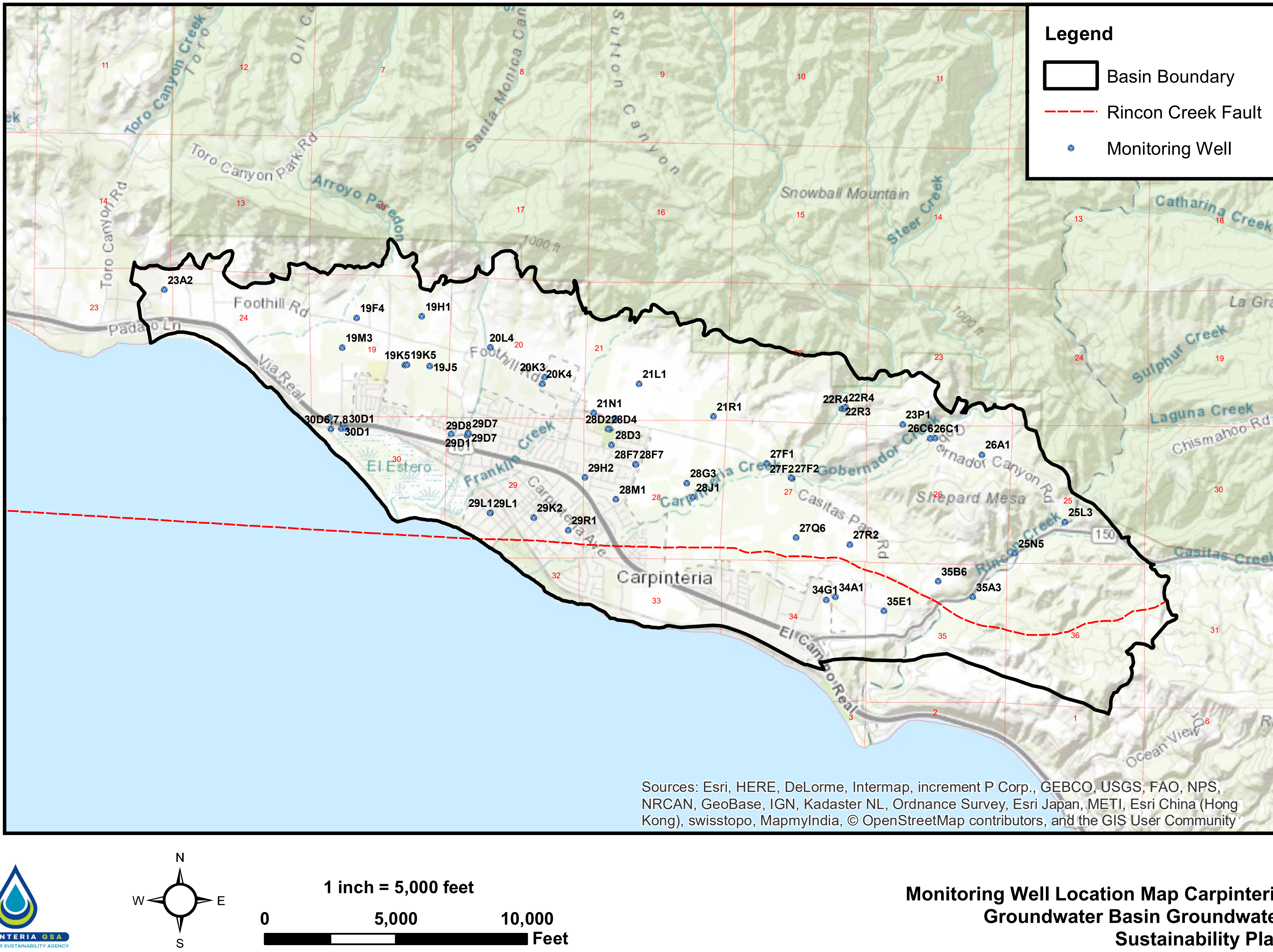
APPENDIX D

Groundwater Elevation Hydrographs



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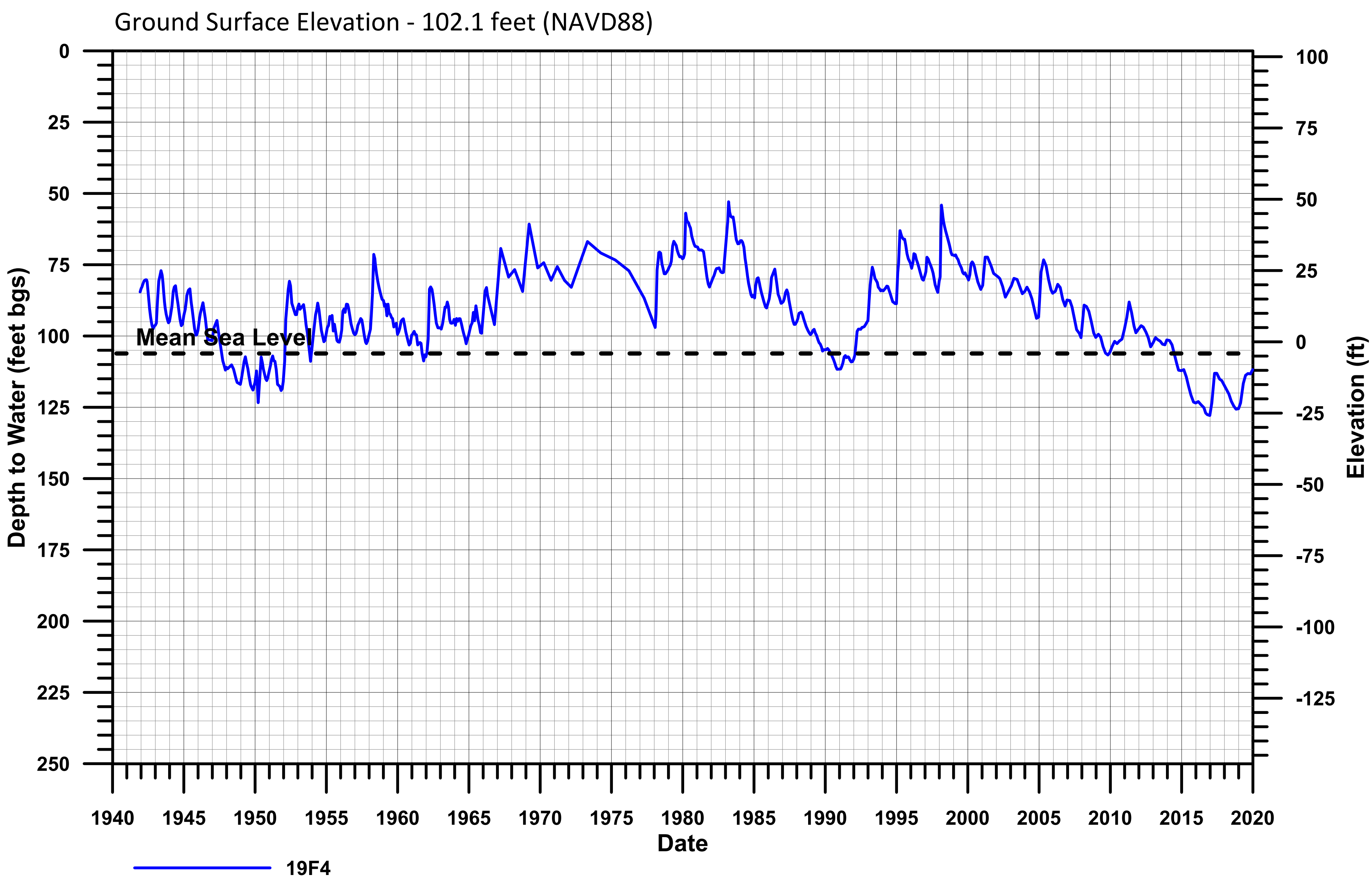
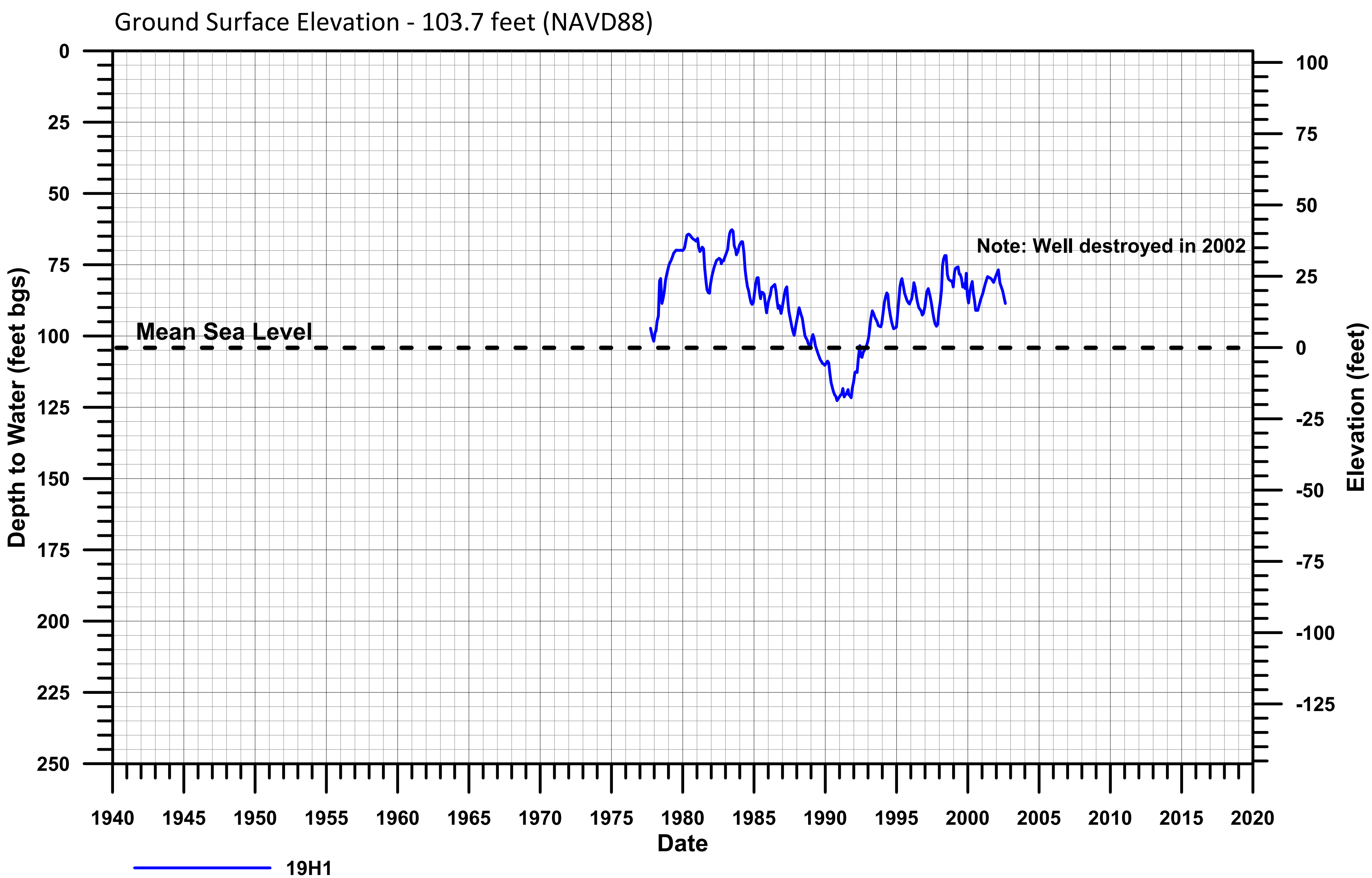
Monitoring Well Location Map Carpinteria Groundwater Basin Groundwater Sustainability Plan



Water Level Data - 4N/25W-19F4 Carpinteria Groundwater Basin Groundwater Sustainability Plan



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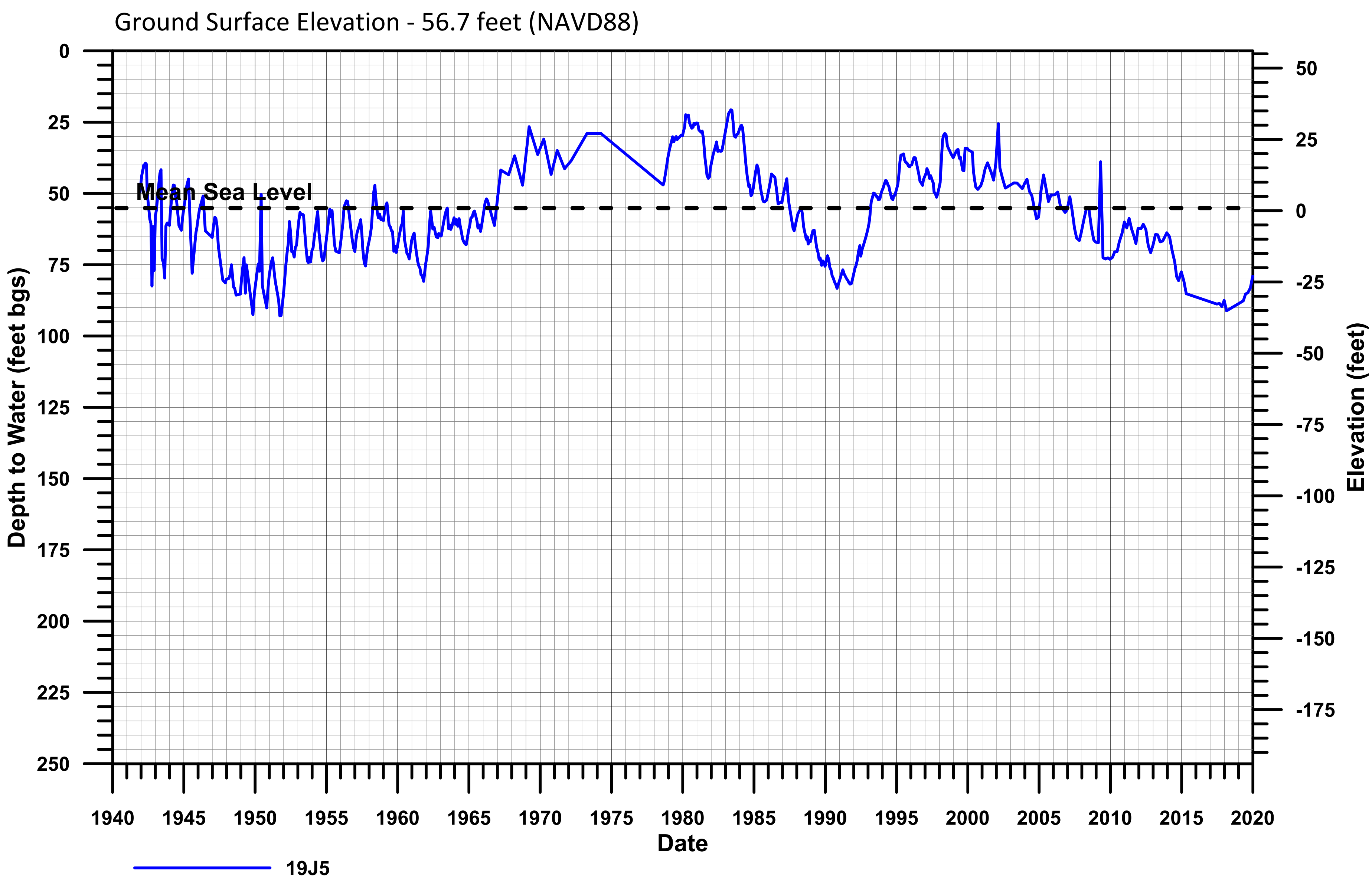

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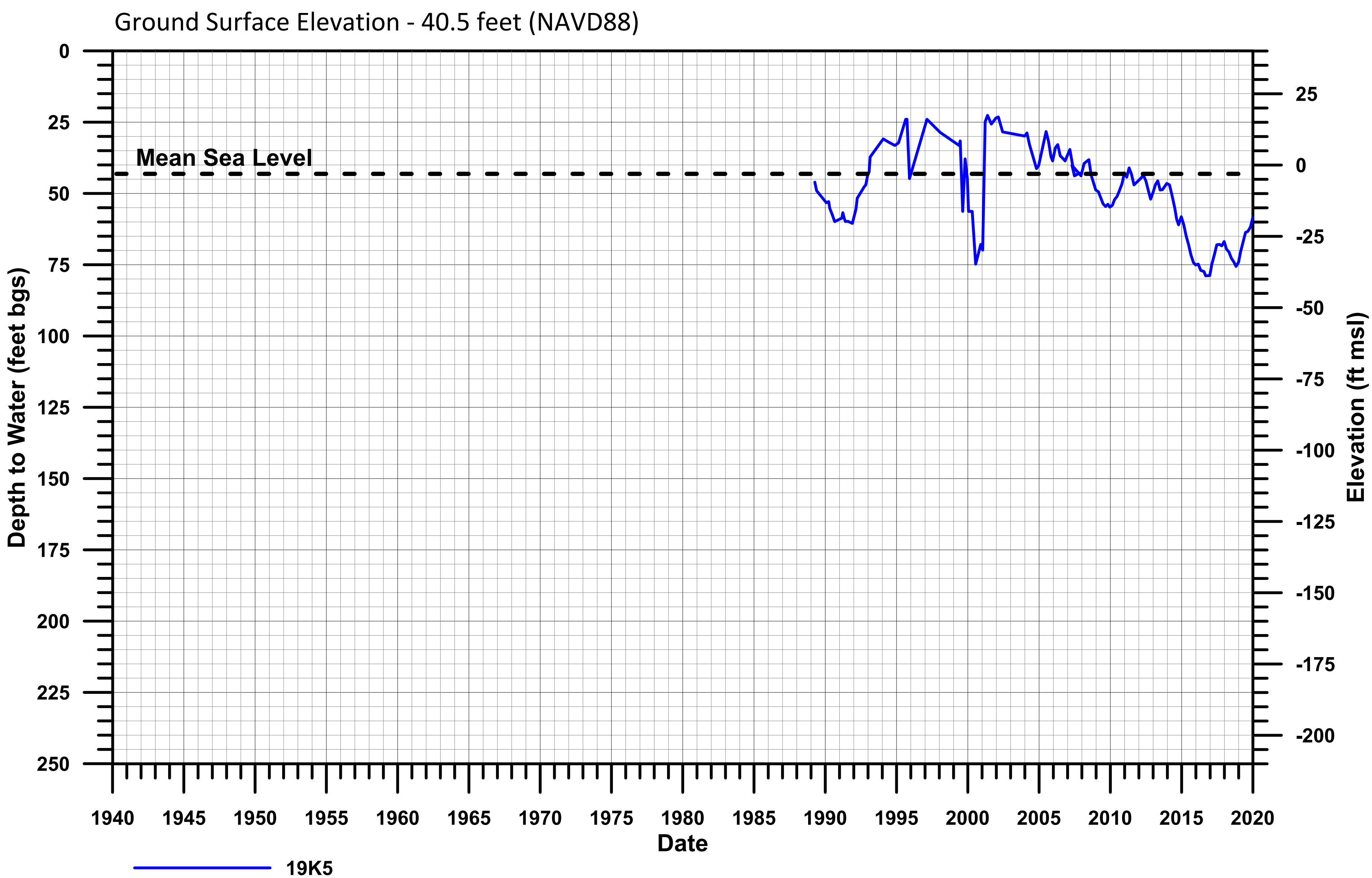
Water Level Data - 4N/25W-19J5 Carpinteria Groundwater Basin Groundwater Sustainability Plan



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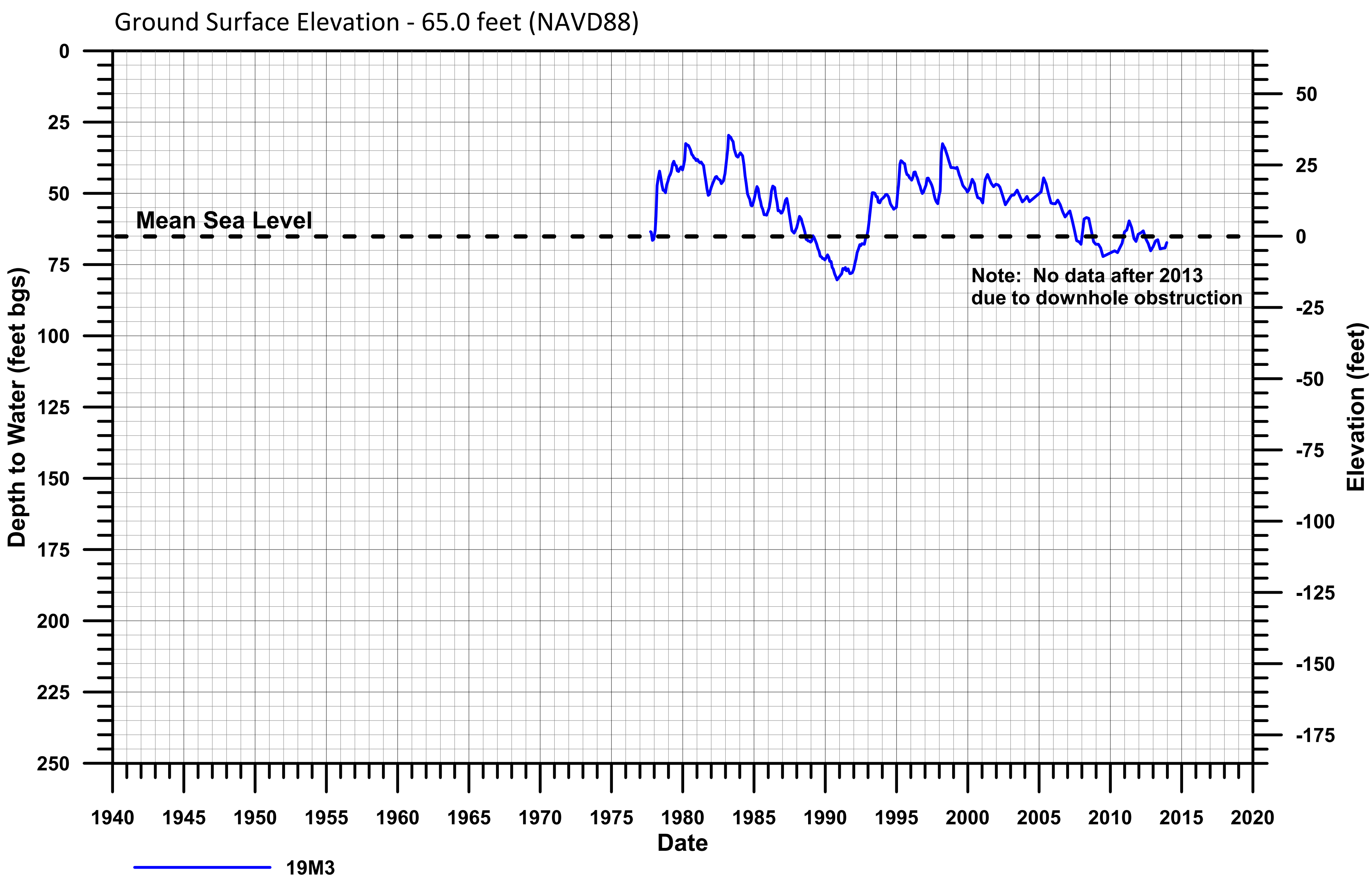
Water Level Data - 4N/25W-19K5 Carpinteria Groundwater Basin Groundwater Sustainability Plan



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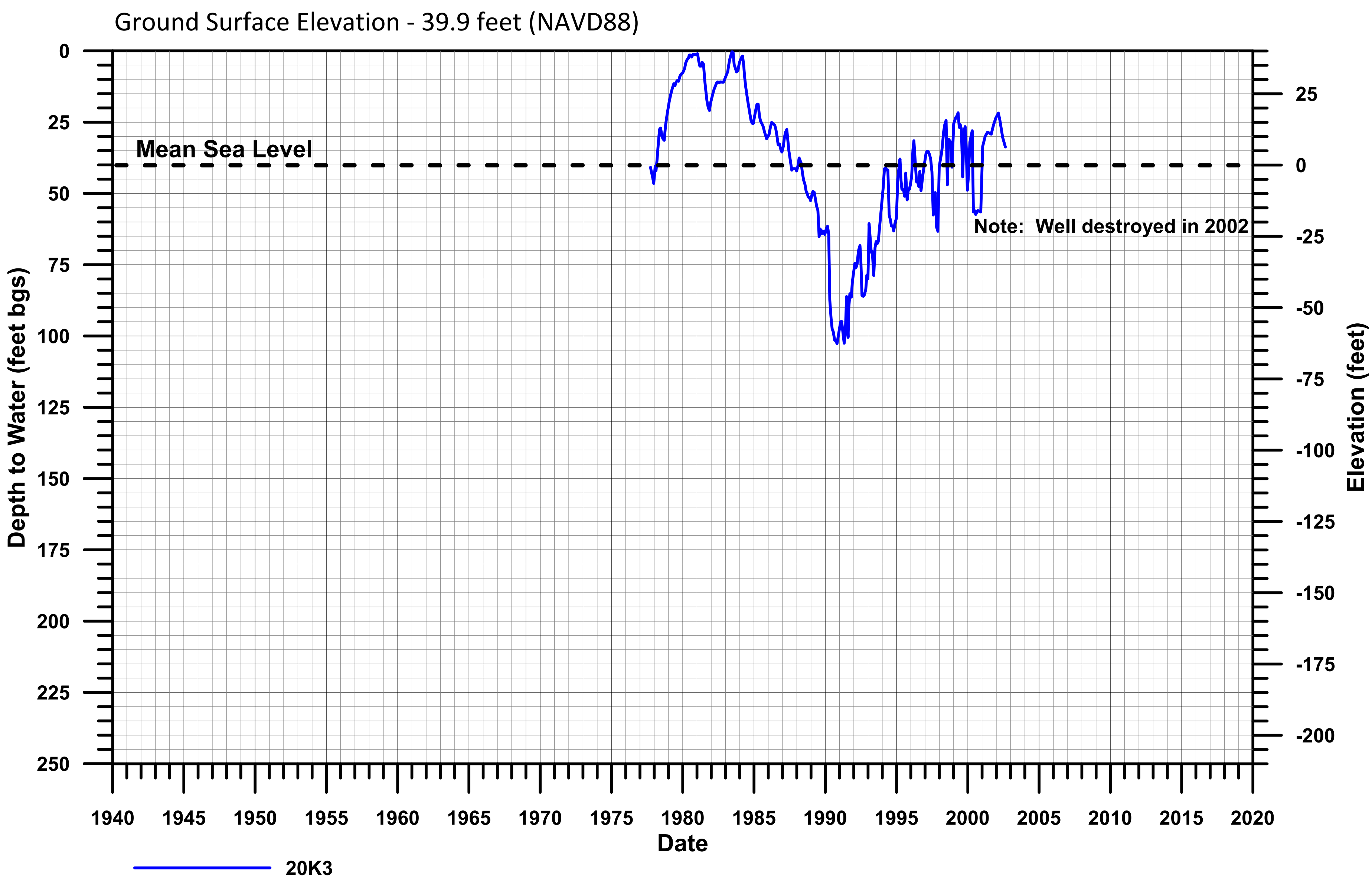

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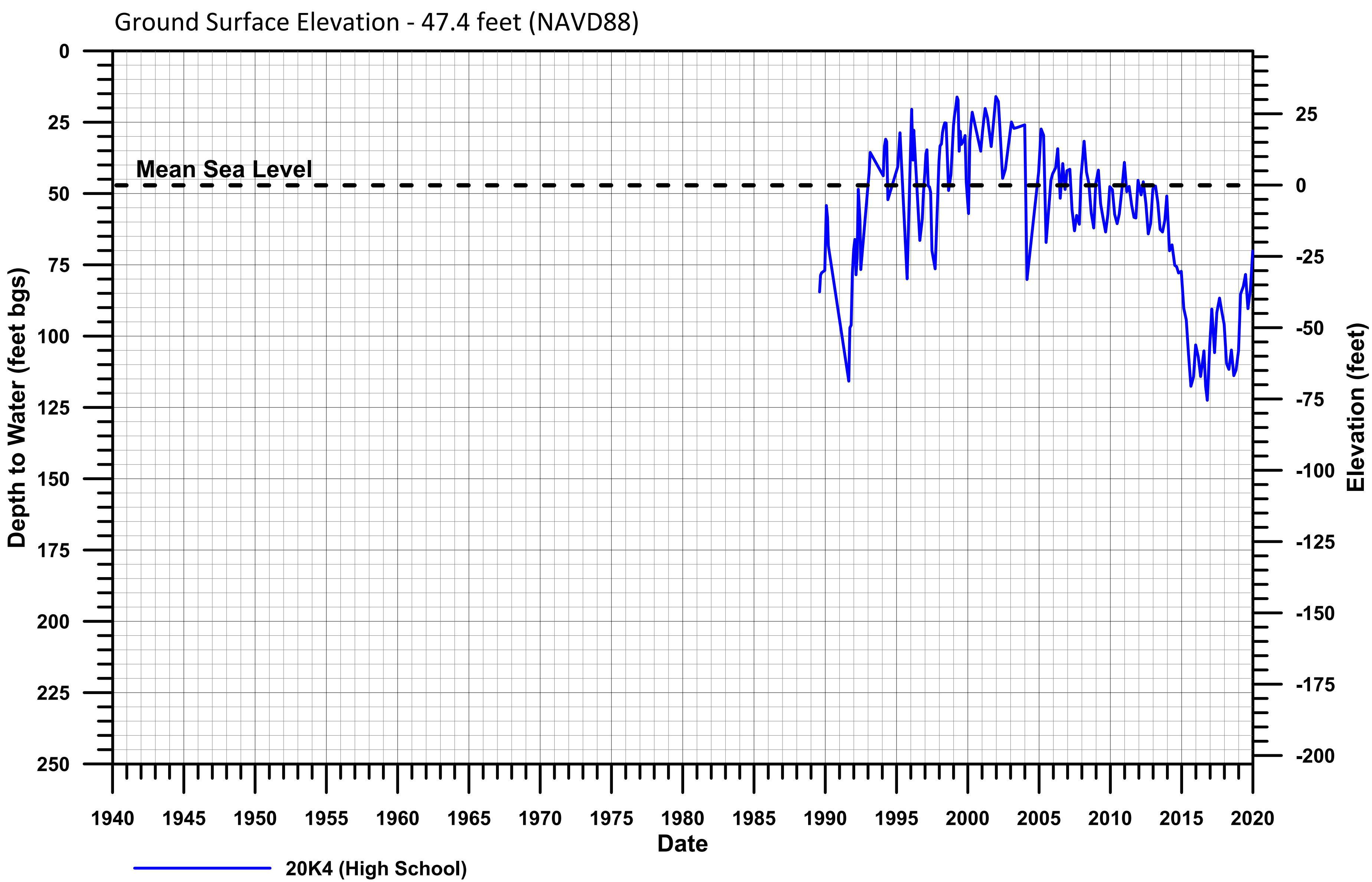

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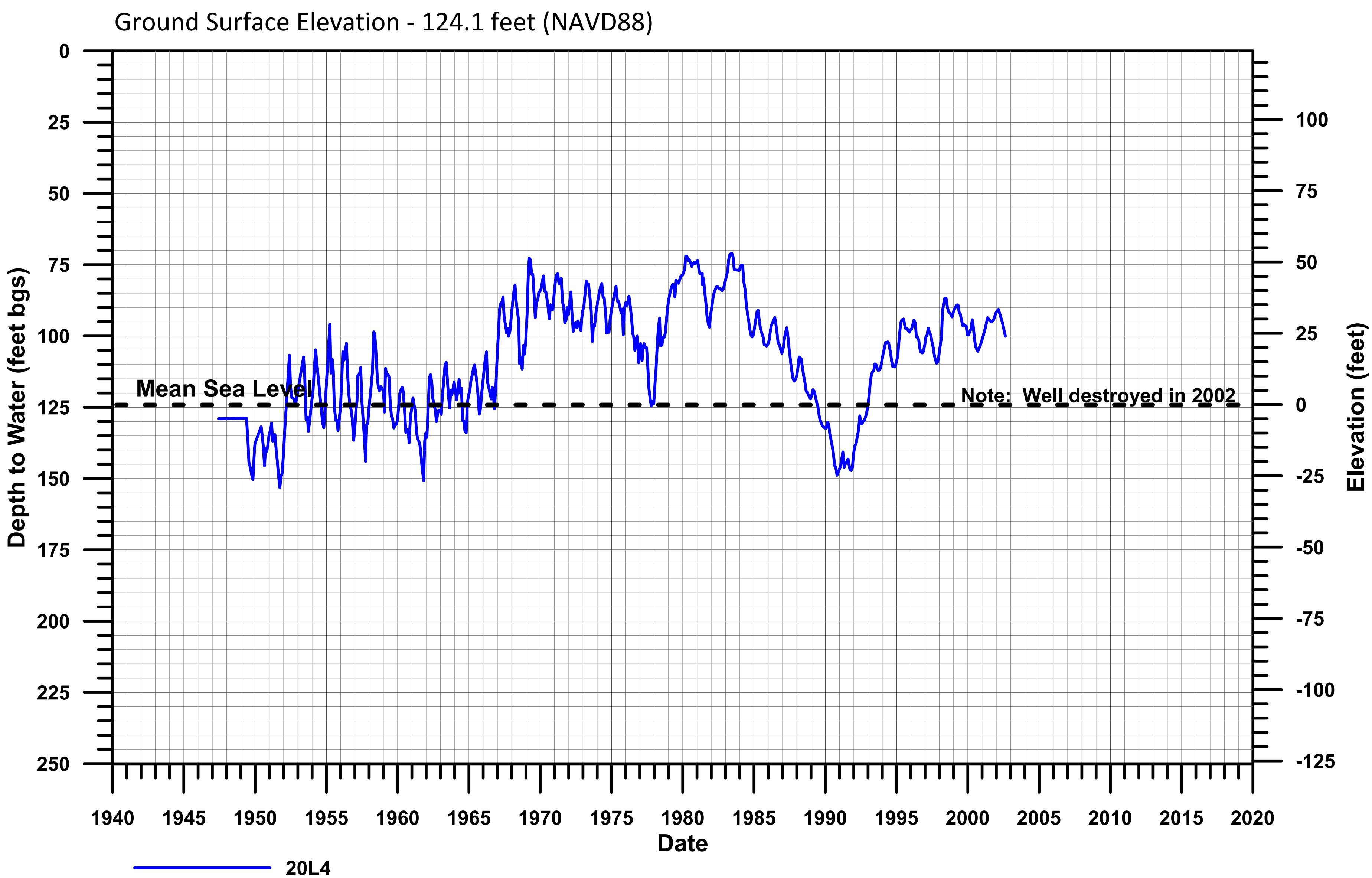

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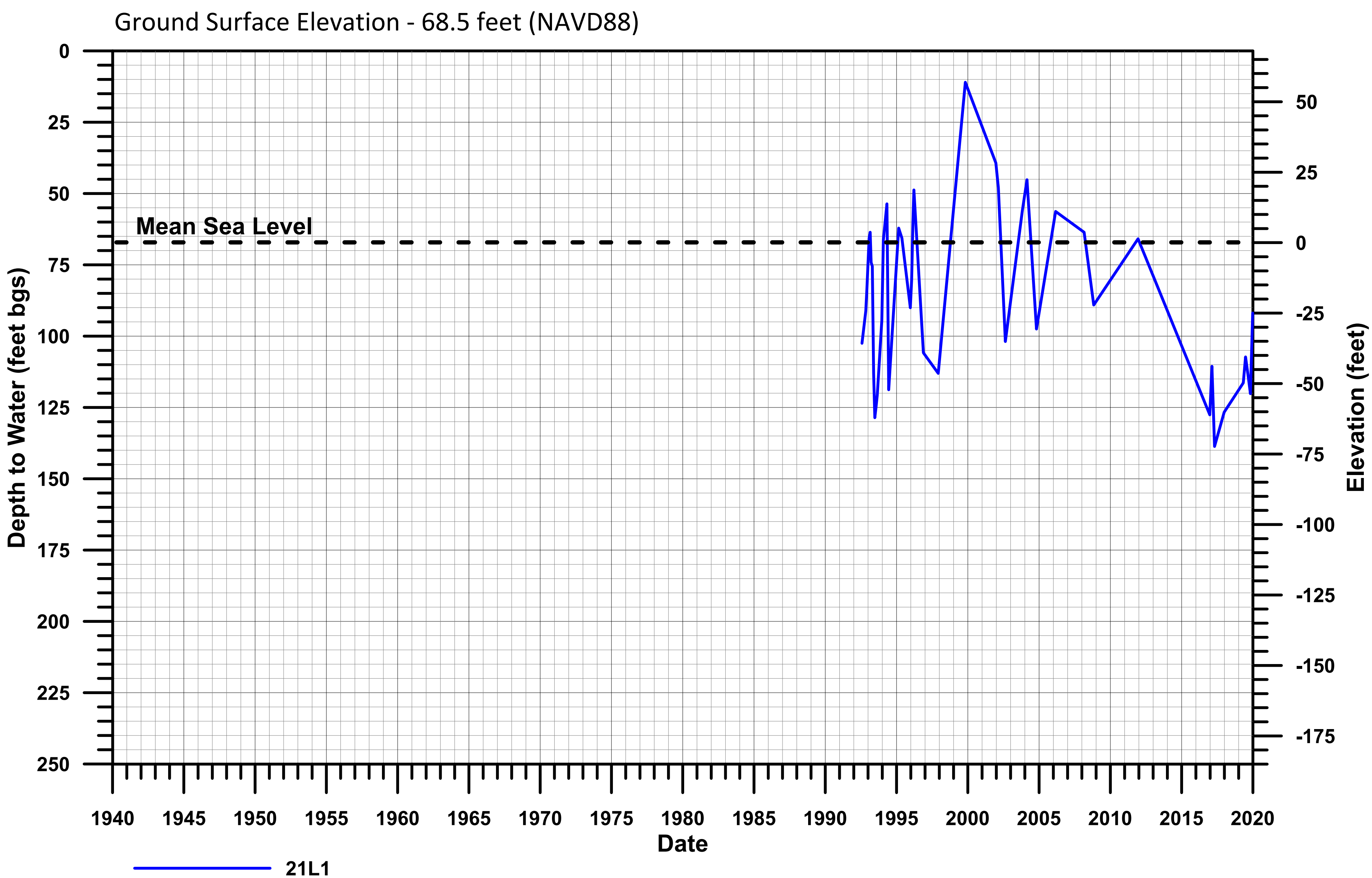
Water Level Data - 4N/25W-20L4 Carpinteria Groundwater Basin Groundwater Sustainability Plan



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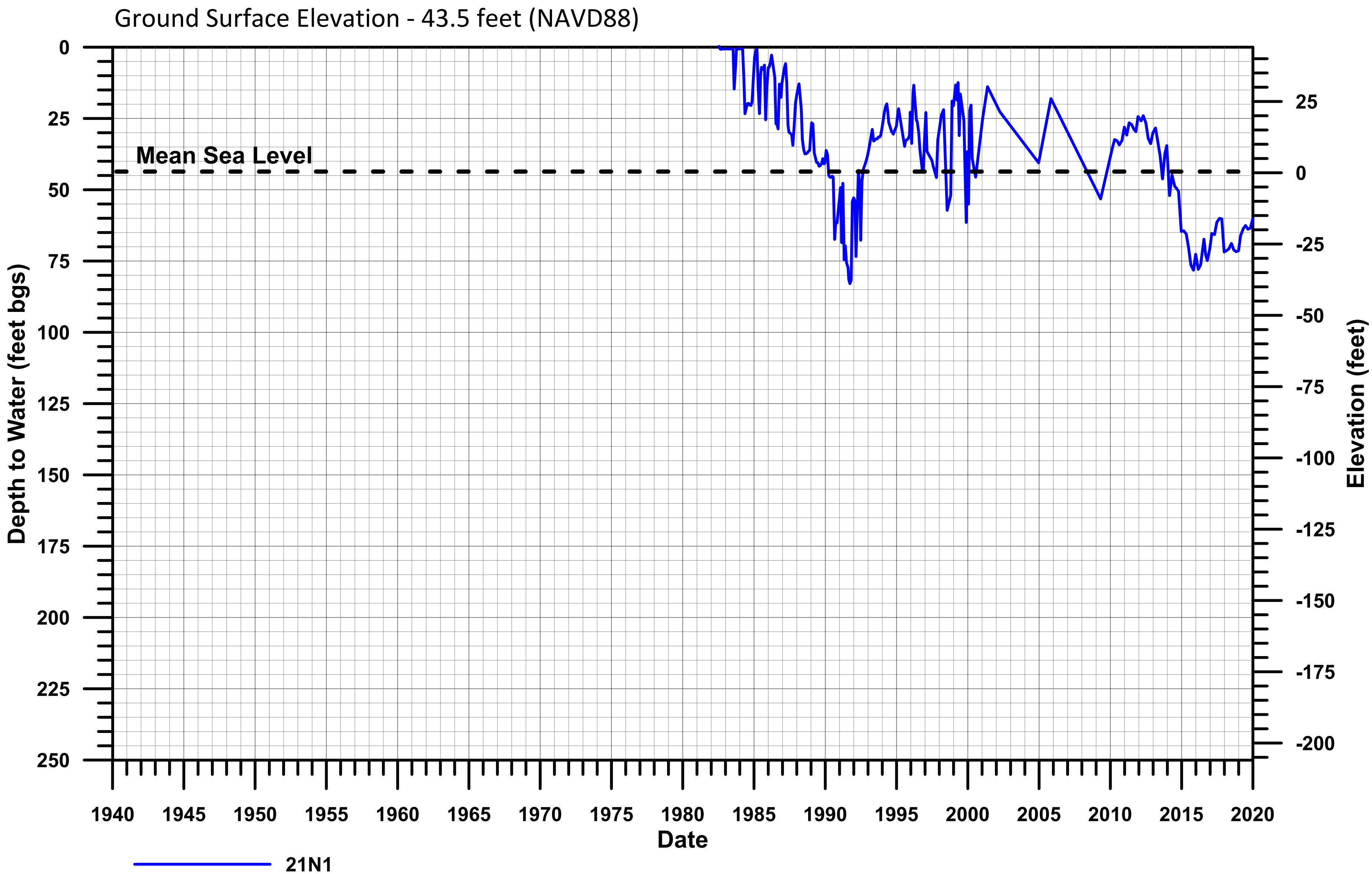

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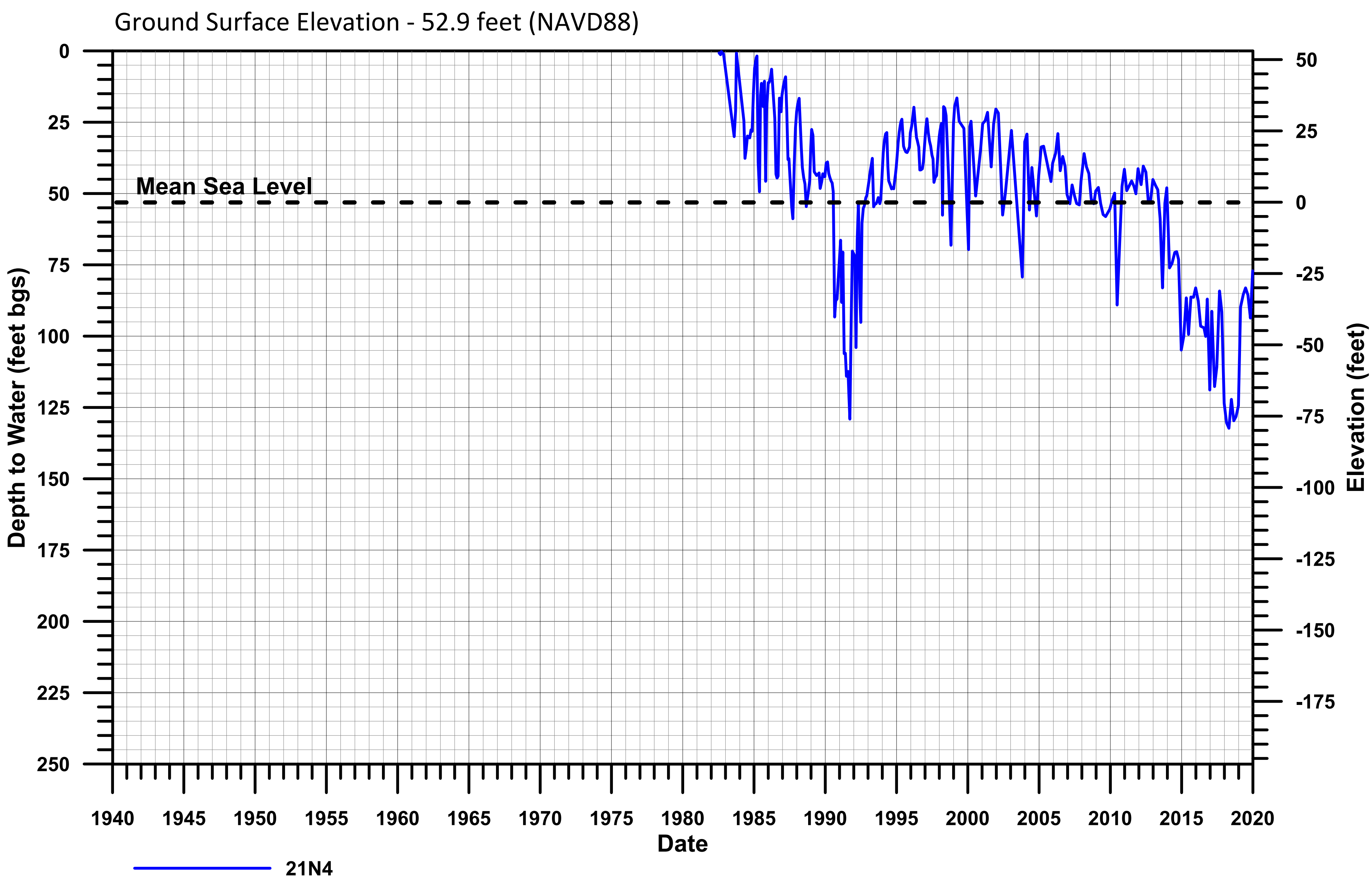
Water Level Data - 4N/25W-21N1 Carpinteria Groundwater Basin Groundwater Sustainability Plan



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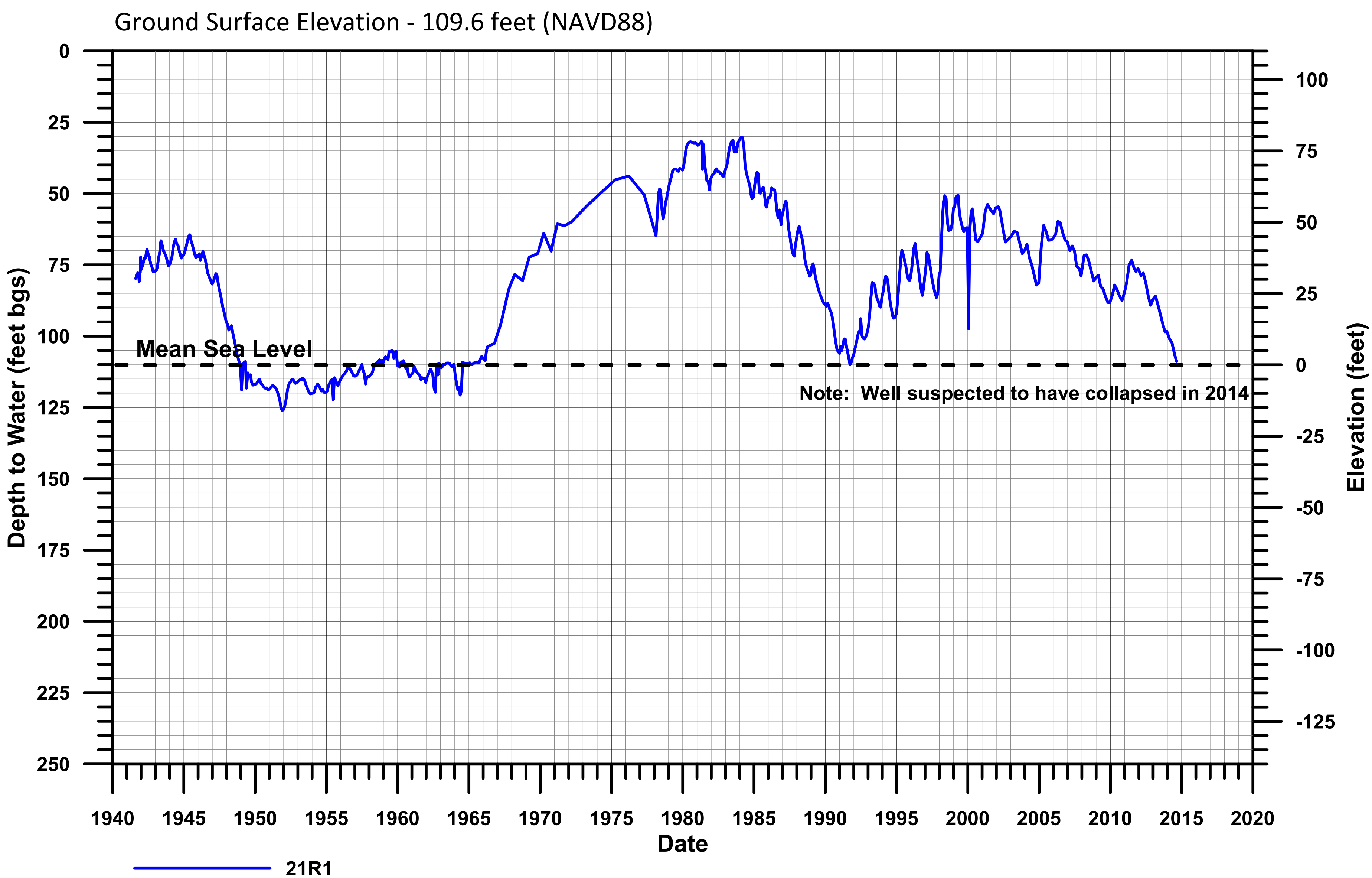

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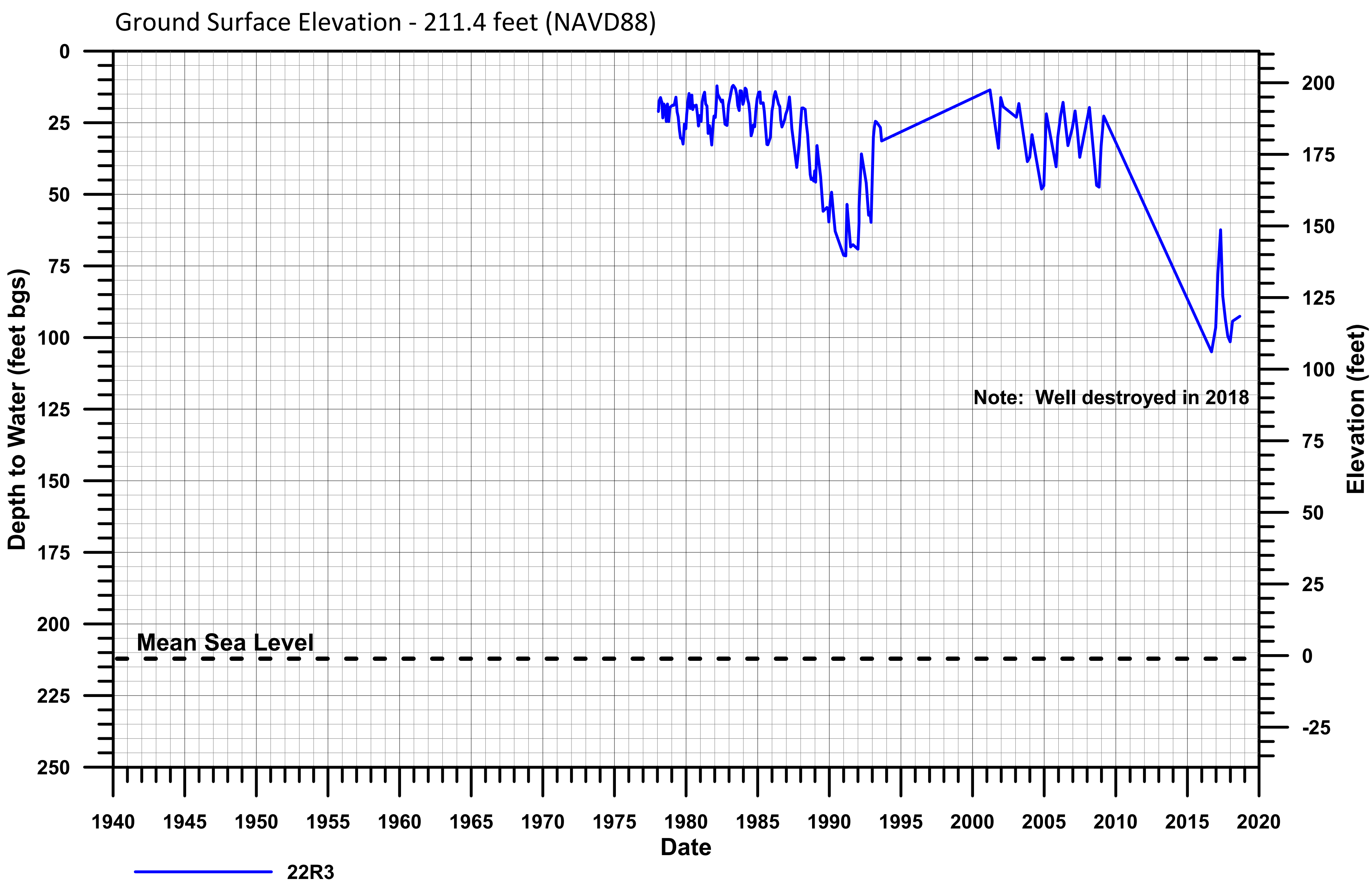
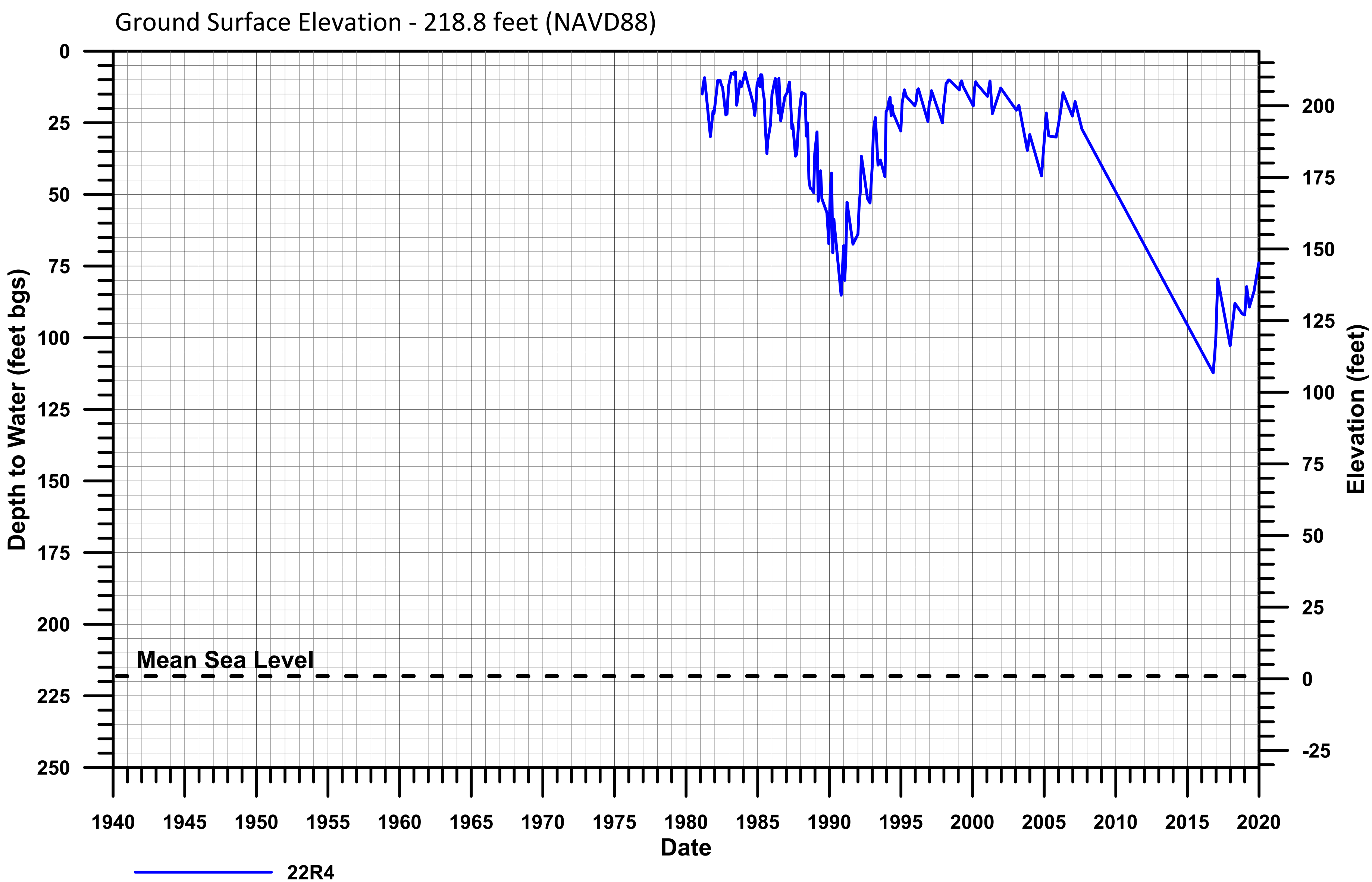
Water Level Data - 4N/25W-21R1 Carpinteria Groundwater Basin Groundwater Sustainability Plan



Water Level Data - 4N/25W-22R3 Carpinteria
Groundwater Basin Groundwater
Sustainability Plan



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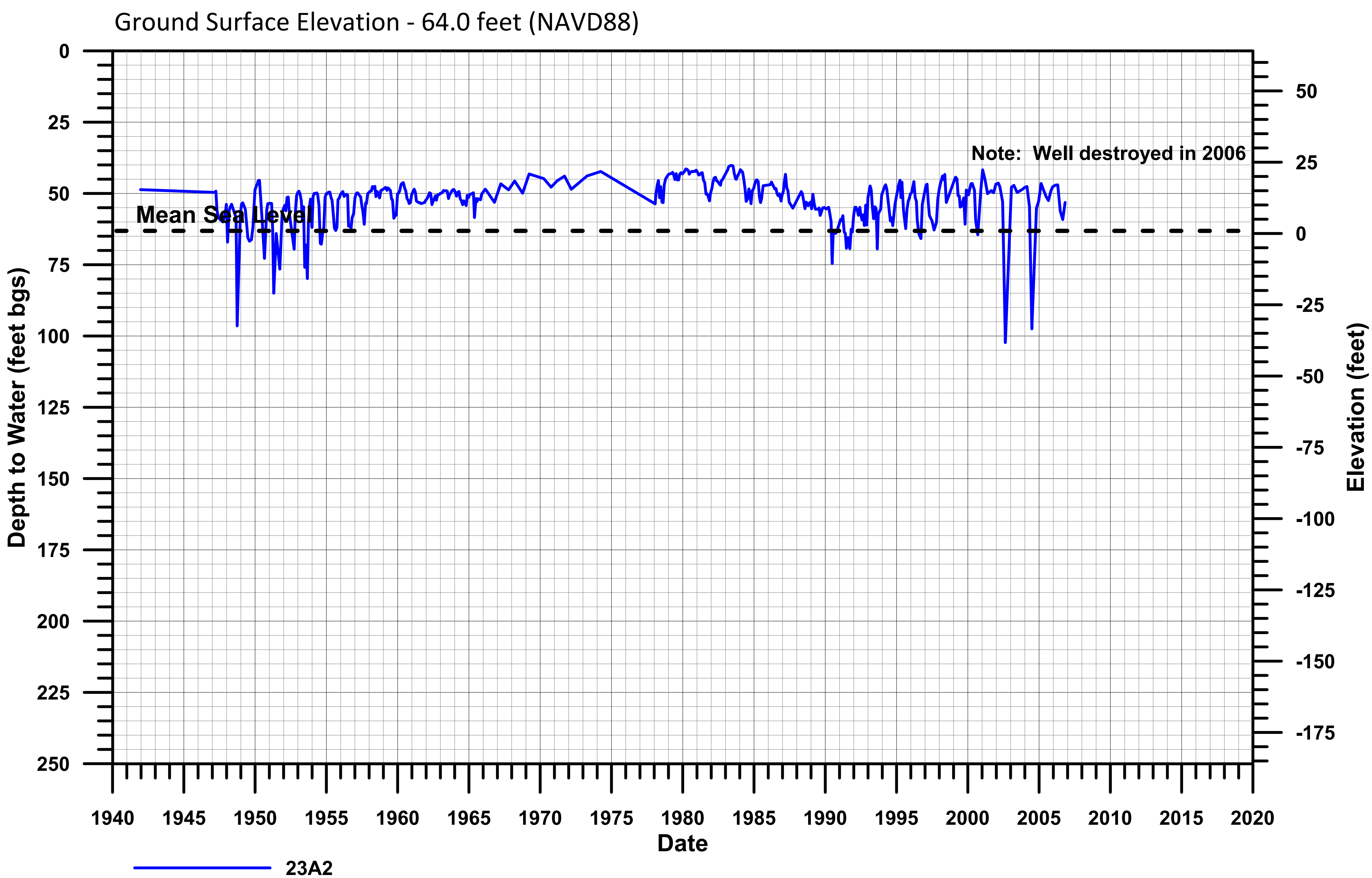
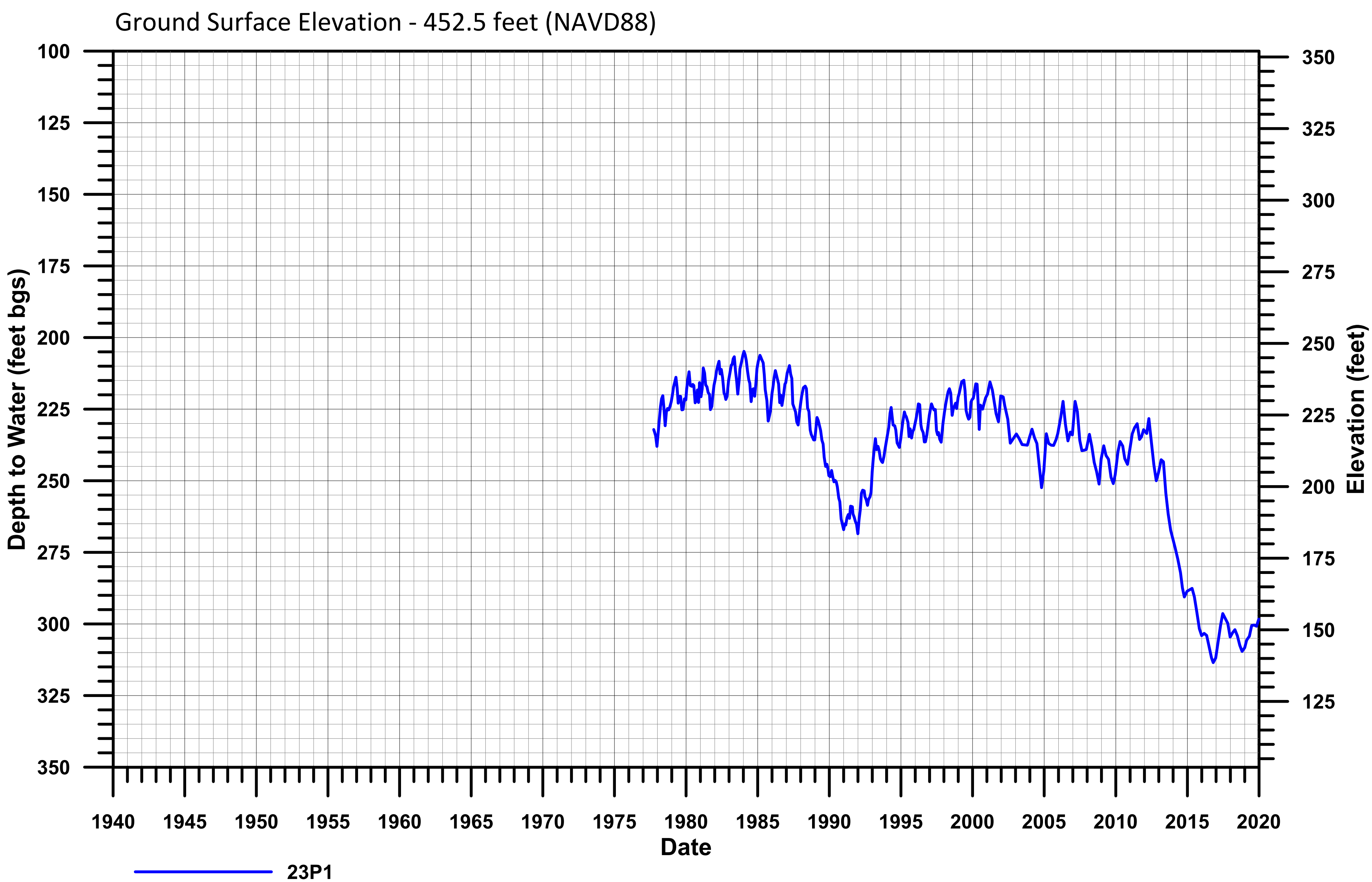
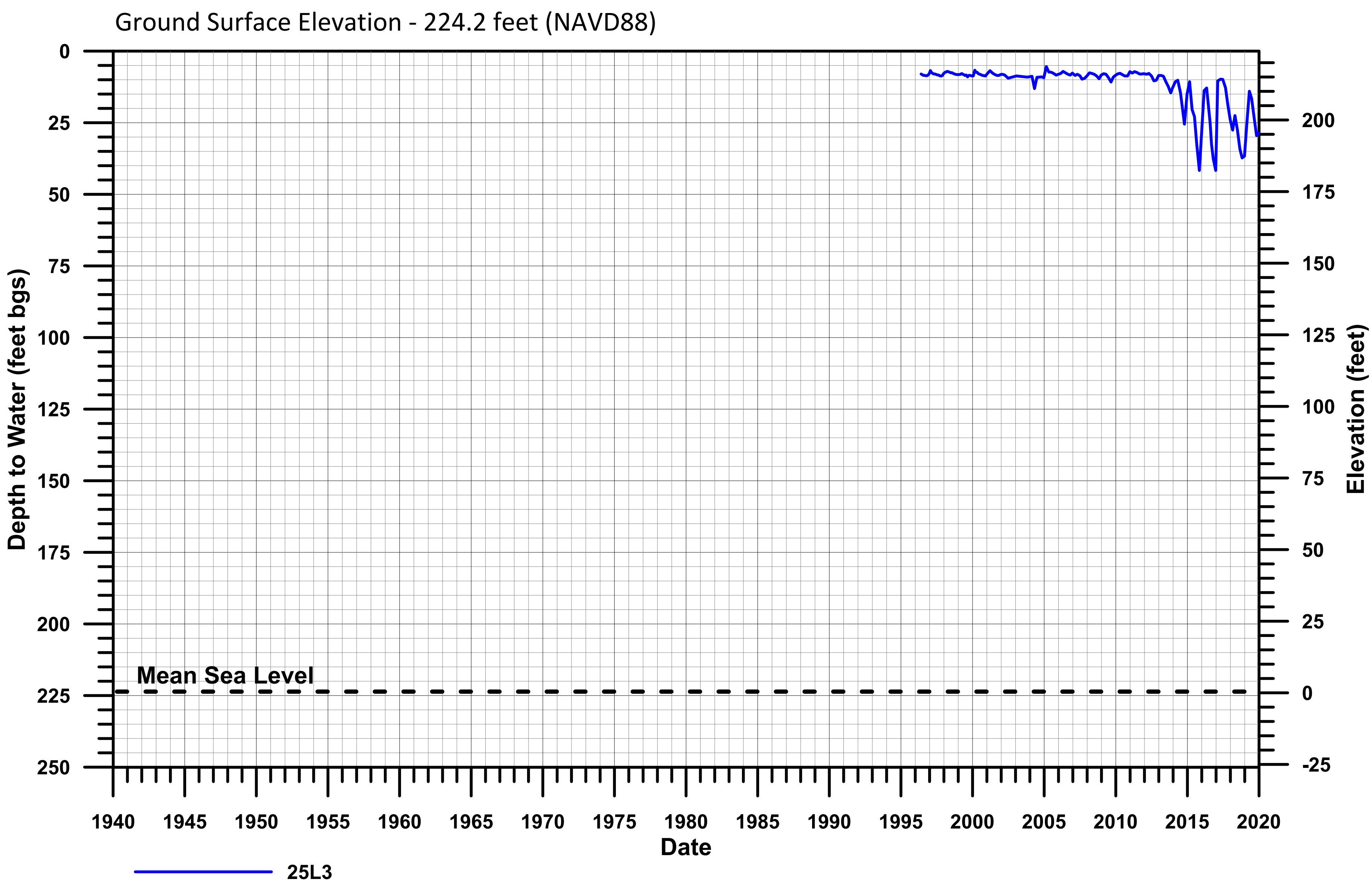


CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Water Level Data - 4N/25W-23A2 Carpinteria Groundwater Basin Groundwater Sustainability Plan

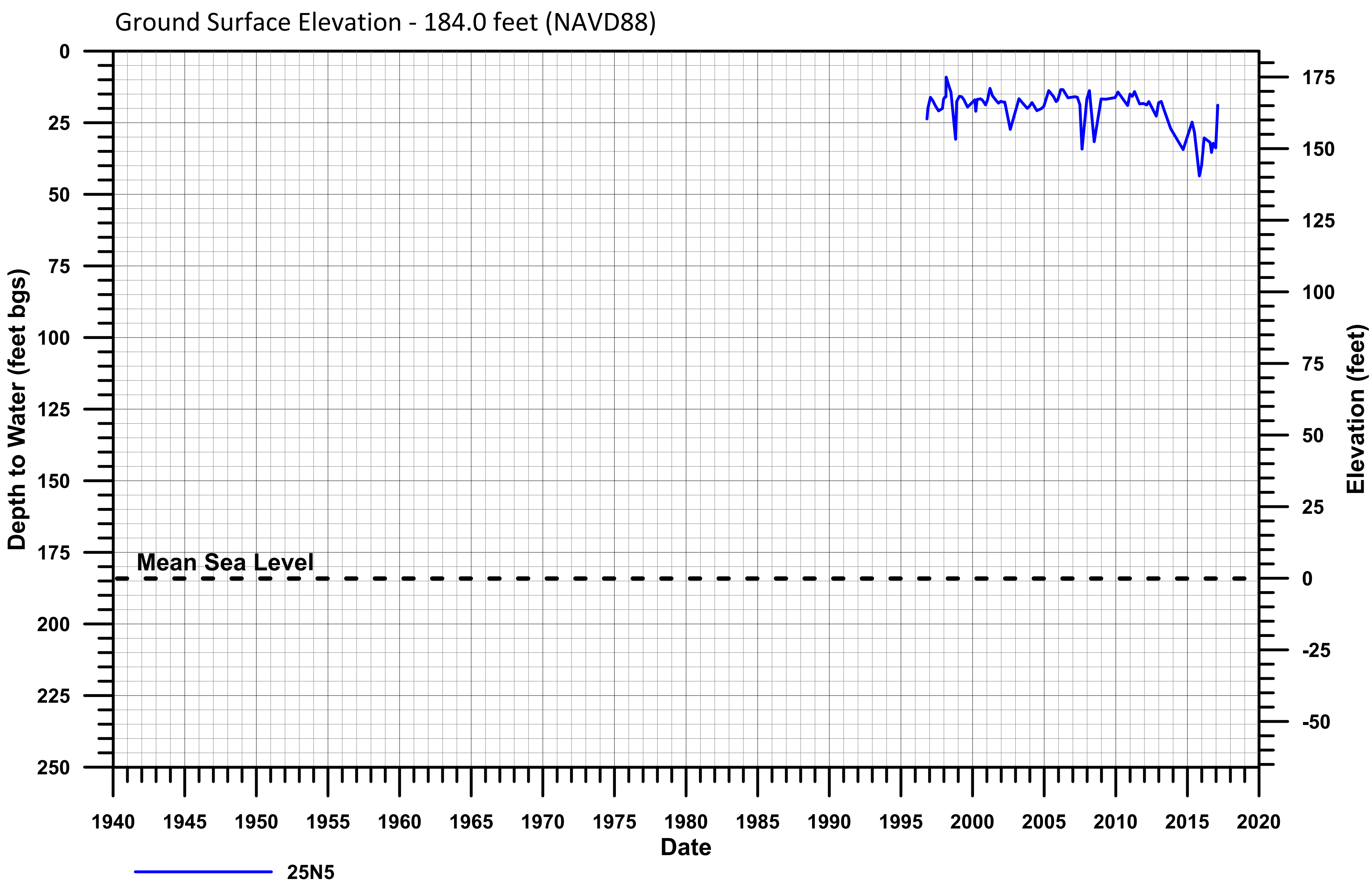


Water Level Data - 4N/25W-23P1 Carpinteria Groundwater Basin Groundwater Sustainability Plan



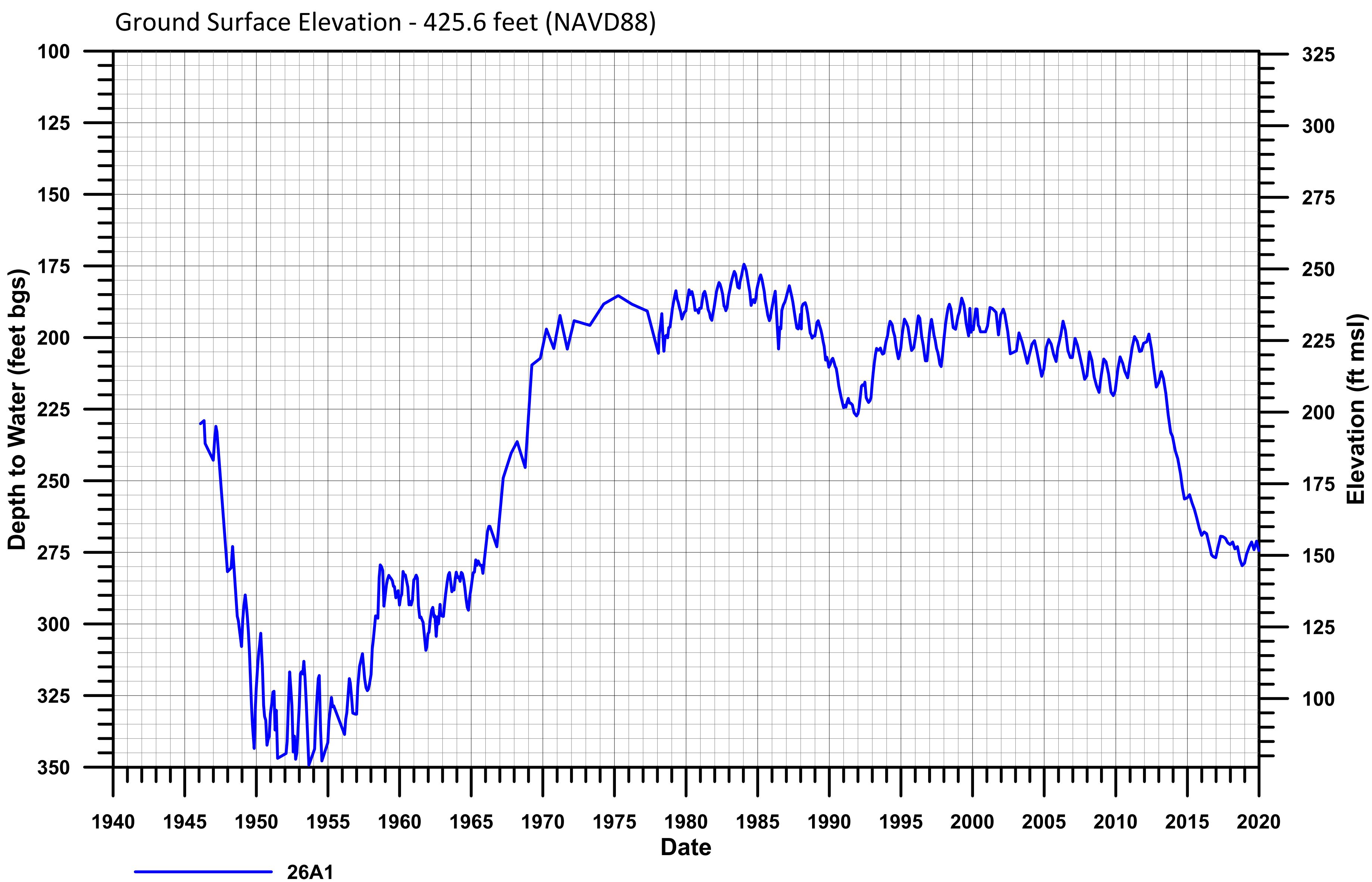
CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Water Level Data - 4N/25W-25L3 Carpinteria Groundwater Basin Groundwater Sustainability Plan



CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Water Level Data - 4N/25W-25N5 Carpinteria Groundwater Basin Groundwater Sustainability Plan



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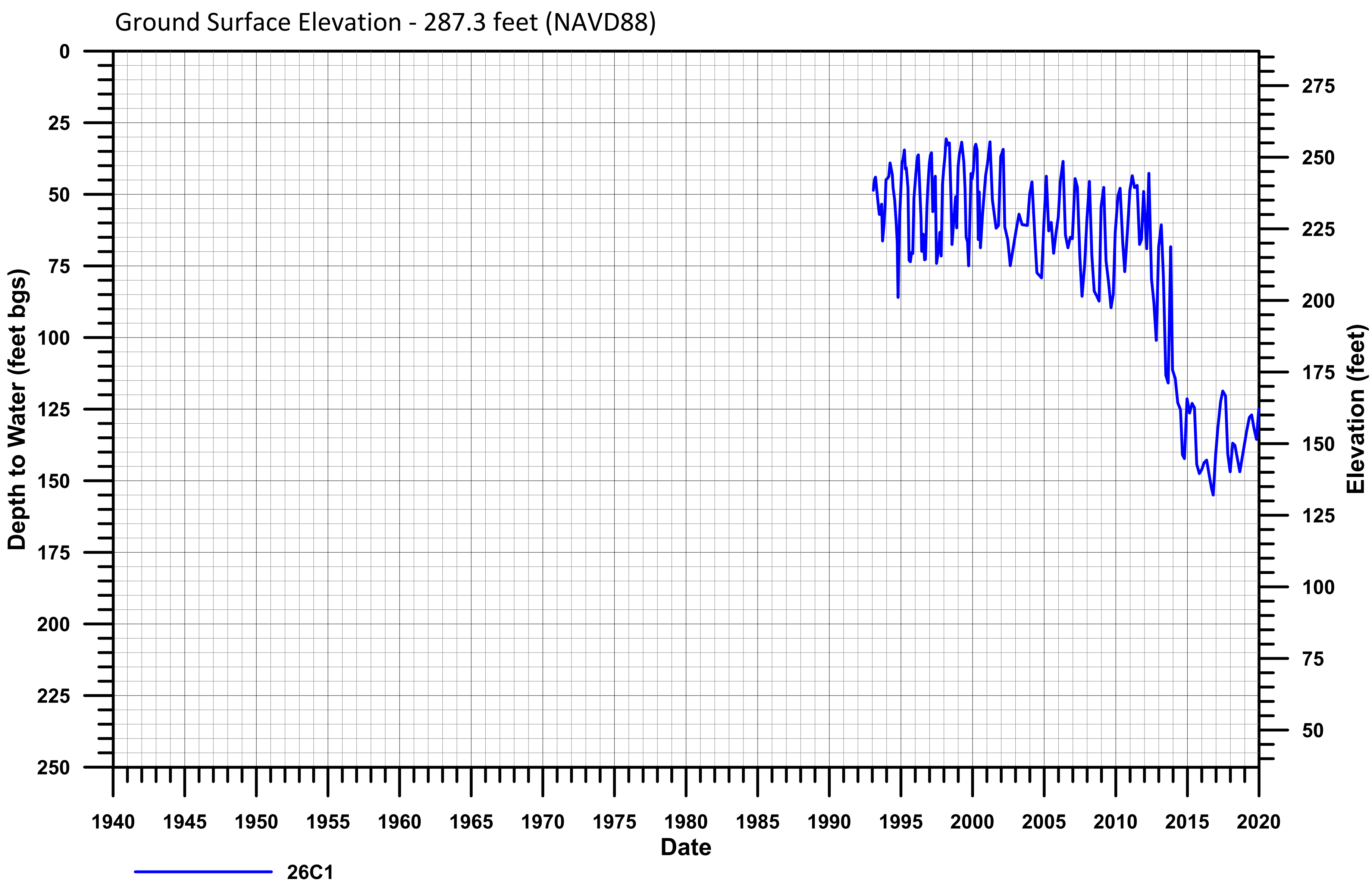

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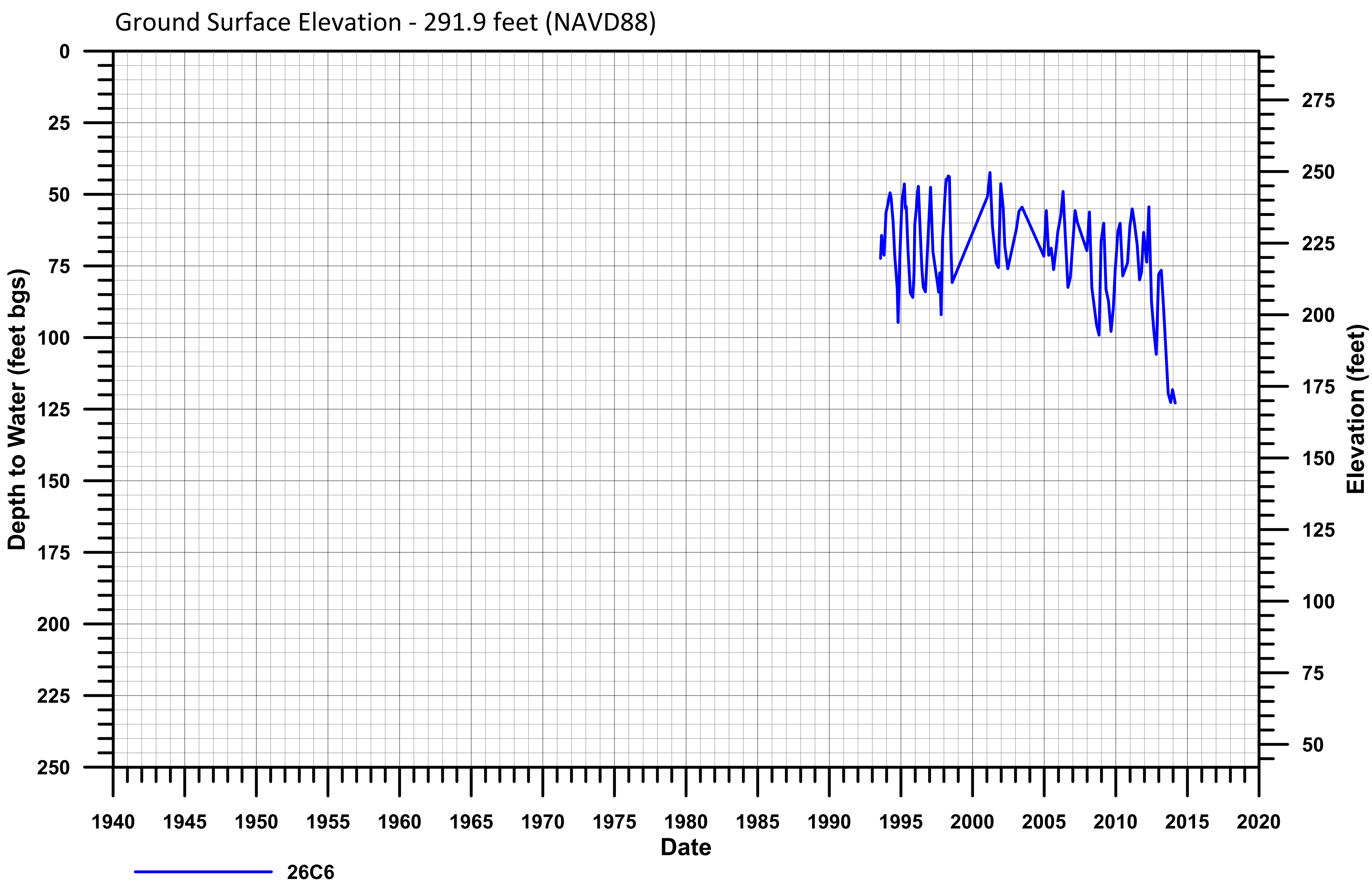

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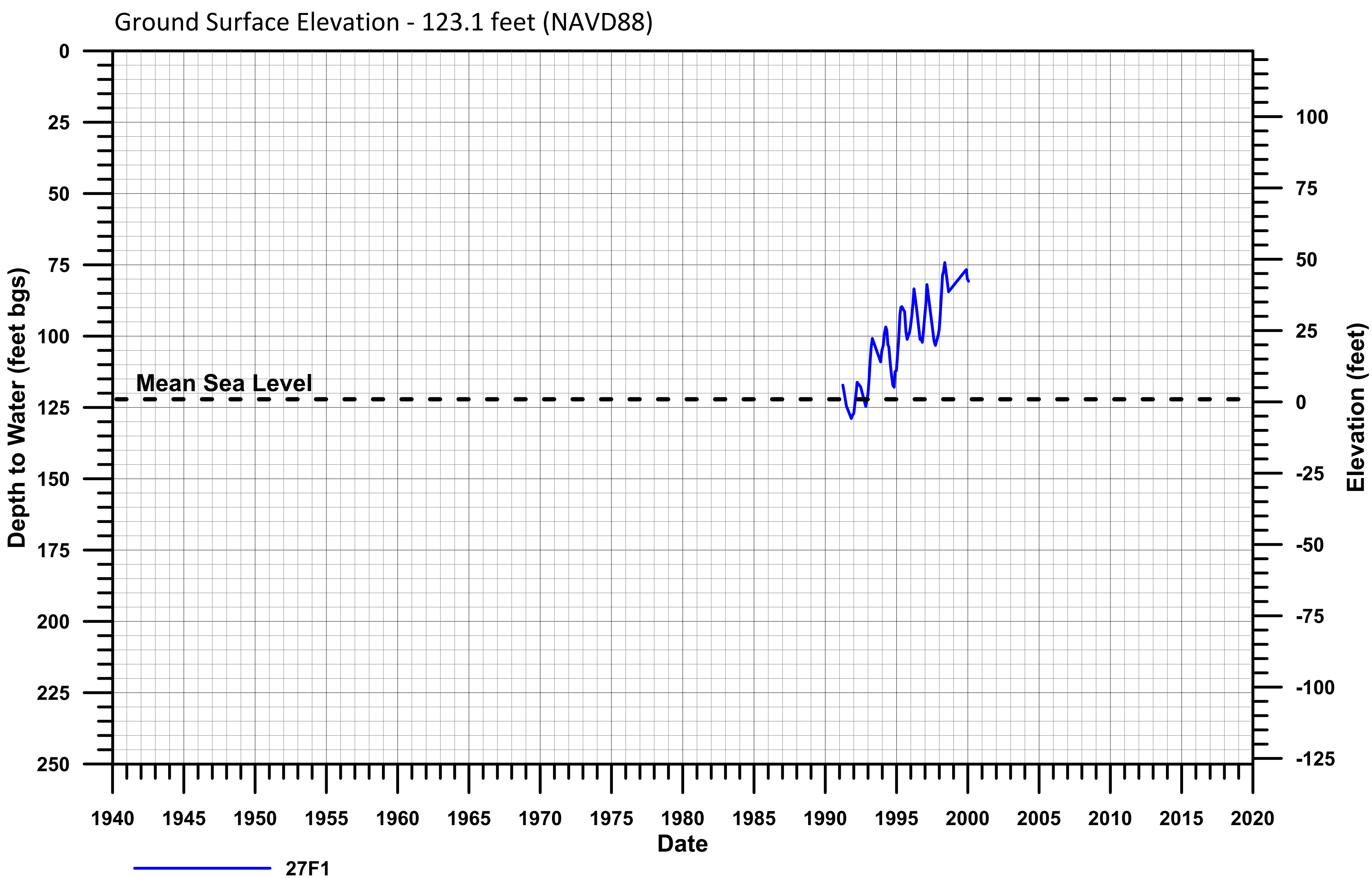

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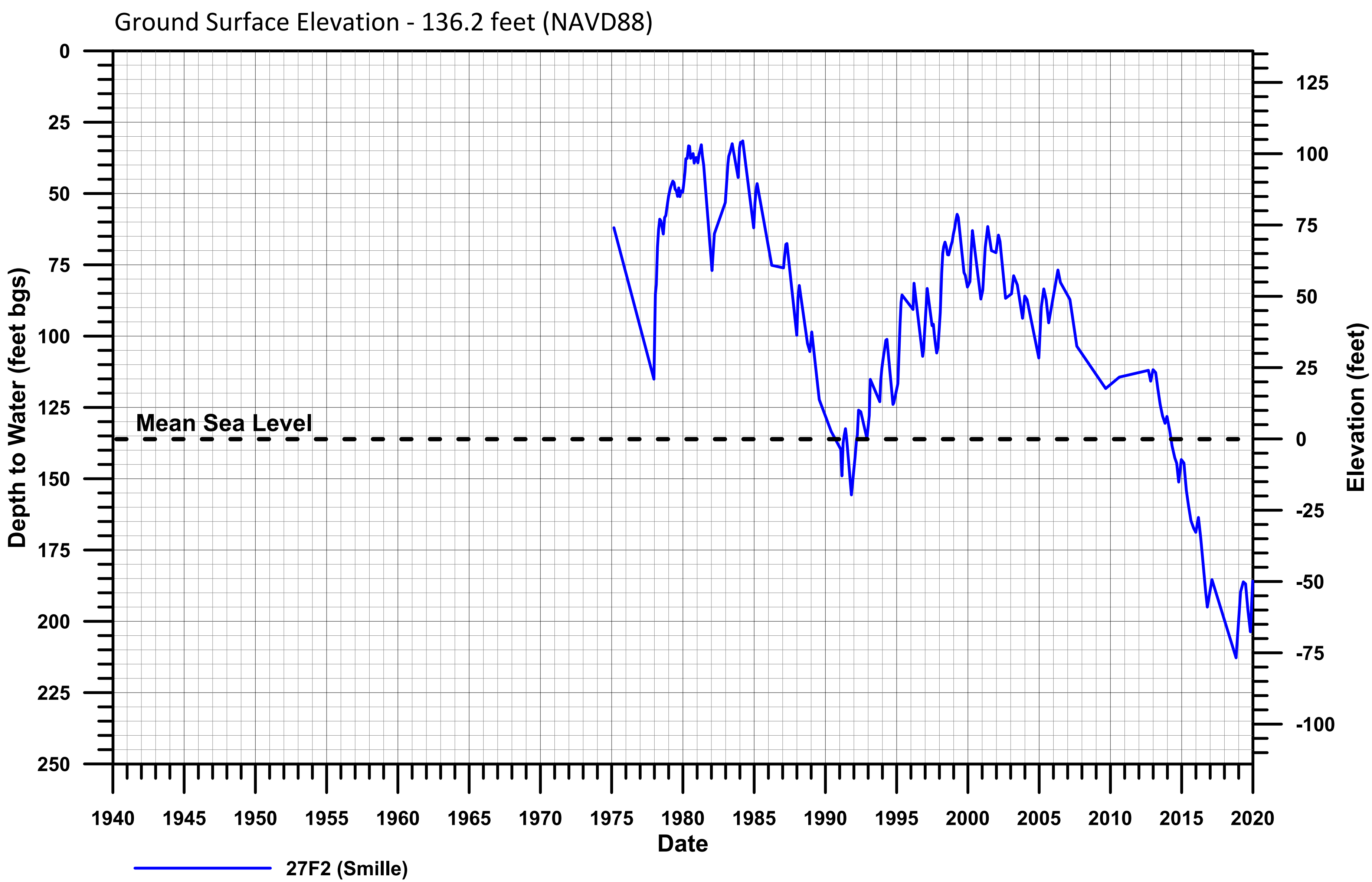

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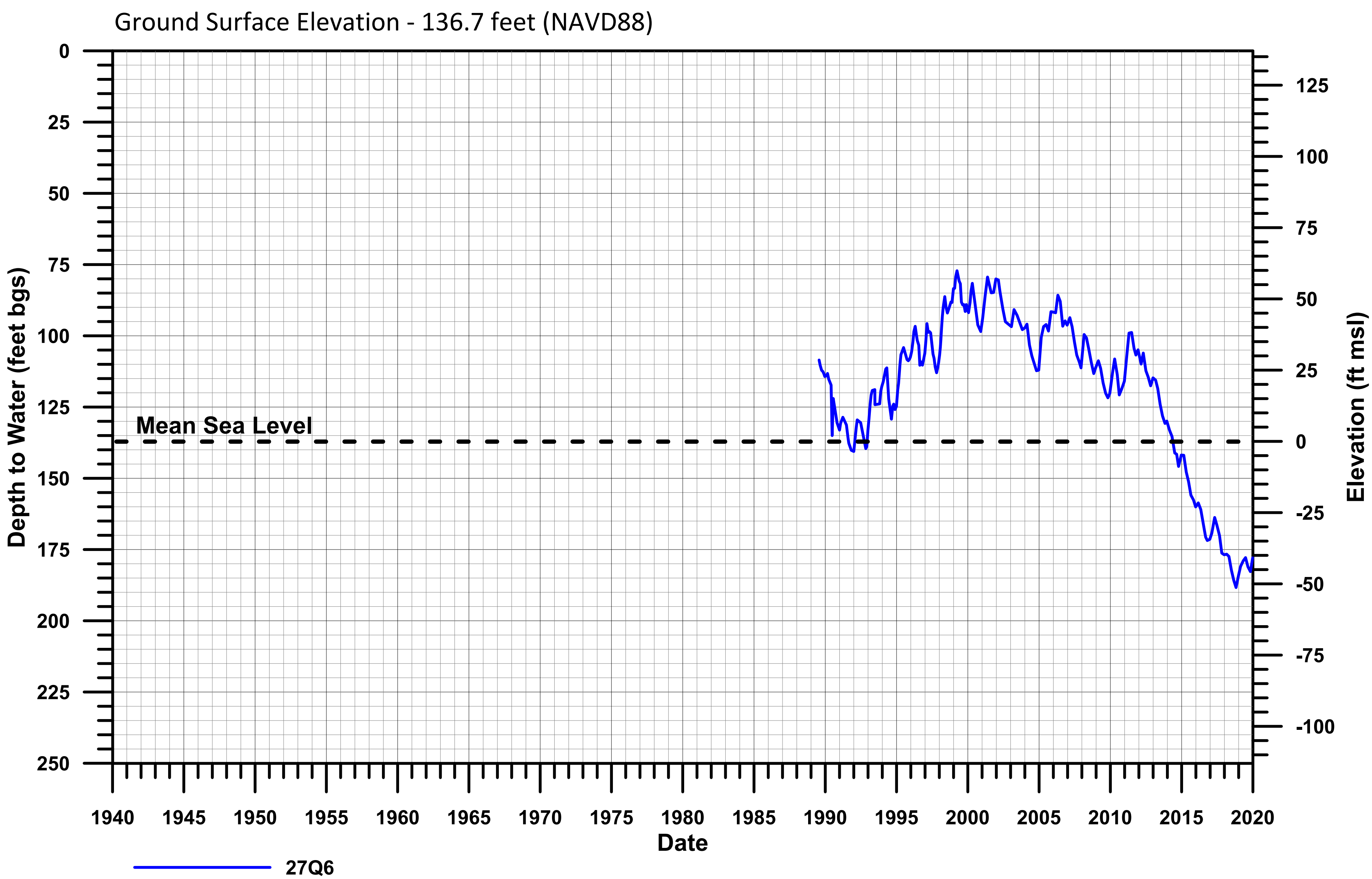

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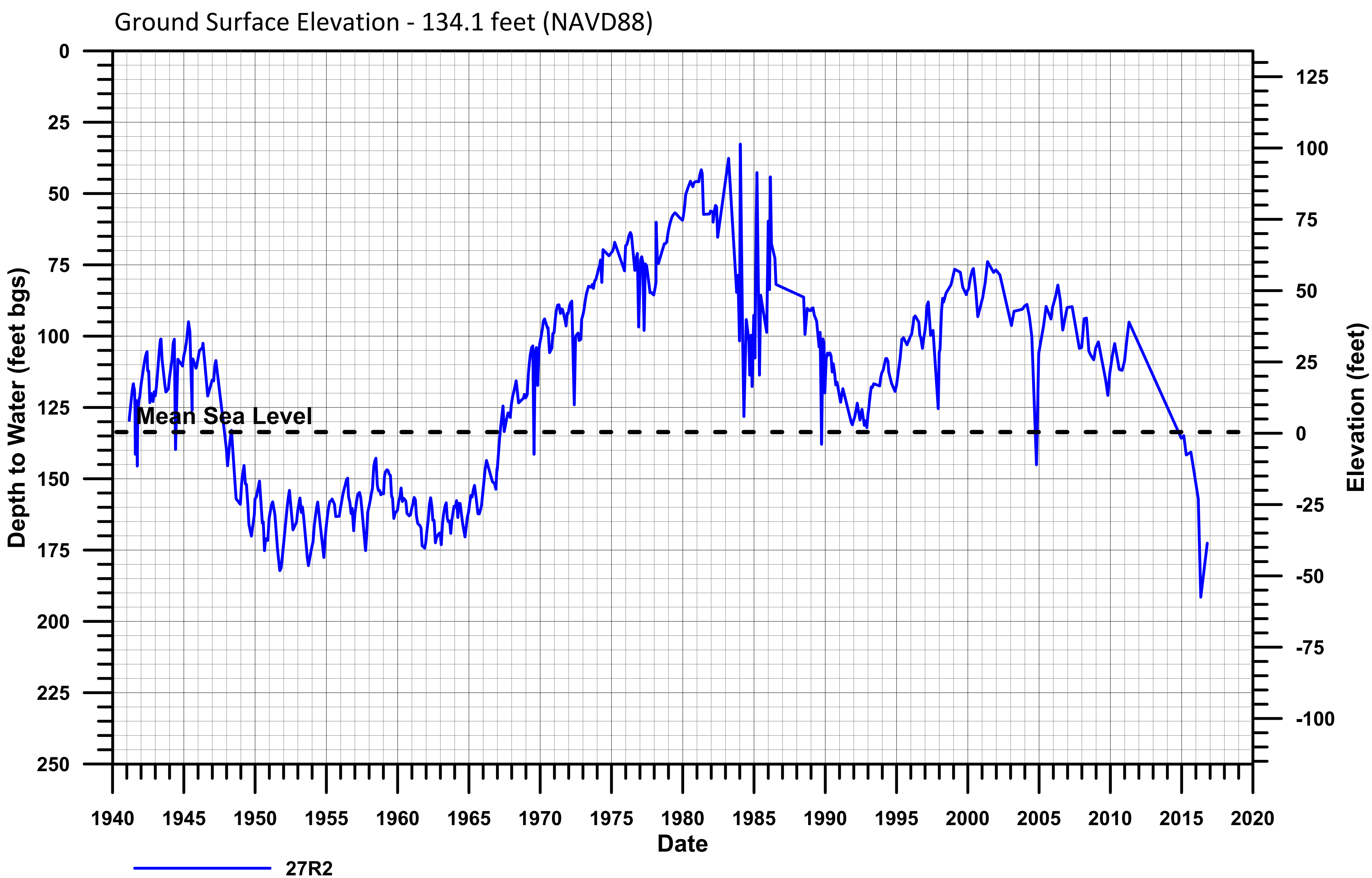

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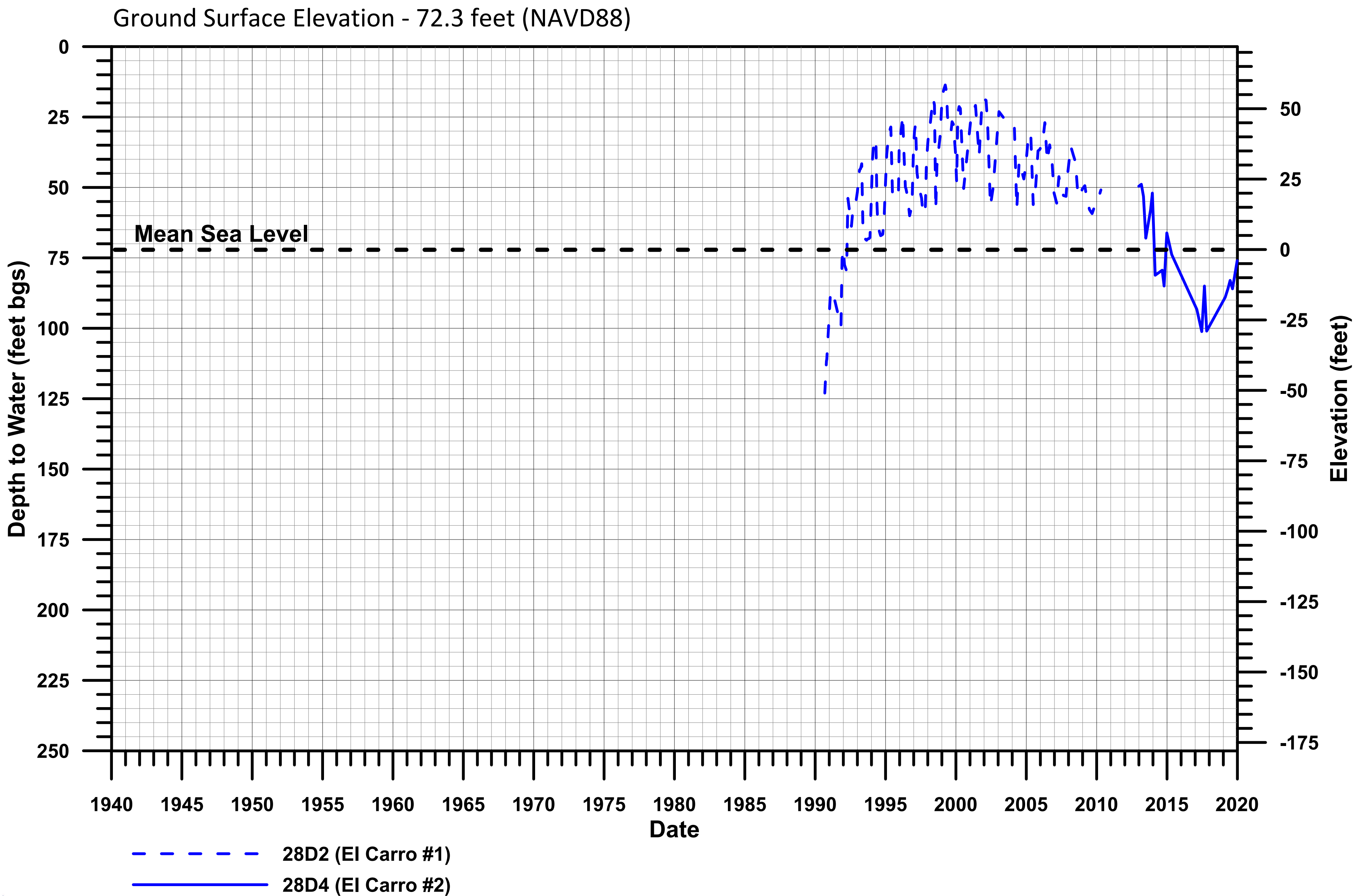

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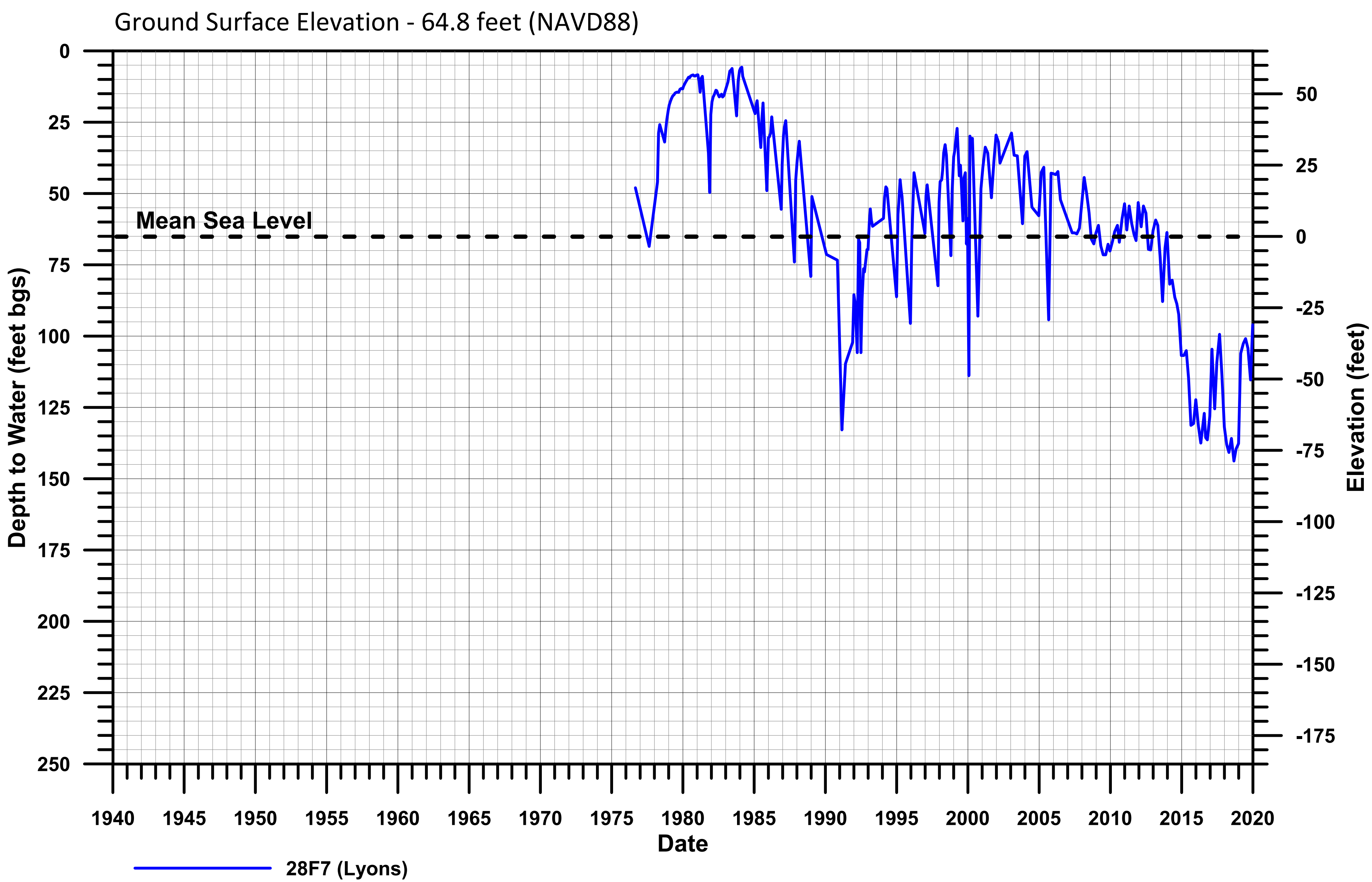

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

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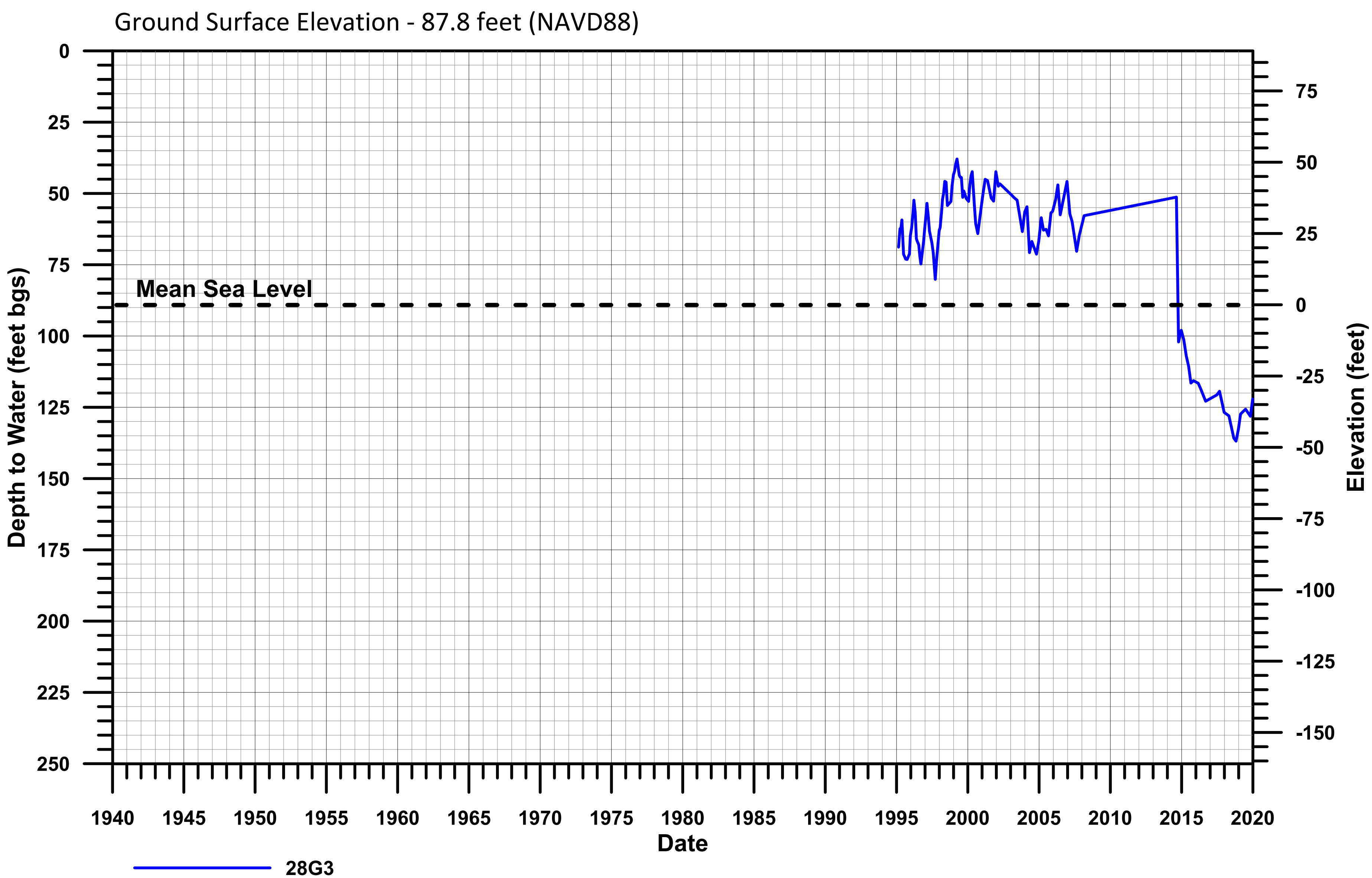

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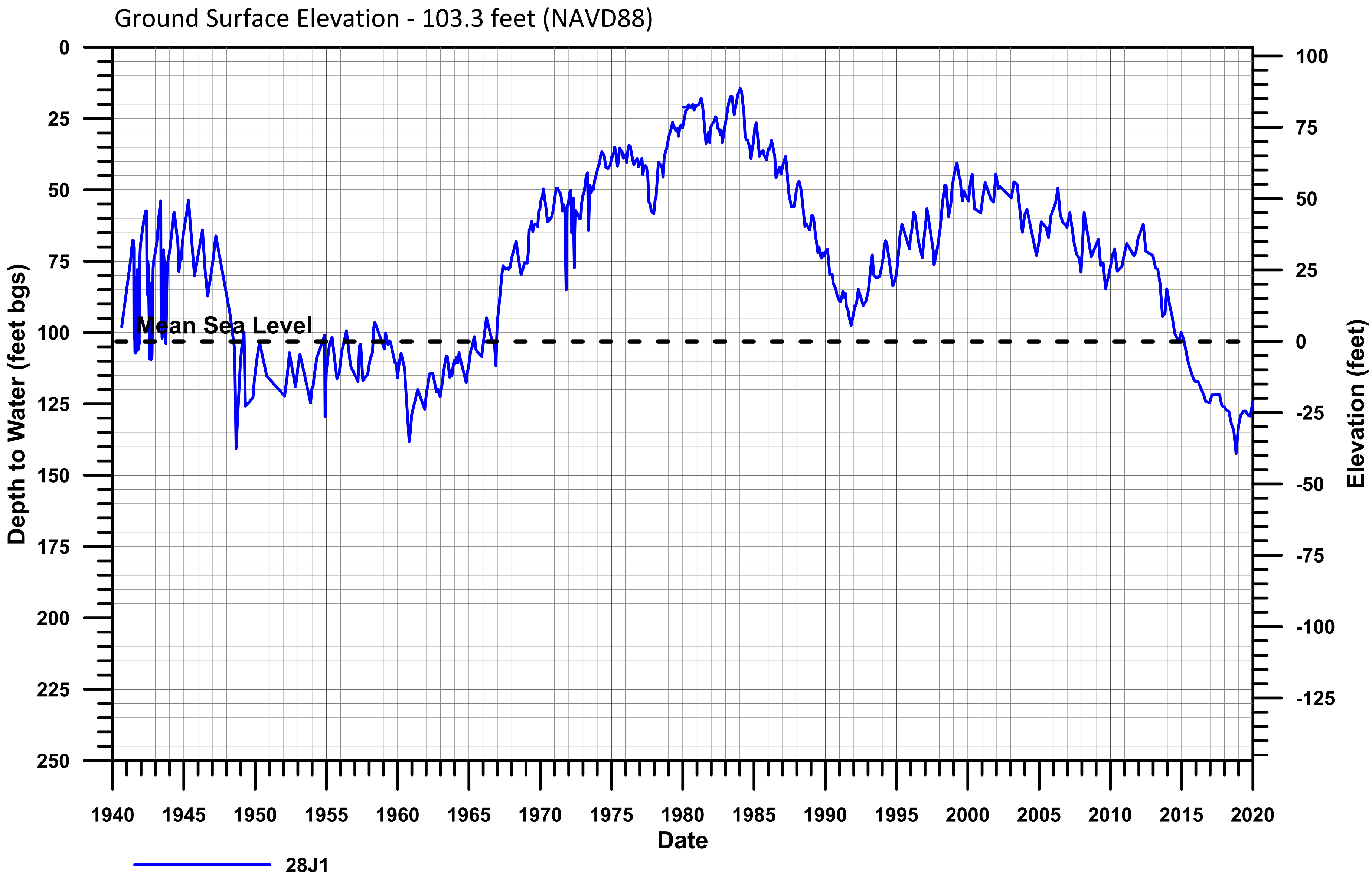

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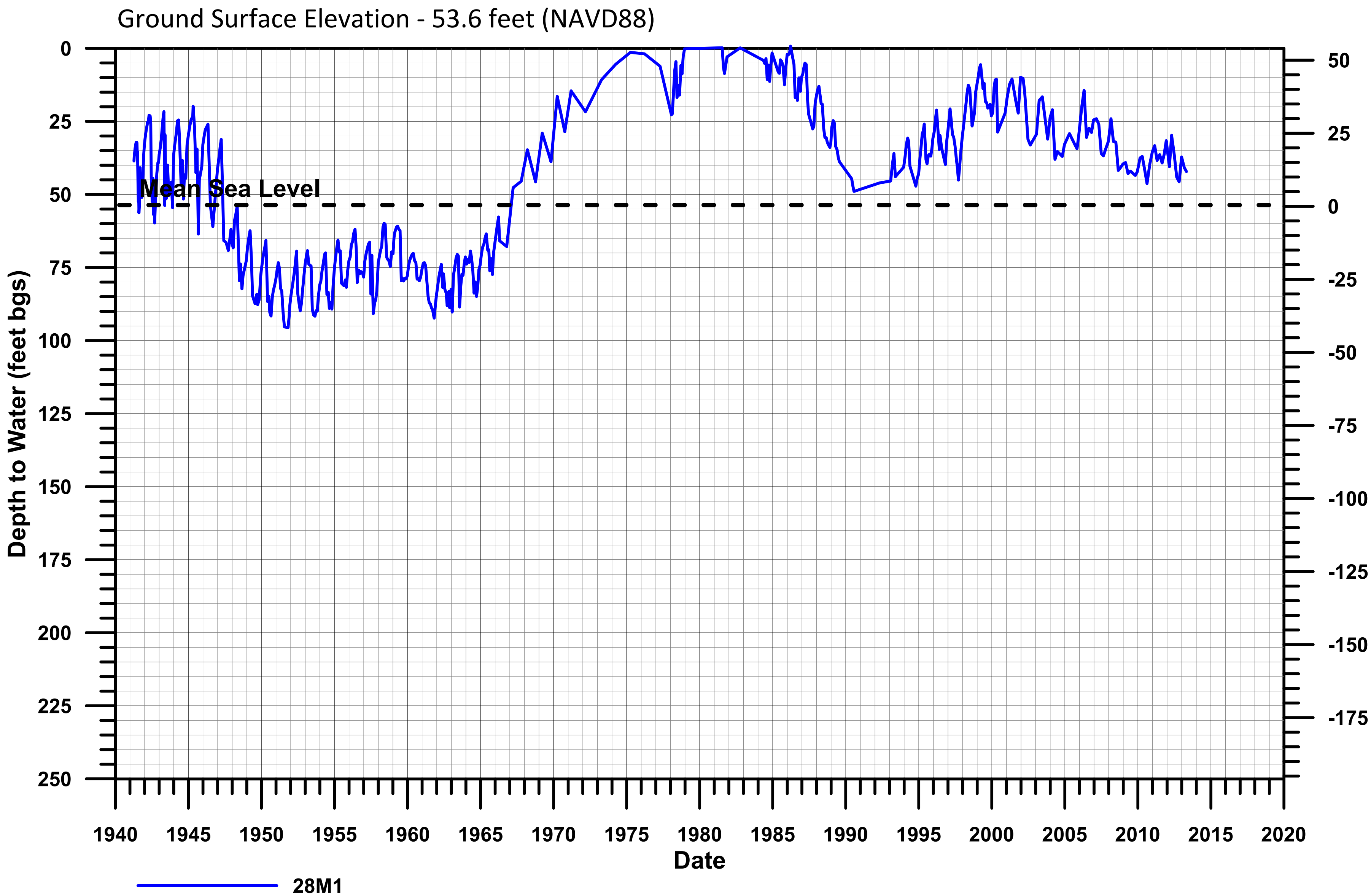

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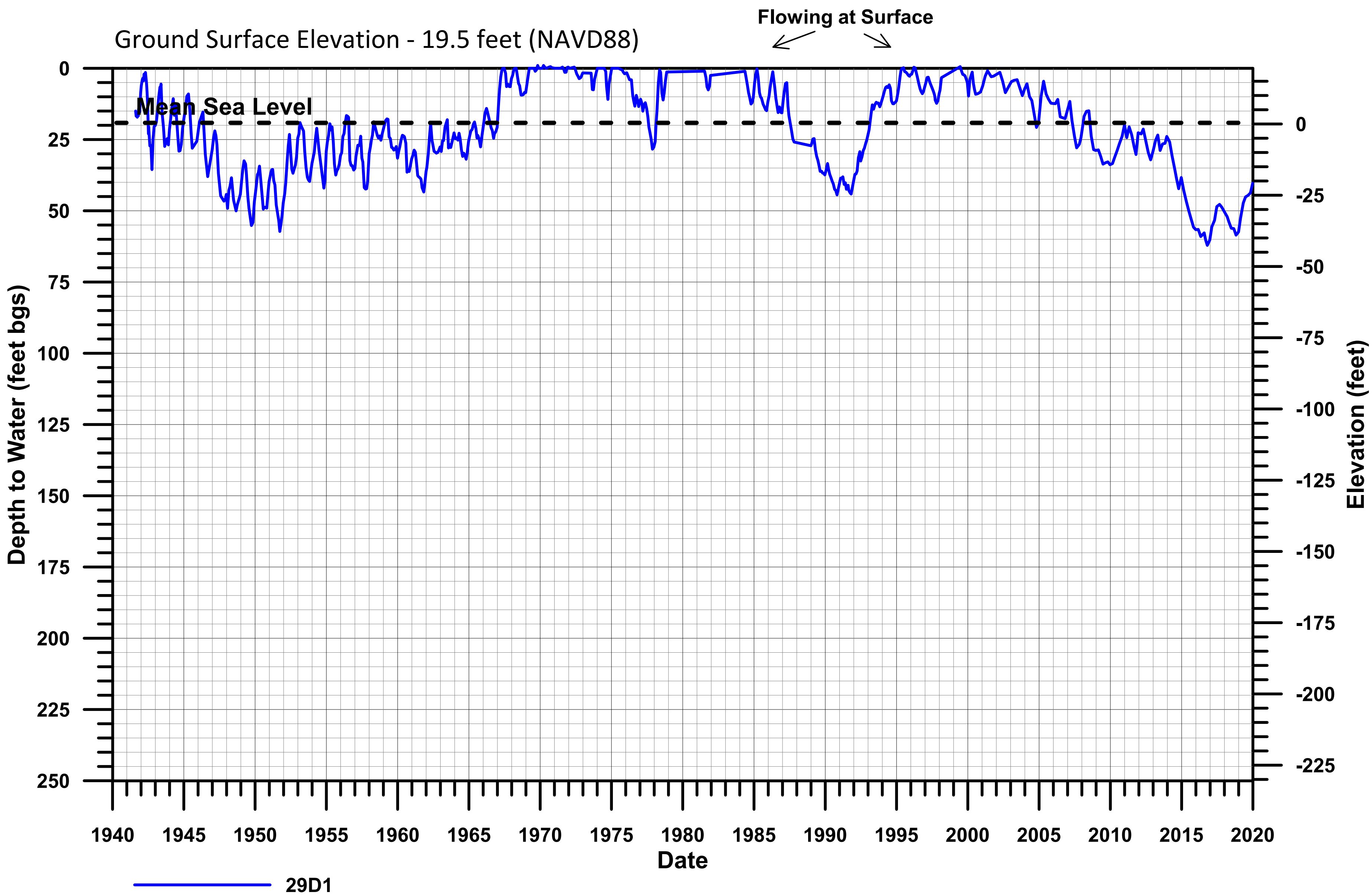

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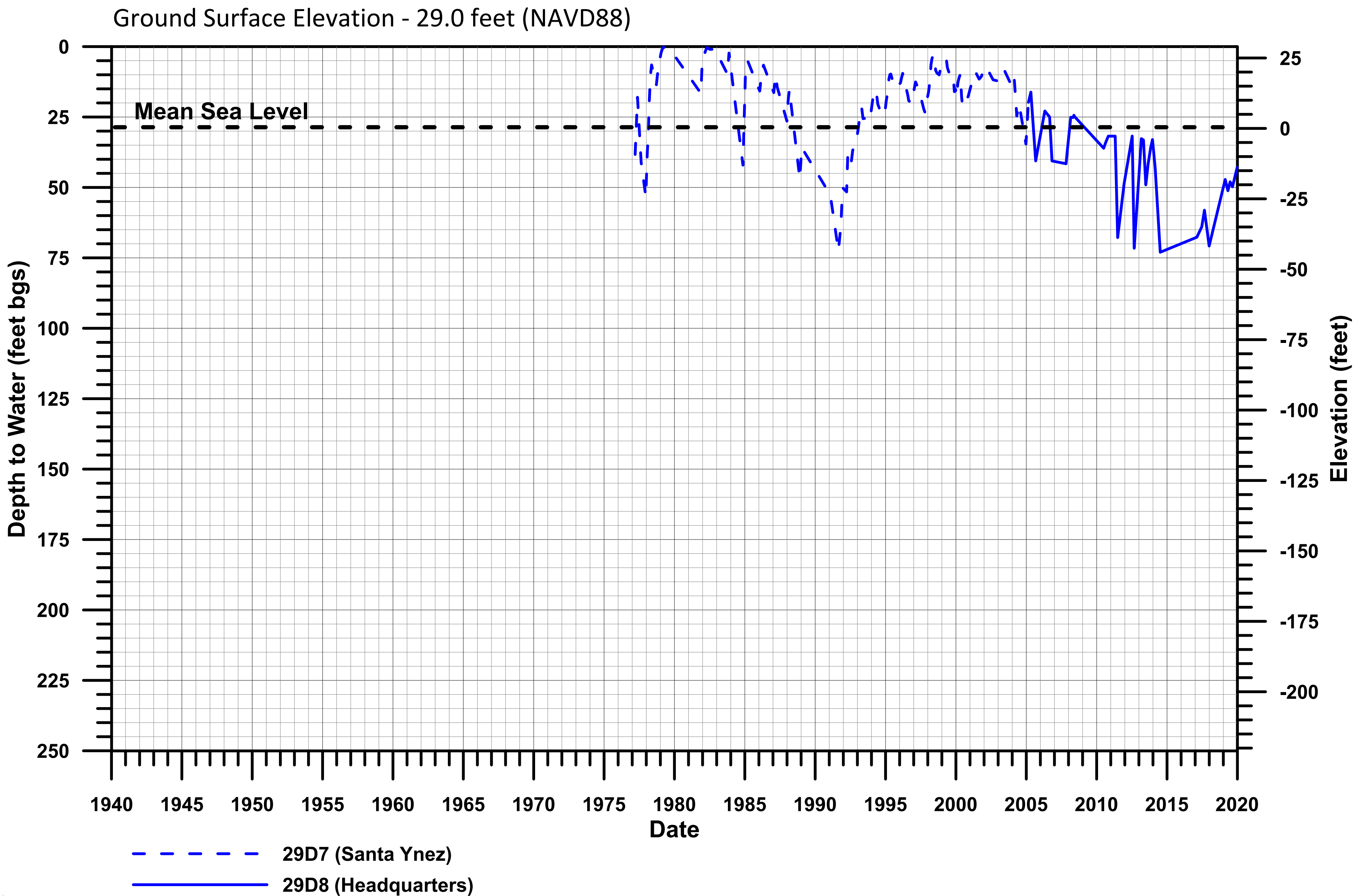

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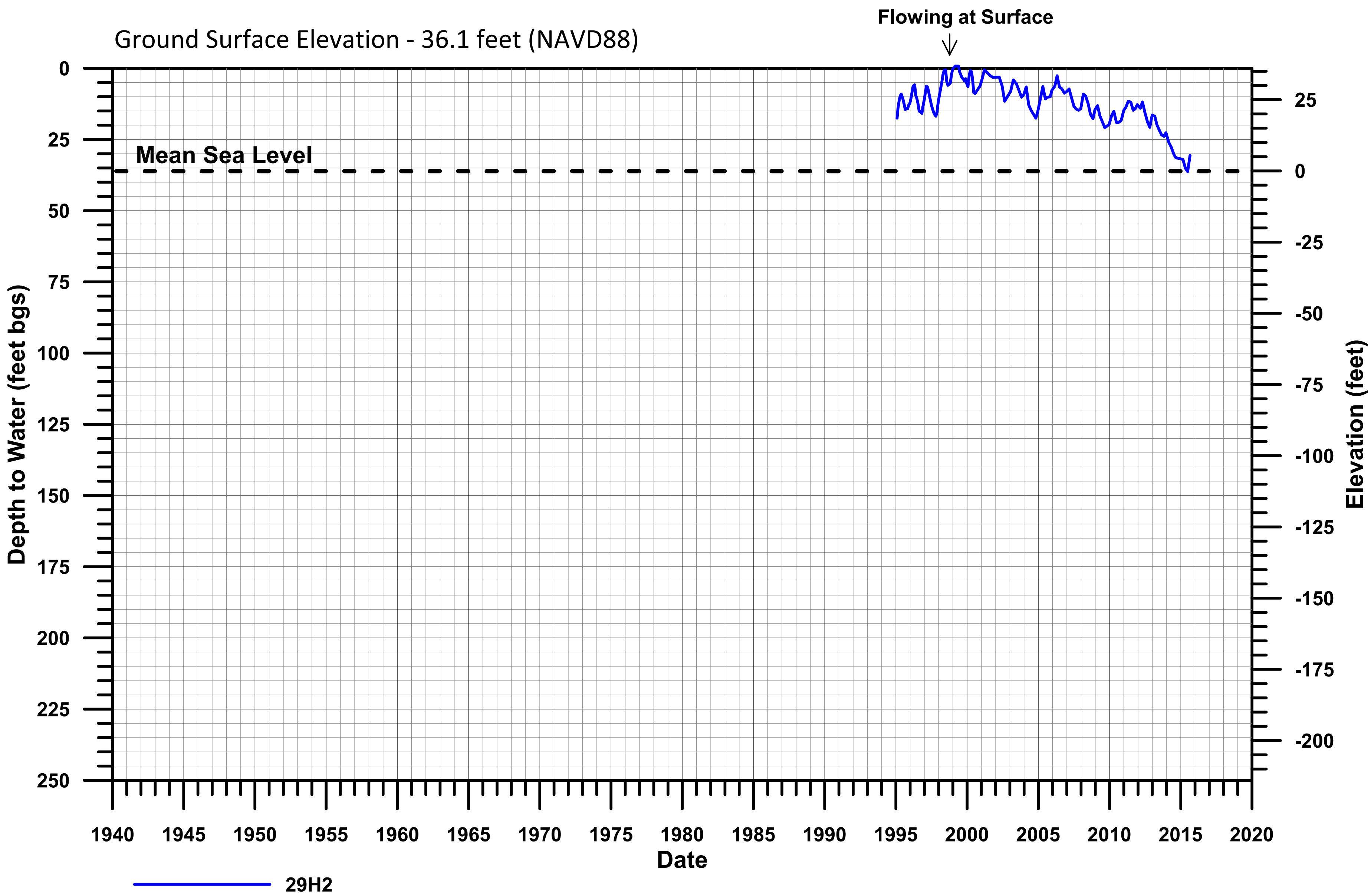

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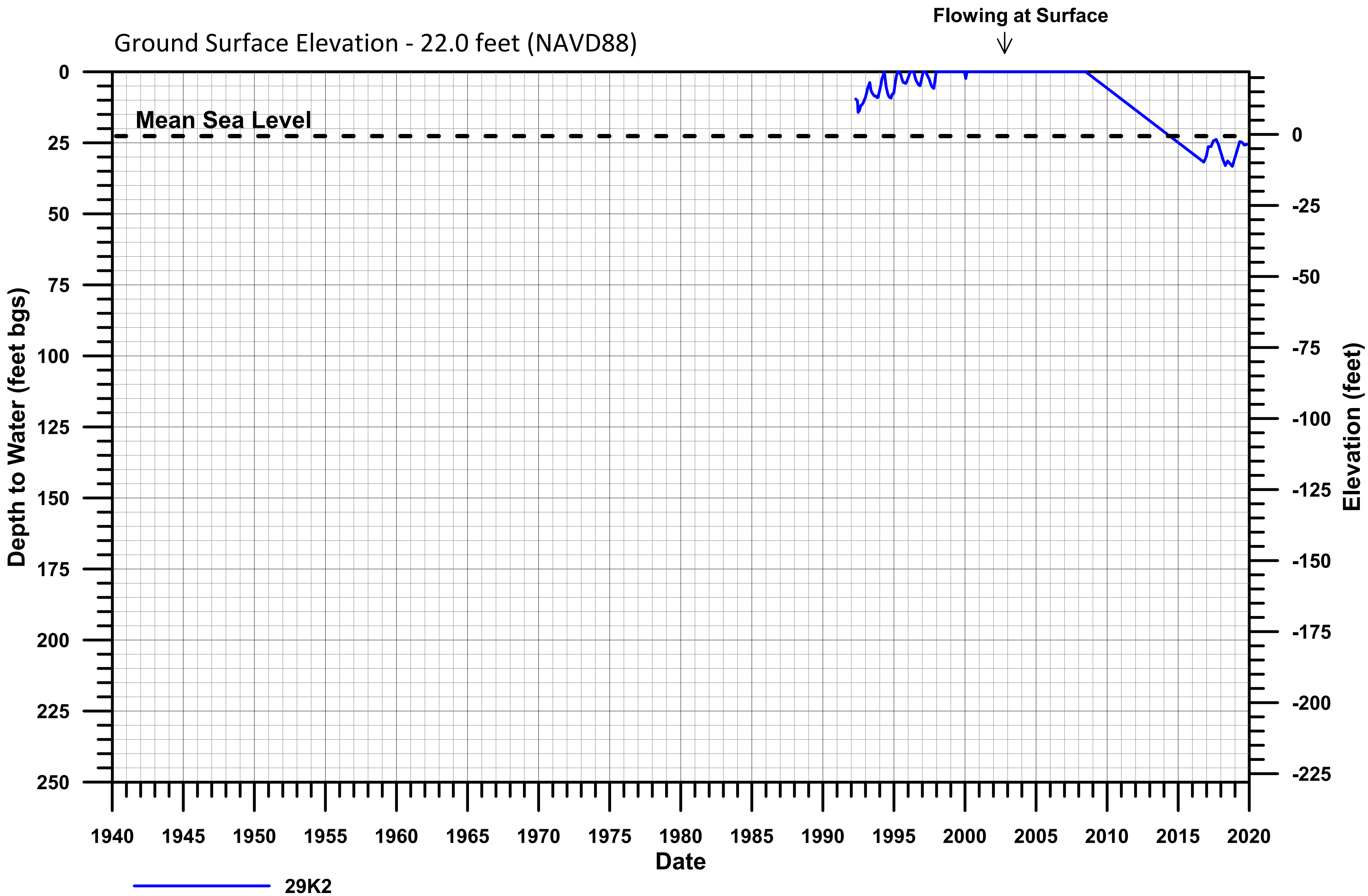

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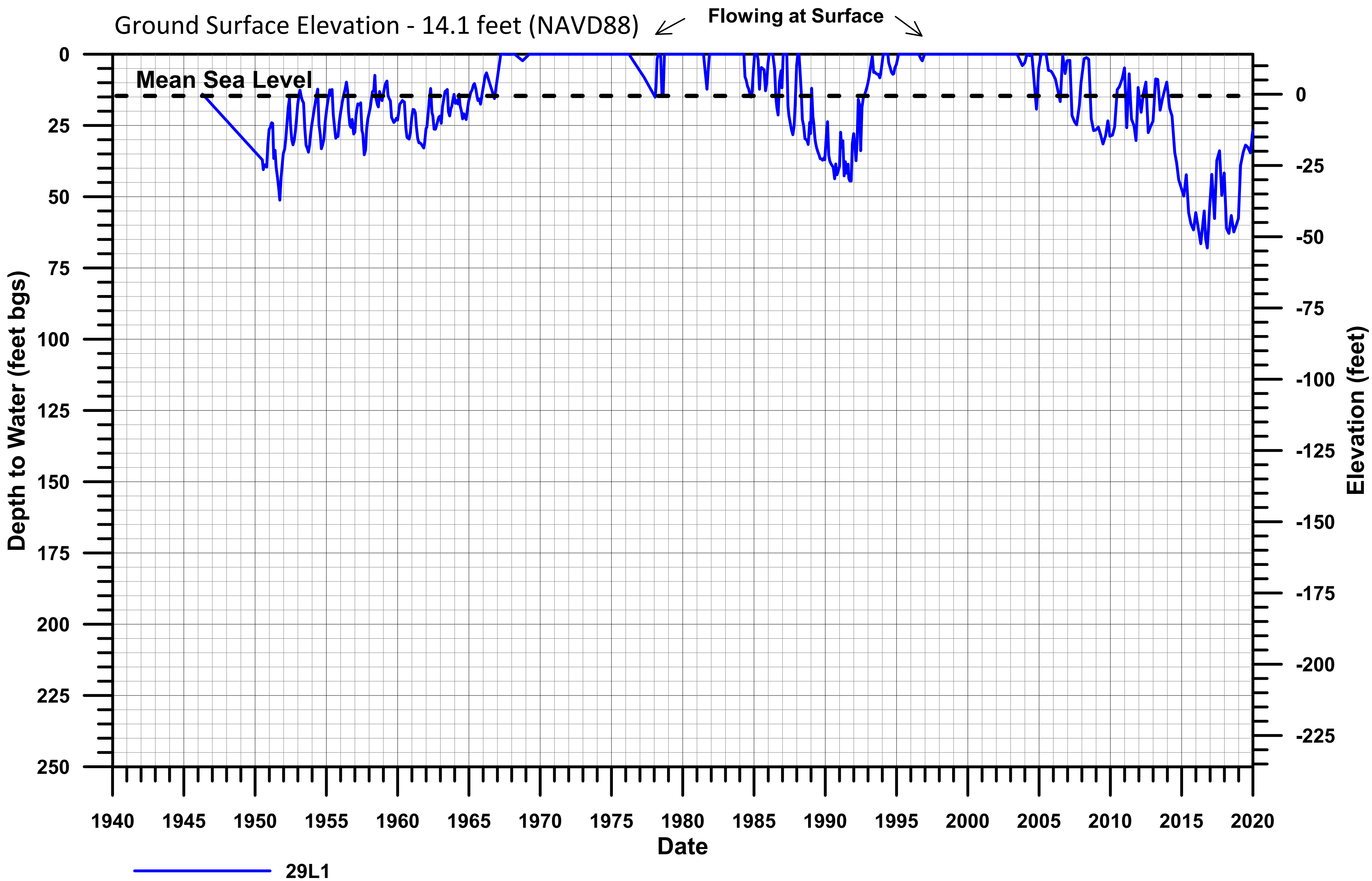

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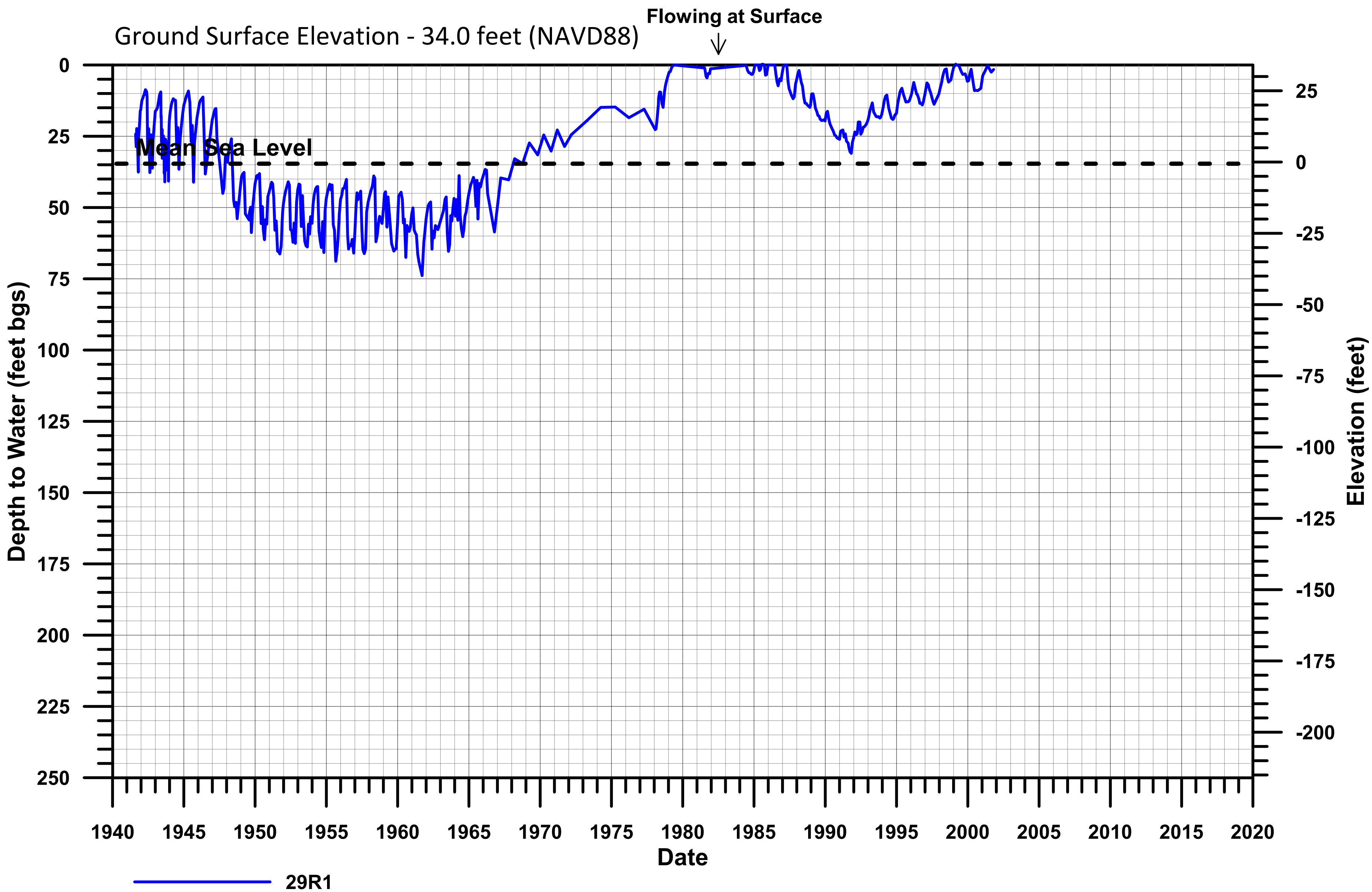

