Carpinteria Groundwater Sustainability Agency

Carpinteria Groundwater Basin Groundwater Sustainability Plan

December 2023

Prepared for:

Carpinteria Groundwater Sustainability Agency

Prepared by:

GSI Water Solutions, Inc.

800 Quintana Road, Suite 2C, Morro Bay, CA 93442

Carpinteria Groundwater Sustainability Agency

Carpinteria Groundwater Basin Groundwater Sustainability Plan

December 2023

Prepared for:
Board of Directors, Carpinteria Groundwater Sustainability Agency
1301 Santa Ynez Ave
Carpinteria, CA 93013

GSI Water Solutions, Inc. (GSI); Pueblo Water Resources, Inc. (PWR); and Montgomery & Associates (M&A) are pleased to submit this Groundwater Sustainability Plan (Plan) prepared in accordance with California Code of Regulations, Title 23. Water, Division 2. Department of Water Resources, Chapter 1.5. Groundwater Management, Subchapter 2. Groundwater Sustainability Plans.

The Plan was prepared by the following authors:

David O'Rourke, PG, CHG, PE (GSI)
Project Manager and Principal Hydrogeologist

Robert C. Marks, PG, CHG (PWR)
Principal Hydrogeologist

Cameron Tana, PE (M&A)
Principal Hydrologist

Contents

Definitions xx
California Water Code xx
Official California Code of Regulations (CCR) xxii

Executive Summary ES-1
ES-1 Introduction ES-2
ES-1.1 Plan Area ES-2
ES-1.2 Sustainable Management Criteria ES-4
ES-1.3 Outreach Efforts ES-5
ES-1.4 Plan Organization ES-5
ES-2 Basin Setting (Plan Section 3) ES-6
ES-2.1 Hydrogeologic Conceptual Model and Principal Aquifers ES-6
ES-2.2 Recharge and Discharge in the Carpinteria Basin ES-7
ES-2.3 Groundwater Conditions ES-8
ES-2.4 Interconnected Groundwater and Surface Water ES-12
ES-2.5 Groundwater Dependent Ecosystems ES-12
ES-2.6 Water Budget Development ES-12
ES-3 Monitoring Networks (Plan Section 4) ES-13
ES-4 Sustainable Management Criteria (Plan Section 5) ES-19
ES-5 Projects and Management Actions (Plan Section 6) ES-22
ES-6 Plan Implementation (Plan Section 7) ES-24

SECTION 1: Introduction to Plan Contents [Article 5 §354] 1-1
1.1 Purpose of the Groundwater Sustainability Plan 1-2
1.2 Description of the Carpinteria Groundwater Basin 1-2
1.3 Organization of the Plan 1-2

SECTION 2: Administrative Information [Article 5, SubArticle 1] 2-1
2.1 Agency Information [§354.6] 2-2
2.2 Member Agencies 2-2
2.2.1 Carpinteria Valley Water District 2-2
2.2.2 City of Carpinteria 2-2
2.2.3 Santa Barbara County Water Agency 2-3
2.2.4 County of Ventura 2-3
2.3 Name and Mailing Address [§354.6(a)] 2-3
2.4 Organization and Management Structure [§354.6(b)] 2-4
2.4.1 Plan Manager and Contact Information [§354.6(c)] 2-4
2.4.2 Legal Authority [§354.6(d)] 2-5
2.4.3 Cost and Funding of Plan Implementation [§354.6(e)] 2-7
2.5 Description of Plan Area [§354.8(a)(1),(a)(2)] 2-7
2.5.1 Summary of Jurisdictional Areas and Other Features [§354.8 (a)(3),(a)(4), and (b)] 2-8
2.5.2 Water Resources Monitoring and Management Programs [§354.8(c) and (d)] 2-15
2.5.3 Land Use/General Plans 2-21

2.5.4 Additional Plan Elements [§354.8(g)] 2-28
2.6 Notice and Communication [§354.10] 2-30
2.6.1 Beneficial Uses and Users [§354.10(a)] 2-30
SECTION 3: Basin Setting [Article 5, Subarticle 2] 3-1
3.1 Hydrogeologic Conceptual Model [§354.14] 3-2
3.1.1 Regional Hydrology 3-3
3.1.2 Regional Geology [§354.14(b)(1),(d)(2), and (d)(3)] 3-8
3.1.3 Principal Aquifers and Aquitards [§354.14(b)(4)(A)] 3-13
3.1.4 Data Gaps and Uncertainty [§354.14(b)(5)] 3-34
3.2 Groundwater Conditions [§354.16] 3-34
3.2.1 Groundwater Elevations [§354.16(a)] 3-34
3.2.2 Change in Storage [§354.16(b)] 3-48
3.2.3 Seawater Intrusion [§354.16(c)] 3-48
3.2.4 Groundwater Quality Distribution and Trends [§354.16(d)] 3-64
3.2.5 Land Subsidence [§354.16(e)] 3-64
3.2.6 Interconnected Surface Water Systems [§354.16(f)] 3-68
3.2.7 Groundwater Dependent Ecosystems [§354.16(g)] 3-74
3.3 Water Budget [§ 354.18] 3-96
3.3.1 Overview of Water Budget Development 3-96
3.3.2 Water Budget Data Sources, Methodology, and Basin Model 3-97
3.3.3 Historical Water Budget [§ 354.18(c)(2)(B)] 3-120
3.3.4 Current Water Budget [§ 354.18(c)(1)] 3-131
3.3.5 Projected Water Budget 3-136
3.3.6 Basin Safe Yield Estimate [§354.18(b)(7)] 3-159
SECTION 4: Monitoring Networks 4-1
4.1 Introduction to Monitoring Networks 4-2
4.2 Monitoring Network Objectives and Design Criteria 4-3
4.3 Existing Monitoring Networks 4-4
4.3.1 Groundwater Levels and Groundwater Quality 4-5
4.3.2 Streamflow Monitoring Network 4-9
4.4 Sustainability Indicator Monitoring Networks 4-11
4.4.1 Chronic Lowering of Groundwater Levels 4-12
4.4.2 Reduction of Groundwater Storage 4-17
4.4.3 Seawater Intrusion Monitoring Network 4-20
4.4.4 Degraded Water Quality Monitoring Network 4-26
4.4.5 Land Subsidence Monitoring Network 4-32
4.4.6 Depletion of Interconnected Surface Water Monitoring Network 4-35
4.5 Reporting Monitoring Data to the Department (Data Management System) 4-38
SECTION 5: Sustainable Management Criteria [Article 5, SubArticle 3] 5-1
5.1 Introduction to Sustainable Management Criteria [§354.22] 5-2
5.2 Definitions 5-3
5.3 Sustainability Goal [§354.24] 5-5

5.3.1 Description of Sustainability Goal 5-5
5.3.2 Strategies for Meeting the Sustainability Goal 5-6
5.4 General Process for Establishing Sustainable Management Criteria [§ 354.22-30] 5-7
5.4.1 Technical and Public Input 5-7
5.4.2 Criteria for Defining Undesirable Results and Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives 5-8
5.5 Chronic Lowering of Groundwater Levels Sustainable Management Criterion 5-9
5.5.1 Undesirable Results for Chronic Lowering of Groundwater Levels [§354.26] 5-9
5.5.2 Minimum Thresholds for Chronic Lowering of Groundwater Levels [§354.28] 5-12
5.5.3 Measurable Objectives for Chronic Lowering of Groundwater Levels Sustainability Indicator [§354.30] 5-30
5.5.4 Interim Milestones for Chronic Lowering of Groundwater Levels Sustainability Indicator [§354.30(e)] 5-31
5.6 Reduction of Groundwater Storage Sustainable Management Criterion 5-31
5.6.1 Undesirable Results for Reduction of Groundwater Storage [§354.26(a)] 5-32
5.6.2 Minimum Thresholds for Reduction of Groundwater Storage [§354.28(a),(b)(1),(c)(2),(d), and (e)] 5-34
5.6.3 Measurable Objectives for Reduction of Groundwater Storage Sustainability Indicator [§354.30(a),(c),(d), and (g)] 5-39
5.6.4 Interim Milestones for Reduction of Groundwater Storage Sustainability Indicator [§354.30(e)] 5-40
5.7 Seawater Intrusion Sustainable Management Criterion 5-40
5.7.1 Undesirable Results for Seawater Intrusion [§354.26(a),(b)(2),(c), and (d)] 5-41
5.7.2 Minimum Thresholds for Seawater Intrusion [§354.28(a),(b)(1),(c)(3),(d), and (e)] 5-43
5.7.3 Measurable Objectives for Seawater Intrusion Sustainability Indicator [§354.30(a),(c),(d), and (g)] 5-50
5.7.4 Interim Milestones for Seawater Intrusion Sustainability Indicator [§354.30(e)] 5-51
5.8 Water Quality Degradation Sustainable Management Criterion 5-51
5.8.1 Undesirable Results for Water Quality Degradation [§354.26(a) (b)(1),(b)(2), and (d)] 5-52
5.8.2 Minimum Thresholds for Water Quality Degradation [§354.28(b)(1) 5-54
5.8.3 Measurable Objectives for Water Quality Degradation Sustainability Indicator [§354.30(a),(b),(c),(d), and (g)] 5-64
5.8.4 Interim Milestones for Water Quality Degradation Sustainability Indicator § 354.28(a)(e) 5-65
5.9 Land Subsidence Sustainable Management Criterion 5-66
5.9.1 Undesirable Results for Land Subsidence [§354.26(a)] 5-66
5.9.2 Minimum Thresholds for Land Subsidence § 354.28(c)(5) 5-68
5.9.3 Measurable Objectives for Land Subsidence § 354.30(a)-(g) 5-69
5.9.4 Interim Milestones for Land Subsidence Sustainability Indicator § 354.28(a)(e) 5-69
5.10 Interconnected Surface Water Depletions Sustainable Management Criterion 5-70
5.11 Management Areas 5-70

SECTION 6: Projects and Management Actions [Article 5, SubArticle 5] 6-1
6.1 Introduction [§354.42, 354.44(a),(c), and (d)] 6-2
6.2 Project and Management Action Implementation Approach [§354.44(b)(6)] 6-5
6.3 Carpinteria Advanced Purification Project (CAPP) [§354.44(b)(1), (d)] 6-6

6.3.1 Project Description 6-6
6.3.2 Relevant Measurable Objective(s) [§354.44(b)(1)] 6-9
6.3.3 Implementation Triggers [§354.44(b)(1)(A)] 6-9
6.3.4 Public Notice Process [§354.44(b)(1)(B)] 6-10
6.3.5 Permitting and Regulatory Process [§354.44(b)(3)] 6-10
6.3.6 Implementation Timeline [§354.44(b)(4)] 6-11
6.3.7 Anticipated Benefits [§354.44(b)(5)] 6-11
6.3.8 Legal Authority [§354.44(b)(7)] 6-12
6.3.9 Cost & Funding [§354.44(b)(8)] 6-12
6.4 Sentinel Monitoring Well Network Expansion Project [§354.44(b)(1), (d)] 6-14
6.4.1 Project Description 6-14
6.4.2 Relevant Measurable Objective(s) [§354.44(b)(1)] 6-16
6.4.3 Implementation Triggers [§354.44(b)(1)(A)] 6-16
6.4.4 Public Notice Process [§354.44(b)(1)(B)] 6-17
6.4.5 Permitting and Regulatory Process [§354.44(b)(3)] 6-17
6.4.6 Implementation Timeline [§354.44(b)(4)] 6-18
6.4.7 Anticipated Benefits [§354.44(b)(5)] 6-18
6.4.8 Legal Authority [§354.44(b)(7)] 6-19
6.4.9 Cost & Funding [§354.44(b)(8)] 6-19
6.5 Local Infrastructure Water System Interties [§354.44(b)(1), (d)] 6-19
6.5.1 Project Description 6-19
6.5.2 Relevant Measurable Objective(s) [§354.44(b)(1)] 6-20
6.5.3 Implementation Triggers [§354.44(b)(1)(A)] 6-22
6.5.4 Public Notice Process [§354.44(b)(1)(B)] 6-22
6.5.5 Permitting and Regulatory Process [§354.44(b)(3)] 6-23
6.5.6 Implementation Timeline [§354.44(b)(4)] 6-23
6.5.7 Anticipated Benefits [§354.44(b)(5)] 6-23
6.5.8 Legal Authority [§354.44(b)(7)] 6-24
6.5.9 Cost & Funding [§354.44(b)(8)] 6-24
6.6 Carpinteria Seawater Intrusion Barrier Project [§354.44(b)(1), (d)] 6-25
6.6.1 Project Description 6-25
6.6.2 Relevant Measurable Objective(s) [§354.44(b)(1)] 6-26
6.6.3 Implementation Triggers [§354.44(b)(1)(A)] 6-26
6.6.4 Public Notice Process [§354.44(b)(1)(B)] 6-26
6.6.5 Permitting and Regulatory Process [§354.44(b)(3)] 6-27
6.6.6 Implementation Timeline [§354.44(b)(4)] 6-27
6.6.7 Anticipated Benefits [§354.44(b)(5)] 6-27
6.6.8 Legal Authority [§354.44(b)(7)] 6-28
6.6.9 Cost & Funding [§354.44(b)(8)] 6-28
6.7 Aquifer Storage and Recovery Projects [§354.44(b)(1), (d)] 6-29
6.7.1 Project Description 6-29
6.7.2 Relevant Measurable Objective(s) [§354.44(b)(1)] 6-30
6.7.3 Implementation Triggers [§354.44(b)(1)(A)] 6-30

6.7.4 Public Notice Process [§354.44(b)(1)(B)] 6-31
6.7.5 Permitting and Regulatory Process [§354.44(b)(3)] 6-31
6.7.6 Implementation Timeline [§354.44(b)(4)] 6-31
6.7.7 Anticipated Benefits [§354.44(b)(5)] 6-32
6.7.8 Legal Authority [§354.44(b)(7)] 6-32
6.7.9 Cost & Funding [§354.44(b)(8)] 6-32
6.8 Recharge Enhancement Projects [§354.44(b)(1), (d)] 6-33
6.8.1 Project Description 6-33
6.8.2 Relevant Measurable Objective(s) [§354.44(b)(1)] 6-34
6.8.3 Implementation Triggers [§354.44(b)(1)(A)] 6-34
6.8.4 Public Notice Process [§354.44(b)(1)(B)] 6-35
6.8.5 Permitting and Regulatory Process [§354.44(b)(3)] 6-35
6.8.6 Implementation Timeline [§354.44(b)(4)] 6-36
6.8.7 Anticipated Benefits [§354.44(b)(5)] 6-36
6.8.8 Legal Authority [§354.44(b)(7)] 6-36
6.8.9 Cost & Funding [§354.44(b)(8)] 6-37
6.9 Local Inter-Agency Water Delivery and Water Banking Agreements [§354.44(b)(1), (d)] 6-38
6.9.1 Project Description 6-38
6.9.2 Relevant Measurable Objective(s) [§354.44(b)(1)] 6-39
6.9.3 Implementation Triggers [§354.44(b)(1)(A)] 6-39
6.9.4 Public Notice Process [§354.44(b)(1)(B)] 6-40
6.9.5 Permitting and Regulatory Process [§354.44(b)(3)] 6-40
6.9.6 Implementation Timeline [§354.44(b)(4)] 6-40
6.9.7 Anticipated Benefits [§354.44(b)(5)] 6-41
6.9.8 Legal Authority [§354.44(b)(7)] 6-41
6.9.9 Cost & Funding [§354.44(b)(8)] 6-42
6.10 Municipal Pumping Re-Distribution Management Action [§354.44(b)(1), (d)] 6-42
6.10.1 Project Description 6-42
6.10.2 Relevant Measurable Objective(s) [§354.44(b)(1)] 6-44
6.10.3 Implementation Triggers [§354.44(b)(1)(A)] 6-44
6.10.4 Public Notice Process [§354.44(b)(1)(B)] 6-45
6.10.5 Permitting and Regulatory Process [§354.44(b)(3)] 6-45
6.10.6 Implementation Timeline [§354.44(b)(4)] 6-45
6.10.7 Anticipated Benefits [§354.44(b)(5)] 6-46
6.10.8 Legal Authority [§354.44(b)(7)] 6-46
6.10.9 Cost & Funding [§354.44(b)(8)] 6-46
6.11 Well Registration and Metering Program Management Action [§354.44(b)(1), (d)] 6-47
6.11.1 Management Action Description 6-47
6.11.2 Relevant Measurable Objective(s) [§354.44(b)(1)] 6-48
6.11.3 Implementation Triggers [§354.44(b)(1)(A)] 6-49
6.11.4 Public Notice Process [§354.44(b)(1)(B)] 6-49
6.11.5 Permitting and Regulatory Process [§354.44(b)(3)] 6-49
6.11.6 Implementation Timeline [§354.44(b)(4)] 6-50

6.11.7 Anticipated Benefits [§354.44(b)(5)] 6-50
6.11.8 Legal Authority [§354.44(b)(7)] 6-51
6.11.9 Cost & Funding [§354.44(b)(8)] 6-51
6.12 Water Use Efficiency Programs Management Action [§354.44(b)(1), (d)] 6-52
6.12.1 Project Description 6-52
6.12.2 Relevant Measurable Objective(s) [§354.44(b)(1)] 6-54
6.12.3 Implementation Triggers [§354.44(b)(1)(A)] 6-54
6.12.4 Public Notice Process [§354.44(b)(1)(B)] 6-55
6.12.5 Permitting and Regulatory Process [§354.44(b)(3)] 6-55
6.12.6 Implementation Timeline [§354.44(b)(4)] 6-55
6.12.7 Anticipated Benefits [§354.44(b)(5)] 6-56
6.12.8 Legal Authority [§354.44(b)(7)] 6-56
6.12.9 Cost & Funding [§354.44(b)(8)] 6-56
6.13 Groundwater Model Revisions and Updates Management Action [§354.44(b)(1), (d)] 6-57
6.13.1 Project Description 6-57
6.13.2 Relevant Measurable Objective(s) [§354.44(b)(1)] 6-58
6.13.3 Implementation Triggers [§354.44(b)(1)(A)] 6-58
6.13.4 Public Notice Process [§354.44(b)(1)(B)] 6-59
6.13.5 Permitting and Regulatory Process [§354.44(b)(3)] 6-59
6.13.6 Implementation Timeline [§354.44(b)(4)] 6-59
6.13.7 Anticipated Benefits [§354.44(b)(5)] 6-60
6.13.8 Legal Authority [§354.44(b)(7)] 6-60
6.13.9 Cost & Funding [§354.44(b)(8)] 6-60
6.14 Address Data Gaps [§354.44(b)(1), (d)] 6-61
6.14.1 Project Description 6-61
6.14.2 Relevant Measurable Objective(s) [§354.44(b)(1)] 6-61
6.14.3 Implementation Triggers [§354.44(b)(1)(A)] 6-62
6.14.4 Public Notice Process [§354.44(b)(1)(B)] 6-62
6.14.5 Permitting and Regulatory Process [§354.44(b)(3)] 6-62
6.14.6 Implementation Timeline [§354.44(b)(4)] 6-63
6.14.7 Anticipated Benefits [§354.44(b)(5)] 6-63
6.14.8 Legal Authority [§354.44(b)(7)] 6-63
6.14.9 Cost & Funding [§354.44(b)(8)] 6-64
6.15 Perform Tier 2 Project and Management Action Feasibility and Ranking Study [§354.44(b)(1), (d)] 6-64
6.15.1 Project Description 6-64
6.15.2 Relevant Measurable Objective(s) [§354.44(b)(1)] 6-65
6.15.3 Implementation Triggers [§354.44(b)(1)(A)] 6-65
6.15.4 Public Notice Process [§354.44(b)(1)(B)] 6-66
6.15.5 Permitting and Regulatory Process [§354.44(b)(3)] 6-66
6.15.6 Implementation Timeline [§354.44(b)(4)] 6-66
6.15.7 Anticipated Benefits [§354.44(b)(5)] 6-67
6.15.8 Legal Authority [§354.44(b)(7)] 6-67

6.15.9 Cost & Funding [§354.44(b)(8)] 6-67

SECTION 7: Implementation Plan [§354.44(b)(6)] 7-1

7.1 Introduction 7-2

7.2 Administrative Approach and Implementation Timing 7-3

7.3 Permitting of Wells 7-4

7.4 Annual Reporting 7-4

7.5 Five-Year Evaluation and Update 7-5

7.6 Management Action Implementation 7-6

7.7 Annual Budget Estimates 7-9

7.8 Funding Sources 7-10

SECTION 8: References and Technical Studies 8-1

Tables

Table ES-1. Summary of Minimum Thresholds, Measurable Objectives, and Interim Milestones for Carpinteria Groundwater Basin Chronic Lowering of Groundwater Levels Sustainability Indicator ES-20
Table ES-2. Minimum Thresholds for the Water Quality Degradation Sustainability Indicator ES-22
Table 2-1. Land Use Summary in 2018 2-9
Table 2-2. Meteorological Monitoring Stations 2-17
Table 2-3. Plan Elements from California Water Code Section 10727.4 2-29
Table 3-1. Sentinel Well Completion Summary 3-50
Table 3-2. NC Dataset Potential GDEs Summary 3-77
Table 3-3. Potential GDE Initial Screening Summary 3-80
Table 3-4. Potential GDE Water-Level Monitoring Well Summary 3-81
Table 3-5. Land Use Categories and Blaney Curve Types Summary 3-110
Table 3-6. Carpinteria Valley Water District Land Use Survey Data Summary 3-112
Table 3-7. Water Budget Data Source Summary 3-119
Table 3-8. Summary of Carpinteria Valley Water District Delivered Water 3-122
Table 3-9. Summary of Surface Water Entering and Leaving the Basin (Water Years 1985 to 2020) 3-123
Table 3-10. Historical Water Budget Inventory (Water Years 1985 to 2020) 3-126
Table 3-11. Historical Water Budget Summary (Water Years 1985 to 2020) 3-128
Table 3-12. Current Water Budget Inventory (Water Years 2012 to 2020) 3-132
Table 3-13. Current Water Budget Summary (Water Years 2012 to 2020) 3-134
Table 3-14. 50-Year Base Period Annual Average Precipitation Summary 3-137
Table 3-15. Projected CVWD Pumping Summary 3-150
Table 3-16. Projected Baseline Private Pumping Summary 3-151
Table 3-17. Projected Surface Water Supplies 3-152
Table 3-18. 50-Year Projected Water Budget Inventory (Water Years 2024–2073) 3-153
Table 3-19. 50-Year Projected Water Budget Summary (Water Years 2024–2073) 3-156
Table 3-20. Sustainable Yield Base Period Water Budget Summary 3-161
Table 3-21. Water Budget Comparison: Baseline (No Project) vs. CAPP 3-163
Table 3-22. Sustainable Yield Comparison: Baseline (No project) vs. CAPP 3-163
Table 4-1. Existing Groundwater Monitoring Network Well Information Summary 4-7
Table 4-2. Summary of Water Level and Storage Reduction RMS Wells 4-13
Table 4-3. Summary of Seawater Intrusion RMS Wells 4-22
Table 4-4. Summary of RMS Wells for Water Quality Degradation 4-29
Table 4-5. Summary of Data Available for Sustainability Indicators 4-39

Table 4-6. Summary of Data Sources 4-40

Table 4-7. Data Management System Table Descriptions 4-42

Table 5-1. Summary of Minimum Thresholds, Measurable Objectives, and Interim Milestones for Carpinteria Groundwater Basin Chronic Lowering of Groundwater Levels Sustainability Indicator....5-10

Table 5-2. Minimum Thresholds for the Water Quality Degradation Sustainability Indicator 5-55

Table 6-1. Carpinteria Advanced Purification Project (CAPP) Funding Summary....6-13

Table 7-1. Conceptual Planning-Level Cost Estimate for Potential Project Implementation....7-7

Table 7-2. Conceptual Planning-Level Cost Estimate for Potential Management Action Implementation....7-8

Table 7-3. Conceptual Planning-Level Cost Estimate for Carpinteria GSA Annual Management and Operation 7-9

Figures

Figure ES-1. Carpinteria Groundwater Basin Plan Area and Jurisdictional Areas ES-3
Figure ES-2. Historical Basin Hydrographs ES-9
Figure ES-3. Groundwater Elevation Contours – Fall 2020 ..... ES-10
Figure ES-4. Sentinel Well Completions Schematic ES-11
Figure ES-5. Historical Water Budget Summary (WY 1985 – 2020) ES-14
Figure ES-6. RMS Wells for Water Level Decline and Reduction of Storage ES-16
Figure ES-7. RMS Wells for Seawater Intrusion Monitoring ES-17
Figure ES-8. RMS Wells for Water Quality Degradation ES-18
Figure ES-9. Seawater Intrusion Isocontour SMC ES-21
Figure 2-1. Carpinteria Groundwater Basin Plan Area and Jurisdictional Areas 2-6
Figure 2-2. Existing Land Use Designations 2-10
Figure 2-3. Water Use Sectors 2-12
Figure 2-4. Water Source Type 2-14
Figure 2-5. Well Density by Section (Domestic Wells) 2-25
Figure 2-6. Well Density by Section (Public Wells) 2-26
Figure 2-7. Well Density by Section (Agricultural Wells) 2-27
Figure 3-1. USGS Topographic Map 3-4
Figure 3-2. Creek Location Map and Contributing Watershed Areas 3-5
Figure 3-3. Historical versus Current Land Use 3-7
Figure 3-4. Geologic Map 3-10
Figure 3-5. Storage Units 1 and 2 Map 3-11
Figure 3-6. Soil Survey Map 3-12
Figure 3-7. Bedrock Structural Contours – Storage Unit 1 3-15
Figure 3-8. Bedrock Structural Contours – Storage Unit 2 3-16
Figure 3-9. Confined and Recharge Areas Map 3-19
Figure 3-10. Geologic Cross-Section A - A' 3-20
Figure 3-11. Geologic Cross-Section B - B' 3-21
Figure 3-12. Geologic Cross-Section C - C' 3-22
Figure 3-13. Geologic Cross-Section D - D' 3-23
Figure 3-14. Geologic Cross-Section E - E' 3-24
Figure 3-15. Geologic Cross-Section F - F' 3-25
Figure 3-16. Water Quality Data - West 3-29
Figure 3-17. Water Quality Data - East 3-30

Figure 3-18. Water Quality Data - Surface Water 3-33
Figure 3-19. Groundwater Elevation Contours - Fall 1991 3-36
Figure 3-20. Groundwater Elevation Contours - Spring 1998 3-37
Figure 3-21. Groundwater Elevation Contours - January 2015 3-38
Figure 3-22. Groundwater Elevation Contours - Spring 2020 3-39
Figure 3-23. Groundwater Elevation Contours - Fall 2020 3-40
Figure 3-24. Monitoring Well Location Map 3-42
Figure 3-25. Water Level Data - 4N/25W-19F4 3-43
Figure 3-26. Water Level Data - 4N/25W-26A1 3-44
Figure 3-27. Water Level Data - 4N/25W-27F2 (Smille) 3-45
Figure 3-28. Water Level Data - 4N/25W-28J1 3-46
Figure 3-29. Water Level Data - 4N/25W-30D1 3-47
Figure 3-30. Change in Groundwater in Storage (WY 1985 - 2020) 3-49
Figure 3-31. Sentinel Well Completions Schematic 3-52
Figure 3-32. Sentinel Well Data - MW-1 (C Zone) 3-53
Figure 3-33. Sentinel Well Data - MW-2 (B Zone) 3-54
Figure 3-34. Sentinel Well Data - MW-3 (A Zone) 3-55
Figure 3-35. MW-1 Induction Surveys 3-58
Figure 3-36. ERT Survey Line Location Map 3-59
Figure 3-37. ERT Profile 01 3-60
Figure 3-38. ERT Profile 02 3-61
Figure 3-39. ERT Profile 03 3-62
Figure 3-40. ERT Profile 04 3-63
Figure 3-41. Known Contamination Sites Map 3-65
Figure 3-42. InSAR Vertical Displacement Map (6/13/15 - 7/1/22) 3-67
Figure 3-43. Gaining, Losing, and Disconnected Streams 3-69
Figure 3-44. Depth to Water Map (Spring 2005) 3-71
Figure 3-45. Depth to Water Map (Spring 2010) 3-72
Figure 3-46. Depth to Water Map (Spring 2015) 3-73
Figure 3-47. Potential GDE Location Map - Vegetation 3-75
Figure 3-48. Potential GDE Location Map - Wetlands 3-76
Figure 3-49. GDE Screening - DTW < 30 feet bgs (Spring 2005) 3-82
Figure 3-50. GDE Screening - DTW < 30 feet bgs (Spring 2010) 3-83
Figure 3-51. GDE Screening - DTW < 30 feet bgs (January 2015) 3-84

Figure 3-52. GDE Screening - Detail Area A Map 3-85
Figure 3-53. GDE Screening - Detail Area B Map 3-86
Figure 3-54. GDE Screening Water Level Data - 4N/25W-19F4 (relative to GDE Polygon 52596)....3-88
Figure 3-55. GDE Screening Water Level Data - 4N/25W-19F4 (relative to GDE Polygon 94525)....3-89
Figure 3-56. GDE Screening Water Level Data - 4N/25W-19M3 (relative to GDE Polygon 52596)....3-90
Figure 3-57. GDE Screening Water Level Data - 4N/25W-19M3 (relative to GDE Polygon 94525)....3-91
Figure 3-58. GDE Screening Water Level Data - 4N/25W-25L3 (relative to GDE Polygon 93679)....3-92
Figure 3-59. GDE Screening Water Level Data - 4N/25W-25N5 (relative to GDE Polygon 93679) 3-93
Figure 3-60. GDE Screening Water Level Data - 4N/25W-35A3 (relative to GDE Polygon 49326)....3-94
Figure 3-61. GDE Screening Water Level Data - 4N/25W-35B6 (relative to GDE Polygon 49326) 3-95
Figure 3-62. GSP Water Budget Time Frames....3-99
Figure 3-63. Rainfall Station Location Map 3-101
Figure 3-64. Historical Annual Rainfall - Carpinteria Fire Station.... 3-102
Figure 3-65. Water Budget Component Schematic 3-104
Figure 3-66. Historical Annual Streamflow 3-106
Figure 3-67. Annual Rainfall vs. Deep Percolation Relationships (Blaney Curves).... 3-109
Figure 3-68. Annual Rainfall vs. Estimated Subsurface Inflow Relationship 3-114
Figure 3-69. Estimated Annual Runoff vs. Streambed Percolation Relationships.... 3-115
Figure 3-70. Historical Water Budget Summary (WY 1985 - 2020).... 3-127
Figure 3-71. Historical Water Budget - Groundwater System Averages Paired Bar Chart (WY 1985 - 2020).... 3-129
Figure 3-72. Current Water Budget Summary (WY 2012 - 2020).... 3-133
Figure 3-73. Current Water Budget - Groundwater System Averages Paired Bar Chart (WY 2012 - 2020).... 3-135
Figure 3-74. Historical Annual Rainfall – Carpinteria Station (WY 1949–2020).... 3-139
Figure 3-75. Projected Baseline Annual Streamflow at USGS Carpinteria Gage 3-141
Figure 3-76. Projected Baseline Annual Deep Percolation Comparison – Native Grass/Weeds.... 3-144
Figure 3-77. Projected Baseline Annual Deep Percolation Comparison – Deciduous Crops.... 3-145
Figure 3-78. Projected Baseline Annual Deep Percolation Comparison – Truck Crops 3-146
Figure 3-79. Projected Baseline Annual Rainfall.... 3-149
Figure 3-80. Projected Water Budget Summary (WY 2024–2073) 3-157
Figure 3-81. Projected Water Budget – Groundwater System Averages Paired Bar Chart (WY 2024–2073) 3-158
Figure 4-1. Existing Groundwater Monitoring Network 4-6
Figure 4-2. Existing Surface Water Monitoring Network 4-10

Figure 4-3. RMS Wells for Water Level Decline and Reduction of Storage 4-14
Figure 4-4. RMS Wells for Seawater Intrusion Monitoring....4-21
Figure 4-5. RMS Wells for Water Quality Degradation 4-28
Figure 4-6. Carpinteria Groundwater Sustainability Plan Data Management Tables 4-41
Figure 5-1. Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 19F4 5-14
Figure 5-2. Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 20K4....5-15
Figure 5-3. Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 21L1 5-16
Figure 5-4. Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 27F2 5-17
Figure 5-5. Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 26A1 5-18
Figure 5-6. Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 28F7 5-19
Figure 5-7. Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 28J1....5-20
Figure 5-8. Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 29D7....5-21
Figure 5-9. Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 35E1 5-22
Figure 5-10. Seawater Intrusion Isocontour SMC 5-44
Figure 5-11. Maximum Nitrate Concentrations (2015–2021)....5-57
Figure 5-12. Maximum TDS Concentrations (2015–2021) 5-58
Figure 5-13. Maximum Chloride Concentrations (2015–2021) 5-59
Figure 5-14. Maximum Boron Concentrations (2015–2021) 5-60
Figure 6-1. Carpinteria Advanced Purification Project (CAPP) Facilities 6-8
Figure 6-2. Conceptual Sentinel Well and Seawater Intrusion Barrier Locations 6-15
Figure 6-3. Casitas Municipal Water District Ventura-Santa Barbara Counties Intertie Project Overview Map....6-21
Figure 6-4. CVWD Production Wells 6-43

Appendices

Appendix A Preparation Checklist for Groundwater Sustainability Plan Submittal

Appendix B Carpinteria Groundwater Sustainability Agency Governance Documents

Appendix C Stakeholder Communications and Engagement Plan

Appendix D Groundwater Elevation Hydrographs

Appendix E Saltwater Intrusion Geophysical Study

Appendix F Groundwater Modeling Documentation

Appendix G Groundwater Monitoring Protocols

Appendix H Data Management System

Appendix I Responses to Public Comments on the Draft Groundwater Sustainability Plan

Abbreviations and Acronyms

AB	Assembly Bill
AF	acre-feet
AFY	acre-feet per year
ANCHOR	Automated Non-Contact Hydrologic Observations in Rivers
AOP	advanced oxidation process
APN	Assessor Parcel Number
ASR	aquifer storage and recovery
AWMP	Agricultural Water Management Plan
AWPF	Advanced Water Purification Facility
Basin	Carpinteria Groundwater Basin
BBM	Basin Boundary Modification
BGC	BGC Engineering, Inc.
bgs	below ground surface
BMP	best management practice
CAPP	Carpinteria Advanced Purification Project
CASGEM	California Statewide Groundwater Elevation Monitoring
CCR	California Code of Regulations
CDEC	California Data Exchange Center
CDFW	California Department of Fish and Wildlife
CDP	coastal development permit
CESA	California Endangered Species Act
CEQA	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
City	City of Carpinteria
CMWD	Casitas Municipal Water District
CSD	Carpinteria Sanitary District
CUP	conditional use permit
CVWD	Carpinteria Valley Water District
DAC	disadvantaged community
DDW	Division of Drinking Water
DEM	Digital Elevation Model
DMS	Data Management System
DWR	California Department of Water Resources
EIR	Environmental Impact Report
EPA	U.S. Environmental Protection Agency
ERT	electrical resistivity tomography
ET	evapotranspiration
FESA	federal Endangered Species Act

ft/day	feet per day
GAMA	Groundwater Ambient Monitoring and Assessment
GDE	groundwater dependent ecosystem
General Plan	City of Carpinteria's General Plan/Local Coastal Use Plan
GIS	geographic information system
GNSS	Global Navigation Satellite System
gpd/ft	gallons per day per foot
Groundwater Report	2021 Santa Barbara County Groundwater Basins Summary Report
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan (also referred to as Plan)
GSPAC	Groundwater Sustainability Public Advisory Committee
GTC	Geotechnical Consultants, Inc.
GWMP	Groundwater Management Plan
GMP	Groundwater Monitoring Program
HCM	hydrogeologic conceptual model
ILRP	Irrigated Lands Regulatory Program
InSAR	Interferometric Synthetic Aperture Radar
IPR	Indirect Potable Reuse
IRWM	Integrated Regional Water Management
ISRad	interferometric stream radar
JPA	Joint Exercise of Powers Agreement
LF	linear feet
LUST	leaking underground storage tank
M&A	Montgomery & Associates
MA	management area
MCL	maximum contaminant level
MF	microfiltration
mg/L	milligrams per liter
MGD	million gallons per day
mm	millimeters
MNW2	multi-node well package
MO	measurable objective
MGB	Montecito Groundwater Basin
MT	minimum threshold
MWD	Montecito Water District
NAVD 88	North American Vertical Datum of 1988
NC Dataset	Natural Communities Commonly Associated with Groundwater Dataset
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NRCS	Natural Resources Conservation Service

NWIS	National Water Information System
Plan	Groundwater Sustainability Plan (also referred to as GSP)
PWR	Pueblo Water Resources, Inc.
QA/QC	quality assurance/quality control
RMS	representative monitoring site
RO	reverse osmosis
RWQCB	Regional Water Quality Control Board
Santa Barbara IRWM Plan	Santa Barbara County Integrated Regional Water Management Plan
SAP	Sampling and Analysis Plan
SBCFCD	Santa Barbara County Flood Control District
SFR2	streamflow routing package
SGMA	Sustainable Groundwater Management Act
SLIC	spills-leaks-investigations-cleanup
SMC	sustainable management criterion
SMCL	secondary maximum contaminant level
SSC	(California) species of special concern
SSURGO	Soil Survey Geographic Service Database
SU-1	Storage Unit No.1
SU-2	Storage Unit No. 2
SWAMP	Surface Water Ambient Monitoring Program
SWP	State Water Project
SWRCB	Stare Water Resources Control Board
TCC	Technical Coordination Committee
TDS	total dissolved solids
TMDL	Total Maximum Daily Load
UCSB	University of California Santa Barbara
USBR	U.S. Bureau of Reclamation
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
UWMP	Urban Water Management Plan
Water Agency	Santa Barbara County Water Agency
WCVC	Watersheds Coalition of Ventura County
WDR	waste discharge requirement
WQ Basin Plan	Water Quality Control Plan for the Central Coastal Basin
WWTP	Wastewater Treatment Plant
WY	water year

Definitions

California Water Code

Sec. 10721

Unless the context otherwise requires, the following definitions govern the construction of this part:

(a) Adjudication action means an action filed in the superior or federal district court to determine the rights to extract groundwater from a basin or store water within a basin, including, but not limited to, actions to quiet title respecting rights to extract or store groundwater or an action brought to impose a physical solution on a basin.

(b) Basin means a groundwater basin or subbasin identified and defined in Bulletin 118 or as modified pursuant to Chapter 3 (commencing with Section 10722).

(c) Bulletin 118 means the department's report entitled California's Groundwater: Bulletin 118 updated in 2003, as it may be subsequently updated or revised in accordance with Section 12924.

(d) Coordination agreement means a legal agreement adopted between two or more groundwater sustainability agencies that provides the basis for coordinating multiple agencies or groundwater sustainability plans within a basin pursuant to this part.

(e) De minimis extractor means a person who extracts, for domestic purposes, two acre- feet or less per year.

(f) Governing body means the legislative body of a groundwater sustainability agency.

(g) Groundwater means water beneath the surface of the earth within the zone below the water table in which the soil is completely saturated with water, but does not include water that flows in known and definite channels.

(h) Groundwater extraction facility means a device or method for extracting groundwater from within a basin.

(i) Groundwater recharge or recharge means the augmentation of groundwater, by natural or artificial means.

(j) Groundwater sustainability agency means one or more local agencies that implement the provisions of this part. For purposes of imposing fees pursuant to Chapter 8 (commencing with Section 10730) or taking action to enforce a groundwater sustainability plan, groundwater sustainability agency also means each local agency comprising the groundwater sustainability agency if the plan authorizes separate agency action.

(k) Groundwater sustainability plan or plan means a plan of a groundwater sustainability agency proposed or adopted pursuant to this part.

(l) Groundwater sustainability program means a coordinated and ongoing activity undertaken to benefit a basin, pursuant to a groundwater sustainability plan.

(m) In-lieu use means the use of surface water by persons that could otherwise extract groundwater in order to leave groundwater in the basin.

(n) Local agency means a local public agency that has water supply, water management, or land use responsibilities within a groundwater basin.

(o) Operator means a person operating a groundwater extraction facility. The owner of a groundwater extraction facility shall be conclusively presumed to be the operator unless a satisfactory showing is made to the governing body of the groundwater sustainability agency that the groundwater extraction facility actually is operated by some other person.

(p) Owner means a person owning a groundwater extraction facility or an interest in a groundwater extraction facility other than a lien to secure the payment of a debt or other obligation.

(q) Personal information has the same meaning as defined in Section 1798.3 of the Civil Code.

(r) Planning and implementation horizon means a 50-year time period over which a groundwater sustainability agency determines that plans and measures will be implemented in a basin to ensure that the basin is operated within its sustainable yield.

(s) Public water system has the same meaning as defined in Section 116275 of the Health and Safety Code.

(t) Recharge area means the area that supplies water to an aquifer in a groundwater basin.

(u) Sustainability goal means the existence and implementation of one or more groundwater sustainability plans that achieve sustainable groundwater management by identifying and causing the implementation of measures targeted to ensure that the applicable basin is operated within its sustainable yield.

(v) Sustainable groundwater management means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.

(w) Sustainable yield means the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus that can be withdrawn annually from a groundwater supply without causing an undesirable result.

(x) Undesirable result means one or more of the following effects caused by groundwater conditions occurring throughout the basin:

(1) Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.

(2) Significant and unreasonable reduction of groundwater storage.

(3) Significant and unreasonable seawater intrusion.

(4) Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.

(5) Significant and unreasonable land subsidence that substantially interferes with surface land uses.

(6) Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

(y) Water budget means an accounting of the total groundwater and surface water entering and leaving a basin including the changes in the amount of water stored.

(z) Watermaster means a watermaster appointed by a court or pursuant to other law.

(aa) Water year means the period from October 1 through the following September 30, inclusive.

(ab) Wellhead protection area means the surface and subsurface area surrounding a water well or well field that supplies a public water system through which contaminants are reasonably likely to migrate toward the water well or well field.

Official California Code of Regulations (CCR)

Title 23. Waters
Division 2. Department of Water Resources
Chapter 1.5. Groundwater Management
Subchapter 2. Groundwater Sustainability Plans
Article 2. Definitions
23 CCR § 351
§ 351. Definitions.

The definitions in the Sustainable Groundwater Management Act, Bulletin 118, and Subchapter 1 of this Chapter, shall apply to these regulations. In the event of conflicting definitions, the definitions in the Act govern the meanings in this Subchapter. In addition, the following terms used in this Subchapter have the following meanings:

(a) “Agency” refers to a groundwater sustainability agency as defined in the Act.

(b) “Agricultural water management plan” refers to a plan adopted pursuant to the Agricultural Water Management Planning Act as described in Part 2.8 of Division 6 of the Water Code, commencing with Section 10800 et seq.

(c) “Alternative” refers to an alternative to a Plan described in Water Code Section 10733.6.

(d) “Annual report” refers to the report required by Water Code Section 10728.

(e) “Baseline” or “baseline conditions” refer to historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin.

(f) “Basin” means a groundwater basin or subbasin identified and defined in Bulletin 118 or as modified pursuant to Water Code 10722 et seq.

(g) "Basin setting" refers to the information about the physical setting, characteristics, and current conditions of the basin as described by the Agency in the hydrogeologic conceptual model, the groundwater conditions, and the water budget, pursuant to Subarticle 2 of Article 5.

(h) "Best available science" refers to the use of sufficient and credible information and data, specific to the decision being made and the time frame available for making that decision, that is consistent with scientific and engineering professional standards of practice.

(i) "Best management practice" refers to a practice, or combination of practices, that are designed to achieve sustainable groundwater management and have been determined to be technologically and economically effective, practicable, and based on best available science.

(j) "Board" refers to the State Water Resources Control Board.

(k) "CASGEM" refers to the California Statewide Groundwater Elevation Monitoring Program developed by the Department pursuant to Water Code Section 10920 et seq., or as amended.

(l) "Data gap" refers to a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation, and could limit the ability to assess whether a basin is being sustainably managed.

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

(n) "Groundwater flow" refers to the volume and direction of groundwater movement into, out of, or throughout a basin.

(o) "Interconnected surface water" refers to surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted.

(p) "Interested parties" refers to persons and entities on the list of interested persons established by the Agency pursuant to Water Code Section 10723.4.

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

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

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

(t) "Minimum threshold" refers to a numeric value for each sustainability indicator used to define undesirable results.

(u) "NAD83" refers to the North American Datum of 1983 computed by the National Geodetic Survey, or as modified.

(v) "NAVD88" refers to the North American Vertical Datum of 1988 computed by the National Geodetic Survey, or as modified.

(w) “Plain language” means language that the intended audience can readily understand and use because that language is concise, well-organized, uses simple vocabulary, avoids excessive acronyms and technical language, and follows other best practices of plain language writing.

(x) “Plan” refers to a groundwater sustainability plan as defined in the Act.

(y) “Plan implementation” refers to an Agency's exercise of the powers and authorities described in the Act, which commences after an Agency adopts and submits a Plan or Alternative to the Department and begins exercising such powers and authorities.

(z) “Plan manager” is an employee or authorized representative of an Agency, or Agencies, appointed through a coordination agreement or other agreement, who has been delegated management authority for submitting the Plan and serving as the point of contact between the Agency and the Department.

(aa) “Principal aquifers” refer to aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems.

(ab) “Reference point” refers to a permanent, stationary and readily identifiable mark or point on a well, such as the top of casing, from which groundwater level measurements are taken, or other monitoring site.

(ac) “Representative monitoring” refers to a monitoring site within a broader network of sites that typifies one or more conditions within the basin or an area of the basin.

(ad) “Seasonal high” refers to the highest annual static groundwater elevation that is typically measured in the Spring and associated with stable aquifer conditions following a period of lowest annual groundwater demand.

(ae) “Seasonal low” refers to the lowest annual static groundwater elevation that is typically measured in the Summer or Fall, and associated with a period of stable aquifer conditions following a period of highest annual groundwater demand.

(af) “Seawater intrusion” refers to the advancement of seawater into a groundwater supply that results in degradation of water quality in the basin, and includes seawater from any source.

(ag) “Statutory deadline” refers to the date by which an Agency must be managing a basin pursuant to an adopted Plan, as described in Water Code Sections 10720.7 or 10722.4.

(ah) “Sustainability indicator” refers to any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721(x).

(ai) “Uncertainty” refers to a lack of understanding of the basin setting that significantly affects an Agency's ability to develop sustainable management criteria and appropriate projects and management actions in a Plan, or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed.

(aj) “Urban water management plan” refers to a plan adopted pursuant to the Urban Water Management Planning Act as described in Part 2.6 of Division 6 of the Water Code, commencing with Section 10610 et seq.

(ak) “Water source type” represents the source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface water sources identified

as Central Valley Project, the State Water Project, the Colorado River Project, local supplies, and local imported supplies.

(al) "Water use sector" refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation.

(am) "Water year" refers to the period from October 1 through the following September 30, inclusive, as defined in the Act.

(an) "Water year type" refers to the classification provided by the Department to assess the amount of annual precipitation in a basin.

Executive Summary

Executive Summary

ES-1 Introduction

The Sustainable Groundwater Management Act (SGMA), effective as of January of 2015, created a new statewide framework for managing California's groundwater at the local level. SGMA empowers local agencies to form groundwater sustainability agencies (GSAs) tasked with developing Groundwater Sustainability Plans (GSPs or Plans), such as this document. A GSP is a detailed road map for maintaining or bringing a designated groundwater basin into a sustainable condition within the next 20 years. When a basin is managed sustainably, groundwater conditions are maintained in a manner that avoids undesirable results caused by groundwater conditions occurring throughout the basin, such as chronic lowering of groundwater levels, or significant and unreasonable depletion of supply, reduction of groundwater storage, degraded water quality, land subsidence, or depletions of interconnected surface waters.

In his signing statement, Governor Brown emphasized that "groundwater management in California is best accomplished locally." The Carpinteria Groundwater Basin (Basin) Plan was developed by a single GSA formed by the Carpinteria Valley Water District (CVWD), the City of Carpinteria, the Santa Barbara County Water Agency (Water Agency), and the County of Ventura. On January 31, 2020, the GSA entered into a Joint Exercise of Powers Agreement (JPA) to form the Carpinteria GSA for the purpose of managing groundwater and coordinating preparation of a single GSP for the Basin. The JPA outlines the powers of the GSA and describes the Board of Directors composition, decision making, and other terms. The Carpinteria GSA Board of Directors adopted Resolution 0001 on February 7, 2020, declaring its intent to designate itself to California Department of Water Resources (DWR) as the recognized GSA for the Basin, and the required documentation was submitted to DWR in February 2020.

The Basin was originally designated as a low-priority basin by DWR. In 2019, DWR conducted a basin reprioritization process that reclassified the Basin as a high-priority basin, resulting in the preparation of this Plan pursuant to Section 10720, et. seq., of the State Water Code as required by SGMA.

This executive summary fulfills the Plan requirement for the Carpinteria GSA. It describes the Basin, develops quantifiable management objectives that account for the interests of the Basin's beneficial groundwater uses and users, and identifies a group of projects and management actions that will allow the Basin to achieve sustainability within 20 years of plan adoption.

ES-1.1 Plan Area

The jurisdictional boundaries for the Plan cover the entire Carpinteria Groundwater Basin identified by DWR as Basin No. 3-018 (DWR, 2004, 2023) as shown in Figure ES-1. This 7,801-acre (12.7 square mile) coastal basin consists of a low-lying alluvial plain that includes portions of County of Santa Barbara and County of Ventura and the incorporated City of Carpinteria. In unincorporated areas under county jurisdiction, the County of Santa Barbara and the County of Ventura are responsible for comprehensive long-range planning, permitting, and development review. The Santa Barbara Flood Control and Water Conservation District has jurisdiction over certain flood control facilities. The City of Carpinteria has land management authority within its boundaries, and municipal and agricultural water service within the City is provided by CVWD. The U.S. Bureau of Reclamation has jurisdiction over the Carpinteria Regulating Reservoir. Lands under state jurisdiction include Carpinteria State Beach (California Department of Parks and Recreation), the beds of tidal waters (California State Lands Commission), and the Carpinteria Salt Marsh Reserve (University of California Natural Reserve System).

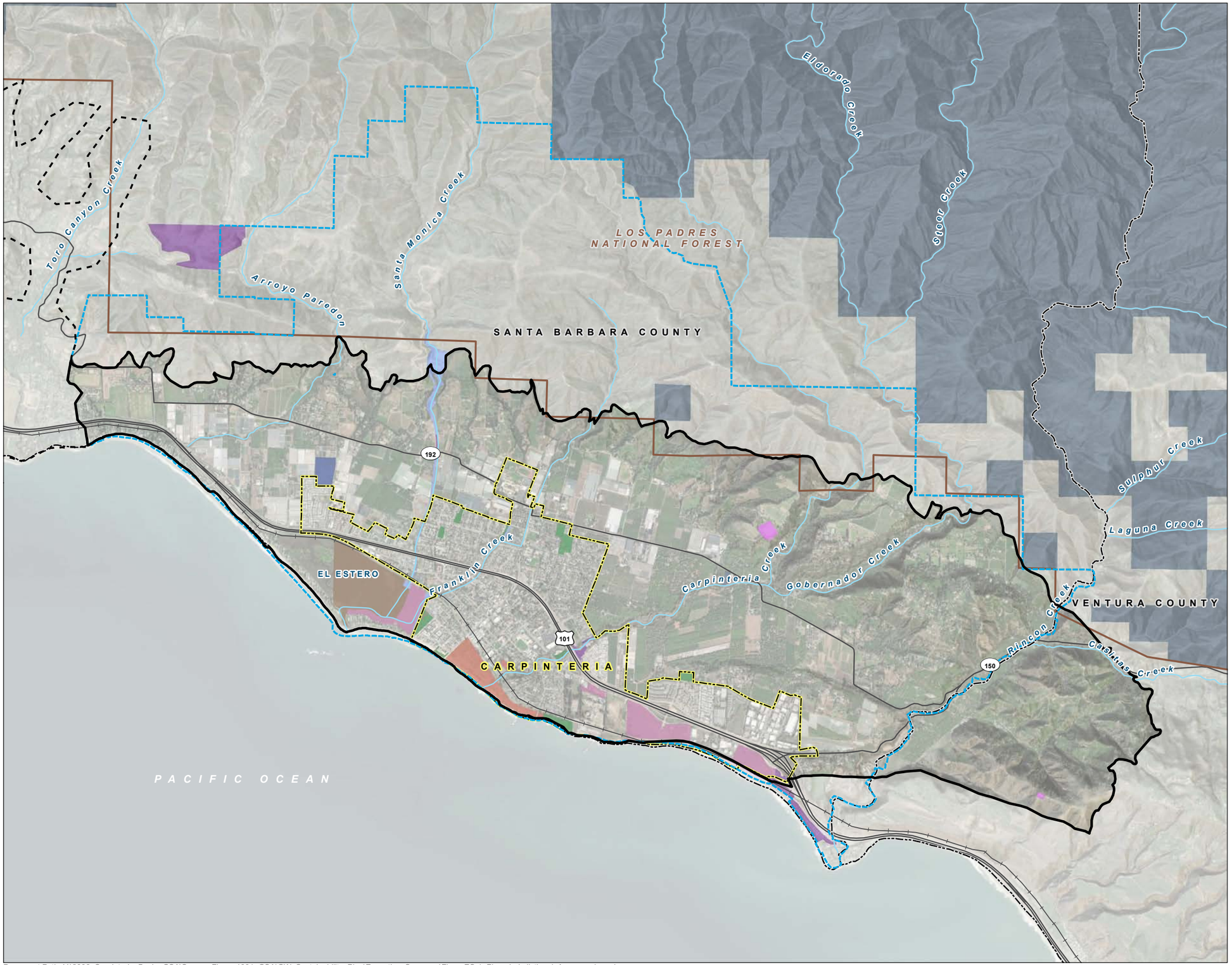


FIGURE ES-1

Carpinteria Groundwater Basin Plan Area and Jurisdictional Areas

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Carpinteria Valley Water District Service Area
- Carpinteria Groundwater Basin
- Los Padres National Forest

Land Ownership

- Bureau of Reclamation
- California Department of Parks and Recreation
- California State Lands Commission
- Carpinteria Cemetery District
- Carpinteria, City of
- Land Trust for Santa Barbara County
- Santa Barbara Flood Control and Water Conserv. District
- Santa Barbara, County of
- USDA Forest Service
- University of California

All Other Features

- City Boundary
- County Boundary
- Montecito Groundwater Basin
- Railroad
- Major Road
- Watercourse

N

0 ½ 1
Miles

Date: October 17, 2023
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118

GSI Water Solutions, Inc.

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Executive_Summary\FigureES-1_Plan_Jurisdictional_Areas.mxd, npalmer

CVWD's service area covers all of the Basin within County of Santa Barbara with the exception of a small area on the northeast edge of the District boundary, and the service area also extends beyond the Basin boundaries to the north and includes a small portion to the southeast of the Basin on the west side of Rincon Point. CVWD has water management and supply authority within its service area. The County of Ventura portion of the Basin is located within the service area of Casitas Municipal Water District, which has water management and supply authority within its service area.

The surface water bodies in the plan area include Carpinteria, Franklin, Gobernador, Rincon, Toro Canyon, and Santa Monica Creeks. U.S. Highway 101 forms the major transportation corridor running from northwest to southeast through the Basin. Average annual precipitation within the Basin ranges from 15 to 19 inches.

The Basin's eastern boundary is defined by the extent of the Casitas Formation mapped at the surface near Laguna Ridge in Ventura County. The Pacific Ocean forms its southern boundary. An adjustment to the western boundary was approved by DWR in 2018 following an application submitted by the Montecito Water District and supported by CVWD for a jurisdictional basin boundary modification. The originally defined Basin boundary was moved to the west to coincide with the boundary between the two water districts' service areas. The new western boundary of the Basin follows the limits of the CVWD service area along Toro Canyon and separates the Basin from the Montecito Groundwater Basin. The Basin's northern boundary is delineated at the geologic contact with the Coldwater Sandstone and Sespe Formations in the foothills of the Santa Ynez Mountains. DWR approved a second basin boundary modification request in 2018 to refine the delineation of the northern boundary using more recently published geologic maps.

Groundwater rights in the Basin have not been adjudicated. No other GSAs have been formed within the Basin, and no alternative plans have been submitted for any part of the Basin.

ES-1.2 Sustainable Management Criteria

The Carpinteria GSA establishes sustainable management criteria (SMCs) to avoid significant and unreasonable conditions caused by groundwater use that could lead to undesirable results for six sustainability indicators listed in SGMA. The sustainability indicators include (1) chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply, (2) significant and unreasonable reduction of groundwater storage, (3) seawater intrusion, (4) degraded water quality, (5) land subsidence, and (6) depletion of interconnected surface water. Basin stakeholders helped to define the sustainability goal, what constitutes undesirable results, and appropriate SMCs for each sustainability indicator. SGMA also requires that GSAs identify groundwater dependent ecosystems (GDEs) and assess the effects of changing groundwater levels on GDEs. The Plan includes a robust groundwater monitoring program and defines projects and management actions that have been developed to maintain long-term groundwater sustainability.

As noted in Section 3 of this Plan, several data gaps exist in the hydrogeologic conceptual model (HCM). The uncertainty created by these data gaps was considered when developing the SMCs. The SMCs are considered initial criteria and will be reevaluated and potentially modified in the future as new data become available.

ES-1.3 Outreach Efforts

The Carpinteria GSA has engaged stakeholders in consultation since its formation, starting with public meetings during development of the JPA forming the GSA. A contact list for interested parties was developed throughout this process, and the Carpinteria GSA has continued seeking broad engagement in management of the Basin's groundwater resources during development of this Plan. Beneficial uses and users identified in the Basin and invited to participate in development and implementation of the Plan include:

- Holders of overlying groundwater rights, including:
  - Agricultural users
  - Domestic well owners
- Municipal well operators
- Public water systems
- Local land use planning agencies
- Environmental users of groundwater
- Surface water users
- Federal government, including, but not limited to, the military and managers of federal lands
- California Native American Tribes
- Disadvantaged Communities, including, but not limited to, those served by private domestic wells or small community water systems
- Entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of the groundwater basin managed by the GSA

The Communication and Engagement Plan developed for the GSP is included as Appendix C. Eight public workshops were held between October 2022 and August 2023. In addition, and Groundwater Sustainability Plan Advisory Committee (GSPAC) was established consisting of Basin stakeholders selected after an interview process, and seven GSPAC meetings, which were open to the general public, were held between February and August 2023.

ES-1.4 Plan Organization

This Plan has been developed collaboratively by the member agencies making up the Carpinteria GSA. The organization of the Plan is as follows:

- **Section 1 – Introduction to Plan Contents:** An introduction to the Plan, including a description of its purpose and a brief description of the Basin.
- **Section 2 – Administrative Information:** Includes the following:
  - Information on the Carpinteria GSA and a brief description of the agencies participating in the GSA, including information on the legal authority of the GSA to plan and coordinate groundwater sustainability for the Basin.
  - An overview of the Basin, including land use and agencies with jurisdiction, a description of the existing groundwater management plans and regulatory programs, any programs for conjunctive use, and urban land use programs that might affect, or be affected by, this Plan.
  - The Carpinteria GSA's communication and engagement planning and implementation, public feedback and stakeholder comments on the plan, how feedback was incorporated into the Plan, and responses to comments received.

- **Section 3 – Basin Setting:** Includes the following:
  - An explanation of the HCM developed for the Basin that includes descriptions of the regional hydrology and geology, principal aquifers and aquitards, and a description of the data gaps in the current model.
  - A detailed description of the groundwater conditions, including groundwater elevations and changes in storage, seawater intrusion, groundwater quality for drinking water and agricultural irrigation and trends over time, an evaluation of land subsidence, locations where surface water and groundwater are interconnected, and the identification and distribution of groundwater-dependent ecosystems.
  - A presentation of the historical, current, and projected future water budgets for the Basin; how the water budgets were developed; an estimate of sustainable yield for the Basin; and the effects of climate change using DWR climate change assumptions.
- **Section 4 – Monitoring Networks:** A detailed description of the monitoring objectives and monitoring in the Basin for groundwater levels, storage, seawater intrusion, water quality, land subsidence, interconnected surface water, representative monitoring sites, and a description of the data management and reporting system.
- **Section 5 – Sustainable Management Criteria:** Defines the sustainability goal for the Basin; describes the process through which the SMCs were established; describes significant and unreasonable effects that could lead to undesirable results as a result of groundwater conditions occurring throughout the Basin; describes and defines SMCs regarding chronic lowering of groundwater levels, significant and unreasonable reduction in groundwater storage, seawater intrusion, degraded groundwater quality, land subsidence, and depletion of interconnected surface water (including quantity and timing of surface water depletion); and describes the minimum thresholds, measurable objectives, and interim milestones to avoid undesirable results.
- **Section 6 – Projects and Management Actions:** Provides a description of each project and management action that may be developed and implemented by the Carpinteria GSA to avoid undesirable results and ensure sustainability within 20 years of Plan adoption.
- **Section 7 –Plan Implementation:** Describes the implementation sequence for projects and management actions, overall schedule, estimated implementation costs, and sources of funding.
- **Section 8 – References and Technical Studies:** Lists the references and technical studies used to develop the Plan.

Summaries of the key technical sections of this Plan are presented below.

ES-2 Basin Setting (Plan Section 3)

Section 3 of the Plan describes the physical setting and characteristics of the Basin, including the basin boundaries, geologic formations and structures, and principal aquifer units. The HCM describes how the groundwater system works and is based on the available body of data and prior studies of the Basin's geology, hydrology, and water quality. In this Plan, the HCM provides a framework for subsequent sections of the basin setting, including groundwater conditions and water budgets. Together these sections provide the basis for understanding the groundwater resources in the Basin and support the GSA's efforts to achieve groundwater sustainability in the Basin by 2043. This Plan will be updated as required to maintain this goal.

ES-2.1 Hydrogeologic Conceptual Model and Principal Aquifers

The HCM of the Basin was initially developed by Geotechnical Consultants, Inc. (GTC) and is documented in their 1976 report. The 1976 GTC report is the most comprehensive report on the Basin, and it is built upon the previous work regarding the basin structure and hydraulic parameters to include a detailed analysis of the water budget for the Basin. An HCM generally describes a groundwater basin as a hydrogeologic system,

including topography, setting, the underlying geologic system, principal aquifers, generalized recharge and discharge areas for the aquifers, and water inflows and outflows.

The Basin is located on the south flank of the Santa Ynez Mountains, one of the east-west trending ridges of the Transverse Range Geomorphic Province. The Basin represents the north limb of a synclinal geologic structure, the deepest parts of which terminate against the traces of the Rincon Creek Fault. This structural depression has subsequently been filled with younger water-bearing deposits. Water-bearing deposits in the Basin include all unconsolidated and semi-consolidated sediments of the Quaternary age, with older consolidated and generally non-water bearing rocks forming the definable boundaries of the Basin.

One principal aquifer has been identified in the Basin occurring primarily of unconsolidated and semi-consolidated sediments of the Pleistocene and upper Pliocene-aged Casitas Formation. In some local alluvial valleys of Basin Creeks, wells penetrate and may possibly screen the sediments of the younger alluvium, but available data indicate that these wells usually are also screened in the Casitas Formation, which provides most of the productive yield. There is no consistent low permeability strata separating the alluvium from Casitas sediments; these sediments function as a single hydrogeologic unit. Such deposits are readily capable of absorbing, storing, transmitting and yielding water to wells. Holocene-aged alluvial deposits are present as a thin veneer along the coastal plain and along all creek channels and comprise the sediment of alluvial fan deposits at canyon mouths along the northern basin boundary. Older Tertiary sedimentary bedrock units are considered to be generally non-water-bearing and constitute the boundaries of the groundwater basin.

The principal aquifer system in the Basin largely occurs in the Casitas Formation, which is contained in the entire basin area north of the Rincon Creek Fault and is exposed in outcrops along the northern and eastern boundaries. The Casitas Formation is an assemblage of poorly to moderately consolidated clayey to gravelly sand with variable amounts of silt and cobbles reaching substantial thicknesses of 2,300 to 2,500 feet in SU-1. Sandy clay is abundant and sandy units are typically thin and lenticular and cannot be correlated over long distances. Notable exceptions to this are the major water producing zones delineated at the A, B, C and D Zones in the Confined Area of the Basin.

Underlying the Casitas Formation is the marine Santa Barbara Formation, which unconformably overlies all older consolidated rocks in the Basin. The formation is only exposed south of the Rincon Creek Fault in SU-2 where it unconformably overlies Miocene shales. The Santa Barbara Formation consists of poorly to moderately consolidated, soft and massive, sandstone and siltstone with abundant clay shale. Available data indicate the formation is 750 to as much as 1,250 feet thick in SU-1 and at least 1,500 feet thick in SU-2. Although the formation represents a potential water-bearing deposit in the Basin, no water wells are known to penetrate it and no major aquifers have been discerned within it (note: the wells shown on the cross-sections that do penetrate the Santa Barbara Formation are exploratory borings or wildcat oil wells).

ES-2.2 Recharge and Discharge in the Carpinteria Basin

Outside of the Confined Area of the Basin and extending to the bedrock boundaries, the Casitas Formation contains laterally discontinuous layers of both permeable and impermeable materials, and water held in these areas is generally unconfined. The primary sources of recharge to the Basin are percolation of precipitation, subsurface inflow, and percolation of irrigation water. This area is delineated as the Recharge Area.

The primary method of discharge from the aquifer is groundwater pumping. Groundwater within the principal aquifer of SU-1 does not discharge directly to the ocean in the southeastern portion of the Basin due to the presence of overlying confining layers and the barrier created by the Rincon Creek Thrust Fault. Subsurface outflow from SU-1 is believed to occur in the general area from Serena Park to Sand Point (a distance of

approximately 9,000 feet) where there is no fault barrier between basin sediments and the Pacific Ocean. In SU-2, significant subsurface outflow is not believed to occur due to the onshore contact of unconsolidated water-bearing materials with consolidated bedrock, which effectively isolates SU-2 from the ocean.

ES-2.3 Groundwater Conditions

Analysis of water-level hydrographs presented in this section led to the identification of the historical basin high and the basin low periods within the WY 1985 to WY 2020 historical water budget base period. Five groundwater elevation hydrographs typical of basin conditions are presented in Figure ES-2.

Water-level contours are presented for the basin high and low periods within the base period, as well as for January CVWD and current conditions. The specific periods for which water-level contours were prepared include:

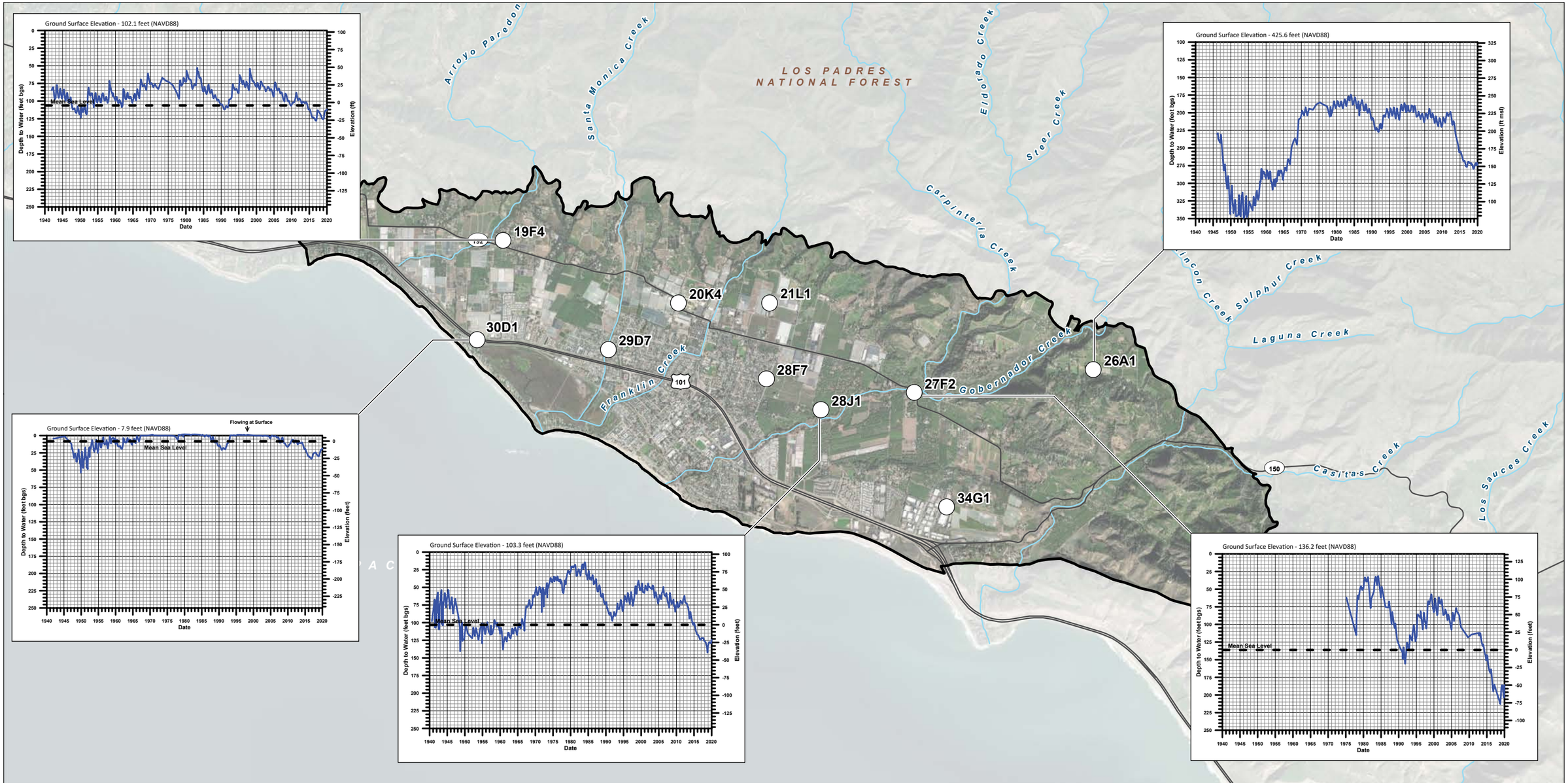
- Fall 1991 –base period historical low
- Spring 1998 – base period historical high
- January 2015 - SGMA effective date
- Spring 2020 – current seasonal high
- Fall 2020 – current seasonal and historical low

The primary purpose of the water-level contours is to help to identify general patterns in the flow regime within the Basin, including those attributable to recharge sources and associated with discharge areas. Water-level contours show that in SU-1, groundwater generally flows in a northeast to southwesterly direction in the eastern half of the Basin, and north to south in the western half of the Basin. The directions of groundwater flow generally reflect the movement of groundwater from the primary sources of recharge in the Recharge Area to the primary sources of extraction (groundwater pumping) in the Confined Area in the central portion of the Basin. It is noted that available data for SU-2 are limited, and water-level contours are not depicted for unit this reason.

Figure ES-3 presents groundwater elevation contours for fall 2020. Water levels for fall 2020 show the development of a water-level depression centered in the central portion of the Basin, with water levels as much as 50 to 60 feet below msl. It is noted that this time period coincides with the most recent drought period experienced in the Basin.

These water-level conditions result in a reversal of the natural pre-development seaward groundwater gradient, creating the potential for seawater intrusion in the western portion of the Basin where basin deposits are exposed to the Pacific Ocean. It is noted that prior to 2019 seawater intrusion had not historically been detected in existing wells in the Basin; however, before 2019 there were no monitoring wells along the coast that that were designed to detect seawater intrusion.

The CVWD and GSA have recognized this deficiency in the historical monitoring well network in the Basin and recently drilled seawater intrusion “sentinel” wells near the coastline just west of El Estero. The Sentinel Wells are screened in the upper three productive units (A-, B-, and C-zone, from shallowest to deepest) of the primary aquifer in the basin. Figure ES-4 presents the well screen intervals for the Sentinel Wells. These wells have been sampled quarterly since installation. Samples from the C-zone well, though initially showing chloride concentrations below basin objectives or regulatory criteria, have exhibited increasing chloride concentrations since 2020. Samples from the A-zone and B-zone wells have not exhibited any trends of increasing chloride concentrations since installation.



LEGEND

- Proposed Water Level RMS Well
- Carpinteria Groundwater Basin
- Major Road
- Watercourse

FIGURE ES-2

Historical Basin Hydrographs

Carpinteria Groundwater Basin Groundwater Sustainability Plan

N

0 2,000 4,000 6,000
feet

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Executive_Summary\FigureES-2_Hydrographs.mxd, npalmer

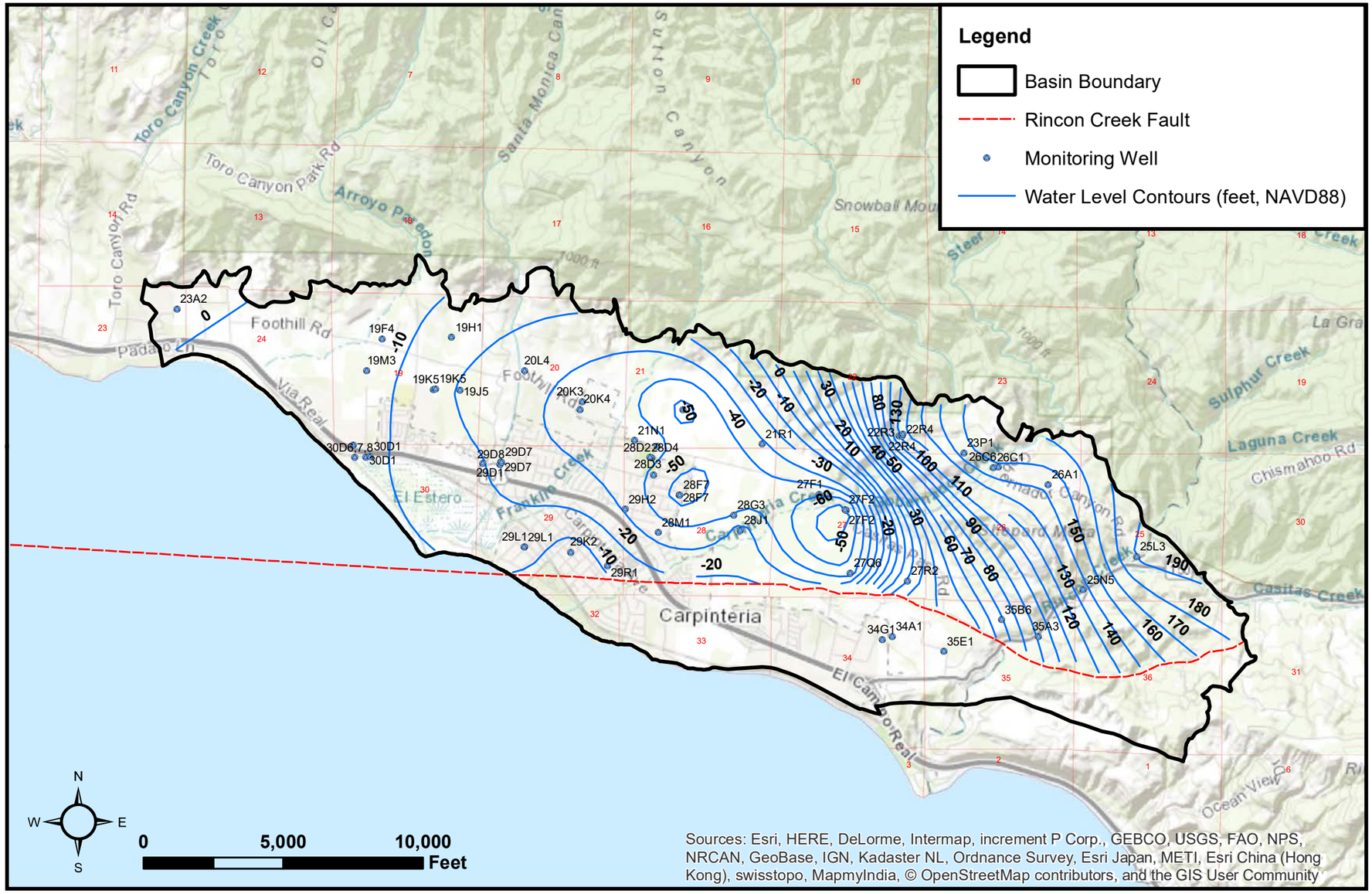


FIGURE ES-3

Groundwater Elevation Contours – Fall 2020

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

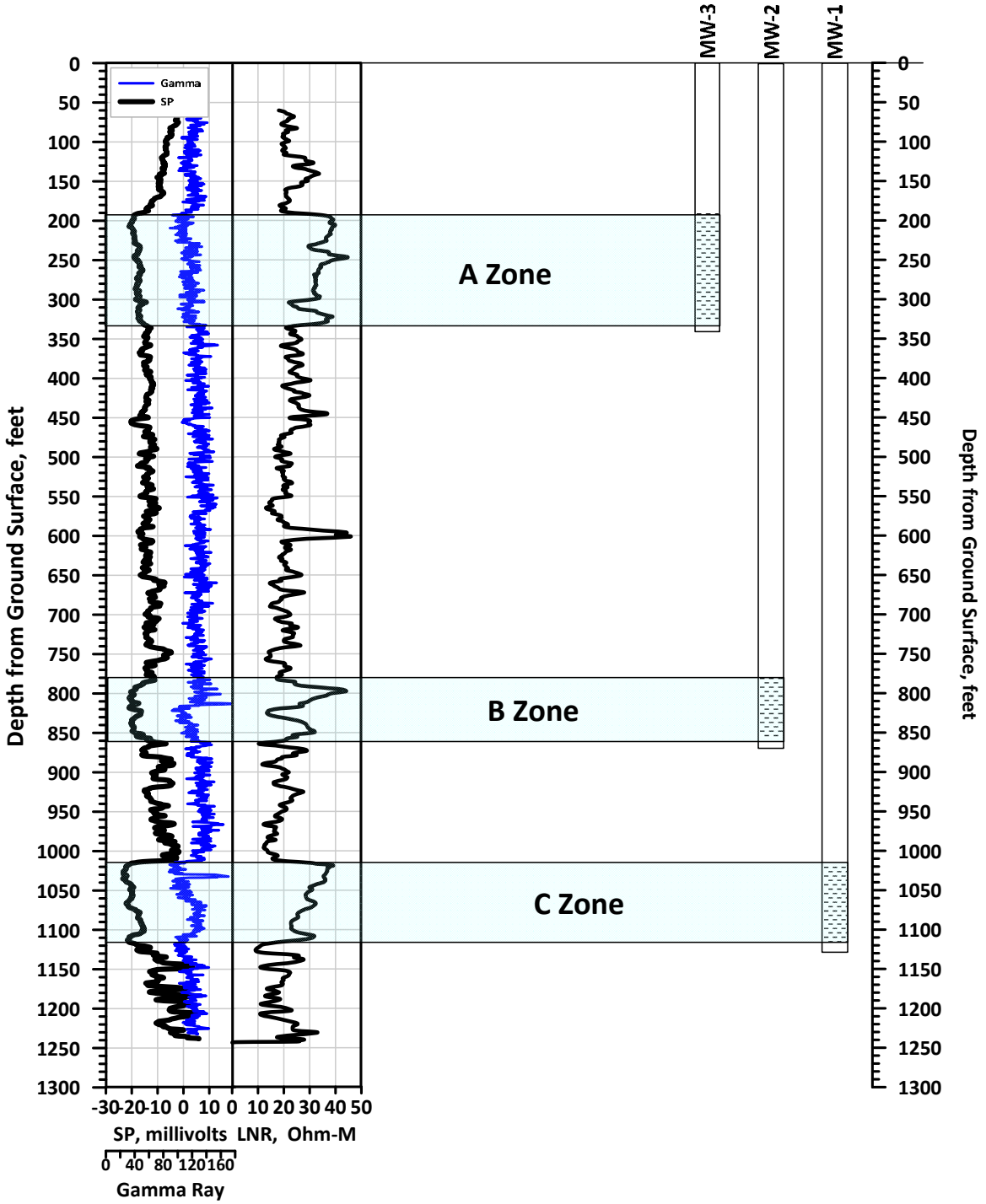


FIGURE ES-4

Sentinel Well Completions Schematic

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

ES-2.4 Interconnected Groundwater and Surface Water

An analysis is presented that compares groundwater elevation data from a wet water year (spring 2005) with Digital Elevation Model (DEM) data of land surface in the creek channels in the Basin. It is observed that even in wet year conditions, there are observed significant thicknesses of unsaturated sediments beneath the basin creek channels. According to DWR stream classification guidance, this condition reflects streams that are hydraulically disconnected from the underlying aquifer. As a result, it is concluded that there are no interconnected surface water systems in the Basin (see Section 3.2.7).

ES-2.5 Groundwater Dependent Ecosystems

GDEs are defined under SGMA as "ecological communities of species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." GDE types include terrestrial vegetation that is supported by groundwater that discharges to seeps, springs, wetlands, streams, and estuaries.

The Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) geographic information system (GIS) shapefiles were downloaded from DWR and mapped in the Basin to identify potential GDEs. The NC Dataset covering the Basin consists of both vegetation and wetlands areas. The potential GDEs are largely concentrated along the primary creeks in the Basin. Historical analysis of groundwater elevations beneath the NC datasets were performed.

Each potential GDE polygon was inspected with respect to whether the depth-to-water was less than 30 feet under wet, normal, and dry water year types. Potential GDEs that had depth-to-water greater than 30 feet during two or more of the above water year types were deemed to not be dependent on groundwater from the principal aquifer and is, therefore, not considered a GDE. This analysis led to screening out all but four of the potential GDE polygons in the NC dataset.

The remaining four potential GDE polygon areas located along Arroyo Paredon and Rincon Creeks continue to be considered potential GDEs, and will be further evaluated during the initial 5-year SGMA implementation period.

ES-2.6 Water Budget Development

According to SGMA regulations (§ 354.18), the Plan must include a water budget for the Basin that provides an accounting and assessment of the total annual volume of surface water and groundwater entering and leaving the Basin, including historical, current, and projected water budget conditions. A water budget accounts for the change in the total volume of water stored in a basin under these different conditions. The regulations require that the water budget be reported in graphical and tabular formats.

This water budget analysis is inextricably tied to the SGMA requirement to ensure the Basin is operated within its sustainable yield. Sustainable yield is defined in SGMA as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus that can be withdrawn annually from a groundwater supply without causing an undesirable result."

In this Plan, the discussion of the water budget periods refers to water years, which run between October 1 and September 30 of the following year. The three water budget periods are as follows:

- The historical water budget period is WY 1985 through 2020.
- The current water budget period is WY 2012 through 2020.
- The projected water budget period is the 52-year period of WY 2021 through 2072 and extends 50 years past the submittal of this Plan as required by SGMA regulations.

The 36-year period selected for the historical water budget includes the most recently available information, two wet and two dry hydrologic cycles, recent changes in imported water supply availability, changes to water demand associated with cropping patterns, and associated land use. The historical water budget period was chosen to define a specific period when all of the elements of recharge and discharge to the Basin may be compared to other periods (e.g., future projected). This historical period allows for the identification of long-term trends in basin supply and demand, water level trends, changes of groundwater in storage, and estimates of the annual components of inflow and outflow to the zone of saturation.

Some water budget data are available via direct measurement (e.g., CVWD metered pumping), whereas others require estimation based on commonly used techniques. In general, the techniques used for this Plan are based on methods used by GTC in their 1976 and 1986 water budget inventories, but as modified by Pueblo Water Resources, Inc., in 2012 given the availability of new data and/or analytical tools. The groundwater budget for the Carpinteria Groundwater Basin is expressed by the following equation:

Inflow = Outflow (+/-) Change in Storage

The historical water budget summary from WY 1985 through WY 2020 is presented graphically in Figure ES-5. The water budget indicates a decline in basin storage associated with the 1988–1992 drought followed by a period of relative stability for 30 years, with further decline in storage associated with the recent drought. A projected water budget is presented in Section 3.3 as part of this Plan.

ES-3 Monitoring Networks (Plan Section 4)

Section 4 describes the existing monitoring networks within the Basin and includes an explanation of the implementation of the monitoring networks for the GSA's Plan and recommended improvements to the monitoring networks. Representative monitoring site (RMS) wells are selected from the existing District monitoring network for each applicable sustainability indicator. Together, these monitoring networks will be used to track the GSA's progress toward achieving sustainability by documenting short-term, seasonal, and long-term trends in groundwater conditions. This section includes monitoring objectives, monitoring protocols, assessment and improvement of monitoring networks, representative monitoring sites, and data reporting requirements for each of the monitoring networks.

The monitoring networks presented in Section 4 were developed based on existing sites monitored for decades by the CVWD (formerly the Carpinteria County Water District) prior to the passage of SGMA. During the 20-year Plan implementation period, it may be necessary to expand the existing monitoring networks to fully demonstrate sustainability and improve the Plan. Monitoring networks and data gaps are described for each of the six sustainability indicators. The data gaps will be addressed during Plan implementation to improve the Carpinteria GSA's ability to track progress and demonstrate sustainability.

The selection of wells used in the monitoring networks presented in this section draws on historical groundwater data compiled by the U.S. Geological Survey (USGS), CVWD, the California Statewide Groundwater Elevation Monitoring (CASGEM), and DWR. The criteria used to determine which wells to use in the monitoring networks are as follows:

- Period of record of historical measurements
- Available well construction information
- Spatial distribution relative to applicable sustainability indicators
- Groundwater use in proximity of wells
- Impacts on beneficial uses of groundwater in the Basin

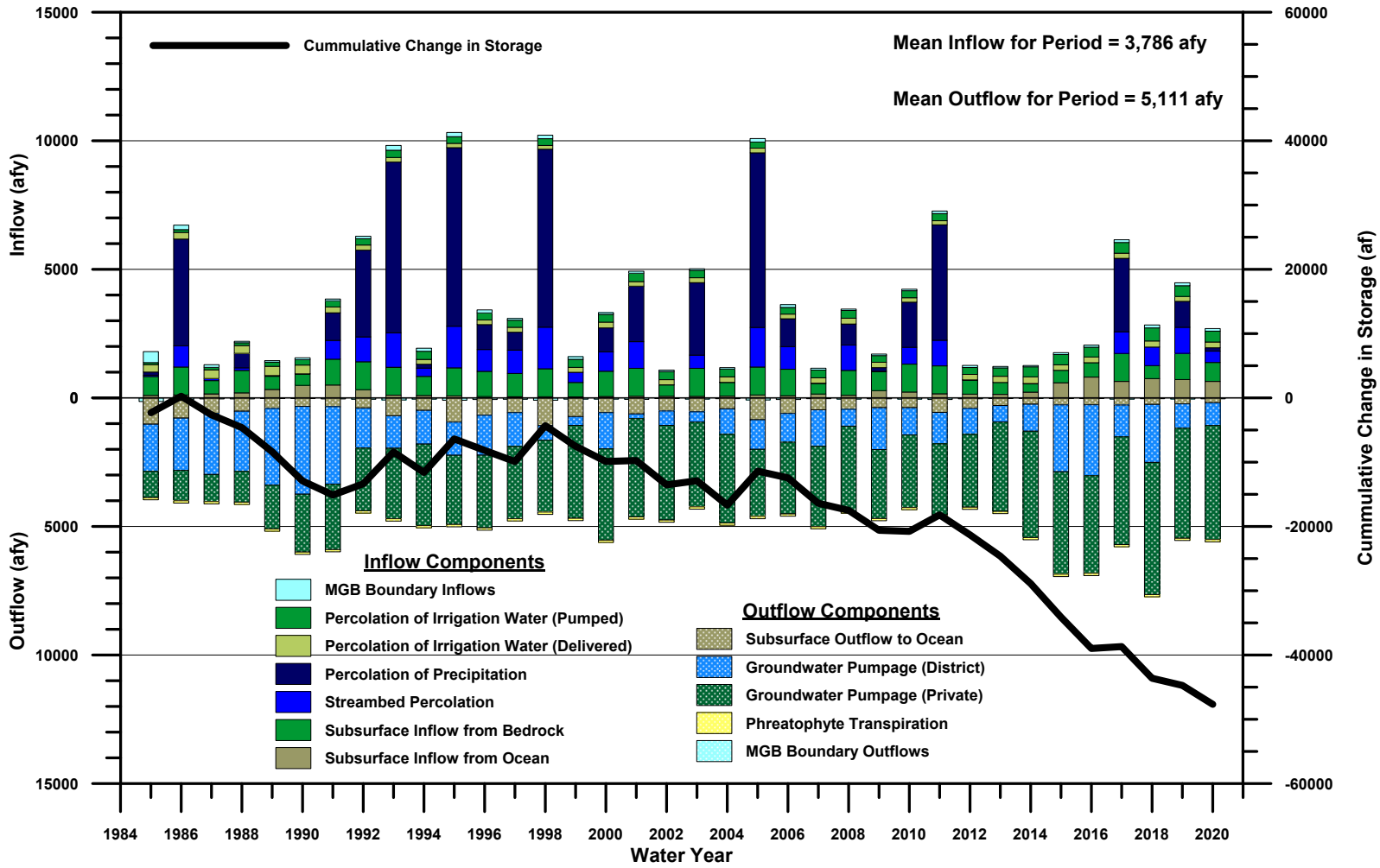


FIGURE ES-5

Historical Water Budget Summary (WY 1985 – 2020)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

The SGMA regulations allow the Plan to use existing monitoring sites for the monitoring network. Monitoring of groundwater elevations in the Carpinteria Valley and within the Basin date back to the 1940s. Historical water level data were collected by the USGS and CVWD. In 1994, CVWD established a Groundwater Monitoring Program (GMP) pursuant to Assembly Bill (AB) 3030, which included collection of groundwater levels, groundwater and surface water quality data, precipitation data, and groundwater production data. The Basin GMP also established annual review of and reporting on the data collected. The well network first established through the GMP now includes all of the well types within the Basin, including municipal, private agricultural, and dedicated monitoring wells. A total of 69 wells are included in the existing monitoring networks for the Basin. Of these, 35 wells are monitored for water levels, 46 wells are monitored for basic water quality parameters, and 12 wells are monitored for both. Several of these wells were selected as RMS wells for the sustainability indicators.

The proposed RMS well network to monitor conditions associated with the chronic water level decline and reduction of groundwater in storage indicators are presented in Figure ES-6. The proposed RMS well network to monitor conditions associated with the seawater intrusion sustainability indicator are presented in Figure ES-7. The proposed RMS well network to monitor conditions associated with the degradation of water quality sustainability indicator is presented in Figure ES-8. The proposed monitoring wells include active and inactive CVWD production wells, active and inactive private agricultural wells, and dedicated monitoring wells. The wells are spatially distributed throughout the confined and recharge areas of the Basin. Most of these wells have been monitored by CVWD prior to and during the AB 3030 GMP. CVWD continues to monitor water levels in these wells in the interim period between the termination of the AB 3030 program and implementation of the Plan and will continue to do so on behalf of the Carpinteria GSA.

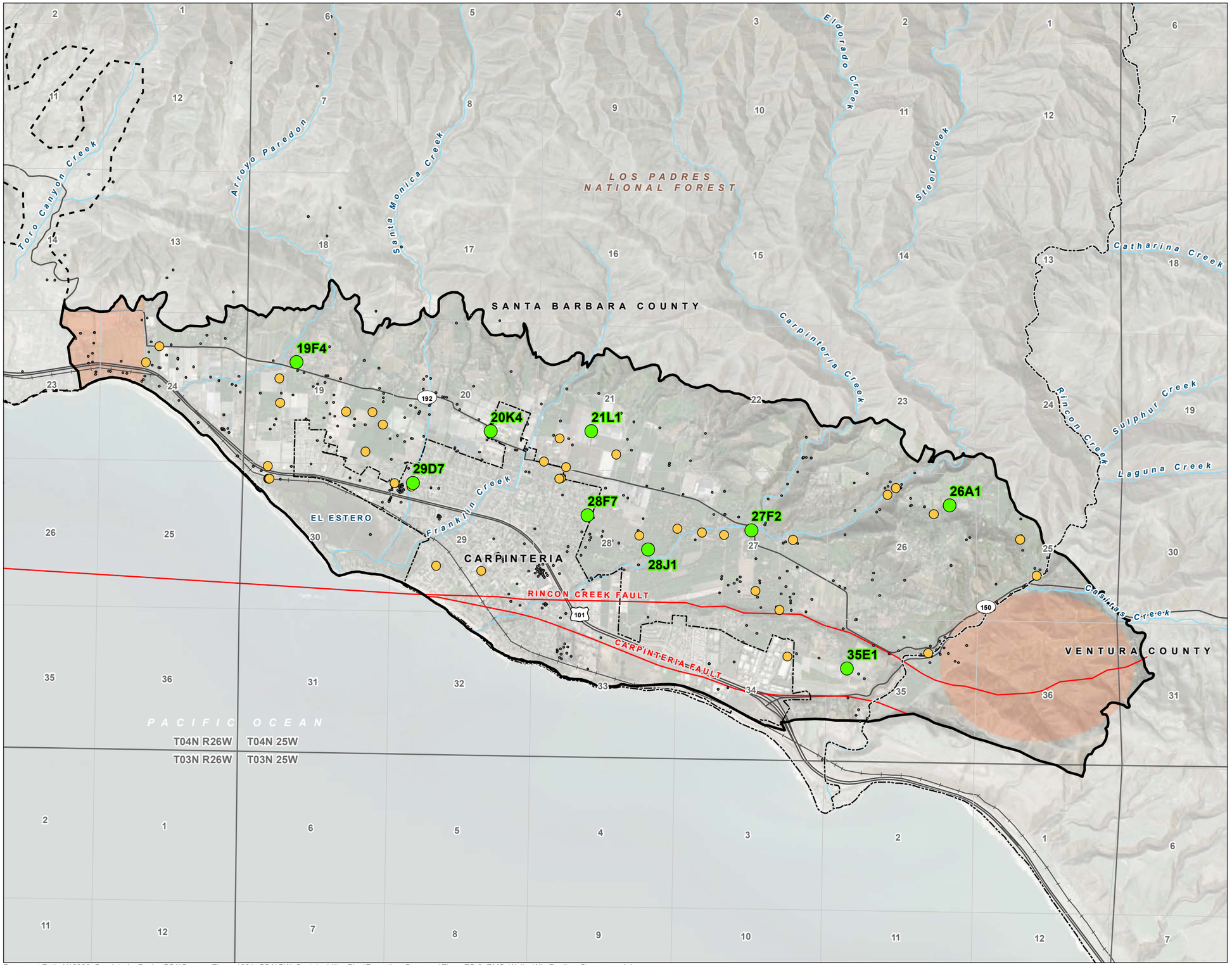


FIGURE ES-6

RMS Wells for Water Level Decline and Reduction of Storage

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Water Level RMS Well
- GSA Monitoring Well
- GSA Database Well
- Data Gap Area
- Carpinteria Groundwater Basin

All Other Features

- City Boundary
- County Boundary
- Montecito Groundwater Basin
- Fault
- Railroad
- Major Road
- Watercourse

NOTES

GSA: Groundwater Sustainability Agency
RMS: representative monitoring well

N

0 ½ 1
Miles

Date: November 20, 2023
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Executive_Summary\FigureES-6_RMS_Wells_WL_Decline_Storage.mxd, iramos

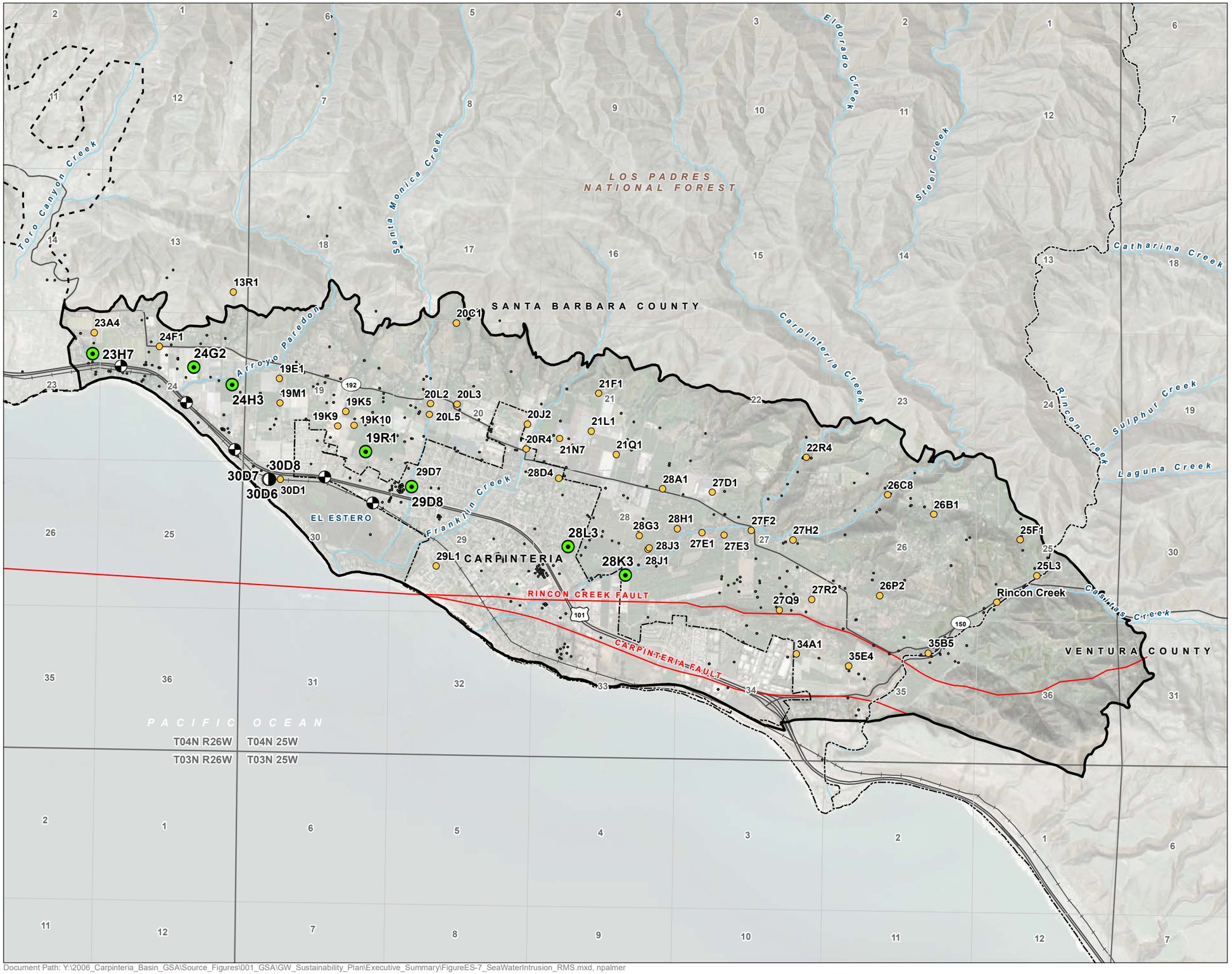


FIGURE ES-7

RMS Wells for Seawater Intrusion Monitoring

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Seawater Intrusion RMS Well
- Existing Monitoring Well
- Proposed Seawater Intrusion Monitor Well
- Water Quality Monitoring Well
- GSA Database Well

All Other Features

- City Boundary
- County Boundary
- Carpinteria Groundwater Basin
- Montecito Groundwater Basin
- Fault
- Railroad
- Major Road
- Watercourse

NOTES

GSA: Groundwater Sustainability Agency
RMS: representative monitoring well

N

0 ½ 1
Miles

Date: November 21, 2023
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Executive_Summary\FigureES-7_SeaWaterIntrusion_RMS.mxd, npalmer

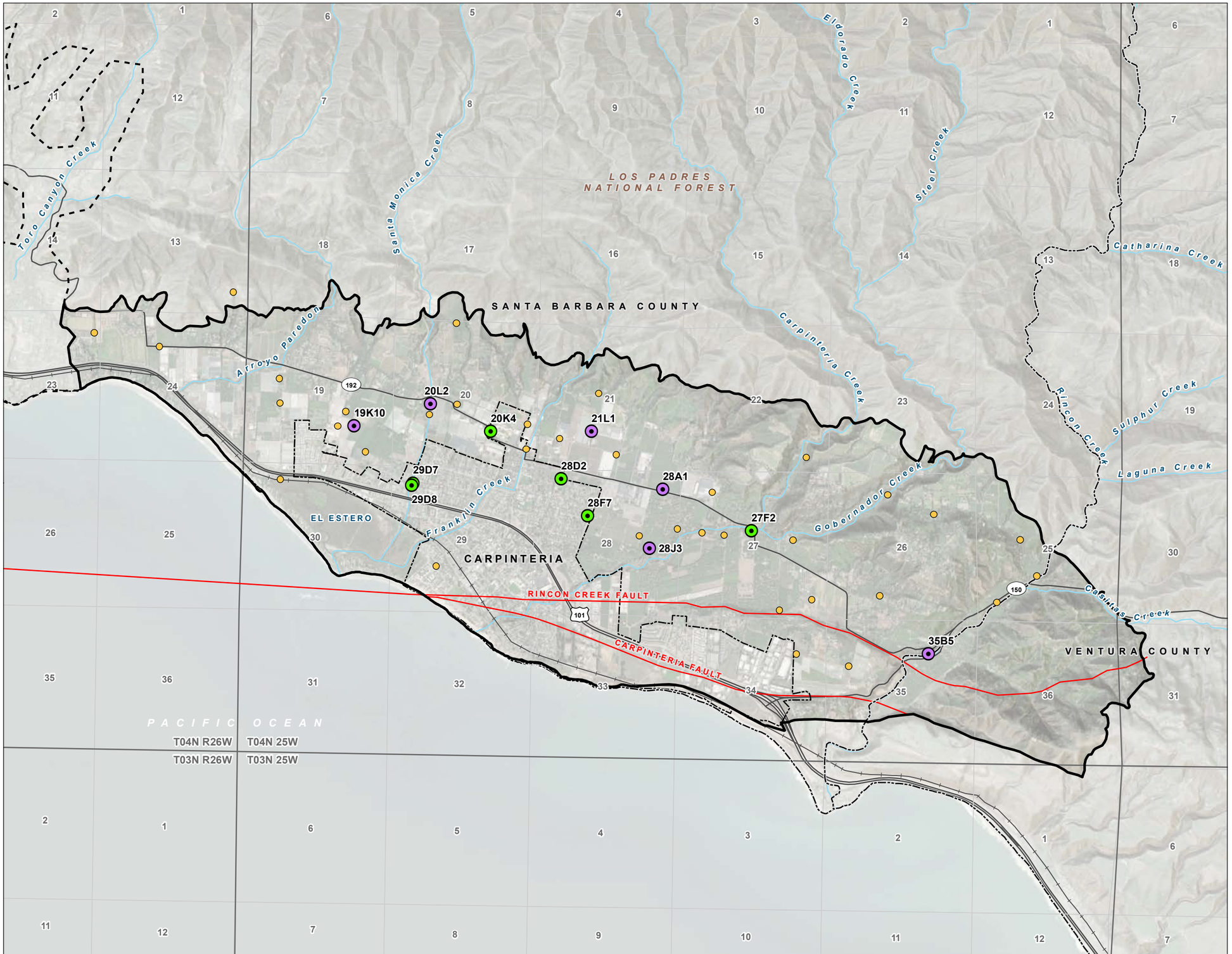


FIGURE ES-8

RMS Wells for Water Quality Degradation

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Chloride, Boron, and TDS RMS Well
- Arsenic and Nitrate RMS Well
- Water Quality Monitoring Well
- Carpinteria Groundwater Basin

All Other Features

- City Boundary
- County Boundary
- Montecito Groundwater Basin
- Fault
- Railroad
- Major Road
- Watercourse

NOTES

GSA: Groundwater Sustainability Agency
RMS: representative monitoring well

N

0 ½ 1
Miles

Date: November 20, 2023
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Executive_Summary\FigureES-8_RMS_Wells_WQ_Degradation.mxd, iramos

ES-4 Sustainable Management Criteria (Plan Section 5)

This section defines the conditions that constitute sustainable groundwater management and discusses the process by which the Carpinteria GSA will characterize undesirable results and establish minimum thresholds and measurable objectives for the six sustainability indicators in the Basin in accordance with SGMA.

The methods and data used to develop the SMCs and how these criteria take into consideration current and future beneficial uses and groundwater users are described below. Defining the SMCs required technical analysis of historical data and input from the affected stakeholders in the Basin. The SMCs presented in this section are based on currently available data and the application of the best available science. As noted in Section 3 of this Plan, several data gaps exist in the HCM. The uncertainty created by these data gaps was considered when developing the SMCs. The SMCs are considered initial criteria and will be reevaluated and potentially modified in the future as new data become available.

The SMCs are grouped by sustainability indicator. The following six sustainability indicators are applicable in the Basin and could lead to significant and unreasonable effects caused by groundwater conditions occurring throughout the Basin:

- Chronic lowering of groundwater levels (Section 5.5)
- Reduction of groundwater storage (Section 5.6)
- Seawater intrusion (Section 5.7)
- Water quality degradation (Section 5.8)
- Land subsidence (Section 5.9)
- Interconnected surface water depletions (Section 5.10)

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

Minimum thresholds for the first two sustainability indicators, chronic lowering of groundwater levels and reduction of groundwater in storage, are defined as minimum groundwater elevations measured in the established RMS well network in the Basin. Measurable objectives are defined as goals considered to be achievable within the 20-year SGMA implementation period after evaluation of historical data. Interim Milestones are interim goals to be assessed every 5 years when GSPs are re-evaluated. Sustainable management criteria for these sustainability indicators are presented in Table ES-1.

Table ES-1. Summary of Minimum Thresholds, Measurable Objectives, and Interim Milestones for Carpinteria Groundwater Basin Chronic Lowering of Groundwater Levels Sustainability Indicator

RMS Well	MT (ft NAVD 88)	2029 IM (ft NAVD 88)	2034 IM (ft NAVD 88)	2039 IM (ft NAVD 88)	MO (ft NAVD 88)	Land Surface Elevation (ft NAVD 88)
19F4	−30	−18	−5	7	20	102
20K4	−77	−58	−39	−20	0	47
21L1	−85	−61	−37	−13	10	69
27F2	−92	−62	−32	−3	25	136
26A1	140	160	180	200	220	425
28J1	−40	−23	−5	13	30	103
28F7	−90	−64	−38	−12	15	65
29D7	−45	−34	−23	−12	0	28
35E1	12	21	30	41	50	243

Notes

ft = foot or feet

IM = interim milestone (see Section 5.5.4)

MO = measurable objective goal for 2044

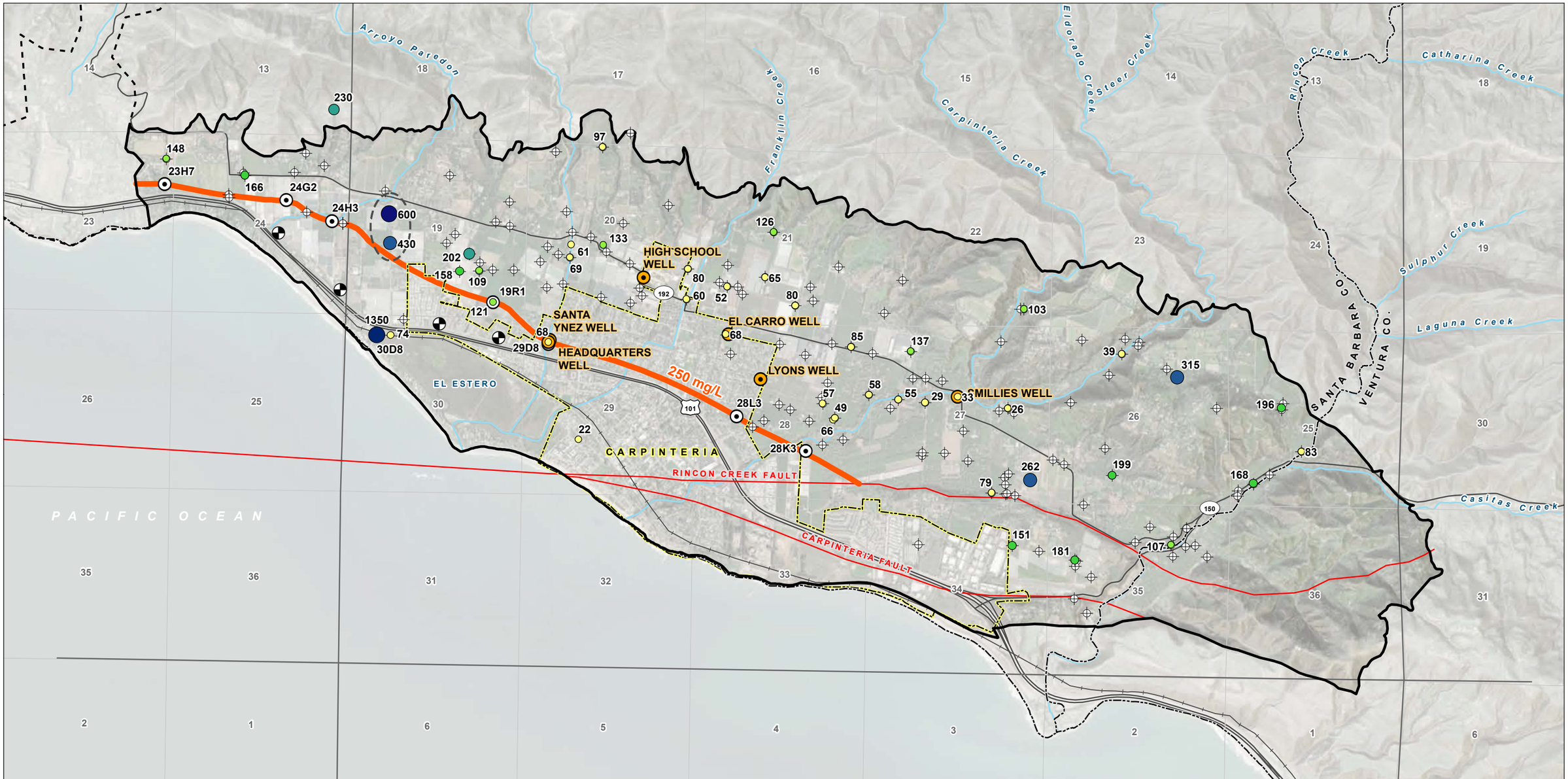
MT = minimum threshold

NAVD 88 = North American Vertical Datum of 1988

RMS = representative monitoring site

Minimum thresholds for the third sustainability indicator, seawater intrusion, are defined as a chloride isocontour of 250 milligrams per liter, with the location of the isocontour line defined by drawing a line through all active wells in the western portion of the Basin (Figure ES-9) whose owners agreed to participate in the monitoring program. The southeastern portion of the Basin is not considered to be at risk from seawater intrusion to the barrier created by the presence of the Rincon Creek and Carpinteria faults.

Minimum thresholds for the degradation of water quality sustainability indicator are based on existing state and federal water quality regulatory criteria, and on basin measurable objectives for this and other coastal basins promulgated by the Regional Water Quality Control Board. The proposed sustainable management criteria for this sustainability indicator are presented in Table ES-2.



LEGEND

Maximum Chloride Concentration in mg/L (2015 - 2021)

- < 100
- 101 - 150
- 151 - 200
- 201 - 250
- 251 - 500
- > 500

- MT Isocontour at 250 mg/L
- CVWD District Well
- Proposed RMS Well (Active)
- Proposed Monitoring Well
- Existing Monitoring Well
- Active Well
- CVWD Database Well

All Other Features

- Carpinteria Groundwater Basin
- Montecito Groundwater Basin
- County Boundary
- City Boundary
- Fault
- Railroad
- Major Road
- Watercourse

FIGURE ES-9

Seawater Intrusion Isocontour SMC

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

N

0 1,500 3,000 4,500
feet

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Executive_Summary\FigureES-9_Sea_Water_Intrusion_RMS_.mxd, npalmer

Table ES-2. Minimum Thresholds for the Water Quality Degradation Sustainability Indicator

Constituent	MT	RMS Locations	Rationale
Arsenic	10 µg/L	5 CVWD supply wells	MCL is the federal regulation for drinking water CVWD is the only potable water supplier in Basin
Nitrate (as N)	10 mg/L	5 CVWD supply wells	MCL is the federal regulation for drinking water CVWD is the only potable water supplier in Basin
TDS	1,000 mg/L	5 CVWD supply wells and 6 monitoring wells	MT set at SMCL
Chloride	142 mg/L	5 CVWD supply wells and 6 monitoring wells	MT set at the Basin Plan's "no problem" agricultural threshold
Boron	0.75 mg/L	5 CVWD supply wells and 6 monitoring wells	MT set at Basin Plan agricultural threshold for other coastal basins

Notes

µg/L = micrograms per liter

CVWD = Carpinteria Valley Water District

MCL = maximum contaminant level

mg/L = milligrams per liter

MT = minimum threshold

N = nitrogen

RMS = representative monitoring site

SMCL = secondary maximum contaminant level

TDS = total dissolved solids

Land subsidence may occur as the result of over pumping of groundwater in areas where shallow clays may be compacted. There is no historical occurrence of land subsidence in the Carpinteria Basin. The minimum thresholds for land subsidence are based on data collected under the California Department of Water Resources Interferometric Synthetic Aperture Radar (InSAR) data program, which measures subsidence from space using satellite technology. The minimum threshold for land subsidence is defined as no more than 0.1 feet of subsidence due to groundwater extraction in any given year, and cumulative measured subsidence of 0.5 feet in any 5-year period.

Because available data analysis indicate that there are no interconnected surface water systems in the Basin, no SMCs are established for the depletion of interconnected surface water depletions sustainability indicator.

ES-5 Projects and Management Actions (Plan Section 6)

SGMA regulations require each GSP to include a description of projects and management actions necessary to achieve the basin sustainability goals and to respond to changing conditions in the Basin. This section describes the projects and management actions that the Carpinteria GSA believes will, when implemented, help the Basin attain sustainability in accordance with § 354.42 and § 354.44 of SGMA regulations. The concepts for the proposed projects and management actions were developed during working sessions with GSA staff, meetings with the Carpinteria GSA Technical Coordination Committee, meetings with the GSA GSPAC, and in public workshops between April and August 2023. In the context of this Plan, "projects" are defined as activities supporting groundwater sustainability that require significant funding, infrastructure,

and engineering support. Groundwater "management actions" generally refer to activities that support groundwater sustainability through policy and regulations without significant infrastructure requirements or capital investments. The effectiveness of the projects and management actions will be assessed based on the ability to avoid undesirable results as discussed in Section 5 of this Plan.

The Carpinteria GSA has developed a portfolio of potential projects and management actions that can be implemented in a phased manner as the conditions in the Basin dictate. Based on the results of the analysis that was performed in conjunction with the development of this Plan, the Carpinteria GSA concludes that the sustainability goals described in this Plan and required under the provisions of SGMA can be achieved through the implementation, as needed, of the projects and management actions described in Sections 6.3 through 6.15 of the Plan. This Plan categorizes listed projects as either Tier 1 projects or Tier 2 projects. Tier 1 projects are priority projects expected to be implemented within the first 5-year SGMA implementation period; three projects are identified as Tier 1 projects. Tier 2 projects are non-priority projects also identified for possible future consideration. It is expected that all management actions discussed in this section will be evaluated and implemented as appropriate in the first 5-year SGMA implementation period.

The Carpinteria GSA plans to continually monitor and assess its progress toward meeting the sustainable management criteria described in Section 5 of this Plan. Under conditions where minimum thresholds are projected to be achieved, the Carpinteria GSA will perform assessments to determine whether the trends are related to groundwater pumping, drought conditions, or other factors. If groundwater level data are trending toward exceeding minimum thresholds as a direct consequence of groundwater pumping in the Basin, then the Carpinteria GSA will determine which additional project(s) and/or management action(s) to implement to address these conditions.

A summary of the projects and management actions identified by the Carpinteria GSA are listed below. Tier 1 projects are expected to be implemented within the first 5-year SGMA implementation period. Tier 2 projects will be evaluated and ranked during the first 5-year period for potential future implementation. Some projects or management actions may occur if drivers other than sustainability, such as water supply management flexibility, necessitate the implementation. These projects and management actions are discussed in detail in Section 6.

Tier 1 Projects

- Carpinteria Advanced Purification Project (CAPP)
- Sentinel Monitoring Well Network Expansion Project
- Local Infrastructure Water System Interties

Tier 2 Projects

- Carpinteria Seawater Intrusion Barrier Project
- Aquifer Storage and Recovery (ASR) Projects
- Recharge Enhancement Projects (Recharge Basins and Creek De-lining)
- Local Inter-Agency Water Delivery and Water Banking Agreements

Potential Management Actions

- Municipal Pumping Re-Distribution
- Well Registration and Metering Program
- Water Use Efficiency Programs
- Groundwater Model Revisions and Updates
- Address Data Gaps
  - Perform Video Surveys in Representative Wells that Currently Do Not Have Adequate Construction Records to Confirm Well Construction
  - Identify wells in the Ventura County portion of the Basin that can be monitored for water levels or water quality
  - Survey and Investigate Potential Groundwater Dependent Ecosystems (GDEs) in the Basin
  - Geophysical monitoring along the coast every 5 years to evaluate seawater intrusion.
- Perform Tier 2 Project and Management Action Feasibility and Ranking Study

As work on supplemental water supply and resource management efforts is ongoing, additional projects and/or management actions may be identified and added to the list in future Plan updates.

ES-6 Plan Implementation (Plan Section 7)

This section provides a conceptual roadmap for the Carpinteria GSA's efforts to implement this Plan after adoption and discusses implementation efforts in accordance with SGMA regulations § 354.44(b)(6). This implementation plan is based on the Carpinteria GSA's current understanding of the Basin's conditions and anticipated administrative considerations that affect the management actions described in Section 6. Understanding of basin conditions and administrative considerations will evolve over time, based on future refinement of the hydrogeologic setting, groundwater flow conditions, and input from basin stakeholders.

Implementation of this Plan requires robust administrative and financing structures, with adequate staff and funding to support compliance with SGMA. The Plan calls for the Carpinteria GSA to routinely provide information to the public about Plan implementation, progress towards sustainability, and the need to use groundwater efficiently. The Plan calls for a website to be maintained as a communication tool for posting data, reports, and meeting information.

Section 6 of the Plan identifies the following three tiers of projects and management actions that may be considered for implementation by the Carpinteria GSA:

- Tier 1 projects are expected to be implemented within the first 5-year SGMA implementation period.
- Tier 2 projects will be considered, as judged appropriate by the GSA, after the first 5-year period and prior to the 20-year implementation deadline.
- Management actions will be evaluated individually after Plan adoption, and implemented as appropriate under the direction of the GSA.

These projects and management actions can be implemented as the conditions in the Basin dictate. It is important to note that the Tier 2 projects and some of the management actions described in Section 6 may not be necessary if the implementation of Tier 1 projects and management actions result in conditions within the Basin that are trending toward meeting the Carpinteria GSA sustainability goals and measurable objectives. However, the Carpinteria GSA may determine that the implementation of Tier 2 projects is desirable for reasons other than reaching sustainability within the Basin and may elect to implement selected initiatives at any time.

Based on the results of the analysis performed in conjunction with the development of this Plan, the Carpinteria GSA concludes that the sustainability goals described in this Plan, and required under the provisions of SGMA, can be achieved through the implementation of the Tier 1 projects (see Sections 6.3 through 6.5), and, as needed, some combination of Tier 2 projects (Sections 6.6 through 6.9) and management actions (see Sections 6.10 through 6.15). Therefore, the Carpinteria GSA does not plan at this time to implement any of the Tier 2 projects and/or to initiate the construction of any project infrastructure for the specific goal of achieving sustainability until such time as evidence indicates that the Tier 2 projects will be necessary for sustainable groundwater management. Planning level budget estimates are provided for Tier 1 and Tier 2 projects, management actions, and GSA administrative costs.

SECTION 1:

Introduction to Plan Contents

SECTION 1: Introduction to Plan Contents [Article 5 §354]

§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.

This section describes the Sustainable Groundwater Management Act (SGMA), the Carpinteria Groundwater Basin (Basin), the purpose of this Groundwater Sustainability Plan (Plan or GSP), and how this Plan is organized.

1.1 Purpose of the Groundwater Sustainability Plan

In 2014, the State of California enacted SGMA. This law requires groundwater basins in California that are designated as medium or high priority to be managed sustainably. Satisfying the requirements of SGMA generally requires four basic activities:

- Forming a Groundwater Sustainability Agency (GSA) to fully cover the basin area
- Developing a Plan that fully covers the basin
- Implementing the Plan and managing the Basin to achieve quantifiable objectives
- Regular reporting to the California Department of Water Resources (DWR)

This document fulfills the Plan requirement for the Carpinteria GSA. It describes the Basin, develops quantifiable management objectives that account for the interests of the Basin's beneficial groundwater uses and users, and identifies a group of projects and management actions that will allow the Basin to achieve sustainability within 20 years of plan adoption.

This document was developed to comply with SGMA's statutory and regulatory requirements, and as such, uses the terminology set forth in these requirements (see California Water Code § 10721 and 23 California Code of Regulations [CCR] § 351), which may be different from the terminology used in other contexts (e.g., past reports or studies, past analyses, judicial rules, or findings). This Plan is a planning document and does not define or change water rights.

1.2 Description of the Carpinteria Groundwater Basin

Located in the Central Coast region of California, the Basin is identified by DWR as Basin No. 3-018 and encompasses an area of approximately 12.7 square miles (DWR, 2004, 2023). The 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. Section 2.2 of this Plan provides a more detailed description of the area covered by the Plan.

1.3 Organization of the Plan

This Plan has been developed collaboratively by the member agencies making up the Carpinteria GSA. The organization of the Plan is as follows:

- **Section 1 – Introduction to Plan Contents:** An introduction to the Plan, including a description of its purpose and a brief description of the Basin.
- **Section 2 – Administrative Information:** Includes the following:
  - Information on the Carpinteria GSA and a brief description of the agencies participating in the GSA, including information on the legal authority of the GSA to plan and coordinate groundwater sustainability for the Basin.
  - An overview of the Basin, including land use and agencies with jurisdiction, a description of the existing groundwater management plans and regulatory programs, any programs for conjunctive use, and urban land use programs that might affect, or be affected by, this Plan.
  - The Carpinteria GSA's communication and engagement planning and implementation, public feedback and stakeholder comments on the plan, how feedback was incorporated into the Plan, and responses to comments received.
- **Section 3 – Basin Setting:** Includes the following:
  - An explanation of the hydrogeologic conceptual model (HCM) developed for the Basin that includes descriptions of the regional hydrology and geology, principal aquifers and aquitards, and a description of the data gaps in the current model.
  - A detailed description of the groundwater conditions, including groundwater elevations and changes in storage, seawater intrusion, groundwater quality for drinking water and agricultural irrigation and trends over time, an evaluation of land subsidence, locations where surface water and groundwater are interconnected, and the identification and distribution of groundwater-dependent ecosystems.
  - A presentation of the historical, current, and projected future water budgets for the Basin; how the water budgets were developed; an estimate of sustainable yield for the Basin; and the effects of climate change using DWR climate change assumptions.
- **Section 4 – Monitoring Networks:** A detailed description of the monitoring objectives and monitoring in the Basin for groundwater levels, storage, seawater intrusion, water quality, land subsidence, interconnected surface water, representative monitoring sites, and a description of the data management and reporting system.
- **Section 5 – Sustainable Management Criteria (SMC):** Defines the sustainability goal for the Basin; describes the process through which the SMCs were established; describes significant and unreasonable effects that could lead to undesirable results as a result of groundwater conditions occurring throughout the Basin; describes and defines SMCs regarding chronic lowering of groundwater levels, significant and unreasonable reduction in groundwater storage, seawater intrusion, degraded groundwater quality, land subsidence, and depletion of interconnected surface water (including quantity and timing of surface water depletion); and describes the minimum thresholds, measurable objectives, and interim milestones to avoid undesirable results.
- **Section 6 – Projects and Management Actions:** Provides a description of each project and management action that may be developed and implemented by the Carpinteria GSA to avoid undesirable results and ensure sustainability within 20 years of Plan adoption.
- **Section 7 –Plan Implementation:** Describes the implementation sequence for projects and management actions, overall schedule, estimated implementation costs, and sources of funding.
- **Section 8 – References and Technical Studies:** Lists the references and technical studies used to develop the Plan.

SECTION 2:

Administrative Information

SECTION 2: **Administrative Information [Article 5, SubArticle 1]**

§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.

2.1 Agency Information [§354.6]

DWR initially designated the Basin as a low priority basin, indicating that it would not be required to form a GSA and prepare a Plan under SGMA. In 2019, DWR conducted a basin reprioritization process that reclassified the Basin as a high priority basin based on a recalculation of the importance and dependency of local water users on groundwater. Therefore, this Plan has been prepared to meet SGMA requirements. On January 31, 2020, the Carpinteria Valley Water District (CVWD), the City of Carpinteria, the Santa Barbara County Water Agency (Water Agency), and the County of Ventura entered into a Joint Exercise of Powers Agreement (JPA) to form the Carpinteria GSA for the purpose of managing groundwater in the Basin and developing this Plan for the Basin. The JPA outlines the powers of the GSA and describes the Board of Directors composition, decision making, and other terms. The Carpinteria GSA Board of Directors adopted Resolution 0001 on February 7, 2020 declaring its intent to designate itself to DWR as the recognized GSA for the Basin, and the required documentation was submitted to DWR in February 2020. The Carpinteria GSA's formation documents are presented in Appendix B.

2.2 Member Agencies

2.2.1 Carpinteria Valley Water District

CVWD was established in 1941 and comprises approximately 11,300 acres in the southern coastal portion of County of Santa Barbara, including the City of Carpinteria. CVWD was formed under California Water Code § 30000 et seq. to provide potable water to residential, commercial, and agricultural customers in the Carpinteria Valley, and it has managed groundwater in the Basin under the authority of Assembly Bill (AB) 3030 since 1994. It is governed by a five-member board of directors elected for four-year terms. The board sets water rates, enters into contracts, and has the authority to adopt ordinances effective within its boundaries. CVWD has a staff of about 20 employees under the direction of a General Manager.

2.2.2 City of Carpinteria

The City of Carpinteria was incorporated on September 28, 1965, as a general law city with a five-member City Council elected for four-year overlapping terms. The mayor and vice-mayor are selected by the council from among its members and serve two-year terms. A City Manager is appointed by the council. Water and wastewater treatment services within the city are provided by CVWD and the Carpinteria Sanitary District, respectively. The City exercises management of stormwater flows and land use authority within city limits.

2.2.3 Santa Barbara County Water Agency

The majority of the Basin is located in Santa Barbara County. The Water Agency was established in 1945 by the California Legislature through the Santa Barbara County Water Agency Act to control and conserve storm, flood, and other surface waters for beneficial use and to enter into contracts for water supply. The Water Agency is part of the Santa Barbara County Public Works Department and is responsible for the following:

- Preparing investigations and reports on the County's water requirements, groundwater conditions, efficient use of water, and other water supply related technical studies.
- Managing County-wide programs, including the Integrated Regional Water Management (IRWM) Program, Regional Water Efficiency Program, and winter cloud seeding program.
- Providing technical assistance to other County departments, water districts, and the public concerning water availability.
- Administering certain provisions of the Cachuma Project and the Twitchell Dam Project contracts with the U.S. Bureau of Reclamation (USBR).
- Participating in GSAs.

2.2.4 County of Ventura

The County of Ventura exercises water management and land use planning authority within lands overlying the eastern portion of the Basin. The County of Ventura was formed in 1873 when it separated from Santa Barbara County. The County is governed by a five-member Board of Supervisors elected to serve four-year terms with chairmanship rotating annually.

2.3 Name and Mailing Address [§354.6(a)]

§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.

Carpinteria Groundwater Sustainability Agency
1301 Santa Ynez Avenue
Carpinteria, CA 93013

2.4 Organization and Management Structure [§354.6(b)]

§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:

(b) The organization and management structure of the Agency, identifying persons with management authority for implementation of the Plan.

The 2020 JPA describes the agreement among the four member agencies to establish the Carpinteria GSA to manage groundwater in the Basin sustainably and to develop, adopt, and implement a SGMA-compliant Plan for the Basin. It specifies procedures for decision making, describes the GSA's powers and responsibilities related to Plan development and implementation, and includes provisions for quarterly and special meetings. The 2020 JPA is presented in Appendix B.

The JPA sets forth a governance structure for the GSA, including a board of directors composed of five "regular" and three "optional" directors. The five regular directors are appointed by CVWD, and each of the three optional directors is appointed by one of the other member agencies of the GSA. Directors are appointed to serve for a 4-year term and must be a member of the appointing member agency's legislative body. Officers of the board include a chair and a vice chair elected by the board. Each member agency can appoint an alternate director to serve as a substitute in a director's absence. Alternate directors may be a member of the appointing member's legislative body or be in a senior management staff position. The board appoints a treasurer/auditor and an executive director.

2.4.1 Plan Manager and Contact Information [§354.6(c)]

§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:

(c) The name and contact information, including the phone number, mailing address and electronic mail address, of the plan manager.

Robert McDonald, Executive Director
Carpinteria GSA
Mailing address:
1301 Santa Ynez Avenue
Carpinteria, CA 93013
Phone: (805) 684-2816 x123
Email: bob@cvwd.net

2.4.2 Legal Authority [§354.6(d)]

§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:

(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.

The Carpinteria GSA was formed in accordance with the requirements of California Water Code § 10723 et seq. The 2020 JPA sets forth the specific authorities of the Carpinteria GSA in developing and implementing this Plan and is included, along with the resolution to designate itself as the GSA for the Basin, in Appendix B. The JPA grants the Carpinteria GSA the authority to have all powers that a GSA is authorized to exercise as provided by SGMA, including, but not limited to, developing a Plan and imposing fees to fund GSA and Plan-related activities.

Figure 2-1 shows the extent of the planning area under this Plan, including the jurisdictional boundaries of each of the Carpinteria GSA's four member agencies. The entire plan area is covered by the four agencies, and no portion of the Basin is covered by an exclusive agency as defined in SGMA. Therefore, the Carpinteria GSA has the legal authority to implement this Plan throughout the plan area, and no authority is needed from any other GSA or agency to implement this Plan.

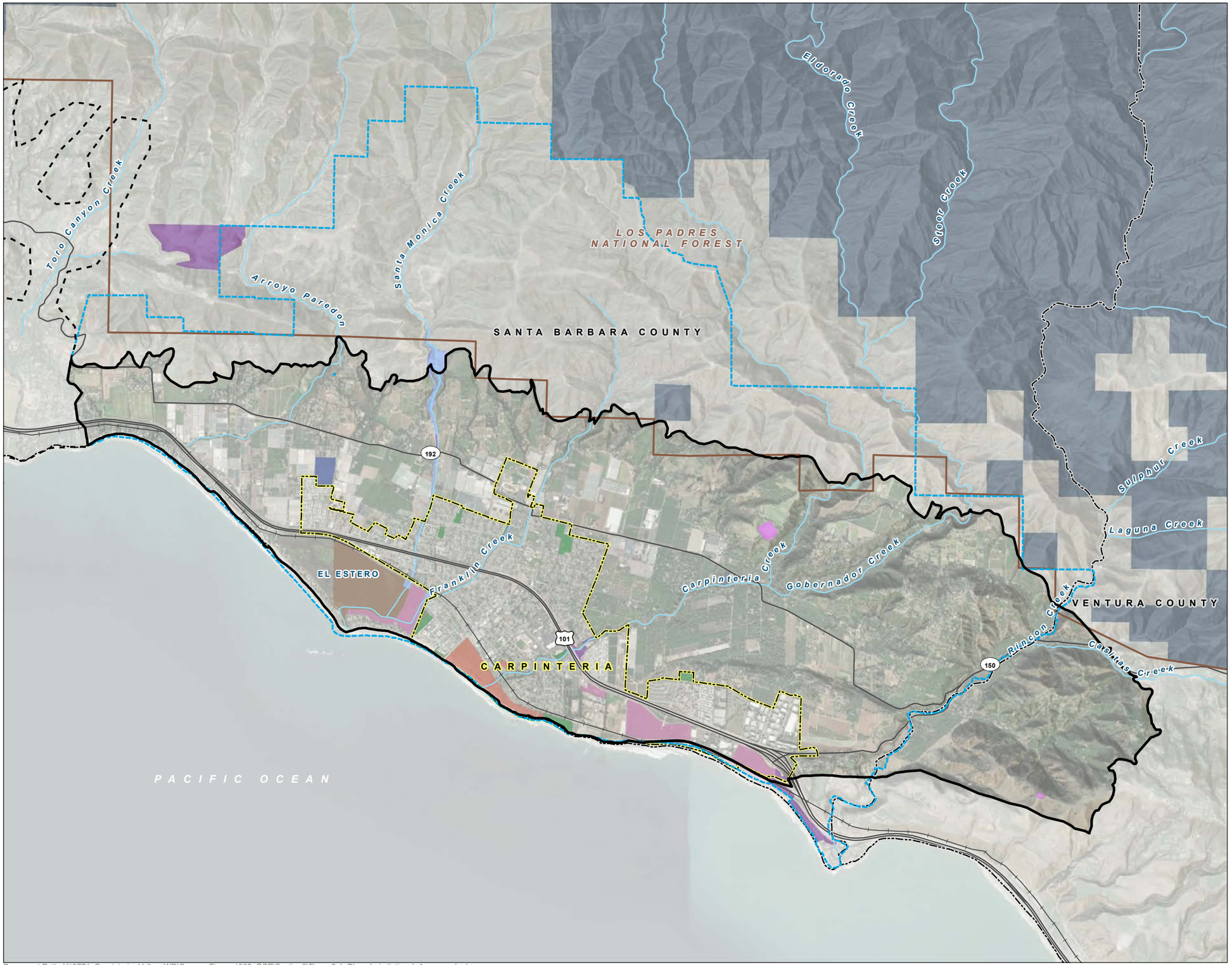


FIGURE 2-1

Carpinteria Groundwater Basin Plan Area and Jurisdictional Areas

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Carpinteria Valley Water District Service Area
- Carpinteria Groundwater Basin
- Los Padres National Forest

Land Ownership

- Bureau of Reclamation
- California Department of Parks and Recreation
- California State Lands Commission
- Carpinteria Cemetery District
- Carpinteria, City of
- Land Trust for Santa Barbara County
- Santa Barbara Flood Control and Water Conserv. District
- Santa Barbara, County of
- USDA Forest Service
- University of California

All Other Features

- City Boundary
- County Boundary
- Montecito Groundwater Basin
- Railroad
- Major Road
- Watercourse

N

0 ½ 1
Miles

Date: September 15, 2022
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118

GSI Water Solutions, Inc.

Document Path: Y:\0771_Carpinteria_Valley_WD\Source_Figures\002_GSP\Section2\Figure2-1_Plan_Jurisdictional_Areas.mxd, abarry

2.4.3 Cost and Funding of Plan Implementation [§354.6(e)]

§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:

(e) An estimate of the cost of implementing the Plan and a general description of how the Agency plans to meet those costs.

Estimated costs and options for funding implementation of this Plan are presented in Section 7 of the Plan.

2.5 Description of Plan Area [§354.8(a)(1),(a)(2)]

This Plan covers the entire Carpinteria Groundwater Basin identified by DWR as Basin No. 3-018 (DWR, 2004, 2023). This 7,801-acre (12.7 square mile) coastal basin includes portions of Santa Barbara County and Ventura County and the incorporated City of Carpinteria. Surface water bodies in the plan area include the Carpinteria, Franklin, Gobernador, Rincon, Toro Canyon, and Santa Monica Creeks. Highway 101 forms the major transportation corridor running from northwest to southeast through the Basin. Average annual precipitation within the Basin ranges from 15 to 19 inches.

The Basin's eastern boundary underlies Rincon Creek near Laguna Ridge. The Pacific Ocean forms its southern boundary. An adjustment to the western boundary was approved by DWR in 2018 following an application submitted by the Montecito Water District (MWD) and supported by CVWD for a jurisdictional basin boundary modification. The originally defined Basin boundary was moved to the west to coincide with the boundary between the two water districts' service areas. The new western boundary of the Basin follows the limits of the CVWD service area along Toro Canyon and separates the Basin from the Montecito Groundwater Basin. The Basin's northern boundary is delineated at the geologic contact with the Coldwater Sandstone and Sespe Formations in the foothills of the Santa Ynez Mountains. DWR approved a second basin boundary modification request in 2018 to refine the delineation of the northern boundary using more recently published geologic maps.

Groundwater rights in the Basin have not been adjudicated. No other GSAs have been formed within the Basin, and no alternative plans have been submitted for any part of the Basin. Therefore, no map is included in this Plan for adjudicated areas or alternative plans.

2.5.1 Summary of Jurisdictional Areas and Other Features [§354.8 (a)(3),(a)(4), and (b)]

§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) Adjudicated areas, other Agencies within the basin, and areas covered by an Alternative.

(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.

(4) Existing land use designations and the identification of water use sector and water source type.

(b) A written description of the Plan area, including a summary of the jurisdictional areas and other features depicted on the map.

Land use jurisdictions in the Basin include Santa Barbara and Ventura Counties, the incorporated City of Carpinteria, and small portions of federal and state-owned lands. In unincorporated areas under county jurisdiction, the County of Santa Barbara and the County of Ventura are responsible for comprehensive long-range planning, permitting, and development review. The Santa Barbara Flood Control and Water Conservation District has jurisdiction over certain flood control facilities. The City of Carpinteria has land management authority within its boundaries, and municipal and agricultural water service within the City is provided by CVWD. The Bureau of Reclamation has jurisdiction over the Carpinteria Regulating Reservoir. Lands under state jurisdiction include Carpinteria State Beach (California Department of Parks and Recreation), the beds of tidal waters (California State Lands Commission), and the Carpinteria Salt Marsh Reserve (University of California Natural Reserve System).

CVWD's service area covers all of the Basin within Santa Barbara County with the exception of a small area on the northeast edge of the District boundary, and the service area also extends beyond the Basin boundaries to the north and includes a small portion to the southeast of the Basin on the west side of Rincon Point. CVWD has water management and supply authority within its service area. The Ventura County portion of the Basin is located within the service area of Casitas Municipal Water District (CMWD), which has water management and supply authority within its service area.

The jurisdictional extent of local, state, and federal jurisdictions within the Basin is shown in Figure 2-1.

2.5.1.1 Land Use

Land use planning authority in unincorporated areas is the responsibility of the Counties. Santa Barbara County and Ventura County collaborate on integrated regional water management, water planning, and land use issues. According to land use data prepared using 2018 data by Land IQ, LLC, and provided to DWR, the primary land uses in the Basin are agriculture, urban areas, and undeveloped land. Current land uses are summarized by category in Table 2-1 and shown on Figure 2-2.

Table 2-1. Land Use Summary in 2018

Land Use Category	Acres
Agriculture by Crop Type	
Citrus and Subtropical	2,055
Truck, Nursery, and Berry Crops	701
Young Perennial	48
Pasture	80
Grain and Hay	6
Vineyard	1
Deciduous Fruits and Nuts	2
Unclassified Fallow	120
Total Agriculture	**3,013**
Urban	**1,673**
Native Vegetation / Rural Residential	**3,115**
Total	**7,801**

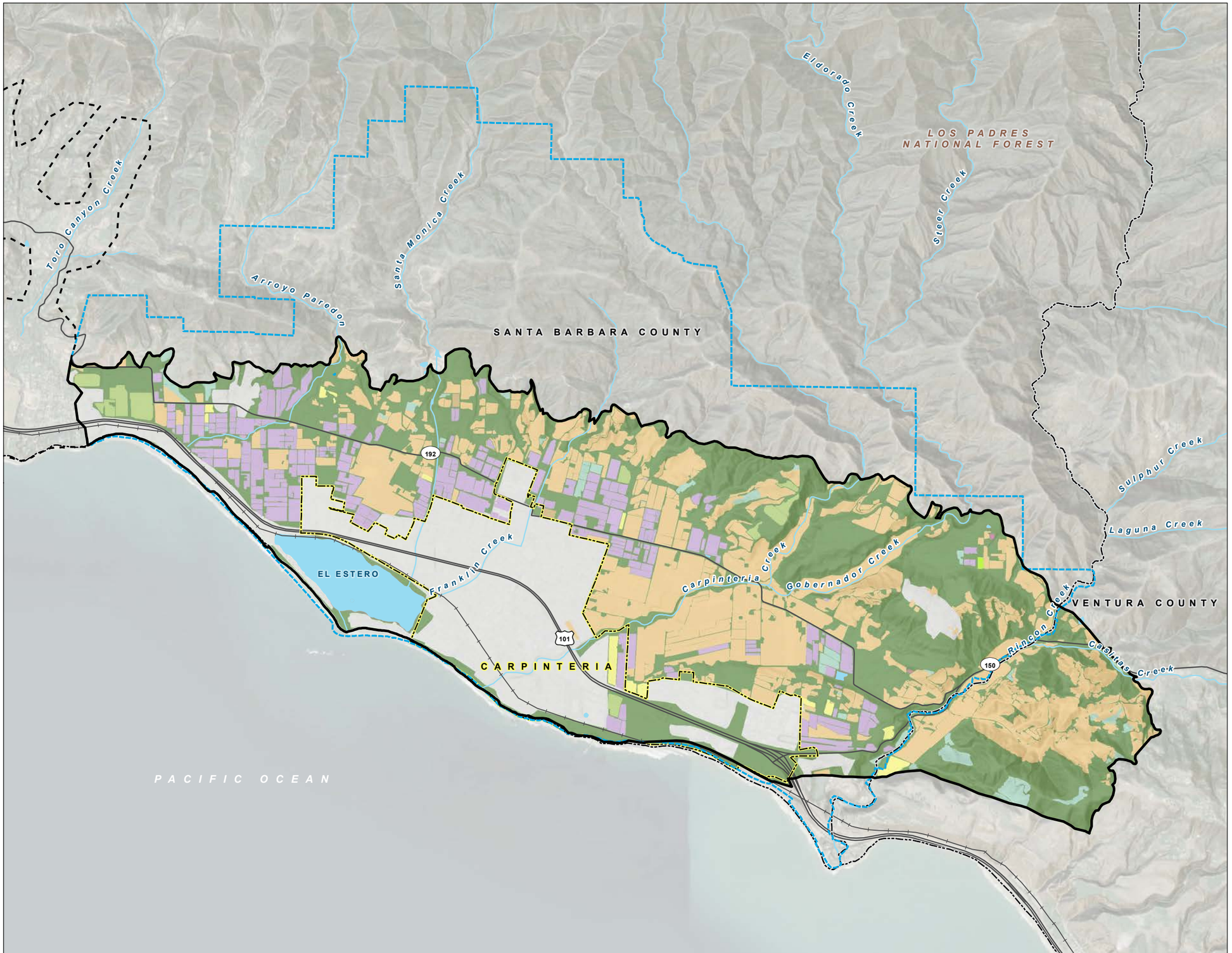


FIGURE 2-2

Existing Land Use Designations

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Carpinteria Valley Water District Service Area
- Carpinteria Groundwater Basin

Land Use

- Citrus and Subtropical
- Deciduous Fruits and Nuts
- Grain and Hay Crops
- Pasture
- Truck, Nursery, and Berry Crops
- Urban
- Vineyards
- Unclassified Fallow
- Young Perennial
- Native Vegetation and Rural Domestic

All Other Features

- City Boundary
- County Boundary
- Montecito Groundwater Basin
- Railroad
- Major Road
- Watercourse
- Waterbody

NOTE

DWR: California Department of Water Resources

N

0 ½ 1
Miles

Date: September 12, 2022
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118, DWR (2018)

GSI Water Solutions, Inc.

Document Path: Y:\0771_Carpinteria_Valley_WD\Source_Figures\002_GSP\Section2\Figure2-2_Land_Use.mxd, abarry

The City of Carpinteria, which occupies approximately 2.6 square miles within the Basin, includes the following zoning designations within its boundaries (City of Carpinteria, 2003):

- Three Residential categories
- Planned Unit Development
- General Commercial and Visitor-serving Commercial
- Three Industrial categories
- Public Facility
- Open Space/Recreation
- Agriculture
- Transportation Corridor

Further details on land use planning are available in Section 2.2.3 of this Plan.

2.5.1.2 Water Use Sector

Water demands in the Basin are organized into the six water use sectors identified in the SGMA emergency regulations. These are:

- **Urban.** Urban water use is assigned to non-agricultural water uses in the City of Carpinteria.
- **Industrial.** There is limited industrial use in the Basin. Most industrial use is located within the City of Carpinteria and is accounted for in the urban water use sector.
- **Agricultural.** This is a major water use sector in the Basin and is mostly outside of the City of Carpinteria.
- **Managed wetlands.** The Carpinteria Salt Marsh, also known as El Estero, includes wetland habitat managed by the University of California Santa Barbara (UCSB) Natural Reserve System, Santa Barbara Land Trust, and the City of Carpinteria.
- **Managed recharge.** At present there is no managed recharge in the Basin.
- **Native vegetation.** This is a major water use sector in the Basin by land area. This sector, required by the regulations, includes rural residential areas. Native vegetation is the term used in the regulations for all other unmanaged and non-irrigated land use sectors.