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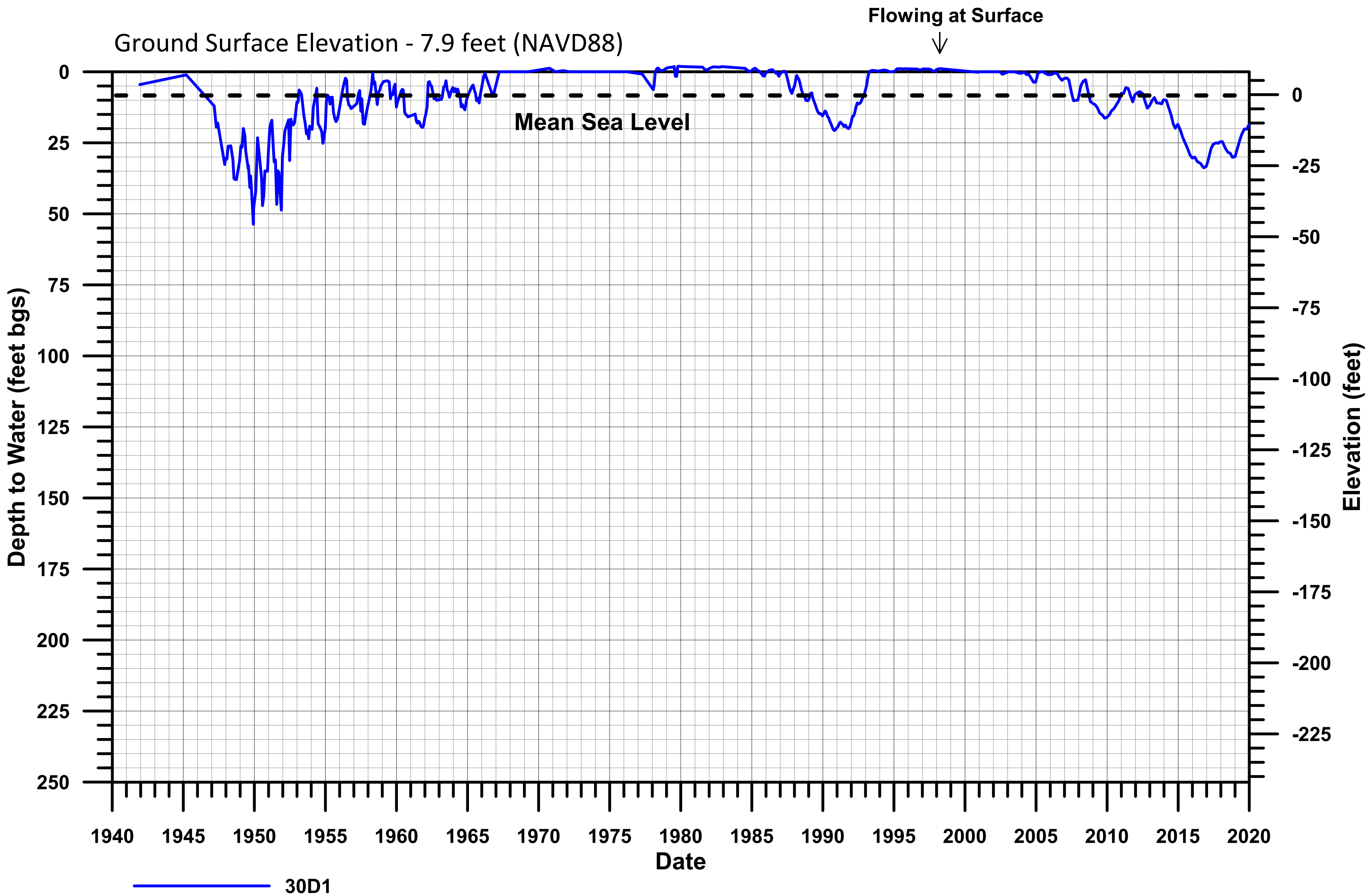

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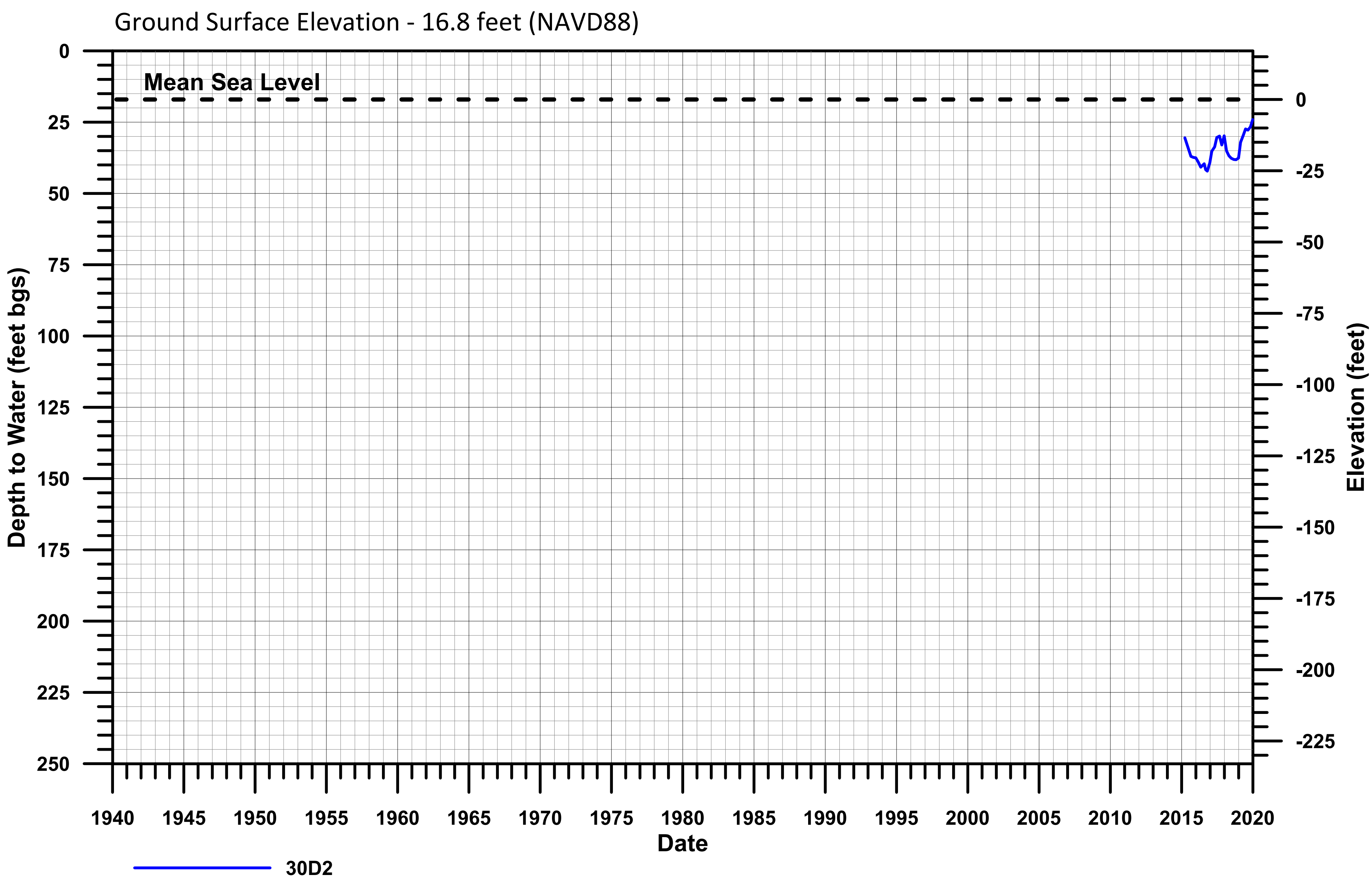

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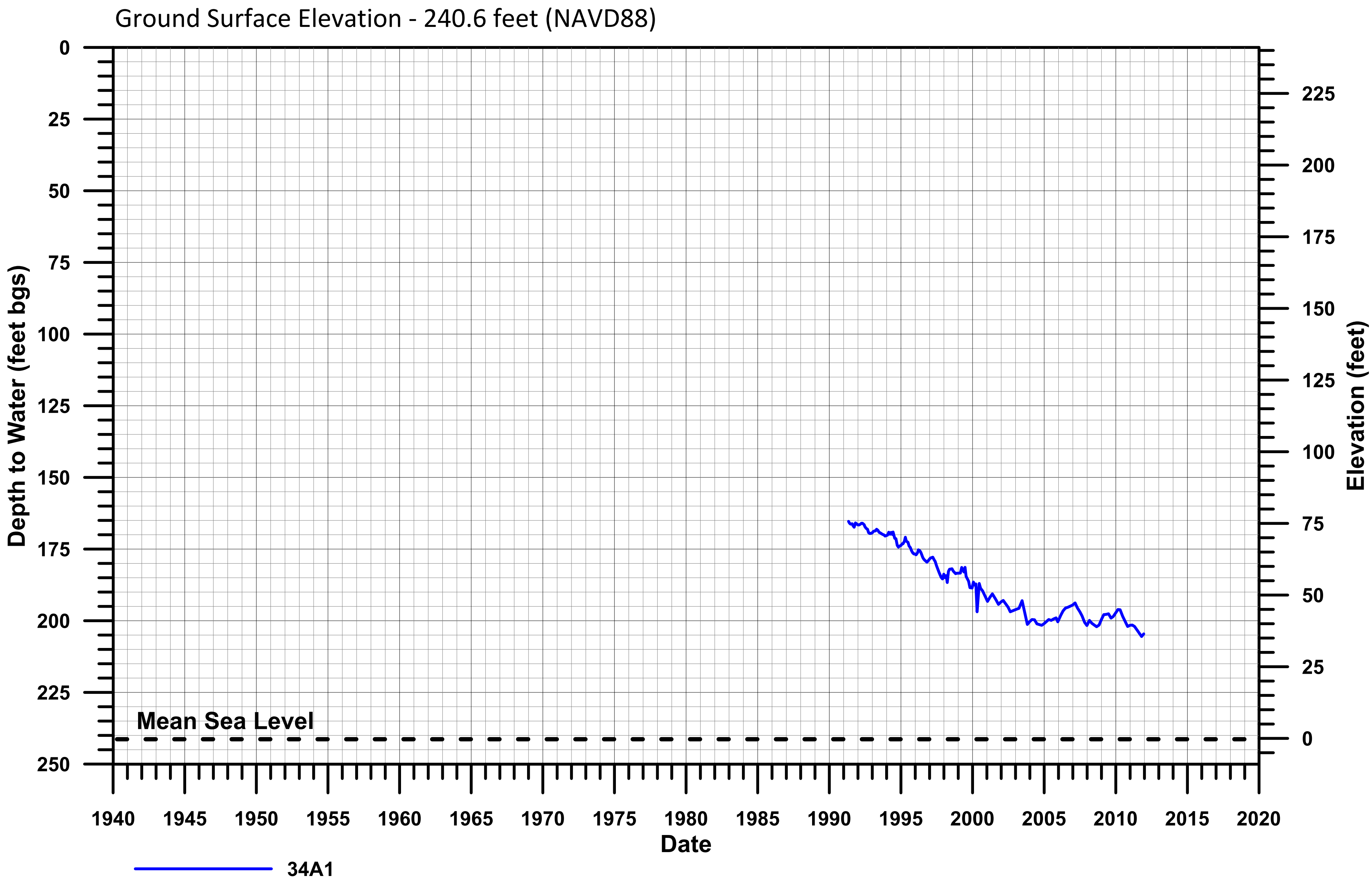

CARPINTERIA GSA
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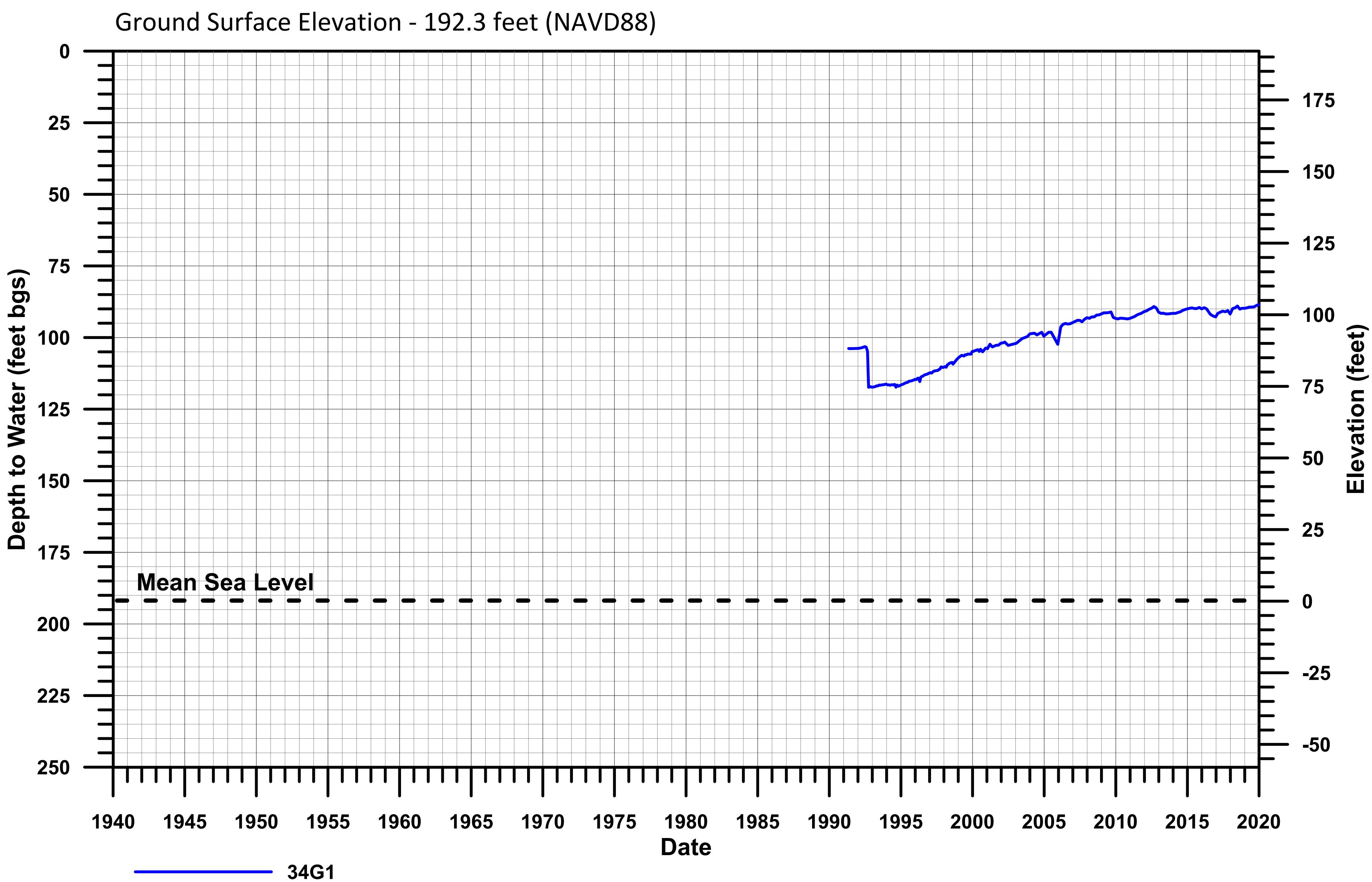

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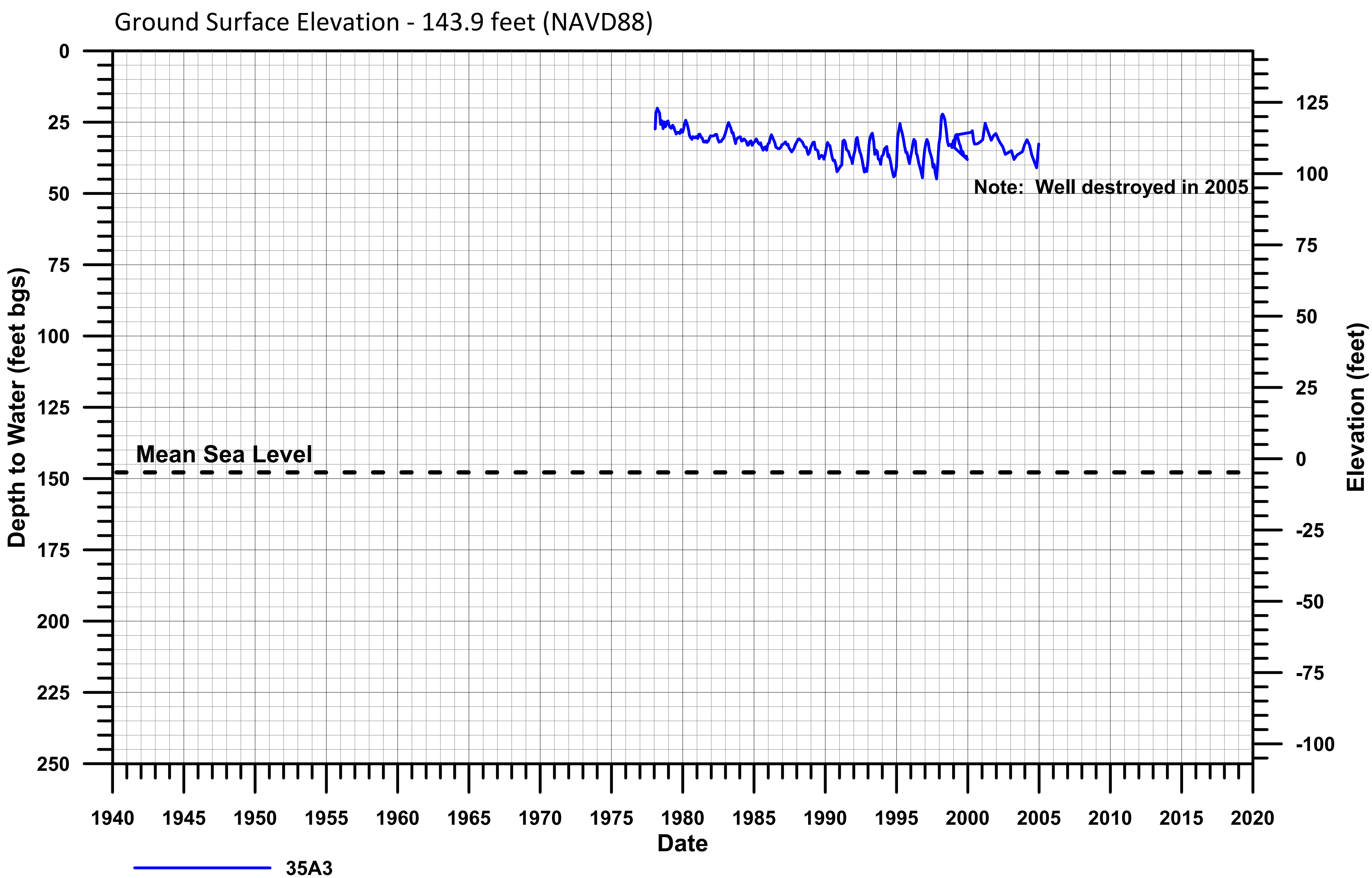

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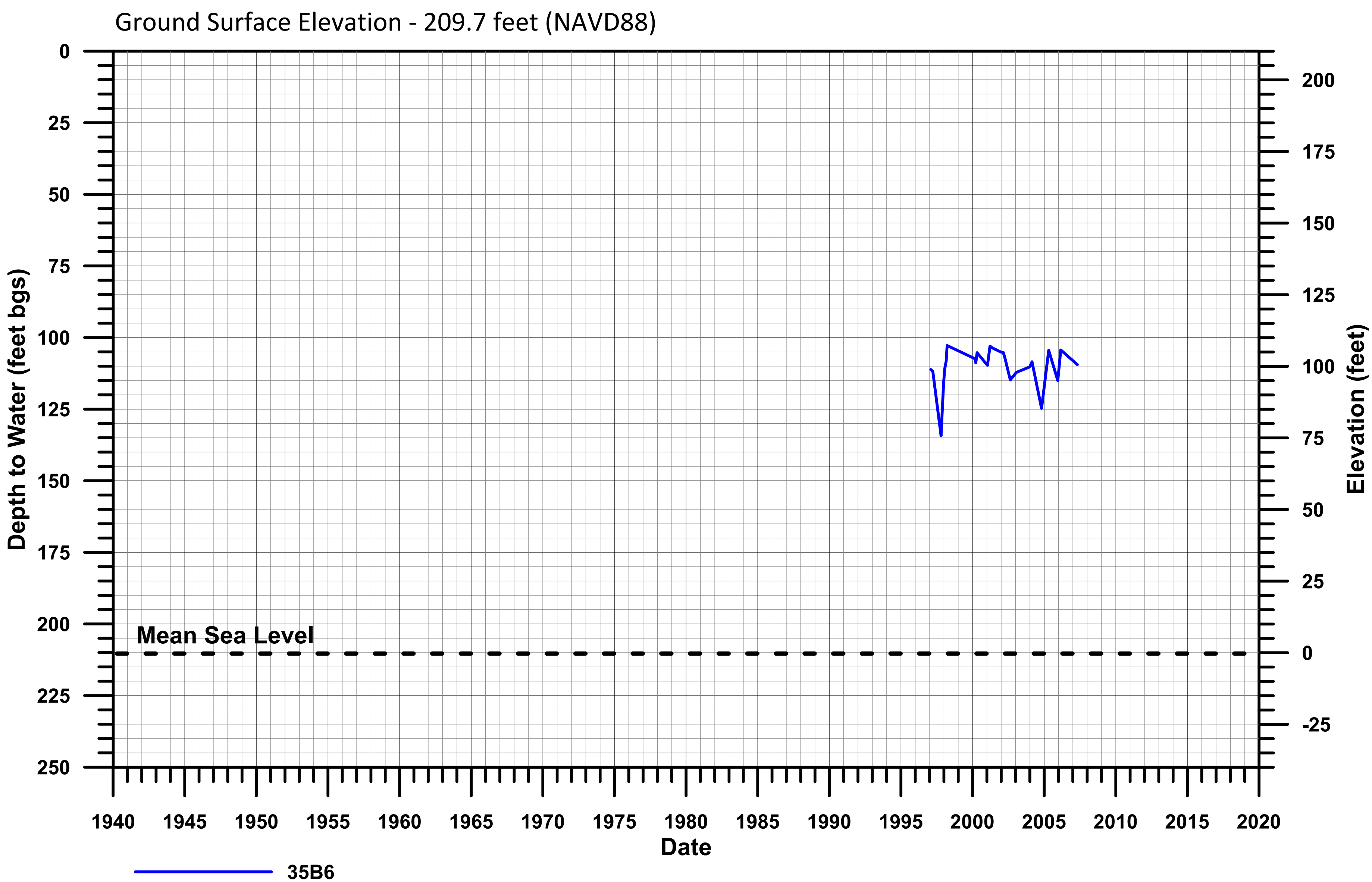

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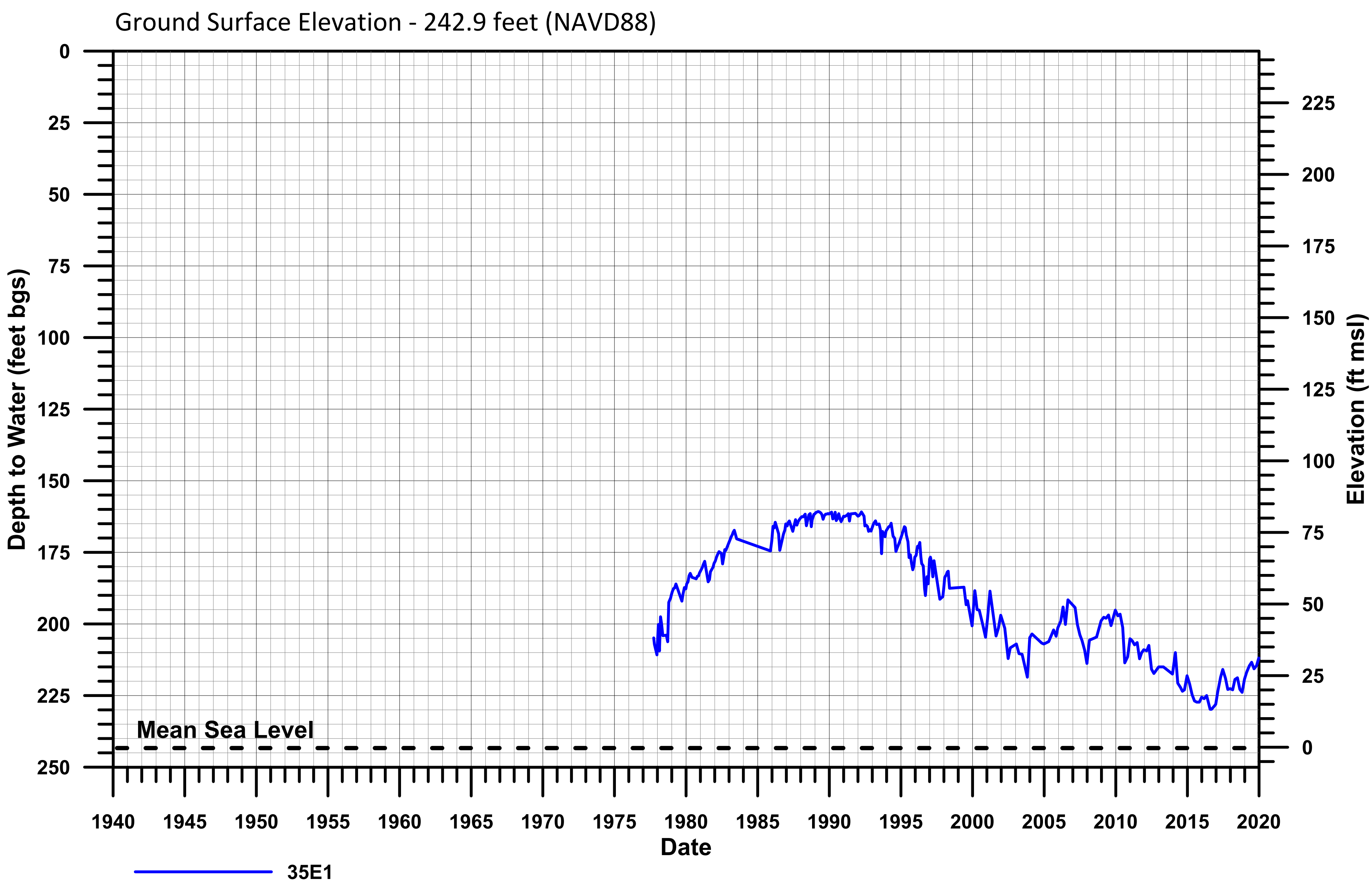

Water Level Data - 4N/25W-35E1 Carpinteria Groundwater Basin Groundwater Sustainability Plan

APPENDIX E

Saltwater Intrusion Geophysical Study

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CARPINTERIA VALLEY WATER DISTRICT (CVWD)

CARPINTERIA SALTWATER INTRUSION

ELECTRICAL RESISTIVITY TOMOGRAPHY (ERT) INVESTIGATION TO MAP SALTWATER INTRUSION IN THE CARPINTERIA GROUNDWATER BASIN, CALIFORNIA

PROJECT NO.: 2252001 DATE: October 7, 2021

EXECUTIVE SUMMARY

In April 2021, electrical resistivity tomography (ERT) surveys were completed in the Carpinteria Groundwater Basin for the purpose of mapping saltwater intrusion into Aquifer Units A, B, and C. A geoelectric technique such as ERT is preferred for imaging resistivities and changes in resistivity of the subsurface. Saltwater intrusion into Aquifer Unit C has been evident from induction logging and water sampling events since the drilling of sentinel wells in 2019 (located in the northwest portion of the Carpinteria Salt Marsh Reserve [i.e., saltmarsh], 500 feet from the beach). The ERT program consisted of a total of four profiles. Two shorter electrode spacing profiles with higher resolution data were collected: one oriented southwest-northeast through the saltmarsh, and another in the northwest portion of the saltmarsh. Two larger electrode spacing profiles, located on the northern boundary of the saltmarsh and along the beach (south of the saltmarsh), provided deeper ERT data. The two deeper ERT profiles were collected to image Aquifer Units B and C and detect saltwater intrusion.

The known saltwater intrusion into Aquifer Unit C was not imaged in the ERT data. This has been attributed to an insufficient contrast in the electrical conductivities between Aquifer Unit C and the overlying confining layer. Even with saltwater intrusion into Aquifer Unit C, the overall bulk electrical conductivities of Aquifer Unit C resemble the surrounding hydrostratigraphy (as evidenced from the induction logs). Other contributing factors for not imaging Aquifer Unit C's saltwater intrusion could be that the unit is too deep, too thin, and/or at the limits of the ERT's spatial resolution. Multiple zones of interpreted saltwater intrusion have been identified in Aquifer Unit A based on the electrical conductivity contrast between the ERT profiles along the beach and northern boundary of the saltmarsh. The ERT profile along the beach exhibited high electrical conductivities indicative of saltwater, including within the general depth range of Aquifer Unit A. However, there is no indication of saltwater intrusion into Aquifer Unit A or B under the northern boundary of the saltmarsh in the ERT data. It is also interpreted that Aquifer Unit A may be thicker in places, as based on the ERT data, than what has been logged in boreholes.

Recommendations for more sentinel wells to "ground-truth" ERT zones of interest along with future ERT surveys to detect changes in these zones would help to further refine the geophysical interpretation. Forward modelling in order to predict at what electrical conductivity Aquifer Unit C must reach to be resolvable by the ERT could help to determine the timing of future ERT surveys. Lastly, the extension of the beach ERT profile to the northwest, in addition to a parallel profile northwest-southeast through the saltmarsh, would benefit the overall understanding.

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LIMITATIONS

BGC Engineering Inc. (BGC) prepared this document for the account of the Carpinteria Valley Water District. The material in it reflects the judgment of BGC staff in light of the information available to BGC at the time of document preparation. Any use which a third party makes of this document or any reliance on decisions to be based on it is the responsibility of such third parties. BGC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this document.

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1.0 INTRODUCTION

BGC Engineering Inc. (BGC) was retained by the Carpinteria Valley Water District (CVWD), working in partnership with Pueblo Water Resources Inc. (Pueblo), to conduct an electrical resistivity tomography (ERT) investigation in the Carpinteria Groundwater Basin, California. The ERT surveys were part of a saltwater intrusion monitoring program to identify zones of elevated electrical conductivity which may indicate the presence of saltwater intrusion. The ERT profiles were located along the beach and within the Carpinteria Salt Marsh Reserve (i.e., the “saltmarsh”; Figure 1-1). The ERT surveys will also provide a baseline of the subsurface electrical conductivity distribution for future surveys at Carpinteria in order to monitor zones of interest (e.g., potentially vulnerable aquifer units).

Figure 1-1. Location of the Carpinteria Salt Marsh Reserve (outlined in yellow).

1.1. Scope of Services

As outlined in the BGC proposal “Proposed Geophysical Surveys for Saltwater Intrusion Mapping Near Carpinteria, California” dated January 19, 2021, the primary objective of the ERT surveys was to provide spatially continuous cross-sections of electrical conductivity (i.e., formation conductivity) to map possible saltwater intrusion. The proposed scope was to collect approximately 2.92 miles of ERT data along three main transects, process and interpret the ERT data to identify zones of possible saltwater intrusion, and to provide the results and interpretation in a report (including interpreted figures) and a 3-D Leapfrog model. The proposed ERT surveys were located along:

- The beach (the “Beach Line”; 1.42 miles long) with a minimum electrode spacing of 73.8 feet

- The northern boundary of the saltmarsh (the “Estuary North line”; 1.16 miles long) with a minimum electrode spacing 73.8 feet
- Through the saltmarsh along an access road (the “Estuary Centre Line”; 0.34 miles long) using a 16.4-foot minimum electrode spacing.

Other objectives were to use the geophysical data to re-interpret the subsurface distribution of hydrostratigraphic units, in addition to baseline geoelectric conditions for future saltwater intrusion ERT surveys (i.e., time-lapse surveys).

The geophysical surveys and subsequent reporting were carried out under the contract 120920 executed December 9, 2020.

1.2. Background

Aquifer units in the Carpinteria Groundwater Basin (CGB) consist primarily of unconsolidated marine sediments of the Casitas Formation and also the interpreted Carpinteria Formation (Pueblo Water Resources Inc., 2012). The Casitas Formation is upper and middle Pleistocene in age, consisting of moderately to well-consolidated siltstone and silt, sandstone and sand, in addition to conglomerates and gravels (Minor et al., 2009). The Carpinteria Formation is not noted by Minor et al. (2009) but appears to consist of similar lithologies as the Casitas Formation based on existing reports (Pueblo Water Resources Inc., 2012 and 2020). The four primary aquifer units (A, B, C, and D) within the CGB are predominantly coarse-grained sand and gravel units which are confined by fine-grained aquitards comprised of interbedded unconsolidated and semi-consolidated sand, gravel, silt, and clay (Pueblo Water Resources Inc., 2012), and therefore can contain minor aquifer units themselves. The Carpinteria Salt Marsh Reserve consists of younger (Holocene) estuarine unconsolidated clays, silts, and subordinate sands which likely have a maximum thickness of 20 m or approximately 66 feet (Minor et al., 2009).

Three sentinel wells were drilled by Pueblo to monitor groundwater salinity in the northwest portion of the geophysics survey area (Figure 1-1). A summary of the sentinel well completions, modified after Pueblo Water Resources Inc. (2020), is shown in Table 1-1 below.

Table 1-1. Summary of sentinel well completions.

Sentinel Well	Total Depth (feet)	Screened Interval (feet)	Screened Aquifer Unit	Aquifer Unit Thickness (feet)
MW-1	1240	1020 - 1120	C	100
MW-2	880	780 - 860	B	80
MW-3	350	190 - 330	A	240

The general stratigraphy from sentinel well MW-1 (i.e., the deepest well) exhibits 150 feet of alluvial and fan deposits overlying 185 feet of the Carpinteria Formation (i.e., 150 feet to 335 feet), all underlain by the Casitas Formation which extends to the total depth of 1240 feet in MW-1 (Pueblo Water Resources Inc., 2020).

Borehole induction logs collected by Pacific Surveys LLC indicate an increase in formation conductivity of nearly 50 mS/m within Aquifer Unit C (1020 – 1120 feet) since August 2019. Additionally, water quality samples from seven sampling events between August 2019 and February 2021 indicate increasing salinity with time, with water electrical conductivities increasing from 101 mS/m to 315 mS/m (1010 µS/cm to 3150 µS/cm) and chloride concentrations increasing from 44 mg/L to 730 mg/L. The induction logs do not indicate an increase in salinity in Aquifer Units A and B, nor do water quality samples. The deep induction logs indicate a heterogenous mix of fine-grained and coarse-grained materials within both the confining layers and primary aquifer units.

2.0 GEOPHYSICAL METHODOLOGIES

2.1. Electrical Resistivity Tomography (ERT)

Electrical resistivity tomography (ERT) is a geoelectric technique for mapping the distribution of subsurface electrical resistivity (or its inverse, conductivity) in a cross-sectional format. Electrical resistivity is a measure of how resistive a unit volume of material is to the flow of electrical current. In typical electrical resistivity surveys, a low frequency alternating current is injected into the ground through a pair of electrodes, and a potential (i.e., voltage) difference is measured between a separate pair of receiver electrodes (Zonge et al., 2005). By using an array of electrodes, and by measuring voltages from various combinations of electrode pairs, multiple subsurface current paths can be sampled. An inversion technique is then used to reconstruct an electrical resistivity tomogram (or cross-section) of the subsurface that best fits all the measurements made from all the different electrode combinations during the survey. Whether or not differences between subsurface materials can be imaged depends on lateral and vertical variations in resistivity, but also on the minimum spacing of the electrodes. By decreasing the inter-electrode spacing, a higher data resolution can be achieved (Reynolds, 2011).

In general, the resistivity of an earth material is a function of porosity, permeability, temperature, fluid chemistry, fluid saturation, and mineralogy of the host material (i.e., rock or sediments) (Zonge et al., 2005). This results in much overlap between resistivity ranges for earth materials; however, for rocks, generally the resistivity increases as the saturated porosity decreases (Keary et al., 2002). In general, fine-grained material (clays and silts) will have lower resistivities than coarser grained material (sands and gravels) if the materials have porewater with similar total dissolved solids (TDS) content.

Resistivity inversion is the process of converting measured apparent resistivities to true earth resistivities. A software package called RES2DINV is utilized to perform two-dimensional (2-D) inversions of the ERT data (Loke and Barker, 1996). Initially, the apparent resistivity data are sorted and displayed in a pseudo-section. The 2-D model mesh generated by the inversion software package consists of rectangular blocks. The arrangement of the model blocks is loosely tied to the distribution of the data points in the pseudo-section, and the distribution and size of these blocks is automatically generated by the program so that the number of blocks does not exceed the number of data points. The depth of the bottom row of blocks is set to be approximately equal to the equivalent depth of investigation (Edwards, 1977) of the data points with the largest electrode spacing. A forward modelling subroutine is then used to calculate the apparent resistivity values, and a non-linear least-squares optimization technique is utilized for the inversion routine (de Groot-Hedlin and Constable, 1990; Loke and Barker, 1996) to model the resistivity distribution in the subsurface.

2.2. Survey Global Positioning System (GPS) Locations

The Trimble GeoExplorer 7x handheld GPS unit uses the Global Navigation Satellite System (GNSS) to obtain positional information and to provide navigation to uploaded coordinates. Under ideal satellite coverage, the horizontal accuracy of the GPS unit may approach 10 cm (3.9 inches) for real-time measurements and possibly approach 1 cm (0.4 inches) accuracy for post-processed data. In practice, horizontal field measurements typically have a < 1 m (< 3.28 feet) accuracy, while vertical measurements are typically less accurate than the horizontal components. Decreased accuracy of GPS positions can result from reduced satellite coverage and/or aerial obstructions (e.g., tree canopy, infrastructure, etc.).

Elevations for this geophysical investigation were sampled from a United States Geological Survey (USGS) 3D Elevation Program (3DEP) LiDAR (light detection and ranging) bare-earth digital elevation model, using the easting and northing GPS locations. GPS data were post-processed using the SOPAC (Scripps Orbit and Permanent Array Center) Noon Peak base station, with over 90% of positional accuracies estimated to be within 5 cm to 15 cm (approximately 2 - 6 inches).

3.0 GEOPHYSICS FIELD SURVEYS AND DATA PROCESSING

3.1. ERT Field Surveys

The ERT surveys were conducted between April 20 and 23, 2021 following a field reconnaissance on April 19, 2021. Four ERT profiles were collected as shown in Figure 1. ERT-01, ERT-02, and ERT-04 were collected within the Carpinteria Salt Marsh Reserve (i.e., the saltmarsh). ERT-03 was collected along the beach. Each ERT profile was collected using both gradient and dipole-dipole electrode arrays to improve the final resistivity model detail and also maximize the depth of investigation (DOI) after combining the arrays (Goebel et al., 2017). Two different minimum electrode spacings were used: 5 m (16.4 feet) and 22.5 m (73.8 feet).

Table 3-1 summarizes the ERT profile details.

Table 3-1. ERT field survey details for the April 2021 program.

ERT Profile	Date (dd/mm/yyyy)	Location	Direction	Minimum Electrode Spacing (feet)	Profile Length (feet)	Gradient DOI (feet)	Dipole-Dipole DOI (feet)
ERT-01	20/04/2021	saltmarsh	SW-NE	16.4	2,031	266	330
ERT-02	21/04/2021	saltmarsh	NW-SE	73.8	6,213	1,204	1,465
ERT-03	22/04/2021	beach	NW-SE	73.8	7,274	1,204	1,465
ERT-04	23/04/2021	saltmarsh	W-E	16.4	1,289	266	330

3.2. ERT Data Processing

Raw ERT data were filtered prior to inversion by removing measurements with variation coefficients exceeding 10% and negative resistivity values. Separate ERT inversions were completed for the gradient and dipole-dipole arrays. After the inversions, a measured versus calculated apparent resistivity residual error exceeding 30% was used as a threshold for further removal of outlier data points in order to improve the root mean square error (RMS error) of the recovered resistivity model. The RMS error ranged from 3.1 – 6.8% for the gradient inversions and 5.1 – 8.7% for the dipole-dipole inversions. Either the fourth or fifth iteration was chosen as the representative resistivity model. A third inversion of the combined edited gradient and dipole-dipole data was run after the successive filtering of the individual files as outlined above. The fifth iteration was selected as the resistivity model for combined inversions after minimal RMS change between iterations (i.e., approximately 0.5 %). The RMS error for the combined inversions ranged between 6.2 – 7.4% for the four combined inversions (ERT-01 to 04). A summary of the data reduction and inversions for the combined arrays is shown in Table 3-2.

Table 3-2. Summary table of data reduction/filtering and model RMS error.

ERT Profile	Number of Raw Gradient Data	Number of Raw Dipole-Dipole Data	Number of Combined Array Data Used in Inversion	Total Number of Data Removed	RMS (%) and Selected Iteration
ERT-01	2,199	2,437	4,427	172	6.2; 5
ERT-02	1,264	1,576	2,460	210	6.9; 5
ERT-03	1,432	1,791	2,940	177	6.5; 5
ERT-04	1,008	1,309	2,071	168	7.4; 5

A depth of investigation (DOI) analysis was conducted on the combined array inversions (i.e., gradient + dipole-dipole) as outlined in Oldenburg and Li (1999) to identify zones within the recovered ERT model sections which may be less constrained by measured data, and therefore potentially less reliable. More details of the DOI analysis and ERT figures with DOI contours are available in Appendix A.

4.0 RESULTS AND INTERPRETATION

The ERT results are shown in Figures 2 to 5 as electrical conductivity (mS/m), where cool colors (i.e., blues) represent lower electrical conductivities and warmer colors (i.e., oranges and pinks) represent higher electrical conductivities. The color grids are scaled from 20 mS/m to 250 mS/m and are displayed on a logarithmic scale. Electrical conductivity contours (solid black lines) for 50, 100, 200, 400, 800, and 1000 mS/m have been overlain on the sections. Additionally, annotations for zones of interest (e.g., Zone 1) are provided to highlight interpretations such as saltwater intrusion or delineated aquifers. Generalized MW-1 sentinel well hydrostratigaphic units along with the February 2021 deep induction and gamma logs are superimposed on ERT-02, ERT-03, and ERT-04. Due to limitations on how far northwest ERT-02 and ERT-03 could be extended, there is very limited spatial overlap of MW-1 with the ERT.

Figures 2 and 5 are displayed at a 1:7500 scale. Figures 3 and 4 are displayed at a 1:22,250 scale.

4.1. Results

Table 4-1 shows the modelled electrical conductivity summary statistics for the four ERT profiles to illustrate the contrasting subsurface geoelectric distribution between the ERT profiles. ERT-01 (saltmarsh) and ERT-02 (northern boundary of saltmarsh) show both the largest range and standard deviation, while ERT-03 (beach) data show the highest mean, smallest range, and lowest standard deviation.

Table 4-1. Summary statistics for the four ERT profiles including minimum, maximum, mean, and standard deviation of the recovered model electrical conductivities.

ERT Profile	Minimum (mS/m)	Maximum (mS/m)	Mean (mS/m)	Standard Deviation (mS/m)
ERT-01	28	6270	435	575
ERT-02	2	5740	118	251
ERT-03	24	1200	154	142
ERT-04	4	1560	134	196

ERT profile results are summarized below:

1. ERT-01 (Figure 2) shows a 50 to 90-foot-thick surficial zone of electrical conductivities exceeding 1000 mS/m. This high conductivity zone overlies an approximately 220-foot-thick layer with electrical conductivities ranging between approximately 30 mS/m and 60 mS/m. Zone 1, labelled on Figure 2, reaches electrical conductivities of 80 mS/m.
2. ERT-02 (Figure 3) shows a high electrical conductivity layer similar in thickness to ERT-01, ranging from 80 – 100 feet thick across the section. Beneath the high conductivity layer, a lower electrical conductivity zone labelled Zone 2-A, approximately 115 feet thick and with values ranging from 25 – 30 mS/m, is imaged between line distances 500 feet and 1600 feet. This lower electrical conductivity zone thickens to the southeast (labelled

Zone 2-B) to a maximum thickness of approximately 400 feet. The electrical conductivity values in Zone 2-B are generally less than 30 mS/m (or greater than 33 ohm-m) and reach as low as 15 mS/m in multiple locations (i.e., 60 ohm-m) between line distances 2270 feet and 4400 feet. This relatively thick, low electrical conductivity zone continues to the southeast with generally increasing electrical conductivity values. Zone 3 also shows relatively low electrical conductivity values in the 25 mS/m to 30 mS/m range over a thickness of approximately 400 feet. It should be noted that Zone 3 overlaps with DOI indices that exceed 0.2, and the model is therefore less constrained by data (see Appendix A). An elevated electrical conductivity zone located at the bottom of ERT-02 (Zone 4) is at the limits of the ERT profile's spatial resolution. It is due to a very small number of data points and likely artificially enlarged during the inversion process. For these reasons, it is not considered to be significant.

3. ERT-03 (Figure 4) has imaged a relatively laterally continuous, lower conductivity zone labelled Zone 5 in the 30 mS/m to 50 mS/m range, which is cut by zones of higher electrical conductivity. Zone 5 ranges in thickness from 73 – 130 feet and is overlain by a high conductivity layer approximately 100 feet thick. Zones 6-A and 6-B reach electrical conductivities of approximately 320 mS/m and 520 mS/m, respectively. Additionally, Zones 6-A and 6-B occupy a smaller portion of an approximately 600-foot-thick layer exceeding 100 mS/m which extends across the entire section.
4. ERT-04 (Figure 5) has imaged similar resistivities as ERT-02. Zone 7 reaches electrical conductivities of approximately 120 mS/m. However, it appears that this zone is artificially thickened due to its location along the bottom edge of the section with sparser data constraints (supported by the DOI index increasing to 0.2; see Appendix A). Zone 8 is spatially adjacent to Zone 2-A on ERT-02 (Figure 3) and records similar resistivity values. The high electrical conductivity zone extending from surface to approximately 60 feet below ground surface (ft bgs) between line distances 0 feet and 200 feet is potentially the result of utilities and electrical interference from the nearby residences.

4.2. Geophysical Interpretation

A geophysical interpretation is provided below. Zones of interest (e.g., layers, anomalies, etc.) have been labelled on Figures 2 to 5 and described in detail.

The lower electrical conductivity layer labelled as Zones 2-A and 2-B on ERT-02 (Figure 3) is interpreted to be associated with Aquifer Unit A beneath the northern boundary of the saltmarsh. The electrical conductivities of this layer are consistent with coarse-grained materials (i.e., sand and/or gravel) and are inconsistent with saltwater impact. Zone 2-A is similar in thickness to Aquifer Unit A but is approximately 70 feet shallower than the Aquifer Unit A interval logged in the sentinel wells. Zone 2-B (approximately 420 feet thick) is inferred to be either a thickening of Aquifer Unit A southeast of Zone 2-A or a thick channel deposit. The electrical conductivity of Zone 3 imaged on ERT-02 (Figure 3) is also consistent with a coarse-grained deposit. However, the overlapping DOI indices exceed 0.2 for a portion of Zone 3 (Appendix A), indicating that this region of the model is less constrained and that the geometry (likely thickness) of the feature may be different from what is shown.

Zone 1, imaged on ERT-01 (Figure 2), could be the result of saltwater intrusion into Aquifer Unit A. It is interpreted that the relatively low electrical conductivity layer (i.e., greens and blues; less than 50 mS/m) that occurs below about 60 to 90 feet bgs is a higher resolution image of the upper 200 feet of Aquifer Unit A (as interpreted on ERT-02). The approximate elevation of the top of Aquifer Unit A, interpreted from ERT-02, is plotted on ERT-01 as a dashed blue line. One possible explanation as to why the magnitude of the ERT-01 Aquifer Unit A conductivity values are different (approximately 50% higher than those interpreted on ERT-02) could be that ERT-01 was collected with a tighter, higher-resolution electrode spacing of 16.4 feet as opposed to 73.8 feet. Additionally, while Zone 1's conductivities on ERT-01 are not exceptionally high in magnitude, its location on the southwest (seaward) end of the ERT section suggests possible saltwater intrusion.

Zone 5, denoted on ERT-03 (Figure 4), is interpreted to be Aquifer Unit A imaged beneath the beach. Zone 5 is similar in thickness to Zone 2-A, but thinner than Zone 2-B (both denoted on ERT-02). This could indicate that either Aquifer Unit A is a relatively uniform thickness beneath the beach, as denoted by Zone 5, or that zones 6-A and 6-B represent saltwater intrusion into the interpreted thickest portion of Aquifer Unit A. However, the thick layer of higher electrical conductivities around Zones 6-A and 6-B coincides with an approximately 450 feet thick confining layer encountered between Aquifer Units A and B encountered in the sentinel wells. This indicates that the higher electrical conductivity layer underlying Zone 5 may instead be interpreted as saltwater-saturated clays and potentially relatively thin coarse-grained deposits (e.g., sand lenses or stringers) or interbeds. The sentinel well deep induction log from February 2021 (shown on Figure 4) indicates multiple thin granular (i.e., low electrical conductivity) layers within the confining layer between Aquifer Units A and B. It is also suspected that agricultural wells in the Carpinteria area are producing from some of these thinner water-bearing units within the confining layers within the CGB (Robert Marks, personal communications, May 6, 2021).

The deep induction conductivity log from February 2021 shows an average conductivity of 54 mS/m within the 450 feet thick confining layer between Aquifer Units A and B and does not exceed electrical conductivities of 90 mS/m. This indicates a considerable lateral change in electrical conductivities between the sentinel wells and 500 feet to the south at the ERT-03 location. Additionally, the northwestern portion of Zone 5 (i.e., interpreted Aquifer Unit A), between line distances of 500 feet and 1500 feet on ERT-03, generally shows higher electrical conductivities than Zone 2-A on ERT-02 (Figure 3). This suggests potential saltwater intrusion is happening into Aquifer Unit A between the beach location and the sentinel wells. There are also similar higher electrical conductivity zones within Zone 5 that could indicate saltwater intrusion into Aquifer Unit A (e.g., line distances 3700 feet to 4600 feet).

Zone 7 on ERT-04 is likely artificially thickened due to its location along the edge of the ERT section; however, Zone 7 does show spatial correlation with an increase in the deep induction log (Figure 5). It is likely that Zone 7 is a response to a more clay-rich lithology, and not saltwater intrusion. Zone 8 is likely associated with the Zone 2-A on ERT02 (Figure 3), and therefore may correspond with Aquifer Unit A.

Two 3D renderings of the ERT profiles are shown in Figure 6, displaying the contrasting electrical conductivities between ERT-02 and ERT-03. A Leapfrog Viewer of the ERT data will accompany this report.

5.0 CONCLUSIONS

The ERT investigation in the Carpinteria Groundwater Basin, California has led to the following conclusions:

- Even though saltwater intrusion in Aquifer Unit C has been confirmed through multiple water quality sampling and induction logging events, it has not been detected in the 2021 ERT surveys. The most likely reason for this is the relatively low bulk electrical conductivities (i.e., a combination of the aquifer materials and groundwater) of the saltwater-intruded Aquifer Unit C, and overall lack of electrical contrast with the confining layer above. Other contributing factors are the depth and thickness of Aquifer Unit C which are at the limit of the ERT survey's spatial resolution. In other words, Aquifer Unit C may be too thin and too deep to image with ERT given the current groundwater salinities.
- ERT-01, ERT-02, and ERT-03 are interpreted to have imaged Aquifer Unit A. No saltwater intrusion is interpreted within Aquifer Unit A along the northern boundary of the saltmarsh, based on the relatively low electrical conductivities shown in ERT-02 and ERT-04. It is possible that ERT-01 is imaging saltwater intrusion within Aquifer Unit A in the southwest portion of the section (Zone 1; the seaward side).
- ERT-02 has imaged a relatively thick zone (Zone 2-B; approximately 420 feet thick) of lower electrical conductivity values, which may be associated with Aquifer Unit A and are indicative of freshwater-saturated coarse-grained materials. It is interpreted that ERT-01 images the upper approximately 200 feet of Aquifer Unit A, using ERT-02 as a guide. However, the electrical conductivities of the interpreted Aquifer Unit A, as modelled in ERT-01, are approximately 50% higher in magnitude, potentially due to higher resolution data.
- ERT-03 images a thick (approximately 600 feet) and laterally continuous higher electrical conductivity layer in which several zones exceeding 300 mS/m have been identified (Zones 6-A and 6-B). This 600-foot-thick layer coincides with the confining layer overlying Aquifer Unit B and logged in sentinel well MW-1. A thick, lower electrical conductivity zone such as Zone 2-B that was imaged on ERT-02 does not appear on ERT-03. This indicates that either Aquifer Unit A is of relatively uniform thickness beneath the beach (as denoted by Zone 5 on ERT-03) or that saltwater intrusion has increased the electrical conductivities of the interpreted 420-foot-thick aquifer zone that has been imaged on ERT-02 (Zone 2-B). The former scenario would suggest that the high electrical conductivities at depth on ERT-03 are due to saltwater-saturated fine-grained sediments (potentially connate water), with the possibility of saltwater intrusion into thinner coarse-grained deposits or interbeds, which would be difficult to resolve in the ERT data. Even so, the large contrasts between ERT-03 and ERT-02 are consistent with a lateral change in electrical conductivities due to saltwater.
- Additional sentinel wells (the target zones provided in Section 6.0) with subsequent geophysical borehole logging and repeat ERT surveys would help reduce uncertainty and refine the geophysical interpretation. In addition to the ground-truthing that more boreholes would provide, repeat or time-lapse ERT surveys would be essential to identify zones in the ERT which may be increasing in electrical conductivity and therefore salinity.

6.0 CARPINTERIA ERT LIMITATIONS

It should be noted that the February 2021 deep induction log for sentinel well MW-1 displays electrical conductivities in Aquifer Unit C that are similar in magnitude to the confining layers above. In consideration of the depth and thickness of Aquifer Unit C, combined with the ERT measurements being bulk values, these factors make the unambiguous delineation of Aquifer Unit C difficult. These limitations are not to be confused with the DOI analysis which assesses how much a recovered resistivity model changes based on different starting (i.e., initial) models, and therefore how well portions of a model are constrained by observed (i.e., field) data. For instance, a portion of a model can be well constrained by data (e.g., DOI index < 0.1), but if a sufficient geoelectric contrast for a particular geological and/or hydrogeological feature is not present, that feature cannot be imaged with ERT.

7.0 RECOMMENDATIONS

To address some of the limitations noted above and to improve the further understanding of saltwater intrusion in the Carpinteria Groundwater Basin, the following actions are recommended:

- Drill additional sentinel wells to ground-truth zones of interest delineated by the ERT and to improve the understanding of the hydrostratigraphy. Potential zones of interest could be Zones 1, 2-A, and 6-A or 6-B as outlined above. This would reduce the non-uniqueness of the ERT results.
- Forward modelling to determine the minimum amount of saltwater intrusion that can be detected in Aquifer Unit C based on bulk electrical conductivity scenarios and Aquifer Unit C's thickness and depth. Multiple forward models could be run to determine the minimum electrical conductivity values needed to produce an elevated conductivity anomaly for Aquifer C.
- Repeat ERT surveys (i.e., time-lapse) over the same (or slightly modified) transects to detect increases in electrical conductivity. Potential improvements could be to extend ERT-03 to the northwest and ERT-01 to the southwest, if granted permission by private landowners. It is anticipated that repeat surveys in two years would be sufficient.
- An additional ERT profile trending northwest-southeast approximately equidistant between ERT-02 and ERT-03 would be very beneficial to the overall understanding, considering the stark contrast in electrical conductivities between these two ERT profiles. This recommendation would depend on the feasibility of traversing the saltmarsh on foot with geophysical equipment, and also depend on granted permissions with respect to habitat and wildlife.
- Repeat induction logging of additional sentinel wells.

8.0 CLOSURE

BGC Engineering Inc. (BGC) prepared this document for the account of Carpinteria Valley Water District. The material in it reflects the judgment of BGC staff in light of the information available to BGC at the time of document preparation. Any use which a third party makes of this document or any reliance on decisions to be based on it is the responsibility of such third parties. BGC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this document.

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Yours sincerely,

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per:

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GEOLOGIST
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Oct 7, 2021

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EE/PB/gc/sjk

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FIGURES

100 0 100 200 300 400 500 600

(US SURVEY FEET)

1 2 3 4 5 6 7 8 9

DIGITAL ELEVATION MODEL (FEET)

LEGEND:

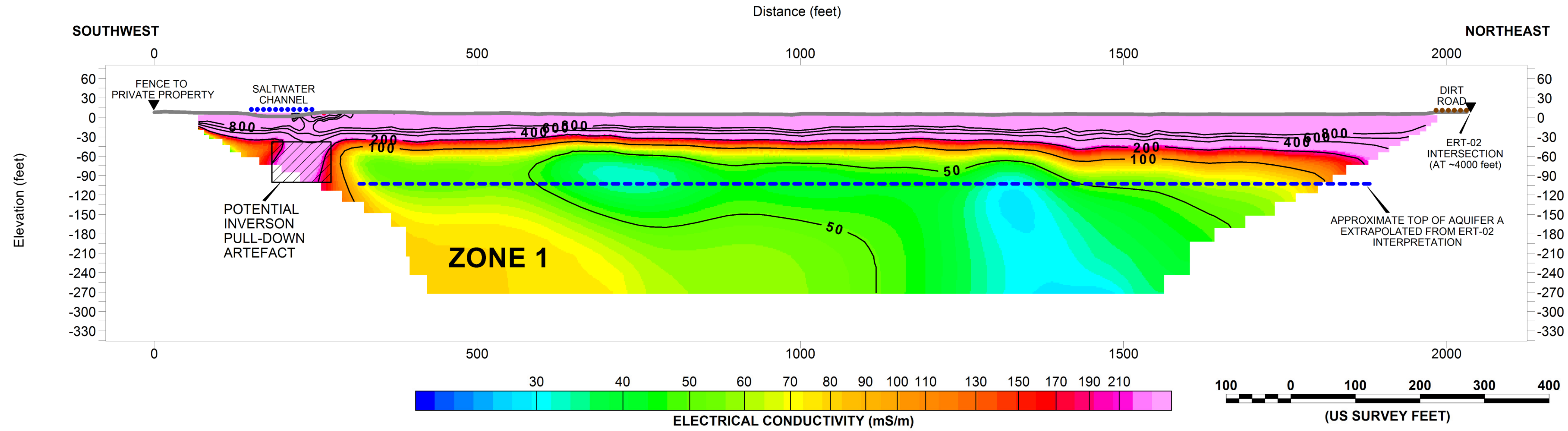
0 500 — ERT PROFILE LOCATION AND CHAINAGE (IN FEET)

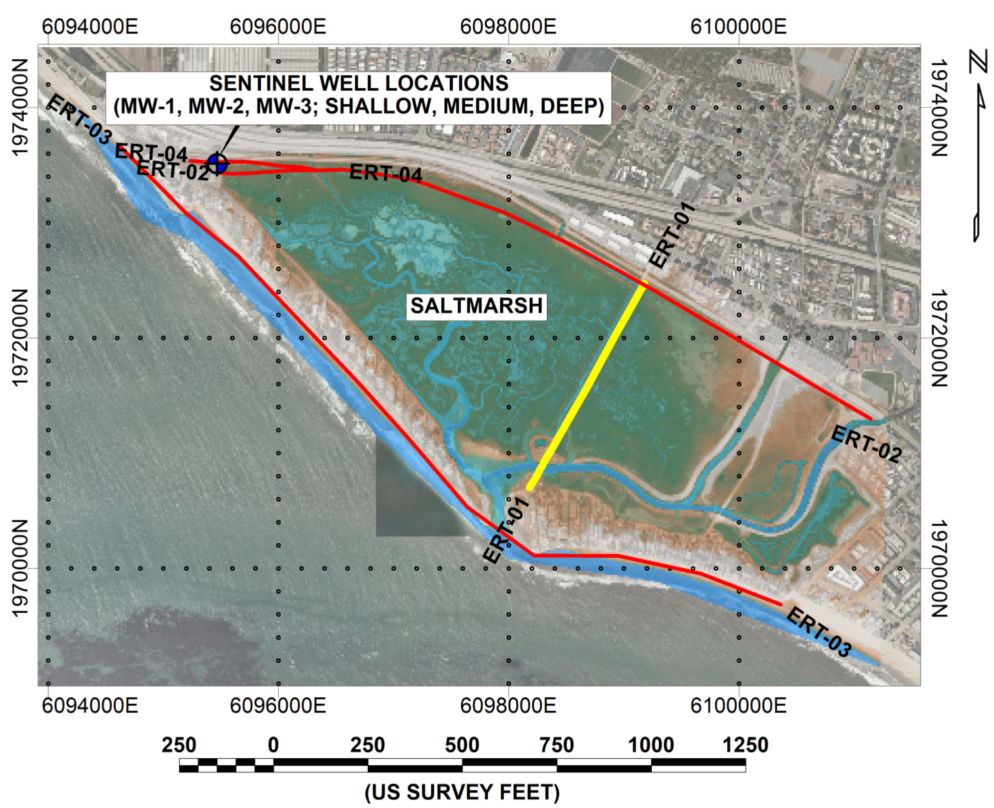
SENTINEL WELLS: MW-1 (SHALLOW), MW-2 (MEDIUM), AND MW-3 (DEEP)

File Path: BGC Engineering Inc\Geophysics - Files\2.0 Current BGC Projects\2252001 - Carpinteria\3.0 Data Processing\4.0 Oasis\Maps\2252001-Pueblo-Carpinteria BaseMap-A.map

Notes:
1. This Figure should be read in conjunction with BGC's report titled "Electrical resistivity tomography (ERT) investigation to map saltwater intrusion in Carpinteria, California", and dated October, 2021.
2. The ERT surveys were collected as part of a saltwater intrusion study at Carpinteria, California between April 20 and 23, 2021.
3. ERT Field Parameters - Minimum Electrode Spacings: 22.5 m (73.8 feet) and 5 m (16.4 feet); Electrode Arrays: Gradient-Plus and Dipole-Dipole.
4. Coordinate system is NAD83 California State Plane Zone V (SPCS83; US Survey Feet). Vertical datum is CGVD2013.
5. Inset map imagery source: Bing Imagery (May 2018).
6. The Carpinteria Salt Marsh Reserve (i.e., saltmarsh) is comprised of an approximately 20 m (65.6 feet) thick estuarine deposit of locally organic-rich fine-grained materials and subordinate sand deposits (Minor et al., 2009).

PREPARED BY: LGW	FIGURE TITLE: CARPINTERIA ERT SURVEY BASEMAP		
CHECKED BY: AFM	CLIENT: CARPINTERIA VALLEY WATER DISTRICT (CVWD)		
APPROVED BY: LGW	SCALE: AS SHOWN	PROJECT NO: 2252001	FIGURE NO: 1





Zone	Maximum Thickness (feet)	Interpretation
1	≥ 138	Possible saltwater intrusion into Aquifer A.

LEGEND:
CROSS-SECTION
ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
NOTABLE WATER CROSSING (> 15 m)
NOTABLE OBSERVED SURFACE FEATURE
INSET
DISPLAYED 2021 ERT PROFILE LOCATION
OTHER 2021 ERT PROFILE LOCATIONS
SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

Notes:
1. This Figure should be read in conjunction with BGC's report titled "Electrical resistivity tomography (ERT) investigation to map saltwater intrusion in Carpinteria, California", and dated October, 2021.
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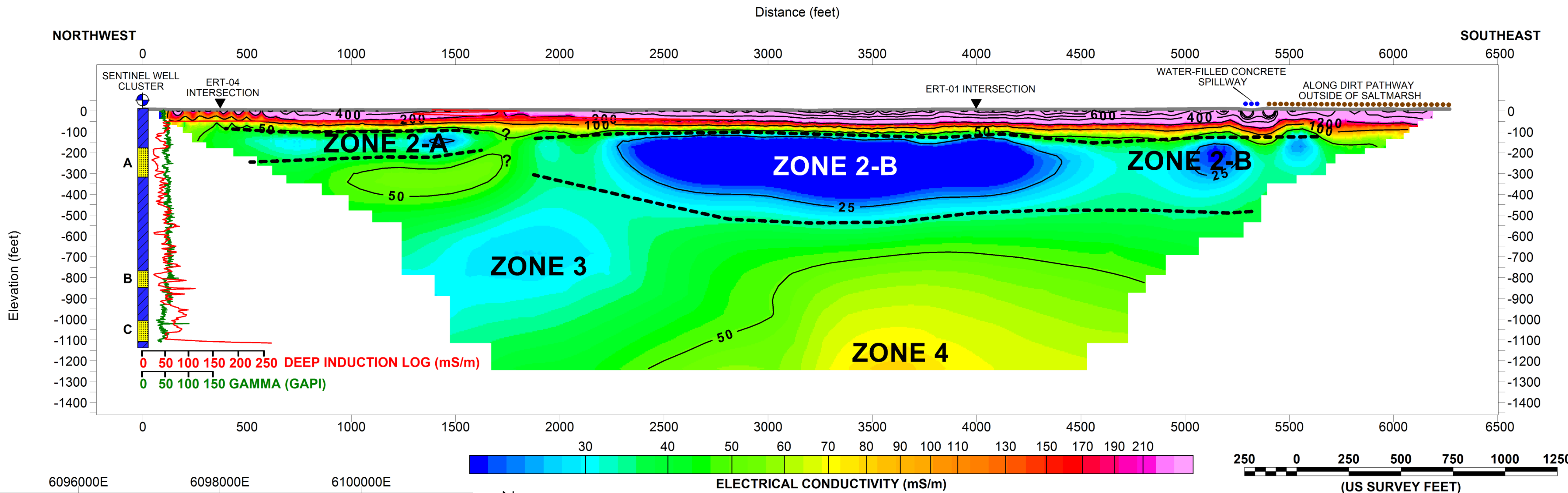
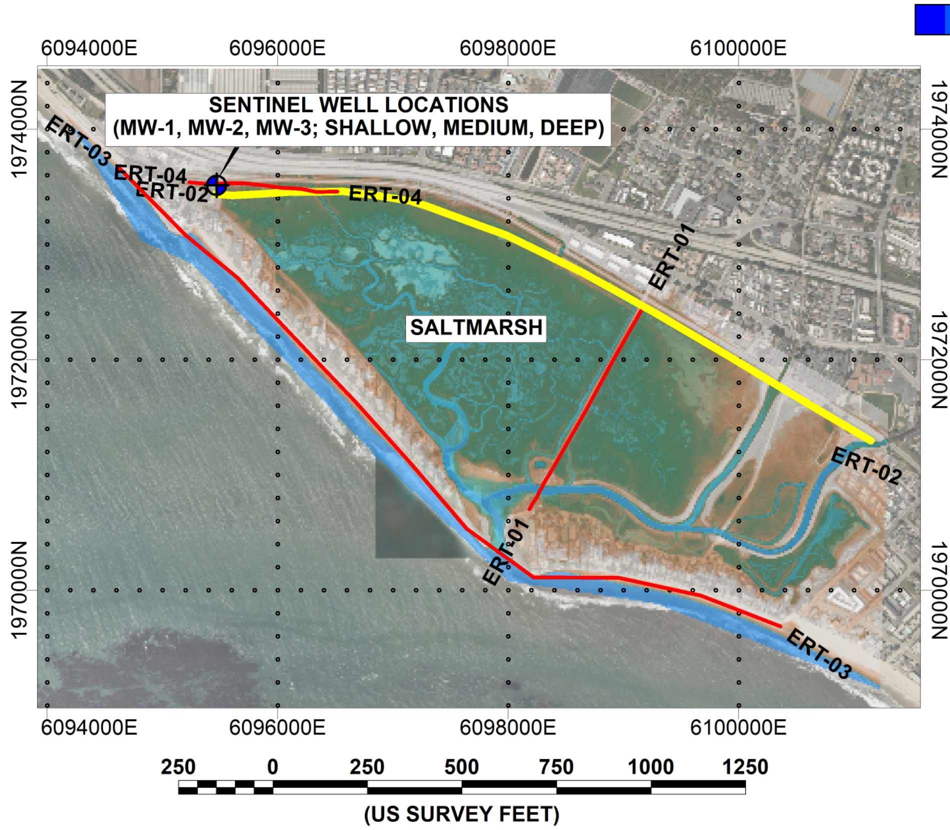
3. ERT-01 Field Parameters - Minimum Electrode Spacing 5 m (16.4 feet); Electrode Arrays: Gradient-Plus and Dipole-Dipole.
4. The ERT-01 section is modelled results of a combined array (i.e., gradient and dipole-dipole) inversion and is displayed as electrical conductivity (mS/m) on a log scale from 20 - 250 mS/m.
5. Coordinate system is NAD83 California State Plane Zone V (SPCS83; US Survey Feet). Vertical datum is CGVD2013.
6. Inset map imagery source: Bing Imagery (May 2018).

PREPARED BY: LGW	FIGURE TITLE: CARPINTERIA SALTWATER INTRUSION: ERT-01			
CHECKED BY: PDB	CLIENT: CARPINTERIA VALLEY WATER DISTRICT (CVWD)			
APPROVED BY: LGW	SCALE: AS SHOWN	PROJECT NO: 2252001	FIGURE NO: 2	

File Path: BGC Engineering Inc\Geophysics - Files\2.0 Current BGC Projects\2252001 - Carpinteria\3.0 Data Processing\4.0 Oasis\Maps\2252001-Pueblo-Carpinteria_ERT01-A.map





Zone	Maximum Thickness (feet)	Interpretation
2-A	115	Aquifer A. No saltwater intrusion.
2-B	400	A thicker zone of Aquifer A. No saltwater intrusion.
3	400	Potential coarse-grained material (i.e., sands/gravels). Possibly Aquifer B.
4	≥ 250	At the bottom of the ERT section and the limits of the ERT profile's spatial resolution. Not considered to be notable or significant.

GENERAL HYDROSTRATIGRAPHIC UNITS:
- PREDOMINANTLY FINE-GRAINED CONFINING LAYERS
- AQUIFER UNITS (ZONE A, B, & C)

LEGEND:

CROSS-SECTION
- ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
- FEBRUARY 2021 DEEP CONDUCTIVITY LOG IN mS/m (PACIFIC SURVEYS)
- FEBRUARY 2021 GAMMA LOG IN GAPI (PACIFIC SURVEYS)
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
- INTERPRETED AQUIFER A BOUNDS
- NOTABLE WATER CROSSING (> 15 m)
- NOTABLE OBSERVED SURFACE FEATURE

INSET
- DISPLAYED 2021 ERT PROFILE LOCATION
- OTHER 2021 ERT PROFILE LOCATIONS
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

Notes:
1. This Figure should be read in conjunction with BGC's report titled "Electrical resistivity tomography (ERT) investigation to map saltwater intrusion in Carpinteria, California", and dated October, 2021.
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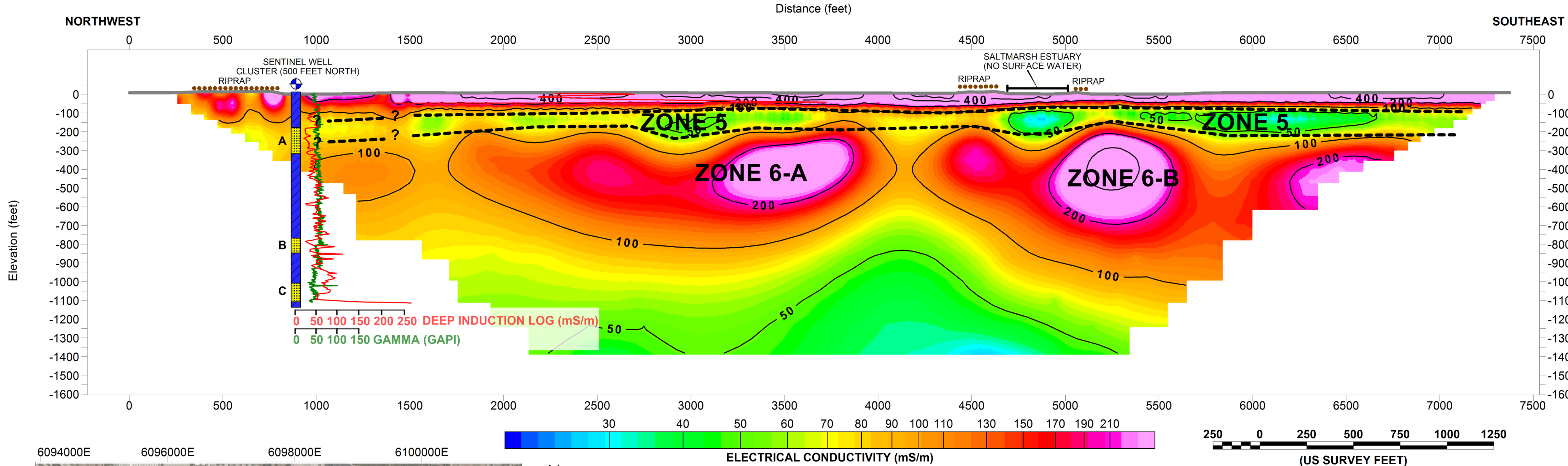
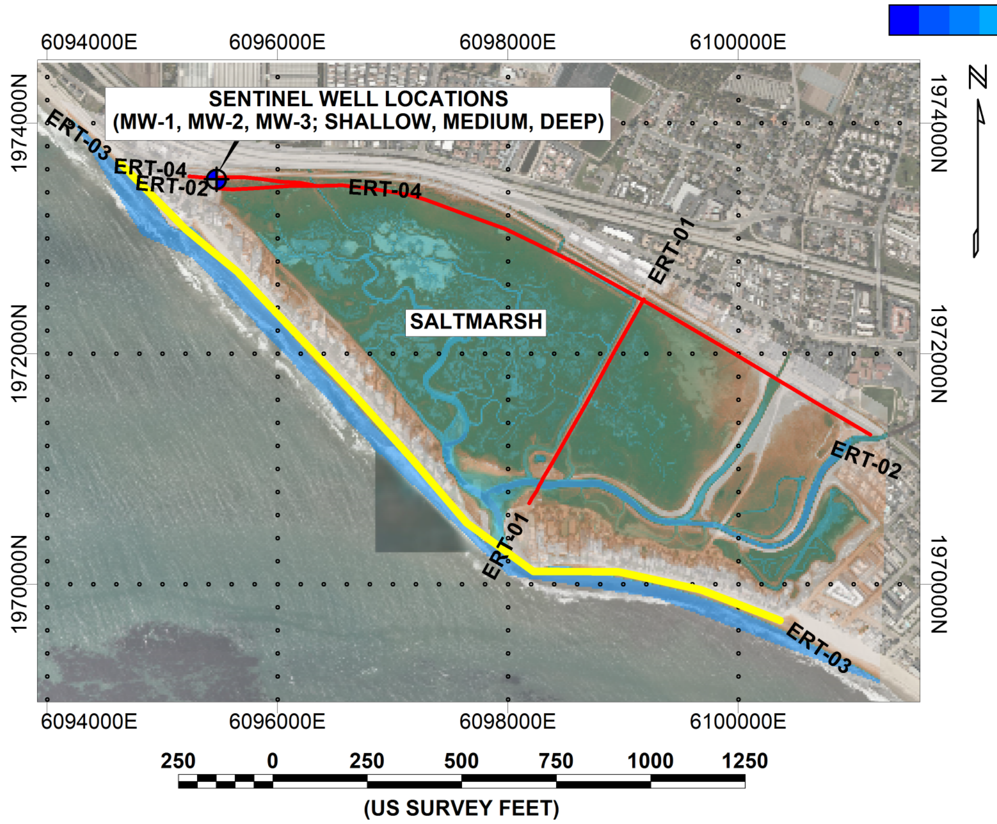
3. ERT-02 Field Parameters - Minimum Electrode Spacing 22.5 m (73.8 feet); Electrode Arrays: Gradient-Plus and Dipole-Dipole.
4. The ERT-02 section is modelled results of a combined array (i.e., gradient and dipole-dipole) inversion and is displayed as electrical conductivity (mS/m) on a log scale from 20 - 250 mS/m.
5. Coordinate system is NAD83 California State Plane Zone V (SPCS83; US Survey Feet). Vertical datum is CGVD2013.
6. Inset map imagery source: Bing Imagery (May 2018).

PREPARED BY: LGW	FIGURE TITLE: CARPINTERIA SALTWATER INTRUSION: ERT-02		
CHECKED BY: PDB	CLIENT: CARPINTERIA VALLEY WATER DISTRICT (CVWD)		
APPROVED BY: LGW	SCALE: AS SHOWN	PROJECT NO: 2252001	FIGURE NO: 3

File Path: BGC Engineering Inc\Geophysics - Files\2.0 Current BGC Projects\2252001 - Carpinteria\3.0 Data Processing\4.0 Oasis\Maps\2252001-Pueblo-Carpinteria_ERT02-A.map

10-2021





Zone	Maximum Thickness (feet)	Interpretation
5	130	Aquifer A. Zones of possible saltwater intrusion (i.e., electrical conductivities exceeding 70 mS/m).
6-A	600	1. Possible saltwater intrusion into the thickest portion of Aquifer A (as interpreted from ERT-02; Zone 2-B). 2. Possible saltwater-saturated fine-grained materials (i.e., clays) and relatively thin coarse-grained deposits (e.g., sand lenses and stringers) associated with confining layer between Aquifer A and B.
6-B	600	1. Possible saltwater intrusion into the thickest portion of Aquifer A (as interpreted from ERT-02; Zone 2-B). 2. Possible saltwater-saturated fine-grained materials (i.e., clays) and relatively thin coarse-grained deposits (e.g., sand lenses and stringers) associated with confining layer between Aquifer A and B.

GENERAL HYDROSTRATIGRAPHIC UNITS:
- PREDOMINANTLY FINE-GRAINED CONFINING LAYERS
- AQUIFER UNITS (ZONE A, B, & C)

LEGEND:

CROSS-SECTION
- ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
- FEBRUARY 2021 DEEP CONDUCTIVITY LOG IN mS/m (PACIFIC SURVEYS)
- FEBRUARY 2021 GAMMA LOG IN GAPI (PACIFIC SURVEYS)
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
- INTERPRETED AQUIFER A BOUNDS
- NOTABLE WATER CROSSING (> 15 m)
- NOTABLE OBSERVED SURFACE FEATURE

INSET
- DISPLAYED 2021 ERT PROFILE LOCATION
- OTHER 2021 ERT PROFILE LOCATIONS
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

Notes:
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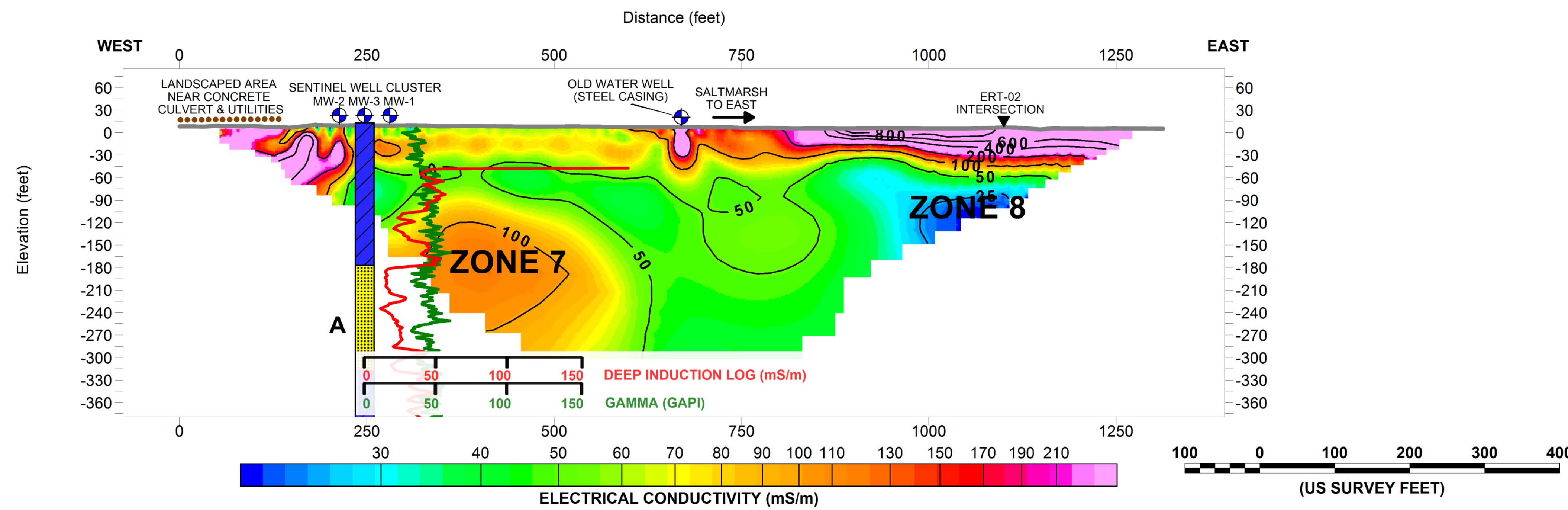
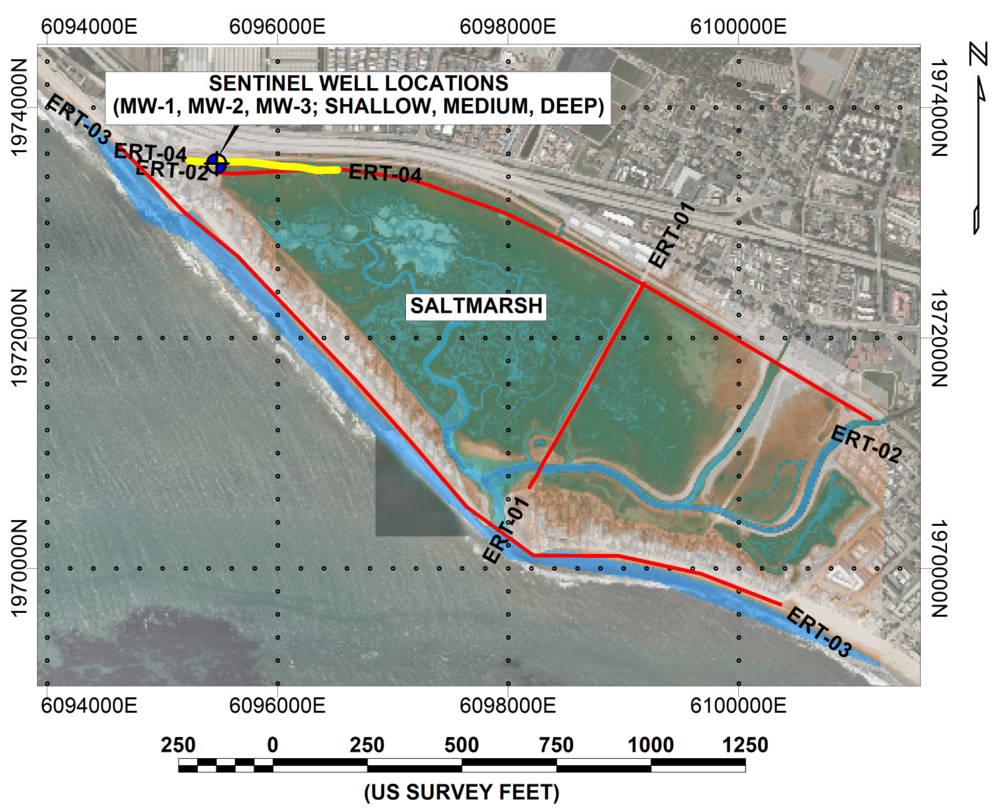
4. The ERT-01 section is modelled results of a combined array (i.e., gradient and dipole-dipole) inversion and is displayed as electrical conductivity (mS/m) on a log scale from 20 - 250 mS/m.
5. Coordinate system is NAD83 California State Plane Zone V (SPCS83; US Survey Feet). Vertical datum is CGVD2013.
6. Inset map imagery source: Bing Imagery (May 2018).

PREPARED BY: LGW	FIGURE TITLE: CARPINTERIA SALTWATER INTRUSION: ERT-03		
CHECKED BY: PDB	CLIENT: CARPINTERIA VALLEY WATER DISTRICT (CVWD)		
APPROVED BY: LGW	SCALE: AS SHOWN	PROJECT NO: 2252001	FIGURE NO: 4

File Path: BGC Engineering Inc\Geophysics - Files\2.0 Current BGC Projects\2252001 - Carpinteria\3.0 Data Processing\4.0 Oasis\Maps\2252001-Pueblo-Carpinteria ERT03-A.map





Zone	Maximum Thickness (feet)	Interpretation
7	30?	Likely artificially thickened (the true thickness is unknown). The deep induction log indicates that Zone 7 could be approximately 30 feet thick and associated with a more clay-rich lithology within the confining layer overlying Aquifer A. No saltwater intrusion.
8	≥ 60	Likely associated with Zone 2-A on ERT-02, and therefore Aquifer A. No saltwater intrusion.

GENERAL HYDROSTRATIGRAPHIC UNITS:
- PREDOMINANTLY FINE-GRAINED CONFINING LAYERS
- AQUIFER UNITS (ZONE A, B, & C)

LEGEND:

CROSS-SECTION
- ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
- FEBRUARY 2021 DEEP CONDUCTIVITY LOG IN mS/m (PACIFIC SURVEYS)
- FEBRUARY 2021 GAMMA LOG IN GAPI (PACIFIC SURVEYS)
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
- INTERPRETED AQUIFER A BOUNDS
- NOTABLE WATER CROSSING (> 15 m)
- NOTABLE OBSERVED SURFACE FEATURE

INSET
- DISPLAYED 2021 ERT PROFILE LOCATION
- OTHER 2021 ERT PROFILE LOCATIONS
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

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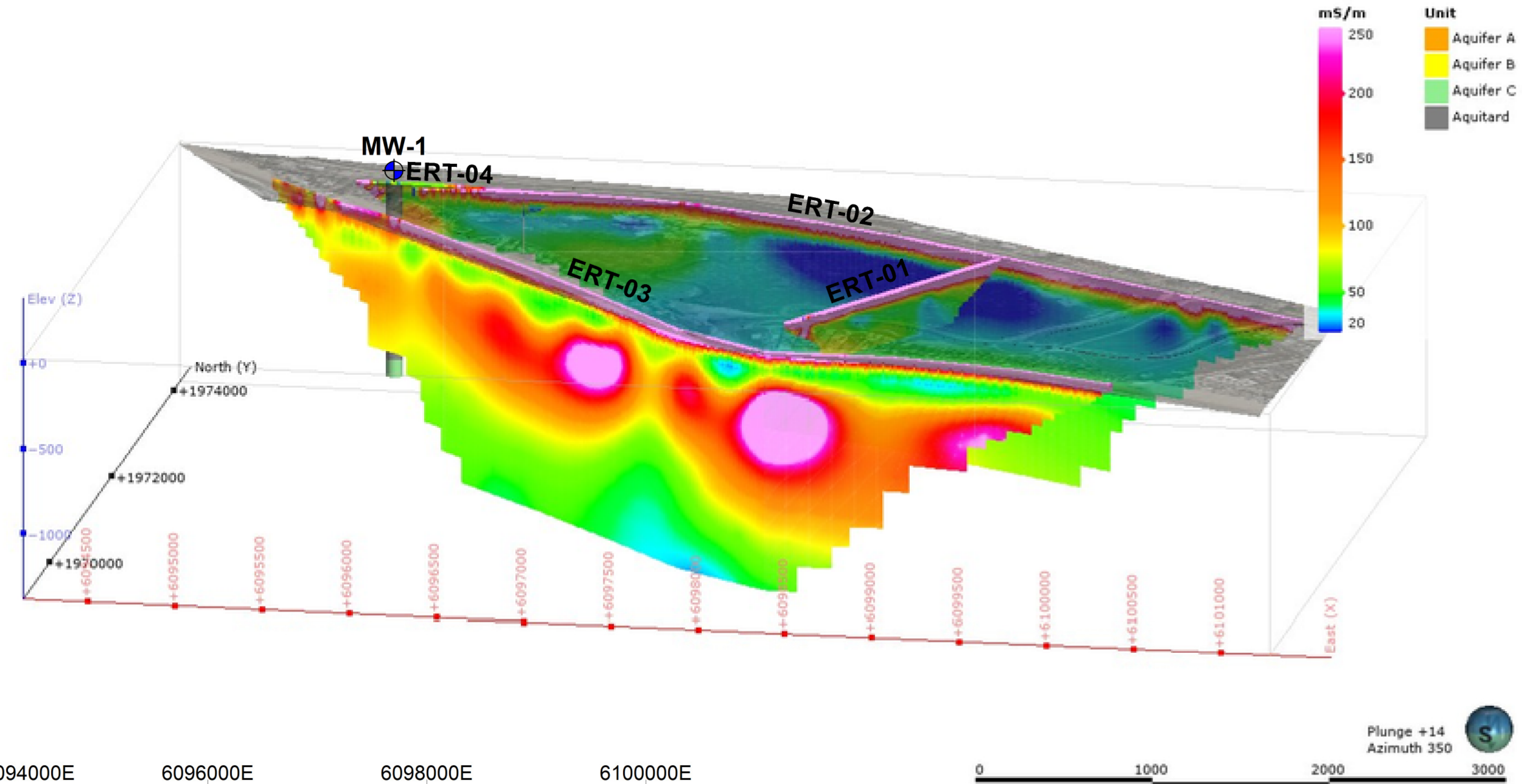
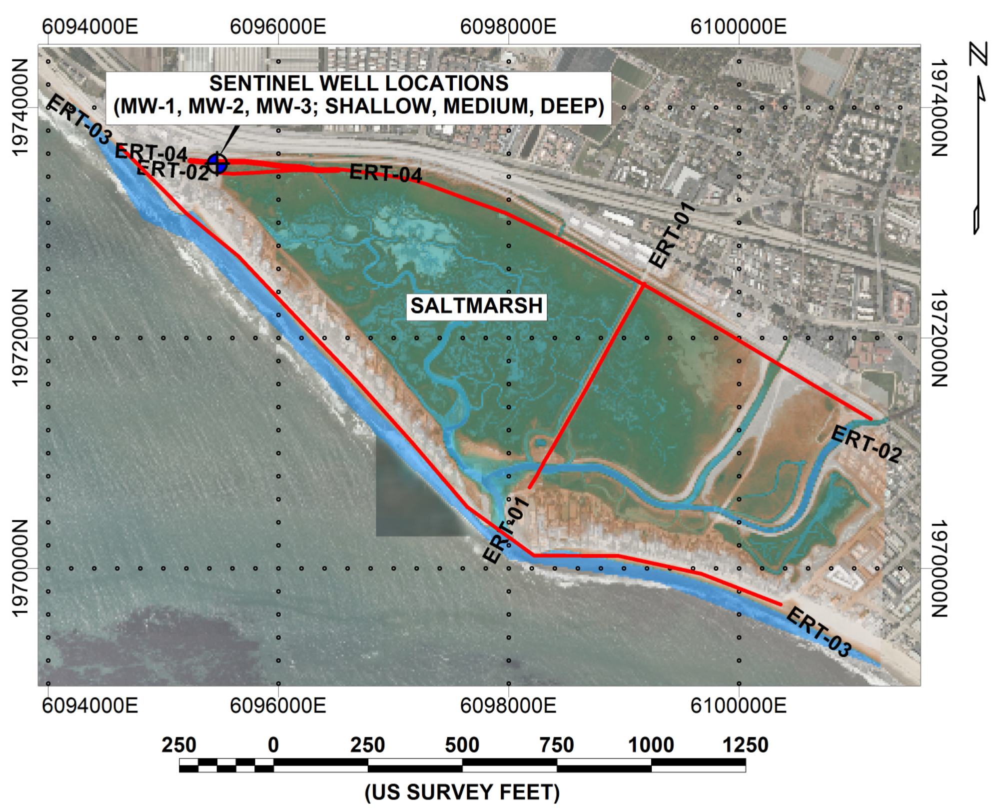
5. Coordinate system is NAD83 California State Plane Zone V (SPCS83; US Survey Feet). Vertical datum is CGVD2013.
6. Inset map imagery source: Bing Imagery (May 2018).

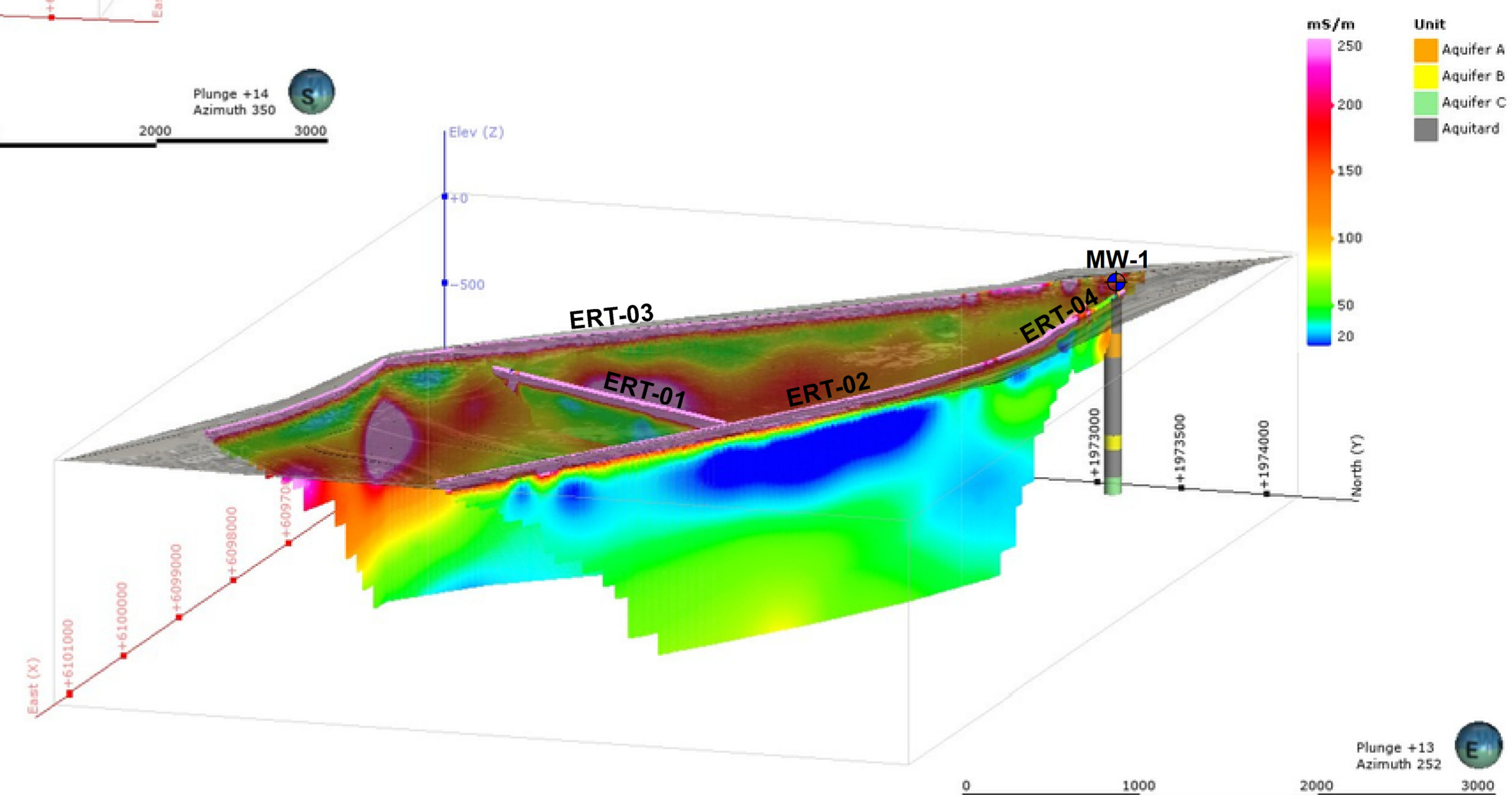
PREPARED BY:	FIGURE TITLE:		
LGW	CARPINTERIA SALTWATER INTRUSION: ERT-04		
CHECKED BY:	CLIENT:		
PDB	CARPINTERIA VALLEY WATER DISTRICT (CVWD)		
APPROVED BY:	SCALE:	PROJECT NO:	FIGURE NO:
LGW	AS SHOWN	2252001	5

File Path: BGC Engineering Inc\Geophysics - Files\2.0 Current BGC Projects\2252001 - Carpinteria\3.0 Data Processing\4.0 Oasis\Maps\2252001-Pueblo-Carpinteria_ERT04-A.map

10-2021







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Notes:

1. This Figure should be read in conjunction with BGC's report titled "Electrical resistivity tomography (ERT) investigation to map saltwater intrusion in Carpinteria, California" , and dated October, 2021.
2. The ERT surveys were collected as part of a saltwater intrusion study at Carpinteria, California between April 20 and 23, 2021.
3. ERT Field Parameters - Minimum Electrode Spacings: 5 m (16.4 feet) and 22.5 m (73.8 feet); Electrode Arrays: Gradient-Plus and Dipole-Dipole.
4. The displayed ERT sections are modelled results of combined array (i.e., gradient and dipole-dipole) inversions from a 3-D Leapfrog Model, displayed as electrical conductivity (mS/m) on a log scale from 20 - 250 mS/m.
5. Coordinate system is NAD83 California State Plane Zone V (SPCS83; US Survey Feet). Vertical datum is CGVD2013.
6. Inset map imagery source: Bing Imagery (May 2018).

PREPARED BY:	FIGURE TITLE:		
LGW	CARPINTERIA SALTWATER INTRUSION: 3D MODEL		
CHECKED BY:	CLIENT:		
PDB	CARPINTERIA VALLEY WATER DISTRICT (CVWD)		
APPROVED BY:	SCALE:	PROJECT NO:	FIGURE NO:
LGW	AS SHOWN	2252001	6

BGC ENGINEERING INC.

APPENDIX A
ERT DEPTH OF INVESTIGATION (DOI) ANALYSIS

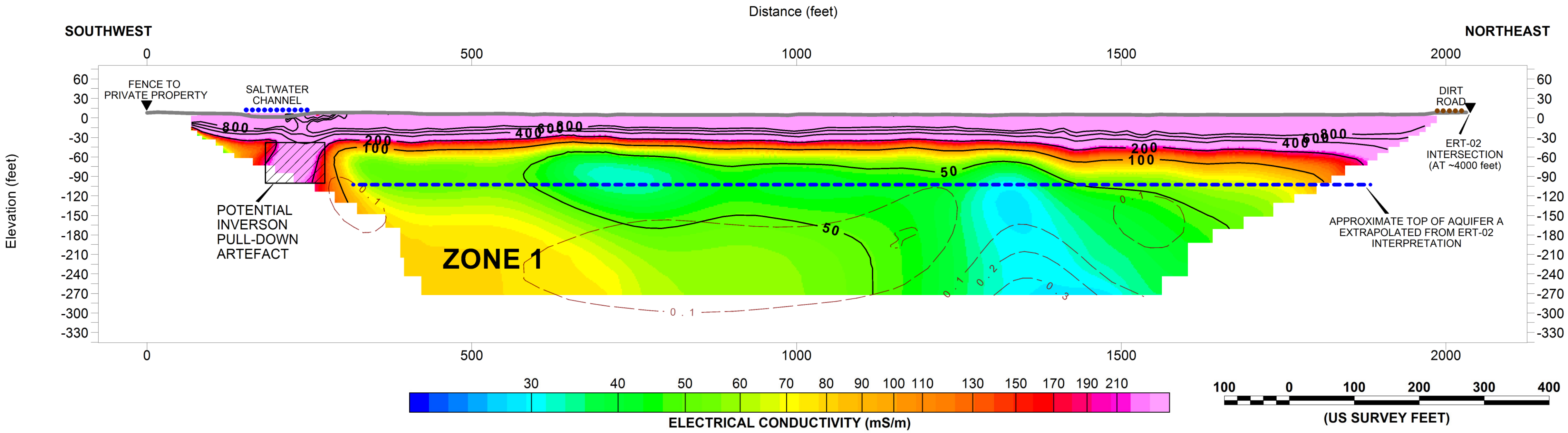
A.1 Depth of investigation (DOI) Analysis

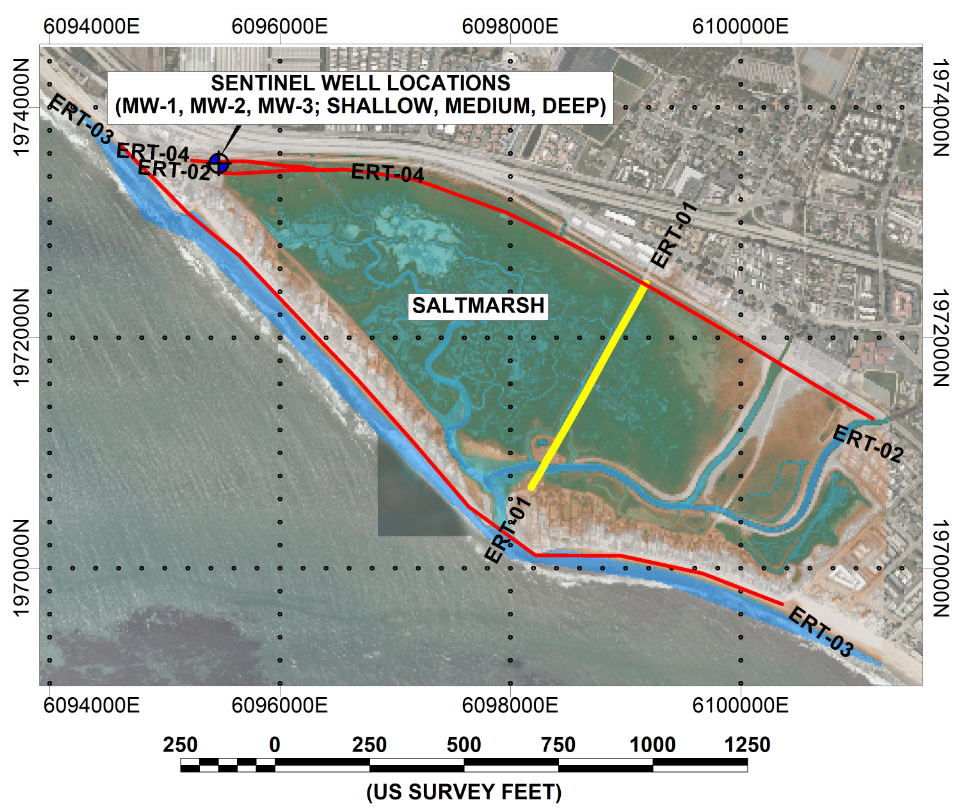
A depth of investigation (DOI) analysis was conducted on the combined array inversions (i.e., gradient + dipole-dipole) as outlined in Oldenburg and Li (1999) to identify zones within the recovered ERT model sections which may be less constrained by measured data, and therefore potentially less reliable. The DOI analysis was carried out in the RES2DINV software package by changing the background reference model resistivity for two inversions to be 0.1 and 10 times the average apparent resistivity (the typical background reference model used as a starting model). For example, if the average apparent resistivity of the data was 7 ohm-m, then the background reference models for DOI analysis inversions were set to 0.7 ohm-m and 70 ohm-m. Differences in the recovered resistivity models are calculated based on a DOI index (Oldenburg and Li, 1999):

$$R(x,z) = \frac{m_1(x,z) - m_2(x,z)}{m_{1r} - m_{2r}} \qquad (1)$$

Equation 1 is the DOI index where m_1 and m_2 are the two recovered resistivity models and m_{1r} and m_{2r} are the constant reference models (i.e., 0.1 and 10 times the average apparent resistivity value). A DOI index approaching zero indicates that the model is well constrained by the measured data, as there is little change between the recovered models using the different constant reference models. Conversely, a DOI index approaching 1 indicates larger differences and therefore a less constrained model. Oldenburg and Li (1999) suggest using a reasonably cautious DOI index value of 0.1 to 0.2 as a threshold value for models being generally well constrained by data.

Figures A-1 to A-4 are duplicates of Figures 2 to 5 with DOI contours overlaid.





Zone	Maximum Thickness (feet)	Interpretation
1	≥ 138	Possible saltwater intrusion into Aquifer A.

LEGEND:

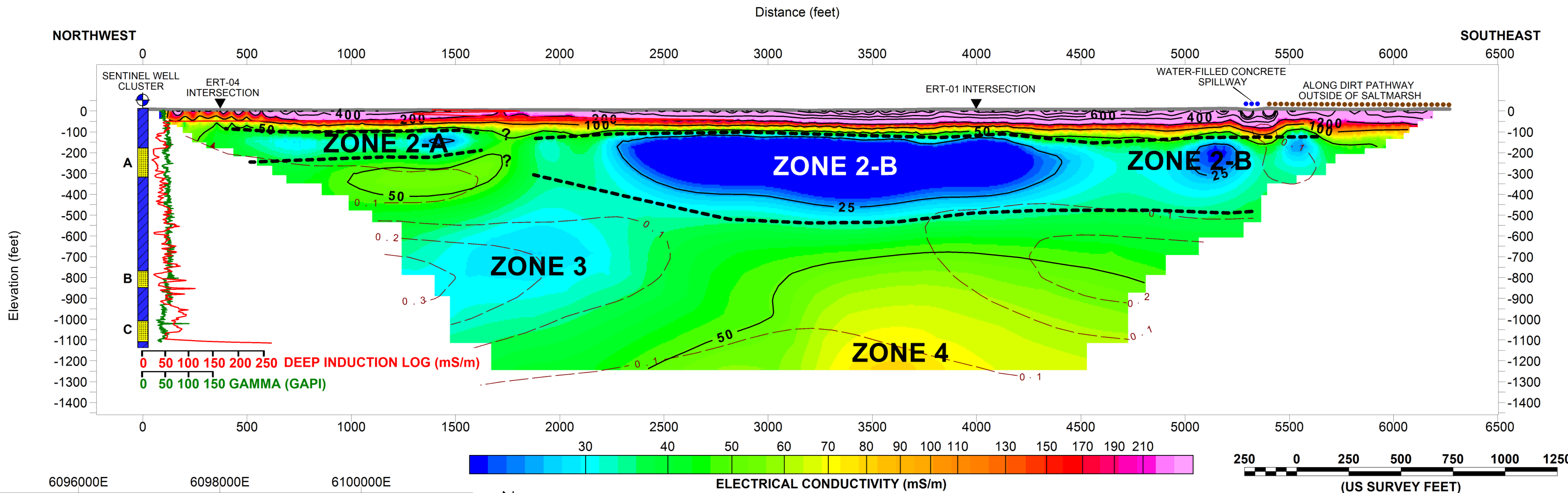
CROSS-SECTION
- ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
- DEPTH OF INVESTIGATION INDEX CONTOUR
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
- NOTABLE WATER CROSSING (> 15 m)
- NOTABLE OBSERVED SURFACE FEATURE

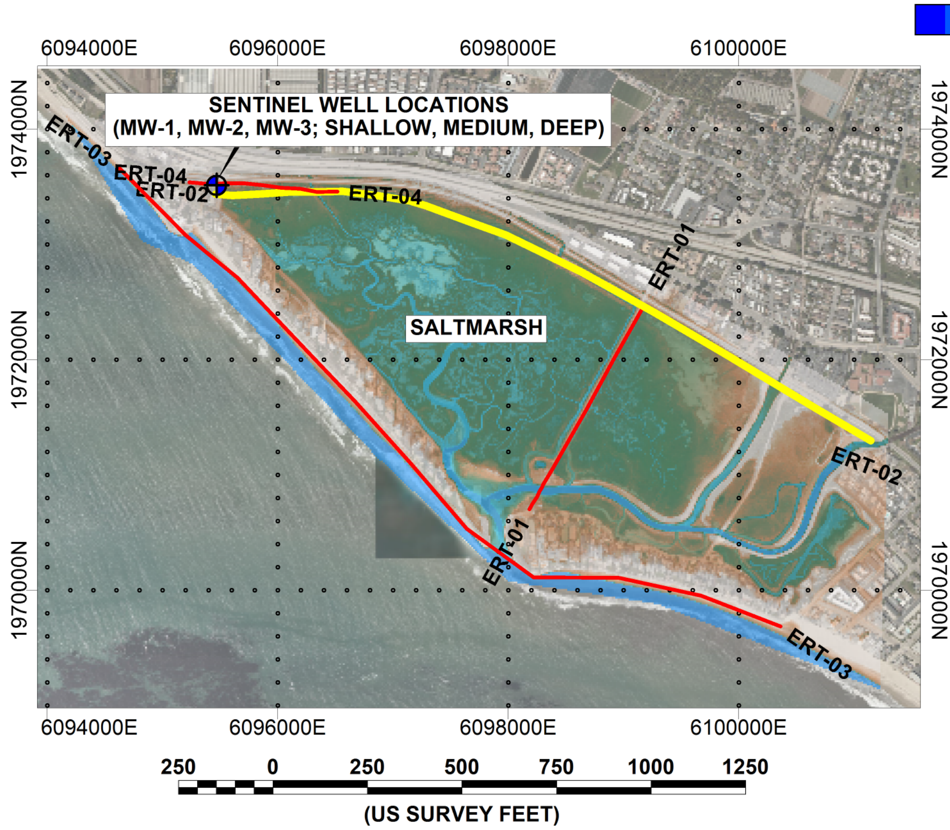
INSET
- DISPLAYED 2021 ERT PROFILE LOCATION
- OTHER 2021 ERT PROFILE LOCATIONS
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

Notes:
1. This Figure should be read in conjunction with BGC's report titled "Electrical resistivity tomography (ERT) investigation to map saltwater intrusion in Carpinteria, California", and dated October, 2021.
2. The ERT surveys were collected as part of a saltwater intrusion study at Carpinteria, California between April 20 and 23, 2021.
3. ERT-01 Field Parameters - Minimum Electrode Spacing 5 m (16.4 feet); Electrode Arrays: Gradient-Plus and Dipole-Dipole.
4. The ERT-01 section is modelled results of a combined array (i.e., gradient and dipole-dipole) inversion and is displayed as electrical conductivity (mS/m) on a log scale from 20 - 250 mS/m.
5. Coordinate system is NAD83 California State Plane Zone V (SPCS83; US Survey Feet). Vertical datum is CGVD2013.
6. Inset map imagery source: Bing Imagery (May 2018).

PREPARED BY: LGW	FIGURE TITLE: CARPINTERIA SALTWATER INTRUSION: ERT-01
CHECKED BY: PDB	CLIENT: CARPINTERIA VALLEY WATER DISTRICT (CVWD)
APPROVED BY: LGW	SCALE: AS SHOWN · PROJECT NO: 2252001 · FIGURE NO: A-1

File Path: BGC Engineering Inc\Geophysics - Files\2.0 Current BGC Projects\2252001 - Carpinteria\3.0 Data Processing\4.0 Oasis\Maps\2252001-Pueblo-Carpinteria_ERT01-A.map





Zone	Maximum Thickness (feet)	Interpretation
2-A	115	Aquifer A. No saltwater intrusion.
2-B	400	A thicker zone of Aquifer A. No saltwater intrusion.
3	400	Potential coarse-grained material (i.e., sands/gravels). Possibly Aquifer B.
4	≥ 250	At the bottom of the ERT section and the limits of the ERT profile's spatial resolution. Not considered to be notable or significant.

GENERAL HYDROSTRATIGRAPHIC UNITS:
- PREDOMINANTLY FINE-GRAINED CONFINING LAYERS
- AQUIFER UNITS (ZONE A, B, & C)

LEGEND:

CROSS-SECTION
- ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
- DEPTH OF INVESTIGATION INDEX CONTOUR
- FEBRUARY 2021 DEEP CONDUCTIVITY LOG IN mS/m (PACIFIC SURVEYS)
- FEBRUARY 2021 GAMMA LOG IN GAPI (PACIFIC SURVEYS)
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
- INTERPRETED AQUIFER A BOUNDS
- NOTABLE WATER CROSSING (> 15 m)
- NOTABLE OBSERVED SURFACE FEATURE

INSET
- DISPLAYED 2021 ERT PROFILE LOCATION
- OTHER 2021 ERT PROFILE LOCATIONS
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

Notes:
1. This Figure should be read in conjunction with BGC's report titled "Electrical resistivity tomography (ERT) investigation to map saltwater intrusion in Carpinteria, California", and dated October, 2021.
2. The ERT surveys were collected as part of a saltwater intrusion study at Carpinteria, California between April 20 and 23, 2021.
3. ERT-02 Field Parameters - Minimum Electrode Spacing 22.5 m (73.8 feet); Electrode Arrays: Gradient-Plus and Dipole-Dipole.
4. The ERT-02 section is modelled results of a combined array (i.e., gradient and dipole-dipole) inversion and is displayed as electrical conductivity (mS/m) on a log scale from 20 - 250 mS/m.
5. Coordinate system is NAD83 California State Plane Zone V (SPCS83; US Survey Feet). Vertical datum is CGVD2013.
6. Inset map imagery source: Bing Imagery (May 2018).

PREPARED BY:	FIGURE TITLE:		
LGW	CARPINTERIA SALTWATER INTRUSION: ERT-02		
CHECKED BY: PDB	CLIENT: CARPINTERIA VALLEY WATER DISTRICT (CVWD)		
APPROVED BY: LGW	SCALE: AS SHOWN	PROJECT NO: 2252001	FIGURE NO: A-2

File Path: BGC Engineering Inc\Geophysics - Files\2.0 Current BGC Projects\2252001 - Carpinteria\3.0 Data Processing\4.0 Oasis\Maps\2252001-Pueblo-Carpinteria_ERT02-A.map

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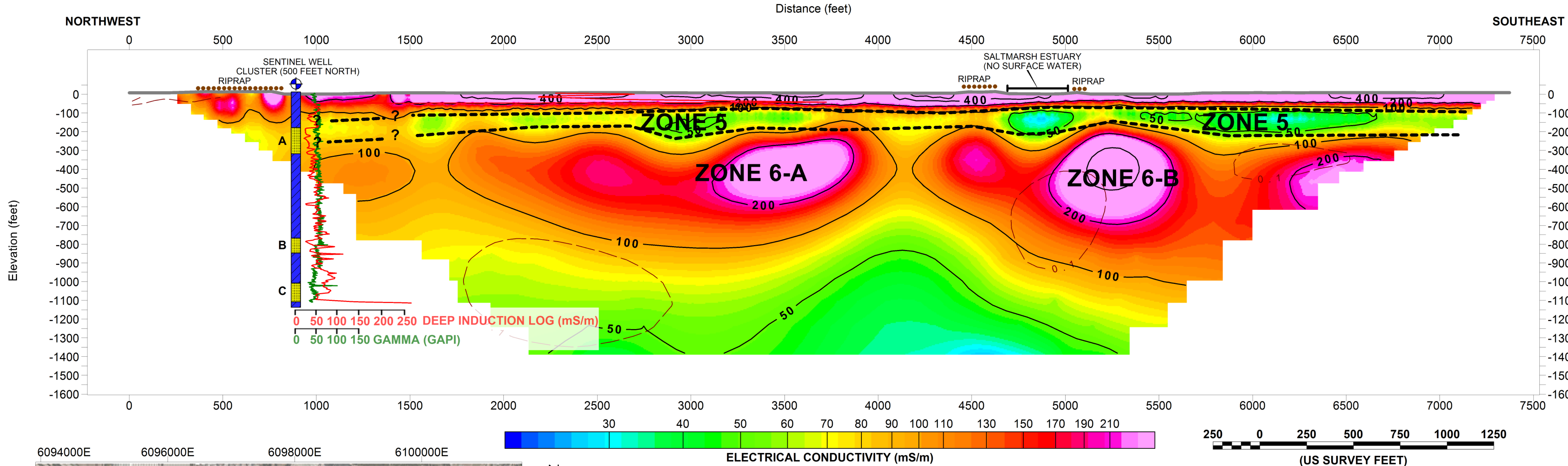

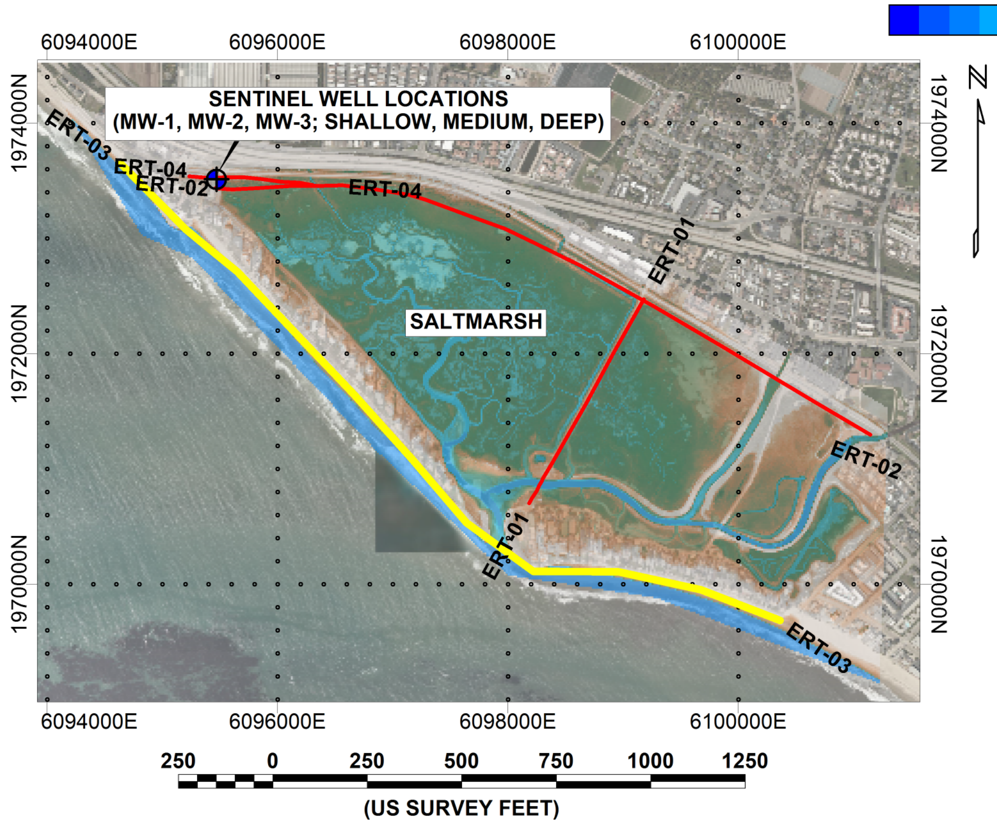

Zone	Maximum Thickness (feet)	Interpretation
5	130	Aquifer A. Zones of possible saltwater intrusion (i.e., electrical conductivities exceeding 70 mS/m).
6-A	600	1. Possible saltwater intrusion into the thickest portion of Aquifer A (as interpreted from ERT-02; Zone 2-B). 2. Possible saltwater-saturated fine-grained materials (i.e., clays) and relatively thin coarse-grained deposits (e.g., sand lenses and stringers) associated with confining layer between Aquifer A and B.
6-B	600	1. Possible saltwater intrusion into the thickest portion of Aquifer A (as interpreted from ERT-02; Zone 2-B). 2. Possible saltwater-saturated fine-grained materials (i.e., clays) and relatively thin coarse-grained deposits (e.g., sand lenses and stringers) associated with confining layer between Aquifer A and B.

GENERAL HYDROSTRATIGRAPHIC UNITS:
- PREDOMINANTLY FINE-GRAINED CONFINING LAYERS
- AQUIFER UNITS (ZONE A, B, & C)

LEGEND:

CROSS-SECTION
- ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
- DEPTH OF INVESTIGATION INDEX CONTOUR
- FEBRUARY 2021 DEEP CONDUCTIVITY LOG IN mS/m (PACIFIC SURVEYS)
- FEBRUARY 2021 GAMMA LOG IN GAPI (PACIFIC SURVEYS)
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
- INTERPRETED AQUIFER A BOUNDS
- NOTABLE WATER CROSSING (> 15 m)
- NOTABLE OBSERVED SURFACE FEATURE

INSET
- DISPLAYED 2021 ERT PROFILE LOCATION
- OTHER 2021 ERT PROFILE LOCATIONS
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

Notes:
1. This Figure should be read in conjunction with BGC's report titled "Electrical resistivity tomography (ERT) investigation to map saltwater intrusion in Carpinteria, California", and dated October, 2021.
2. The ERT surveys were collected as part of a saltwater intrusion study at Carpinteria, California between April 20 and 23, 2021.
3. ERT-03 Field Parameters - Minimum Electrode Spacing 22.5 m (73.8 feet); Electrode Arrays: Gradient-Plus and Dipole-Dipole.
4. The ERT-01 section is modelled results of a combined array (i.e., gradient and dipole-dipole) inversion and is displayed as electrical conductivity (mS/m) on a log scale from 20 - 250 mS/m.
5. Coordinate system is NAD83 California State Plane Zone V (SPCS83; US Survey Feet). Vertical datum is CGVD2013.
6. Inset map imagery source: Bing Imagery (May 2018).

PREPARED BY:	FIGURE TITLE:		
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CHECKED BY:	CLIENT:		
PDB	CARPINTERIA VALLEY WATER DISTRICT (CVWD)		
APPROVED BY:	SCALE:	PROJECT NO:	FIGURE NO:
LGW	AS SHOWN	2252001	A-3

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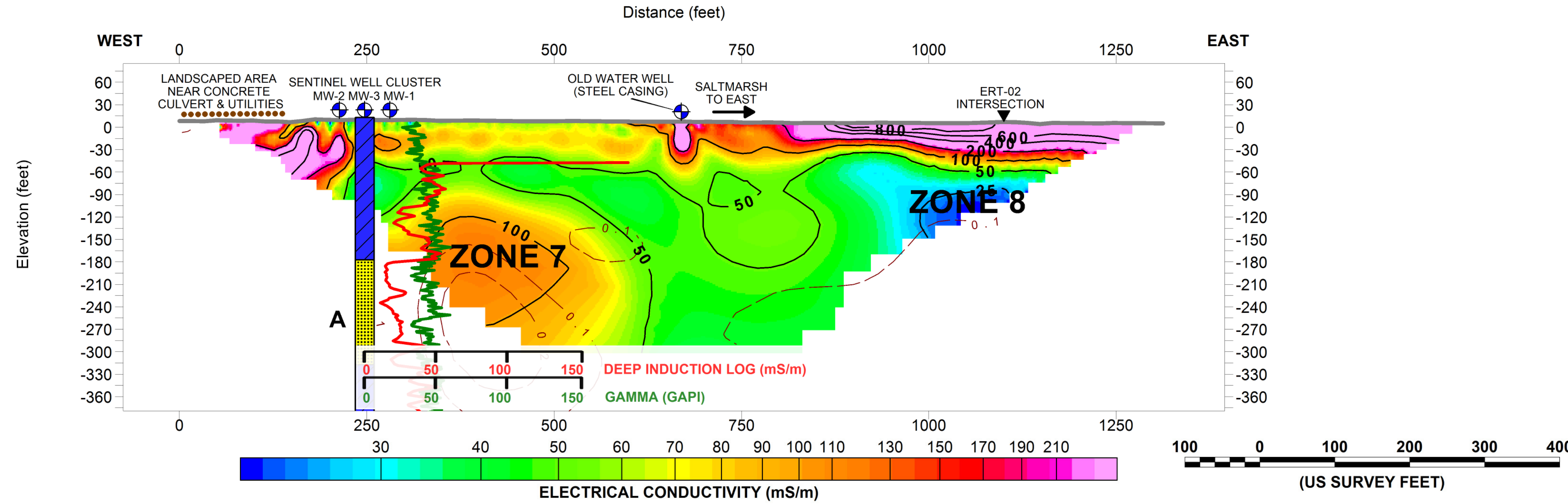

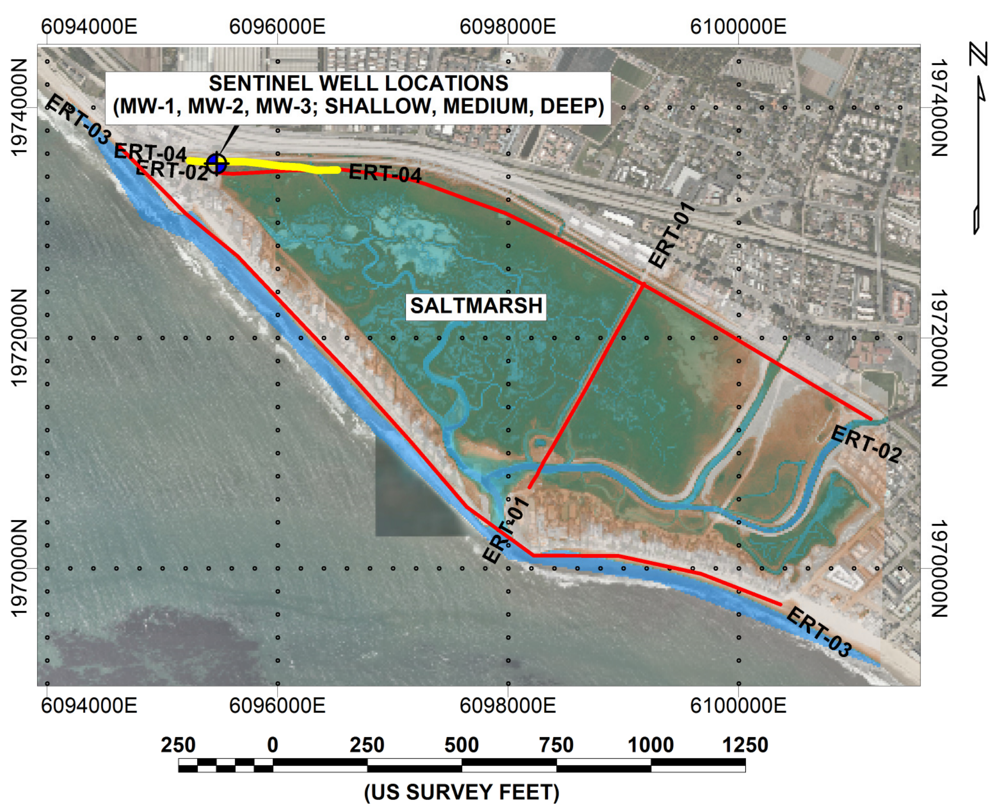

Zone	Maximum Thickness (feet)	Interpretation
7	30?	Likely artificially thickened (the true thickness is unknown). The deep induction log indicates that Zone 7 could be approximately 30 feet thick and associated with a more clay-rich lithology within the confining layer overlying Aquifer A. No saltwater intrusion.
8	≥ 60	Likely associated with Zone 2-A on ERT-02, and therefore Aquifer A. No saltwater intrusion.

GENERAL HYDROSTRATIGRAPHIC UNITS:
- PREDOMINANTLY FINE-GRAINED CONFINING LAYERS
- AQUIFER UNITS (ZONE A, B, & C)

LEGEND:

CROSS-SECTION
- ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
- DEPTH OF INVESTIGATION INDEX CONTOUR
- FEBRUARY 2021 DEEP CONDUCTIVITY LOG IN mS/m (PACIFIC SURVEYS)
- FEBRUARY 2021 GAMMA LOG IN GAPI (PACIFIC SURVEYS)
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
- NOTABLE WATER CROSSING (> 15 m)
- NOTABLE OBSERVED SURFACE FEATURE

INSET
- DISPLAYED 2021 ERT PROFILE LOCATION
- OTHER 2021 ERT PROFILE LOCATIONS
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

Notes:
1. This Figure should be read in conjunction with BGC's report titled "Electrical resistivity tomography (ERT) investigation to map saltwater intrusion in Carpinteria, California", and dated October, 2021.
2. The ERT surveys were collected as part of a saltwater intrusion study at Carpinteria, California between April 20 and 23, 2021.
3. ERT-04 Field Parameters - Minimum Electrode Spacing 5 m (16.4 feet); Electrode Arrays: Gradient-Plus and Dipole-Dipole.
4. The ERT-01 section is modelled results of a combined array (i.e., gradient and dipole-dipole) inversion and is displayed as electrical conductivity (mS/m) on a log scale from 20 - 250 mS/m.
5. Coordinate system is NAD83 California State Plane Zone V (SPCS83; US Survey Feet). Vertical datum is CGVD2013.
6. Inset map imagery source: Bing Imagery (May 2018).

PREPARED BY:	FIGURE TITLE:		
LGW	CARPINTERIA SALTWATER INTRUSION: ERT-04		
CHECKED BY:	CLIENT:		
PDB	CARPINTERIA VALLEY WATER DISTRICT (CVWD)		
APPROVED BY:	SCALE:	PROJECT NO:	FIGURE NO:
LGW	AS SHOWN	2252001	A-4

File Path: BGC Engineering Inc\Geophysics - Files\2.0 Current BGC Projects\2252001 - Carpinteria\3.0 Data Processing\4.0 Oasis\Maps\2252001-Pueblo-Carpinteria ERT04-A.map

APPENDIX F

Groundwater Modeling Documentation

Montgomery & Associates

Carpinteria Basin Model Update for Groundwater Sustainability Plan

MONTGOMERY
& ASSOCIATES
Water Resource Consultants

September 29, 2023

Carpinteria Basin Model Update for Groundwater Sustainability Plan

Prepared for:

Carpinteria Groundwater Sustainability Agency

Prepared by:

Montgomery & Associates
1970 Broadway, Suite 225, Oakland, CA 94612

Contents

Tables

Figures

Appendices

1 INTRODUCTION AND BACKGROUND

1.1 Purpose and Scope

The purpose of this project is to update the existing numerical groundwater flow model to support the groundwater sustainability plan (GSP) development by the Carpinteria Groundwater Sustainability Agency. Components of this update include the following:

- Refinement and expansion of the model's active area to conform with adjusted Carpinteria Basin boundaries (DWR, 2020; DWR, 2022)
- Update of offshore boundary condition heads to reflect saltwater density
- Temporal expansion of the model from previous range of Water Year (WY) 1985-2008 to WY 1985-2020
- Temporal refinement of the model from annual to monthly stress periods
- Incorporation of updated estimates for water budget components
- Model recalibration
- Model water budget preparation and analysis
- Predictive model scenario development and analysis

1.2 Project Area

The model area is focused on the Carpinteria Groundwater Basin (Basin) in Santa Barbara and Ventura Counties, a coastal alluvial plain bordered by foothills to the north and east, the Pacific Ocean to the south, and the Montecito Groundwater Basin (Montecito Basin, MGB, or Montecito) to the west. The model grid shown on Figure 1 covers the entire Basin in addition to offshore areas and a portion of the Montecito Basin.

The Carpinteria Basin lies within the Transverse Range Geomorphic Province, south of the Santa Ynez mountains. The Basin consists of a synclinal structure filled in with unconsolidated and semi-consolidated water bearing Quaternary sediments. Older consolidated non-water bearing rocks form the Basin's northern, eastern, and bottom boundaries. The western Basin boundary is a jurisdictional boundary without a significant flow barrier, and the southern boundary is the Pacific Ocean.

The Basin's geologic structure is significantly characterized by the Rincon Creek Fault, which divides the Basin in an east-west direction. North of the Rincon Creek Fault is known as storage unit 1 (SU-1), where 3 mapped high-production zones (A, B, and C) are separated by more heterogeneous and lower permeability materials. South of the fault, tectonics have uplifted formations and bedrock is present at a significantly shallower depth. This area is known as storage unit 2 (SU-2). The Rincon Creek fault presents a hydraulic flow barrier, largely separating these 2 storage units with an approximately 50 degrees from horizontal southward dip (Figure 2).

Confined aquifer conditions exist in the center of the Basin, beneath the City of Carpinteria, which is referred to as the Confined Area. Outside of this area unconfined conditions exist and aquifer units are less discrete, referred to as the Recharge Area.

A thorough description of Basin hydrogeology can be found in the Carpinteria Basin GSP hydrogeologic conceptual model section (GSI Water, 2022).

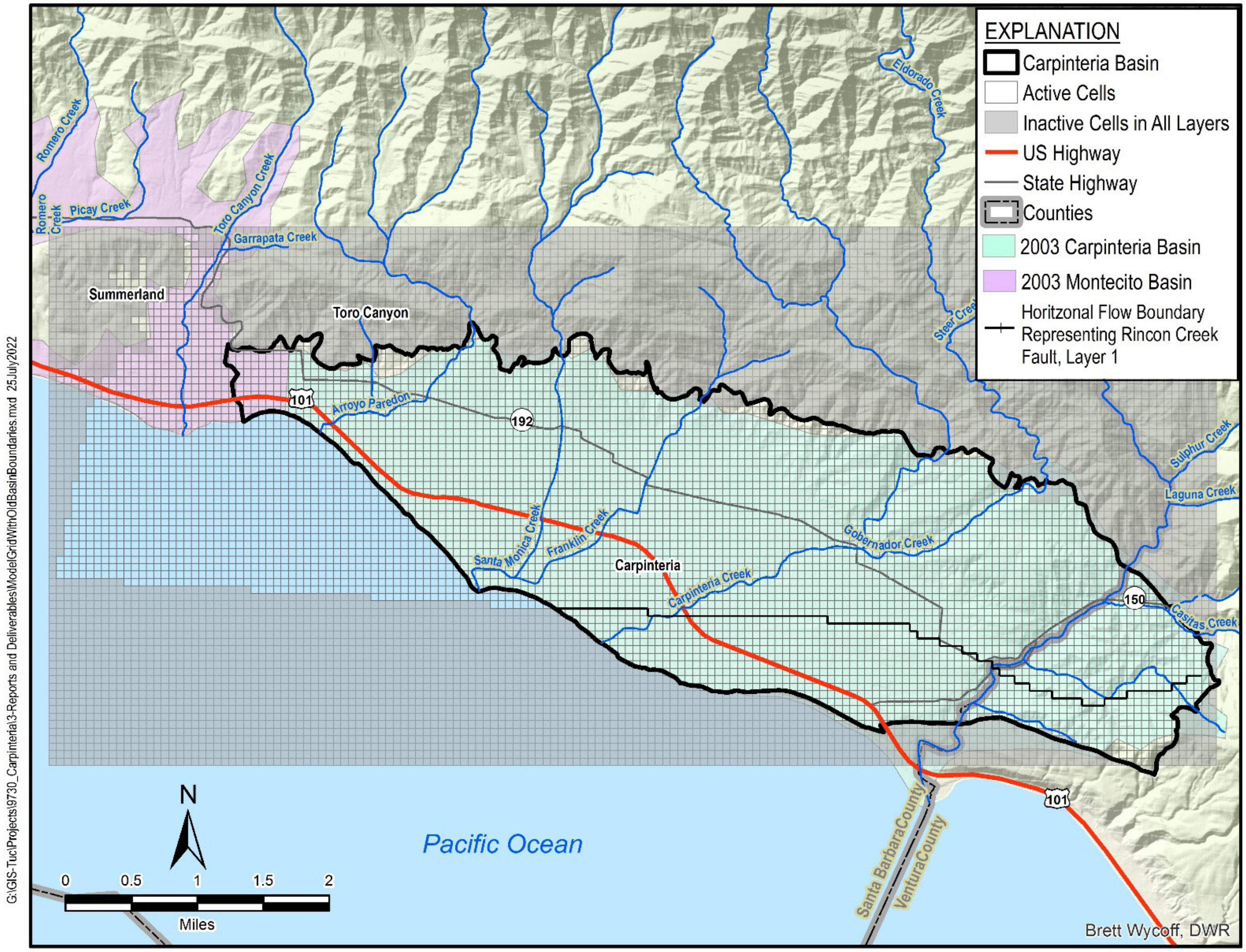

Figure 1. Project Area

1.3 Previous Investigations

Hydrogeologic studies of the Basin date back to at least 1951 (USGS, 1951) and the Basin's numerical groundwater model was first constructed in 2012 (HydroMetrics WRI, 2012). Information from previous investigations utilized in construction of the 2012 model included the following:

- Outline of the Basin boundary (no longer coincident with the modern Basin boundary; DWR, 2020)
- Contours for the top and bottom of significant high production zones (A, B, and C), and top of bedrock
- Locations of boundary conditions such as the ocean and Rincon Creek Fault
- Water budget estimates including percolation of precipitation, percolation of irrigation water, streambed percolation, mountain-front subsurface inflow, groundwater pumping, and extraction by phreatophytes
- Watershed contact boundaries for mountain-front subsurface inflow
- Pumping well data including production and screen intervals
- Pumping test estimates of hydraulic conductivity
- Groundwater level data for calibration

Much of these data were originally collected during construction of the Basin's conceptual model in 2011 (Pueblo, 2012) and are described further in that report. How these data were utilized in construction of the original numerical model is described further in HydroMetrics WRI, 2012.

2 NUMERICAL MODEL DEVELOPMENT

2.1 Model Code Selection

The MODFLOW-NWT model code was selected for original model construction and the same code was maintained in this update (Niswonger *et al.*, 2011; HydroMetrics WRI, 2012).

2.1.1 Selection Process/Rationale

MODFLOW-NWT and the associated Upstream Weighting package were selected during the original model construction to assist in achieving convergence for cells that simulated drying and wetting conditions representing a fluctuating water table. The U.S. Geological Survey's MODFLOW codes are an industry standard, public domain, and are well documented.

2.1.2 Treatment of Groundwater Conditions (Confined / Unconfined)

Model layer 1 is considered unconfined as it lies at surface. All other model layers are convertible meaning they can be either confined or unconfined and convert from one to the other depending upon water levels within the given layer. Model layers 2-7 are confined if groundwater elevations are above the top elevation of the cell. They are unconfined if groundwater elevations are below the top of the cell.

2.2 Model Extent and Discretization

The following subsections describe the model's lateral, vertical, and temporal discretization.

2.2.1 Lateral discretization and grid spacing

The model is discretized into 300-foot by 300-foot cells, with the full model grid comprising 72 rows and 156 columns.

2.2.2 Vertical discretization

The model is divided into 7 vertical layers. All 7 layers are active for SU-1 north of the Rincon Creek fault (Table 1, Figure 1, and Figure 2), while only 3 layers are active for SU-2 south of the Rincon Creek fault (layer 1, 2, and 3; see Figure 3). In SU-1 within the confined area layers 2, 4, and 6 represent the high-production A, B, and C zones, respectively. Outside of this area, these zones are less defined and model layering is not meant to represent these distinct production zones. Figure 3 displays the model bottom elevations and active extents by layer. Due to the orientation of the Rincon Creek Fault, layer 7 in SU-1 occurs below layer 3 in SU-2, but is not considered part of SU-2 since it is separated from layer 3 in SU-2 by the Rincon Creek Fault and a thick layer of inactive cells representing a no-flow boundary (Figure 7). Table 1 summarizes how the model layers are implemented in the model to represent different geologic units in each storage unit, in accordance with the GSP hydrogeologic conceptual model (Pueblo, 2022).

Table 1. Model Layering Description

Model Layer	Representation in SU-1	Representation in SU-2	Number of Active Cells
1	Quaternary alluvium and Casitas Formation above A zone	Quaternary alluvium above A zone (analogous to layer 1 in SU-1)	3553
2	A Aquifer zone	Shallow Santa Barbara Formation	3396
3	Casitas Formation between A and B zone	Deep Santa Barbara Formation (analogous to layer 7 in SU-1)	3696
4	B Aquifer zone	Not active in SU-2	3246
5	Casitas Formation between B and C zone	Not active in SU-2	3388
6	C Aquifer zone	Not active in SU-2	3894
7	Casitas Formation and Santa Barbara Formation below C zone	Not active in SU-2 (layer 7 is present below SU-2)	3905

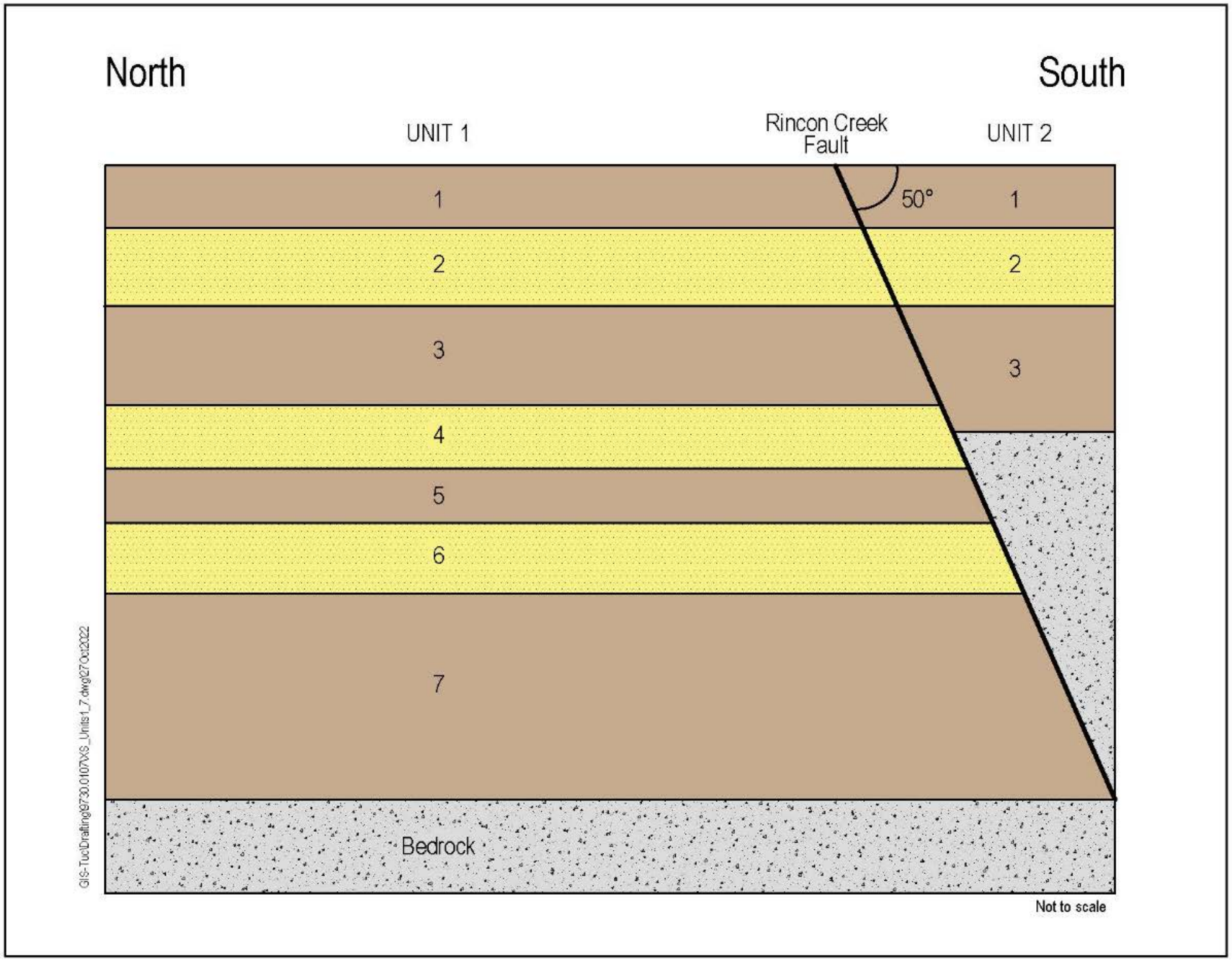

Figure 2. Schematic Cross Section Through Storage Units 1 and 2

2.2.3 Time Frame, Stress Periods, and Timesteps

The model time frame runs from October 1984 through September 2020, representing WY 1985 through WY 2020.

The model operates using monthly stress periods; therefore water budget components are input to the model on a monthly basis. Within each monthly stress period, 5 timesteps are simulated during which groundwater flow and mass conservation is calculated based on the stress period's water budget input.

2.2.4 Lateral and Vertical Active Extent

The model domain covers approximately 36 square miles encompassing the Basin and surrounding areas as shown on Figure 1, which displays the Model's lateral extent. Dark grey cells are inactive in all layers, while clear cells are active in at least 1 layer. The original model active area described in HydroMetrics WRI, 2012, was based on the extent of Carpinteria basin at the time, as defined in the conceptual model (Pueblo Water Resources Inc., 2012). Since this period, the Carpinteria Basin boundaries have been modified. Major changes include the following:

- The Montecito area near Summerland is no longer considered part of the Basin for jurisdictional purposes
- The Basin's northern and southeastern boundaries have been refined (DWR, 2020)
- The eastern boundary of the Basin has been moved to the east

The latter 2 changes have been incorporated into the current model's active areas; the model's active area has been expanded or restricted as required to correspond to the alluvial Basin's modified boundaries. As the border with the Montecito area does not reflect a hydrogeologic barrier, this portion of the model has been kept active.