Figure 2-3 shows the distribution of the water use sectors in the Basin.

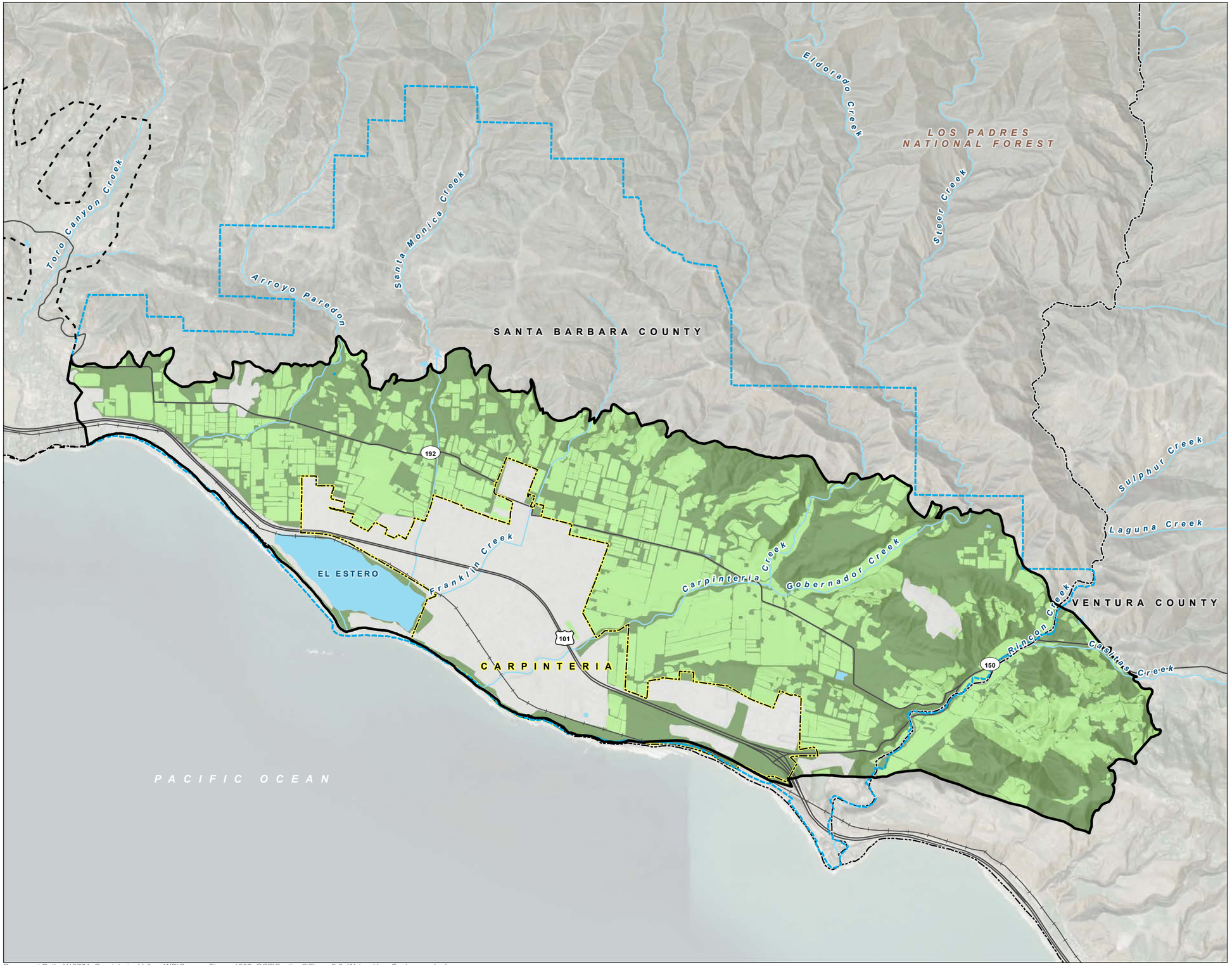


FIGURE 2-3

Water Use Sectors

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Carpinteria Valley Water District Service Area
- Carpinteria Groundwater Basin

Water Use Sectors

- Agricultural
- Urban
- Native Vegetation and Rural Domestic

All Other Features

- City Boundary
- County Boundary
- Montecito Groundwater Basin
- Railroad
- Major Road
- Watercourse
- Waterbody

NOTE
DWR: California Department of Water Resources

N

0 ½ 1
Miles

Date: September 12, 2022
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118, DWR (2018)

GSI Water Solutions, Inc.

Document Path: Y:\0771_Carpinteria_Valley_WD\Source_Figures\002_GSP\Section2\Figure2-3_Water_Use_Sectors.mxd, abarry

2.5.1.3 Water Source Type

Water supply sources include groundwater pumped within the Basin and surface water imported from outside the Basin. Within the Santa Barbara County portion of the Basin, groundwater is used by CVWD for domestic and agricultural water service, and it is also pumped by individual agricultural users.

CVWD receives a significant portion of its water supply from the Cachuma Project, which stores water from the Santa Ynez River in Lake Cachuma. Santa Barbara County Water Agency holds a Master Water Supply Contract with USBR to use Lake Cachuma as a source of water supply, and CVWD has a Water Supply Agreement with the Water Agency to receive water from this source. Under this agreement, CVWD is allocated 10.94 percent of the available water supply in Cachuma Lake each year, which amounts to a maximum allocation of 2,813 acre-feet (AF) annually. The long-term average annual allocation has been approximately 1,970 AF. In addition, CVWD receives up to 400 acre-feet per year (AFY) of water stored in Lake Cachuma via a State Water exchange program with the Santa Ynez Water Conservation District, Improvement District No. 1.

The Santa Barbara County Flood Control and Water Conservation District is a State Water Project (SWP) Contractor that divides its annual allocation of SWP water among multiple participating agencies, including the Central Coast Water Authority. CVWD is a member agency of the Central Coast Water Authority and has a contract to receive 2,000 AF of water from the SWP per year with an additional 200 AFY of drought buffer. Depending on hydrologic conditions in the state each year, delivery of SWP water to CVWD can vary from 5 to 100 percent of its contracted entitlement, averaging about 876 AFY. From 2016 through 2020, CVWD's average annual water supply was composed of around 38 percent local groundwater, 40 percent Cachuma Project water, and 22 percent SWP water (Woodard & Curran, 2021).

Within the Ventura County portion of the Basin, the source of water is groundwater and surface water supplied by CMWD from Lake Casitas. Lake Casitas receives inflow from surface runoff in its surrounding watershed, Coyote Creek, Santa Ana Creek, and the Ventura River via the Robles Canal. CMWD's surface water supply sources and municipal groundwater wells are located east of the Basin in Ventura County. CMWD holds a contract for 5,000 AFY of SWP water; however, infrastructure has not been developed to deliver the water. Figure 2-4 shows areas with access to imported surface water and groundwater.

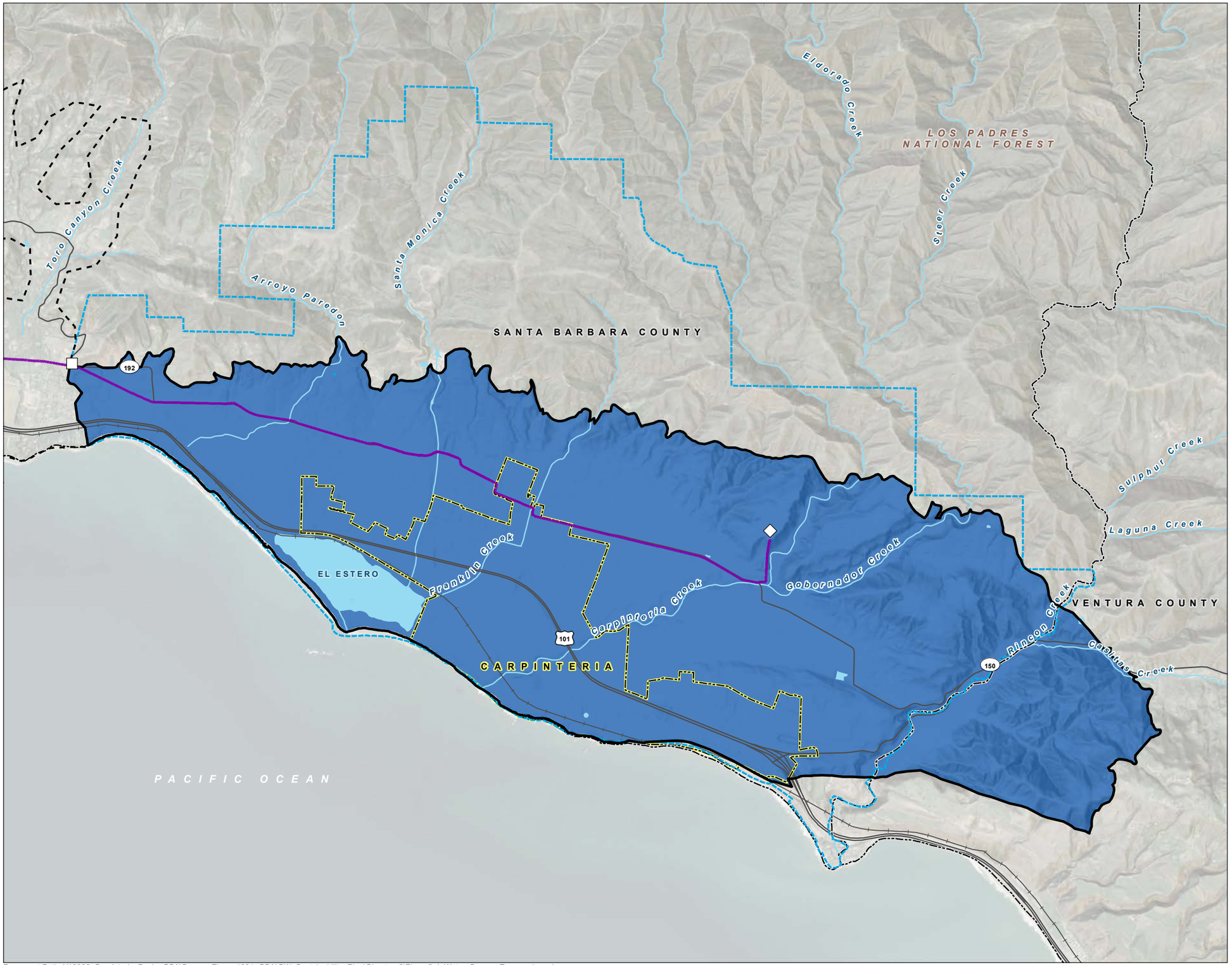


FIGURE 2-4

Water Source Type

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Carpinteria Valley Water District Service Area
- Delivery Point
- Reservoir
- South Coast Conduit for Cachuma Water and State Water
- Carpinteria Groundwater Basin

Water Source

- Groundwater and Imported Surface Water

All Other Features

- City Boundary
- County Boundary
- Montecito Groundwater Basin
- Railroad
- Major Road
- Watercourse
- Waterbody

NOTE
DWR: California Department of Water Resources

N

0 ½ 1
Miles

Date: November 20, 2023
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118

GSI Water Solutions, Inc.

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_2\Figure2-4_Water_Source_Type.mxd, npalmer

2.5.2 Water Resources Monitoring and Management Programs [§354.8(c) and (d)]

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

(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.

(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.

2.5.2.1 Groundwater Level Monitoring

Groundwater level monitoring has been conducted in the Basin since the early 1940s. In 1996, CVWD adopted a Groundwater Management Plan (GWMP) that includes collection and reporting of data on groundwater levels, production, and water quality. Under the GWMP, CVWD monitors 44 wells throughout the Basin including CVWD production wells, private production wells, and monitoring wells. Water level data are collected bimonthly from 25 to 28 of the wells in the monitoring network. These data are used to prepare hydrographs for 20 key representative wells and to create contour maps of basin-wide groundwater elevation conditions for the fall and spring periods of each water year.

In 2009, the California legislature passed Senate Bill X7-6, the California Statewide Groundwater Elevation Monitoring (CASGEM) Program, mandating that local agencies collect groundwater elevation data to track seasonal and long-term trends in groundwater elevations in groundwater basins statewide. CVWD is the designated monitoring entity for the Basin and monitors groundwater levels in 12 wells within the Basin under the CASGEM Program, some of which have groundwater level data dating back to the 1940s. The wells monitored include 10 observation wells and 2 inactive irrigation wells. Monitoring is generally conducted on a bimonthly basis. Many of the functions of the CASGEM Program will be replaced or subsumed by the GSAs under SGMA.

In 2019, CVWD implemented the Sentinel Well Project, installing a cluster of monitoring wells in the western portion of the Basin near the northwestern edge of the Carpinteria Salt Marsh. This location was selected to provide water level, water quality, and geophysical data (bulk conductivity via induction surveys) related to evaluating the potential for seawater intrusion.

Groundwater level data sources and representative monitoring sites are discussed further in Sections 3 and 5 of this Plan.

2.5.2.2 Groundwater Quality Monitoring

Groundwater quality is monitored under several programs by different entities in the Basin, including the following:

- Groundwater quality data are collected by CVWD in the fall and spring of each water year from 25 to 30 wells under the GWMP. Water samples are analyzed for total dissolved solids (TDS), chloride, and nitrate. Water quality samples are collected in the Sentinel Wells on a quarterly basis. Each Sentinel Well was also equipped with a probe to continuously measure and record electrical conductivity and temperature

data, but the transducers failed due to high pressure and a replacement solution has not yet been identified.

- CVWD monitors water quality in its municipal supply wells and develops annual water quality reports to comply with its water supply permits and California Safe Drinking Water requirements.
- The State Water Resources Control Board's (SWRCB's) Groundwater Ambient Monitoring and Assessment (GAMA) program compiles groundwater quality data from multiple sources and regulatory programs, such as the U.S. Geological Survey (USGS), Department of Pesticide Regulations, Irrigated Lands Regulatory Program (ILRP), and SWRCB Division of Drinking Water (DDW). This data is publicly available in the GeoTracker GAMA Program database.

Groundwater quality for drinking water and agricultural purposes is discussed in more detail in Section 3 of this Plan.

2.5.2.3 Surface Water Monitoring

The USGS measures streamflow in Carpinteria Creek at a gage located just downstream of the confluence with Gobernador Creek. Data from this gage (USGS Station 11119500) are available from 1941 to the present in the electronic National Water Information System (NWIS) files retrievable from the USGS Water Resources website. A new stream gage was installed in 2020 by DWR on Carpinteria Creek downstream of the Eighth Street/Calle Ocho footbridge. Gage data is retrievable from DWR's California Data Exchange Center web application.

USBR maintains data on water releases from Lake Cachuma's Bradbury Dam. Water from the State Water Project is conveyed via the Coastal Branch and Central Coast Water Authority Extension to Lake Cachuma, and from there through the Tecolote Tunnel to coastal water providers including CVWD.

Selected water quality data collected by USGS at the Carpinteria Creek stream gage site from 1979 through 1992 are available on the USGS website. The SWRCB's Surface Water Ambient Monitoring Program (SWAMP) currently monitors water quality at 12 sites in the Basin, and data can be accessed on the SWAMP Data Dashboard (https://gispublic.waterboards.ca.gov/swamp-data/) and through the U.S. Environmental Protection Agency's (EPA) "How's My Waterway?" web tool (https://mywaterway.epa.gov/).

2.5.2.4 Climate Monitoring

Climate data are available from two meteorological stations in the Basin monitored by the Santa Barbara County Flood Control District (SBCFCD): Carpinteria Fire Station (Station No. 208), located in downtown Carpinteria, and Carpinteria USFS (Station No. 383), located at Rincon Station in the Los Padres National Forest near the USGS stream gage on Carpinteria Creek. In addition to these stations, there are four weather stations near the Basin that are monitored by the County, one of which is located within CVWD's service area boundary. Table 2-2 displays information on the meteorological stations within and near the Basin.

Table 2-2. Meteorological Monitoring Stations

Station No.	Station Name	Beginning of Record	Location	Elevation (feet)	Period Average Precipitation (inches)
208	Carpinteria Fire Station	1949	Within Basin	30	17.13
383	Carpinteria USFS	1949	Within Basin	120	19.58
325	Montecito	1926	Outside Basin	135	19.65
328	Summerland	1971	Outside Basin	85	18.50
231	Doulton Tunnel	1932	Outside Basin	1,775	27.15
252	Edison Trail	1974	Outside Basin (Carpinteria Valley Water District service area)	1,700	24.68

The closest California Irrigation Management Information Center station is the Santa Barbara station (Station No. 107) located about 8 miles west of the Basin at the north end of the Santa Barbara Golf Club. This station measures several climatic factors that allow a calculation of daily reference evapotranspiration (ET) for the area since 1993.

2.5.2.5 Existing Water Resource Management Programs [§354.8(c) and (d)]

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

(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.

(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.

Existing water management plans in the Basin include the CVWD Urban Water Management Plan (UWMP), CVWD Agricultural Water Management Plan (AWMP), the CMWD UWMP, the Water Quality Control Plan for the Central Coast Basin, the Santa Barbara County IRWM Plan (Santa Barbara IRWM Plan), and the Watersheds Coalition of Ventura County (WCVC) IRWM Plan. In addition, the Santa Barbara County Groundwater Basins Summary Report provides monitoring data and further information about groundwater resources in the region.

CVWD Urban Water Management Plan

The UWMP Act requires urban water suppliers to compare the total projected demand for water supply with the amount of water supply that is available over the next 20 years, in 5-year increments. The CVWD UWMP was updated in 2020 and describes CVWD's facilities and service area, available water supplies, water

demands, water reliability, and water shortage contingency plans. The UWMP includes CVWD's Groundwater Management Plan, originally developed in 1996, as an appendix. As described in the UWMP, the Groundwater Management Plan will be superseded by this Plan, so it will not limit operational flexibility in the Basin. All groundwater level and water quality monitoring activities described in this Plan are consistent with the UWMP.

CVWD Agricultural Water Management Plan

The CVWD AWMP was prepared in 2016 to comply with the California Agricultural Water Management Planning Act's requirements for agricultural water suppliers. The AWMP describes CVWD's service area, agricultural water demands, water supplies, water supply reliability, and water demand management (conservation) activities.

CMWD Urban Water Management Plan

CMWD prepared its UWMP in 2020 for its service area in western Ventura County, including the portion of the Basin in Ventura County where the district provides retail water supply services. The UWMP describes the service area, coordination of wholesale and retail water service, water supplies, water demands, water reliability, and strategies for managing risks and potential water shortages. CMWD's groundwater supply wells and surface water sources are not located within the Basin. CMWD imports surface water into the Basin from the adjacent Ventura River Watershed.

Water Quality Control Plan for the Central Coast Basin – Planning Elements

The Water Quality Control Plan for the Central Coastal Basin (WQ Basin Plan) (RWQCB et al., 2017) provides management strategies to ensure that surface water and groundwater in the Central Coast Region are managed to provide the highest possible quality. The WQ Basin Plan includes the following elements:

- The water quality standards that must be maintained for all the water uses in the region
- An implementation plan that describes the programs, projections, and other actions necessary to achieve the water quality standards
- The existing plans and policies of the SWRCB and the Regional Water Quality Control Board (RWQCB) that protect water quality
- A description of the monitoring and surveillance programs to support ensuring management of surface and groundwater

The WQ Basin Plan includes recommended actions, requirements, and management principles, including salt source control, to ensure high-quality surface water and groundwater for all beneficial uses. The present and potential future beneficial uses for inland waters listed in the WQ Basin Plan include surface water and groundwater as municipal supply (water for community, military, or individual water supplies); agricultural purposes; groundwater recharge; recreational water contact and non-contact; sport fishing; warm freshwater habitat; wildlife habitat; rare, threatened or endangered species; and spawning, reproduction, and/or early development of fish.

The WQ Basin Plan also describes the existing regulatory monitoring and assessment of point sources of pollution and a program to control nonpoint sources of pollution; the GAMA program to assess groundwater quality; the Central Coast Ambient Monitoring Program; and the available state, federal, and regional assessments of water quality (see Section 2.2.2.6 for more on the water quality measures outlined in the WQ Basin Plan).

Santa Barbara County Integrated Regional Water Management Plan

The Santa Barbara IRWM Plan (Dudek, 2019), updated in 2019, provides guidance for integrating water management across the Santa Barbara region, which includes the portion of the Basin within Santa Barbara County. The Santa Barbara IRWM Plan was updated through a 2-year process that included a broad array of stakeholders and objectives, priorities, and resource management strategies were revisited to respond to the changing conditions in the region, including increasing vulnerabilities from climate change, and in response to new state-mandated requirements, including SGMA regulations.

The Santa Barbara IRWM Plan integrated 34 selected water management strategies and considered and included an additional eight strategies for the region. The strategies included in the Santa Barbara IRWM Plan have or will have a role in protecting the region's water supply reliability, water quality, ecosystems, groundwater, and flood management objectives. The integration of these strategies resulted in a list of action items (projects, programs, and studies) needed to implement the Santa Barbara IRWM Plan over the 25-year planning horizon.

WCVC Integrated Regional Water Management Plan

The WCVC IRWM Plan (WCVC, 2019), updated in 2019, addresses region-wide water management issues for the Ventura region, including the portion of the Basin in Ventura County. The WCVC IRWM Plan supports the development and implementation of individual watershed management plans for major watersheds in the region, including the Ventura River watershed, which partially overlaps with the Basin. This plan integrates 32 resource management strategies and describes current and future plans for implementation.

Santa Barbara County Groundwater Basins Summary Report

The 2021 Santa Barbara County Groundwater Basins Summary Report (Groundwater Report) (Santa Barbara County, 2021) describes the conditions of groundwater and groundwater basins in Santa Barbara County. The Groundwater Report provides data from state and federal monitoring for water quantity and quality following the local drought emergency that lasted from 2014 to 2019. For each basin in the County, the report describes basin characteristics and status, provides groundwater levels and hydrographs for selected wells, and discusses developments in supplemental supplies and basin management plans.

2.5.2.6 Existing Groundwater Regulatory Programs

Agricultural Orders

In 2017, the Central Coast RWQCB issued Agricultural Order No. R3-2017-0002, a Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (RWQCB, 2017). The order required that growers implement practices to reduce nitrate leaching into groundwater and improve surface receiving water quality. Specific requirements for individual growers were structured into three tiers based on the relative risk their operations posed to water quality. Growers were required to enroll, pay fees, and meet various monitoring and reporting requirements according to the tier to which they were assigned. All growers were required to implement groundwater monitoring, either individually or as part of a cooperative regional monitoring program. Growers that elected to implement individual monitoring (i.e., did not participate in the regional monitoring program) were required to test all on-farm domestic wells and the primary irrigation supply well for nitrate or nitrate plus nitrite, and general minerals, including, but not limited to, total dissolved solids, sodium, chloride, and sulfate.

The Central Coast RWQCB adopted Agricultural Order No. R3-2021-0040 on April 15, 2021 (RWQCB, 2021). The updated Agricultural Order No. R3-2021-0040 has more frequent groundwater monitoring requirements than Agricultural Order No. R3-2017-0002. Beginning in 2022, all growers must conduct annual sampling of

all on-farm domestic drinking water supply wells and the primary irrigation wells between March 1 and May 31. Growers must report monitoring results by July 31 each year. Additionally, groundwater trend monitoring is required under the updated Agricultural Order No. R3-2021-0040. All growers are required to implement groundwater trend monitoring work plans either individually or as part of a cooperative regional monitoring program. Work plans for groundwater trend monitoring must be submitted by a date dependent on the phase area.

Title 22 Drinking Water Program

The DDW regulates public water systems in the state to ensure the delivery of safe drinking water to the public. A public water system is defined as a system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. Private domestic wells, wells associated with drinking water systems with less than 15 residential service connections, and industrial and irrigation wells are not regulated by the DDW.

The County of Santa Barbara has primacy and regulates state small water systems as defined in Chapter 34B Domestic Water Systems (Ordinance No. 12-4843). The DDW enforces the monitoring requirements established in Title 22 of the CCR for public water system wells, and all the data collected must be reported to the DDW. Title 22 also designates the regulatory limits (known as maximum contaminant levels) for various waterborne contaminants, including volatile organic compounds, non-volatile synthetic organic compounds, inorganic chemicals, radionuclides, disinfection byproducts, general physical constituents, and other parameters.

Water Quality Control Plan for the Central Coast Basin – Water Quality Requirements

The pollution control actions required by, and best management practices (BMPs) recommended by, the SWRCB and the RWQCB are described in the Basin Plan (RWQCB et al., 2017). The plans and policies of the SWRCB for managing water quality are listed in Section 5 and included as appendices to the Basin Plan. Key policies that affect the management of surface water and groundwater in the Basin include the State Policy for Water Quality Control, Sources of Drinking Water Policy, and the Nonpoint Source Management Plan. Discharge prohibitions outlined in the Basin Plan include regulations for groundwaters, salt discharge, and other discharge requirements. BMPs recommended in the Basin Plan include source controls that prevent a discharge or threatened discharge and treatment controls that remove pollutants from a discharge before it reaches surface water or groundwater. The Basin Plan also lists the thresholds for Total Maximum Daily Loads (TMDLs) for water bodies covered by the plan. A TMDL for nitrogen and phosphorus compounds in the Franklin Creek watershed was developed by the RWQCB in 2018 and approved by the EPA in 2019. In the Arroyo Paredon watershed, a TMDL for diazinon and additive toxicity with chlorpyrifos was approved in 2013, and a TMDL for nitrate was approved in 2014.

2.5.2.7 Conjunctive Use Programs [§354.8(e)]

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

(e) A description of conjunctive use programs in the basin.

In accordance with CVWD's Groundwater Management Plan, developed to comply with AB 3030 requirements, CVWD has managed its groundwater sources in conjunction with its allocation of SWP water and water from the Cachuma Project to optimize long-term sustainability in the Basin. Details on water sources and historical, current, and projected water budgets are available in Section 3 of this Plan.

2.5.3 Land Use/General Plans

2.5.3.1 Land Use and General Plans Summary [§354.8(f)(1),(f)(2), and (f)(3)]

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

(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) 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.

(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.

Land use planning authority in the Basin is the responsibility of Santa Barbara County, Ventura County, and the City of Carpinteria. The Santa Barbara County Comprehensive Plan includes the following elements that have a bearing on water quantity or quality:

- A land use element that outlines the distribution of real estate, open space and agricultural land, mineral resources, recreational facilities, schools, and waste facilities
- A conservation element[1] that addresses the conservation, development, and use of natural resources including water, forests, soils, rivers, and mineral deposits
- Community and specific plans for municipalities and more urban areas to provide goals, policies, and standards to guide community development

[1] Various studies indicate slight to moderate levels of overdraft in several groundwater basins within the County and substantial overdraft in one basin (Santa Barbara County, 2012). The goals and policies in the Santa Barbara County Comprehensive Plan, Conservation Element, Groundwater Resources Section were developed to protect local groundwater.

- An open space element that details plans and measures for preserving open space for natural resources, outdoor recreation, public health and safety, and agriculture.

The Ventura County 2040 General Plan includes the following chapters that may impact water quantity or quality:

- A land use and community character element that establishes land use designations identifying the type and intensity of uses in unincorporated areas, along with goals and policies for future change, development, and natural resource protection
- A public facilities, services, and infrastructure element that describes policies related to wastewater treatment and flood control and drainage facilities
- A conservation and open space element that addresses the conservation and development of natural resources, including policies related to saltwater intrusion
- A water resources element that discusses water supply, water quality, conservation and reuse, watershed management, and groundwater sustainability.

The City of Carpinteria's General Plan/Local Coastal Use Plan (General Plan) was updated in 2003 and includes several elements related to water resources:

- A land use element establishing the type and intensity of land uses within the city to guide growth and development
- An open space, recreation, and conservation element that describes local water resources and outlines policies to protect them.

In 2019 the Santa Barbara County Board of Supervisors limited cannabis cultivation in the unincorporated areas of the County within the Carpinteria Agricultural Overlay District to no more than 186 acres of cannabis cultivation, nurseries, and microbusinesses with cultivation (Santa Barbara County Code § 50-7) and added a required special land use permit. The Carpinteria Agricultural Overlay District encompasses nearly all lands zoned for agricultural use within the Basin. As of 2020 in Ventura County, the cultivation of cannabis in pre-existing greenhouses and other indoor structures on lands zoned for agricultural, industrial, or commercial use is generally permitted with a required special business license, provided the premises are more than 1,200 feet away from specified sensitive land uses.

2.5.3.2 How Land Use Plans May Impact Water Demands and Sustainable Groundwater Management

The Santa Barbara County Comprehensive Plan includes goals, principles, and policies aligned with sustainable groundwater management. In particular, the Groundwater Resources Section of the plan's Conservation Element outlines four major goals that are compatible with sustainable management objectives under SGMA. These goals are:

- Goal 1: To ensure adequate quality and quantity of groundwater for present and future County residents, and to eliminate prolonged overdraft of any groundwater basins.
- Goal 2: To improve existing groundwater quality, where feasible, and to preclude further permanent or long-term degradation in groundwater quality.
- Goal 3: To coordinate County land use planning decisions and water resources planning and supply availability.
- Goal 4: To maintain accurate and current information on groundwater conditions throughout the County.

As a county-wide document, the Comprehensive Plan does not make specific policy recommendations for the Basin. Nonetheless, the overarching policies and strategies in the plan promote water conservation, coordinated decision making around land use and water resources, groundwater recharge, and prevention of prolonged overdraft, all of which are consistent with the sustainable groundwater management objectives of this Plan.

Similarly, the water element of the Ventura County General Plan sets a goal that is compatible with sustainable groundwater management under SGMA:

- Goal WR-4: To maintain and restore the chemical, physical, and biological integrity and quantity of groundwater resources.

The Ventura County General Plan does not make specific policy recommendations for the Basin, but its strategies and principles apply throughout the County, including within the Ventura portion of the Basin. Among others, these policies direct Ventura County to work with GSAs in support of SGMA implementation and groundwater management, to identify important groundwater recharge area protections needed, and to support groundwater recharge projects.

The City of Carpinteria General Plan sets objectives and policies supporting sustainable groundwater management, including water conservation measures, protection of water quality in groundwater basins, and working with CVWD to implement the Groundwater Management Plan, which will be superseded by this Plan.

2.5.3.3 How Sustainable Groundwater Management May Affect Water Supply Assumptions

As described above, the sustainable groundwater management focus of this Plan is well-aligned with the goals and policies in the Santa Barbara County Comprehensive Plan, Ventura County General Plan, and Carpinteria General Plan. Local land use policies regarding coordination of land use planning with water resources planning may present opportunities to include groundwater sustainability data in decision making. Data collected during the development and implementation of this Plan may be used to refine water supply assumptions and support sustainability. Historical, current, and projected groundwater budgets are presented in Section 3 of this Plan. Groundwater budget components include natural and anthropogenic sources of recharge and discharge from the Basin. Projects and management actions contemplated by the Carpinteria GSA to mitigate water supply deficit or future drought conditions are discussed in Section 6 of this Plan.

2.5.3.4 Well Permitting [§354.8(f)(4), §354.8(a)5)]

§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:

(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.

(f) A plain language description of the land use elements or topic categories of applicable general plans that includes the following:

(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.

Within the Santa Barbara portion of the Basin, the Santa Barbara County Public Health Department's Environmental Health Services Division requires a Water Well Permit for all new and replacement wells and for modifications to wells, such as deepening, replacement or repairs. A permit application and map must be submitted describing the proposed location, construction, and intended use of the well. An Environmental Health Services representative reviews the application and conducts a site inspection before issuance of a permit can occur. Standards for well construction are set forth in Santa Barbara County Code § 34A-12. Once the well construction or replacement is completed, the property owner or well driller must provide a copy of the completed well log to Environmental Health Services.

In the Ventura portion of the Basin, the Ventura County Public Works Agency's Groundwater Section requires a Well Permit for new and replacement wells and modifications to existing wells. A permit application and map must be submitted describing the proposed location, construction, and intended use of the well. Standards for well construction are set forth in Ventura County Water Well Standards Bulletin No. 74-9. All new wells, other than those for de minimus extractors, are required to be equipped with a flowmeter. After well construction or modification is completed, the licensed water well contractor who completed the work must provide a well completion report to the Ventura County Public Works Agency.

Well types in the Basin include domestic, public supply, and agricultural wells. Figures 2-5, 2-6, and 2-7 present the number and density of these well types in the Basin. Well data were retrieved from the DWR Well Completion Report Database, via the SGMA Data Viewer Web Application (https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer). This database contains the locations and construction details for newly constructed, modified, or destroyed wells in California. DWR categorizes wells as domestic, production, or public supply, among other usage types. The majority of well completion reports have been spatially registered to the center of the 1 x 1 mile Public Land Survey System section that the well is located in.

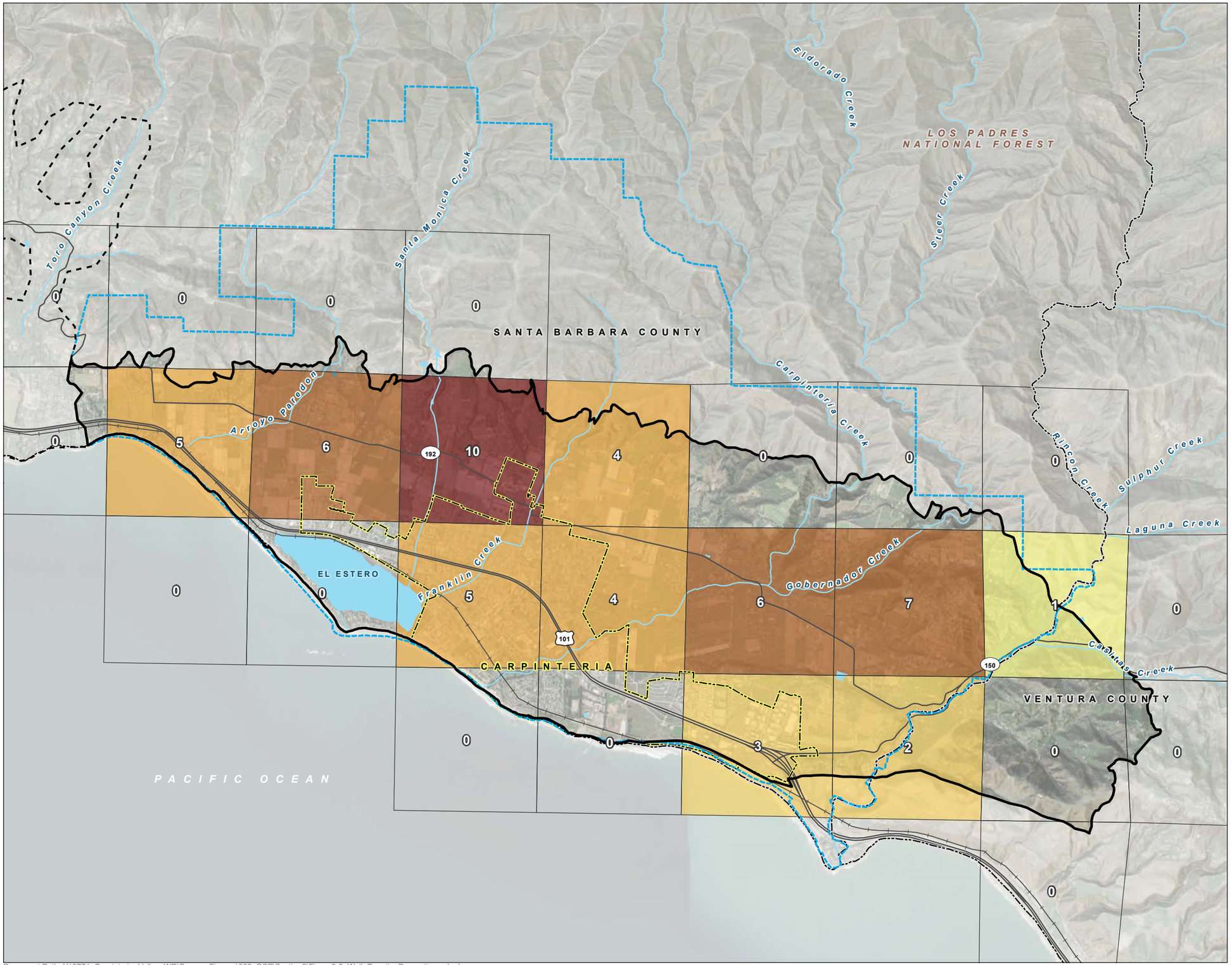


FIGURE 2-5

Well Density by Section (Domestic Wells)

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Carpinteria Valley Water District Service Area
- Carpinteria Groundwater Basin
- Section

Domestic Well Count by Section

- 1
- 2 - 3
- 4 - 5
- 6 - 7
- 8 - 10

All Other Features

- City Boundary
- County Boundary
- Montecito Groundwater Basin
- Railroad
- Major Road
- Watercourse
- Waterbody

NOTE
DWR: California Department of Water Resources

N

0 ½ 1
Miles

Date: September 12, 2022
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118, CA.gov

GSI Water Solutions, Inc.

Document Path: Y:\0771_Carpinteria_Valley_WD\Source_Figures\002_GSP\Section2\Figure2-5_Well_Density_Domestic.mxd, abarry

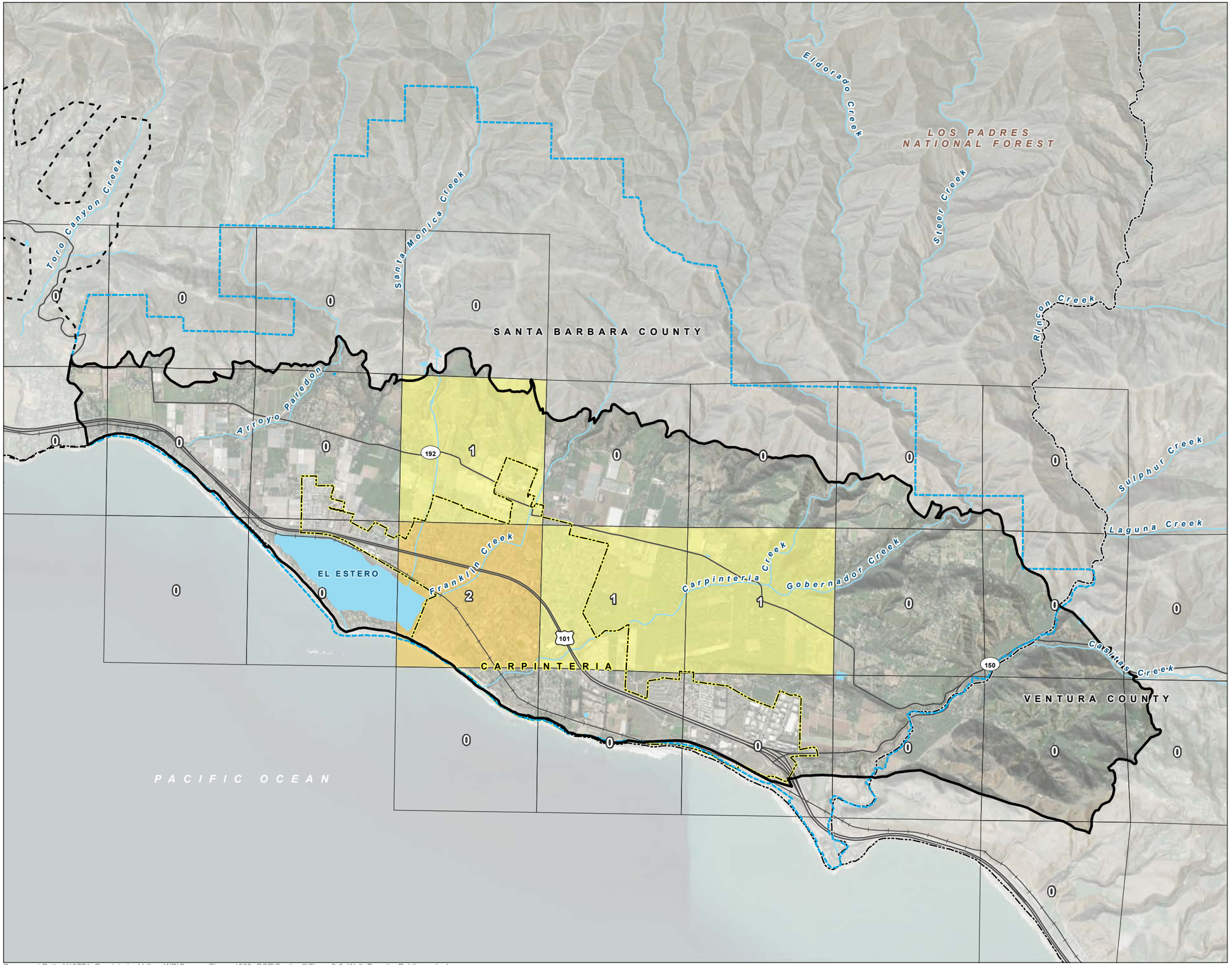


FIGURE 2-6

Well Density by Section (Public Wells)

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Carpinteria Valley Water District Service Area
- Carpinteria Groundwater Basin
- Section

Public Well Count by Section

- 1
- 2 - 3
- 4 - 5
- 6 - 7
- 8 - 10

All Other Features

- City Boundary
- County Boundary
- Montecito Groundwater Basin
- Railroad
- Major Road
- Watercourse
- Waterbody

NOTE
DWR: California Department of Water Resources

N

0 ½ 1
Miles

Date: September 12, 2022
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118, CA.gov

GSI Water Solutions, Inc.

Document Path: Y:\0771_Carpinteria_Valley_WD\Source_Figures\002_GSP\Section2\Figure2-6_Well_Density_Public.mxd, abarry

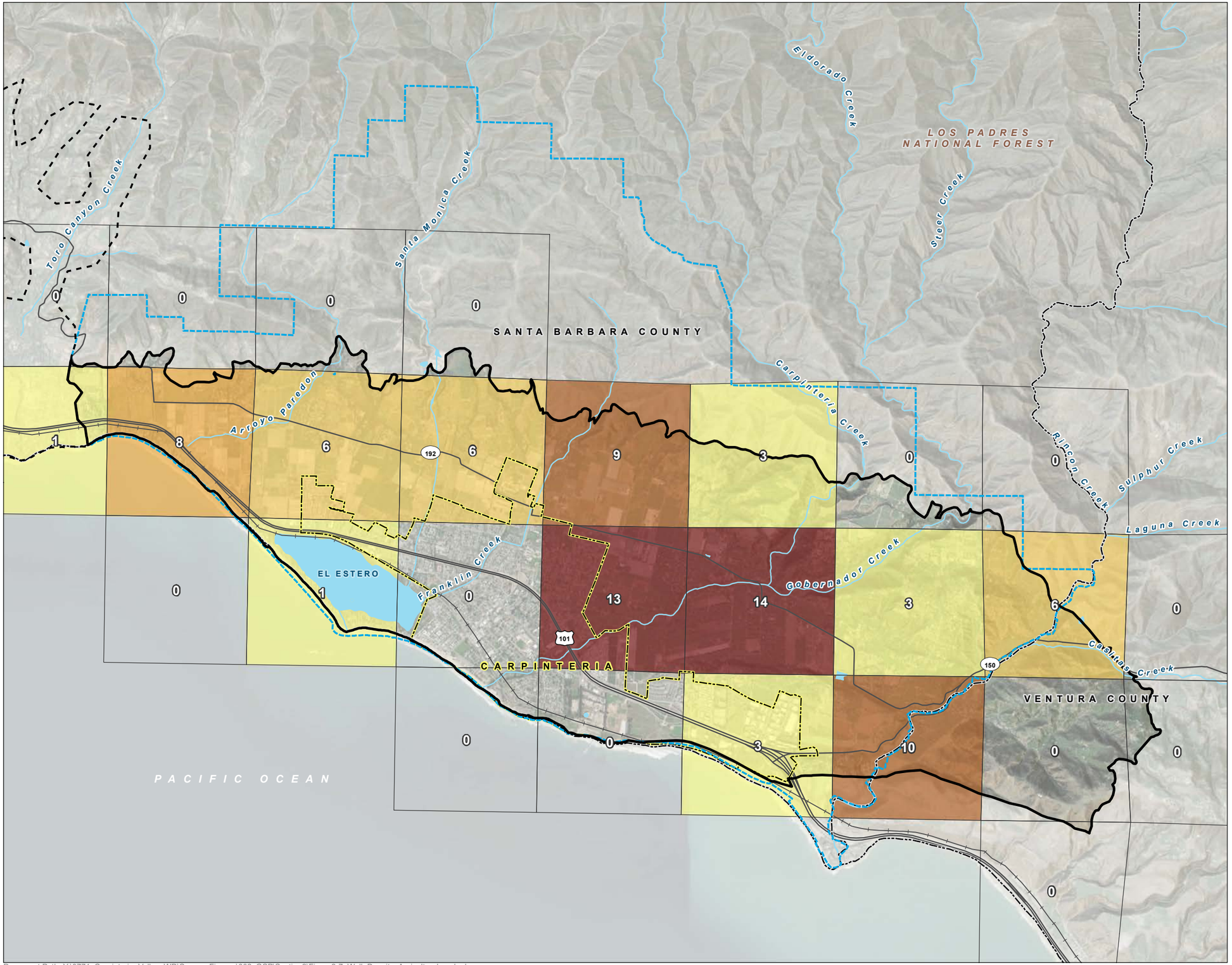


FIGURE 2-7

Well Density by Section (Agricultural Wells)

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Carpinteria Valley Water District Service Area
- Carpinteria Groundwater Basin
- Section

Agricultural Well Count by Section

- 1 - 3
- 4 - 6
- 7 - 8
- 9 - 10
- 11 - 14

All Other Features

- City Boundary
- County Boundary
- Montecito Groundwater Basin
- Railroad
- Major Road
- Watercourse
- Waterbody

NOTE
DWR: California Department of Water Resources

N

0 ½ 1
Miles

Date: September 12, 2022
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118, CA.gov

GSI Water Solutions, Inc.

Document Path: Y:\0771_Carpinteria_Valley_WD\Source_Figures\002_GSP\Section2\Figure2-7_Well_Density_Agricultural.mxd, abarry

The Well Completion Report Database contains over 600 entries for wells within the Basin. Many of these entries represent well abandonments, modifications, or test hole borings for which wells were not constructed. There are often duplicate entries for wells due to the existence of multiple well-naming conventions. To the extent possible, the dataset was filtered to remove duplicate entries and identify unique subsets of domestic, irrigation, and public supply wells. Database entries which lacked an accompanying well completion report and for which no usage data were available were excluded. The location and status (active, inactive, destroyed) of the wells shown on the maps have not been verified.

2.5.3.5 Impact of Land Use Plans Outside of Basin on Sustainable Groundwater Management [§354.8(f)(5)]

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

(f) A plain language description of the land use elements or topic categories of applicable general plans that includes the following:

(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.

The Santa Barbara County Comprehensive Plan and Ventura County General Plan described previously apply throughout their respective counties and are not specific to the Basin. Implementation of these two county plans is anticipated to be complementary to implementation of this Plan and achievement of sustainable groundwater management. The Carpinteria GSA is not aware of any other land use plans outside the Basin that would limit progress toward sustainability or prevent sustainable groundwater management.

2.5.4 Additional Plan Elements [§354.8(g)]

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

(g) A description of any of the additional Plan elements included in Water Code Section 10727.4 that the Agency determines to be appropriate.

Additional Plan elements from California Water Code § 10727.4 are shown in Table 2-3 below along with a description of how they are addressed in the Plan, coordinated with other entities, or are not applicable to the Basin.

Table 2-3. Plan Elements from California Water Code Section 10727.4

Element	Location
(a) Control of saline water intrusion	Section 3.2.3, Seawater Intrusion, and Section 4, Monitoring Networks
(b) Wellhead protection areas and recharge areas	To be coordinated with Santa Barbara County and Ventura County
(c) Migration of contaminated groundwater	Section 3, Basin Setting, and Section 4, Monitoring Networks
(d) A well abandonment and well destruction program	To be coordinated with Santa Barbara County and Ventura County
(e) Replenishment of groundwater extractions	Section 6, Projects and Management Actions
(f) Activities implementing, opportunities for, and removing impediments to, conjunctive use or underground storage	Section 6, Projects and Management Actions
(g) Well construction policies	To be coordinated with Santa Barbara County and Ventura County
(h) Measures addressing groundwater contamination cleanup, groundwater recharge, in-lieu use, diversions to storage, conservation, water recycling, conveyance, and extraction projects	Section 6, Projects and Management Actions
(i) Efficient water management practices, as defined in Section 10902, for the delivery of water and water conservation methods to improve the efficiency of water use	To be coordinated with Carpinteria Valley Water District and other entities as applicable
(j) Efforts to develop relationships with state and federal regulatory agencies	Section 6, Projects and Management Actions
(k) Processes to review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity	To be coordinated with Santa Barbara County, Ventura County, and City of Carpinteria
(l) Impacts on groundwater dependent ecosystems	Section 3, Basin Setting, and Section 3.2.7, Groundwater Dependent Ecosystems

2.6 Notice and Communication [§354.10]

2.6.1 Beneficial Uses and Users [§354.10(a)]

§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.

The Carpinteria GSA has engaged stakeholders in consultation since its formation, starting with public meetings during development of the JPA Agreement forming the GSA. A contact list for interested parties was developed through this process, and the Carpinteria GSA has continued seeking broad engagement in management of the Basin's groundwater resources during development of this Plan. Beneficial uses and users identified in the Basin and invited to participate in development and implementation of the Plan include:

- Holders of overlying groundwater rights, including:
  - Agricultural users. There are agricultural users of groundwater operating on land overlying the Basin. The Carpinteria GSA anticipates that the Plan will address the collective interests of agricultural users of groundwater wells and will continue to engage in outreach to them throughout the development and implementation of the Plan through inviting their participation in the GSA's public meetings.
  - Domestic well owners. There are domestic wells overlying the Basin. The majority of these domestic well owners are likely to be de minimus users, as defined by SGMA. The Carpinteria GSA anticipates that the Plan will address the collective interests of domestic users of groundwater wells and plans to continue to engage in outreach to them throughout the development and implementation of the Plan through inviting their participation in the GSA's public meetings.
- Municipal well operators. The Carpinteria GSA is a joint powers authority created by four local public agencies. One of the GSA's signatory members, CVWD, owns and operates municipal wells in the Basin. The City of Carpinteria also owns wells, which are used for landscape irrigation.
- Public water systems. CVWD is a public water system located within the Basin and is a signatory member to the JPA Agreement. CMWD is a public water system serving the Ventura County portion of the Basin and will be invited to participate in the GSA's public meetings.
- Local land use planning agencies. The County of Santa Barbara, County of Ventura, and City of Carpinteria have land use planning authority on land overlying the Basin. All three agencies are signatory members to the JPA Agreement forming the Carpinteria GSA. Santa Barbara County is represented via the Santa Barbara County Water Agency.
- Environmental users of groundwater. The Carpinteria GSA will assess whether any environmental users of groundwater exist within the Basin and will reach out to appropriate resource agencies if any are identified. The Carpinteria GSA will conduct outreach to environmental organizations within the Basin and will consider environmental interests throughout development of the Plan by inviting their participation in the GSA's public meetings.

- Surface water users, if there is a hydrologic connection between surface and groundwater bodies. Three potential surface water diversions within the Basin were identified on the State Water Resources Control Board Electronic Water Rights Information Management System. These users will be reached out to if a hydrologic connection between surface water and groundwater is determined to exist near the points of diversion.
- Federal government, including, but not limited to, the military and managers of federal lands. Portions of the Basin lie within the Los Padres National Forest. The Carpinteria GSA will reach out to the United States Department of Agriculture.
- California Native American Tribes. The Carpinteria GSA will ensure that a representative of overlying California Native American tribes is on the GSA's interested parties list, in order to receive notices of all public meetings and other stakeholder involvement opportunities.
- Disadvantaged Communities (DACs), including, but not limited to those served by private domestic wells or small community water systems. DACs located within the Basin are served by CVWD, a JPA member, and by CMWD. CVWD will assist the Carpinteria GSA with DAC outreach and engagement.
- Entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of the groundwater basin managed by the GSA. CVWD is the designated CASGEM entity for the Basin. CVWD is a JPA member.

Based on several datasets, two DACs were identified in the Basin. DWR's DACs online mapping tool shows the Ventura County portion of the Basin and one census block group in the City of Carpinteria as DACs (DWR, 2022). The CMWD's UWMP shows the Ventura County portion of the Basin as a DAC (CMWD, 2021).

SECTION 3:

Basin Setting

SECTION 3: **Basin Setting [Article 5, Subarticle 2]**

§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.

This section describes the basin setting based on existing studies related to the geology, climate, historical groundwater and surface water conditions. The purpose of this section is to provide an overview of what is currently know about the general physical characteristics related to regional hydrology, land use, geology and geologic structure, water quality, and principal aquifers and aquitards in the Basin.

3.1 Hydrogeologic Conceptual Model [§354.14]

§354.14 Hydrogeological 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.

The hydrogeology of the Basin has been studied extensively over the last 70 years. The most significant reports include:

- Upson, J.E. and H.G. Thomasson. 1951. *Geology and Ground-Water Resources of the South-Coast Basins of Santa Barbara County, California*. U.S. Geological Survey Water Supply Paper 1108.
- Lian, H.M. 1952. The Geology and Paleontology of the Carpinteria District, Santa Barbara, California. unpublished Ph. D. dissertation, University of California at Los Angeles.
- Evenson, R.E., H.D. Wilson, Jr., and K.S. Muir. 1962. *Yield of the Carpinteria and Goleta Ground Water Basins, Santa Barbara County, California, 1941 – 58*. U.S. Geological Survey Open-File Report.
- Slade, R.C. 1975. Hydrogeologic Investigation of the Carpinteria Ground Water Basin, unpublished M.A. Thesis, University of Southern California.
- Geotechnical Consultants, Inc. 1976. *Hydrogeologic Investigation of Carpinteria Ground Water Basin*. Prepared for Carpinteria County Water District.
- Geotechnical Consultants, Inc. 1986. *Hydrogeologic Update, Carpinteria Groundwater Basin*. Prepared for Carpinteria County Water District.
- Sullwold, H.H. 1996. *Carpinteria Groundwater Basin, A Geological Up-date*. Prepared for Carpinteria Valley Water District.
- Pueblo Water Resources, Inc. 2012. *Carpinteria Groundwater Basin, Hydrogeologic Update and Groundwater Model Project*. Prepared for Carpinteria Valley Water District.

These documents describe the stratigraphy, structure, and hydraulic characteristics of the Basin. Taken together, they also document the evolution of the understanding of the hydrogeology of the Basin. The Hydrogeologic Conceptual Model (HCM) of the Basin was initially developed by Geotechnical Consultants, Inc. (GTC) and is documented in their 1976 report. The 1976 GTC report is the most comprehensive report on the Basin, and it built upon the previous work regarding the basin structure and hydraulic parameters to include a detailed analysis of the water budget for the Basin. Sullwold (1996) later refined the structural and hydrostratigraphic delineations of the Basin, taking into consideration water and oil wells drilled after 1975.

Most recently, Pueblo Water Resources, Inc. (PWR) (2012) performed an update of the hydrogeologic conditions within the Basin. Since the 1976 GTC report was published, significant additional information had been developed. In particular, the CVWD had constructed, tested, and operated several high-capacity municipal production wells in the Basin, and had implemented basin-wide water level, water quality, and production data collection programs pursuant to the AB3030 Groundwater Management Plan. PWR (2012) also updated the water budget for the Basin since the last time it was updated by GTC in 1986. The 2012 hydrogeologic update formed the basis for the development and calibration of the existing three-dimensional MODFLOW groundwater model of the Basin (see Appendix F).

This section presents a current description of the HCM of the Basin and is based largely on a compilation and synthesis of information from the sources listed above.

3.1.1 Regional Hydrology

3.1.1.1 Topography and Watershed Boundary [§354.14(d)(1)]

§354.14 Hydrogeological Conceptual Model.

(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.

The Basin consists of a low-lying alluvial plain that is physically bordered on the south by the Pacific Ocean and on the north and east by bedrock. The western boundary is an administrative boundary with the Montecito Groundwater Basin (MGB). As originally described by Upson and Thomasson (1951), the watershed area of the Basin can be broadly categorized into three main parts: 1) a mountainous headwaters area, the principal area of surface water runoff; 2) the marginal part of the groundwater basin, the principal area of groundwater recharge; and 3) the central alluvial valley, which is underlain by low permeability deposits near the surface and constitute an area of confined groundwater conditions. A USGS topographic map of the basin area is shown in Figure 3-1. As shown, the Basin is approximately 7 miles long in an east-west direction and extends northward from the coastline a maximum of about 2 miles. The lowest ground surface elevations occur in El Estero, an active intertidal salt marsh west of the City of Carpinteria. From this area, the topography gradually rises northward to elevations of up to approximately 650 feet above sea level along the northern and eastern boundaries of the Basin. North of the basin boundary are the foothills of the Santa Ynez Mountains. The area of the contributing watersheds to the Basin are presented on Figure 3-2.

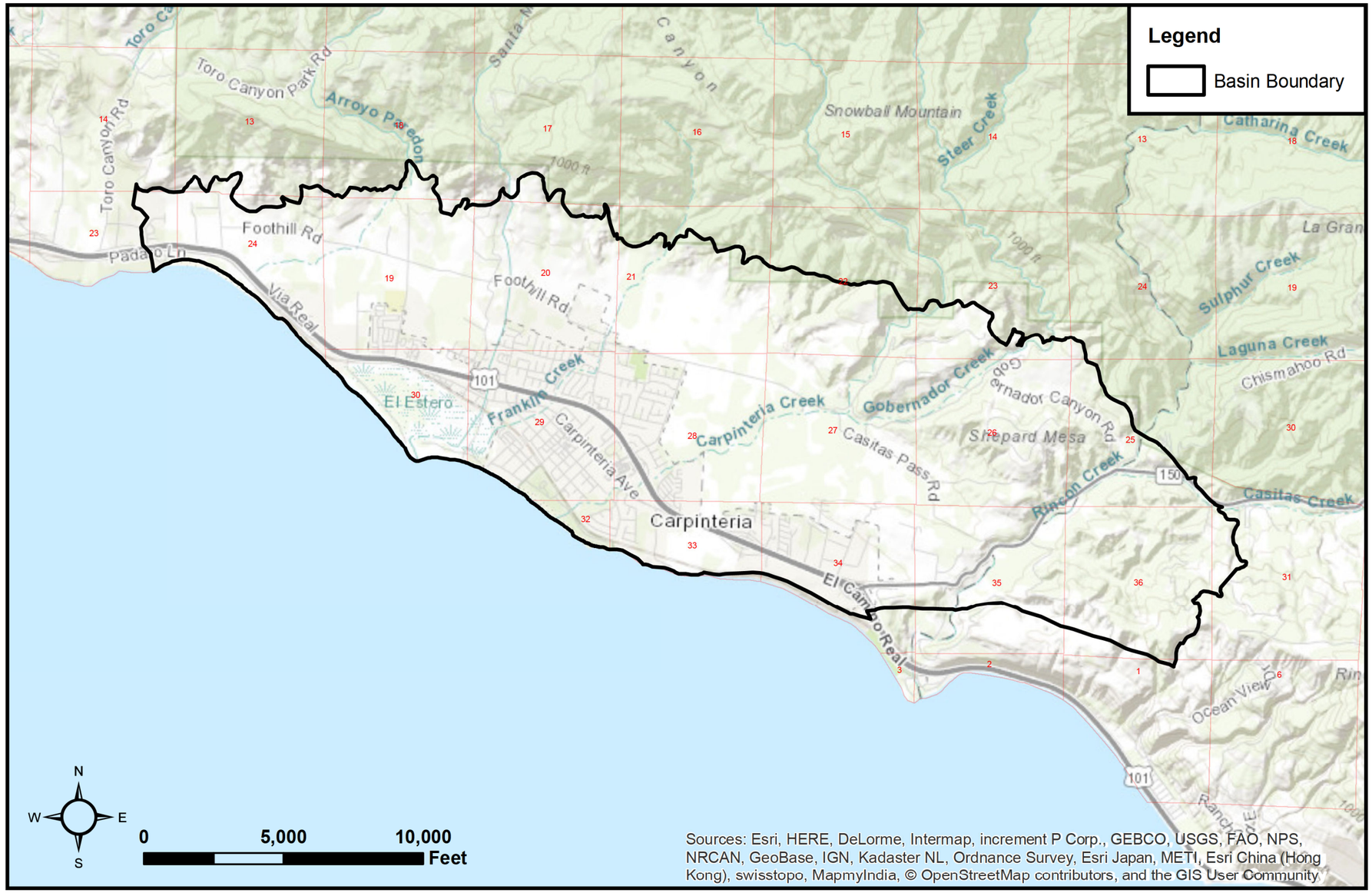


FIGURE 3-1

USGS Topographic Map

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

LEGEND

- Surface Water Sampling Location
- USGS Stream Gage
- Carpinteria Groundwater Basin
- Watershed Boundary
- County Boundary
- Railroad
- Major Road
- Watercourse

FIGURE 3-2

Creek Location Map and Contributing Watershed Areas

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

N

0 2,300 4,600 6,900
feet

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3\Figure3-2_GW_Basins.mxd, iramos

As is typical of the entire southern and central coast of California, the Carpinteria Basin has undergone continuous and significant growth in population since early state settlement, with attendant changes in land use and water resources development. Figure 3-3 presents a historical map of the Carpinteria Basin area circa 1869 alongside a recent air photo of the Basin. These figures demonstrate the significant historical changes in land use and the underlying hydrology over the past 150 years. Some of the significant changes apparent in the comparison of these figures include the following. The area occupied by the El Estero Salt Marsh extends significantly farther to the southwest in 1869, nearly to Carpinteria Creek; much of that area has been reclaimed and is now used primarily as residential land within the City of Carpinteria boundaries. Orchards and agriculture are evident in the historical map and are obviously greatly expanded in the present day. Low lying areas along Carpinteria Creek and other creeks that are represented as marshy areas associated with overbank flood deposits and shallow groundwater have also been filled in and converted to residential use, with some of the former marsh areas used for agriculture. The dune system near Sand Point that is evident in the historical map has now been reclaimed for beachfront residential properties. The filling, reclamation, and redevelopment of dune and marsh coastal areas is significant; the historical development of the Basin has altered the stream drainage network in areas near the coast. As is discussed in later sections of this Groundwater Sustainability Plan (GSP), much of the growth and development in the Basin was made possible by development of groundwater resources within the Basin, resulting in changes from historical hydrogeologic conditions.

3.1.1.2 Surface Water Bodies [§354.14(d)(5)]

§354.14 Hydrogeological Conceptual Model.

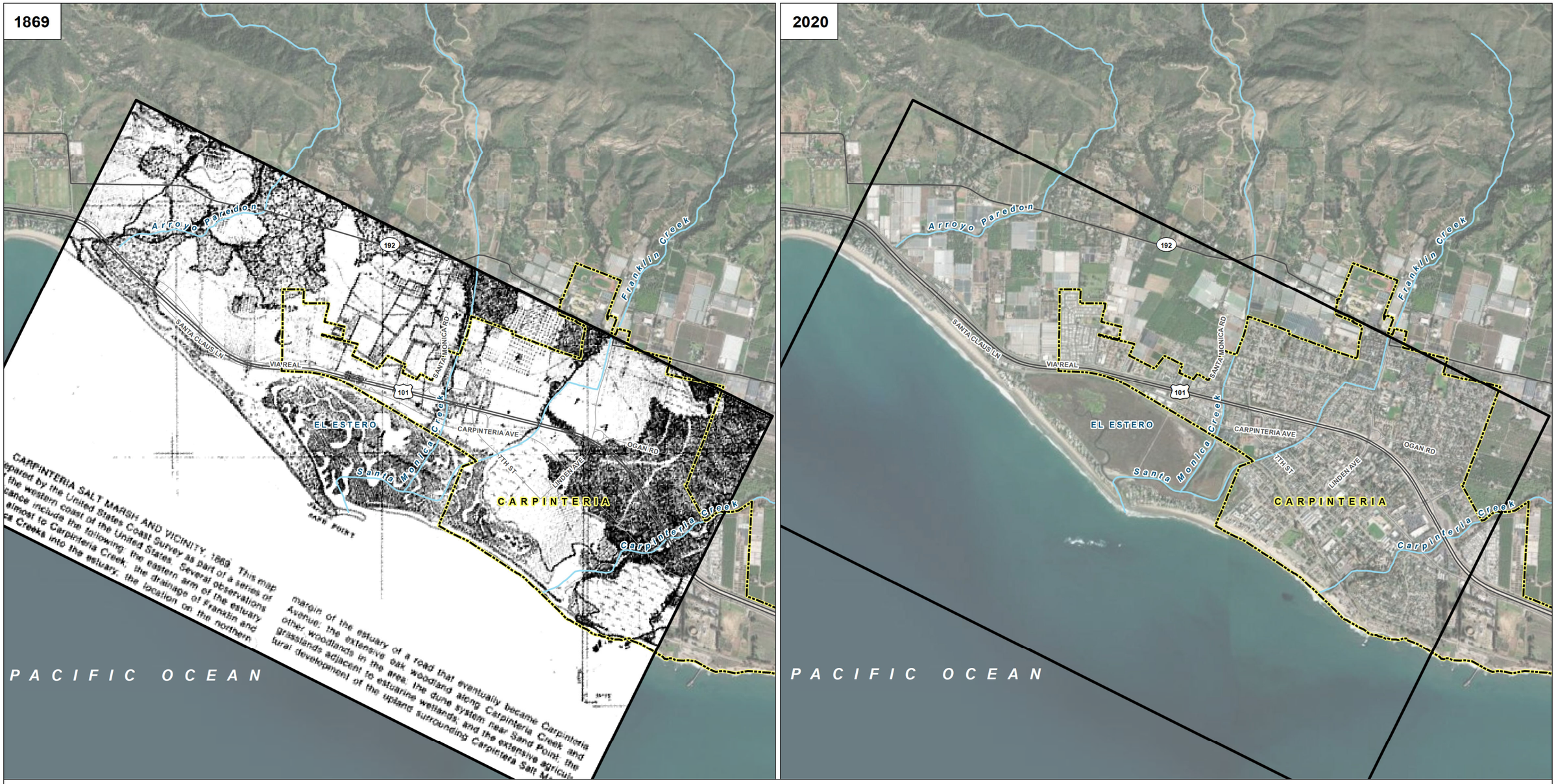
(d) Physical characteristics of the basin shall be represented on one or more maps that depict the following:

(5) Surface water bodies that are significant to the management of the basin.

There are five major creeks in the Basin, each of which extends from the crest of the Santa Ynez Mountains and flows in a generally southerly direction across the Basin to the Pacific Ocean. The creeks in the Basin area are shown on Figure 3-2. As shown, Gobernador, Carpinteria and Santa Monica Creeks are the main drainages into the central portion of the Basin. Rincon Creek crosses the east end of the Basin and dissects the remnant terrace deposits and older alluvial fans in this area. Toro Creek enters the Basin at the west end of the Basin. Smaller drainages, including Franklin and Arroyo Paredon Creeks, are headed in the adjacent foothills and flow as a result of direct runoff following storms. It is noted that the channels of both Santa Monica and Franklin Creeks were concrete lined in 1973 to control flood flows.

There is only one active stream gage in the Basin with a significant period of record, the USGS Carpinteria Creek gage (gage no. 11119500), located just downstream of the confluence of Gobernador and Carpinteria Creeks, as shown on Figure 3-2. This gage has a period of record from January 1941 through the current period, with annual discharge ranging between 0 and approximately 24,250 AFY and a long-term mean of approximately 2,700 AFY. Also shown on Figure 3-2 are the locations of CVWD surface water sampling stations (discussed in Section 5).

The El Estero Salt Marsh is an approximate 215-acre intertidal marshland area west of the City of Carpinteria. Given the intertidal nature and location in the Confined Area of the Basin (Section 3.1.3.1), which limits the hydraulic connection between the marsh and the underlying principal aquifer, this surface water body is not considered to be significant to the management of the Basin.



LEGEND

- City Boundary
- Watercourse

FIGURE 3-3

Historical versus Current Land Use

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

N

0 1,250 2,500 3,750
feet

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3\Figure3-3_Historic_Comparison.mxd, iramos

3.1.2 Regional Geology [§354.14(b)(1),(d)(2), and (d)(3)]

§354.14 Hydrogeological Conceptual Model.

(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.

(d) Physical characteristics of the basin shall be represented on one or more maps that depict the following:

(2) Surficial geology derived from a qualified map including the locations of cross-sections required by this Section.

(3) Soil characteristics as described by the appropriate Natural Resources Conservation Service soil survey or other applicable studies.

The Basin is located on the south flank of the Santa Ynez Mountains, one of the east-west trending ridges of the Transverse Range Geomorphic Province. The Basin represents the north limb of a synclinal geologic structure, the deepest parts of which terminate against the traces of the Rincon Creek Fault. This structural depression has subsequently been filled with younger water-bearing deposits. Water-bearing deposits in the Basin include all unconsolidated and semi-consolidated sediments of the Quaternary age, with older consolidated and generally non-water bearing rocks forming the definable boundaries of the Basin.

Quaternary Age water-bearing basin deposits primarily consist of the following:

- Alluvial Deposits
- Carpinteria Formation (not exposed within or adjacent to the Basin)
- Casitas Formation
- Santa Barbara Formation

Tertiary Age formations that form the primary bedrock boundaries of the Basin include the following:

- Sisquoc Formation
- Monterey Formation
- Rincon Shale
- Vaqueros Formation
- Sespe Formation
- Coldwater Sandstone

The geologic contact between unconsolidated water-bearing deposits and bedrock formations delineates the northern and southeastern lateral boundaries and the definable bottom of the Basin. The southwestern portion of the Basin is bounded by the Pacific Ocean. The western boundary is a jurisdictional boundary with the Montecito GSA.

The most recent published geologic maps covering the basin area were utilized to refine the delineation of the basin boundaries as part of a formal Basin Boundary Modification (BBM) through DWR in 2018 based on the geologic contacts of the formations listed above. A geologic map showing the surficial geology from the recent geologic mapping and the corresponding current basin boundaries is presented on Figure 3-4. In addition, the 2018 BBM included removal of the Toro Canyon area from the formal Bulletin 118 basin delineation and created an approximate 3,000-foot-long jurisdictional boundary at the western edge of the Basin coinciding with the boundary between the CVWD and Montecito Water District (MWD).

Within the Basin, the Rincon Creek Thrust Fault has created a barrier to subsurface groundwater movement within the Basin, and the surface trace of the fault has been used to segregate the Basin into two Storage Units: Storage Unit No. 1 (SU-1) is on the north side of the fault trace, and Storage Unit No. 2 (SU-2) is to the south. The southeastern portion of SU-1 is hydrogeologically separated from the ocean by the Rincon Creek Thrust Fault; however, west of El Estero, basin deposits are understood to be in contact with the ocean. SU-1 contains all of the CVWD's principal municipal supply wells and the vast majority of agricultural wells and has accordingly been the primary focus of previous basin investigations and data collection programs. A map showing the boundaries of the two Storage Units is presented in Figure 3-5.

3.1.2.1 Soil Types

The soils of the Basin are derived primarily from exposed geologic formations. Soil and vegetation affect how much precipitation can infiltrate into the soil to recharge the basin aquifer system. Soil data from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic Service Database (SSURGO) is shown by the four hydrologic groups and two dual classes present in the Basin (A/D and C/D) on Figure 3-6. The groups are defined as follows:

- **Group A.** Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
- **Group B.** Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
- **Group C.** Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
- **Group D.** Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter describes the condition of soils that are actively drained, and the second letter describes the condition of the soils in their natural (undrained) condition. Only the soils that in their natural condition are in group D are assigned to dual classes.