The bottom elevations of each model layer are presented on Figure 3. Model layer elevations were derived from contours provided by Pueblo Water as described in HydroMetrics WRI, 2012, including the following:

- Contours for the top and bottom of A, B, and C zones in SU-1
- Contours for the top of bedrock in both SU-1 and SU-2

As these contours did not cover the full model extent, they were extrapolated as necessary to cover the full model active area. This process is described in HydroMetrics WRI, 2012. For this 2022 update, layering was further extrapolated using radial basin function extrapolation to cover areas of the Basin expanded from the 2012 model. A schematic diagram illustrating the model layering in each storage unit is presented on Figure 2. Within SU-1, layers 2, 4, and 6 represent high producing zones.

A 3D diagram of the active model extent is presented on Figure 4, presented with 2x vertical exaggeration to highlight model layering. The nature of model layering is synclinal, correspondent with the Basin's stratigraphy. The following figures (Figure 5 through Figure 7) display 3D cross sections of model layering. The locations of these cross sections are labeled and outlined on Figure 4.

Figure 5 presents an east-west cross section through model grid row 46; this cross section runs through the center of the Basin in SU-1 and illustrates how model layers progressively outcrop to the west. This construction is reflective of the synclinal nature of the Basin's stratigraphy. Note the relative thickness of the model layers that include representation of high production A, B, and C zones - model layers 2 (green), 4 (pink), and 6 (dark blue). Consistent with hydrogeologic understanding, these layers are relatively thin in comparison to the overlying and underlying layers.

Figure 6 presents a north-south cross section through model grid column 70; this cross section runs through the central-western portion of the Basin through SU-2. Here the layering is simple "layer cake" stratigraphy, reflecting the alluvial basin-fill nature of Basin stratigraphy in SU-1.

Figure 7 presents a north-south cross section through model grid column 122; this cross section runs through the eastern portion of the Basin through SU-1 and SU-2. Here the transition between SU-1 and SU-2 can be seen, reflecting the influence of the Rincon Creek Thrust Fault. South of this fault (left side of cross section), only layers 1, 2, and 3 exist in SU-2. Layer 7 is present below SU-2, separated by inactive cells, as shown by the gap between layers 3 and 7.

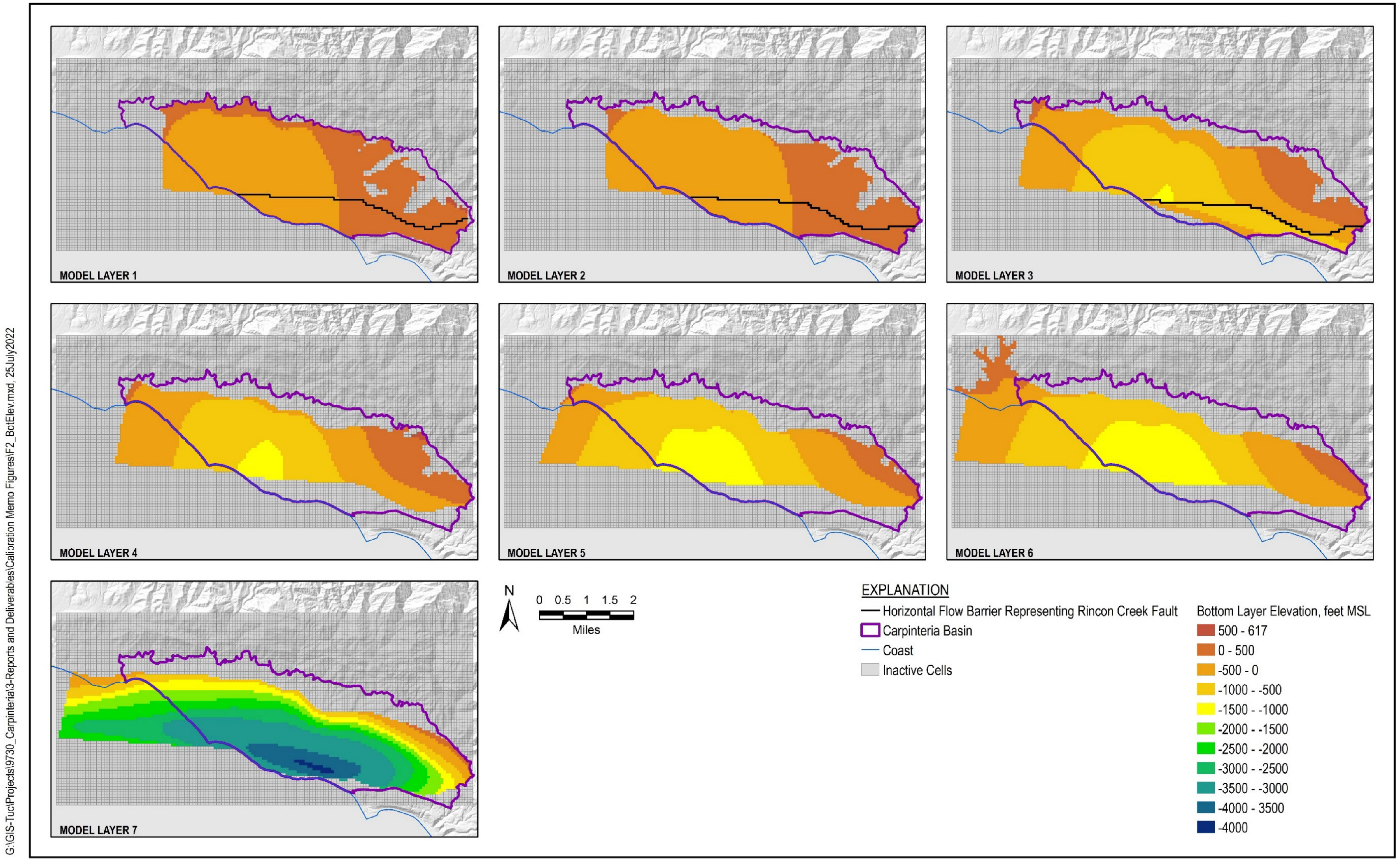

Figure 3. Model Layer Bottom Elevations

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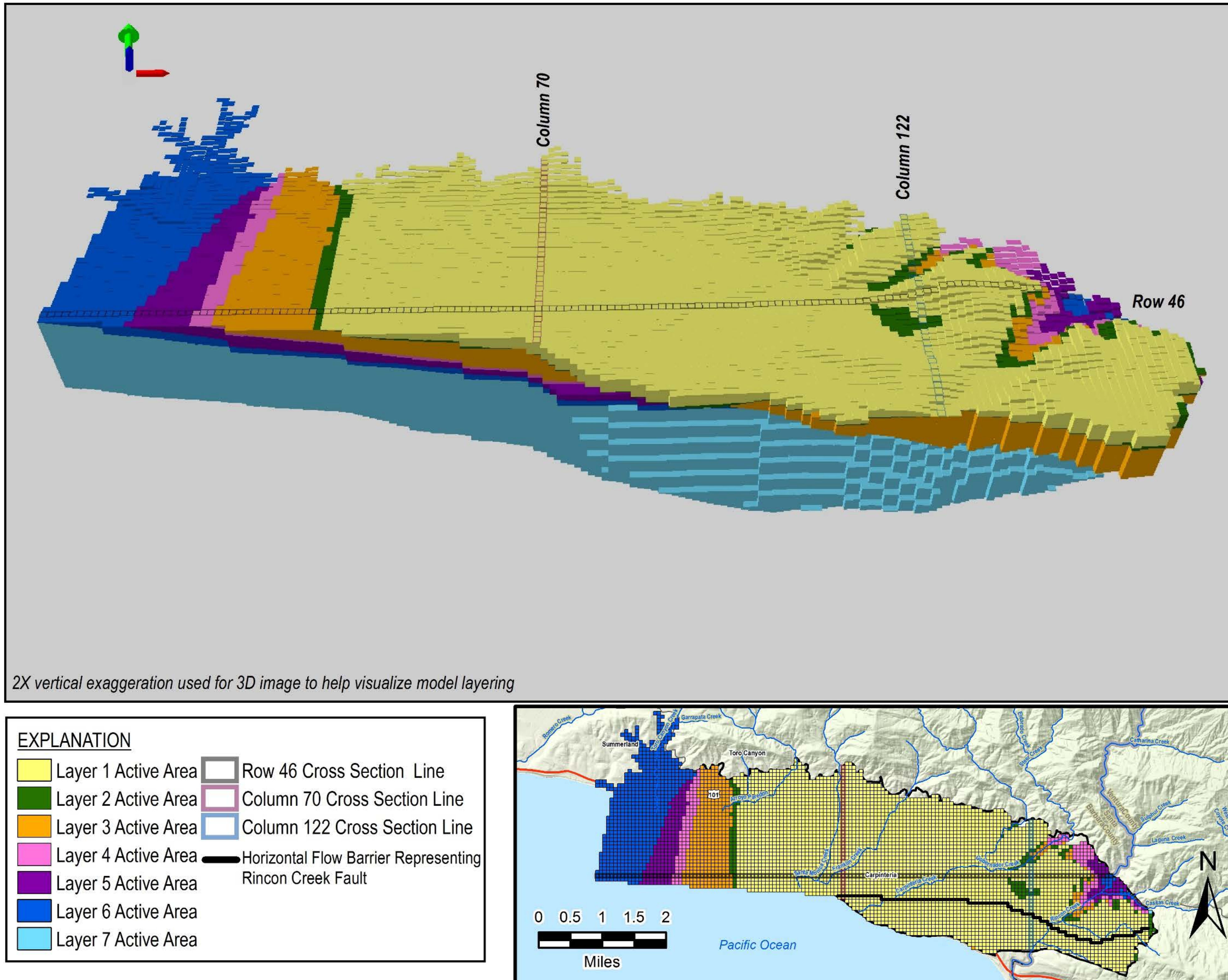

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Figure 4. 3D Visualization of Active Model Cells and Location of Cross Sections (2x Vertical Exaggeration)

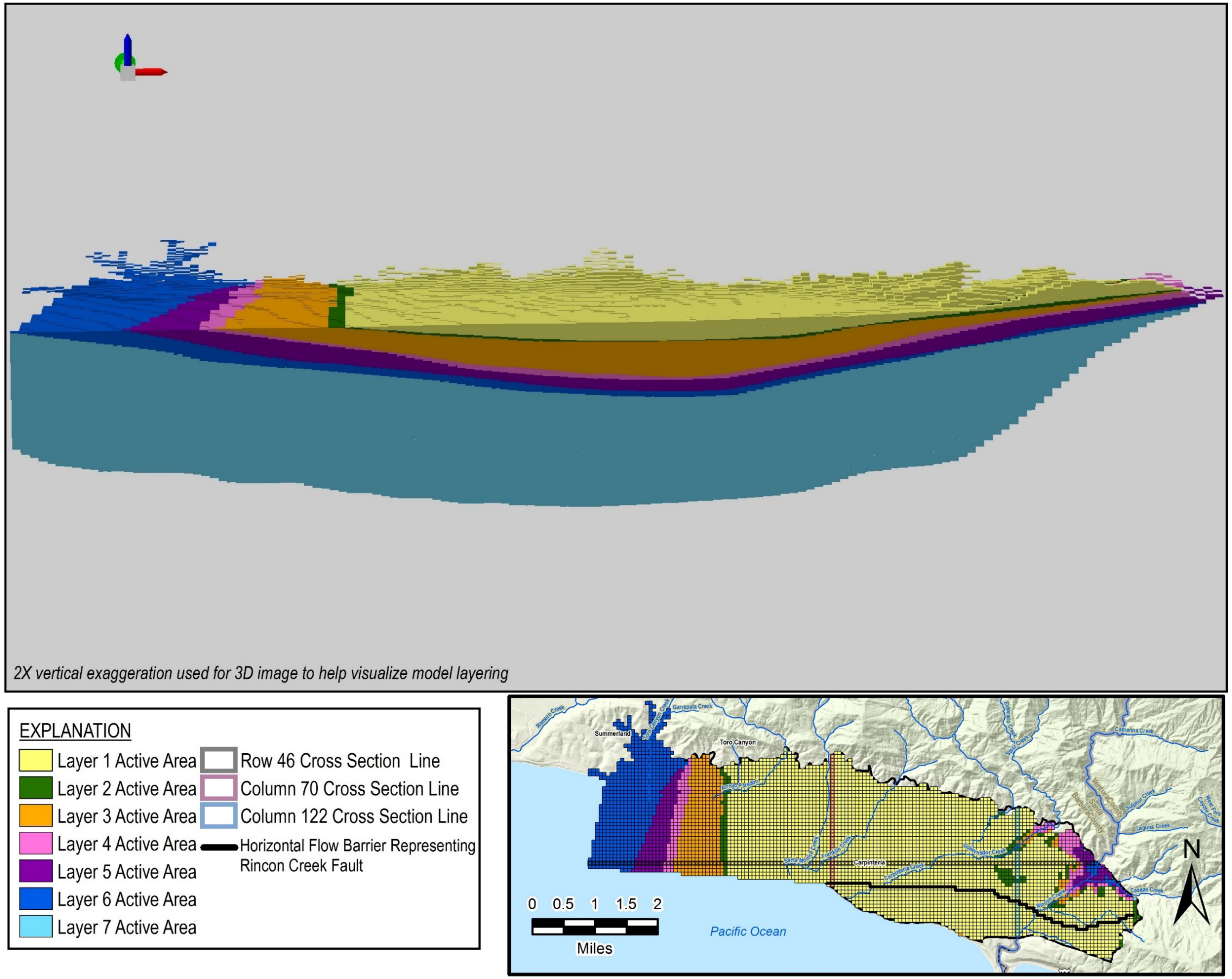

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Figure 5. Row 46 East-West Cross Section of Active Model Cells (2x Vertical Exaggeration)

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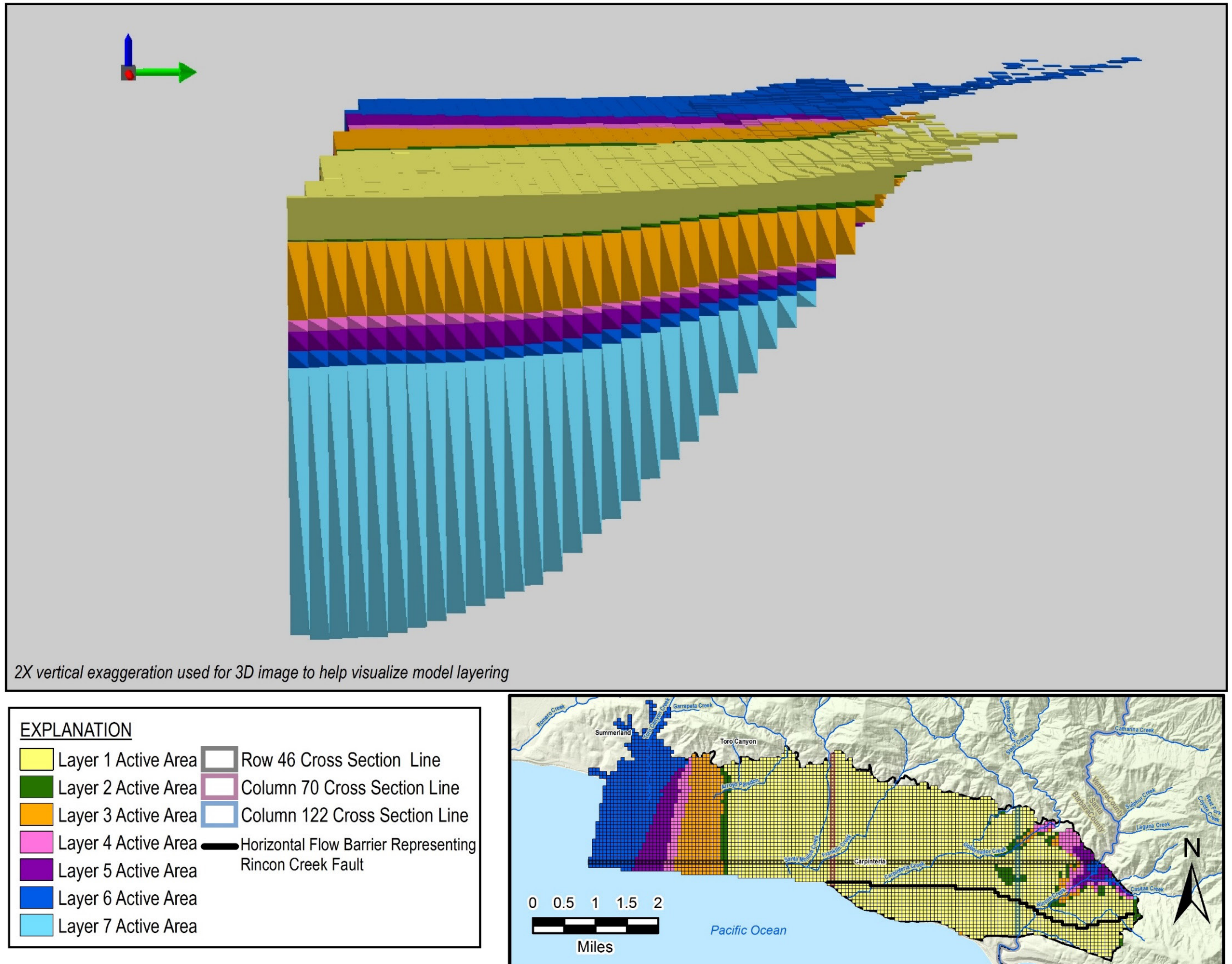

Figure 6. Column 70 North-South Cross Section of Active Model Cells (2x Vertical Exaggeration)

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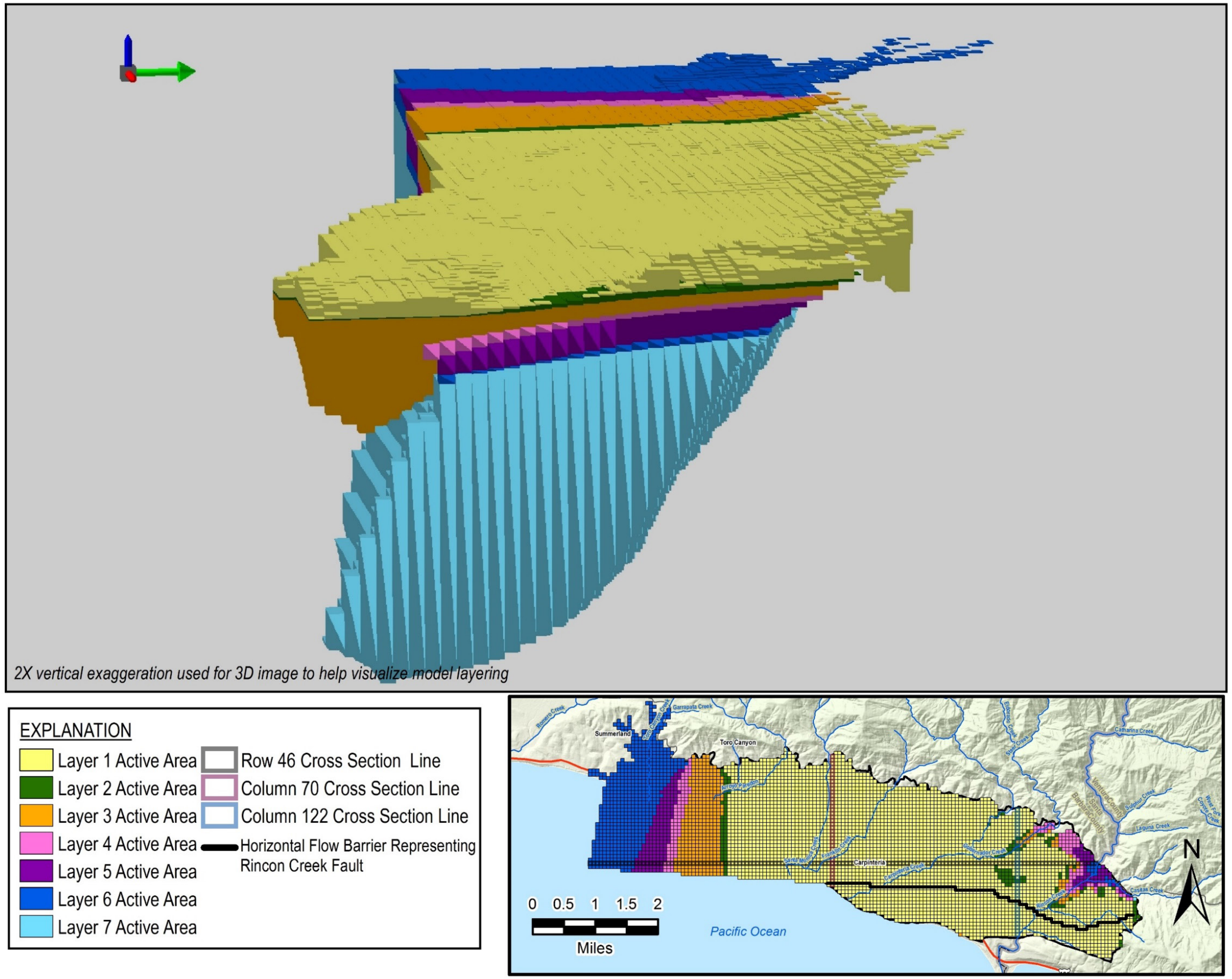

Figure 7. Column 122 North-South Cross Section of Active Model Cells (2x Vertical Exaggeration)

2.3 Initial Heads

Initial heads are specified using the MODFLOW BAS6 (.bas6) file. Over the majority of the model area, initial heads are identical to the annual 2012 model (HydroMetrics WRI, 2012). The initial heads (Figure 8) are representative of fall 1984 groundwater conditions, originally developed using an interpolation of historical groundwater elevations. In the expanded model areas described in Section 1.2, radial basis function extrapolation was used to develop appropriate initial heads.

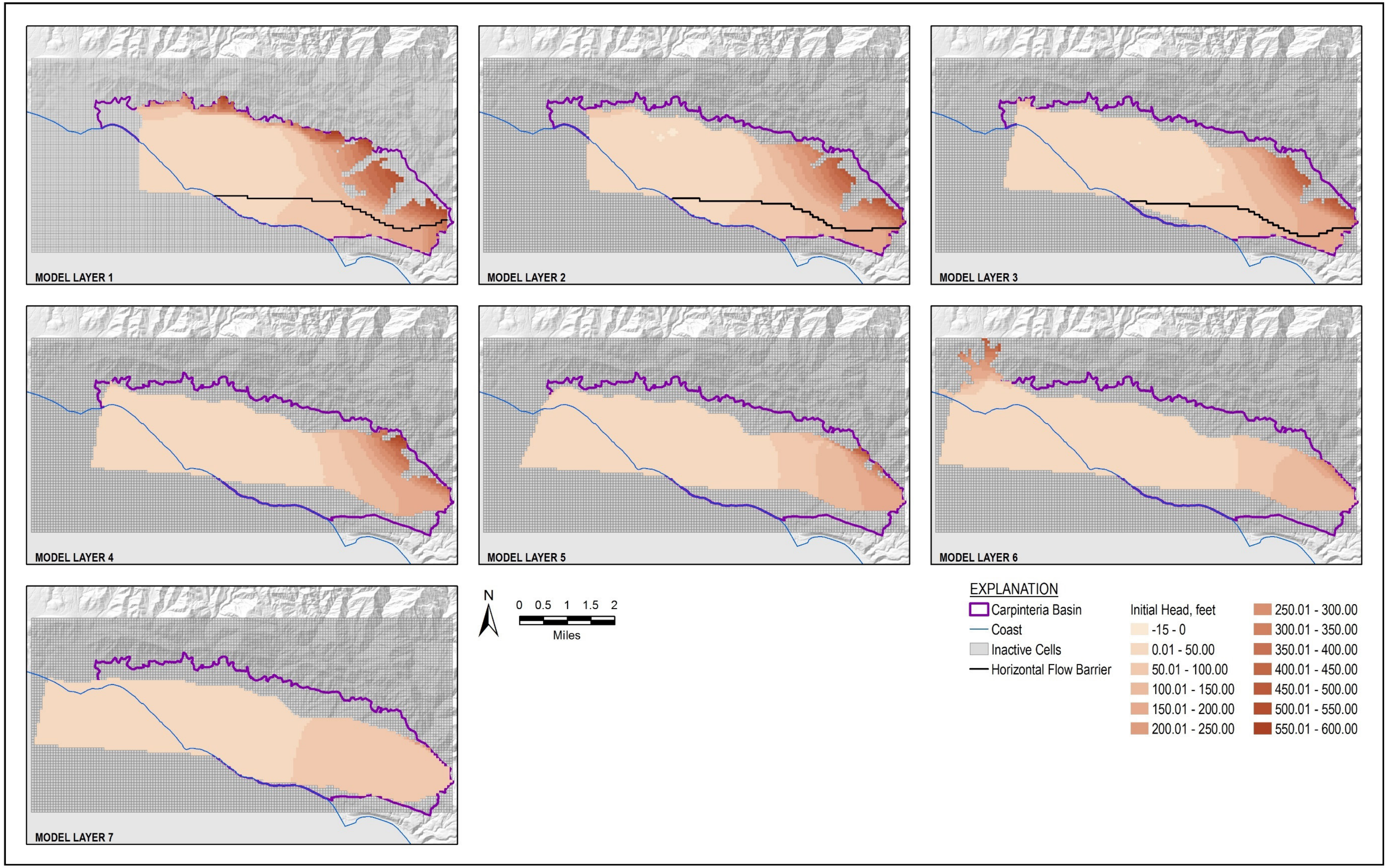

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Figure 8. Initial Heads

2.4 Boundary Conditions

The following subsections describe how Rincon Creek Thrust Fault and the ocean boundary condition are implemented in the model.

2.4.1 Faults and Flow Barriers

The Rincon Creek Thrust Fault has an approximately 50 degrees from horizontal southward dip and constitutes a barrier to groundwater flow within the Basin separating SU-1 and SU-2. To represent this fault in 3 dimensions, the MODFLOW Horizontal Flow Barrier (HFB; .hfb) package was used to implement a horizontal flow barrier, and the MODFLOW Layer-Property Flow (LPF; .lpf) package was used to implement a vertical flow barrier (HydroMetrics WRI, 2012). As part of this update, these boundaries were extended to match the updated eastern Basin boundary.

To represent the fault's southward dip, HFB barrier cells were implemented increasingly southward through layers 1 through 3 (Figure 9). HFB barrier thickness is assumed to be 1 foot. In the cells south of the HFB (Figure 9), quasi-3D confining beds are implemented beneath layers 1 and 2 to limit vertical flow consistent with how the HFB limits horizontal flow. Quasi-3D confining bed thickness is assumed to be 1 foot and bed conductivity is set to be consistent with the conductivity of the HFB in the layer above.

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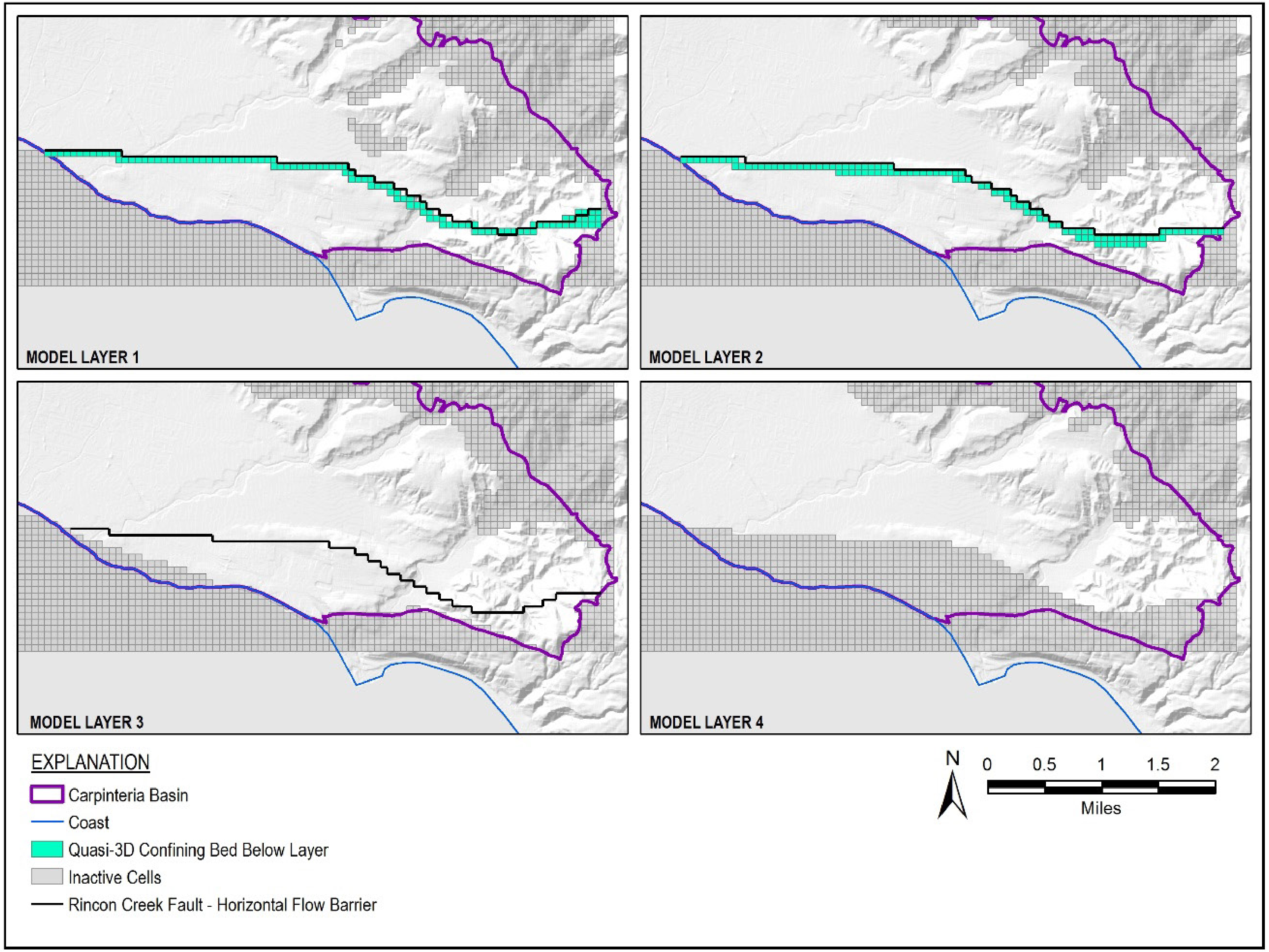

Figure 9. Horizontal Flow Barriers and Quasi-3D Confining Beds

2.4.2 Ocean Boundary Condition

East of the El Estero wetlands near the mouth of the Santa Monica Creek, SU-1 is hydrogeologically separated from the ocean by the Rincon Creek Thrust Fault, which creates a barrier to flow between SU-1 and SU-2. Further east, significant subsurface outflow is not believed to occur in SU-2 due to the onshore contact of unconsolidated water-bearing materials with consolidated bedrock.

Basin deposits in SU-1 west of El Estero are understood to be in contact with the ocean (Pueblo, 2012). Available geologic information from offshore oil well logs in this area is insufficient to establish whether there is hydraulic continuity between the basin deposits and ocean bed, and therefore it remains unclear whether the productive A, B, and C zones continue offshore. Further, known undifferentiated continental shelf sediments could substantially limit hydraulic continuity between the Pacific Ocean and the basin deposits. Despite this, extrapolation of the A, B, and C zones suggests they may constitute a conduit for substantial flows to and from the ocean. Historical understanding of this connection has been that average climactic and water level conditions support a net outflow from the Basin to ocean. If conditions occur such that inflow from ocean occurs, seawater intrusion may be possible.

Where model layers outcrop to the ocean, and hydrogeologic conditions described above substantiate a connection to the ocean, a MODFLOW general head boundary is implemented to simulate the ocean boundary condition. Figure 10 shows the implementation of general head boundaries by model layer. The boundary condition heads are held constant over the historical model period. As seawater has a higher density than freshwater, the ocean boundary condition is implemented using a freshwater equivalent head calculation derived from Guo and Langevin, 2002:

$$H_{Fw} = \frac{\rho_{sw}}{\rho_{fw}} * (H_{Sw} - Z) + Z$$

Where:

H_{Fw}= Freshwater equivalent head
ρ_{sw} = Density of seawater
ρ_{fw} = Density of freshwater
H_{Sw}= Measured saltwater head (ocean top)
Z = Top of model cell where general head boundary condition exists

This results in a more accurate pressure head reflective of the denser seawater in the ocean.

For this report, Z is considered at the top of the model cell where the general head boundary condition exists. Therefore, the boundary condition represents the groundwater/seawater boundary and not necessarily the saltwater/freshwater boundary which may exist inside the aquifer. To evaluate the importance of this assumption, the model was also tested using the middle of the cell elevation (centroid) for Z, whereupon no substantial influence on simulation was observed. This analysis is described in more detail in Section 3.4.2.

Consistent with the 2012 annual model, all ocean boundary cells are assigned a conductance of 90,000 square feet per day. This conductance is equivalent to a seabed hydraulic conductivity of 1 foot per day and a thickness of 1 foot for cells with a surface area of 90,000 square feet (300 by 300 foot). Additional conductance values were tested to evaluate model sensitivity, described further in Section 3.4.3.

The color flood shown on Figure 10 displays the equivalent freshwater head in feet above NAVD88 for each GHB cell. Mean sea level is roughly 2.73 feet NAVD88 at the nearby Rincon Island station (NOAA, 2022) so H_{SW} in the above equation is assumed to be 2.73 feet NAVD88. 2.73 feet NAVD88 is thus the minimum equivalent freshwater head used for GHBs as all model layers are below sea level. This is relevant for analysis of seawater intrusion potential, as coastal heads must be higher than applicable GHB height values to discourage conditions conducive to seawater intrusion.

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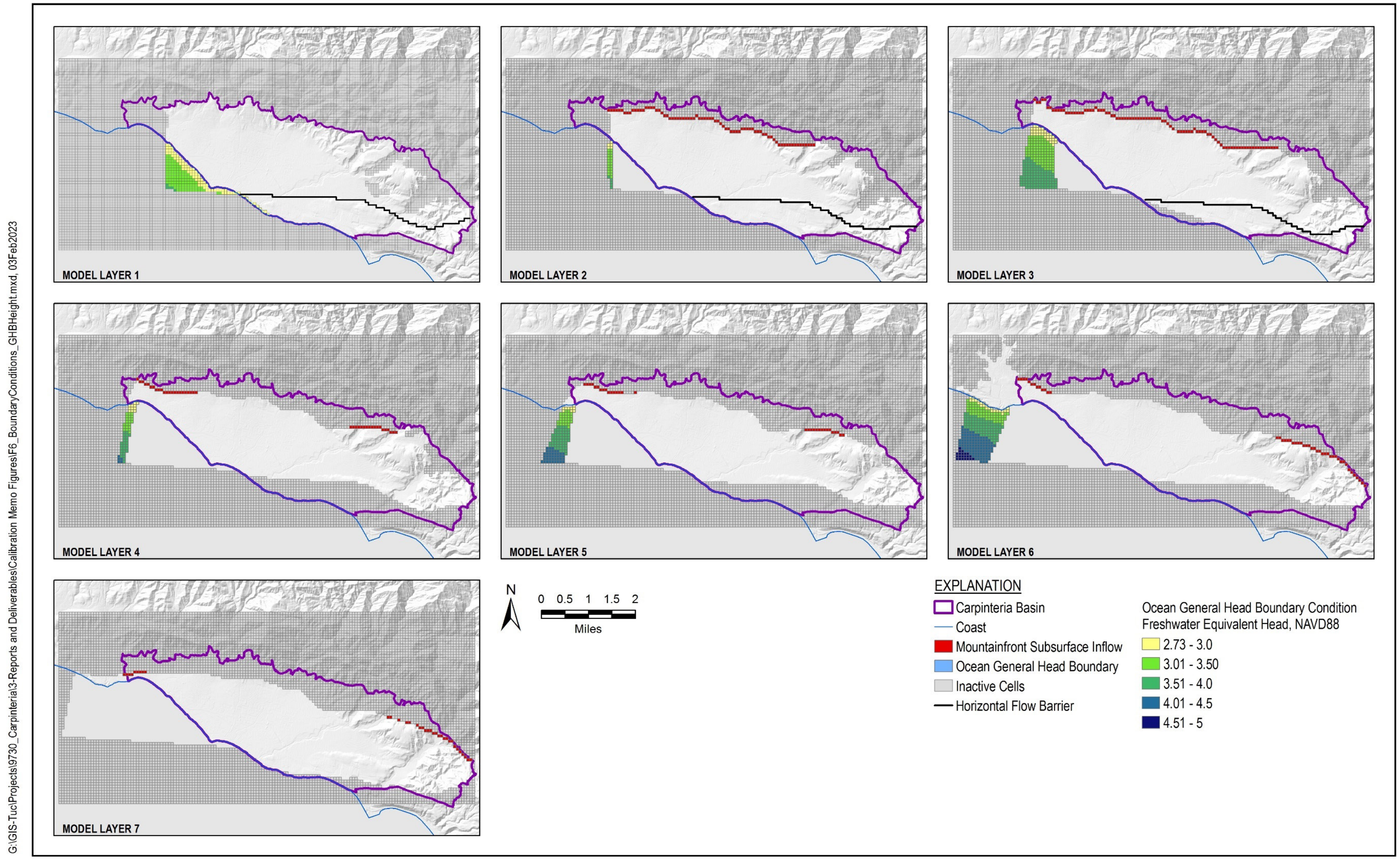

Figure 10. Ocean and Mountain-front Recharge Boundary Condition

2.5 Representation of Groundwater Budget

The following subsections describe how groundwater budget components are implemented in the model. Budget components incorporated in the model are identical to those presented in the Carpinteria Basin GSP Water Budget Section, where they are described further (GSI Water, 2022). The GSP Water Budget tables incorporate both analytically calculated budget components and components simulated by the model. How the model simulation compared to analytical GSP water budget components is described in Section 3.1. The GSP water budget components derived from the model are described in Section 3.5.

2.5.1 Mountain-front Recharge

Mountain-front recharge is flow from consolidated rocks in the mountainous areas north of the Basin into the Basin. Historical reports have identified a direct correlation between mountain-front recharge and precipitation, a relationship that has been utilized in previous model construction efforts (HydroMetrics WRI, 2012). Seasonal amounts of subsurface inflow are estimated based on a simple regression curve calculation from known relationships of average annual rainfall to subsurface inflow in any given year. The development of mountain-front recharge timeseries is described further in the Carpinteria Basin GSP Water Budget Section (GSI, 2022). The total volume of mountain-front recharge is split between the Toro (7.1%), Arroyo Parida (9.1%), Santa Monica (9.9%), Franklin (9.6%), Carpinteria (13.6%), Gobernador (20.0%), and Rincon (30.7%) watersheds.

Mountain-front recharge is simulated using injection wells from the MODFLOW WEL (.wel) package. These wells are placed along the northern boundaries of the model in layers 2 through 7 (Figure 11). These wells inject monthly volumes corresponding to the analytically calculated subsurface inflow into their corresponding watershed, as shown on Figure 11. The placement of mountain-front recharge injection wells by layer is shown on Figure 10 above. Comparison of analytically derived mountain-front recharge against the model's final simulated values is presented in Section 3.1.1.

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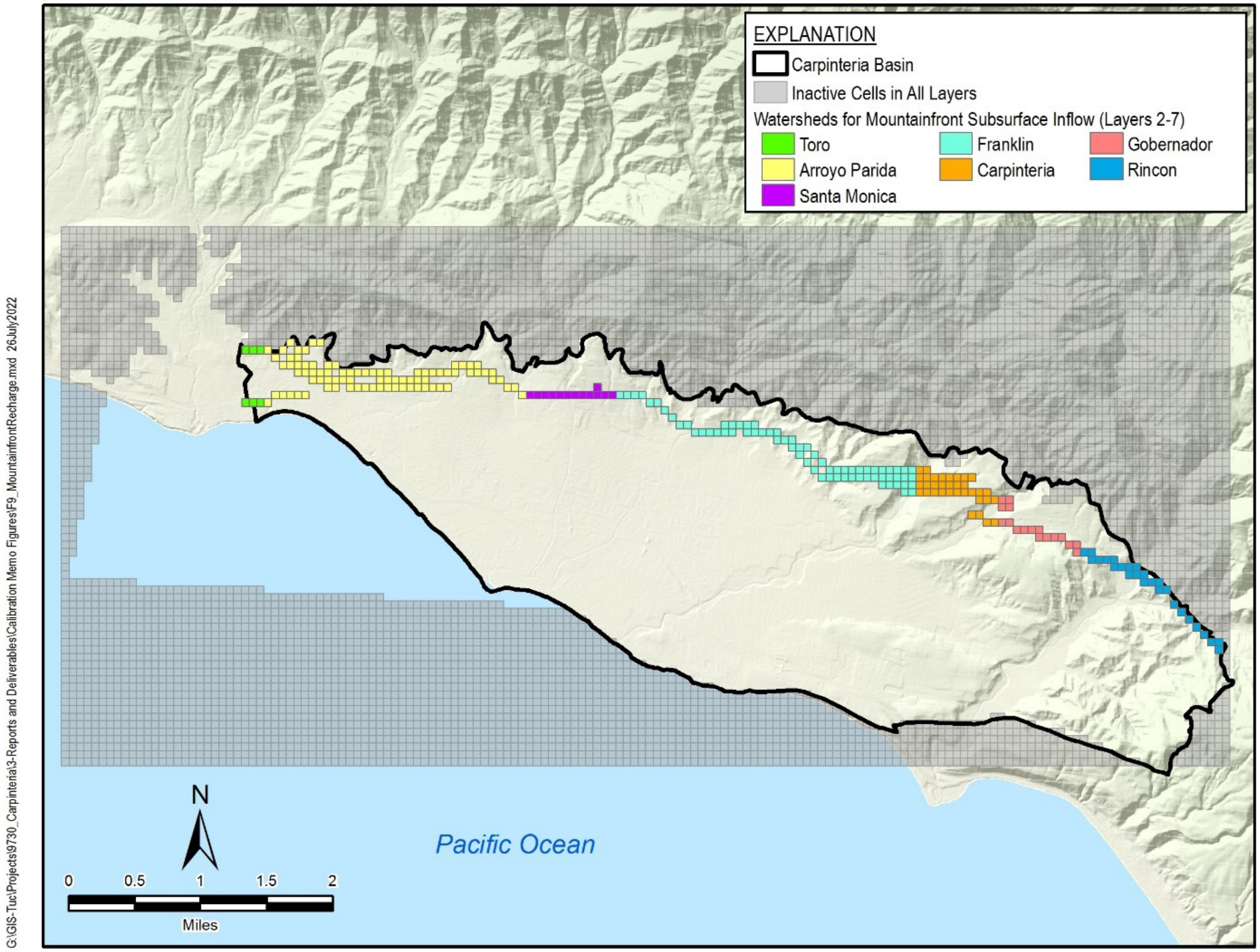

Figure 11. Mountain-front Recharge Injection Wells

2.5.2 Recharge Components

All recharge components are combined and then simulated using the MODFLOW RECHARGE (.rch) package. These include:

- Percolation of Precipitation (Areal Recharge)
- Streambed Percolation
- Irrigation Return Flows
- Extraction by Phreatophytes

Monthly volumes are applied in the model's top layer on a zonal basis (Figure 12). These zones correspond to the areas where different recharge components occur. All recharge components increase recharge to the Basin except extraction by phreatophytes, which decreases recharge to the Basin. The model's top active layering can be seen on Figure 4. A brief description of how each of these recharge inputs are developed is given in the following paragraphs. The development of recharge timeseries is described further in the Carpinteria Basin GSP Water Budget Section (GSI Water, 2022).

Direct infiltration and percolation of precipitation (areal recharge) is the most important source of recharge to the Basin. As described in Pueblo 2022, most areal recharge occurs in the Recharge Area (zones 1 and 3-7), as relatively impermeable sediments above the confined area limit percolation to groundwater. Table 2 shows the amount of average recharge that included in each zone as a percentage of that total recharge component, and shows that less than 30% of percolation of precipitation falls on the confined area. Areal recharge volumes are calculated using land use acreage and deep percolation to rainfall best-fit curve relationships. Consistent with the annual model, it is assumed that 5% of areal recharge components to SU2 reach the water table (HydroMetrics WRI, 2012).

Streambed percolation is assumed to occur only where streams cross the Recharge Area (zones 3-7) as relatively impermeable sediments above the confined area limit percolation to groundwater (GSI, 2022). There are 5 principal streams within the Basin: the Carpinteria, Gobernador, Santa Monica, Arroyo Parida, and Rincon Creeks. As described in Pueblo 2012, relationships developed using an analysis of annual runoff and stream seepage losses are utilized to develop monthly streambed percolation volumes.

Percolation of irrigation water to groundwater is dependent on climate, crop type, and irrigation practices. Studies by the U.S. Soil Conversation Service for Santa Barbara County indicate irrigation efficiencies range from 65 to 70 percent (GSI, 2022). For purposes of estimating deep percolation of irrigation return water in the CGB, a conservative estimate that 20% of applied water (both pumped and delivered) percolates into the Basin is used. This conservative factor considers the relatively steeper slopes found in many portions of the Recharge Area and the relatively more efficient sprinkler-type irrigation commonly used in the Basin. Irrigation return flow calculations consider pumped and delivered imported water.

Phreatophyte plants have roots that directly tap groundwater. Within the Basin, these exist in the vicinity of stream channels and in areas of shallow groundwater (GSI, 2022). While there are no direct measurements of consumptive use by phreatophytes in the Basin, volumes are estimated using known plant species, vegetative density, climate, soil types, and depth to groundwater (GSI, 2022).

Comparison of analytically derived recharge components against the model's final simulated values is presented in Section 3.1.2.

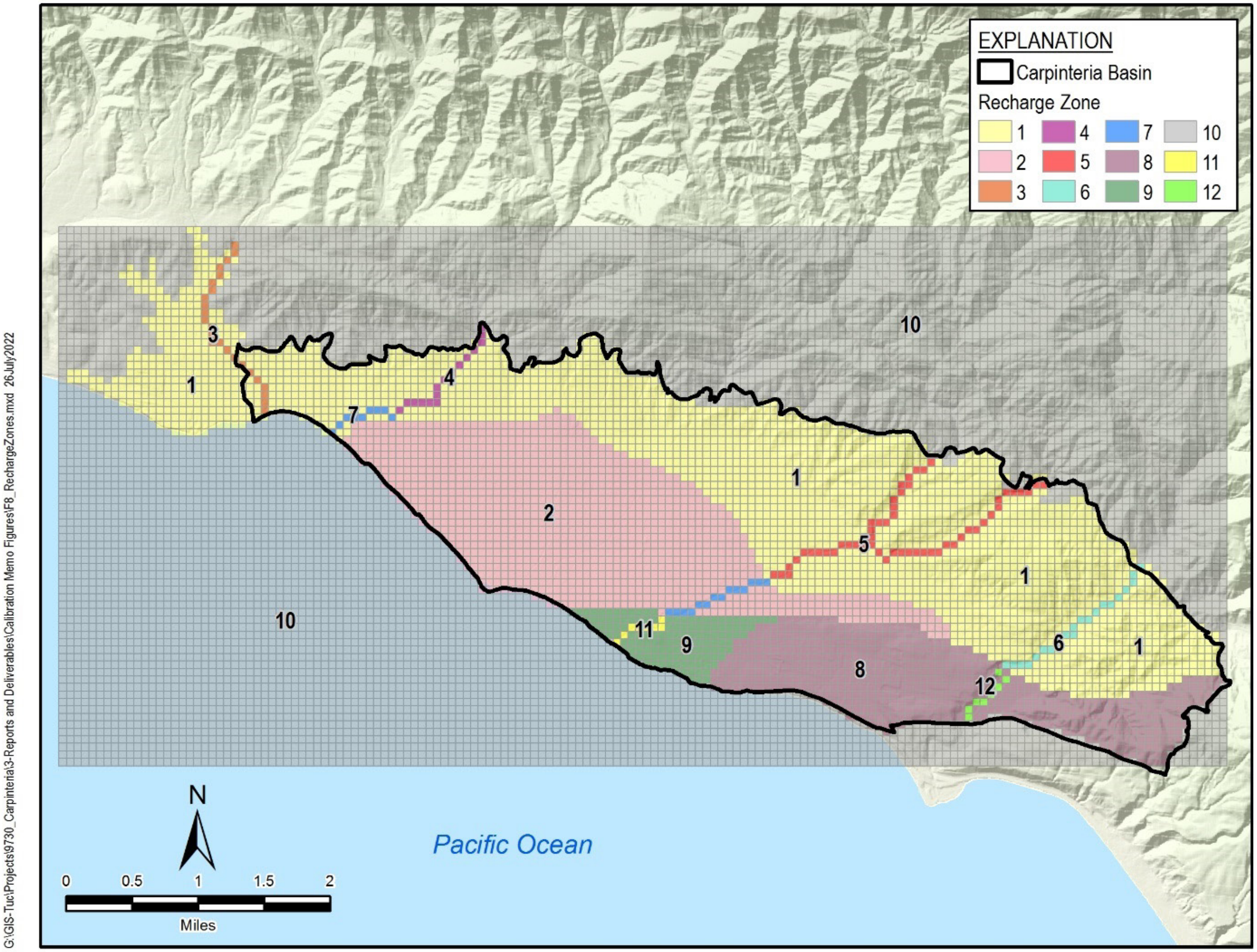

Figure 12. Model Recharge Zones

Table 2. Percentage of Each Recharge Component Assigned to Each Zone

Zone	No. Cells	Zone Description	Percolation of Precipitation	Percolation of Delivered Water	Percolation of Pumped Water	Percolation of Streamflow	Extraction by Phreatophytes
1	2231	Unconfined area, SU-1	67.47%	94.20%	94.20%	0.00%	0.00%
2	1051	Confined area, SU-2	27.58%	0.00%	0.00%	0.00%	0.00%
3	24	Toro Canyon Creek, unconfined area, SU-1	0.73%	1.01%	1.01%	7.79%	15.69%
4	16	Arroyo Parida Creek, unconfined area, SU-1	0.48%	0.68%	0.68%	5.98%	10.46%
5	53	Gobernador Creek, unconfined area, SU-1	1.60%	2.24%	2.24%	63.88%	34.64%
6	21	Rincon Creek, unconfined area, SU-1	0.64%	0.89%	0.89%	16.19%	13.73%
7	23	Gobernador Creek, confined area, SU-1	0.60%	0.00%	0.00%	0.00%	15.03%
8	571	Unconfined Area, SU-2	0.70%	0.98%	0.98%	0.00%	0.00%
9	134	Confined Area, SU-1	0.18%	0.00%	0.00%	0.00%	0.00%
10	7092	Ocean and inactive model cells (no recharge)	0.00%	0.00%	0.00%	0.00%	0.00%
11	8	Gobernador Creek, confined area, SU-2	0.01%	0.00%	0.00%	0.00%	5.23%
12	8	Rincon Creek, unconfined area, SU-2	0.01%	0.01%	0.01%	6.17%	5.23%
Total	**11232**	**Entire model area**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

2.5.3 Groundwater Extraction

Groundwater extraction in the basin occurs in both Carpinteria Valley Water District (CVWD) metered production wells and private wells. CVWD wells are equipped with flow meters that provide monthly pumping volumes. As private pumping in the Basin is typically not metered, volumes are estimated using land use survey and imported water delivery information.

CVWD supplies imported water and/or local groundwater to numerous agricultural parcels of known acreage and crop type (avocados, cherimoyas, open and covered nurseries, etc.). From these metered deliveries, unit use values (known by CVWD as “determining factors”) for various crop types have been estimated each year since 1984. These unit use values have been combined by CVWD with land use acreage data to estimate private well production in the Basin. The development of groundwater extraction timeseries is described further in the Carpinteria Basin GSP Water Budget Section (GSI Water, 2022)

Appendix C contains the screening elevations and identified layers for each production well included in the model. At some wells, screening elevations were found to be lower than the model bottom elevation, indicating a well potentially screened in bedrock. Where wells were screened completely below the model, pumping was not included. Where wells were screened partially below the model, pumping was reduced proportionally to length of screen below the model, as noted in Appendix C.

Groundwater pumping is simulated using the MODFLOW Revised Multi-Node Well (MNW2; .mnw2) Package (Konikow *et al.*, 2009). The location of MNW2 extraction wells is shown on Figure 13, with CVWD municipal wells shown in yellow. While most wells were implemented as multi-node wells (wells screened across 2 or more model layers), select wells were implemented as single node to minimize seepage face pumping losses, as indicated in Appendix C. Seepage face losses are an unavoidable component of MNW2 code, where MODFLOW reduces pumping at multi-node wells with lower groundwater levels to maintain what it considers a realistic pumping rate based on the saturated face of the well. Comparison of analytically derived groundwater extraction against the model’s final simulated values is presented in Section 3.1.3.

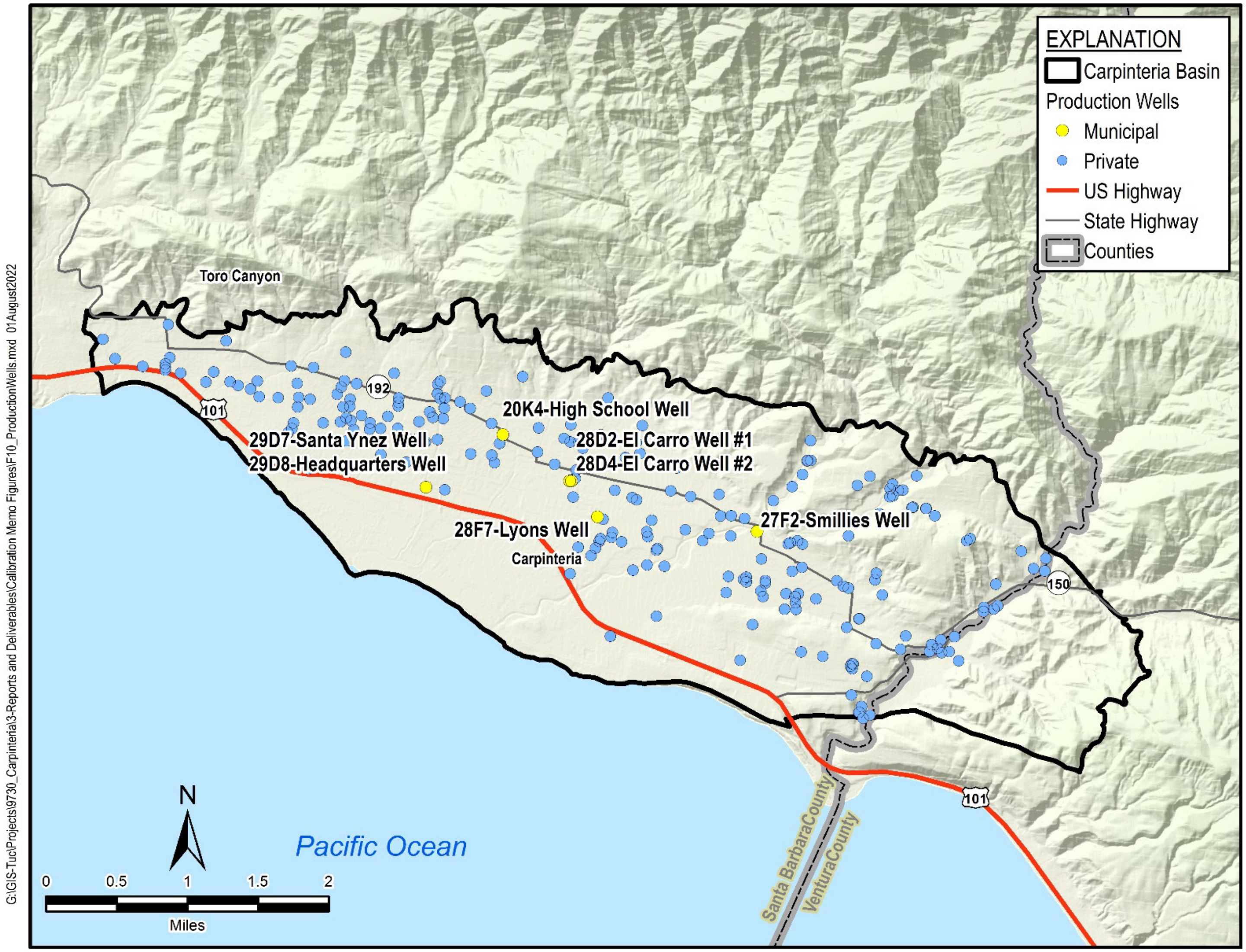

Figure 13. MNW2 Production Well Locations

3 MODEL CALIBRATION AND HISTORICAL SIMULATION RESULTS

3.1 Comparison of Model Simulation to Water Budget Components Used in GSP

The following subsections compare simulated model outputs against the analytically calculated inputs to describe how well the model matches input assumptions. Understanding discrepancies between analytical inputs and model outputs is critical to understanding the model's strengths and limitations.

3.1.1 Mountain-front Recharge

As described in Section 2.5.1, the MODFLOW WEL (.wel) package is used to simulate mountain-front recharge into the Basin.

Figure 14 compares mountain-front recharge inputs and simulated monthly mountain-front recharge. Mountain-front recharge is simulated very well by the model; average monthly simulated recharge is 100% of input recharge. In some months, simulated recharge is slightly lower than the corresponding month’s input, which may be a result of model dry cells or mounded heads delaying input.

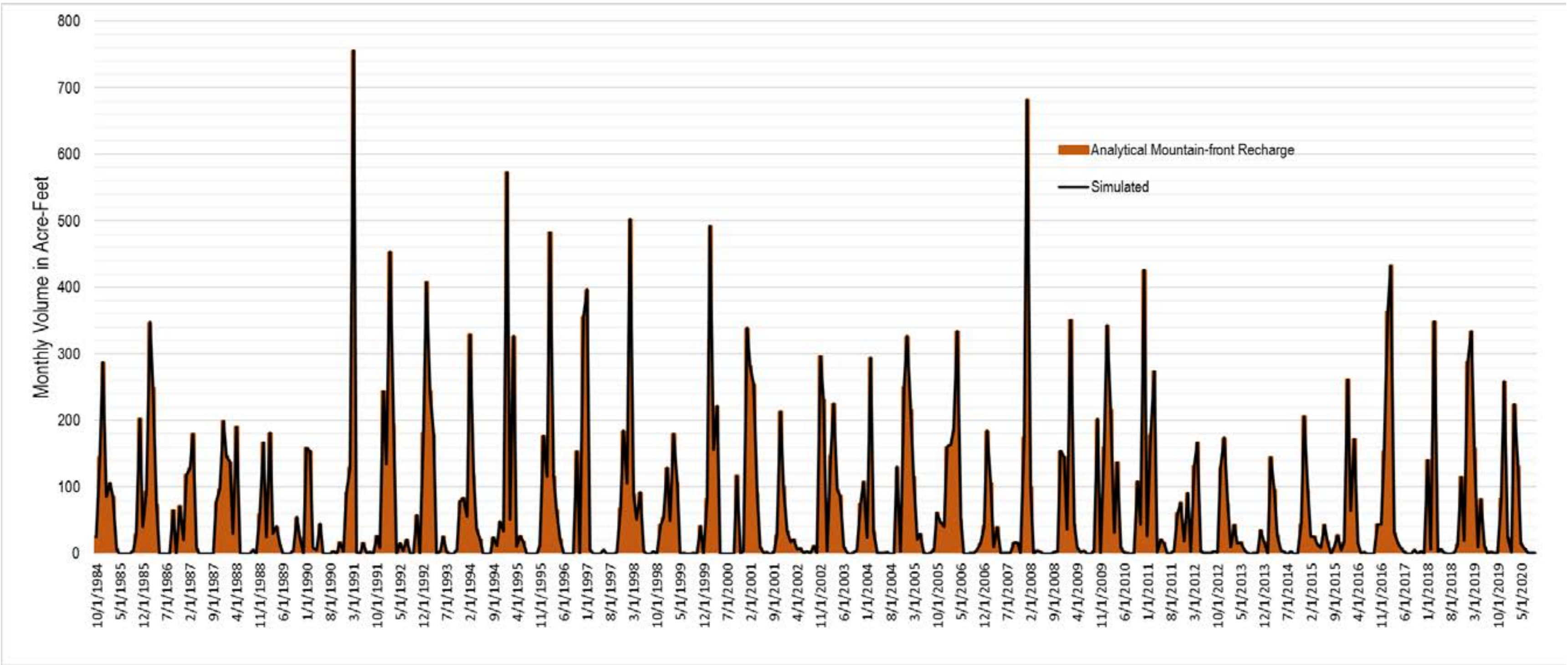

Figure 14. Simulated Monthly Mountain-front Recharge

3.1.2 Recharge Inputs

As described in section 2.5.2, several recharge inputs are simulated using the MODFLOW .rch package. The monthly volume of each recharge input as compared to simulated recharge in each zone is displayed on Figure 15 through

Figure 17. These inputs are extremely well represented by the total simulated recharge in each zone. Note the differing Y axis scale on each figure; recharge zone 1 and recharge zone 2 receive the most recharge. Because the recharge package is used to simulate phreatophyte extraction along riparian zones as negative recharge at the water table, some zones experience net negative recharge.

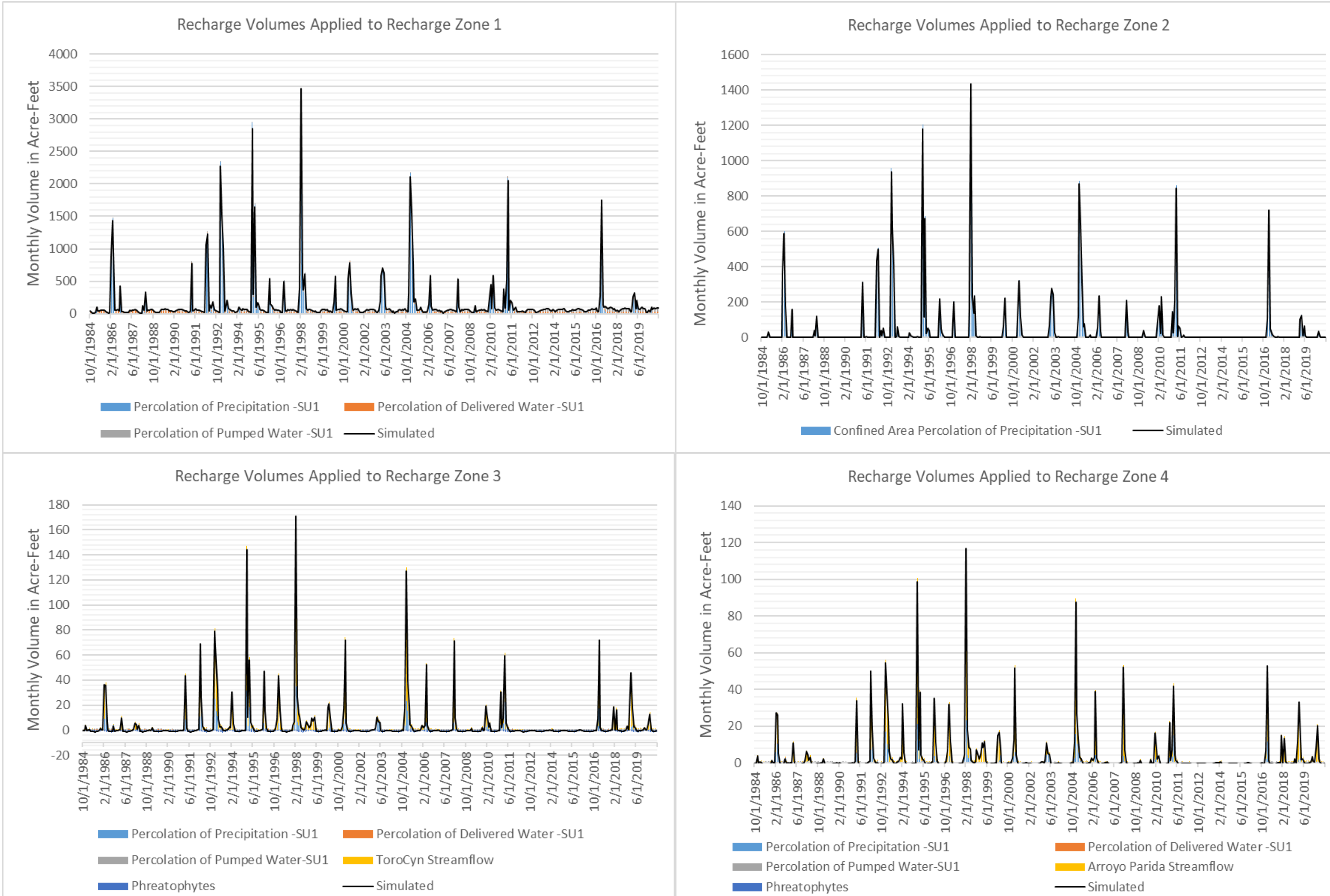

Figure 15. Simulated Recharge Components for Recharge Zones 1 Through 4

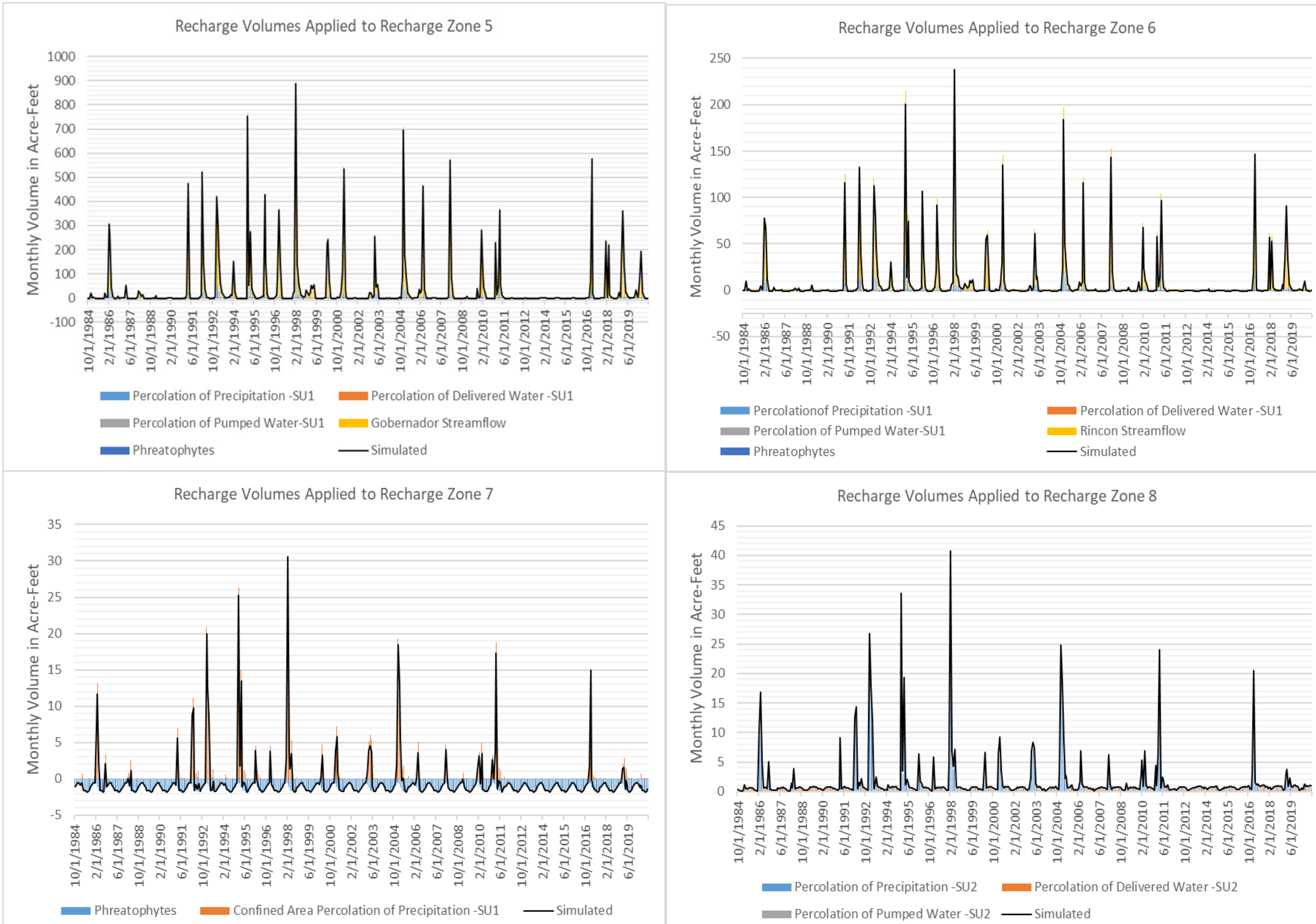

Figure 16. Simulated Recharge Components for Recharge Zones 5 Through 8

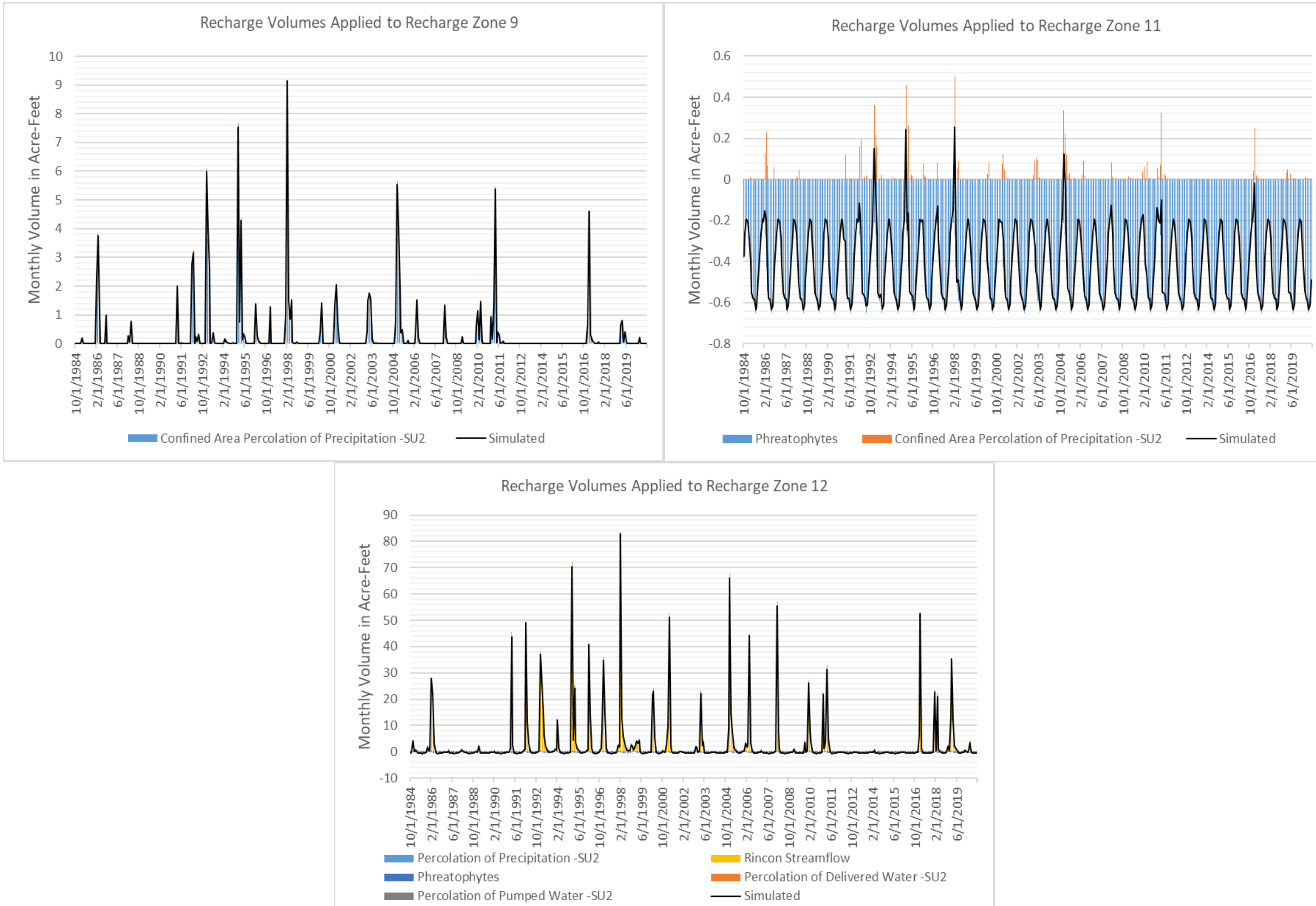

Figure 17. Simulated Recharge Components for Recharge Zones 9, 11, and 12

3.1.3 Groundwater Pumping

As described in Section 2.5.3, the MODFLOW MNW2 (.mnw2) package is used to simulate private and municipal pumping in the Basin. Monthly estimated historical groundwater extraction is compared with model simulated MNW2 pumping on Figure 18. Simulated pumping does not exactly match pumping input to the model due to the influence of internal MODFLOW seepage face calculations. The MODFLOW MNW2 package utilizes an internal Theim calculation to determine groundwater head in each layer of a given well simulated to extract from multiple layers; this calculation factors in groundwater elevations in the cell where the well exists, neighboring well pumping, and aquifer parameters in the cell. If this calculation results in well head lowering such that there exists a seepage face (unsaturated interval above the head in the well), MODFLOW will restrict pumping at the well to maintain local mass balance at the well location (Konikow *et al.*, 2009). This feature cannot be turned off. The discrepancy between input and simulated pumping is referred to as seepage face losses and can be seen on Figure 18.

Substantial seepage face losses were also present in the original model version, which utilized annual stress periods (see Figure 28 of HydroMetrics WRI, 2012). The shift from annual to monthly pumping exacerbated these losses by concentrating high pumping into a smaller time periods, correspondent with seasonal fluctuations. This can be seen on Figure 18; most seepage face losses occur during the growing season when pumping is higher.

Substantial work was done during this update to minimize seepage face losses, including editing MNW2 file parameters and adjusting screening of wells with particularly notable seepage face losses. This work focused on ensuring that metered municipal wells were accurately represented, since these wells pump relatively large volumes and have low uncertainty associated with their pumped volumes. The model currently reflects just under 94% of total input pumping on average; prior to these edits the model reflected under 90% of total input pumping on average.

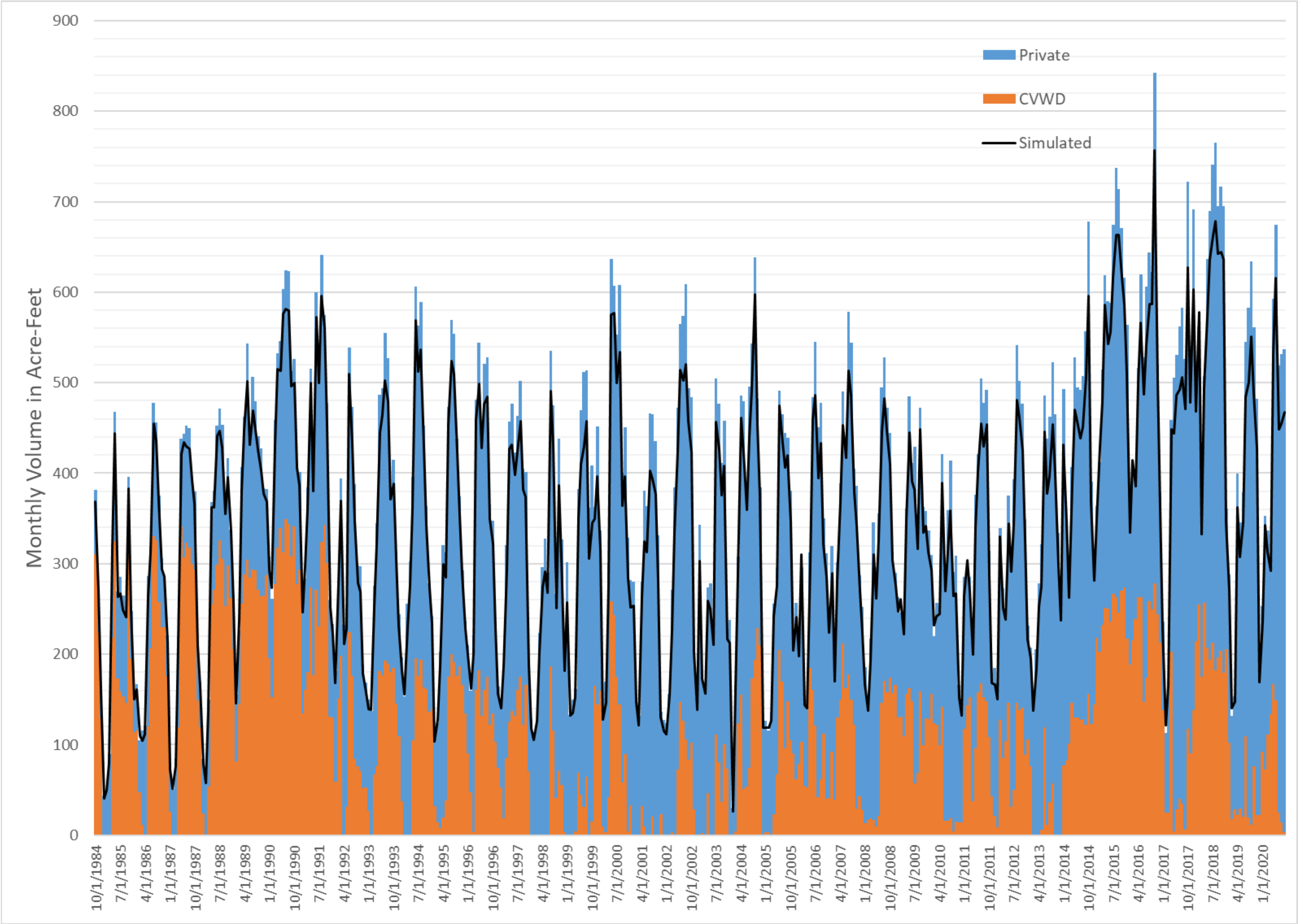

Figure 18. Simulated Monthly Groundwater Pumping

3.2 Calibration Dataset and Techniques

Parameter-based calibration methods iteratively edit model parameters (adjusted variables) at specific locations in the model grid (pilot points) until a suitable fit between model outputs and real-world observations (target variables) is reached. This updated calibration utilized Model-Independent Parameter Estimation and Uncertainty Analysis (PEST) software informed by the results of sensitivity test runs. A pilot point approach and regularization were used to smoothly distribute hydraulic conductivity, specific storage, and specific yield over each layer. Prior information from pumping test estimates for horizontal hydraulic conductivity was also used to constrain calibration. The model was considered calibrated when simulated results acceptably matched observations, and when successive calibration attempts did not notably improve calibration statistics.

3.2.1 Target Variable

The target variable for calibration was groundwater elevation (head). A groundwater level dataset from the GSP data management system containing a total of 199 wells. Of these, 39 wells encompassing 8,901 observations were selected for model calibration based on adherence to the following criteria:

- More than 1 water level measurement
- Data within the model time frame
- Inclusion in 2012 calibration or availability of data to assign well screen elevations
- Adequate representation of the screened aquifer by the model, necessitating removal of wells screening perched groundwater or other anomalous data

As the model runs on a monthly stress period, more frequent transducer data at the Sentinel wells were summarized to monthly averages for calibration. In other cases where more than 1 manual observation existed in a stress period, these were weighted proportionate to the total number of observations in the stress period. Elevation measurements influenced by nearby pumping or pumping at the observation well itself were also removed. In the context of PEST calibration, these wells are called observation wells. A table of observation wells used, their absolute screening elevations, and their model layering percentages is presented in Appendix B.

3.2.2 Adjusted Variables

The following variables were set up to be adjusted by PEST:

- Horizontal hydraulic conductivity (Kx)

- Vertical hydraulic conductivity (Kz) using vertical anisotropy (Kx/Kz)
- Specific storage (Ss)
- Specific yield (Sy)

Kx, Kz, and Ss were also adjusted variables in the 2012 annual model calibration (HydroMetrics WRI, 2012). The 2012 annual model also had Rincon Creek Fault conductance as an adjusted variable, using horizonal flow barrier hydraulic conductivity and quasi-3D confining bed hydraulic conductivity, but was not modified for this update. The current model uses 0.000001 for both these values. Rather than directly manipulating Kz, anisotropy (Kx/Kz) was used so that appropriate relationships between Kx and Kz were maintained.

Specific yield was not an adjusted variable in the 2012 annual model calibration but was added for this update. Evaluation of seasonal head fluctuations and locations of dry cells indicated that large swaths of the model in layers 1 through 5 became unconfined due to the presence of dry cells in overlying layers. Adding Sy as an adjusted parameter helped the model better reflect the unconfined conditions at these locations and to better predict changes in interannual climate period groundwater elevations.

As PEST is not aware of hydrogeologic limits, its manipulation of adjusted parameters must be constrained using lower and upper bounds. These bounds restrain values based on common hydrogeology and the Basin hydrogeologic conceptual model. Upper and lower bounds for each adjusted parameter are summarized in Table 3. These ranges are relatively wide to better facilitate fit with observations given limitations of model construction including uncertainty of the water budget input and the 300 foot by 300 foot by 7 layer discretization.

Table 3. Adjusted Parameter Bounds

Adjusted Variable	Initial Values	Lower Bound	Upper Bound
Kx	Inherited from 2012 annual model	0.01 (feet/day)	500 (feet/day)
Anisotropy	Inherited from 2012 annual model	3 (Kx/Kz)	500 (Kx/Kz)
Specific Storage	Inherited from 2012 annual model	0.000001	0.001
Specific Yield	0.12	0.05	0.45

3.2.3 Distribution of Hydraulic Properties

The locations of pilot points and observation wells by layer are shown on Figure 19. These pilot point locations remain unchanged from the distribution implemented in the 2012 annual model, though specific yield is now manipulated at these locations as described above.

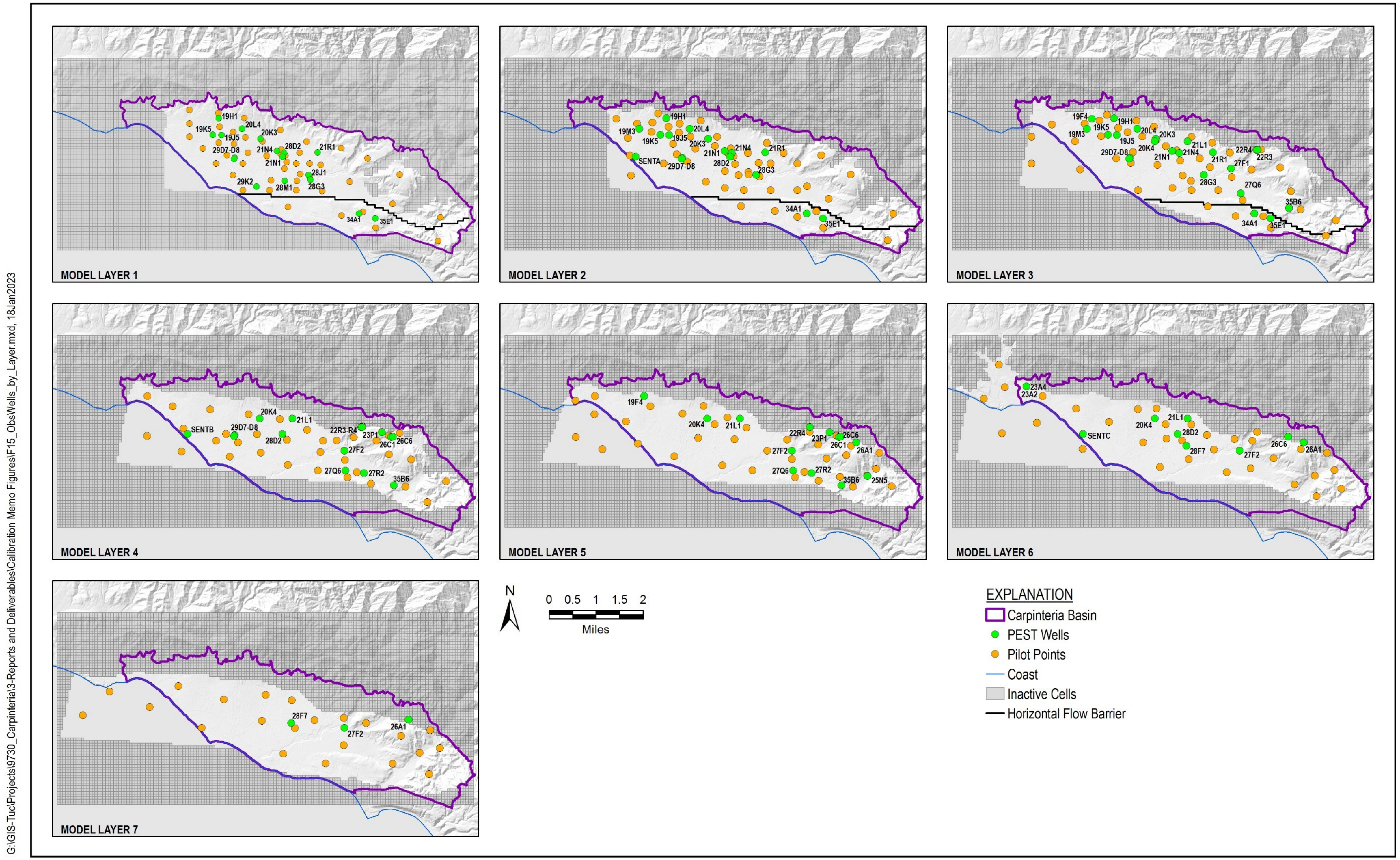

Figure 19. Pilot Point and Observation Well (PEST Well) Locations

3.2.4 Prior Information Equations / Regularization

Historical estimates of Kx were used in PEST prior information equations in an attempt to maintain an approximate adherence to historical estimates while calibrating to observation data. These historical estimates are shown in Table 4 in Section 3.3.1.5. Geostatistical regularization was used to constrain adjusted variable heterogeneity at pilot points relative to surrounding points. This process favors development of smoother parameter fields and may shed light on where parameter heterogeneity may exist.

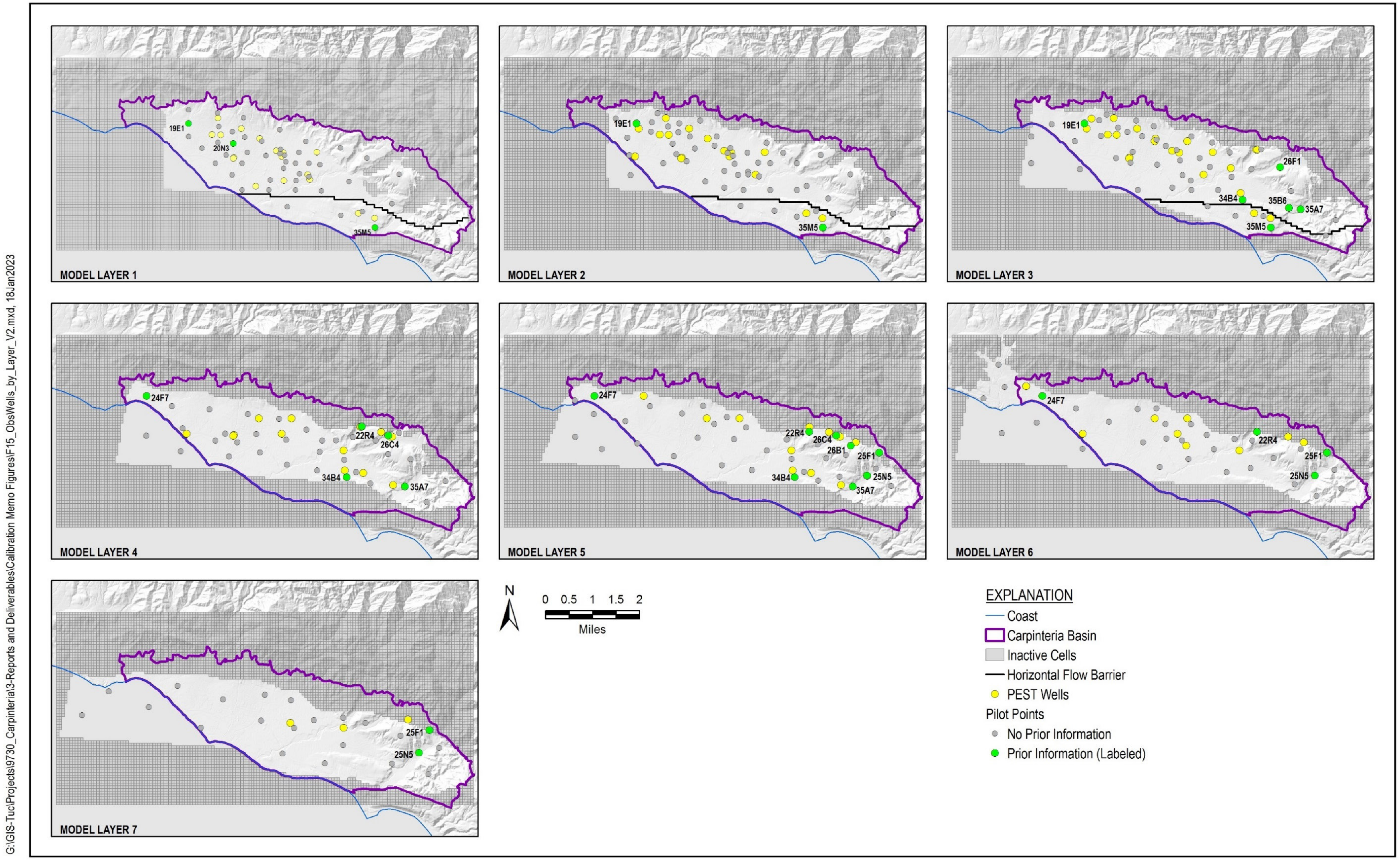

Figure 20. Pilot Point and Observation Well (PEST Well) Locations

3.3 Calibration Results

The following subsections describe the results of calibration including estimated hydraulic property fields and simulated groundwater elevations.

3.3.1 Estimated Hydraulic Properties

As described in Section 3.2, model aquifer parameters were modified during calibration to improve the model's ability to simulate known conditions. This included adjustments to the distribution and magnitude of the following:

- Horizontal hydraulic conductivity (Kx)
- Vertical hydraulic conductivity (Kz) using vertical anisotropy
- Specific storage (Ss)
- Specific yield (Sy)

Updated parameter fields for each of these parameters are summarized in the following subsections.

3.3.1.1 Horizonal Hydraulic Conductivity

As expected, the model appears sensitive to Kx over the entire grid. Layers 2, 4, and 6, meant to represent highly productive zones in the central Basin, showcase relatively high Kx. Kx remains low in layers 1, 3, 5, and 7, apart from some portions of layer 1 and the SU-2 portion of layer 3. This distribution is consistent with geologic understanding and historical calibration efforts (HydroMetrics WRI, 2012). Areas with higher hydraulic conductivity close to the upper bound (such as in layer 6) may indicate limitations of model construction in those areas.

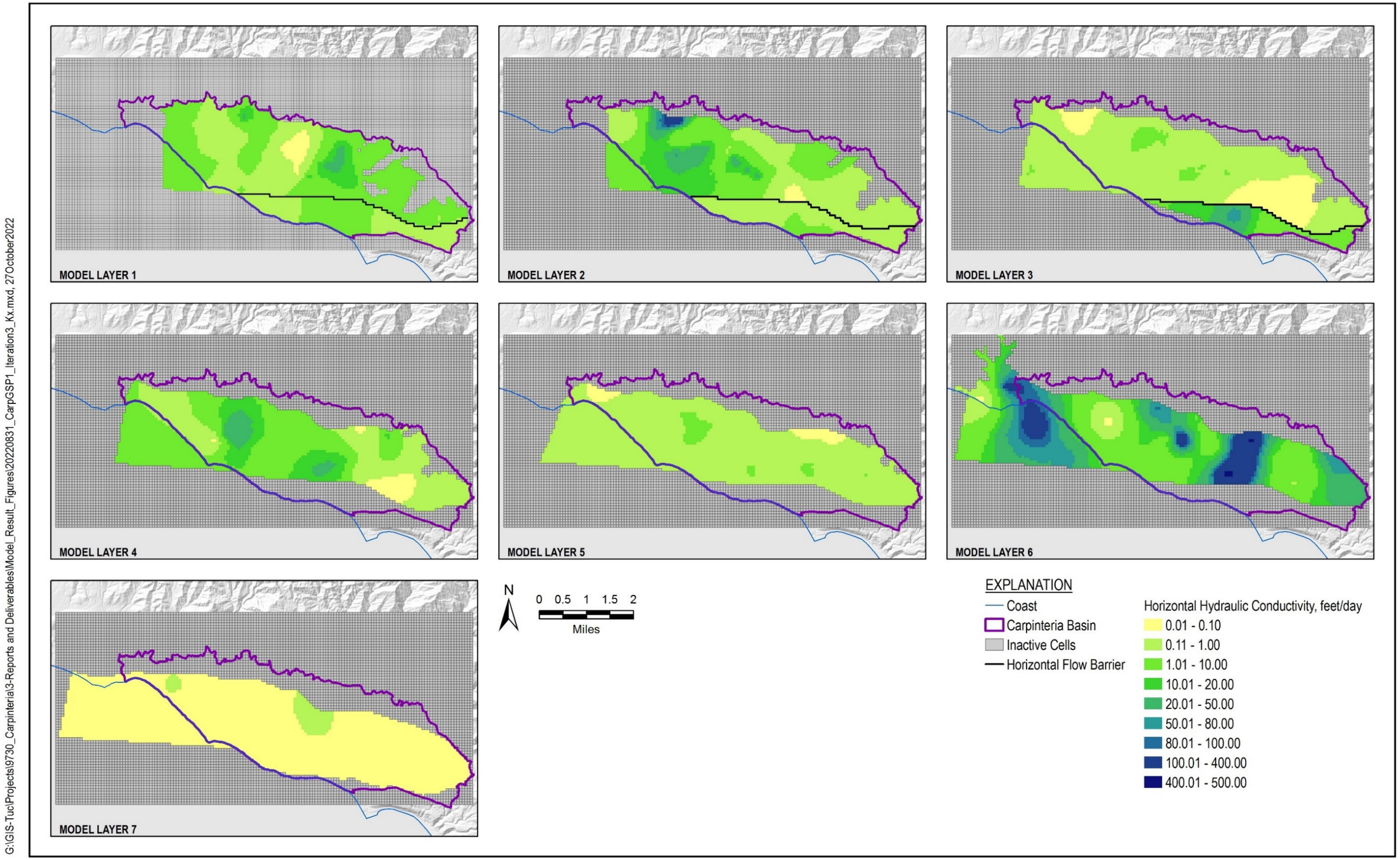

Figure 21. Calibrated Model Horizonal Hydraulic Conductivity Values

3.3.1.2 Vertical Hydraulic Conductivity

The model appears sensitive to Kz over the entire grid. Layers 2, 4, and 6 typically have higher Kz than layers 1, 3, 5, and 7 (Figure 22). This distribution is consistent with geologic understanding and historical calibration efforts (HydroMetrics WRI, 2012). As compared to HydroMetrics WRI, 2012, the Kz distribution is more complex and varied. This is likely a result of adding more observation points and additional time periods to the calibration. Anisotropy (Kx/Kz) is presented on Figure 23; layers 1, 3, 6, and 7 have wide areas of high anisotropy (>200).

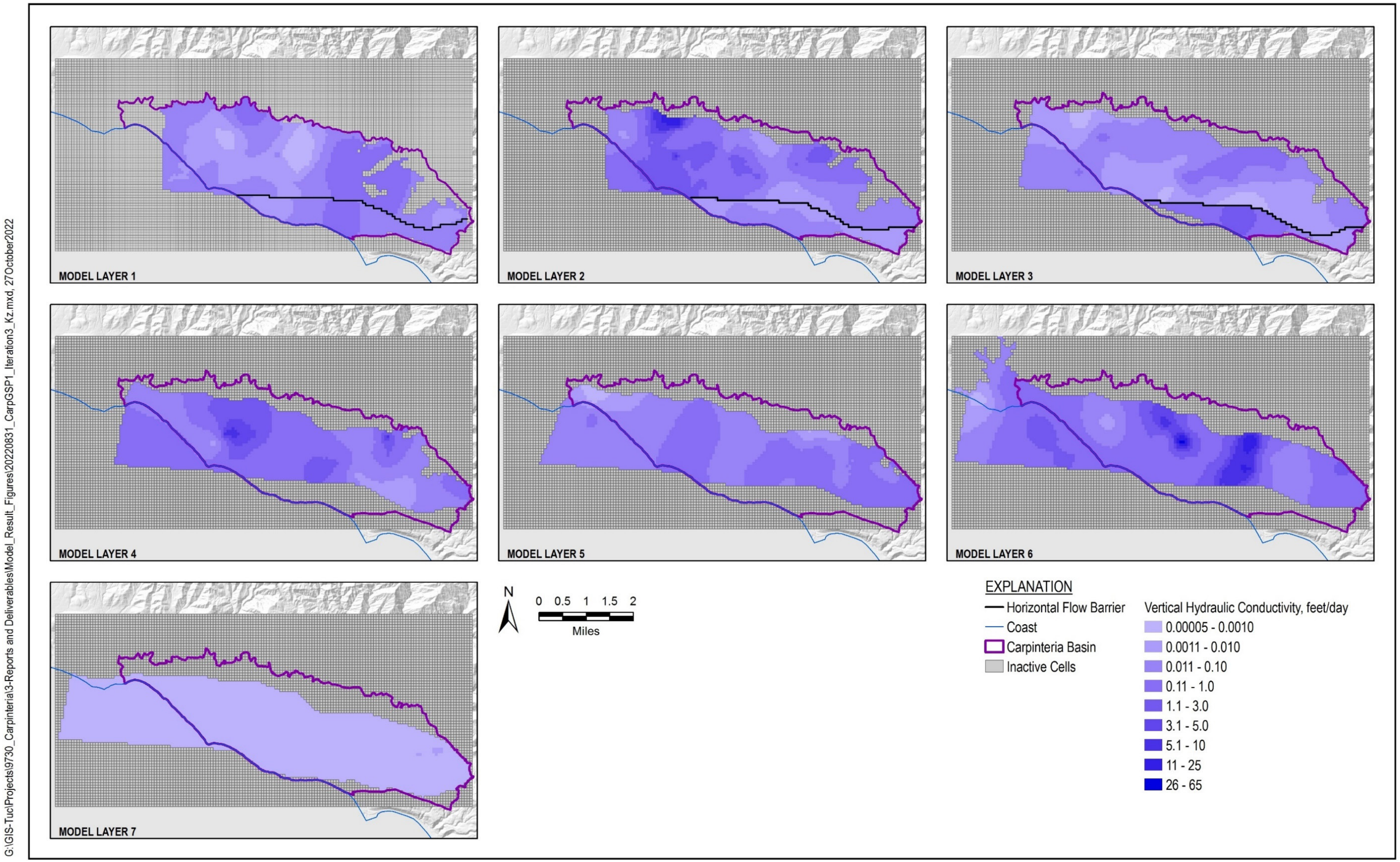

Figure 22. Calibrated Model Vertical Hydraulic Conductivity Values

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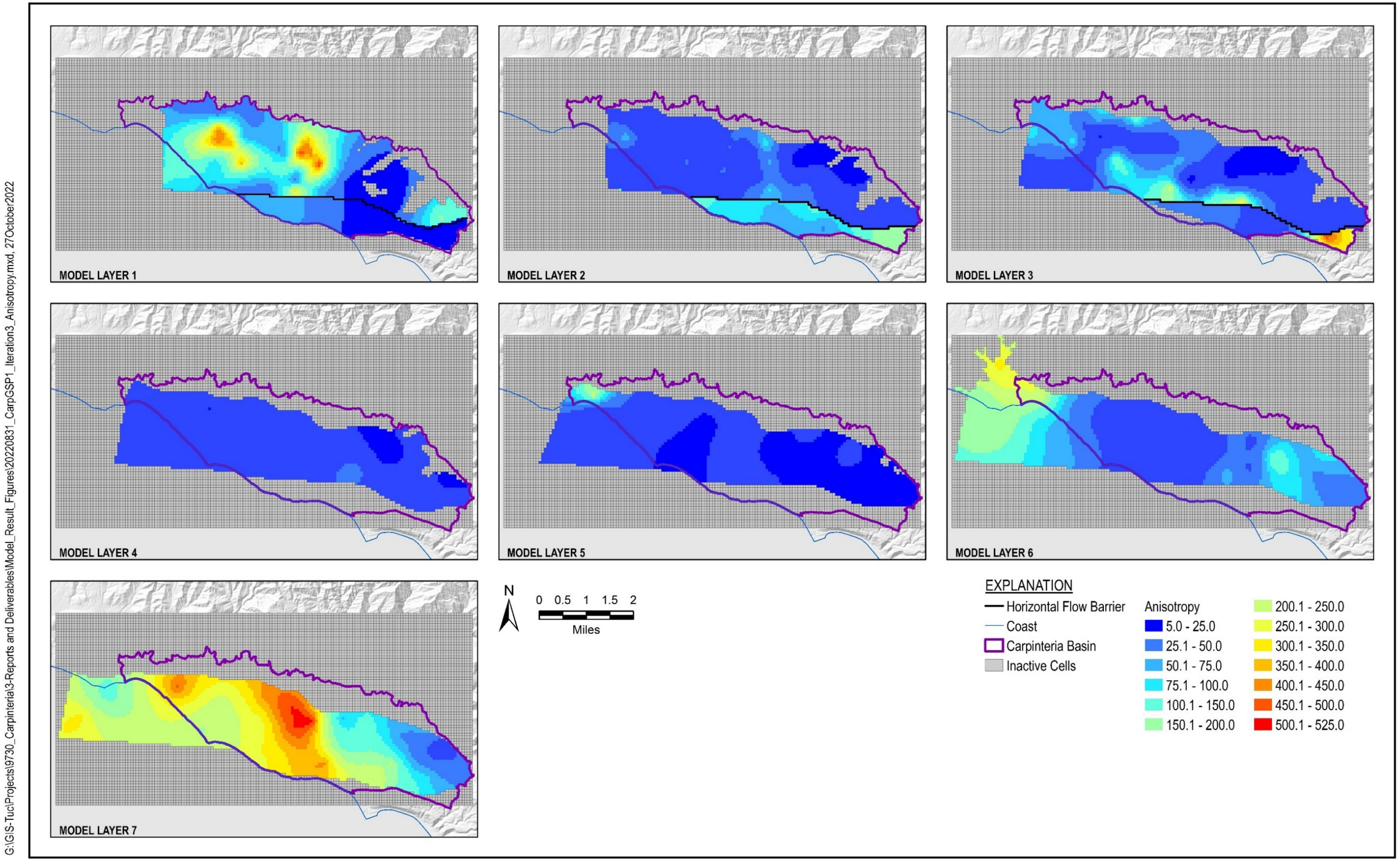

Figure 23. Calibrated Model Conductivity Anisotropy Values

3.3.1.3 Specific Storage

The model appears sensitive to Ss over the entire grid, though there are no apparent trends in parameter distribution by layer (Figure 24). This distribution is consistent with geologic understanding and historical calibration efforts (HydroMetrics WRI, 2012). As compared to HydroMetrics WRI, 2012 the updated model's Ss parameter fields are much more varied and complex. This is likely a result of adding more observation points and additional time periods to the calibration. Further, the change from an annual to a monthly timestep may have shifted focus from hydraulic conductivity to storage parameters, as storage parameters allow for relatively fast changes in groundwater elevation to represent interannual changes.

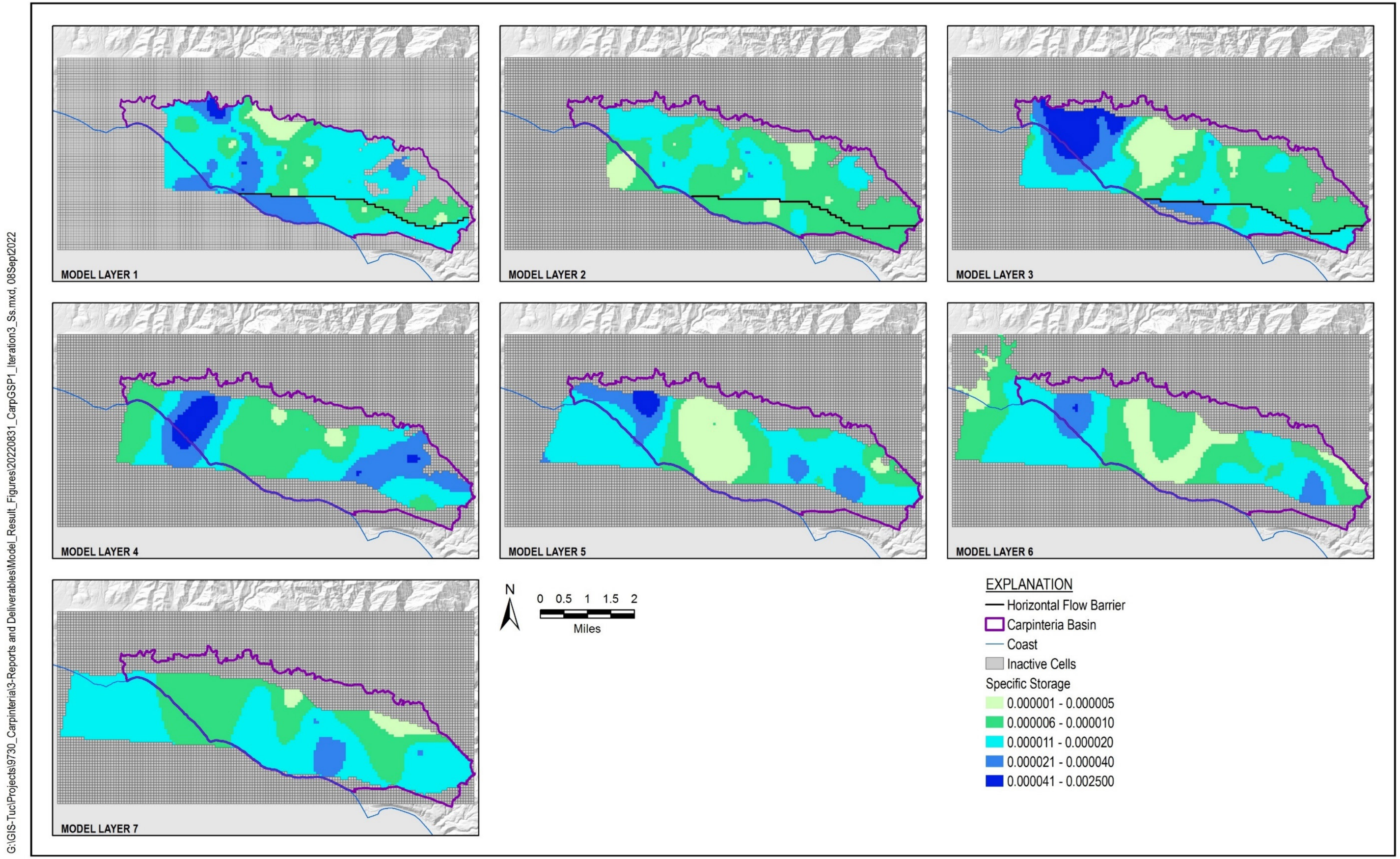

Figure 24. Calibrated Model Specific Storage Values

3.3.1.4 Specific Yield

Sy was not included as an adjusted parameter in previous model iterations, and was included during this update to better simulate hydraulic conditions in unconfined portions of the aquifer. Because the model is only sensitive to Sy during unconfined conditions, the areas where Sy has been adjusted on Figure 25 resemble the unconfined portions of the Basin as simulated by the model. The model appears more sensitive to Sy in the upper layers and in the model's west and east. Unconfined conditions never exist in layer 7 over the historical period, and therefore Sy was not manipulated in that layer. Areas with higher specific yield close to the upper bound may indicate limitations of model construction in those areas.

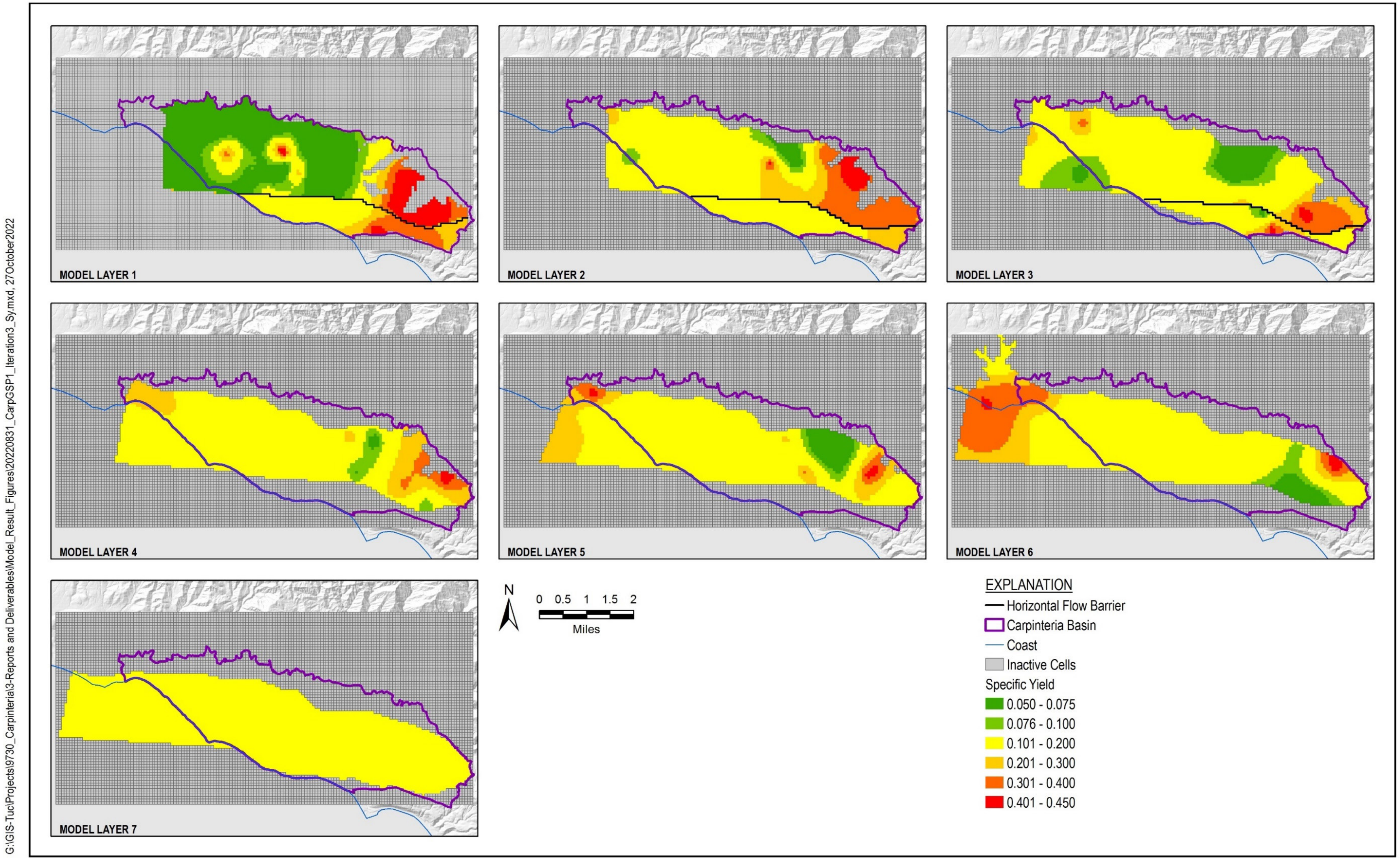

Figure 25. Calibrated Model Specific Yield Values

3.3.1.5 Relation to prior information

Table 4 compares calibrated model horizontal conductivity against the prior information values incorporated into model calibration as described in Section 3.2.4. Horizontal hydraulic conductivity estimates from outside of the estimated mapped aquifer extents were included in the calibration process, and model conductivities were allowed to vary if needed to match observed groundwater levels. These aquifer test estimates are calculated for the entire well, while the calibrated model conductivities are discrete for each layer the well is screened in.

In general, calibrated model conductivities are within an order of magnitude of the aquifer test estimates, bearing in mind that the comparison is between discrete model layering and a non-discrete aquifer test estimate. At a few wells, such as 22R4 and 24F7, the calibrated model has large vertical differences in hydraulic conductivity. These were necessary for calibrating the model to nearby local groundwater elevations in discrete layers.

Table 4. Aquifer Test Horizonal Hydraulic Conductivity Estimates and Calibrated Model Values

Well	Model Layer	Horizonal Hydraulic Conductivity (feet/day)	
		Aquifer Test Estimate	Model Value
19E1	1	1.93	0.992
	2		0.460
	3		0.0100
20N3	1	0.87	0.162
22R4	4	0.94	0.0492
	5		0.0100
	6		137.073
24F7	4	1.57	0.748
	5		0.031
	6		71.184
25F1	5	1.55	0.553
	6		77.534
	7		0.0212
25N5	5	0.80	1.192
	6		5.778
	7		0.0352
26B1	5	1.59	1.000
26C4	4	0.78	21.303
	5		0.01
26F1	3	0.45	0.476
34B4	3	0.14	0.013
	4		1.192
	5		0.337
35A7	3	1.00	0.0571

Well	Model Layer	Horizonal Hydraulic Conductivity (feet/day)	
		Aquifer Test Estimate	Model Value
	4		0.0260
	5		0.383
35B6	3	2.66	0.0871
35M5	1	0.5	0.836
	2		1.248
	3		2.712

3.3.2 Global Statistics / Plots

Comparison of simulated and observed values against a 1:1 line is a common methodology to evaluate overall model accuracy. Figure 26 illustrates this, with each observation well given unique symbology to showcase individual trends. R^2 is calculated against the true 1:1 line; the trendline is forced through 0 and the slope is forced to 1. Overall, the model is not skewed to over or underpredict. Table 5 summarizes global calibration statistics and globally the model is very well calibrated. Despite nearly double the number of observation wells and the transfer from annual to monthly comparison, global calibration statistics remain comparable to those presented in HydroMetrics WRI, 2012.

As a measure of successful model calibration, Anderson and Woessner (1992) state that the ratio of error spread to total head range in the system should be less than 10% to ensure that errors are only a small part of the overall model response. A second rule is that the mean error should be less than 5% of the total model head range. For this model, the standard deviation of residuals is approximately 3.0% of the total head range. Absolute mean residual is approximately 2.1% of the total head range, while geometric mean residual is 1.2% of total head range. Therefore, the model can be considered globally well calibrated.

Figure 27 presents mean residuals spatially and by layer for each observation well location. Mean residuals are useful for identifying areas where the model over or underpredicts, and by what average magnitude. Negative values (blue) on Figure 27 indicate areas where the model is generally overpredicting head. Positive values (red) on Figure 27 indicate areas where the model is generally underpredicting head. Overall, there is no spatial area or layer where the model tends to substantially over or underpredict. However, the model may trend higher than observed in the northeastern model peripheries at specific wells (26A1, 26C1). The model appears to be poorly calibrated in this area relative to the rest of the model. These wells can be seen readily on Figure 26

Figure 28 presents root mean squared error (RMSE) spatially and by layer for each observation well location. When visualized in this way, RMSE is useful for spatial trends in model accuracy. Overall, RMSE is low; 93% of wells have RMSE lower than 20 feet, 63% of wells have RMSE lower than 10 feet, and 10% have RMSE lower than 5 feet. The model tends to be extremely well calibrated in the central Basin and less well calibrated toward the model's eastern peripheries. Wells 26A1 and 26C1 have especially high RMSE (>20 feet), as mentioned earlier. Calibration in the SU-2 area (34A1, 35E1) is also limited, likely because there are only 2 observation wells in that area.

Table 5. Global Calibration Statistics

Calibration Statistic	Value
R^2	0.99
Mean Residual	-1.84
Mean Absolute Residual	8.6
Geometric Mean Absolute Residual	5.1
Median Residual	-0.57
Standard Deviation	12.4
Root Mean Squared Error	12.5
Observation Range	410.1
Standard Deviation / Range	3.0%

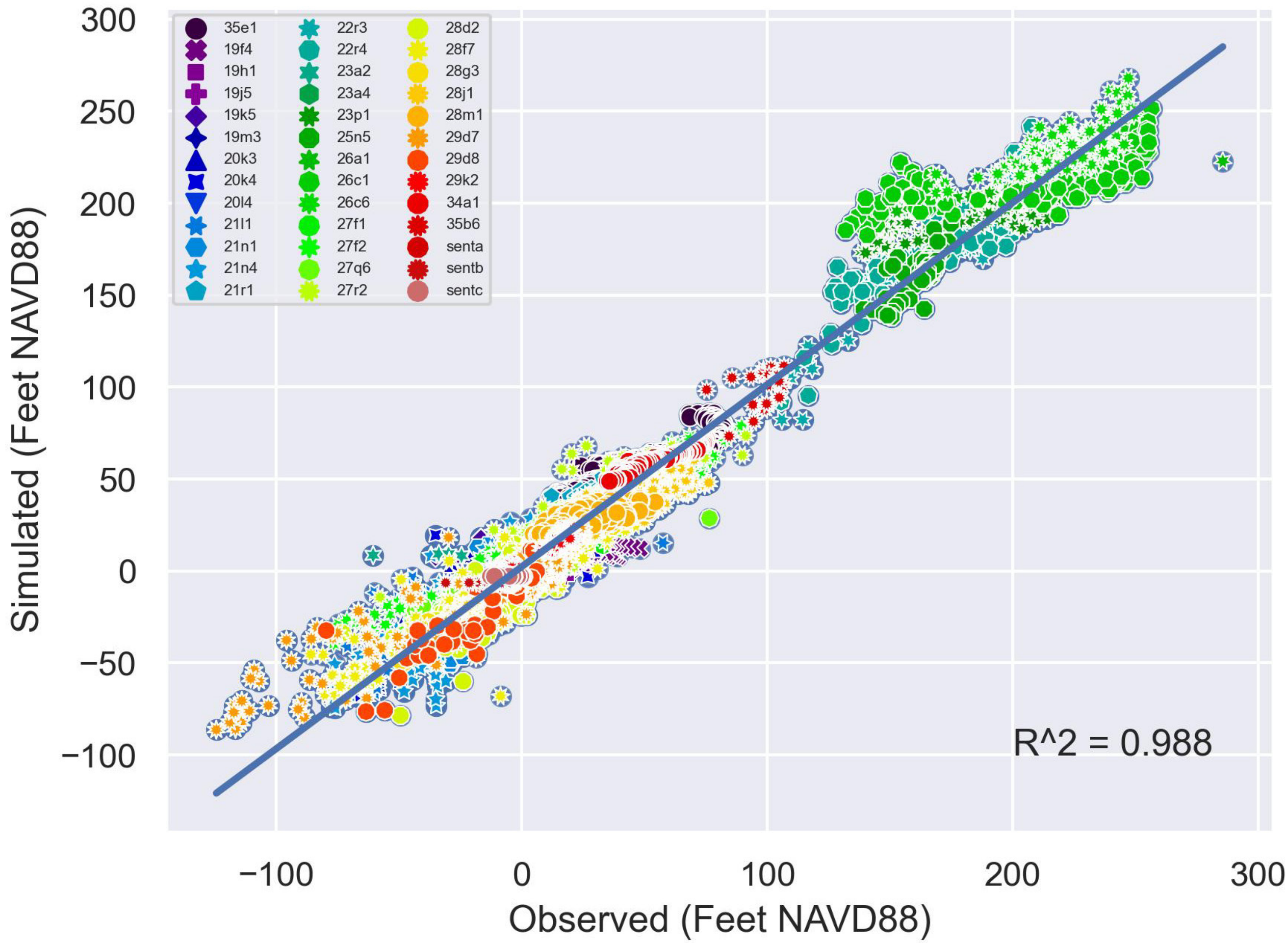

Figure 26. Observed and Simulated Values Against 1:1 Line

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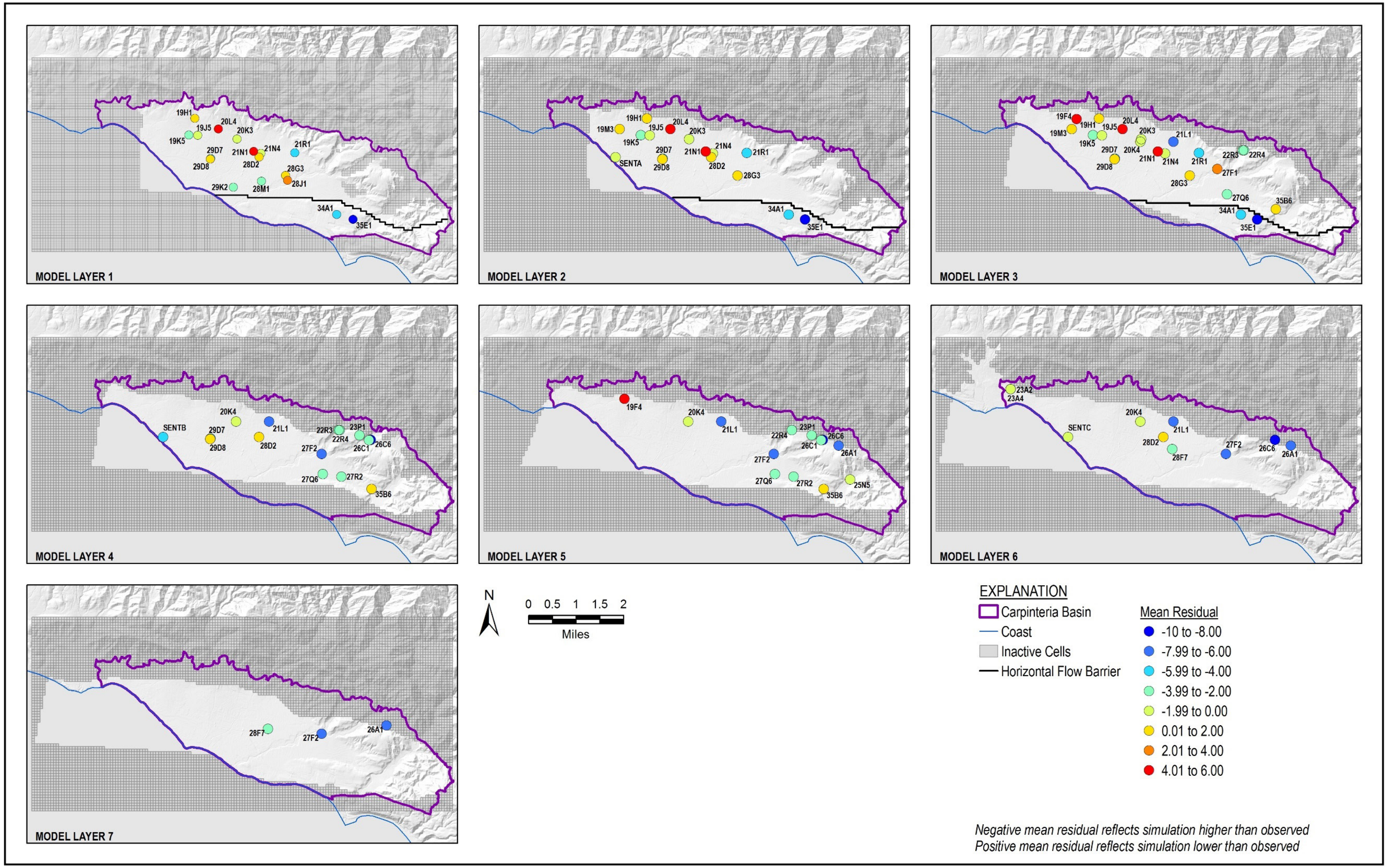

Figure 27. Mean Residual By Layer

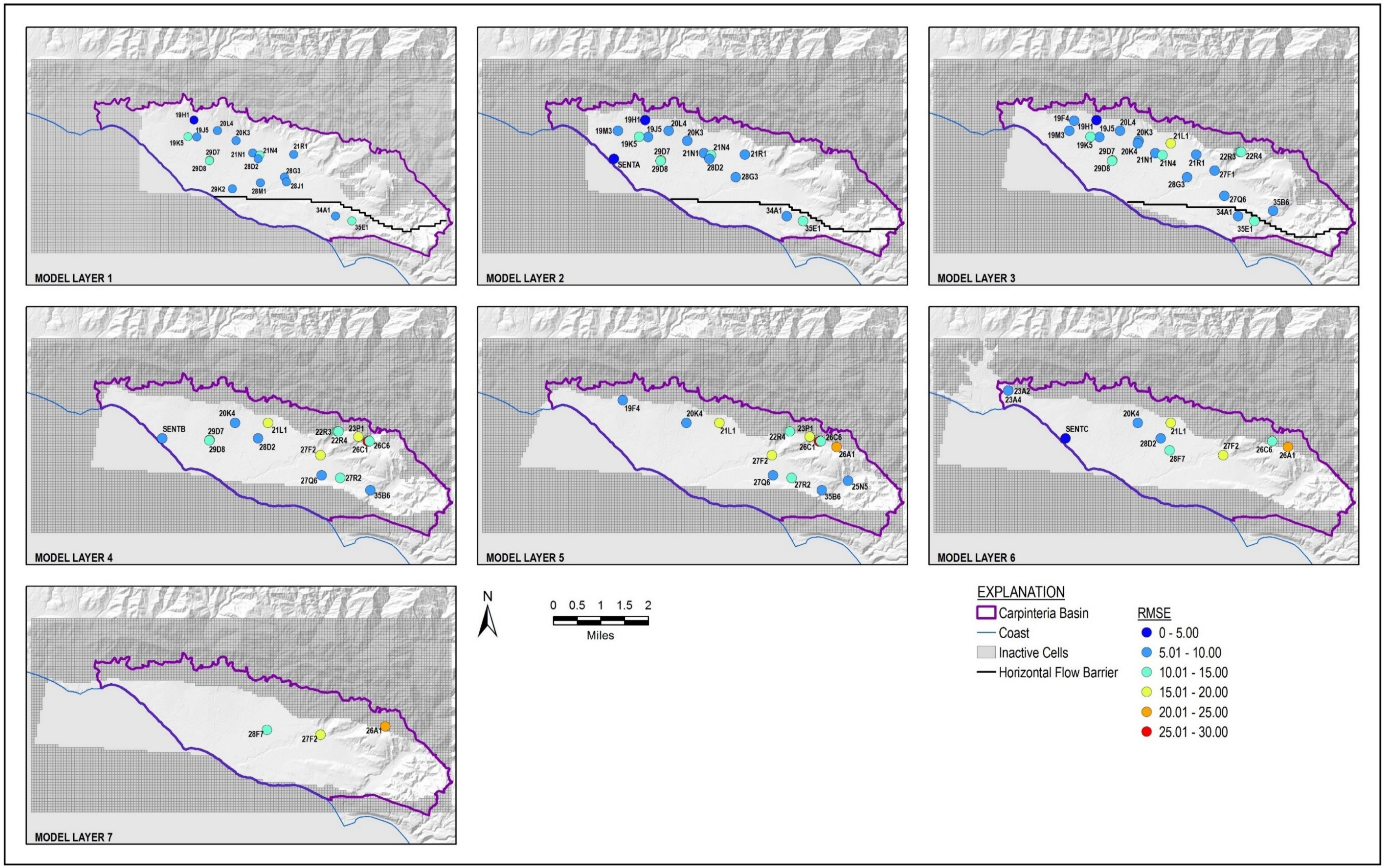

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Figure 28. Root Mean Squared Error by Layer

3.3.3 Calibration Hydrographs

Appendix A is a compendium of groundwater hydrographs containing currently monthly calibrated model elevations, annual 2012 model elevations (HydroMetrics WRI, 2012), and measured observations. Evaluation of the current calibrated monthly model against observations illustrates current calibration status, while evaluation against the 2012 annual model illuminates model development progress. As the model can now simulate monthly groundwater levels it captures seasonal oscillations that are informative for groundwater management and sustainability. The WY climate classification shown on these figures was developed by Pueblo Water Resources using local Carpinteria Basin precipitation data, and differs from the regional DWR climate classification.

The model is very well calibrated in SU-1 in the central Basin; elevations at private wells (Figure 29; Figure 30) and municipal wells (Figure 31) are generally within 10 feet of observed values and follow seasonal and climactic trends closely. While there are only a few years of data to calibrate to, elevations at the coastal SU-1 Sentinel Wells are also close to observed (Figure 32 through Figure 34). The model is less well calibrated in the SU-2 (Figure 35) and periphery areas of the Basin (Figure 36). Additional refinement of the model geometry and water budget may be required to improve calibration in these areas.

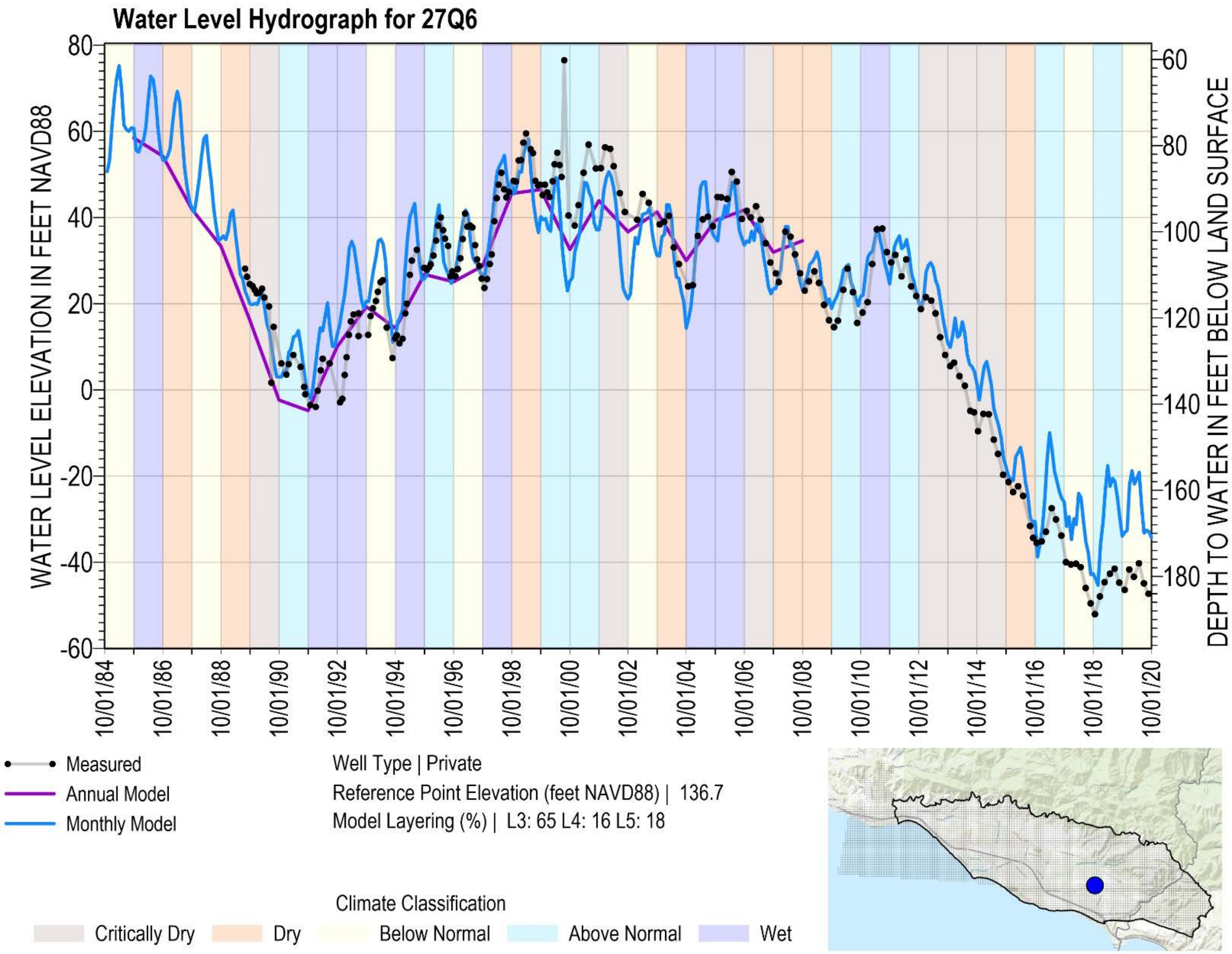

Figure 29. Calibration Hydrograph for SU-1 Private Well 27Q6, Feet NAVD88

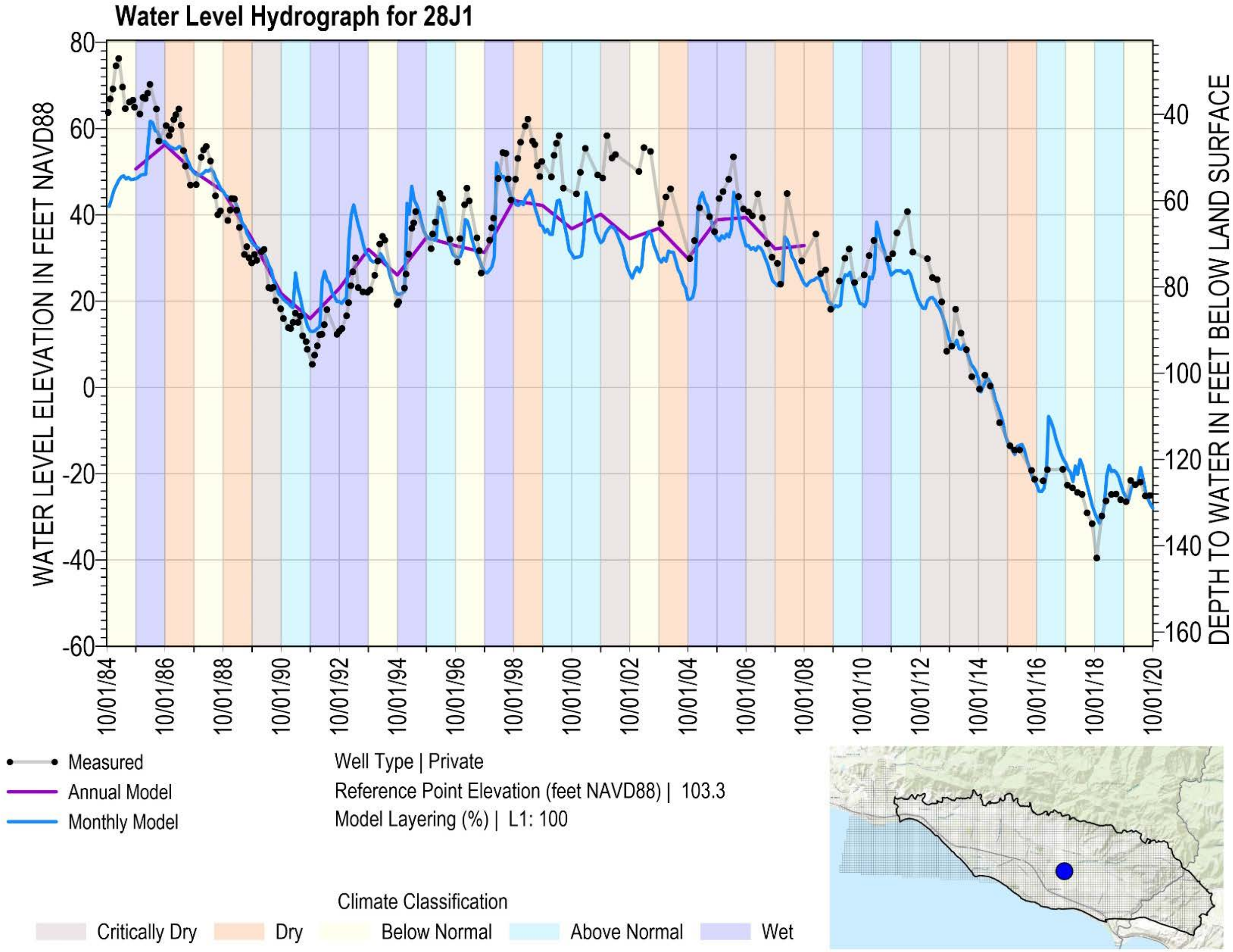

Figure 30. Calibration Hydrograph for SU-1 Private Well 28J1, Feet NAVD88

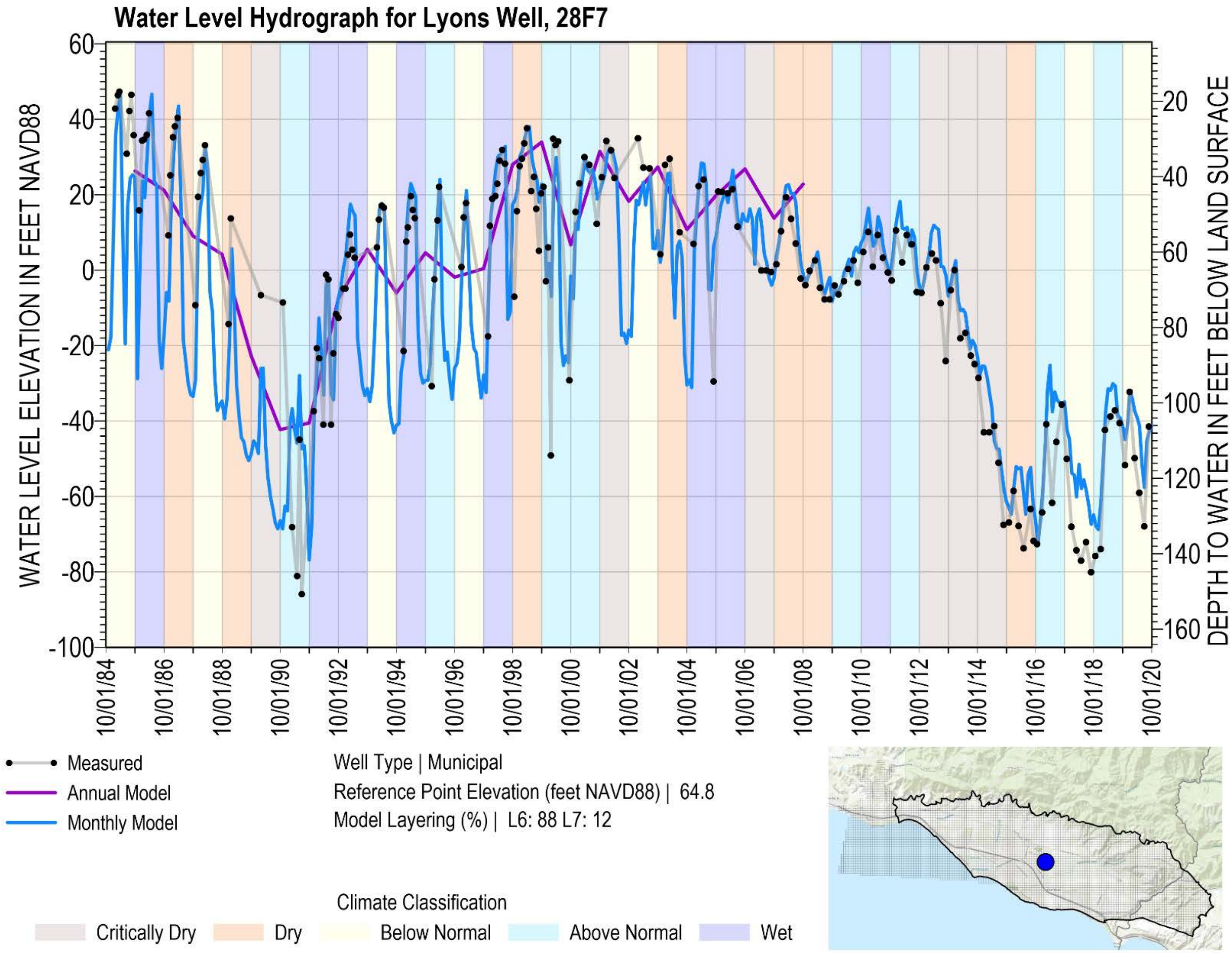

Figure 31. Calibration Hydrograph for SU-1 Lyons Municipal Well (28F7), Feet NAVD88

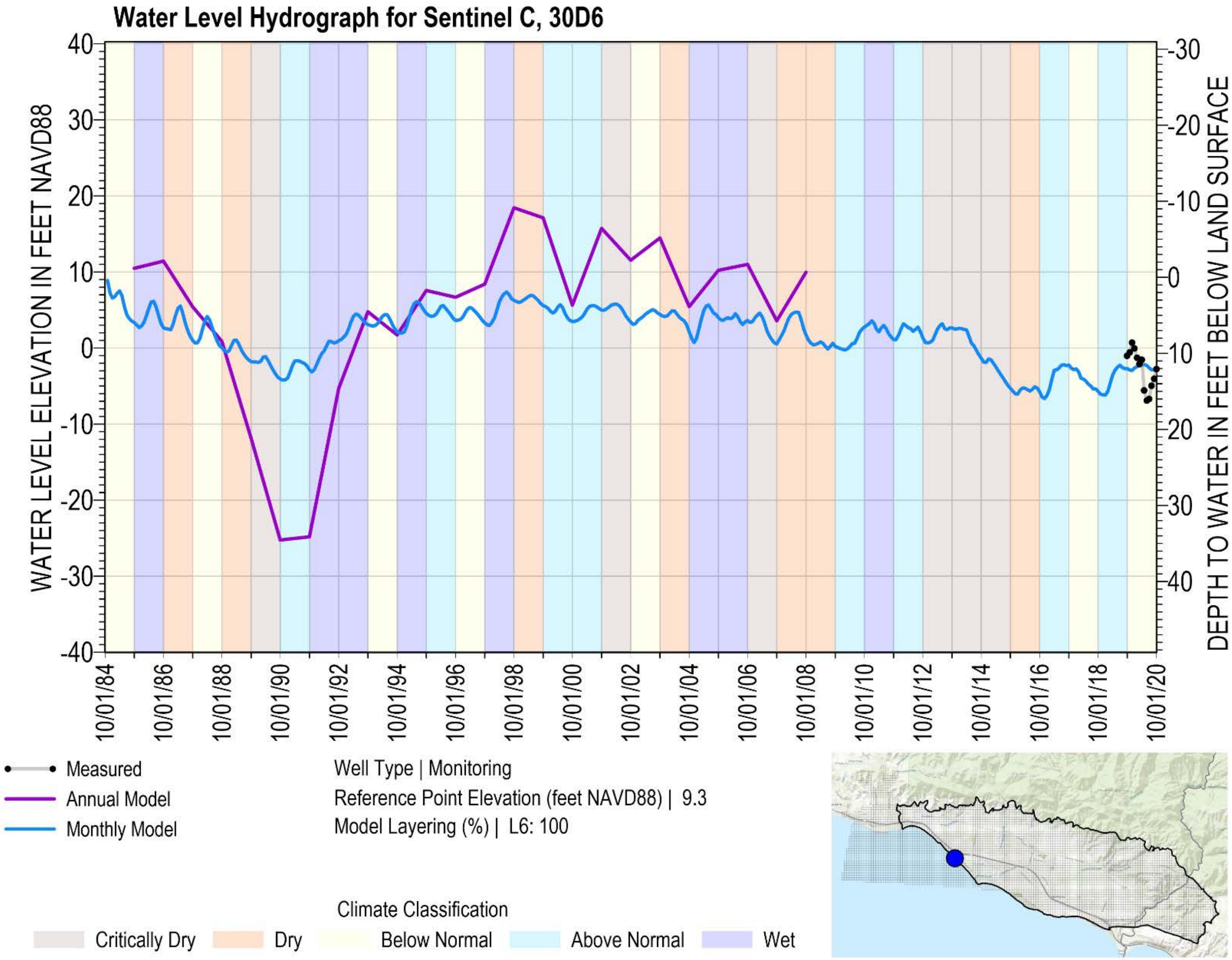

Figure 32. Calibration Hydrograph for SU-1 Monitoring Well Sentinel C (30D6), Feet NAVD88

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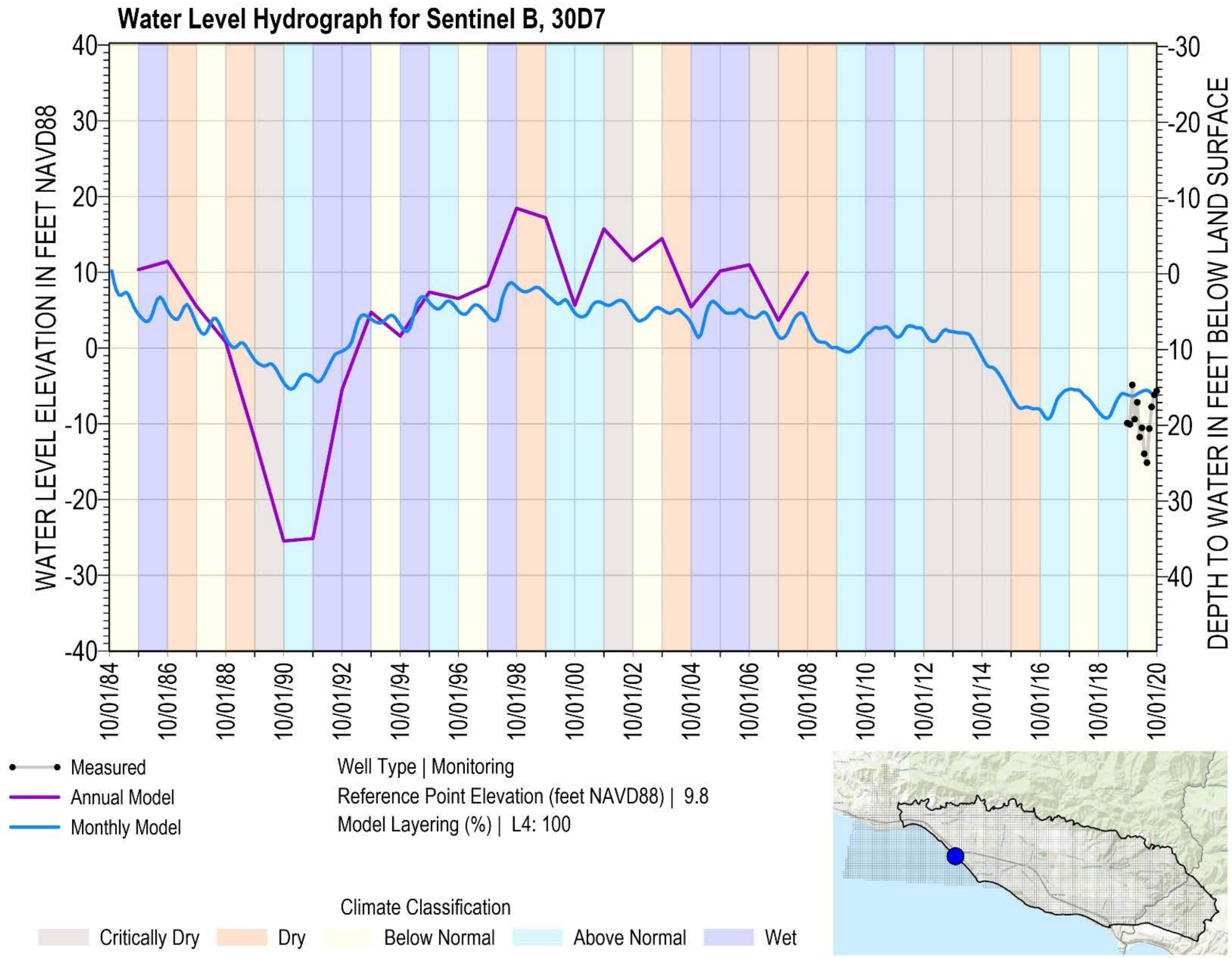

Figure 33. Calibration Hydrograph for SU-1 Monitoring Well Sentinel B (30D7), Feet NAVD88

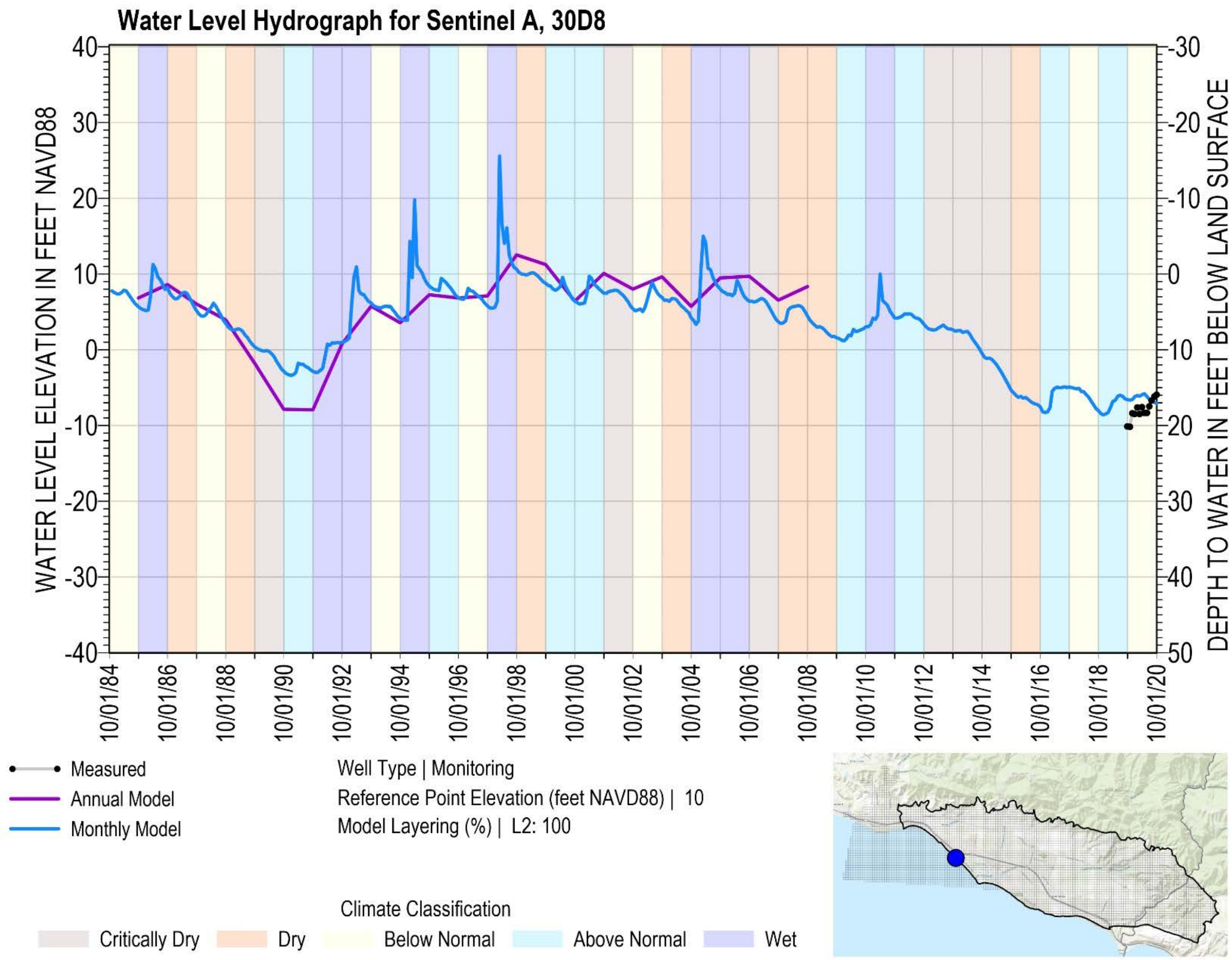

Figure 34. Calibration Hydrograph for SU-1 Monitoring Well Sentinel A (30D8), Feet NAVD88

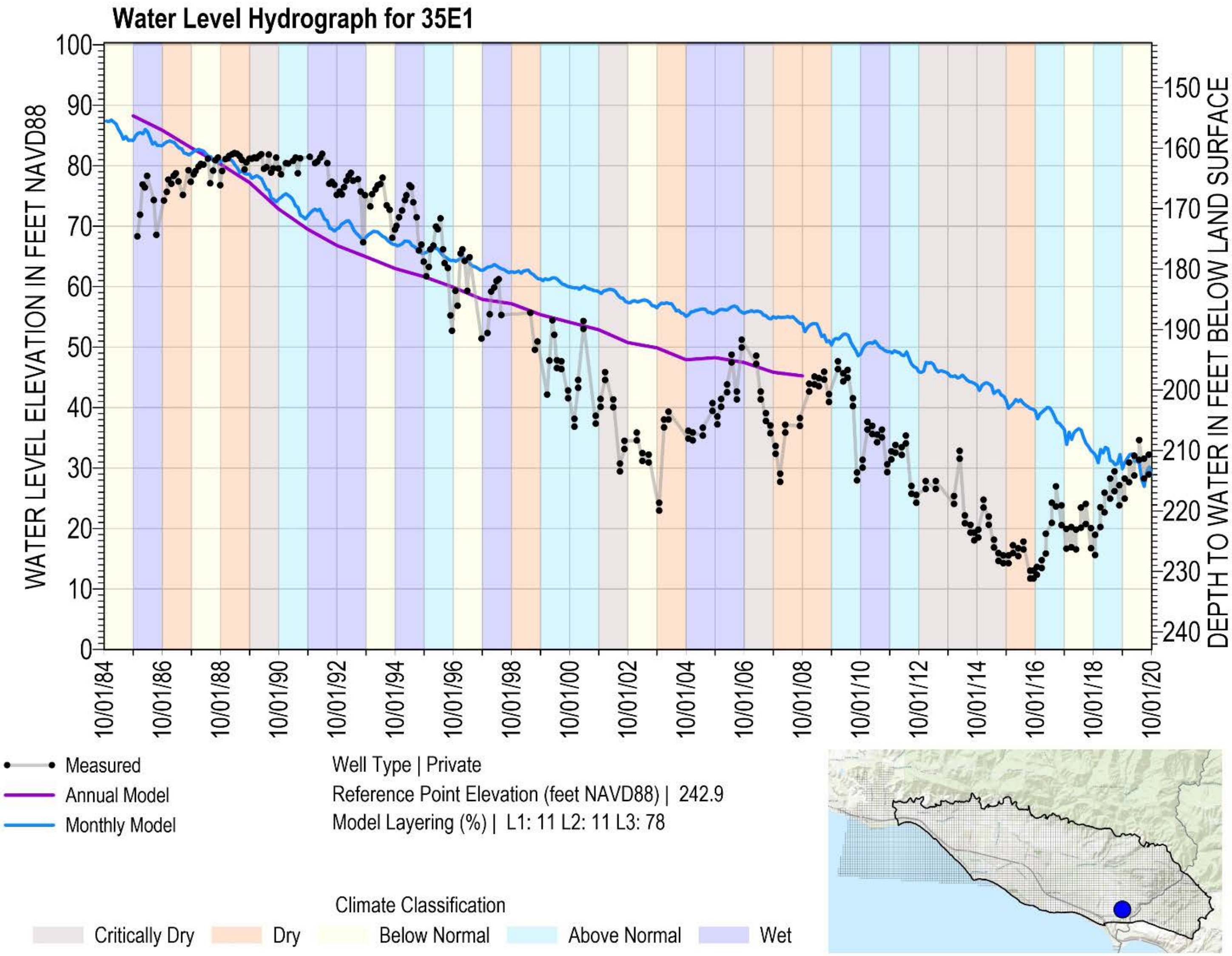

Figure 35. Calibration Hydrograph for SU-2 Private Well 35E1, Feet NAVD88

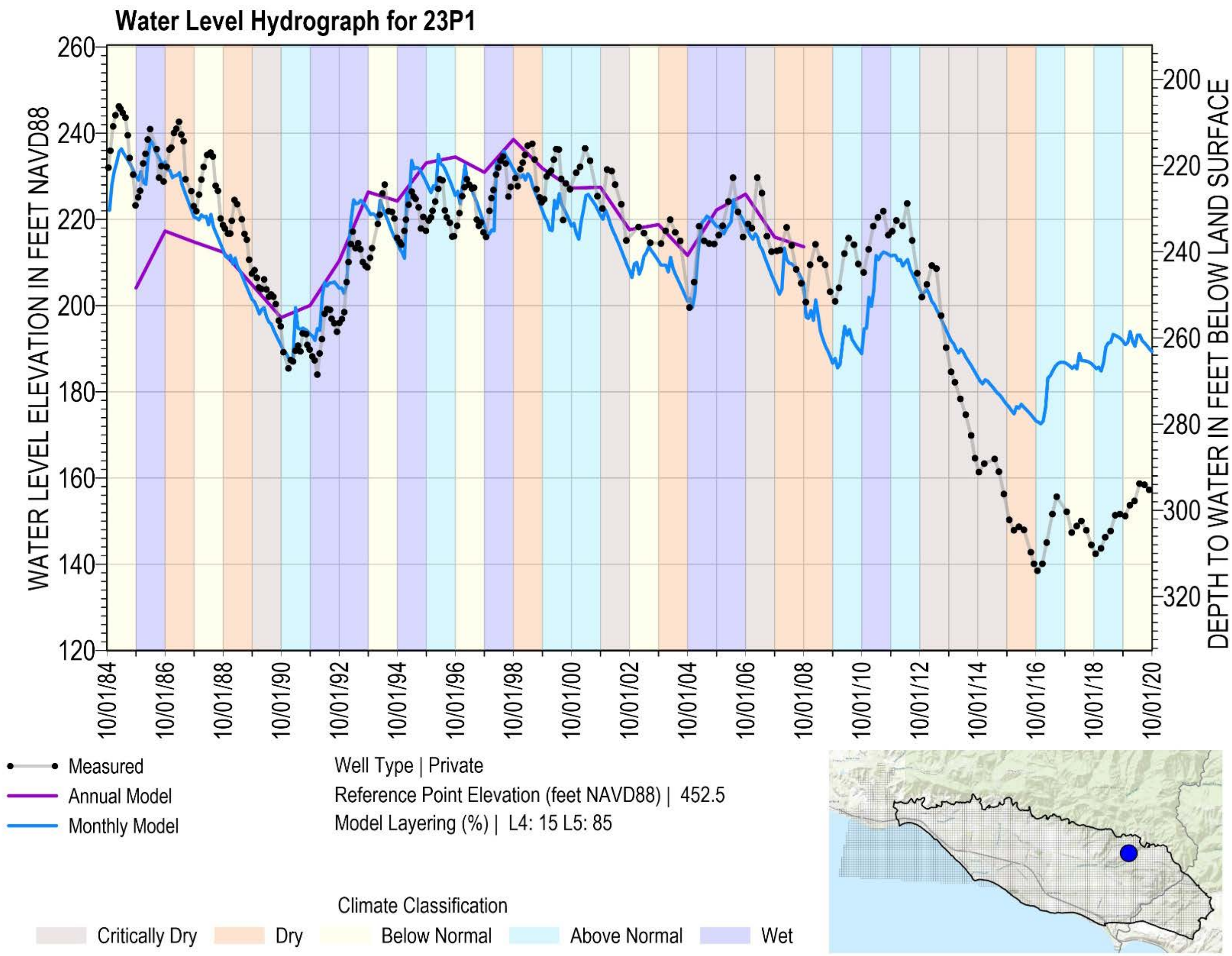

Figure 36. Calibration Hydrograph for SU-1 Private Well 23P1, Feet NAVD88

3.3.4 Simulated Contours

Contours of model piezometric surface elevations are shown on Figure 37 through Figure 42. These maps illustrate the model's prediction of each layer's groundwater elevations during a snapshot in time. Figure 37 and Figure 38 display spring (May) and late summer/fall (August) elevations for WY 1990, respectively. Comparison of these 2 maps illuminate interannual seasonal fluctuations that are informative for groundwater management. These can be compared to Figure 16 of HydroMetrics WRI, 2012, which showed annual elevations for WY 1990. The monthly model is now able to capture increased detail about seasonal changes in groundwater elevation as needed by SGMA to evaluate seasonal highs and lows; during this dry year, the model simulates a drop in elevations of approximately 20-30 feet from May to August.
Figure 39 and Figure 40 display May and August elevations for WY 2008, respectively. These can be compared to Figure 17 of HydroMetrics WRI, 2012, which showed annual elevation for WY 2008. During this wet year, the model simulates a similar drop in elevations from spring to fall, however elevations in spring are generally above sea level. Overall average elevations are comparable to the annual model, though the current monthly model is better calibrated as shown in Section 3.3.3 above.

Figure 41 and Figure 42 display groundwater elevations for May and August 2020, respectively. These maps illustrate groundwater elevations near the end of the simulation period. As described in Section 3.3.3 and shown on hydrographs in Appendix A, groundwater elevations dropped significantly during the WY 2012-2016 drought and then remained stable or experienced slight recovery from WY 2017 to 2020. Interestingly, August 2020 elevations were somewhat higher than May 2020. Pumping in the summer of 2020 was lower than typical recorded volumes, while May pumping was atypically high, potentially a result of Covid-19 impacts. Alternatively, this may simply be a result of the gradual increase in groundwater elevations seen in some wells from WY 2019 to WY 2020 (Figure 35; Figure 36).

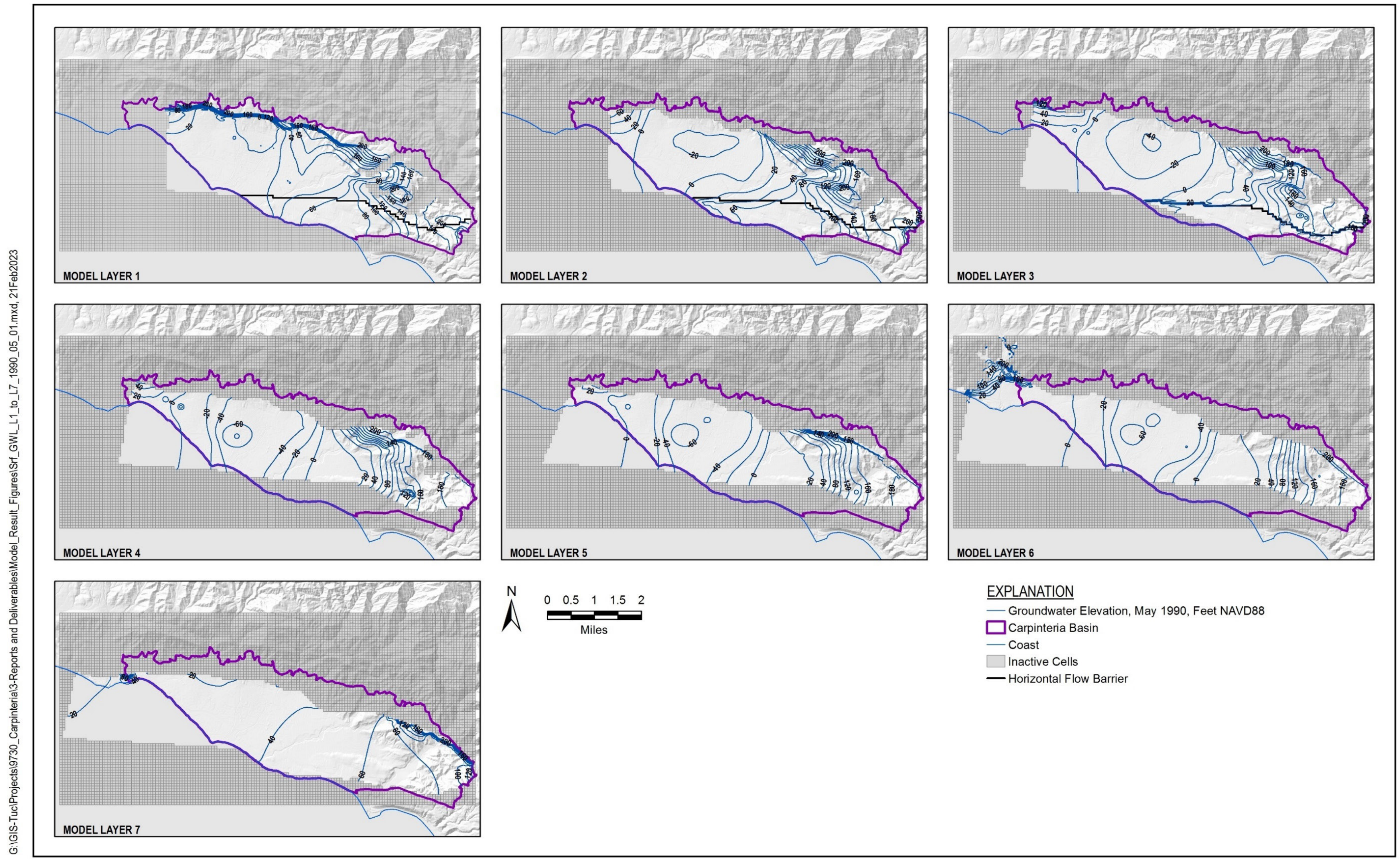

Figure 37. Simulated Groundwater Elevation Contours, May 1990

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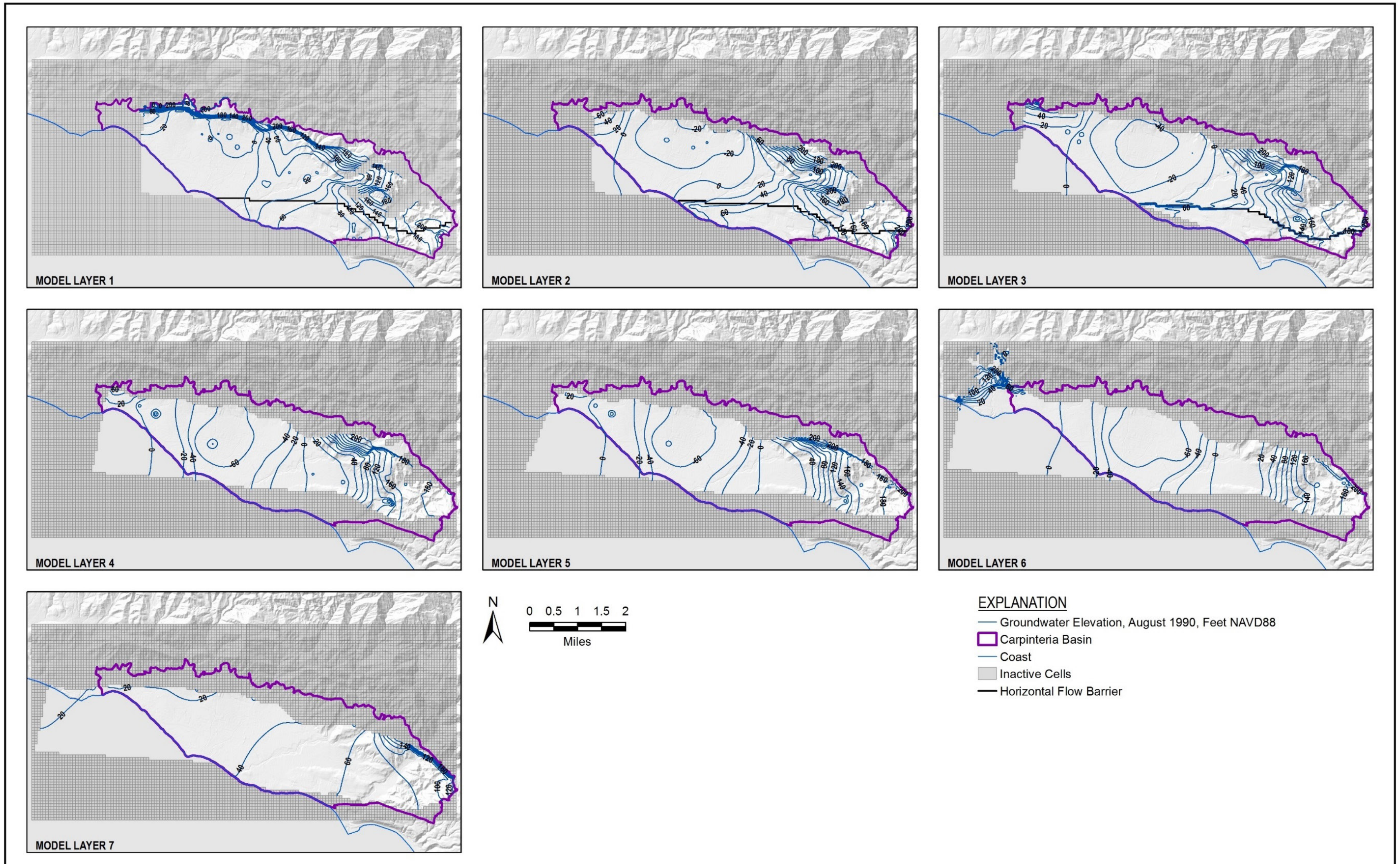

Figure 38. Simulated Groundwater Elevation Contours, August 1990

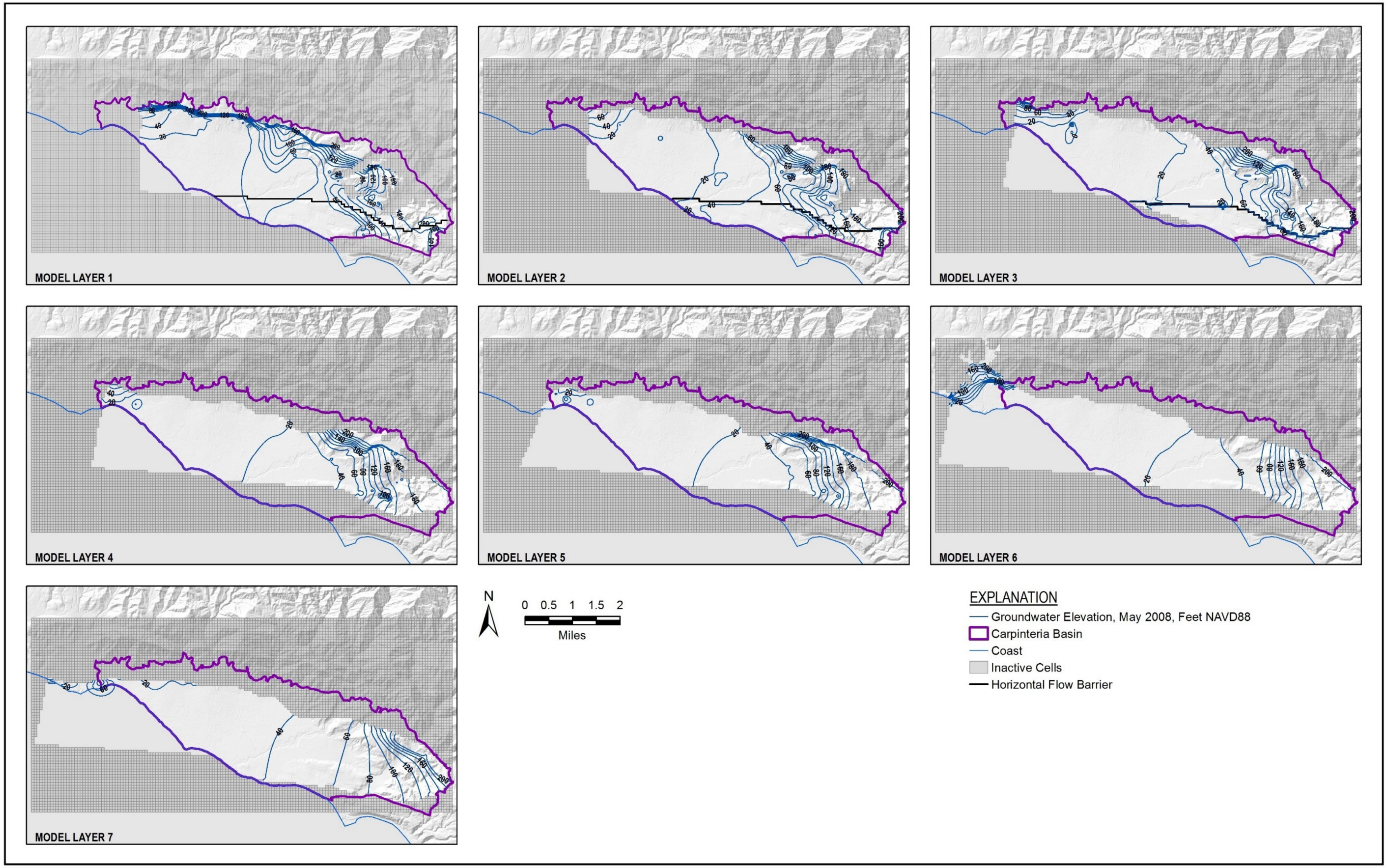

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Figure 39. Simulated Groundwater Elevation Contours, May 2008

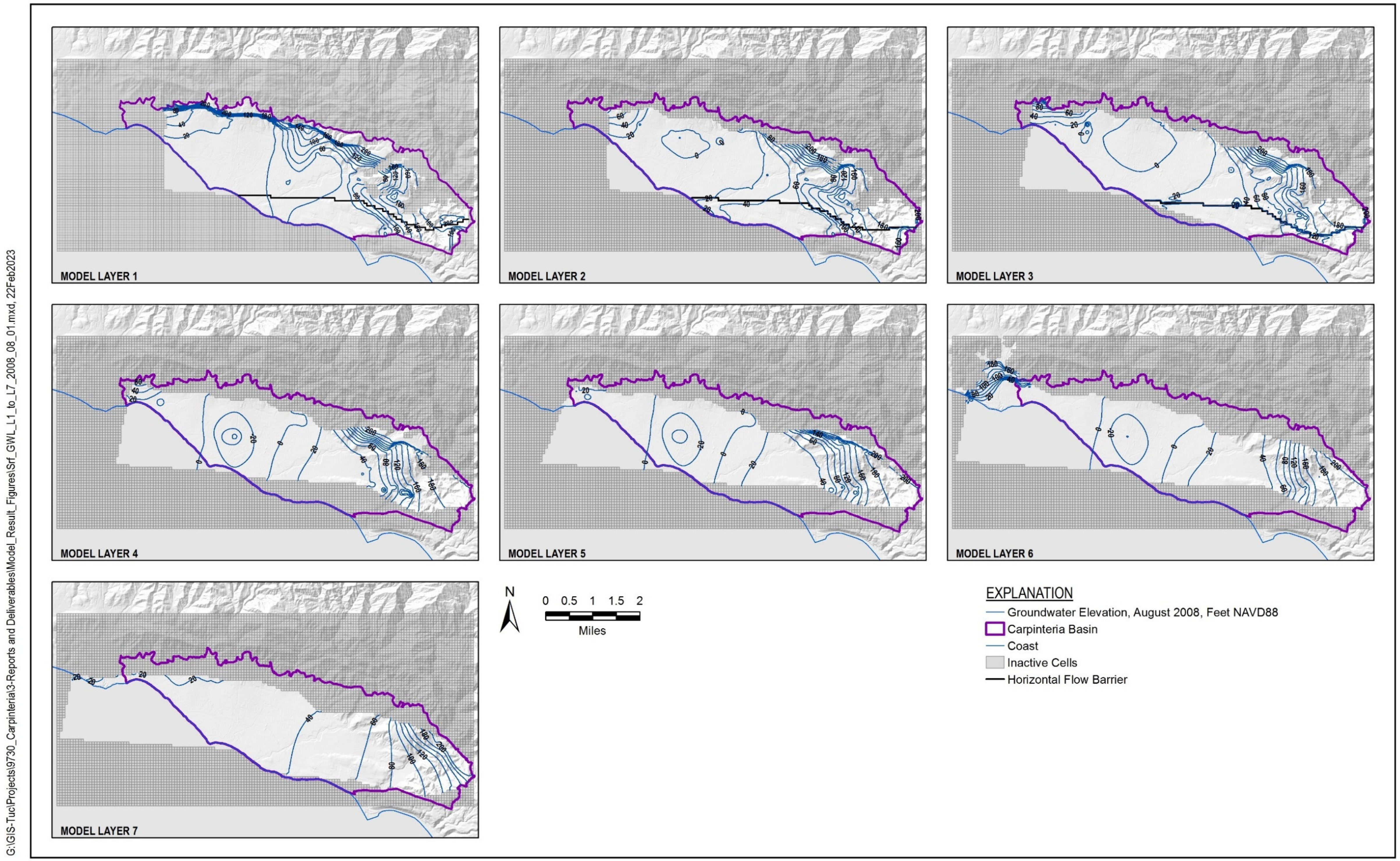

Figure 40. Simulated Groundwater Elevation Contours, August 2008

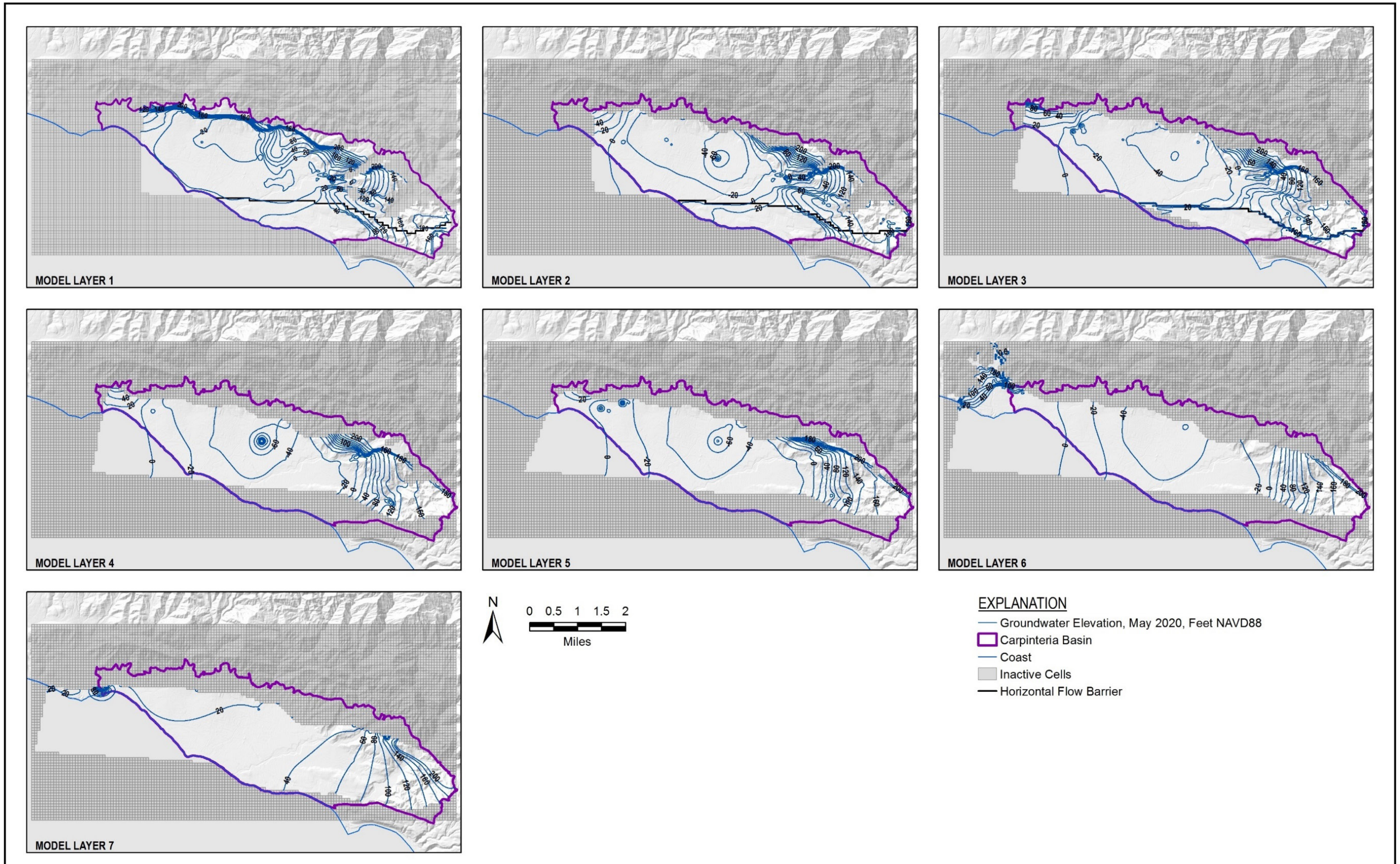

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Figure 41. Simulated Groundwater Elevation Contours, May 2020

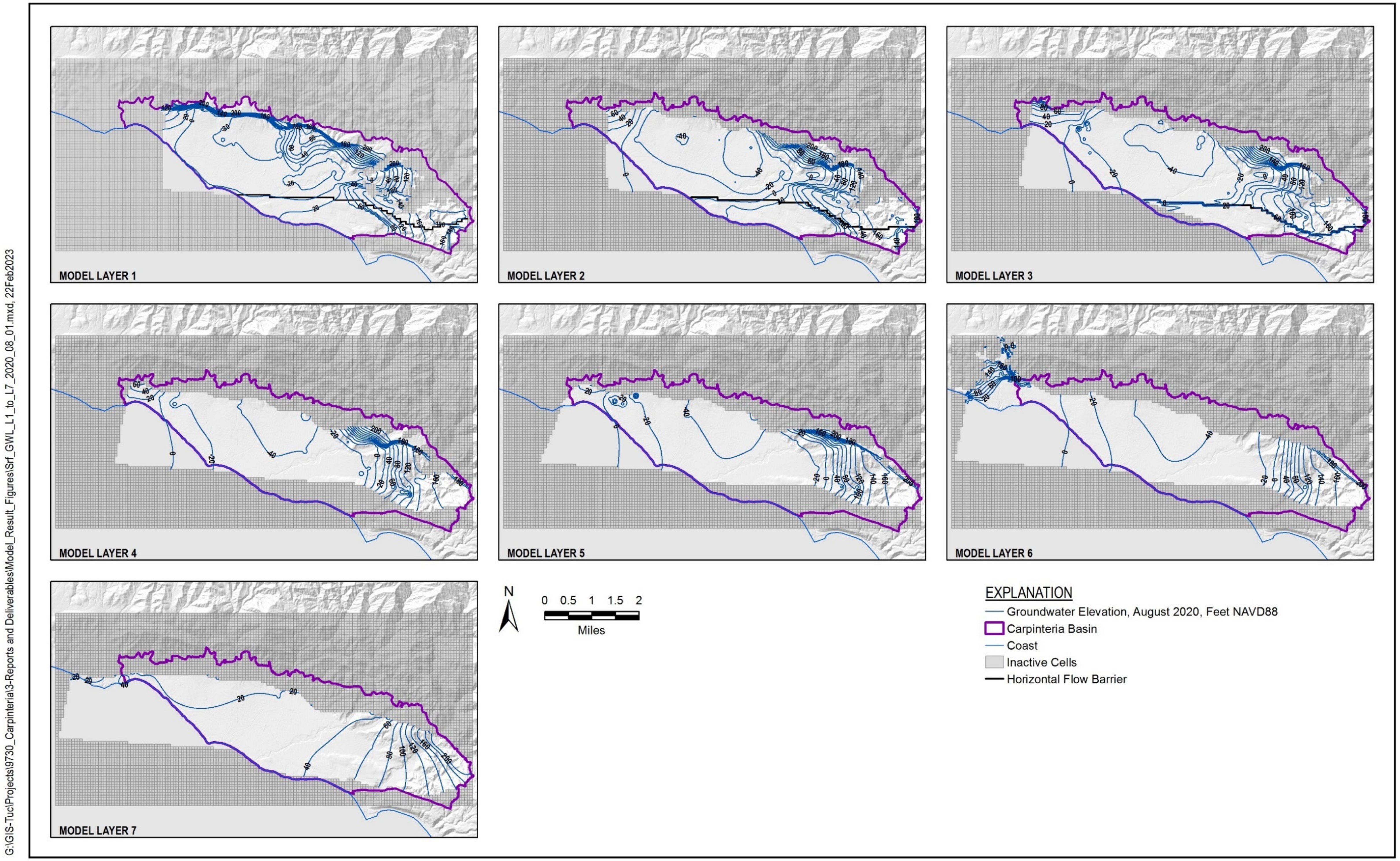

Figure 42. Simulated Groundwater Elevation Contours, August 2020

3.4 Sensitivity Analyses, Mass Balance, and Convergence

The following sections describe sensitivity analyses conducted with specific input parameters, analysis of mass balance error, and analysis of model convergence. These analyses help further validate the model's efficacy and identify areas where it might be improved in future updates.

3.4.1 Specific Yield Sensitivity Analysis

As described in Section 3.2.2, the 2012 annual model did not vary Sy, which was kept at a uniform value of 0.12. However, model evaluation prior to recalibration of the monthly model indicated that dry cells exist in model layers 1 through 5, suggesting that the model may be sensitive to Sy. Therefore, 3 model runs with uniform Sy values were set up to evaluate the influence of Sy on simulation of groundwater heads. These runs evaluated the following:

- Sy=0.2
- Sy=0.12
- Sy=0.08

All other model parameters were kept constant.

Evaluation of these runs indicated that the model was sensitive to SY in layers 1 through 6, with groundwater elevation differences of up to 40 feet between these runs. The model did not appear significantly sensitive to Sy in layer 7, likely a result of a lack of dry cells in the overlying layer 6. Therefore, Sy was incorporated as an adjusted parameter in layers 1 through 6 during PEST calibration.

3.4.2 Ocean General Head Boundary Height Sensitivity Analysis

As described in Section 2.4.2, general head boundary condition calculations used in this model update assume that the groundwater/seawater interface (Z) is considered the top of the model cell. To evaluate the significance of this assumption, the model was tested with Z set at both the top of the cell and at the middle of the cell, with all other model parameters kept constant. Groundwater elevations in the Basin resulting from these runs were essentially identical, with a maximum elevation difference of less than 2 feet in select wells. It was therefore concluded that the model was not highly sensitive to setting the height of Z at either the top or the middle of the general head boundary cell.

3.4.3 Ocean General Head Boundary Conductance Sensitivity Analysis

As described in Section 2.4.2, general head boundary condition cells are assigned a uniform conductance of 90,000 square feet per day. To test the sensitivity of ocean general head boundary conductance on head simulation, the following conductance values were tested while keeping all other model parameters fixed.

- 900,000 square feet per day (10 foot/day *300 foot *300 foot)
- 90,000 square feet per day (1 foot/day *300 foot *300 foot)
- 9,000 square feet per day (0.1 foot/day *300 foot *300 foot)
- 900 square feet per day (0.01 foot/day *300 foot *300 foot)

Groundwater elevations in the Basin resulting from these runs were essentially identical, with a maximum elevation difference of less than 2 feet in select wells. It was therefore concluded that the model is not highly sensitive to general head boundary conductance. Groundwater elevations near the coast (such as the Sentinel wells) were sensitive to hydraulic conductivities in model layers offshore of the coast between wells and the general head boundary condition. Calibration at those wells reflect adjustment of those conductivities.

3.4.4 Mass Balance Error

Evaluation of simulation mass balance error ensures the model can adequately reflect logical groundwater flow in its internal calculations. Mass balance error per stress period is presented on Figure 43; the maximum mass balance error is 0.26%. Cumulative mass balance error is presented on Figure 44 and does exceed 0.007%. These values indicate that mass balance error in the historical calibration simulation is very low.

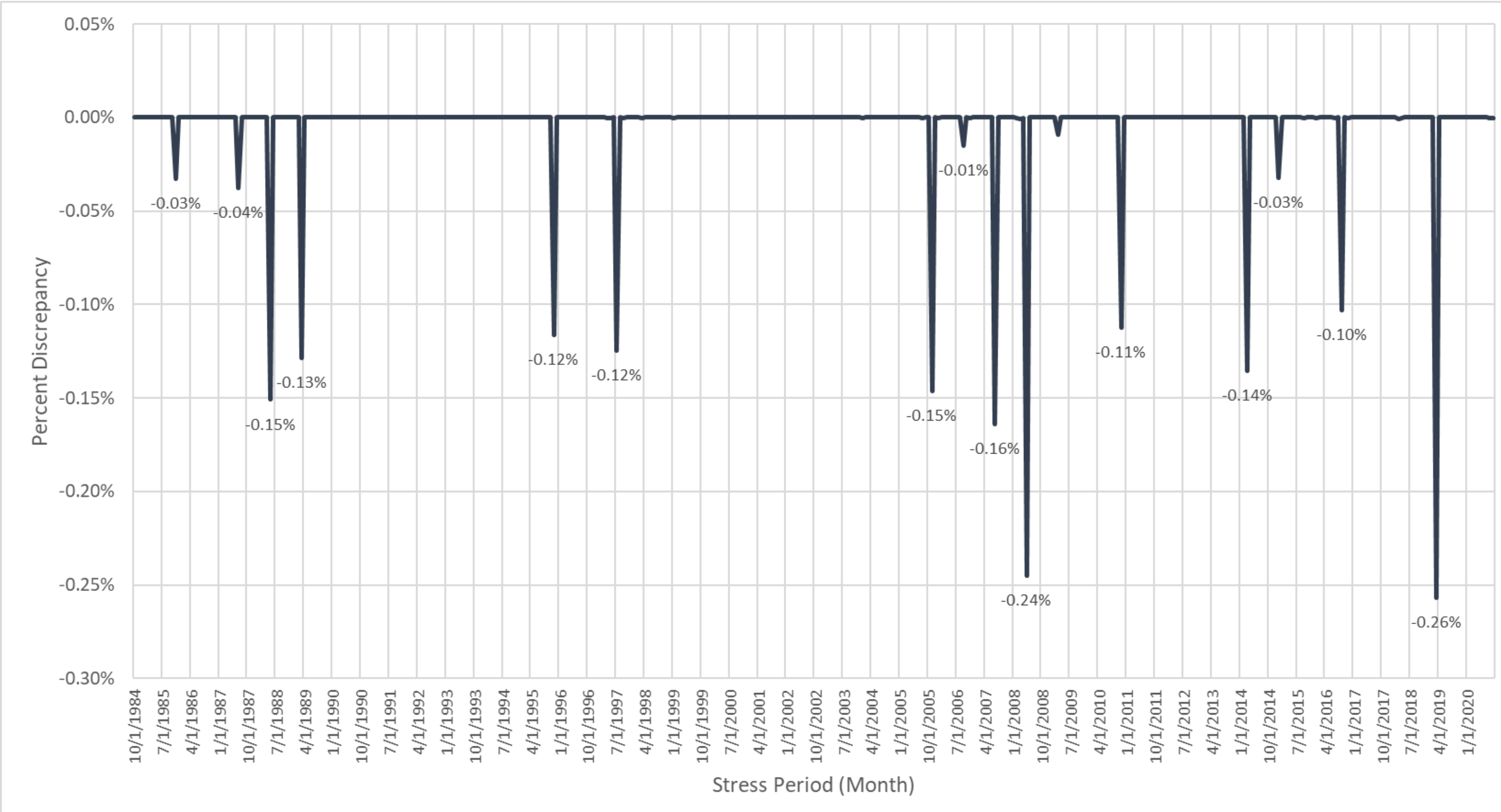

Figure 43. Model Mass Balance Error per Stress Period

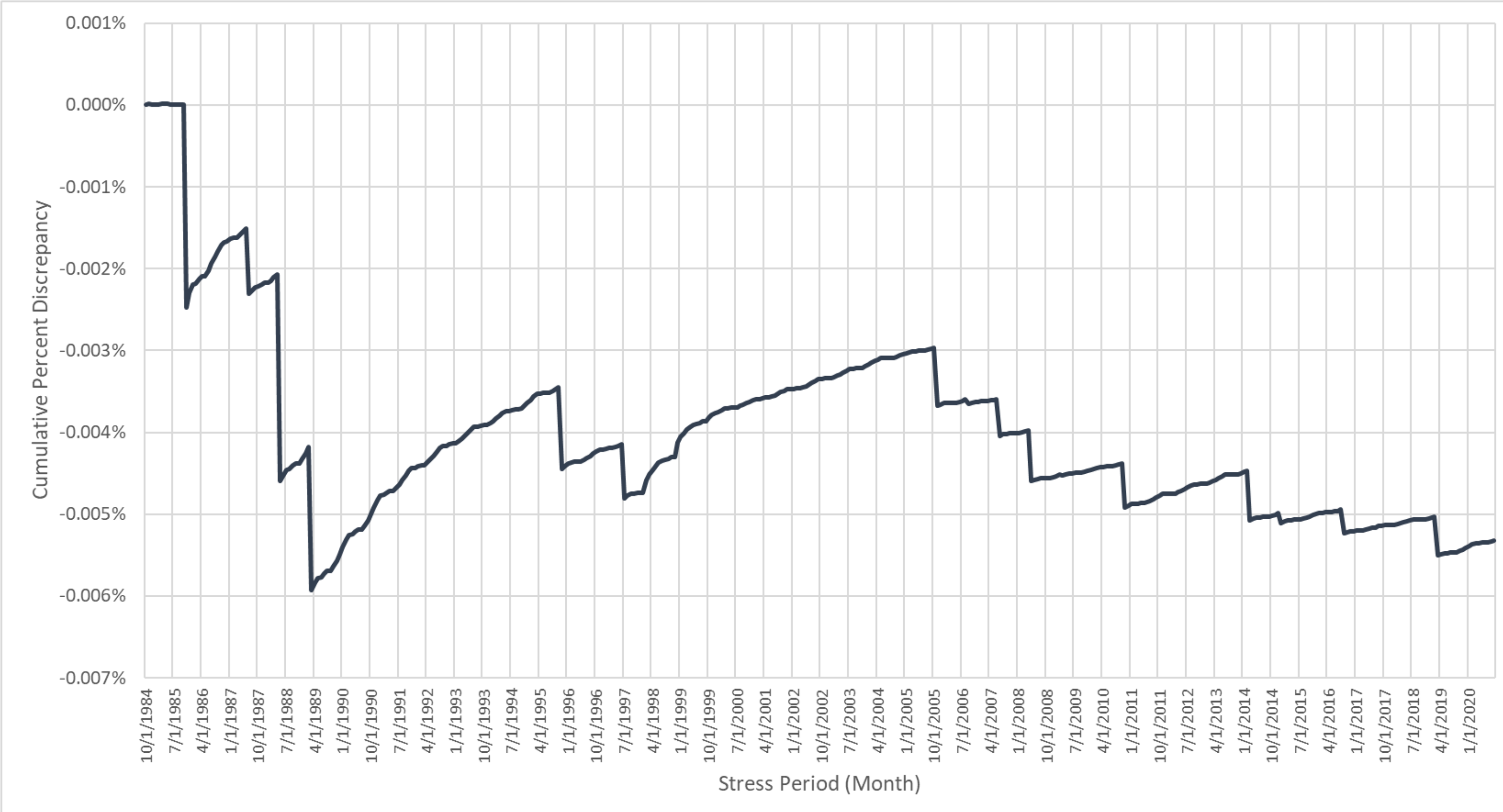

Figure 44. Model Cumulative Balance Error

3.4.5 Convergence

Despite very low mass balance error, the Carpinteria Basin model has historically experienced convergence issues. The annual model was anecdotally known to fail to converge and upon first converting to a monthly model for this update, the model failed to converge in 30% of timesteps. Significant effort was undertaken for this update to minimize these convergence failures, resulting in an improvement of roughly 10%. Convergence errors were lessened by iteratively changing the MODFLOW-NWT .nwt file solvers, and by removing thin periphery cells and adjusting the model's water budget components accordingly. Thin periphery cells, particularly in areas of high horizontal hydraulic conductivity, are known to complicate MODFLOW's ability to converge.

If overall mass balance error is low, failure to converge does not indicate issues with the model's ability to accurately predict head and flow, especially given adequate calibration statistics. However, convergence issues increase model runtimes which is particularly problematic during iterative model runs for calibration. Convergence issues may also indicate problems with head prediction in specific areas of the model where observation wells do not exist. In addition to minimizing convergence issues where possible, as described above, the spatial distribution of convergence failures was analyzed to provide information for potential future model updates. Overall, the model struggles to converge in model peripheries where thin cells exist. While many of these thin cells in the central north and northeast of the model were removed, some areas remain. In particular, the far northwest portion of layer 6 near Toro Canyon continually experiences convergence issues. The cells here are thin (Figure 4; Figure 6; Figure 7), highly conductive Figure 21), and are in some cases vertically discontinuous. These conditions all contribute to convergence difficulties. Given that there are no observation wells in the area of concern, and these cells lie outside the Carpinteria Basin, it is suggested that in a future update the model structure be altered. This alteration would deactivate the thin cells with convergence issues and transfer applicable recharge volumes into thicker cells south of this area to maintain identical water balance.

3.5 Model Output Used for GSP Water Budgets

The following subsections analyze model-calculated water budget components that are used for water budgets in the Carpinteria Basin GSP: flows between the Basin and offshore and flows between the Basin and Montecito Basin. The Carpinteria Basin GSP uses analytically derived calculations of other water budget components as representing best available information. Although the model does not exactly match analytically derived calculations, particularly for groundwater extraction (Section 3.1.3), the model is well calibrated (Section 3.3.2). Therefore, the model is consistent with observed gradients and resulting output for water budget components used for the GSP are reasonable approximations and represent best available information for the water budgets presented in the GSP.

3.5.1 Flows to/from Offshore

Flows to and from offshore are calculated at the Carpinteria Basin coastline boundary (Figure 1). These flows are subsurface groundwater flows between the Basin and aquifers underlying the Pacific Ocean. Monthly gross inflow, gross outflow, and net flow are shown on Figure 45 from the perspective of the Basin; flows leaving the Basin to offshore are shown as negative, flows entering the Basin from offshore are shown as positive.

Net flow from offshore is negative over the majority of the simulation, representing conditions of net outflow and reduced potential for seawater intrusion. However, local conditions resulting in net inflow from ocean may still exist and could cause localized seawater intrusion. Additional budget analysis could help further identify these areas.

Net inflow (positive) conditions exist during the WY 1990-1992 and WY 2014-2020 periods, corresponding with drought periods. During periods where there is net inflow from offshore (positive), increased potential for seawater intrusion exists. Seawater intrusion does not necessarily occur when there is inflow from offshore because there may be freshwater stored in the offshore aquifers.

Figure 46 illustrates net flows from ocean to the Carpinteria Basin by layer. The total stacked value (sum of all net flows by layer) is equivalent to the Basin-wide dashed black net flow line on Figure 45.

The model predicts layer 6 (productive zone C) to be the volumetrically largest and most consistent source of net inflow from ocean during dry periods (WY 1990-1992 and WY 2014-2020), followed by layer 4 and layer 2. These formations are pumped extensively and are highly conductive which could support seawater intrusion during dry periods. However, as described in Section 2.4.2 the extent to which these conductive layers continue offshore and are hydrogeologically connected to the ocean is not certain. The model geometry extrapolates these layers offshore in accordance with best available knowledge. By the end of the simulation, the model simulates net inflow from ocean in all layers. Recent induction log increases in aquifer zone C (layer 6) appear to suggest seawater intrusion may be occurring in that unit, corroborating the model’s conclusions about recent inflows from offshore.

Table 6 details average annual (WY) flows to and from offshore by water budget period and WY type. Net flow was negative (net outflow to offshore) during the historical period of WY 1985-2020, and positive during the current period of WY 2012-2020. Flow to and from ocean is directly correlated with WY type; net flow to offshore during dry periods is substantially less than flow during wet periods. The net inflow from offshore during the current period is greater than the near zero average net inflow during critically dry years due to the 3 consecutive critically dry years at the beginning of the current period that dropped groundwater levels followed by only minimal groundwater level recovery in the subsequent years.

Table 6. Flows to and from Offshore by Water Budget Period and Water Year Type, Acre-feet per Year

	From Offshore	To Offshore	Net Flow
Historical Period WY 1985-2020	253	-491	-238
Current Period, WY 2012-2020	531	-266	266
All Historical Wet and Above Normal Water Years	224	-581	-357
All Historical Below Normal and Dry Water Years	273	-455	-183
All Historical Critically Dry Years	286	-335	-48

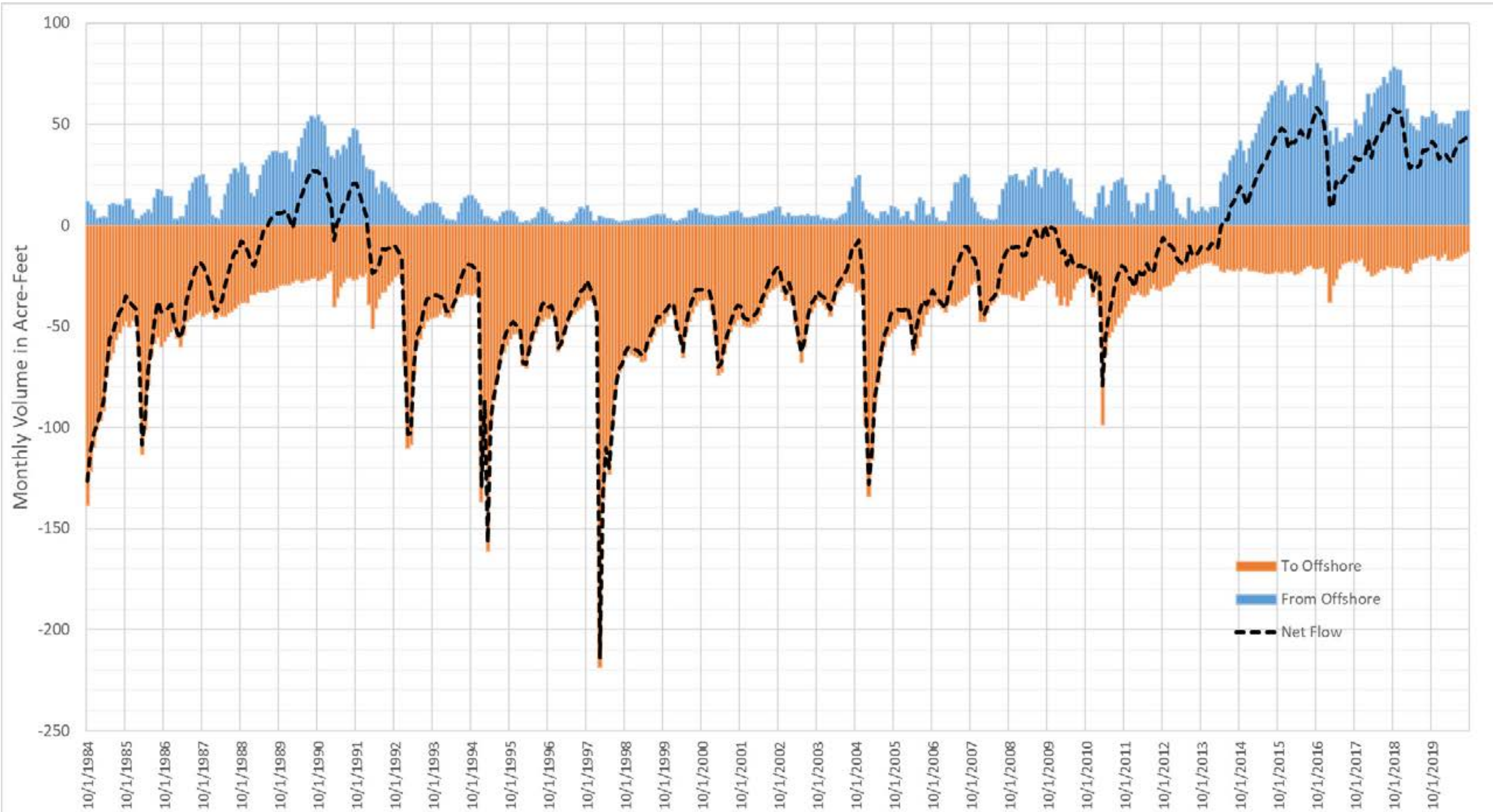

Figure 45. Carpinteria Basin Flow to and from Offshore

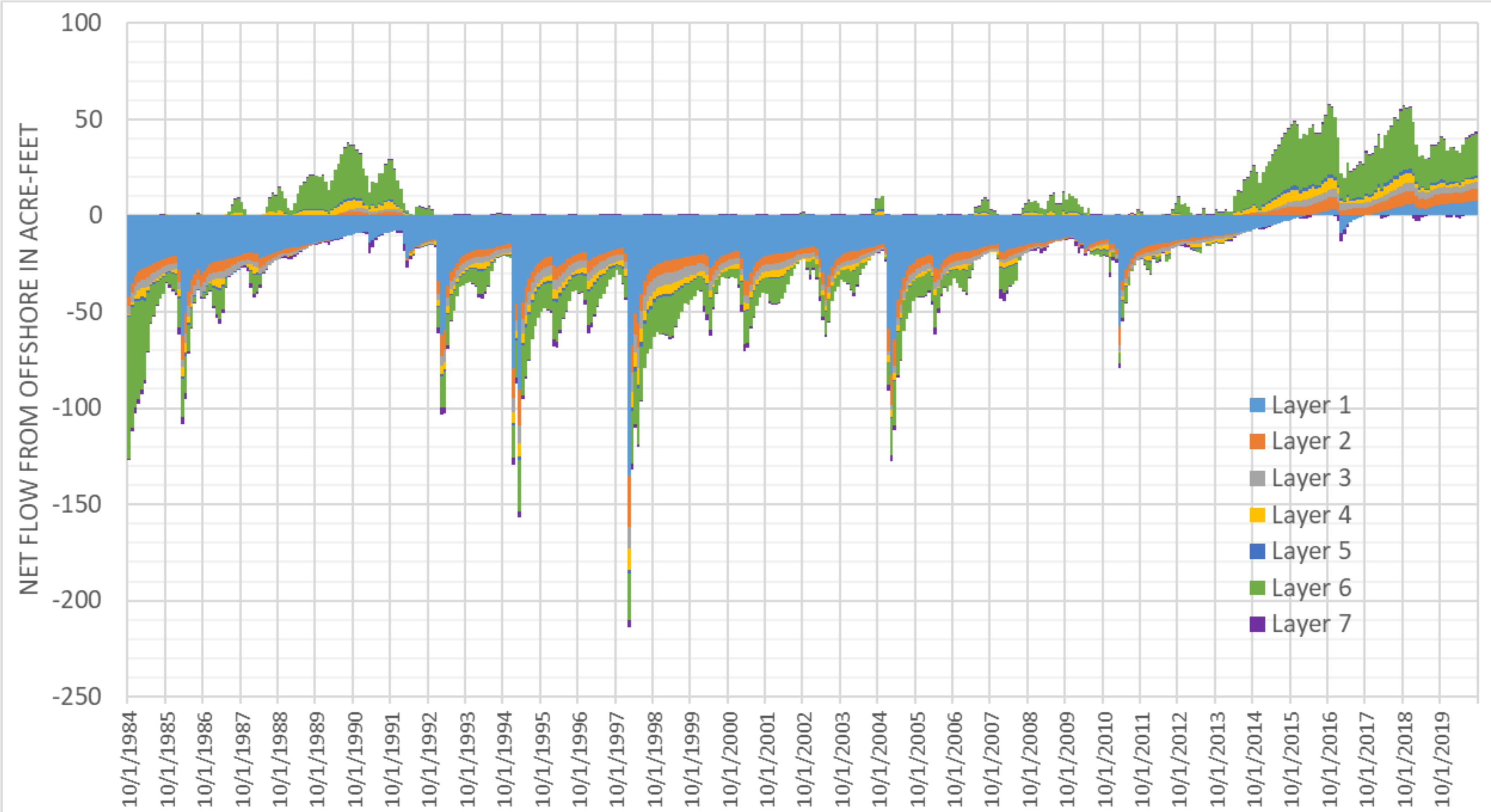

Figure 46. Carpinteria Basin Net Flow from Offshore by Layer

3.5.2 Flows to/from Montecito Groundwater Basin

Flows to and from the Montecito Groundwater Basin (MGB or Montecito Basin) are calculated where the Carpinteria Basin boundary meets the MGB (Figure 1).

Figure 47 displays flow to and from the MGB over the historical time period. With the exception of limited net outflow during wet periods, the Carpinteria Basin generally receives net inflow from MGB. Table 7 details average annual (WY) flows to and from MGB by water budget period and WY type. In general, there is more flow both to and from MGB during wetter periods, and less during dry periods.

Table 7. Flows to and from Montecito Basin by Water Budget Period and Water Year Type, Acre-feet per Year

	From Montecito Basin	To Montecito Basin	Net Flow
Historical Period WY 1985-2020	101	-56	45
Current Period WY 2012-2020	87	-37	50
All Historical Wet and Above Normal Water Years	113	-70	42
All Historical Below Normal and Dry Water Years	104	-52	52
All Historical Critically Dry Years	65	-29	36

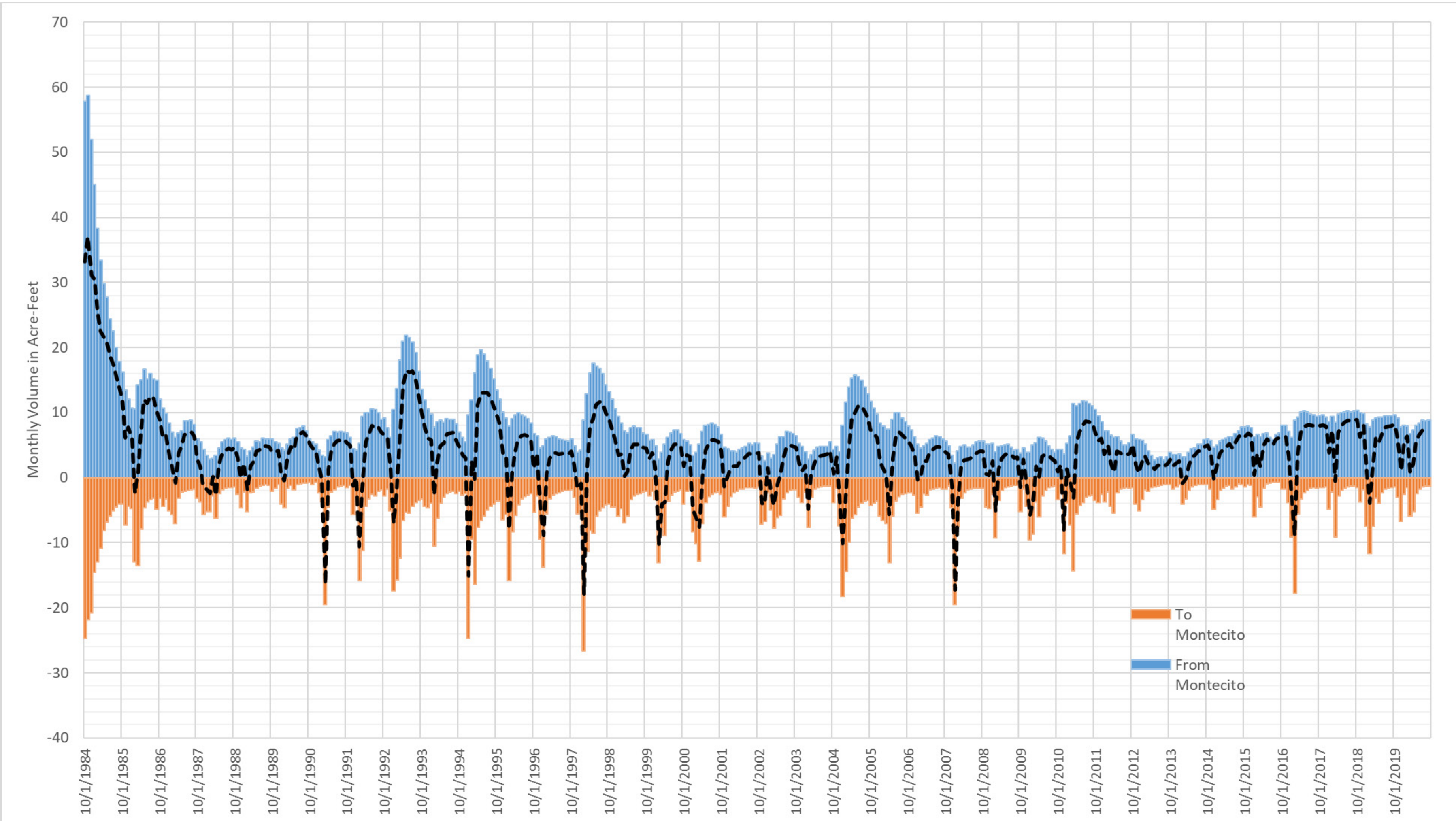

Figure 47. Carpinteria Basin Flow to and from Montecito Basin

4 PREDICTIVE SCENARIO DEVELOPMENT AND ANALYSIS

4.1 Predictive Baseline

This report describes development and analysis of the baseline predictive scenario, which projects groundwater conditions 53 years from the end of the historical calibration simulation. To support ongoing groundwater sustainability planning and project development, SGMA GSP regulations require construction of a projected water budget to quantify aquifer response to future baseline conditions of supply, demand, and climate change over at least 50 years. Simulated water budget components from this baseline scenario are utilized to develop these GSP water budgets, and simulated hydrographs and contour maps will be informative for sustainability planning. The methodologies used to develop baseline scenario inputs are described further in Pueblo, 2022.

The baseline scenario does not include future projects and management actions that will be identified by the GSP. Modeling of projects and management actions will be included in the GSP. The simulations of projects and management actions will be based on the same climate and water demand assumptions as the baseline scenario. The results can then be compared to the results of the baseline scenario to describe expected sustainability benefits of the projects and management actions in the GSP.

4.1.1 Scenario Assumptions

The subsections below describe scenario assumptions utilized when developing the predictive baseline scenario.

4.1.1.1 Projected Time Period and Initial Conditions

The projected scenario extends from WY 2021 to WY 2073 (10/1/2021 – 9/1/2073). This 53-year period encompasses the 2043 deadline for the Basin to achieve sustainability based on the late 2023 planned submittal of the GSP. The period extends an additional 30 years beyond the sustainability deadline, over which SGMA requires sustainability be maintained. Scenario initial heads are equivalent to the end of the historical scenario (9/1/2021).

4.1.1.2 Climate

Climate for the projected scenario is based on the historical 1950-2002 climate, adjusted for climate change. The 1950-2002 period was chosen because it includes periods of dry, wet, and alternating dry and wet conditions (Figure 48; Pueblo, 2022). DWR central tendency datasets are used to adjust historical precipitation and evapotranspiration (ET) to account for climate change

(Pueblo, 2022). These adjustments to historical precipitation and ET then cascade to influence areal recharge components, mountain-front recharge, and groundwater extraction. DWR central tendency 2030 climate change factors are used for the WY 2021-2043 pre-sustainability deadline period, while DWR central tendency 2070 climate change factors are used for the 2044-2073 post-sustainability deadline period. The precipitation adjustments result in roughly 4% more precipitation on average when compared to the historical 1950-2002 data, with more variability in precipitation (Pueblo, 2022). The ET adjustments result in a 3.1% increase in ET during the WY 2021-2043 period, and a 7.9% increase in ET during the WY 2044-2073 period.

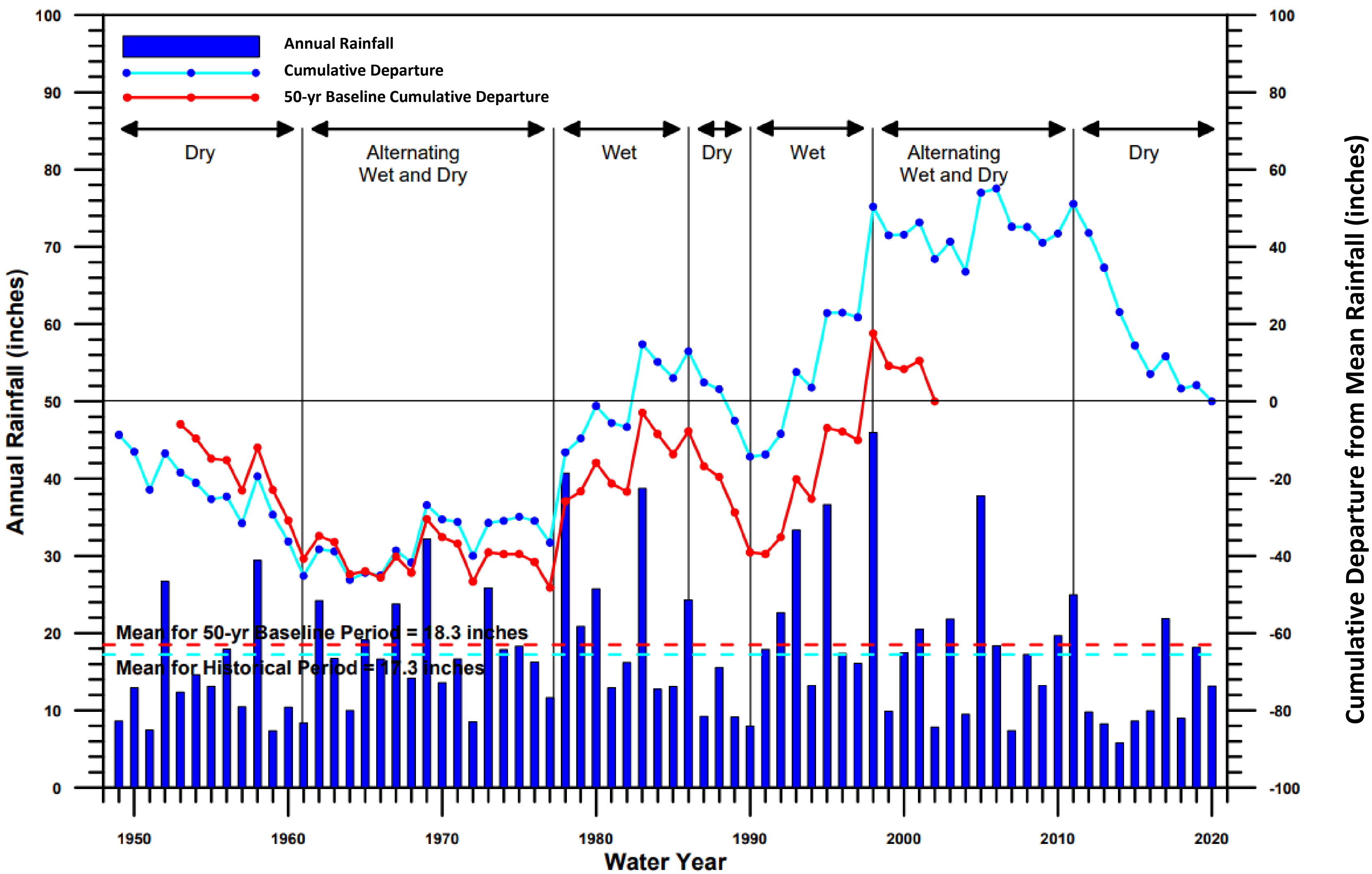

Figure 48. Historical Annual Rainfall at the Carpinteria Fire Station WY 1949-2020 [Pueblo, 2022]

4.1.1.2.1 Mountain-front Recharge

As described in Section 2.5.1, mountain-front recharge is simulated using injection wells from the MODFLOW WEL (.wel) package. These wells are placed along the northern boundaries of the model in layers 2 through 7 (Figure 11). As described further in Pueblo 2022, mountain-front recharge inflow is calculated using an analytical relationship to streamflow.

Figure 49 displays historical and projected mountain-front recharge; annual projected mountain-front recharge is 6.4% higher than the historical simulation on average. This increase results from the WY 1950-2002 period being wetter than the WY 1985-2020 period, and the application of DWR climate change factors.

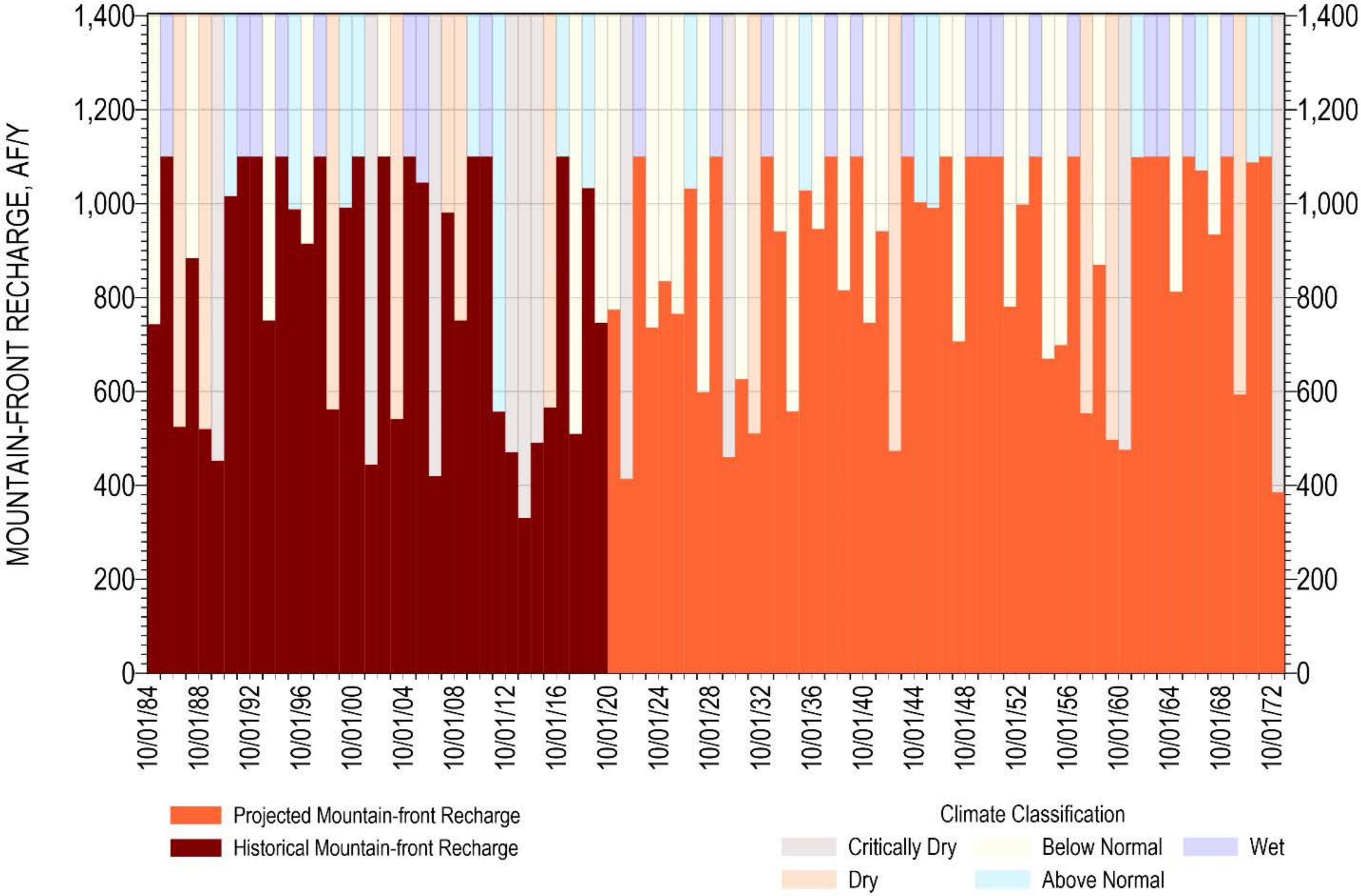

Figure 49. Historical and Projected Mountain-Front Recharge

4.1.1.2.2 Recharge Components

As described in Section 2.5.2, all recharge components are combined and then simulated using the MODFLOW RECHARGE (.rch) package. These include percolation of precipitation, streambed percolation, irrigation return flows, and extraction by phreatophytes. Recharge zonation is show visually on Figure 12.

For the predictive scenario, components are adjusted using the DWR central tendency climate change factors as outlined above and described further in Pueblo 2022.

Figure 50 illustrates historical and projected recharge for the largest recharge zone (Zone 1; Figure 12); total projected annual recharge for zone 1 is 12.7% higher than the historical simulation on average. This is a combination of the 1950-2002 period being wetter than the 1984-2020 period and the application of DWR climate change factors such that increase in precipitation outweighs increase in evapotranspiration.

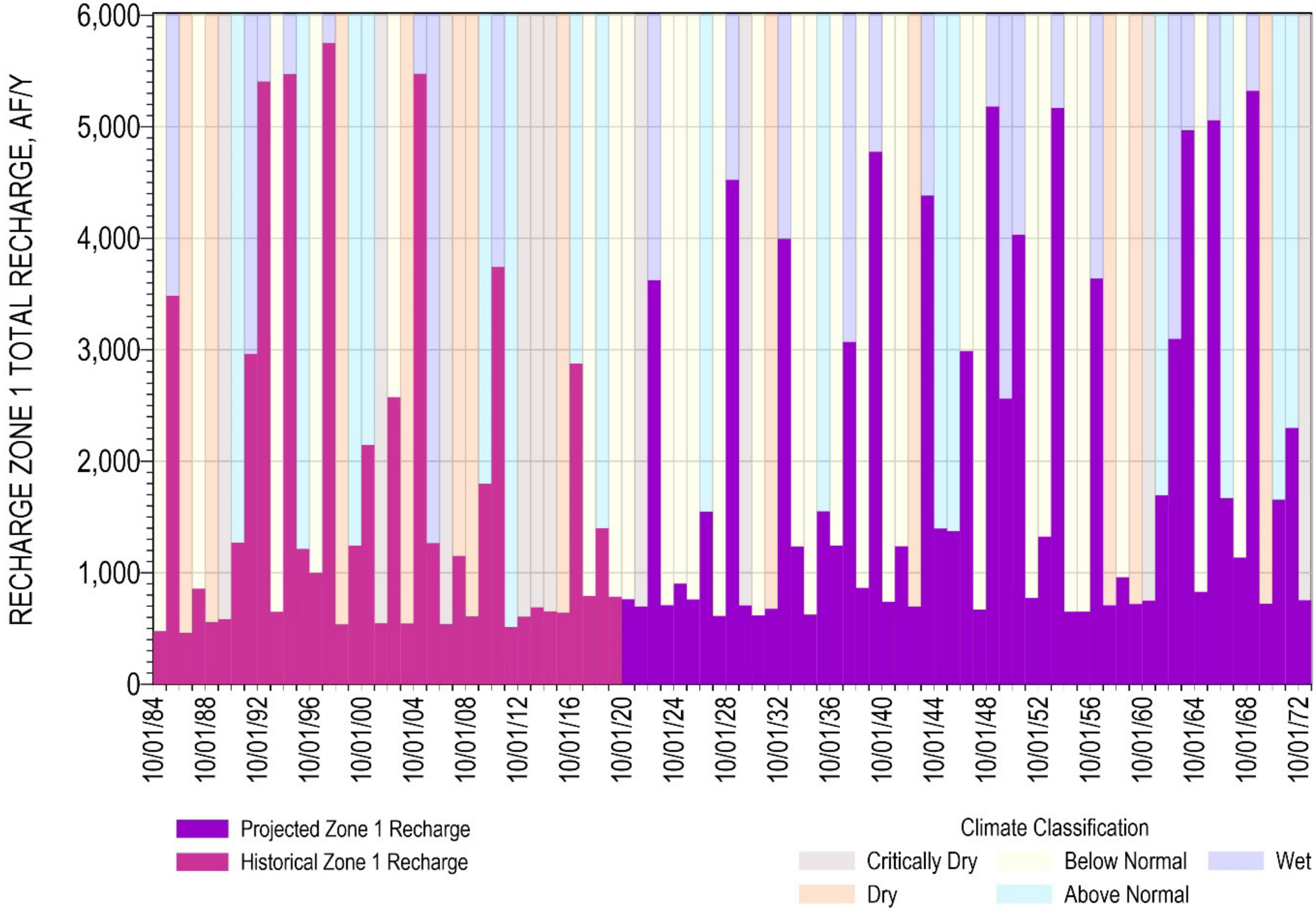

Figure 50. Historical and Projected Zone 1 Total Recharge

4.1.1.3 Groundwater Extraction

Municipal (CVWD) and private pumping is simulated using the MNW2 package as described in Section 2.5.3. As was the case in the historical simulation (3.1.3), seepage face losses result in 94% of input pumping being represented in the model. CVWD pumping is derived from the 2020 CVWD Urban Water Management Plan, which provides gross estimated CVWD pumping during normal, single-dry, and multiple-dry WYs and incorporates projected growth in demands through 2045 (Woodard and Curran, 2021; Pueblo, 2022). WY type and monthly distribution averaging of the historical data is utilized to develop monthly timeseries of CVWD pumping, which is then distributed to existing municipal wells according estimated per-well pumping capacities (Pueblo, 2022). Projected CVWD pumping is 12.4% lower on average than the historical simulation. This decrease results from consideration of existing plans to expand surface water and recycled water, and the generally wetter projected period (Woodard and Curran, 2021).

Because the CVWD Urban Water Management Plan (Woodard and Curran, 2021) and Agricultural Water Management Plan do not project private water use, gross annual private pumping is based on WY type and monthly use averaging of the historical simulation period (1984-2020). Results of WY type annual averaging were adjusted to ensure a consistent trend from wet years (lowest private pumping) critically dry years (highest private pumping) without disrupting the anticipated total simulation pumping. Monthly private pumping is then increased in accordance with DWR climate change ET factors (Section 4.1.1.2; Pueblo, 2022). Projected private pumping is 3% greater on average than the historical simulation. Private pumping is distributed between the wells which exist in WY 2020, according to their historical average pumping (Pueblo, 2022). Figure 51 shows simulated pumping for the historical simulation and the projected baseline simulation. Note that, as was the case with the historical simulation, seepage face losses result in 7% of this pumping not being simulated by the model on average. Simulated pumping for both the historical and projected scenarios is known on Figure 51 to illustrate this. The locations of CVWD and private wells with projected pumping are shown on Figure 52.

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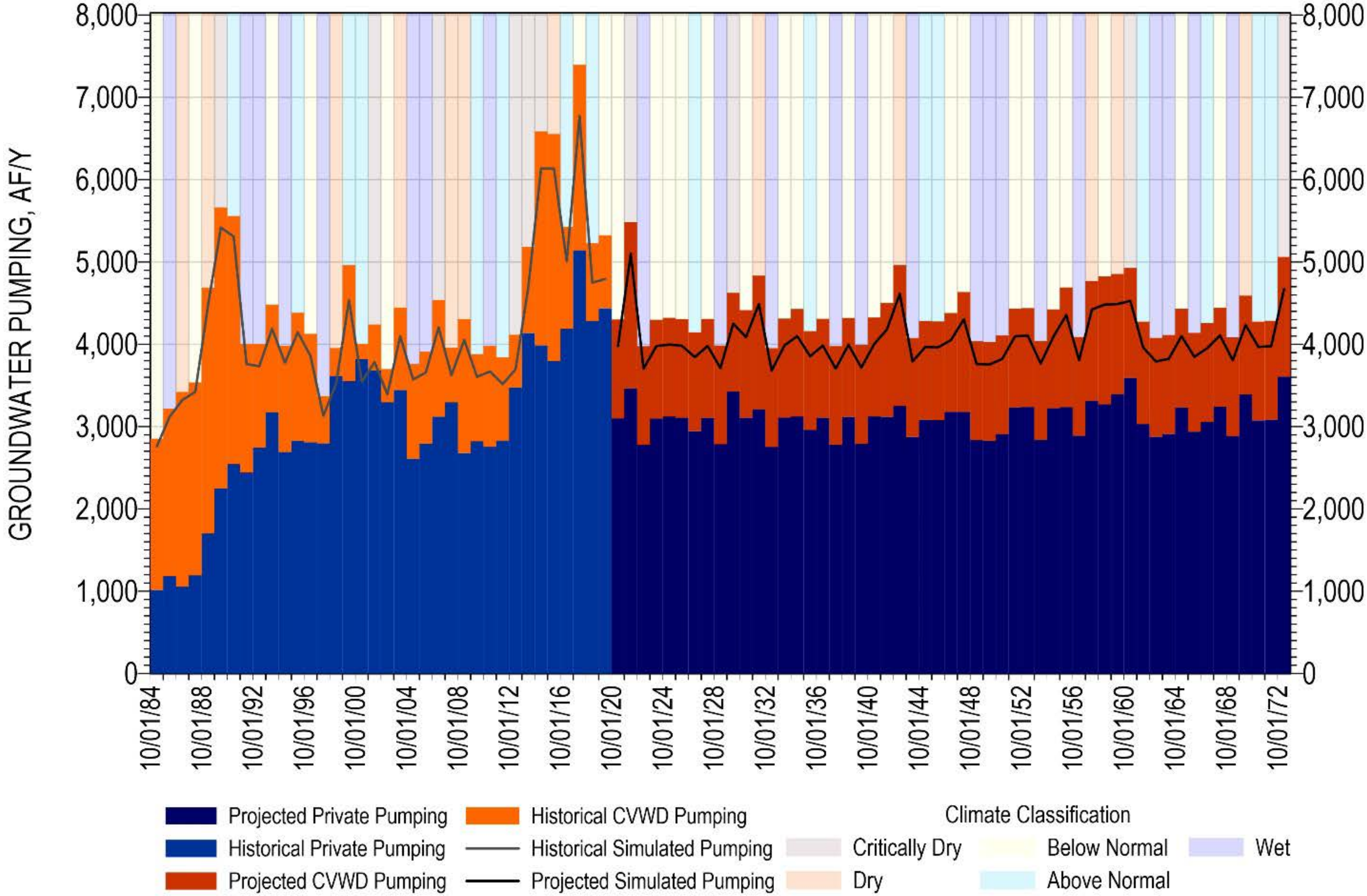

Figure 51. Historical and Projected Pumping

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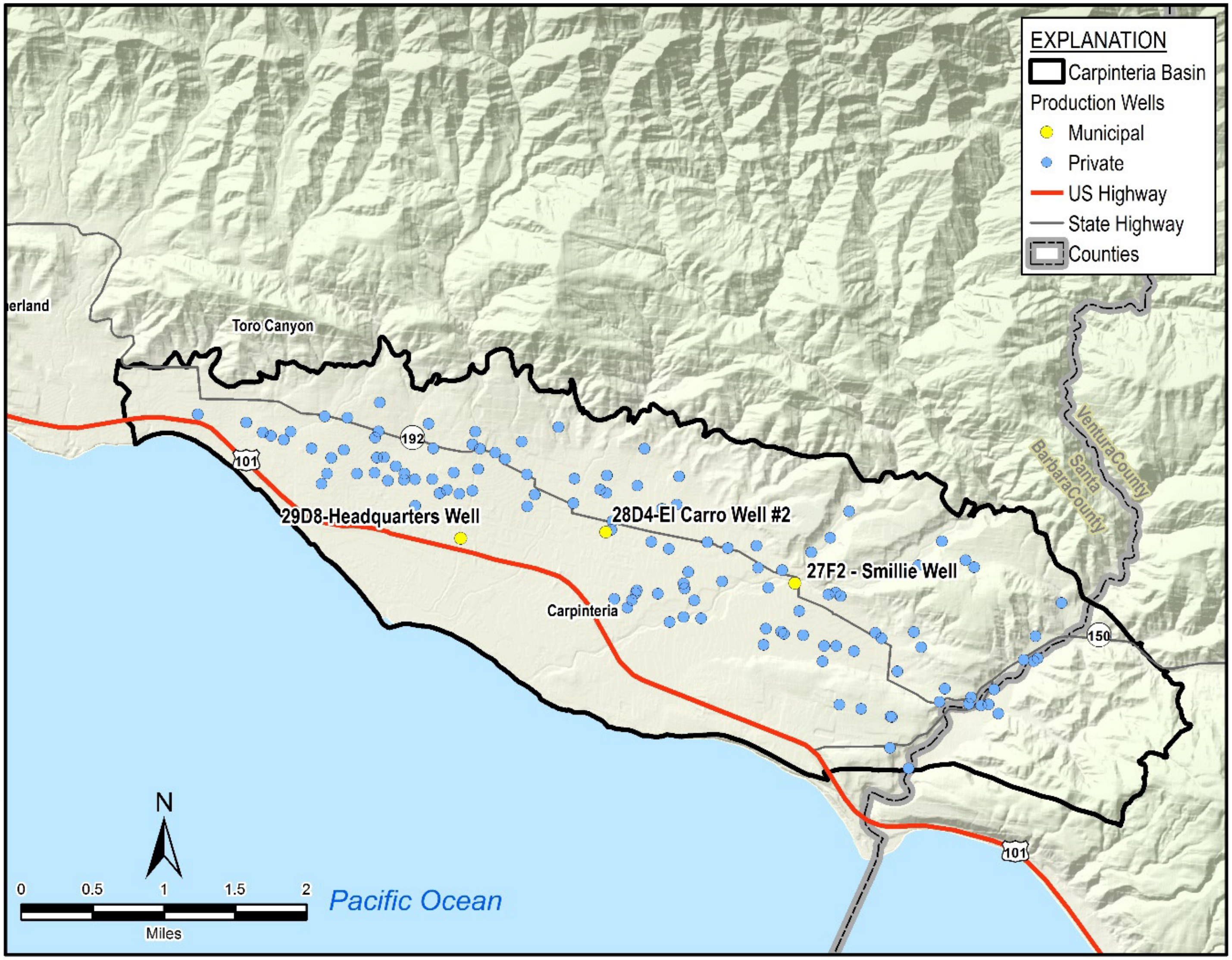

Figure 52. Projected MNW2 Well Locations

4.1.1.4 Sea Level Rise

Implementation of the ocean boundary condition using a MODFLOW general head boundary is described in Section 2.4.2 and presented visually on Figure 10. For the projected scenario, the general head boundary is adjusted using San Francisco sea level rise estimates relative to 2000, developed by the National Research Council and recommended by DWR. These estimates predict sea level rise of 5.9 inches by 2030 (0.49 feet) and 17.7 inches (1.48 feet) by 2070 compared to 2020. These values are higher than the median sea level rise estimates for Santa Barbara, and therefore provide a conservative estimate in line with DWR recommendations (CNRA, 2018).

Figure 53 depicts how sea level rise is implemented in the general head boundary. In the historical model, the ocean general head boundary was held steady and did not account for any sea level rise. For the projected model, linear equations are used to shift the general head boundary according to date (stress period) and initial freshwater adjusted head. Transient heads at the general head boundary conditions are shifted up using 2 linear equations, first to match the 2030 sea level rise estimates during the pre-WY 2030 period, and then to match the 2070 sea level rise estimates during the post-WY 2030 period (Figure 53). Because the projected model starts in WY 2021 but DWR sea level rise estimates are relative to 2000, the general head boundary rises with a steeper slope in the pre-WY 2030 period, as it catches up to the 2030 estimate. During this period total sea level rise is slightly underestimated, though the rate of monthly sea level rise is overestimated. During the post-WY 2030 period, sea level rise is very good match to the DWR guidance values (Figure 53). As described in Section 2.4.2, the historical ocean general head boundary was adjusted for density dependence to develop equivalent freshwater head. When adding sea level rise to this freshwater equivalent head, the DWR sea level rise factors were adjusted for freshwater dependence consistent with the methodology described in Section 2.4.2. Figure 54 and Figure 55 illustrate the general head boundary during October 2030 and October 2070, respectively.

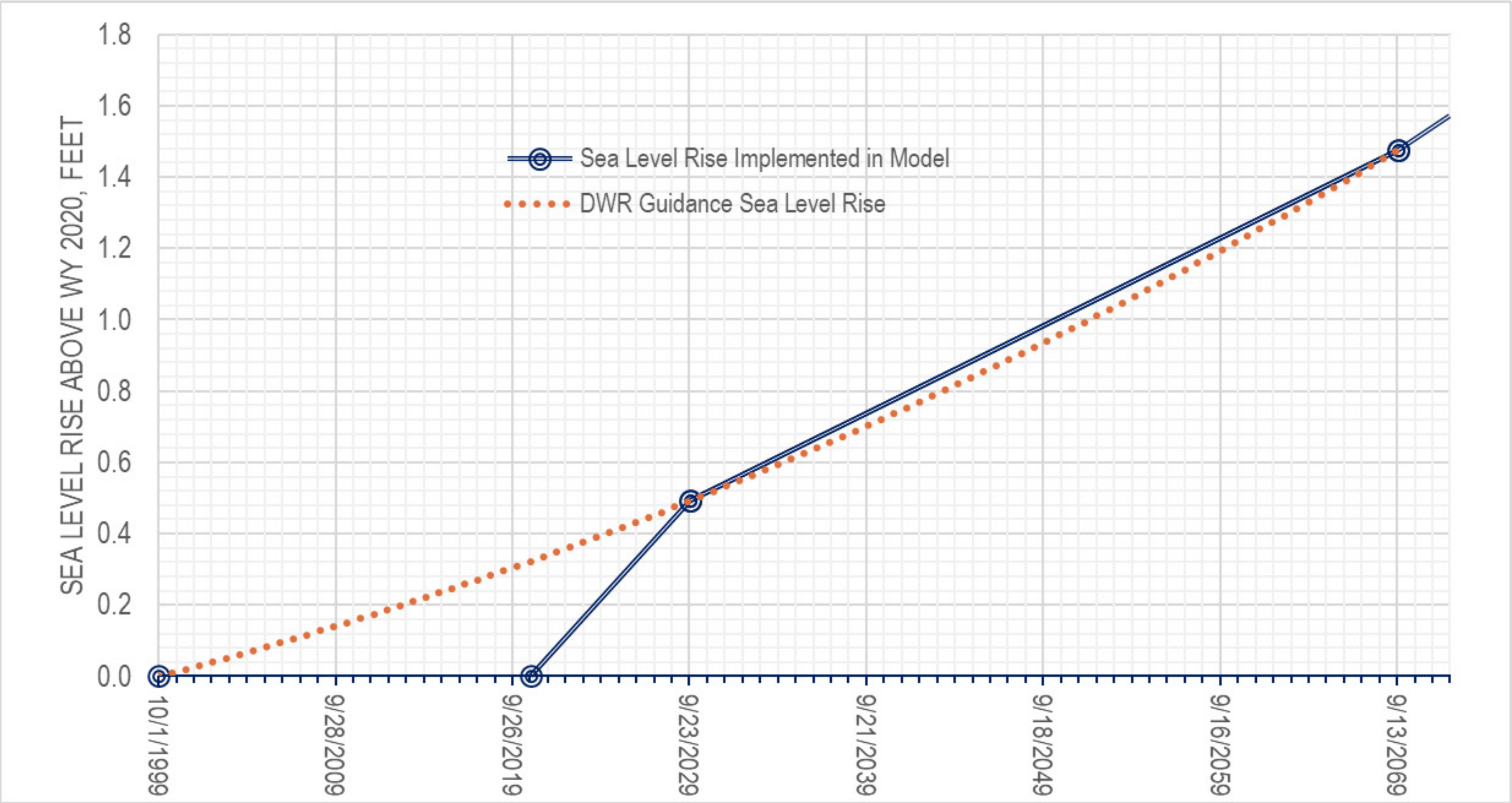

Figure 53. Projected Sea Level Rise

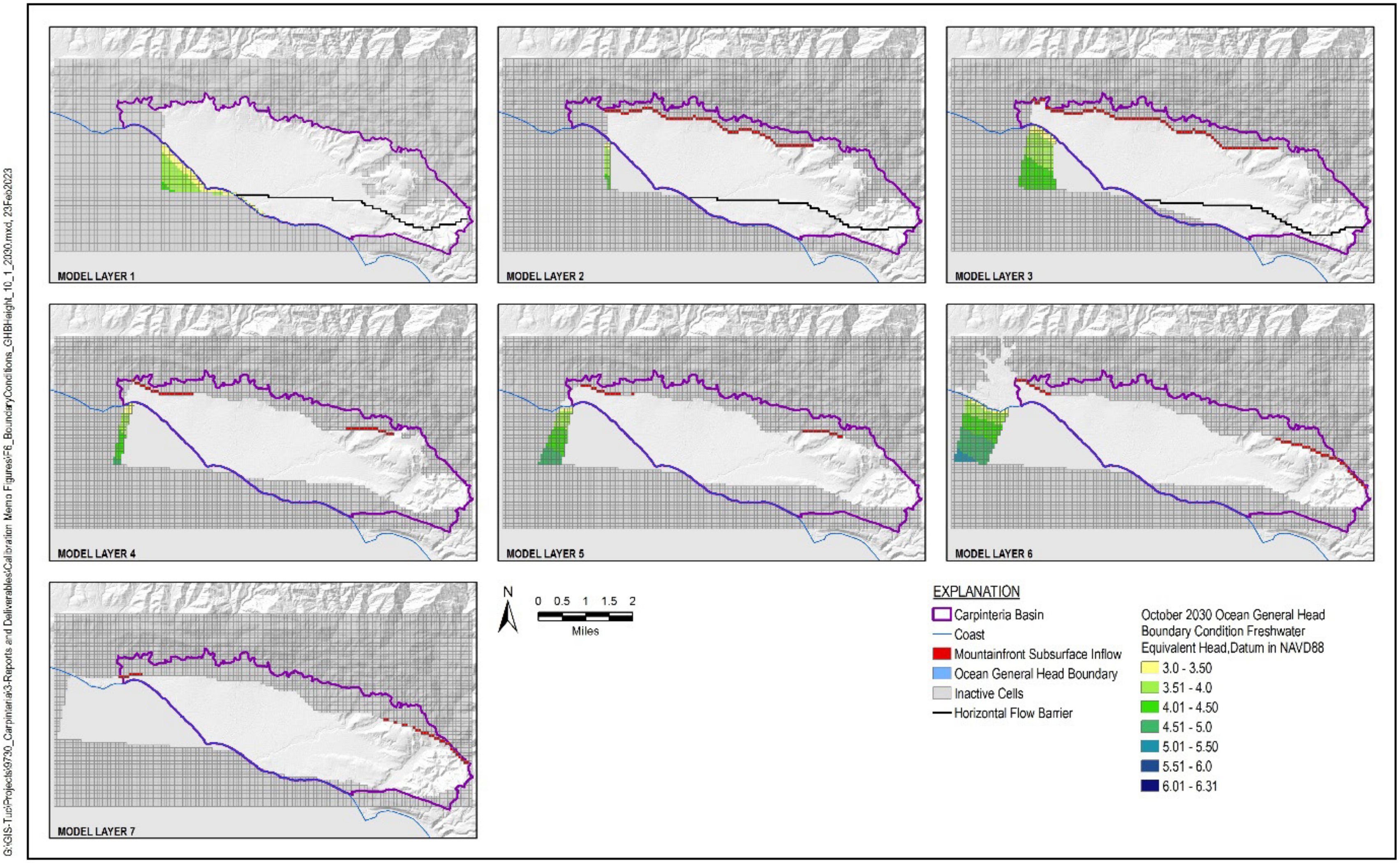

Figure 54. Ocean General Head Boundary 10/1/2030

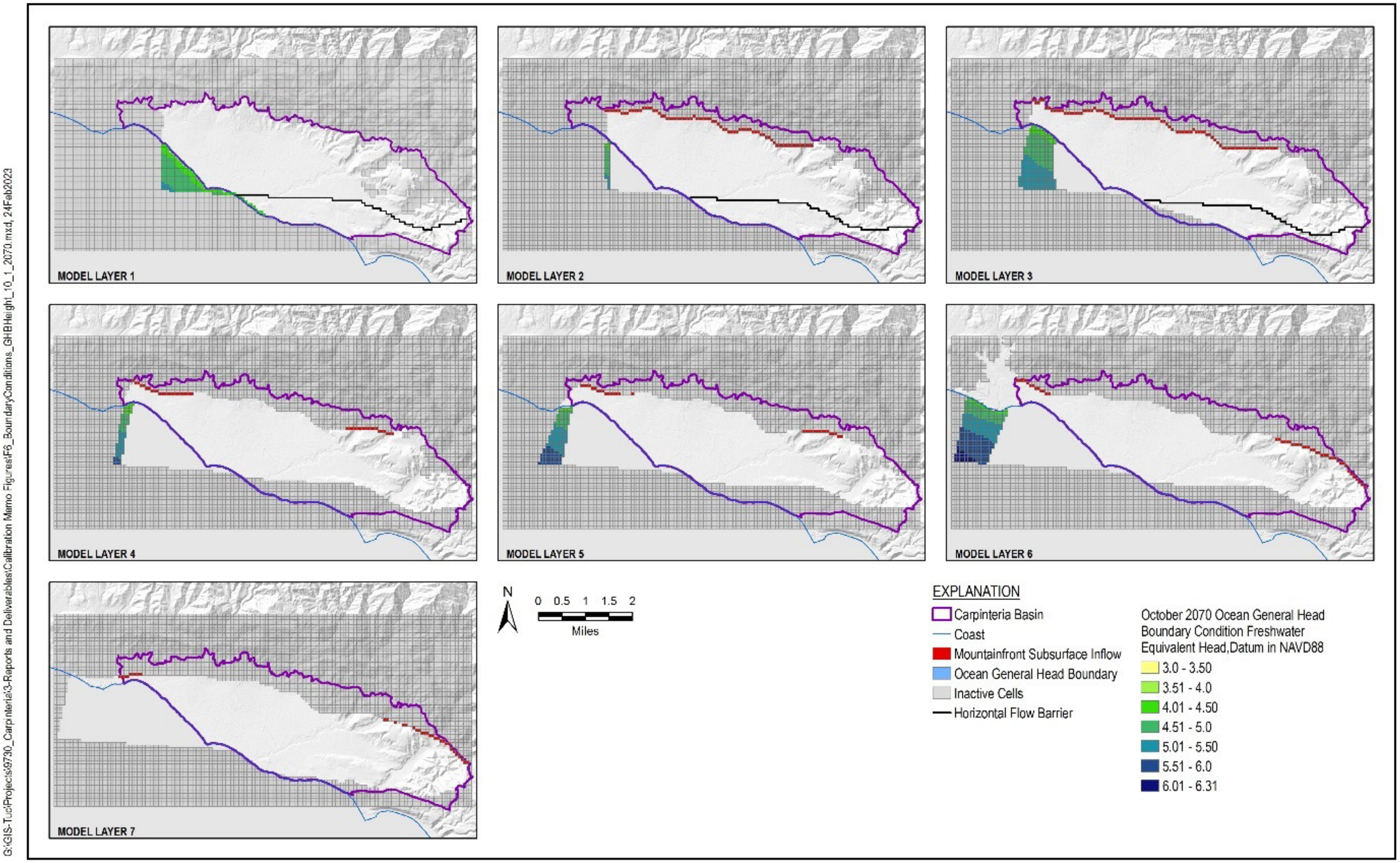

Figure 55. Ocean General Head Boundary 10/1/2070

4.1.2 Predictive Simulation Results

The following subsections analyze results of the predictive baseline scenario with a focus on groundwater elevations and Basin groundwater budget components utilized for the GSP.

4.1.2.1 Hydrographs

Select hydrographs are shown on Figure 56 through Figure 62, displaying historical simulated elevations, historical observations, and projected scenario elevations. The wells shown on these hydrographs mirror those shown on Figure 29 through Figure 35 in Section 3.3.3.

All SU1 hydrographs showcase similar trends (Figure 56 through Figure 61). Elevations slowly rise from the 2022 low point until around 2055, at which point they decline sharply in an extended dry period (2056-2063), and experience recovery during an extended wet period (2064-2073).

Elevations in SU2 follow their historical pattern of continued decline until around WY 2040 then remain relatively stable through 2073 (Figure 62). As noted in Section 3.3.3, the model is very well calibrated in SU1; the model is less well calibrated in SU2 though it simulates the downward trend in groundwater elevations observed historically.

The projected water budgets presented for the GSP (Pueblo, 2023) show a small reduction of groundwater in storage for the Basin. The hydrographs indicate that reduction is driven by projected groundwater declines in SU2. Projected groundwater level increases in SU1 can simultaneously occur while groundwater in storage declines for the entire Basin that includes SU2.

The overall rise in simulated SU1 groundwater elevations may also be overestimated due in part to seepage face losses, which reduce pumping in the predictive scenario at a similar percentage to the calibration period (6%, See Section 3.1.3)2.5.3. Because pumping budget components in Basin water budgets developed for the GSP do not include these seepage face losses, the water budgets included in the GSP show greater pumping than what is simulated in the model. Regardless of the accounting of pumping seepage losses, the projected baseline simulation represents improved conditions compared to historical conditions.

Examination of elevations relative to sea level (approximately 3 feet NAVD88) is useful for anticipating directionality and magnitude of flows from offshore, which may cause seawater intrusion. Elevations in SU1 start below sea level across most of the western and central Basin including along the coastal boundary of the Basin (see Figure 42 in Section 3.3.4) and remain below sea level until around WY 2045-2050. After the 2043 sustainability deadline for the Basin. Elevations also dip below sea level during the dry period from WY 2057-2064. Elevations in the central Basin's deeper layers, notably layer 6 (productive zone C), are projected to remain below sea level for effectively the entire projected simulation (Figure 58). Despite this, the relatively wetter climate in the projected scenario (Section 4.1.1.2) and the decreased private and municipal pumping relative to the 2010-2020 period (Section 4.1.1.3) result in SU1 elevations returning to roughly 2010 values by 2073.

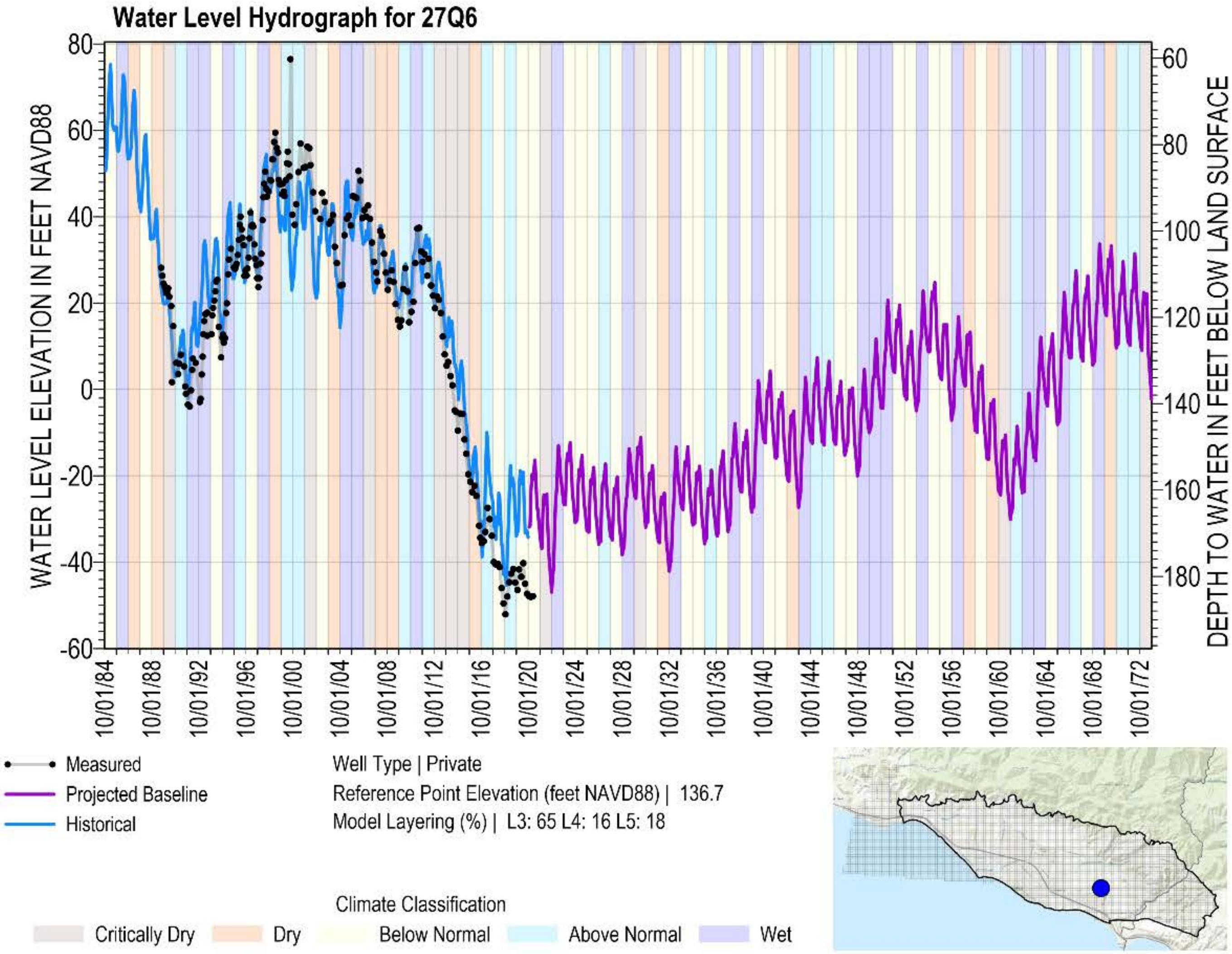

Figure 56. Historical and Projected Hydrograph for SU-1 Private Well 27Q6, Feet NAVD88

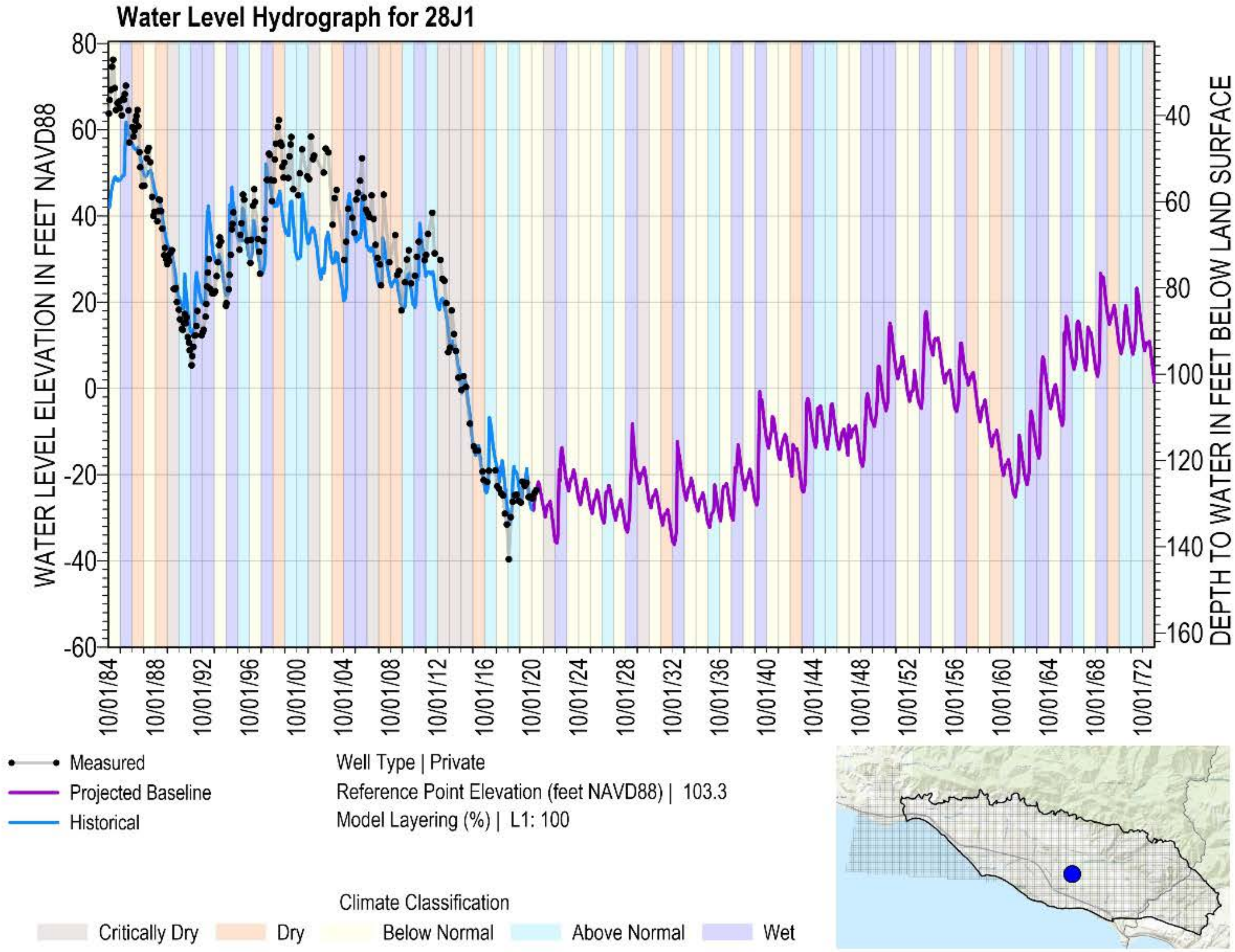

Figure 57. Historical and Projected Hydrograph for SU-1 Private Well 28J1, Feet NAVD88

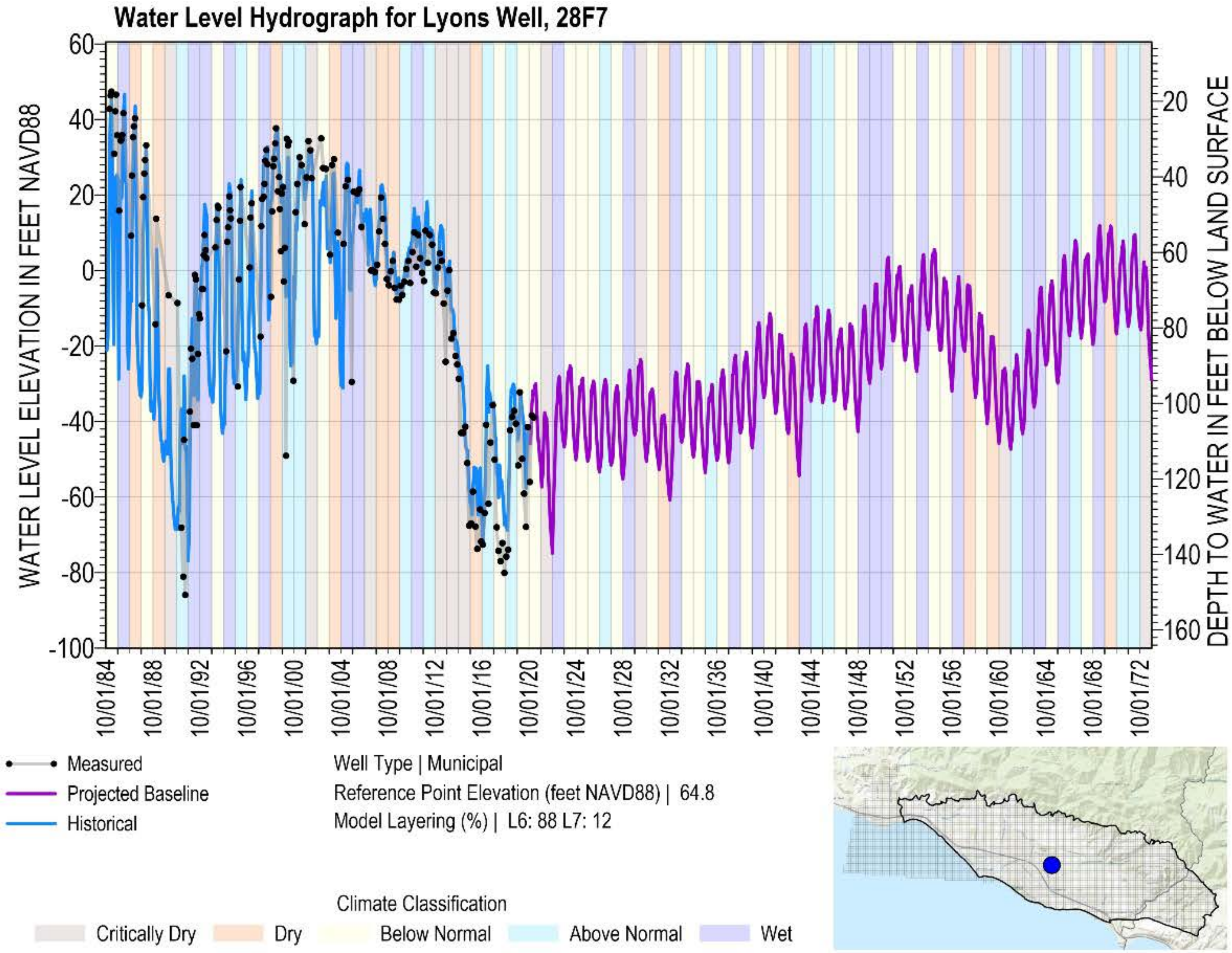

Figure 58. Historical and Projected Hydrograph for SU-1 Lyons Municipal Well (28F7), Feet NAVD88

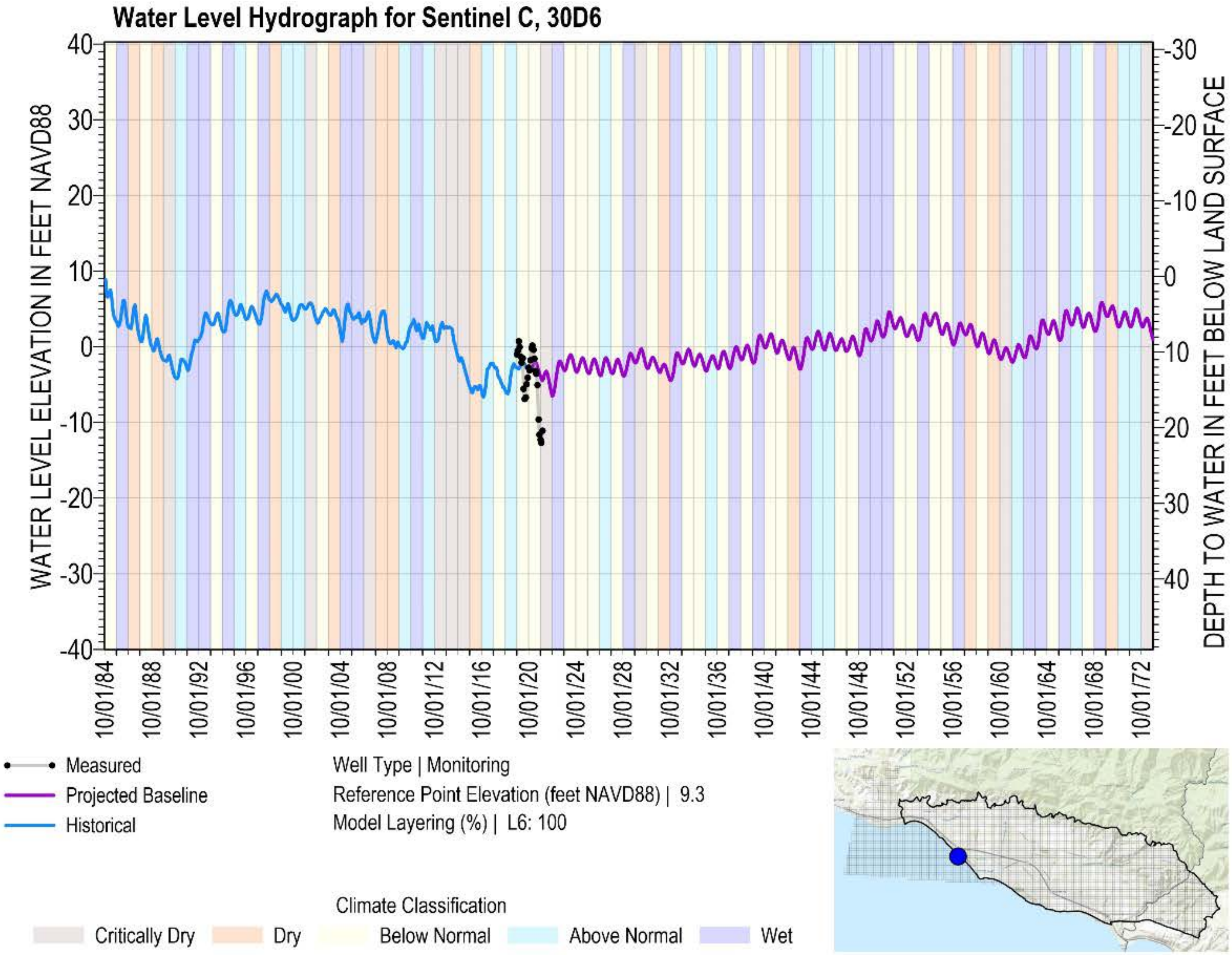

Figure 59. Historical and Projected Hydrograph for SU-1 Monitoring Well Sentinel C (30D8), Feet NAVD88

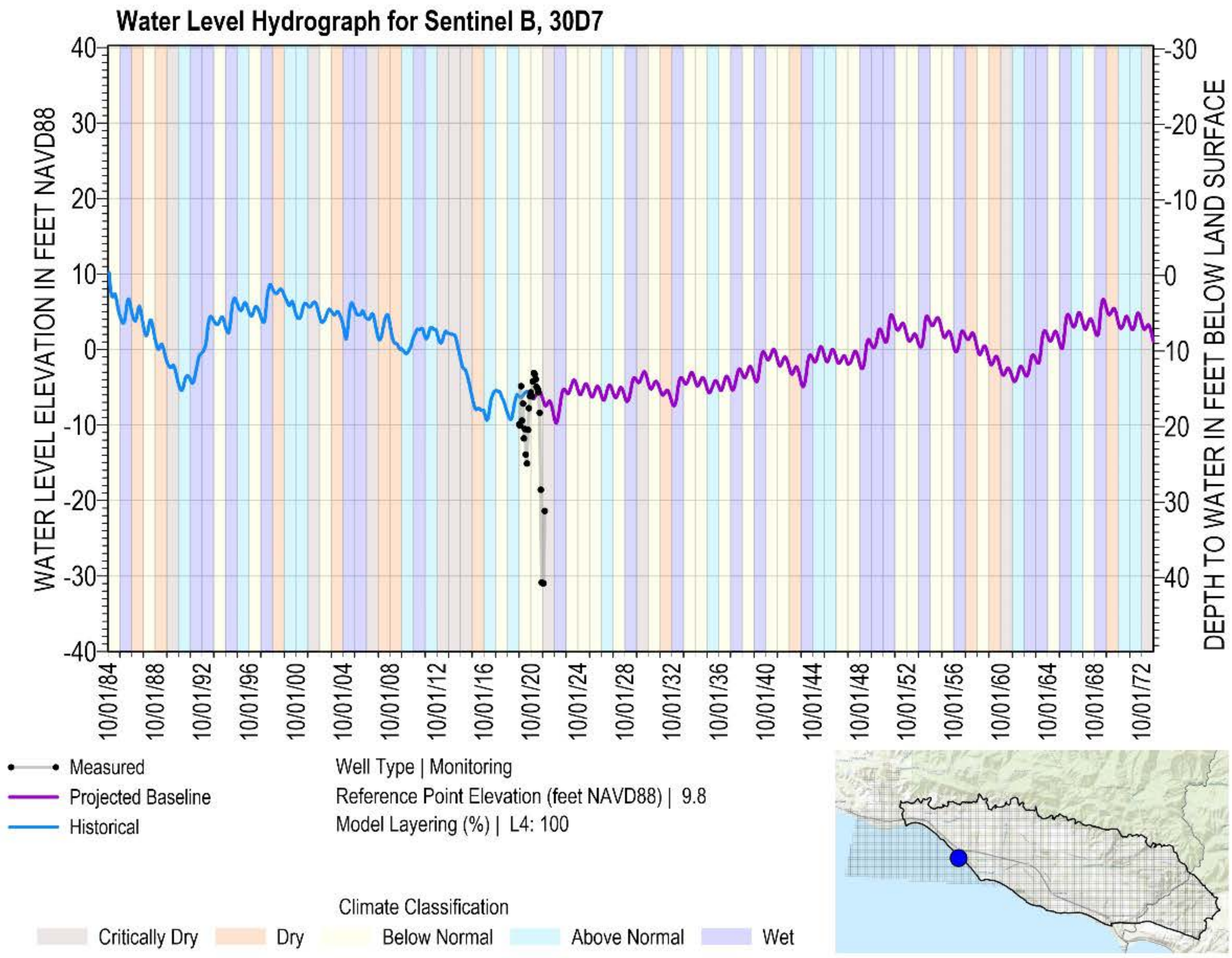

Figure 60. Historical and Projected Hydrograph for SU-1 Monitoring Well Sentinel B (30D7), Feet NAVD88

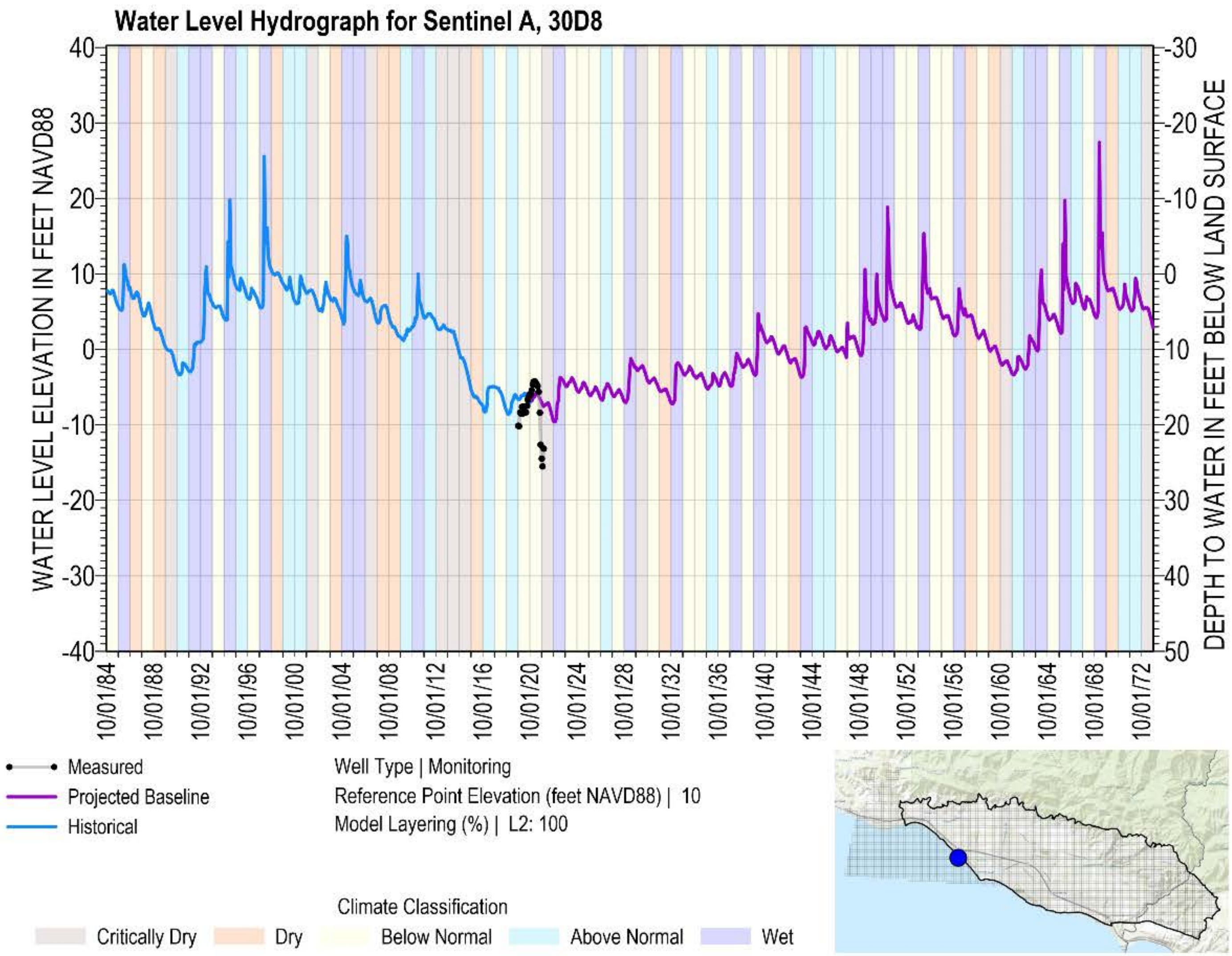

Figure 61. Historical and Projected Hydrograph for SU-1 Monitoring Well Sentinel A (30D8), Feet NAVD88

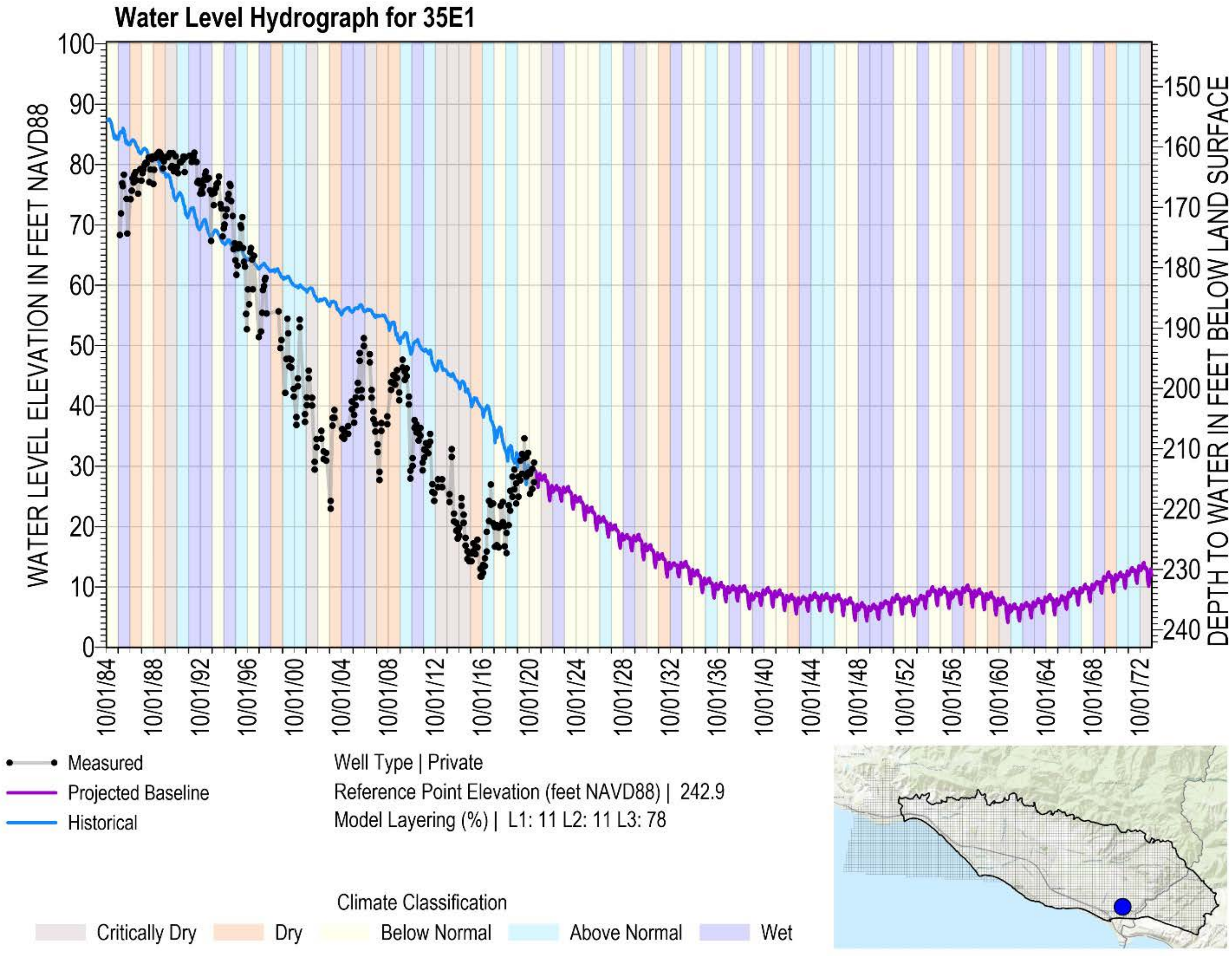

Figure 62. Historical and Projected Hydrograph for SU-2 Private Well 35E1, Feet NAVD88

4.1.2.2 Simulated Contours

Contours of model piezometric surface elevations are shown on Figure 63 through Figure 70. These maps illustrate the model's prediction of each layer's groundwater elevations during a snapshot in time. Spring (May) and late summer/fall (August) elevations are shown for each projected WY chosen for evaluation. Comparison of May and August contours illuminate interannual seasonal fluctuations that are informative for groundwater management.

WY 2033 is shown on Figure 63 (May) and Figure 64 (August). This falls 13 years into the projected simulation, in a wet year following an extended dry period. Conditions here during both May and April are significantly below sea level (approximately 3 feet NAVD88) across most of the Basin including along the coastal Basin boundary. The pumping depression beneath the central Basin increases roughly 20 feet between May (Figure 63) and August (Figure 64).

WY 2043 is shown on Figure 65 (May) and Figure 66 (August). This year falls 23 years into the projected simulation and corresponds with the SGMA sustainability deadline for the Basin. While conditions here reflect roughly 5-20 feet of improvement from 2033 conditions, both May and April elevations remain significantly below sea level across most of the Basin including along the coastal Basin boundary.

WY 2063 is shown on Figure 67 (May) and Figure 68 (August). This year falls 43 years into the projected simulation, following an extended dry period. Conditions during this period are similar to 2043 elevations and remain below sea level across much of the Basin including along the coastal Basin boundary. However as can be seen on hydrographs in Appendix D, groundwater elevations at some wells in the center of the Basin do rise above sea level during the wet period between WY 2049 and WY 2057.

WY 2073 is shown on Figure 69 (May) and Figure 70 (August). This year marks the end of the projected simulation and is a critically dry year following an extended wet period. Conditions during this period among the highest which occur during the projected simulation, and are generally comparable to elevations during WY 2000-2010 of the historical period.