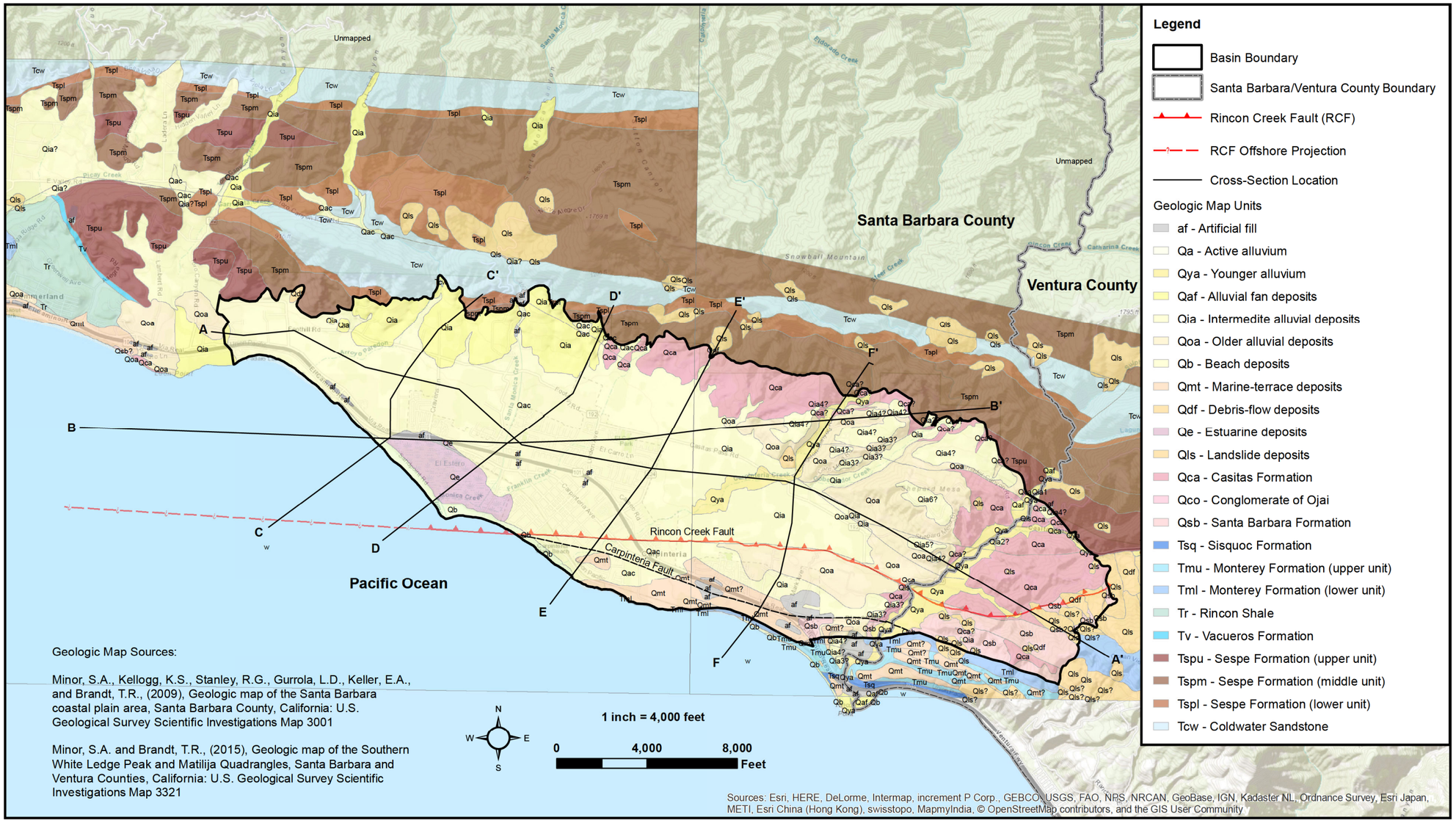


FIGURE 3-4

Geologic Map

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

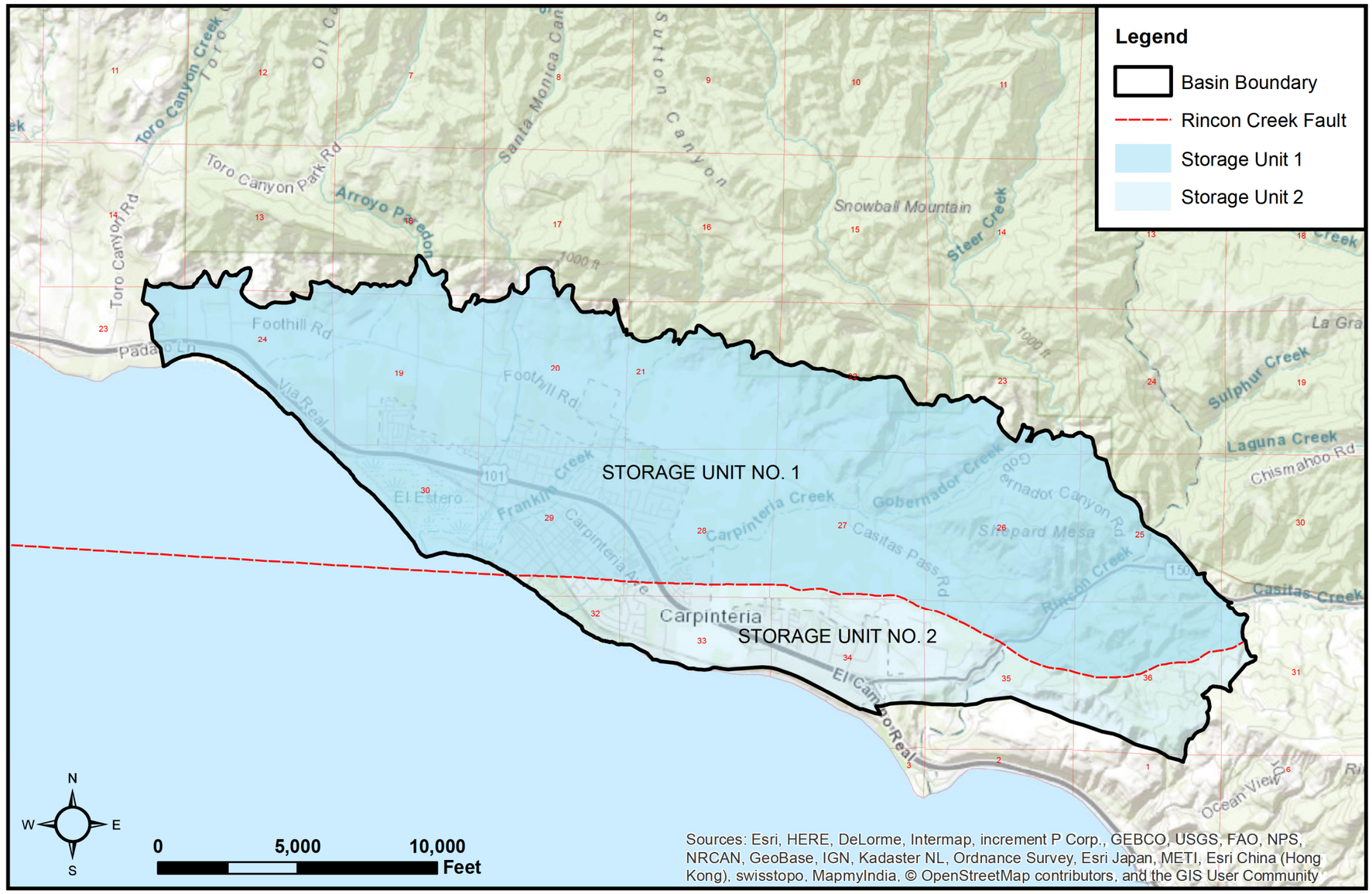


FIGURE 3-5

Storage Units 1 and 2 Map

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

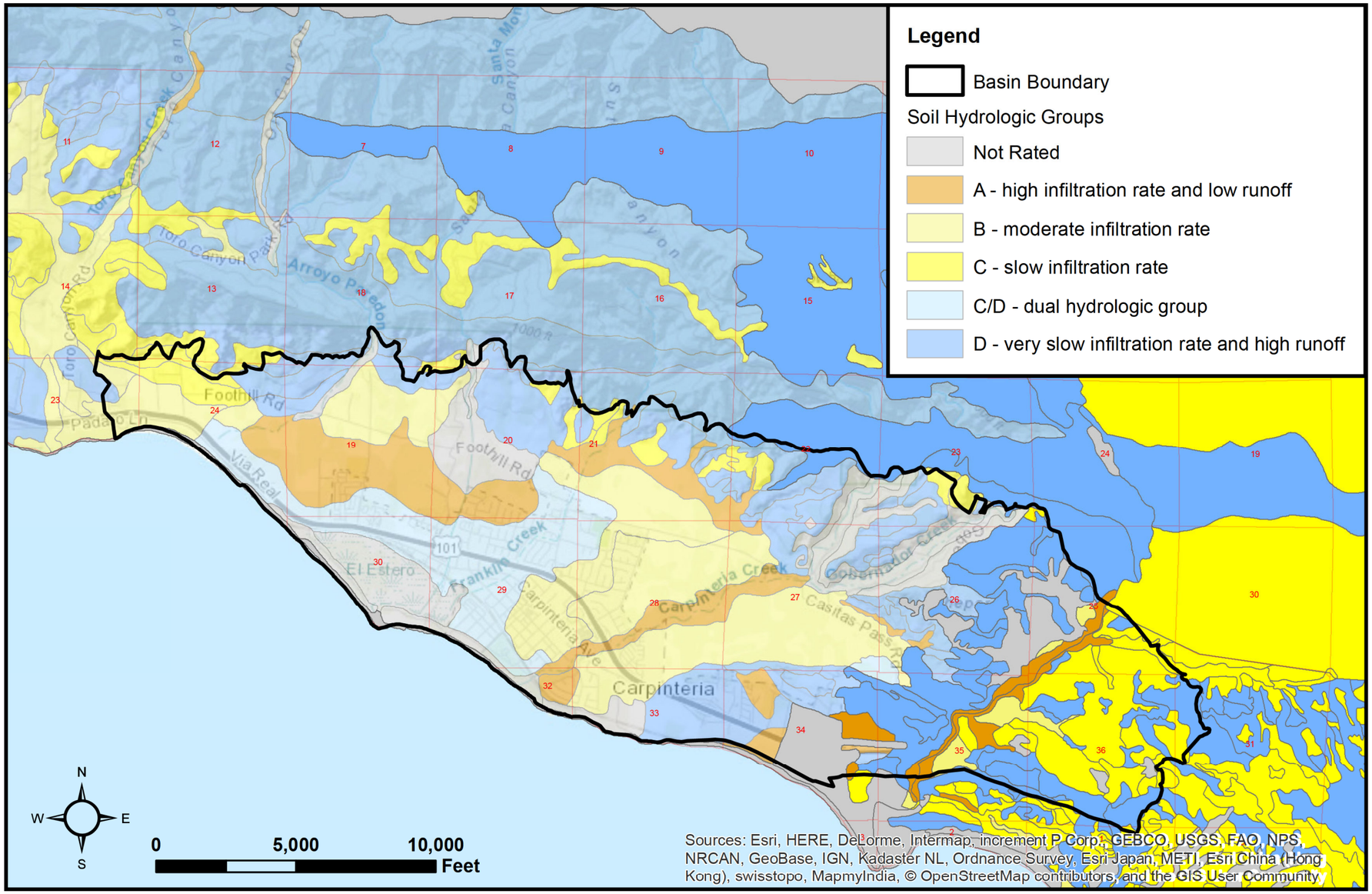


FIGURE 3-6

Soil Survey Map

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

3.1.3 Principal Aquifers and Aquitards [§354.14(b)(4)(A)]

§354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(4) Principal aquifers and aquitards, including the following information:

(A) Formation names, if defined.

In the Basin, a single principal aquifer occurs primarily within unconsolidated and semi-consolidated sediments of the Pleistocene- and upper Pliocene-aged Casitas Formation. In some local alluvial valleys of Basin Creeks (Figure 3-2), wells penetrate and may possibly screen the sediments of the younger alluvium, but available data indicate that these wells usually are also screened in the Casitas formation, which provides most of the productive yield. There is no consistent low permeability strata separating the alluvium from Casitas sediments; these sediments function as a single hydrogeologic unit. Such deposits are readily capable of absorbing, storing, transmitting and yielding water to wells. Holocene-aged alluvial deposits are present as a thin veneer along the coastal plain and along all creek channels and comprise the sediment of alluvial fan deposits at canyon mouths along the northern basin boundary. Older Tertiary sedimentary bedrock units are considered to be generally non-water-bearing and constitute the boundaries of the groundwater basin.

In the vicinity of the City of Carpinteria, the Holocene alluvial deposits are comprised predominantly of silt and clay to depths of approximately 150 to 250 feet. Because these deposits do not readily transmit water, they limit the downward percolation of water and also serve to confine water in the underlying principal aquifer under artesian pressure (discussed further later).

The principal aquifer system in the Basin largely occurs in the Casitas Formation, which is contained in the entire basin area north of the Rincon Creek Fault and is exposed in outcrops along the northern and eastern boundaries (see Figure 3-4). The Casitas Formation is an assemblage of poorly to moderately consolidated clayey to gravelly sand with variable amounts of silt and cobbles reaching substantial thicknesses of 2,300 to 2,500 feet in SU-1. Sandy clay is abundant and sandy units are typically thin and lenticular and cannot be correlated over long distances. Notable exceptions to this are the major water producing zones delineated at the A, B, C and D Zones in the Confined Area of the Basin (Section 3.1.3.1).

Underlying the Casitas Formation is the marine Santa Barbara Formation, which unconformably overlies all older consolidated rocks in the Basin. The formation is only exposed south of the Rincon Creek Fault in SU-2 where it unconformably overlies Miocene shales. The Santa Barbara formation consists of poorly to moderately consolidated, soft and massive, sandstone and siltstone with abundant clay shale. Available data indicate the formation is 750 to as much as 1,250 feet thick in SU-1 and at least 1,500 feet thick in SU-2. Although the formation represents a potential water-bearing deposit in the Basin, no water wells are known to penetrate it and no major aquifers have been discerned within it (note: the wells shown on the cross-sections that do penetrate the Santa Barbara Formation are exploratory borings or wildcat oil wells).

3.1.3.1 Physical Properties of the Aquifers and Aquitards

§ 354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(2) Lateral basin boundaries, including major geologic features that significantly affect groundwater flow.

(3) The definable bottom of the basin.

(4) Principal aquifers and aquitards, including the following information:

(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.

Basin Boundary (Vertical and Lateral Extent of Basin) [§354.14(b)(2),(b)(3), and (c)]

The geologic contact between unconsolidated water-bearing deposits and bedrock formations delineates the northern and southeastern lateral boundaries and the definable bottom of the Basin. The southwestern portion of the Basin is bounded by the Pacific Ocean. The western boundary is a jurisdictional boundary with the Montecito GSA.

The most recently published geologic maps covering the basin area were utilized to refine the delineation of the basin boundaries as part of a formal BBM through DWR in 2018 based on the geologic contacts of the formations listed in Section 3.1.2. A geologic map showing the surficial geology from the recent geologic mapping and the corresponding current basin boundaries is presented on Figure 3-4. In addition, the 2018 BBM included removal of the Toro Canyon area from the formal Bulletin 118 basin delineation and created an approximate 3,000-foot-long jurisdictional boundary at the western edge of the Basin, coinciding with the boundary between the CVWD and MWD.

Water-bearing deposits in the Basin include all unconsolidated and semi-consolidated sediments, with older consolidated non-water bearing rocks bounding the Basin both laterally and vertically (see Figure 3-4). The top of bedrock represents the definable bottom of the Basin. Structural contours of the top of bedrock for SU-1 and SU-2 based on the evaluation of wildcat oil wells in the Basin (Sullwold, 1996) are shown on Figure 3-7 and Figure 3-8, respectively. As shown, in the deepest portion of the basin bedrock is as much as 4,000 feet below sea level in SU-1 and rises to approximately 500 feet above sea level along the northern boundary of the Basin. As also shown, the bedrock contours and overlying basin deposits extend offshore beyond the formal basin boundary at the Pacific Ocean coastline. In SU-2 (where there is relatively little geologic control) the bedrock is estimated to reach depths of approximately 1,000 feet below sea level.

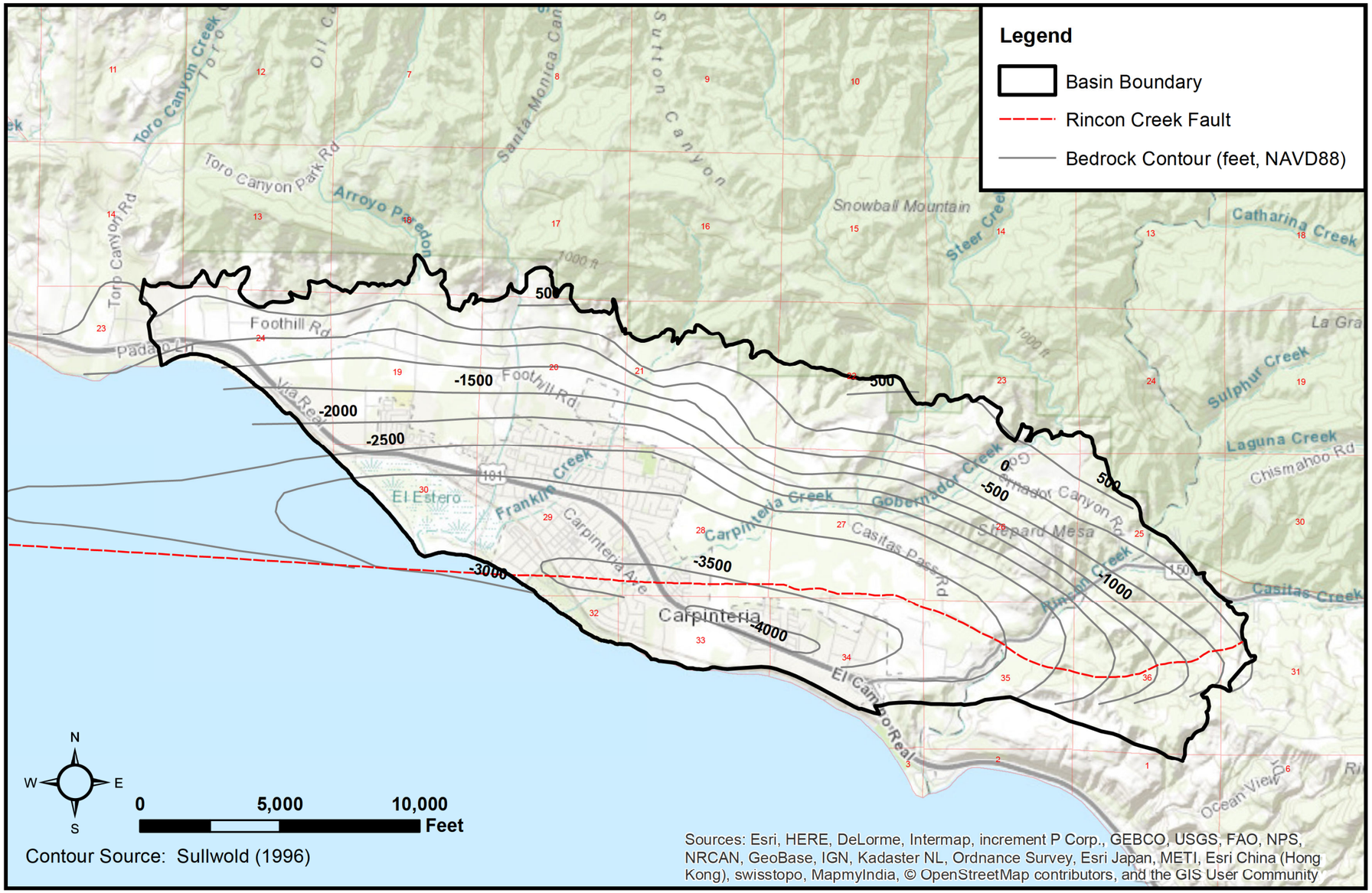


FIGURE 3-7

Bedrock Structural Contours – Storage Unit 1

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

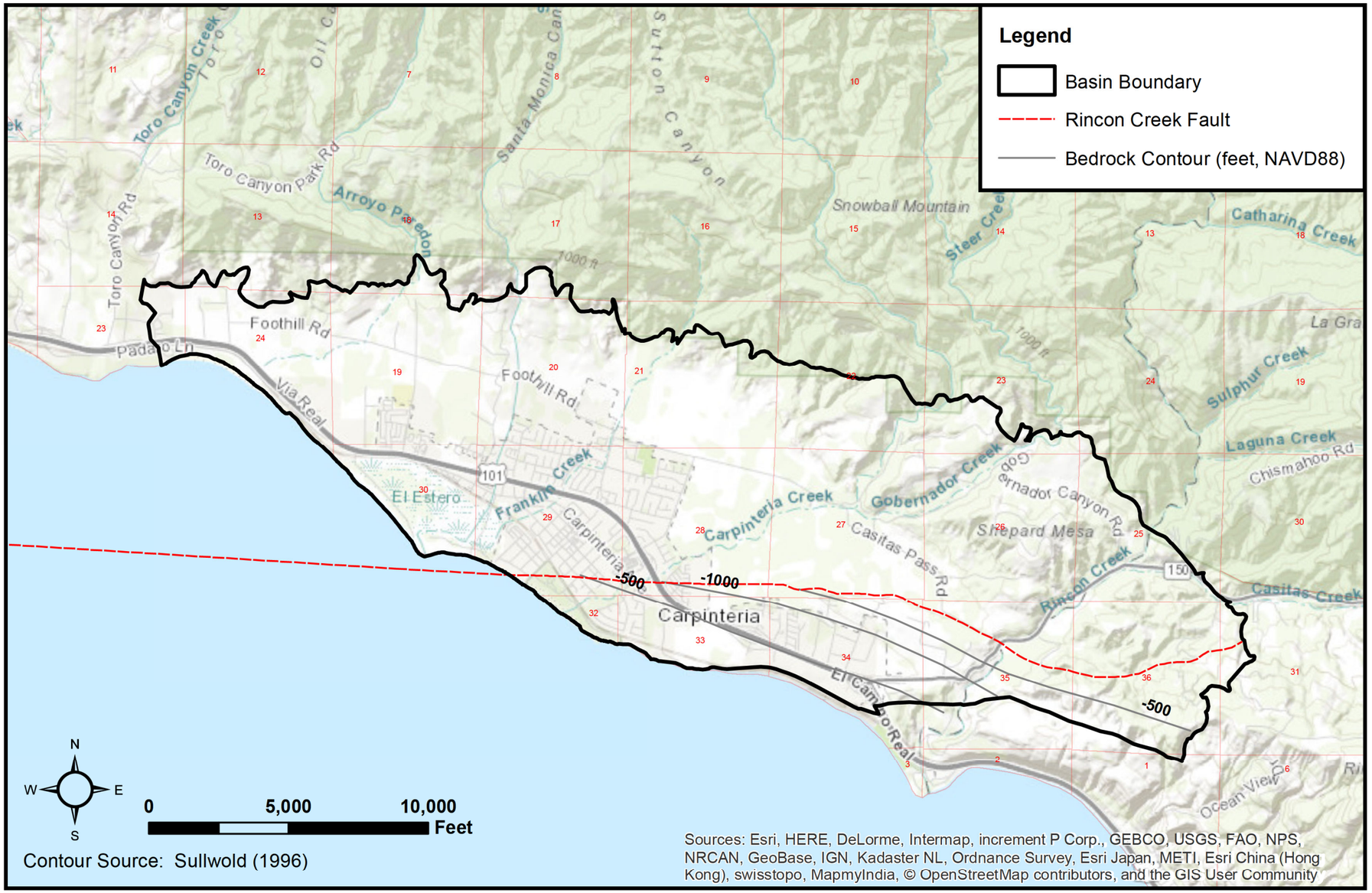


FIGURE 3-8

Bedrock Structural Contours – Storage Unit 2

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

Lithologically, the primary water bearing deposits in the Basin consist of interbedded unconsolidated and semi-consolidated sand, gravel, silt and clay (and combinations thereof) deposits. The coarser grained sandy/gravelly strata in these deposits comprise the individual primary water producing zones (A through D Zones) for wells in the central portion of the Basin. These primary producing zones are generally on the order of 50 to 100 feet thick each. Finer grained strata of silt and clay are generally thicker and form a series of aquitards between the primary producing zones in this area. These aquitards are laterally extensive in the central alluvial plain portion of the Basin and confine water held in the primary aquifers under artesian pressure. This area of the Basin is referred to as the Confined Area (Figure 3-9).

Outside the Confined Area of the Basin and extending to the bedrock boundaries, the A to D Zones become laterally discontinuous and generally non-correlatable. The alluvial deposits and Casitas Formation in these areas contain laterally discontinuous layers of both permeable and impermeable materials, and water held in these areas is generally unconfined (although various degrees of local confinement likely do occur). The source of recharge water to the Basin is primarily by infiltration of precipitation, irrigation water and streamflow seepage (discussed later); however, in the Confined Area, downward percolation of water is limited due to the presence of fine-grained low-permeability materials overlying most of the area of the principal aquifers; therefore, recharge to the primary aquifers occurs primarily in the areas between the Confined Area and the boundaries of consolidated bedrock. This area is referred to as the Recharge Area (Figure 3-9).

It is noted that no new information since 2012 (i.e., correlatable producing zones and/or aquitards from recently drilled wells) indicates that the previous delineations of the Confined and Recharge Areas should be modified at this time; therefore, the previous delineations of these areas of the Basin have been adopted for this GSP. A map showing the Confined and Recharge Areas is presented on Figure 3-9.

Well logs obtained for new wells in the Basin have been used to refine the previous interpretations of the hydrostratigraphy of the Basin and prepare six geologic cross-sections through the Basin. The locations of the cross-section lines are shown on Figure 3-4. The cross-sections are shown in Figures 3-10 through 3-15. As shown, the cross-sections depict the overall basin structure and distribution of the A through D Zones discussed previously in this section.

The western edge of cross-section A – A' (Figure 3-10), and bedrock structural contours for SU-1 (Figure 3-7) show that basin sediments at the jurisdictional boundary with the MWD range from a maximum thickness of approximately 500 feet at the coastline and rapidly thinning to northern bedrock boundary. Given these conditions, groundwater can move freely across this boundary, depending on hydrologic conditions and water-level gradients at the boundary.

The western portion of cross-section B - B' (Figure 3-11) shows the current understanding of the relationship between the basin deposits and the Pacific Ocean. It is noted that the available geologic control offshore is limited to oil wells that have been drilled in the area, from which the geologic contact between unconsolidated sediments and the underlying bedrock have been established, but the lithologic descriptions for the overlying deposits are insufficient to reliably delineate the A – D Zones within the Carpinteria and Casitas Formations. The delineations of the A – D Zones shown are based on extrapolation of the structure from the onshore area to the offshore area and is accordingly shown as queried on the cross section. As shown, these zones are conceptualized to outcrop at (or near) the sea floor. It is noted that offshore geologic mapping does indicate that the seafloor surface consists of undifferentiated continental shelf sediments of unknown thicknesses, which may limit the hydraulic continuity between the Pacific Ocean and the basin deposits to an unknown extent.

The other cross-sections also show the physical relationship between the basin deposits and the Rincon Creek Fault and the northern and eastern basin boundaries. As shown, the thickness of basin deposits terminating at the base of the Rincon Creek Fault range between approximately 1,500 to over 3,000 feet and gradually thin towards the basin boundaries and contacts with the bedrock.

In the southeastern extent of the Basin in Ventura County, Younger Alluvium is present at the surface along Rincon Creek. The Rincon Creek Fault is mapped through this portion of the Basin, with the Casitas Formation exposed at the surface in the hills north of the fault and east of Rincon Creek, and the older Santa Barbara Formation cropping out south of the fault. The Monterey Formation is exposed along the ridge southeast of the Basin boundary. Most wells in this area are located in the low-lying area along Rincon Creek. However, as discussed previously, available well data indicate that wells in this area may screen some alluvial sediments, but usually penetrate through the Younger Alluvium to screen the underlying sediments of the Casitas Formation.

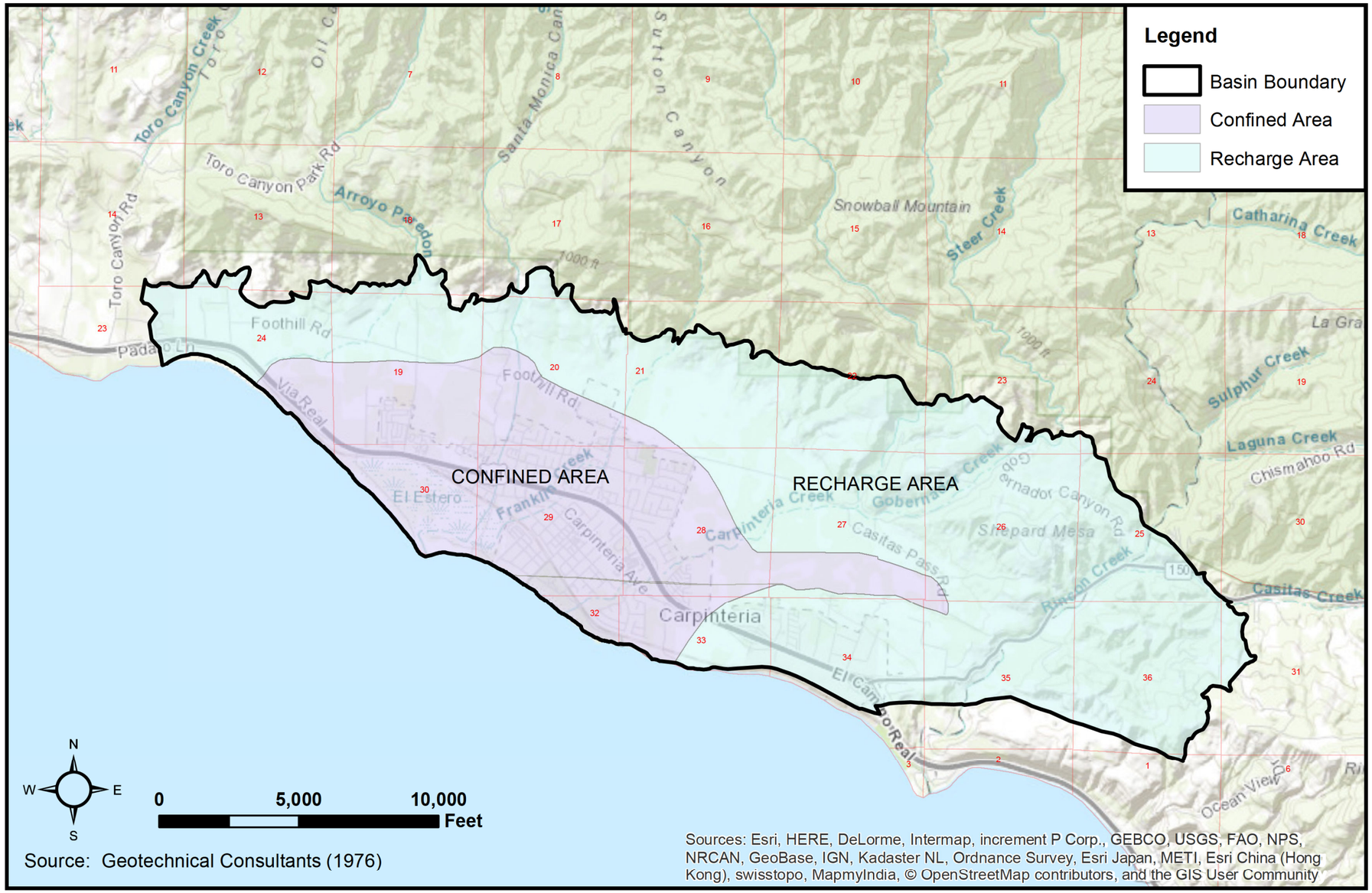
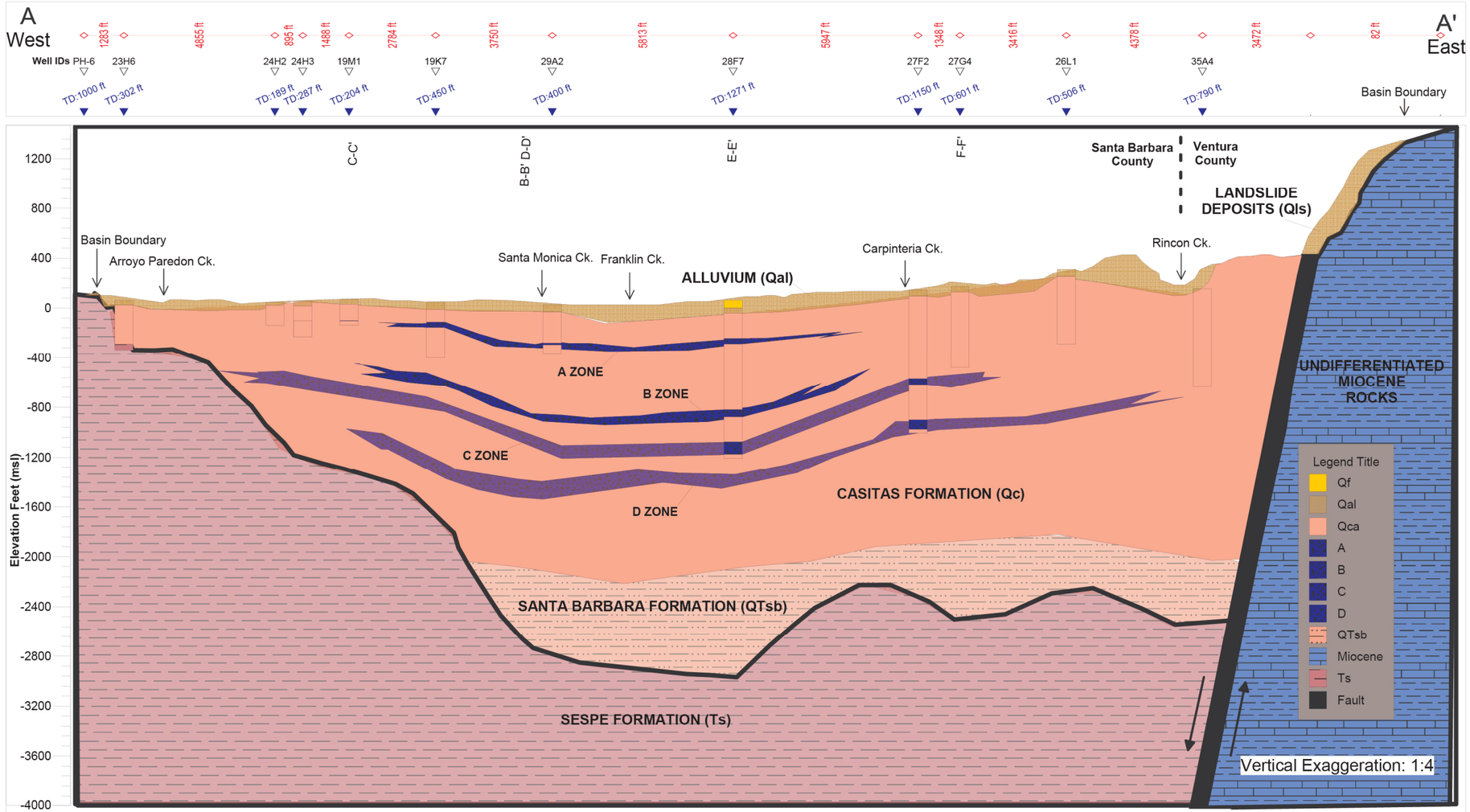


FIGURE 3-9

Confined and Recharge Areas Map

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3



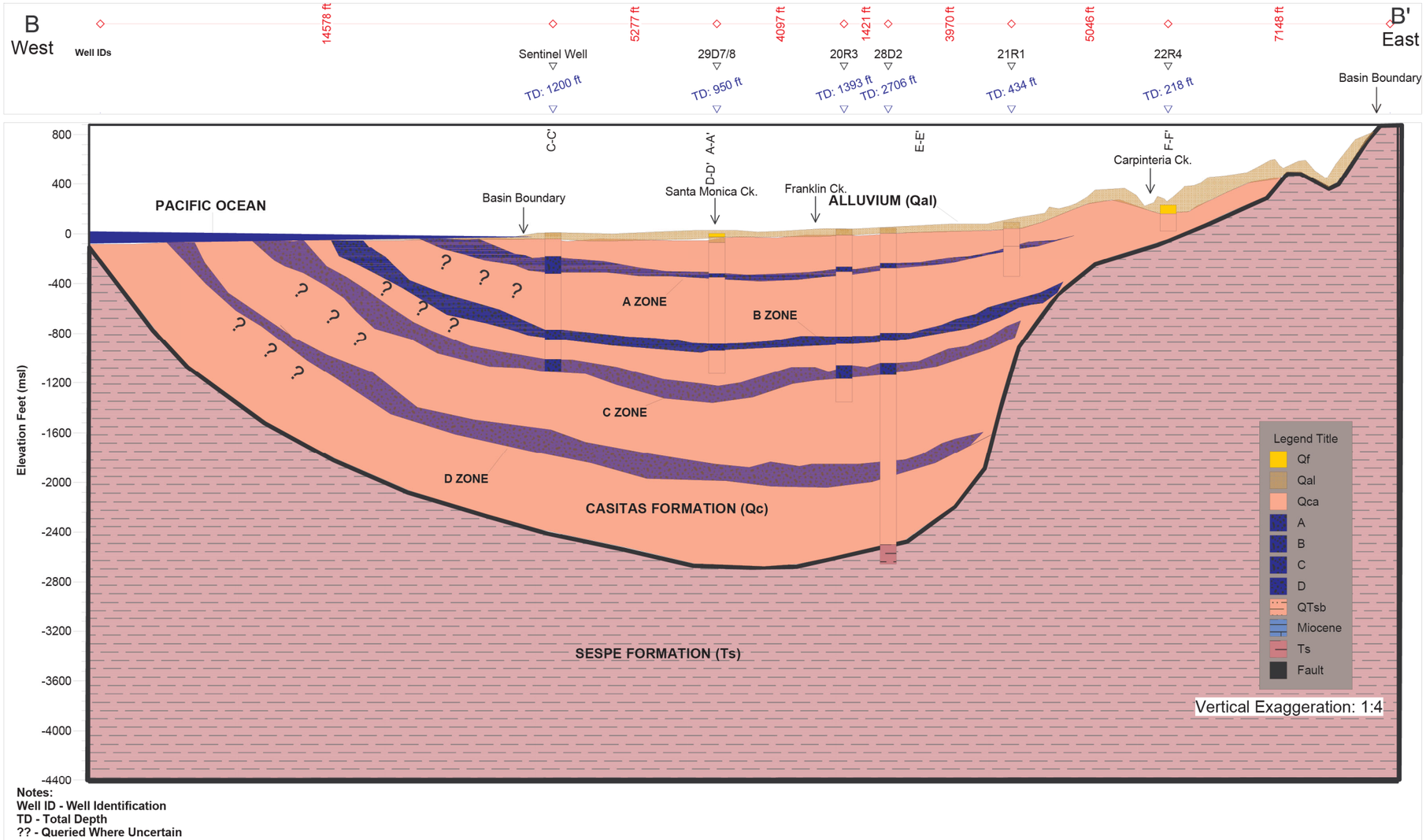
Notes:
Well ID - Well Identification
TD - Total Depth

FIGURE 3-10

Geologic Cross-Section A – A'

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3



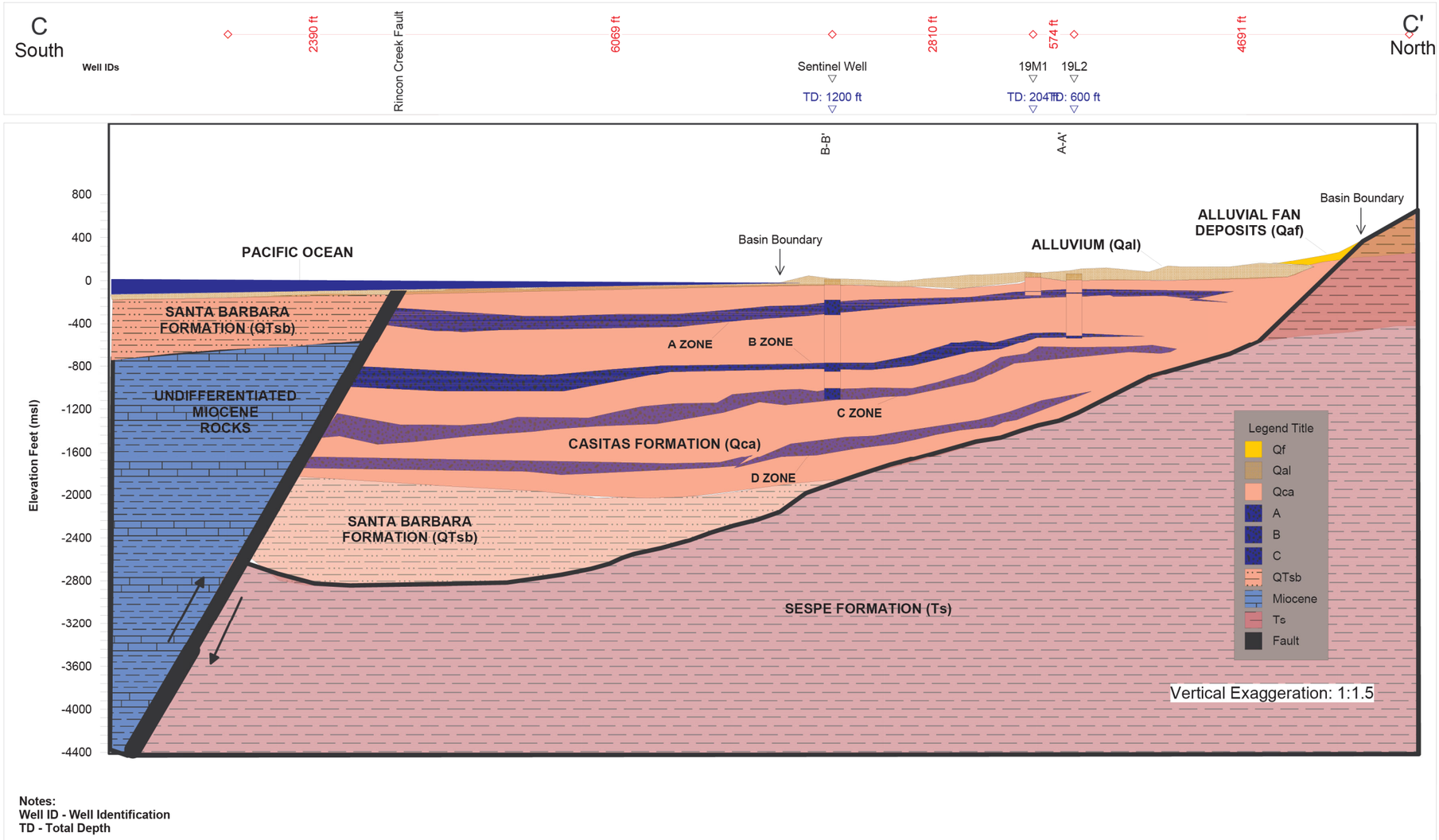
Notes:
Well ID - Well Identification
TD - Total Depth
?? - Queried Where Uncertain

FIGURE 3-11

Geologic Cross-Section B – B'

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3



Notes:
Well ID - Well Identification
TD - Total Depth

FIGURE 3-12

Geologic Cross-Section C – C'

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

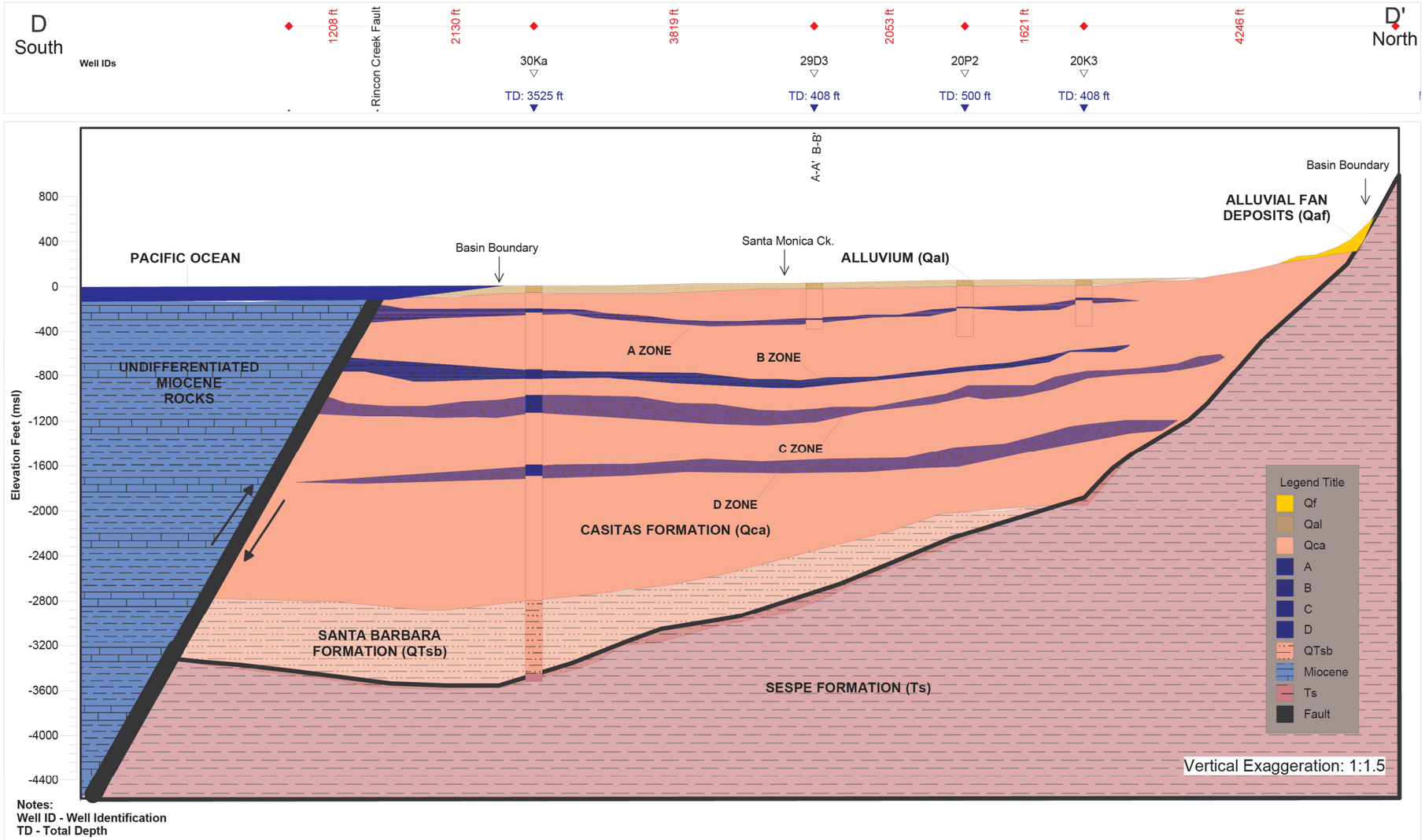
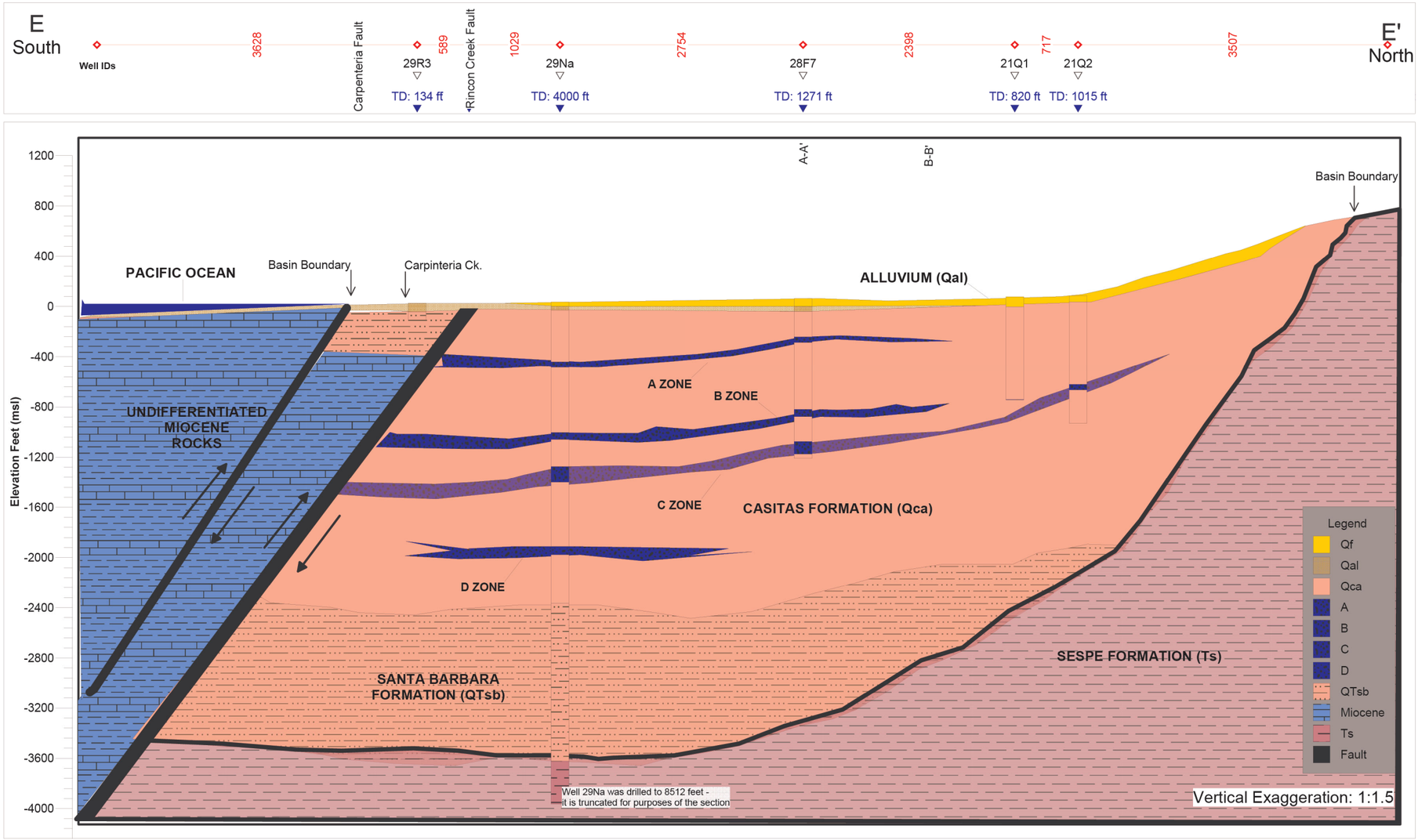


FIGURE 3-13

Geologic Cross-Section D – D'

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3



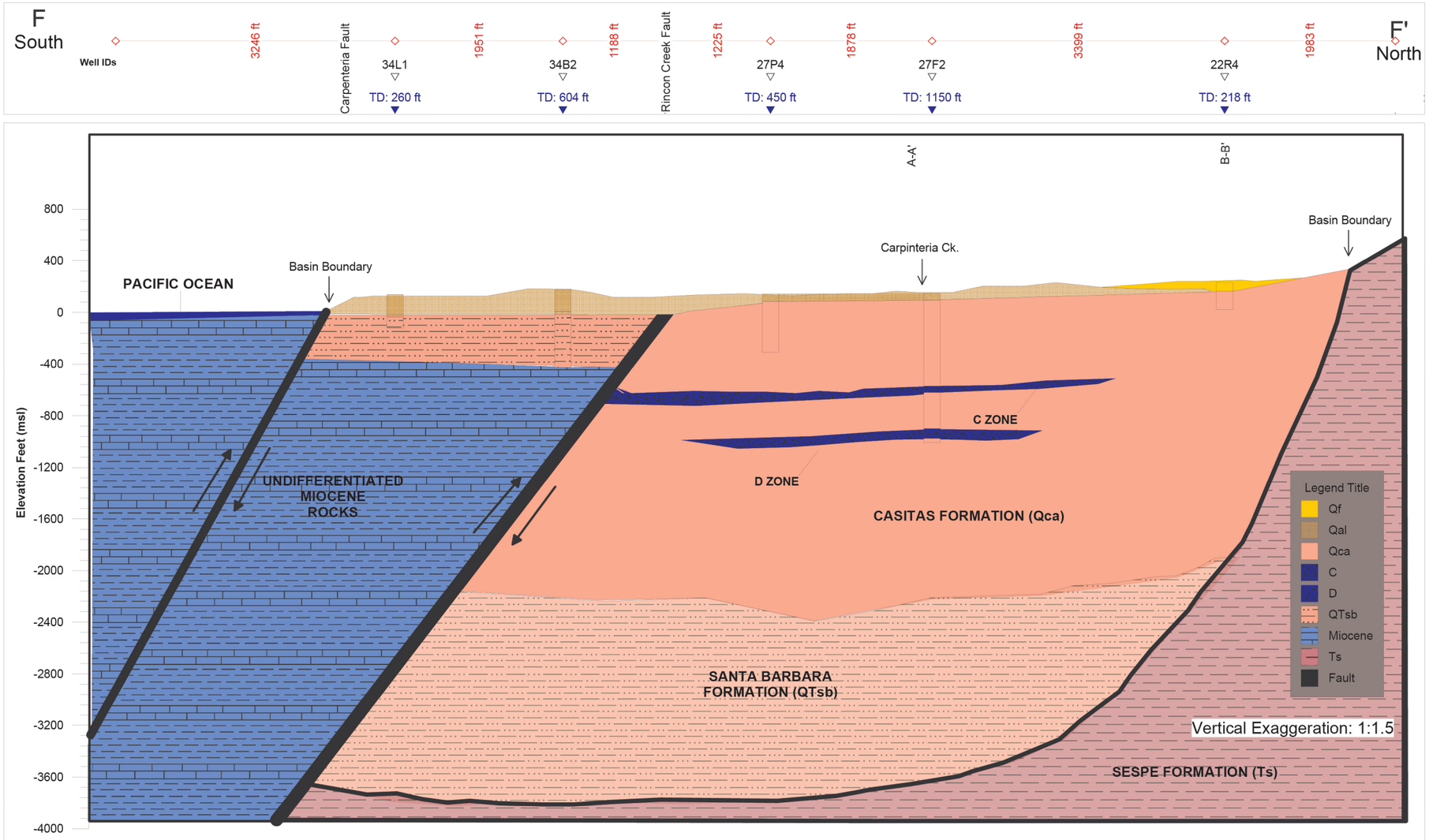
Notes:
Well ID - Well Identification
TD - Total Depth

FIGURE 3-14

Geologic Cross-Section E – E'

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3



Notes:
Well ID - Well Identification
TD - Total Depth

FIGURE 3-15

Geologic Cross-Section F – F'

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

§ 354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(4) Principal aquifers and aquitards, including the following information:

(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.

Groundwater Flow Barriers [§354.14(b)(4)(C)]

As discussed previously, the Rincon Creek Thrust Fault represents a hydraulic flow barrier within the Basin. The fault plain has been intersected by several wildcat oil wells. As shown in Figure 3-4, the surface trace of the fault extends westerly across the Basin from the Ventura County side of Rincon Creek, through El Estero, and then offshore. As shown on the cross-sections, in the central portions of the Basin, consolidated bedrock have been thrust up and over basin sediments. Subsurface data indicate fault plane dips south at angles ranging from 50 to 70 degrees with displacement as much as 3,000 to 4,000 feet. Analysis of available hydrogeologic data by previous investigators (GTC) strongly suggests that Rincon Creek Fault has created a barrier of the southward movement of groundwater in the Basin and forms the basis for the delineation of SU-1 and SU-2 discussed previously.

As discussed in section 3.1.2, west of El Estero in SU-1, the water-bearing deposits of the Basin are in contact with the Pacific Ocean. Otherwise, the remainder of the Basin is hydrogeologically separated from the Pacific Ocean by the Rincon Creek Fault or by consolidated bedrock exposed near the shoreline in SU-2 as a result of smaller displacement (approximately 300 to 400 feet) of the Santa Barbara Formation by the Carpinteria Fault.

§354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(4) Principal aquifers and aquitards, including the following information:

(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.

Hydraulic Properties [§354.14(b)(4)(B)]

The primary aquifer parameters necessary to characterize the hydraulics of groundwater movement and calculate basin storage include transmissivity, hydraulic conductivity, and storativity. Transmissivity and hydraulic conductivity are related (transmissivity is the product of hydraulic conductivity and aquifer thickness) and characterize the permeability of aquifer materials. Storativity is a measure of the aquifer's ability to store and release water. These aquifer parameters are used in the construction of the numerical groundwater flow model of the Basin (see Appendix F). Estimates of these parameters are ideally obtained from analysis of pumping test data; however, the number of controlled pumping tests conducted in the Basin is relatively limited. Transmissivity can also be roughly estimated from specific capacity data (ratio of well yield to drawdown), which are a commonly measured parameter at pumping wells and are, therefore, more plentiful than pumping test data.

Data available to most previous investigations was generally limited to specific capacity data. Formal post-construction pumping tests conducted at the CVWD High School, El Carro, and Headquarters wells have been analyzed to determine aquifer parameters at those locations. In addition to pumping tests, transmissivities have also been estimated from specific capacity data for this GSP. For wells where only specific capacity data are available, the methods presented in Driscoll (1995) to estimate transmissivity were utilized. Hydraulic conductivities were calculated by dividing transmissivity by total screen length of each well. Summaries of the aquifer parameters derived for the Confined and Recharge Areas are presented below:

- **Confined Area.** Transmissivities derived from pumping test and specific capacity data in the Confined Area range between approximately 5,500 and 21,600 gallons per day per foot (gpd/ft) and average approximately 12,100 gpd/ft. Storage coefficients average approximately 6.5 x 10^{-4} (dimensionless), indicative of confined conditions. Estimated hydraulic conductivities for the primary producing zones in the Confined Area range between approximately 9 and 18 feet per day (ft/day).
- **Recharge Area.** Transmissivities derived from pumping test and specific capacity data in the unconfined Recharge Area range between approximately 400 and 18,000 gpd/ft, averaging approximately 3,200 gpd/ft. Hydraulic conductivities range between 0.2 and 7 ft/d, averaging approximately 1.4 ft/d. Storage coefficients could not be calculated from the available pumping test data in the Recharge Area due to a lack a nearby monitoring well to base calculations.

3.1.3.2 Groundwater Recharge and Discharge Areas [§354.14(d)(4)]

§354.14 Hydrogeological Conceptual Model.

(d) Physical characteristics of the basin shall be represented on one or more maps that depict the following:

(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.

As discussed previously, outside the Confined Area of the Basin and extending to the bedrock boundaries, the Carpinteria and Casitas Formations contain laterally discontinuous layers of both permeable and impermeable materials, and water held in these areas is generally unconfined. The primary sources of recharge to the Basin are percolation of precipitation, subsurface inflow, and percolation of irrigation water. This area is delineated as the Recharge Area as shown on Figure 3-9.

Groundwater within the principal aquifer of SU-1 does not discharge directly to the ocean in the southeastern portion of the Basin, due to the presence of overlying confining layers and the barrier created by the Rincon Creek Thrust Fault. Subsurface outflow from SU-1 is believed to occur in the general area from Serena Park to Sand Point (a distance of approximately 9,000 ft.) where there is no fault barrier between basin sediments and the Pacific Ocean. In SU-2, significant subsurface outflow is not believed to occur due to the onshore contact of unconsolidated water-bearing materials with consolidated bedrock, which effectively isolates SU-2 from the ocean (see Figures 3-4, 3-14, and 3-15).

3.1.3.3 Water Quality [§354.14(b)(4)(D)]

§354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(4) Principal aquifers and aquitards, including the following information:

(D) General water quality of the principal aquifers, which may be based on information derived from existing technical studies or regulatory programs.

Groundwater quality within the Basin has historically been monitored as part of the CVWD's AB 3030 Groundwater Management Plan program through the analysis of samples collected from 25 wells located throughout the Basin. Water samples are also collected from six surface water stations when surface water is present. The laboratory analytical program for the samples includes total dissolved solids and basic inorganic chemical constituents, including chloride and nitrate. Chemical hydrographs for the 25 wells monitored are presented in Figures 3-16 and 3-17. Figure 3-16 presents water quality data for wells located generally in the western portion of the Basin and Figure 3-17 presents data for wells located in the eastern portion.

In general, the chemistry of groundwater within the Basin has a calcium-bicarbonate character, with concentrations of total dissolved solids (TDS) within the range of 600 to 900 milligrams per liter (mg/L) mg/L, and chloride ion concentrations in the range of 40 to 80 mg/L (notable exceptions are discussed later). Specific constituents of concern are discussed in detail below.

TDS and Chloride. There are some notable trends in the Basin with respect to TDS and chloride ion concentrations. At most of the monitored private wells in the western portion of the Basin, TDS and chloride concentrations have been relatively stable; however, increasing trends have been observed in wells 19E1 and 19K5 (see Figure 3-16).

At 19E1, beginning in about 2010, the TDS concentration has increased steadily from approximately 1,100 to 1,500 mg/L, while the chloride concentration over this same period rose from about 300 to 500 mg/L, peaking at 600 mg/L in 2019, exceeding the secondary Maximum Contaminant Level (MCL) for chloride of 250 mg/L. At Well 19K5, the TDS concentration rose from about 1,200 to 1,370 mg/L between 2008 and the end of 2019, with some higher spikes in between. Similarly, the chloride concentration at that well rose from 160 to 190 mg/L during that period with some spikes in the middle of that period.

At well 19M1, on the other hand, the TDS concentration increased from approximately 1,000 to 2,500 mg/L between 1990 and 2006, but has since declined to about 1,750 mg/L. The chloride concentration at this well showed a similar trend, increasing from 100 to 500 mg/L between 1990 and 2005. Since 2005, the chloride concentration has been variable at 19M1, possibly experiencing a slight declining trend, with a concentration of 370 mg/L observed in 2019.

In the eastern portion of the Basin, TDS and chloride concentrations have also been relatively stable at most of the monitored private wells. TDS and chloride concentration increases have been observed at wells 27E1, 28H1, and 34B4 (see Figure 3-17).

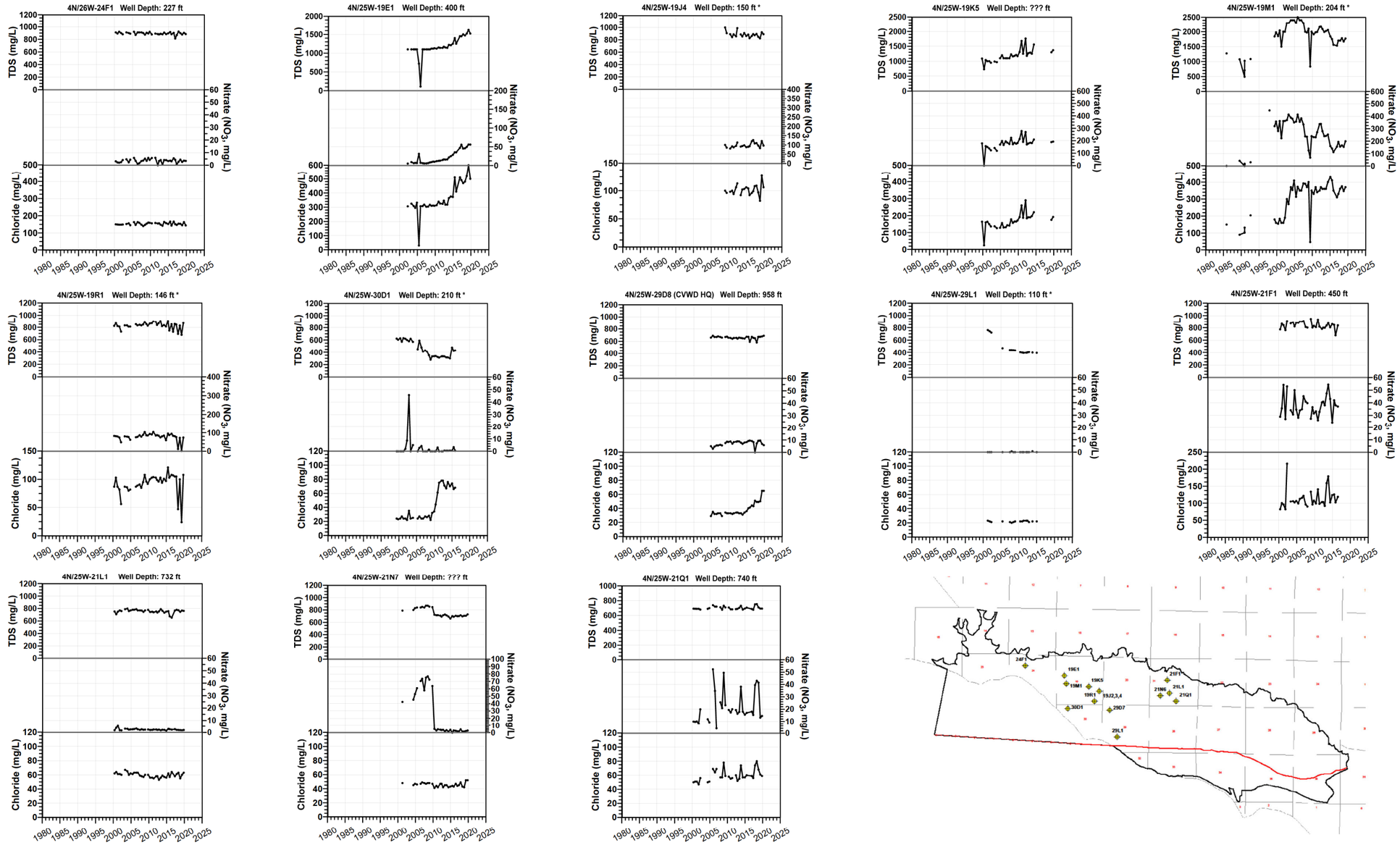


FIGURE 3-16

Water Quality Data – West

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

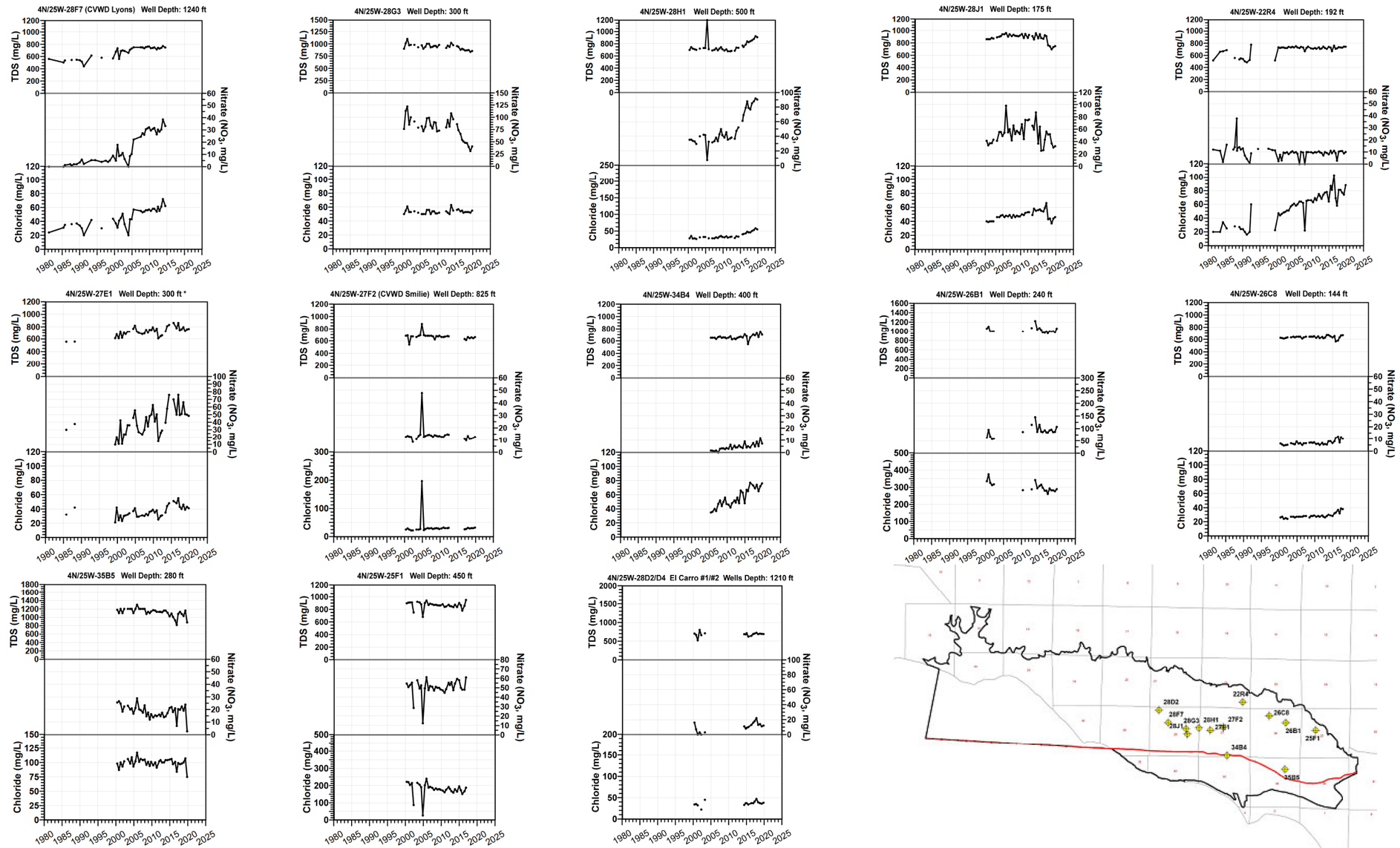


FIGURE 3-17

Water Quality Data – East

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

Increasing trends of these constituents at well 27E1 began in the late 1990s. In the early 1990s the TDS concentration at this well was approximately 600 mg/L, peaking in 2006, and has generally been declining since then with a level of 860 recorded in 2019. The pattern of chloride concentrations at this well has been similar, starting at 20 mg/L, peaking at 55 mg/L, with an observed level of about 40 mg/L in 2019. At well 28H1, TDS and chloride concentrations have been steadily increasing since about 2013. In 2013, the TDS at this well was approximately 690 mg/L. The concentration at the end of 2019 was 907 mg/L. The chloride concentration in 2013 was about 30 mg/L and at the end of 2019 it was 55 mg/L. The TDS and chloride concentration at well 34B4 has also increased since monitoring of this well began in 2005, when the TDS concentration was 650 mg/L and the chloride concentration was 35 mg/L. The TDS and chloride concentrations in well 34B4 at the end of 2019 were 700 and 76 mg/L, respectively.

At well 22R4, while the TDS concentration has remained relatively stable over the monitoring period, the chloride concentration at this well has displayed an increasing trend, starting at approximately 20 mg/L in the early 1990s, reaching a level of 88 mg/L at the end of 2019.

The GSA will continue to track the water quality trends during GSP implementation to assess the potential cause of the trends discussed above, including whether degradation of groundwater quality is caused by groundwater extractions and is, hence, a sustainability issue that must be addressed by the GSA.

Nitrate. Nitrate concentrations (as NO_3) in the Basin are generally lower in wells that are completed in relatively deep aquifer units, and higher in shallow wells located in agricultural areas. Some trends of increasing nitrate concentrations have been identified. In the western portion of the Basin (see Figure 3-16), nitrate concentrations have been increasing at wells 19E1 and 19K5 since about 2005, coincident with increasing TDS and chloride concentrations during this same period at each of these two wells For 19E1, nitrate concentrations were below 10 mg/L during the mid- to late-2000s and have increased to 56 mg/L by the end of 2019. At 19K5, nitrate concentrations were at around 170 mg/L in the mid-1980s, peaked at 280 mg/L in 2010, and during 2019 were reported to be at 190 mg/L.

Nitrate concentration increases have also been occurring at private wells in the eastern portion of the Basin (see Figure 3-17), most notably at wells 27E1 and 28H1. At 27E1, the nitrate concentration at this well was approximately 10 mg/L in 1980, peaked at 63 mg/L in 2009, and dropped to 50 mg/L in 2019. The MCL for nitrates in drinking water in California is 45 mg/L (as NO_3). The increases in nitrate concentrations in the noted wells appear to be localized and may be associated with well completion depths and/or agricultural practices.

CVWD Municipal Wells. Water quality at the CVWD municipal production wells is also monitored through the AB 3030 program. Chemical hydrographs for CVWD wells are also presented on Figures 3-16 and 3-17. In the western portion of the Basin at the Headquarters well (29D8) (see Figure 3-16), while the TDS concentration has been relatively stable over the period of record, generally within the range of 640 mg/L to 680 mg/L, the chloride concentration at this well increased slowly from approximately 40 mg/L in 2015, to about 50 mg/L at the end of 2018, to 65 mg/L at the end of 2019. While the chloride concentration at the Headquarters Well is well below the secondary MCL of 250 mg/L, the steady increase over the past several years is noteworthy. Unlike other private wells in the western portion of the Basin where increases in TDS and chlorides were sometimes accompanied by increases in nitrate concentrations, the nitrate concentration at the Headquarters Well has been stable and less than 10 mg/L over the period of record.

The CVWD production wells in the eastern portion of the Basin are the El Carro No. 1 (28D2) and No. 2 (28D4) wells, Lyons (28F7) and the Smillie (27F2) wells (see Figure 3-17). At the El Carro well site,[2] there does not appear to be any notable or significant trends in water quality, with concentrations of TDS,

[2] El Carro No. 1 was drilled in 1990 and was replaced by the El Carro #2 well in 2010.

chlorides, and nitrates at the end of 2019 at 691 mg/L, 38 mg/L, and 12 mg/L, respectively. At the Smillie well, water quality also appears to be stable with no notable trends, with concentrations of TDS, chloride, and nitrate at the end of 2019 of 658 mg/L, 32 mg/L, and 13 mg/L, respectively.