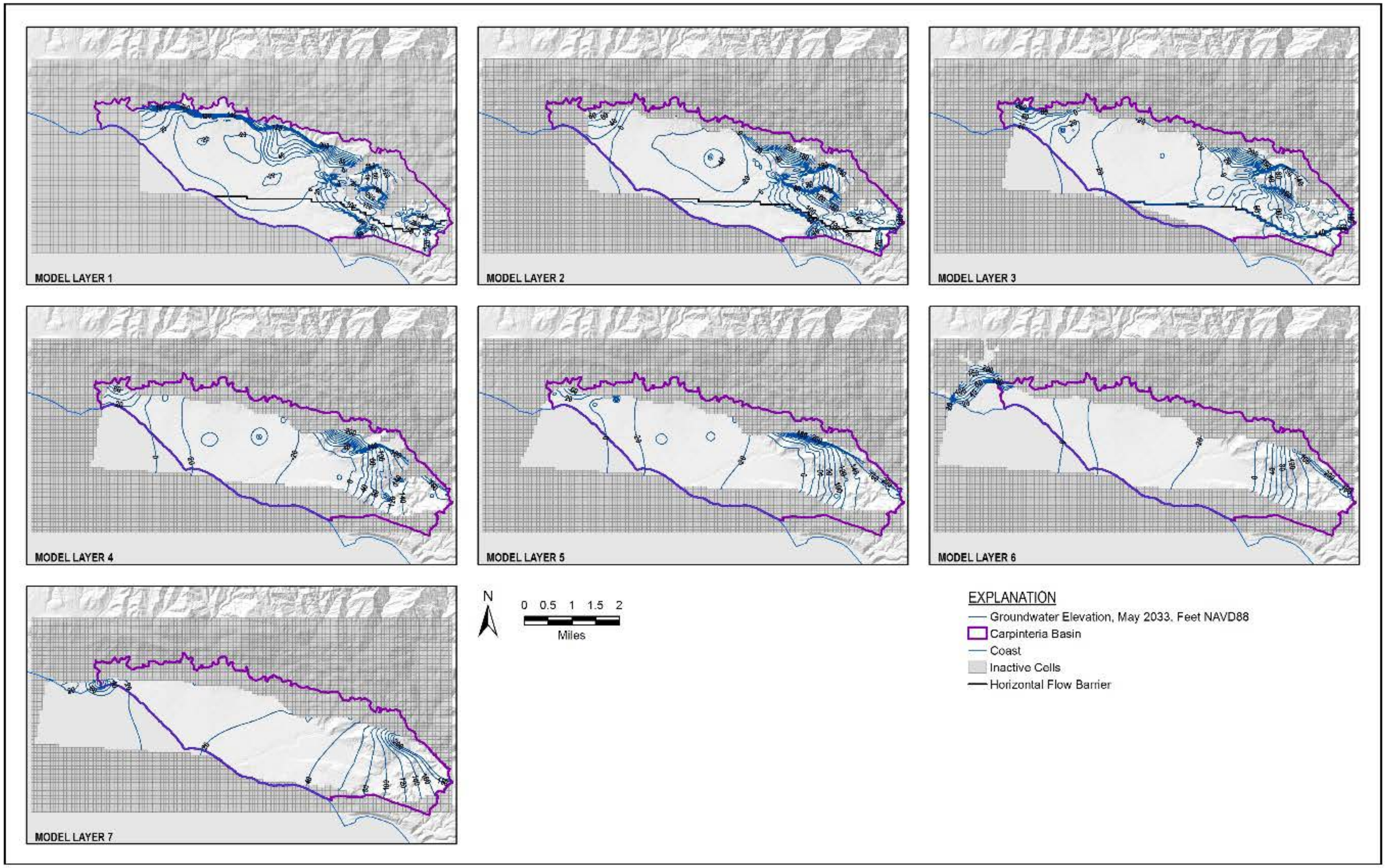

Figure 63. Simulated Groundwater Elevation Contours, May 2033

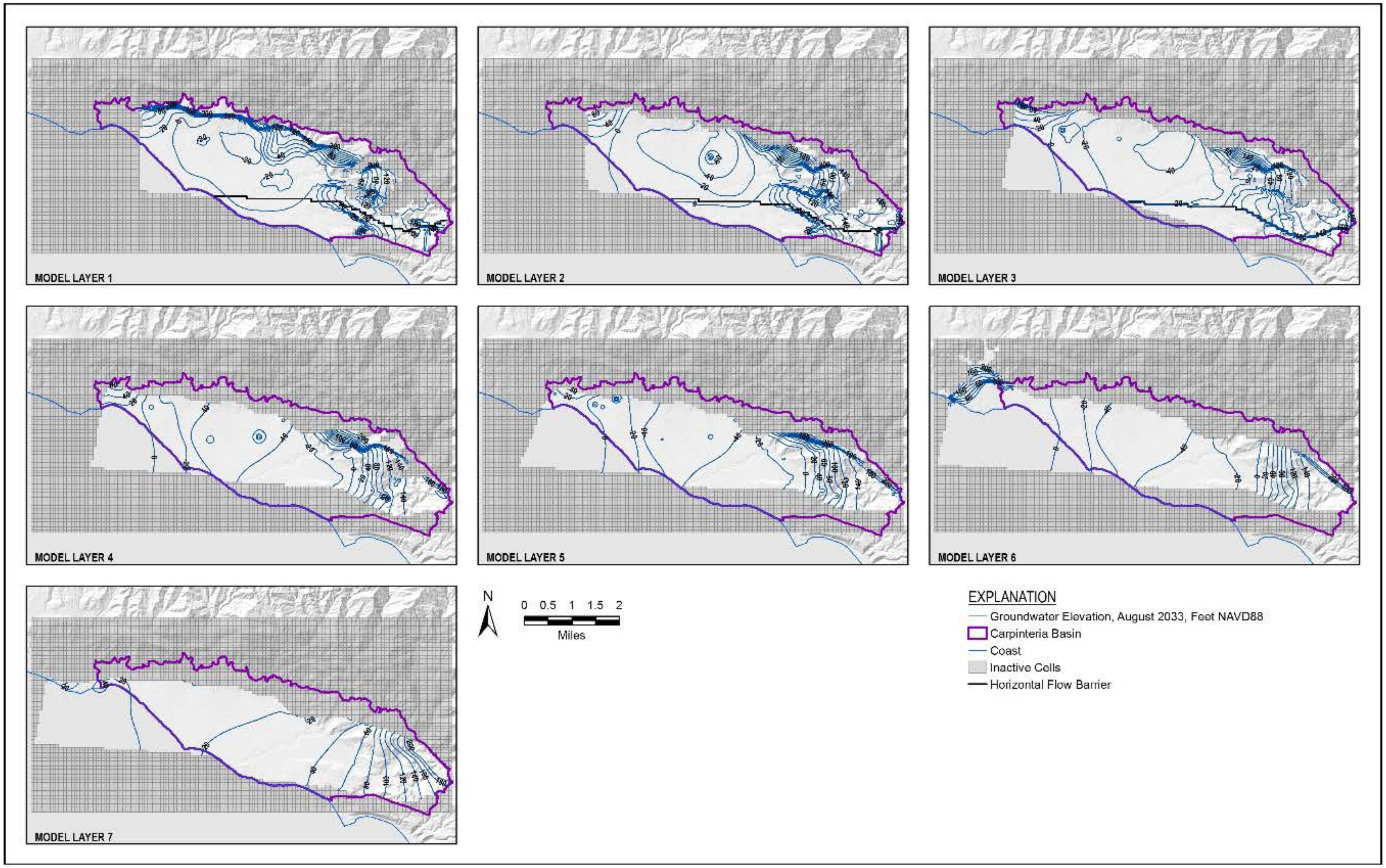

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Figure 64. Simulated Groundwater Elevation Contours, August 2033

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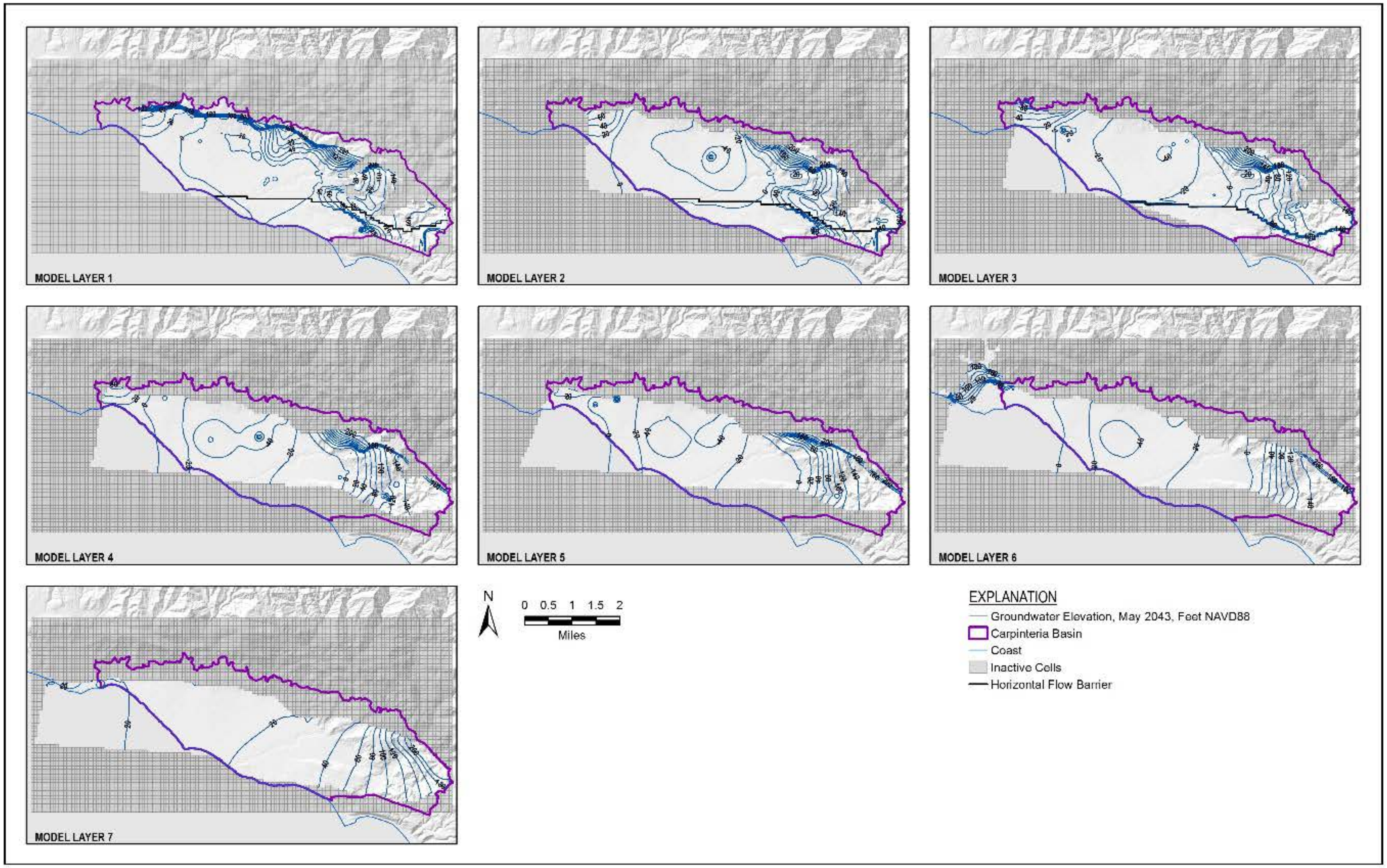

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Figure 65. Simulated Groundwater Elevation Contours, May 2043

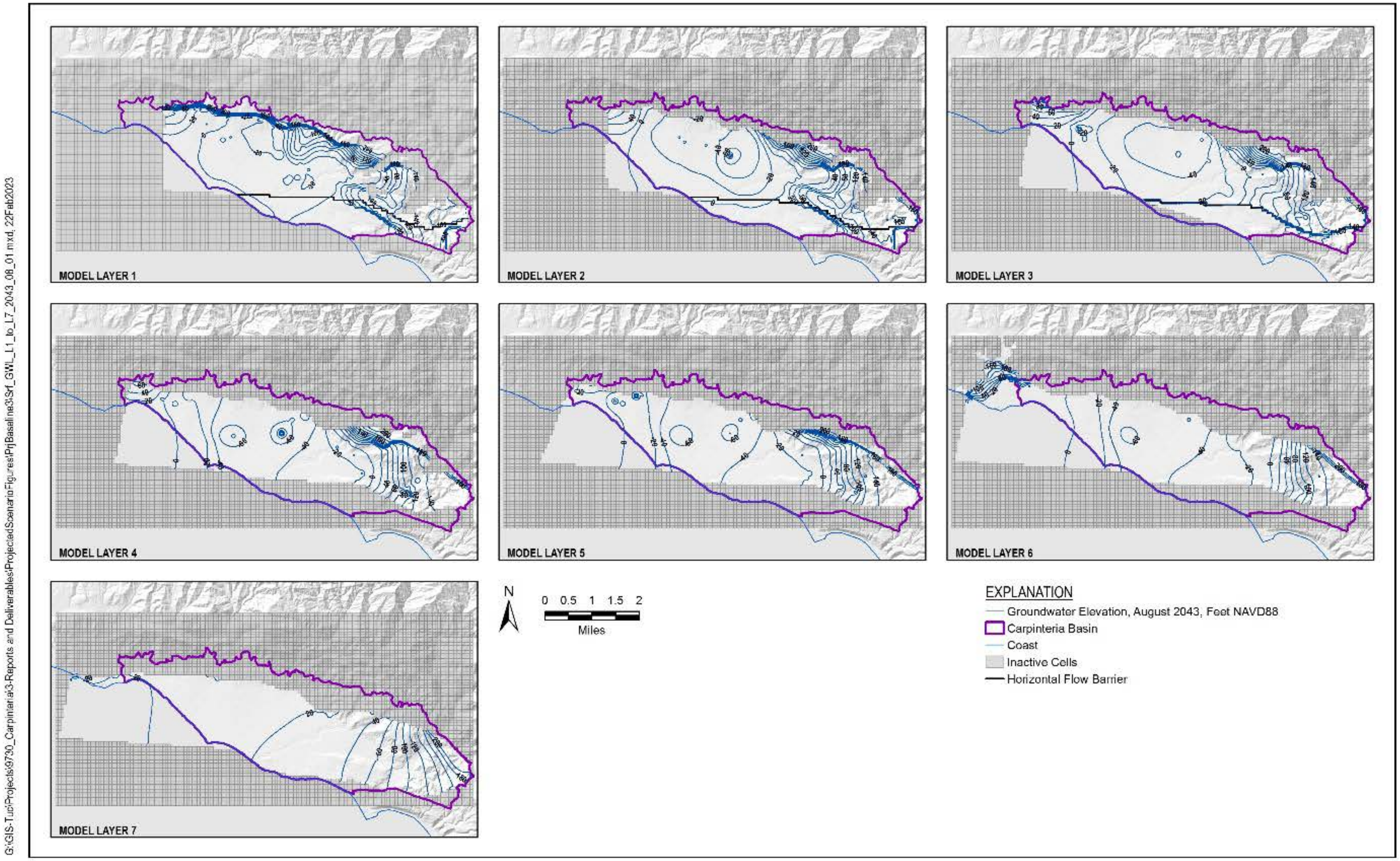

Figure 66. Simulated Groundwater Elevation Contours, August 2043

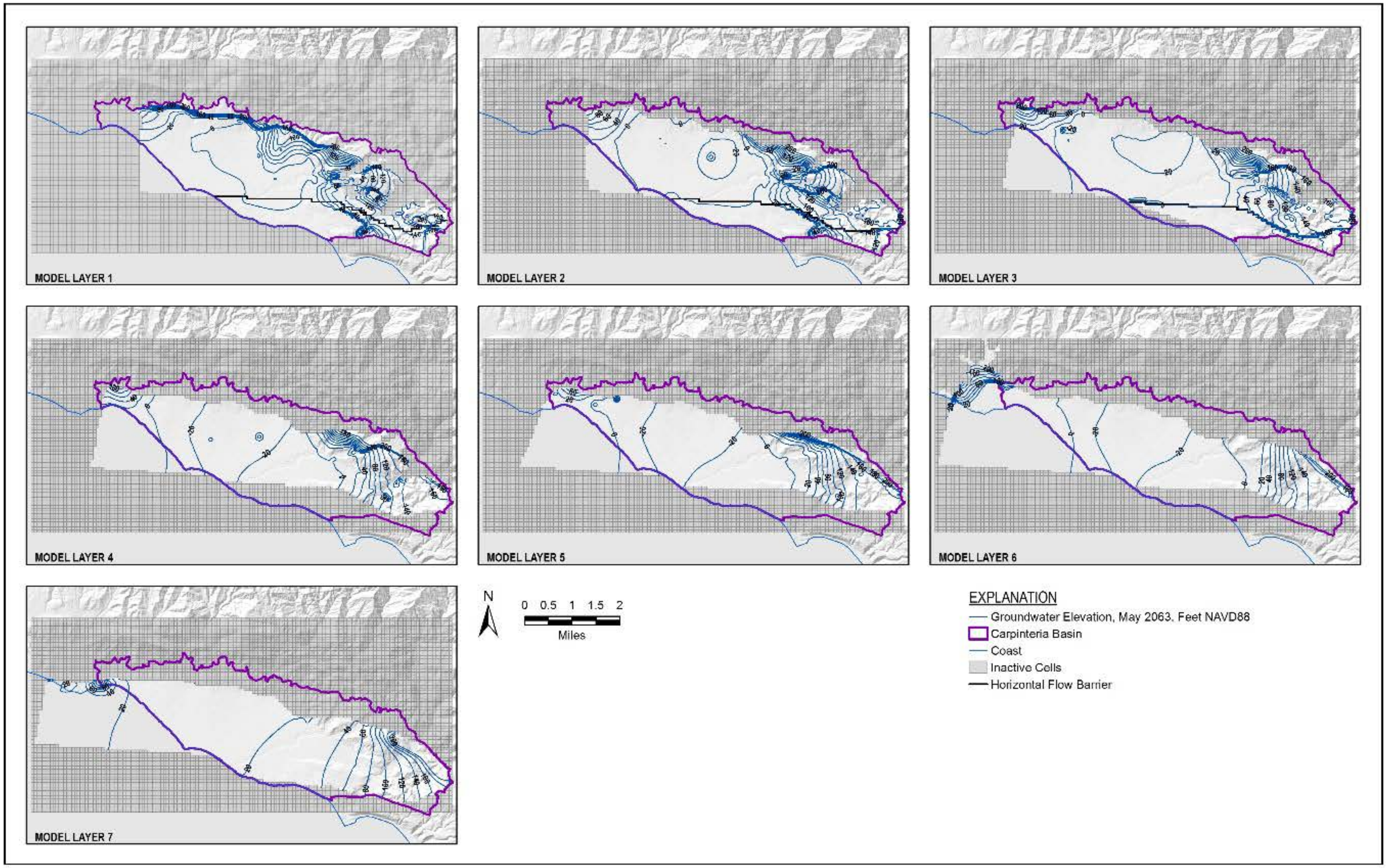

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Figure 67. Simulated Groundwater Elevation Contours, May 2063

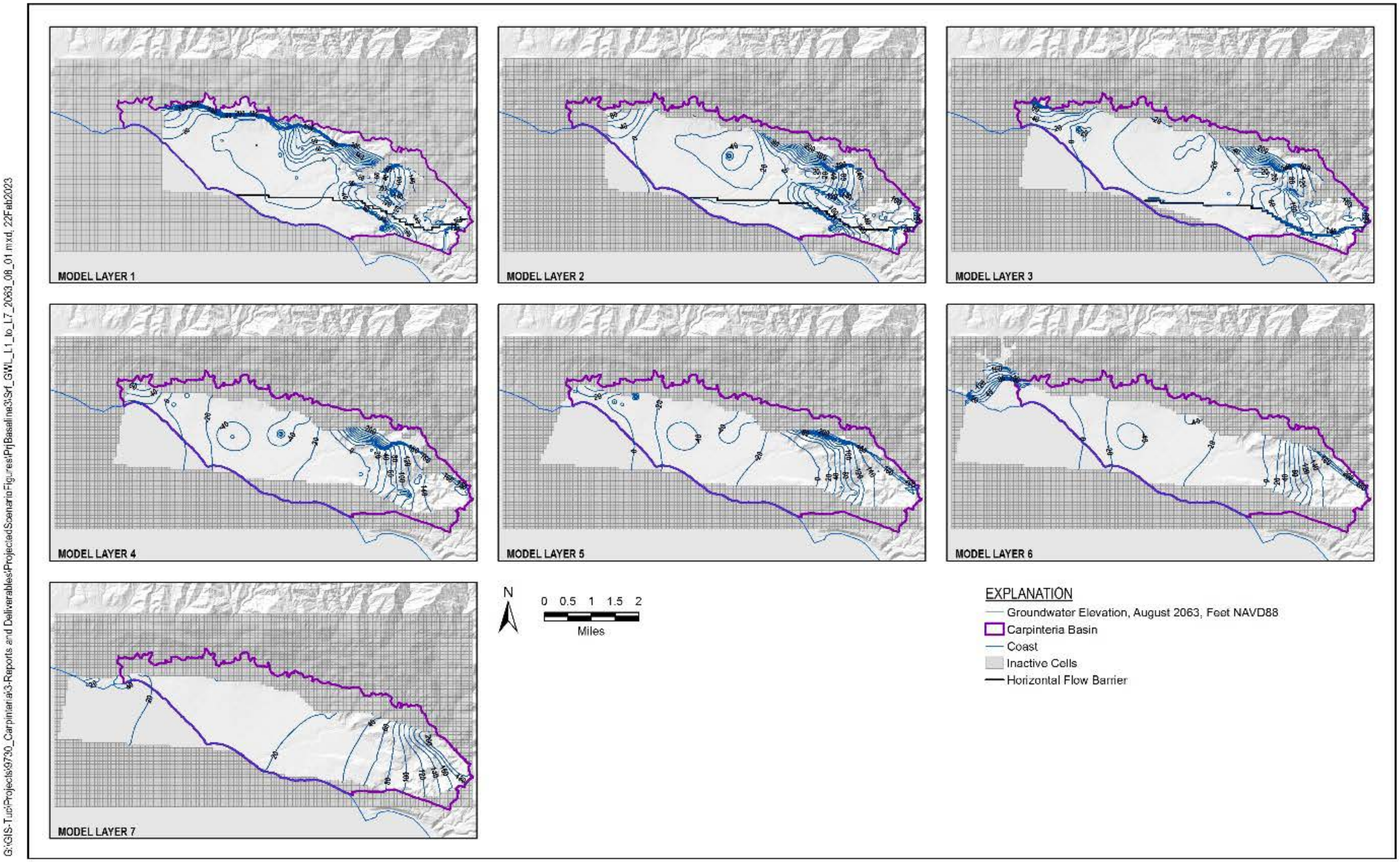

Figure 68. Simulated Groundwater Elevation Contours, August 2063

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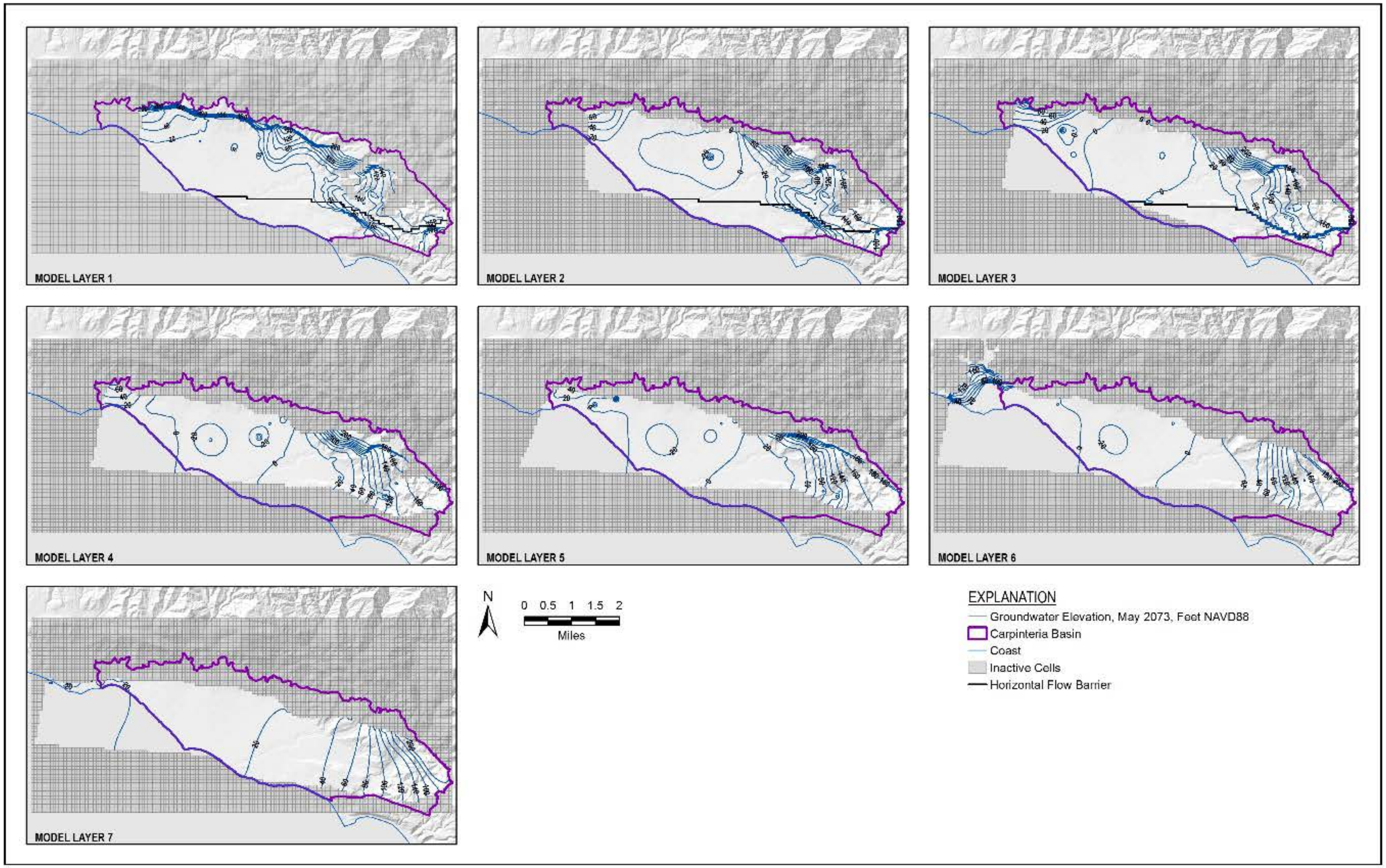


Figure 69. Simulated Groundwater Elevation Contours, May 2073

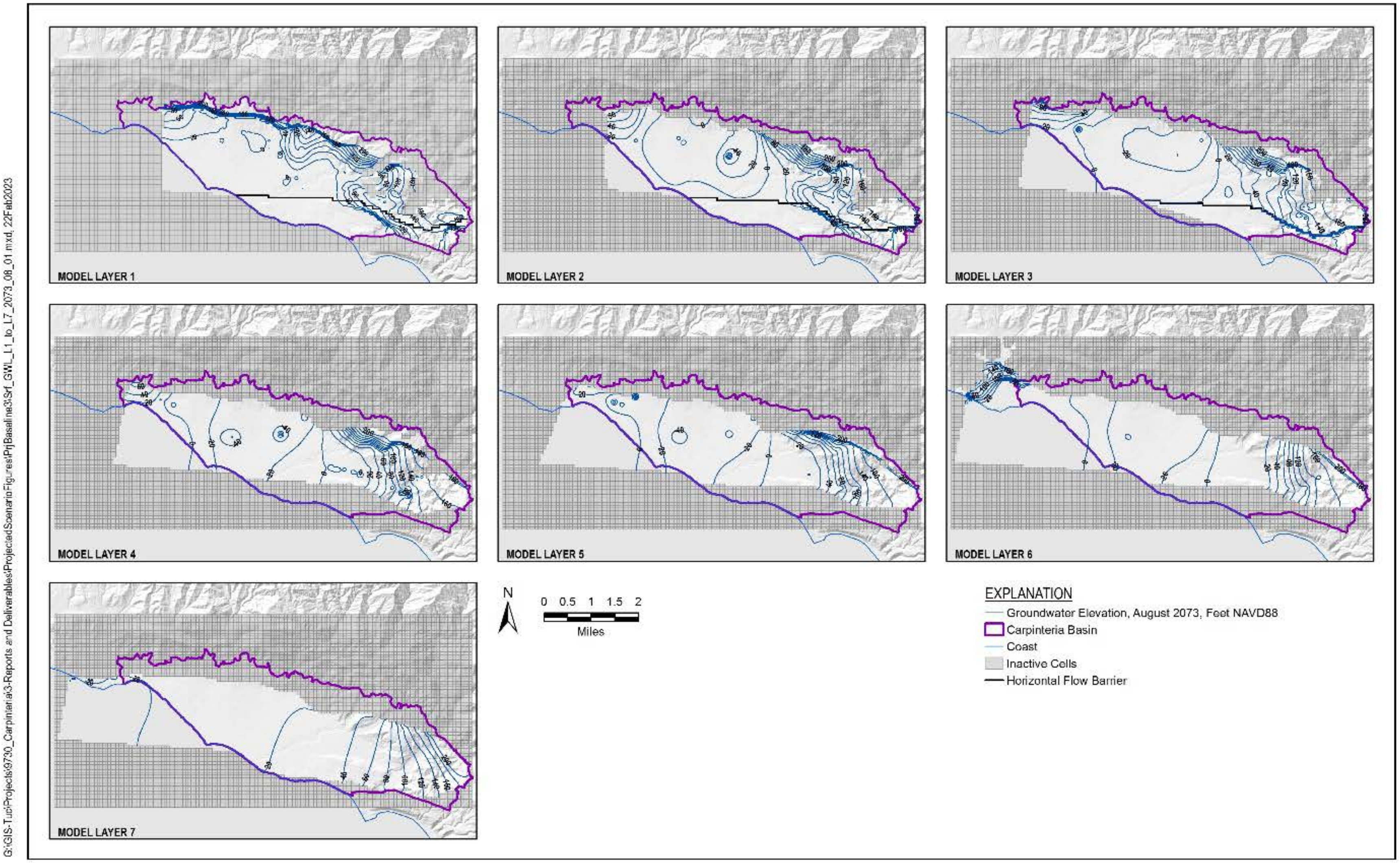


Figure 70. Simulated Groundwater Elevation Contours, August 2073

4.1.2.3 Model Output Used for GSP Water Budgets

The Carpinteria Basin GSP utilizes several simulated water budget components to develop GSP Basin water budgets. These budget components are calculated at or within the Carpinteria Basin boundary (Figure 1).

4.1.2.3.1 Flow To/From Offshore

Flows to and from offshore are calculated at the Carpinteria Basin coastline boundary (Figure 1). These flows are subsurface groundwater flows between the Basin and aquifers underlying the Pacific Ocean. Monthly gross inflow, gross outflow, and net flow for the projected scenario are shown on Figure 71. This figure presents flows from the perspective of the Basin; flows leaving the Basin to offshore are shown as negative, flows entering the Basin from offshore are shown as positive. As noted previously, seawater intrusion does not necessarily occur when there is inflow from offshore because there may be freshwater stored in the offshore aquifers. Overall, net flow from offshore is positive over most of the projected simulation, representing conditions of net inflow and increased potential for seawater intrusion.

Projected scenario elevations start below sea level over much of the central Basin that extends to the coastal Basin boundary, following dry conditions in the WY 2012-2020 period. This can be witnessed in hydrographs (see Appendix D) and contours for WY 2020 (Figure 41; Figure 42). These low elevations result in conditions conducive to seawater intrusion at the end of the historical simulation (Figure 45). Accordingly, the Basin starts in a state of net inflow from offshore in the projected scenario (Figure 71). Net inflow (positive) conditions continue through 2048, when a rise in groundwater elevations and a series of wet years reverse net flow back to ocean. After this point, conditions of net outflow or inflow are tied closely to climate. Conditions alternate between net outflow during wet periods (WY 2048-2058, WY 2063-2073) and net inflow during dry periods (WY 2058-2063).

Figure 72 illustrates net flows from ocean to the Carpinteria Basin by layer. The total stacked value (sum of all net flows by layer) is equivalent to the Basin-wide dashed black net flow line on Figure 70. Notably, the model predicts significant net inflow in layer 6, layer 4, and layer 2 during dry periods. These formations are pumped extensively and are highly conductive which could support seawater intrusion during periods when hydraulic gradients drive flow inland from offshore. Like the analogous Figure 46, which presented flows by layer for the historical simulation, the Figure 71 shows layer 6 (productive zone C) to be the largest and most consistent source of inflow during dry periods. Most times of net outflow are dominated by net outflow in layer 1, which is not a primary source of water supply.

Table 8 details average annual (WY) flows to and from offshore over the projected period and by WY type. Flow to and from ocean is directly correlated with WY type; net flow to offshore during dry periods is substantially less than flow during wet periods. When compared with the historical simulation (Table 6), the projected simulation presents conditions more conductive to seawater intrusion. Average net flow from offshore is positive during below critically dry, dry, and below normal years, and only marginally negative during above normal and wet years. In total, average net flow from offshore is increased roughly 300 acre-feet per year when compared to the historical simulation. This simulation suggests that given current sea level rise and climate projections, climate variability plays a larger role in determining the directionality and magnitude of offshore flows than sea level rise.

Local areas of inflow may exist despite net outflow across the entire coastline. Figure 73 through Figure 75 present groundwater elevations relative to average offshore GHB boundary for cross sections across the coastal interface. Cross sections are present from northwest (A) to southeast (A'), and for layers 2 (Figure 73), 4 (Figure 74), and 6 (Figure 75). These 3 layers are highlighted because they represent key production zones and witness high volumes of flow between the Basin and offshore (Figure 72). Each line on these graphs presents the average difference between coastal heads and the average offshore GHB head over a discrete time period, each of which has its own unique precipitation, sea level, and groundwater use trends. The inset map on the bottom right of each figure displays the A-A' coastline cross section (yellow) and GHB locations (aqua), which differs for each layer. These figures are useful for identifying where and when conditions supporting seawater intrusion are likely to occur. While each layer and period display unique elevations, similar trends can be seen on all 3 figures:

- Coastline elevations are above GHB head along the northwest coastline near Toro Canyon.
- Coastline elevations are below GHB head in the central Basin near Carpinteria State Beach.
- Despite rising sea levels, the wetter projected scenario climate results in higher elevations relative to GHB head in later periods
- Only 1 layer (layer 2) has central Basin elevations at GHB or above GHB head . This only occurs during 1 period (WY 2064-2073)

Continued evaluation of flows to and from offshore will be critical to predicting the efficacy of project and management simulations. The conclusions drawn above, namely that central Basin groundwater elevations are nearly always below offshore GHB height, will be useful in planning projects such as seawater intrusion barriers.

Table 8. Projected Flows to and From Offshore by Water Year Type, Acre-feet per Year

	From Offshore	To Offshore	Net Flow
All Projected Water Years (2021-2073)	456	-350	106
All Projected Wet and Above Normal Water Years	410	-435	-25
All Projected Below Normal and Dry Water Years	472	-266	206
All Projected Critically Dry Years	564	-222	342

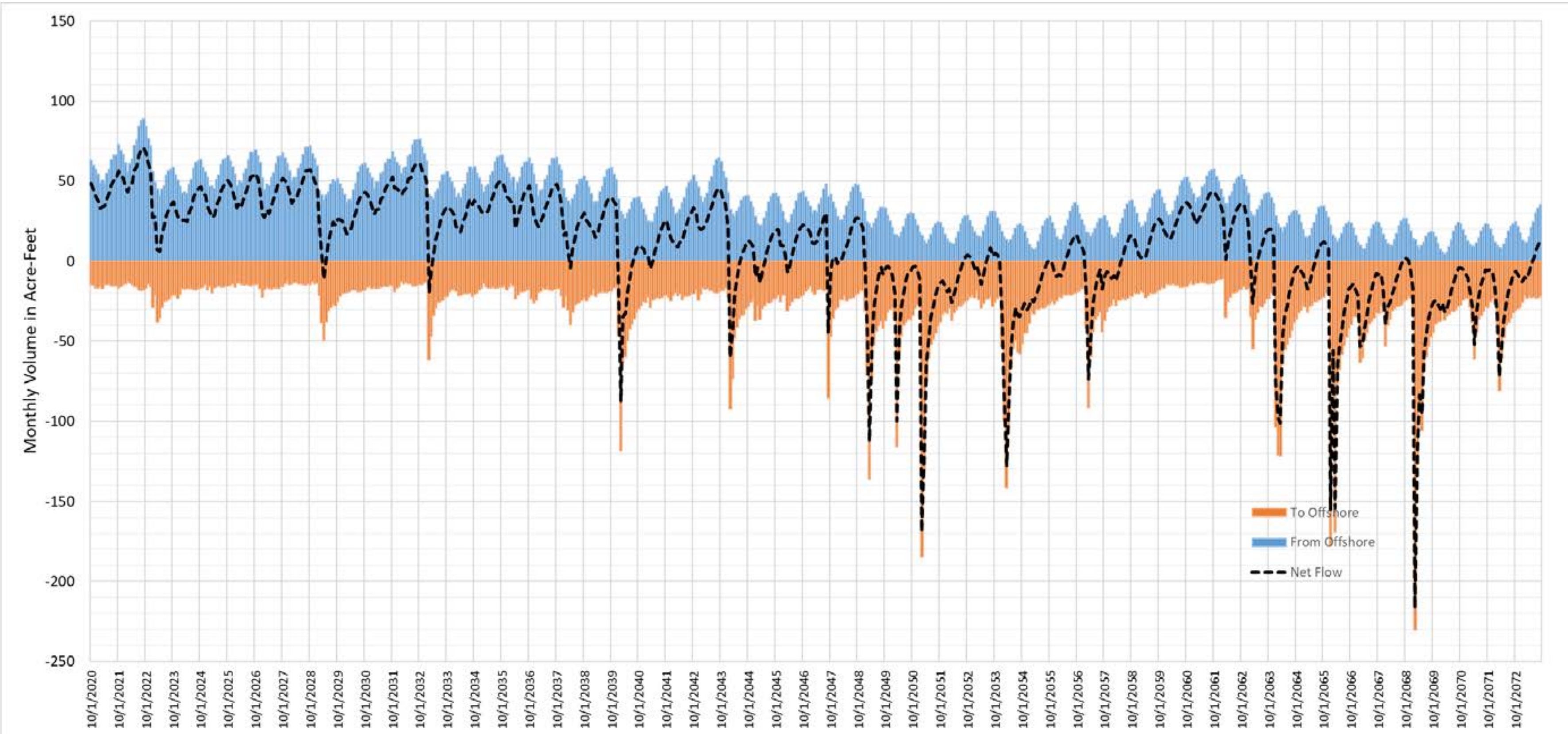


Figure 71. Carpinteria Basin Projected Flow to and from Offshore

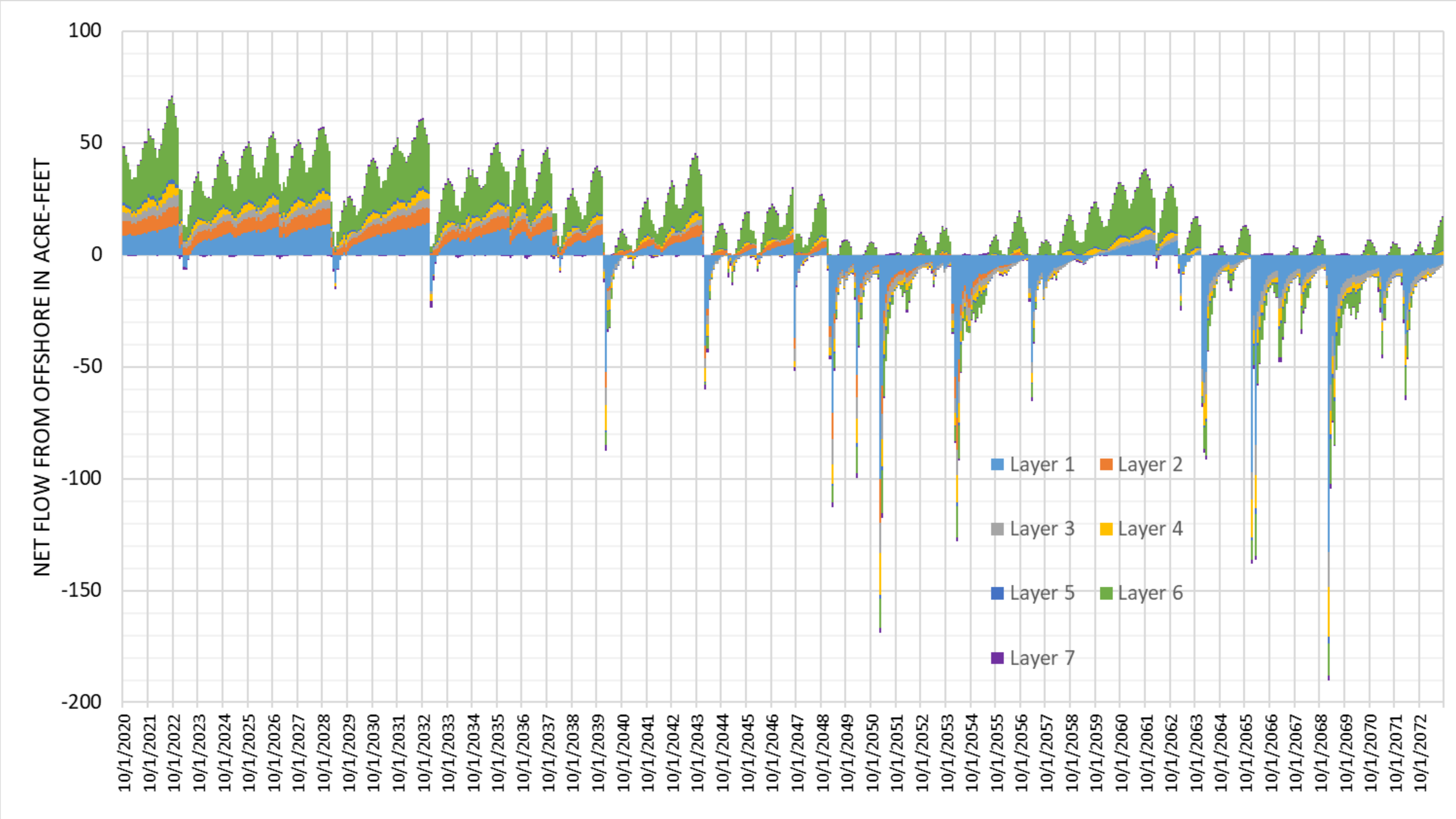
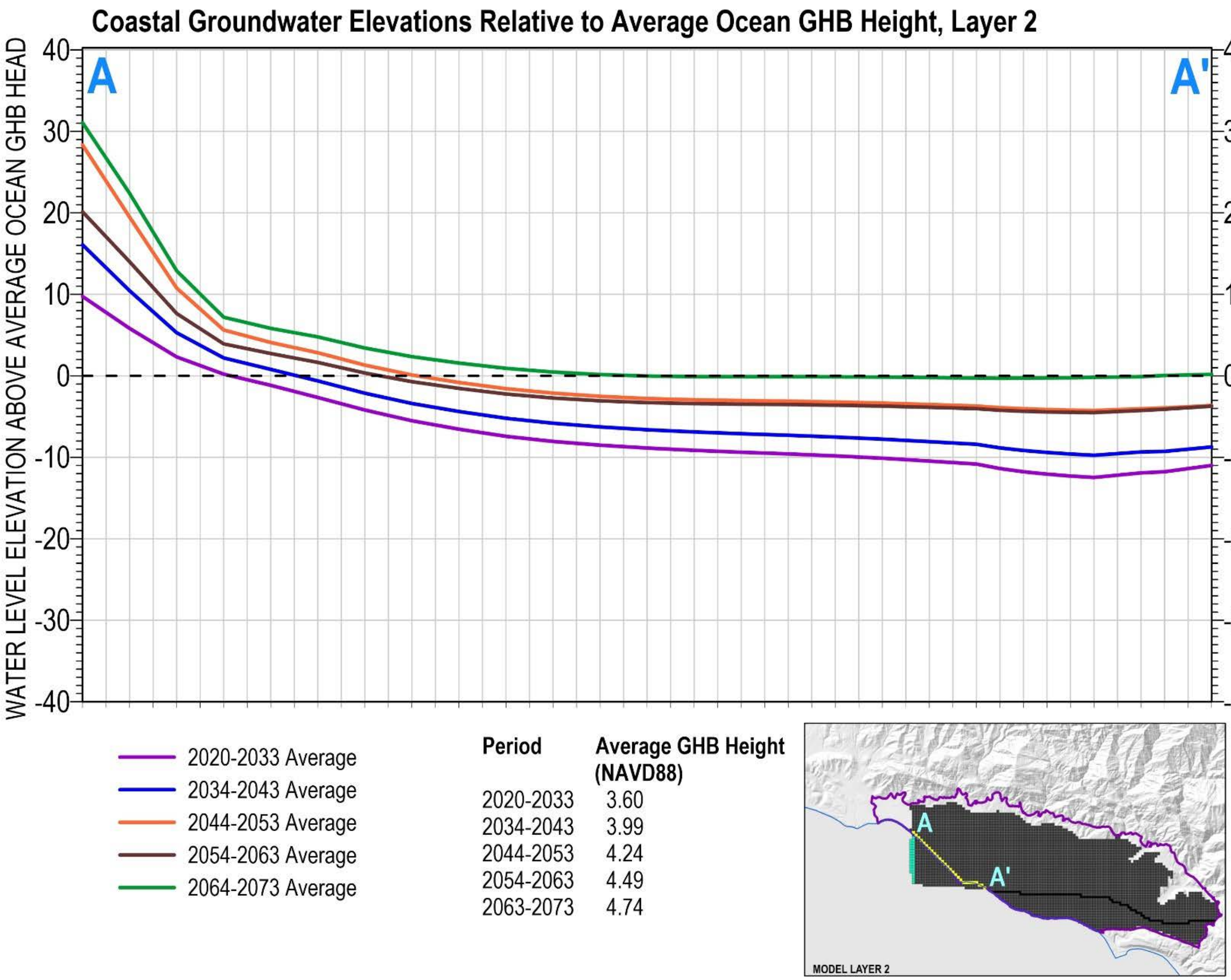
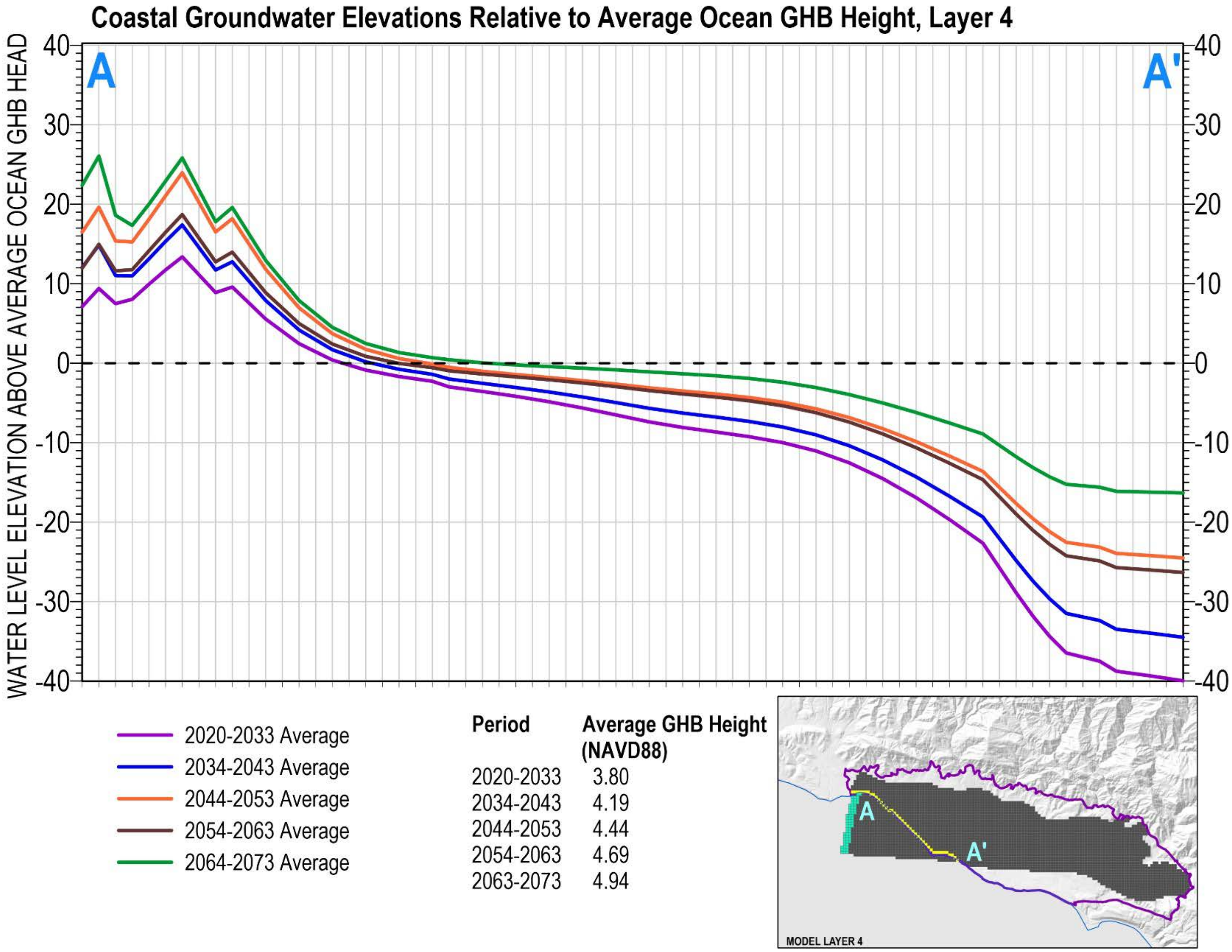


Figure 72. Carpinteria Basin Projected Net Flow from Offshore by Layer



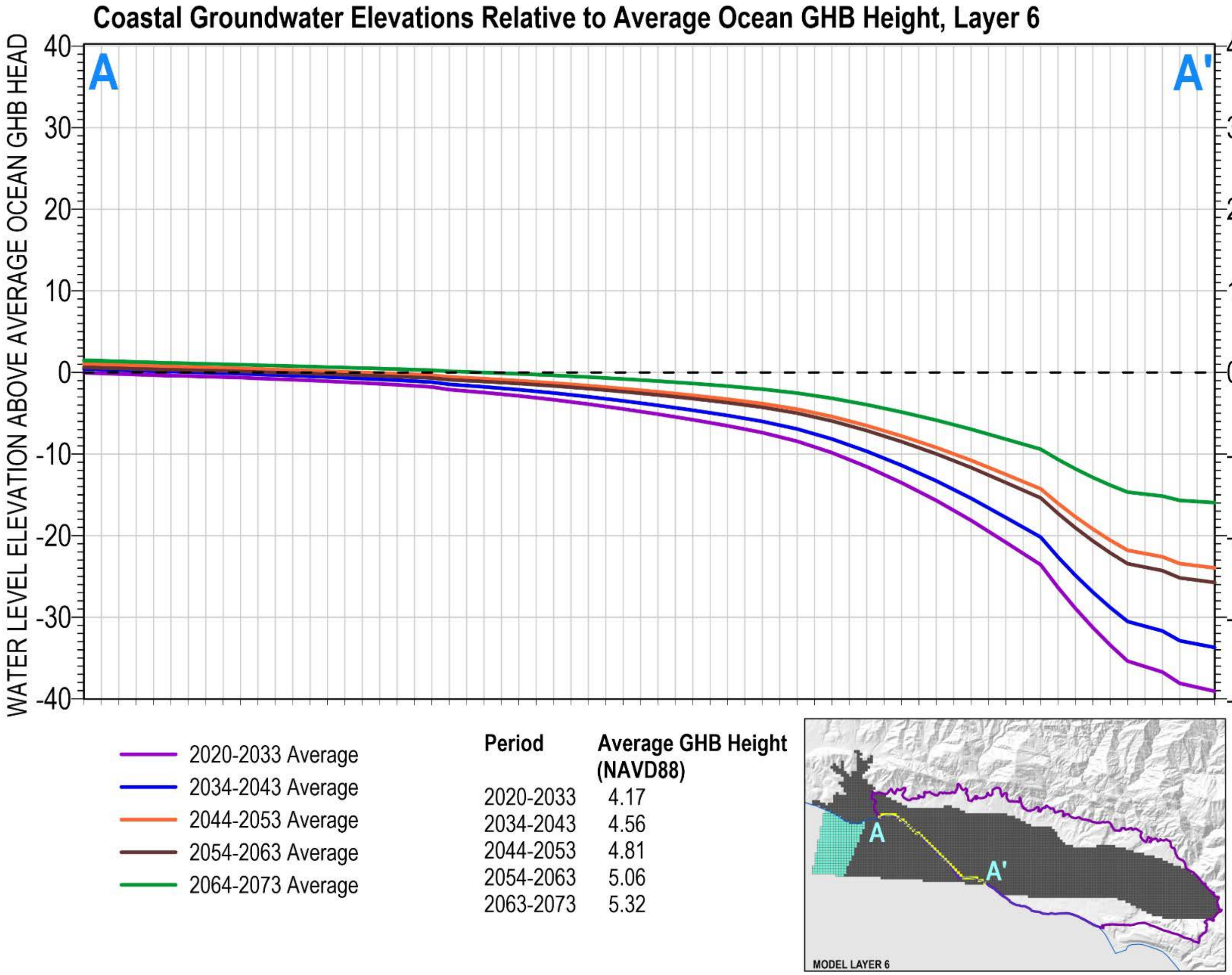
Period	Average GHB Height (NAVD88)
2020-2033	3.60
2034-2043	3.99
2044-2053	4.24
2054-2063	4.49
2063-2073	4.74

Figure 73. Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 2



Period	Average GHB Height (NAVD88)
2020-2033	3.80
2034-2043	4.19
2044-2053	4.44
2054-2063	4.69
2063-2073	4.94

Figure 74. Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 4



Period	Average GHB Height (NAVD88)
2020-2033	4.17
2034-2043	4.56
2044-2053	4.81
2054-2063	5.06
2063-2073	5.32

Figure 75. Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 6

4.1.2.3.2 Flow To/From Montecito Groundwater Basin

Flows to and from MGB are calculated where the Carpinteria Basin boundary meets the MGB (Figure 1).

Figure 76 displays flow to and from the MGB over the projected time period. Table 9 details average annual (WY) flows to and from the MGB for the entire projected simulation and WY type. As was the case in the historical simulation, the Carpinteria Basin generally receives net inflow from the MGB. More flow occurs both to and from the MGB during wetter periods, and less during dry periods. When compared to the historical simulation (Table 7) net flow from the MBG is increased by roughly 2 to 20 acre-feet per year in the projected simulation, reflecting generally lower groundwater elevations in the Carpinteria Basin.

Table 9. Projected Flows to and From Montecito Basin by Water Year Type, Acre-feet per Year

	From Montecito Basin	To Montecito Basin	Net Flow
All Projected Water Years (2021-2073)	121	-60	61
All Projected Wet and Above Normal Water Years	134	-76	57
All Projected Below Normal and Dry Water Years	107	-45	61
All Projected Critically Dry Years	102	-32	70

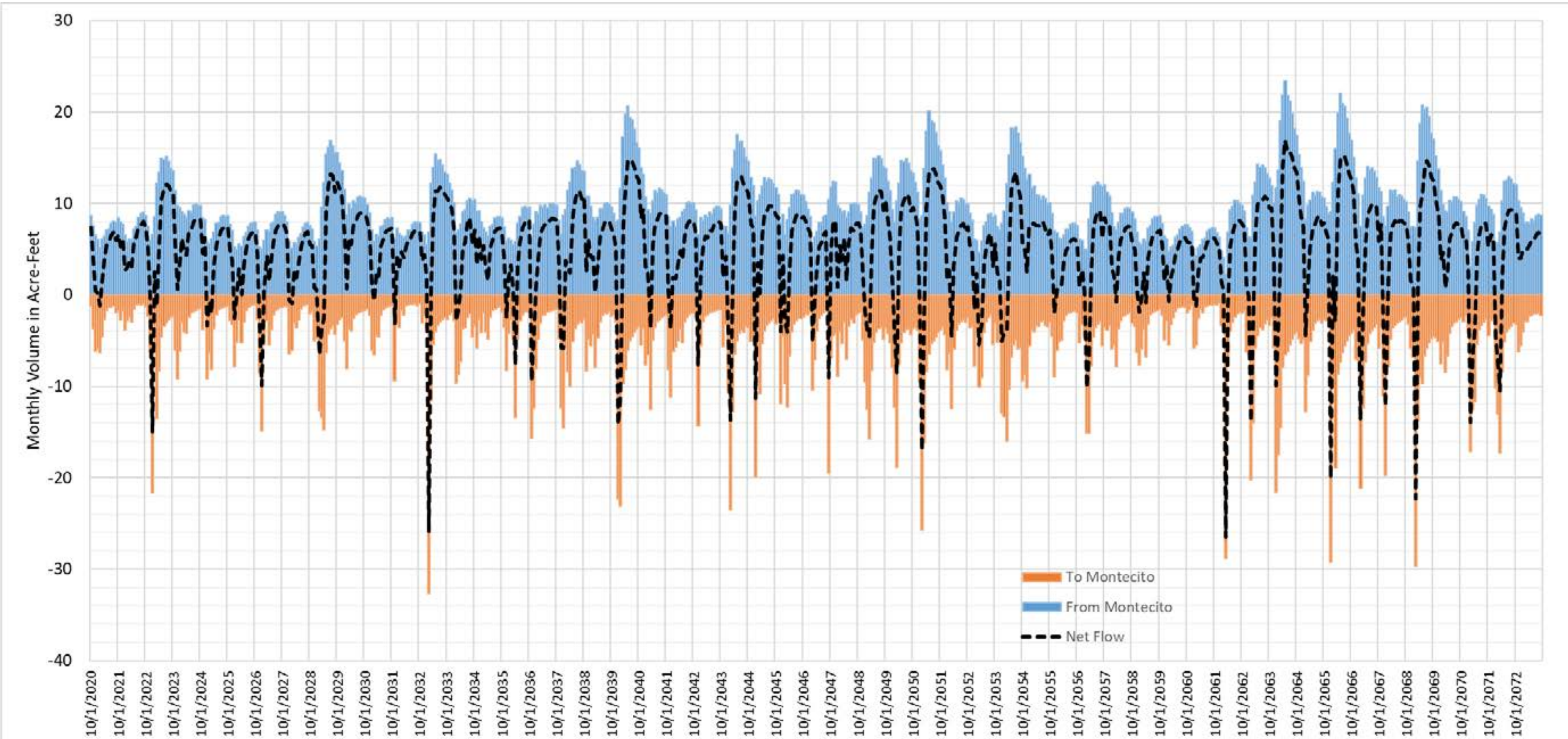


Figure 76. Carpinteria Basin Projected Flow to and from Montecito Basin

4.2 CAPP Project Scenario and Particle Tracking

The CAPP_6 scenario simulates a proposed configuration of the Carpinteria Advanced Purification Project (CAPP) (Pueblo 2023, Appendix D). CAPP objectives are to consistently recharge the Basin with purified recycled water to increase local supply and lessen the risk of seawater intrusion.

4.2.1 Scenario Assumptions

All groundwater model inputs to the CAPP_6 scenario are identical to the predictive baseline except for the MNW2 package input. MNW2 package input has been modified to simulate a proposed CAPP configuration including 2 new indirect potable reuse (IPR) wells and modifications to CVWD pumping volumes. These 2 IPR wells inject a combined volume of roughly 93 acre-feet per month (AF/m) starting in WY 2027. CVWD pumping is increased or decreased relative to baseline, depending on water year type; there is an overall increase in municipal pumping of roughly 77 AF/m. Figure 77 presents a comparison of CVWD pumping and IPR recharge in the CAPP_6 scenario relative to the baseline. Comparison of the total CAPP_6 CVWD pumping accounting for IPR (dotted black line) against the baseline CVWD pumping (grey rectangles) illustrates how the CAPP project impacts annual net pumping volumes.

- WY 2016 – WY 2037: CAPP_6 net pumping is 500-1,000 acre-foot per year (AF/y) less than baseline.
- WY 2038 – WY 2062: CAPP_6 net pumping varies annually relative to baseline, from 1,000 AFY more, to 1,000 AF/y less.
- WY 2063 – WY 2073: CAPP_6 net pumping is generally 1,000 AF/y more than baseline.

These trends are useful when evaluating offshore flows and particle tracking results in the following sections.

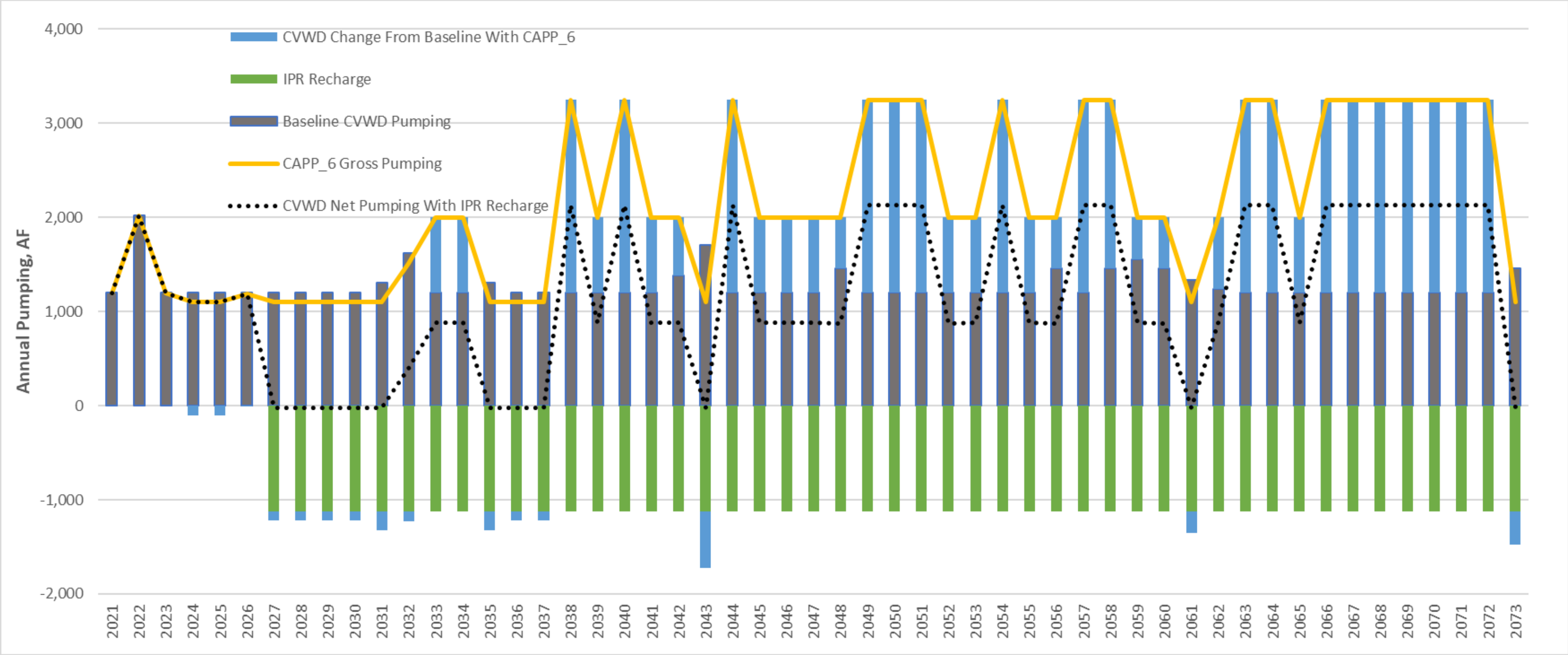


Figure 77. Municipal Pumping and Indirect Potable Reuse Recharge in CAPP_6 Scenario and Predictive Baseline

4.2.2 Predictive Simulation Results

Analysis of the CAPP_6 scenario results focuses on the project's impacts on seawater intrusion relative to the predictive baseline, including particle tracking analysis.

4.2.2.1 Model Output Used for GSP Water Budgets

The Carpinteria Basin GSP utilizes several simulated water budget components to develop GSP Basin water budgets. These budget components are calculated at or within the Carpinteria Basin boundary (Figure 1). Namely, the GSP water budgets use flow to/from offshore and flows to/from Montecito. As described earlier, groundwater pumping is not used for GSP water budgets due to the presence of seepage face losses within the model that decrease total simulated pumping relative to the desired model input values (See Section 3.1.3)

4.2.2.1.1 Flow To/From Offshore

Flows to and from offshore are calculated at the Carpinteria Basin coastline boundary (Figure 1). These flows are subsurface groundwater flows between the Basin and aquifers underlying the Pacific Ocean. Monthly gross inflow, gross outflow, and net flow for the projected scenario are shown on Figure 78Figure 71. This figure presents flows from the perspective of the Basin; flows leaving the Basin to offshore are shown as negative, flows entering the Basin from offshore are shown as positive. As noted previously, seawater intrusion does not necessarily occur when there is inflow from offshore because there may be freshwater stored in the offshore aquifers. Flows from offshore are summarized in Table 10 and presented on Figure 78 and Figure 79. These can be compared with the baseline results presented in Section 4.1.2.3.1. On average, there is approximately 100 AF/y less flow from offshore into the Basin with the CAPP_6 scenario relative to baseline. Flows from offshore and coastal heads (Figure 80 through Figure 82) are significantly improved from baseline during period before the sustainability deadline of 2043.

Although the CAPP_6 scenario shows net flow to offshore on average, it does not show that CAPP eliminates risk of seawater intrusion. Figure 78 shows much of the flow to offshore is in layer 1 and there is consistently flow from offshore in deeper production layers like layer 6. Table 10 also still significant net flow from offshore in dry years with CAPP. These water budget flows for the entire Basin also do not fully represent seawater intrusion risk, which can be more localized. The potential for localized seawater intrusion in the CAPP_6 scenario is evaluated with particle tracking in Section 4.2.2.1.2.

Table 10. CAPP_6 Projected Flows to and From Offshore by Water Year Type, Acre-feet per Year

	From Offshore	To Offshore	Net Flow
All Projected Water Years (2021-2073)	347	-349	-2
All Projected Wet and Above Normal Water Years	352	-445	-92
All Projected Below Normal and Dry Water Years	325	-251	74
All Projected Critically Dry Years	402	-182	220

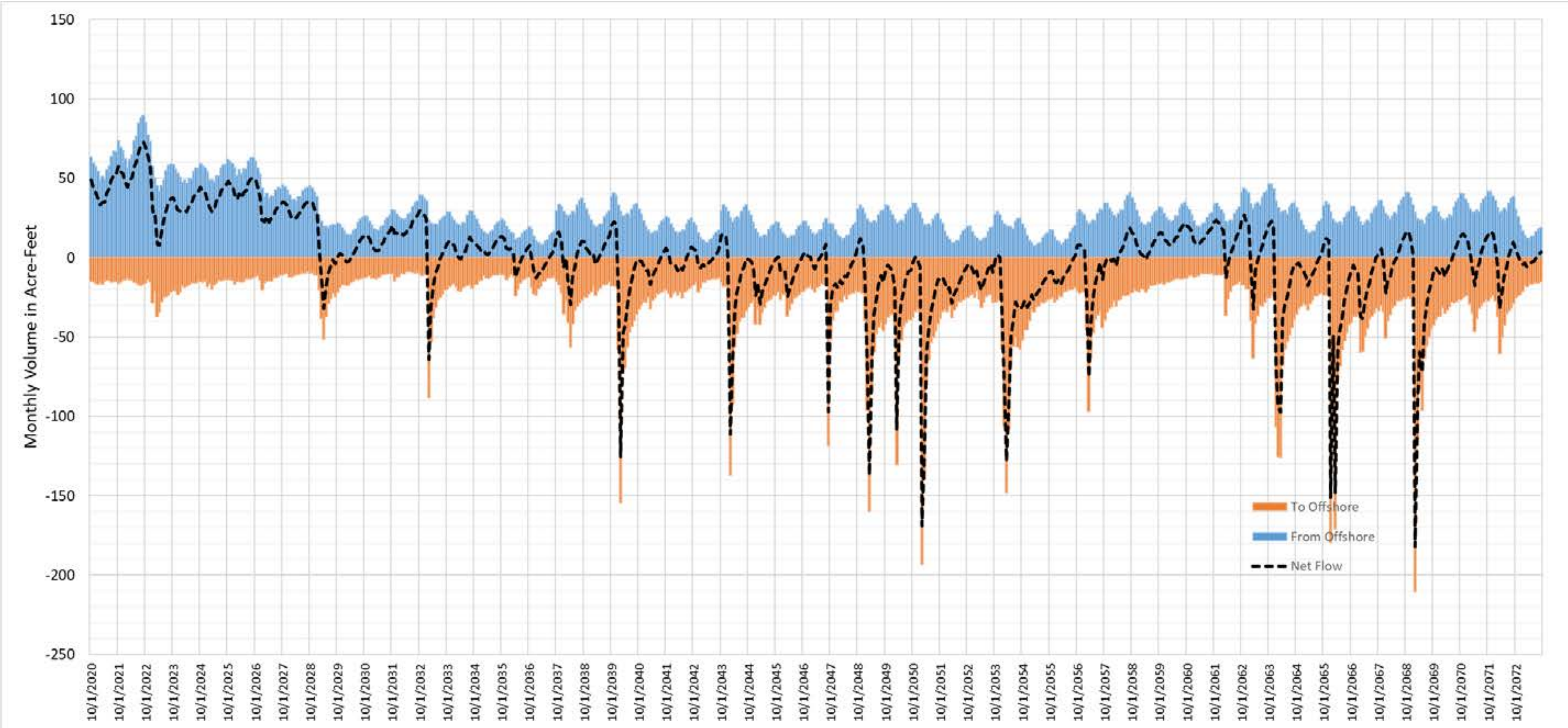


Figure 78. CAPP_6 Carpinteria Basin Projected Flow to and from Offshore

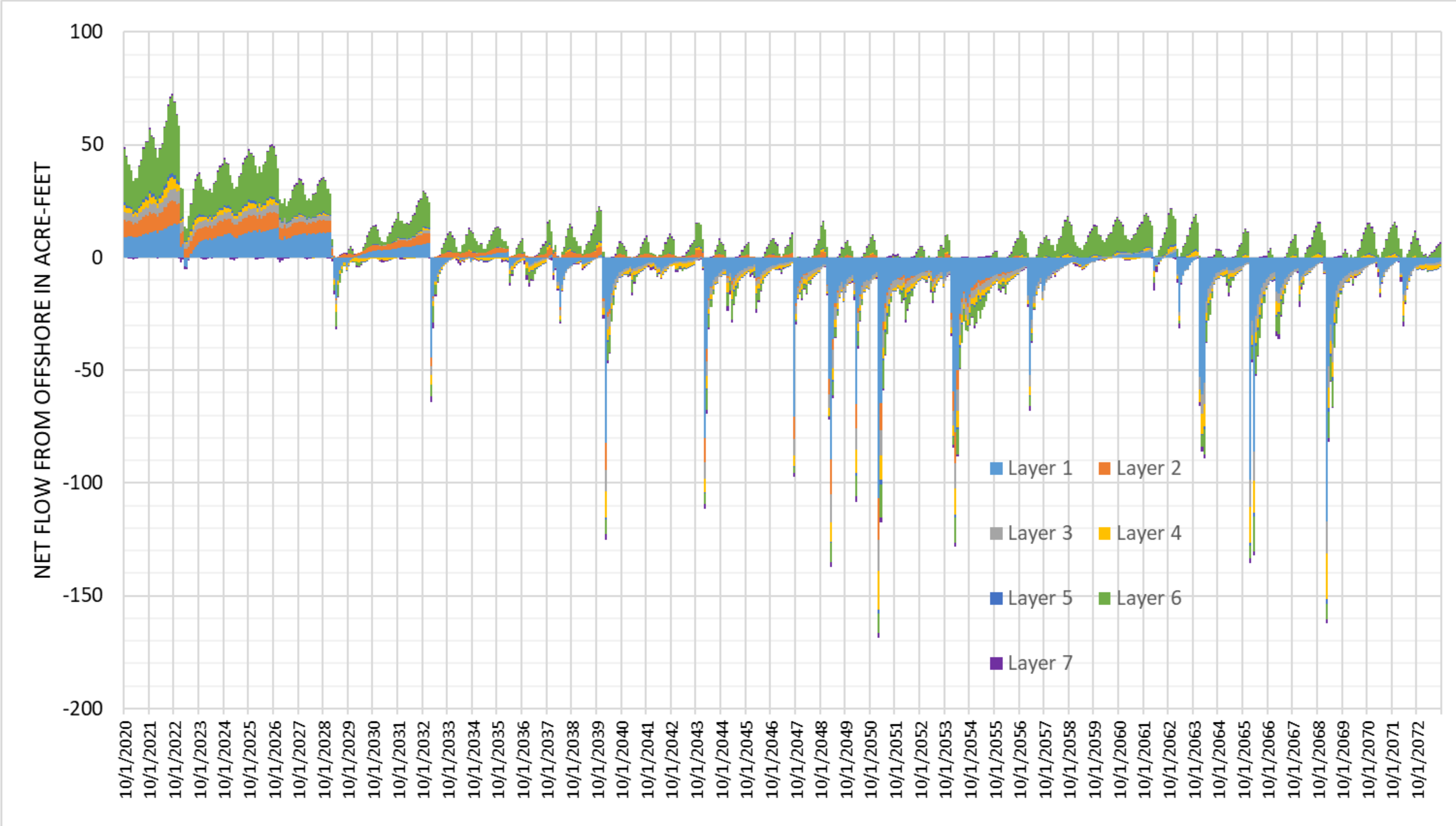
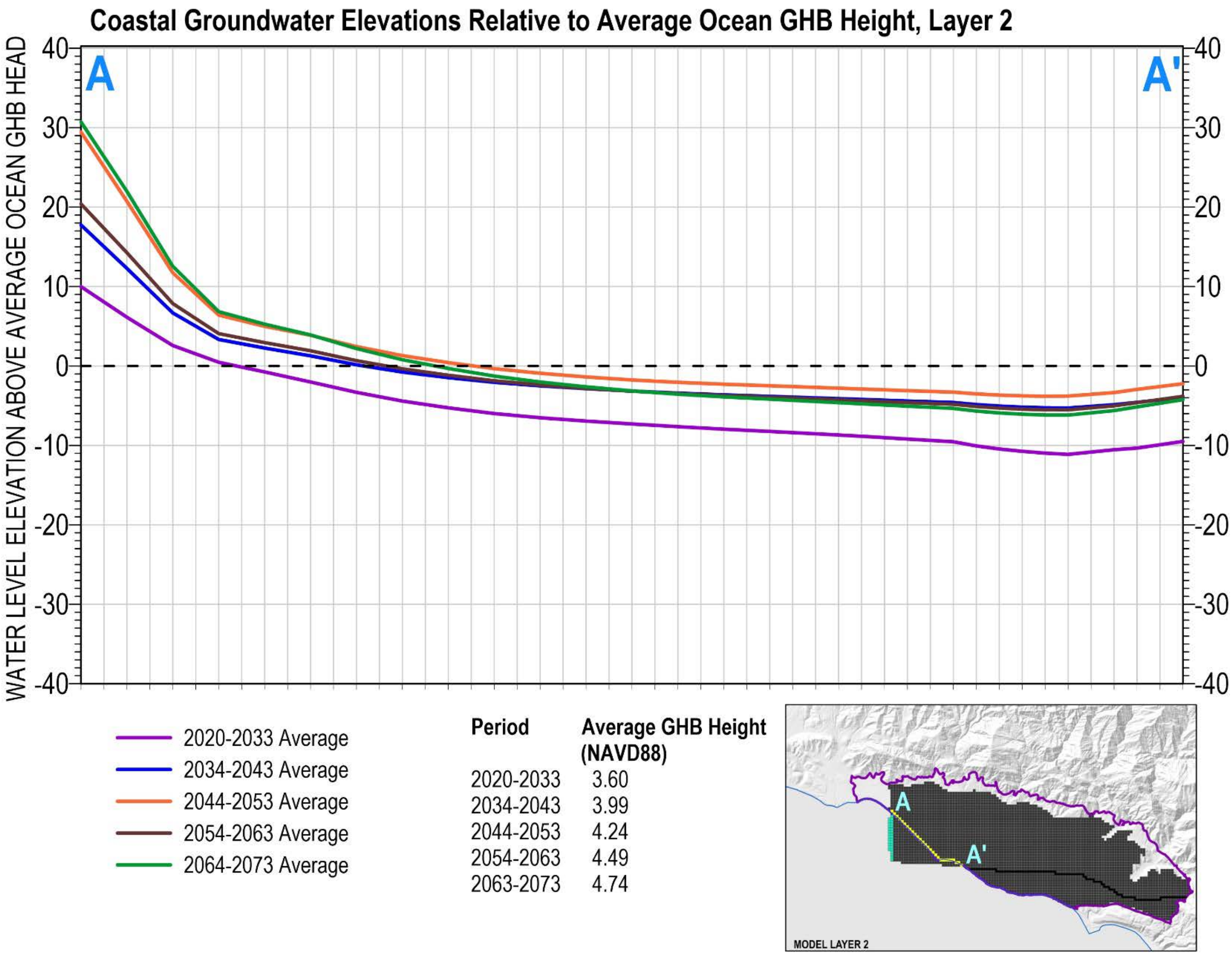


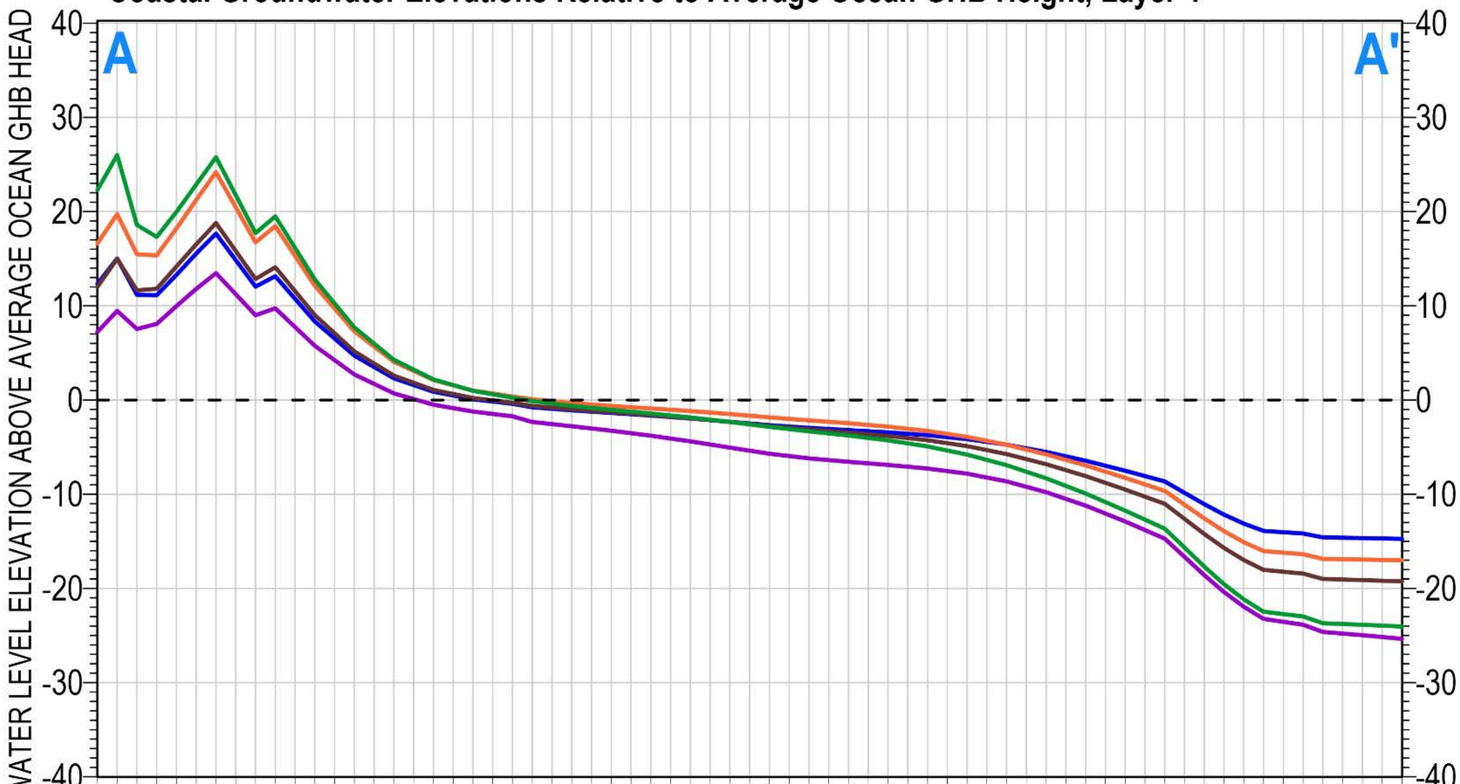
Figure 79. CAPP_6 Carpinteria Basin Projected Net Flow from Offshore by Layer



Period	Average GHB Height (NAVD88)
2020-2033	3.60
2034-2043	3.99
2044-2053	4.24
2054-2063	4.49
2063-2073	4.74

Figure 80. CAPP_6 Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 2

Coastal Groundwater Elevations Relative to Average Ocean GHB Height, Layer 4



Period	Average GHB Height (NAVD88)
2020-2033	3.80
2034-2043	4.19
2044-2053	4.44
2054-2063	4.69
2063-2073	4.94

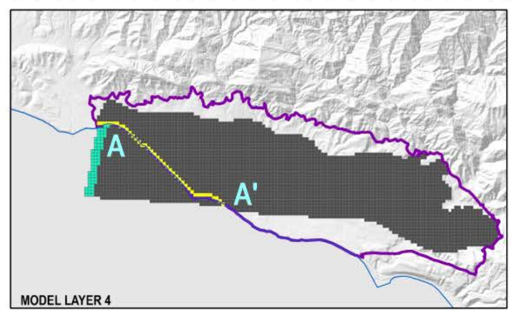


Figure 81. CAPP_6 Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 4

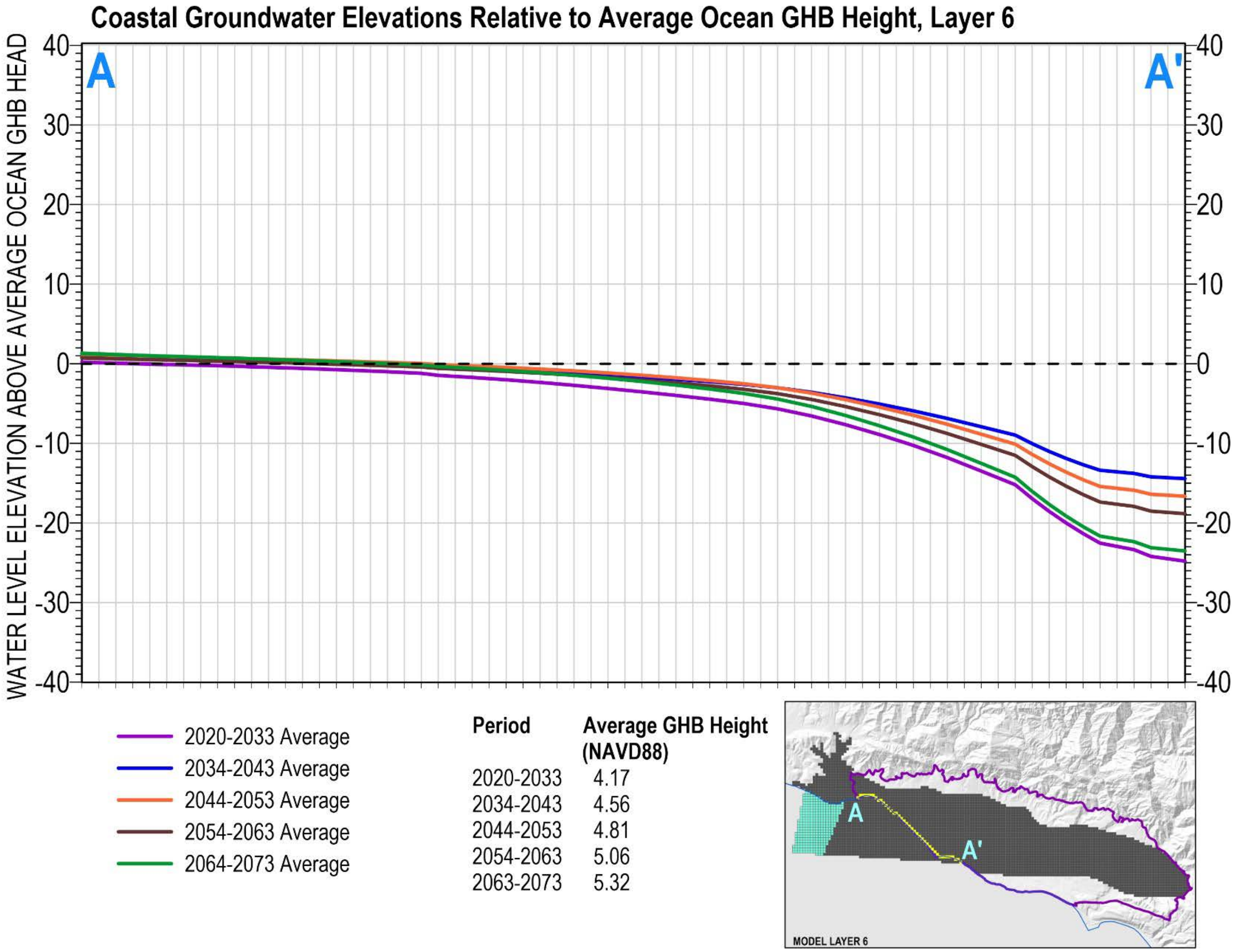


Figure 82. CAPP_6 Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 6

4.2.2.1.2 Flow To/From Montecito Groundwater Basin

Flows to and from MGB are calculated where the Carpinteria Basin boundary meets the MGB (Figure 1). Figure 83 displays flow to and from the MGB for the CAPP_6 scenario over the projected time period. Table 11 details average annual (WY) flows to and from the MGB for the entire CAPP_6 projected simulation and WY type. When compared to the predictive baseline simulation (Table 11Table 9) net flow from the MBG is decreased by roughly 3 to 15 acre-feet per year in the CAPP_6 simulation, reflecting generally higher groundwater elevations in the Carpinteria Basin with CAPP implementation.

Table 11. CAPP_6 Projected Flows to and From Montecito Basin by Water Year Type, Acre-feet per Year

	From Montecito Basin	To Montecito Basin	Net Flow
All Projected Water Years (2021-2073)	114	-61	53
All Projected Wet and Above Normal Water Years	130	-77	54
All Projected Below Normal and Dry Water Years	97	-45	51
All Projected Critically Dry Years	89	-32	57

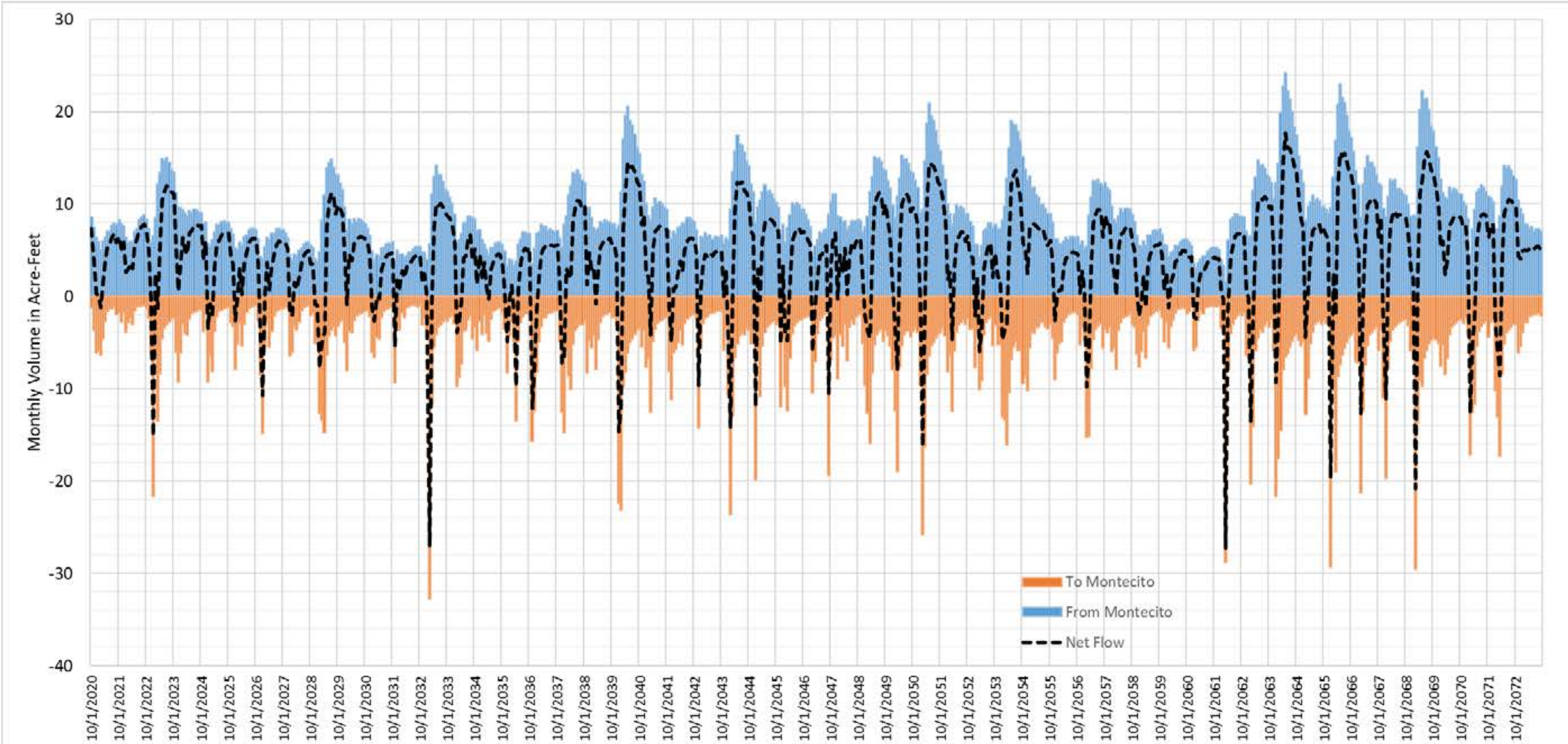


Figure 83. Carpinteria Basin Projected Flow to and from Montecito Basin

4.2.2.2 Particle Tracking Results and Comparison to Baseline

Particle tracking was conducted for the predictive baseline and CAPP_6 scenarios to estimate the distance and timing of seawater intrusion with and without CAPP_6 implementation. Particles were placed along the coastline in layers 2 (A, Figure 84) , 4 (B, Figure 85), and 6 (C, Figure 86) and released at the start of the projected runs (WY 2020). A homogenous aquifer porosity of 0.2 is assumed based on particle tracking to estimate travel times of CAPP purified water (Pueblo, 2017). Particle paths for CAPP_6 are color coded based on particle locations over 10-year time ranges, aligned with the sustainability deadline of 2043. Particle paths for the predictive baseline are black with a solid line before 2043 and a dashed line afterward for comparison.

Comparison of the CAPP_6 scenario and the predictive baseline demonstrates that prior to 2043, there is less advancement with CAPP_6 (light blue) vs. baseline (solid black). With both CAPP_6 and baseline, particles do not advance to the seawater intrusion MT isocontour before 2043. Particles arrive at the Headquarters well by January 2049 (green, in layer 2).

MONTGOMERY & ASSOCIATES

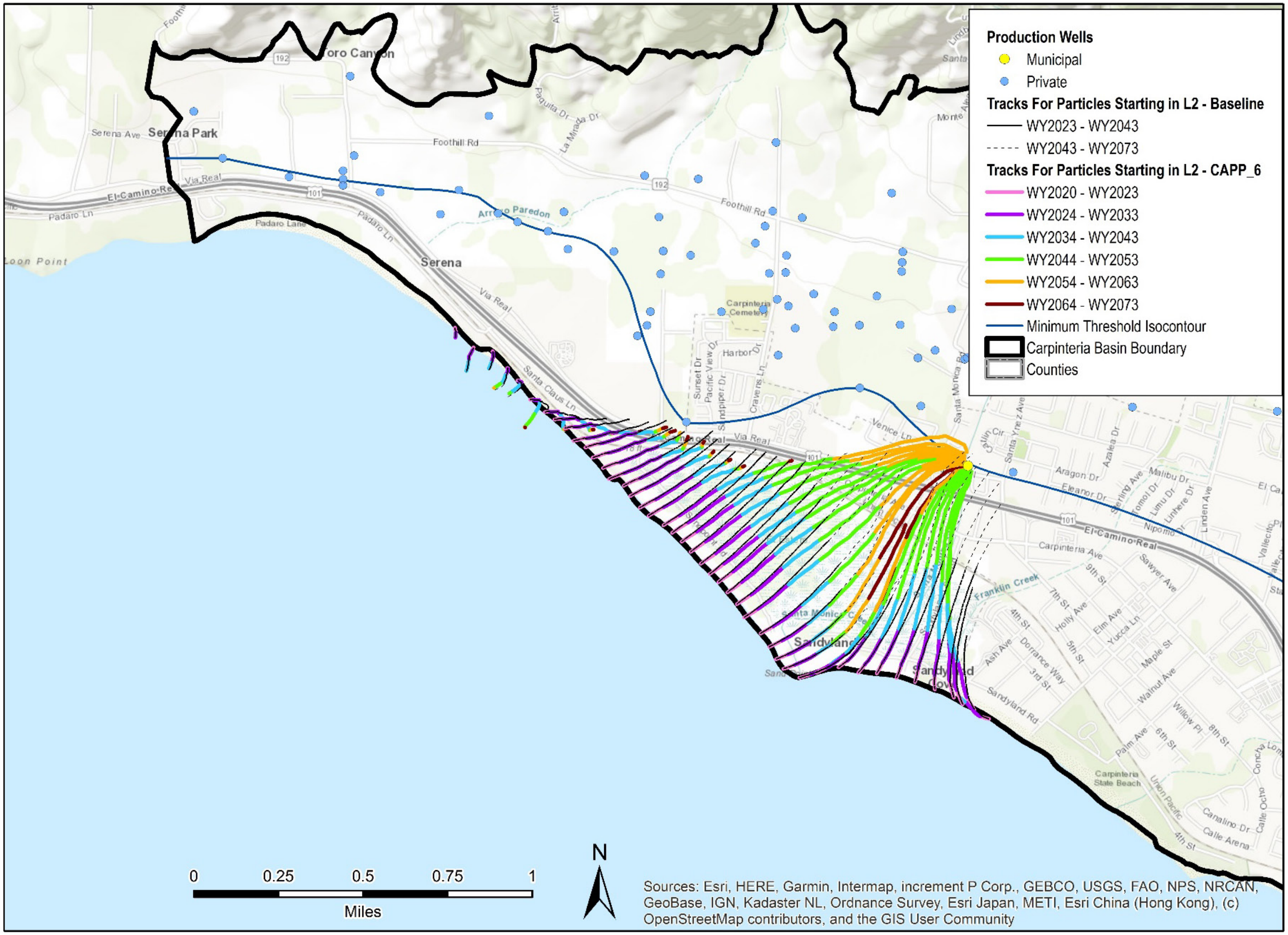


Figure 84. Particle Tracking Results, Layer 2

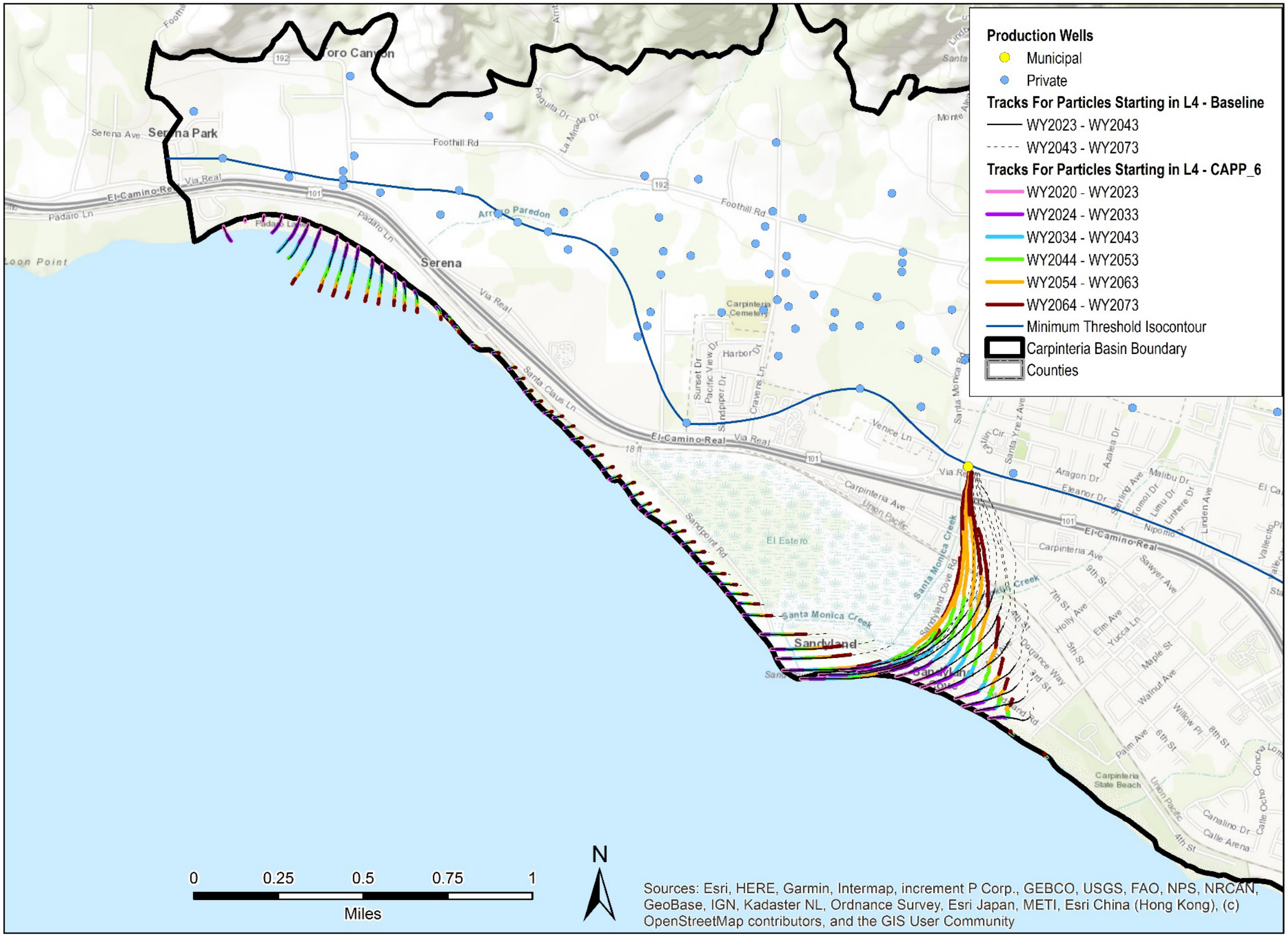


Figure 85. Particle Tracking Results, Layer 4

MONTGOMERY & ASSOCIATES

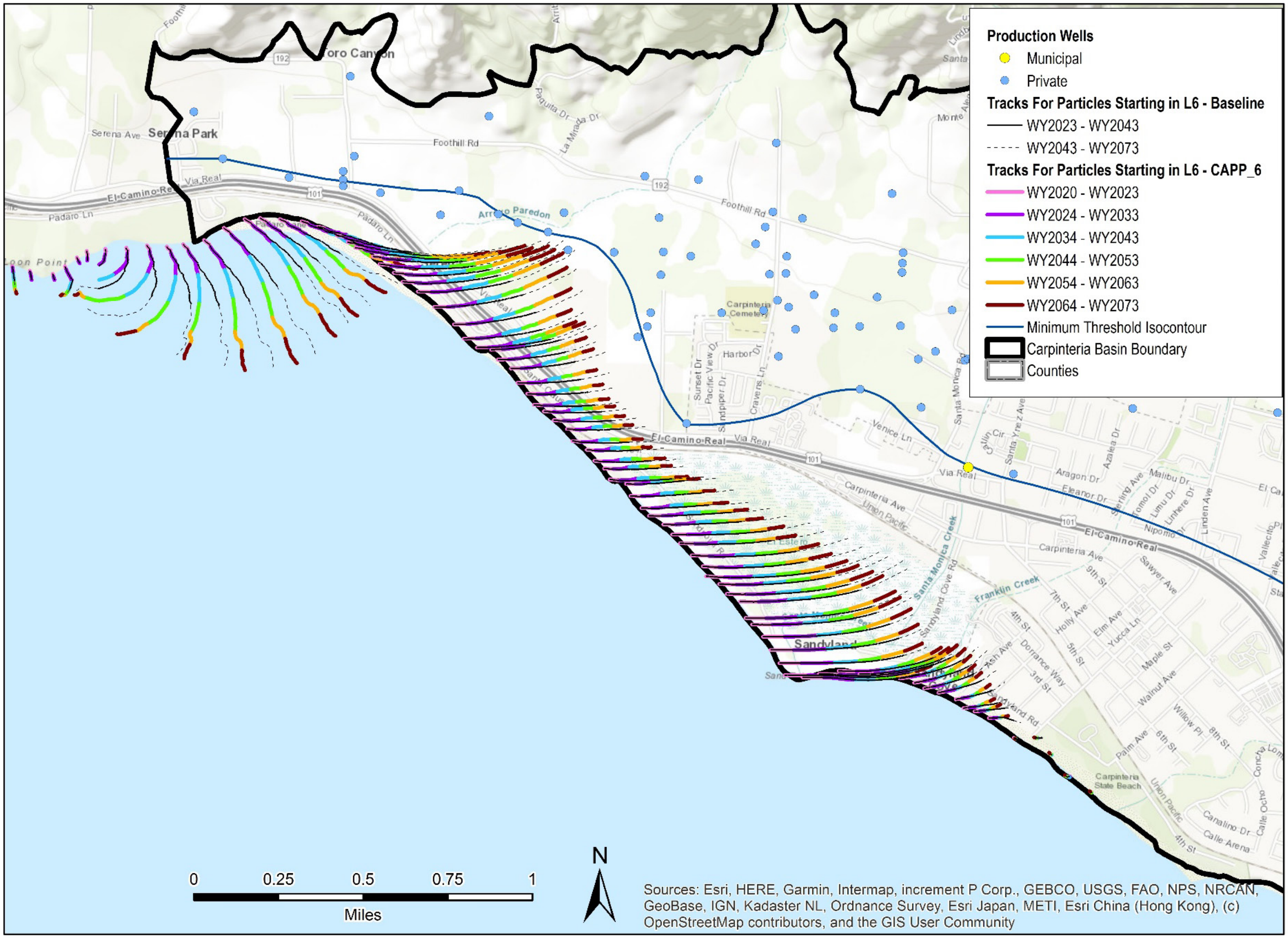


Figure 86. Particle Tracking Results, Layer 6

ACRONYMS & ABBREVIATIONS

Acre-feet per month	AF/m
Acre-feet per year	AF/yr
Basin	Carpinteria Groundwater Basin
CVWD	Carpinteria Valley Water District
ET	evapotranspiration
GSP	groundwater sustainability plan
HFB	Horizontal Flow Barrier
Kx	horizontal hydraulic conductivity
Kz	vertical hydraulic conductivity
Montecito Basin, MGB	Montecito Groundwater Basin
PEST	Parameter Estimation and Uncertainty Analysis
RMSE	root mean squared error
Ss	specific storage
SU-1	Storage unit 1
SU-2	Storage unit 2
Sy	specific yield
WY	Water year
Z	groundwater/seawater interface

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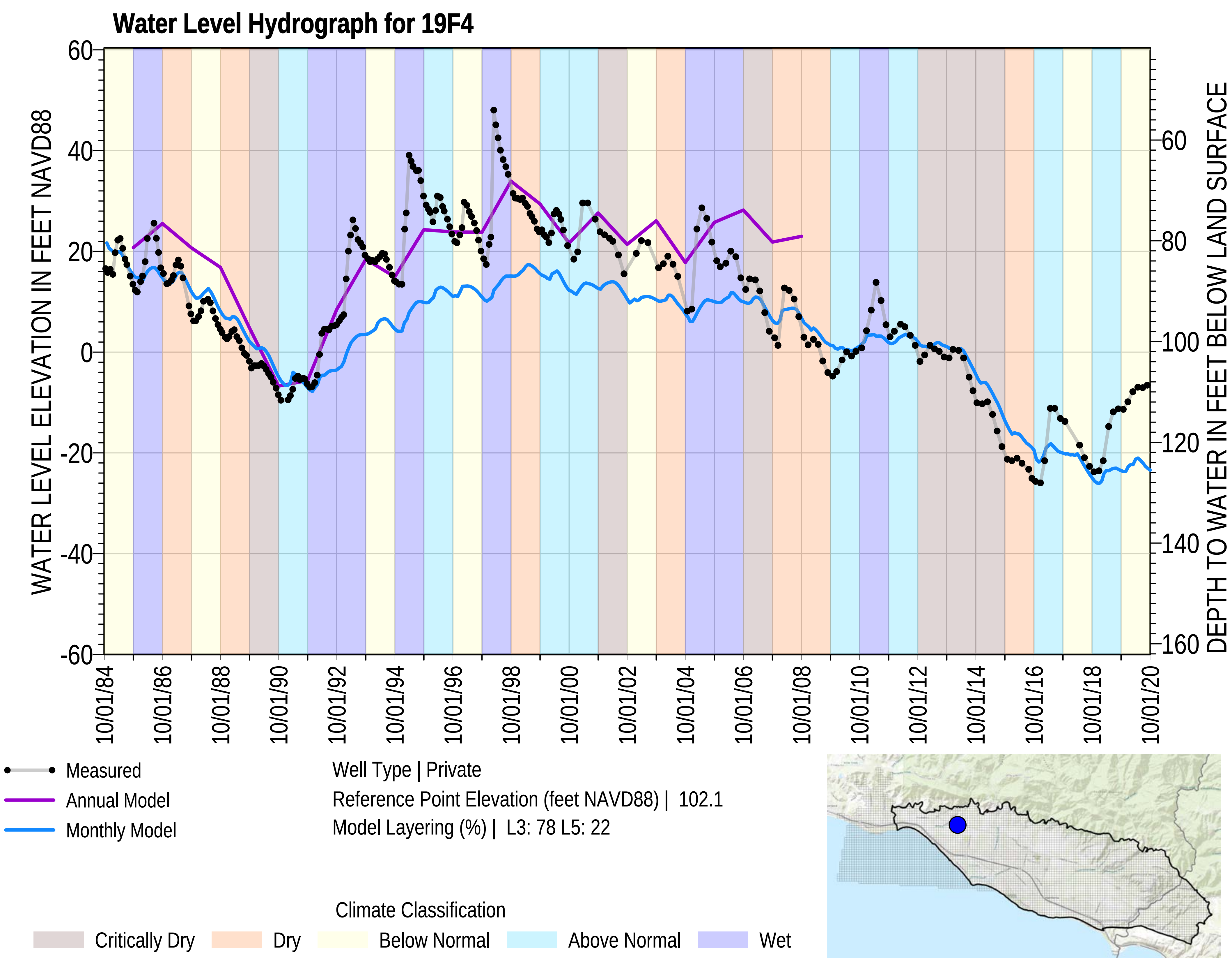
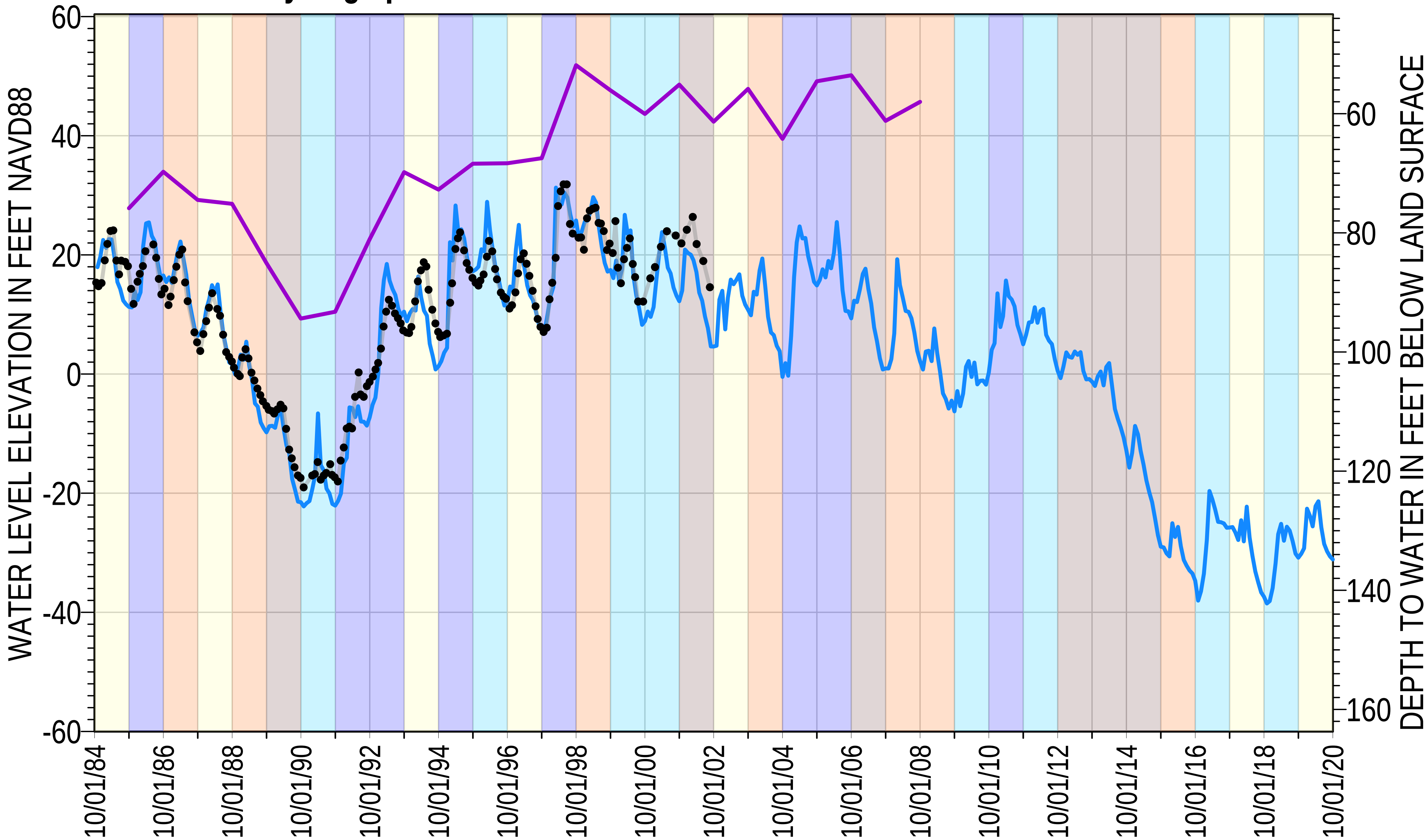
APPENDIX A CALIBRATION HYDROGRAPHS


Water Level Hydrograph for 19F4
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
60
80
100
120
140
160
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
10/01/10
10/01/12
10/01/14
10/01/16
10/01/18
10/01/20
Measured
Annual Model
Monthly Model
Well Type | Private
Reference Point Elevation (feet NAVD88) | 102.1
Model Layering (%) | L3: 78 L5: 22
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for 19H1

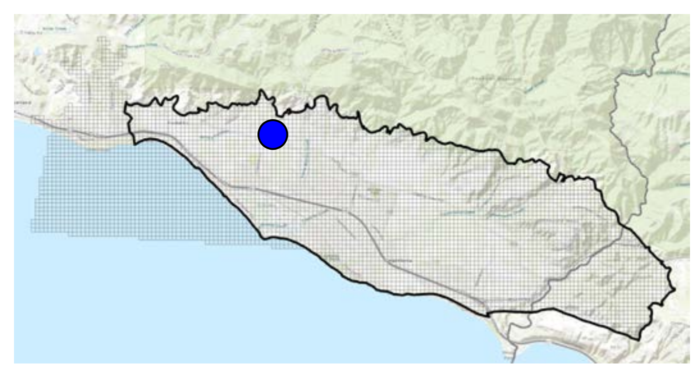


Measured
Annual Model
Monthly Model

Well Type | Private

Reference Point Elevation (feet NAVD88) | 103.7

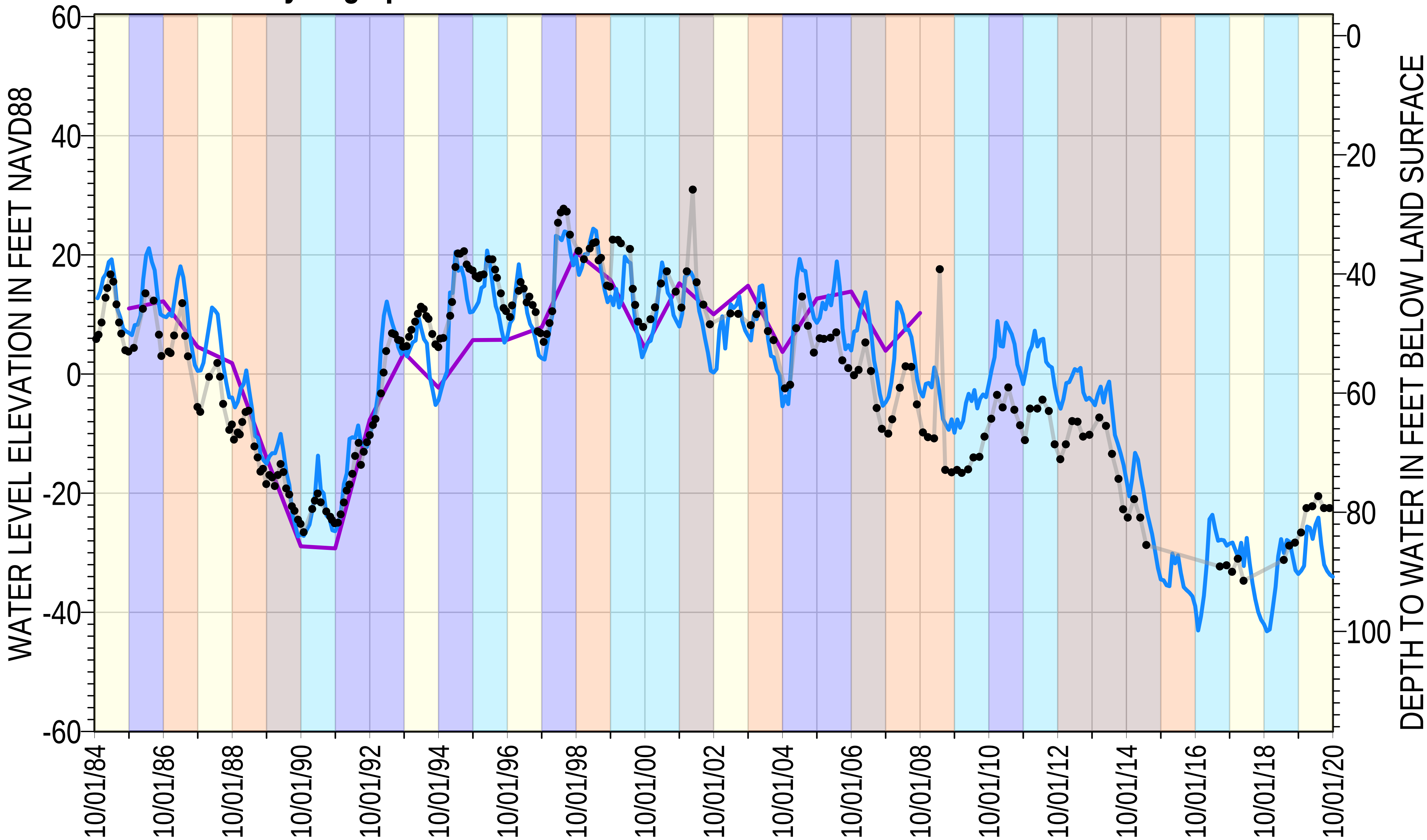
Model Layering (%) | L1: 46 L2: 9 L3: 46



Climate Classification

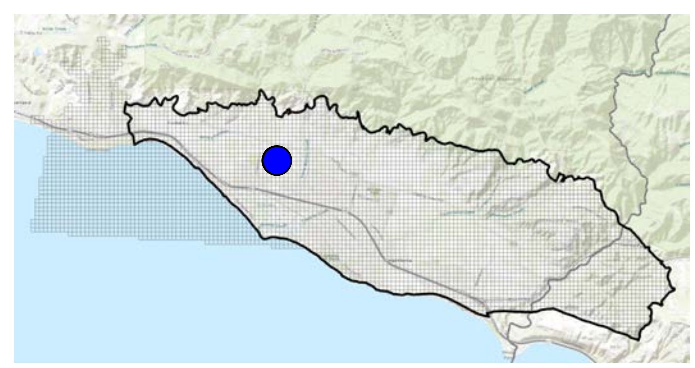
Critically Dry · Dry · Below Normal · Above Normal · Wet

Water Level Hydrograph for 19J5



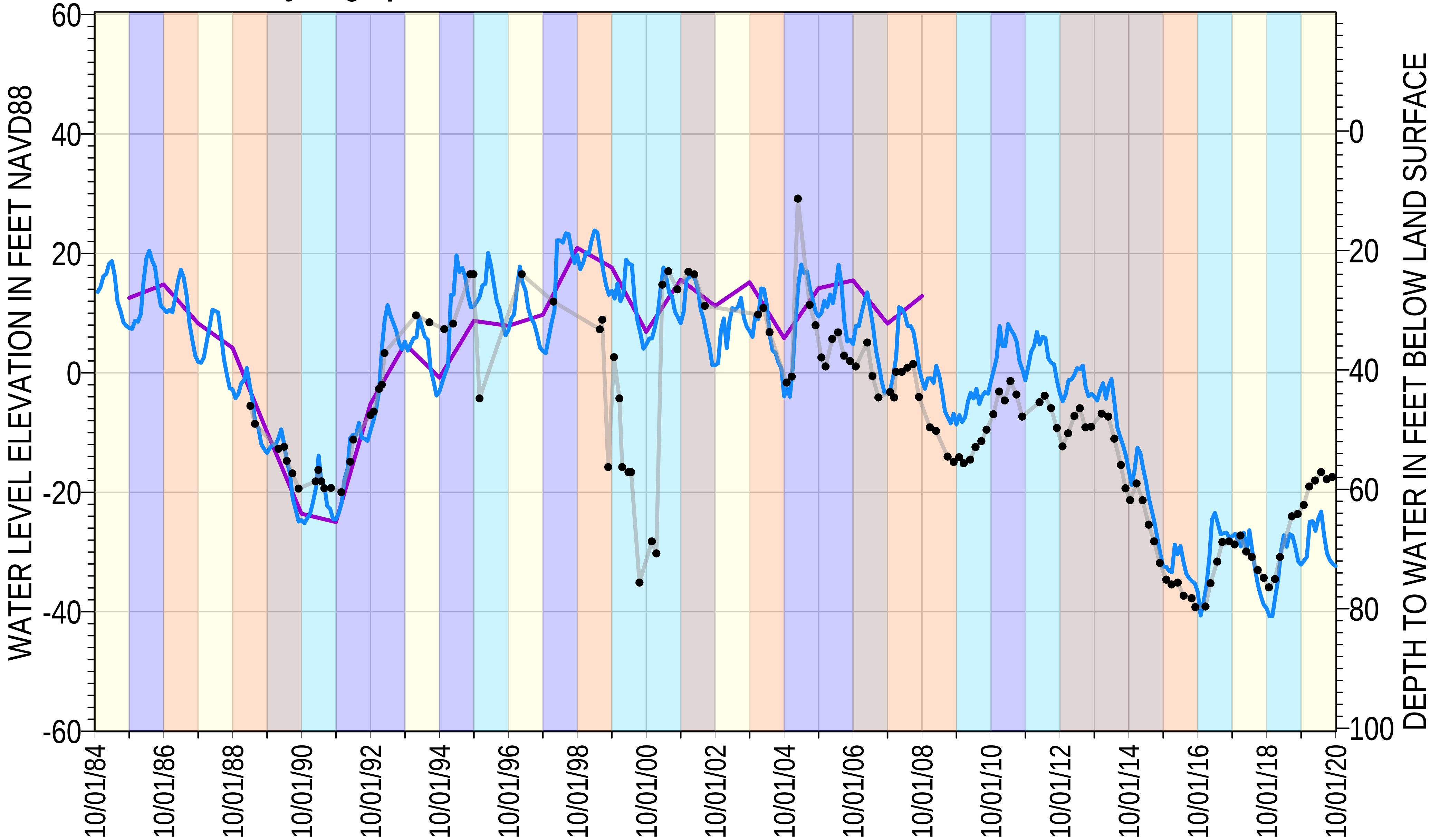
Measured
Annual Model
Monthly Model

Well Type | Private
Reference Point Elevation (feet NAVD88) | 56.8
Model Layering (%) | L1: 19 L2: 17 L3: 64



Climate Classification
Critically Dry Dry Below Normal Above Normal Wet

Water Level Hydrograph for 19K5



Measured

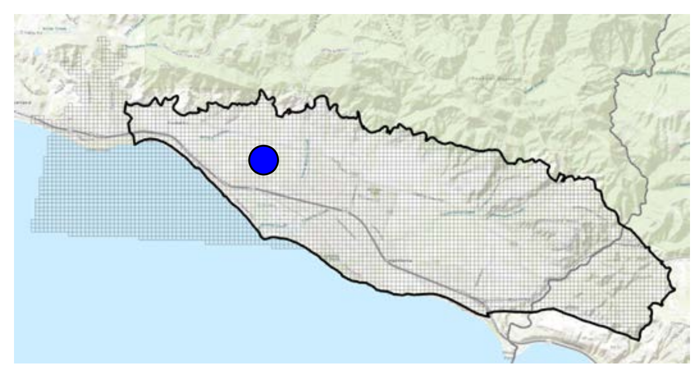
Annual Model

Monthly Model

Well Type | Private

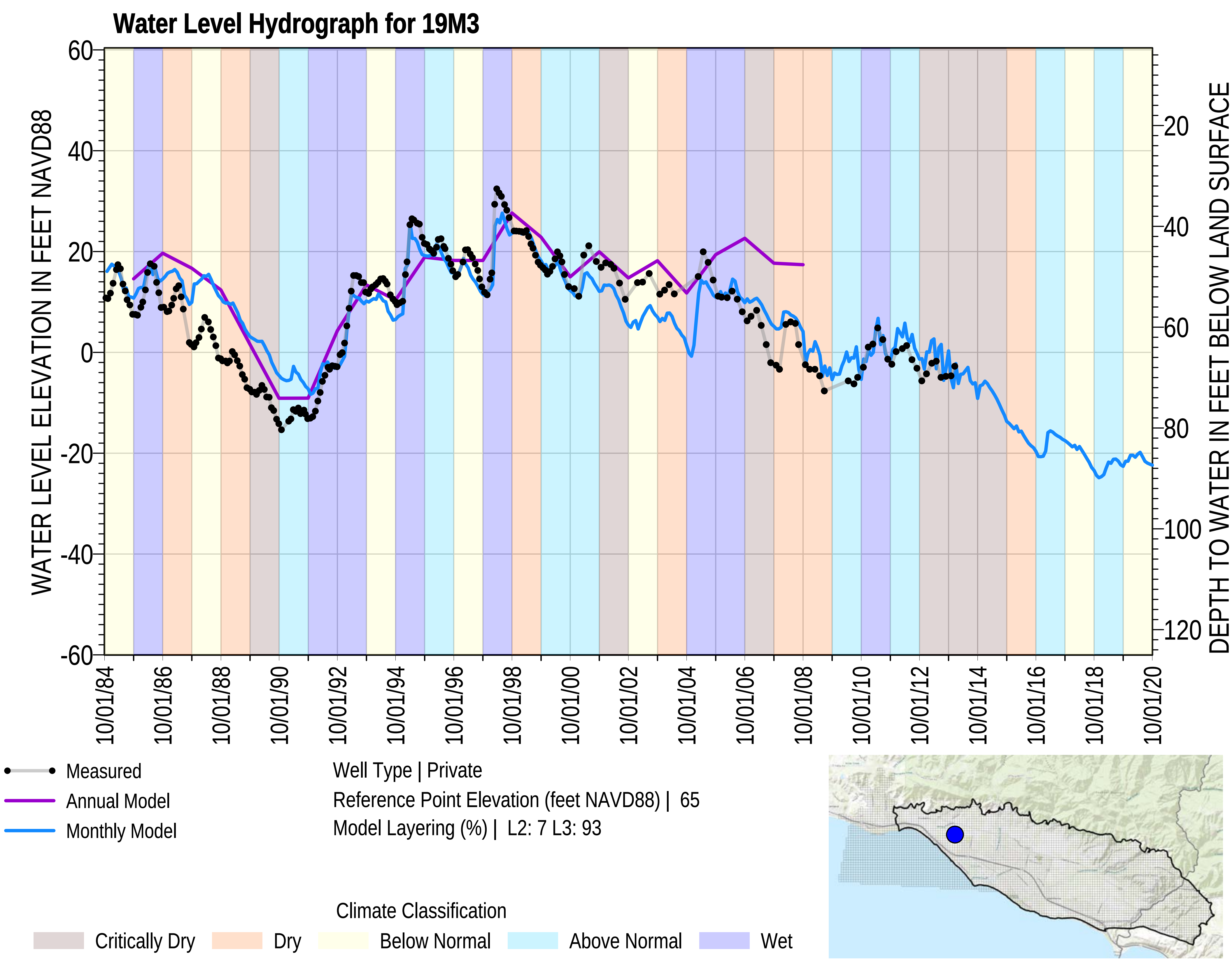
Reference Point Elevation (feet NAVD88) | 40.5

Model Layering (%) | L1: 12 L2: 18 L3: 71



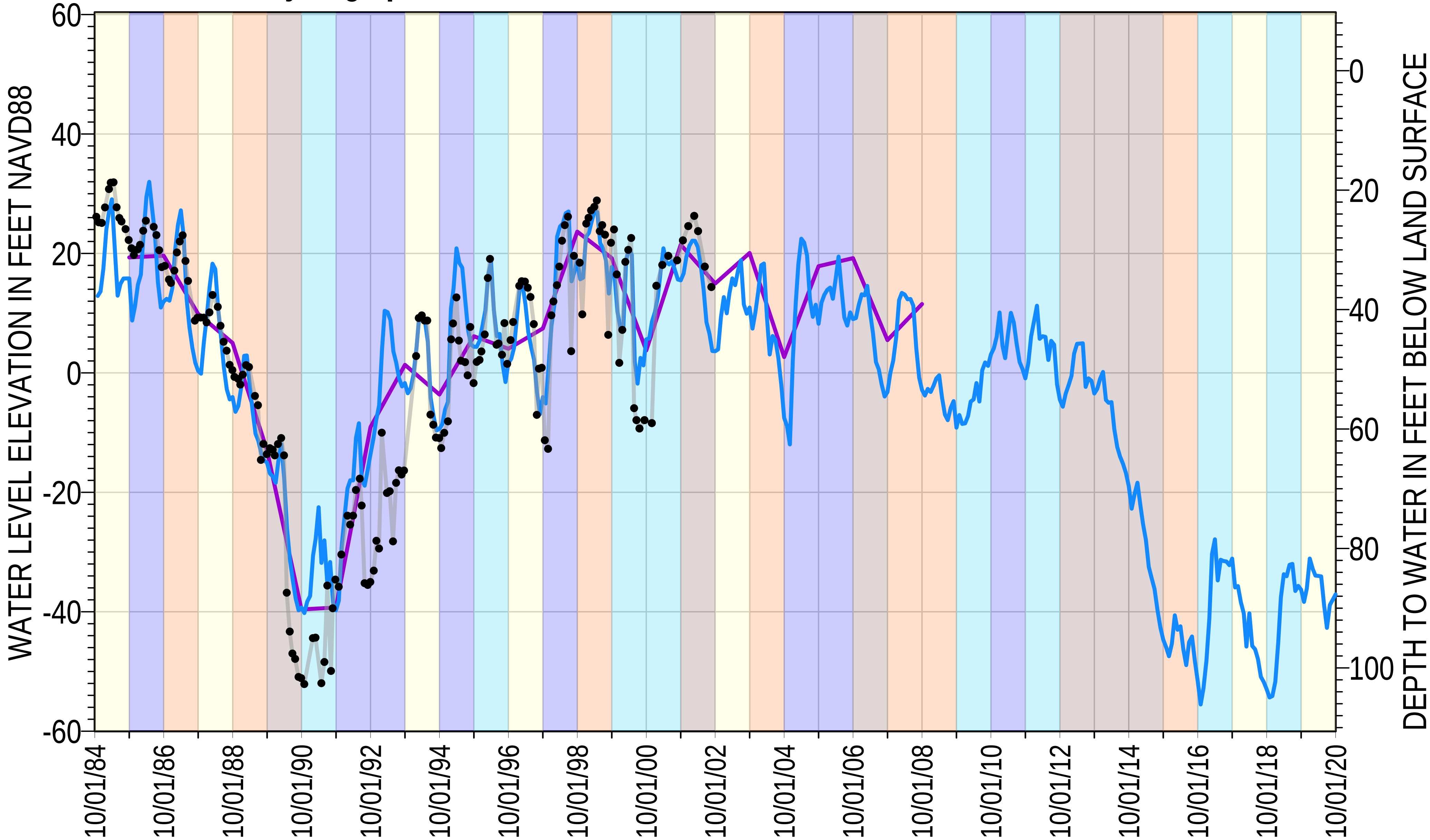
Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet



Water Level Hydrograph for 19M3
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
20
40
60
80
100
120
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
10/01/10
10/01/12
10/01/14
10/01/16
10/01/18
10/01/20
Measured
Annual Model
Monthly Model
Well Type | Private
Reference Point Elevation (feet NAVD88) | 65
Model Layering (%) | L2: 7 L3: 93
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

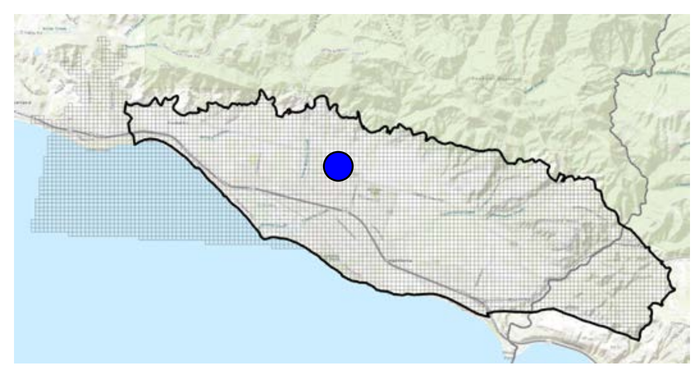
Water Level Hydrograph for 20K3



Well Type | Private

Reference Point Elevation (feet NAVD88) | 50.6

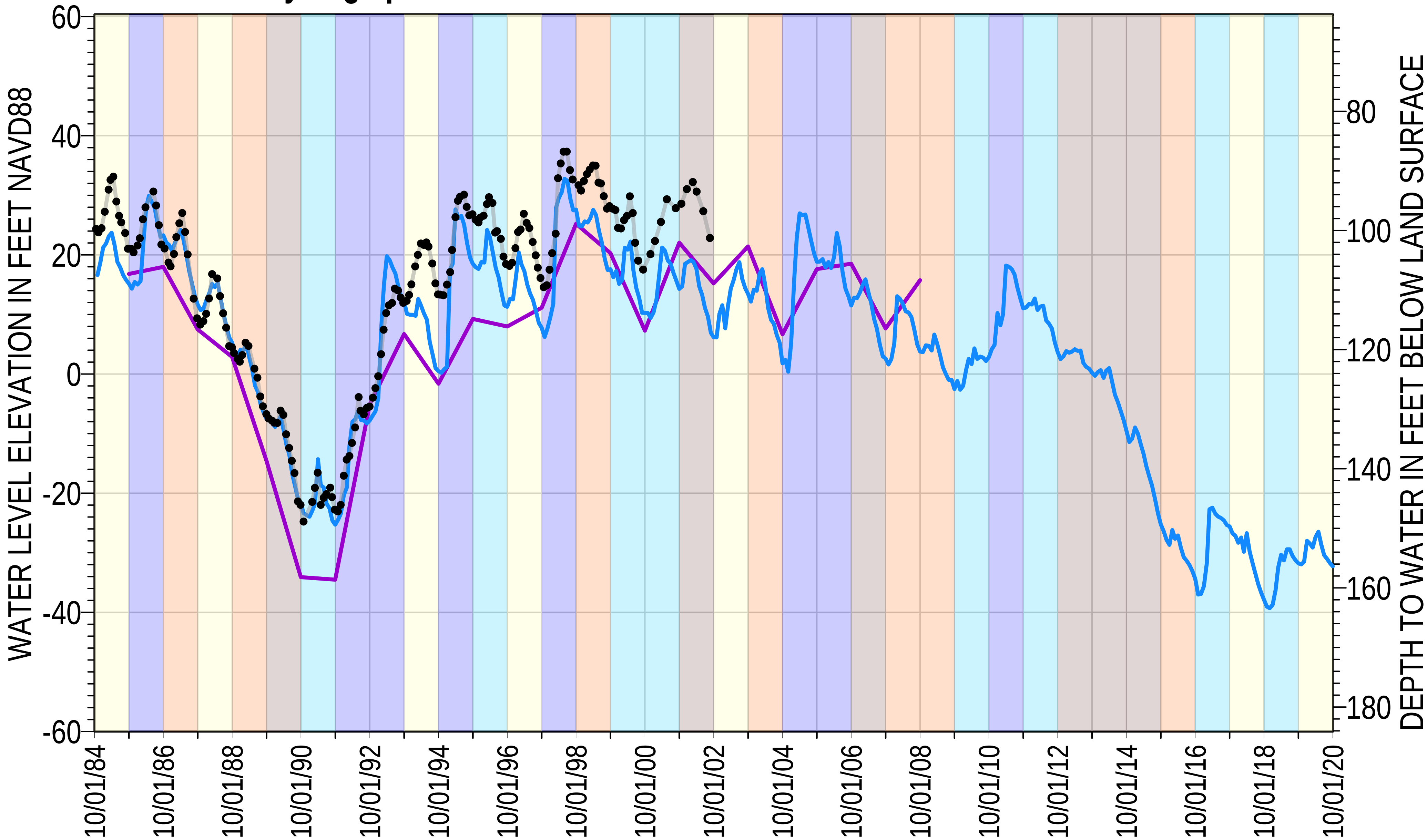
Model Layering (%) | L1: 7 L2: 11 L3: 81



Climate Classification

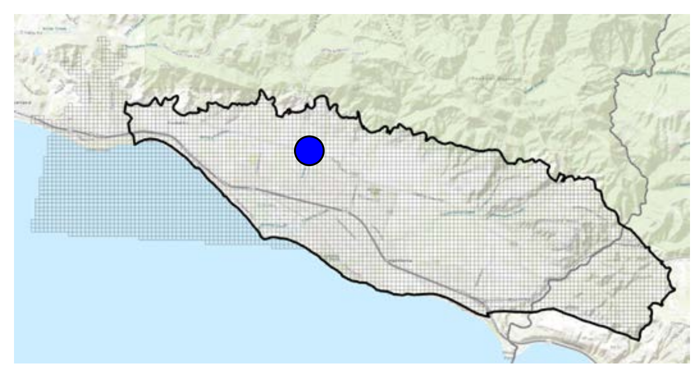
Critically Dry | Dry | Below Normal | Above Normal | Wet

Water Level Hydrograph for 20L4



Measured
Annual Model
Monthly Model

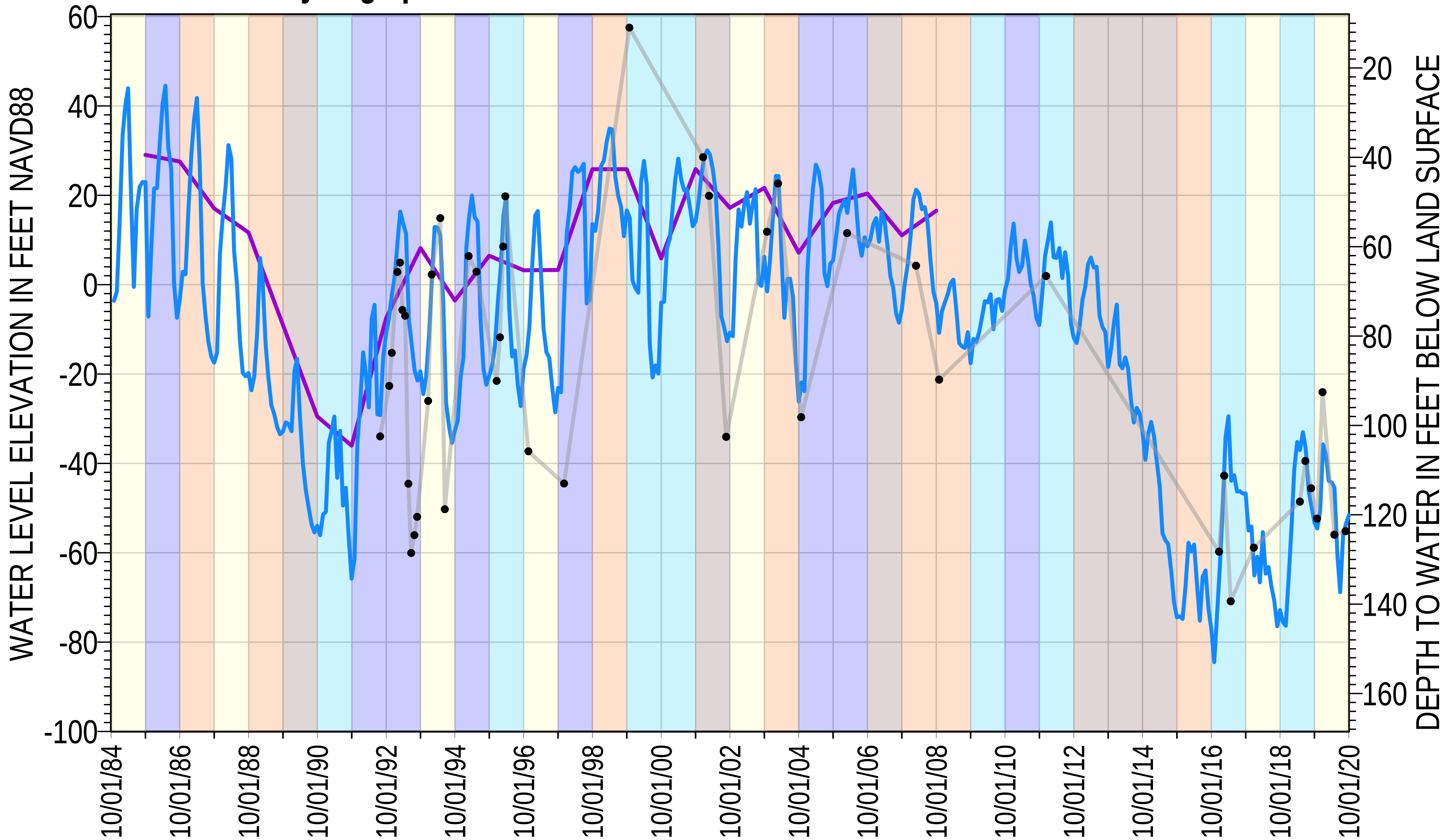
Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 124.1
Model Layering (%) | L1: 78 L2: 18 L3: 4



Climate Classification

Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for 21L1



Measured

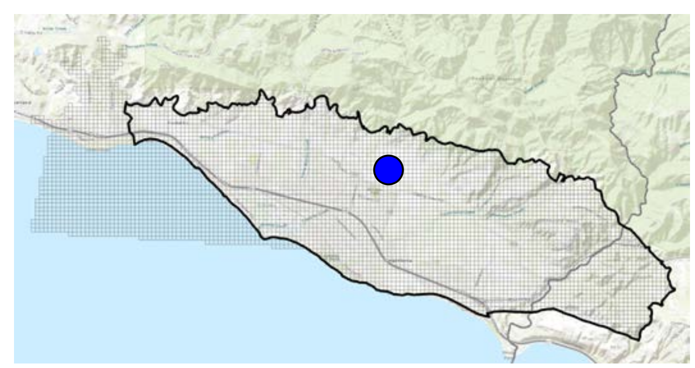
Annual Model

Monthly Model

Well Type | Private

Reference Point Elevation (feet NAVD88) | 68.5

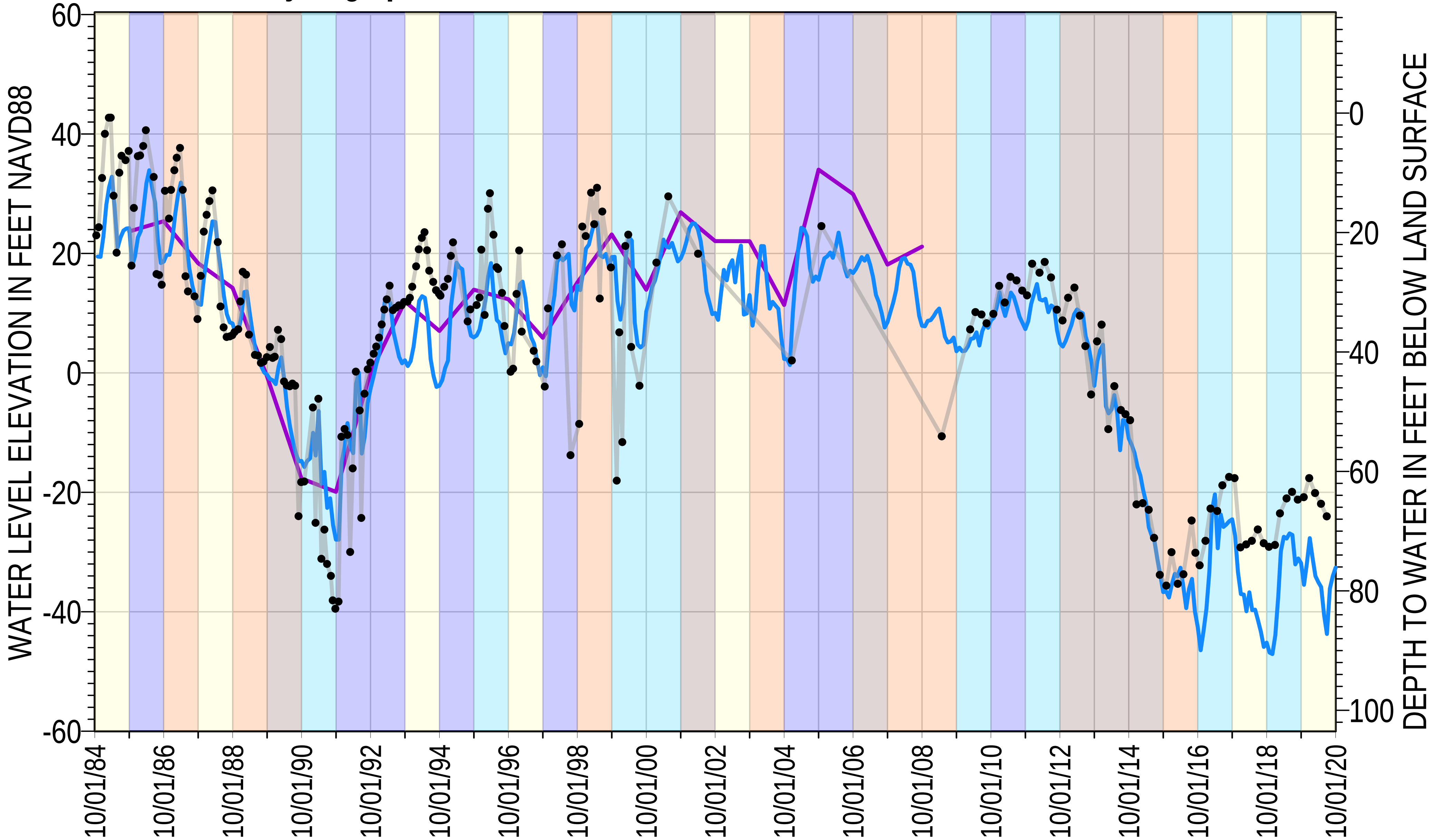
Model Layering (%) | L3: 51 L4: 13 L5: 21 L6: 15



Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

Water Level Hydrograph for 21N1



Measured

Annual Model

Monthly Model

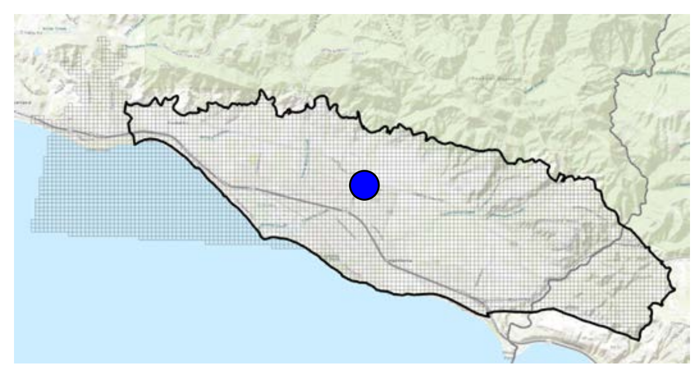
Well Type | Private

Reference Point Elevation (feet NAVD88) | 43.5

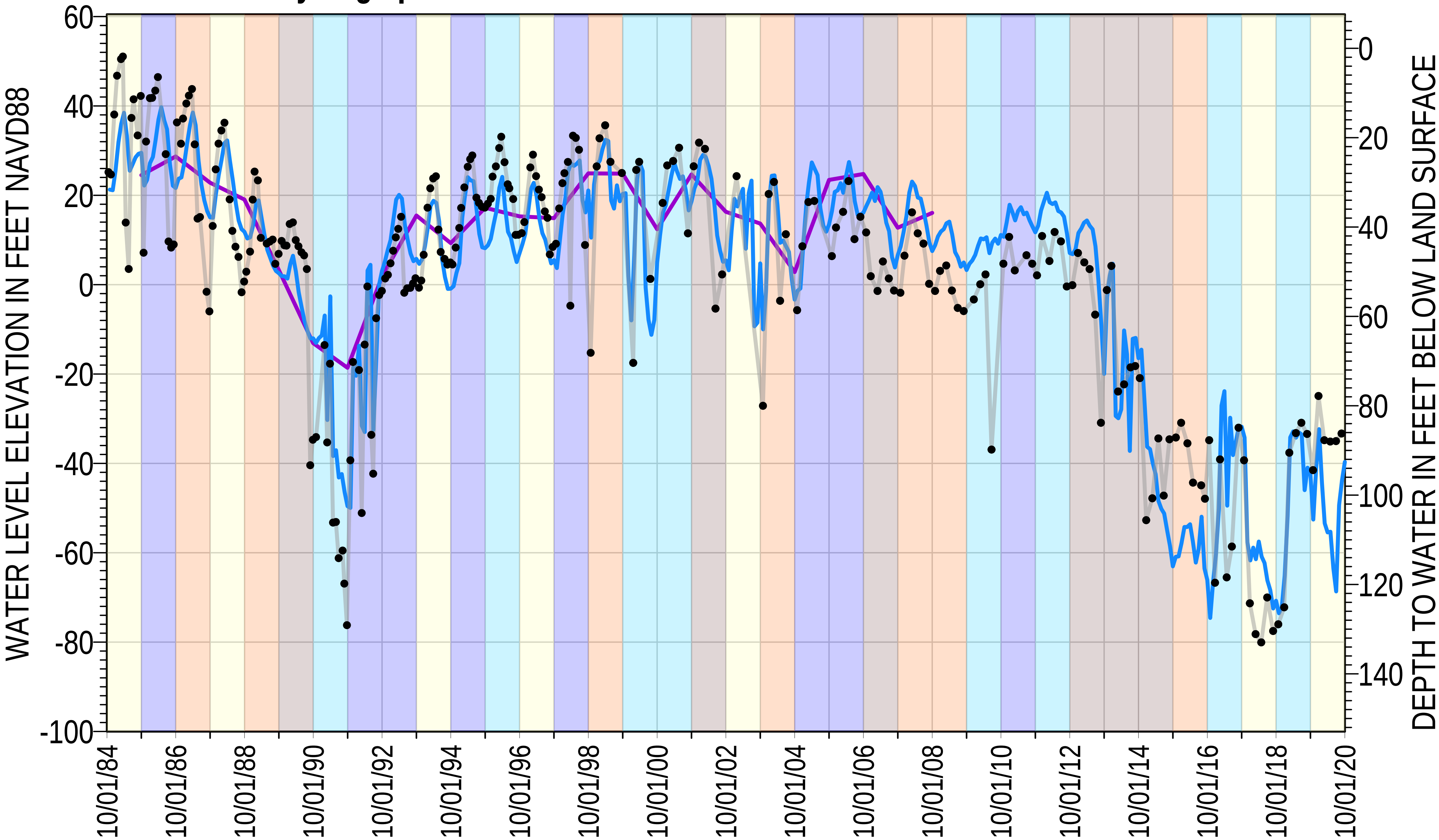
Model Layering (%) | L1: 56 L2: 12 L3: 32

Climate Classification

Critically Dry, Dry, Below Normal, Above Normal, Wet



Water Level Hydrograph for 21N4



Measured

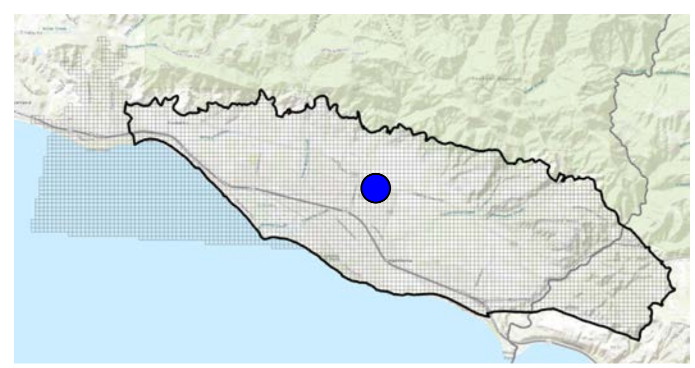
Annual Model

Monthly Model

Well Type | Private

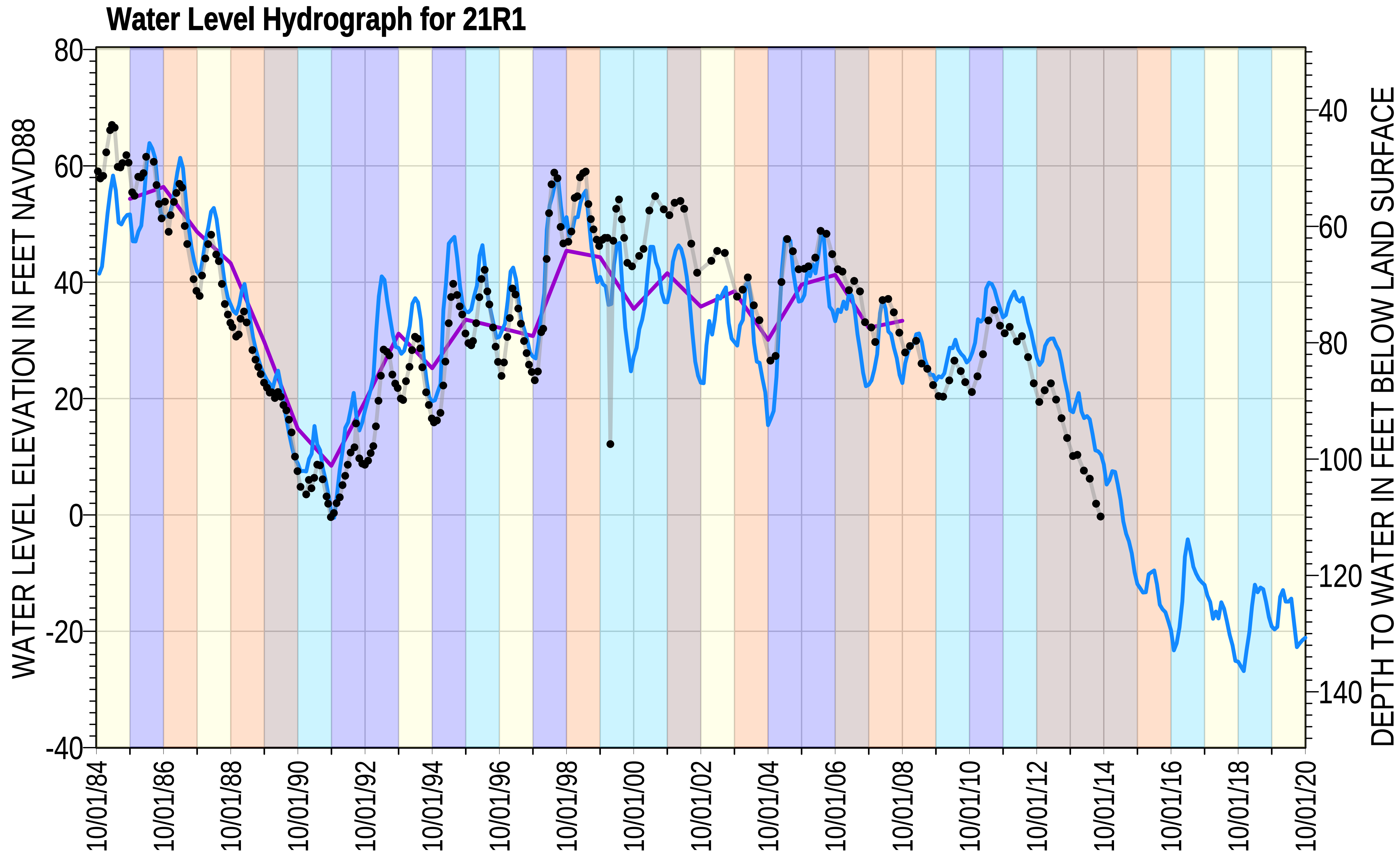
Reference Point Elevation (feet NAVD88) | 52.9

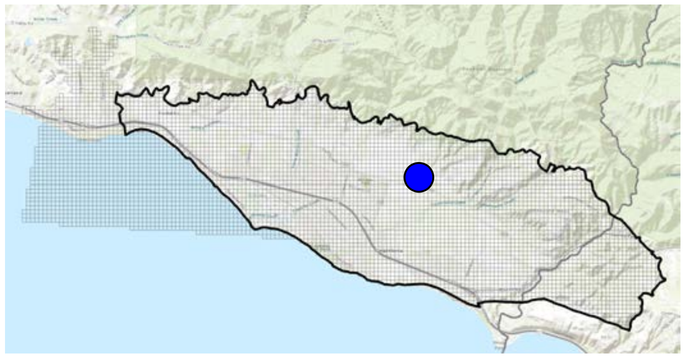
Model Layering (%) | L1: 56 L2: 11 L3: 33



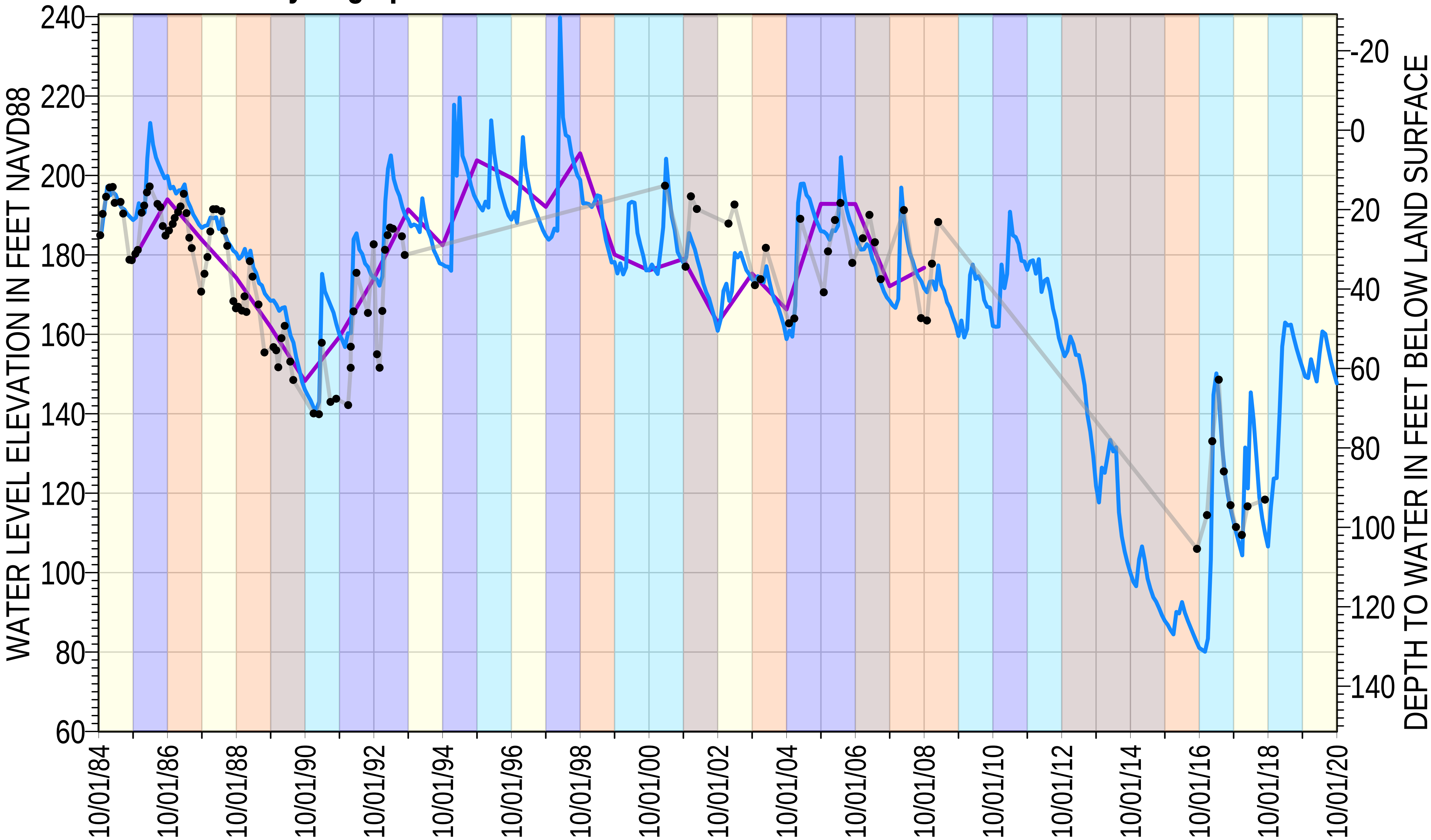
Climate Classification

Critically Dry Dry Below Normal Above Normal Wet


Water Level Hydrograph for 21R1
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
80
60
40
20
0
-20
-40
40
60
80
100
120
140
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
10/01/10
10/01/12
10/01/14
10/01/16
10/01/18
10/01/20
Measured
Annual Model
Monthly Model
Well Type | Private
Reference Point Elevation (feet NAVD88) | 109.6
Model Layering (%) | L1: 35 L2: 6 L3: 59
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet



Water Level Hydrograph for 22R3



Measured

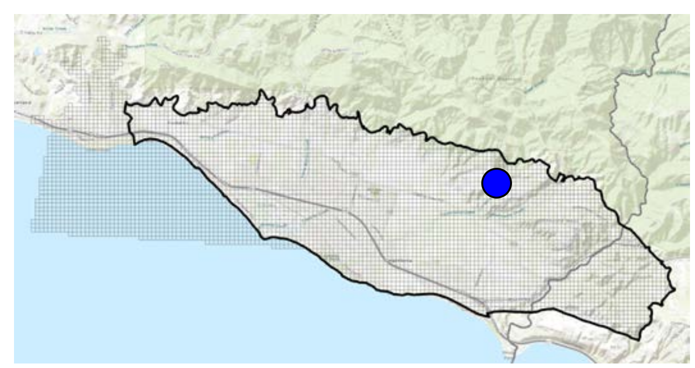
Annual Model

Monthly Model

Well Type | Private

Reference Point Elevation (feet NAVD88) | 211.4

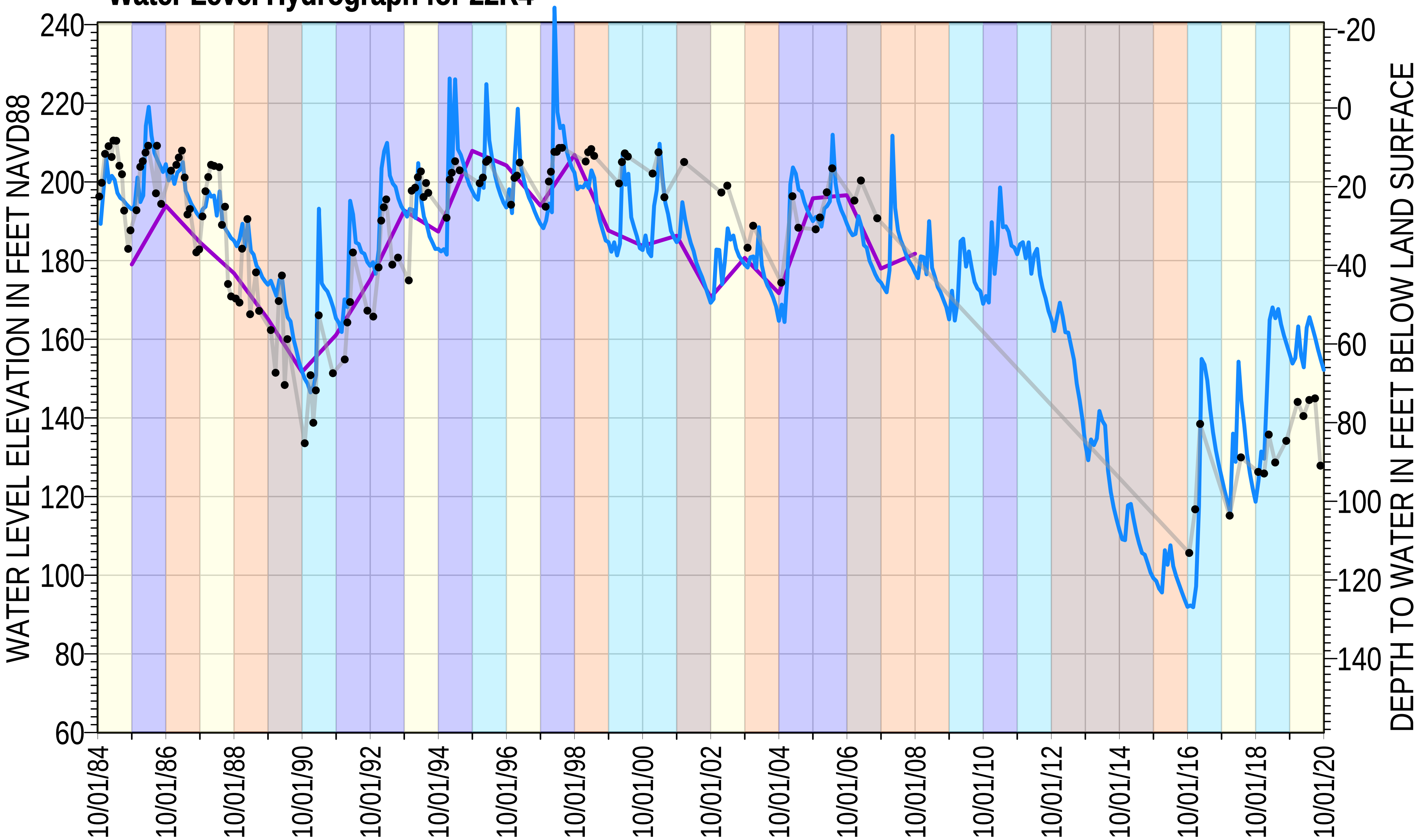
Model Layering (%) | L3: 70 L4: 30



Climate Classification

Critically Dry Dry Below Normal Above Normal Wet

Water Level Hydrograph for 22R4



Measured

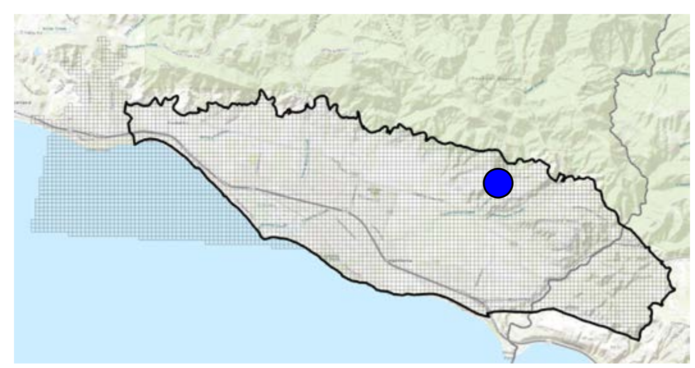
Annual Model

Monthly Model

Well Type | Private

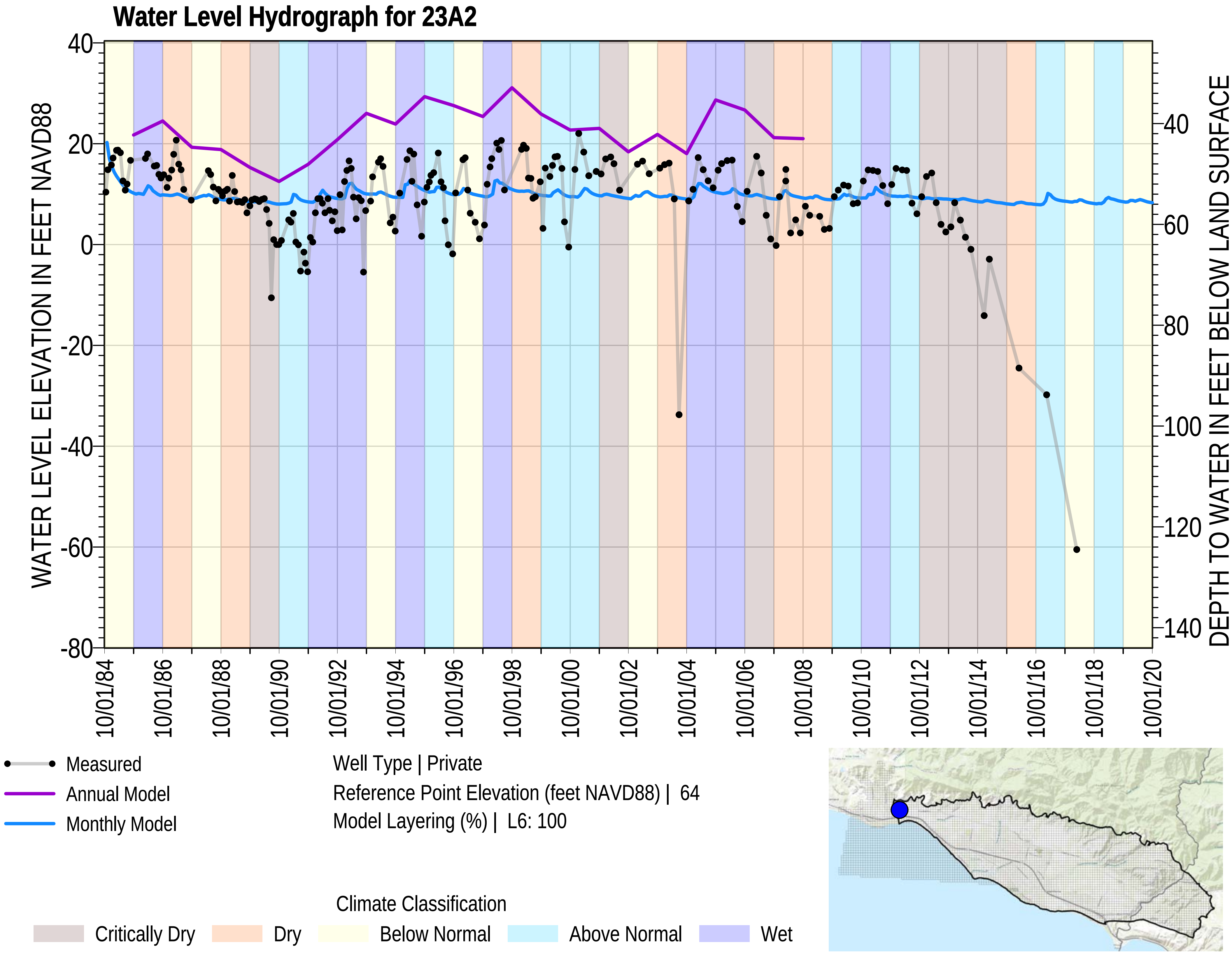
Reference Point Elevation (feet NAVD88) | 218.8

Model Layering (%) | L3: 4 L4: 41 L5: 54

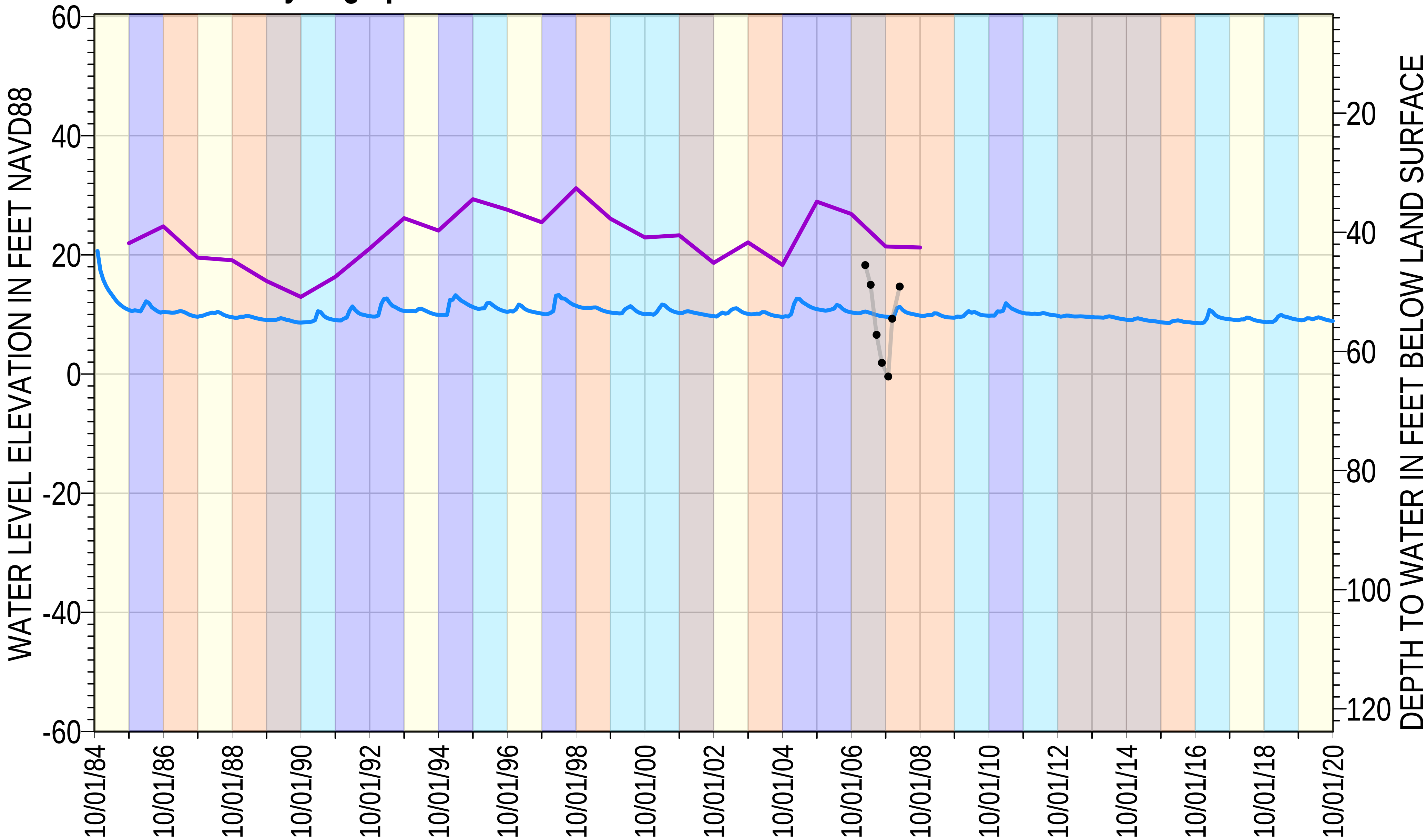


Climate Classification

Critically Dry   Dry   Below Normal   Above Normal   Wet


Water Level Hydrograph for 23A2
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
40
20
0
-20
-40
-60
-80
40
60
80
100
120
140
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
10/01/10
10/01/12
10/01/14
10/01/16
10/01/18
10/01/20
Measured
Annual Model
Monthly Model
Well Type | Private
Reference Point Elevation (feet NAVD88) | 64
Model Layering (%) | L6: 100
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for 23A4



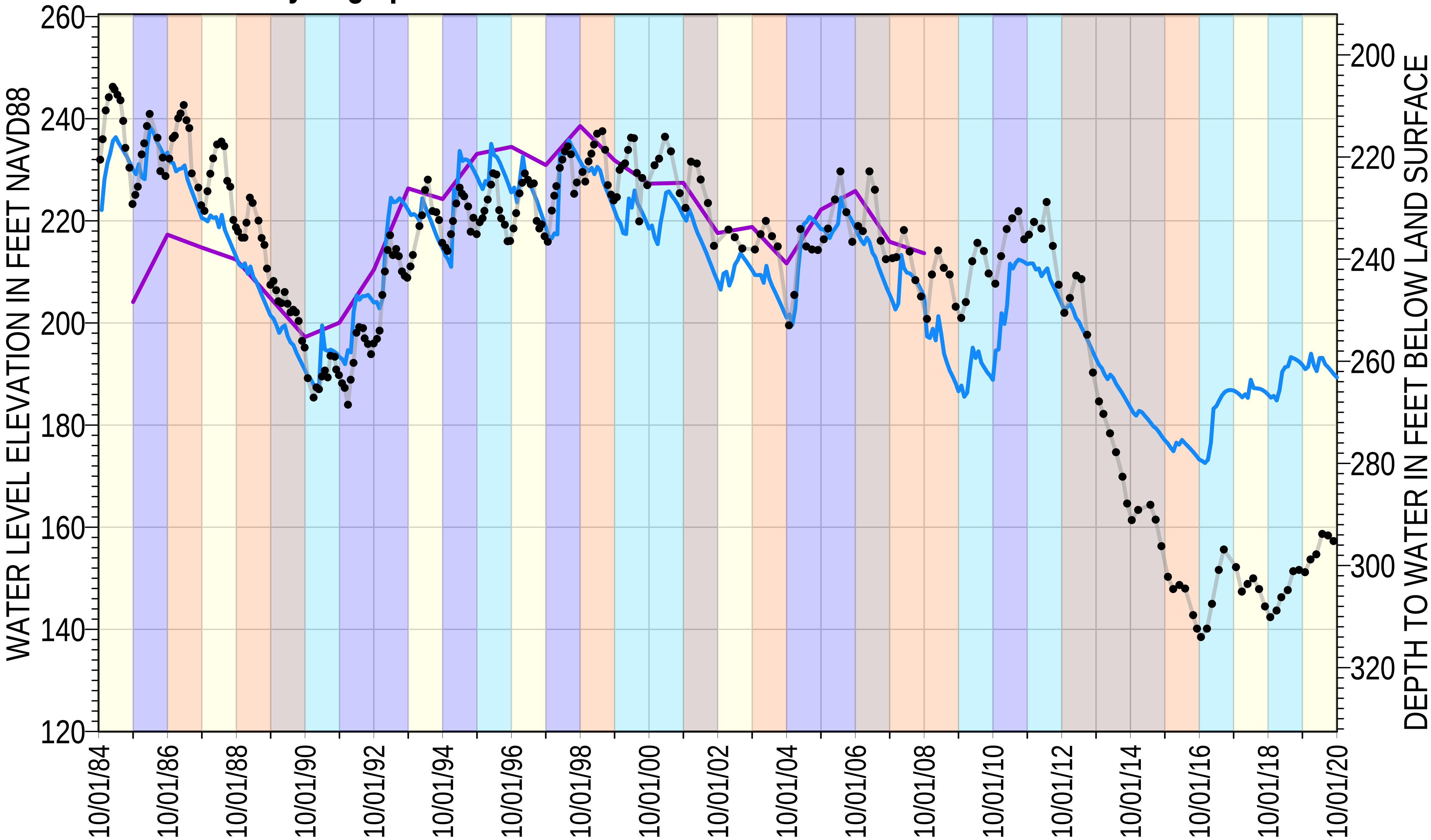
Measured
Annual Model
Monthly Model

Well Type | Private
Reference Point Elevation (feet NAVD88) | 63.8
Model Layering (%) | L6: 100

Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

Water Level Hydrograph for 23P1



Measured

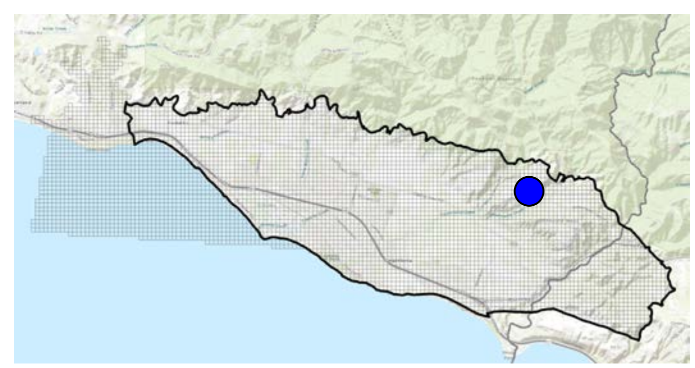
Annual Model

Monthly Model

Well Type | Private

Reference Point Elevation (feet NAVD88) | 452.5

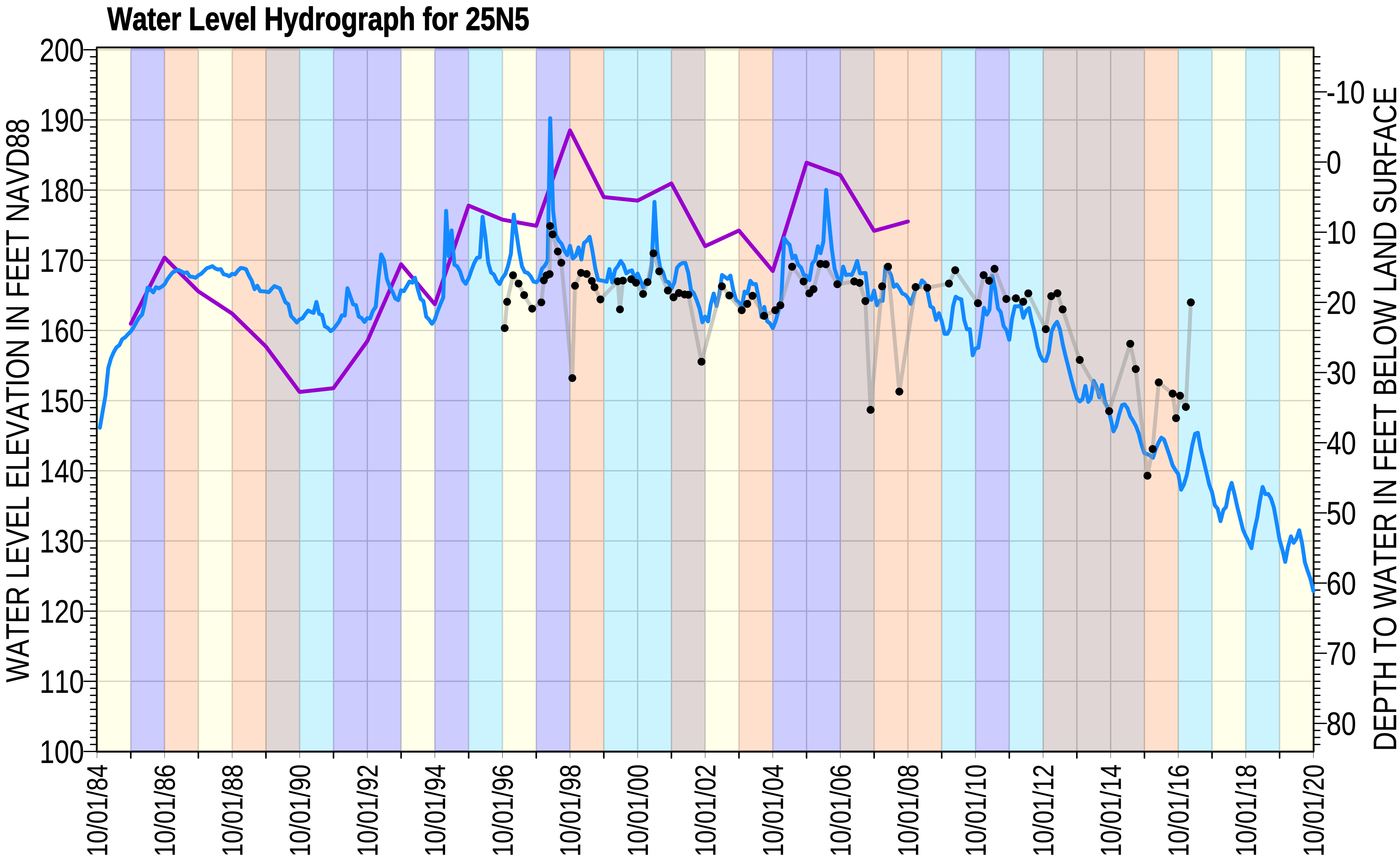
Model Layering (%) | L4: 15 L5: 85



Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

Water Level Hydrograph for 25N5

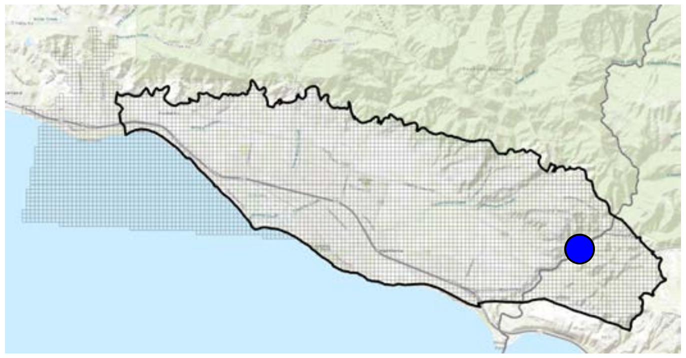


- Measured
- Annual Model
- Monthly Model

Well Type | Private

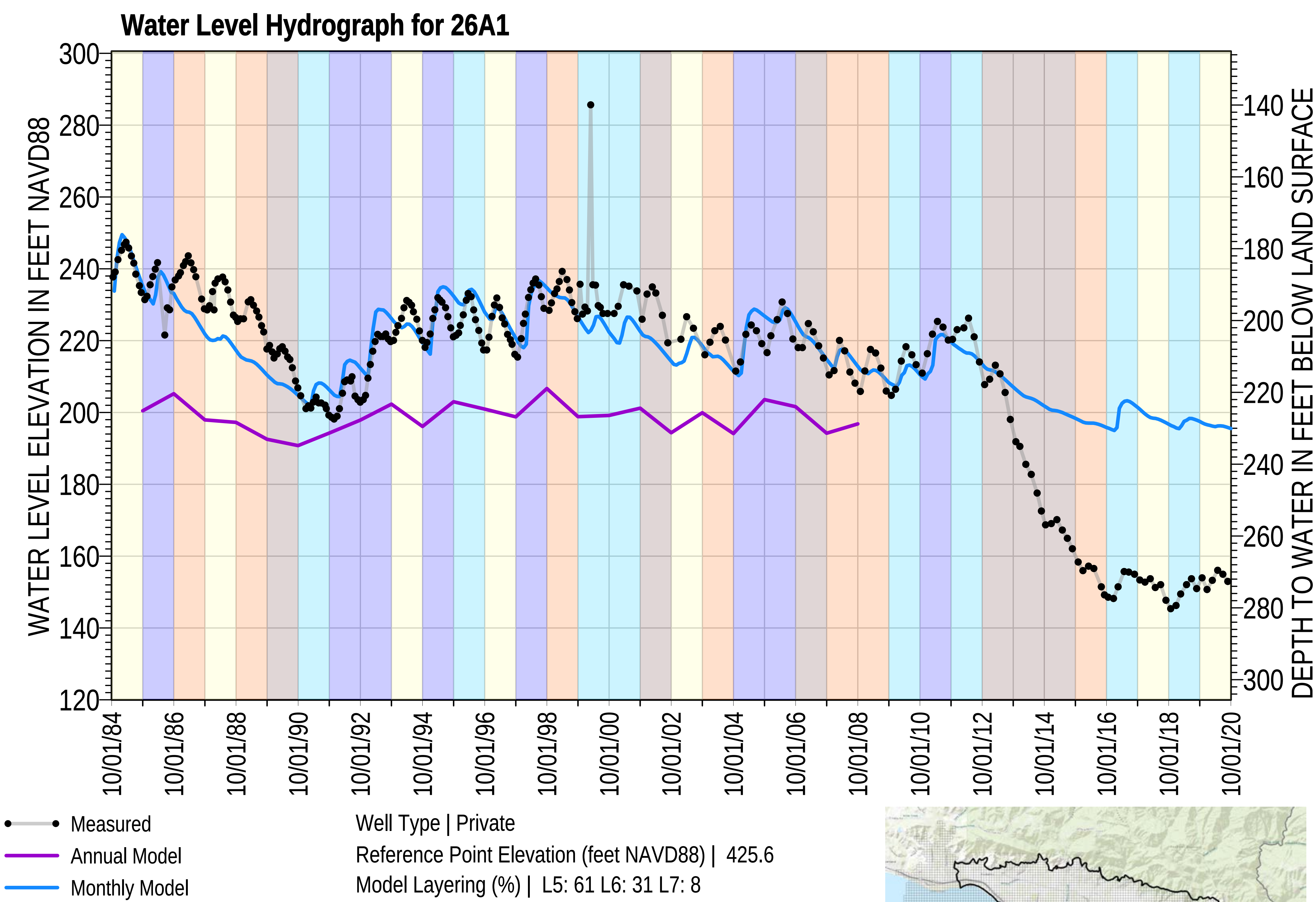
Reference Point Elevation (feet NAVD88) | 184

Model Layering (%) | L5: 100



Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

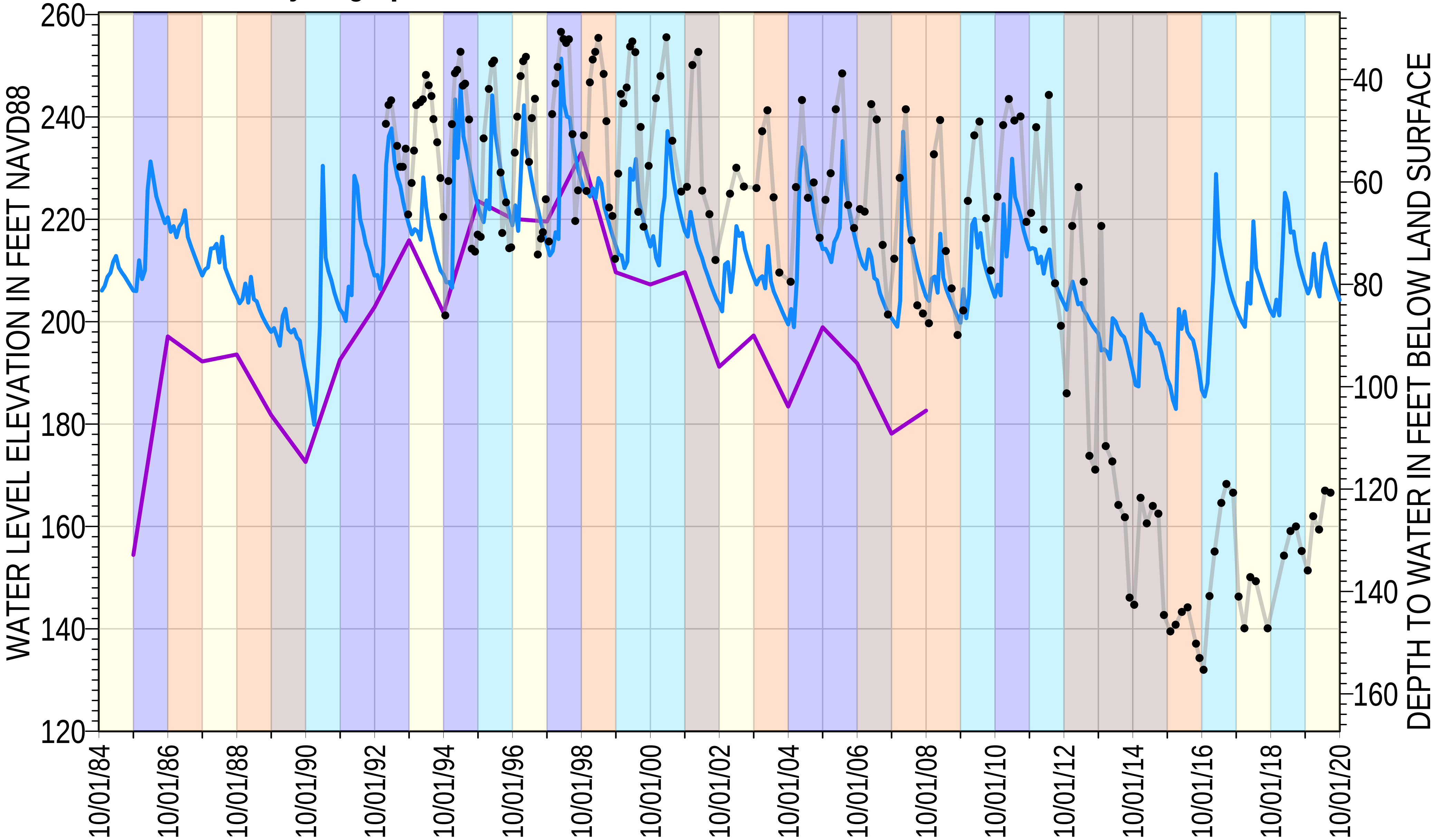


Well Type | Private

Reference Point Elevation (feet NAVD88) | 425.6

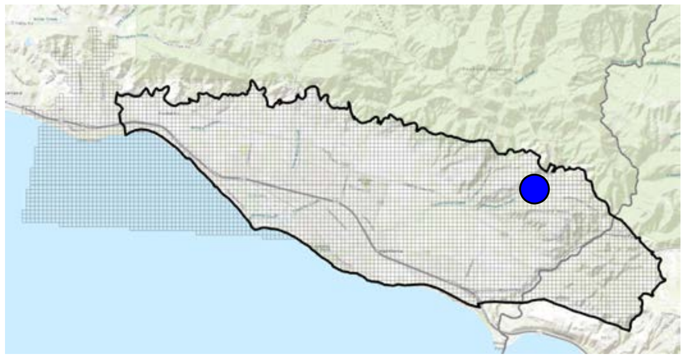
Model Layering (%) | L5: 61 L6: 31 L7: 8

Water Level Hydrograph for 26C1



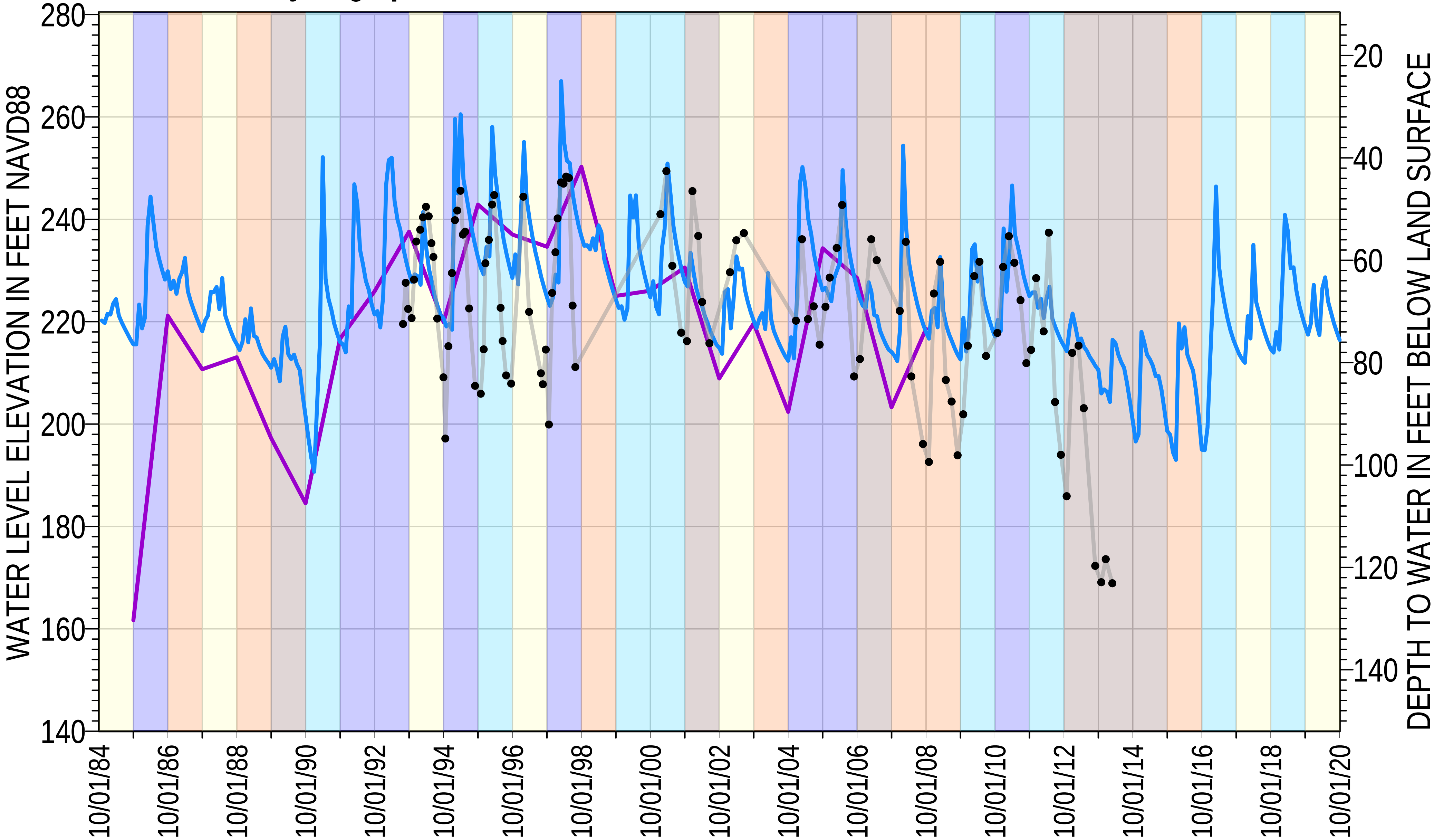
Measured
Annual Model
Monthly Model

Well Type | Private
Reference Point Elevation (feet NAVD88) | 287.3
Model Layering (%) | L4: 3 L5: 97



Climate Classification
Critically Dry | Dry | Below Normal | Above Normal | Wet

Water Level Hydrograph for 26C6



Measured

Annual Model

Monthly Model

Well Type | Private

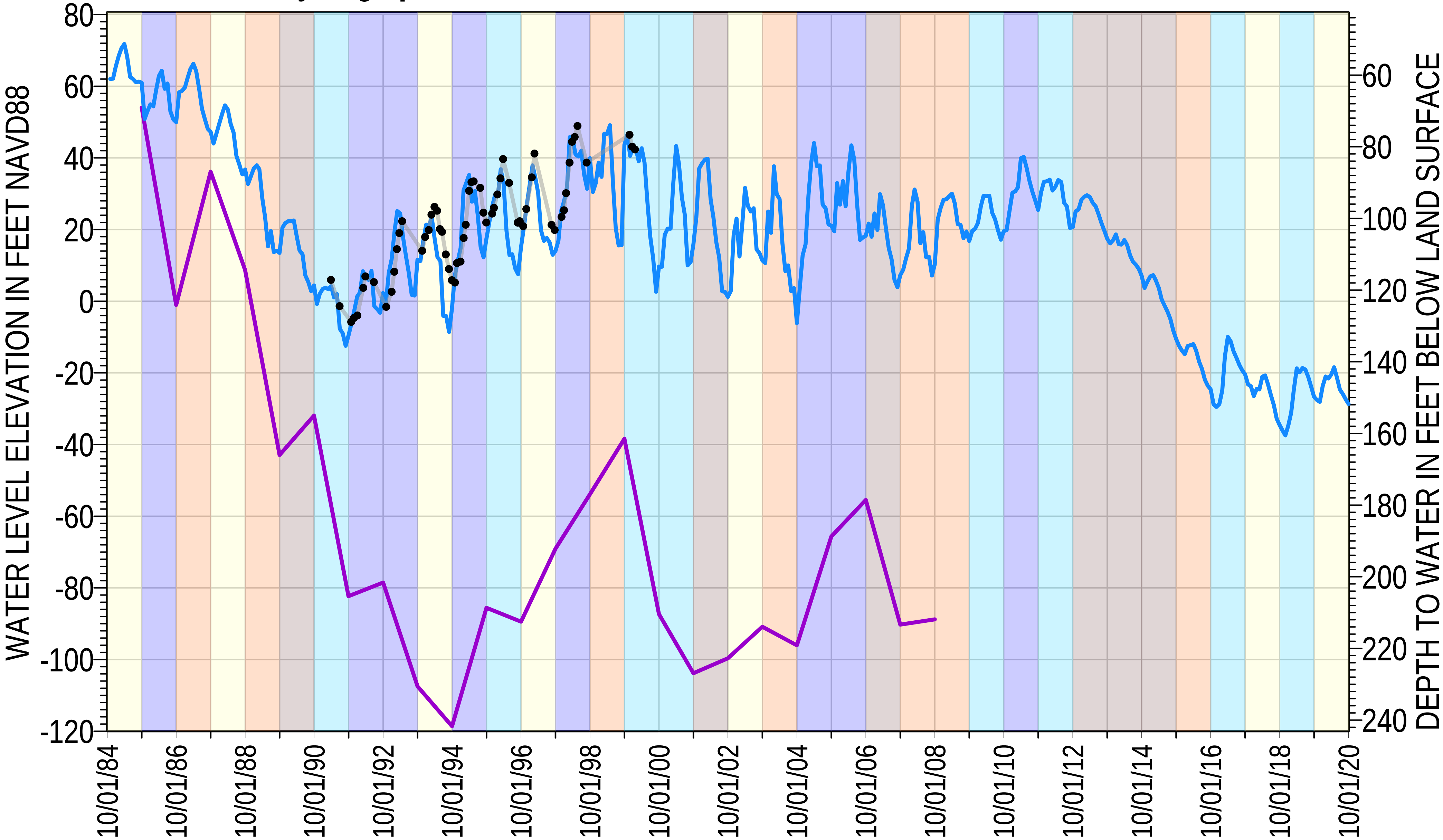
Reference Point Elevation (feet NAVD88) | 292

Model Layering (%) | L4: 4 L5: 85 L6: 11

Climate Classification

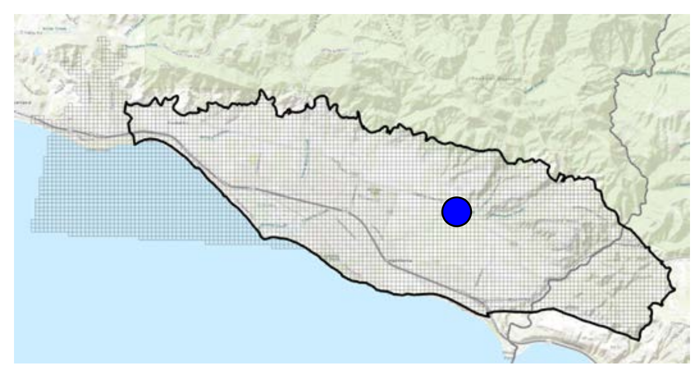
Critically Dry | Dry | Below Normal | Above Normal | Wet

Water Level Hydrograph for 27F1



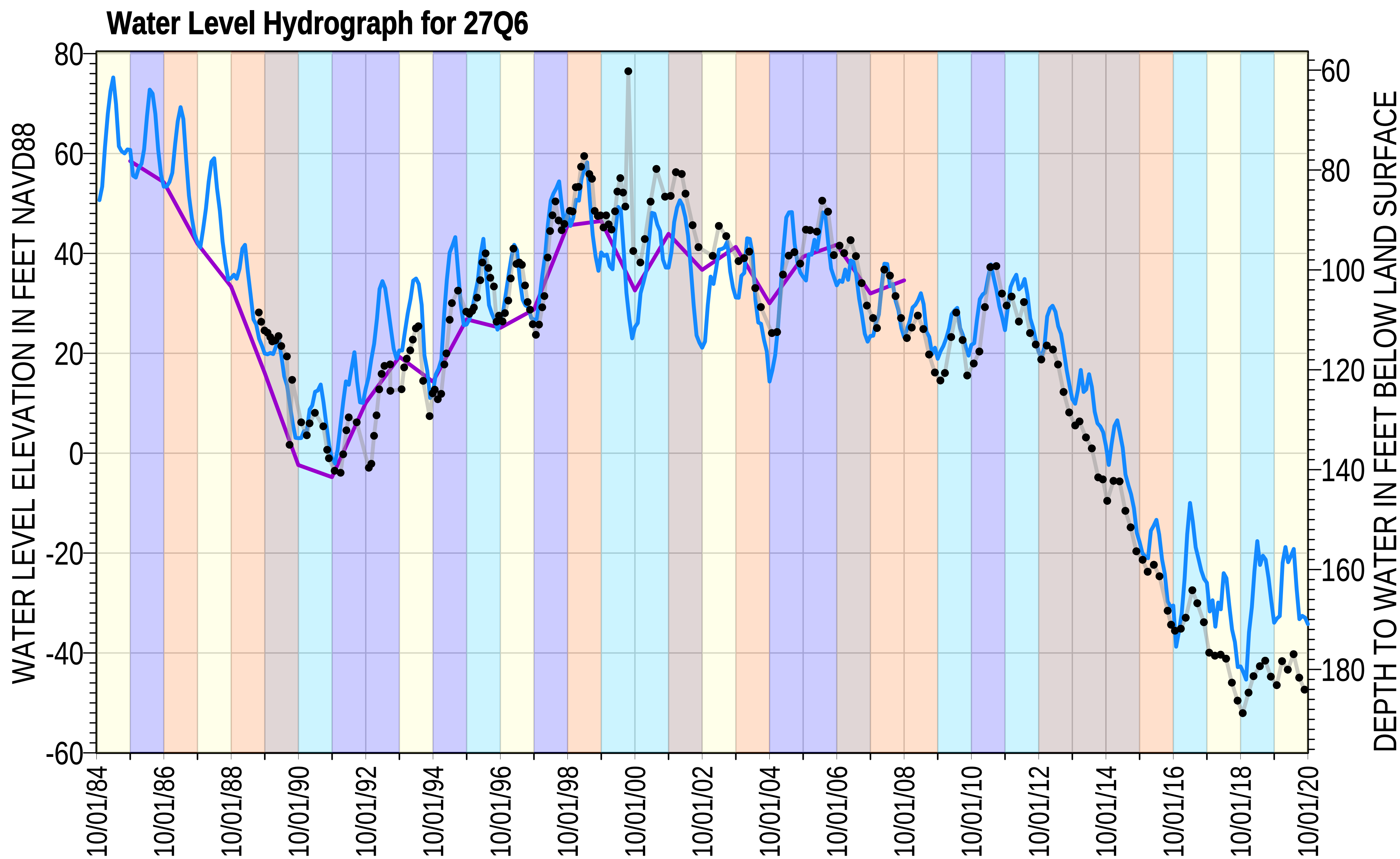
Measured
Annual Model
Monthly Model

Well Type | Private
Reference Point Elevation (feet NAVD88) | 123.1
Model Layering (%) | L3: 100



Climate Classification

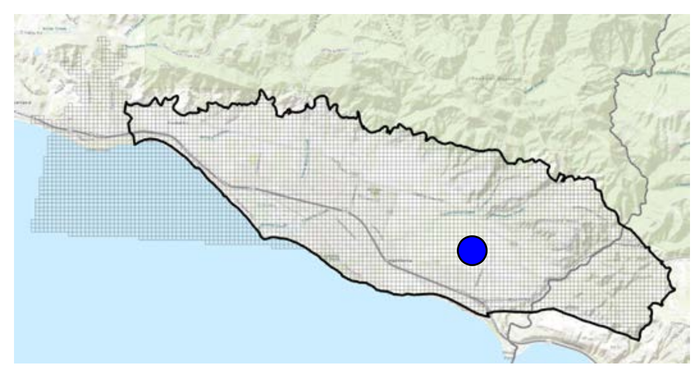
Critically Dry, Dry, Below Normal, Above Normal, Wet

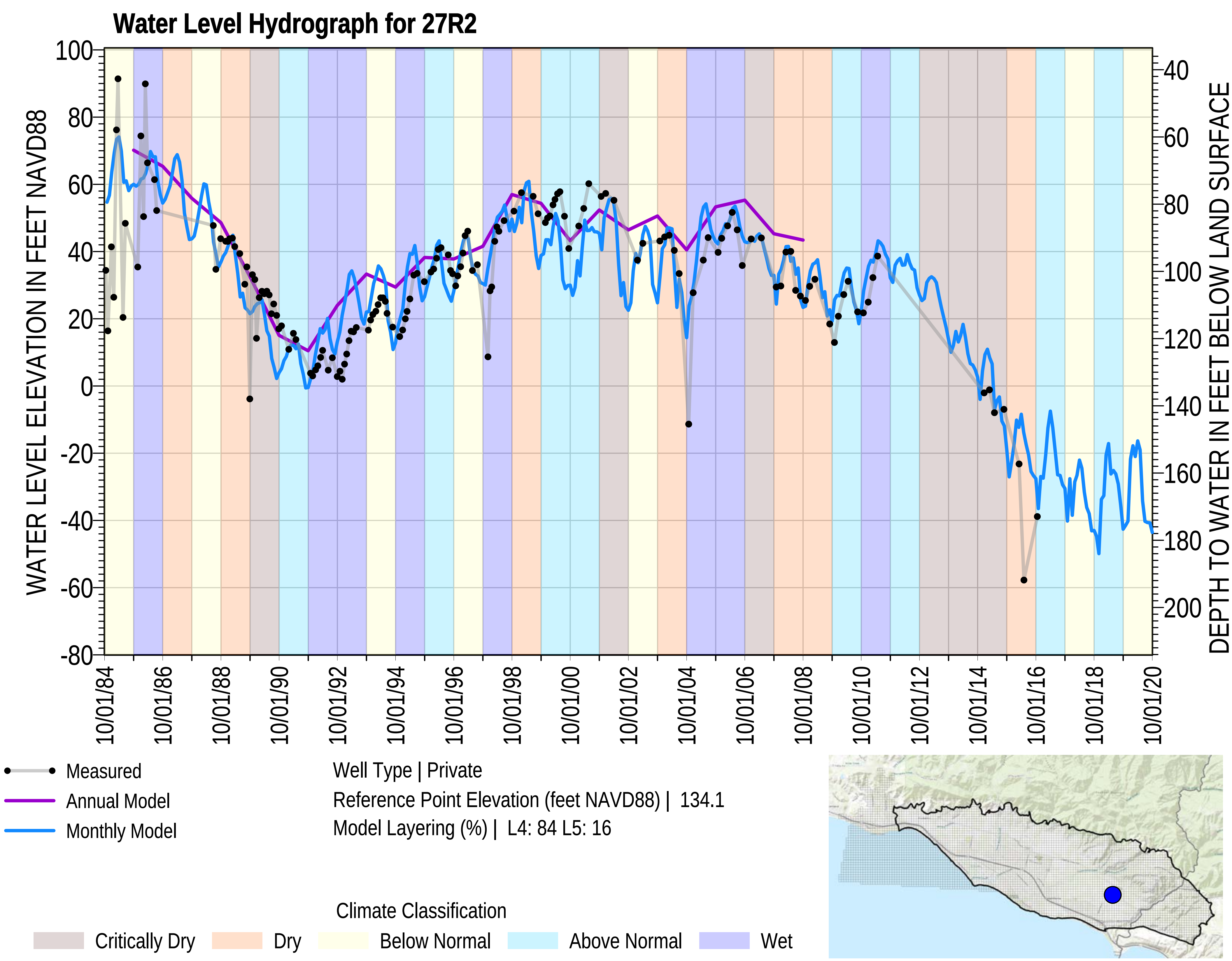


Measured
Annual Model
Monthly Model

Well Type | Private
Reference Point Elevation (feet NAVD88) | 136.7
Model Layering (%) | L3: 65 L4: 16 L5: 18

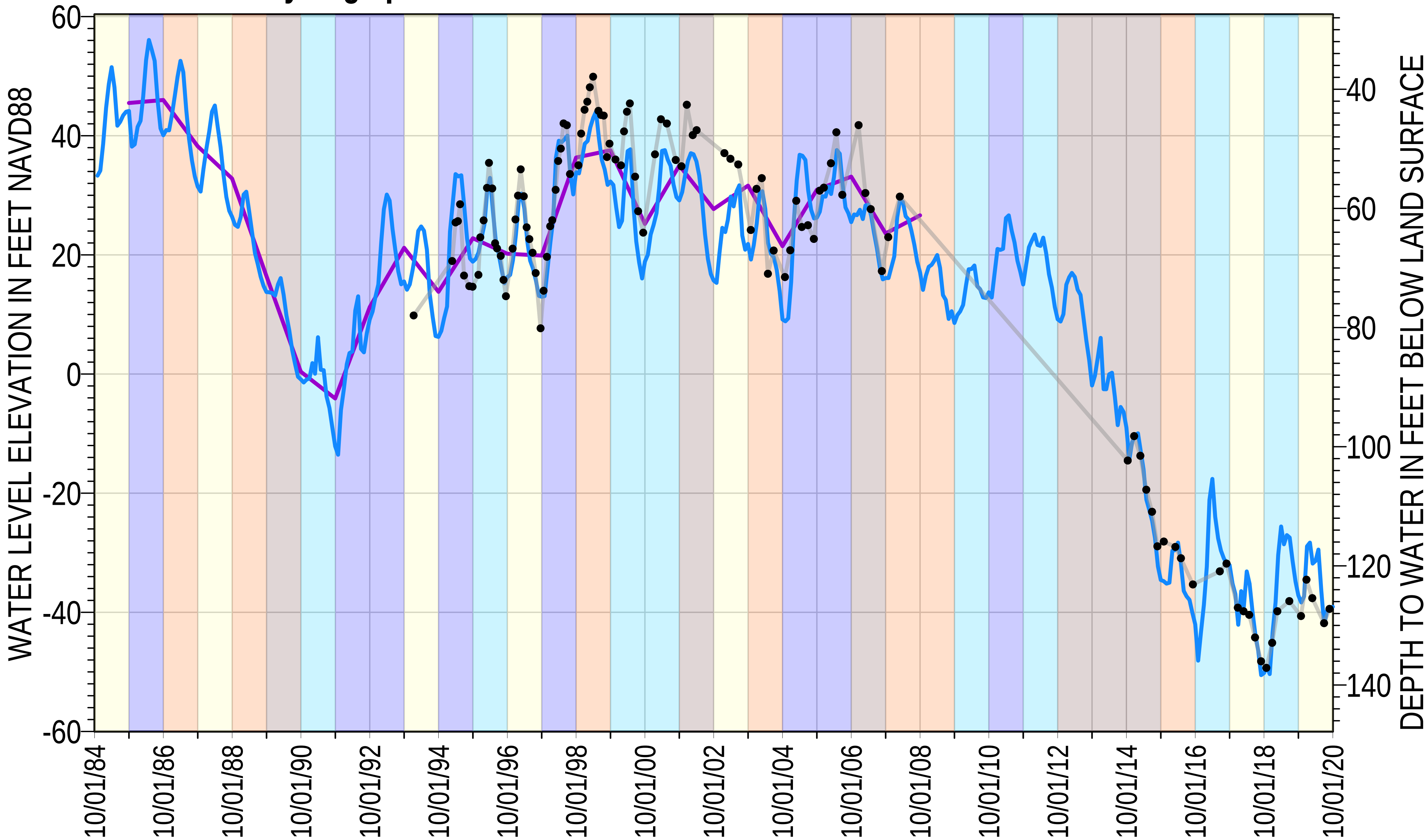
Climate Classification
Critically Dry Dry Below Normal Above Normal Wet





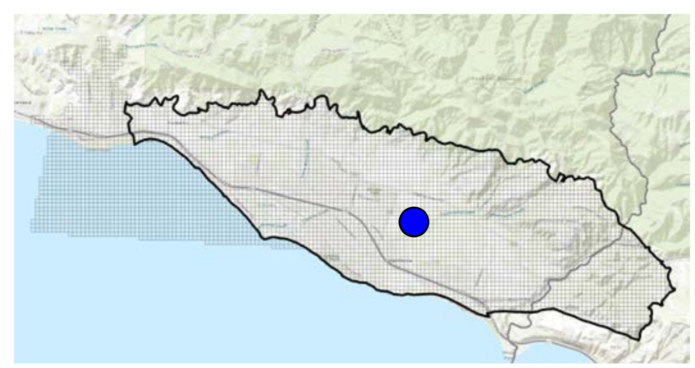
Water Level Hydrograph for 27R2
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
100
80
60
40
20
0
-20
-40
-60
-80
40
60
80
100
120
140
160
180
200
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
10/01/10
10/01/12
10/01/14
10/01/16
10/01/18
10/01/20
Measured
Annual Model
Monthly Model
Well Type | Private
Reference Point Elevation (feet NAVD88) | 134.1
Model Layering (%) | L4: 84 L5: 16
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for 28G3



Measured
Annual Model
Monthly Model

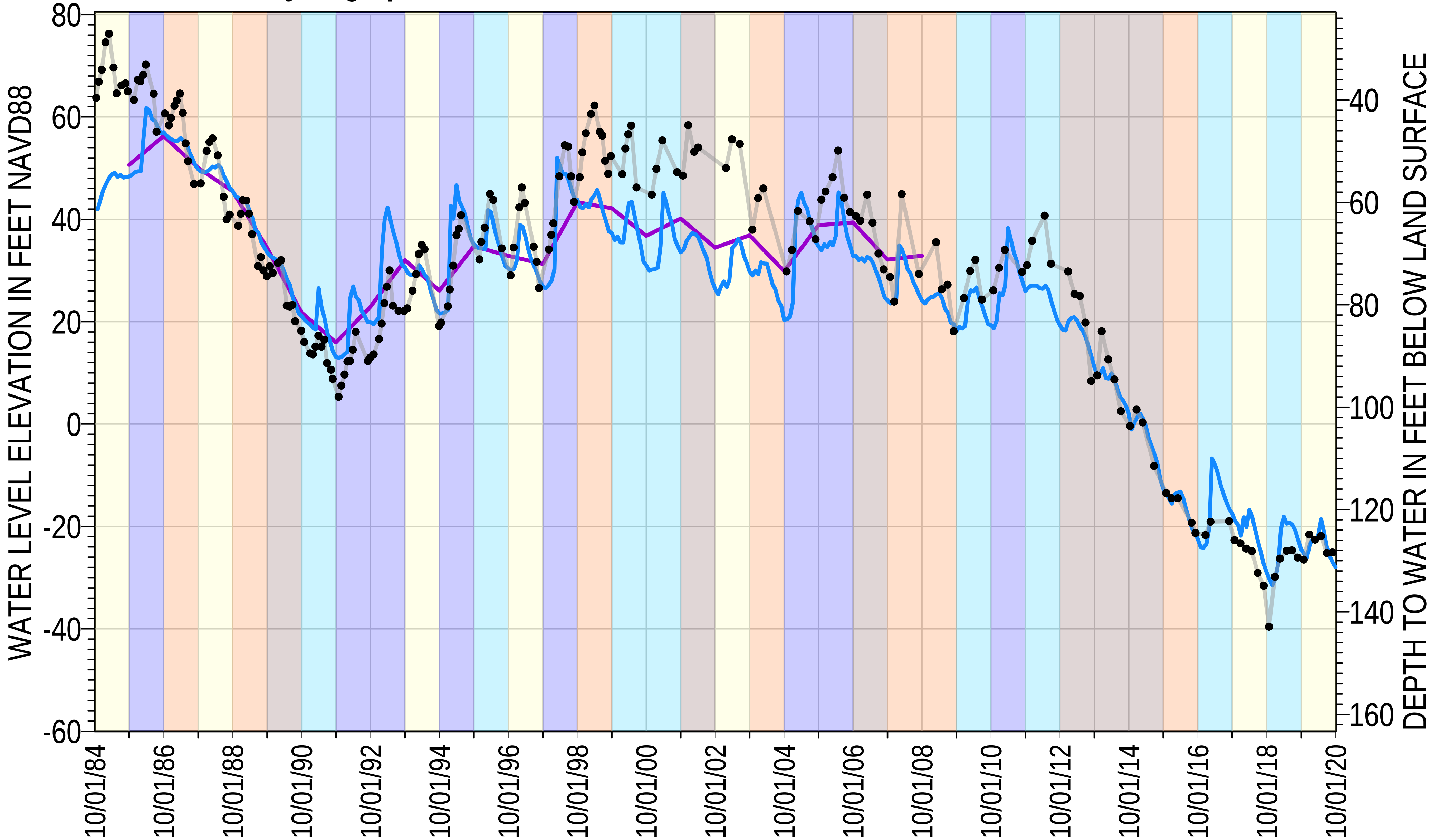
Well Type | Private
Reference Point Elevation (feet NAVD88) | 87.8
Model Layering (%) | L1: 21 L2: 49 L3: 30



Climate Classification

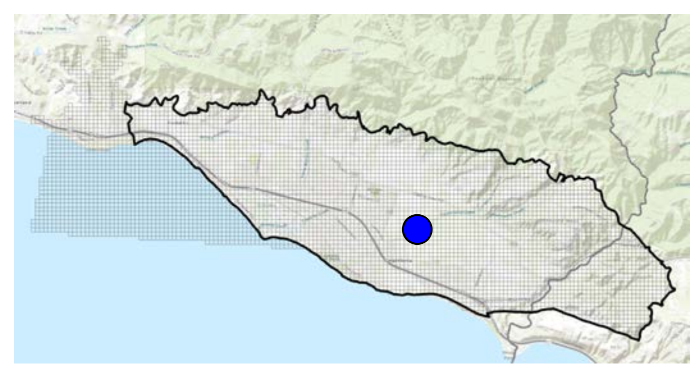
Critically Dry · Dry · Below Normal · Above Normal · Wet

Water Level Hydrograph for 28J1



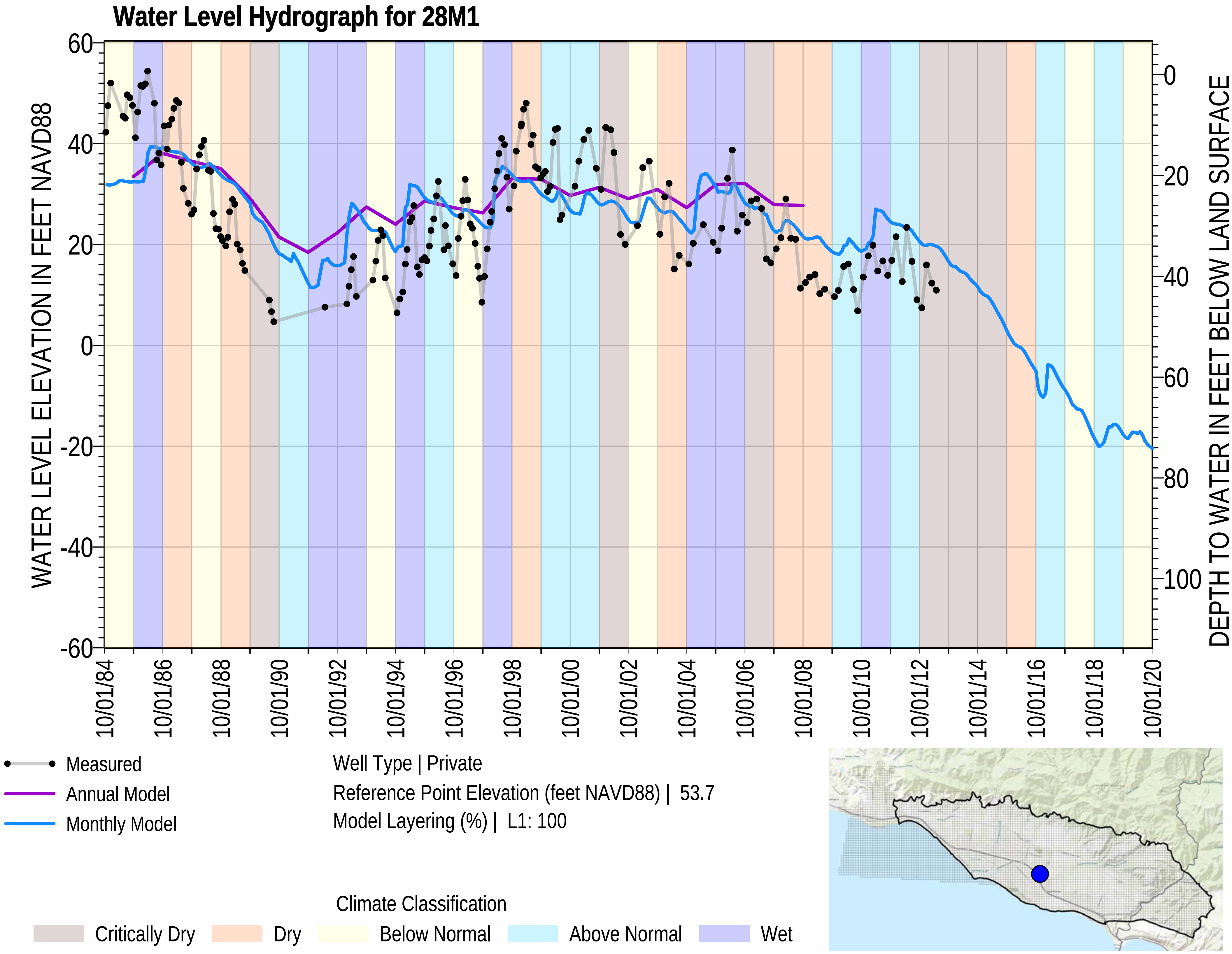
Measured
Annual Model
Monthly Model

Well Type | Private
Reference Point Elevation (feet NAVD88) | 103.3
Model Layering (%) | L1: 100

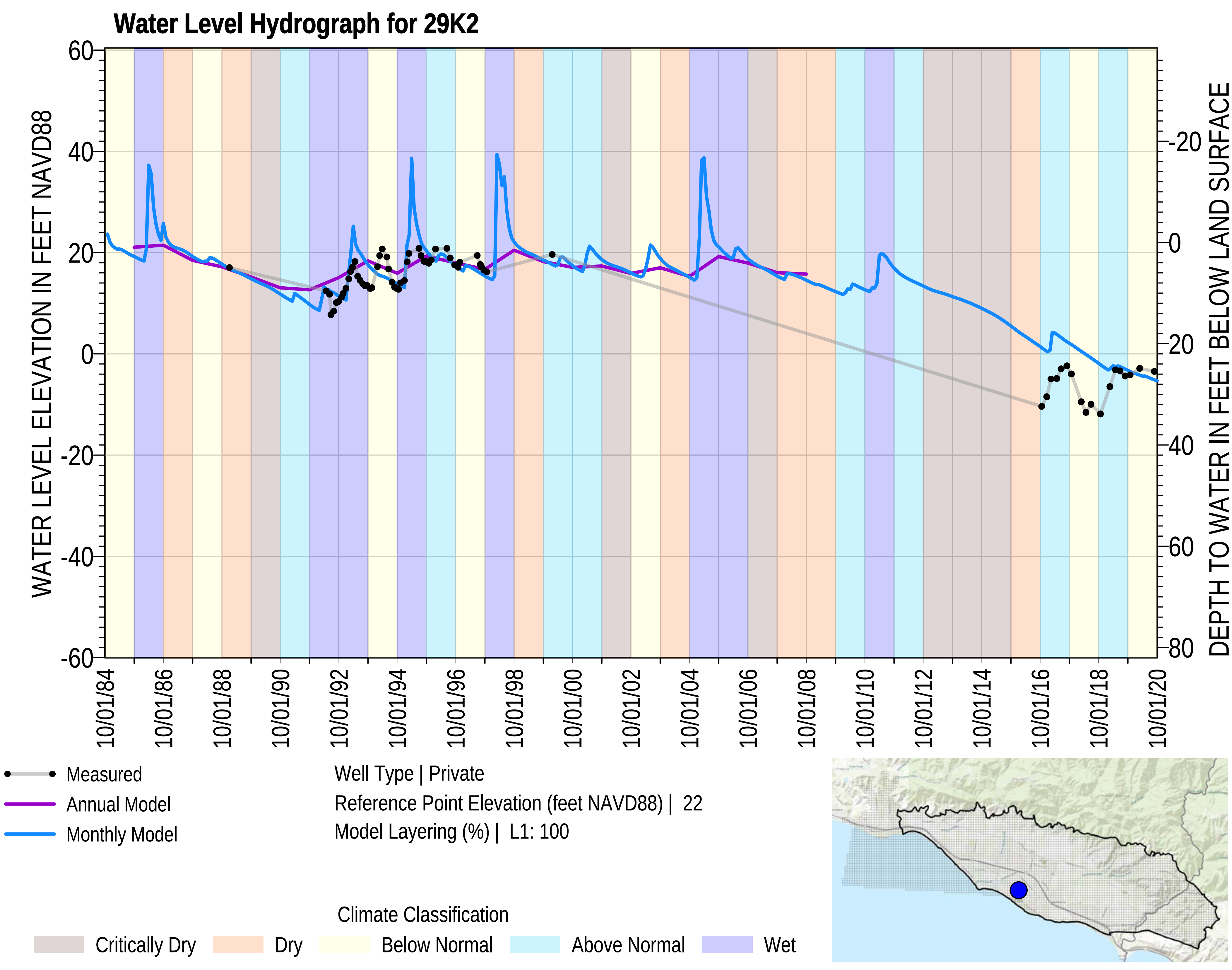


Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

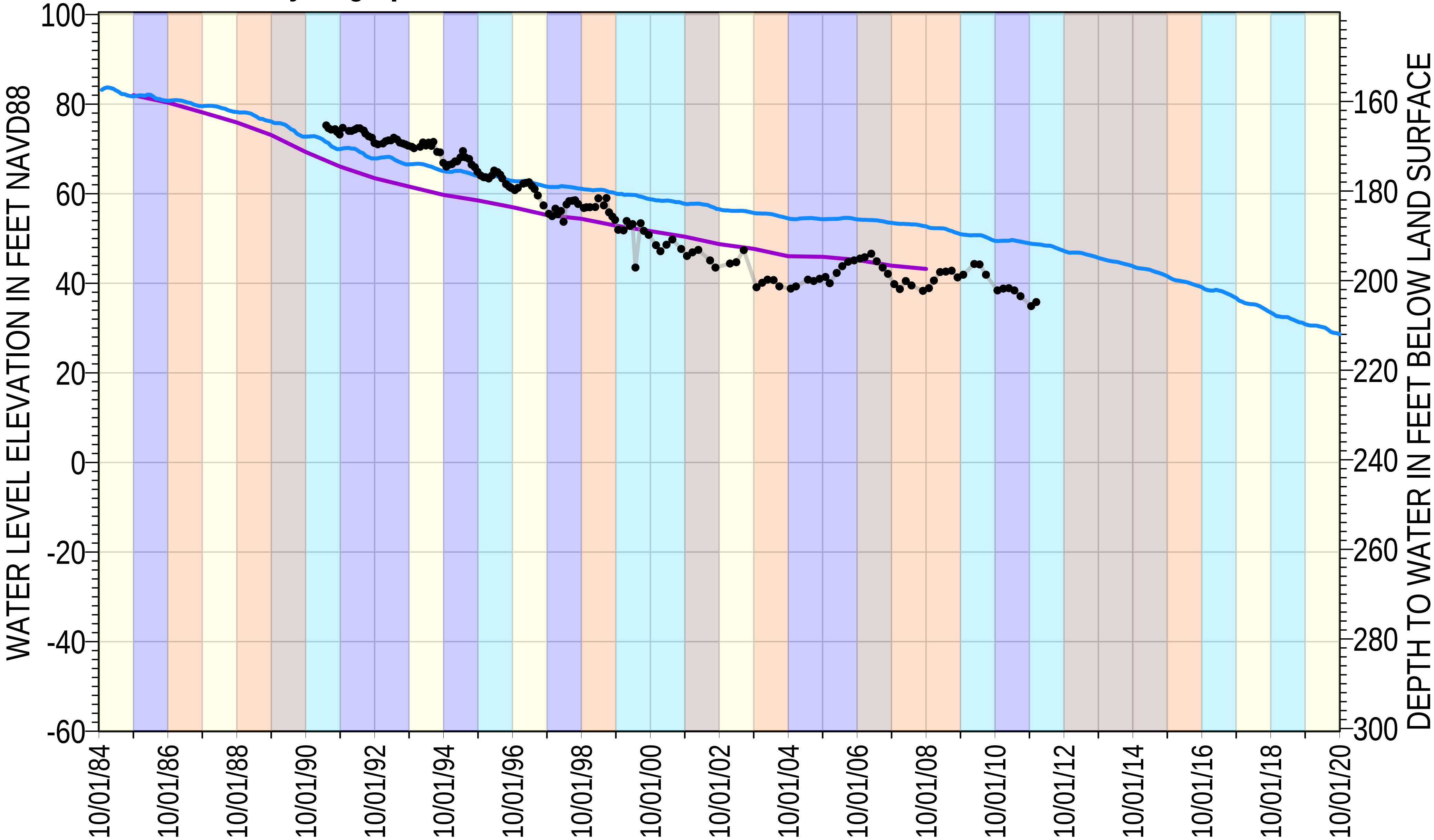


Water Level Hydrograph for 28M1
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
0
20
40
60
80
100
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
10/01/10
10/01/12
10/01/14
10/01/16
10/01/18
10/01/20
Measured
Annual Model
Monthly Model
Well Type | Private
Reference Point Elevation (feet NAVD88) | 53.7
Model Layering (%) | L1: 100
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet



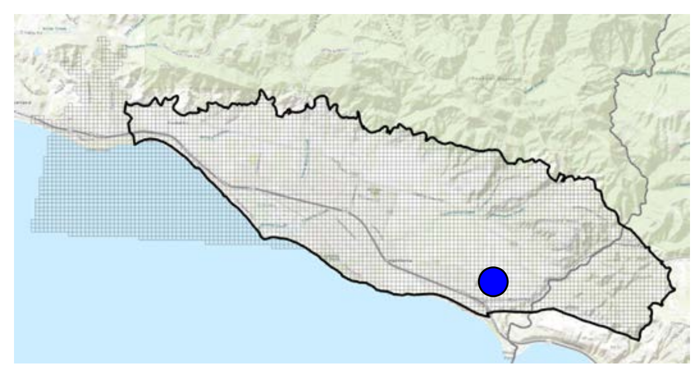
Water Level Hydrograph for 29K2
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
-20
0
20
40
60
80
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
10/01/10
10/01/12
10/01/14
10/01/16
10/01/18
10/01/20
Measured
Annual Model
Monthly Model
Well Type | Private
Reference Point Elevation (feet NAVD88) | 22
Model Layering (%) | L1: 100
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for 34A1



Measured
Annual Model
Monthly Model

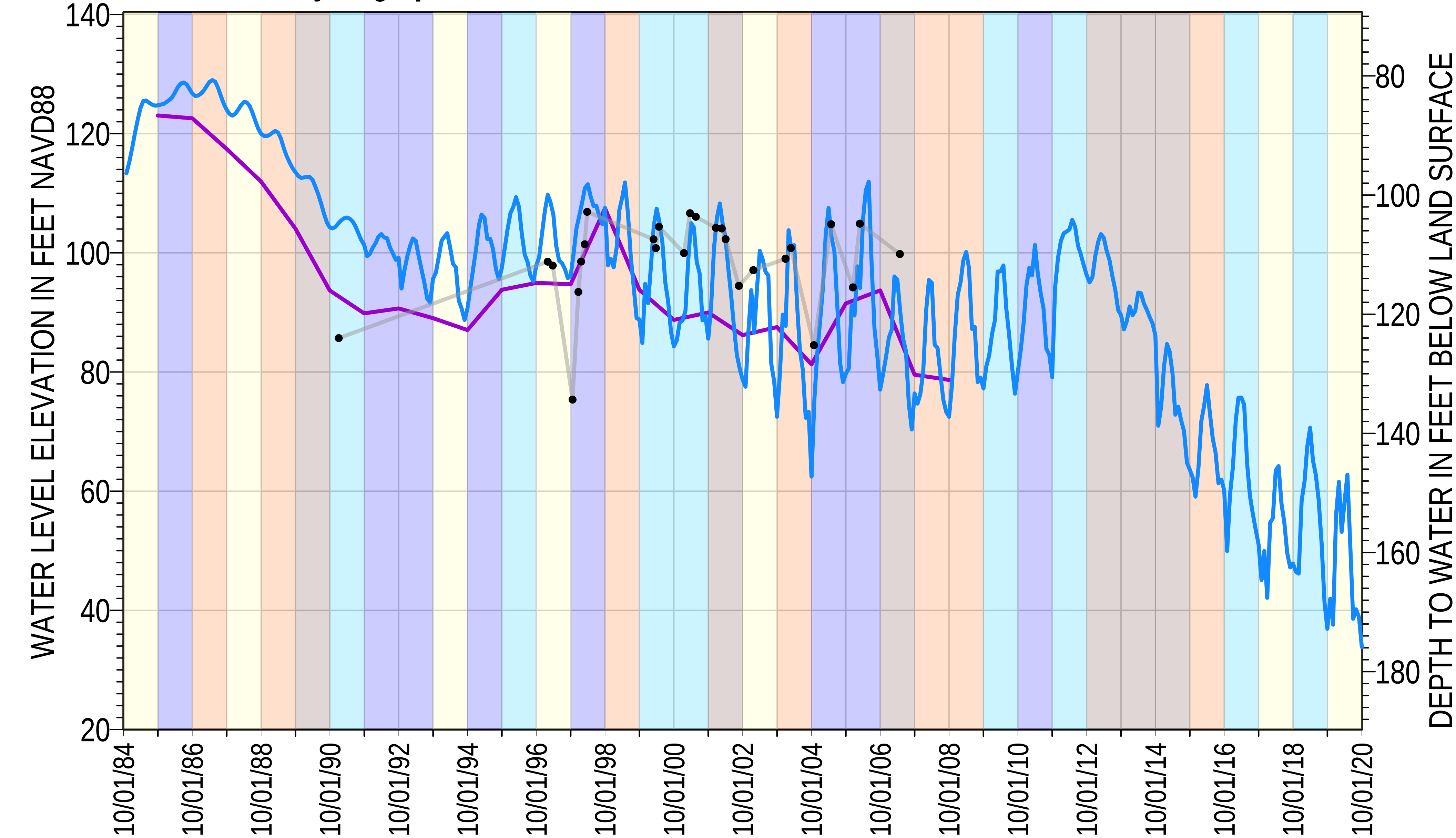
Well Type | Private
Reference Point Elevation (feet NAVD88) | 240.6
Model Layering (%) | L1: 33 L2: 23 L3: 44



Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

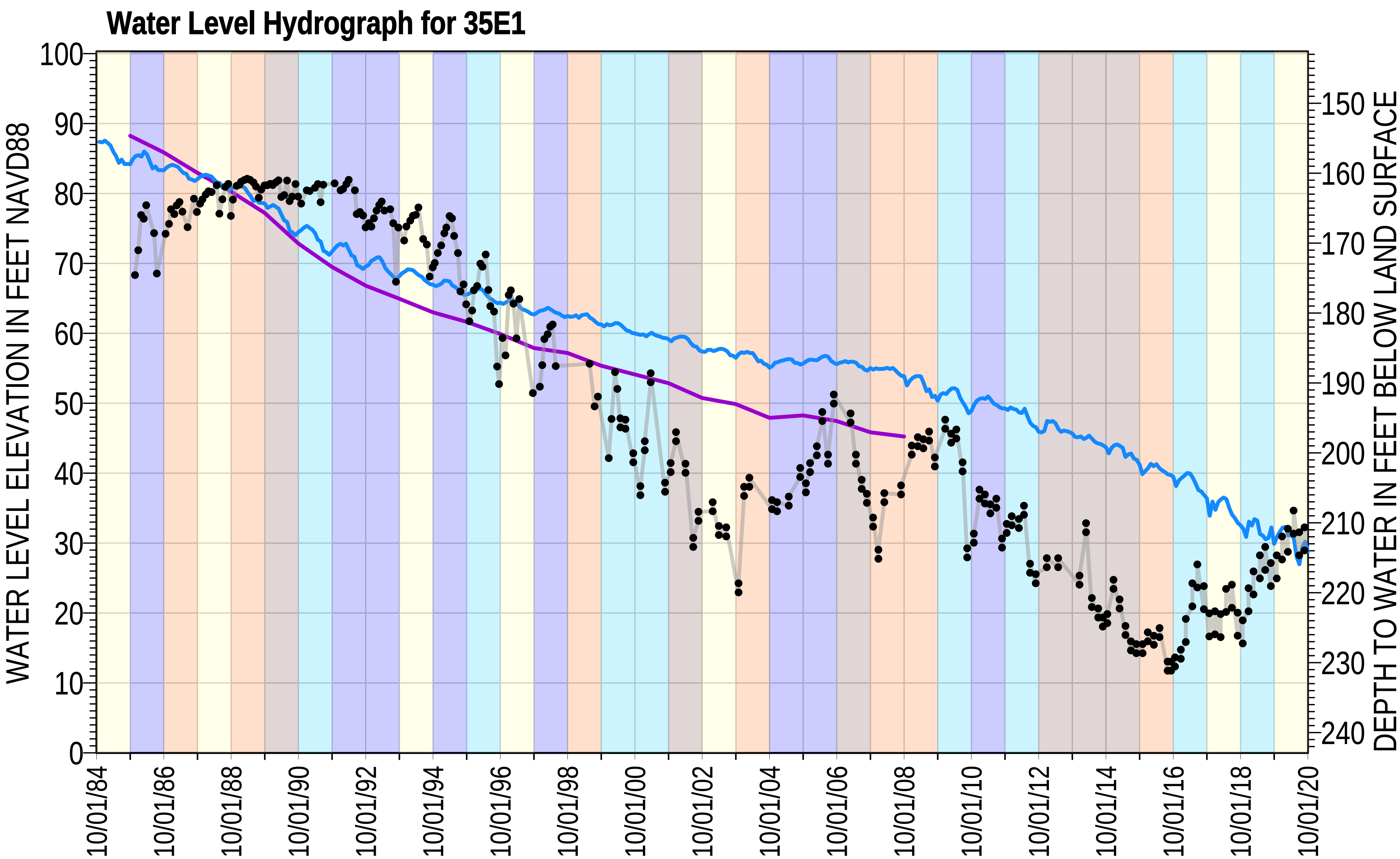
Water Level Hydrograph for 35B6



Well Type | Private

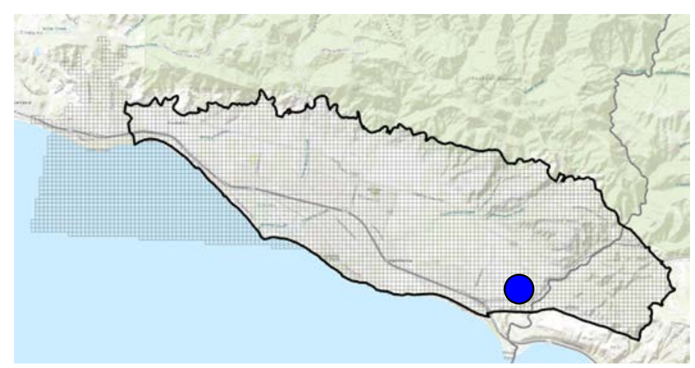
Reference Point Elevation (feet NAVD88) | 209.7

Model Layering (%) | L3: 37 L4: 24 L5: 40



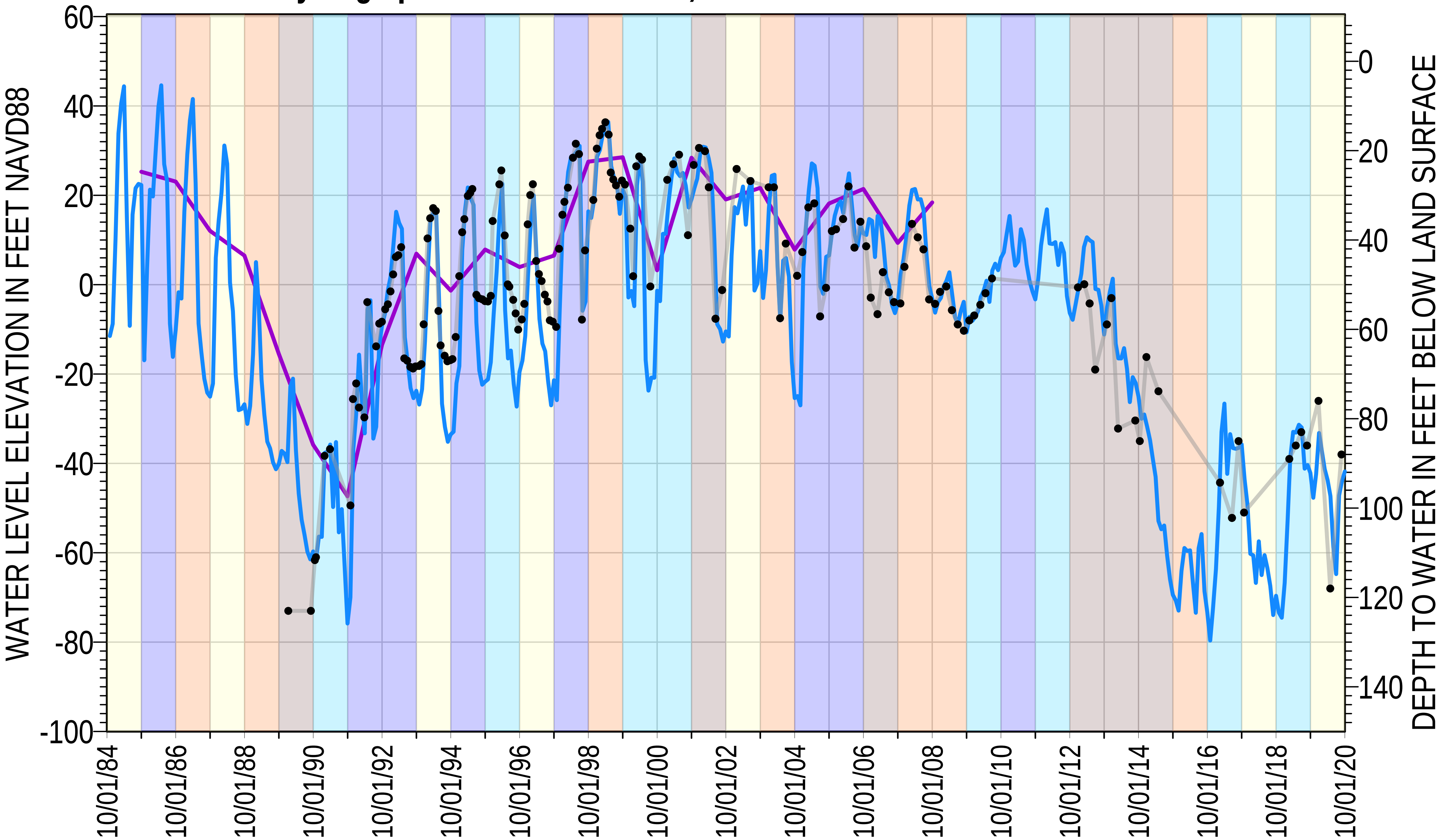
Measured
Annual Model
Monthly Model

Well Type | Private
Reference Point Elevation (feet NAVD88) | 242.9
Model Layering (%) | L1: 11 L2: 11 L3: 78



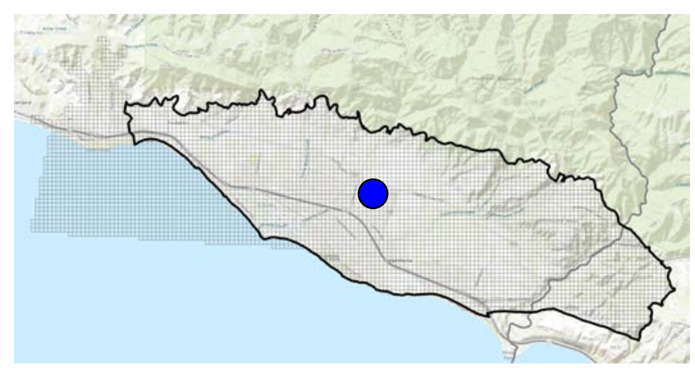
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for El Carro Well #1, 28D2



Measured
Annual Model
Monthly Model

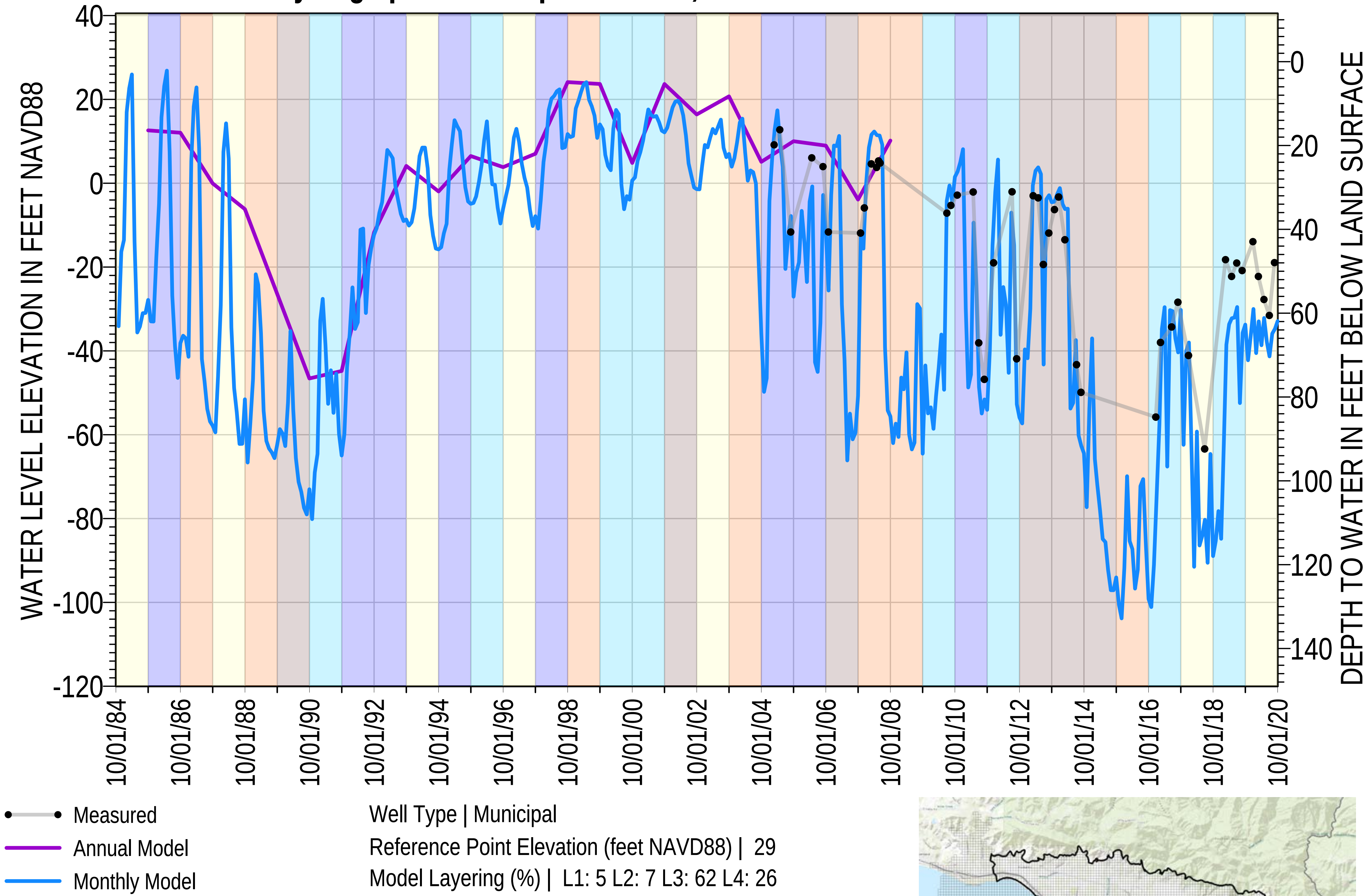
Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 50
Model Layering (%) | L1: 2 L2: 18 L4: 30 L6: 50



Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

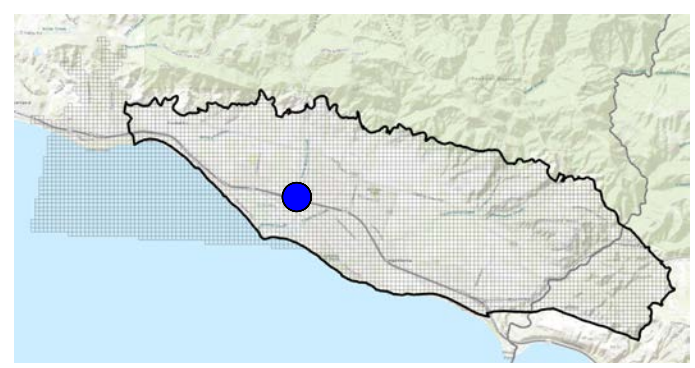
Water Level Hydrograph for Headquarters Well, 29D8



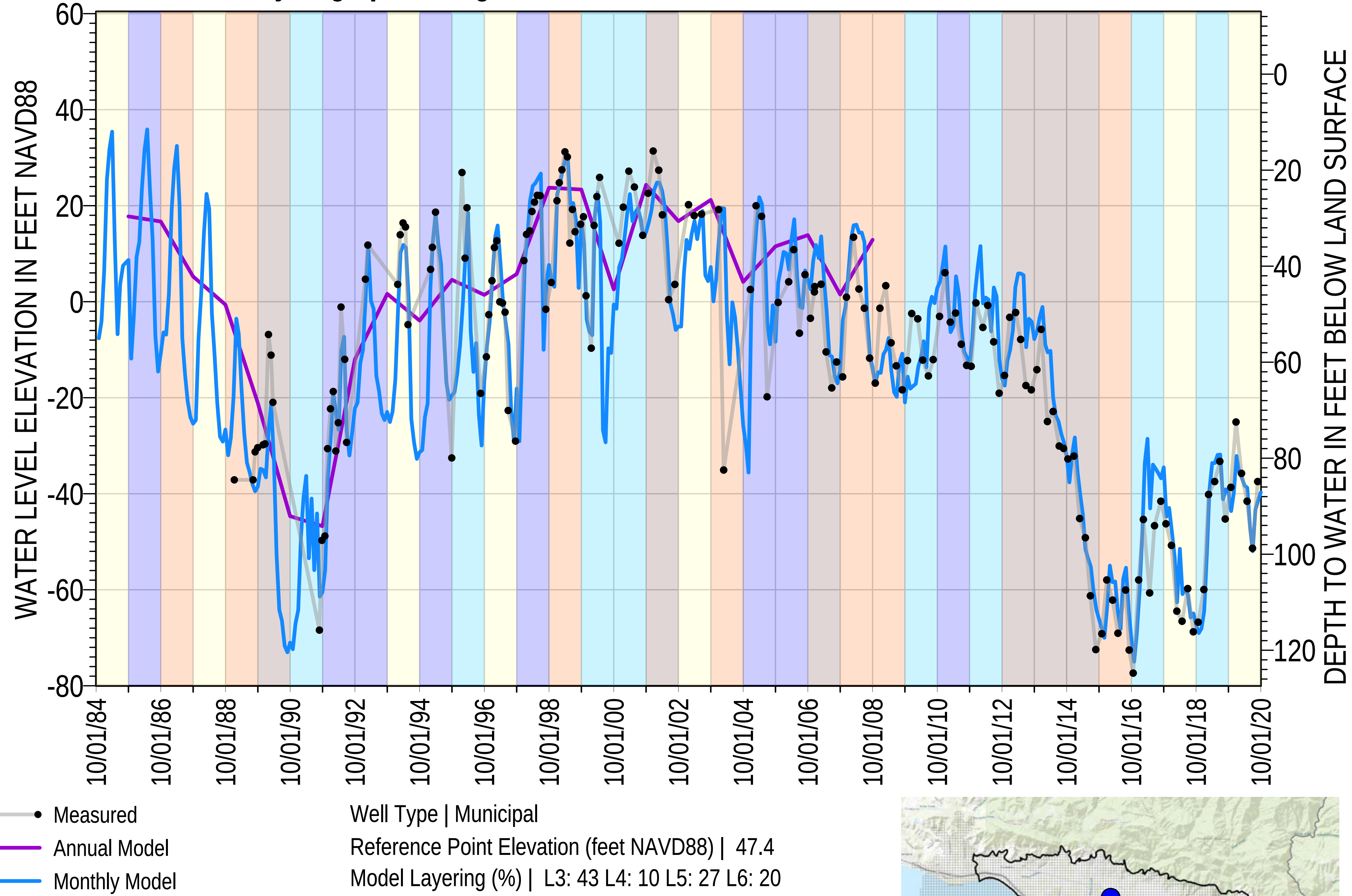
Well Type | Municipal

Reference Point Elevation (feet NAVD88) | 29

Model Layering (%) | L1: 5 L2: 7 L3: 62 L4: 26



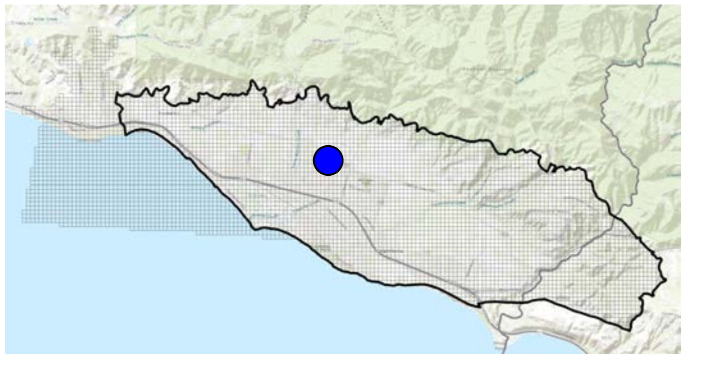
Water Level Hydrograph for High School Well, 20K4



Well Type | Municipal

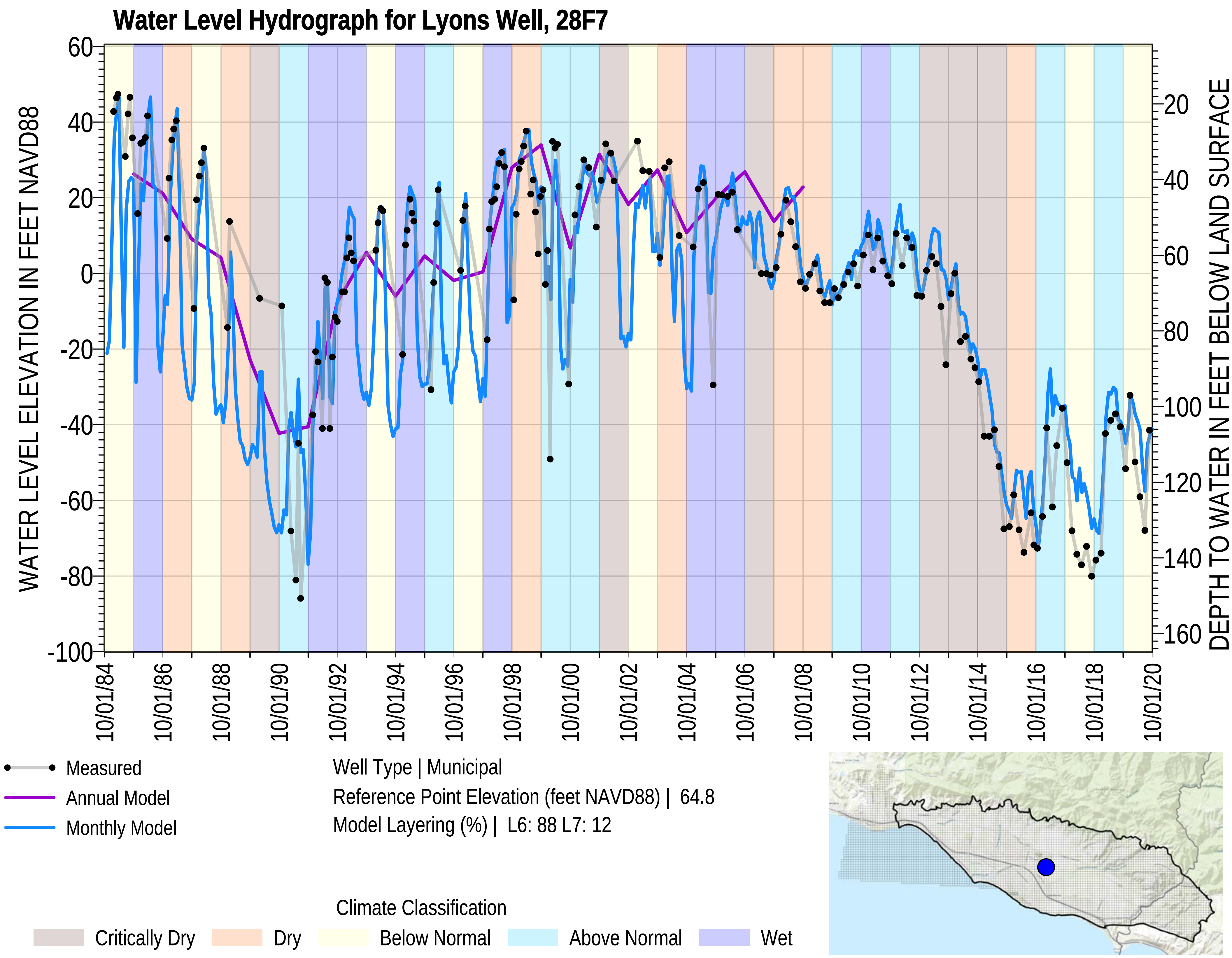
Reference Point Elevation (feet NAVD88) | 47.4

Model Layering (%) | L3: 43 L4: 10 L5: 27 L6: 20

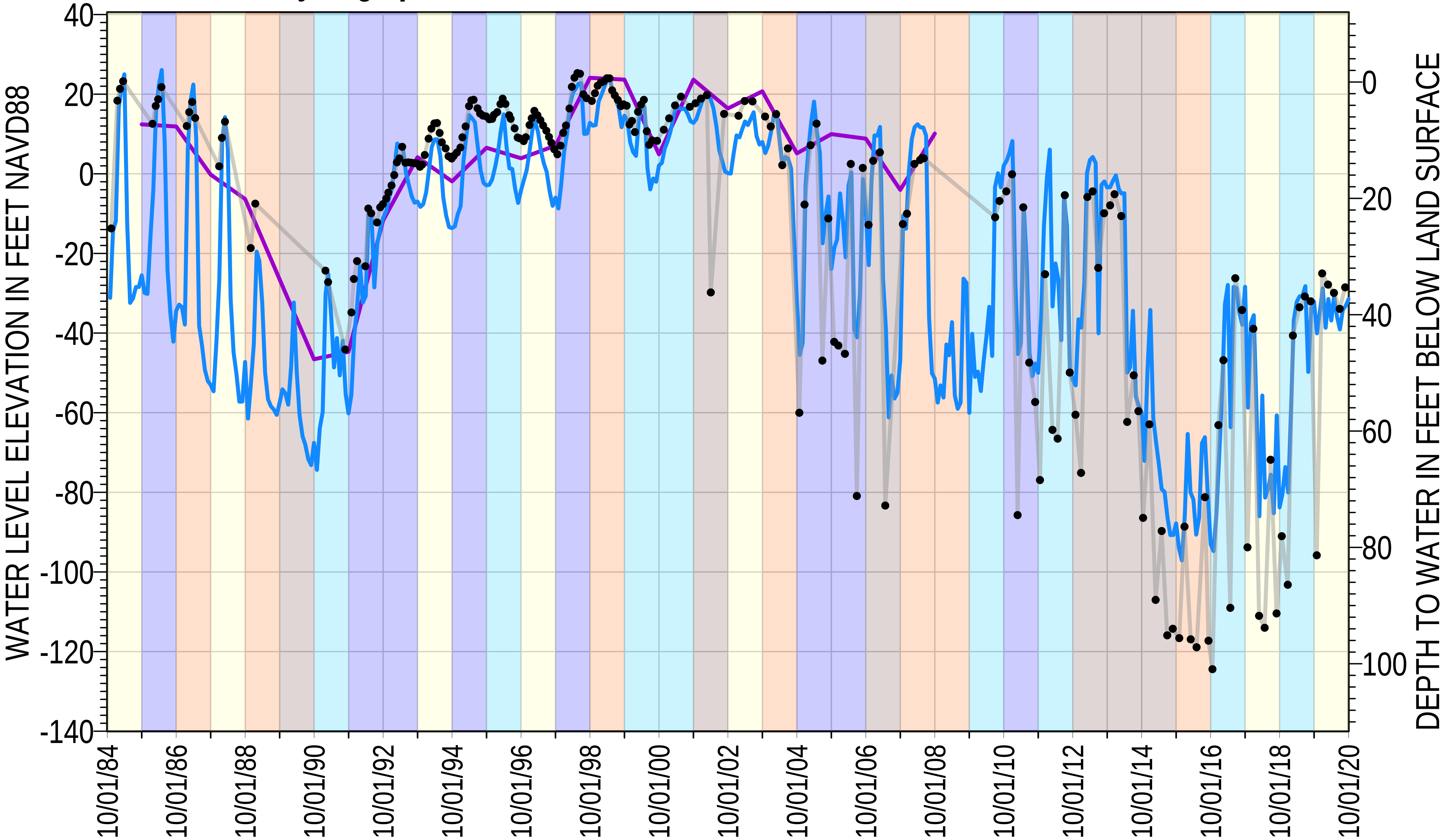


Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

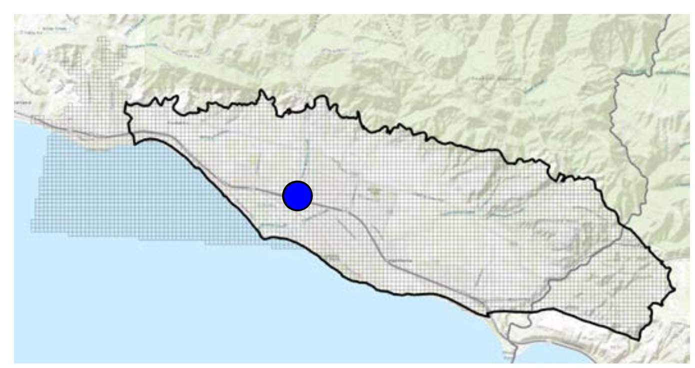

Water Level Hydrograph for Lyons Well, 28F7
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
-80
-100
20
40
60
80
100
120
140
160
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
10/01/10
10/01/12
10/01/14
10/01/16
10/01/18
10/01/20
Measured
Annual Model
Monthly Model
Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 64.8
Model Layering (%) | L6: 88 L7: 12
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for Santa Ynez Well, 29D7



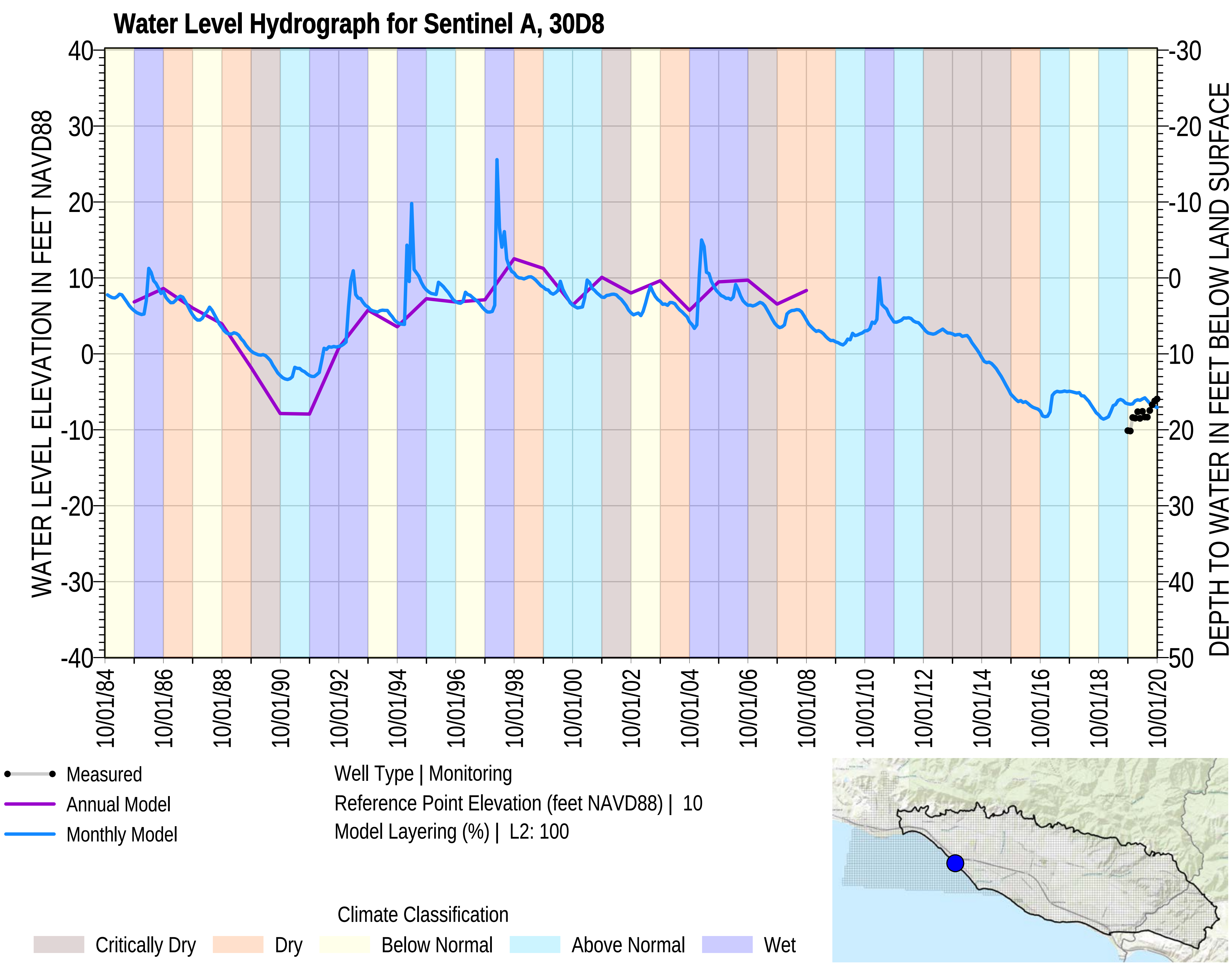
Measured
Annual Model
Monthly Model

Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 28.4
Model Layering (%) | L1: 34 L2: 1 L3: 59 L4: 5



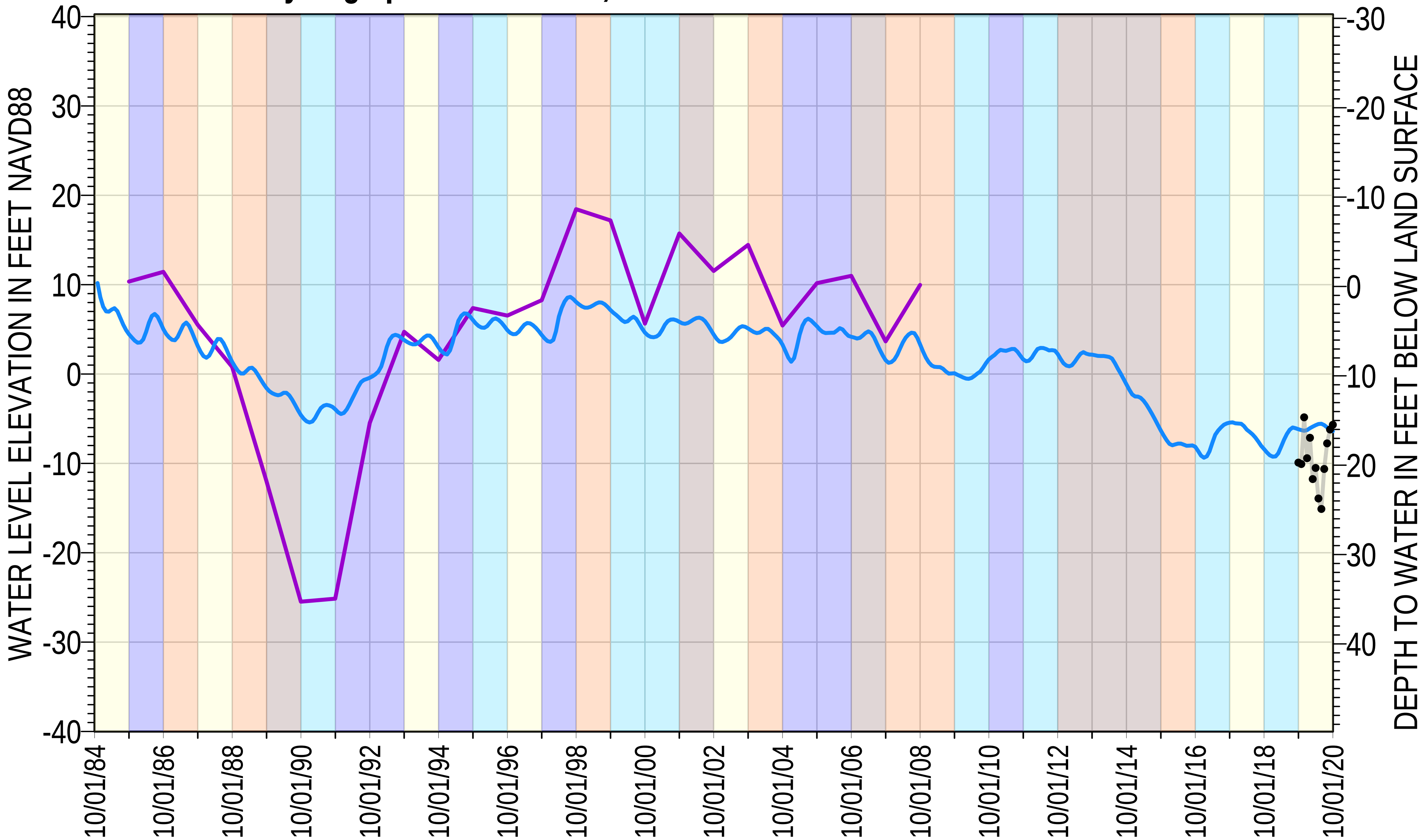
Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet



Water Level Hydrograph for Sentinel A, 30D8
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
40
30
20
10
0
-10
-20
-30
-40
-30
-20
-10
0
10
20
30
40
50
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
10/01/10
10/01/12
10/01/14
10/01/16
10/01/18
10/01/20
Measured
Annual Model
Monthly Model
Well Type | Monitoring
Reference Point Elevation (feet NAVD88) | 10
Model Layering (%) | L2: 100
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for Sentinel B, 30D7



Measured

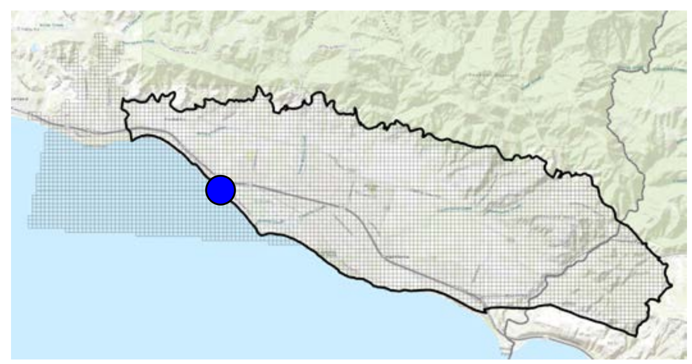
Annual Model

Monthly Model

Well Type | Monitoring

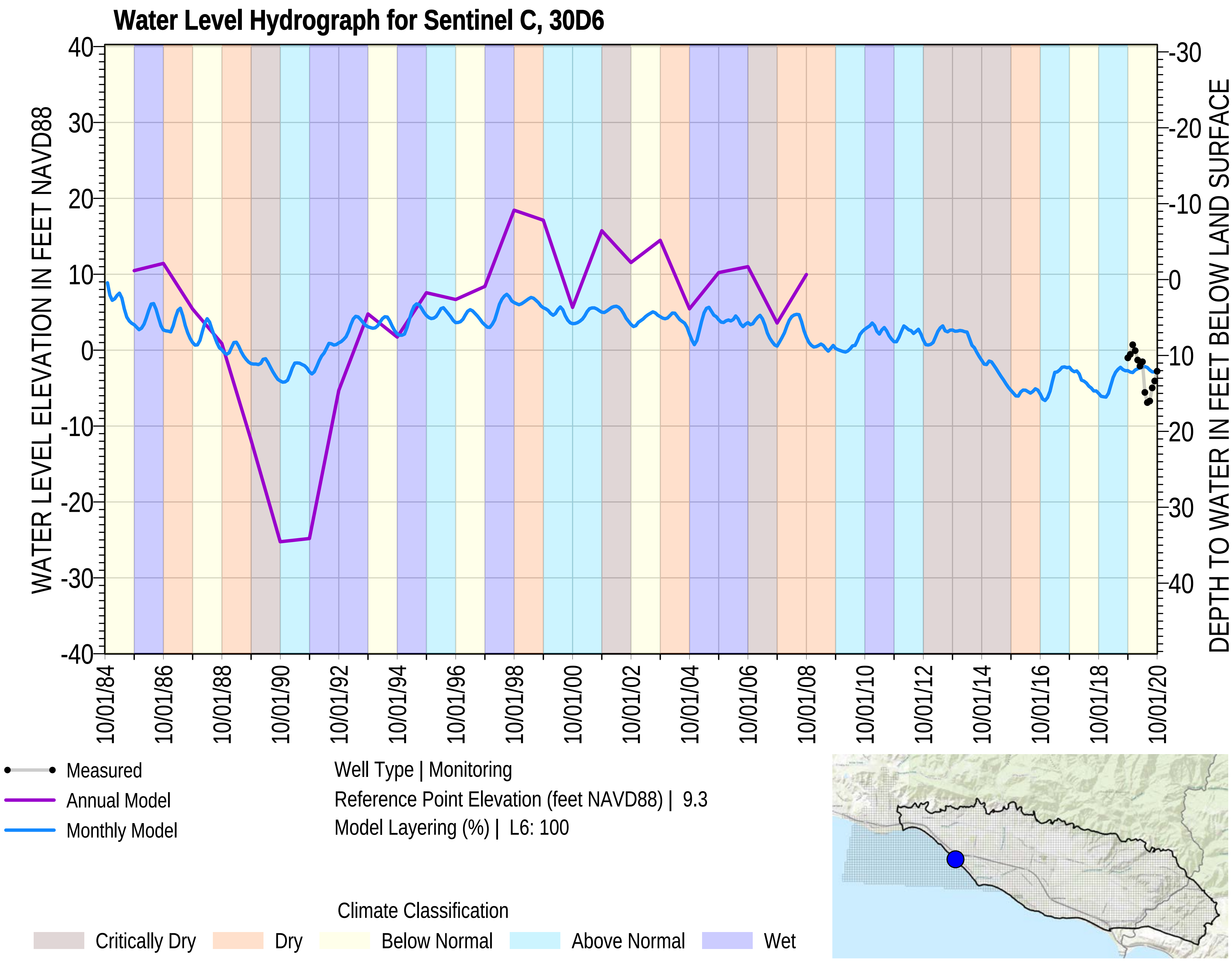
Reference Point Elevation (feet NAVD88) | 9.8

Model Layering (%) | L4: 100



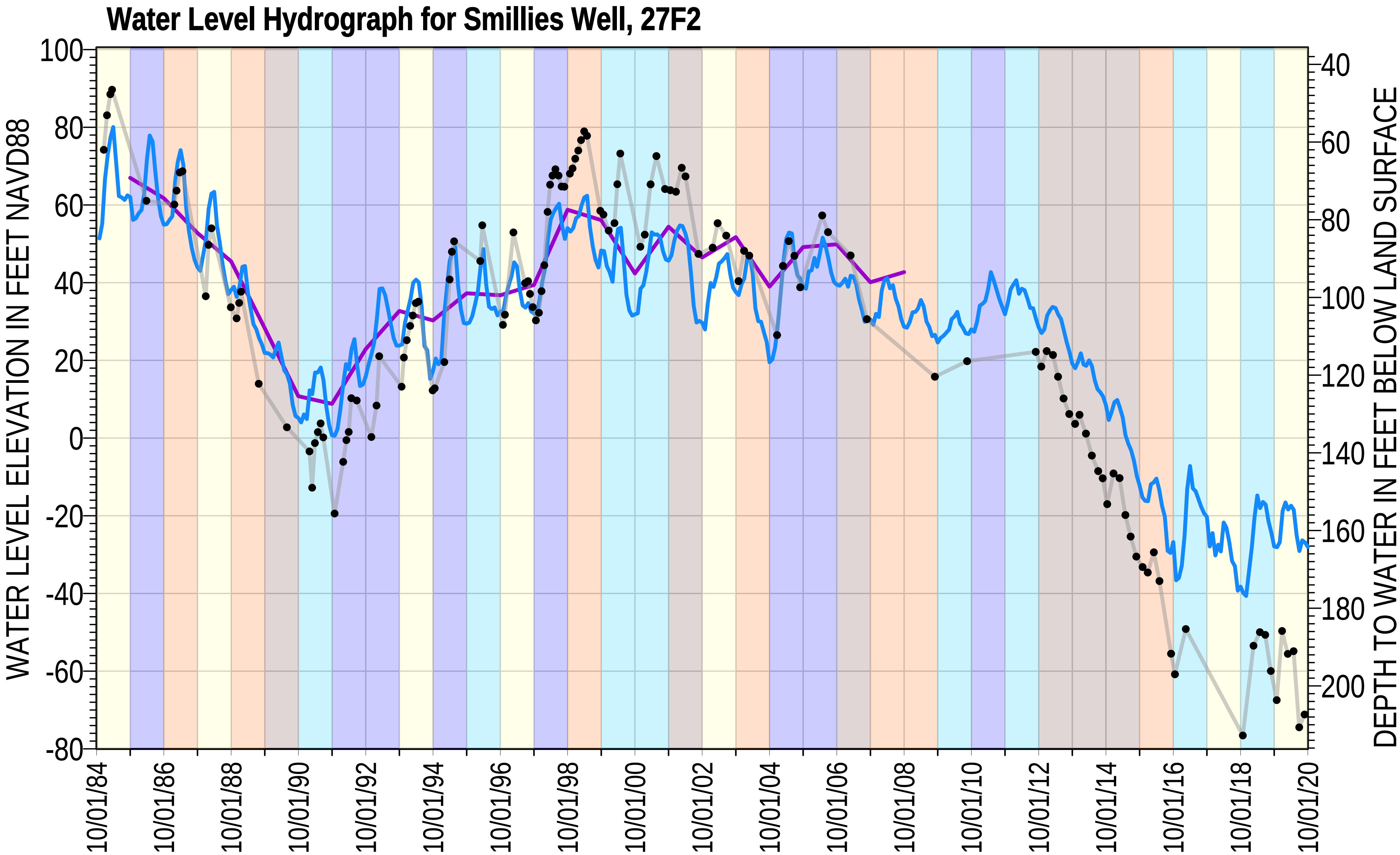
Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet



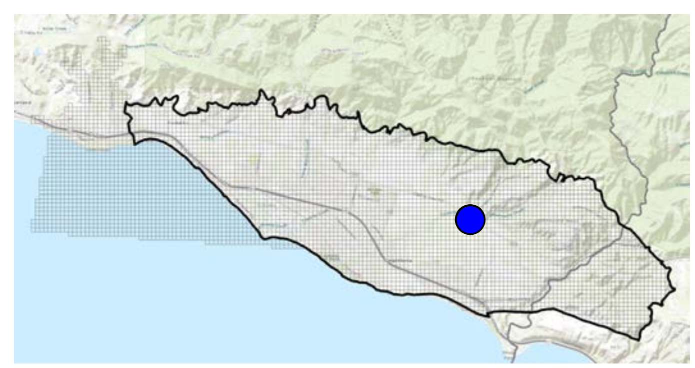
Water Level Hydrograph for Sentinel C, 30D6
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
40
30
20
10
0
-10
-20
-30
-40
-30
-20
-10
0
10
20
30
40
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
10/01/10
10/01/12
10/01/14
10/01/16
10/01/18
10/01/20
Measured
Annual Model
Monthly Model
Well Type | Monitoring
Reference Point Elevation (feet NAVD88) | 9.3
Model Layering (%) | L6: 100
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for Smillies Well, 27F2



Measured
Annual Model
Monthly Model

Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 136.2
Model Layering (%) | L4: 9 L5: 69 L6: 16 L7: 6



Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

APPENDIX B TABLE OBSERVATION WELL SCREENING

Well	Screening Elevations Implemented in Model	Percent Screening Thickness by Model Layer						
		Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7
19F4	-171.88--271.88 331.88--371.88 471.88--511.88	0%	0%	78%	0%	22%	0%	0%
19H1	106--254	46%	9%	46%	0%	0%	0%	0%
19J5	-100--400	19%	17%	64%	0%	0%	0%	0%
19K5	-100--400	12%	18%	71%	0%	0%	0%	0%
19M3	-80--400	0%	7%	93%	0%	0%	0%	0%
20K3	-101--363	7%	11%	81%	0%	0%	0%	0%
20K4	-305.86--325.86 345.86--365.86 565.86--595.86 655.86--675.86 695.86--715.86 775.86--835.86-	0%	0%	43%	10%	27%	20%	0%
20L4	62.13--129.87	78%	18%	4%	0%	0%	0%	0%
21L1	-339.796--409.796 429.796--706.796	0%	0%	51%	13%	21%	15%	0%
21N1	-60--400	56%	12%	32%	0%	0%	0%	0%
21N4	-40.478--386.478	56%	11%	33%	0%	0%	0%	0%
21R1	27.625-19.625 10.375--40.375 60.375--66.375 120.375--130.375 179.375--194.375 204.375--208.375 230.375--231.375 246.375--276.375 302.375--306.375	35%	6%	59%	0%	0%	0%	0%
22R3	115.38--52.62	0%	0%	70%	30%	0%	0%	0%
22R4	26.759128-- 285.240872	0%	0%	4%	41%	54%	0%	0%
23A2	-61--76 111--131	0%	0%	0%	0%	0%	100%	0%
23A4	-116.2--136.2 196.2-- 236.2 276.2--286.2	0%	0%	0%	0%	0%	100%	0%
23P1	152.488125-- 17.511875	0%	0%	0%	15%	85%	0%	0%
25N5	103.999--26.001	0%	0%	0%	0%	100%	0%	0%
26A1	197--55	0%	0%	0%	0%	61%	31%	8%
26C1	200-0	0%	0%	0%	3%	97%	0%	0%
26C6	202.951--125.049	0%	0%	0%	4%	85%	11%	0%

Well	Screening Elevations Implemented in Model	Percent Screening Thickness by Model Layer						
		Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7
27F1	-35.9--297.9	0%	0%	100%	0%	0%	0%	0%
27F2	-316.97--662.97	0%	0%	0%	9%	69%	16%	6%
27Q6	-57.944--537.944	0%	0%	65%	16%	18%	0%	0%
27R2	-160.899--175.899 215.899--243.899 257.899--285.899	0%	0%	0%	84%	16%	0%	0%
28D2	-234.005--274.005 804.005--864.005 1044.005--1144.005	2%	18%	0%	30%	0%	50%	0%
28F7	-1173.44--1204.44	0%	0%	0%	0%	0%	88%	12%
28G3	-172.719--272.719	21%	49%	30%	0%	0%	0%	0%
28J1	-32.874--148.874	100%	0%	0%	0%	0%	0%	0%
28M1	53.74--98.26	100%	0%	0%	0%	0%	0%	0%
29D7	26--902.7	34%	1%	59%	5%	0%	0%	0%
29D8	-286.04--317.04 327.04--358.04 538.04--579.04 729.04--760.04 860.04--907.04	5%	7%	62%	26%	0%	0%	0%
29K2	-188--218	100%	0%	0%	0%	0%	0%	0%
SENTC	Single Node Well	0%	0%	0%	0%	0%	100%	0%
SENTB	Single Node Well	0%	0%	0%	100%	0%	0%	0%
SENTA	Single Node Well	0%	100%	0%	0%	0%	0%	0%
34A1	95--5	33%	23%	44%	0%	0%	0%	0%
35B6	67.6--312.4	0%	0%	37%	23%	40%	0%	0%
35E1	89--11	11%	11%	78%	0%	0%	0%	0%

MONTGOMERY & ASSOCIATES

APPENDIX C TABLE PRODUCTION WELL SCREENING

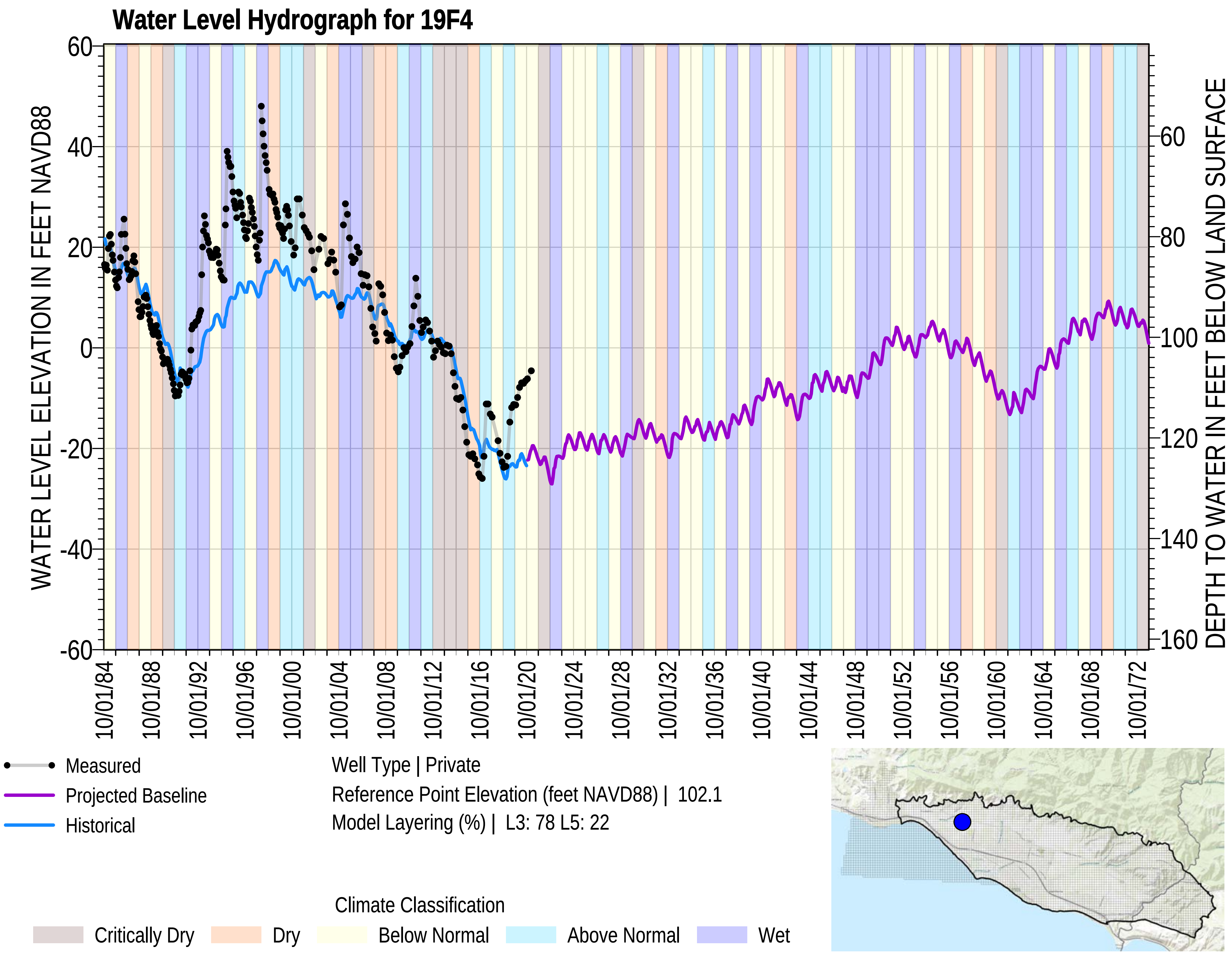
Well	Screening Elevations Implemented in Model	Model Layering							
		Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Percent Removed to Bedrock
19B2	-9--509	6%	9%	83%	3%	0%	0%	0%	0.1%
19E1	-42--322	3%	11%	86%	0%	0%	0%	0%	0.0%
19E2	Assigned as Single Node Well	0%	0%	0%	0%	100%	0%	0%	0.0%
19F1	-125--400	0%	3%	97%	0%	0%	0%	0%	0.0%
19F4	-172--272 |-332--372 |-472--512	0%	0%	78%	0%	22%	0%	0%	0.0%
19G1	-10--300	21%	14%	65%	0%	0%	0%	0%	0.0%
19G2	-133--233 |-293--333 |-433--473	0%	0%	100%	0%	0%	0%	0%	0.0%
19G3	-10--300	23%	15%	62%	0%	0%	0%	0%	0.0%
19H2	-54--234 |-294--434	7%	11%	81%	0%	0%	0%	0%	0.0%
19J1	-10--300	38%	19%	43%	0%	0%	0%	0%	0.0%
19J2	-10--300	44%	20%	36%	0%	0%	0%	0%	0.0%
19J234	-42--142	100%	0%	0%	0%	0%	0%	0%	0.0%
19J5	-100--400	19%	17%	64%	0%	0%	0%	0%	0.0%
19J6	-100--400	13%	19%	68%	0%	0%	0%	0%	0.0%
19J7	-134--254 |-274--434	22%	12%	66%	0%	0%	0%	0%	0.0%
19K1	-100--400	0%	15%	85%	0%	0%	0%	0%	0.0%
19K10	-204--564	0%	5%	95%	0%	0%	0%	0%	0.0%
19K2	-100--400	12%	16%	73%	0%	0%	0%	0%	0.0%
19K3	-100--400	2%	17%	82%	0%	0%	0%	0%	0.0%
19K4	-197--557	0%	0%	86%	14%	0%	0%	0%	0.0%
19K5	-100--400	12%	18%	71%	0%	0%	0%	0%	0.0%
19K6	-100--400	9%	14%	76%	0%	0%	0%	0%	0.0%
19K7	-100--400	12%	16%	73%	0%	0%	0%	0%	0.0%
19K8	-100--400	21%	15%	63%	0%	0%	0%	0%	0.0%
19K9	-100--400	19%	16%	65%	0%	0%	0%	0%	0.0%
19L1	-100--400	5%	12%	83%	0%	0%	0%	0%	0.0%
19L2	-126--166 |-176--216 |-266--286 |-306--346 |-356--366	0%	0%	100%	0%	0%	0%	0%	0.0%
19M1	-105--400	0%	2%	98%	0%	0%	0%	0%	0.0%
19M2	-130--400	0%	0%	100%	0%	0%	0%	0%	0.0%
19M3	-80--400	0%	7%	93%	0%	0%	0%	0%	0.0%
19M4	-120--400	0%	0%	100%	0%	0%	0%	0%	0.0%
19M5	-92--272	0%	0%	100%	0%	0%	0%	0%	0.0%
19N1	-110--290	0%	7%	93%	0%	0%	0%	0%	0.0%
19P1	-214--314	0%	0%	100%	0%	0%	0%	0%	0.0%
19Q4	-133--253 |-273--463	9%	14%	77%	0%	0%	0%	0%	0.0%
19R1	-100--350	50%	15%	35%	0%	0%	0%	0%	0.0%
19R2	-111--231 |-251--441	38%	5%	57%	0%	0%	0%	0%	0.0%
20E1	8--12 |-52--92 |-112--152	46%	25%	29%	0%	0%	0%	0%	0.0%
20E2	8--12 |-52--92 |-112--152	41%	21%	38%	0%	0%	0%	0%	0.0%
20F1	-288--448 |-528--608	0%	0%	86%	14%	0%	0%	0%	0.0%
20G1	-156--596	0%	0%	83%	6%	11%	0%	0%	0.0%
20H1	-22--542	8%	6%	83%	3%	0%	0%	0%	4.2%
20J2	-20--40 |-60--80 |-120--200 |-220--318	41%	14%	45%	0%	0%	0%	0%	0.0%
20K1	-50--400	25%	8%	68%	0%	0%	0%	0%	0.0%
20K4	-306--326 |-346--366 |-566--596 |-656--676 |-696--716 |-776--836 -	0%	0%	43%	10%	27%	20%	0%	0.0%
20K5	-119--619	0%	0%	94%	2%	4%	0%	0%	0.0%
20L1	-20--400	19%	7%	73%	0%	0%	0%	0%	0.0%
20L2	-20--400	22%	10%	67%	0%	0%	0%	0%	0.0%

Well	Screening Elevations Implemented in Model	Model Layering							Percent Removed to Bedrock
		Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	
20L3	-48--331	18%	5%	77%	0%	0%	0%	0%	0.0%
20L5	-300--320 |-460--620 |-700--760	0%	0%	75%	6%	19%	0%	0%	0.0%
20M1	13--99	100%	0%	0%	0%	0%	0%	0%	0.0%
20M2	-201--421	0%	0%	100%	0%	0%	0%	0%	0.0%
20M3	-30--300	49%	16%	35%	0%	0%	0%	0%	0.0%
20M4	-30--300	40%	16%	44%	0%	0%	0%	0%	0.0%
20M6	0--300	33%	15%	53%	0%	0%	0%	0%	0.0%
20M6_actual	-199--419	0%	0%	100%	0%	0%	0%	0%	0.0%
20N1	-60--330	73%	13%	14%	0%	0%	0%	0%	0.0%
20N2	-40--220	93%	7%	0%	0%	0%	0%	0%	0.0%
20N3	-62--254	82%	17%	0%	0%	0%	0%	0%	0.0%
20N4	-93--313	58%	15%	27%	0%	0%	0%	0%	0.0%
20N5	-187--227 |-237--247 |-257--267	9%	54%	38%	0%	0%	0%	0%	0.0%
20P1	-100--250	73%	11%	17%	0%	0%	0%	0%	0.0%
20Q3	42--864	22%	4%	57%	4%	12%	1%	0%	0.0%
20Q4	-70--120 |-140--160 |-190--215 |-260--290 |-320--360 |-380--425 -	35%	11%	55%	0%	0%	0%	0%	0.0%
20R4	-77--207	100%	0%	0%	0%	0%	0%	0%	0.0%
21F1	147--83	92%	8%	0%	0%	0%	0%	0%	0.3%
21K1	-235--325 |-345--645	0%	0%	52%	19%	21%	9%	0%	2.0%
21L1	-340--410 |-430--707	0%	0%	51%	13%	21%	15%	0%	0.0%
21M2	24--316	51%	18%	31%	0%	0%	0%	0%	0.0%
21N1	-60--400	56%	12%	32%	0%	0%	0%	0%	0.0%
21N3	-280--800	0%	0%	58%	9%	32%	1%	0%	0.0%
21N4	-40--386	56%	11%	33%	0%	0%	0%	0%	0.0%
21N5	-315--820	0%	0%	47%	4%	36%	13%	0%	0.0%
21N6	-290--370 |-460--670 |-730--830	0%	0%	52%	12%	28%	9%	0%	0.0%
21N7	-277--797	0%	0%	61%	7%	31%	0%	0%	0.0%
21Q1	-162--362 |-412--662	0%	4%	76%	16%	3%	0%	0%	0.0%
21Q2	-402--682	0%	0%	37%	27%	27%	10%	0%	0.0%
21Q3	10--490	21%	13%	66%	0%	0%	0%	0%	0.0%
21R1	28-20 |-10--40 |-60--66 |-120--130 |-179--194 |-204--208 |-230--231 |-246--276 |-302--306 |	35%	6%	59%	0%	0%	0%	0%	0.0%
22R1	114--54	0%	0%	69%	31%	0%	0%	0%	0.0%
22R2	179-166 |152-143 |141-137 |121-117 |100-96 |77-73 |72-61 |51-41	0%	34%	66%	0%	0%	0%	0%	0.0%
22R3	115--53	0%	0%	70%	30%	0%	0%	0%	2.1%
22R4	Assigned as Single Node Well	0%	0%	0%	100%	0%	0%	0%	14.3%
22R5	Assigned as Single Node Well	0%	0%	100%	0%	0%	0%	0%	0.0%
23A1	51-10	0%	0%	0%	0%	11%	89%	0%	0.0%
23H7	-50--368	0%	0%	0%	0%	7%	93%	0%	0.6%
23P1	152--18	0%	0%	0%	15%	85%	0%	0%	0.4%
23Q1	309-302	0%	0%	0%	100%	0%	0%	0%	0.0%
24A1	70-35	45%	55%	0%	0%	0%	0%	0%	0.0%
24C1	95-86	100%	0%	0%	0%	0%	0%	0%	0.0%
24C4	-50--300	0%	0%	7%	19%	73%	2%	0%	0.0%
24E3	Assigned as Single Node Well	0%	0%	0%	0%	100%	0%	0%	0.0%
24F3	-68--135	0%	0%	63%	37%	0%	0%	0%	0.0%
24F4	-60--360	0%	0%	4%	17%	70%	9%	0%	0.0%

Well	Screening Elevations Implemented in Model	Model Layering							
		Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Percent Removed to Bedrock
24F8	-56--401	0%	0%	1%	14%	54%	30%	0%	0.0%
24F9	-149--389	0%	0%	0%	0%	61%	39%	0%	0.0%
24G1	-93--203	0%	0%	77%	23%	0%	0%	0%	0.0%
24G2	-176--406	0%	0%	3%	24%	72%	0%	0%	0.0%
24H1	-200--500	0%	0%	36%	19%	45%	0%	0%	0.0%
24H2	-200--500	0%	0%	23%	20%	57%	0%	0%	0.0%
24H3	-200--500	0%	0%	47%	20%	33%	0%	0%	0.0%
24H4	-188--388 |-568--758	0%	0%	31%	14%	6%	17%	32%	0.0%
24H5	-326--466	0%	0%	0%	0%	100%	0%	0%	0.0%
25L2	200-10	0%	0%	0%	0%	0%	19%	81%	0.0%
25L4	41-39 |27-24	0%	0%	0%	0%	0%	0%	100%	4.4%
25M1	160--50	0%	0%	0%	0%	43%	28%	28%	0.0%
25N1	80--120	0%	0%	0%	0%	84%	16%	0%	0.0%
25N4	103-23 |23--107	0%	0%	0%	0%	61%	22%	17%	0.0%
25N5	104--26	0%	0%	0%	0%	100%	0%	0%	0.0%
25N6	103-23 |23--107	0%	0%	0%	0%	61%	22%	17%	0.0%
26B1	217--95	0%	0%	0%	0%	59%	16%	26%	0.0%
26B2	230--374	0%	0%	0%	0%	62%	14%	24%	8.4%
26B3	241--259	0%	0%	0%	10%	44%	9%	37%	0.0%
26B9	10--90	0%	0%	0%	0%	0%	34%	66%	1.5%
26C1	200-0	0%	0%	0%	3%	97%	0%	0%	0.0%
26C2	237--263	0%	0%	0%	9%	44%	9%	37%	0.0%
26C3	150-80	0%	0%	0%	0%	100%	0%	0%	0.0%
26C4	Assigned as Single Node Well	0%	0%	0%	0%	0%	100%	0%	14.1%
26C6	203--125	0%	0%	0%	4%	85%	11%	0%	3.2%
26C7	191--103	0%	0%	0%	6%	76%	16%	1%	1.9%
26C8	Assigned as Single Node Well	0%	0%	0%	0%	0%	100%	0%	0.0%
26D1	134--36	0%	0%	0%	22%	78%	0%	0%	0.0%
26E1	-16--266	0%	0%	0%	0%	100%	0%	0%	0.0%
26F1	110--160	0%	0%	0%	5%	84%	11%	0%	0.0%
26H1	350-100	0%	0%	0%	23%	73%	5%	0%	0.0%
26H2	194-74 |54--86	0%	0%	0%	0%	42%	12%	46%	0.0%
26L1	74-34 |-66--146	0%	0%	22%	12%	67%	0%	0%	0.0%
26N1	-10--400	0%	0%	25%	29%	47%	0%	0%	0.0%
26N2	-50--350	0%	0%	5%	29%	67%	0%	0%	0.0%
26N3	-80--180 |-200--300	0%	0%	0%	35%	65%	0%	0%	0.0%
26N4	-168--188 |-288--488	0%	0%	0%	0%	70%	7%	23%	0.0%
26P1	43-3 |-97--177	0%	0%	11%	22%	67%	0%	0%	0.0%
26P2	166-16 |-4--94	0%	11%	52%	17%	21%	0%	0%	0.0%
27B2	55--173	0%	0%	56%	33%	10%	0%	0%	0.0%
27B3	60--300	0%	0%	55%	27%	19%	0%	0%	0.0%
27D1	88--732	11%	5%	38%	11%	22%	7%	6%	0.0%
27D2	-205--730	0%	0%	49%	14%	30%	7%	0%	0.0%
27E1	20--260	25%	8%	67%	0%	0%	0%	0%	0.0%
27E2	20--260	32%	5%	63%	0%	0%	0%	0%	0.0%
27E3	-126--686	0%	0%	39%	17%	38%	5%	0%	0.0%
27F1	-36--298	0%	0%	100%	0%	0%	0%	0%	0.0%
27F2	Assigned as Single Node Well	0%	0%	0%	0%	0%	0%	100%	0.0%
27F3	24--376	12%	8%	80%	0%	0%	0%	0%	0.0%
27F4	-25--65 |-105--185 |-205--425	0%	0%	57%	32%	12%	0%	0%	0.0%
27G1	-30--300	0%	0%	38%	39%	23%	0%	0%	0.0%
27G4	-80--430	0%	0%	15%	30%	55%	0%	0%	0.0%
27H1	-105--165	0%	0%	0%	100%	0%	0%	0%	0.0%
27H2	-90--130 |-150--330	0%	0%	9%	35%	56%	0%	0%	0.0%
27J1	-40--400	0%	0%	22%	29%	49%	0%	0%	0.0%
27K1	-40--400	0%	0%	38%	35%	28%	0%	0%	0.0%
27K3	-140--380 |-420--520 |-580--640	0%	0%	24%	30%	39%	7%	0%	0.0%

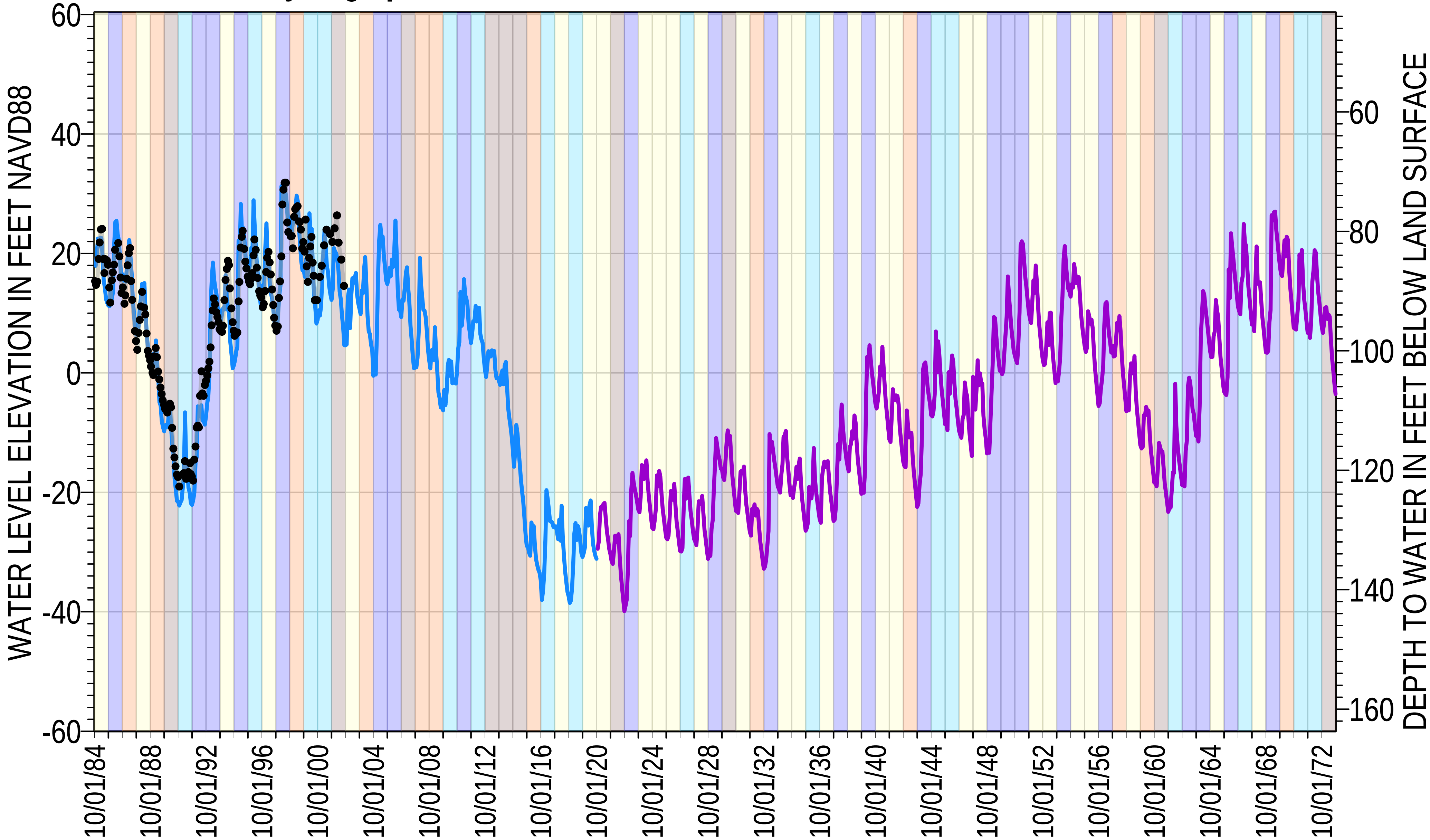
Well	Screening Elevations Implemented in Model	Model Layering							Percent Removed to Bedrock
		Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	
27L1	20--460	0%	6%	73%	18%	3%	0%	0%	0.0%
27L2	-70--470	0%	0%	100%	0%	0%	0%	0%	0.0%
27L3	-60--460	0%	0%	81%	19%	0%	0%	0%	0.0%
27P1	-50--470	0%	0%	100%	0%	0%	0%	0%	0.0%
27P4	-228--708	0%	0%	40%	14%	45%	0%	0%	0.0%
27Q1	10--460	0%	0%	67%	21%	12%	0%	0%	0.0%
27Q2	35--461	1%	5%	73%	17%	4%	0%	0%	0.0%
27Q6	-58--538	0%	0%	65%	16%	18%	0%	0%	0.0%
27Q7	-8--398	0%	0%	50%	34%	16%	0%	0%	0.0%
27Q8	40--400	0%	6%	72%	22%	0%	0%	0%	0.0%
27Q9	-201--221 |-381--661	0%	0%	7%	7%	86%	0%	0%	0.0%
27R2	-161--176 |-216--244 |-258--286	0%	0%	0%	84%	16%	0%	0%	0.0%
27R3	-205--225 |-365--385 |-465--505	0%	0%	24%	1%	75%	0%	0%	0.0%
27R4	-10--300	0%	0%	74%	26%	0%	0%	0%	0.0%
27R5	38--162	0%	0%	100%	0%	0%	0%	0%	0.0%
27R5_actual	-206--226 |-366--386 |-466--506	0%	0%	16%	9%	75%	0%	0%	0.0%
27R6	-100--160 |-220--240 |-340--360	0%	0%	60%	20%	20%	0%	0%	0.0%
28A1	-140--240 |-260--280 |-280--320	0%	8%	92%	0%	0%	0%	0%	0.0%
28B1	-50--400	35%	17%	49%	0%	0%	0%	0%	0.0%
28B2	-19--179 |-219--279	73%	10%	17%	0%	0%	0%	0%	0.0%
28C2	-40--60 |-90--120 |-200--240	56%	44%	0%	0%	0%	0%	0%	0.0%
28D1	-141--357	45%	19%	36%	0%	0%	0%	0%	0.0%
28D2	-234--274 |-804--864 |-1044--1144	2%	18%	0%	30%	0%	50%	0%	0.0%
28D3	-250--380	0%	32%	68%	0%	0%	0%	0%	0.0%
28D4	-235--276 |-776--841	2%	36%	23%	38%	0%	0%	0%	0.0%
28F11	-50--350	69%	15%	16%	0%	0%	0%	0%	0.0%
28F2	-50--350	69%	15%	16%	0%	0%	0%	0%	0.0%
28F3	-50--350	65%	16%	19%	0%	0%	0%	0%	0.0%
28F5	-50--350	76%	10%	14%	0%	0%	0%	0%	0.0%
28F6	-50--350	76%	10%	14%	0%	0%	0%	0%	0.0%
28F7	Assigned as Single Node Well	0%	0%	0%	0%	0%	0%	100%	0.0%
28G2	-20--300	54%	19%	28%	0%	0%	0%	0%	0.0%
28G3	-173--273	21%	49%	30%	0%	0%	0%	0%	0.0%
28G4	-47--227	100%	0%	0%	0%	0%	0%	0%	0.0%
28G5	-172--332 |-372--772	7%	9%	68%	15%	1%	0%	0%	0.0%
28H1	-91--291 |-311--391	6%	10%	84%	0%	0%	0%	0%	0.0%
28J1	-33--149	100%	0%	0%	0%	0%	0%	0%	0.0%
28J2	-50--300	53%	19%	27%	0%	0%	0%	0%	0.0%
28J3	-48--88 |-168--748	9%	7%	71%	12%	1%	0%	0%	0.0%
28K2	-73--133 |-153--233 |-253--333 |-353--433	46%	15%	38%	0%	0%	0%	0%	0.0%
28K3	-105--305 |-345--425	50%	21%	30%	0%	0%	0%	0%	0.0%
28L1	-50--350	82%	6%	12%	0%	0%	0%	0%	0.0%
28L3	-50--350	83%	5%	12%	0%	0%	0%	0%	0.0%
28L4	-50--350	78%	9%	13%	0%	0%	0%	0%	0.0%
28M5	-50--350	85%	6%	9%	0%	0%	0%	0%	0.0%
29A2	-100--360	76%	4%	19%	0%	0%	0%	0%	0.0%
29B1	-78--128 |-148--168 |-198--223 |-268--298 |-328--368 |-388--433 -	43%	3%	55%	0%	0%	0%	0%	0.0%

Well	Screening Elevations Implemented in Model	Model Layering							Percent Removed to Bedrock
		Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	
29D8	Assigned as Single Node Well	0%	0%	0%	0%	100%	0%	0%	0.0%
33A1	-200--400	0%	32%	68%	0%	0%	0%	0%	0.0%
33C1	-280--400	0%	25%	75%	0%	0%	0%	0%	0.0%
34A1	95--5	33%	23%	44%	0%	0%	0%	0%	0.0%
34B1	-20--280	0%	0%	100%	0%	0%	0%	0%	0.0%
34B4	79-59 |-41--61 |-161--261	14%	0%	86%	0%	0%	0%	0%	0.0%
34F2	79--400	18%	4%	78%	0%	0%	0%	0%	0.0%
34H1	-10--90 |-130--230	0%	0%	100%	0%	0%	0%	0%	0.0%
35A6	70--120	0%	0%	44%	34%	22%	0%	0%	0.0%
35A7	25--165 |-185--248	0%	0%	4%	22%	65%	9%	0%	0.0%
35B1	80--80	0%	0%	87%	13%	0%	0%	0%	0.0%
35B4	33-3 |-67--117	0%	0%	38%	63%	0%	0%	0%	0.0%
35B5	52-12 |-18--58 |-58--108 |-108--128	0%	0%	75%	25%	0%	0%	0%	0.0%
35B6	68--312	0%	0%	37%	24%	40%	0%	0%	0.0%
35C1	60--340	0%	0%	53%	33%	14%	0%	0%	0.0%
35C3	50--350	0%	0%	41%	28%	31%	0%	0%	0.0%
35D1	25--370	0%	0%	47%	35%	18%	0%	0%	0.0%
35D2	-164--224 |-284--664	0%	0%	0%	12%	37%	7%	44%	0.0%
35E1	-140--250	0%	0%	100%	0%	0%	0%	0%	0.0%
35E2	-147--156 |-165--173 |-237--246	0%	0%	100%	0%	0%	0%	0%	0.0%
35E3	-140--250	0%	0%	100%	0%	0%	0%	0%	0.0%
35E4	-41--201	0%	0%	100%	0%	0%	0%	0%	0.0%
35F1	-140--250	0%	0%	100%	0%	0%	0%	0%	0.0%
35G1	77-7 |-23--83	0%	0%	96%	4%	0%	0%	0%	0.0%
35H1	30--140	0%	0%	68%	32%	0%	0%	0%	0.0%
35H2	-33--162	0%	0%	25%	75%	0%	0%	0%	0.0%
35L1	24--466	100%	0%	0%	0%	0%	0%	0%	0.0%
35M1	-140--250	0%	0%	100%	0%	0%	0%	0%	0.0%
35M23	23--467	0%	0%	100%	0%	0%	0%	0%	0.0%
35M4	31--459	0%	0%	100%	0%	0%	0%	0%	0.0%
35M5	165--325	18%	2%	80%	0%	0%	0%	0%	0.0%
25L7	122--198	0%	0%	0%	0%	0%	0%	%100	0.0%
21E1	Considered Bedrock								100.0%
23A4	Considered Bedrock								100.0%
22R6	Considered Bedrock								100.0%
23A2	Considered Bedrock								100.0%
24B2	Considered Bedrock								100.0%
21J1	Considered Bedrock								100.0%
25F2	Considered Bedrock								100.0%
24F1	Considered Bedrock								100.0%
20C1	Considered Bedrock								100.0%
25F1	Considered Bedrock								100.0%



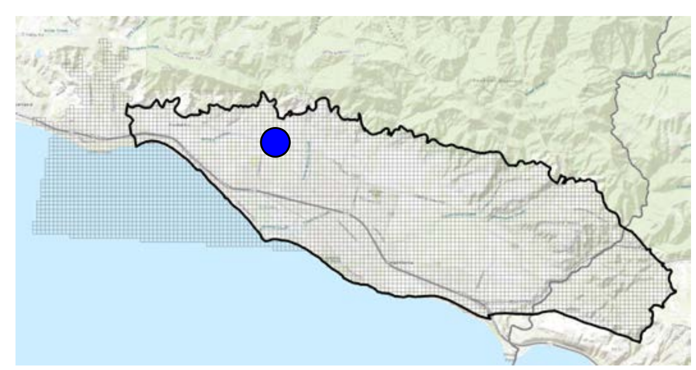
Water Level Hydrograph for 19F4
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
60
80
100
120
140
160
10/01/84
10/01/88
10/01/92
10/01/96
10/01/00
10/01/04
10/01/08
10/01/12
10/01/16
10/01/20
10/01/24
10/01/28
10/01/32
10/01/36
10/01/40
10/01/44
10/01/48
10/01/52
10/01/56
10/01/60
10/01/64
10/01/68
10/01/72
Measured
Projected Baseline
Historical
Well Type | Private
Reference Point Elevation (feet NAVD88) | 102.1
Model Layering (%) | L3: 78 L5: 22
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for 19H1

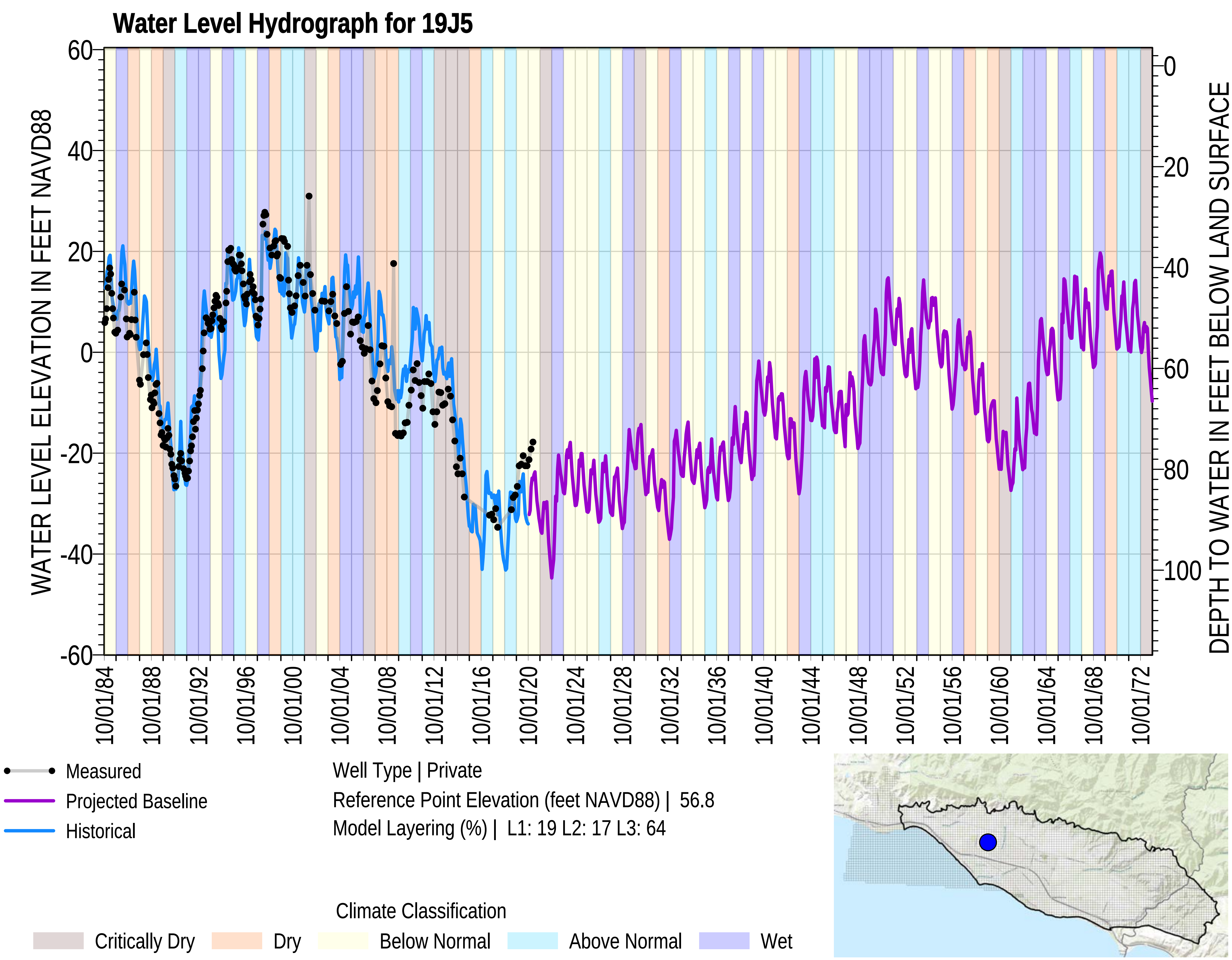


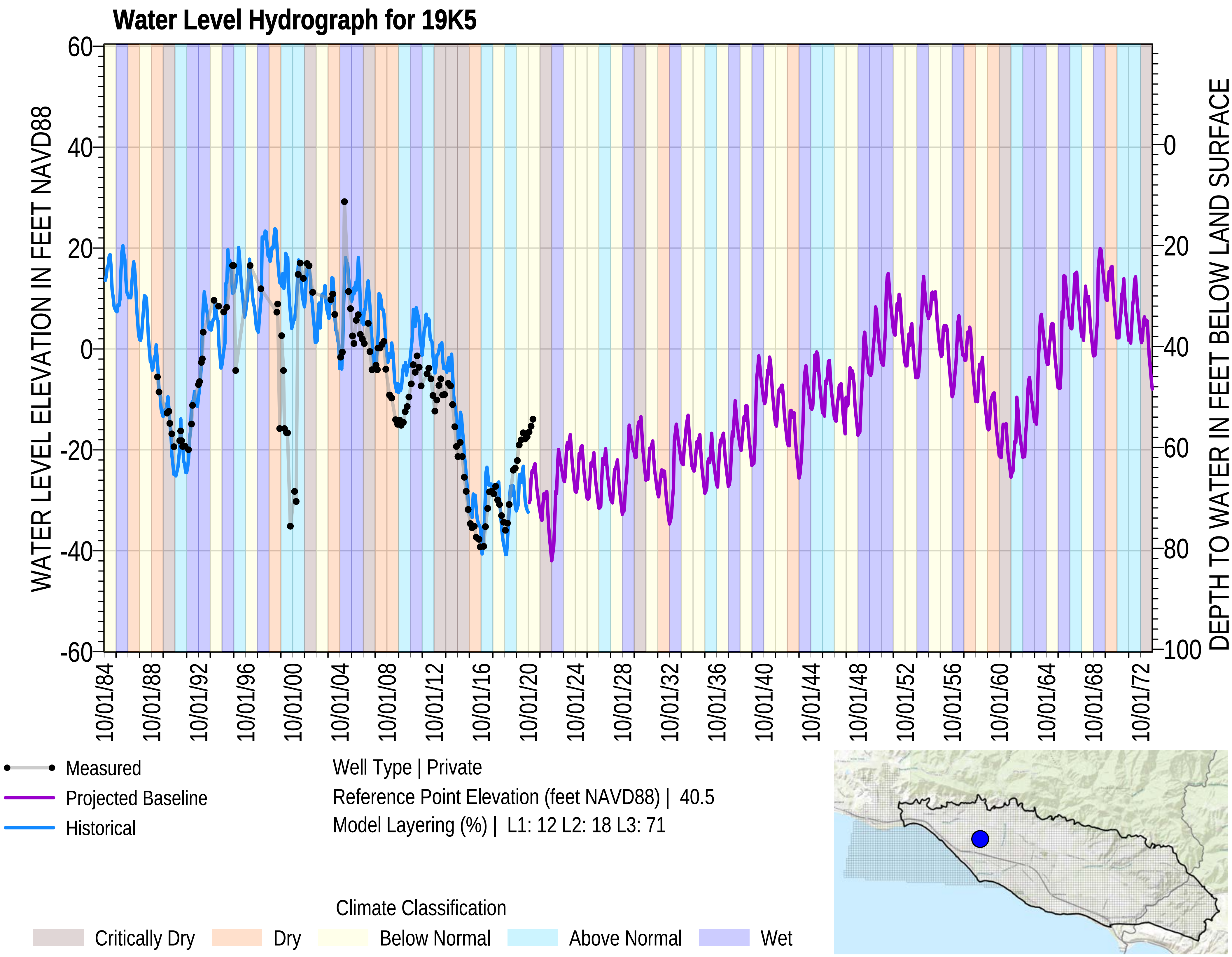
Measured
Projected Baseline
Historical

Well Type | Private
Reference Point Elevation (feet NAVD88) | 103.7
Model Layering (%) | L1: 46 L2: 9 L3: 46



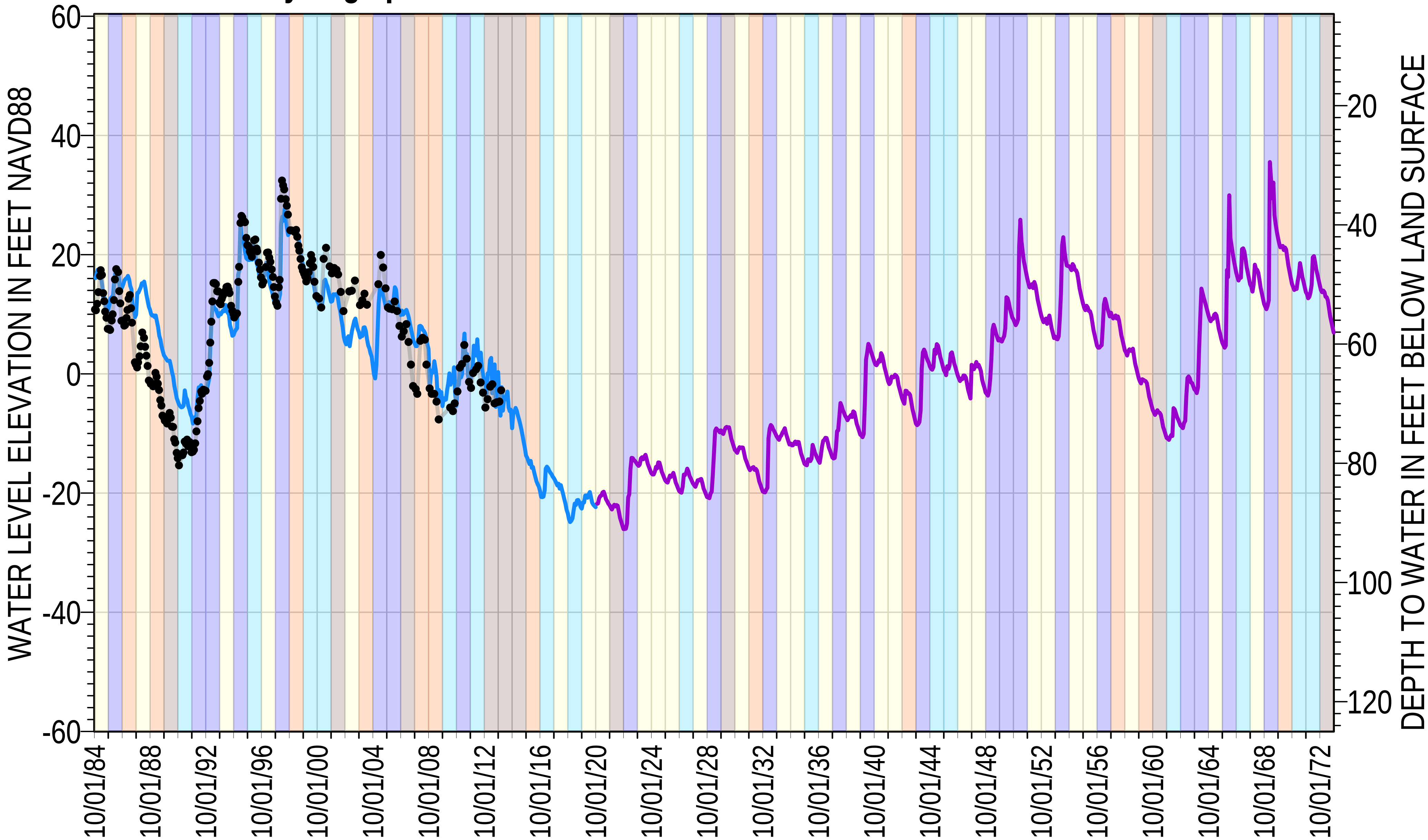
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet


Water Level Hydrograph for 19J5
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
0
20
40
60
80
100
10/01/84
10/01/88
10/01/92
10/01/96
10/01/00
10/01/04
10/01/08
10/01/12
10/01/16
10/01/20
10/01/24
10/01/28
10/01/32
10/01/36
10/01/40
10/01/44
10/01/48
10/01/52
10/01/56
10/01/60
10/01/64
10/01/68
10/01/72
Measured
Projected Baseline
Historical
Well Type | Private
Reference Point Elevation (feet NAVD88) | 56.8
Model Layering (%) | L1: 19 L2: 17 L3: 64
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet



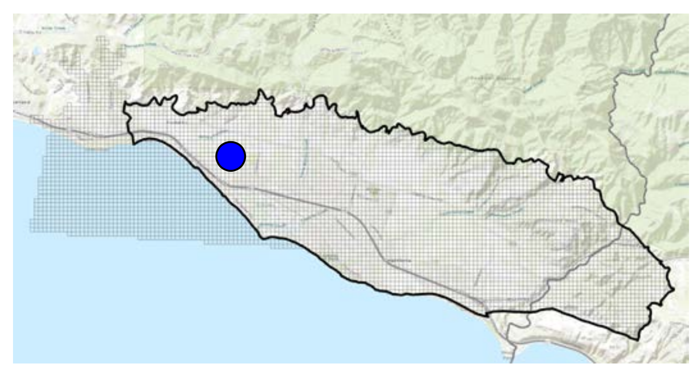
Water Level Hydrograph for 19K5
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
0
20
40
60
80
100
10/01/84
10/01/88
10/01/92
10/01/96
10/01/00
10/01/04
10/01/08
10/01/12
10/01/16
10/01/20
10/01/24
10/01/28
10/01/32
10/01/36
10/01/40
10/01/44
10/01/48
10/01/52
10/01/56
10/01/60
10/01/64
10/01/68
10/01/72
Measured
Projected Baseline
Historical
Well Type | Private
Reference Point Elevation (feet NAVD88) | 40.5
Model Layering (%) | L1: 12 L2: 18 L3: 71
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for 19M3



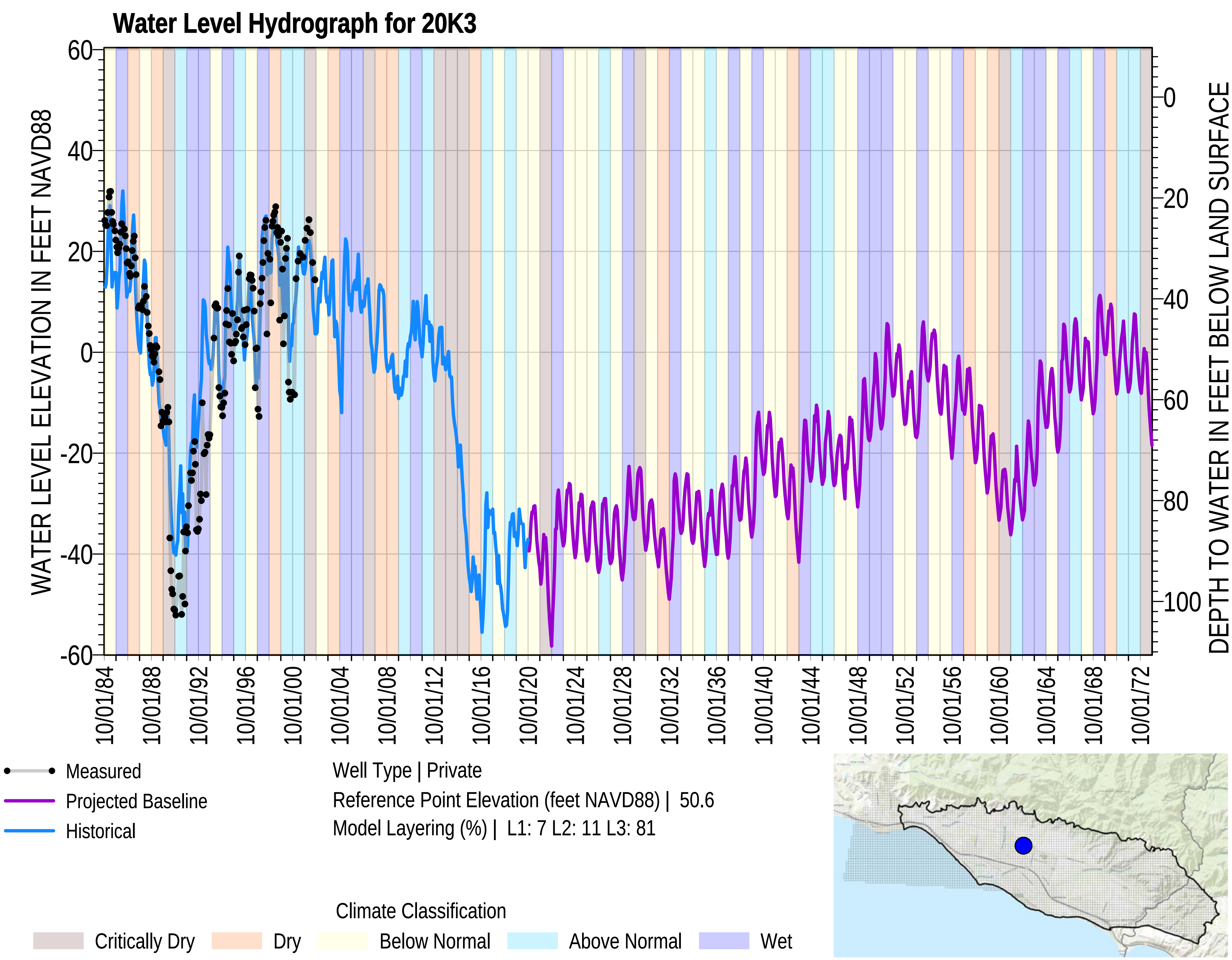
Measured
Projected Baseline
Historical

Well Type | Private
Reference Point Elevation (feet NAVD88) | 65
Model Layering (%) | L2: 7 L3: 93



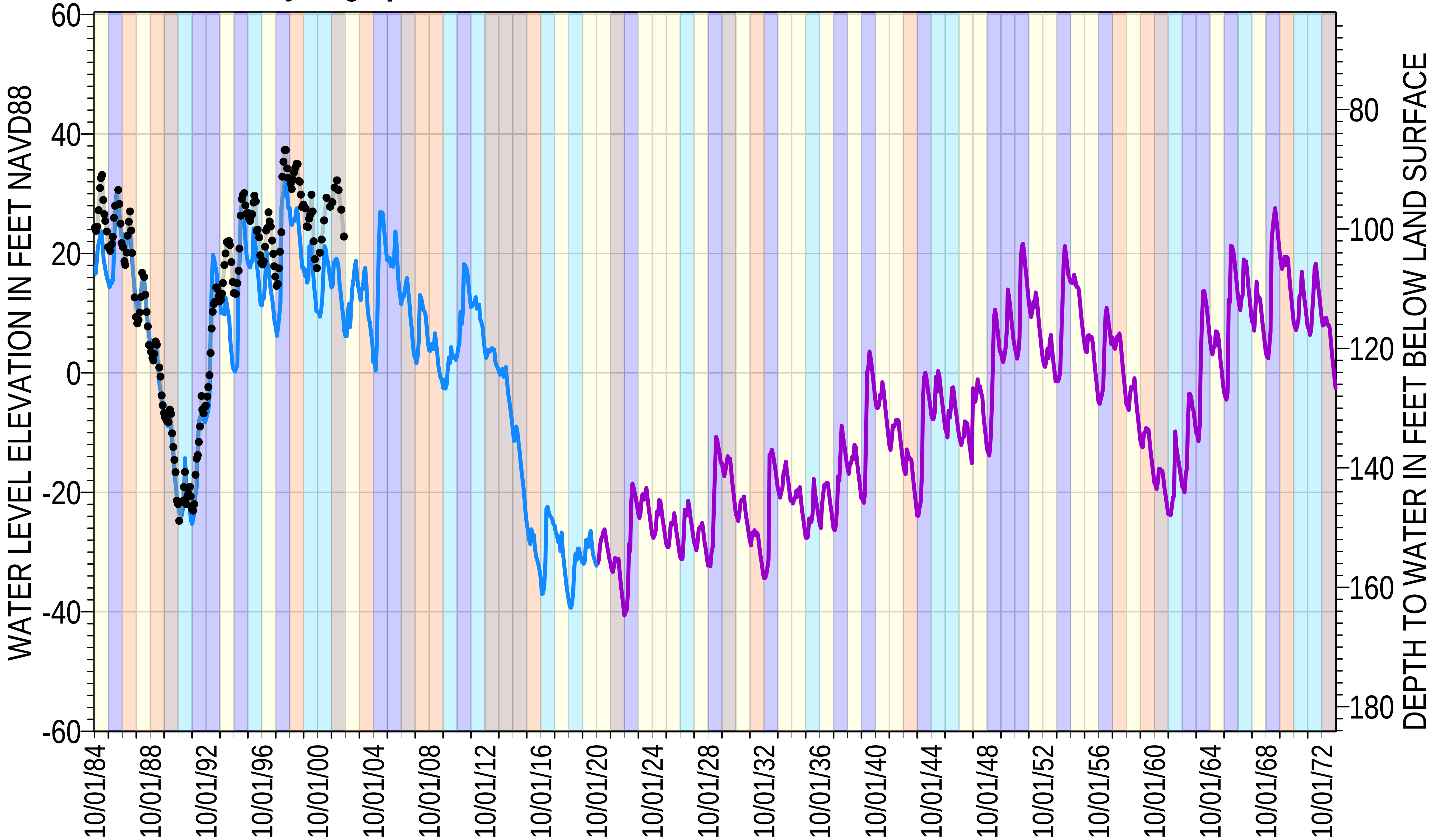
Climate Classification

Critically Dry   Dry   Below Normal   Above Normal   Wet



Water Level Hydrograph for 20K3
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
0
20
40
60
80
100
10/01/84
10/01/88
10/01/92
10/01/96
10/01/00
10/01/04
10/01/08
10/01/12
10/01/16
10/01/20
10/01/24
10/01/28
10/01/32
10/01/36
10/01/40
10/01/44
10/01/48
10/01/52
10/01/56
10/01/60
10/01/64
10/01/68
10/01/72
Measured
Projected Baseline
Historical
Well Type | Private
Reference Point Elevation (feet NAVD88) | 50.6
Model Layering (%) | L1: 7 L2: 11 L3: 81
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

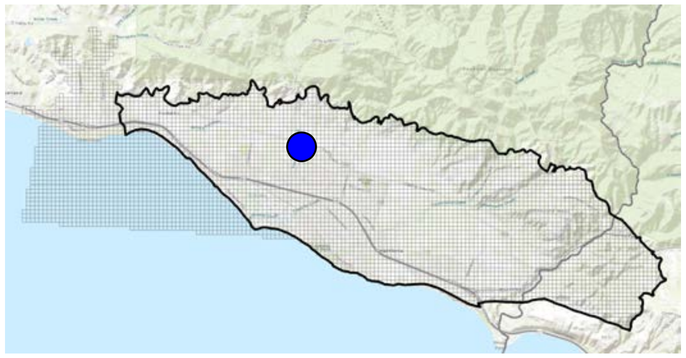
Water Level Hydrograph for 20L4



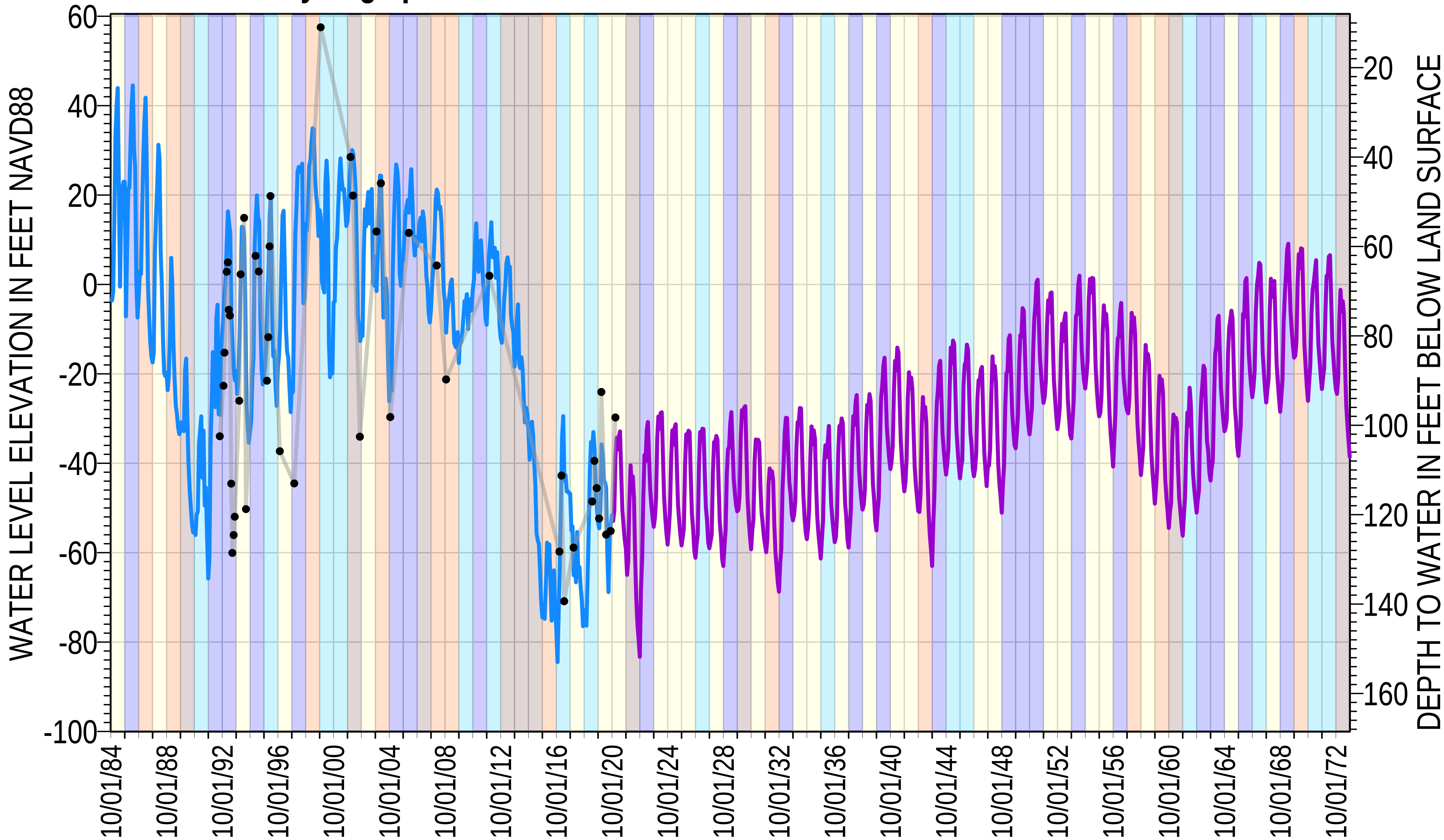
Measured
Projected Baseline
Historical

Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 124.1
Model Layering (%) | L1: 78 L2: 18 L3: 4

Climate Classification
Critically Dry | Dry | Below Normal | Above Normal | Wet

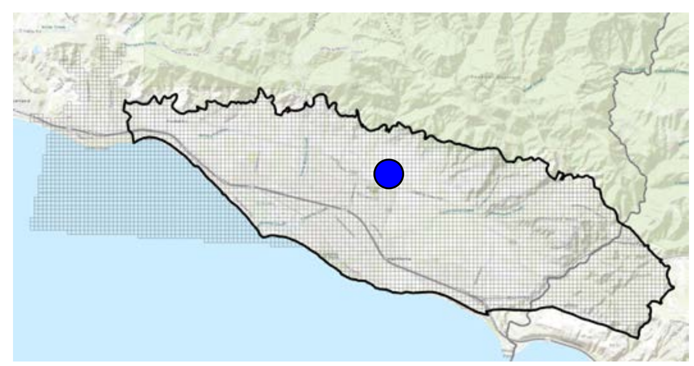


Water Level Hydrograph for 21L1



Measured
Projected Baseline
Historical

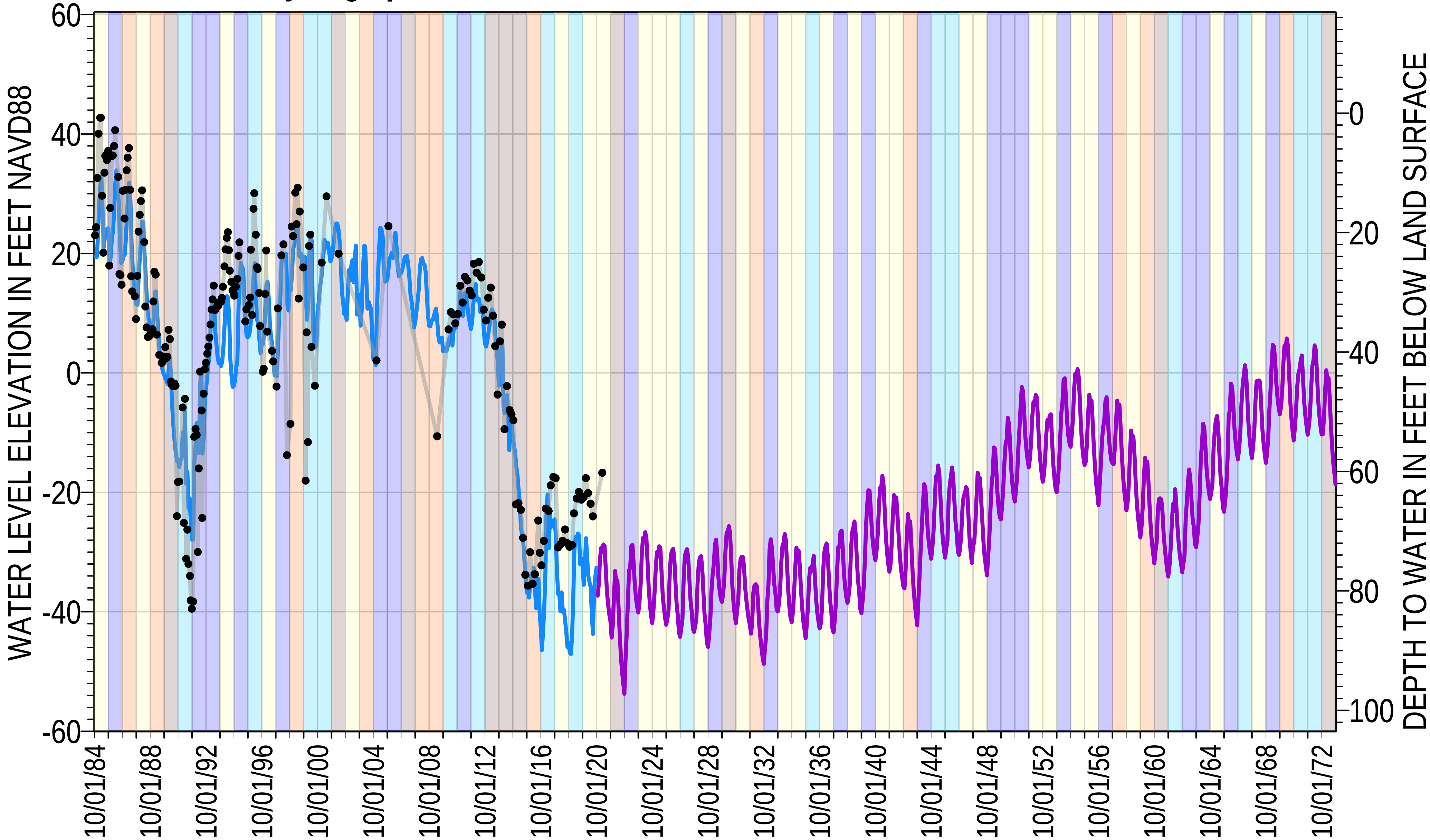
Well Type | Private
Reference Point Elevation (feet NAVD88) | 68.5
Model Layering (%) | L3: 51 L4: 13 L5: 21 L6: 15



Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

Water Level Hydrograph for 21N1



Measured

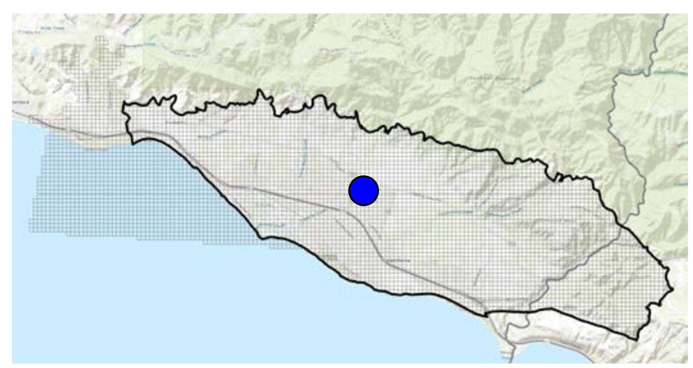
Projected Baseline

Historical

Well Type | Private

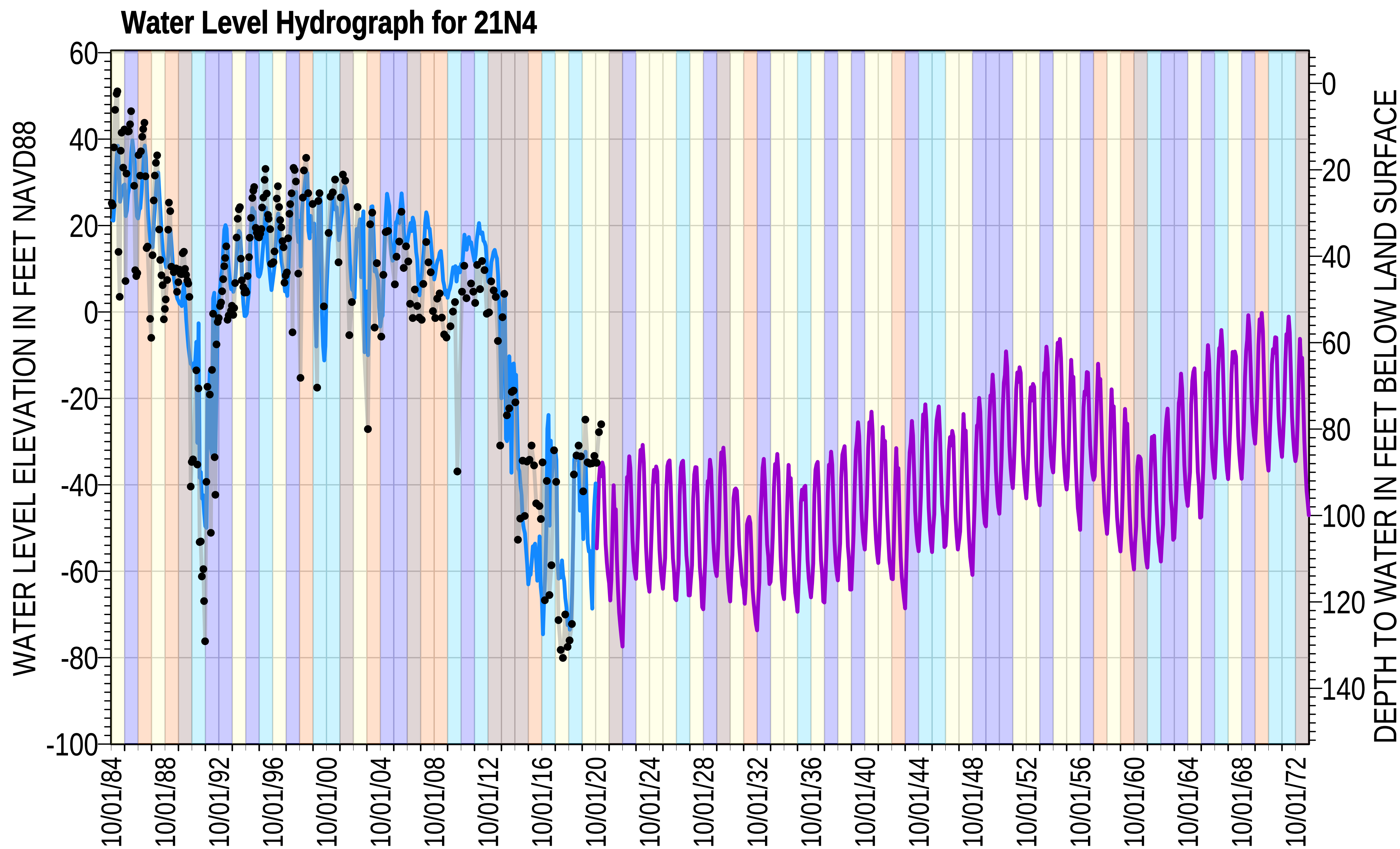
Reference Point Elevation (feet NAVD88) | 43.5

Model Layering (%) | L1: 56 L2: 12 L3: 32



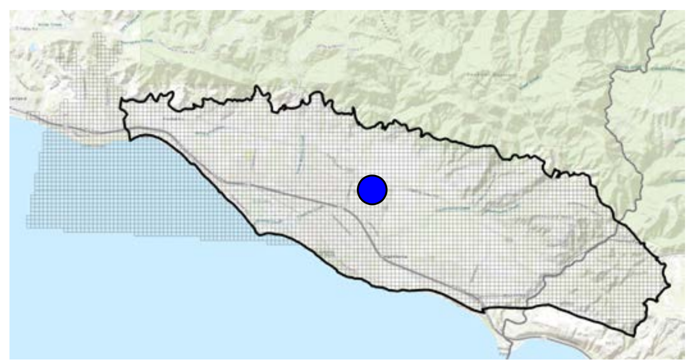
Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet



Measured
Projected Baseline
Historical

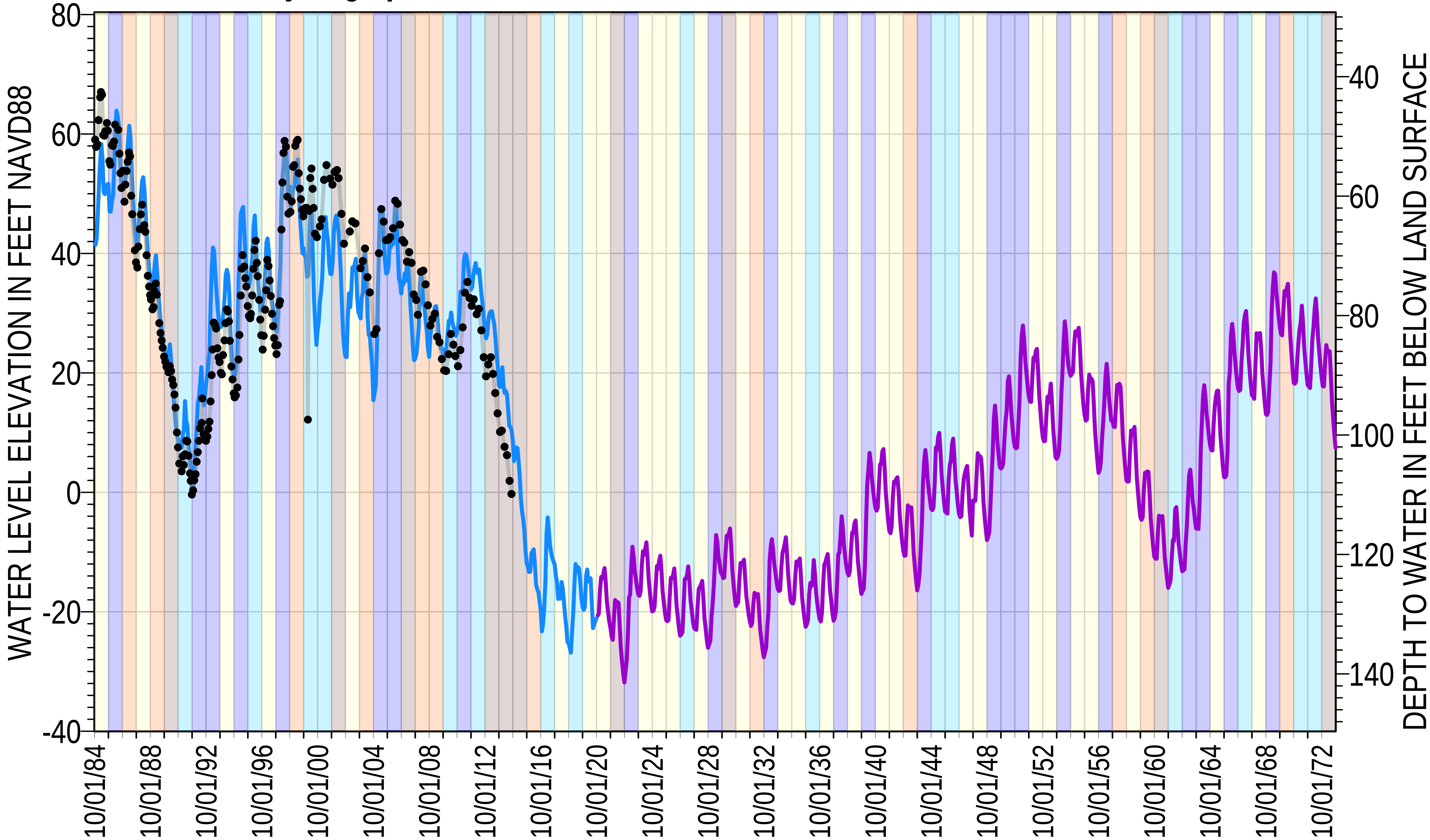
Well Type | Private
Reference Point Elevation (feet NAVD88) | 52.9
Model Layering (%) | L1: 56 L2: 11 L3: 33



Climate Classification

Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for 21R1



Measured

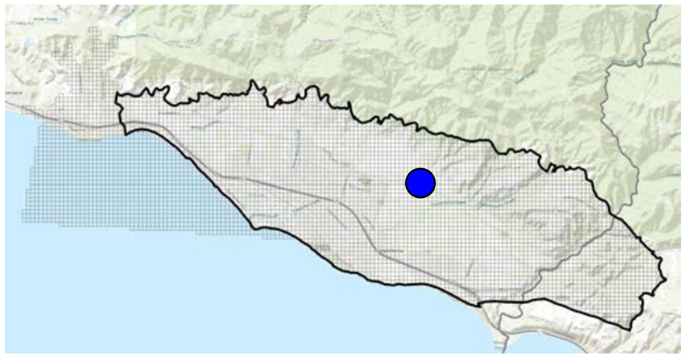
Projected Baseline

Historical

Well Type | Private

Reference Point Elevation (feet NAVD88) | 109.6

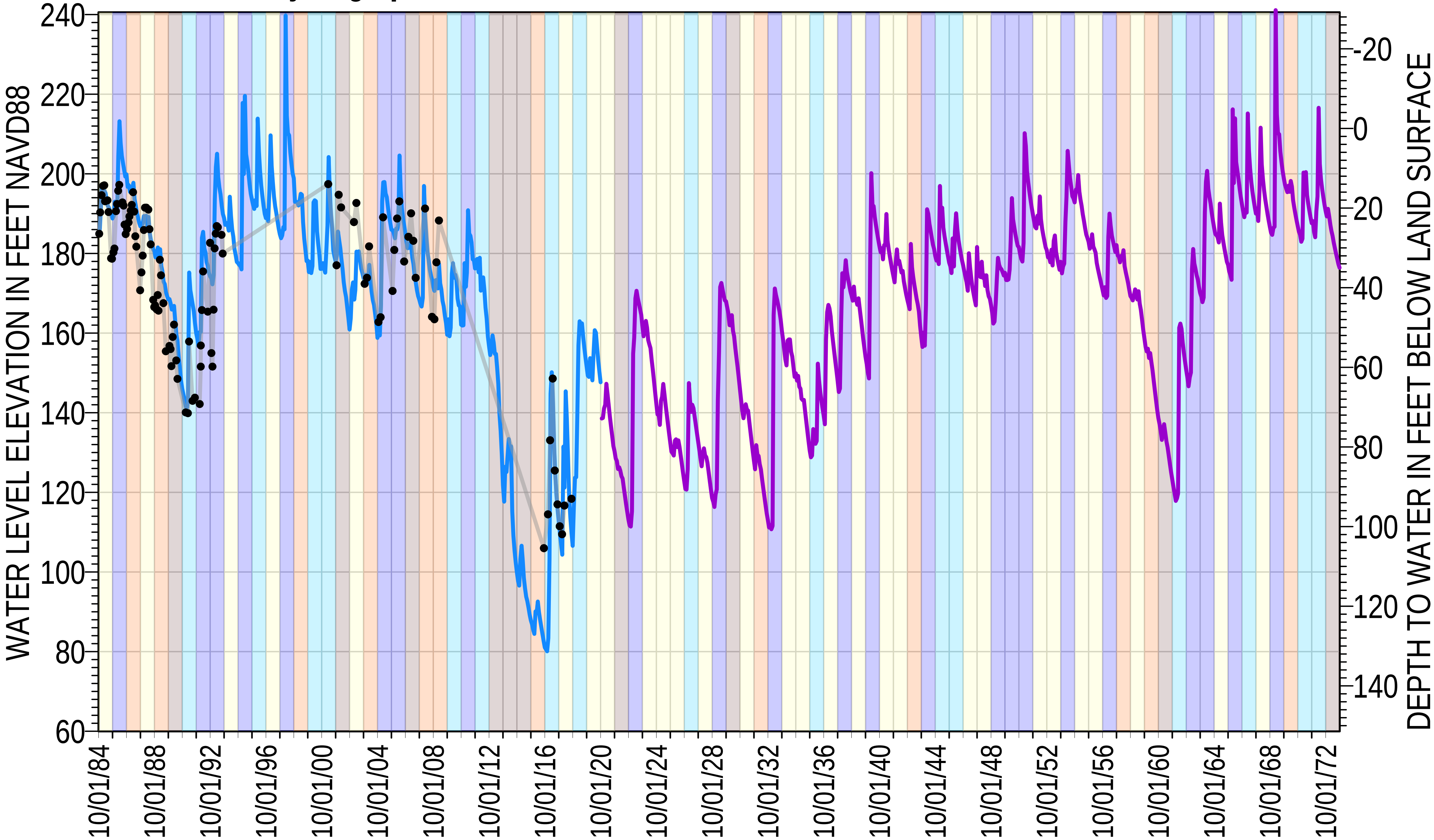
Model Layering (%) | L1: 35 L2: 6 L3: 59



Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

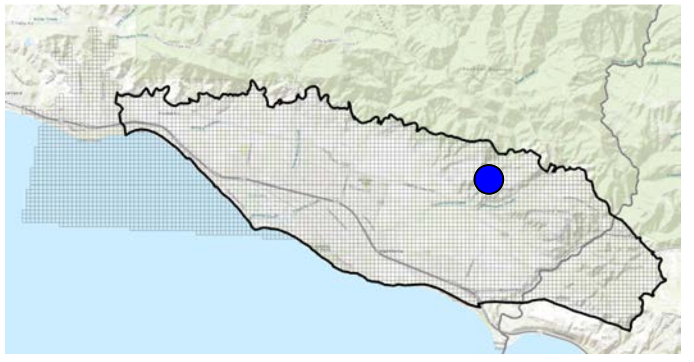
Water Level Hydrograph for 22R3



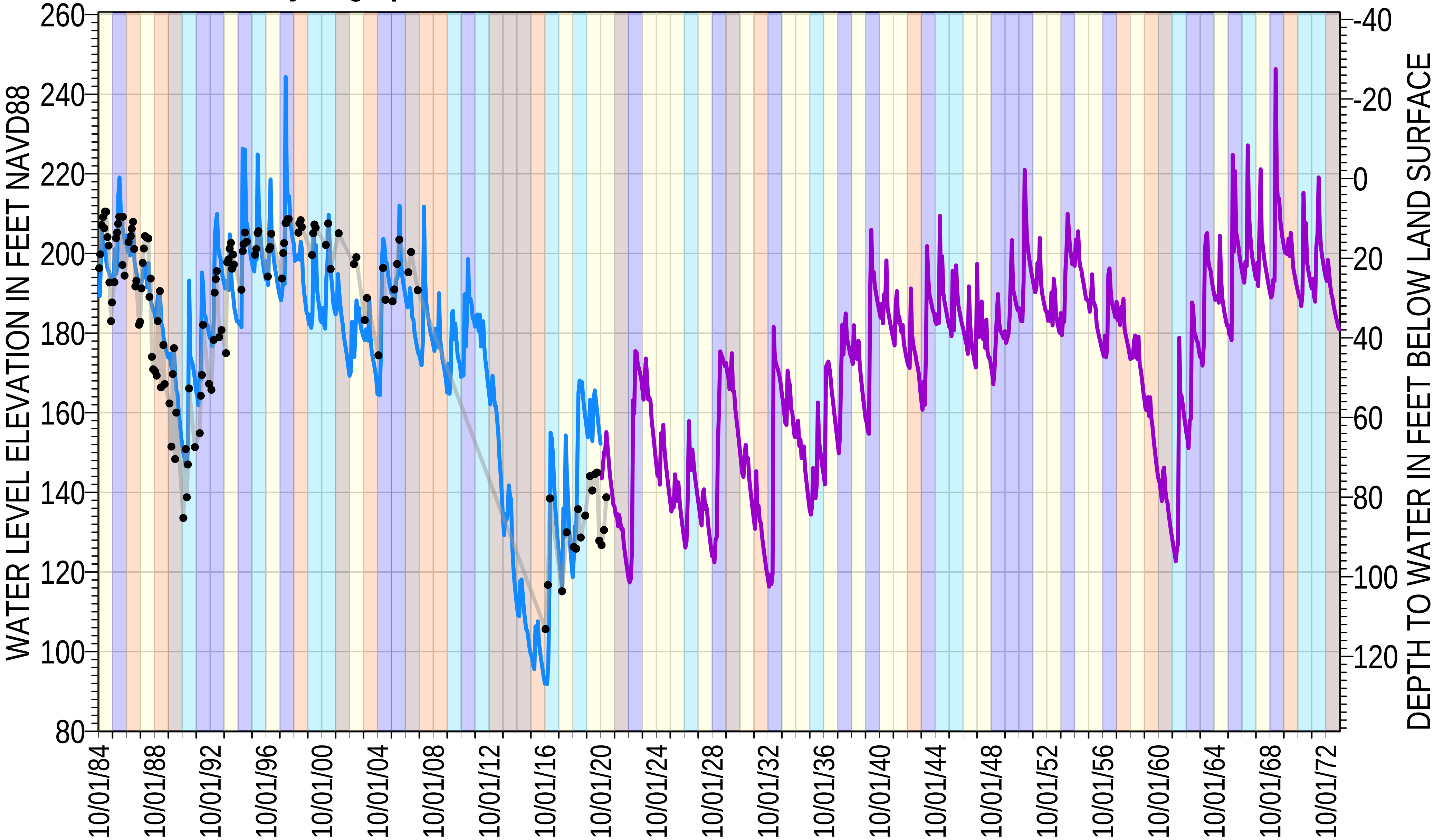
Measured
Projected Baseline
Historical

Well Type | Private
Reference Point Elevation (feet NAVD88) | 211.4
Model Layering (%) | L3: 70 L4: 30

Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet



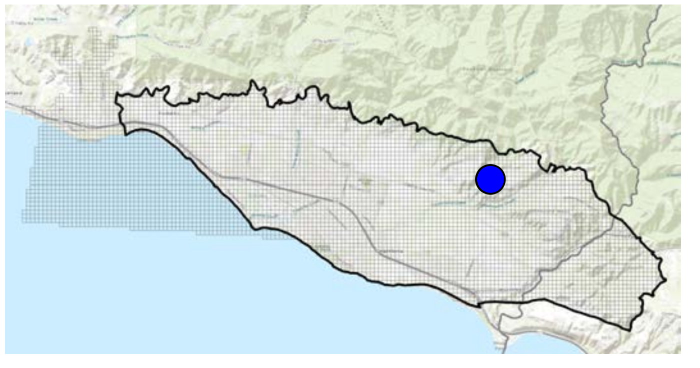
Water Level Hydrograph for 22R4



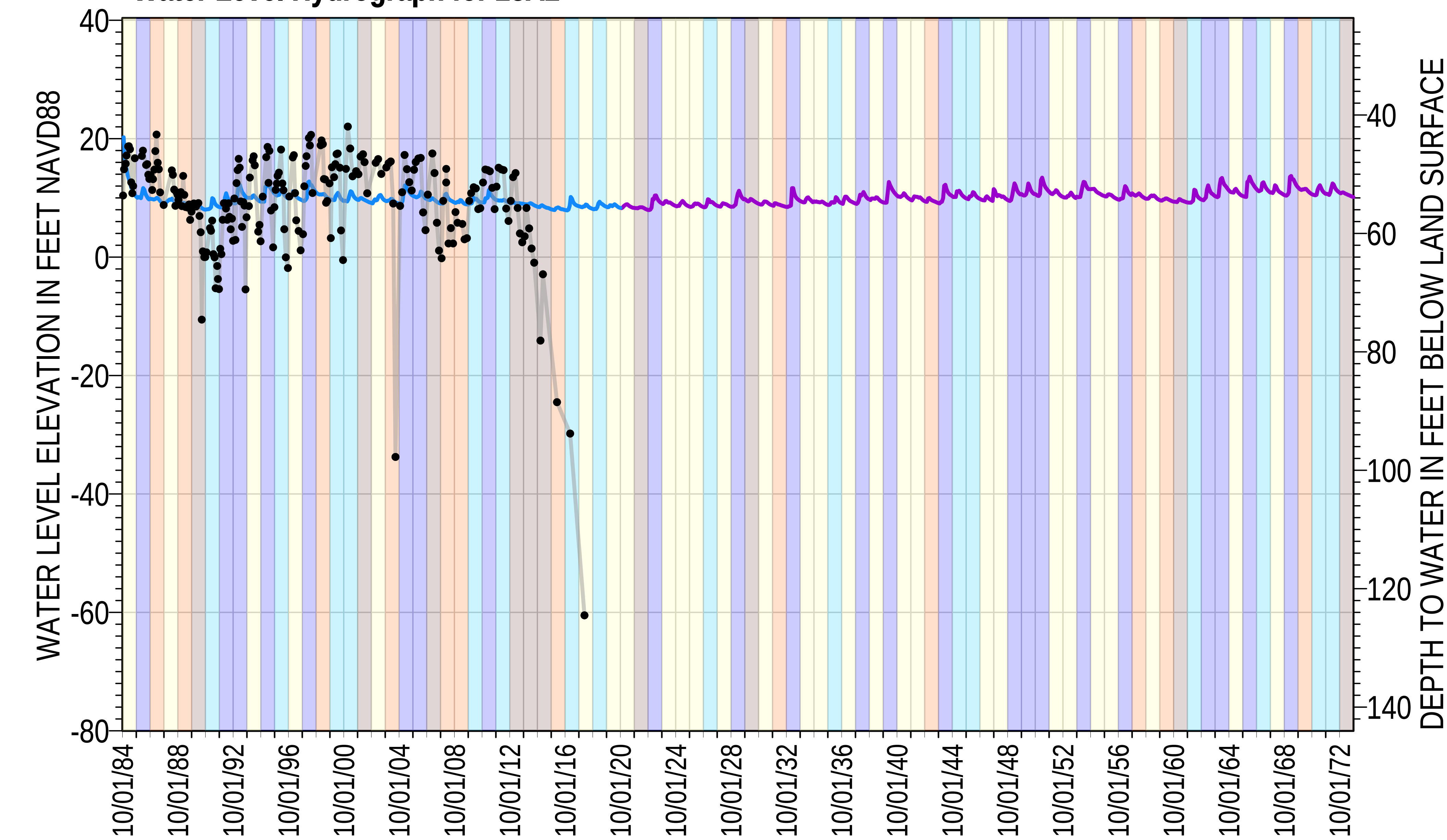
Measured
Projected Baseline
Historical

Well Type | Private
Reference Point Elevation (feet NAVD88) | 218.8
Model Layering (%) | L3: 4 L4: 41 L5: 54

Climate Classification
Critically Dry Dry Below Normal Above Normal Wet



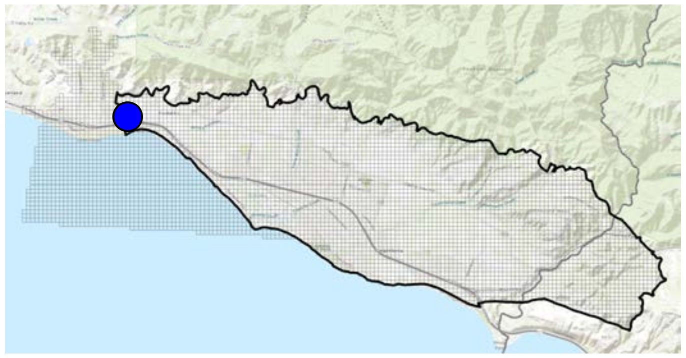
Water Level Hydrograph for 23A2

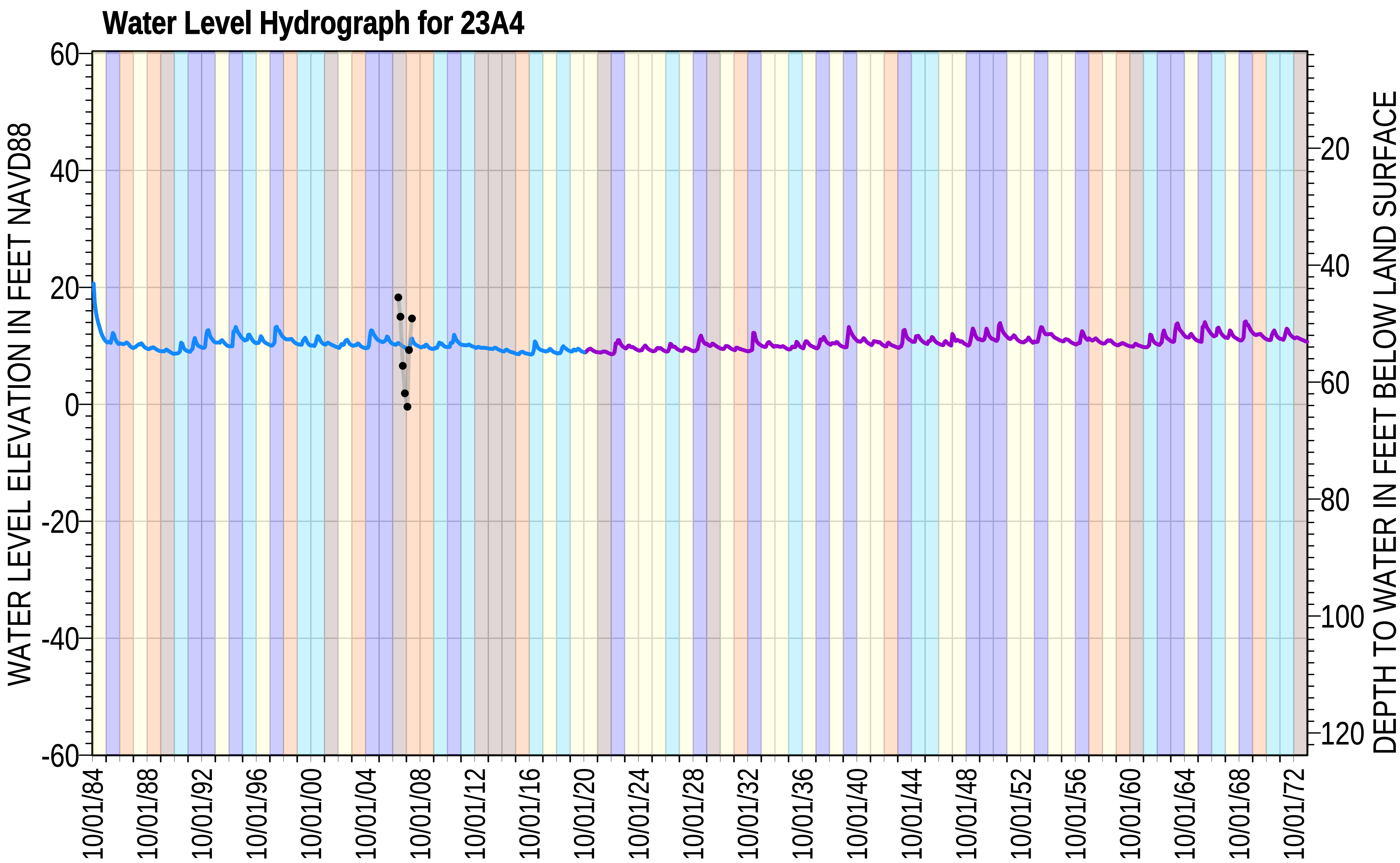


Well Type | Private

Reference Point Elevation (feet NAVD88) | 64

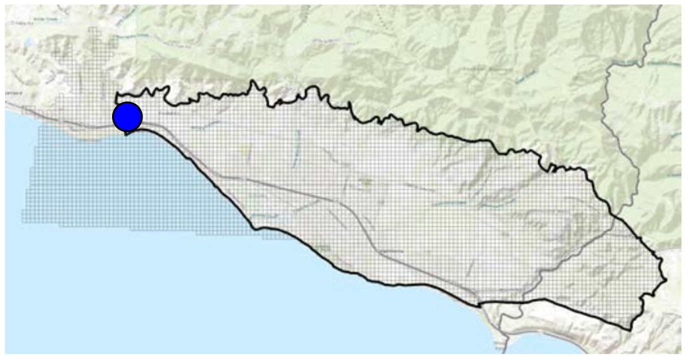
Model Layering (%) | L6: 100





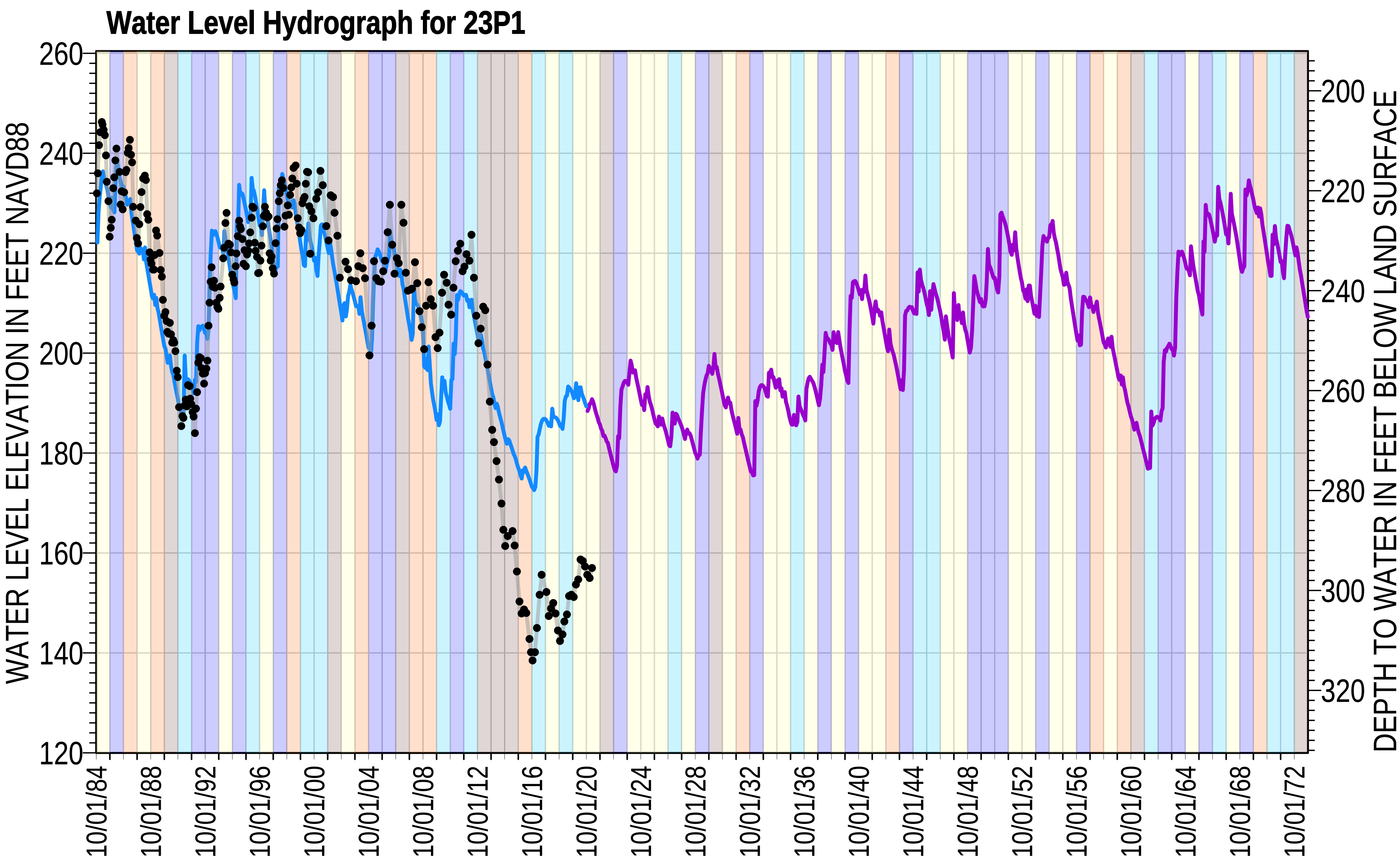
Measured
Projected Baseline
Historical

Well Type | Private
Reference Point Elevation (feet NAVD88) | 63.8
Model Layering (%) | L6: 100



Climate Classification

Critically Dry Dry Below Normal Above Normal Wet

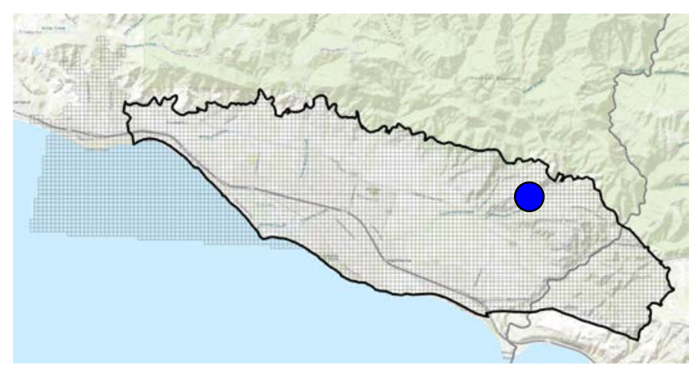


Measured
Projected Baseline
Historical

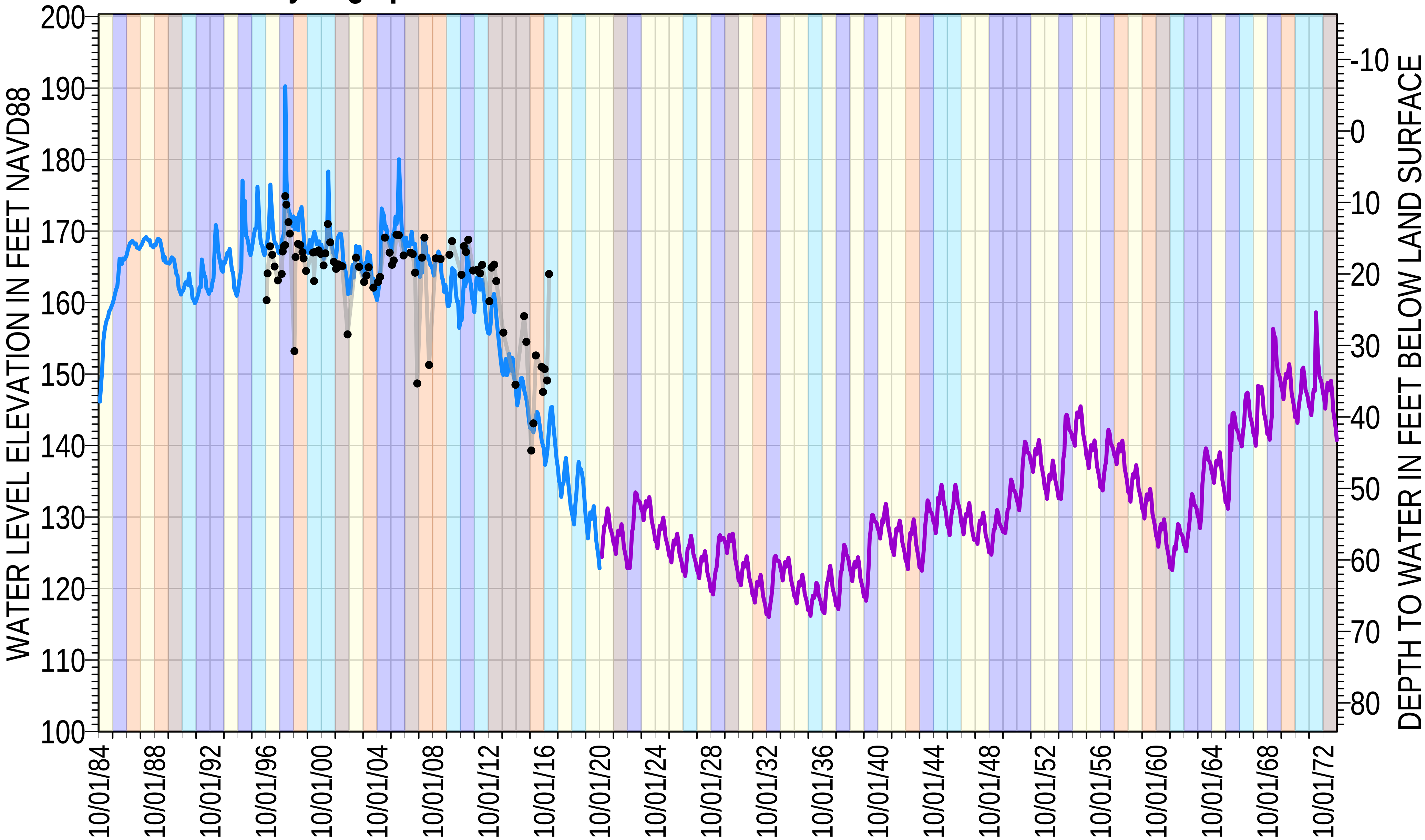
Well Type | Private
Reference Point Elevation (feet NAVD88) | 452.5
Model Layering (%) | L4: 15 L5: 85

Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet



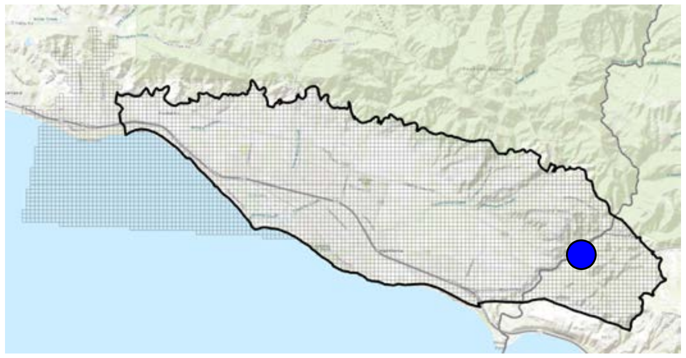
Water Level Hydrograph for 25N5



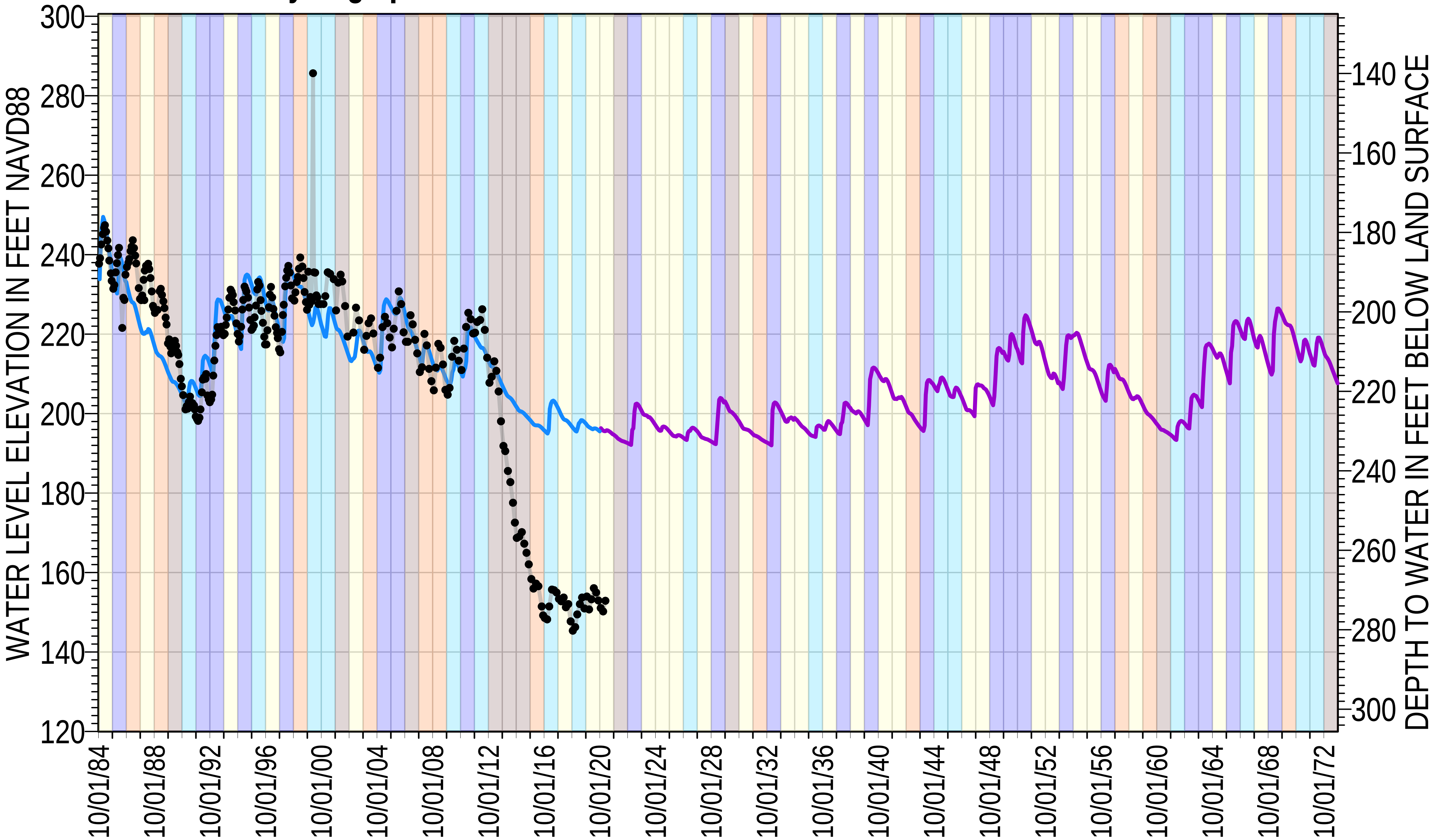
Well Type | Private

Reference Point Elevation (feet NAVD88) | 184

Model Layering (%) | L5: 100

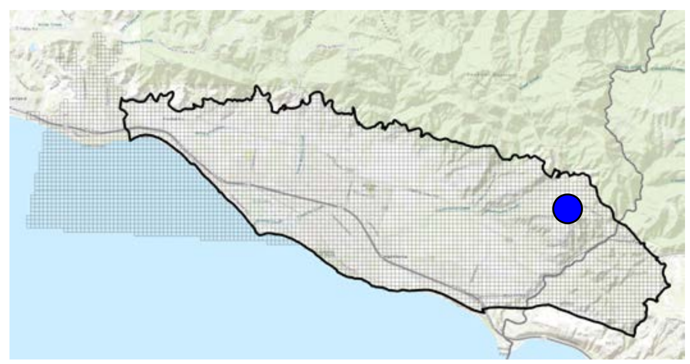


Water Level Hydrograph for 26A1



Measured
Projected Baseline
Historical

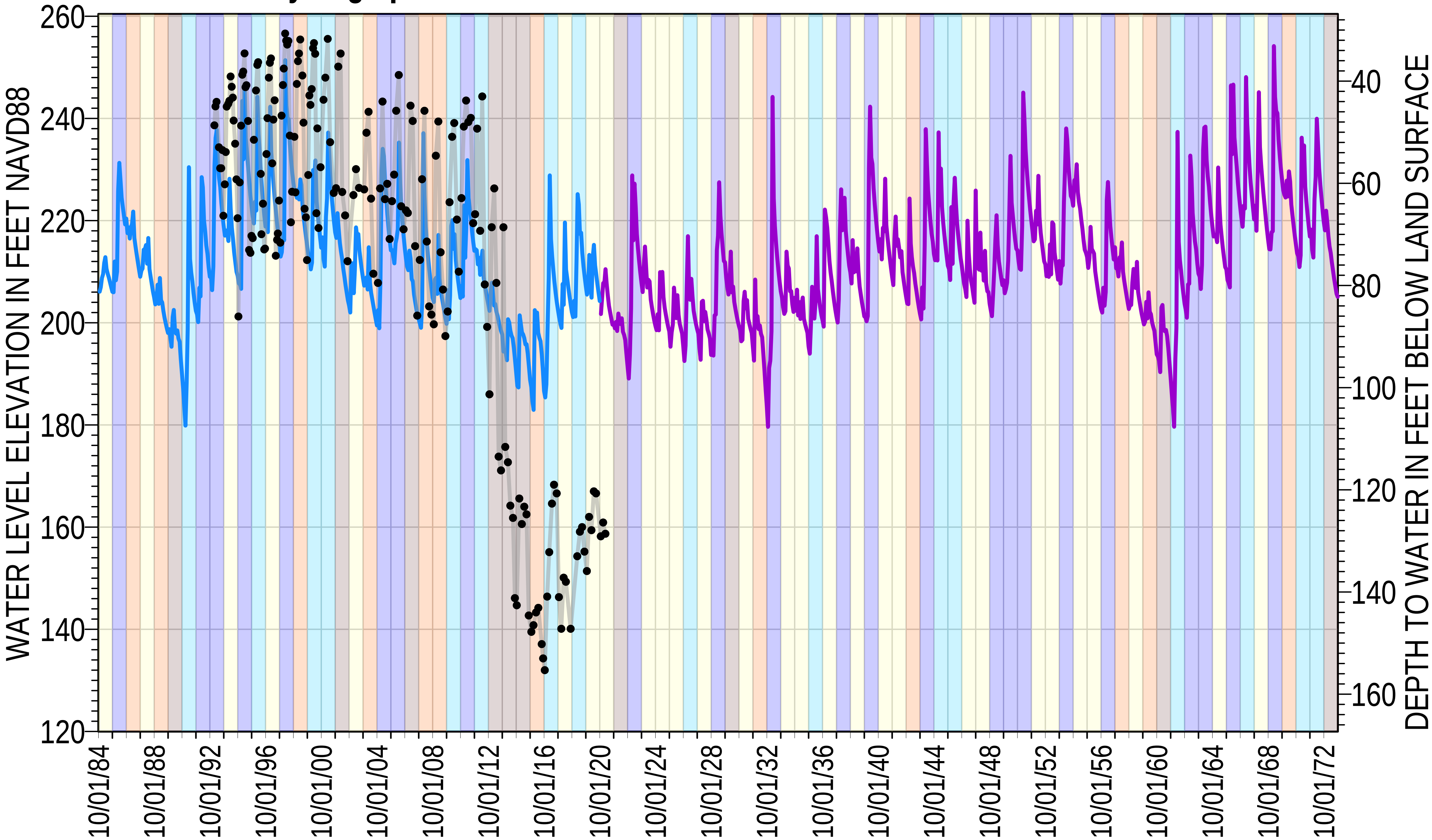
Well Type | Private
Reference Point Elevation (feet NAVD88) | 425.6
Model Layering (%) | L5: 61 L6: 31 L7: 8



Climate Classification

Critically Dry   Dry   Below Normal   Above Normal   Wet

Water Level Hydrograph for 26C1



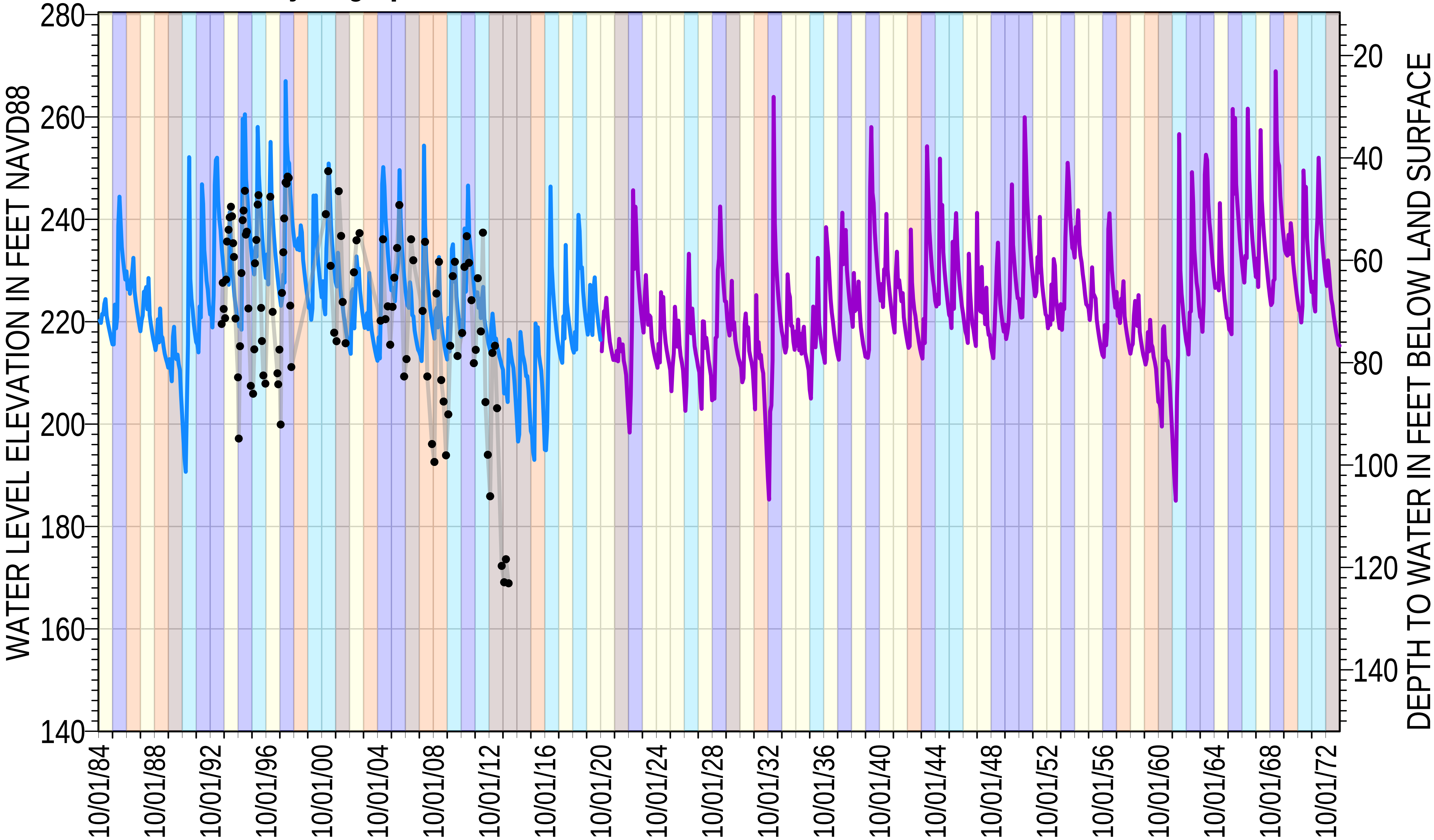
Measured
Projected Baseline
Historical

Well Type | Private
Reference Point Elevation (feet NAVD88) | 287.3
Model Layering (%) | L4: 3 L5: 97

Climate Classification

Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for 26C6



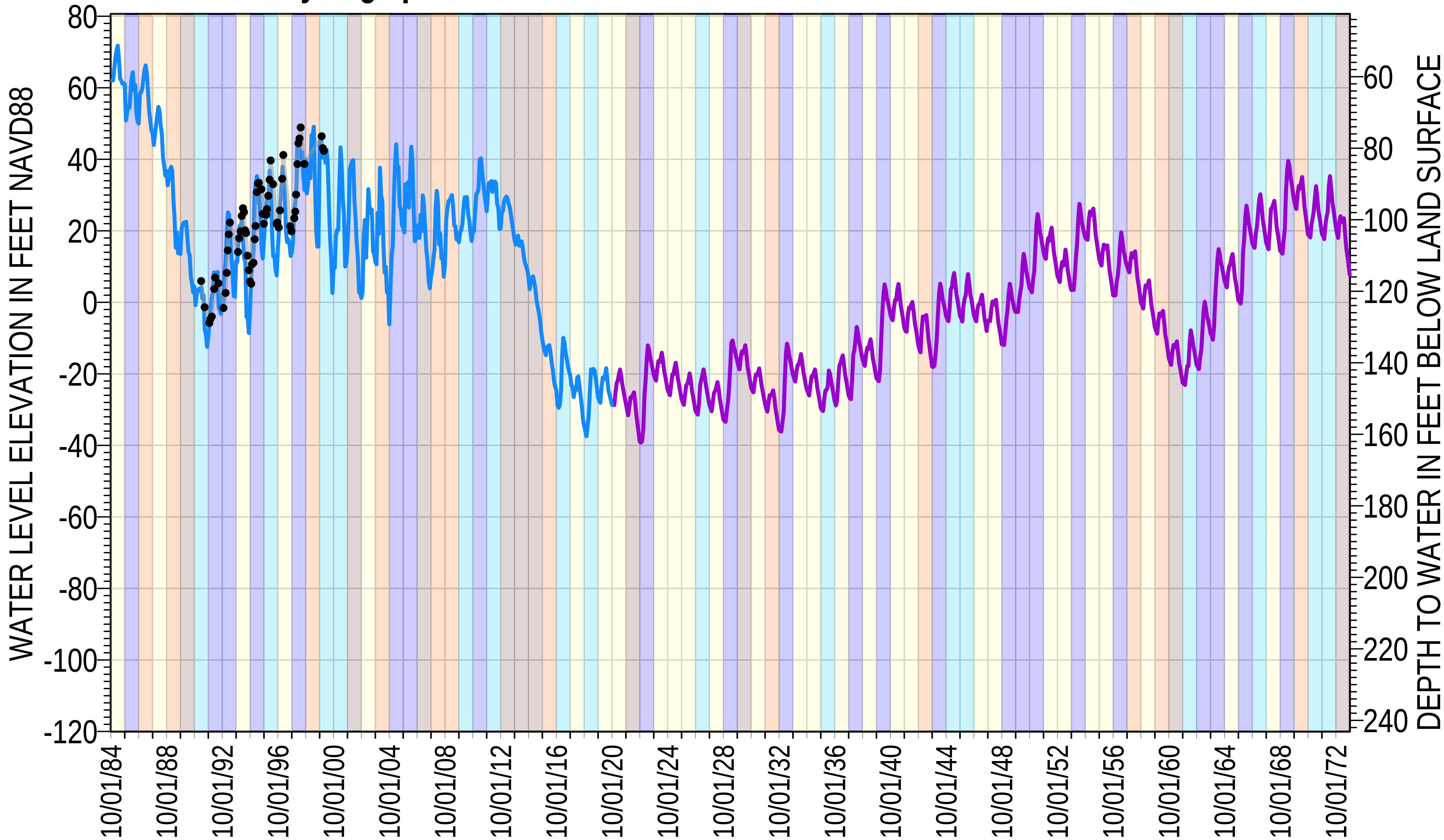
Measured
Projected Baseline
Historical

Well Type | Private
Reference Point Elevation (feet NAVD88) | 292
Model Layering (%) | L4: 4 L5: 85 L6: 11

Climate Classification

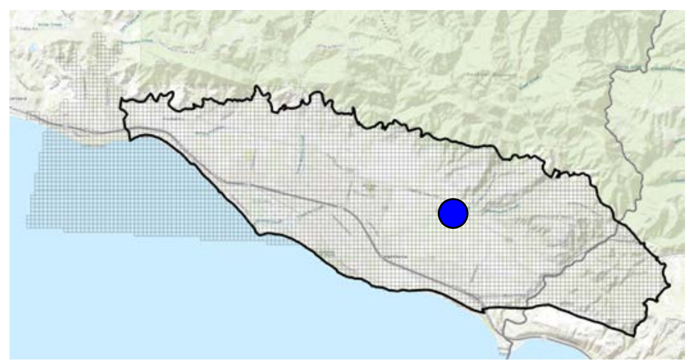
Critically Dry Dry Below Normal Above Normal Wet

Water Level Hydrograph for 27F1



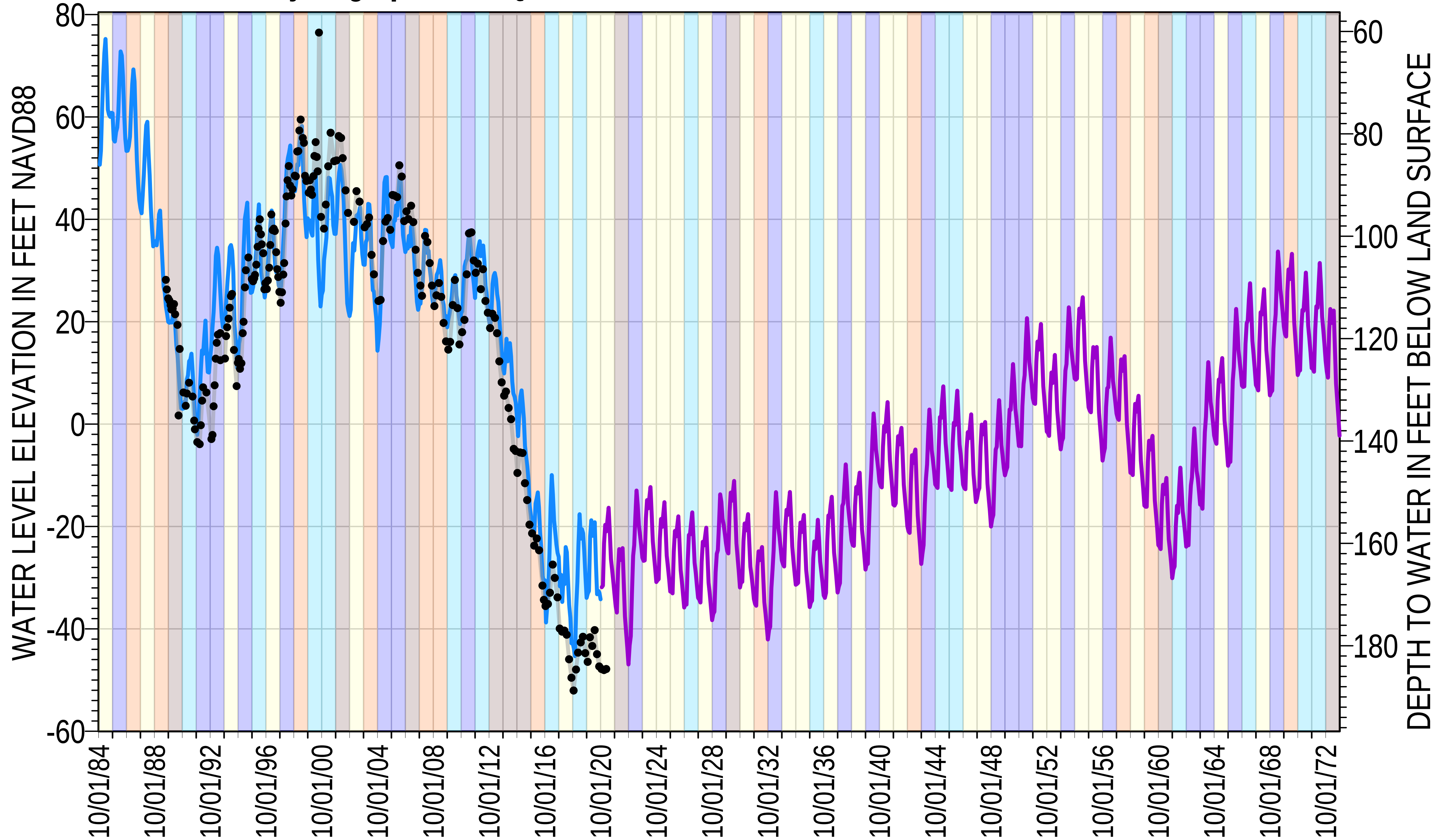
Measured
Projected Baseline
Historical

Well Type | Private
Reference Point Elevation (feet NAVD88) | 123.1
Model Layering (%) | L3: 100



Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

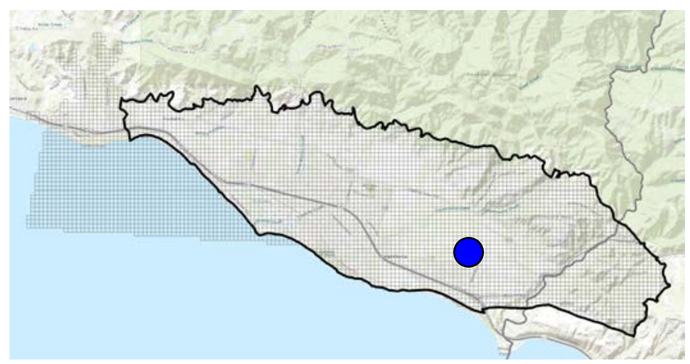
Water Level Hydrograph for 27Q6



Well Type | Private

Reference Point Elevation (feet NAVD88) | 136.7

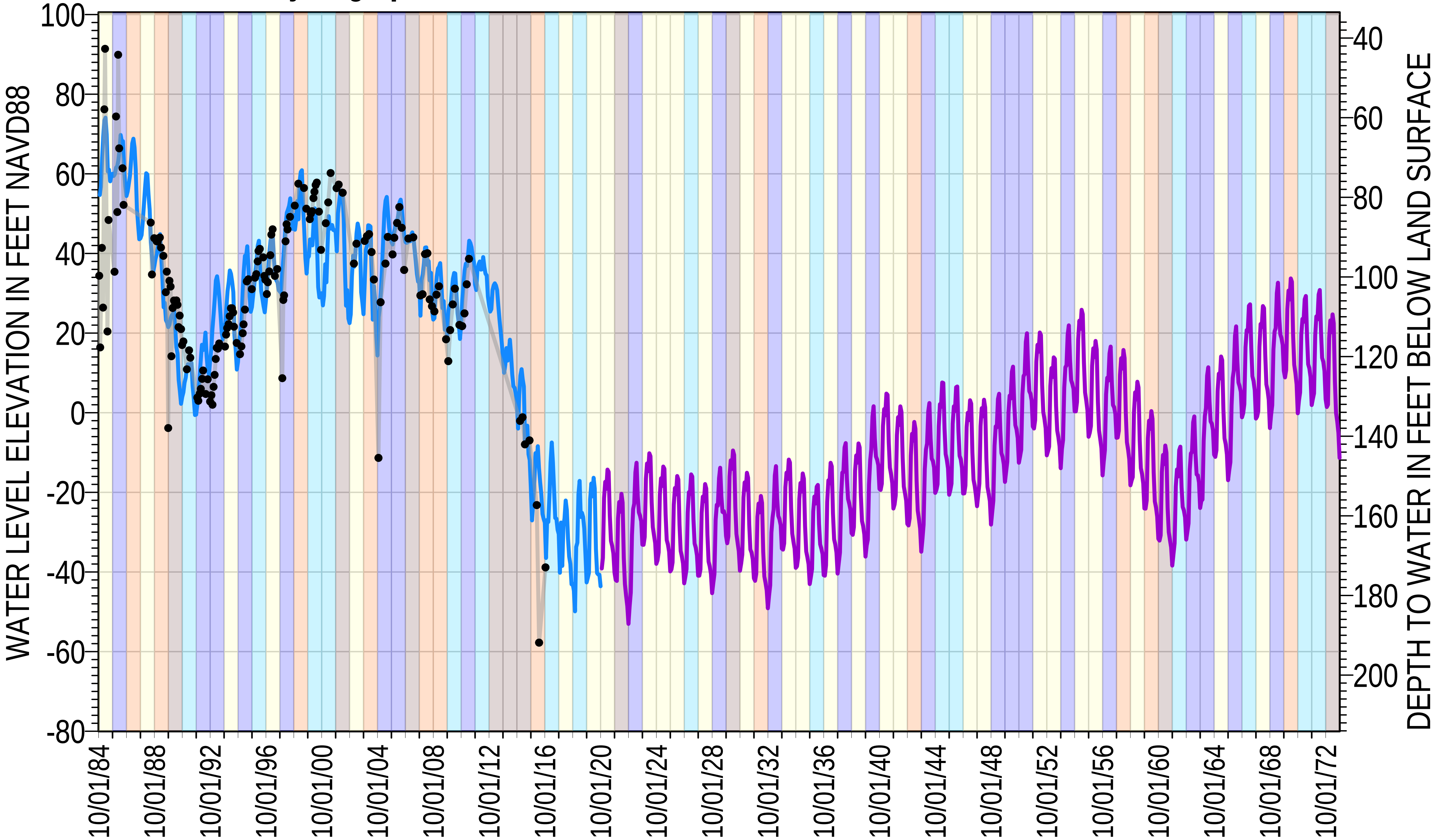
Model Layering (%) | L3: 65 L4: 16 L5: 18



Climate Classification

Critically Dry · Dry · Below Normal · Above Normal · Wet

Water Level Hydrograph for 27R2

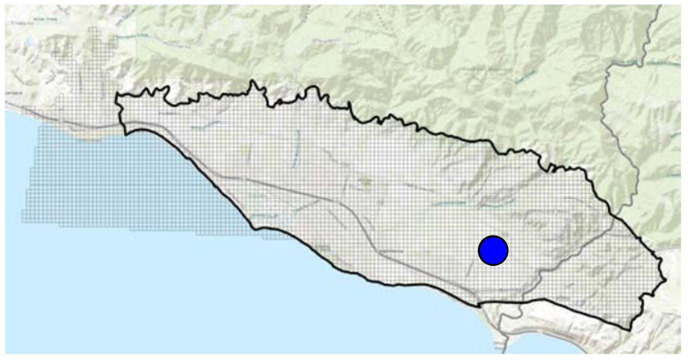


Measured
Projected Baseline
Historical

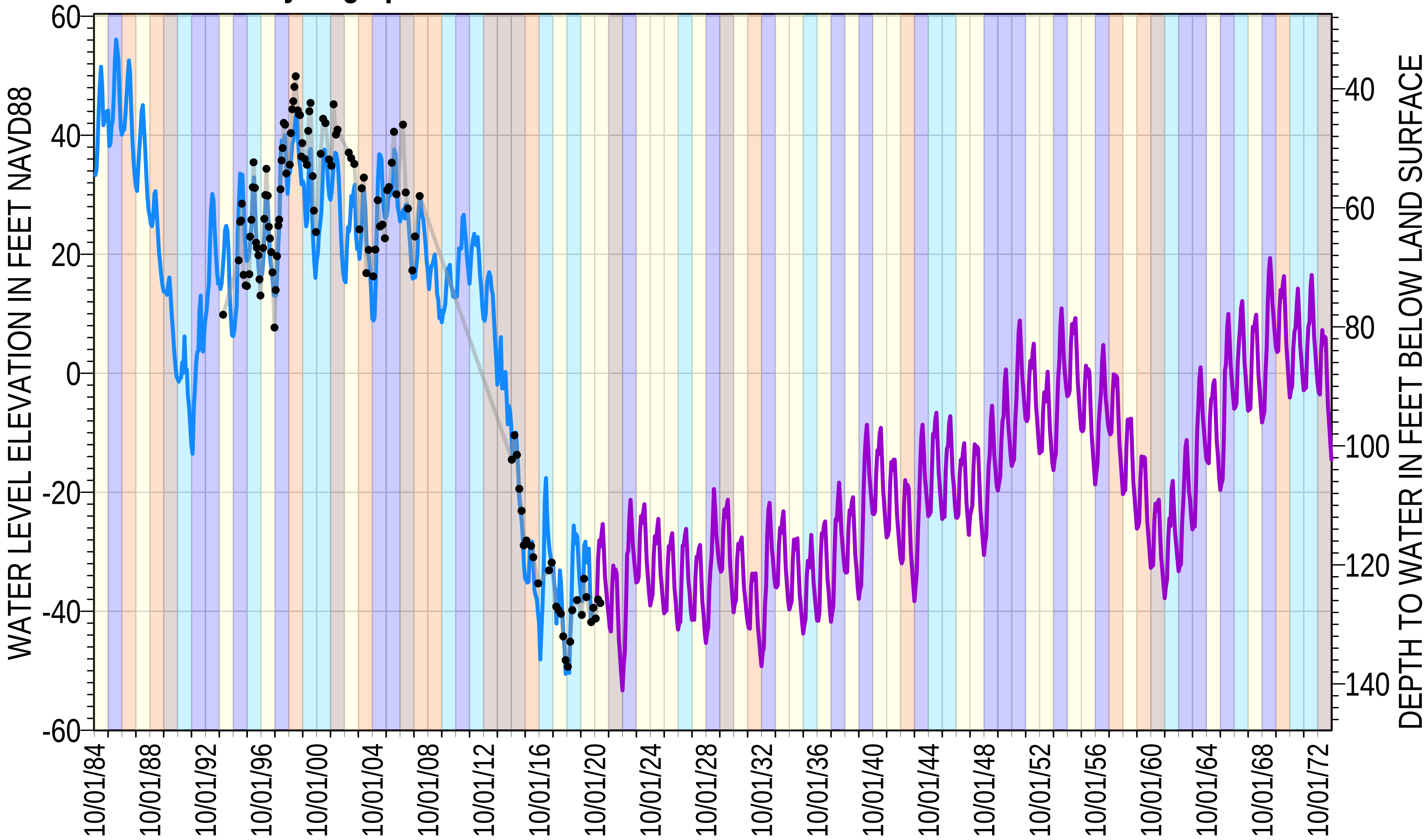
Well Type | Private
Reference Point Elevation (feet NAVD88) | 134.1
Model Layering (%) | L4: 84 L5: 16

Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

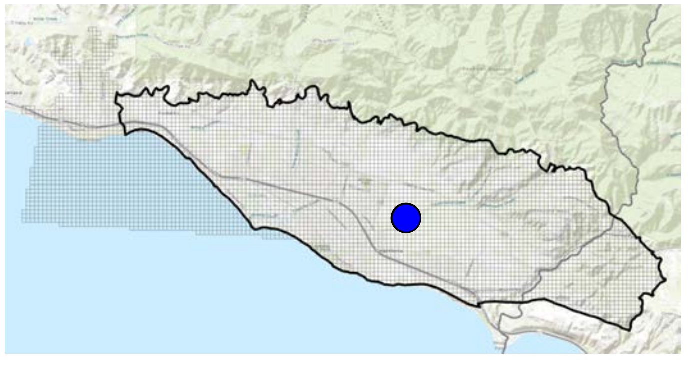


Water Level Hydrograph for 28G3



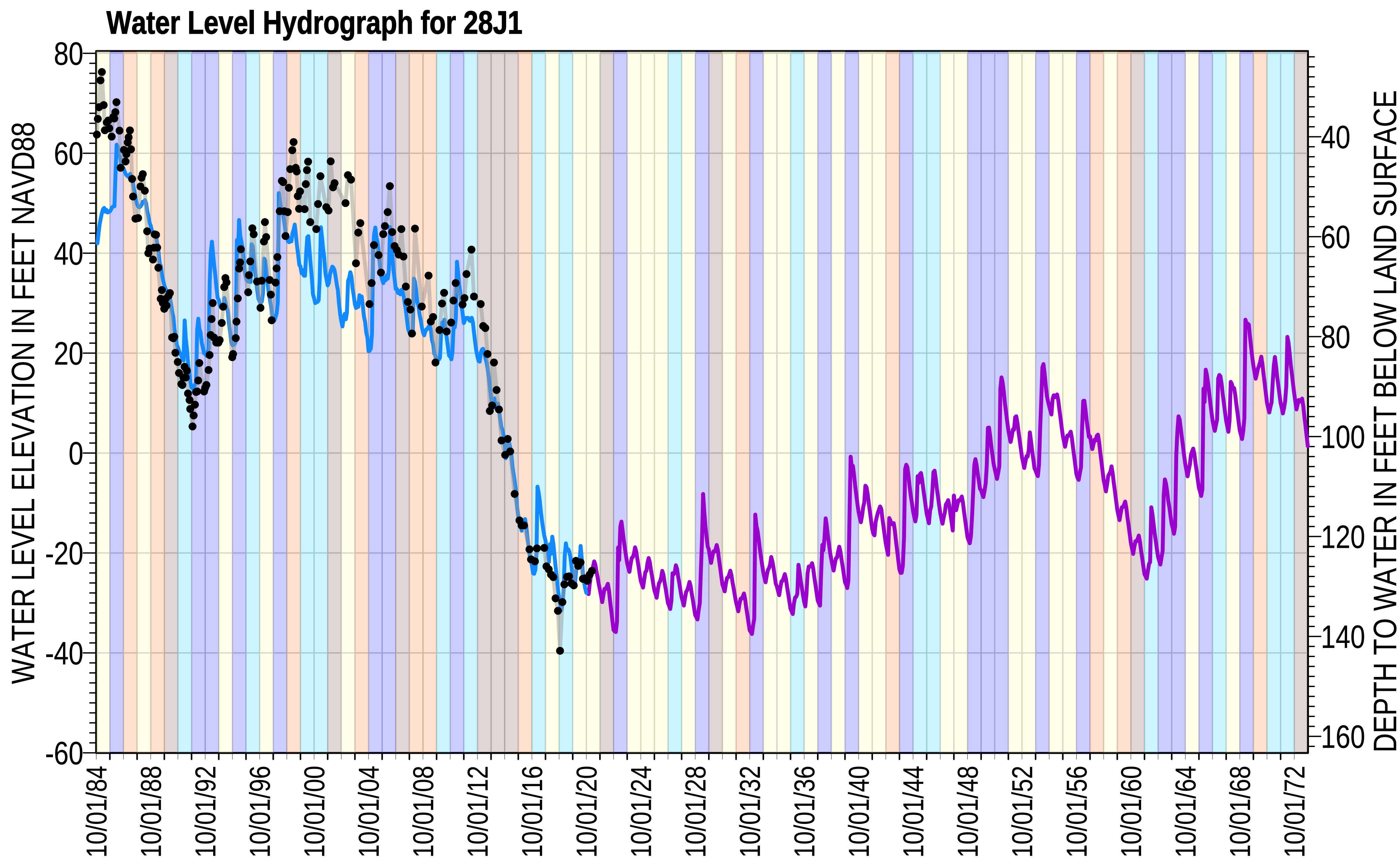
Measured
Projected Baseline
Historical

Well Type | Private
Reference Point Elevation (feet NAVD88) | 87.8
Model Layering (%) | L1: 21 L2: 49 L3: 30



Climate Classification

Critically Dry   Dry   Below Normal   Above Normal   Wet



Measured

Projected Baseline

Historical

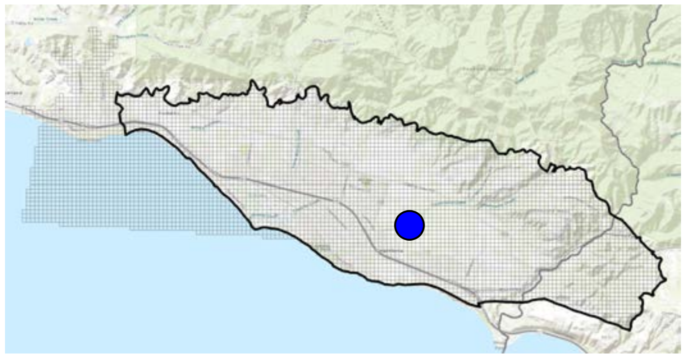
Well Type | Private

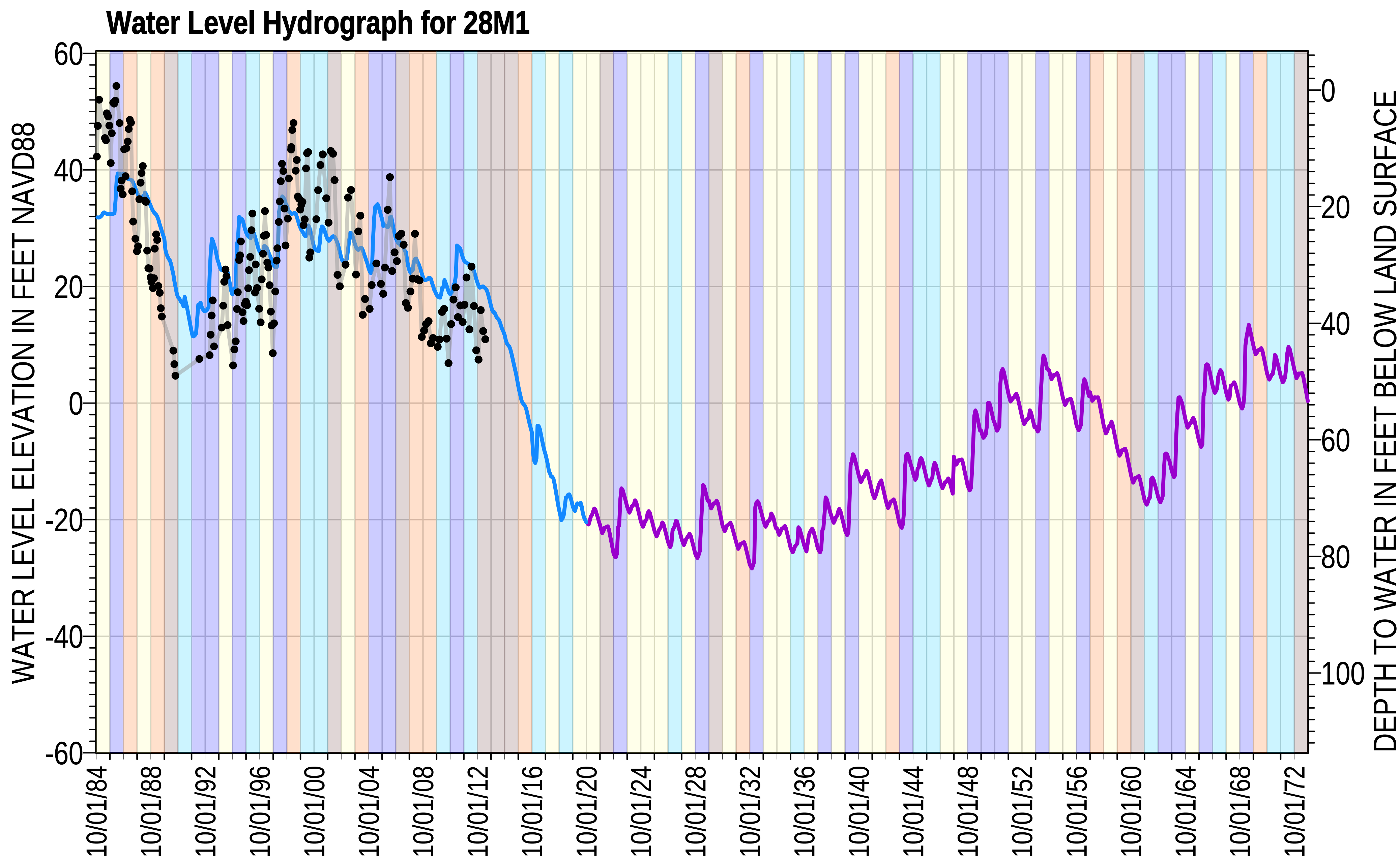
Reference Point Elevation (feet NAVD88) | 103.3

Model Layering (%) | L1: 100

Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet





Measured

Projected Baseline

Historical

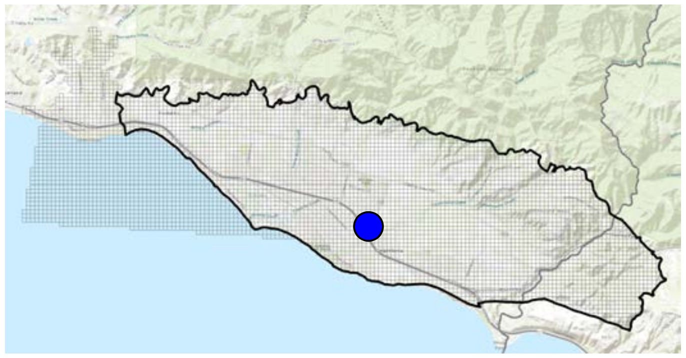
Well Type | Private

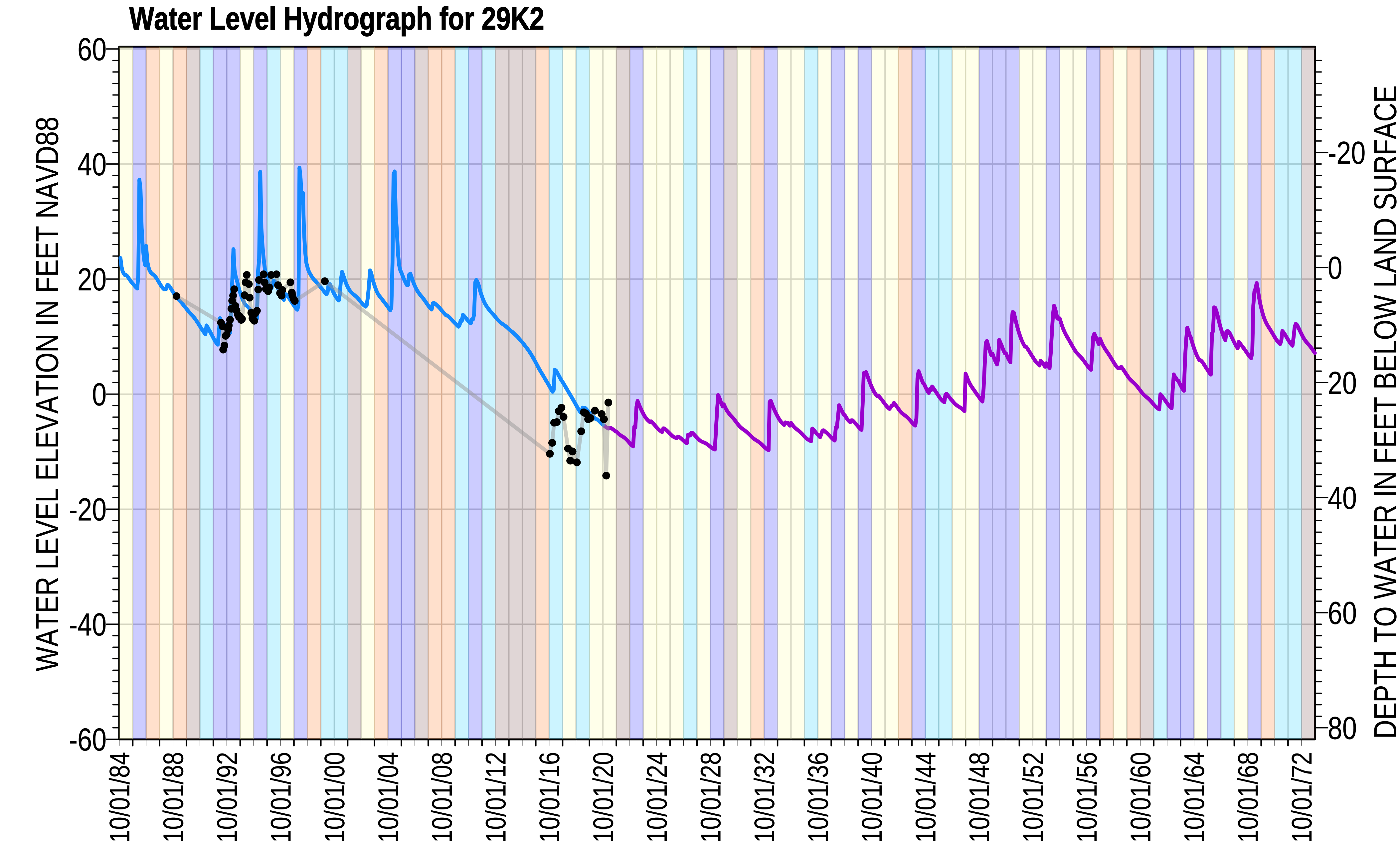
Reference Point Elevation (feet NAVD88) | 53.7