The Lyons well is currently inactive and has not been sampled since 2014, however; some notable trends of increasing concentrations of TDS, chlorides, and nitrates are apparent for this well during the period of record. Prior to 2000, the TDS concentration at this well was consistently under 600 mg/L. Since 2005, the TDS concentration at Lyons has ranged between about 730 and 770 mg/L, although the TDS concentration at this well does not appear to be recently increasing. Chloride concentrations at the Lyons well generally shows a steady increase from about 25 mg/L in the early 1980s to 62 mg/L in 2014. Nitrate concentrations have also increased over the period of record at this well, going from concentrations generally below 10 mg/L prior to 2005 to a concentration of 39 mg/L in 2013. It is noted that this well has a relatively shallow annular seal depth (50 feet), which may allow the vertical migration of poor-quality shallow water through the gravel-packed annular space into the screen zones of this well.

Surface Water Quality. Available surface water-quality data are presented on Figure 3-18 and the locations of the surface water sampling locations are shown on Figure 3-2. As shown, a long-term trend of slightly increasing TDS concentrations for the surface water quality is apparent over the period of record, particularly on Arroyo Paredon Creek, although most recently the TDS concentrations were relatively stable, if not slightly diminished. Nitrate and chloride concentrations at surface water sampling stations appear to be relatively stable since monitoring began. It is noted that Arroyo Paredon Creek, located in the western portion of the Basin, generally has significantly higher concentrations of both TDS and chloride compared to the other creeks in the Basin. The reason(s) for this are not known but may be a contributing factor to the elevated levels of these constituents in groundwater at wells in this area (i.e., wells 19E1, 19K5 and 19M1).

3.1.3.4 Primary Beneficial Uses [§354.14(b)(4)(E)]

§354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(4) Principal aquifers and aquitards, including the following information:

(E) Identification of the primary use or uses of each aquifer, such as domestic, irrigation, or municipal water supply.

The primary uses of the principal aquifer in the Basin are municipal and agricultural water supply. To the extent non-municipal small domestic wells provide water supply in the Basin, it is considered de minimis and historically has not been quantified. Municipal pumping by the CVWD is metered and agricultural pumping is estimated by CVWD via annual land use surveys. The average proportion of pumping by these two user types from WY 1985 through WY 2020 is summarized below:

- Municipal = 36 percent
- Agricultural = 64 percent

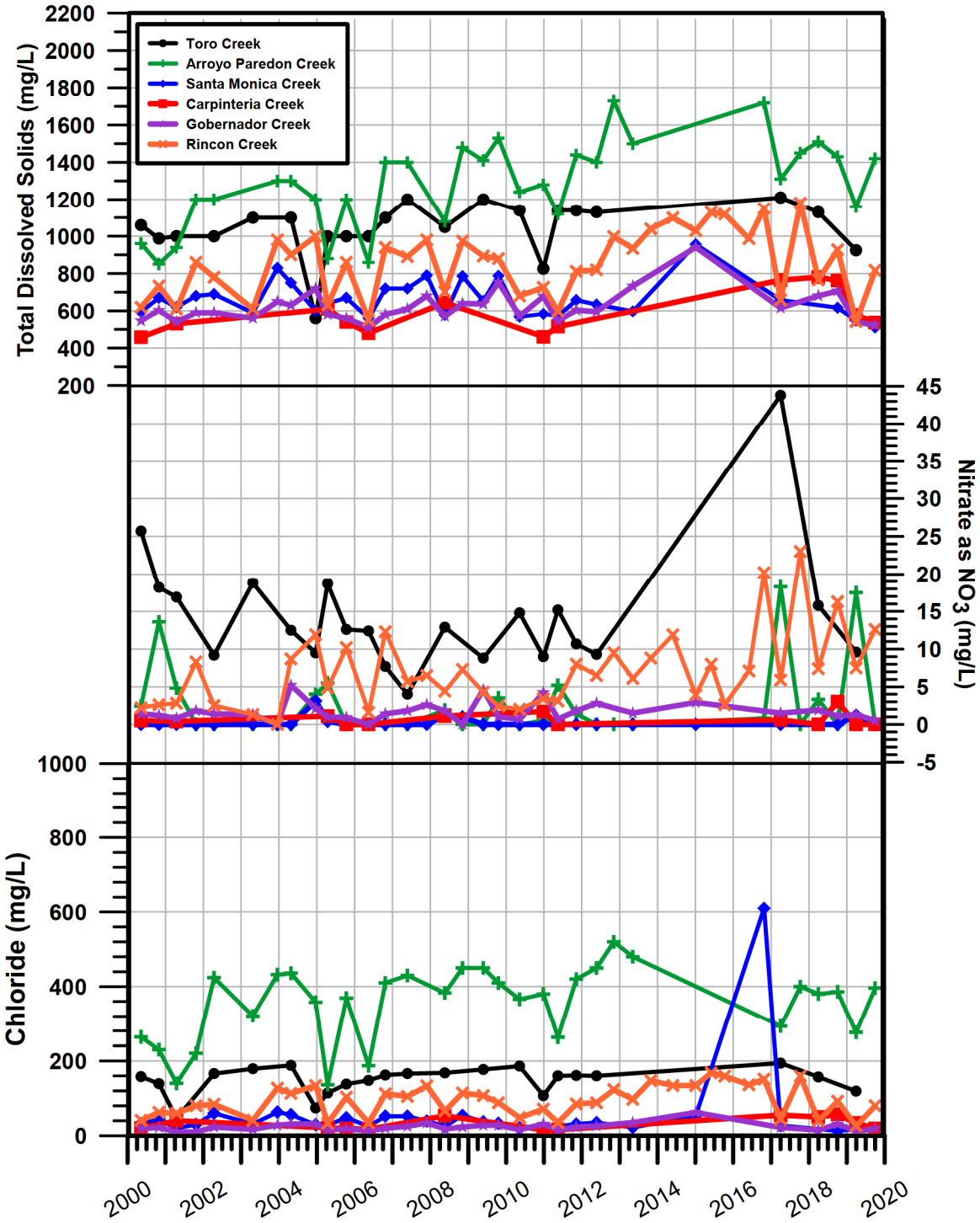


FIGURE 3-18

Water Quality Data – Surface Water

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

3.1.4 Data Gaps and Uncertainty [§354.14(b)(5)]

§354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(5) Identification of data gaps and uncertainty within the hydrogeologic conceptual model.

There is relatively good general hydrogeologic conceptual understanding of the central portion of the Basin in SU-1, primarily because this is where the municipal and the majority agricultural production and monitoring wells, as well as wildcat oil wells, have been historically drilled and been the focus of previous hydrogeologic investigations in the Basin. There are specific areas where the hydrogeologic conceptual understanding is less understood due to data limitations:

1. The stratigraphy of basin sediments offshore and the nature of the connection with the Pacific Ocean. While there is geologic control for the depth to bedrock formations and the trace of the Rincon Creek Fault offshore from oil well drilling, the geometry of the A – D Zones is currently based on extrapolation of the onshore surfaces to the offshore area.
2. The structure and aquifer parameters of SU-2 are not well understood due to the lack of wells drilled and pumping tests performed in this unit.
3. The structure, aquifer parameters and amounts of pumping in the Ventura County portion of the Basin are not well understood, largely due to this area being outside the boundaries of the CVWD and a historical lack of hydrogeologic investigation in this area of the Basin.
4. The hydraulic parameters of the individual A through D producing zones in the central portion of the Basin can only be roughly estimated because most wells in the Basin (except the recently drilled Sentinel Wells, discussed later) penetrate two or more of the main producing zones, and data developed from pumping tests therefore represent a composite of all of the zones penetrated by any given well.

3.2 Groundwater Conditions [§354.16]

3.2.1 Groundwater Elevations [§354.16(a)]

3.2.1.1 Groundwater Elevation Contours [§354.16(a)(1)]

§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.

Analysis of water-level hydrographs presented in this section led to the identification of the historical basin high and the basin low periods within the WY 1985 – WY 2020 historical water budget base period (discussed in a later section). Water-level contours have been prepared for the basin high and low periods within the base period, as well as for January 2015 and current conditions. The specific periods for which water-level contours were prepared include:

- Fall 1991 –base period historical low
- Spring 1998 – base period historical high
- January 2015 - SGMA effective date
- Spring 2020 – current seasonal high
- Fall 2020 – current seasonal and historical low

The water-level contours for these periods are presented in Figures 3-19 through 3-23.

The primary purpose of the water-level contours is to help to identify general patterns in the flow regime within the Basin, including those attributable to recharge sources and associated with discharge areas. The water-level contours show that in SU-1, groundwater generally flows in a northeast to southwesterly direction in the eastern half of the Basin, and north to south in the western half of the Basin. The directions of groundwater flow generally reflect the movement of groundwater from the primary sources of recharge in the Recharge Area to the primary sources of extraction (groundwater pumping) in the Confined Area in the central portion of the Basin. It is noted that available data for SU-2 are limited, and water-level contours are not depicted for unit this reason.

The water-level contours for the base-period historical low of fall 1991 (Figure 3-19), coinciding with the extended drought period of 1987–1991, show the development of a water-level depression centered in the central portion of SU-1. In the center of the depression, water levels during this period declined to an elevation of more than 50 feet below msl.

The water-level contours for the base period historical high of spring 1998 (Figure 3-20) show the depression earlier in the decade being filled as a result of basin recharge, with water levels recovering to levels of as much as 50 feet above msl in the same area and a seaward gradient restored throughout the Basin.

Water levels for January 2015 (Figure 3-21) show the development of a water-level depression again centered in the central portion of the Basin. It is noted that this time period coincides with the most recent drought period of WY 2012 through WY 2016. This depression persists into WY 2020, with water levels as much as 50 to 60 feet below msl in both spring and fall 2020 (Figures 3-22 and 3-23, respectively), which are presented as the current seasonal high and low, as required in the GSP Emergency Regulations.

These water-level conditions result in a reversal of the natural seaward groundwater gradient, creating the potential for seawater intrusion in the western portion of the Basin (i.e., in the general area from Sand Point to Serena) where basin deposits are exposed to the Pacific Ocean. It is noted that prior to 2019 seawater intrusion had not historically been detected in existing wells in the Basin; however, before 2019 there were no monitoring wells along the coast that that could have detected seawater intrusion.

The CVWD has recognized this deficiency in the historical monitoring well network in the Basin and recently drilled seawater intrusion “sentinel” wells near the coastline just west of El Estero (Section 3.2.3).

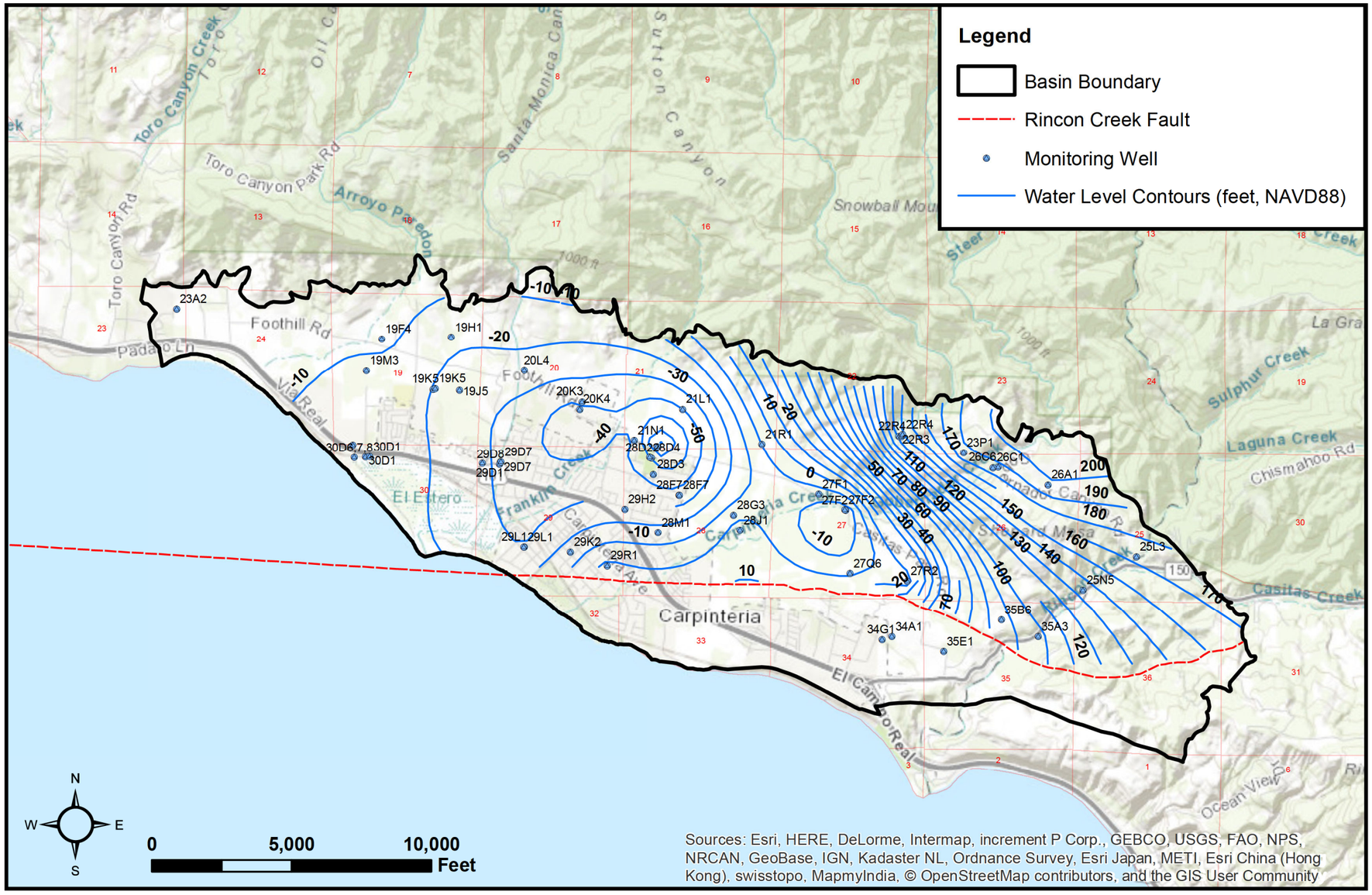


FIGURE 3-19

Groundwater Elevation Contours – Fall 1991

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

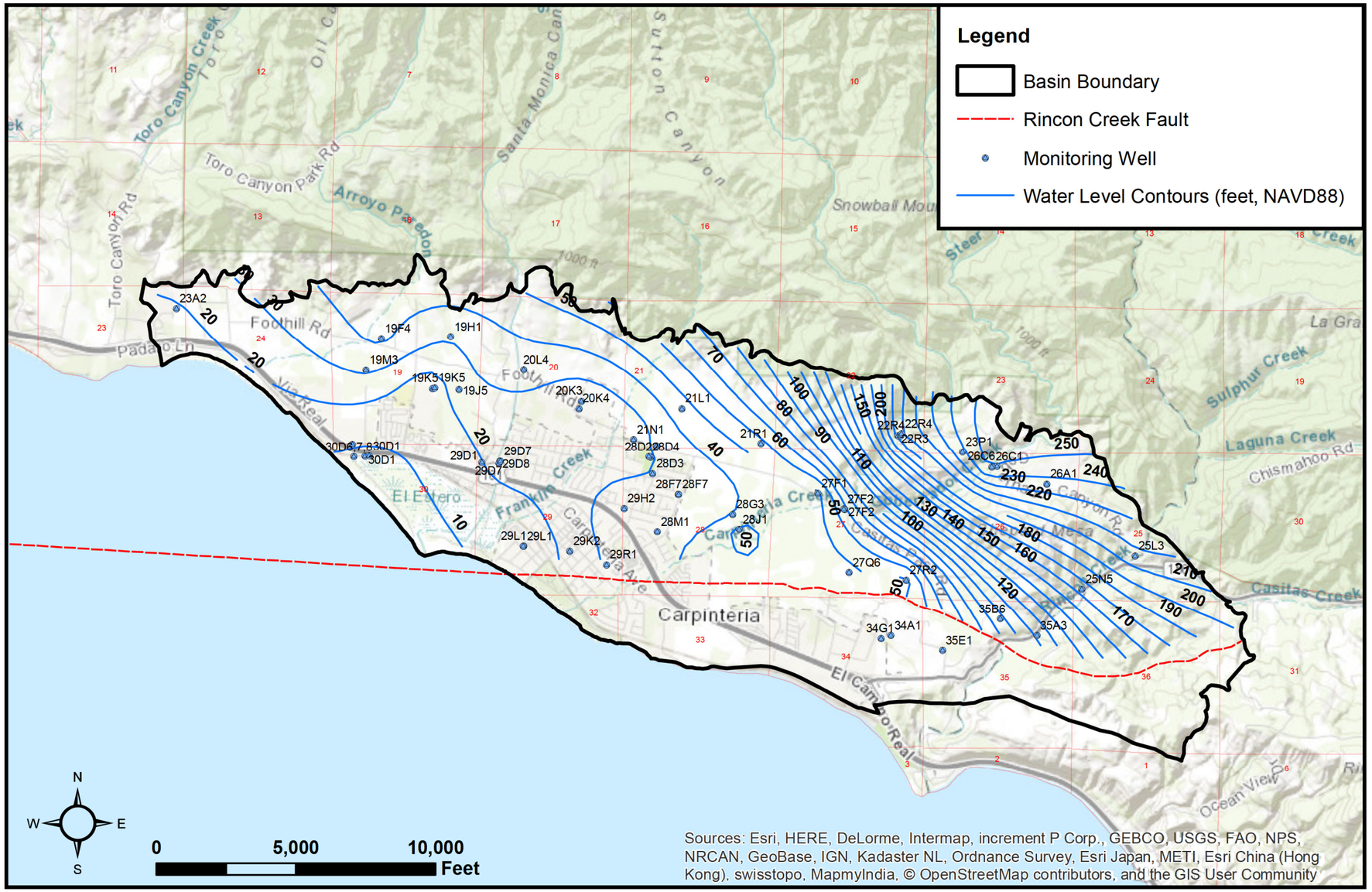


FIGURE 3-20

Groundwater Elevation Contours – Spring 1998

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

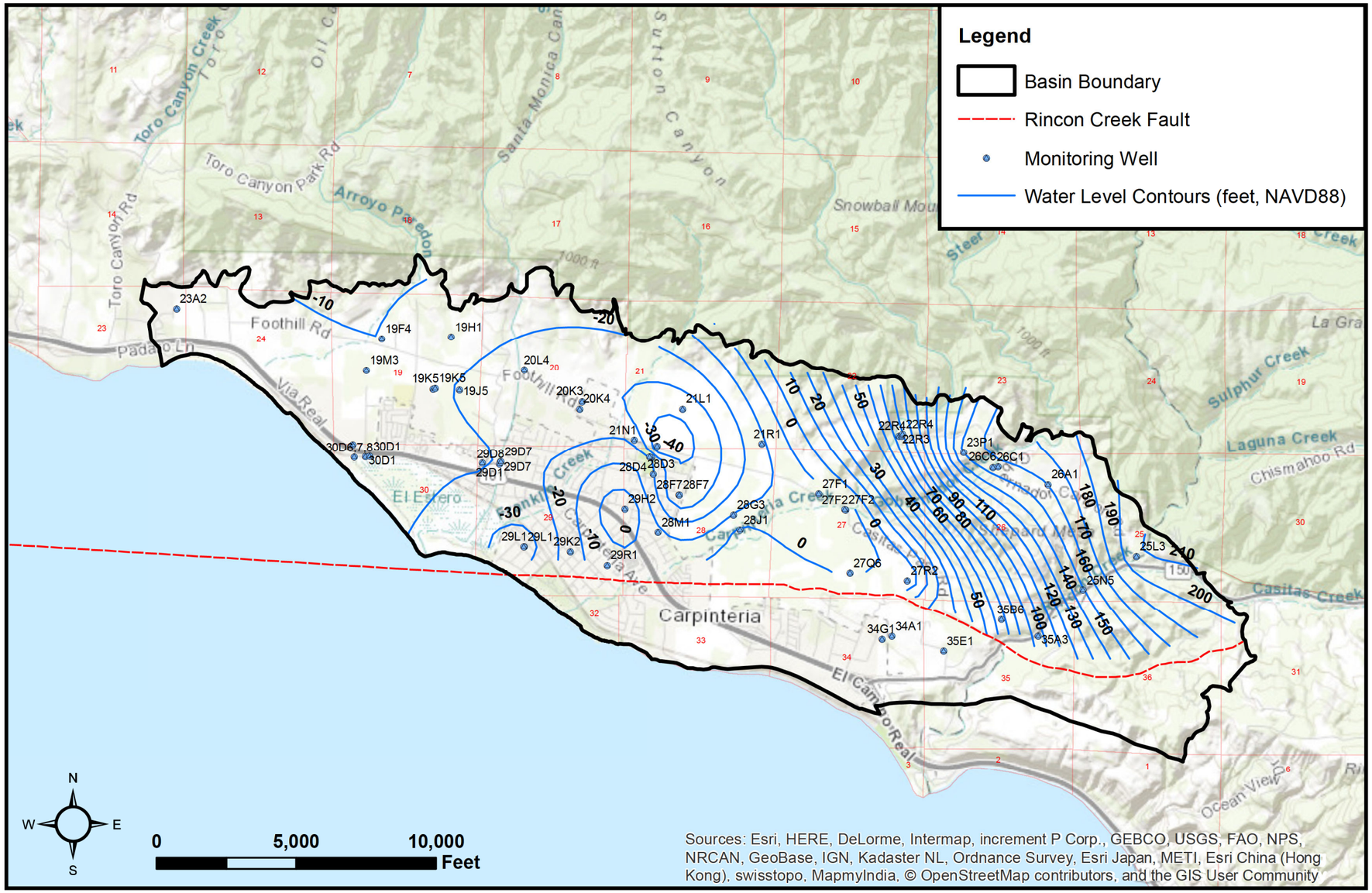


FIGURE 3-21

Groundwater Elevation Contours – January 2015

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

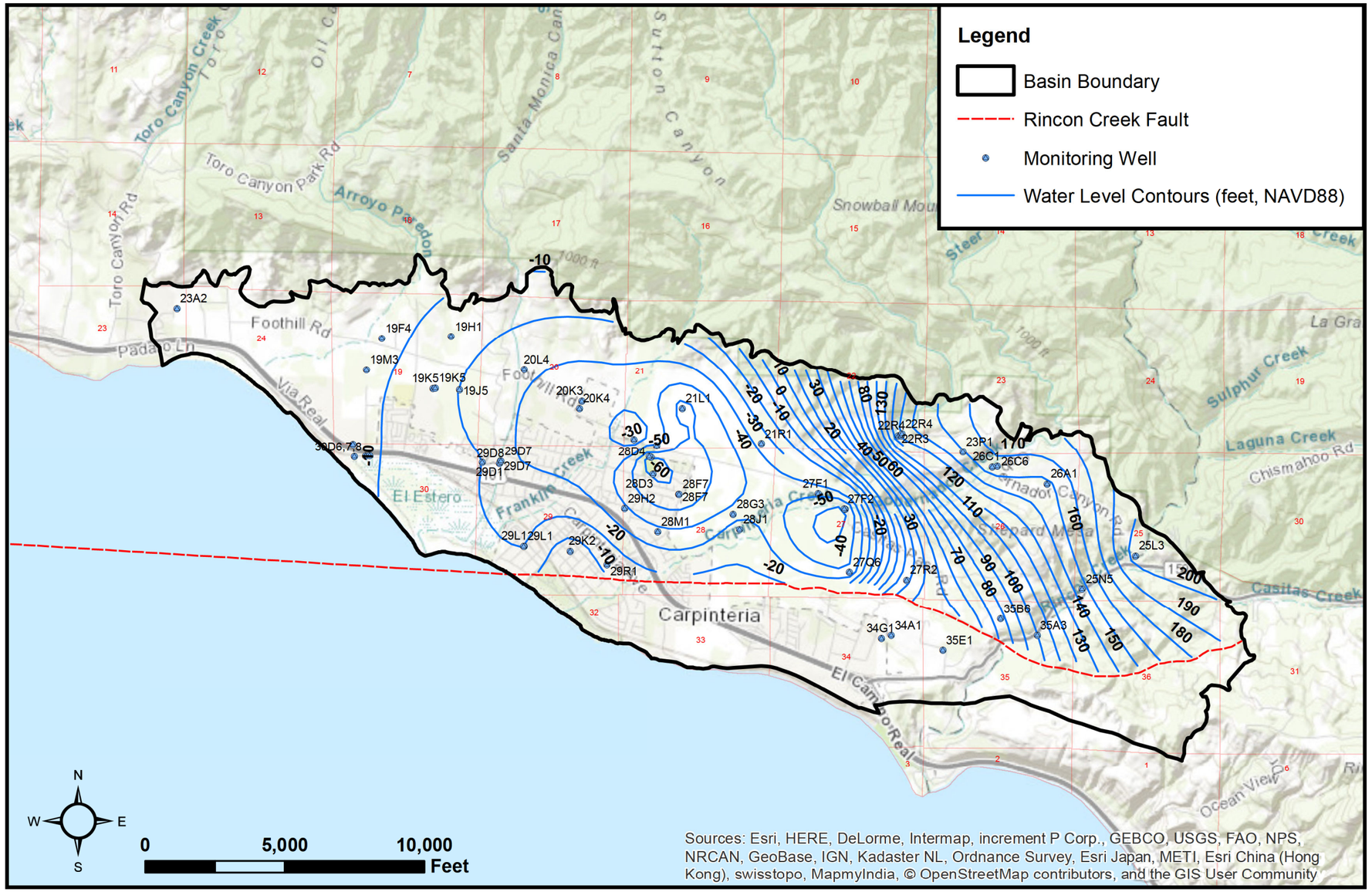
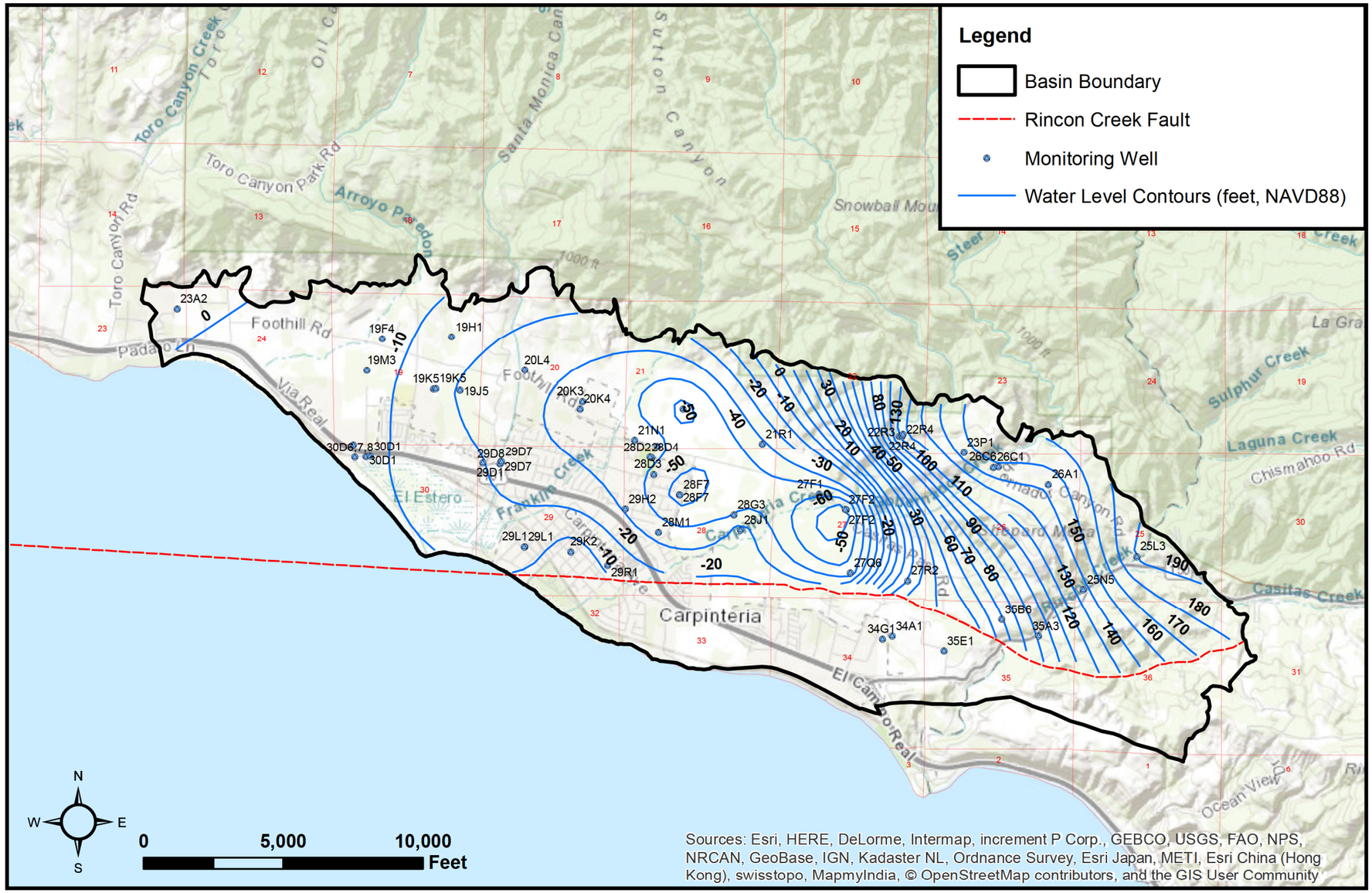


FIGURE 3-22

Groundwater Elevation Contours – Spring 2020

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

FIGURE 3-23

Groundwater Elevation Contours – Fall 2020

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

3.2.1.2 Groundwater Elevations [§354.16(a)(2)]

§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:

(2) Hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers.

Hydrographs for water-level monitoring wells in the CVWD database have been prepared for the GSP. The hydrographs are essential for understanding basin dynamics. They are used to identify water-level trends and assess aquifer response to various hydrogeologic conditions. They are also used as groundwater model calibration targets.

Water-level data in the Basin have historically been collected and maintained by the USGS and the CVWD. The USGS database contains water-level records for 75 wells in the Basin, dating back to as early as 1919 (State Well No. 4N/25W-28J1); however, most records begin in either the 1940s or 1970s. The USGS database does not extend beyond 2001. The CVWD has historically made monthly measurements at over 40 wells in the Basin, and until 2001, provided the USGS with these data to supplement the USGS database. After 2001 the CVWD continued measuring water levels at these wells as part of the AB 3030 Groundwater Management Plan program and assumed the responsibility for maintaining the water-level records. Currently, there are records for 48 wells in the CVWD database. The locations of the monitoring wells are shown in Figure 3-24 and hydrographs for selected wells are presented on Figures 3-25 through 3-29. The following discussion pertains to these selected hydrographs. A complete set of hydrographs with all available data is included in Appendix D.

In general, the long-term hydrographs for SU-1 display seasonal and small amplitude annual fluctuations superimposed upon some larger, more prominent trends. Prior to the historical water budget period of WY 1985 – WY 2020, the most notable trends occurred during the late-1940s through the mid-1950s when water levels in the Basin declined substantially, and between approximately the early 1960s and about 1975 when water levels in the Basin increased significantly. These trends are evident in the hydrographs depicted in Figures 3-25 through 3-29 (wells 19F4, 26A1, 28J1, in the Recharge Area (Figure 3-9) and well 30D1 in the Confined Area.

There are notable trends within the historical WY 1985 – WY 2020 water budget period as well. Water levels declined relatively sharply starting at the beginning of the base period through the fall of 1991, corresponding to the extended six-year drought of 1987–1992. This was followed by a relatively steep upward trend in water levels peaking around the spring of 1998, which was the wettest year on record (approximately 55.5 inches of rainfall). After 1998, water levels throughout most of the Basin displayed a gradual declining trend until the early- to mid-2000s when water levels essentially stabilized until around 2012. Water levels at most wells steadily declined during the extreme drought period of 2012 through 2016. Water levels have generally been stable or slightly rising at many, but not all, wells since 2016. It is notable that recent (2020) water levels at many locations are at lower elevations than occurred in during the 1987–1992 drought period and are approaching the historical lows observed during the 1950s at some locations. In wells 19F4 and 28J1 (Figures 3-25 and 3-28), current water levels are comparable to those observed in the 1940s/1950s drought, In wells 26A1 and 30D1 (Figures 3-26 and 3-29), water levels in the 1940s/1950s drought are lower than current water levels. All five hydrographs indicate that current water levels are lower than water levels observed in the 1980s/1990s drought.

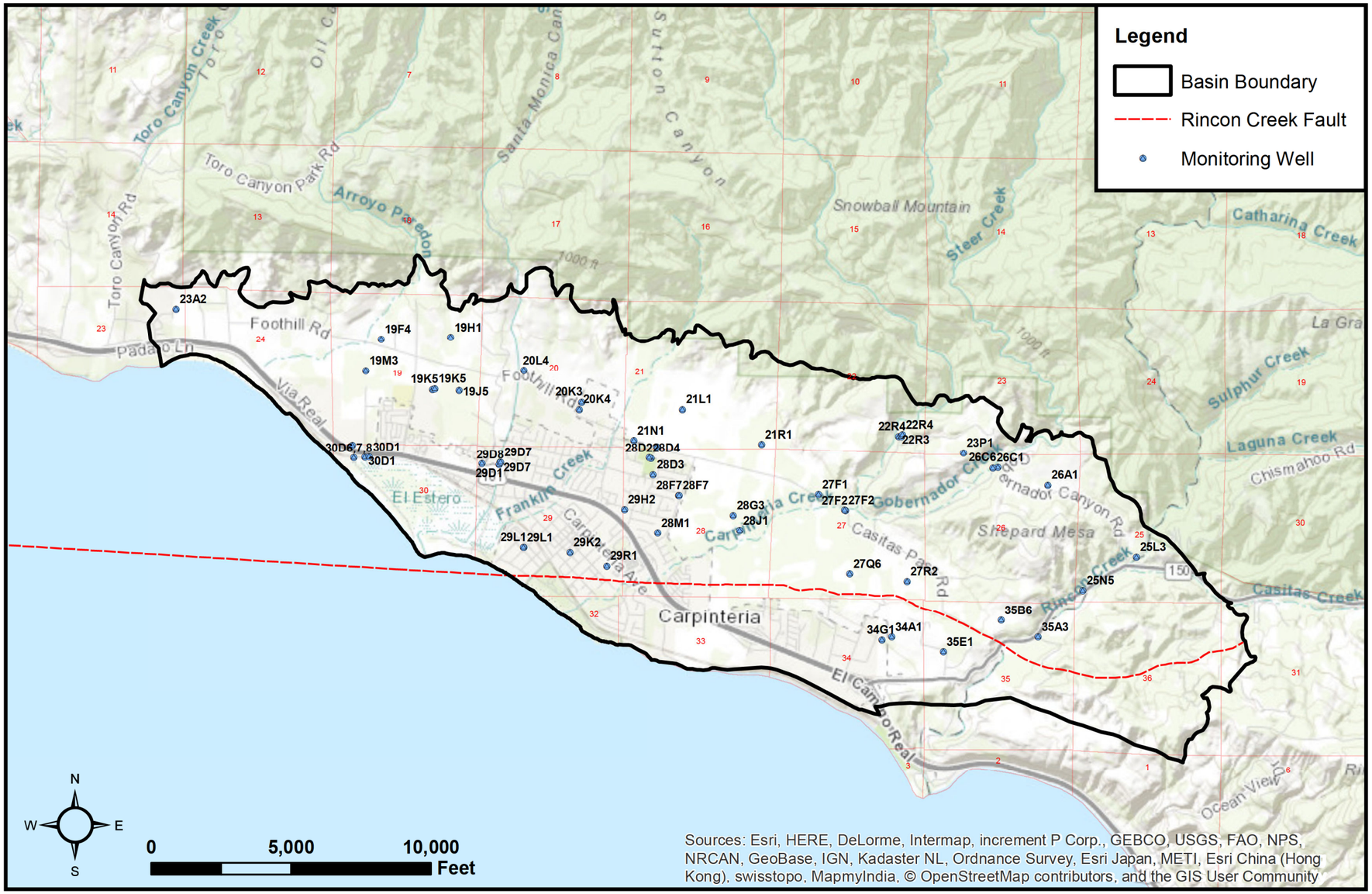
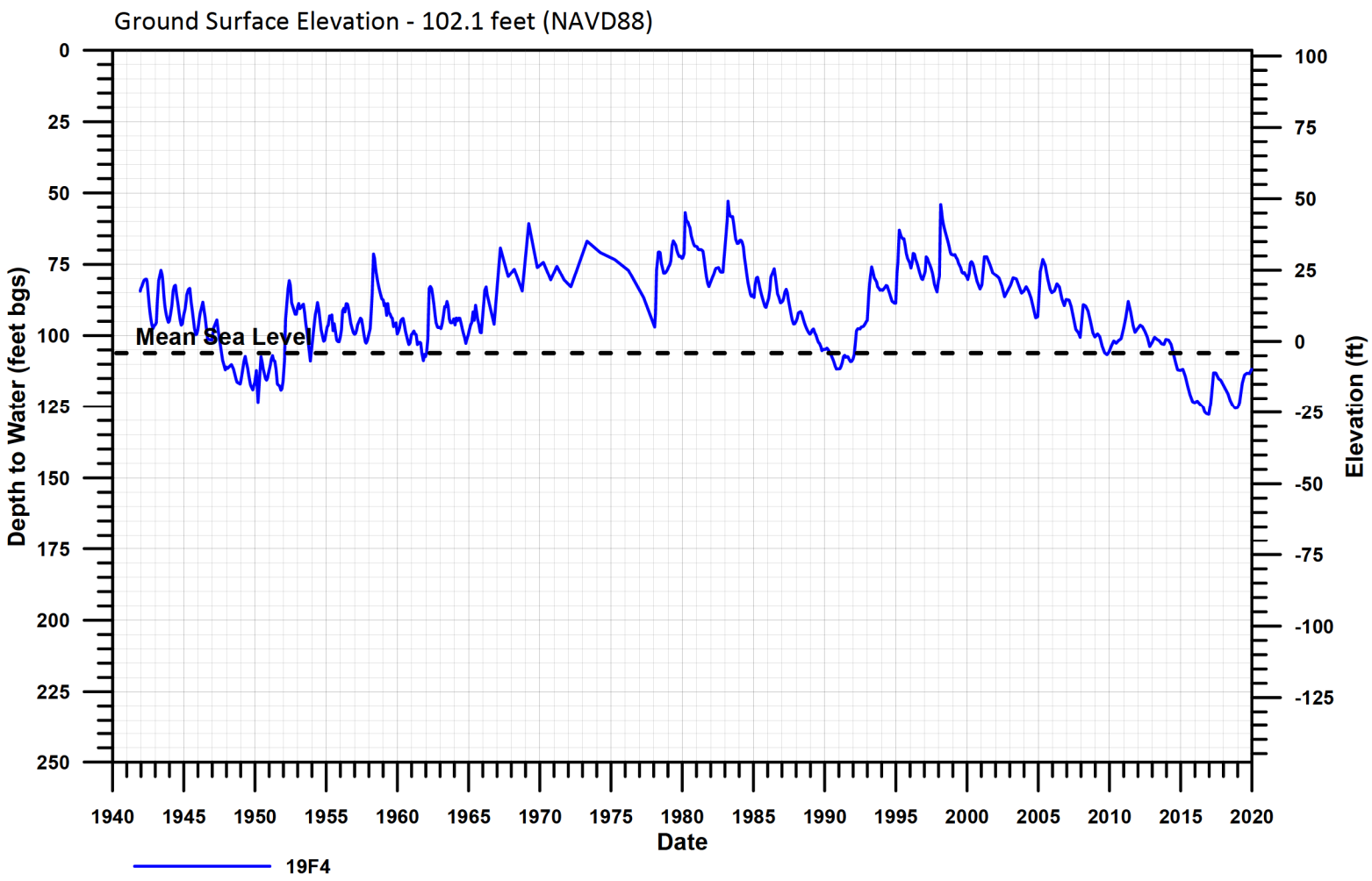


FIGURE 3-24

Monitoring Well Location Map

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3



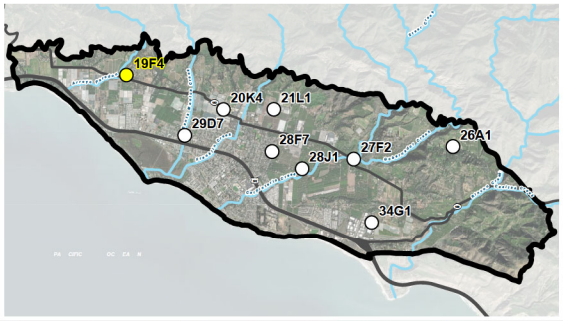


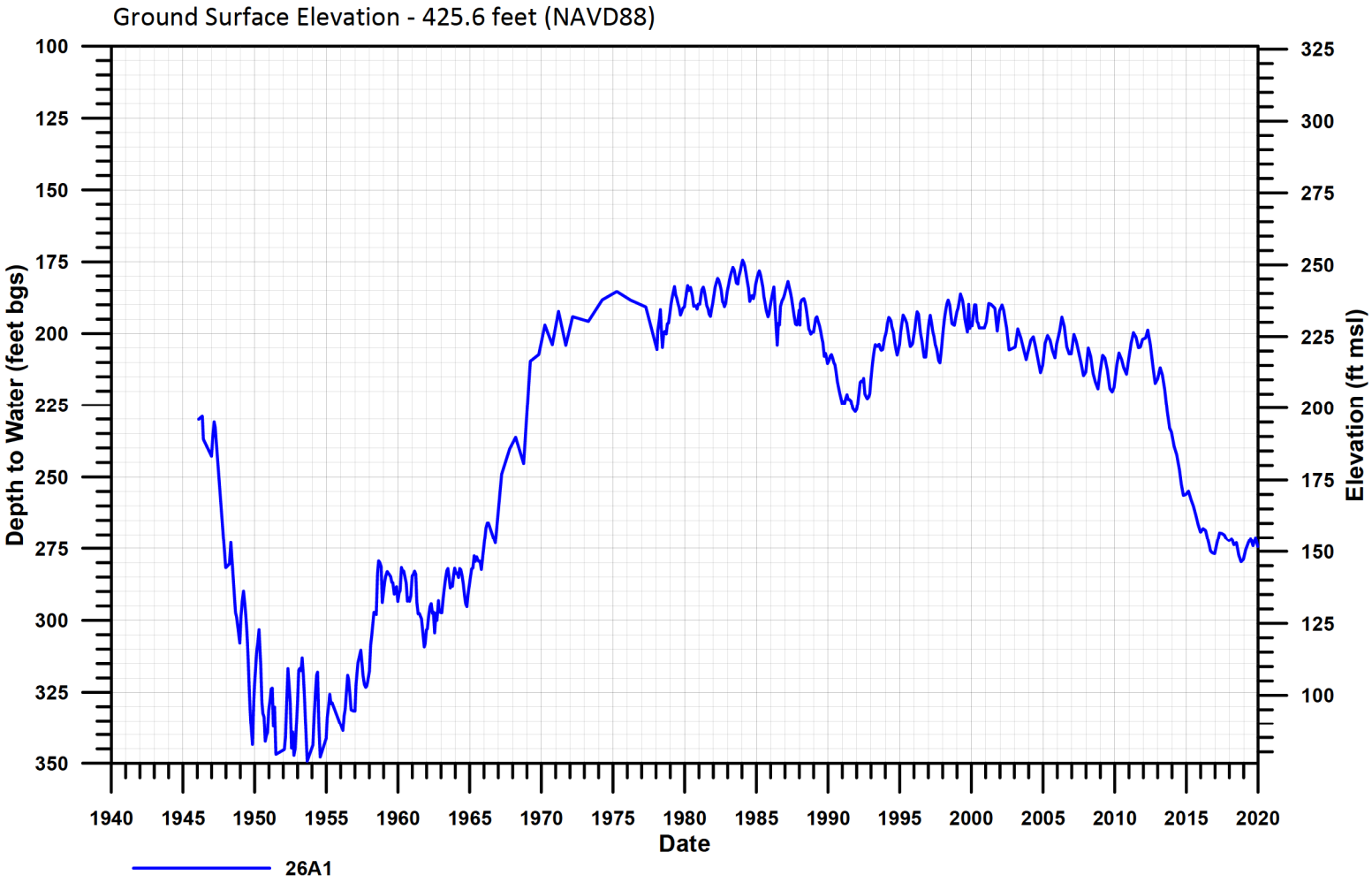
FIGURE 3-25

Water Level Data – 4N/25W-19F4

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3



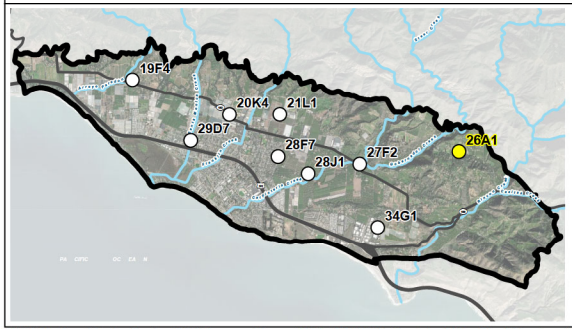
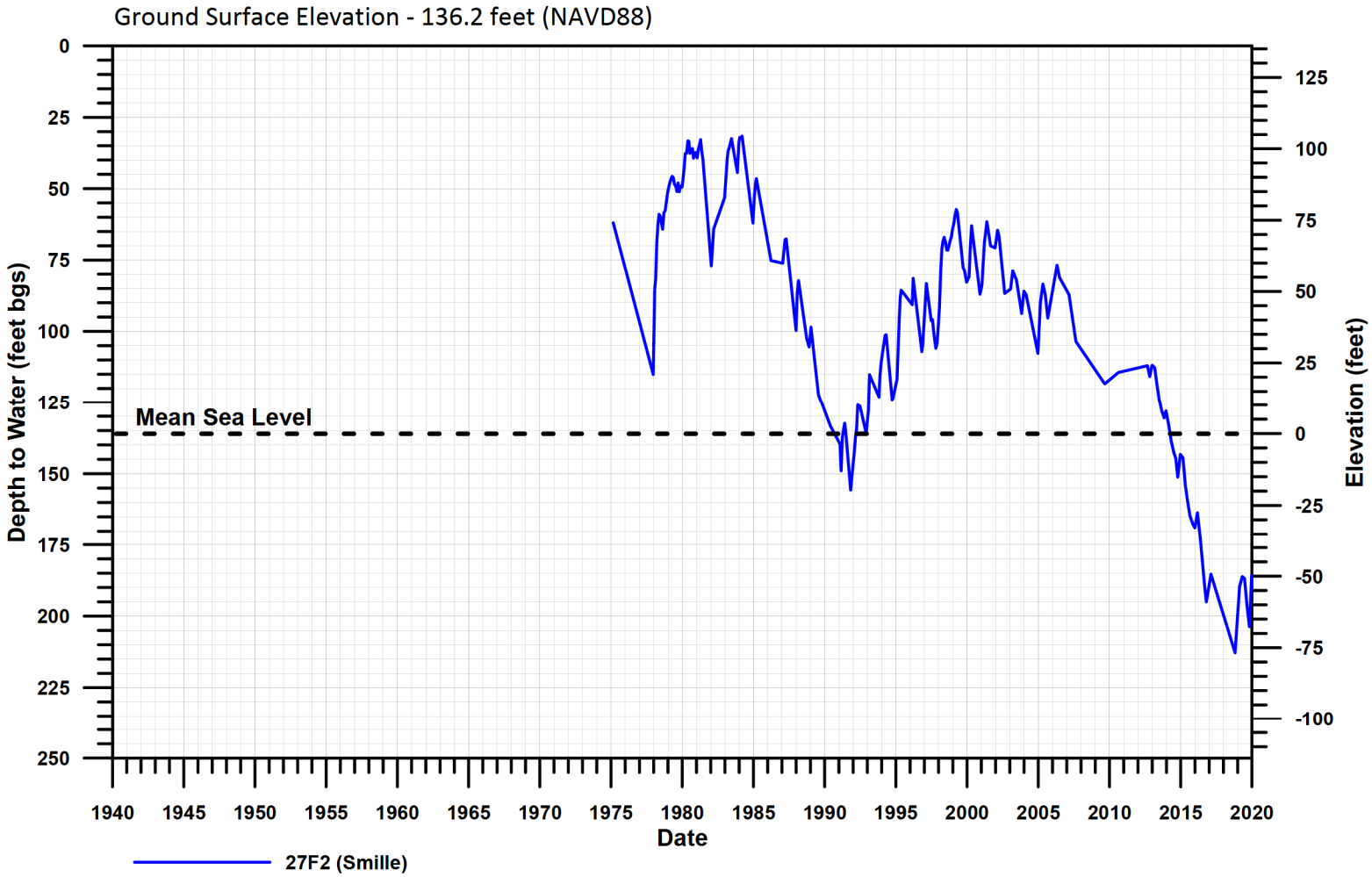


FIGURE 3-26
Water Level Data – 4N/25W-26A1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3



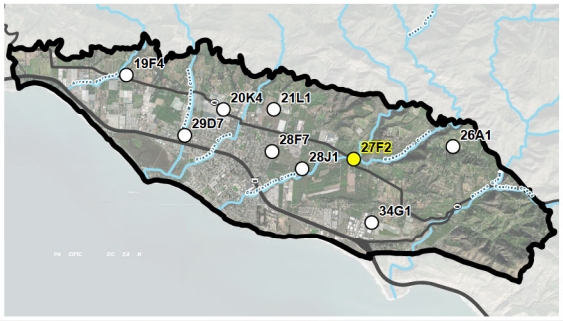


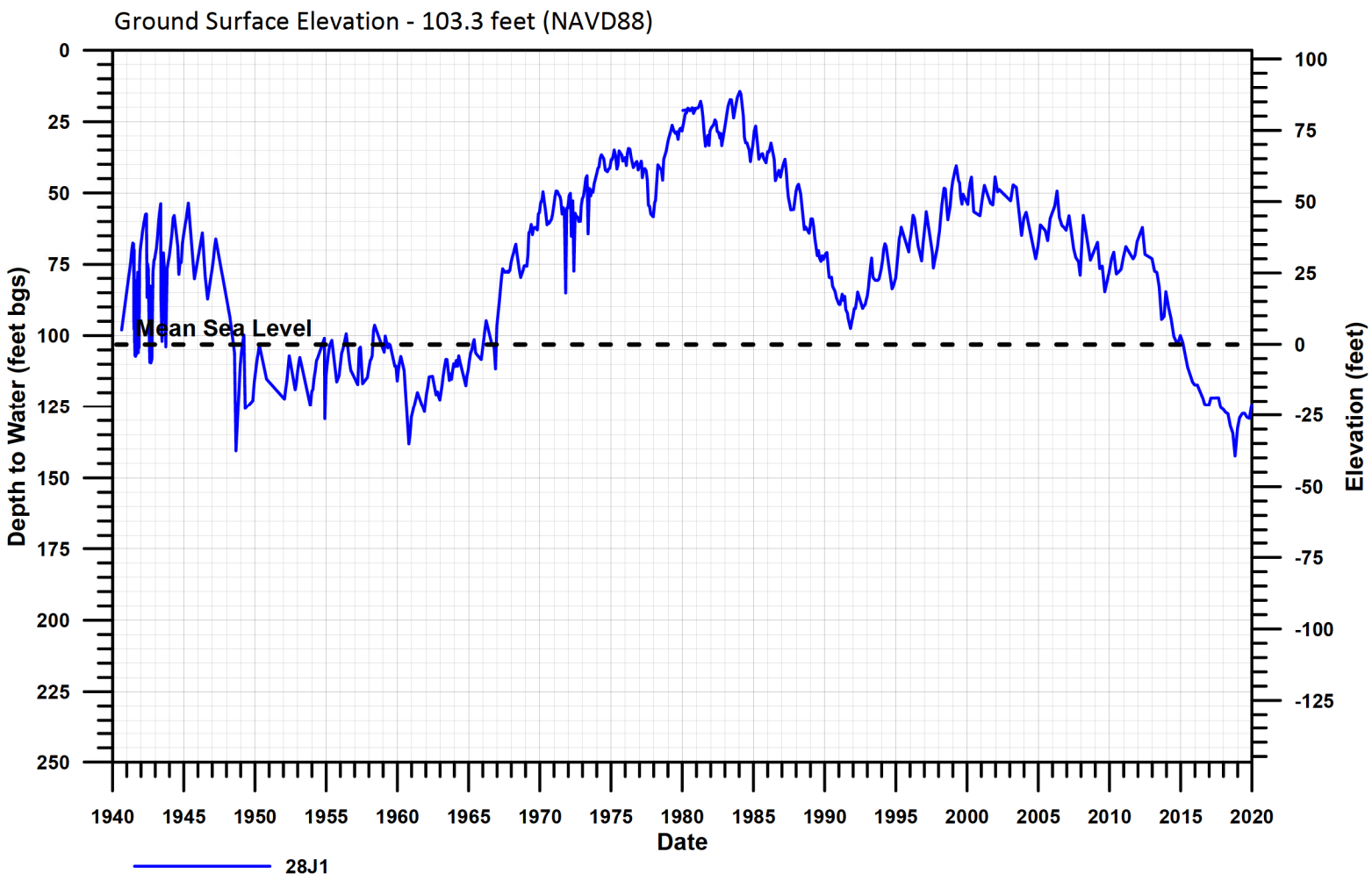
FIGURE 3-27

Water Level Data – 4N/25W-27F2 (Smille)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3



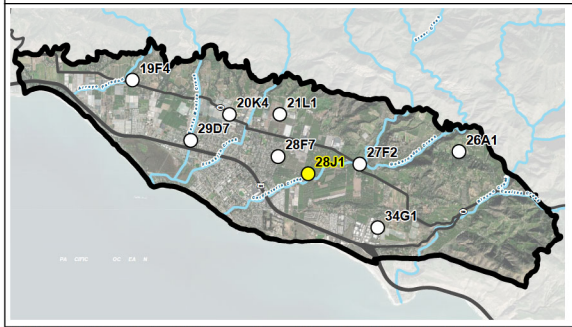


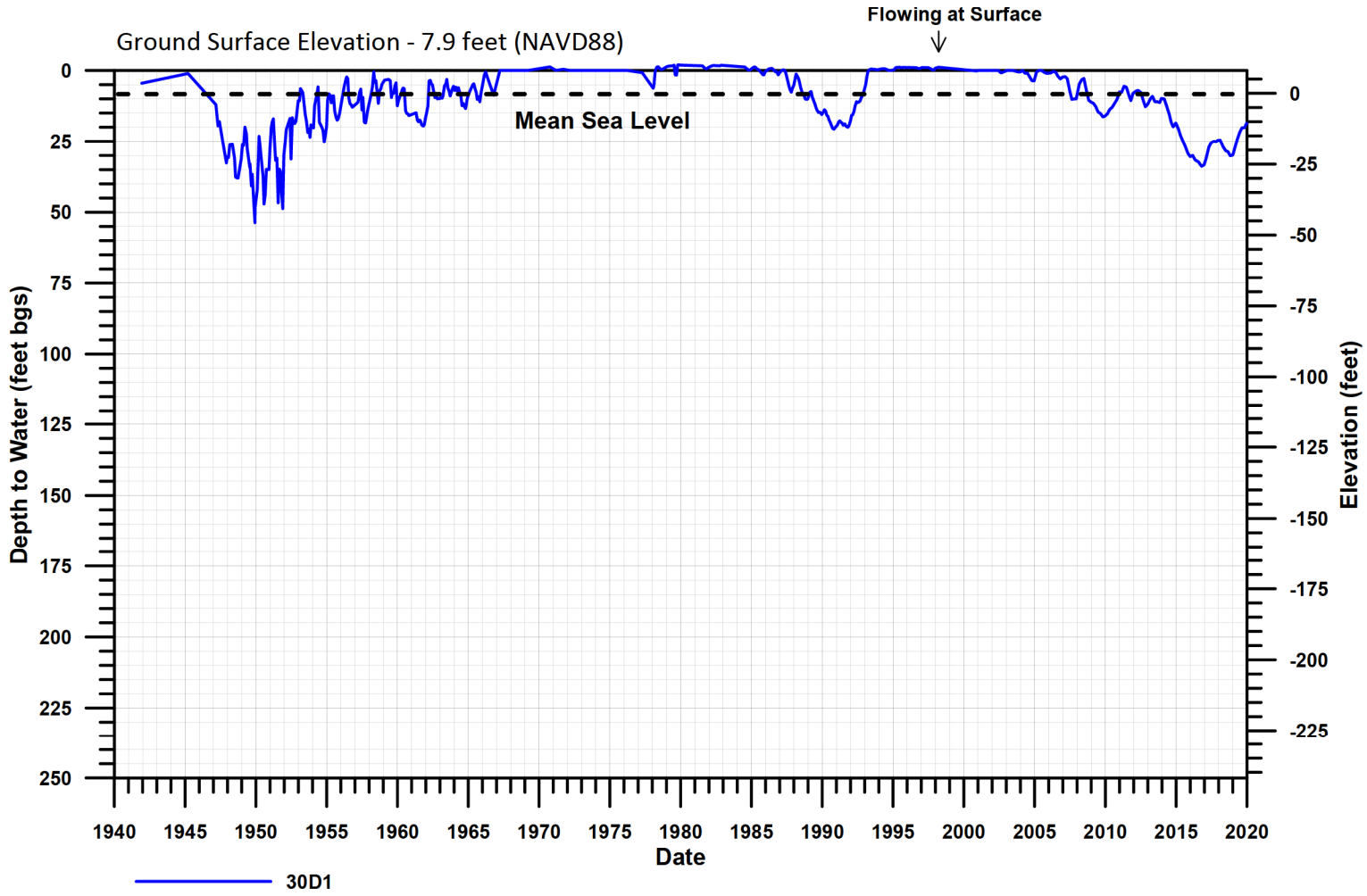
FIGURE 3-28

Water Level Data – 4N/25W-28J1

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3



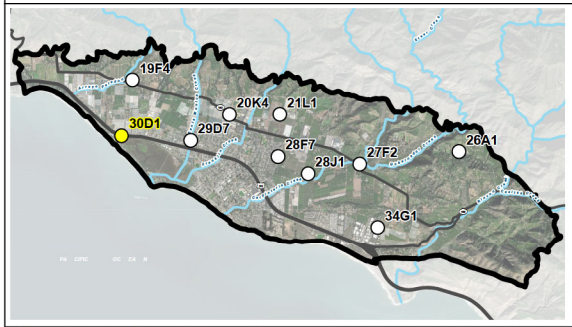


FIGURE 3-29

Water Level Data – 4N/25W-30D1

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

3.2.2 Change in Storage [§354.16(b)]

§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:

(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.

The amount of groundwater in storage in the Basin generally reflects changes in groundwater elevations over time. Figure 3-30 shows the changes in storage from WY 1985 through WY 2020 as calculated by the difference between annual inflows and outflows according to the historical water budget (see Section 3.3). During this period groundwater elevations were depressed in SU-1 during the late 1980s/early 1990s when groundwater pumping was between approximately 3,300 and 5,400 AFY and during the more recent period of 2012 through 2020 when groundwater pumping was between approximately 3,400 and 6,700 AFY. As discussed later in the Water Budget section, these periods coincide with below-normal rainfall and recharge of the basin aquifers. Figure 3-30 shows how groundwater was consistently lost from storage most years during these dry periods as a result of the imbalance between recharge and pumping in the Basin.

3.2.3 Seawater Intrusion [§354.16(c)]

§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:

(c) Seawater intrusion conditions in the basin, including maps and cross-sections of the seawater intrusion front for each principal aquifer.

As discussed previously, the primary producing zones of SU-1 north of the Rincon Creek Fault to the vicinity of Serena Park is believed to be exposed to the Pacific Ocean and, therefore, at potential risk for seawater intrusion. From limited water-quality data from the 1930s for shallow wells in the vicinity of Serena Park, Upson and Thomasson (1951) observed that, although chloride ion concentrations in this area were relatively high, such concentrations were present in wells further inland as well. He concluded that seawater intrusion had not occurred in the Basin but could occur if excessive pumping caused a lowering of groundwater levels in the Basin. Subsequent studies conducted by the USGS during the 1950s showed that shallow wells near the coastline maintained relatively consistent chloride concentrations around 30 mg/L even though water levels had declined in areas of the Basin to as much as 40 feet below msl.

GTC (1976) further concluded that the relatively high chloride concentrations in shallow wells discussed by Upson and Thomasson (1951) appeared to be the result of the chemical nature of the sediments (e.g., connate water still incompletely flushed), local degradation by irrigation returns and/or minor amounts of degradation of the shallow deposits where they are in direct communication with the Pacific Ocean. In the central Confined Area of the Basin, the low-permeability confining layer was believed to prevent the vertical communication between the shallow and deeper aquifer system, although vertical communication between zones likely occurs at the western margins of the Basin outside the Confined Area.

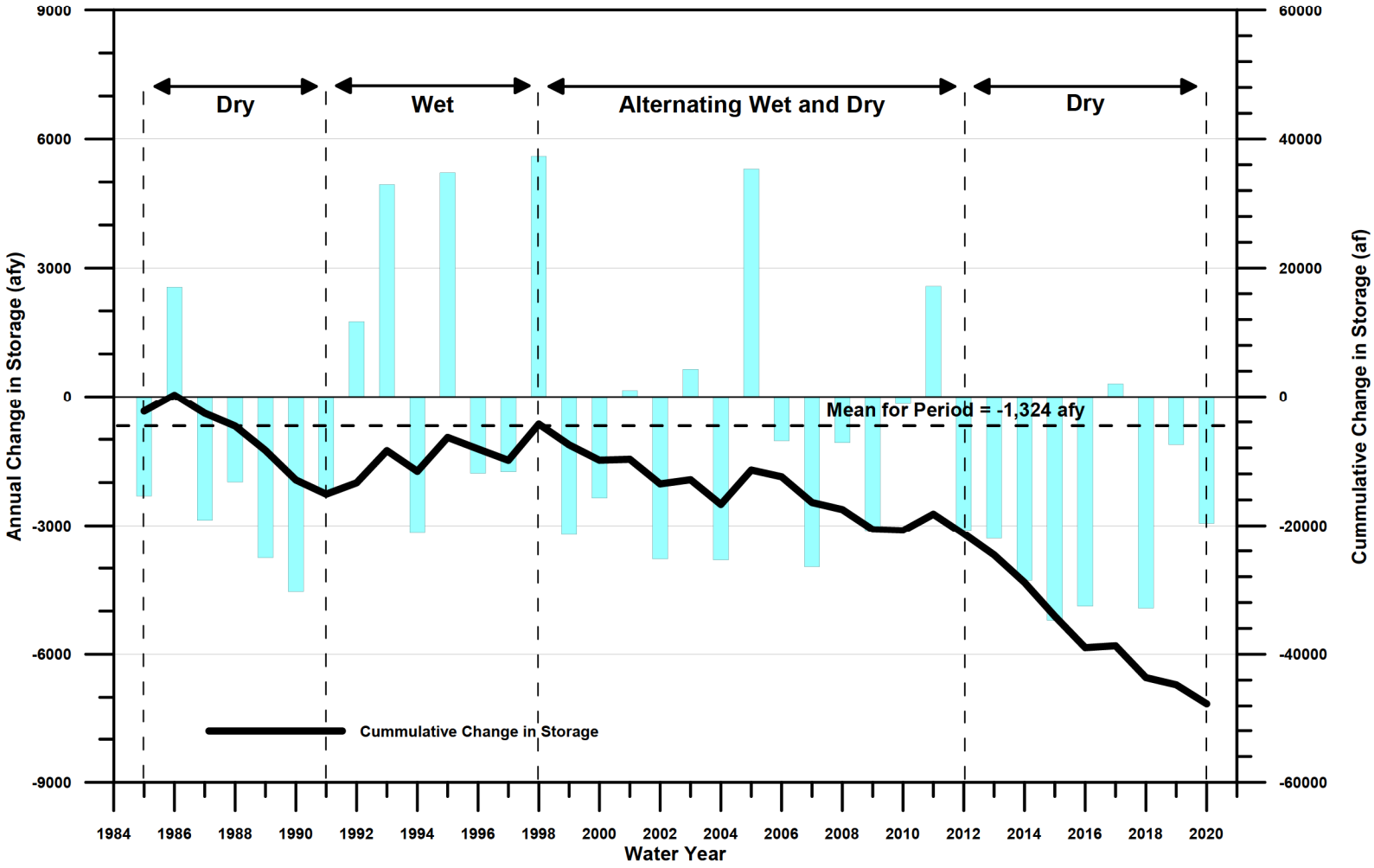


FIGURE 3-30

Change in Groundwater in Storage (WY 1985-2020)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

Thus, seawater intrusion has not historically been documented by previous investigations in the Basin. Evaluation of basin conditions over recent years through the AB 3030 program, however, led to the identification of gaps in the existing monitoring well network, one of which was a monitoring well capable of the detection of seawater intrusion into the primary producing zones of the Basin (i.e., the absence of evidence is not evidence of absence). This important data gap was initially identified in PWR (2012), which documented the Hydrogeologic Update and Groundwater Model Project and recommended that the CVWD should install at least one coastal sentinel monitoring well in the northwest portion of SU-1 of the Basin that has dedicated monitoring wells completed in the A, B and C Zones. This recommendation was repeated in each subsequent AB 3030 annual reports.

Sentinel Monitoring Wells. In 2019 the CVWD implemented the CGB Sentinel Well Project, which consisted of the installation of a cluster of monitoring wells near the northwestern margin of the Carpinteria Salt Marsh (El Estero), a location considered to be key for the collection of water-level and water-quality data related to evaluating the potential for seawater intrusion in the Basin. The primary purposes of the Sentinel Well Project were:

1. Determine baseline water-quality conditions at this key location in the Basin;
2. Allow for the collection of water-level and water-quality data through routine monitoring;
3. Establish a mechanism to track water-quality changes in distinct water bearing zones through routine induction logging; and,
4. Serve as an early warning indicator (i.e., “sentinel”) for seawater intrusion into the Basin.

It is noted that, in addition to providing the first monitoring location capable of detecting seawater intrusion in the principal aquifer of the Basin, the Sentinel Wells are also the first monitoring well cluster in the Basin with discrete and isolated completions within the three main producing zones in the Confined Area (A, B and C Zones).

The drilling and construction of the wells occurred between May 20 and August 1, 2019. The wells are identified as the CGB Sentinel Monitoring Well Nos. 1, 2, and 3, with well completions (screens) within the C, B, and A Zones of the Basin, respectively. Well construction and completion details are provided in Table 3-1.

Table 3-1. Sentinel Well Completion Summary

Parameter	MW-1	MW-2	MW-3
Total Drilled Depth (feet)	1,240	880	350
Casing Depth (feet)	1,130	870	340
Casing Diameter (inches)/PVC Grade	3 / sch. 120	3 / sch. 80	3 / sch. 80
Screened Interval (feet)	1,020 – 1,120	780 to 860	190 – 330
Depth of Cement Grout Annular Seal (feet)	955	709	150
Screened Producing Zone	C	B	A

Depictions of the monitoring well completions with respect to the hydrostratigraphic conditions at the Sentinel Well site are provided on Figure 3-31.

Following well completion, water-level transducer/dataloggers were installed in each of the Sentinel wells to continuously measure and record water levels. Water-quality samples are also collected on a quarterly basis, which includes chloride ion, a key indicator of seawater intrusion. The water-level and chloride data collected after the construction of the wells are presented graphically in Figure 3-32 (MW-1), Figure 3-33 (MW-2), and Figure 3-34 (MW-3).

As shown on Figure 3-32, the initial water level in MW-1 in August 2019 was approximately -2.7 feet msl. As shown, during periods of limited pumping, such as during the winter/spring period of 2020/2021, water levels recovered to levels slightly above sea level. During periods of continuous pumping, such as fall/winter period 2021/2022, the water level declined to approximately 15 feet below msl.

As also shown on Figure 3-32, chloride concentrations at MW-1 have been steadily increasing throughout the limited period of record. The baseline chloride concentration in July 2019 in MW-1 (C Zone) was less than the recommended Secondary Maximum Contaminant Level (SMCL) of 250 mg/L at a level of 44 mg/L. Increasing chloride concentrations began to exceed the SMCL as early as December 2019 with the most recent concentration in February 2022 at 1,530 mg/L. Although the rate of increase does appear to moderate somewhat during periods of relatively higher water levels, such as winter/spring of 2021/2022, the overall increasing trend appears to be relatively insensitive to the approximate 10 to 15 feet of water level fluctuations observed to date at this well.

At MW-2 (Figure 3-33, B Zone) was also below the SMCL at a level of 24 mg/L with the initial water level in August 2019 well below sea level at an elevation of approximately -17.5 feet msl. The water levels at MW-2 appear to respond rapidly to Basin pumping. During periods of limited pumping, such as during the winter/spring of 2020/2021, water levels increased to levels just below sea level at elevations of approximately -3 to -5 feet msl. During periods of significant continuous pumping, such as the fall/winter of 2021/2022, water levels declined to levels greater than 30 feet below msl (as shown on Figure 3-33, the water levels during some of this period declined below the depth setting of the water-level transducer, which has recently been lowered). Interestingly, chloride concentrations have fluctuated significantly at this well, ranging between 44 and 577 mg/L, without an apparent correlation with either water level conditions or estimated pumping. Most recently, the chloride concentration was at the lowest recorded level of 44 mg/L in February 2022, well below the SMCL.

As shown on Figure 3-34 (A Zone), the baseline chloride concentration in July 2019 was less than the SMCL of 250 mg/L, at a level of 22 mg/L, with the initial water level in August 2019 at an elevation of approximately -12.9 feet msl. Similar to MW-2, the water levels at MW-3 appear to respond rapidly to Basin pumping. During periods of limited pumping, such as the winter/spring of 2020/2021, water levels increased to elevations of approximately -4 to -5 feet msl. During periods of significant continuous pumping, such as the fall/winter of 2021/2022, water levels declined up to 17 feet below msl. Chloride concentrations at MW-3 have remained stable throughout the period record, fluctuating only between 21 and 24 mg/L, well below the SMCL of 250 mg/L.