Model Layering (%) | L1: 100

Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

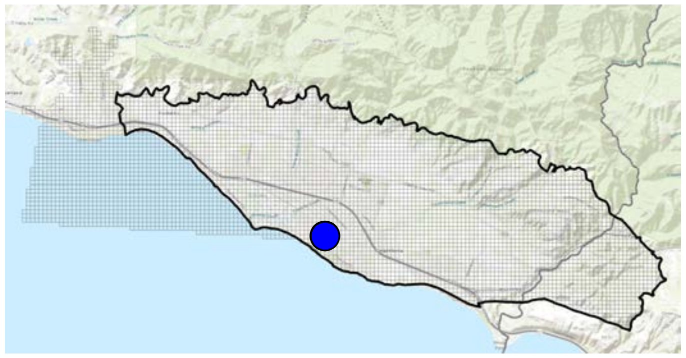




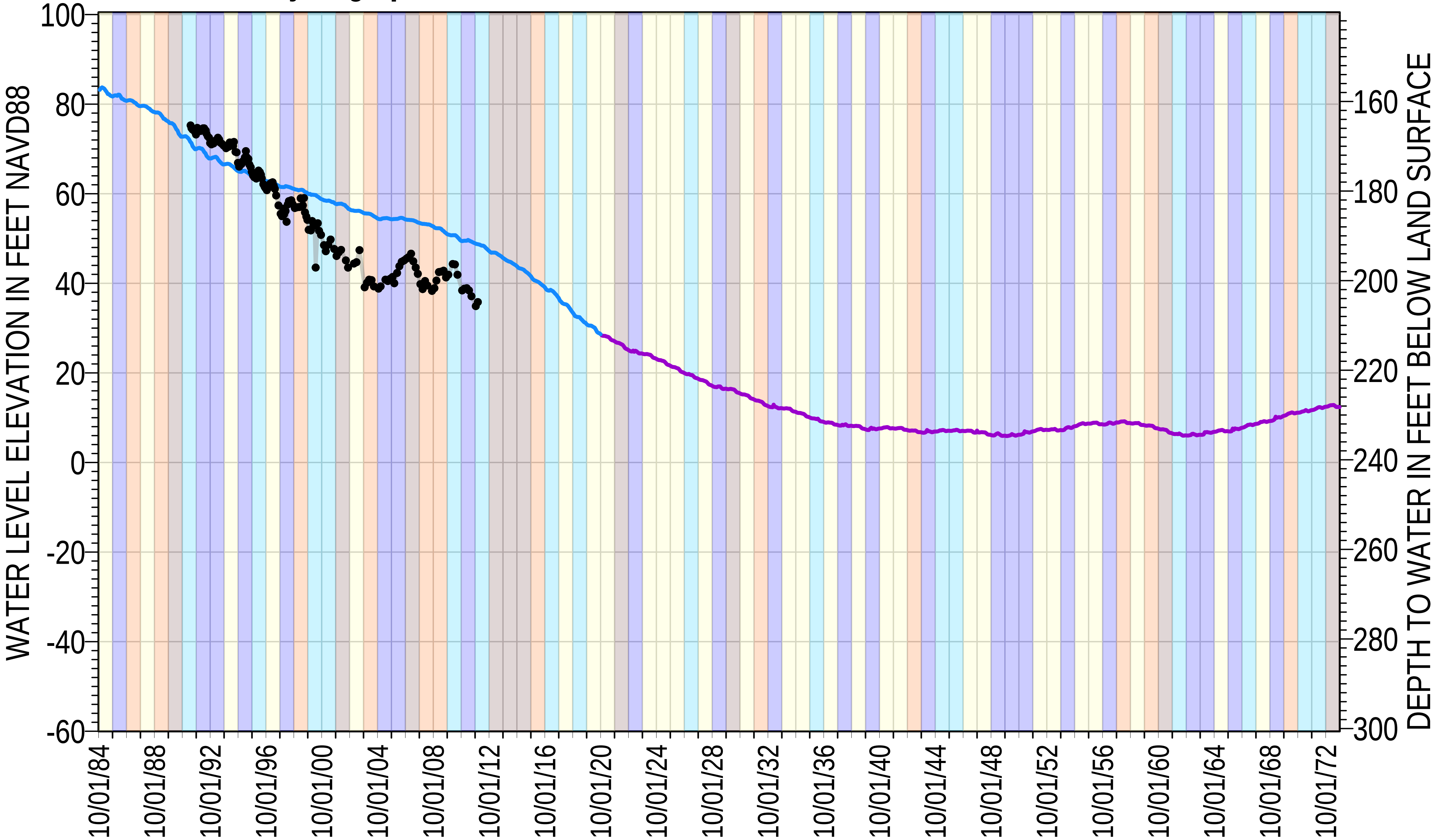
Well Type | Private

Reference Point Elevation (feet NAVD88) | 22

Model Layering (%) | L1: 100

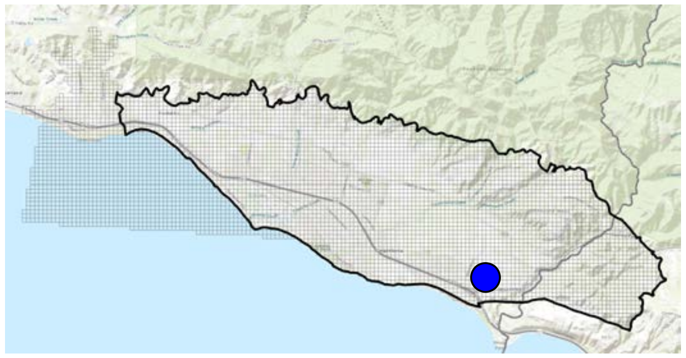


Water Level Hydrograph for 34A1



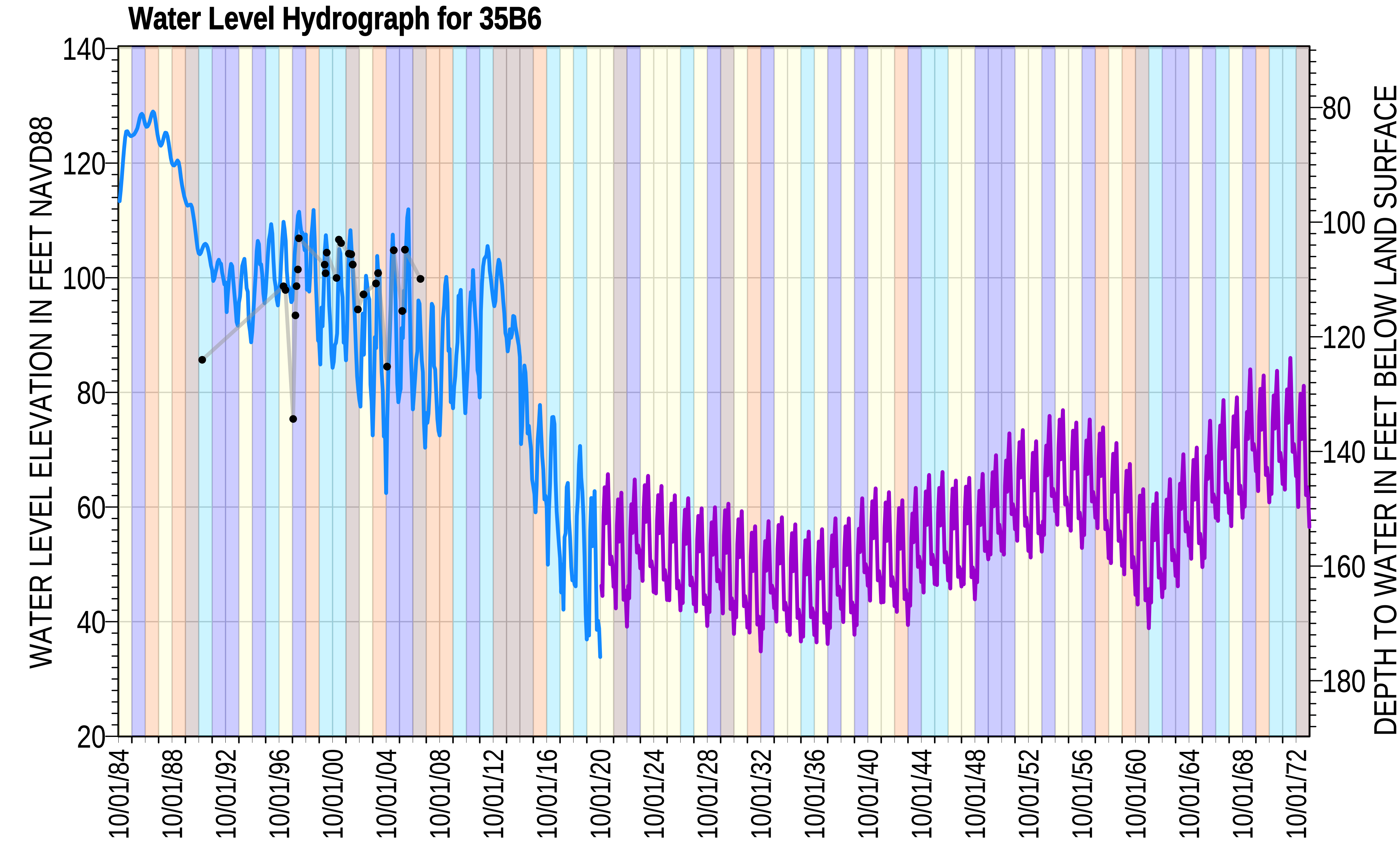
Measured
Projected Baseline
Historical

Well Type | Private
Reference Point Elevation (feet NAVD88) | 240.6
Model Layering (%) | L1: 33 L2: 23 L3: 44



Climate Classification

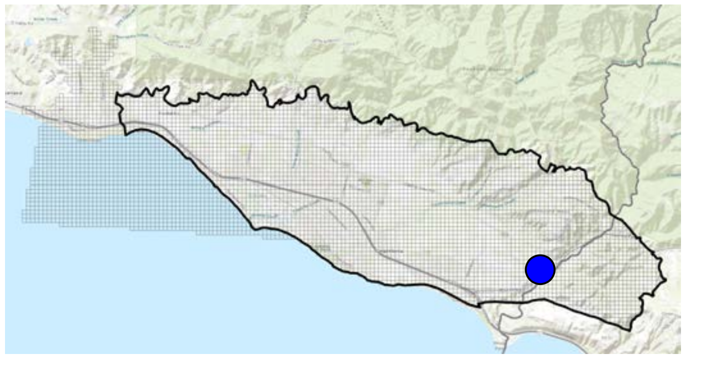
Critically Dry | Dry | Below Normal | Above Normal | Wet

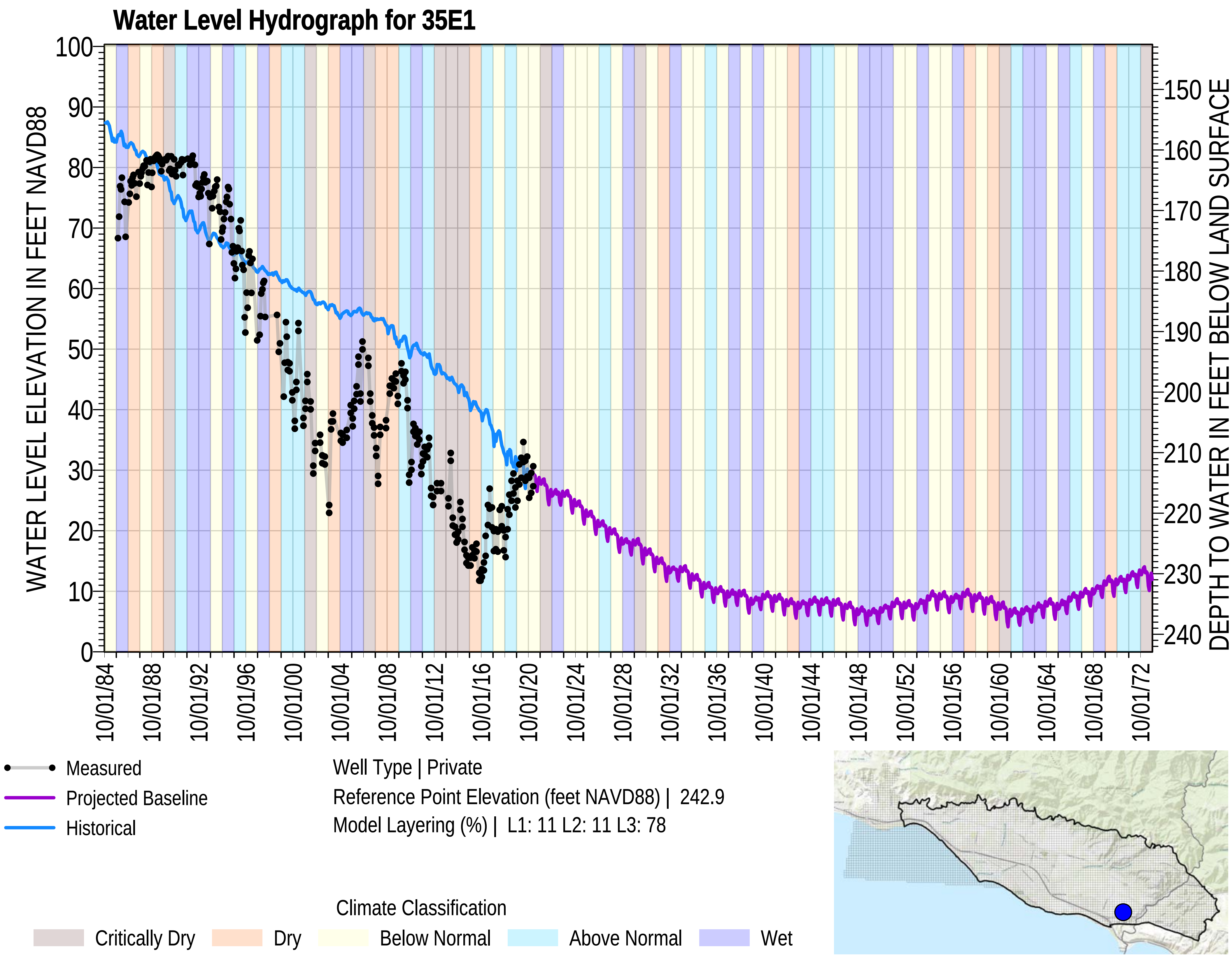


Well Type | Private

Reference Point Elevation (feet NAVD88) | 209.7

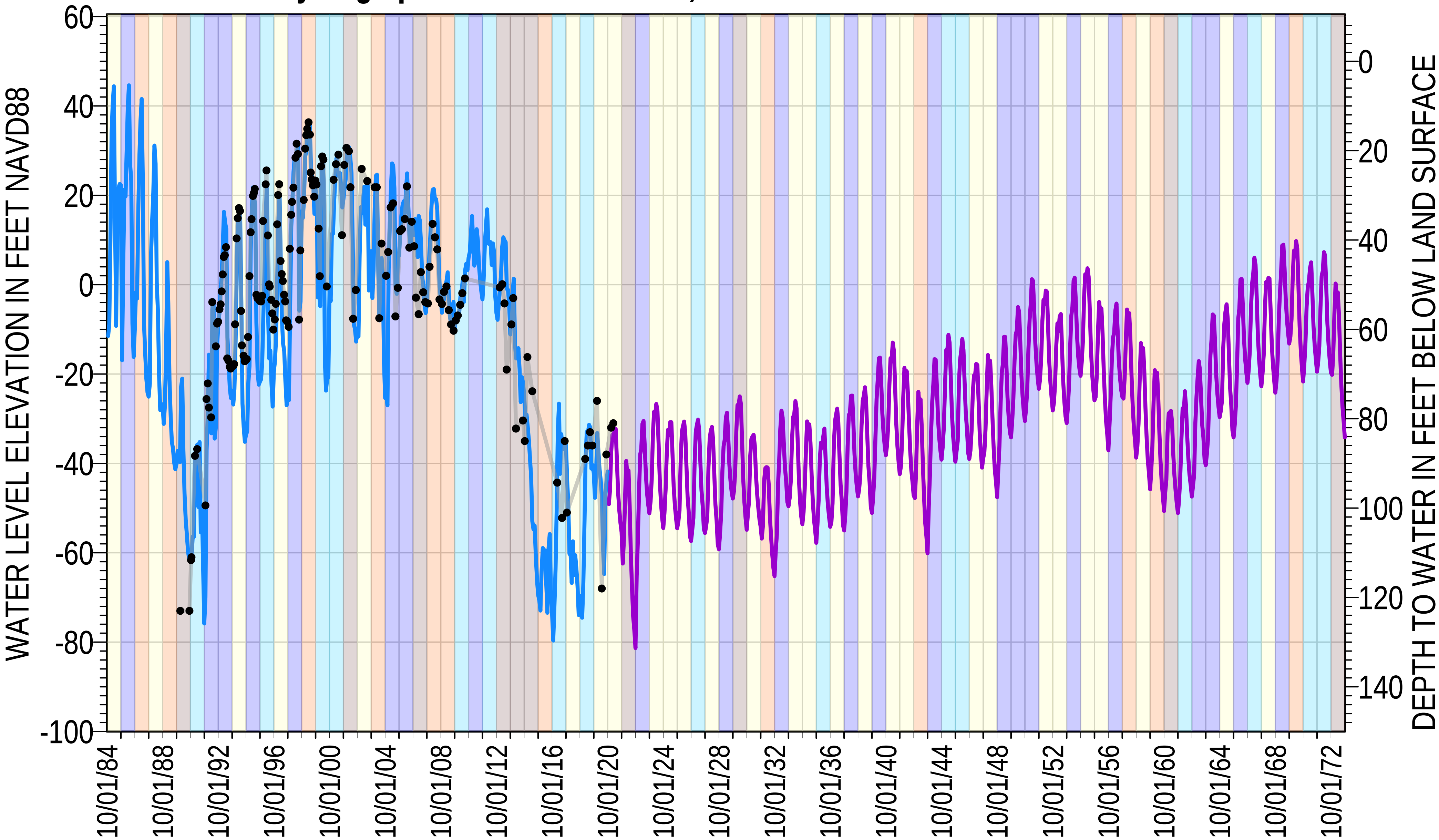
Model Layering (%) | L3: 37 L4: 24 L5: 40





Water Level Hydrograph for 35E1
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
0
10
20
30
40
50
60
70
80
90
100
150
160
170
180
190
200
210
220
230
240
10/01/84
10/01/88
10/01/92
10/01/96
10/01/00
10/01/04
10/01/08
10/01/12
10/01/16
10/01/20
10/01/24
10/01/28
10/01/32
10/01/36
10/01/40
10/01/44
10/01/48
10/01/52
10/01/56
10/01/60
10/01/64
10/01/68
10/01/72
Measured
Projected Baseline
Historical
Well Type | Private
Reference Point Elevation (feet NAVD88) | 242.9
Model Layering (%) | L1: 11 L2: 11 L3: 78
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for El Carro Well #1, 28D2

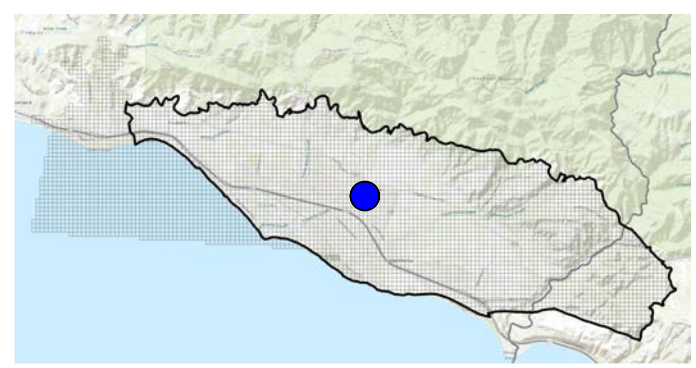


Measured
Projected Baseline
Historical

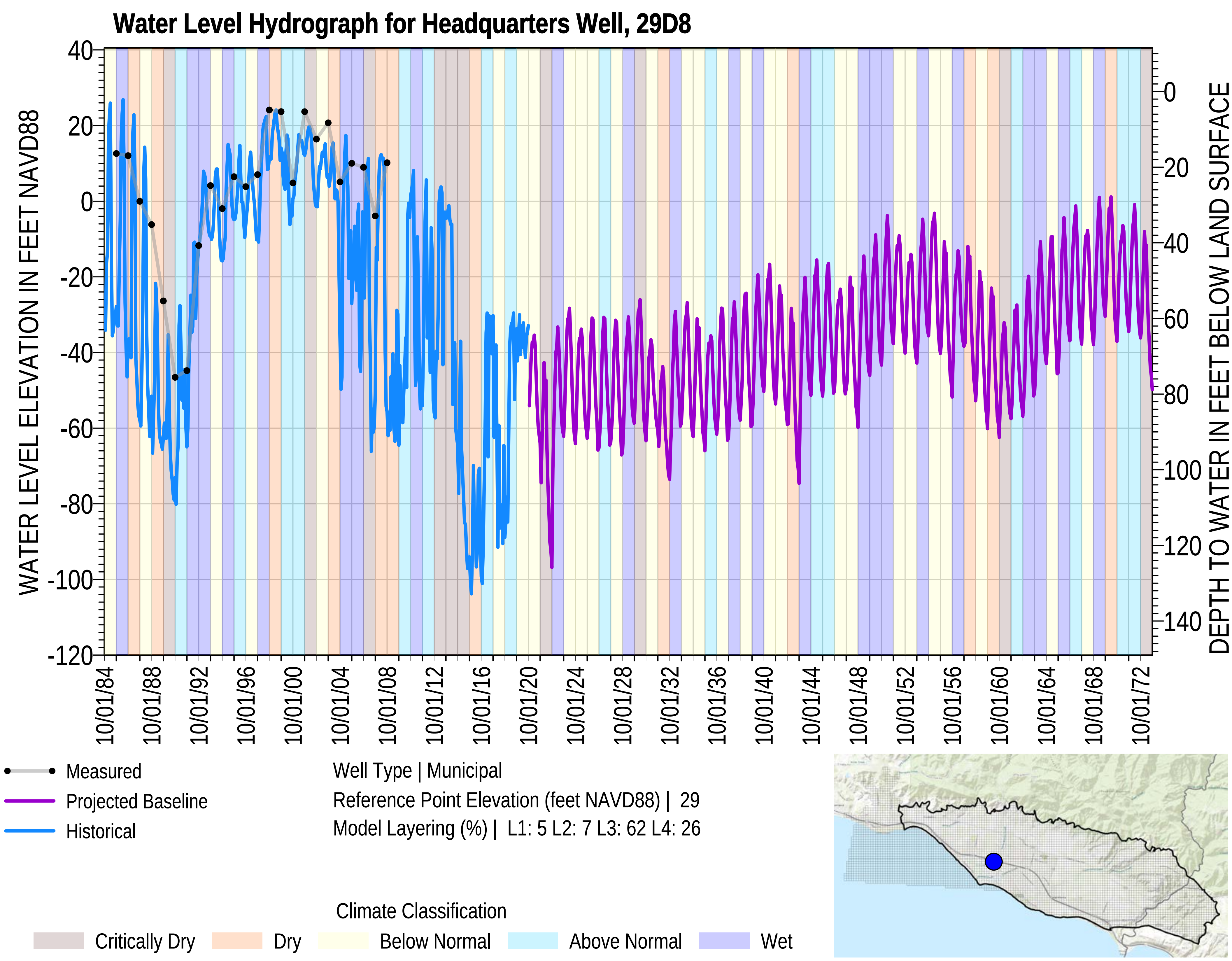
Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 50
Model Layering (%) | L1: 2 L2: 18 L4: 30 L6: 50

Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

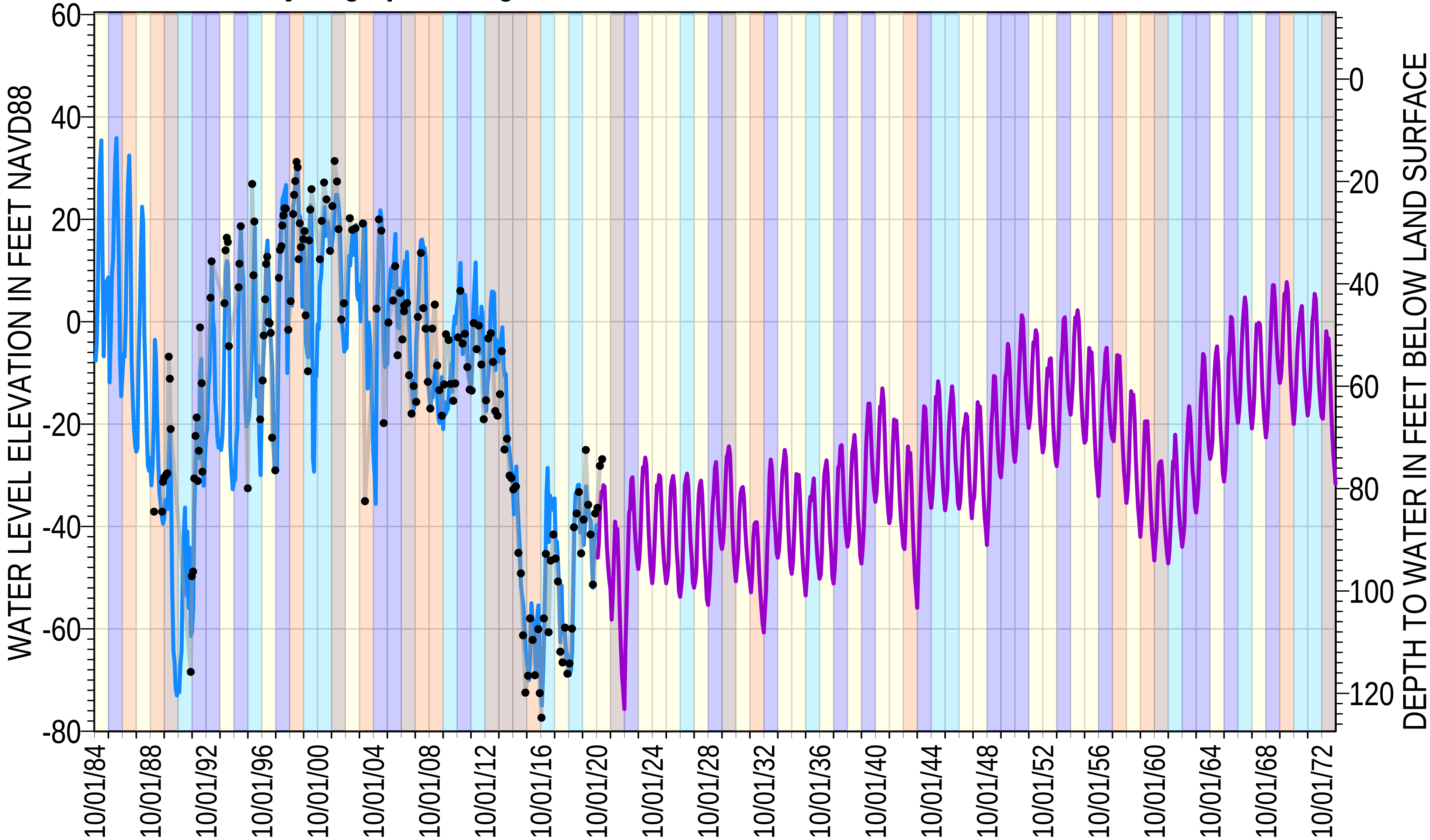


DOES NOT MAKE FILE CORRECTLY



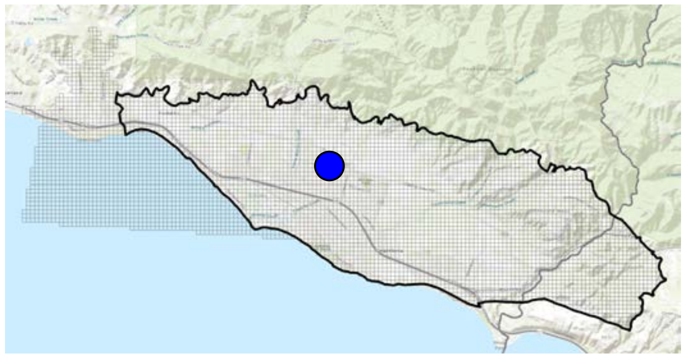
Water Level Hydrograph for Headquarters Well, 29D8
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
40
20
0
-20
-40
-60
-80
-100
-120
0
20
40
60
80
100
120
140
10/01/84
10/01/88
10/01/92
10/01/96
10/01/00
10/01/04
10/01/08
10/01/12
10/01/16
10/01/20
10/01/24
10/01/28
10/01/32
10/01/36
10/01/40
10/01/44
10/01/48
10/01/52
10/01/56
10/01/60
10/01/64
10/01/68
10/01/72
Measured
Projected Baseline
Historical
Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 29
Model Layering (%) | L1: 5 L2: 7 L3: 62 L4: 26
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for High School Well, 20K4



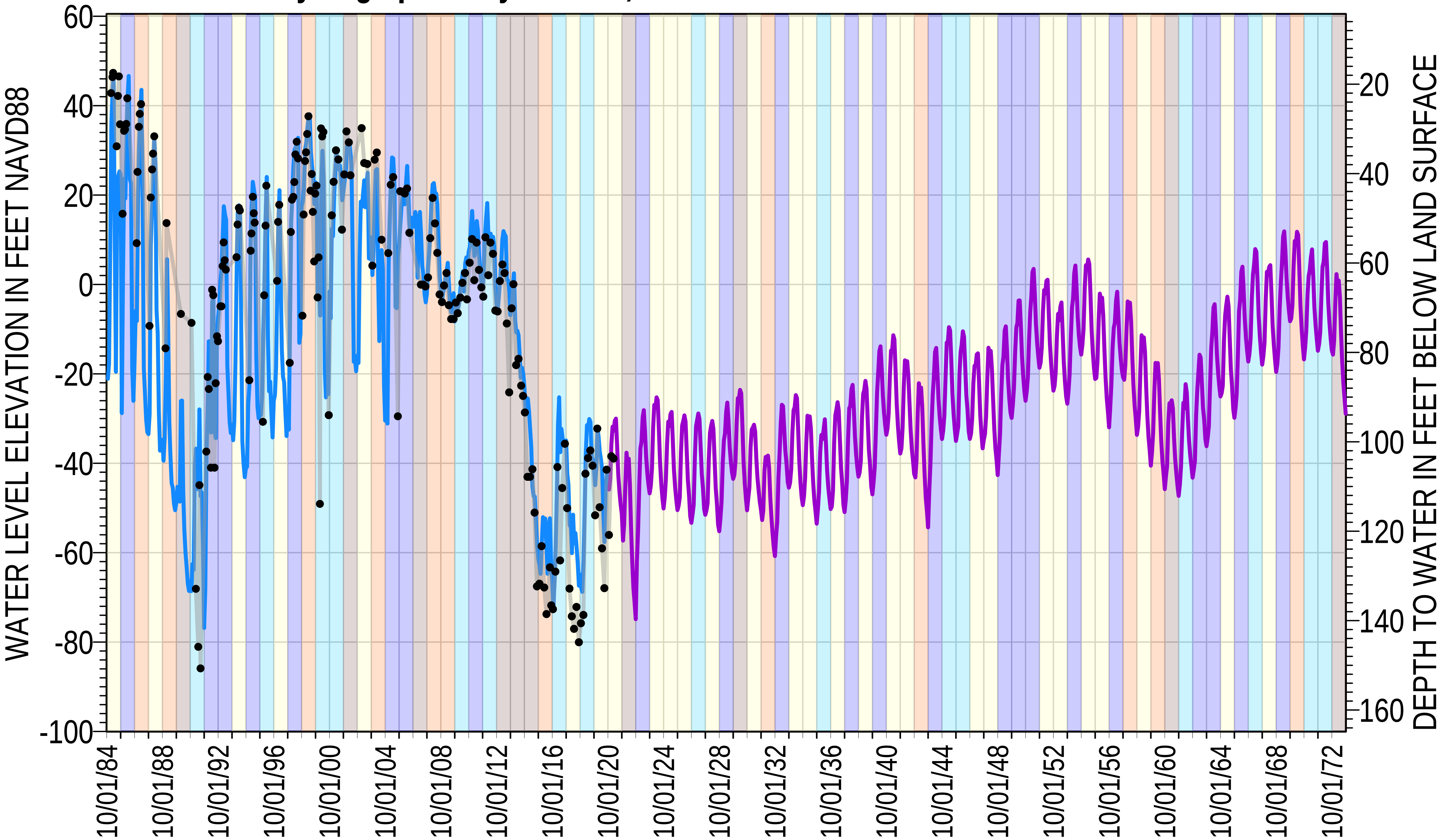
Measured
Projected Baseline
Historical

Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 47.4
Model Layering (%) | L3: 43 L4: 10 L5: 27 L6: 20



Climate Classification
Critically Dry · Dry · Below Normal · Above Normal · Wet

Water Level Hydrograph for Lyons Well, 28F7



Measured

Projected Baseline

Historical

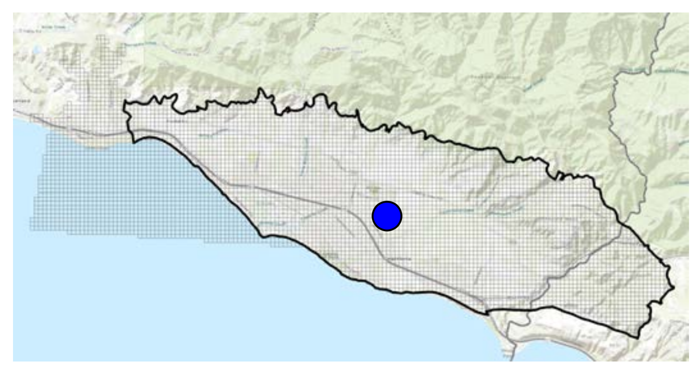
Well Type | Municipal

Reference Point Elevation (feet NAVD88) | 64.8

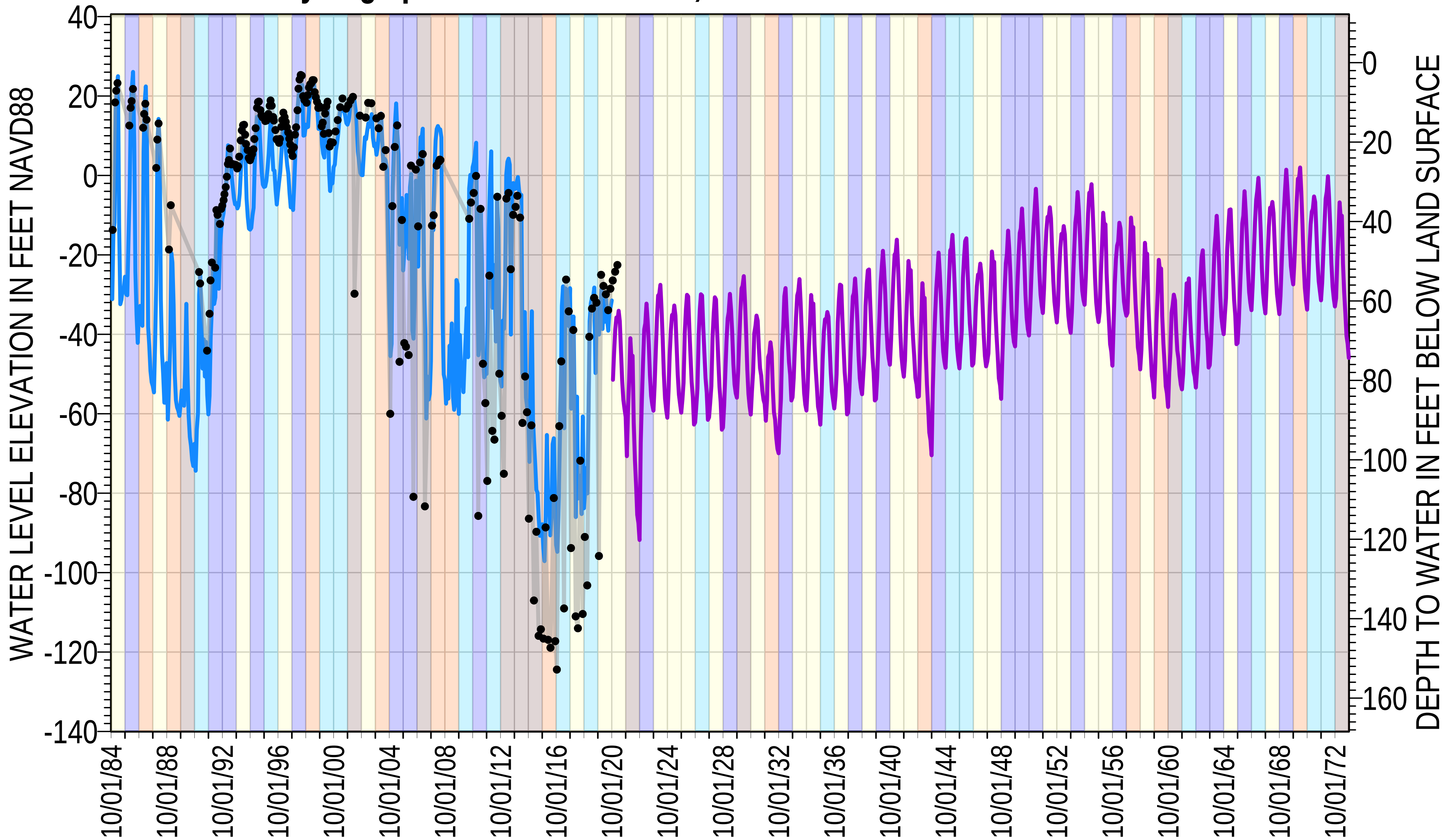
Model Layering (%) | L6: 88 L7: 12

Climate Classification

Critically Dry Dry Below Normal Above Normal Wet



Water Level Hydrograph for Santa Ynez Well, 29D7

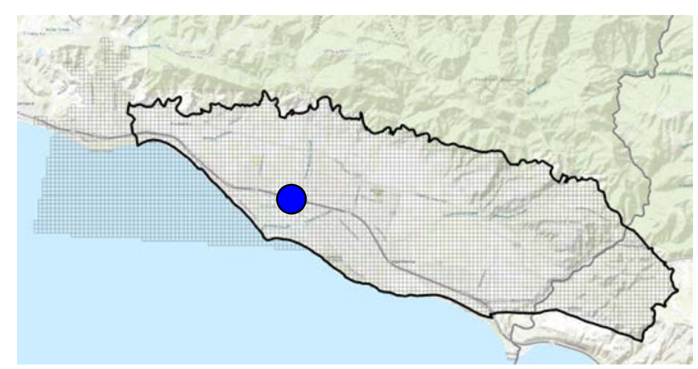


Measured
Projected Baseline
Historical

Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 28.4
Model Layering (%) | L1: 34 L2: 1 L3: 59 L4: 5

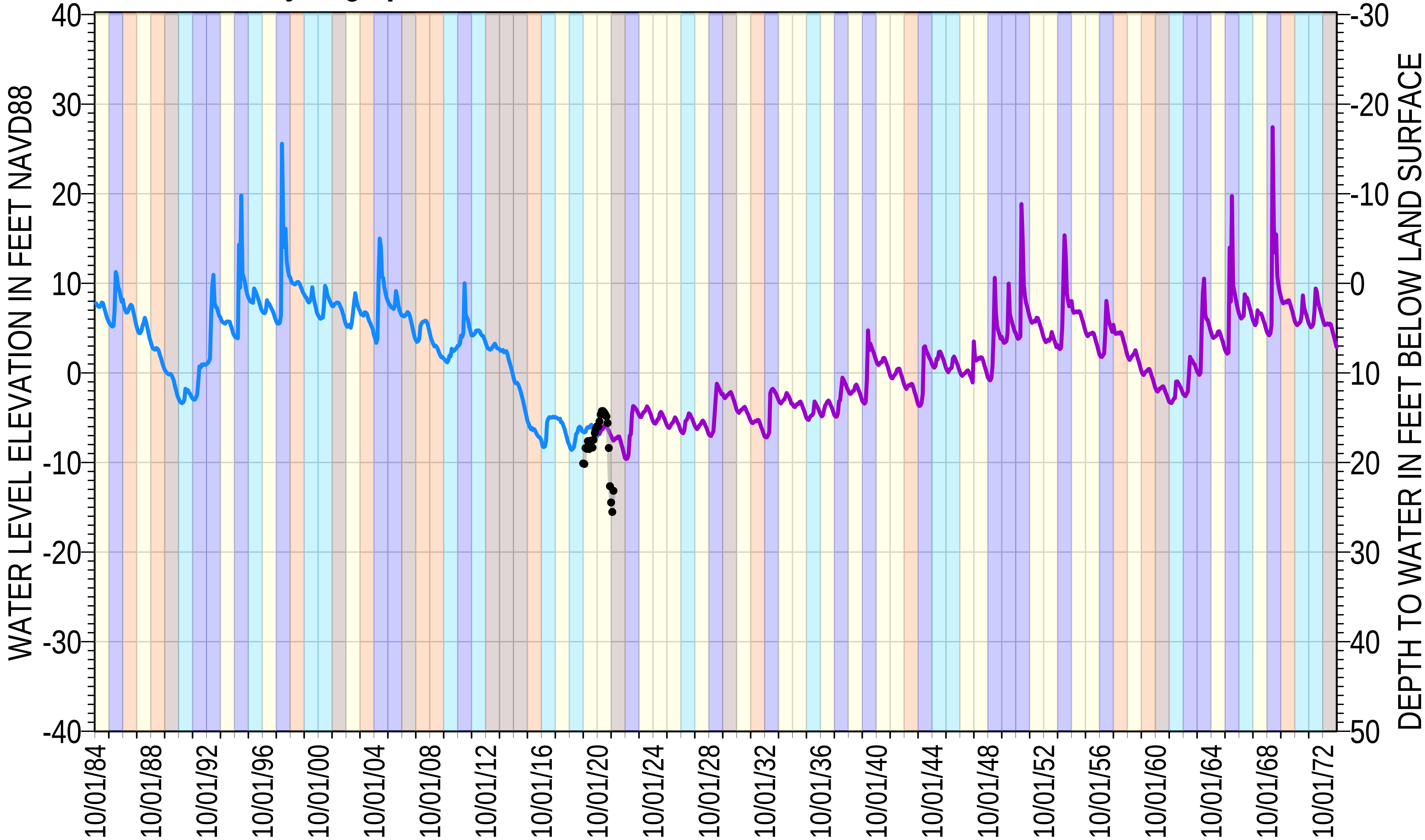
Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet



DOES NOT MAKE FILE CORRECTLY

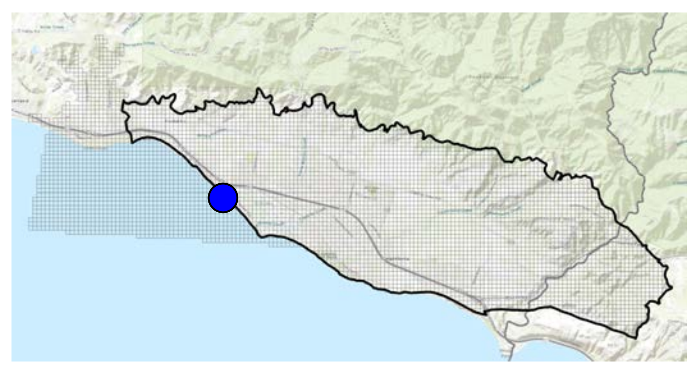
Water Level Hydrograph for Sentinel A, 30D8



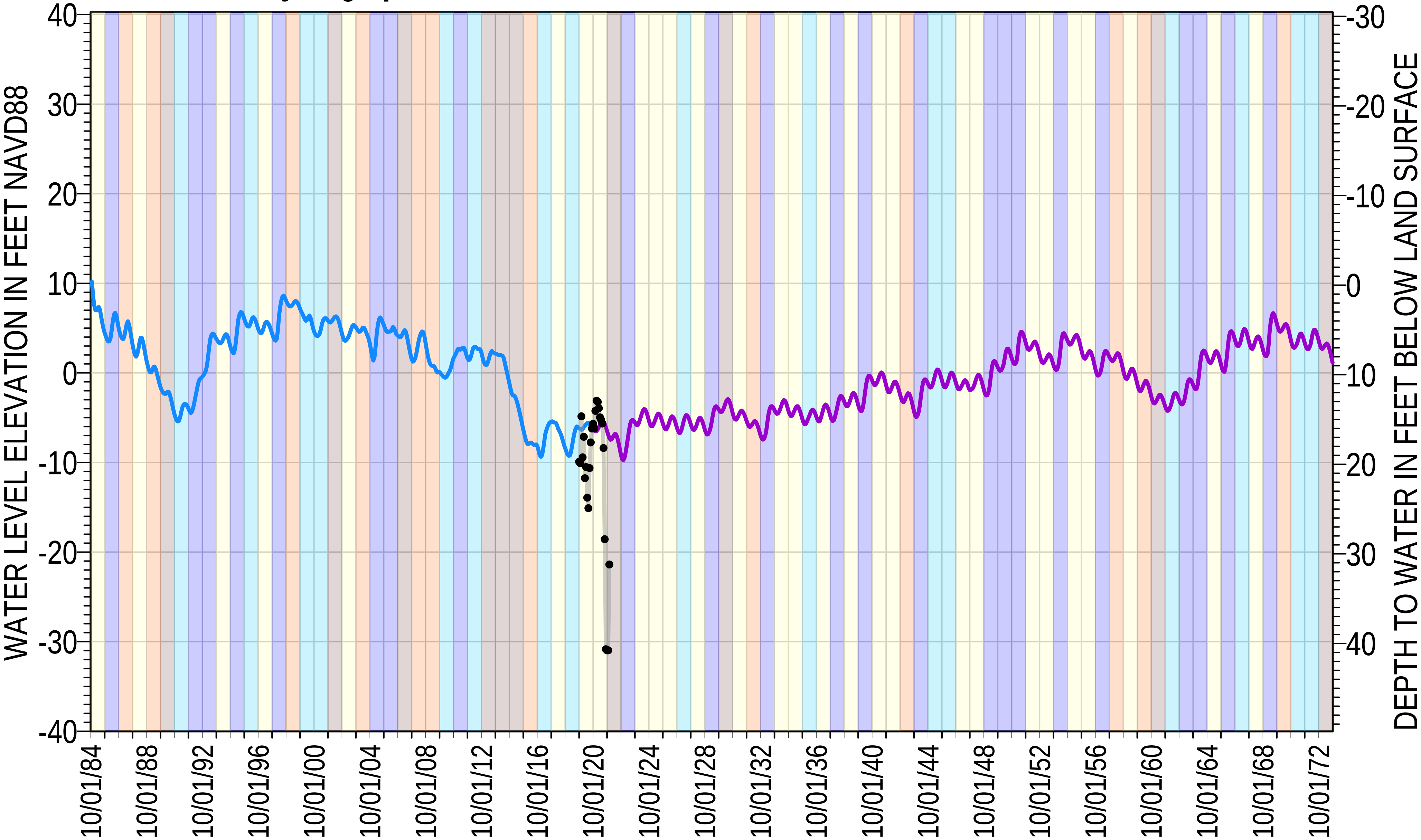
Measured
Projected Baseline
Historical

Well Type | Monitoring
Reference Point Elevation (feet NAVD88) | 10
Model Layering (%) | L2: 100

Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet



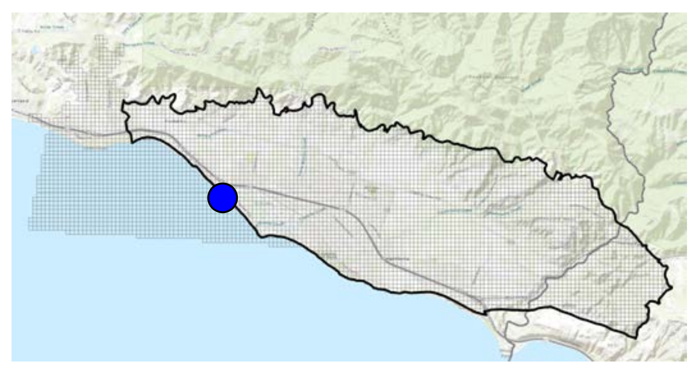
Water Level Hydrograph for Sentinel B, 30D7



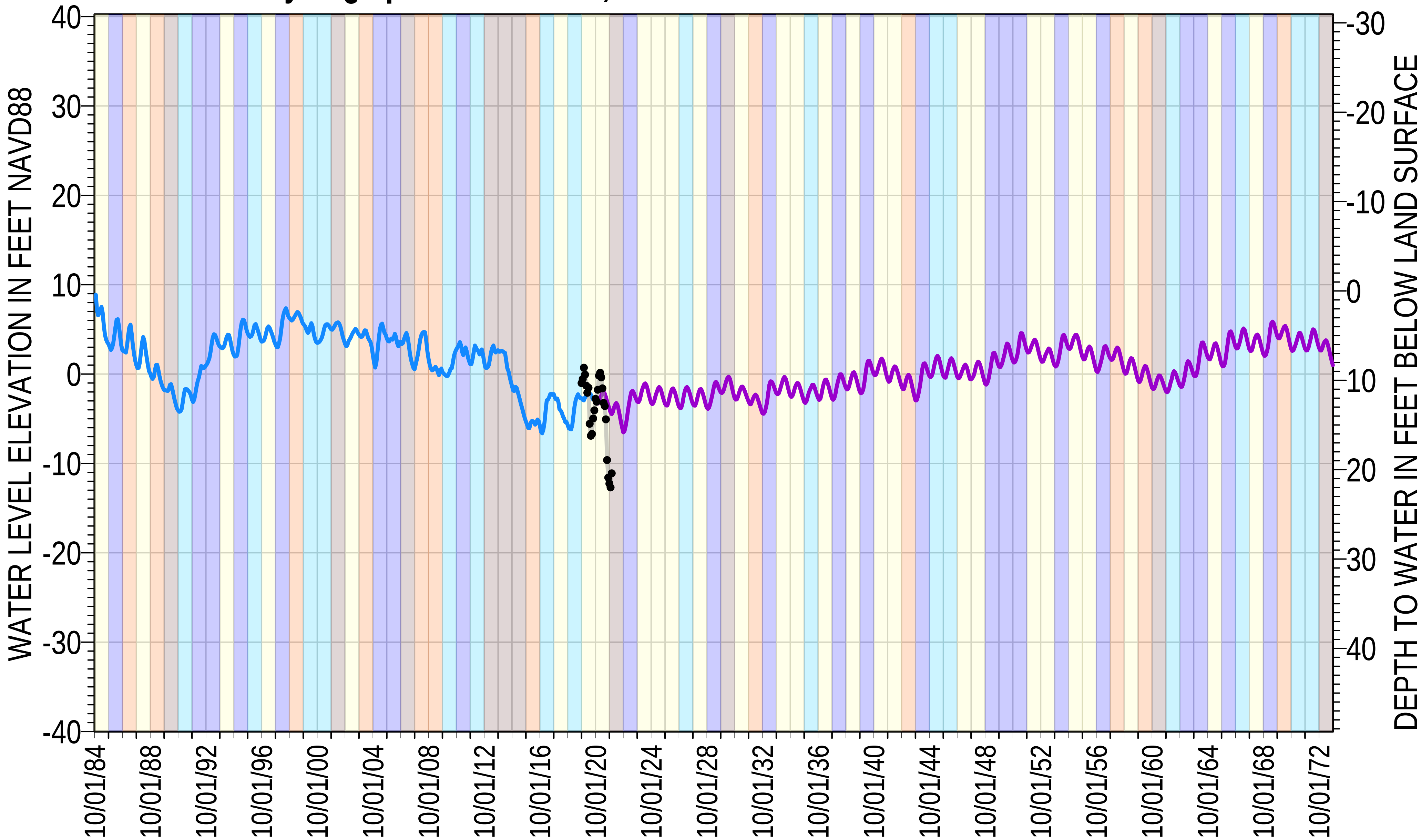
Measured
Projected Baseline
Historical

Well Type | Monitoring
Reference Point Elevation (feet NAVD88) | 9.8
Model Layering (%) | L4: 100

Climate Classification
Critically Dry | Dry | Below Normal | Above Normal | Wet

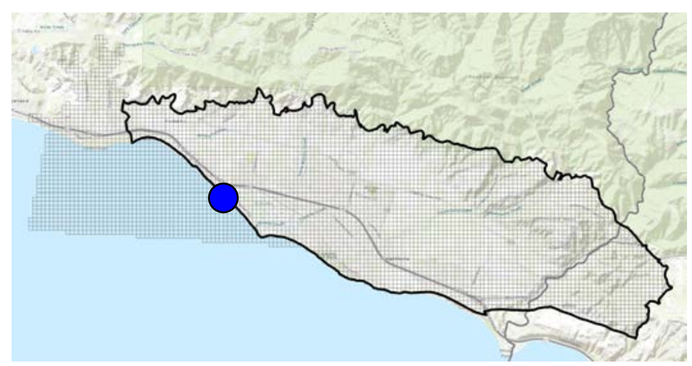


Water Level Hydrograph for Sentinel C, 30D6



Measured
Projected Baseline
Historical

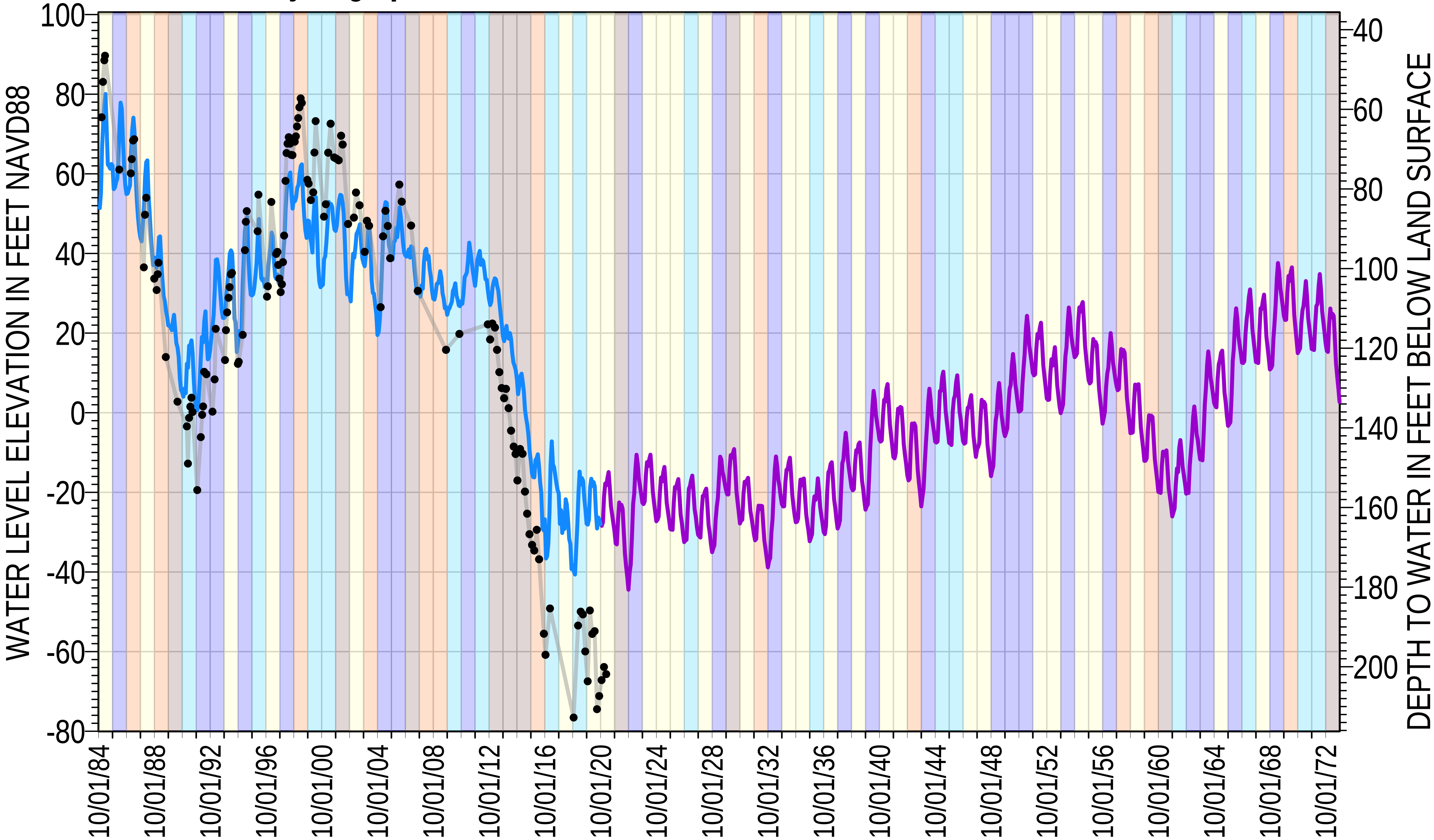
Well Type | Monitoring
Reference Point Elevation (feet NAVD88) | 9.3
Model Layering (%) | L6: 100



Climate Classification

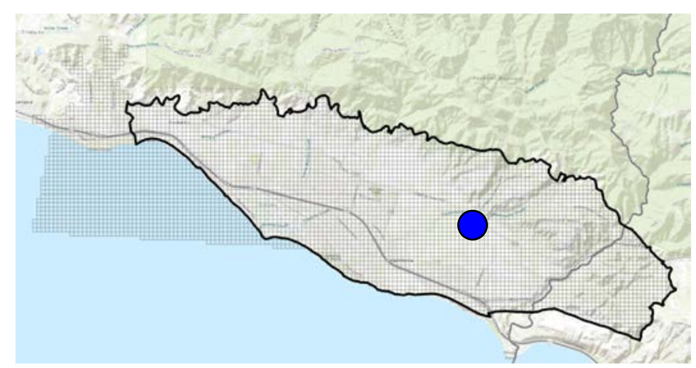
Critically Dry
Dry
Below Normal
Above Normal
Wet

Water Level Hydrograph for Smillies Well, 27F2



Measured
Projected Baseline
Historical

Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 136.2
Model Layering (%) | L4: 9 L5: 69 L6: 16 L7: 6



Climate Classification

Critically Dry | Dry | Below Normal | Above Normal | Wet

Pueblo Water Resources, Inc.

Projected Groundwater Modeling of the Carpinteria Advanced Purification Project (CAPP) Technical Memorandum

(Note: This technical memorandum is under development and will be finalized after the Public Draft version of this GSP is released.)

APPENDIX G

Groundwater Monitoring Protocols

Carpinteria Valley Water District

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CASGEM Groundwater Monitoring Plan

Carpinteria Valley Water District

September 2011

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CASGEM GROUNDWATER MONITORING PLAN

FIGURES:

1.0 WELL NETWORK

The Carpinteria Valley Water District CASGEM well network consists of 12 wells distributed throughout the approximately 15 square mile area of the groundwater basin. A map of the well network is presented as Figure 1. The Carpinteria Groundwater Basin is separated by a fault line into two distinct hydrogeologic storage units. Storage Unit No. 1 contains four confined aquifers (Aquifers A through D). Aquifers A and B, being the most shallow, provide the majority of groundwater to Carpinteria. Aquifers C and D, the deepest aquifers, are mostly unused. Storage Unit No. 2 does not contain a confined aquifer and is not used as a source of municipal groundwater. A more detailed description of the Carpinteria Groundwater Basin is included in the Monitoring Plan Rationale section of the report. A map of the separate storage units is provided as Figure 2.

Storage Unit No. 1 is the primary source of groundwater and therefore contains 10 of the 12 selected CASGEM wells. The penetration depths of the wells in this area range from 30 feet above mean sea level, in the higher elevation recharge areas, to 450 feet below mean sea level. The majority of the selected wells are representative of Aquifer A, one of the most commonly used aquifers. A map displaying the structural contours of Aquifer A is included as Figure 3.

Storage Unit No. 2 contains two wells, with penetration depths of 91 and 136 feet below mean sea level.

2.0 MONITORING SCHEDULE

Groundwater monitoring will be conducted on a bimonthly basis, occurring during the even numbered months (Feb, April, June, etc). The monitoring will be conducted during the last week of the month and will take no more than two consecutive days. The Subcommittee on Ground Water of the Advisory Committee on Water Information recommends that an aquifer with low hydraulic conductivity (<200 ft/day) and moderate withdrawals should be surveyed once per quarter. The Carpinteria Groundwater Basin has a hydraulic conductivity between 9 and 18 feet per day and has moderate long-term aquifer withdrawals. The bimonthly monitoring schedule therefore exceeds conservative recommendations.

3.0 DESCRIPTION OF FIELD METHODS

3.1 Establishing Reference Points

Groundwater level monitoring has taken place in the Carpinteria Groundwater Basin since the early 1940's. Reference points have been established, clearly described on data collection forms, and marked in the field at the actual reference point. The elevations of the reference points were determined using a USGS 7.5' quadrangle map, with an estimated accuracy of about 2.5 feet.

3.2 Instructions on Measuring Depth to Water

The following steps are based on the Department of Water Resources Groundwater Elevation Monitoring Guidelines document detailing the use of an electric sounding tape.

The following steps will be followed during each groundwater level measuring event.

1. Inspect the electric sounding tape and electrode probe before use. Check tape for wear, kinks, frayed electrical connections and possible stretch. Test battery.
2. Check the distance from the electrode probe's sensor to the nearest foot marker on the tape, to ensure that the distance puts the sensor at the zero foot point for the tape. If it does not, apply correction to measurements and record information in equipment log book.
3. Prepare field forms and check previous water level data.
4. Check that the RP is clearly marked on the well and is accurately described on the field form.
5. Check the circuitry of the electric sounding tape before using in well by dipping the electrode probe into tap water.
6. Wipe off the electrode probe and the lower 5 to 10 feet of the tape with a disinfectant wipe, rinse with de-ionized or tap water, and dry.

Steps for making a measurement

1. If the water level was measured previously at the well, use the previous measurement to estimate the length of tape that should be lowered into the well.
2. Lower the electrode probe slowly into the well until the indicator shows that the circuit is closed and contact with the water surface is made. Avoid letting the tape rub across the top of the well casing. Place the tip of nail of the index finger on the insulated wire at the RP and read the depth to water to the nearest 0.1 foot. Record this value in the Below MP box on the data collection form, along with the date of the measurement.
3. Lift the electrode probe slowly up a few feet and make a second measurement by repeating step 2. If the second measurement does not agree with the first measurement, make a third measurement.

After making a measurement

1. Wipe down the electrode probe and the section of the tape that was submerged in the well water, using a disinfectant wipe and rinse thoroughly with de-ionized or tap water. Dry the tape and probe and rewind the tape onto the tape reel. Do not rewind or otherwise store a dirty or wet tape.

A copy of the data collection form is presented as Figure 11.

3.3 Methods to Ensure Measurements of Static Groundwater Conditions

To ensure that groundwater elevation measurements are valid, data collection should only occur at a well during static (non-pumping conditions). 10 of the 12 CASGEM wells are observation wells and the two irrigation wells are currently inactive. The status of the CASGEM wells establishes that static conditions should exist at the well site during data collection. Although the CASGEM well sites should be under static conditions, surrounding areas to each CASGEM well will be observed closely for signs of recent or current pumping. Along with talking to any farmers in the area, the person collecting data will look for active irrigation systems and moist soil. The person collecting data will also view the previous groundwater elevation measurements to make sure that the current levels do not vary by a drastic amount.

4.0 MONITORING PLAN RATIONALE

4.1 History of Groundwater Monitoring in Basin

Groundwater level monitoring in Carpinteria has been in effect since the early 1940's. Most of the wells included in this CASGEM Monitoring Plan have groundwater level data from the early 1940's to the present day. Almost all of those wells have consistent monthly or bi-monthly data beginning in the late 1970's to early 1980's and continuing to the present day. Groundwater level data is currently collected on a bi-monthly schedule.

4.2 Principle Features of Basin

Carpinteria basin has been subdivided on the basis of a fault alignment into two separate hydrogeologic storage units. Each unit contains distinct geologic, hydrogeologic, and groundwater storage characteristics.

Storage Unit No. 1, located north of the Rincon Creek thrust fault, is bounded to the north, east, and west by consolidated non-water-bearing rocks of the Santa Ynez Mountains. Storage Unit No. 2, located south of this fault, is bounded to the east and south by similar non-water-bearing rocks and to the southwest by the Pacific Ocean.

Storage Unit No. 1 contains four major water-bearing deposits. These deposits are referred to as Aquifers A through D. Aquifer A is the most shallow at an approximate depth ranging from 50 to 400 feet. Aquifer D is the deepest, with an approximate depth between 600 and 2,000 ft. The aquifers are composed of unconsolidated and semi-consolidated non-marine and marine sediments from the Holocene, Pleistocene, and upper Pliocene age. The aquifer sediments contain the coarse grained, sandy or gravelly strata. These deposits are readily capable of absorbing, storing, transmitting, and yielding water to wells. The confining layers that separate each of the four aquifers are composed of finer grained strata, such as silts, clays, and combinations thereof and are generally more abundant.

Figures 4 through 8 provide cross section views of the multiple aquifers throughout the groundwater basin.

The recharge area for Storage Unit No. 1 is limited due to the presence of fine-grained, low-permeability materials overlying most of the area of the aquifers. This material blocks the downward percolation of water, making the recharge area for all four aquifers in Storage Unit No. 1 a narrow strip of land located along the south facing foot of the Santa Ynez Mountains. The recharge area is bounded to the north by the consolidated rocks of the mountain area and to the south by the area of confined water. The recharge area encompasses approximately 7 square miles and covers roughly 4,480 acres and has no distinctive confined areas. Rainfall is the primary source of recharge to the basin, whether it falls directly on the basin or on adjacent areas and flows into the basin via the surface or subsurface. The majority of rainfall occurs between the months of November and April. Even during a rainy season, deep percolation of rainfall beyond the root zone will not occur unless the soil moisture deficiency has been satisfied. Figure 9 provides a map of the recharge area.

Discharge from Storage Unit No. 1 is believed to occur only through shallow alluvial sediments where they are in contact with the ocean boundary. Groundwater within the principal aquifers of Storage Unit No.1 is not able to discharge directly to the ocean due to the presence of overlying confining layers and the barrier created by the Rincon Creek Fault. Groundwater is believed to be rising along the fault boundary, and that subsurface water enters the alluvium through notches eroded in the fault by streams in the area.

Storage Unit No.2 does not contain a confined aquifer. The area is shallow with a maximum depth of approximately 600 feet. The uppermost portion of Storage Unit No. 2 consists of a thin layer of unconsolidated to poorly consolidated, marine and non-marine sediments from the middle to late Pleistocene age. The sediments contain sand with variable amounts of gravels and cobbles. Portions of the sand are impregnated with heavy, inert oil and tar. Marine and floral remains are abundant in this layer. Underlying this formation is a thicker layer of poorly to moderately consolidated, soft and massive, sandstone and siltstone with abundant clay shale. The sandstone is generally well sorted and is very fine to medium grain. This formation also contains abundant marine remains. The base of this deeper layer forms the boundary with non-water bearing, undifferentiated miocene rock.

Storage Unit No. 2 does not have a confining surface layer of fine-grained, low-permeability materials like Storage Unit No. 1. Therefore most of Storage Unit No.2's surface acts as a recharge area through infiltration of precipitation, irrigation water, and streamflow seepage. The majority of rainfall occurs between the months of November and April. Figure 9 provides a map of the recharge area.

Discharge from Storage Unit No. 2 is not believed to occur on a significant level due to the contact of unconsolidated water-bearing materials with consolidated bedrock, which effectively isolates Storage Unit No.2 from the ocean, with the exception of a relatively narrow (3,500 ft) strip of alluvium on the western boundary of Storage Unit No.2 with the ocean.

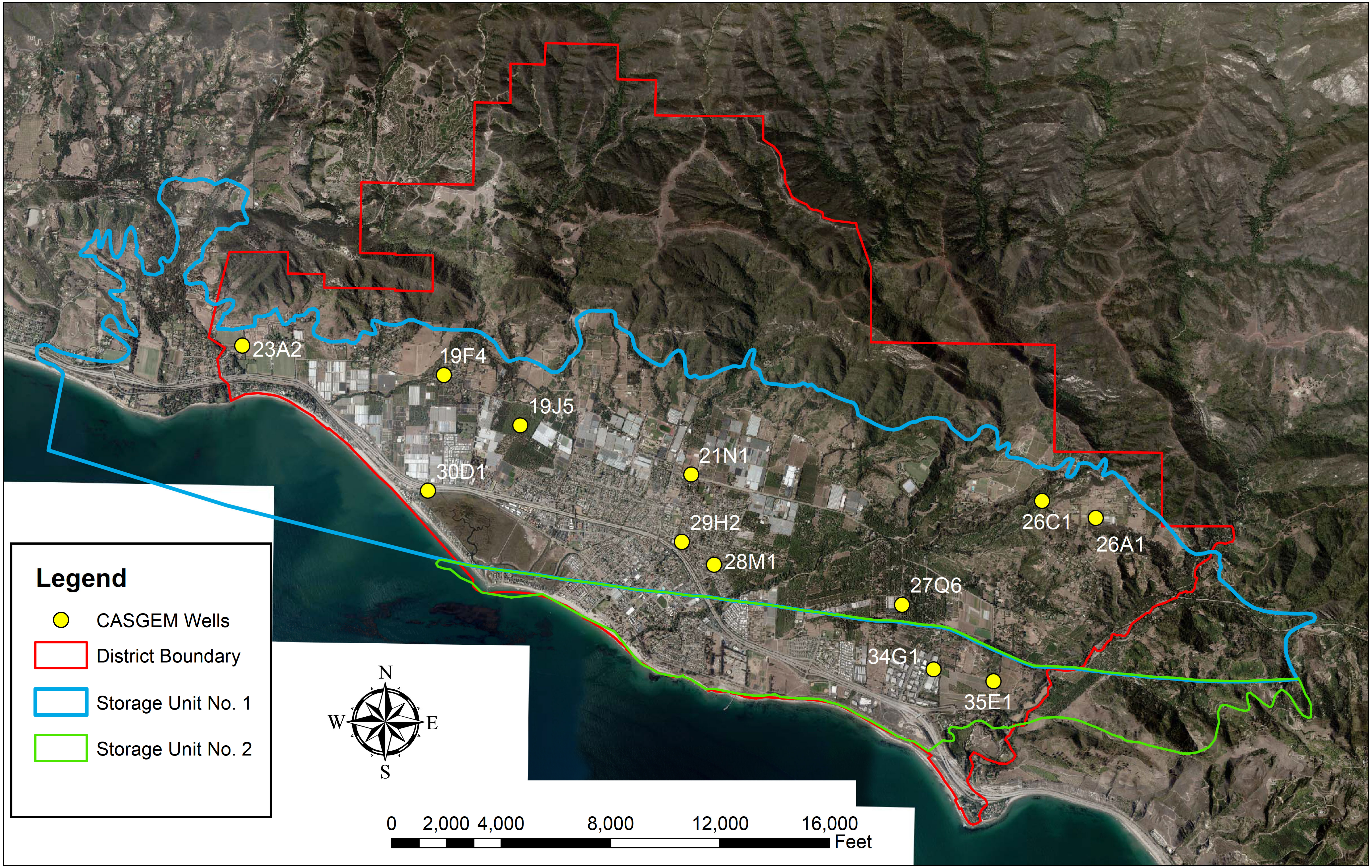
4.3 Selection of Wells

Twelve wells are selected for the CASGEM program. Storage Unit No. 1 is the primary source of groundwater and therefore contains 10 of the 12 selected CASGEM wells. The penetration depths of the wells in this area range from 30 feet above mean sea level, in the higher elevation recharge areas, to 450 feet below mean sea level. The majority of the selected wells are representative of Aquifer A, one of the most commonly used aquifers. Deeper wells that enter into Aquifers B through D are either screened across more than one aquifer or are in close proximity to a production well. Storage Unit No. 2 contains two wells, with penetration depths of 91 and 136 feet below mean sea level.

The Department of Water Resources Groundwater Elevation Monitoring Guidelines document references multiple studies pertaining to the density of wells in a monitoring network. The consensus of those studies was between 2 and 10 monitoring wells per 100 square miles. Based on the most conservative number of that range, the Carpinteria Groundwater Basin would require approximately 1.5 wells for the 15 square mile area that it encompasses. The eleven wells selected exceed the recommended number.

Water level contour maps (Figure 10) show the groundwater table sloping from the foothills of the Santa Ynez Mountains towards downtown Carpinteria and the Pacific Ocean. The CASGEM wells were selected throughout the groundwater basin to represent both the high and low groundwater elevation areas along with data points in between. There is a high concentration of wells within the structural confines of Aquifer A to provide a clear representation of this major Aquifer.

FIGURES

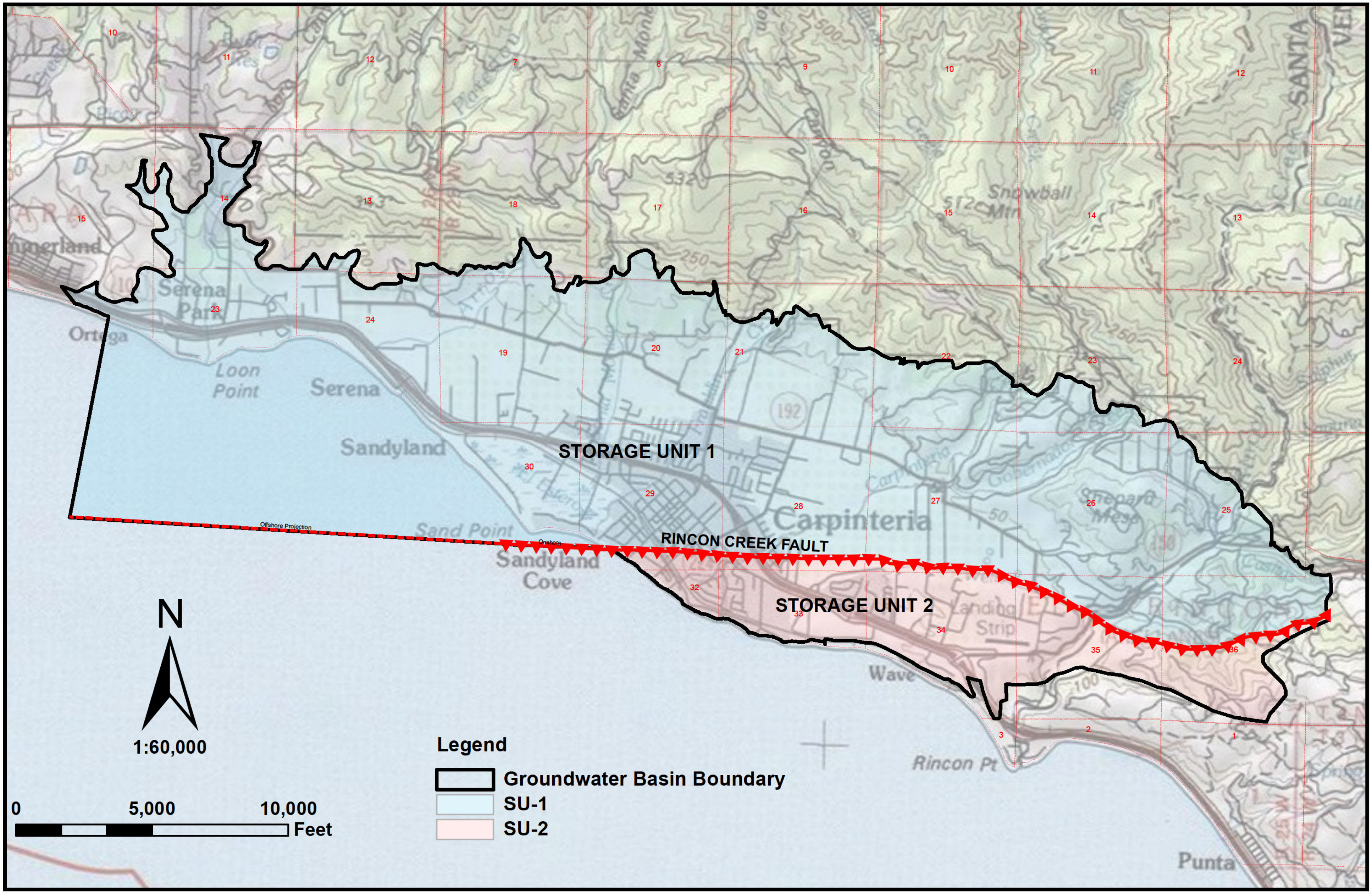


Created by CVWD Engineering
September 2011

CASGEM Well Network
Carpinteria Valley Water District

FIGURE 1

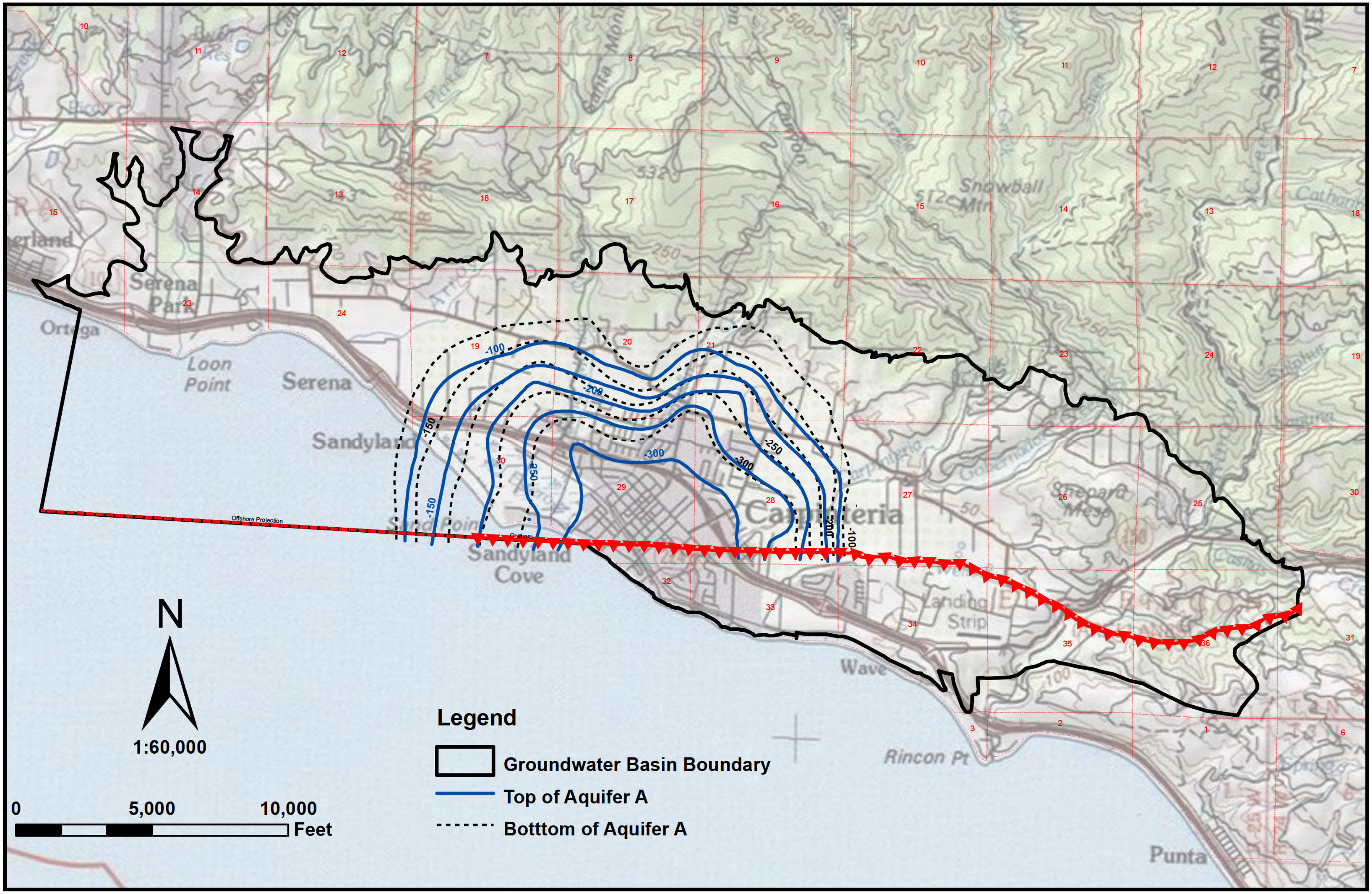
February 2011
Project No. 06-0125



PUEBLO water resources

PLATE 2. STORAGE UNITS 1 AND 2
CGB Hydrogeologic Update
Carpinteria Valley Water District

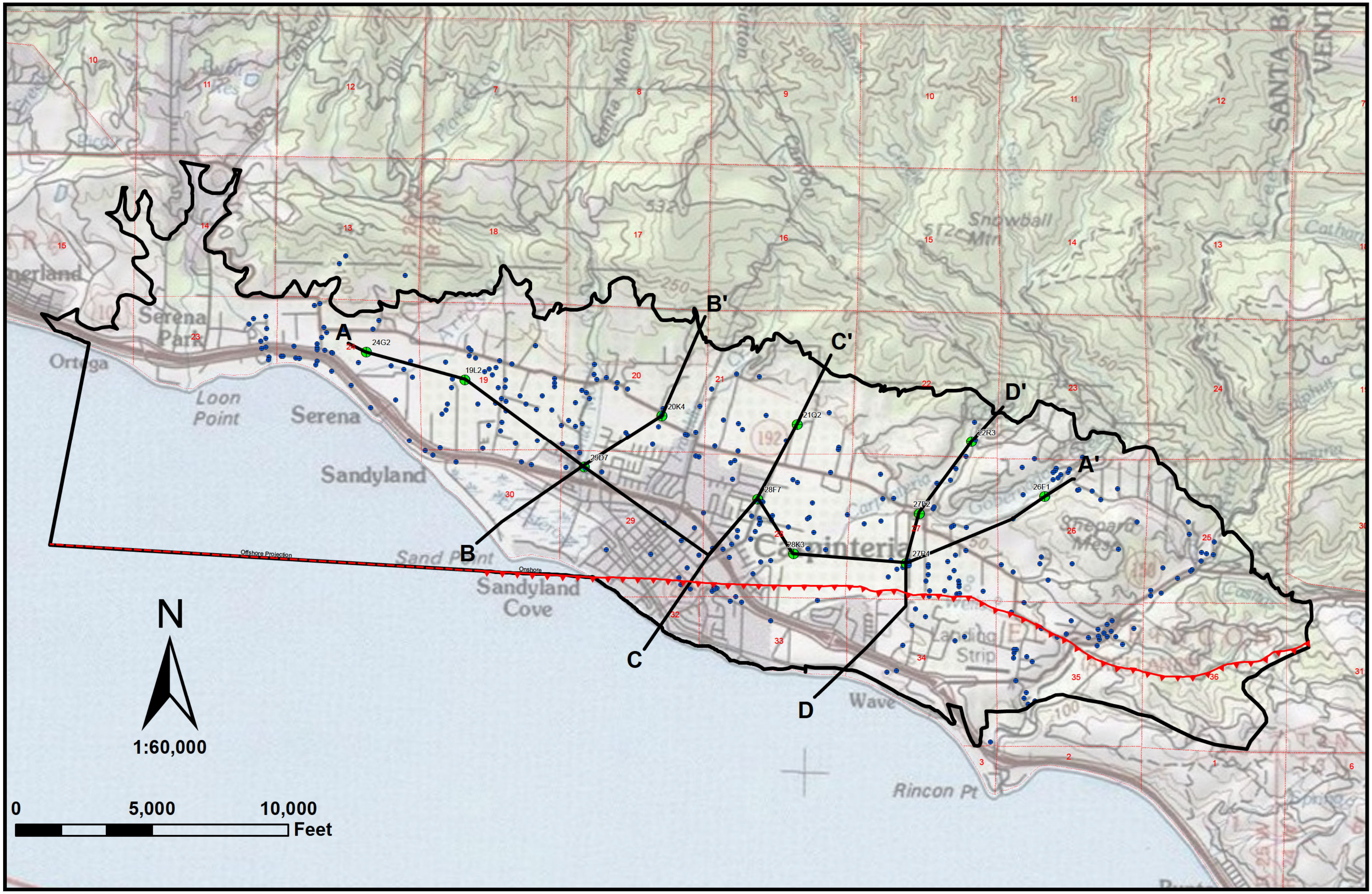
February 2011
Project No. 06-0125



PUEBLO water resources

PLATE 9. STRUCTURAL CONTOURS - AQUIFER A
CGB Hydrogeologic Update
Carpinteria Valley Water District

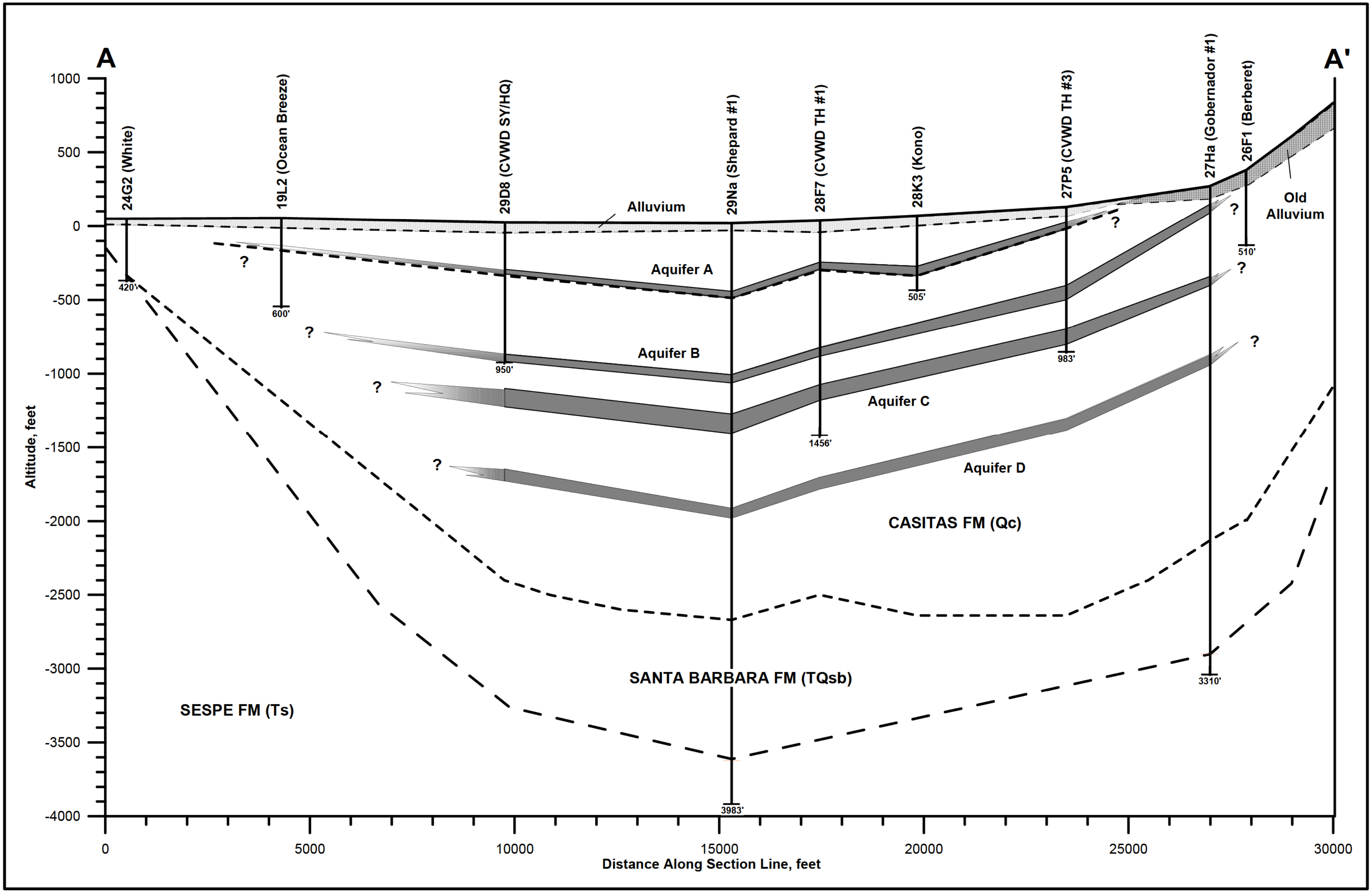
February 2011
Project No. 06-0125



PUEBLO
water resources

PLATE 3. CROSS-SECTION LOCATION MAP
CGB Hydrogeologic Update
Carpinteria Valley Water District

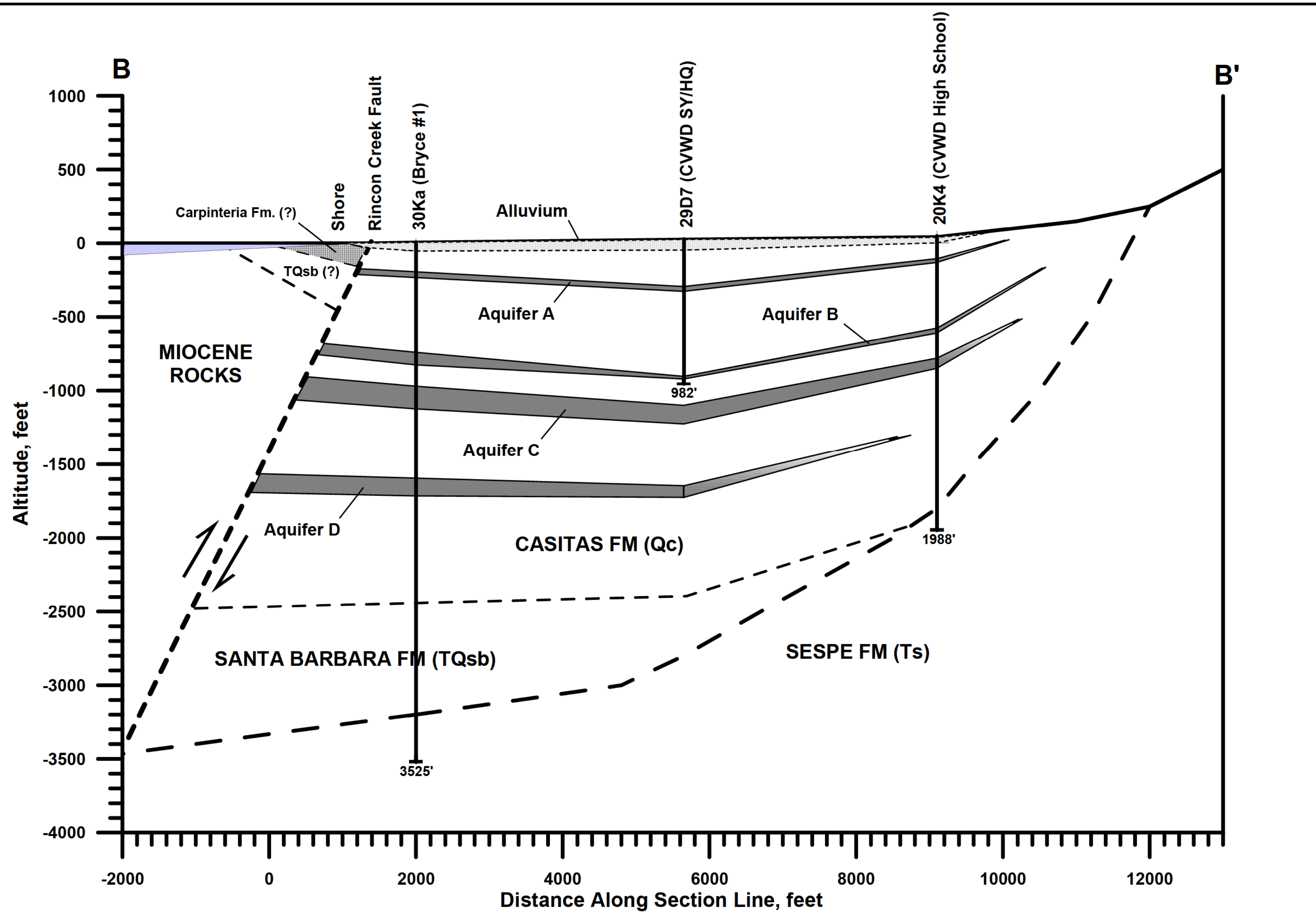
February 2011
Project No. 06-0125



PUEBLO water resources

PLATE 4. HYDROGEOLOGIC CROSS SECTION A-A'
CGB Hydrogeologic Update
Carpinteria Valley Water District

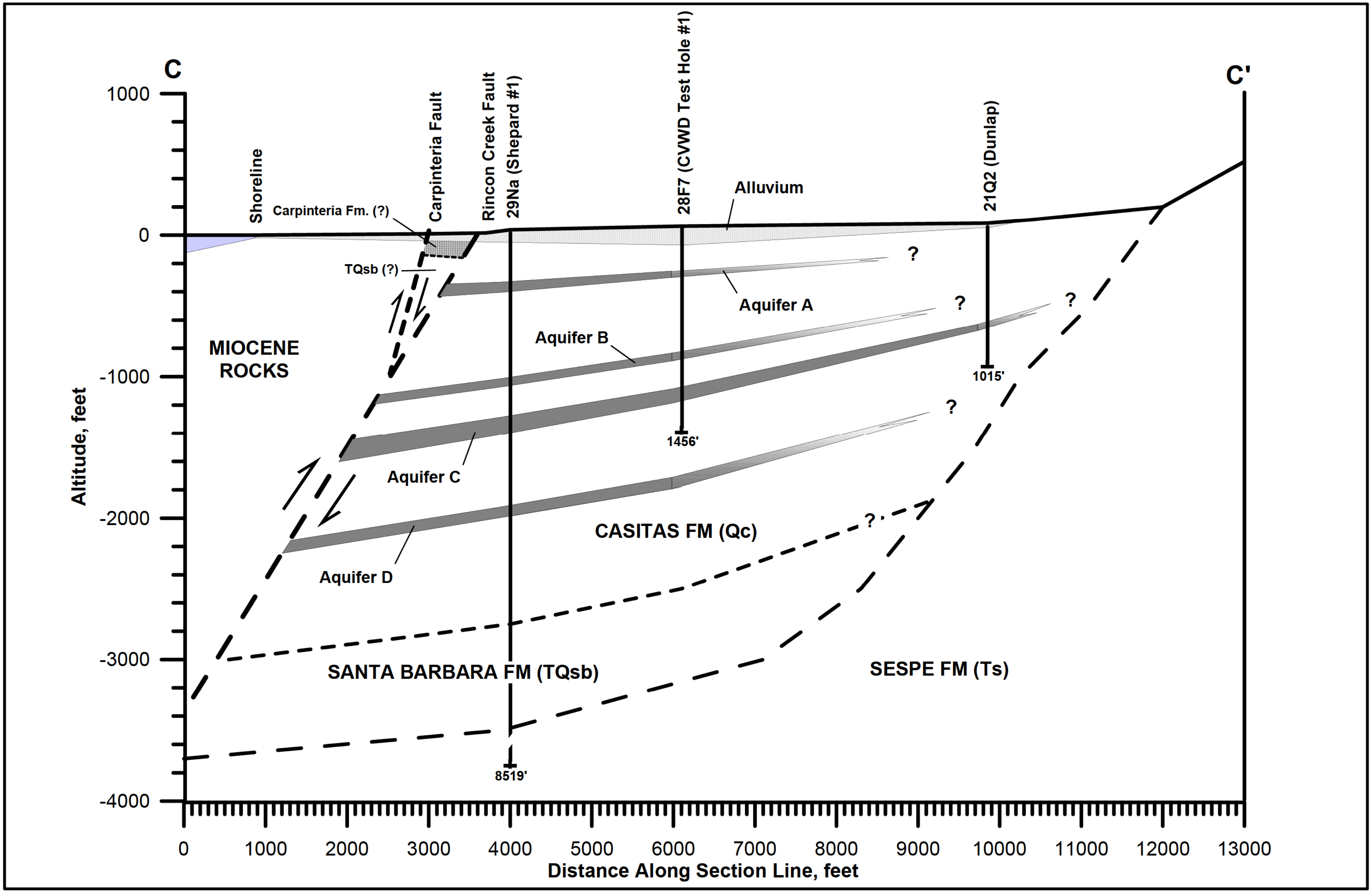
February 2011
Project No. 06-0125



PUEBLO water resources

PLATE 5. HYDROGEOLOGIC CROSS SECTION B-B'
CGB Hydrogeologic Update
Carpinteria Valley Water District

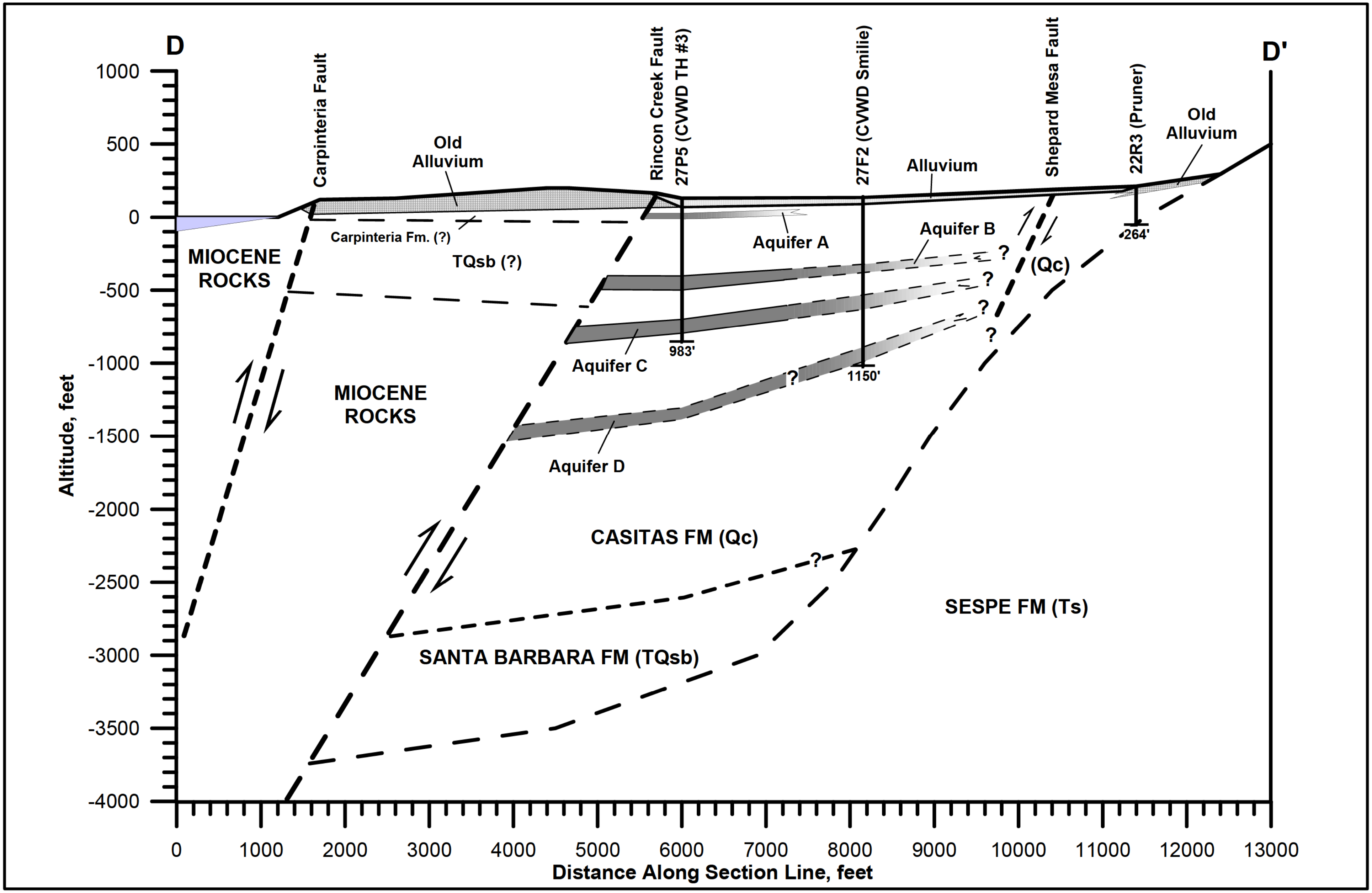
February 2011
Project No. 06-0125



PUEBLO water resources

PLATE 6. HYDROGEOLOGIC CROSS SECTION C-C'
CGB Hydrogeologic Update
Carpinteria Valley Water District

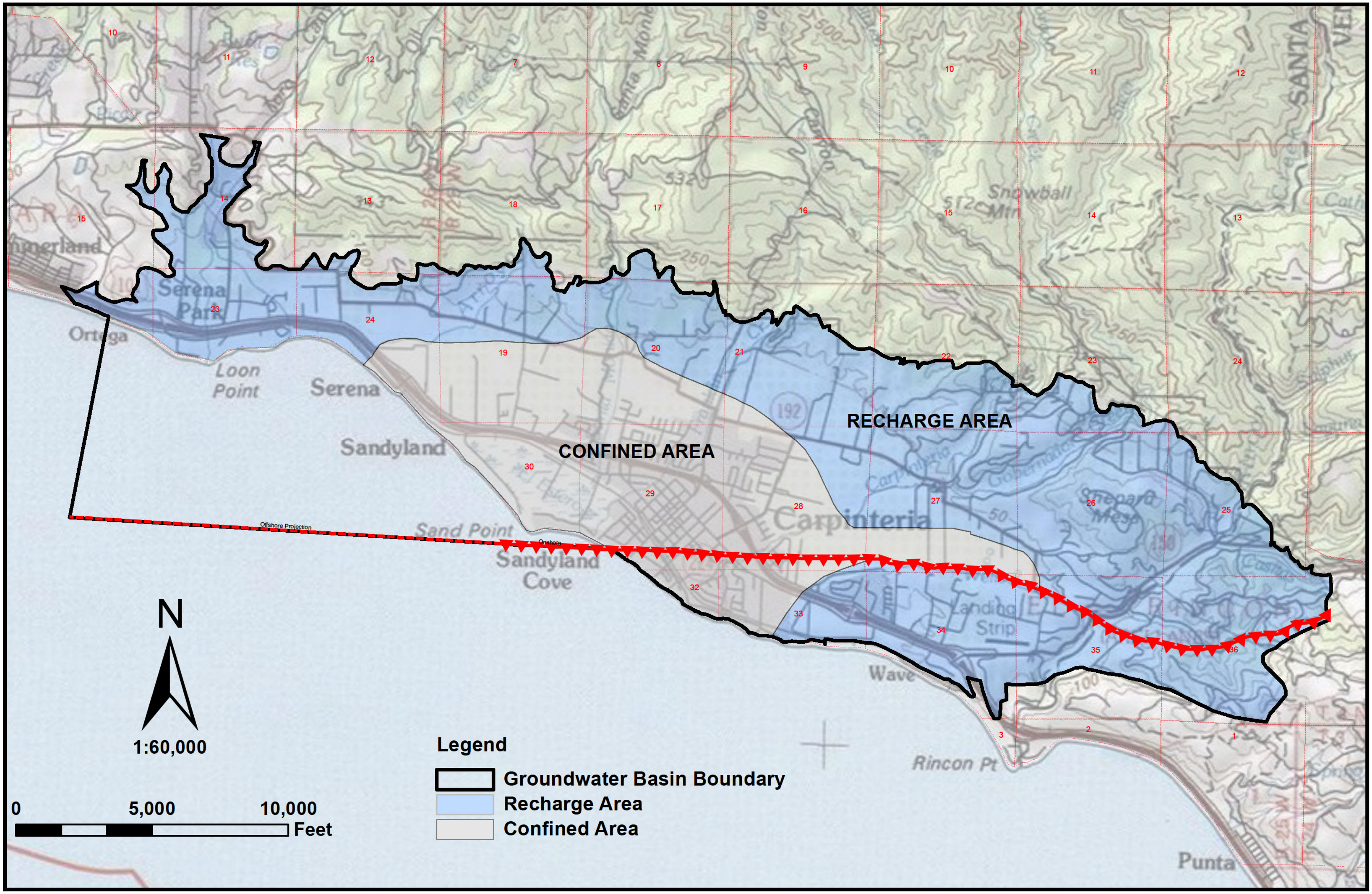
February 2011
Project No. 06-0125



PUEBLO water resources

PLATE 7. HYDROGEOLOGIC CROSS SECTION D-D'
CGB Hydrogeologic Update
Carpinteria Valley Water District

February 2011
Project No. 06-0125



PUEBLO water resources

PLATE 8. CONFINED AND RECHARGE AREAS
CGB Hydrogeologic Update
Carpinteria Valley Water District

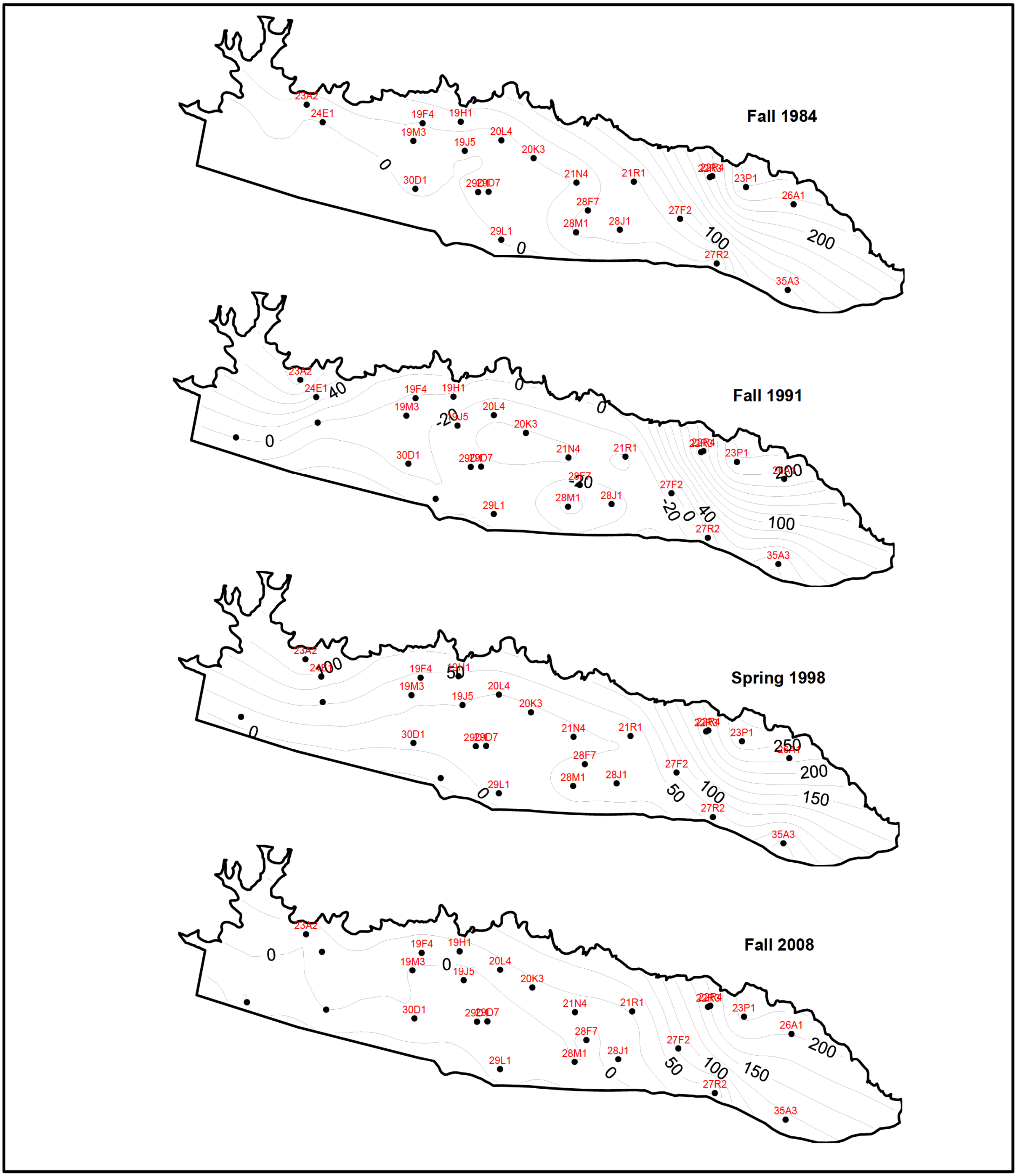


PLATE 14. WATER LEVEL CONTOURS - STORAGE UNIT 1
CGB Hydrogeologic Update
Carpinteria Valley Water District

FIGURE 11

DATA COLLECTION FORM

WATER-LEVEL DATA

U. S. G. S. WELL NO 4N/25W-19M3 QUADRANGLE CARPINTERIA

Site Sta	238 -	D	E	F	G	H	O	P	R	S	T	V	X	Z
		dry	recently flowing	flowing	nearby flowing	nearby recently flowing	obstruction	pumping	recently pumped	nearby pumping	nearby recently pumped	foreign substance	affected by surface water	other

Meas Method	239 -	A	C	E	G	H	L	M	R	S	T	V	Z
		airline	calibrated airline	estimated	pressure gage	calibrated pressure gage	geophysical logs	manometer	reported	steel tape	electric tape	calibrated electric tape	other

MEASURING POINT

(A) TOP OF CASING E. SIDE 1.0 ft. Above / Below LSD

(B) ft. Above / Below LSD

(C) ft. Above / Below LSD

ALTITUDE OF LSD 65

Site I.D. No.

DATE M/D/Y	WATER LEVEL (BELOW LSD)	STATUS	METHOD	MP USED	MEAS BY	DEPTH HELD	CUT	Below MP	REMARKS
235 # 12/28/2010	237 - 63.5	238 -	239 -	A	MS			64 5	
235 # 02/24/2011	237 - 62.9	238 -	239 -	A	MS			63 9	
235 # 04/26/2011	237 - 59.7	238 -	239 -	A	MS			60 7	
235 # 06/29/2011	237 - 62.0	238 -	239 -	A	MS			63 0	
235 # 08/30/2011	237 - 65.9	238 -	239 -	A	MS			66 9	
235 # / /	237 - .	238 -	239 -						
235 # / /	237 - .	238 -	239 -						

PUNCHED

GPO: 687-617 ABBOTT

WELL NO 4N/25W-19M3

SAMPLING AND ANALYSIS PLAN
CARPINTERIA GROUNDWATER BASIN SENTINEL WELLS
CARPINTERIA VALLEY WATER DISTRICT
December 2019

PURPOSE AND SCOPE

This Sampling and Analysis Plan (SAP) has been developed by Pueblo Water Resources, Inc. (Pueblo) for the Carpinteria Valley Water District (District) to establish standard protocols and consistent procedures for routine, regularly scheduled groundwater sampling and analysis for the Carpinteria Groundwater Basin Sentinel Wells. The intent of the SAP is to allow for the collection of reliable and representative groundwater quality data.

GROUNDWATER SAMPLING

Sentinel Monitoring Well Cluster

The Sentinel Monitoring Well Cluster includes three wells, MW-1, MW-2, and MW-3, completed in the 'C Zone', the 'B Zone', and the 'A Zone', respectively, of the Carpinteria Groundwater Basin. The well casings are 3-inch diameter flush threaded PVC, with an inside diameter of approximately 2.8-inches. Each well was finished with a flush mounted, water tight well enclosure, and the reference point elevation for each well was surveyed. The reference point for each well is the top of the PVC casing. Well completion details are listed in **Table 1**.

Table 1. Well Completion Summary
Carpinteria Groundwater Basin Sentinel Wells

	MW-1	MW-2	MW-3
Total Drilled Depth, (ft.)	1240	880	350
Casing Depth (ft.)	1130	870	340
Casing Diameter (in.)/PVC Grade	3 / sch. 120	3 / sch. 80	3 / sch. 80
Screened Interval (ft.)	1,020 – 1,120	780 to 860	190 - 330
Reference Point Elevation (ft., msl, top PVC)	9.28	9.76	9.77

Documentation Protocol

All data collected as part of the groundwater sampling will be recorded on field data forms specifically developed for the Sentinel Well SAP to guide the sampling technician through the sampling process and ensure that consistent sampling and documentation protocols are followed. The field data form will include the following information:

- well identification;
- date and time of sampling;
- sampler identification;
- static water level;
- volume of water in casing;
- required purge volume;
- pump depth setting;
- purge start time
- pumping rate;
- field water quality parameters;
- purge end time;
- total purge volume;
- final pumping level;
- laboratory identification and method of transport of samples to lab;
- deviations from SAP procedures and reason for deviation, and
- any other field observations related to samples (e.g., weather conditions, noticeable odors, colors, etc.).

Groundwater Monitoring Equipment

The equipment required to perform the groundwater monitoring as prescribed in the SAP will include:

- submersible pump with control unit and portable generator;
- water level sounder;
- bucket (for measuring flow rate);
- discharge hose (approximately 100 feet);
- field water quality monitoring devices;
- de-ionized rinse water;
- sample containers; and
- coolers and ice.

Water Level Monitoring

The static water level (swl) will be measured and recorded prior to installation of the sampling pump. The swl will be measured from the reference point for each well, and the amount of water in the casing will be determined based on the swl measurement and the depth of the well casing

Purging and Field Water Quality Monitoring

The pumping rate shall be measured after initiation of purging to determine the time required for the minimum purge volume. Based on the time required, the interval of field water quality measurements shall be determined. A minimum of six field water quality measurements shall be performed during the purging of each well. The purging of each well shall be performed until either; 1) three casing volumes are pumped from the well, or 2) water quality parameters are stable, whichever is ***greater***. Field water quality will be considered stable if for two consecutive readings:

- temperature range is no more than +1oC;
- pH varies by no more than 0.2 pH units;
- turbidity is within 10% of the average of the previous two readings; and
- specific conductance is within 10% of the average of the previous two readings.

Total chlorine residual measurements shall be made at the beginning and at the end of the purging period to document compliance with NPDES discharge limitations.

Sampling, Sample Handling, and Chain-of-Custody Documentation

Samples shall be collected in containers provided by the laboratory specifically for the SAP analytical program. Sample labels will allow for documentation of the following information: well identification; sampler identification; date and time of sampling; analytical parameters, and method of sample preservation. After collection, samples shall be immediately placed in a cooler maintained at a temperature of approximately 4°C, and samples shall remain in the cooler and the temperature will be maintained at 4°C through delivery to the laboratory.

Chain-of-Custody (COC) documentation shall be completed for each set of samples collected during a monitoring event. The COC documentation shall include the following:

- District contact information;
- sampler identification;
- well identification;
- date and time of sampling;
- nature of sample (i.e. non-potable, raw groundwater);
- sample type (i.e. grab vs. composite);
- number and type of sample containers, and preservatives;
- analytical parameters;
- final measured field pH; and,
- sample relinquish details (i.e. time and sample receiver).

ANALYTICAL PROGRAM

The analytical program for the SAP shall include analysis for general mineral constituents, which includes the major anions and cations, nitrates, total dissolved solids, specific conductance, and other parameters.

RECORD KEEPING

The District will maintain Excel spreadsheets of water level and water quality data for each of the three sentinel wells. The spreadsheets shall include field water level data, field water quality data, and laboratory analytical data. Water level hydrographs and graphs presenting key water quality parameters shall be maintained to allow for the tracking of water level and water quality conditions.

SCHEDULE

Water quality sampling of the Sentinel Wells shall be performed on a quarterly basis until it is determined that a less frequent sampling schedule is warranted. This will occur when water quality parameters are deemed to be relatively stable.

Carpinteria Valley Water District Sentinel Well Project
Field Sampling Data

Well Identification:		
Date:	Purge Start Time:	Sample Time:

Well and Purge Information
Static Water Level (ft from top of casing):
Casing Depth (ft):
Inside Casing Diameter (in):
Casing Volume (gal):
Pump Depth (ft):
Pumping Rate (gpm):
Required Purge Time (min, for 3 casing volumes):
Final Pumping Water Level (ft):

Water Quality Parameters

Time:						
Temperature (^{o}C)						
Turbidity (NTU)						
Conductivity (umhos/cm)						
pH						
Total Chlorine Residual (mg/L)						

Sampling Information
Sampler:
Laboratory:
# of Containers:
Sample Shipping Information:

Additional Information and Observations

WATER LEVEL FIELD PROTOCOLS

Instructions on Measuring Depth to Water

The following steps are based on the Department of Water Resources Groundwater Elevation Monitoring Guidelines document detailing the use of an electric sounding tape.

The following steps will be followed during each groundwater level measuring event.

1. Inspect the electric sounding tape and electrode probe before use. Check tape for wear, kinks, frayed electrical connections and possible stretch. Test battery.
2. Check the distance from the electrode probe's sensor to the nearest foot marker on the tape, to ensure that the distance puts the sensor at the zero foot point for the tape. If it does not, apply correction to measurements and record information in equipment log book.
3. Prepare field forms and check previous water level data.
4. Check that the RP is clearly marked on the well and is accurately described on the field form.
5. Check the circuitry of the electric sounding tape before using in well by dipping the electrode probe into tap water.
6. Wipe off the electrode probe and the lower 5 to 10 feet of the tape with a disinfectant wipe, rinse with de-ionized or tap water, and dry.

Steps for making a measurement

1. If the water level was measured previously at the well, use the previous measurement to estimate the length of tape that should be lowered into the well.
2. Lower the electrode probe slowly into the well until the indicator shows that the circuit is closed and contact with the water surface is made. Avoid letting the tape rub across the top of the well casing. Place the tip of nail of the index finger on the insulated wire at the RP and read the depth to water to the nearest 0.1 foot. Record this value in the Below MP box on the data collection form, along with the date of the measurement.
3. Lift the electrode probe slowly up a few feet and make a second measurement by repeating step 2. If the second measurement does not agree with the first measurement, make a third measurement.

After making a measurement

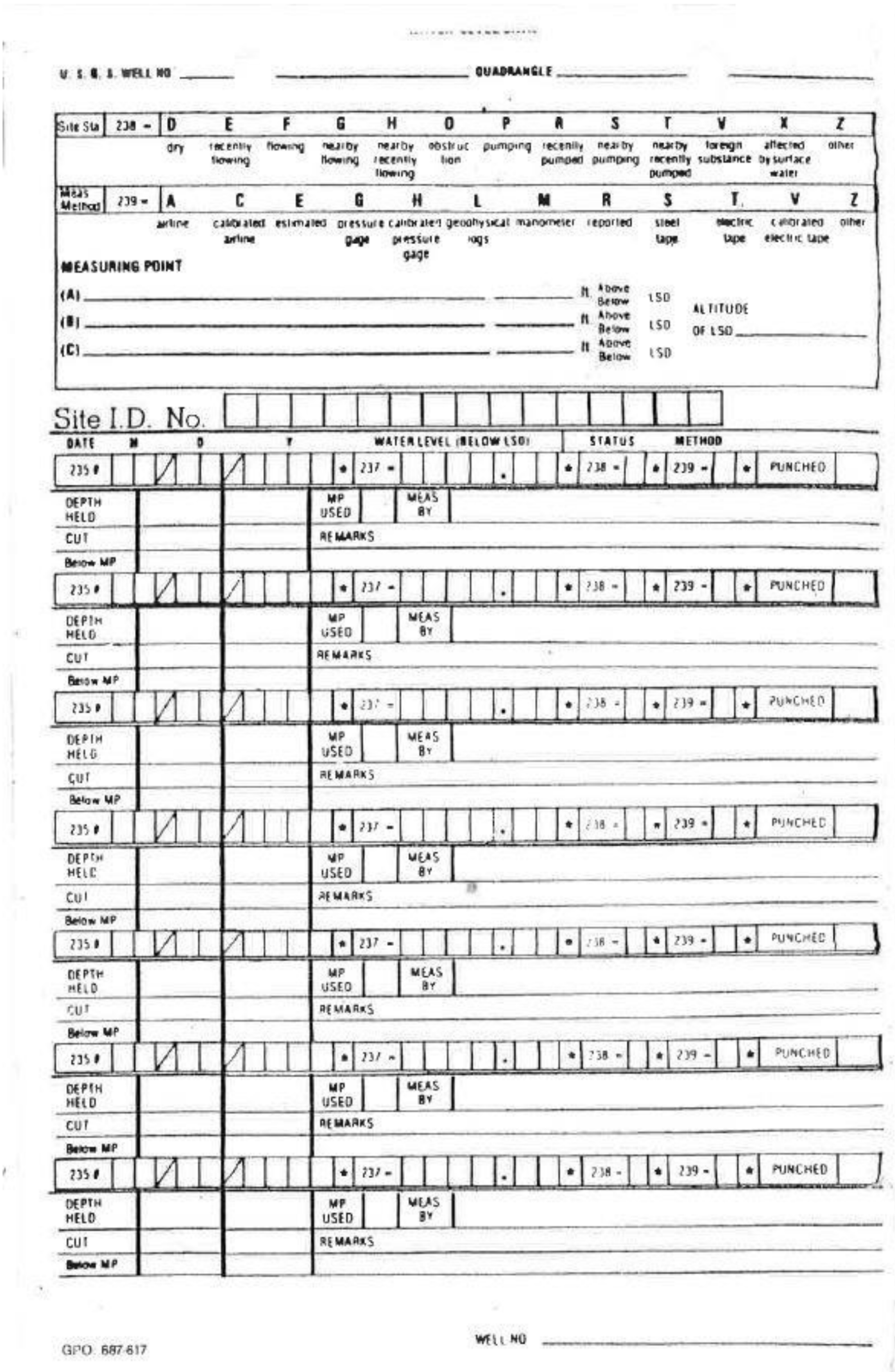
1. Wipe down the electrode probe and the section of the tape that was submerged in the well water, using a disinfectant wipe and rinse thoroughly with de-ionized or tap water. Dry the tape and probe and rewind the tape onto the tape reel. Do not rewind or otherwise store a dirty or wet tape.

A copy of the data collection form is presented as Figure 1.

Methods to Ensure Measurements of Static Groundwater Conditions

To ensure that groundwater elevation measurements are valid, data collection should only occur at a well during static (non-pumping conditions). 10 of the 12 CASGEM wells are observation wells and the two irrigation wells are currently inactive. The status of the CASGEM wells establishes that static conditions should exist at the well site during data collection. Although the CASGEM well sites should be under static conditions, surrounding areas to each CASGEM well will be observed closely for signs of recent or current pumping. Along with talking to any farmers in the area, the person collecting data will look for active irrigation systems and moist soil. The person collecting data will also view the previous groundwater elevation measurements to make sure that the current levels do not vary by a drastic amount.

FIGURE 1 DATA COLLECTION FORM



U. S. G. S. WELL NO ______ ______ QUADRANGLE ______ ______

Site Sta	238 -	D	E	F	G	H	O	P	R	S	T	V	X	Z
		dry	recently flowing	flowing	nearby flowing	nearby recently flowing	obstruction	pumping	recently pumped	nearby pumping	nearby recently pumped	foreign substance	affected by surface water	other

Meas Method	239 -	A	C	E	G	H	L	M	R	S	T	V	Z
		airline	calibrated airline	estimated	pressure gage	calibrated pressure gage	geophysical logs	manometer	reported	steel tape	electric tape	calibrated electric tape	other

MEASURING POINT

(A) ______ ______ ft. Above / Below LSD

(B) ______ ______ ft. Above / Below LSD — ALTITUDE OF LSD ______

(C) ______ ______ ft. Above / Below LSD

Site I.D. No.

DATE M D Y — WATER LEVEL (BELOW LSD) — STATUS — METHOD

235 # / / * 237 - . * 238 - * 239 - * PUNCHED
DEPTH HELD — MP USED — MEAS BY
CUT — REMARKS
Below MP

235 # / / * 237 - . * 238 - * 239 - * PUNCHED
DEPTH HELD — MP USED — MEAS BY
CUT — REMARKS
Below MP

235 # / / * 237 - . * 238 - * 239 - * PUNCHED
DEPTH HELD — MP USED — MEAS BY
CUT — REMARKS
Below MP

235 # / / * 237 - . * 238 - * 239 - * PUNCHED
DEPTH HELD — MP USED — MEAS BY
CUT — REMARKS
Below MP

235 # / / * 237 - . * 238 - * 239 - * PUNCHED
DEPTH HELD — MP USED — MEAS BY
CUT — REMARKS
Below MP

235 # / / * 237 - . * 238 - * 239 - * PUNCHED
DEPTH HELD — MP USED — MEAS BY
CUT — REMARKS
Below MP

235 # / / * 237 - . * 238 - * 239 - * PUNCHED
DEPTH HELD — MP USED — MEAS BY
CUT — REMARKS
Below MP

GPO 687-617

WELL NO ______

WATER QUALITY FIELD PROTOCOLS

Instructions on Obtaining a Water Quality Sample

Introduction

The following steps are Carpinteria Valley Water District's water quality sampling protocols for the District's spring and fall water groundwater quality monitoring. Some aspects of this guidance document were adopted from Fruit Grower's Laboratory Environmental' s (FGL) *Sampling Instructions for Aqueous Samples* (revised 01/09/2012, Doc ID: 2D1200001_SOP_3.DOC), FGL's *Sampling Instructions: Irrigation Suitability Analysis* guidance document, and University of California's Agriculture and Natural Resources' (UCANR) *Groundwater Sampling and Monitoring Reference Sheet 11.4* (Publication 8085). All field data recorded for CVWD's bi-annual sampling events are to be filled out on the District's field notes form, shown in **Figure 1,** which should be scanned and saved at the end of the seasonal sampling period. Additionally, the well name, sampling date, and sampling time must be appropriately recorded on the sample's associated labels and chain-of-custody (COC) which is provided by, and later returned to, FGL.

Private Well Sampling

1. Obtain all appropriate containers from FGL, COCs, labels, ice chest, and ice packs prior to heading out into the field for sampling.
2. Coordinate with the property owner, or a representative, ahead of time to schedule a time for sampling. Discuss their irrigation schedule to find the best time to arrive at the property. This will help to ensure that the well is on and has been purged ahead of your arrival. If the well has been stagnant for a period of time, have the property owner turn on the well ahead of time to flush the stagnant water before you arrive. If you arrive on site and the well has not been running, wait 15-20 minutes after it is turned on before taking a sample to flush out contaminants (i.e., rust, algae, etc.) that may have accumulated while the well was inactive. District staff are instructed not to touch any electrical or pump equipment. The well must be turned on and off by the owner or property representative.
3. Select the best possible sampling station, which is as close to the well-head as possible and ahead of any filtration or chemigation equipment.
4. Take care opening the sampling containers from the laboratory, as some may contain preservative chemicals that may be corrosive. Care must also be taken to ensure that only the water being sampled comes into contact with the inside of the bottle and cap to avoid contamination.
5. Fill all necessary sample bottles as required.
6. Take the pen-type digital water quality meter and submerge its probe into the water in the sample bottle without preservatives. Collect and document the electrical conductivity, pH, and temperature for each water sample on the field notes form (**Figure 1**). Also indicate the date and time of sample.
7. Identify every container by attaching an appropriately inscribed tag or label which corresponds to the record on the chain of custody.
8. Make an accurate record on the chain of custody for every sample collected.
9. Ensure all samples are cooled to approximately 4°C prior to delivering to the laboratory or leave in the Operations & Maintenance building's refrigerator for the laboratory to pick up if this has been previously scheduled.
10. Ensure all samples make it to the laboratory within the specified holding time.

Carpinteria Creek Sampling

1. Obtain all appropriate containers from FGL, COCs, labels, ice chest, and ice packs prior to heading out into the field for sampling.
2. If the creek is not running at the time of seasonal sampling, write “DRY” on the field notes form.
3. Find a location with running water, do not collect the sample from a stagnant pool of water within the creek.
4. Take care opening the sampling containers from the laboratory, as some may contain preservative chemicals that may be corrosive. Care must also be taken to ensure that only the water being sampled comes into contact with the inside of the bottle and cap to avoid contamination.
5. Tilt the bottle approximately 45 degrees and hold the sampling container at the base. In a scooping motion, move the bottle away from you, mouth first, as you fill the bottle. Fill with water to the fill line. If creek flows or water level are too low to fill the bottle at an angle, you may use an empty, uncontaminated sample bottle with no preservatives to collect water and pour into the other bottle until the fill line has been reached.
6. Fill all necessary sample bottles as required. Note that there is an additional sample bottle for the local creeks to test for Ammonia/Nitrogen. Ensure that the COC represents this.
7. Take the pen-type digital water quality meter and submerge its probe into the water in the sample bottle without preservatives. Collect and document the electrical conductivity, pH, and temperature for each water sample on the field notes form (**Figure 1**). Also indicate the date and time of sample.
8. Identify every container by attaching an appropriately inscribed tag or label which corresponds to the record on the chain of custody.
9. Make an accurate record on the chain of custody for every sample collected.
10. Ensure all samples are cooled to approximately 4°C prior to delivering to the laboratory or leave in the Operations & Maintenance building’s refrigerator for the laboratory to pick up if this has been previously scheduled.
11. Ensure all samples make it to the laboratory within the specified holding time.

FIGURE 1. WATER QUALITY FIELD NOTES FORM

GSA: WATER QUALITY SAMPLING GROUNDWATER (FALL YYYY) FIELD NOTES								
FOR ALL CHAINS GSA REPORTING LAB NUMBER IS **XXXXXXX**					**E.C. (µS unless noted)**	**PH**	**Temp.**	**Remarks**
Permission	**Well No. or Creek Name**	**Owner/Name**	**Date**	**Time**	**Field**	**Field**	**Field**	**Field**
Y/N	State Well Number	Owner, Site Contact, or Property Name						
Y/N	State Well Number	Owner, Site Contact, or Property Name						
Y/N	State Well Number	Owner, Site Contact, or Property Name						
Y/N	State Well Number	Owner, Site Contact, or Property Name						
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Y/N	State Well Number	Owner, Site Contact, or Property Name						
	Arroyo Paredon Creek							
	Carpinteria Creek							
	Gobernador Creek							
	Rincon Creek							
	Santa Monica Creek							
	Toro Creek							

APPENDIX H

Data Management System

Water Solutions, Inc.

TECHNICAL MEMORANDUM

Carpinteria Valley Groundwater Sustainability Agency Data Management Plan

To: Carpinteria Valley Groundwater Sustainability Agency Consultants and Staff

From: Tim Nicely and Josh Bale, GSI Water Solutions, Inc.

Date: May 25, 2022

This Data Management Plan presents a guide the use of a Data Management System (DMS) developed by GSI Water Solutions (GSI). The DMS was developed for the consultants working on the Groundwater Sustainability Plan (Plan) for the Carpinteria Groundwater Sustainability Agency (GSA) as a data storage and reporting tool for groundwater-related information to support the Hydrogeological Conceptual Model and Groundwater Conditions sections of the Plan. This Data Management Plan describes the process for collection, review, and upload of data used to develop the Plan. This document focuses on the protocols for data entry and reporting and specific protocols to ensure data housed in the DMS are of good quality, well documented, and reliably stored and managed to support data analyses during Plan development. These DMS protocols address requirements associated with all aspects of the data life cycle for Plan information, water quality data, water level data, groundwater extraction data, well construction data, and associated geospatial data. Planning for proper data management will help mitigate loss of data integrity throughout the data life cycle and produce data as required by the consultant team and California Department of Water Resources for development of the Plan.

This Data Management Plan does not provide documentation or final specifications for the DMS, but instead provides a reference for the use of the DMS by the consultant team for the Plan development. The documentation of the DMS will be included in the Plan in compliance with Sustainable Groundwater Management Act (SGMA) requirements. The consultant team includes GSI, Pueblo Water Resources, Bondy Groundwater Consulting and Montgomery and Associates. Carpinteria Valley Water District staff are also assisting with data compilation.

Management of Database

This memorandum describes the protocol to be followed to input data into and to retrieve the data from the DMS. The DMS is being developed and hosted by GSI and is based on commercially-available software on an SQL server platform. To foster collaboration, the DMS will be maintained by GSI throughout the development of the Plan for the use of the consultants and Groundwater Sustainability Agency working on the Plan.

The DMS incorporates data from a variety of external sources, of varying data types, and in multiple formats. The usefulness of the data housed in the DMS database is dependent on the quality of the data stored throughout the development of the Plan.

Any questions or assistance needs related to data should be directed to Tim Nicely (805-979-3084).

Data Needs

Data are required in support of sustainable groundwater management, which is defined within the California Department of Water Resource's (DWR's) SGMA regulations as "the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results." Furthermore, SGMA outlines six undesirable results as follows:

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

The status of each of these six undesirable is determined by assessment of data for the sustainability indicators. The DMS for the Carpinteria GSA will store relevant data for each sustainability indicator. The data that are required, at a minimum, are presented on Table 1.

Table 1. Sustainability Indicator Metrics

Sustainability Indicators	Lowering GW Levels	Reduction of Storage	Seawater Intrusion	Degraded Quality	Land Subsidence	Surface Water Depletion
Metric(s) Defined in GSP Regulations	• Groundwater Elevation	• Total Volume	• Chloride concentration isocontour	• Migration of Plumes • Number of supply wells • Volume • Location of isocontour	• Rate and Extent of Land Subsidence	• Volume or rate of surface water depletion

Database Management

As the database manager, GSI will:

1. Maintain the DMS in accordance with this data management plan.
2. Ensure data entries are correct and complete.
3. Verify the satisfactory electronic transfer of data to the consultant team.
4. Ensure accurate entry of information, including associated metadata, into the DMS.
5. Provide access to the entire consultant team via the DMS or other output tools.

Tabular Data Management

Most data associated with supporting Plan development consist of tabular data collected from wells. Data stored in the DMS is separated by categories into tables, which contain columns and rows of data. Each field holds a specific data types, such as a number, text, or date. This DMS will be housed on a Microsoft SQL Server 2017 to serve as the master data repository for all analytical information. This information includes locations, results, field measurements, and associated ancillary and descriptive information that will be documented using formal metadata.

Unstructured Data Management

Unstructured data is information that does not have an established data model or lacks a pre-defined structure or organization and is being collected in support of the Plan. This data is not included directly in the DMS but will be managed using procedures described below. Examples of unstructured data may include reports, memos, correspondences, maps or figures (including boring logs), photos, field forms or field notes, videos, audio files, presentations, webpages, and other documents. This unstructured data is recorded and managed as noted below:

- **Reports and Memos:** Microsoft Word is used to develop reports and memos. Figures, graphs, maps, and other associated media will be created using other software.
- **Presentations:** Project presentations will be created using Microsoft PowerPoint.
- **Maps and Figures:** Digital, interactive, hard copy, and static maps will be used to depict information used in support of Plan development. ArcGIS will be the primary GIS platform used for the creation of maps. GSI maintains standard mapping templates and defined cartographic elements to maintain consistency in all mapping deliverables.
- **Other Unstructured Data:** A spatially referenced geodatabase will be developed to manage unstructured data such as photos and field forms. These data will be accessed using defined relationships within the database itself. Photograph meta data will include date/time and location.

Data Documentation

Documentation of spatial and tabular data will be essential to the use of the data and will be documented in the Plan. Metadata is a term that is used to describe “data that provides information about other data,” which is key to providing context or supporting information relevant to a managed dataset. Retention and archiving of metadata should be clearly defined and related directly to the primary data.

Integration Standards

The data management efforts need to ensure that the data sources are accurate, timely, and reliable. Additionally, spatiotemporal data requires consistent spatial and temporal extents, resolutions, coordinate projections, and data quality. Finally, all data need to use data sources that are not restricted, requiring appropriate documentation of data privacy, as applicable.

Protocol for Data Entry and Requests

GSI will collect, process and manage the data within the DMS from a variety of sources and formats as shown in Figure 1. This data will be used to support the Plan development, tracking of sustainability indicators, and annual reporting.

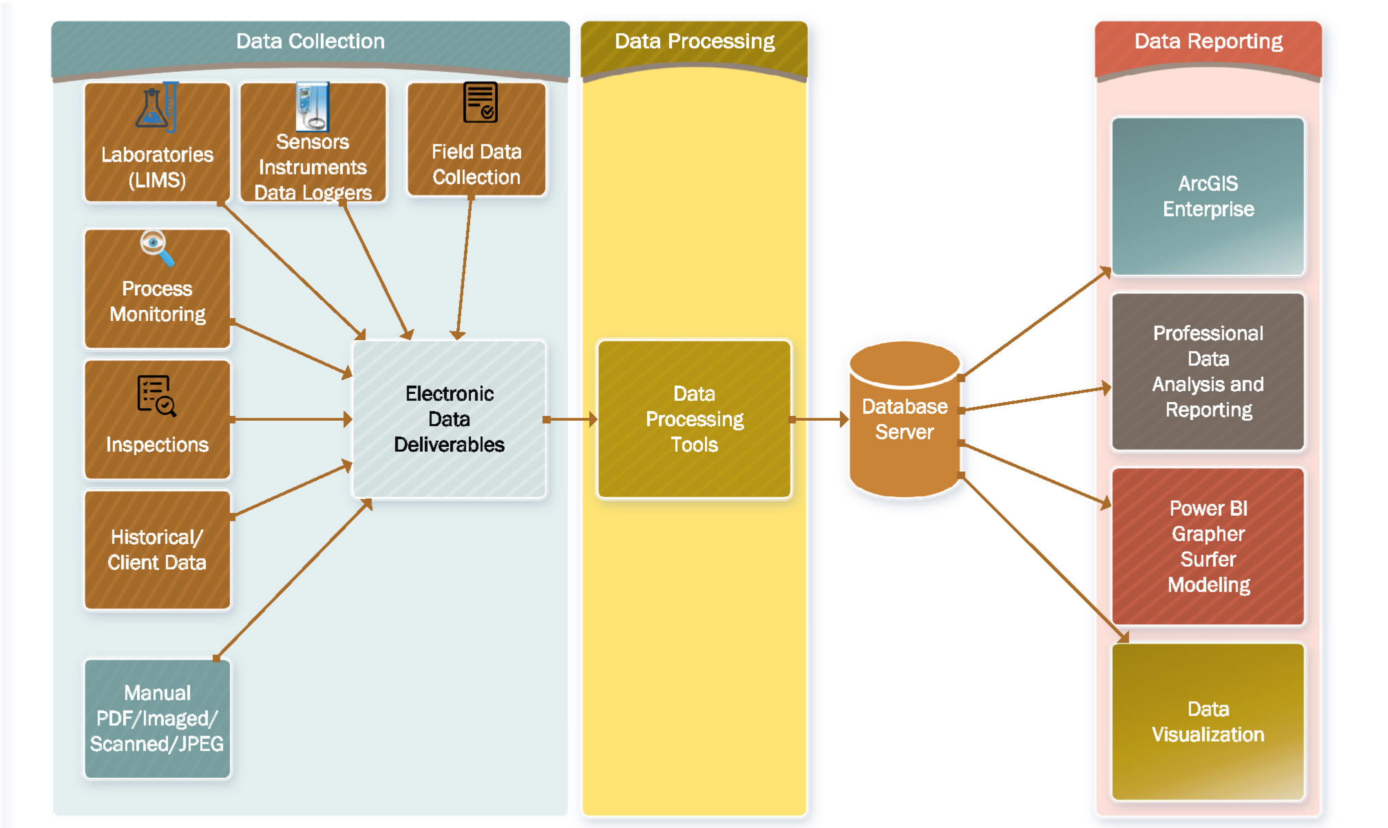

Figure 1. Database Process Flowchart

Inputting of data into the DMS including data entry, changes, and other requests should be made as follows:

- **Step 1:** A summary of the data request should be emailed to CarpGSA@gsiws.com, which will be sent to the GSI database manager. Please be specific about the scope of any request, change or addition and include any details as warranted. Each request should include well name, location identifier, date range, subset of type of wells, and specific parameters of interest. Indicate the format in which the data report should be presented.
- **Step 2:** GSI staff will send a confirmation email acknowledging the request has been received.
- **Step 3:** GSI staff will then process the request.

Data Quality Control

Data Quality Objectives and Data Integrity

Quality control procedures will help ensure that data used to support Plan development meet the data quality objectives for preparation of the Plan. The essential objectives of the data quality control process are presented in Table 1 below.

Table 2. Components of Data Quality

Component	Description
Completeness	An indication of the comprehensiveness of a respective data set, particularly in context of the intended use of the data
Uniqueness	A discrete measure identifying any duplication in the respective data set
Timeliness	A measure indicating whether the respective data set is up-to-date
Validity	A set of measures to determine the validity of the data
Accuracy	A measure detailing the conformance of the data to the to the actual site conditions.
Consistency	A set of measures describing the usability of the respective data set

The data will comply with the DWR's data templates for delivery following Plan completion, at which time all data will be evaluated for validity and acceptable use. The entry of data will be normalized by transfer to templates with a set of rules restricting formatting, alphanumeric properties, and other filters. The quality control and quality assurance will comply with methods described in SGMA GSP Regulation §354.44 (c).

Quality Control for Importation of Outside Data Sources

Outside data sources include data collected by the District, data housed in state databases, private data, data presented in published and unpublished reports, and data collected by the consultant team. Quality control will include documentation of the source of the data, verification of the well ID and location, reconciliation with previously used well IDs, verification and consistent use of measurement units, elimination of duplicate data, and identification of potentially erroneous data. Information and data will be formatted in a manner that enhances importation into the DMS. Metadata that documents the source of the data will be included.

Field Data Quality Control Procedures

GSI will perform quality control procedures on all data provided for upload. GSI staff will scan hard-copy field forms and enter information into the database using standardized data entry forms. quality control of incoming field data will be facilitated through data entry forms and batch loading tools that check for consistent sample names, standard attribute values, and other aspects of database integrity.

Unstructured Data Quality Control Procedures

This section details the quality control procedures associated with the development of unstructured data, when provided.

Quality Control of Reports and Memos

All reports, memos, and associated figures produced by the consultant team will go through an internal review process and technical editors. Other reports and information will be maintained in the condition they were received. Draft reports with redlines of comments received will be retained for the duration of the Plan preparation period and deleted when the Plan is complete and submitted to DWR.

Quality Control of Maps

GSI staff will review all visual representations of project geospatial and analytical data produced by the consultant team from the tabular data within the DMS. Figures with geospatial data will be subjected to an internal quality control review process by GIS Specialists. Senior GSI staff will ensure that all figure elements are constructed and placed correctly. Further review of figures and maps will take place by technical staff during report generation.

Quality Control of Other Unstructured Data

Other unstructured data do not have formal quality control procedures applied. As appropriate and practical, other unstructured data will be reviewed and checked for quality pertinent to the use of the corresponding data.

Protocol for Data Output

Once a data request is completed, the following procedure will be performed:

- **Step 1:** Completed data tables or output files will be posted on: Carp GSA Datashare Consultants.
- **Step 2:** An email will be sent to the DMS members to inform the consultant team that new data is available for review and use, including a summary of the request, changes that were made, and notes including location of the files.

APPENDIX I

Responses to Public Comments on the Draft Groundwater Sustainability Plan

(Note: Appendix I will be developed after the Public Draft version of this GSP is released.)