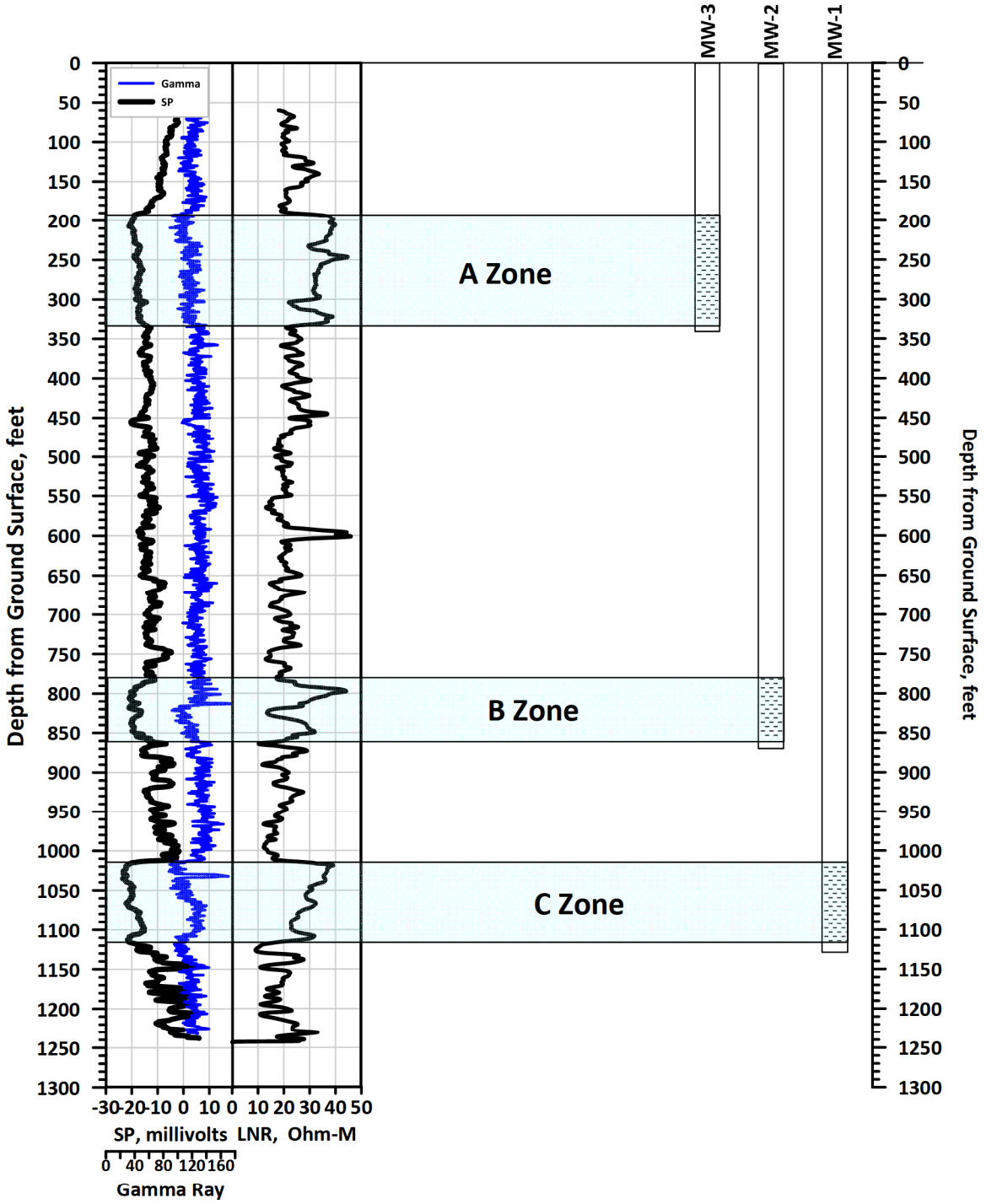


FIGURE 3-31

Sentinel Well Completions Schematic

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

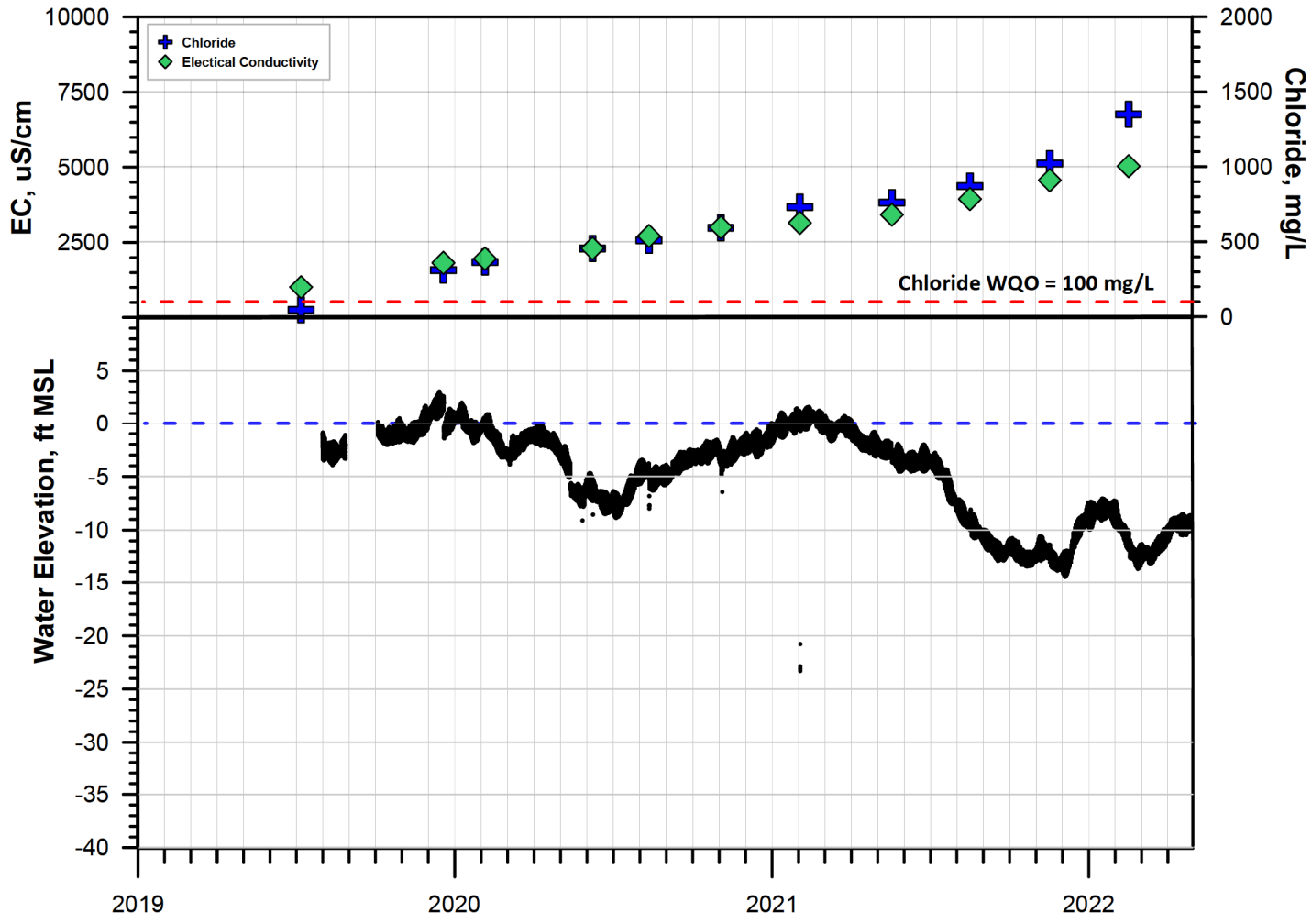


FIGURE 3-32

Sentinel Well Data – MW-1 (C Zone)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

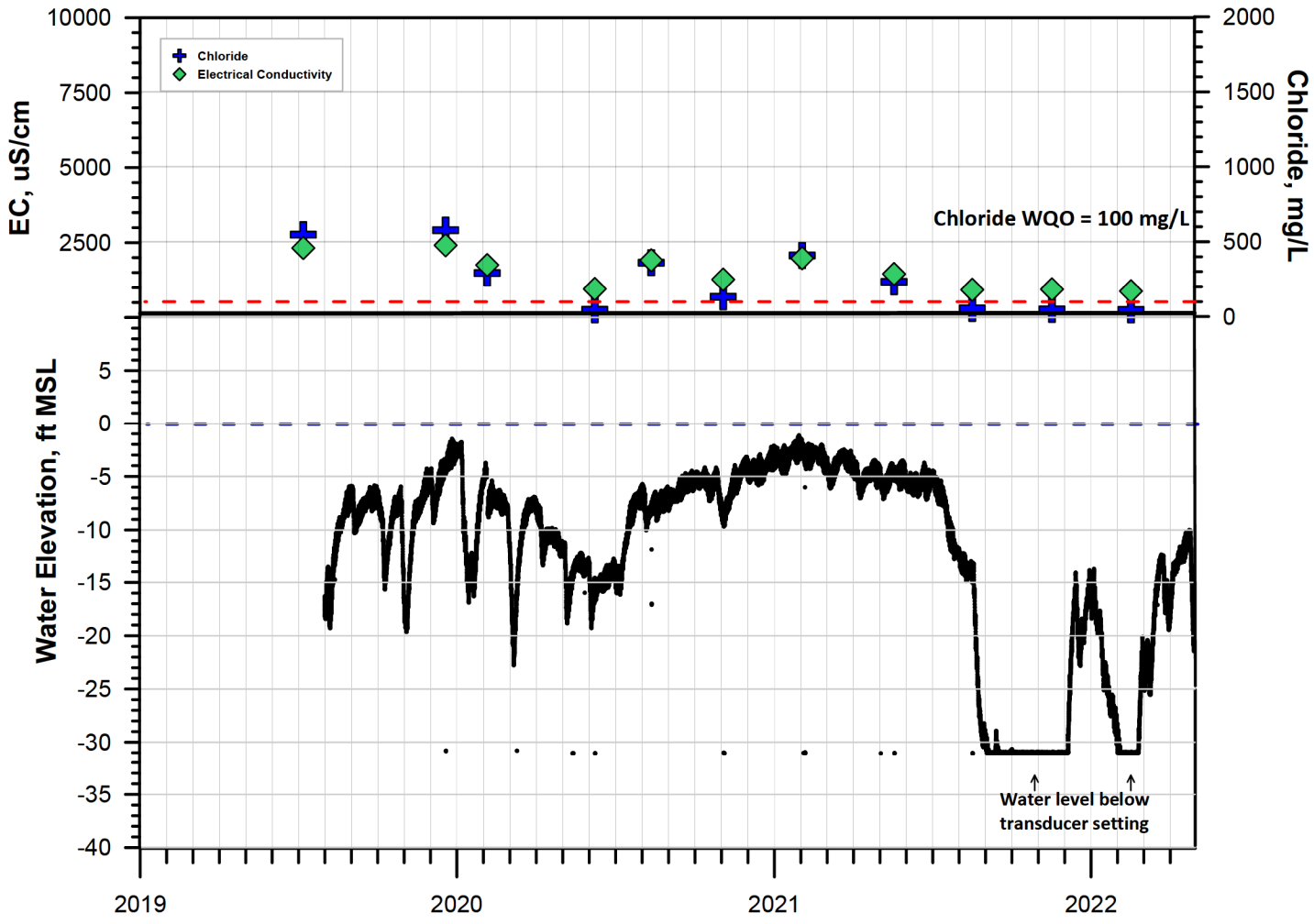


FIGURE 3-33

Sentinel Well Data – MW-2 (B Zone)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

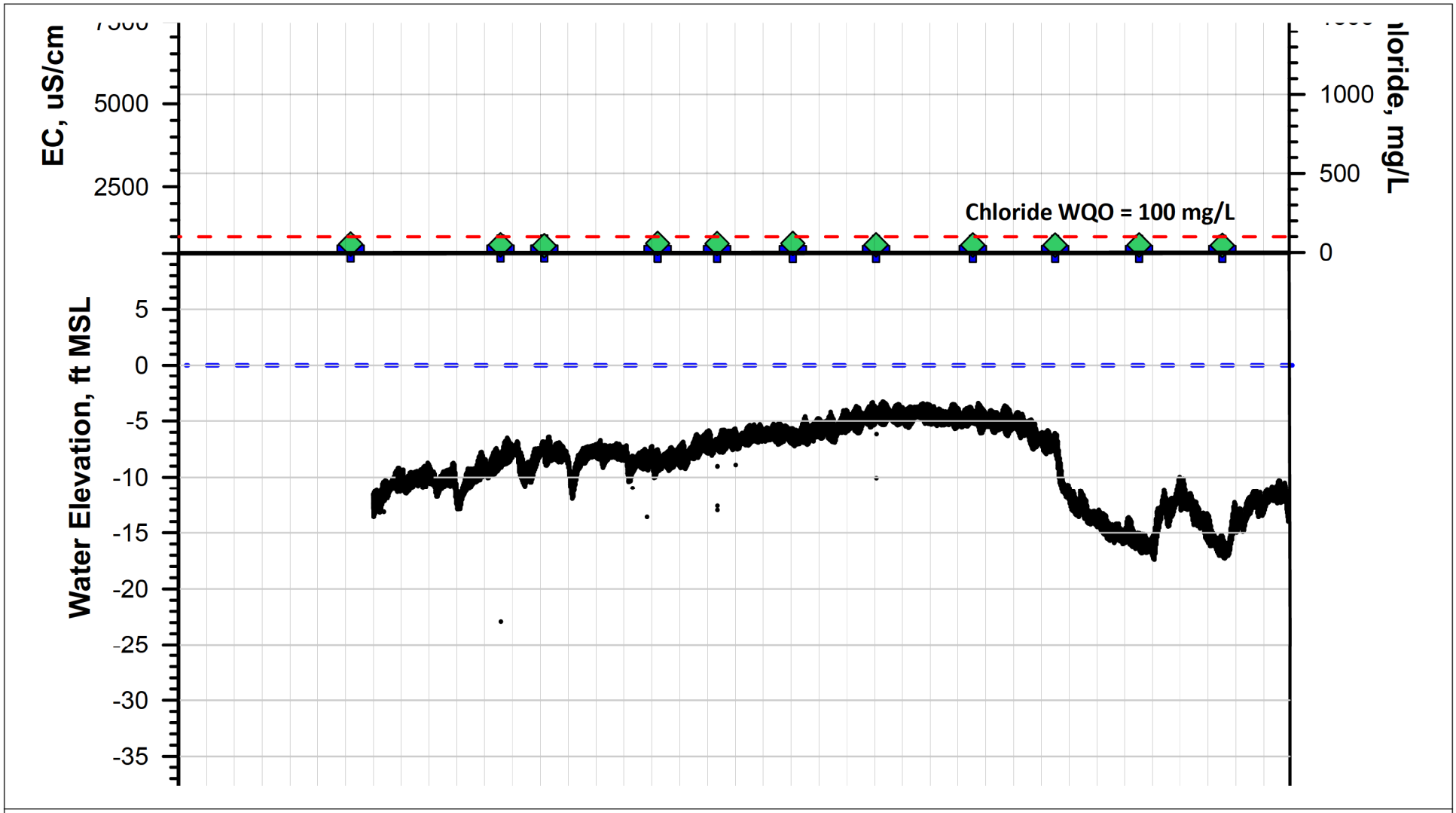


FIGURE 3-34

Sentinel Well Data – MW-3 (A Zone)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

In addition to the water-level and water-quality data discussed previously in this section, downhole induction logging is being performed at MW-1 on a quarterly basis. Induction logging measures the bulk electroconductivity of the aquifer materials and formation water within an approximate 6-foot diameter sphere of the tool. The tool is lowered down the well and captures the combined conductivity of the fluid and solids surrounding the casing for the length of the well. Its ability to capture changes in water quality is based on the fact that the solids (silt, sand and clay) that comprise the materials outside the casing have constant conductivities, whereas the conductivity of the pore fluid can change over time. If water of poorer or better quality replaces existing pore water in the formation, conductivities will increase or decrease, respectively, and the relative changes can be measured through induction logging. Sequential logging captures temporal conductivity changes in the aquifer system.

The results of the quarterly induction logging surveys performed at MW-1 are shown on Figure 3-35. A total of 10 surveys have been performed to date, with the baseline survey performed following well construction in August 2019 and the most recent performed in May 2022. As shown, there have been very limited changes occurring at this location in the A Zone. Some variations in the bulk conductivity have been occurring in B Zone, but the most recent log shows lower conductivity than was observed during several previous surveys and reverting close to baseline values.

In contrast to the observations in the A and B Zones, the induction surveys show consistent increases in bulk conductivity in the C Zone with every survey. The induction survey results are consistent with the water-quality sampling results discussed previously in this section. In particular both the induction surveys and water-quality sampling results display consistent increasing trends in conductivity and chloride concentrations in the C Zone, suggesting that seawater intrusion is likely occurring in this zone.

ERT Geophysical Surveys. In April 2021, electrical resistivity tomography (ERT) geophysical surveys were performed by BGC Engineering, Inc. (BGC) under contract with the CVWD for the purpose of mapping the presence (or absence) of seawater intrusion into the A, B, and C Zones. The ERT survey built upon the foundation of information acquired through the Sentinel Well project and was intended to provide three-dimensional characterization of basin stratigraphy and water quality conditions within the Basin in the vicinity of the Sentinel Well site and the Carpinteria Salt Marsh (El Estero).

ERT is a geophysical technique for imaging the distribution of subsurface electrical resistivity in a cross-sectional format. Resistance data are collected through rolling linear arrays of electrodes, coupled to a DC resistivity transmitter and a receiver. Current is injected over specified time intervals between two electrodes. During each injection interval, voltages are measured between reception electrodes. The electrical resistivity of a given geological unit is related to the pore-fluid conductivity, clay content, liquid saturation, temperature, and matrix composition, and is used to map the extent of units with similar electrical properties when bounded by units with contrasting electrical properties. The final product of each line of survey is a 2-D cross-section plotting electrical resistivity versus depth. Raw geophysical and positional data is post-processed, and cross sections of the resistivity signatures along each survey line are generated.

Four ERT profiles were collected along lines shown on Figure 3-36. and the ERT profile results are shown on Figures 3-37 through 3-40. The full BGC report is presented in Appendix E, the details of which will not be repeated here. In summary, the suspected seawater intrusion into the C Zone based on the Sentinel Well data discussed previously in this section was not imaged in the ERT data. This has been attributed to an insufficient contrast in the electrical conductivities between the C Zone and the overlying confining layer, but could also be due to the C Zone being too deep, too thin, and/or at the limits of the ERT's spatial resolution. The ERT profile along the beach (see Figure 3-39) exhibited high electrical conductivities indicative of saltwater, including within the general depth range of the A Zone; however, there is no indication of seawater intrusion into the A or B Zones under the northern boundary of the saltmarsh in the ERT data

(see Figure 3-38). BCG also interpreted that the A Zone may be thicker in places, as based on the ERT data, than what had been logged in the Sentinel Well boreholes.

Based on the results of the ERT survey, it was recommended that additional monitoring wells be installed to "ground-truth" ERT zones of interest, along with performing future ERT surveys to detect changes in these zones (i.e., time series of ERT surveys similar to the time-series of induction surveys at MW-1 discussed previously) would help to further refine the geophysical interpretation. Forward modelling in order to predict at what electrical conductivity the C Zone must reach to be resolvable by the ERT could help to determine the timing of future ERT surveys. In addition, extension of the beach ERT profile (see Figure 3-39) to the northwest, in addition to a parallel profile northwest-southeast through the saltmarsh, would further improve the overall understanding of conditions in this area of the Basin.

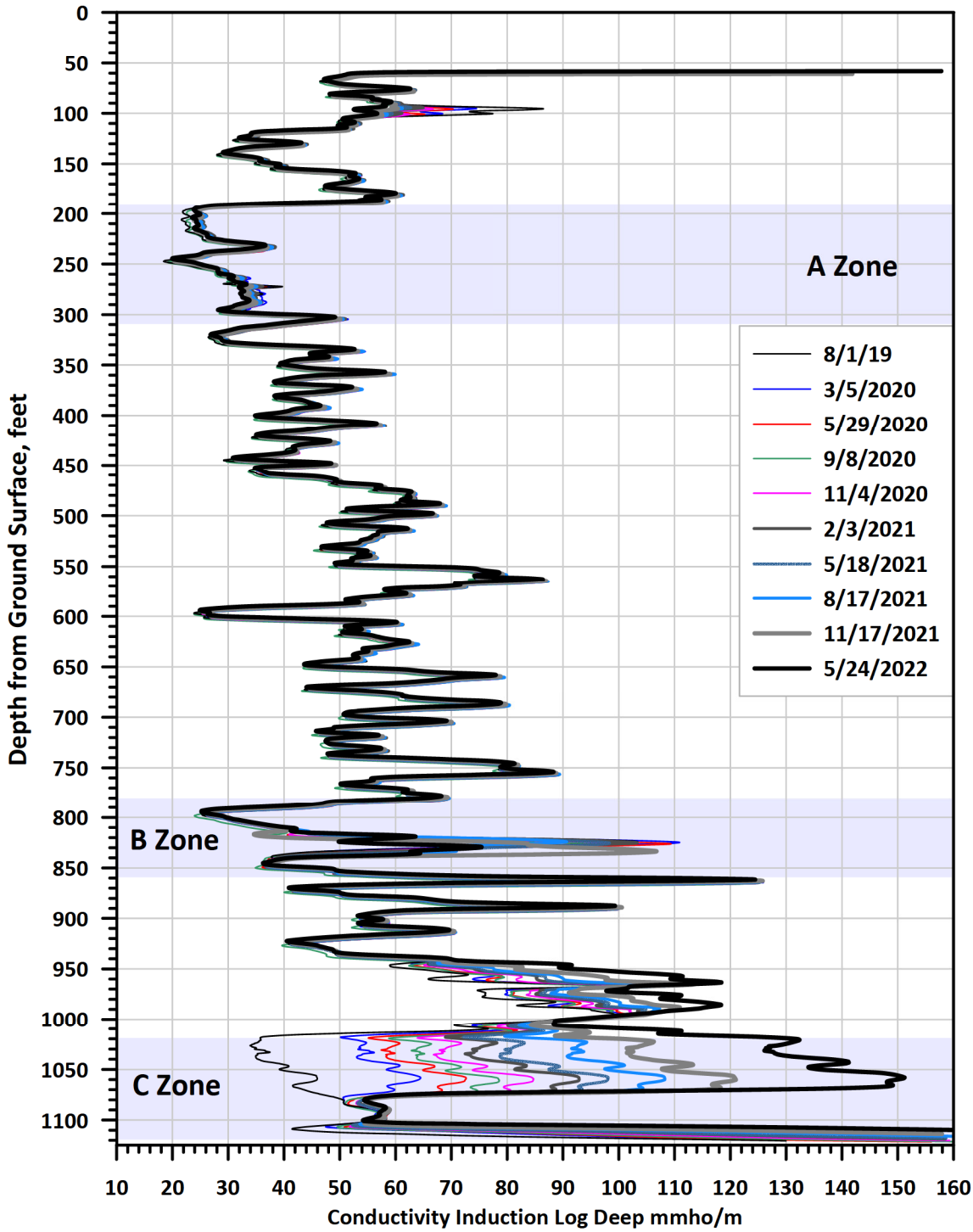


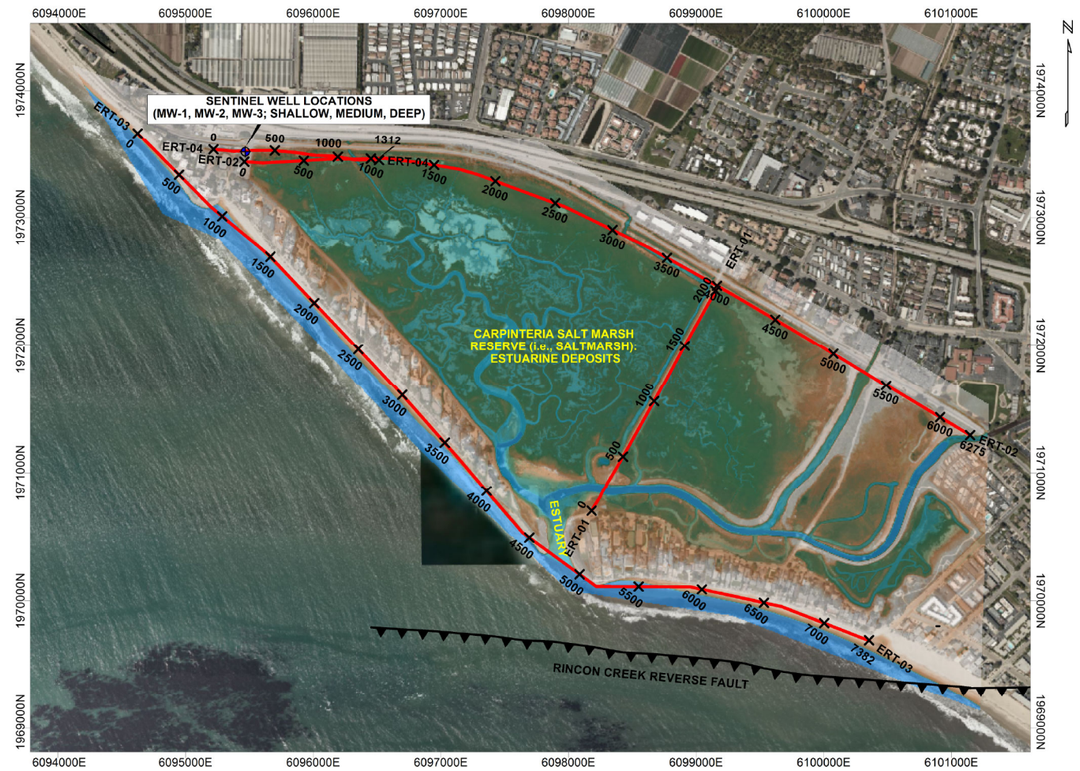
FIGURE 3-35

MW-1 Induction Surveys

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

10-2021



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)

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

BGC ENGINEERING INC.

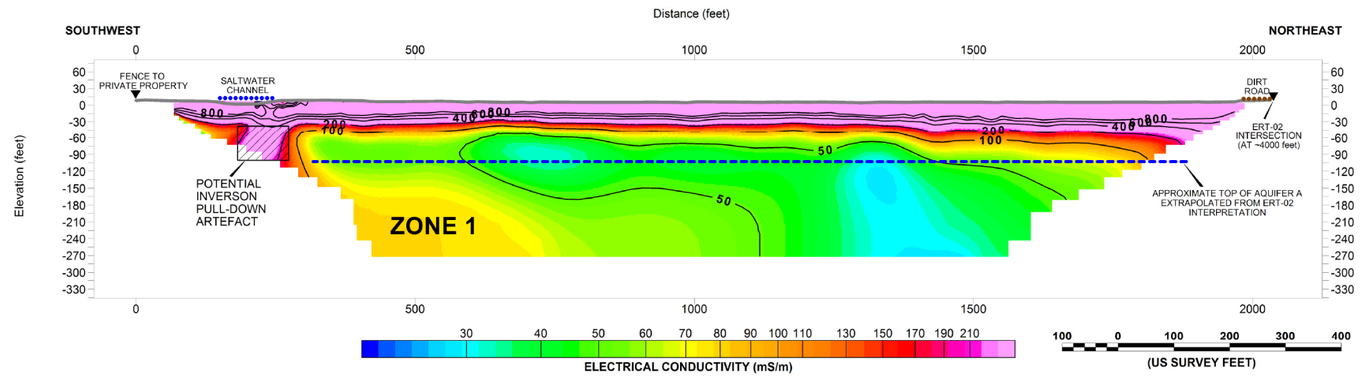
File Path: BGC Engineering Inc\Geophysics - Files\2.0 Current BGC Projects\2252001 - Carpinteria\3.0_Data_Processing\4.0_OasisMaps\2252001Pueblo-Carpinteria_BaseMap-A.map

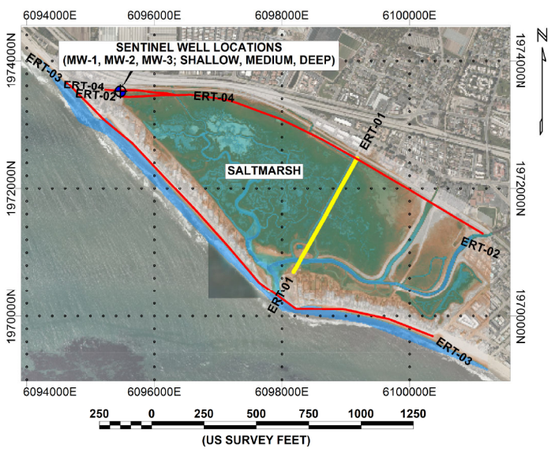
FIGURE 3-36

ERT Survey Line Location Map

Carpinteria Groundwater Basin Groundwater Sustainability Plan

10-2021





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

BGC ENGINEERING INC.

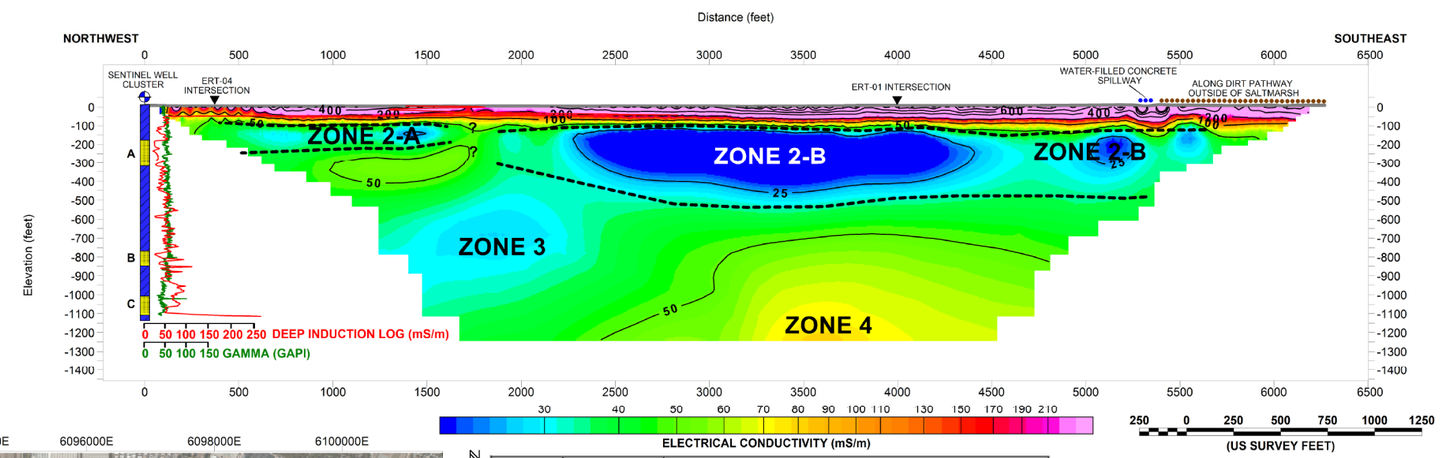
File Path: BGC Engineering Inc\Geophysics - Files\2.0 Current BGC Projects\2252001 - Carpinteria\3.0 Data Processing\4.0 Oasis\Maps\2252001-Pueblo-Carpinteria_ERT01-A.map

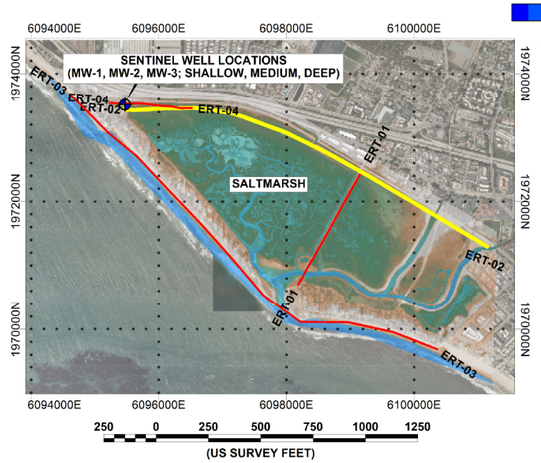
FIGURE 3-37

ERT Profile 01

Carpinteria Groundwater Basin Groundwater Sustainability Plan

10-2021





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.
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 (73.0 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:	CLIENT:		
PDB	CARPINTERIA VALLEY WATER DISTRICT (CVWD)		
APPROVED BY:	SCALE:	PROJECT NO:	FIGURE NO:
LGW	AS SHOWN	2252001	3

BGC ENGINEERING INC.

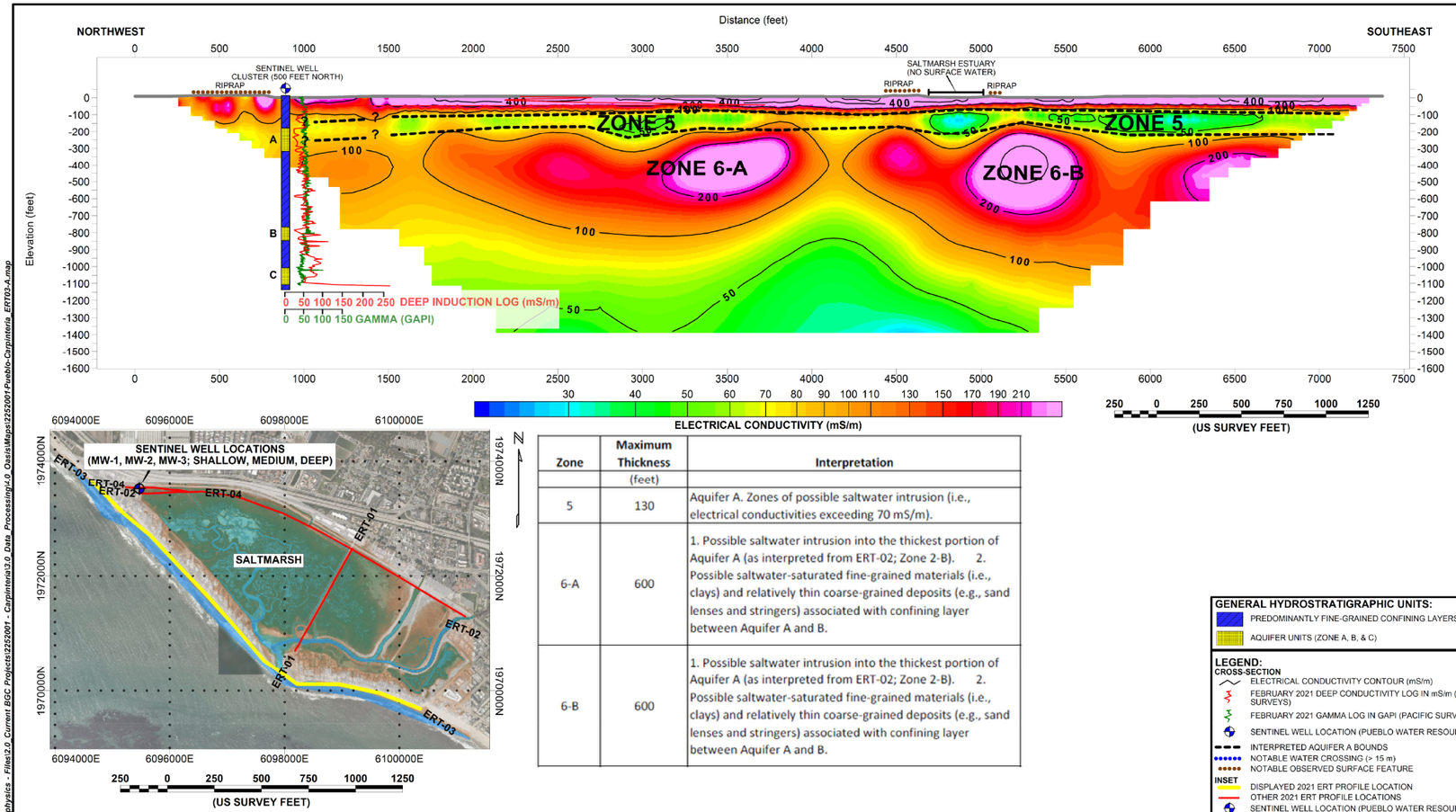
File Path: BGC Engineering Inc\Geophysics - Files\2.0 Current BGC Projects\2252001 - Carpinteria\3.0_Data_Processing\2.0_OasisMaps\2252001-Pueblo-Carpinteria_ERT02-A.map

FIGURE 3-38

ERT Profile 02

Carpinteria Groundwater Basin Groundwater Sustainability Plan

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:
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 (73.0 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-03		
CHECKED BY:	CLIENT:		
PDB	CARPINTERIA VALLEY WATER DISTRICT (CVWD)		
APPROVED BY:	SCALE:	PROJECT NO:	FIGURE NO:
LGW	AS SHOWN	2252001	4

BGC ENGINEERING INC.

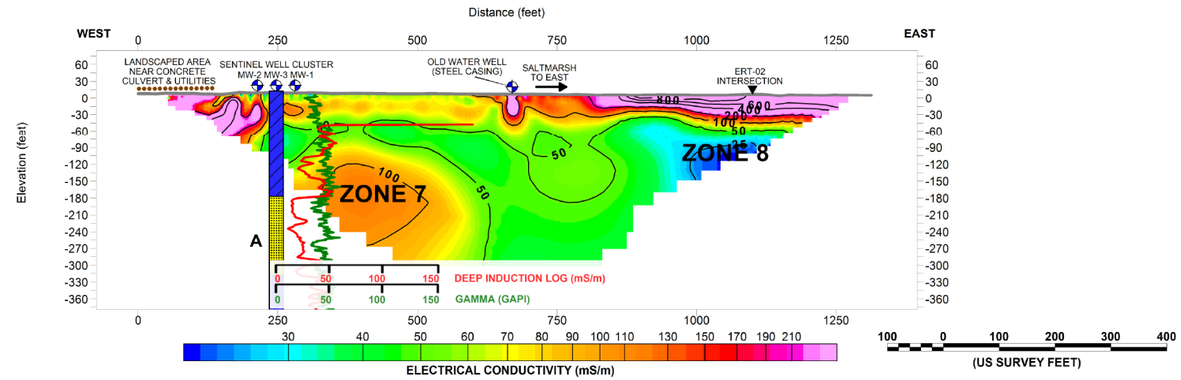
File Path: BGC Engineering Inc\Geophysics - Files\2.0_Current BGC Projects\2252001 - Carpinteria\3.0_Data_Processing\1.0_OasisMaps\2252001-Pueblo-Carpinteria_ERT03-A.map

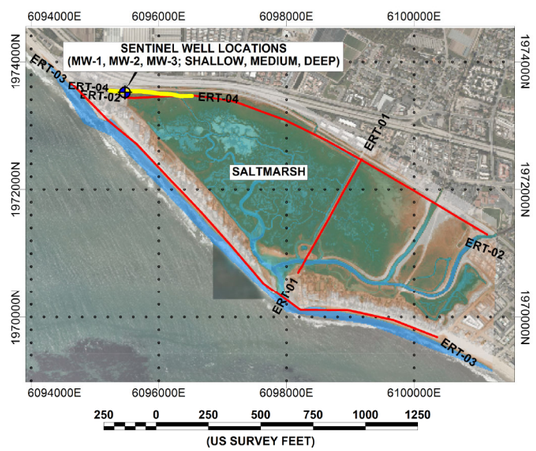
FIGURE 3-39

ERT Profile 03

Carpinteria Groundwater Basin Groundwater Sustainability Plan

10-2021





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)

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	5

BGC ENGINEERING INC.

File Path: BGC Engineering Inc\Geophysics - Files\2.0 Current BGC Projects\2252001 - Carpinteria\3.0_Data_Processing\2.0_OasisMaps\2252001-Pueblo-Carpinteria_ERT04-A.map

FIGURE 3-40

ERT Profile 04

Carpinteria Groundwater Basin Groundwater Sustainability Plan

3.2.4 Groundwater Quality Distribution and Trends [§354.16(d)]

§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:

(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

An inventory of known contamination sites in the Basin in 2022 was developed by searching the GeoTracker database maintained by the SWRCB. GeoTracker is a data management system for managing sites that impact groundwater in the State. The database contains information on leaking underground storage tanks (LUSTs), spills-leaks-investigations-cleanups (SLICs), landfills, military and other cleanup sites. The locations of the known contaminated sites and their current status is shown in Figure 3-41.

As shown, a total of 43 site have been identified in the Basin. Of these, 38 have had their cases closed without land use restrictions and an additional 3 are closed cases with land use restrictions, which no longer pose a threat to aquifers used for drinking water supply. There are only 2 open sites, both of which are located on Carpinteria Avenue within the Confined Area. One is in the assessment stage (4819 Carpinteria Ave.) and the other is being actively remediated (5661-5675 Carpinteria Ave.); however, as discussed previously, in the Confined Area downward percolation of water is limited due to the presence of fine-grained low-permeability materials overlying the principal aquifer system; therefore, it is unlikely that contaminates associated with these sites would migrate vertically into the deep aquifer system.

3.2.5 Land Subsidence [§354.16(e)]

§354.16 Groundwater Conditions. Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:

(e) The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or the best available information.

Land subsidence is the gradual (or sudden) lowering of the land surface. For land subsidence to occur certain conditions are needed, such as:

- Drainage and decomposition of organic soils,
- Underground mining, oil and gas extraction, hydrocompaction, natural compaction, sinkholes, and thawing permafrost, or,
- Aquifer-system compaction.

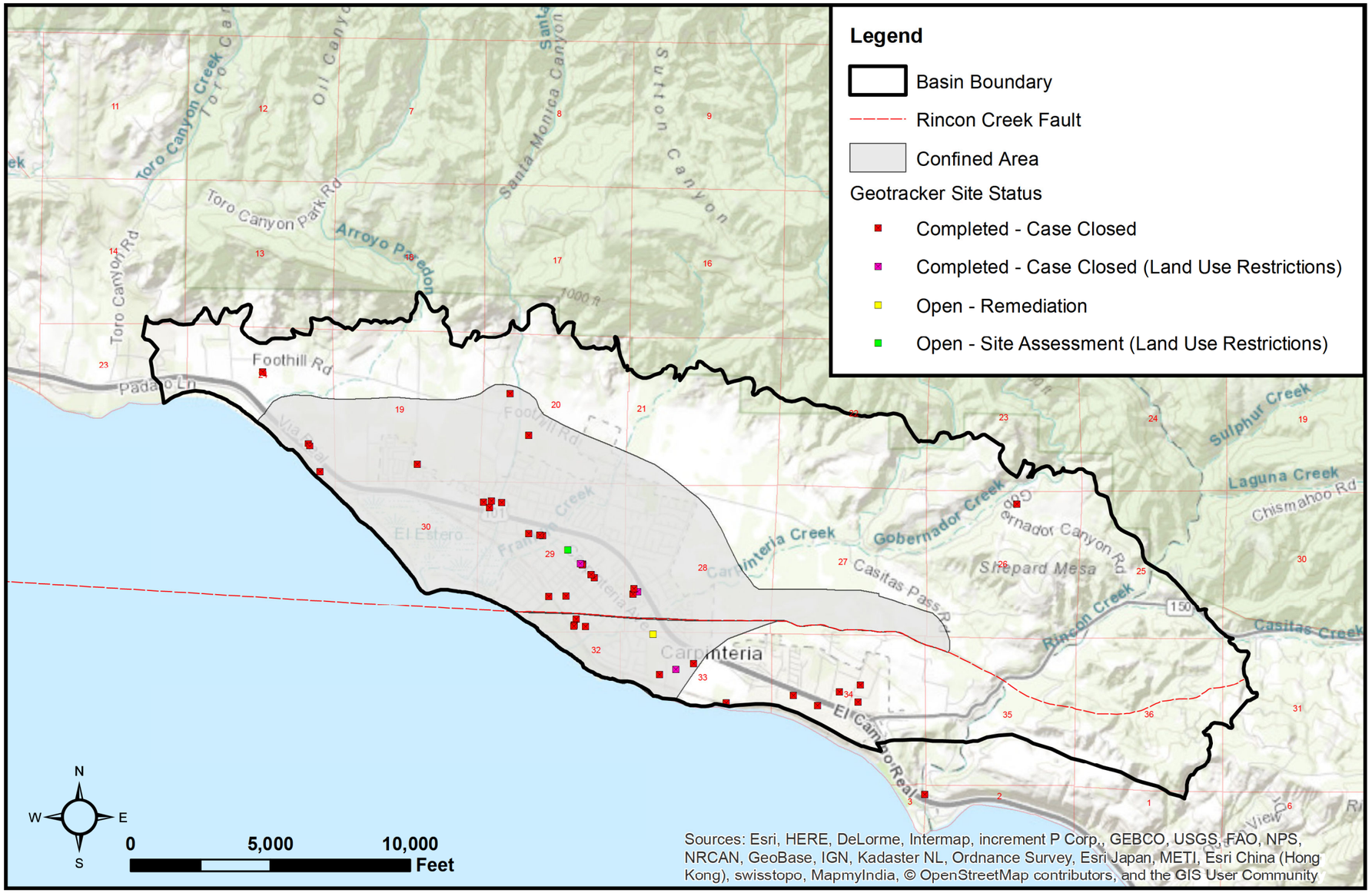


FIGURE 3-41

Known Contamination Sites Map

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

None of these conditions are known to be present in the Basin and there is no known or anecdotal evidence of subsidence related to groundwater extraction in the Basin. As discussed previously, there have been periods of historical water levels declines in the Basin during the 1950s, the late 1980s/early 1990s, and the current period of the mid-to-late 2010s/early 2020s associated with prolonged droughts when water level declines on the order of 100 to 150 feet have occurred in some places in the Basin. Even during these periods of significant groundwater level declines, no subsidence has been documented in the Basin.

The DWR provides subsidence related data to support the development of GSPs from their "SGMA Data Viewer" (DWR, 2020). These data include ground surface elevation estimates derived from Interferometric Synthetic Aperture Radar (InSAR) data provided by DWR are shown on Figure 3-42. These InSAR data are derived from satellite imagery to generate vertical deformation time series data, calibrated using data from ground-based, continuously operating Global Navigation Satellite System (GNSS) stations located throughout the state of California. Presented on Figure 3-42 is total vertical displacement as of July 1, 2022, relative to June 13, 2015, which is the period of record for the data provided by DWR.

The accuracy of the InSAR data is presented in a report (Towill, Inc., 2020), which states that "InSAR data accurately models change in ground elevation to an accuracy tested to be 16 millimeters (mm) at 95% confidence." The measurement accuracy when converting from the raw InSAR data to the maps provided by DWR is 0.048 feet with 95% confidence level. Therefore, the total estimated error is 0.1 ft.

As shown on Figure 3-42, the total vertical displacement during this period in ranges between approximately -0.129 and 0.0034 feet. Areas falling within the reported accuracy are shown in gray on Figure 3-42. Areas depicted in color indicate measurable subsidence above the accuracy tolerance. As shown, the highest total displacement occurs in the central portion of the Basin, immediately east of the City of Carpinteria. This area is not covered by InSAR data.

InSAR results do not differentiate between subsidence caused by groundwater withdrawal and other potential causes, such as tectonic activity. The Basin is located in an area characterized by high tectonic activity.

This lack of evidence of subsidence linked to substantial groundwater level declines indicates the inapplicability of the subsidence sustainability indicator in the Basin.

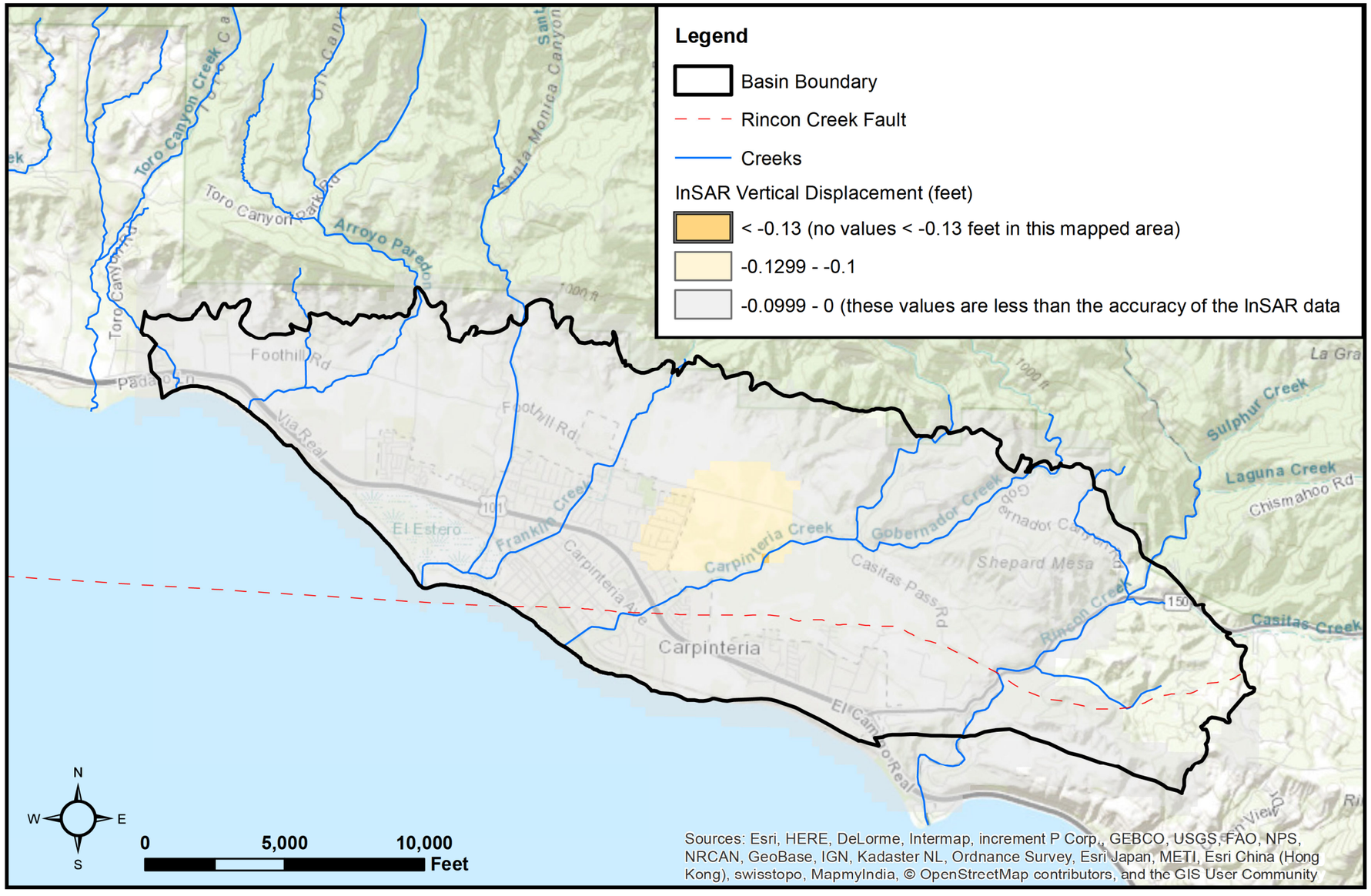


FIGURE 3-42

InSAR Vertical Displacement Map (6/13/15 – 7/1/22)

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

3.2.6 Interconnected Surface Water Systems [§354.16(f)]

§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:

(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.

Although there is limited stream gage data in the Basin, it is observed that the streams that flow through the Basin are essentially ephemeral, with flow occurring during the wet winter months in response to storm events, and frequent conditions of no flow during the dry summer months. The potential interactions between surface water bodies (such as creeks) and groundwater in a Basin can take place in three basic ways:

1. A gaining stream or creek that receives water from groundwater,
2. A losing stream or creek that recharges basin aquifers from surface water, or
3. A disconnected stream or creek that (a) may be separated from groundwater by a hydrologic formation, such as a low-permeability aquitard that prevents interaction between surface water and groundwater completely, or (b) hydraulicly separated where the water table surface is disconnected from the stream or creek bed. (A disconnected stream still "loses" surface flow by percolating water to the subsurface to recharge the aquifer).

Schematics illustrating these three types of surface water/groundwater interactions are shown in Figure 3-43. This diagram is taken from the DWR Water Budget BMP (DWR, 2016a).

As discussed previously, the Confined Area of the Basin is defined by the presence of fine-grained low-permeability materials overlying the principal aquifer; therefore, the situation described in Item 3(a) above applies to the reaches of basin creeks in the Confined Area of the Basin. The creek channel is separated from the groundwater of the principal aquifer by a low-permeability aquitard. The fine-grained sediments of the confining layer are not used for groundwater supply and are not considered to be a primary aquifer; therefore they are not subject to management under SGMA.

In the Recharge Area, for groundwater to discharge into a basin creek (i.e., a gaining creek, Item 1 above), the elevation of the water table in the vicinity of the creek must be higher than the elevation of the surface-water body surface (Figure 3-43 [Part A]). This condition does not occur in the Basin. For a losing stream as identified in Item 2 above, water flows from the stream to the aquifer because the elevation of the water table in the vicinity of the creek is lower than the elevation of the surface-water body surface, but a *continuous zone of saturation* is present between the stream and the water table (Figure 3-43 [Part B]). In the Disconnected Stream example (Item 3b above and Figure 3-43 [Part C]), surface water percolates to the water table as in the losing stream example, but there is no zone of continuous saturation between the stream channel and the water table. Based on previous investigations in the Basin, the current understanding of the Basin HCM is that in the Recharge Area, basin creeks are all losing creeks and represent principal sources of recharge to the Basin (see Section 3.3) but are hydraulically disconnected from groundwater because the water table surface is below the bottoms of the creek beds in this area of the Basin (i.e., Item 3b above and Figure 3-43 [Part C]).

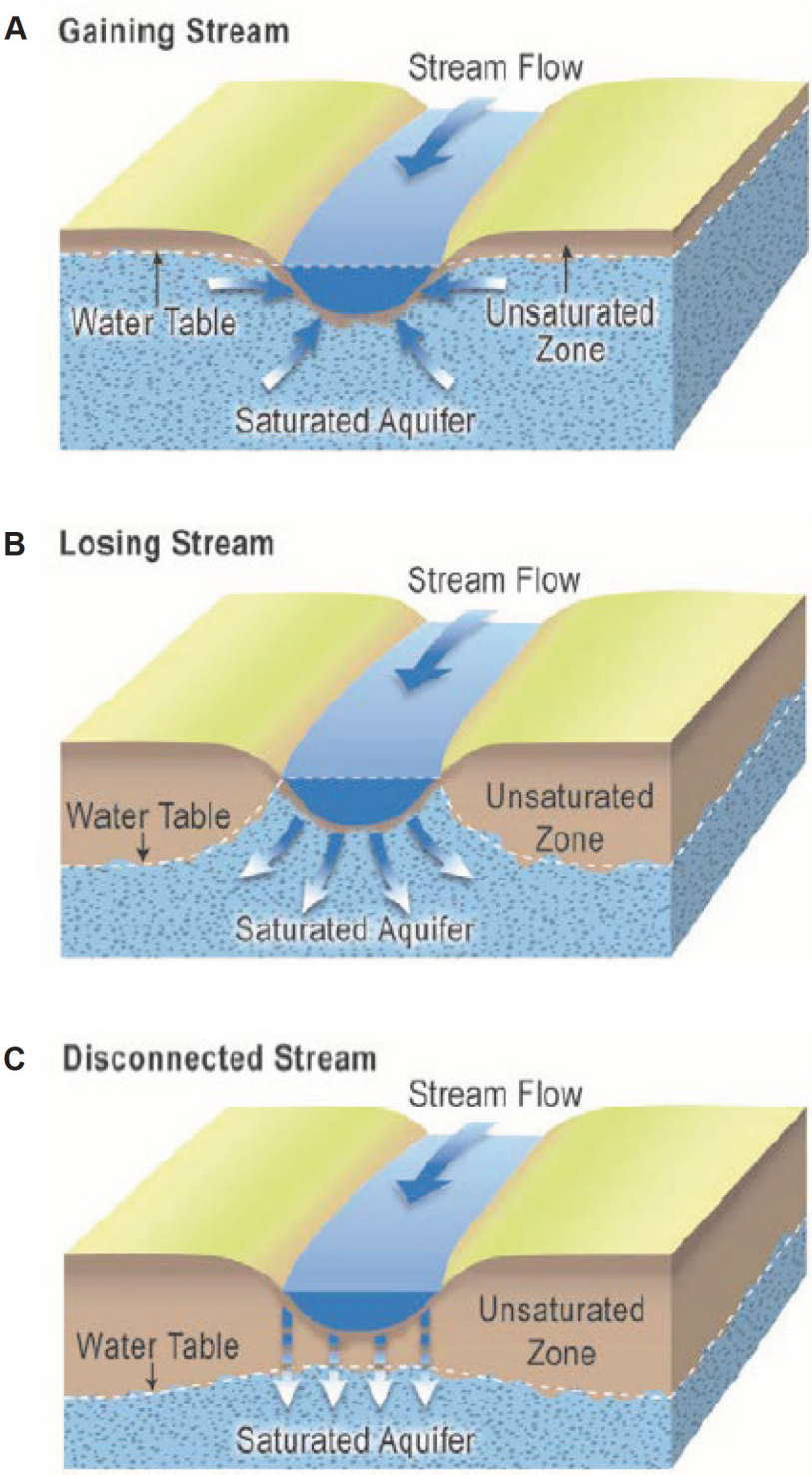


FIGURE 3-43

Gaining, Losing, and Disconnected Streams

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

SOURCE:
Best Management Practices for the Sustainable Management of Groundwater, Water Budget. California Department of Water Resources Sustainable Groundwater Management Program. Dec. 2016

To corroborate this understanding, depth-to-water was calculated for the spring water levels for three different water year types in the recent past:

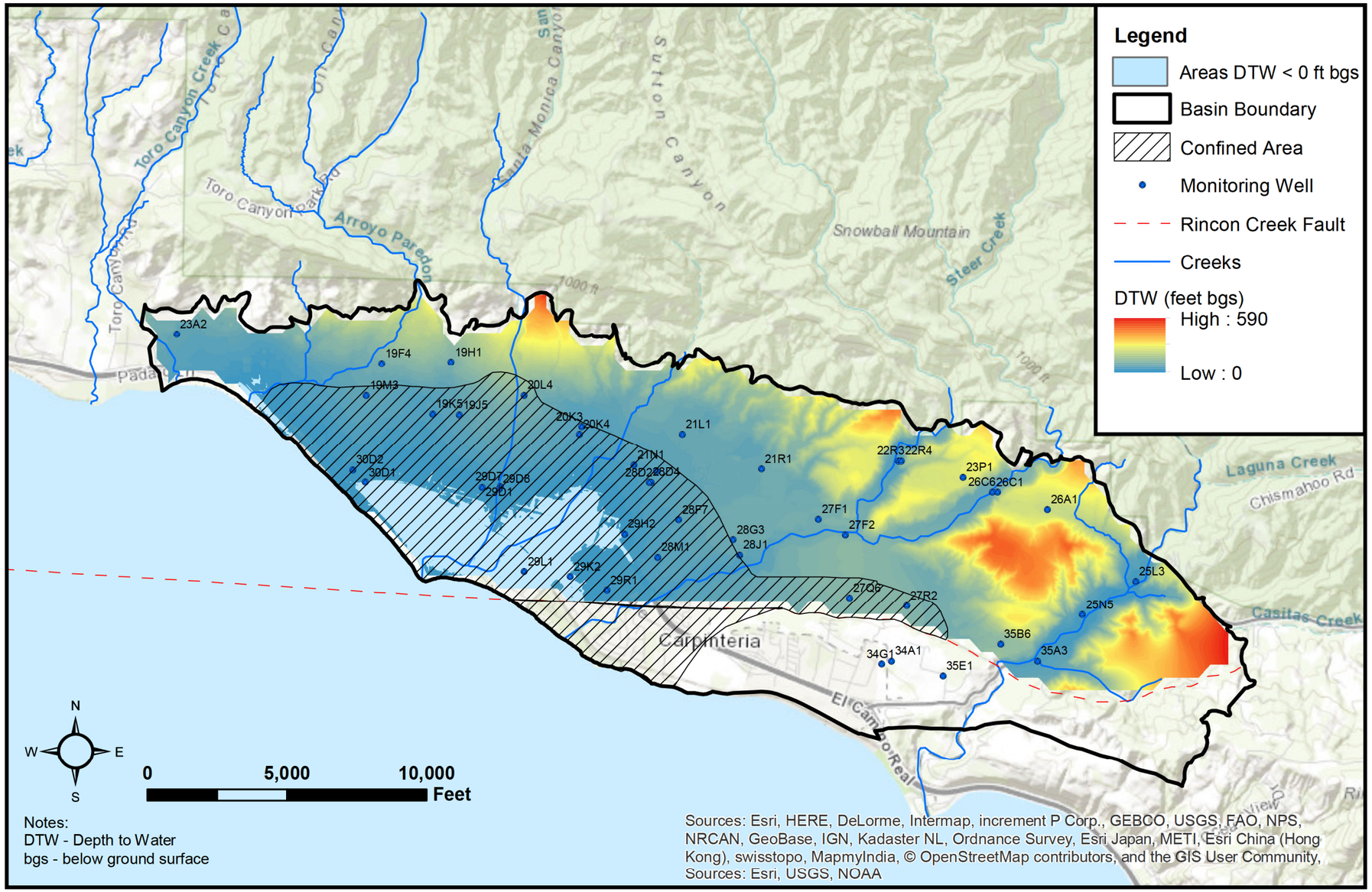
- WY 2005 – Wet water year type
- WY 2010 – Normal water year type
- WY 2015 – Critically Dry water year type

Groundwater elevations were contoured for each of these periods and these groundwater elevation surfaces were subtracted from the Digital Elevation Model (DEM) of ground surface elevations to estimate depth-to-water contours in SU-1 (as discussed previously, available water-level data for SU-2 are limited and contours for this unit are not presented). This approach provides accurate contours of depth-to-water along the creeks. The depth-to-water contours for each of the above periods are shown in Figures 3-44 through 3-46.

As shown in Figures 3-44 through 3-46, the water table elevations are below the creek bottom elevations at all locations in the Recharge Area during all three water year type conditions. Even during the wet year conditions that represent the highest groundwater elevations (spring 2005, Figure 3-44), the water table elevation is observed to be lower than the creek channel elevations. The three creeks identified as steelhead habitat are Arroyo Paredon, Carpinteria Creek, and Rincon Creek. The depth to water below Arroyo Paredon between the northern basin boundary and the edge of the confined area during wet weather conditions, as displayed in Figure 3-44, ranges from 8 to 221 feet. Below Carpinteria Creek, the depth to water during wet weather conditions ranges from 23 to 42 feet. Below Rincon Creek, the depth to water during wet weather conditions ranges from 15 to 20 feet. During normal and dry years, depths to water are greater. This analysis indicates that even under wet year conditions, water table elevations are demonstrably lower than stream channel elevations, indicating that the streams are hydraulically disconnected from the saturate aquifer, as displayed in Figure 3-43 (Part C). If the streams are disconnected from the saturated aquifer, they are, by definition, not considered to be interconnected surface water.

The areas where the depth-to-water is less than 0 feet bgs, indicating groundwater elevations above the stream channel elevation, are limited in time to the WY 2005 map (Figure 3-44), and limited in area to the downstream vicinity of Santa Monica and Franklin Creeks within the Confined Area; this area is highlighted in a light blue color on the figures where the aquifer water-level elevations are higher than the creek bottom elevations, indicating artesian conditions. However, as noted previously in this section, the stream channels in the Confined Area are hydraulically separated from the principal aquifer by the low-permeability sediments of the confining layer. It is also noted that both of these creeks are concrete lined in the Basin.

SGMA requires GSAs to use the best available science and data to conduct analyses in support of their GSPs. The water level contours used in the analysis presented herein are based on groundwater elevation data collected from over 30 wells, including several wells located along basin creeks, and are considered to have a high degree of confidence. The DEM data used for land surface also has a high degree of confidence. Based on the results foregoing analysis, it is concluded that there are no interconnected surface water systems in the Basin.



Notes:
DTW - Depth to Water
bgs - below ground surface

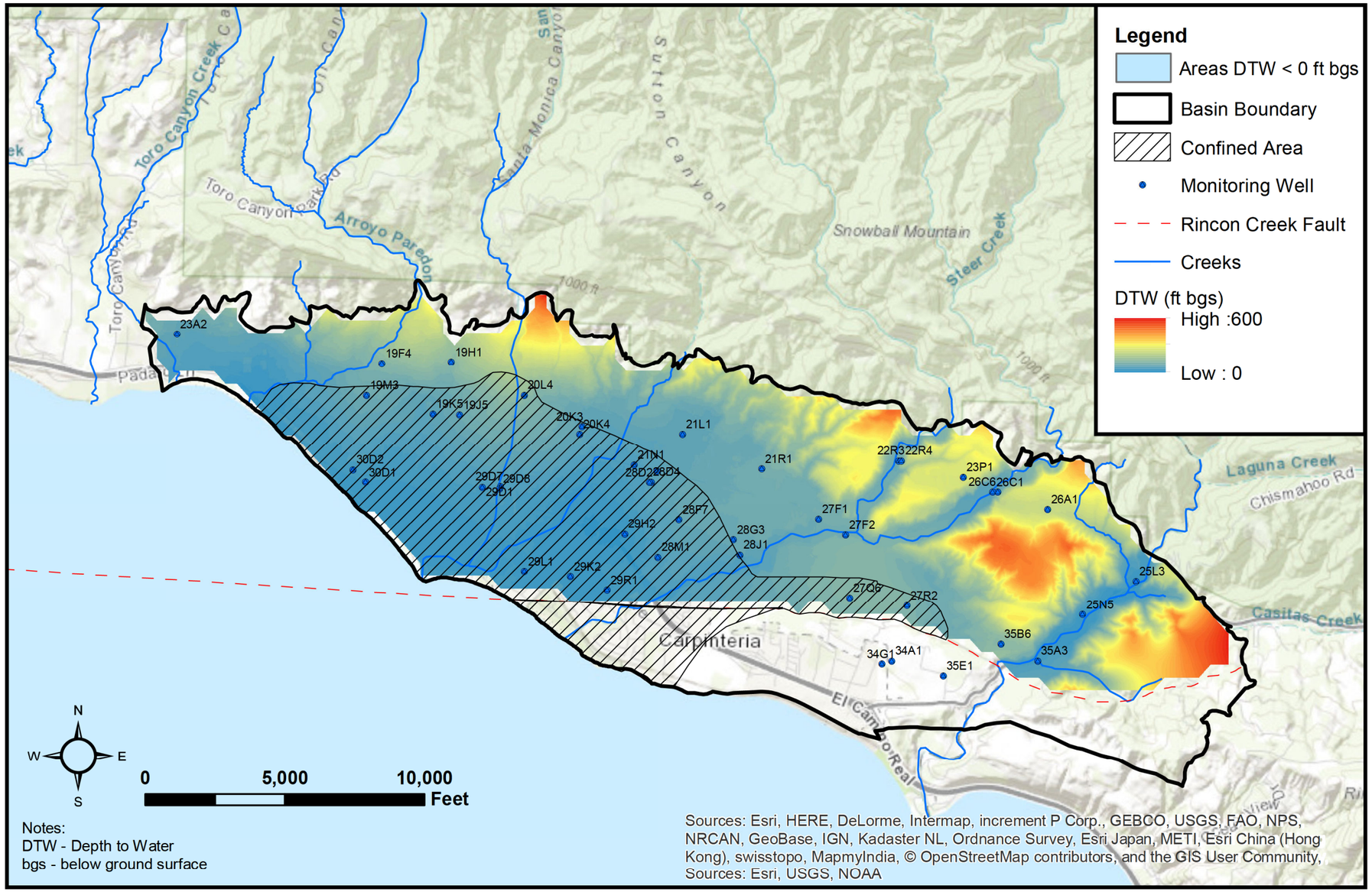
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community, Sources: Esri, USGS, NOAA

FIGURE 3-44

Depth to Water Map (Spring 2005)

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3



Notes:
DTW - Depth to Water
bgs - below ground surface

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community, Sources: Esri, USGS, NOAA

FIGURE 3-45

Depth to Water Map (Spring 2010)

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

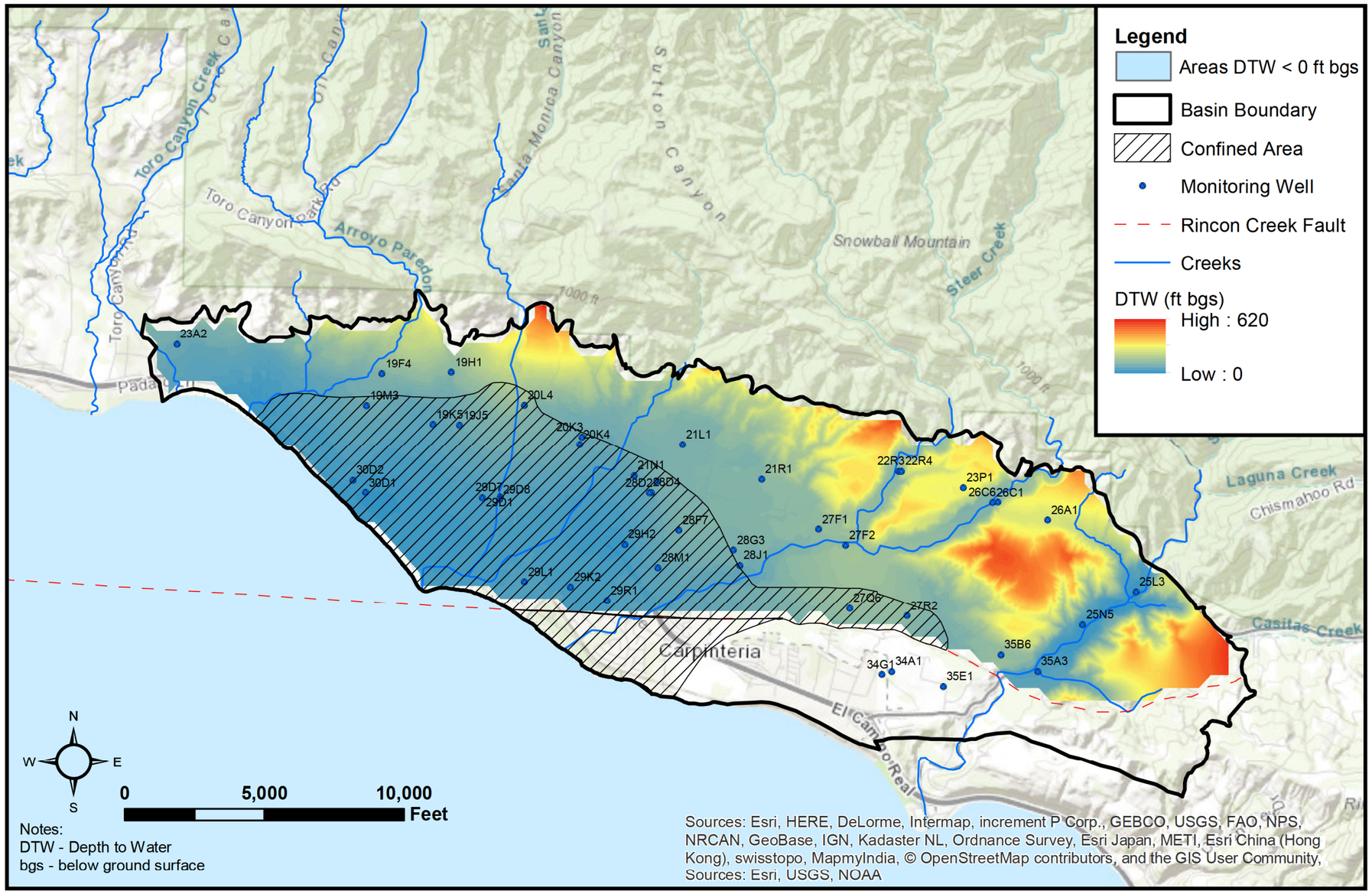


FIGURE 3-46

Depth to Water Map (Spring 2015)

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

3.2.7 Groundwater Dependent Ecosystems [§354.16(g)]

§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:

(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.

GSP Emergency Regulations require the identification of groundwater dependent ecosystems (GDEs) that could be adversely affected by lowered groundwater levels in principal aquifer.

The area overlying the Carpinteria Groundwater Basin has habitat that supports the federal Endangered Species Act (FESA) listed and the California Endangered Species Act (CESA) candidate-listed southern California steelhead (*Oncorhynchus mykiss* or steelhead); California red-legged frog (*Rana draytonil*), which is listed as a threatened species under the FESA and is a California species of special concern (SSC); least Bell's vireo (*Vireo belli pusillus*), which is listed as an endangered species under the FESA and CESA; and southwestern willow flycatcher (*Empidonax traillii extimus*), which is listed as an endangered species under the FESA and CESA. According to the California Department of Fish and Wildlife's (CDFW's) California Natural Diversity Database (CDFW, 2023), additional CDFW SSCs occurring in the area include yellow warbler (*Setophaga petechia*), yellow-breasted chat (*Icteria virens*), Cooper's hawk (*Accipiter cooperi*), arroyo chub (*Gila orcuttii*), southwestern pond turtle (*Actinemys pallida*). These species utilize habitats in the watershed, but it is not demonstrated to date that these species are dependent on groundwater for habitat. The analysis presented in Section 3.2.6 indicates that the basin creeks are hydraulically disconnected from the underlying water table, which implies that the listed fauna are not dependent on groundwater.

Sensitive vegetative species may be dependent on groundwater if the water table is within 30 feet of ground surface, within the rooting zone of the identified fauna. The following analysis was performed to determine if potential vegetative. As a starting point, the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) GIS shapefiles were downloaded from DWR and mapped in the Basin to identify potential GFEs. The NC Dataset covering the Basin consists of both vegetation and wetlands areas, the locations of which are shown on Figures 3-47 and 3-48, respectively, with each potential GDE area consisting of a mapped polygon with an associated Polygon ID number, which are summarized in Table 3-2.

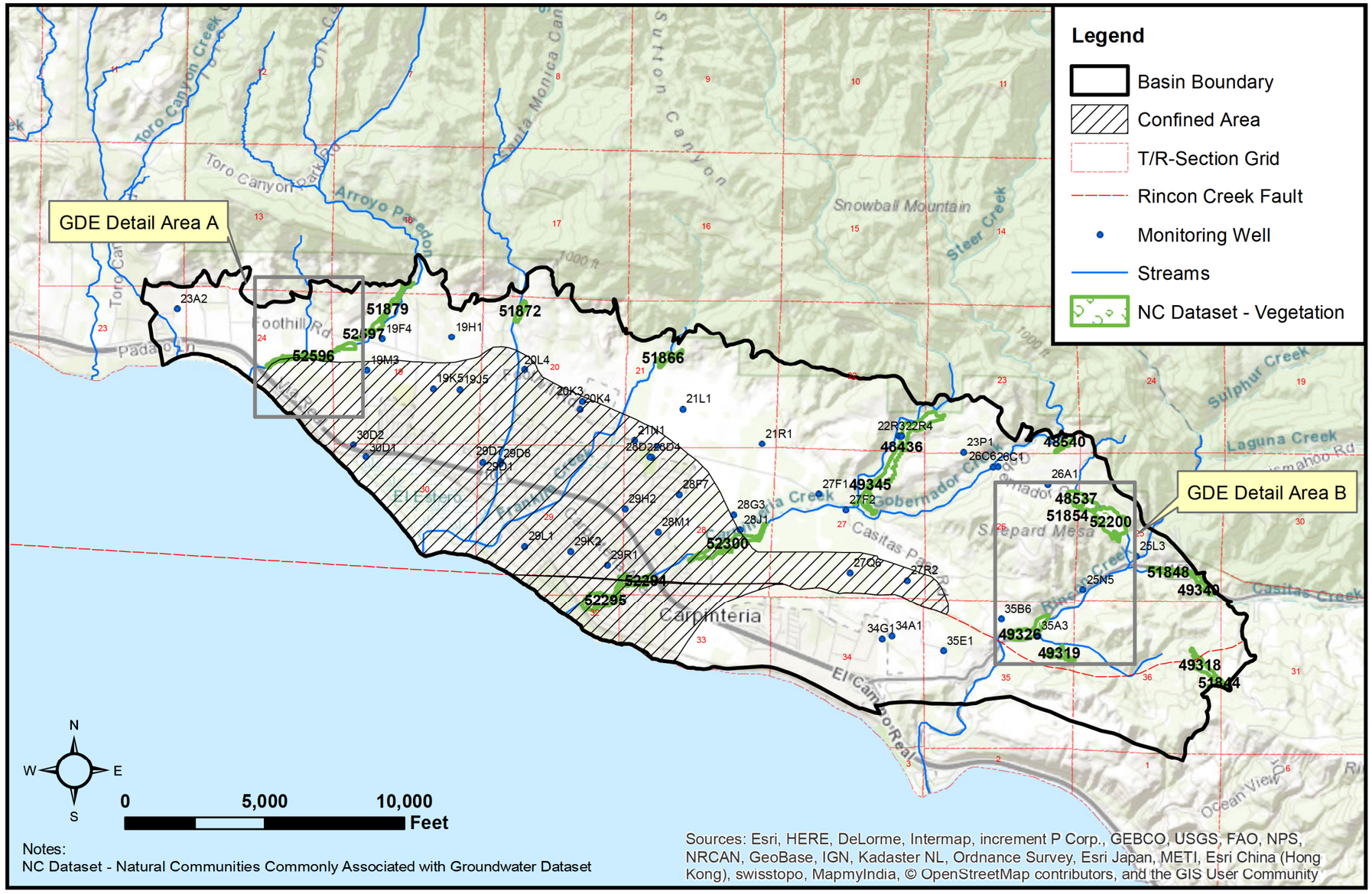


FIGURE 3-47

Potential GDE Location Map – Vegetation

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

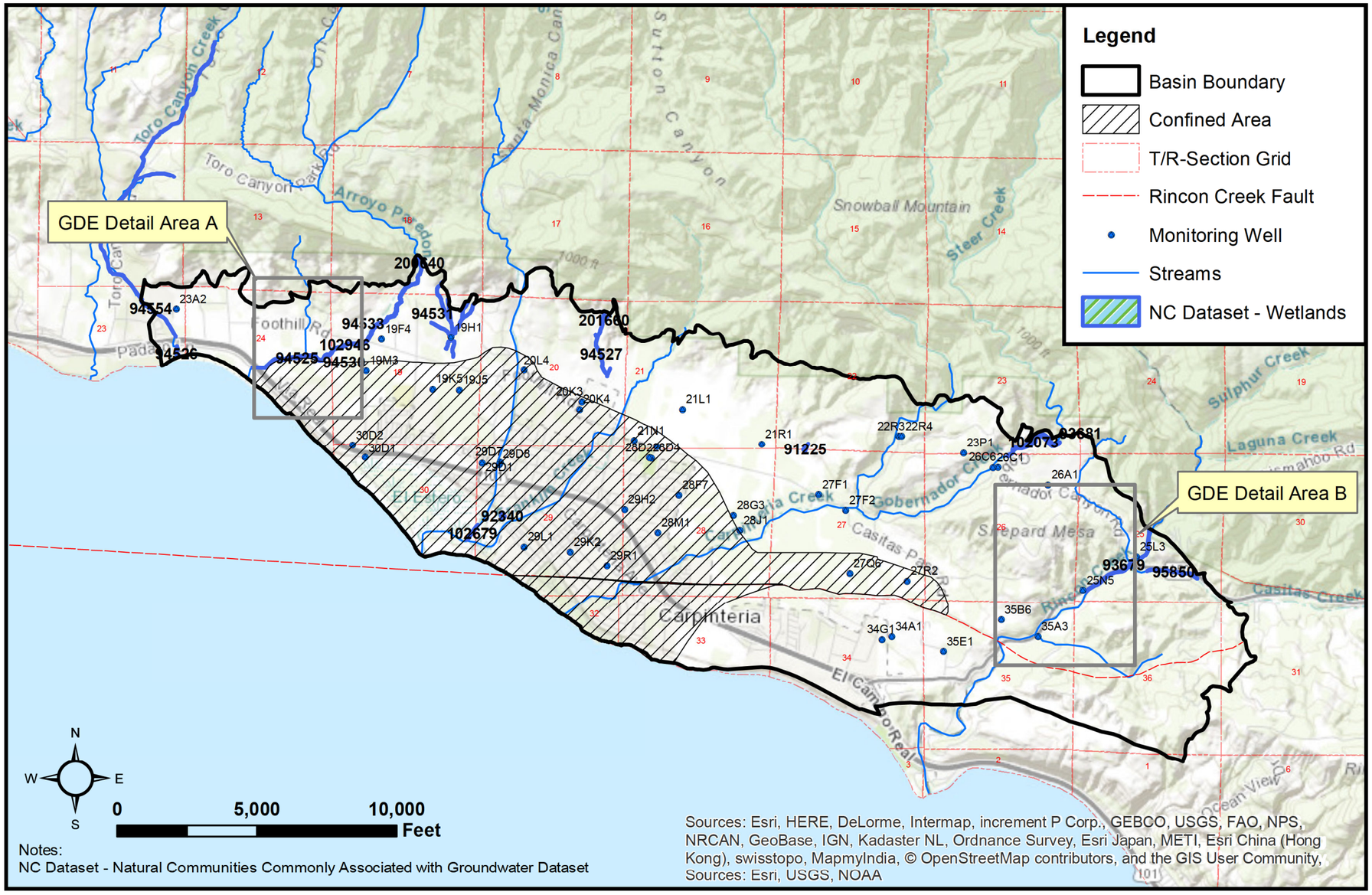


FIGURE 3-48

Potential GDE Location Map – Wetlands

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

Table 3-2. NC Dataset Potential GDEs Summary

NC Dataset Polygon ID	Coverage Type	Description	T/R Section	Nearest Creek
51879	Vegetation	Coast Live Oak	19	Arroyo Paredon
52597	Vegetation	Riparian Mixed Hardwood	19	Arroyo Paredon
52596	Vegetation	Riparian Mixed Hardwood	24	Arroyo Paredon
51872	Vegetation	Coast Live Oak	20	Santa Monica
51866	Vegetation	Coast Live Oak	21	Franklin
48436	Vegetation	Coast Live Oak	22	Carpinteria
49435	Vegetation	Coast Live Oak	27	Carpinteria
42300	Vegetation	Riparian Mixed Hardwood	28	Carpinteria
52294	Vegetation	Riparian Mixed Hardwood	28	Carpinteria
52295	Vegetation	Riparian Mixed Hardwood	32	Carpinteria
48540	Vegetation	Coast Live Oak	23	Gobernador
48537	Vegetation	Coast Live Oak	26	Unnamed Tributary
51854	Vegetation	Coast Live Oak	25	Unnamed Tributary
52200	Vegetation	Riparian Mixed Hardwood	25	Unnamed Tributary
51848	Vegetation	Coast Live Oak	25	Casitas
49340	Vegetation	Coast Live Oak	25	Casitas
49326	Vegetation	Coast Live Oak	35	Rincon
49319	Vegetation	Coast Live Oak	35	Rincon
49318	Vegetation	Coast Live Oak	36	Unnamed Tributary
51844	Vegetation	Coast Live Oak	36	Unnamed Tributary
94554	Wetlands	Palustrine, Forested, Seasonally Flooded	23	Toro
94526	Wetlands	Palustrine, Forested, Seasonally Flooded	23	Toro
94525	Wetlands	Palustrine, Forested, Seasonally Flooded	19	Arroyo Paredon
94530	Wetlands	Palustrine, Forested, Seasonally Flooded	24	Arroyo Paredon
102946	Wetlands	Riverine, Upper Perennial, Unconsolidated Bottom, Permanently Flooded	19, 24	Arroyo Paredon
94533	Wetlands	Palustrine, Forested, Seasonally Flooded	19	Arroyo Paredon
200640	Wetlands	Riverine, Upper Perennial, Unconsolidated Bottom, Permanently Flooded	18	Arroyo Paredon
94531	Wetlands	Palustrine, Forested, Seasonally Flooded	19	NA
201660	Wetlands	Palustrine, Forested, Seasonally Flooded	20	NA
94527	Wetlands	Palustrine, Forested, Seasonally Flooded	20	NA
92340	Wetlands	Palustrine, Emergent, Persistent, Seasonally Flooded - Fresh Tidal	29	Franklin (El Estero)
102679	Wetlands	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	30	Santa Monica (El Estero)
91225	Wetlands	Palustrine, Emergent, Persistent, Seasonally Flooded	22, 27	NA
93680	Wetlands	Palustrine, Forested, Seasonally Flooded	23	Gobernador
93681	Wetlands	Palustrine, Forested, Seasonally Flooded	23	Gobernador
102073	Wetlands	Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	23	Gobernador
93679	Wetlands	Palustrine, Forested, Seasonally Flooded	25	Rincon
95850	Wetlands	Palustrine, Scrub-Shrub, Seasonally Flooded	25	Rincon

As shown on Figures 3-47 and 3-48, the potential GDEs are largely concentrated along the primary creeks in the Basin. As shown in Table 3-2, there are 20 vegetation and 18 wetland individual polygon areas. The potential GDE vegetation areas consist of the following types:

- Coast Live Oak
- Riparian Mixed Hardwood

The potential GDE wetland areas consist of the following types:

- Palustrine, Forested, Seasonally Flooded
- Riverine, Upper Perennial, Unconsolidated Bottom, Permanently Flooded
- Palustrine, Emergent, Persistent, Seasonally Flooded - Fresh Tidal
- Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded
- Palustrine, Scrub-Shrub, Seasonally Flooded

Verification of whether the mapped potential GDE areas in the NC Dataset are likely to be dependent on groundwater from the principal aquifer consisted of the use of the best currently available science on the hydrogeologic setting and groundwater levels in the Basin to screen the mapped areas for further analysis. The initial screening consisted of determining whether a mapped potential GDE area is located in the Confined Area or unconfined Recharge Area of the Basin. As discussed previously, the principal aquifer in the Confined Area consists of the A, B and C Zones, which underly a low-permeability confining layer, and groundwater management is not likely to affect water levels in the overlying shallow zone or the ecosystems in the area.

In the unconfined Recharge Area, using the depth-to-water to the rooting depth of the vegetation is a reasonable method to infer the groundwater dependence of potential GDE areas. As discussed in the previous section, basin creeks in the Recharge Area are disconnected from groundwater; therefore, stream depletion due to pumping is not expected to occur. Similarly, if the groundwater levels are well below the rooting zone of the plants and any wetland features, groundwater management is not likely to affect the ecosystem in the area.

Depth-to-water groundwater levels of less than 30 feet (The Nature Conservancy, 2018) of the land surface is a generally accepted method to initially screen potential GDEs for groundwater dependence; however, many of the potential GDEs in California have adapted to dealing with intermittent periods of water stress; therefore, utilizing groundwater data from one point in time can misrepresent groundwater levels required by GDEs. To consider the interannual variability of the areas of the Basin where the depth-to-water has been less than 30 feet, depth-to-water was calculated as described in the preceding section for the spring water levels for three different water year types in the recent past:

- WY 2005 – Wet water year type
- WY 2010 – Normal water year type
- WY 2015 – Critically Dry water year type

As described in the previous section, groundwater elevations were contoured for each of these periods and these groundwater elevation surfaces subtracted from the DEM of ground surface elevations to estimate depth-to-water contours across the Basin. Again, this approach provides accurate contours of depth-to-water along the creeks (and other land surface depressions) where the potential GDEs tend to be located. The areas of the Basin where the depth-to-water is less than 30 feet for each of the above periods are shown on Figures 3-49 through 3-51.

Each potential GDE polygon was inspected with respect to whether the depth-to-water was less than 30 feet under each of the above water year types. Potential GDEs that had depth-to-water *greater than 30 feet* during two or more of the above water year types were deemed to not be dependent on groundwater from the principal aquifer and is, therefore, not considered a GDE. Potential GDE polygons areas located outside of the Confined Area that had depth-to-water *less than 30 feet* under at least two of the above conditions were retained for further evaluation. The results of the initial GDE screening are summarized in Table 3-3.

As shown on Figures 3-47 and 3-48 and Table 3-3, three of the vegetation and two of the wetlands potential GDE polygons are located in the Confined Area and, as such are not considered dependent on groundwater in the principal aquifer subject to basin management. Of the remaining 17 vegetation and 16 wetlands potential GDE polygons located in the unconfined Recharge Area, two vegetation and two wetlands areas met the screening criteria of having depth-to-water less than 30 feet under at least two of the above water-year types. As shown in Figures 3-52 and 3-53, these four potential GDE polygons are located in and along Arroyo Paredon and Rincon Creeks. The remaining 15 vegetation and 14 wetlands potential GDE polygons areas, located primarily along the upper reaches of Carpinteria and Gobernador Creeks, are not considered GDE's based on consistent groundwater depths occurring below the root zone.

The remaining four potential GDE polygon areas located along Arroyo Paredon (GDE Detail Area A) and Rincon Creeks (GDE Detail Area B) are shown in greater detail in Figures 3-52 and 3-53 (see Figures 3-46 and 3-47 for the detail area map locations). These potential GDEs were analyzed further by identifying existing monitoring wells in the vicinity of each area, also shown on Figures 3-52 and 3-53. Well logs (where available) and water-level hydrographs for these monitoring wells were reviewed to further examine seasonal and interannual variability in ground water levels in the vicinity of the potential GDEs.

The available information for the existing monitoring wells in the vicinity of these remaining potential GDE polygon areas is summarized in Table 3-4 and discussed below.

Table 3-3. Potential GDE Initial Screening Summary

NC Dataset Polygon ID	Coverage Type	Nearest Creek	Basin Area	Spring DTW < 30 ft bgs?[1]		
				2005[2]	2010[3]	2015[4]
51879	Vegetation	Arroyo Paredon	Recharge	No	No	No
52597	Vegetation	Arroyo Paredon	Recharge	No	No	No
52596	**Vegetation**	**Arroyo Paredon**	**Recharge**	**Yes**	**Yes**	**No**
51872	Vegetation	Santa Monica	Recharge	No	No	No
51866	Vegetation	Franklin	Recharge	No	No	No
48436	Vegetation	Carpinteria	Recharge	Yes	No	No
49435	Vegetation	Carpinteria	Recharge	No	No	No
42300	Vegetation	Carpinteria	Both	Yes	No[5]	No
52294	Vegetation	Carpinteria	Confined	Yes	Yes	No
52295	Vegetation	Carpinteria	Confined	No	No	No
48540	Vegetation	Gobernador	Recharge	No	No	No
48537	Vegetation	Unnamed Tributary	Recharge	No	No	No
51854	Vegetation	Unnamed Tributary	Recharge	No	No	No
52200	Vegetation	Unnamed Tributary	Recharge	No	No	No
51848	Vegetation	Casitas	Recharge	Yes	No	No
49340	Vegetation	Casitas	Recharge	No	No	No
49326	**Vegetation**	**Rincon**	**Recharge**	**Yes**	**Yes**	**No**
49319	Vegetation	Rincon	Recharge	No	No	No
49318	Vegetation	Unnamed Tributary	Recharge	No	No	No
51844	Vegetation	Unnamed Tributary	Recharge	No	No	No
94554	Wetlands	Toro	Recharge	No	No	No
94526	Wetlands	Toro	Recharge	Yes	No	No
94525	**Wetlands**	**Arroyo Paredon**	**Recharge**	**Yes**	**Yes**	**No**
94530	Wetlands	Arroyo Paredon	Recharge	No	No	No
102946	Wetlands	Arroyo Paredon	Recharge	Yes	No	No
94533	Wetlands	Arroyo Paredon	Recharge	No	No	No
200640	Wetlands	Arroyo Paredon	Recharge	No	No	No
94531	Wetlands	NA	Recharge	No	No	No
201660	Wetlands	NA	Recharge	No	No	No
94527	Wetlands	NA	Recharge	No	No	No
92340	Wetlands	Franklin (El Estero)	Confined	Yes	Yes	No
102679	Wetlands	Santa Monica (El Estero)	Confined	Yes	Yes	No
91225	Wetlands	NA	Recharge	No	No	No
93680	Wetlands	Gobernador	Recharge	No	No	No
93681	Wetlands	Gobernador	Recharge	No	No	No
102073	Wetlands	Gobernador	Recharge	No	No	No
93679	**Wetlands**	**Rincon**	**Recharge**	**Yes**	**Yes**	**Yes**
95850	Wetlands	Rincon	Recharge	Yes	No	No

Notes

Potential GDE Polygon areas meeting screening criteria shown in **BOLD TYPE**.

[1] Ground surface elevation at center of GDE polygon.

[2] Wet Water Year Type

[3] Normal Water Year Type

[4] Critically Dry Water Year Type

[5] Portion of mapped polygon area in unconfined Recharge Area.

bgs = below ground surface

DTW = depth to water

ft = feet or foot

GDE = groundwater dependent ecosystem

NA = not applicable

Table 3-4. Potential GDE Water-Level Monitoring Well Summary

NC Dataset Polygon ID	GS Elevation[1]	Nearest MWs	Distance (ft)[2]	WCR? (y/n)	Water Level Record		Comments
					Start	End	
52596	38	19F4	1,145	n	12/8/49	8/27/20	Up to 9 years DTW > 30 ft during extended dry periods
		19M3	1,020	n	12/14/49	12/18/13	Up to 7 years DTW > 30 ft during extended dry periods
94525	27	19F4	1,920	n	12/8/49	8/27/20	Up to 6 years DTW > 30 ft during extended dry periods
		19M3	1,390	n	12/14/49	12/18/13	**Available data show DTW consistently < 30 ft**
93679	206	25L3	68	n	5/30/96	8/26/20	**Available data show DTW consistently < 30 ft**
		25N5	125	y	5/30/96	2/14/17	Available data show DTW consistently > 30 ft
49326	142	35A3	195	n	1/25/78	2/24/05	**Available data show DTW consistently < 30 ft**
		35B6	870	n	6/18/96	4/27/07	**Available data show DTW consistently < 30 ft**

Notes

Potential GDE Polygon areas meeting screening criteria shown in **BOLD TYPE**.

[1] Ground surface elevation at center of GDE polygon.

[2] Distance from subject well to center of GDE polygon.

DTW = depth to water

ft = feet or foot

GDE = groundwater dependent ecosystem

GS = ground surface

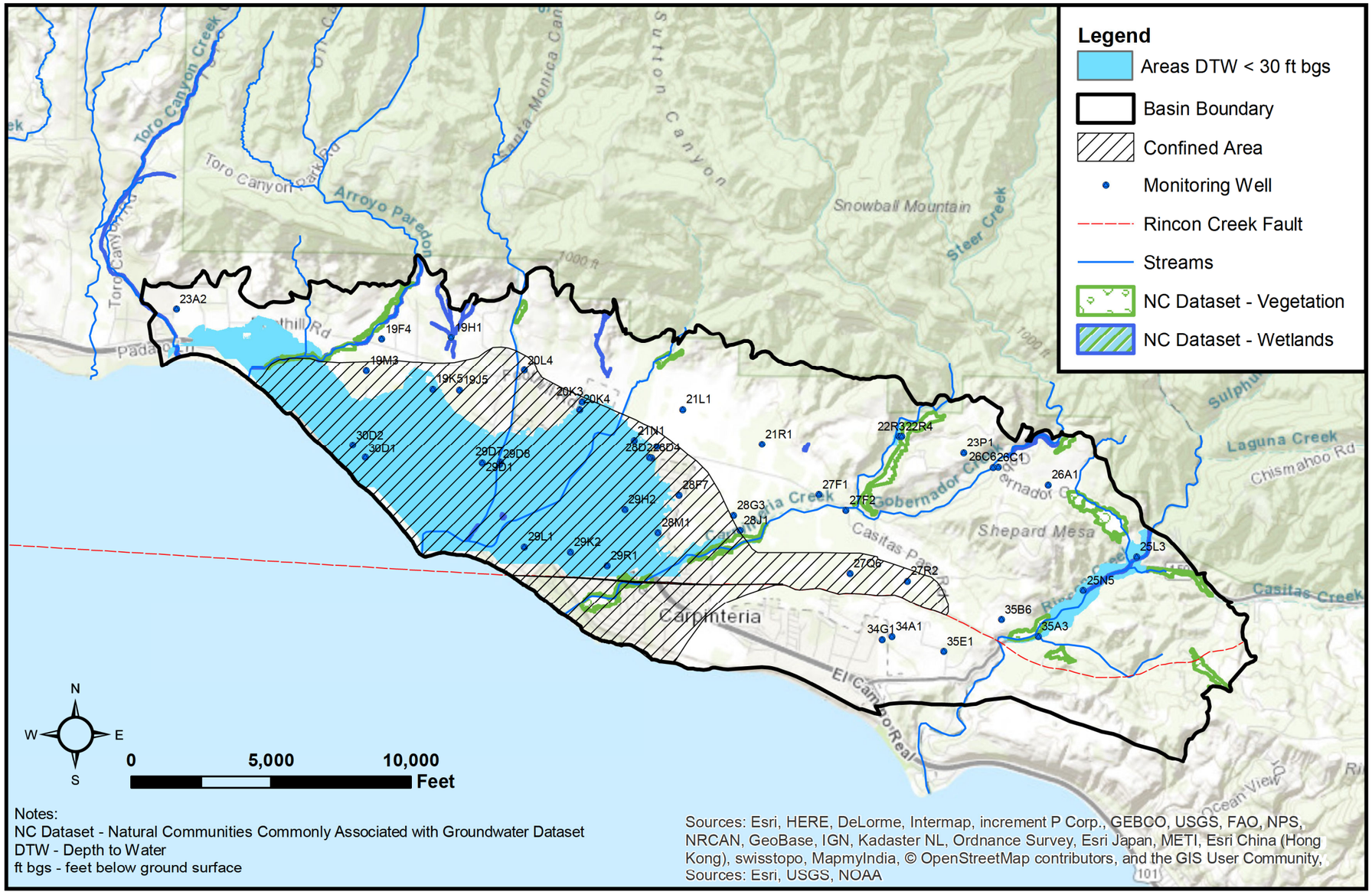
MW = monitoring well

n = no

NA = Not Available

NC = Natural Communities

y = yes



Notes:
NC Dataset - Natural Communities Commonly Associated with Groundwater Dataset
DTW - Depth to Water
ft bgs - feet below ground surface

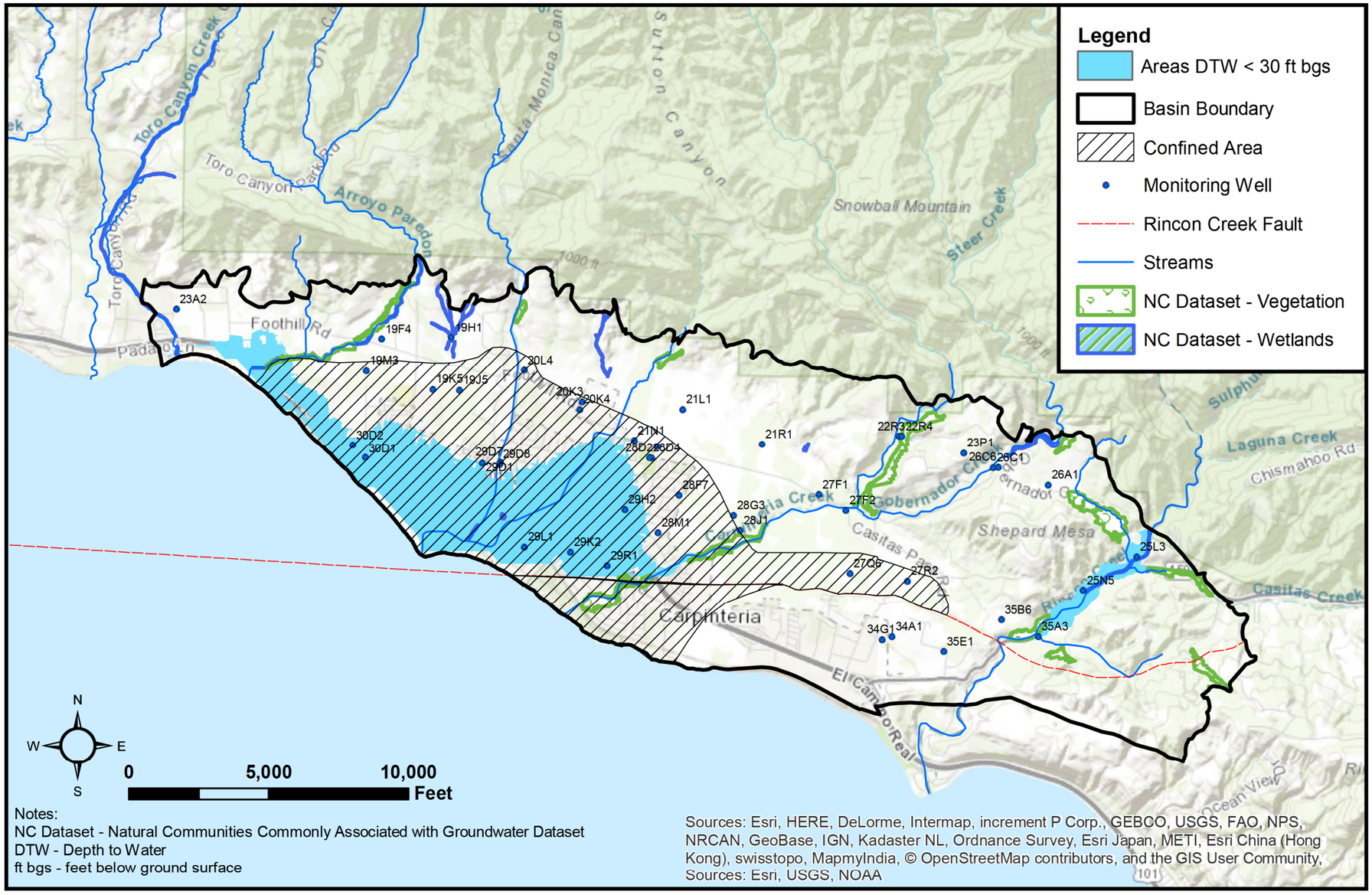
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community, Sources: Esri, USGS, NOAA

FIGURE 3-49

GDE Screening – DTW < 30 ft bgs (Spring 2005)

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3



Notes:
NC Dataset - Natural Communities Commonly Associated with Groundwater Dataset
DTW - Depth to Water
ft bgs - feet below ground surface

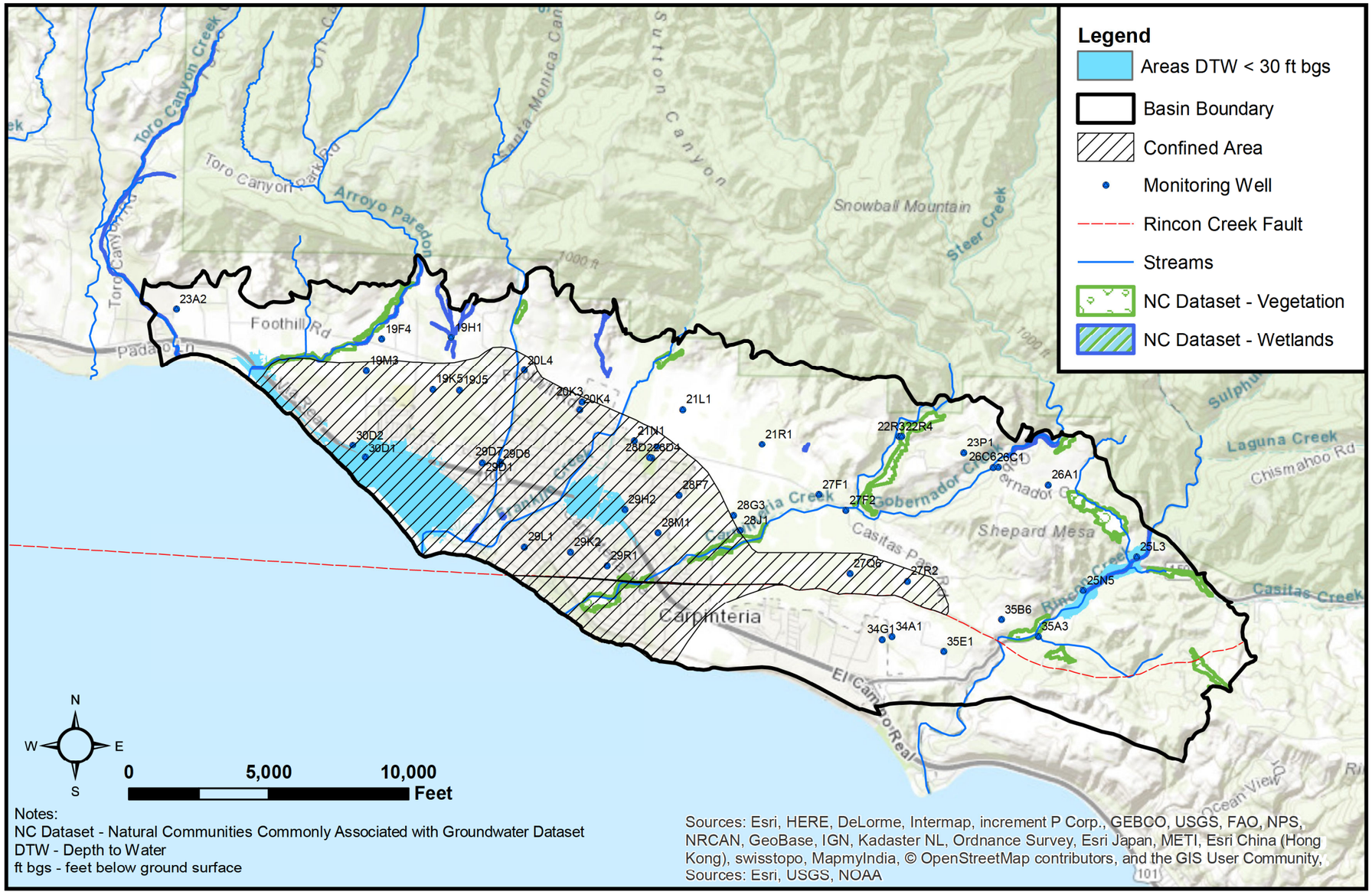
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community, Sources: Esri, USGS, NOAA

FIGURE 3-50

GDE Screening – DTW < 30 ft bgs (Spring 2010)

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3



Notes:
NC Dataset - Natural Communities Commonly Associated with Groundwater Dataset
DTW - Depth to Water
ft bgs - feet below ground surface

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community, Sources: Esri, USGS, NOAA

FIGURE 3-51

GDE Screening – DTW < 30 ft bgs (January 2015)

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

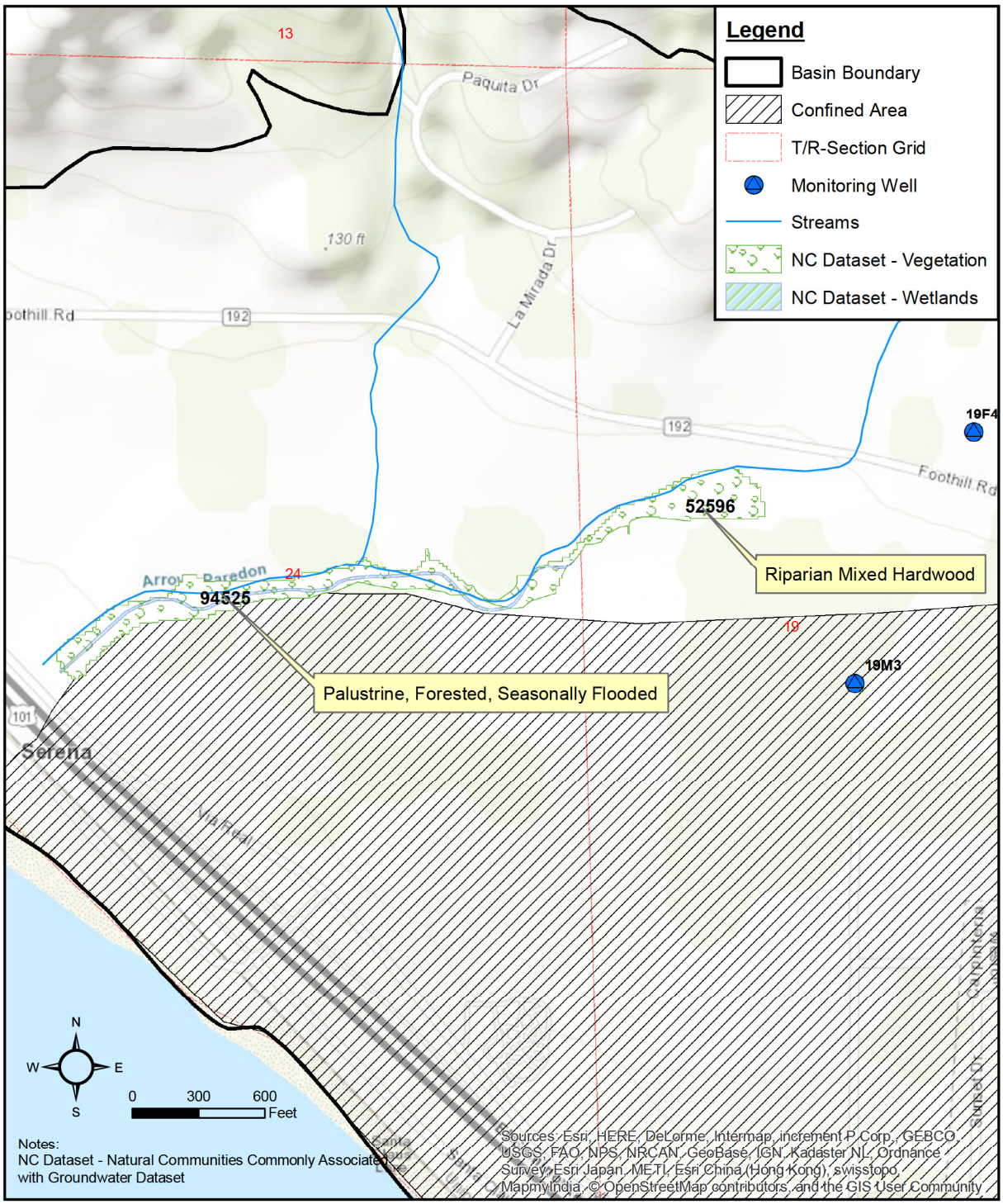


FIGURE 3-52

GDE Screening – Detail Area A Map

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

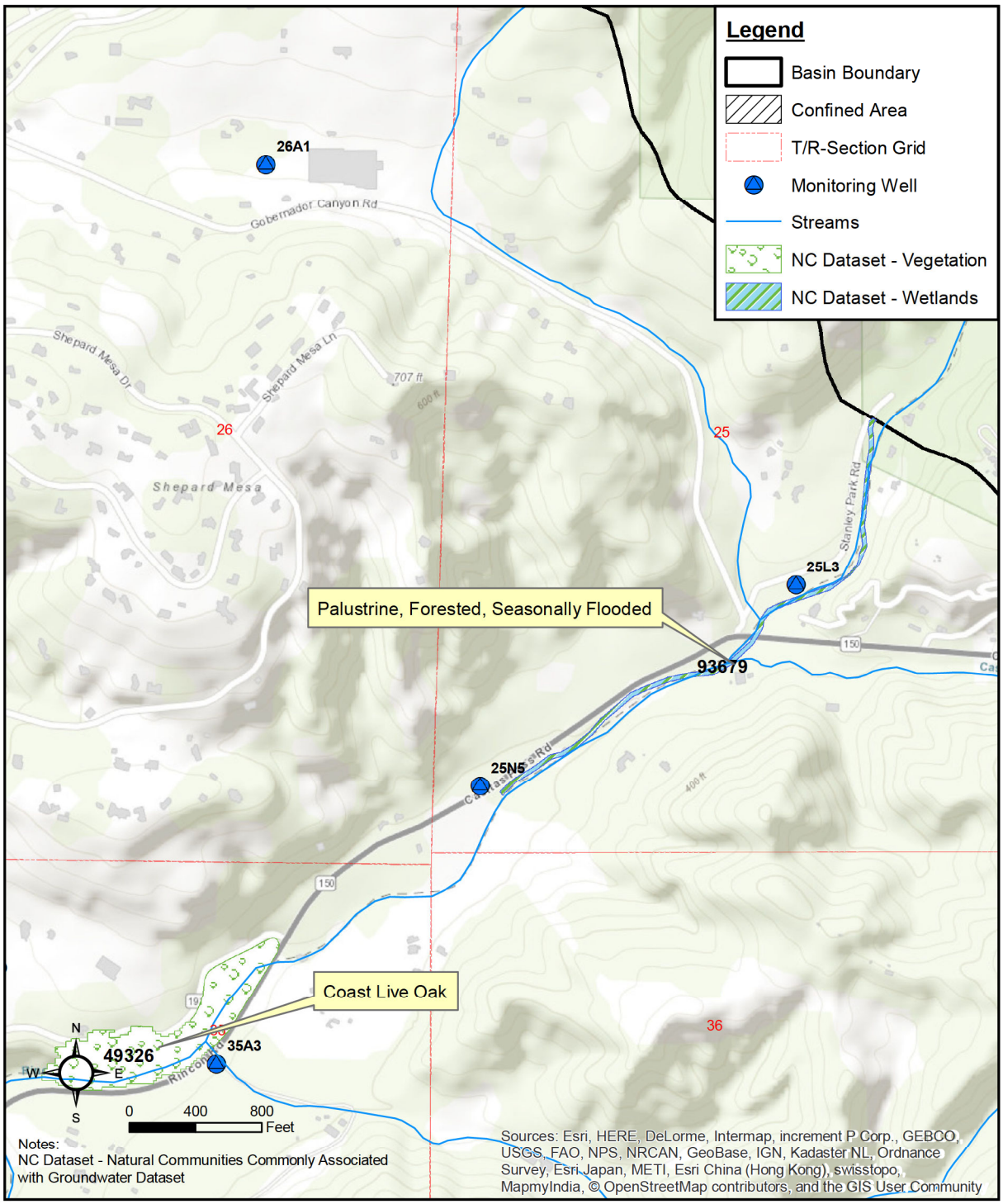


FIGURE 3-53

GDE Screening – Detail Area B Map

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

As shown in Table 3-4, only one of the monitoring wells in the vicinity of the subject potential GDE's has a well log available (25N5). Although water-level data are available for all of these proximate wells, and represent the best currently available information, their depths and screened intervals are unknown.

Nevertheless, water-level hydrographs for the two existing monitoring wells located in the vicinity of the Arroyo Paredon Creek potential GDEs (19F4 and 19M3) are shown on Figures 3-54 and 3-57. Also shown are the bottom elevations of the potential GDE polygons (at the center nearest the subject monitoring well) and the associated 30 feet depth-to-water distances. As shown on the hydrographs for 19F4 (Figures 3-54 and 3-55), there are up to 6 to 9 consecutive years (depending on the GDE polygon) during which water levels are greater than 30 feet below the potential GDE.

As shown on the hydrographs for 19M3 (Figures 3-56 and 3-57), there are up to 6 consecutive years where the depth-to-water below potential GDE polygon 52596 (vegetation - riparian mixed hardwood) is greater than 30 feet; however, for potential GDE polygon 94525 (wetlands - palustrine, forested, seasonally flooded), the depth-to-water is consistently less than 30 feet during the period of record. It is noted that the period of record for 19M3 ends in December 2013; therefore, water-level data during the current cumulatively dry period of WY 2012 through WY 2020 are not available.

Based on the water-level data available for monitoring wells 19F4 and 19M3, there are numerous consecutive years when depths-to-water are greater than 30 feet below the potential GDE. Based on these observations, it appears that these potential GDEs along Arroyo Paredon Creek may not be dependent on groundwater; however, as discussed previously, well logs for these two monitoring wells are unavailable. These potential GDE polygons will be further evaluated during GSP implementation.

Water-level hydrographs for the four existing monitoring wells located in the vicinity of the Rincon Creek potential GDEs (25L3, 25N5, 35A3 and 35B6) are shown on Figures 3-58 through 3-61. As shown for wells 25L3, 35A3 and 35B6, depth-to-water levels are consistently less than 30 feet below the bottom elevations of both potential GDE polygon 93679 (wetlands - wetlands - palustrine, forested, seasonally flooded) and GDE polygon 49326 (vegetation – coast live oak), whereas for well 25N5 (Figure 3-59), depth-to-water levels are consistently greater than 30 feet below the bottom elevations of potential GDE polygon 93679. However, screen interval information for 3 of the 4 monitoring wells is not currently available. These potential GDEs will be further evaluated during GSP implementation.

It is also noted that there is anecdotal information suggesting that these two creeks may be fed by springs and/or seeps located in the bedrock areas outside the basin boundaries. If so, the potential GDEs could be supported during dry periods by these surface water flows emanating from outside the Basin rather than being dependent on groundwater. However, as noted previously, there are no streamflow monitoring data for either of the two creeks to definitively support this. Historical satellite imagery (Google Earth) was examined, but the available imagery resolution was insufficient to visually determine if surface water has historically been present in Arroyo Paredon and Rincon creeks during dry periods or not. Each of these creeks was subsequently visually inspected in the field at bridges located upstream of the potential GDEs in July 2022. During these field visits, the creek beds were observed to be dry at all locations.

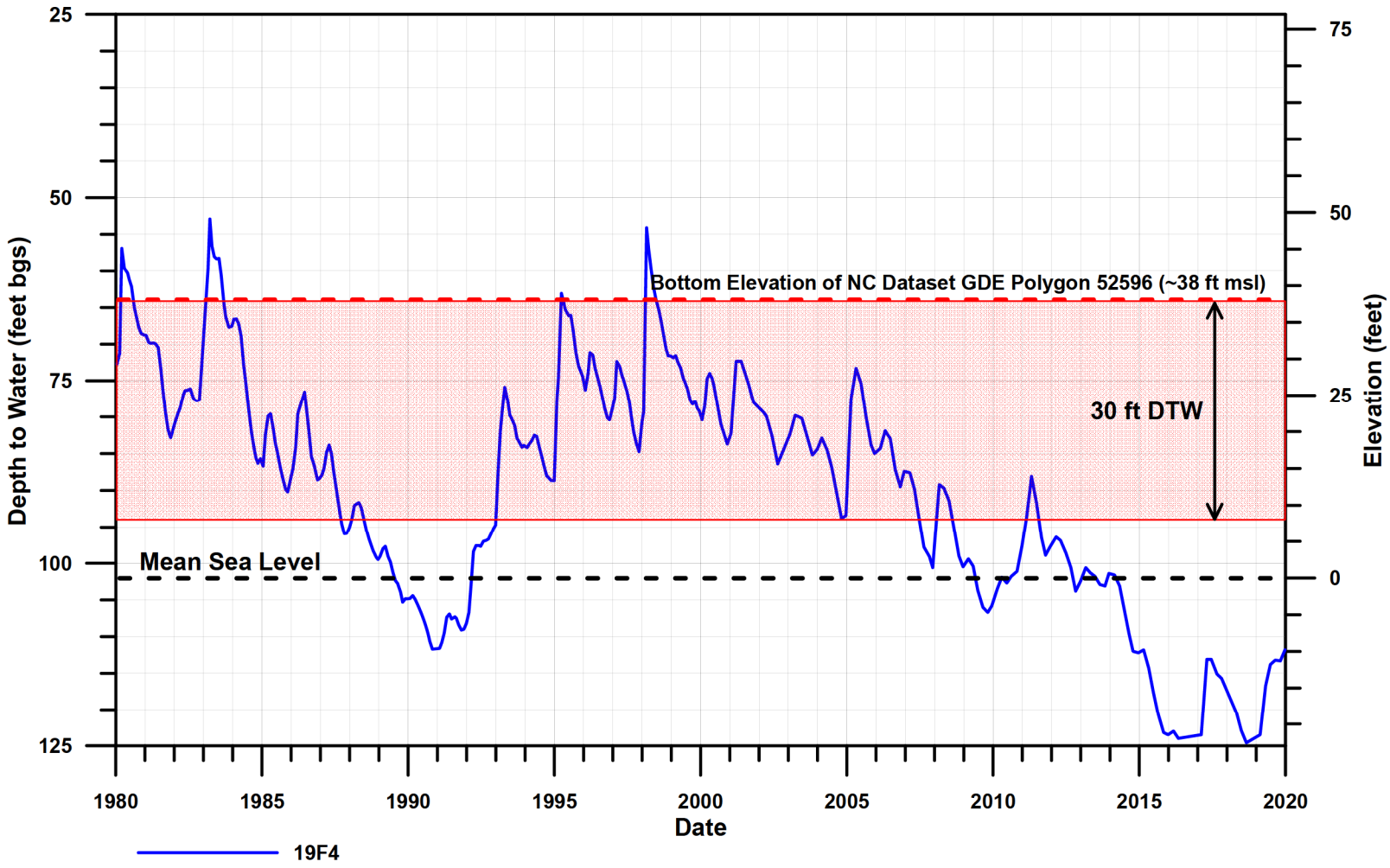


FIGURE 3-54

GDE Screening Water Level Data – 4N/25W-19F4 (relative to GDE Polygon 52596)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

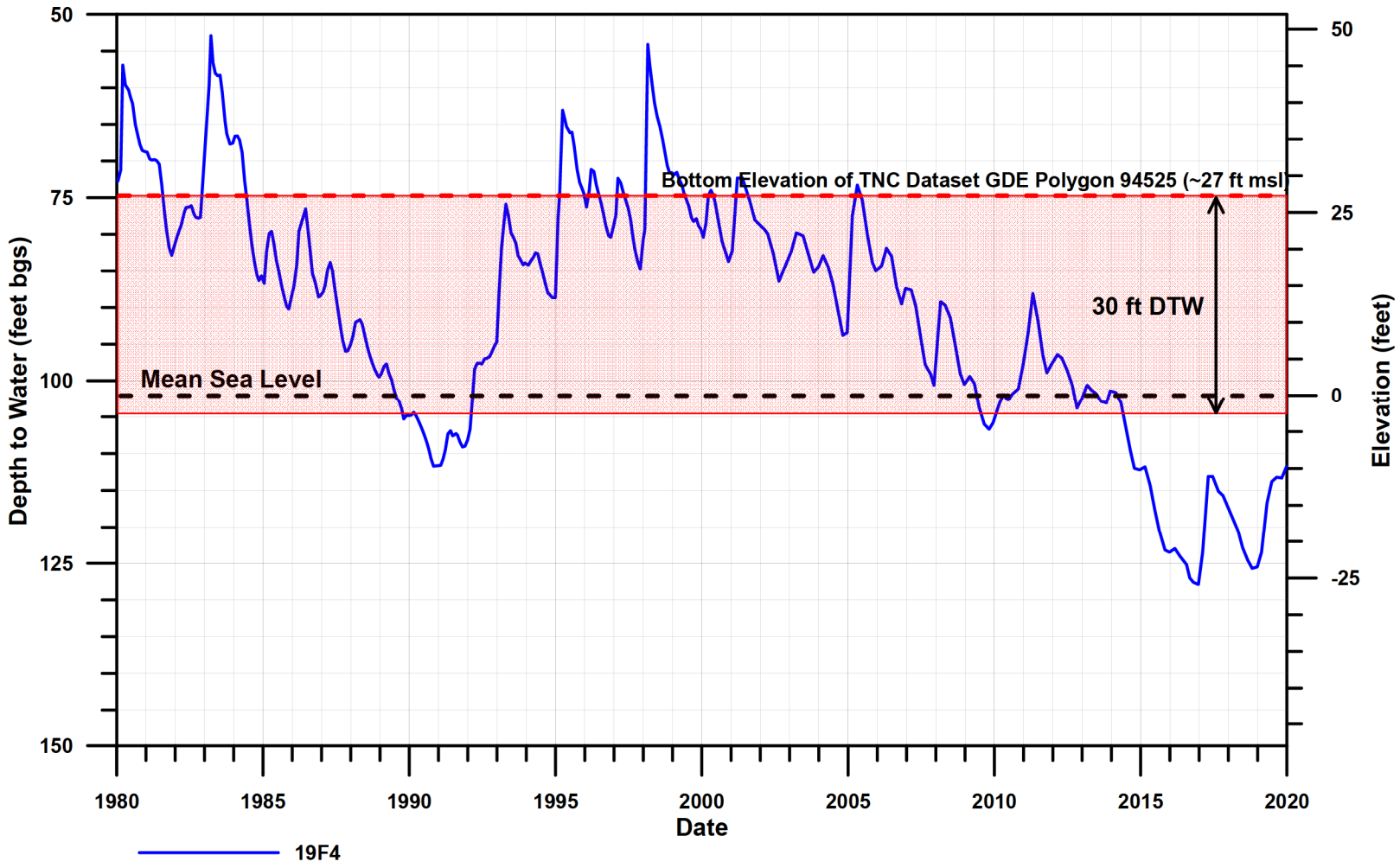


FIGURE 3-55

GDE Screening Water Level Data – 4N/25W-19F4 (relative to GDE Polygon 94525)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

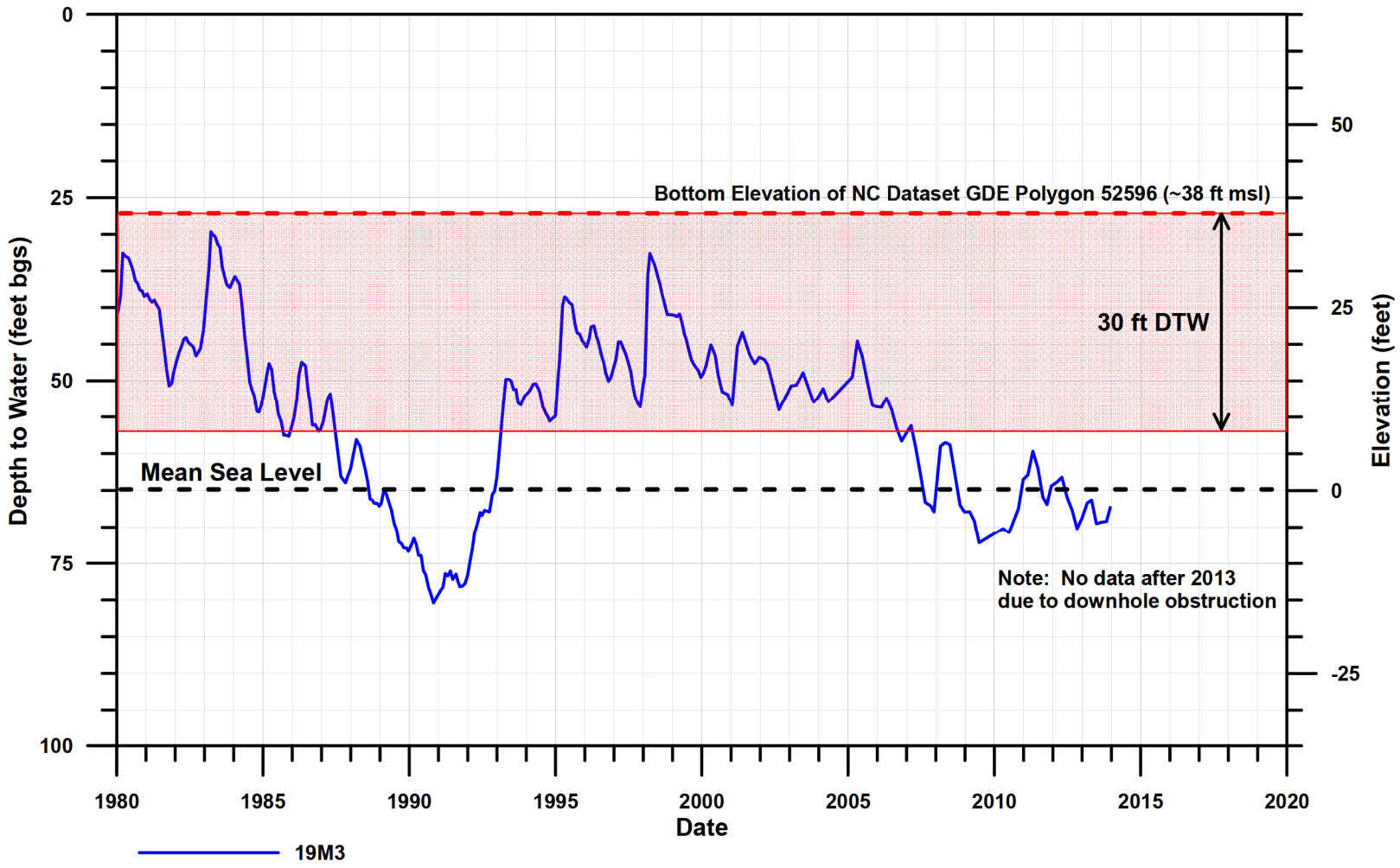


FIGURE 3-56

GDE Screening Water Level Data – 4N/25W-19M3 (relative to GDE Polygon 52596)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

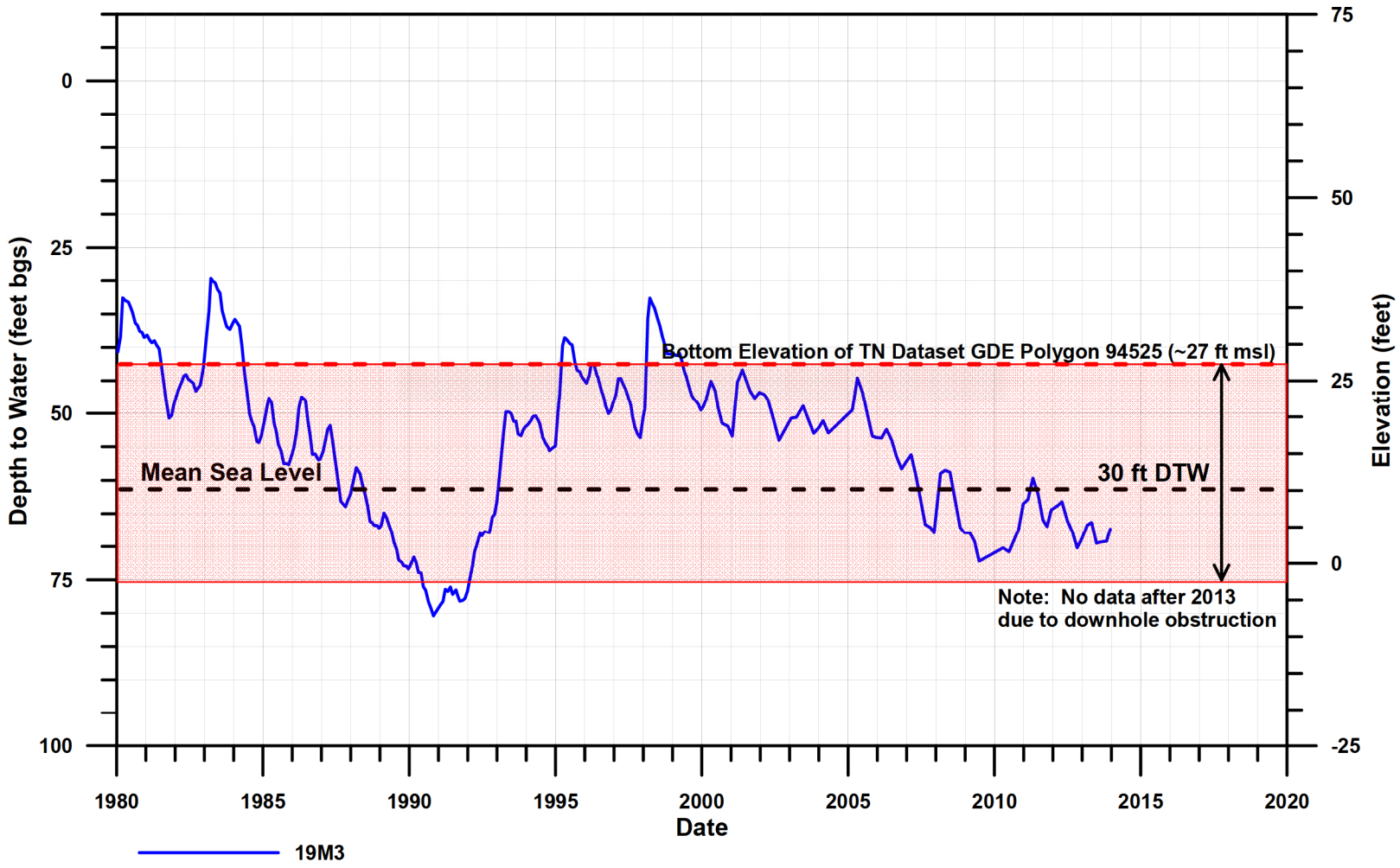


FIGURE 3-57

GDE Screening Water Level Data – 4N/25W-19M3 (relative to GDE Polygon 94525)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

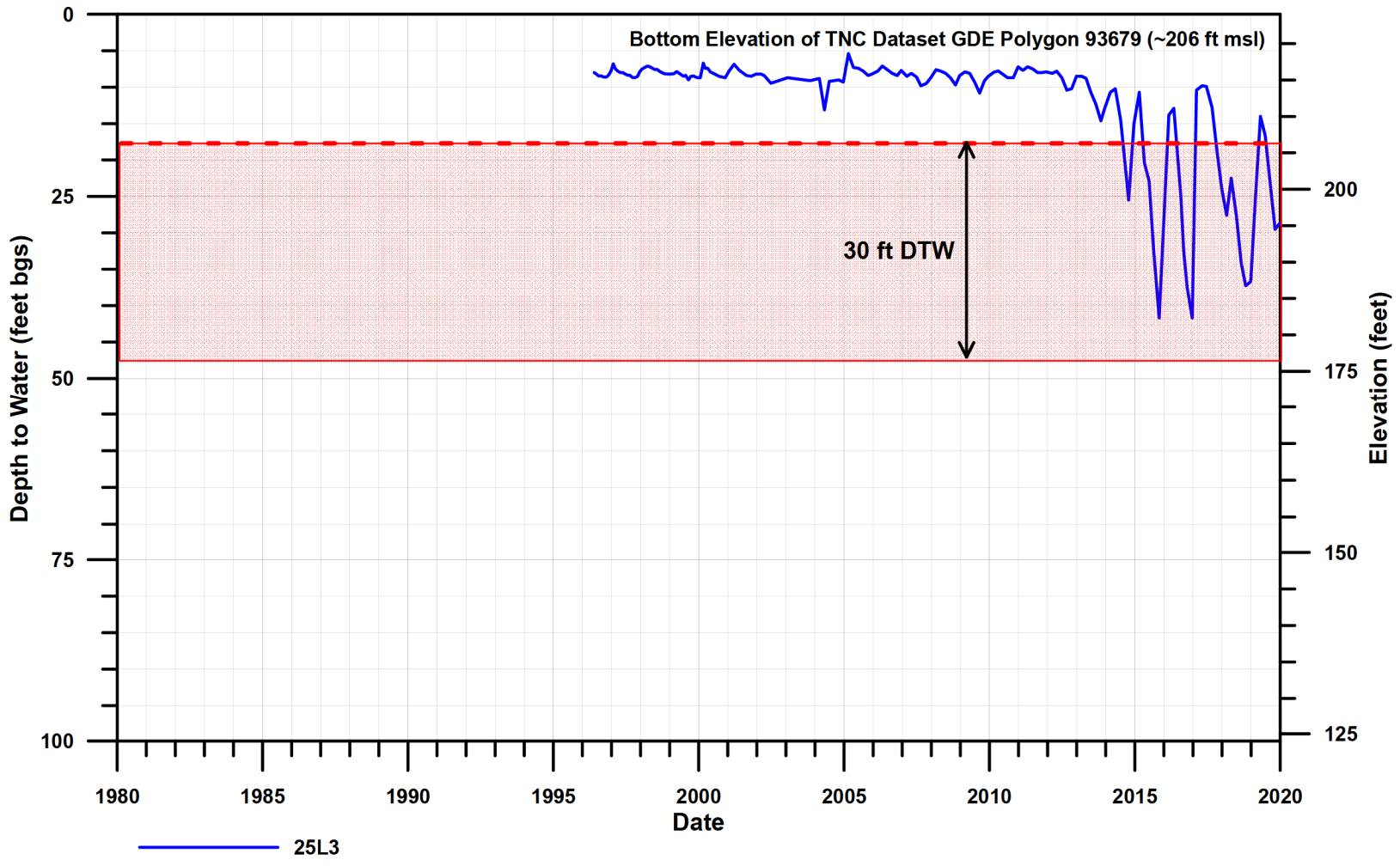


FIGURE 3-58

GDE Screening Water Level Data – 4N/25W-25L3 (relative to GDE Polygon 93679)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

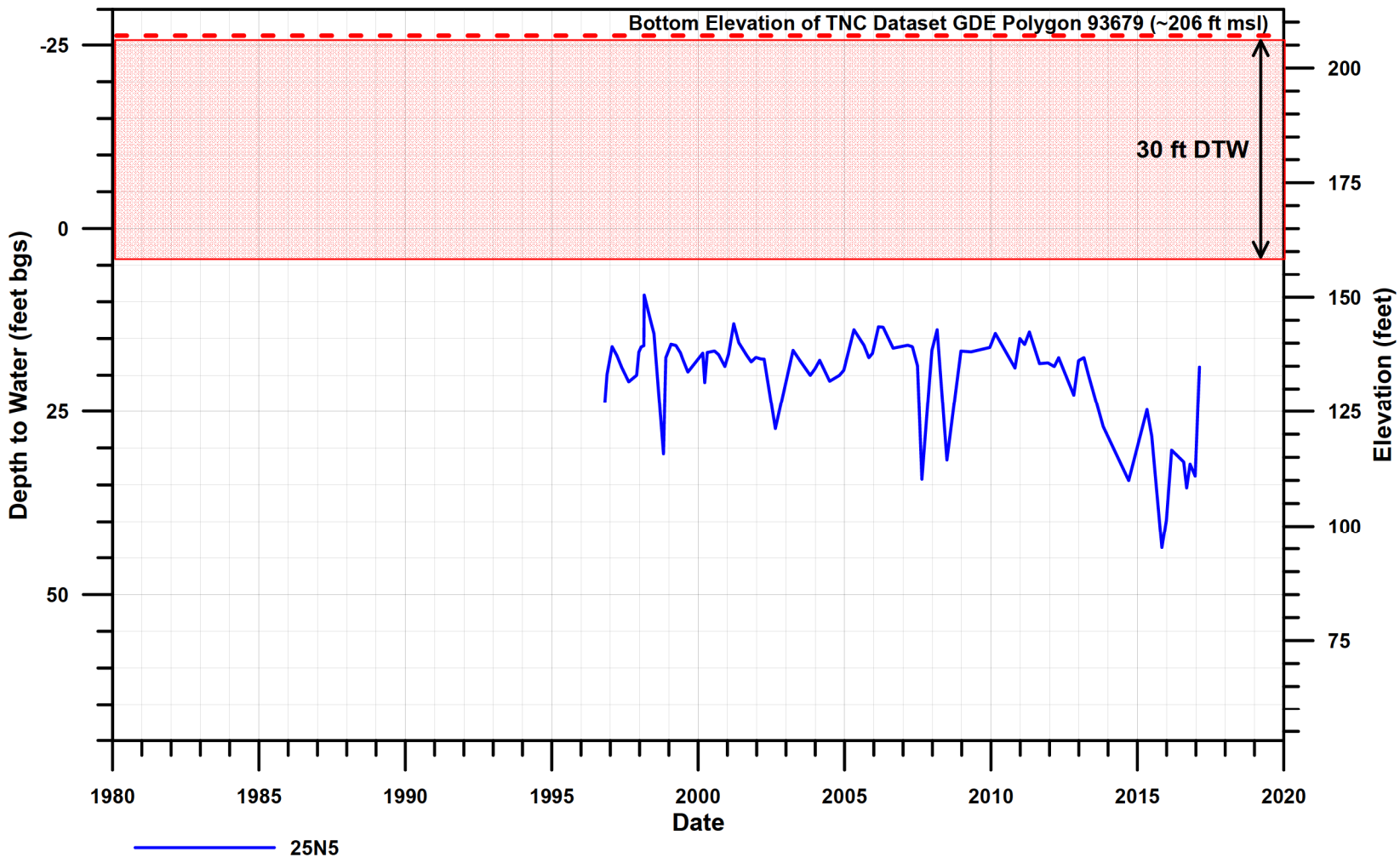


FIGURE 3-59

GDE Screening Water Level Data – 4N/25W-25N5 (relative to GDE Polygon 93679)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

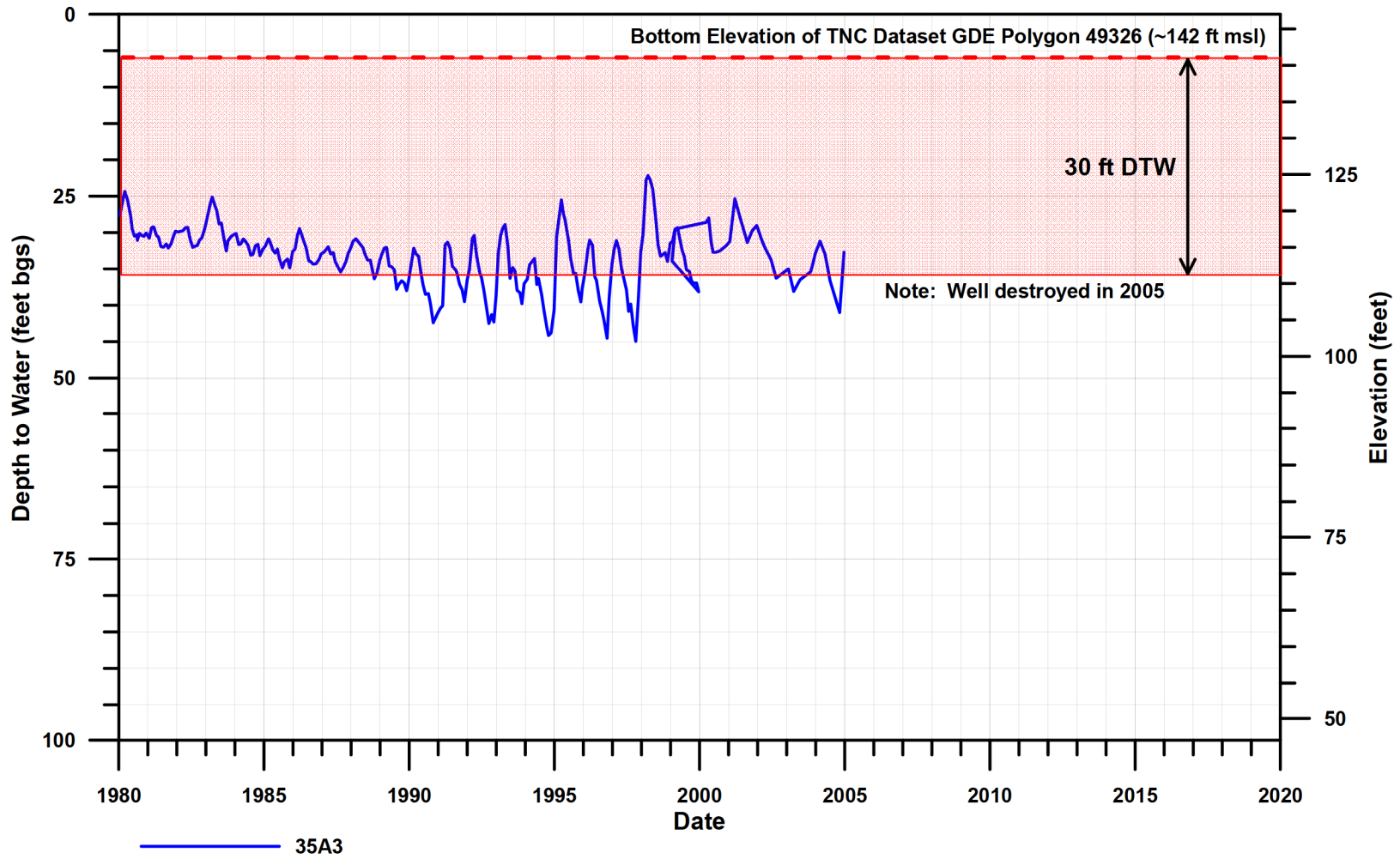


FIGURE 3-60

GDE Screening Water Level Data – 4N/25W-35A3 (relative to GDE Polygon 49326)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

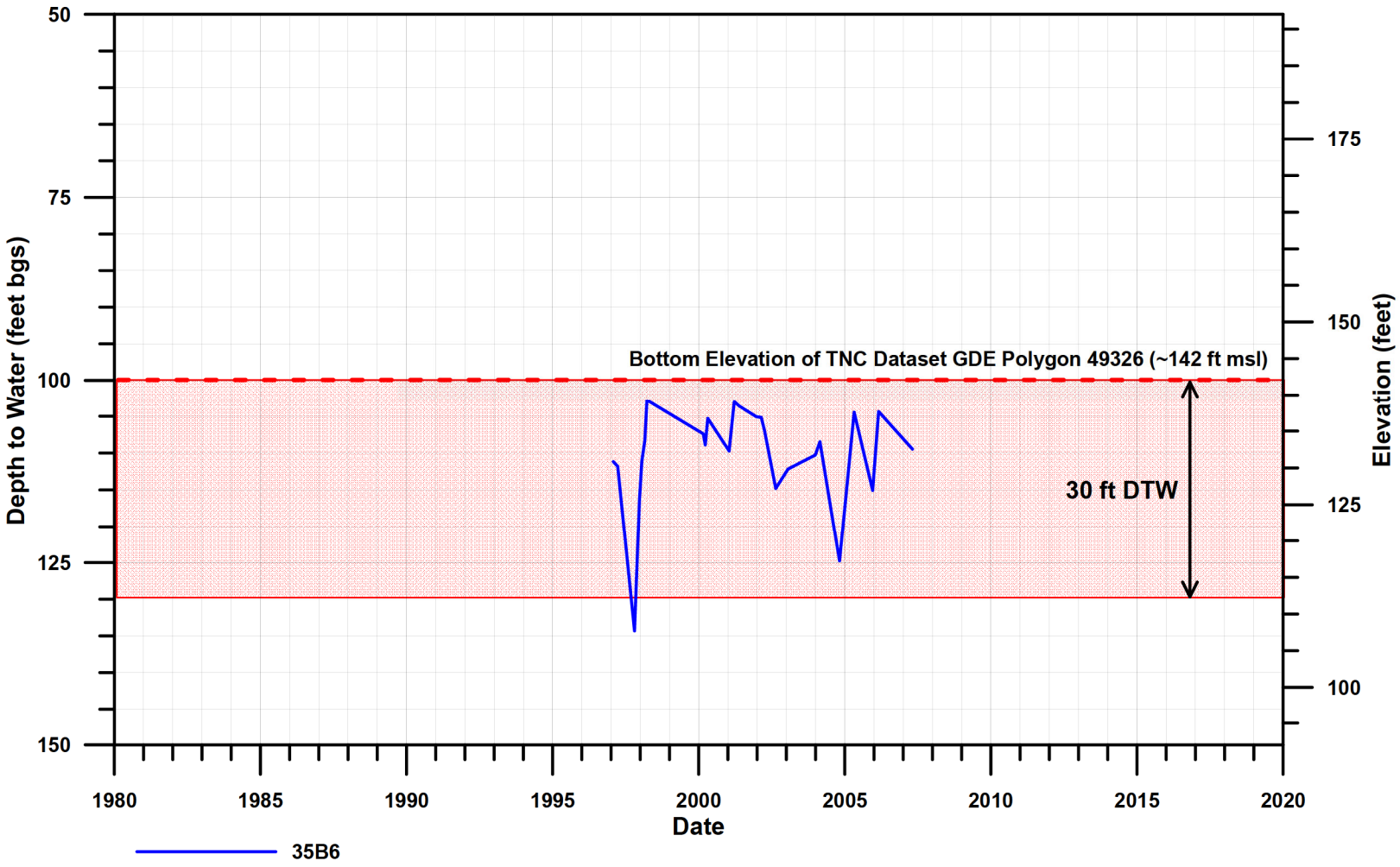


FIGURE 3-61

GDE Screening Water Level Data – 4N/25W-35B6 (relative to GDE Polygon 49326)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

3.3 Water Budget [§ 354.18]

§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.

(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.

(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) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow.

(4) The change in the annual volume of groundwater in storage between seasonal high conditions.

(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.

(6) The water year type associated with the annual supply, demand, and change in groundwater stored.

A water budget is the key integrating aspect of the basin setting. The HCM (see Section 3.1) and water budgets (this section) form the basis for the numerical flow model used to quantitatively evaluate the management alternatives considered in this Plan.

3.3.1 Overview of Water Budget Development

This section presents the water budgets prepared for the Basin and contains information required by SGMA regulations and information that is important for developing an effective plan to achieve sustainable groundwater management. According to SGMA regulations (§ 354.18), the GSP must include a water budget for the basin that provides an accounting and assessment of the total annual volume of surface water and groundwater entering and leaving the basin, including historical, current, and projected water budget conditions. A water budget accounts for the change in the total volume of water stored in a basin under these different conditions. The regulations require that the water budget be reported in graphical and tabular formats.

This water budget analysis is inextricably tied to the SGMA requirement to ensure the Basin is operated within its sustainable yield. Sustainable yield is defined in SGMA as “the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any

temporary surplus that can be withdrawn annually from a groundwater supply without causing an undesirable result." An undesirable result is one or more of the following effects caused by groundwater conditions occurring throughout a basin:

- Chronic lowering of groundwater levels in the aquifer(s) 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 groundwater extractions and recharge are managed as necessary to ensure that reductions of groundwater levels or storage during a period of drought are offset by increases of groundwater levels or storage during other periods.
- Significant and unreasonable reduction of groundwater in storage.
- Significant and unreasonable degradation of water quality, including the migration of contaminant plumes that impair water supplies.
- Seawater intrusion.
- Significant and unreasonable land subsidence that substantially interferes with surface land uses.
- Depletion of interconnected surface water that has significant and unreasonable adverse impacts on beneficial uses of surface water.

Defining the sustainable yield of a groundwater basin based upon a water budget provides a starting point that may be adjusted by considering whether there are undesirable results associated with any of the six sustainability indicators described above. Section 5 presents consideration of the sustainability indicators for defining sustainable yield. Section 354.18 of the SGMA regulations requires development of a water budget that includes both groundwater and surface water components to provide an accounting of the total volume of water entering and leaving a basin. To satisfy the requirements of the regulations, water budgets were prepared for the Basin for each of the three water budget periods.

3.3.2 Water Budget Data Sources, Methodology, and Basin Model

This section describes data sources and methodologies used in the calculation of the historical and current water budgets for the Basin. A description of the data sources and methodologies used in the calculations of the projected water budget is presented later in Section 3.3.5.

In this GSP, the discussion of the water budget periods refers to water years (WY), which run between October 1 and September 30 of the following year. The three water budget periods are as follows:

- The historical water budget period is WY 1985 through 2020.
- The current water budget period is WY 2012 through 2020.
- The projected water budget period is the 52-year period of WY 2021 through 2072 and extends 50 years past the submittal of this GSP as required by SGMA regulations.

The three GSP water budget time frames are illustrated graphically in Figure 3-62 and each of these periods is discussed in further detail in Sections 3.3.3, 3.3.4, and 3.3.5. The 36-year period between WY 1985 and 2020 (inclusive) has been selected for the historical water budget to comply with DWR regulatory requirements, which include the following:

> "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 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."

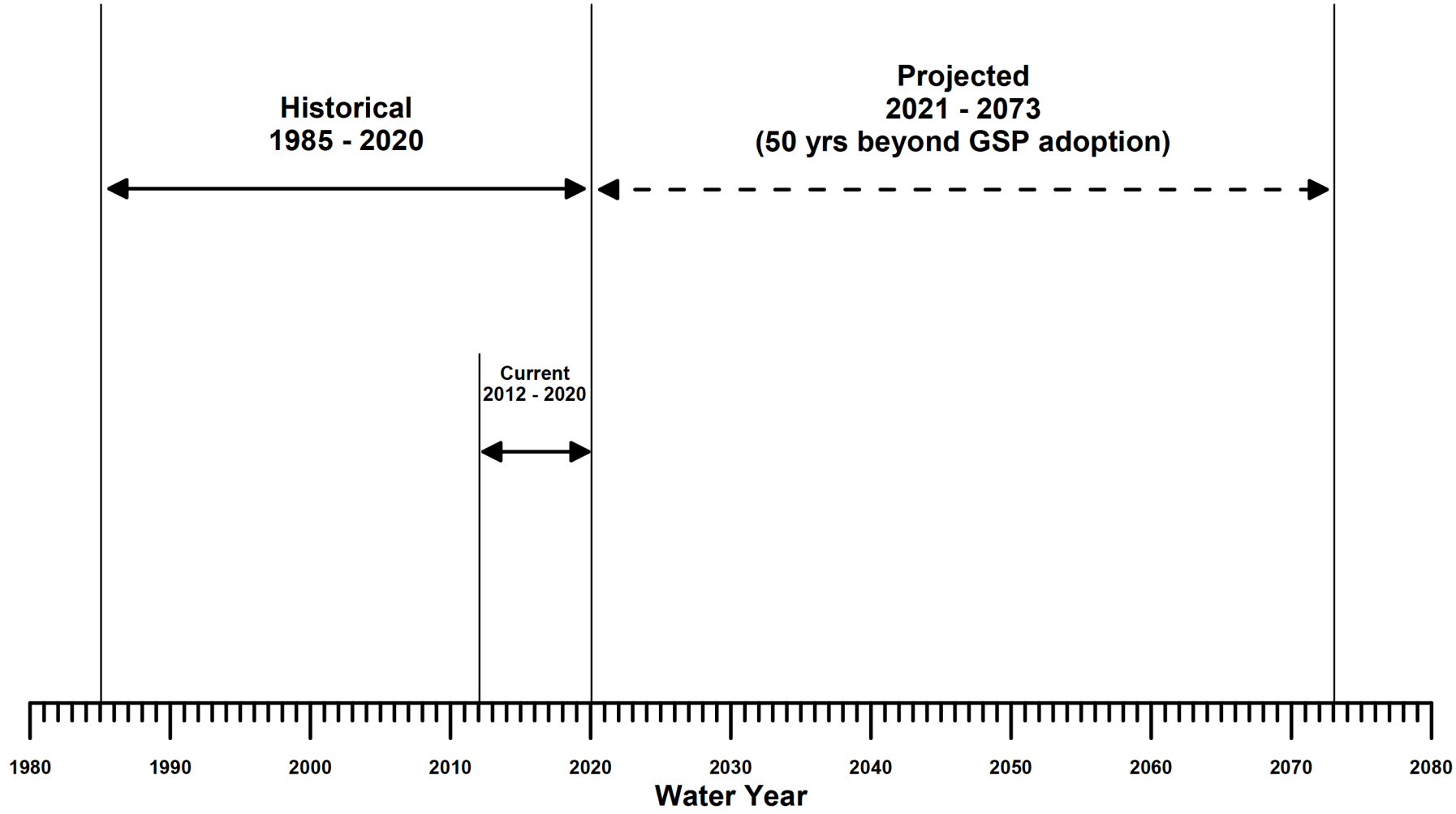


FIGURE 3-62

GSP Water Budget Time Frames

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

The 36-year period selected for the historical water budget includes the most recently available information, two wet and two dry hydrologic cycles, recent changes in imported water supply availability, changes to water demand associated with cropping patterns, and associated land use. The selection of the historical period considered the availability of good-quality data for the principal water budget components, including precipitation water level data, pumping data, and land use information, which will be discussed individually later. The historical water budget period was chosen to define a specific period when all of the elements of recharge and discharge to the Basin may be compared to other periods (e.g., future projected). This historical period allows for the identification of long-term trends in basin supply and demand, water level trends, changes of groundwater in storage, and estimates of the annual components of inflow and outflow to the zone of saturation. This information is fundamental to input into the numerical groundwater flow model (see Appendix F).

Precipitation data was obtained from the gage located at Carpinteria Fire Station No. 1 (see Figure 3-63). Figure 3-64 presents a graph showing the cumulative departure from mean precipitation for precipitation for the period of record from WY 1949 through 2020. Upward trending portions of the line represent wet periods of above-average rainfall, and downward trending portions represent drought periods of below-average rainfall. In the Basin, precipitation occurs primarily as rainfall. The average precipitation, measured at the Carpinteria Fire Station No. 1 is 17.3 inches for the period of record since 1949. The lower portion of the chart shown on Figure 3-64 shows the annual precipitation. Climatic trends (historical wet-dry cycles) are also shown on the graph. Climatic trends were selected in the context of longer-term multi-year climatic periods of wet, normal, and drought conditions within the Basin. Notable aspects of these periods include the following:

- A long, moderate drought occurred between the beginning of the period of record in WY 1945 and lasted through 1960.
- Between 1960 and 1977, rainfall was approximately average.
- Between 1977 and 1986 there was a short but intense wet period of substantially above-average precipitation. After the intense wet period, there was a 4-year drought (1987–1990) and a 8-year wet period (1991 to 1998). The wettest month on record occurred during this wet period in February of 1998.

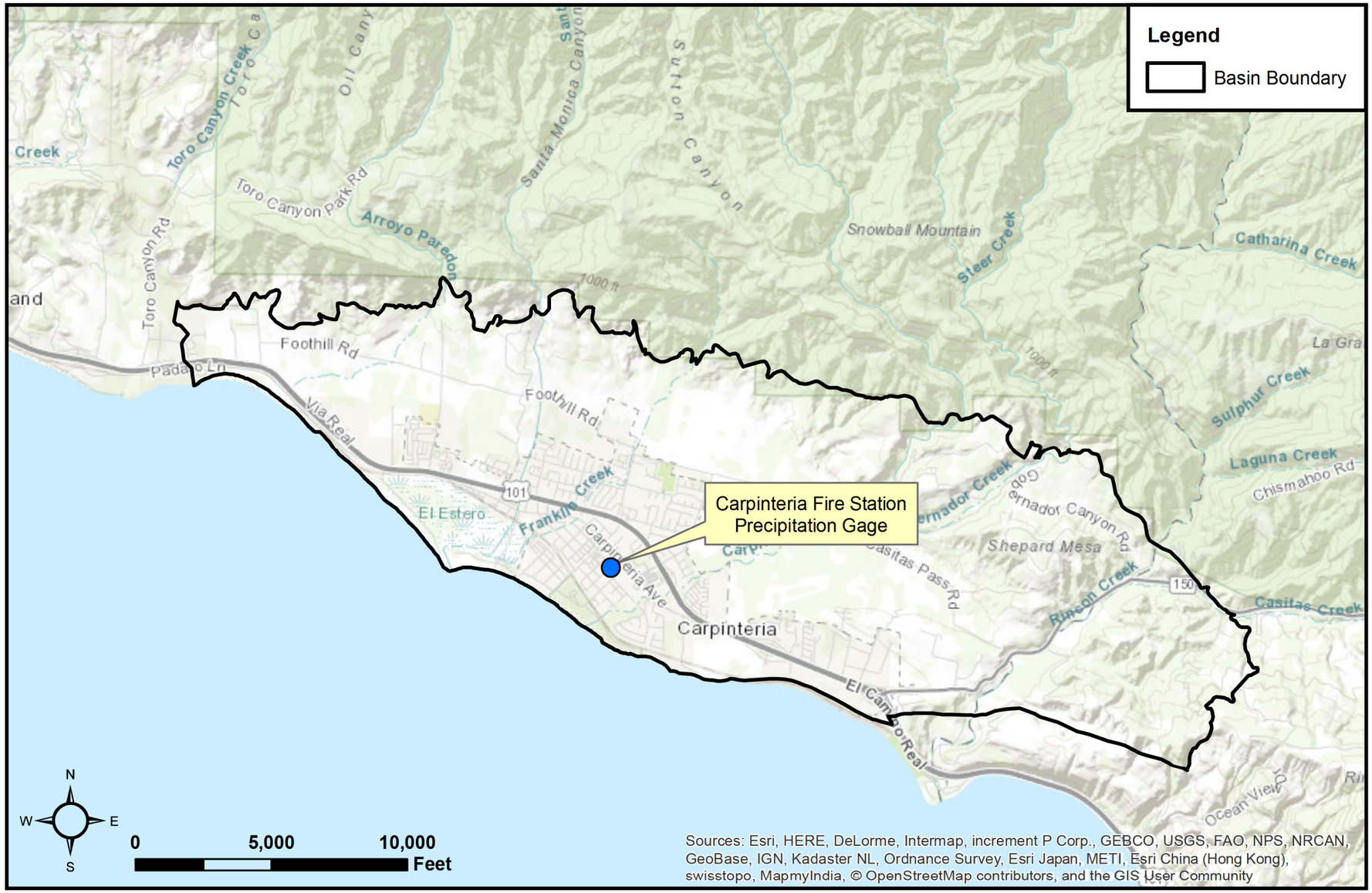


FIGURE 3-63

Rainfall Station Location Map

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

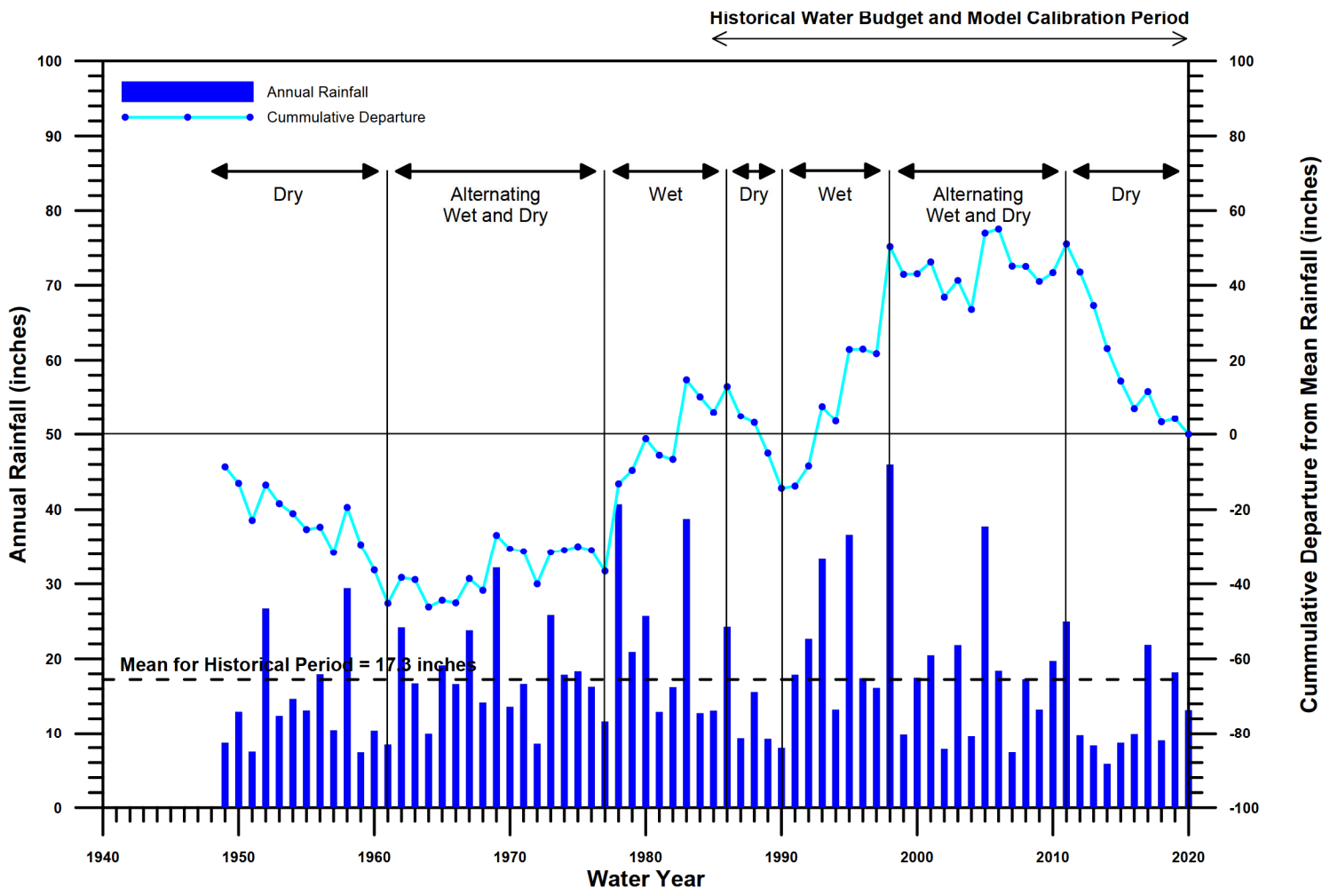


FIGURE 3-64

Historical Annual Rainfall – Carpinteria Fire Station

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

The current drought started in WY 2012 and remains the most severe drought during this period. The period included two wet year in 2017 and 2019. The current water budget period was selected to be between 2012 and 2020. This period represents a very dry period overall, which—although not as hydrologically balanced as the historical period—is considered representative of the current drought conditions. Precipitation at the Carpinteria Fire Station No. 1 during this period averaged 11.6 inches, which is just 67 percent of the historical period. Section 3.3.4 presents the current water budget information.

The projected water budget for the 53-year period between 2021 and 2072 (inclusive) extends 50 years past the submittal of this GSP. Section 3.3.5 presents the projected water budget information.

Some water budget data are available via direct measurement (e.g., CVWD metered pumping), whereas others require estimation based on commonly used techniques. In general, the techniques used for this GSP are based on methods used by GTC in their 1976 and 1986 water budget inventories, but as modified by PWR in 2012 given the availability of new data and/or analytical tools. The groundwater budget for the Carpinteria Groundwater Basin is expressed by the following equation:

Inflow = Outflow (+/-) Change in Storage

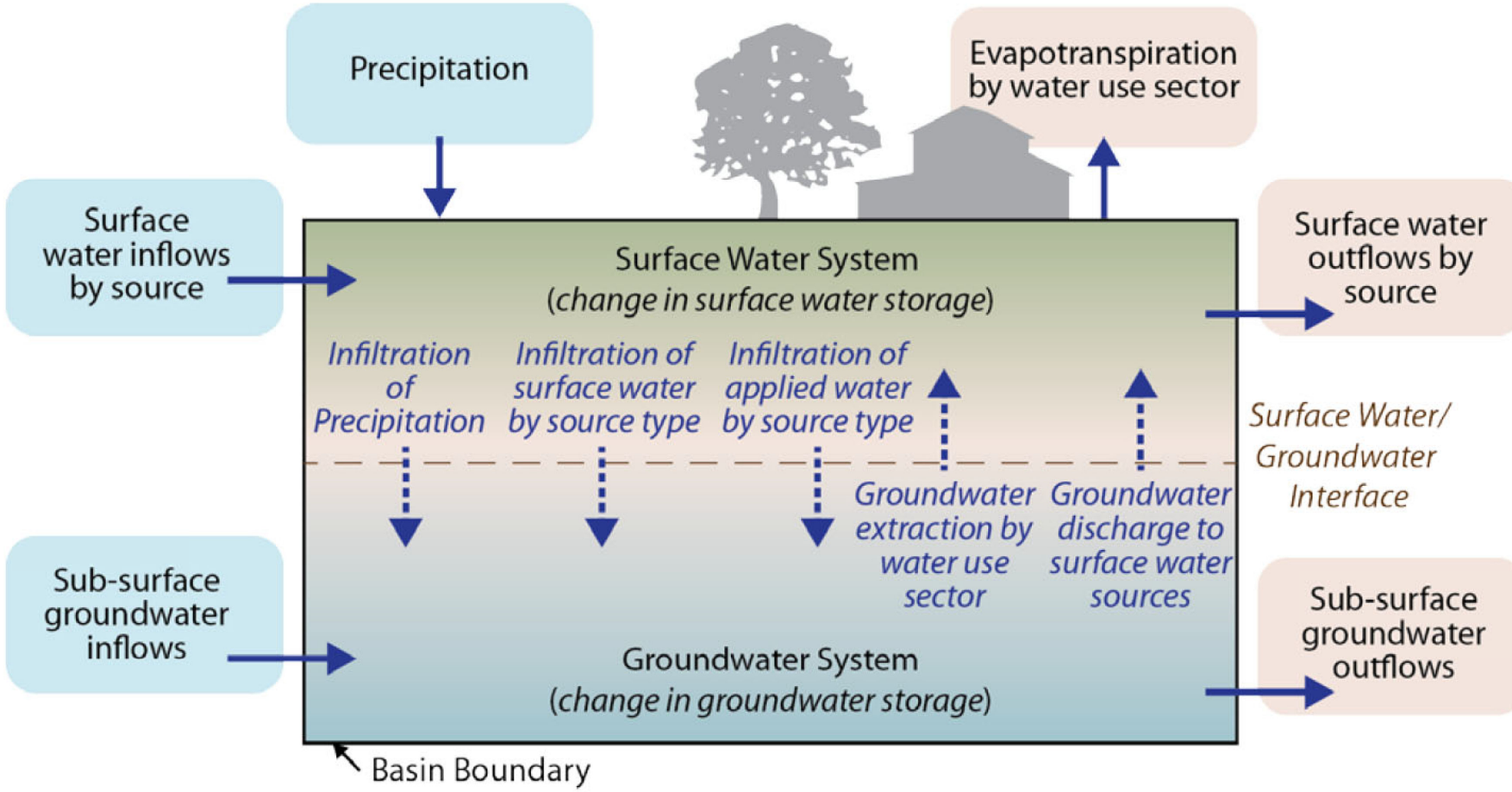
where Inflow equals:

- Percolation of precipitation
- Subsurface inflow from bedrock boundary (mountain front recharge)
- Streambed percolation
- Percolation of irrigation return water (pumped and delivered)
- Subsurface inflow from boundary with Pacific Ocean
- Subsurface inflow from boundary with MGB

and Outflow equals:

- Groundwater pumping
- Evapotranspiration by phreatophytes
- Subsurface outflow to boundary with Pacific Ocean
- Subsurface outflow to boundary with MGB

Figure 3-65 presents a general schematic diagram illustrating the hydrologic cycle and various water budget components.



Source: DWR (2016)

FIGURE 3-65

Water Budget Component Schematic

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

3.3.2.1 Water Budget Data Sources

Rainfall Data. Deep percolation of rainfall precipitation is the primary source of inflow/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 inflows. The SBCFCD maintains precipitation data from the Carpinteria Fire Station No. 1 with a period of record from 1949 to the present. Figure 3-63 shows the location of the Carpinteria Fire Station No. 1. Figure 3-64 presents the annual rainfall during the period of record for the station, which is 17.3 inches.

Figure 3-64 shows the cumulative departure of annual rainfall from the long-term mean. The cumulative departure from mean graphs the sum of annual departures over time, beginning with the first-year departure and adding each subsequent year departure. The climatic trends present in the cumulative departure curve exhibit a cyclical series of dry periods (falling segments) and wet periods (rising segments) in the Basin. The historical water budget period coincides with the beginning of a cumulatively dry period that occurred from about WY 1984 through WY 1991, followed by a wet period from WY 1992 through WY 1998, with alternating wet and dry periods from WY 1999 through WY 2011, followed by a cumulatively dry period extending from WY 2012 through WY 2020 (see Figure 3-64). The mean annual rainfall for the water budget historical period is 17.0 inches, which is within 2 percent of the long-term historical mean at the station.

Streamflow Data. There are five principal streams in the Basin: Carpinteria, Gobernador, Santa Monica, Arroyo Paredon, and Rincon Creeks. Additional minor drainages include Toro and Franklin Creeks. Only two of these creeks have runoff records—Carpinteria Creek and Franklin Creek. Stream gages have historically been maintained and monitored by the USGS, and the data is stored on the USGS Water Resources website. The Carpinteria Creek gage is the only currently active gage and has essentially continuous data since 1941 (there is a brief hiatus in the record for WY 1978). Figure 3-2 shows this gage, which is located just downstream of the confluence with Gobernador Creek. Records for Franklin Creek are limited to WY 1971 through 1978. Available data for the other drainages in the Basin are limited to miscellaneous measurements made by the USGS from 1941 to 1945.

GTC (1976) developed a correlation index for each drainage in the Basin to reflect the variation in precipitation with elevation, drainage area, and runoff lost as seepage based on seepage loss measurements made during the 6-year period of WY 1968 through 1973. Runoff from the ungaged streams was then estimated by GTC for WY 1941 through 1984 using these rainfall-runoff relationships. Similar rainfall-runoff relationships have been used to estimate streamflow in the ungaged streams for the historical water budget period of WY 1985 through 2020 for this Plan.

Figure 3-66 presents graphically the total annual measured and estimated surface water discharge from the Basin for the period of record. Total annual discharges range from 0 to as much as 57,700 AFY. The mean annual stream discharge in the Basin (measured plus estimated) for the period of record is 7,078 AFY.

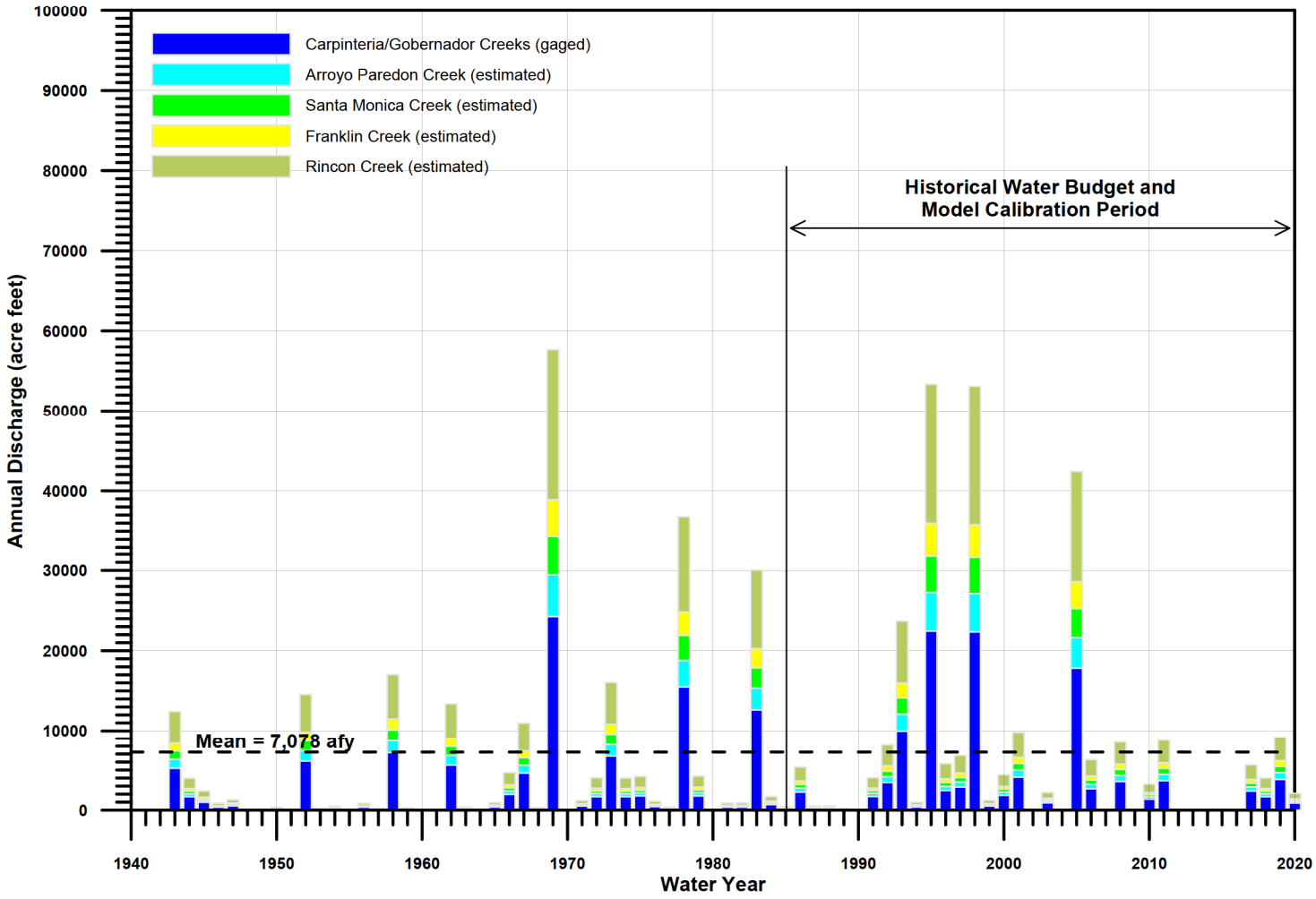


FIGURE 3-66

Historical Annual Streamflow

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

Imported Surface Water Data. Data for surface water imported into the Basin is from CVWD records. The CVWD maintains records on the quantities of water imported into the Basin by CVWD from its Cachuma and State Water Project (SWP) sources.

Numerical Groundwater Flow Model Data. The existing numerical groundwater flow model of the Basin is used to estimate subsurface flows across the basin boundaries with the Pacific Ocean and MGB for the water budgets. The USGS public-domain code MODFLOW-NWT (Niswonger et al., 2011) was used for the basin flow model. MODFLOW-NWT was developed by the USGS as a standalone version of MODFLOW-2005 (Harbaugh, 2005) to better solve nonlinearities of the unconfined groundwater flow equation. The 2012 basin model was calibrated to the period of WY 1985 to 2008 and is documented in the 2012 PWR report. The model has been updated and recalibrated for this GSP by Montgomery & Associates (M&A) for the period of WY 1985 to 2020 and temporally re-discretized from annual to monthly stress periods. The groundwater model update and recalibration results are documented in Appendix F. The water budget has been updated to cover the period of WY 1985 to 2020 and the various components calculated on a monthly basis for the groundwater model input, which have then been aggregated into annual periods for each component discussed in this section.

The majority of the water budget components are calculated outside the model using the approaches to quantify water budget components in the Basin discussed in section 3.3.2.2 and 3.3.2.3, and are implemented in the numerical groundwater model recharge, well, and multi-node well input packages. The recharge (RCH) package is used to define percolation of precipitation, percolation of irrigation water, streambed percolation, and extraction by phreatophytes. The well (WEL) package is used to define the flux of subsurface inflow at the northern boundary. The multi-node well (MNW2) package is used to simulate extraction by groundwater pumping wells. The only components of the water budgets that are calculated by the model are subsurface flows to and from the ocean boundary and across the jurisdictional boundary with the MGB are calculated by the model.

3.3.2.2 Groundwater System Water Budget Methods – Inflows

The methods used to estimate each of the inflow components of the water budget are discussed in the following paragraphs.

Percolation of Precipitation. Percolation of rainfall precipitation is the most important sources of recharge to the Basin. Precipitation recharges the Basin principally through deep percolation to the zone of saturation. The amount of precipitation that percolates downward to the principal aquifer can vary considerably, depending mostly upon the type of soil, density of vegetation, the quantity, intensity and duration of rainfall, the vertical permeability of the soil, and topography. Much of the infiltrating rainfall is held within the root zone because at the beginning of each rainy season there is an initial deficiency of soil moisture. During the summer months the capillary soil moisture is more or less completely depleted from the soil within the root zone by the processes of evaporation and transpiration. No deep percolation of rainfall can occur until the initial fall soil moisture deficiency is exceeded. Many years may pass before any rainfall penetrates beyond the root zone of native vegetation. In irrigated soils, because of the artificial application of water, the initial fall moisture content can be greater and less annual rainfall is required to meet the soil moisture deficiency. Once the soil moisture deficiency within the root zone has been satisfied, the excess precipitation will percolate downward until it eventually reaches the water table.

There are two primary considerations in calculating the volume of precipitation that percolates beyond the root zone and contributes recharge to the Basin's single principal aquifer: (1) the calculation of deep percolation of rainfall in inches for the various land uses / vegetative covers in the Basin for each year of the period, and (2) the determination of the total area of the various land uses and vegetative covers in the

Basin for each year of the period. The total volume of percolation in acre-feet (AF) is then calculated (i.e., inches of percolation x acreage) for each year of the period.

Deep Percolation. The approach to estimating deep percolation in the Basin uses relationships between annual rainfall and deep percolation made by Blaney in 1933 (cited in GTC, 1976) in Ventura County. Although conditions in the Basin are not exactly the same as in Ventura County, it is believed that they are sufficiently similar for the estimates to be valid. Blaney empirically tabulated the amounts of rain that percolated beyond the root zone, depending upon the type of vegetation and amount of seasonal precipitation. Blaney's values of deep percolation (in inches) versus seasonal rainfall have been plotted for land covers similar to those in the Basin, and best-fit curves drawn trough these points (see Figure 3-67). These are referred to as "Blaney Curves." Values of percolation of rainfall corresponding to seasonal rainfall and vegetative cover types in the Basin were calculated from these curves. GTC modified the Blaney Curves to account for deep percolation in years of heavy precipitation when precipitation greatly exceeded the long-term average. Due to the intensity and duration of storms in these years, infiltration can probably not an exceed a maximum amount because of the saturation of the soil within a relatively short period of time and runoff increases greatly; therefore, an upper limit of deep percolation has been fixed at 8 and 15 inches in the unirrigated native and irrigated land use categories, respectively.

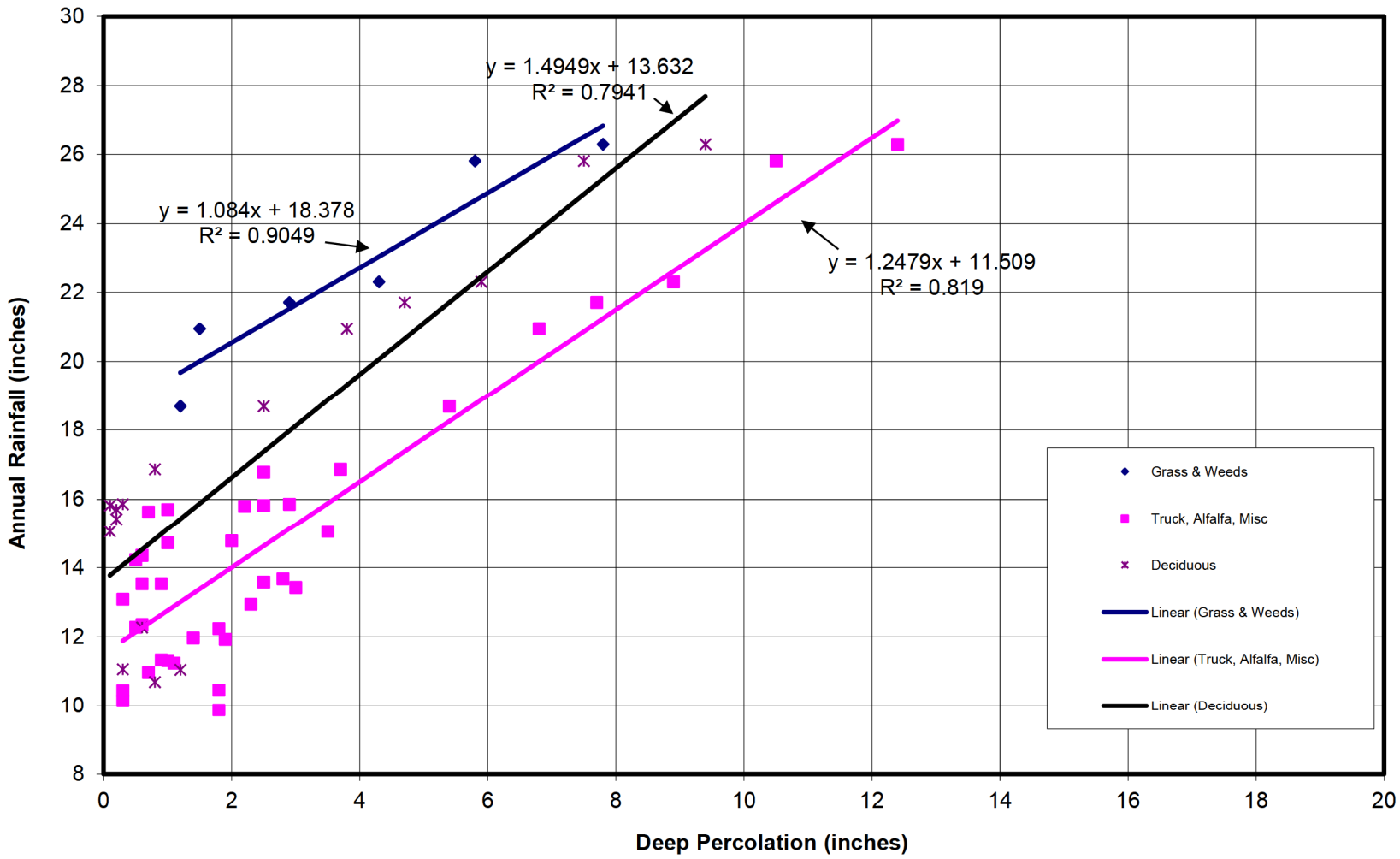


FIGURE 3-67

Annual Rainfall vs Deep Percolation Relationships (Blaney Curves)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

Land Use Acreage. The CVWD has estimated land use acreage within its service area boundaries for the period 1984 through 2020. In 2002, the CVWD undertook a comprehensive land use study utilizing a combination of digital imagery, GIS layers of land use and parcel boundaries, and statistical analysis to evaluate land use activities and estimate private well extractions. Prior to 2002, CVWD relied on periodic aerial photography of the Basin and staff to update land use records ("paper cards") when changes in land use activities were noticed as part of other CVWD duties. Since 2002, the land use studies by CVWD have been GIS-based. For the 2012 hydrogeologic update (which covered the period of WY 1985 to 2008), PWR used GIS to intersect land use acreages within the basin boundaries.

Although the CVWD land use surveys do not include areas of the Basin outside its service area boundaries (i.e., the Ventura County portion of the Basin), the land uses in these areas are generally comparable to the land uses present in the Recharge Area within the CVWD service area and are accordingly extrapolated from the CVWD land use data and applied to the entire Recharge Area. For the period WY 1985 to 2001, annual changes in the acreages of each land use category within the Basin were proportioned consistent with annual changes in the percentage of each land use category within the CVWD boundaries as whole. This approach has also been applied to the period of WY 2009 to 2020 as part of annual updates to the basin water budget as part of the AB 3030 program, which are also used for this GSP.

Blaney developed curves for several, but not all of the land cover types that are present in the Basin. Table 3-5 summarizes the CVWD land use categories and the corresponding Blaney curve used to estimate deep percolation in the Basin.

Table 3-5. Land Use Categories and Blaney Curve Types Summary

Land Use Category	Blaney Curve Used
Native Land	Grass/Weeds
Vacant	
Residential	
Commercial	
Industrial	
Freeway, Railway, Roads, Other	
Irrigated Orchard	Deciduous Crops
Irrigated Crops	Truck Crops, Miscellaneous
Nurseries	
Public Parks, Schools, etc.	
Polo Grounds, Horse Stables	

As shown on Table 3-5, Blaney's curve for grass and weeds is used for the residential/commercial/industrial areas. While the actual land use is very different, the grass and weeds curve is considered reasonable because the amount of deep percolation occurring on grass and weeds is the most limited of all the Blaney Curves, due primarily to the large initial soil moisture deficiencies. Due to the presence of impervious surfaces in the residential/commercial/industrial areas where no percolation can occur and much of the rainfall runs off, a relatively limited amount of deep percolation is expected to occur in these areas. The Blaney Curve for irrigated crops land covers was used for the public parks/schools/polo grounds areas in the Basin. Again, it is acknowledged that the actual land use underlying these areas is somewhat different than those shown on Table 3-5. The curve for irrigated truck crops was considered to better reflect the deep percolation conditions on irrigated turf, primarily due to the similarly shallow rooting depths, as compared to, for example, deciduous crops with relatively deep rooting depths.

Table 3-6 presents CVWD land use survey data for the various land use categories present in the Basin during the historical water budget period.

Table 3-6. Carpinteria Valley Water District Land Use Survey Data Summary

Water Year	Land Use Acreage within the Basin											
	Native	Irrigated Orchard	Irrigated Crops	Nurseries	Vacant	Residential	Commercial	Industrial	Public Parks, Schools, etc.	Polo Grounds	Roads etc.	Total
1985	1,683	2,465	6	775	650	1,078	129	67	456	0	670	7,980
1986	1,652	2,416	9	772	713	1,082	130	67	463	0	675	7,980
1987	1,646	2,342	8	835	724	1,091	132	67	466	0	668	7,980
1988	1,616	2,275	8	857	770	1,097	132	67	484	0	673	7,980
1989	1,615	2,311	24	841	681	1,110	138	69	486	0	706	7,980
1990	1,571	2,300	58	858	660	1,127	139	69	489	0	707	7,980
1991	1,571	2,272	100	862	628	1,133	139	69	491	0	715	7,980
1992	1,575	2,263	86	859	652	1,137	137	69	498	0	705	7,980
1993	1,578	2,257	58	861	680	1,145	138	69	497	0	696	7,980
1994	1,572	2,223	106	843	693	1,153	141	69	490	0	689	7,980
1995	1,507	2,173	78	948	693	1,188	152	73	446	0	721	7,980
1996	1,504	2,161	95	953	681	1,192	152	73	447	0	722	7,980
1997	1,498	2,127	110	911	735	1,193	146	75	457	0	728	7,980
1998	1,496	2,118	136	887	733	1,200	147	76	457	0	730	7,980
1999	1,496	2,113	137	887	732	1,203	148	77	457	0	730	7,980
2000	1,659	2,087	129	836	619	1,186	148	77	405	40	794	7,980
2001	1,822	2,060	121	784	507	1,169	148	77	353	80	859	7,980
2002	1,986	2,033	114	732	394	1,152	147	77	301	120	924	7,980
2003	2,048	2,011	128	733	365	1,063	147	75	273	127	1,009	7,980
2004	2,048	2,011	128	733	365	1,063	147	75	273	127	1,009	7,980
2005	2,055	2,013	144	716	349	1,063	148	75	352	139	925	7,980
2006	2,055	2,013	144	716	349	1,063	148	75	352	139	925	7,980
2007	2,055	2,013	144	716	349	1,063	148	75	352	139	925	7,980
2008	1,895	1,863	129	720	312	1,033	144	72	322	146	1,344	7,980
2009	1,895	2,053	133	720	339	1,033	144	72	322	146	1,124	7,980
2010	1,895	2,053	133	720	350	1,079	161	78	322	146	1,044	7,980
2011	1,895	2,053	133	720	350	1,079	161	78	322	146	1,044	7,980
2012	1,949	2,055	193	654	350	1,079	161	78	322	146	994	7,980
2013	1,949	2,055	193	654	350	1,079	161	78	322	146	994	7,980
2014	1,949	2,055	193	654	350	1,079	161	78	322	146	994	7,980
2015	1,961	2,041	174	637	319	1,079	161	78	322	165	1,043	7,980
2016	1,961	2,041	174	637	319	1,079	161	78	322	165	1,043	7,980
2017	1,954	1,940	191	590	289	1,079	161	78	322	229	1,147	7,980
2018	1,954	1,940	191	590	289	1,079	161	78	322	229	1,147	7,980
2019	1,954	1,940	191	590	289	1,079	161	78	322	229	1,147	7,980
2020	1,957	2,153	210	504	275	1,044	141	71	420	178	1,028	7,980

Recharge from deep percolation of precipitation in the Confined Area has been included in the numerical model. The HCM and analytic water budget approach balances for all groundwater in the Basin regardless of location: the groundwater model must account for water at every unique location in the model. Therefore, even small amounts of recharge from precipitation in the Confined Area need to be accurately modeled in order to avoid model numerical instability. Accordingly, the deep percolation of precipitation calculations presented in this GSP are consistent with the groundwater model inputs for the entire Basin and are inclusive of both the Recharge and Confined Areas.

Subsurface Inflow (mountain front recharge). The subsurface inflow component is flow from consolidated rocks in the hill and mountain areas generally adjacent to the northern basin boundary (subsurface inflow across the basin boundary with MGB is separate from this component). As discussed by Upson and Thomasson (1951) and Evenson et al. (1962), underflow from the consolidated rocks must be considered as a source of recharge to the Basin. Studies conducted by DWR (Bulletin Nos. 104 and 104-2) similarly concluded that such components of recharge cannot be ignored. Amounts of subsurface inflow to the Basin were estimated in the 1976 GTC report using several interrelated methods of analysis, including:

- Total precipitation less surface runoff and consumptive use
- Natural water loss and recoverable water from mountain basins (the so-called Crippen methodology)
- Base flow regression curves
- Comparison of Tecolote tunnel inflow volumes and Darcy's Law

Data on groundwater gradients, average seasonal volumes of runoff, and consumptive use of native vegetation in the watershed areas tributary to the Basin are subject to considerable uncertainty and interpretation. However, each of the methods of analysis essentially limited the amount of water that can theoretically be available as a source of recharge to the Basin. Based on the GTC analysis, the upper limit of subsurface inflow was estimated to be 1,100 AFY. A direct relationship between subsurface inflow and annual precipitation was developed from the GTC analysis by PWR (2012), and seasonal amounts of subsurface inflow are estimated based on a simple regression curve calculation from the GTC relationships of average annual rainfall to subsurface inflow in any given year. Figure 3-68 presents a graph of the relationship between annual rainfall and estimated subsurface inflow.

This relationship was estimated based on the previous basin boundary and associated groundwater model domain, which includes the Toro Canyon Area. For this GSP water budget, this relationship was adjusted proportionally based on the watershed areas at the northern basin boundary at the present basin boundary (i.e., the Toro Canyon area was removed from the calculations for the Basin presented in this GSP).

Streambed Percolation. Streambed percolation in the Basin is assumed to occur only where the stream reaches cross the Recharge Area (see Figure 3-9). Once streamflow reaches the Confined Area, the amount of deep percolation to the principal groundwater aquifer is assumed to be insignificant. The 1976 GTC study included an analysis of annual runoff and seepage losses for streams in the Basin and developed annual runoff versus streambed percolation relationships for each individual stream in the Basin, and these same relationships are used for this GSP. Figure 3-69 presents a graph of the relationships between annual stream runoff and estimated streambed percolation.

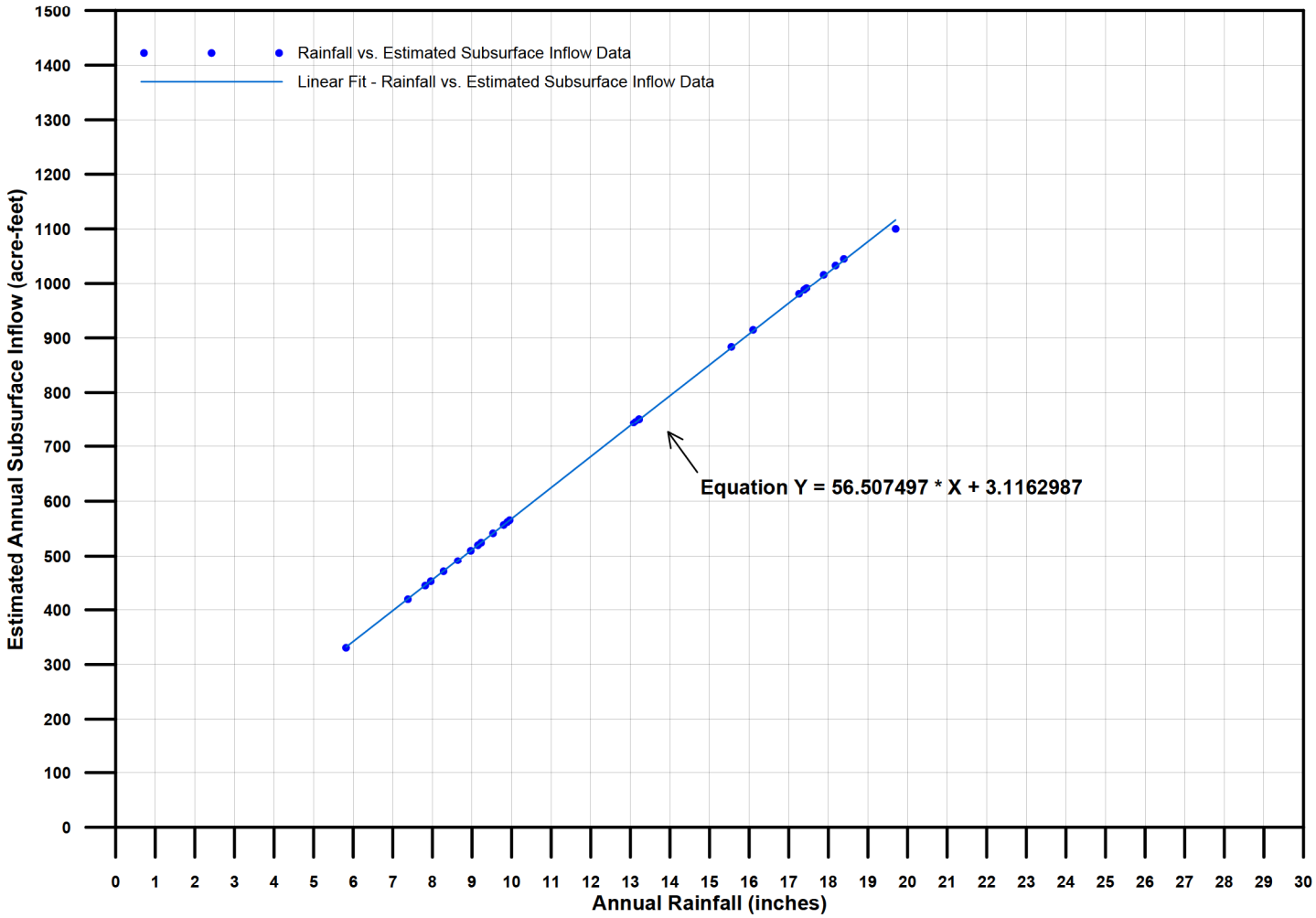


FIGURE 3-68

Annual Rainfall vs. Estimated Subsurface Inflow Relationship

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

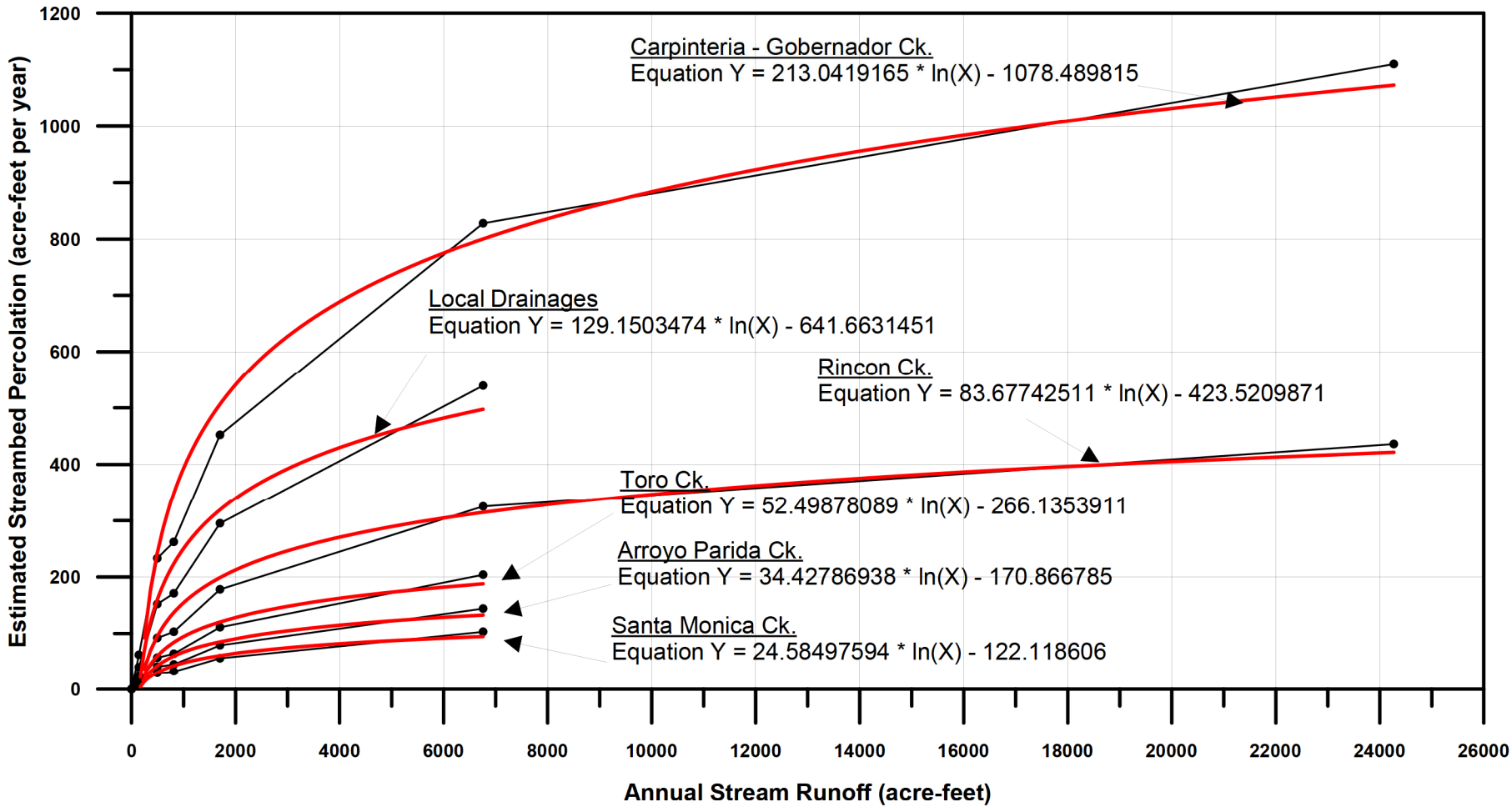


FIGURE 3-69

Estimated Annual Runoff vs. Streambed Percolation Relationships

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

Most of Toro Creek is no longer included in the Basin as a result of the 2018 Basin Boundary Modification. In addition, the reaches of both Santa Monica and Franklin Creeks that cross the Recharge Area were channelized into concrete-lined box channels as part of the Carpinteria Valley Watershed Project in 1974; therefore, these two streams are considered to no longer recharge the Basin in a significant way and are not included in the water budget calculations.

Percolation of Irrigation Water. Percolation of irrigation return water (i.e., "return flows") in the Basin is dependent on a variety of factors, including climatic factors, crop type, and irrigation practices. An estimate of the amount of irrigation return water was one of the primary objectives of studies conducted in the Lompoc area by Blaney and Criddle in 1962. The study area was within the coastal zone where consumptive use is depressed due to the influence of the coastal fog belt, similar to conditions in the Basin. The studies were also conducted on crops with consumptive use factors similar to those in the Basin. The results indicated irrigation efficiencies ranged varied from 60 to 80 percent. In addition, studies by the U.S. Soil Conversation Service for Santa Barbara County indicate irrigation efficiencies, under good practice, range from 65 to 70 percent. For the purposes of estimating deep percolation of irrigation return water in the Basin, a conservative factor of 20 percent of applied water (both pumped and delivered) is used. This factor takes into account the relatively steeper slopes found in many portions of the Recharge Area within the Basin, and hence greater amounts of runoff, as well as the relatively more efficient sprinkler-type irrigation commonly used in the Basin.

Water provided for residential, municipal, and industrial land uses (and the associated water distribution system losses) occur primarily in the developed area of the City of Carpinteria, which is located in the Confined Area (whereas agricultural land is primarily located in the Recharge Area). As discussed previously, downward percolation of water in the Confined Area is limited due to the presence of fine-grained low-permeability materials overlying the principal aquifer of the Basin; therefore, the approaches to quantifying the water budget in the Basin assume that the contributions of such losses to basin recharge are relatively insignificant and are ignored.

MGB Boundary Inflows. Groundwater inflows across the jurisdictional boundary with the MGB are calculated by the calibrated groundwater flow model of the Basin.

3.3.2.3 Groundwater System Water Budget Methods – Outflows

The methods used to estimate each of the outflow components of the water budget are discussed in the following paragraphs.

Groundwater Pumping. Groundwater extractions from the Basin occur from both CVWD production wells and from approximately 50 to 170 private wells in any given year and constitute the primary source of outflow from the Basin. CVWD well production is metered, and monthly totals of production from each of the five CVWD wells have been obtained for the period of 1985 through 2020, which have been aggregated by water year for the historical water budget for this GSP.

Private pumping in the Basin is not metered and has been estimated on an annual basis by CVWD since 1984 using land use survey and CVWD's water sales records. CVWD supplies imported water and/or local groundwater to numerous agricultural parcels of known acreage and crop type (e.g., avocados, cherimoyas, and open and covered nurseries). 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.

As mentioned previously, in 2002 the CVWD undertook a comprehensive land use study for the first time using a combination of digital imagery, GIS layers of land use and parcel boundaries, and statistical analysis to evaluate land use activities and estimate private well extractions. For this GSP, estimates of monthly pumping were assigned to individual private wells in the Basin by CVWD by intersecting land use "determining factors," acreages of land use per parcel (Assessor Parcel Number [APN]), and well IDs by APN for each month from WY 1985 to 2020.

Subsurface Outflow. Groundwater outflow from the Basin has previously been assumed to occur only through shallow alluvial sediments where they are in contact with the ocean boundary. For previous water budget updates performed for the CVWD (e.g., the PWR 2012 update and subsequent AB 3030 annual updates), the quantity of subsurface outflow has been calculated using Darcy's Law, in which the rate of discharge through a given cross section of saturated material is proportional to the seaward hydraulic gradient. For this GSP, however, subsurface outflow at the basin boundary with the Pacific Ocean as calculated by the updated and re-calibrated groundwater model (see Appendix F) is used in the water budget calculations instead of the values derived from the more simplistic Darcy-based calculations, and includes subsurface outflow for all depths in the Basin at the boundary.

Phreatophyte Transpiration. Phreatophytes are water loving plants (i.e., plants with roots that extend into the water table) that live in the vicinity of stream channels and in areas of high groundwater. Groundwater consumed by phreatophytes is dependent on many factors, including plant species, vegetative density, climate, soil, and depth to groundwater. Direct measurements of consumptive use by phreatophytes in the Basin do not exist. GTC (1976) roughly estimated phreatophyte transpiration for the Basin by applying results of a 5-year study in San Diego County using the Blaney-Criddle formula (Blaney and Criddle, 1962). Phreatophyte transpiration was estimated to be approximately 120 to 130 AFY from the 1930s through 1970, then reduced by GTC to approximately 100 AFY as a result of removal of phreatophytes from the Santa Monica and Franklin Creek channels that occurred as part of the flood control channelization projects in 1974. It has been further reduced for this GSP because most of Toro Creek was eliminated from the Basin as a result of the 2018 Basin Boundary Modification and accordingly assumed that phreatophyte transpiration is 89 AFY.

MGB Boundary Outflows. Groundwater outflows across the jurisdictional boundary with the MGB are calculated by the calibrated groundwater flow model of the Basin.

Evapotranspiration. The only historical evapotranspiration data available in the area is from the California Irrigation Management Information System (CIMIS) Santa Barbara station (Station 107), which has a period of record limited to April 1993 through the present. The missing years of historical data is insignificant for the water budget calculation methodology used here because it accounts for evapotranspiration indirectly, rather than directly. As discussed above, estimates of deep percolation of precipitation in the Basin are made using relationships developed by Blaney in 1933 (cited in GTC, 1976). Blaney's values of deep percolation versus annual rainfall mean that the amount of annual rainfall that does not infiltrate as deep percolation is lost to evapotranspiration and/or replenishes deficient soil moisture using this method. In addition, estimates of evapotranspiration from phreatophytes are roughly estimated at 100 AFY and do not vary from year to year, which is acknowledged to be an oversimplification, but is nonetheless based on the best available information.

Summary of Water Budget Data Sources. Table 3-7 presents a summary of the water budget components discussed above, and their associated qualitative uncertainty ratings.

Some minor water budget components that may be present in the Basin are considered to represent relatively insignificant components to the groundwater system ignored by both past approaches and this Plan's approach to the water budget for the Basin, including the following:

- **Rural domestic pumping and septic return flows.** The CVWD land use and private pumping estimation methodology does not consider rural domestic consumption separately from agricultural pumping in the Recharge Area as it is considered to be a de minimis factor. Associated septic return flows are similarly considered a de minimis factor.
- **Losses from potable water and sewer piping systems.** The CVWD potable water distribution system and the Carpinteria Sanitary District sewer piping system are largely associated with urban and industrial land uses that are located primarily within the City of Carpinteria, which overlies the Confined Area of the Basin. As discussed in Section 3.1, in the Confined Area, downward percolation of water is limited due to the presence of fine-grained low-permeability materials overlying most of the area of the principal aquifer; therefore, losses from these systems are considered de minimis factors.
- **Percolation of urban irrigation.** Similar to the consideration of losses from potable water and sewer piping systems, urban land uses occur primarily in the Confined Area; therefore, downward percolation of urban irrigation flows is considered to be limited and represents a de minimis contribution to the principal aquifer of the Basin.

It is also acknowledged that shallow groundwater present in the Confined Area is not considered a principal aquifer of the Basin as discussed in Section 3.1, and for that reason, the details of the inflows/outflows of shallow groundwater in the Confined Area was not further investigated for this GSP.

Table 3-7. Water Budget Data Source Summary

Water Budget Component	Source of Data	Comments	Qualitative Uncertainty
Rainfall	Santa Barbara County	Measured at Carpinteria Fire Station No. 1	Gaged - Low
Subsurface Inflow	GTC (1976) methodology	Methods described in text	Estimated - Medium
Streambed Percolation	GTC (1976) methodology	Methods described in text	Estimated - Medium
Percolation of Precipitation	GTC (1976) methodology	Methods described in text	Estimated - Medium
Percolation of Irrigation Water	GTC (1976) methodology	Methods described in text	Estimated - Medium
MGB Boundary Flows	Numerical Groundwater Flow Model	Simulated from calibrated model	Calibrated Model - Medium
Subsurface Outflow to Ocean	Numerical Groundwater Flow Model	Simulated from calibrated model	Calibrated Model - Medium
CVWD Pumping	CVWD	Metered and recorded by CVWD	Metered - Low
Private Pumping	CVWD	Methods described in text	Estimated - Medium
Transpiration by Phreatophytes	GTC (1976) methodology	Methods described in text	Estimated - High

Notes

CVWD = Carpinteria Valley Water District

GTC = Geotechnical Consultants, Inc.

MGB = Montecito Groundwater Basin

3.3.3 Historical Water Budget [§ 354.18(c)(2)(B)]

§354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(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:

(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.

As discussed in Section 3.3.2, WY 1985 to 2020 was selected as the historical water budget period primarily because the data sources needed to support the approach to quantifying water budget components in the Basin are available, in particular, CVWD land use data and private pumping estimates. The 36-year period selected for the historical water budget includes the most recently available information, recent changes in imported water supply availability, changes to water demand associated with cropping patterns, and associated land use. It coincides with the groundwater model calibration period and is long enough to capture typical climate variations (with one wet, two dry and one alternating wet and dry hydrologic cycles) and includes recent changes in imported water supply availability, changes to water demand associated with cropping patterns, and associated land use.

This historical period allows for the identification of long-term trends in basin supply and demand, water level trends, changes of groundwater in storage, and estimates of the annual components of inflow and outflow to the groundwater system. This information is fundamental to input into the numerical groundwater flow model (see Appendix F).

Total Surface Water Entering and Leaving the Basin by Water Source Type. SGMA regulations require an accounting of total surface water entering and leaving the Basin by water source type. The inflow and outflow of surface water to the Basin is required to be annually quantified as a total annual volume according water source type from which water is derived to meet the applied beneficial uses. There are no known surface water diversions from basin creeks; therefore, surface water sources entering the Basin that are applied to beneficial uses are limited to the following sources:

- Imported local supplies from the Cachuma Project
- Imported supplies from the SWP

The CVWD imports surface water supplies from the Cachuma Project and the SWP. Imported water was first made available to the CVWD in 1956 from the Cachuma Project and water from the SWP was first made available in 1997. The CVWD distributes imported water to commercial, industrial, institutional, residential, and agricultural customers within its boundaries. The CVWD's maximum local surface water allocation from the Cachuma Project is currently 2,813 AFY, while the long-term average is estimated to be approximately 1,970 AFY. Maximum allocation from the SWP is 2,200 AFY (including 200 AF of drought buffer), while the long-term average is estimated to be approximately 876 AFY (Woodard & Curran, 2021). Table 3-8 presents

a breakdown of the annual deliveries from each of these sources to agricultural users. Application of native surface water sources in the Basin is limited to streambed percolation to the groundwater system.

SGMA regulations also require that the annual volume of applied surface water be quantified according to the appropriate water use sector. The water use sectors that apply imported surface water to meet beneficial uses in the Basin include the following:

- Urban
- Industrial
- Agricultural

CVWD maintains records of imported supplies and deliveries in the Basin. Table 3-9 summarizes the annual accounting of surface water entering and leaving the Basin (including native local creeks).

Table 3-8. Summary of Carpinteria Valley Water District Delivered Water

Water Year	Annual Water Delivered (af)		
	Cachuma Project	State Water Project	Pumped Groundwater
1985	1,110	0	560
1986	865	0	613
1987	1,160	0	785
1988	1,049	0	695
1989	1,064	0	1,008
1990	757	0	1,201
1991	402	0	889
1992	718	0	410
1993	711	0	292
1994	766	0	316
1995	671	0	290
1996	686	0	362
1997	793	0	322
1998	728	0	126
1999	1,009	0	85
2000	869	0	410
2001	949	0	49
2002	989	0	145
2003	821	158	106
2004	761	208	246
2005	744	30	259
2006	745	0	303
2007	790	27	390
2008	989	69	229
2009	751	5	452
2010	737	0	257
2011	638	0	294
2012	939	0	276
2013	1,163	15	192
2014	791	359	317
2015	280	143	818
2016	327	82	865
2017	151	627	383
2018	217	404	726
2019	589	229	289
2020	1,000	0	289

Table 3-9. Summary of Surface Water Entering and Leaving the Basin (Water Years 1985 to 2020)

Water Year	Inflows (acre-feet)			Outflows (acre-feet)			
	Local Creeks	Cachuma Project	State Water Project	Local Creeks	Applied Water Use		
					Urban	Industrial	Agricultural
1985	476	3,637	0	424	2,358	164	2,875
1986	6,193	2,868	0	5,382	2,296	136	2,544
1987	581	3,492	0	503	2,536	157	3,349
1988	629	3,533	0	532	2,498	154	3,002
1989	210	3,148	0	186	2,454	160	3,568
1990	36	2,150	0	32	2,151	118	3,231
1991	4,783	1,364	0	4,065	1,821	113	2,186
1992	9,120	2,733	0	8,171	2,065	116	2,099
1993	25,004	3,073	0	23,703	2,131	120	1,972
1994	1,303	3,173	0	992	2,225	139	2,089
1995	54,920	2,983	0	53,349	2,175	129	1,905
1996	6,629	2,946	0	5,794	2,071	144	1,979
1997	7,732	3,245	0	6,842	2,358	138	2,178
1998	54,662	3,325	0	53,093	2,048	124	1,704
1999	1,610	4,026	0	1,227	2,223	139	2,080
2000	5,148	2,991	0	4,404	2,290	128	2,253
2001	10,808	3,550	0	9,799	2,135	121	1,799
2002	55	3,792	0	49	2,207	126	2,035
2003	2,707	3,125	600	2,194	2,165	136	1,945
2004	20	3,090	844	18	2,112	124	2,141
2005	43,884	3,309	132	42,390	2,022	128	1,789
2006	7,170	2,755	0	6,307	1,942	122	1,799
2007	78	2,873	100	70	2,150	134	2,147
2008	9,472	2,853	200	8,509	2,215	109	2,210
2009	124	2,700	17	112	2,086	90	1,929
2010	3,884	3,033	0	3,241	1,956	70	1,634
2011	9,738	2,658	0	8,766	1,933	72	1,573
2012	61	3,448	0	55	2,035	83	1,930
2013	2	3,888	50	2	2,104	83	2,140
2014	58	2,613	1,185	48	1,988	80	2,287
2015	2	889	456	2	1,584	67	1,981
2016	0	1,042	261	0	1,563	64	2,019
2017	6,484	490	2,028	5,656	1,525	60	1,834
2018	4,709	675	1,254	3,997	1,746	71	2,094
2019	10,142	1,925	747	9,156	1,643	73	1,732
2020	2,544	3,077	0	2,110	1,799	65	1,987
Minimum	0	490	0	0	1,525	60	1,573
Maximum	54,920	4,026	2,028	53,349	2,536	164	3,568
Average	8,083	2,791	219	7,533	2,073	113	2,167

Inflows, Outflows and Change in Storage of Groundwater System. A tabular summary of the historical water budget inventory for the WY 1985 to 2020 period by water year is presented in Table 3-10 and graphically on Figure 3-70. A summary of the annual minimum, maximum, and average volumes for each water budget component is presented in Table 3-11 and the inflow and outflow averages are presented graphically as a paired bar chart on Figure 3-71. Mean annual inflow during the historical period was estimated at approximately 3,786 AFY and mean annual outflow estimated at 5,111 AFY, resulting in a mean annual deficit (i.e., groundwater storage reduction) of 1,324 AFY over the 36-year historical water budget period.

Deep percolation of precipitation represents the largest source of inflow to the Basin, constituting approximately 42 percent of the total, averaging approximately 1,572 AFY. During wet years (e.g., 1993, 1995, 1998, and 2005) when average annual rainfall exceeds approximately 30 inches, over 7,000 AF of annual deep percolation can occur; however, during dry years, when average annual rainfall is less than approximately 10 inches, zero deep percolation occurs.

Groundwater pumping represents the largest source of outflow from the Basin, representing approximately 87 percent of the total (28 and 59 percent by the CVWD and private pumpers, respectively). CVWD historical pumping has ranged between a low of 185 AFY to a high of approximately 3,400 AFY, in response to CVWD customer demands and the availability of its other sources of supply (e.g., Cachuma Project water) during the period. Estimated private agricultural pumping has experienced an overall increasing trend during the period, with pumping levels of around 1,000 to 2,000 AFY during the mid-1980s increasing to as much as approximately 4,440 AFY in recent years, reflecting both an increase in overall acreage of irrigated crops in production as well as deficient rainfall conditions, which increased irrigation demands during the drought period of WY 2012 to 2020.

Subsurface outflow across the basin boundary with ocean as calculated by the groundwater model ranges from as little as approximately 190 AFY during dry years to as much as approximately 1,000 AFY during wet years (e.g., WY 1998). Subsurface inflow across the basin boundary with the ocean ranges from as little as approximately 40 AFY to as much as approximately 800 AFY. During extended drought periods, inflows across the basin boundary increase relative to wet periods as result of below sea level water- level conditions in the central portion of the Basin. For example, during the later years of the previous drought (WY 1990 and 1991), inflows across the boundary were as much as approximately 500 AFY, compared to as little as approximately 40 AFY during wet periods such as WY 1998. Similarly, during the later years of the current extended drought period, during WY 2015 through 2020 inflow from across the basin boundary with the ocean ranged between approximately 600 to 800 AFY. As discussed in Section 3.1, basin sediments are known to extend some distance offshore. The location of the freshwater/seawater interface offshore is not known, and while there is undoubtedly some amount of freshwater in groundwater storage offshore, these model results indicate the potential for seawater intrusion into the Basin to occur during these conditions.

Subsurface inflow to the Basin across the western boundary with the MGB is relatively limited, ranging between approximately 50 to 428 AFY, averaging approximately 101 AFY (see Table 3-11).

Variability in the components of the water budget is directly influenced by annual variations in climatic conditions. During the historical period, two full periods of wet and dry climatic cycles were evident. During dry climatic periods (drought), the amount of recharge was relatively low. For example, during the drought between 2012 and 2016, recharge from precipitation and mountain front recharge were reduced significantly, to near zero. The graph indicates that the drought resulted in a substantial net reduction of groundwater in storage. The variability within the water budget generally follows the trends evident in observed groundwater level wells, which are presented as hydrographs in Figures 3-25 through 3-29.

In contrast, wet conditions prevailed in the early 1990s, and the amount of recharge and streamflow percolation was relatively high. The net result during these periods was a gain of groundwater in storage.

The water budget for the historical period is also influenced by the amount of groundwater pumping that occurs. Over the historical period, the total amount of groundwater pumping was variable, with CVWD pumping generally decreasing since the early 1990s, and private well pumping generally increasing since the early 1990s (see Figure 3-70).

Table 3-10. Historical Water Budget Inventory (Water Years 1985 to 2020)

Water Year	Water Year Type	Rainfall (inches)	Inflow (AFY)								Outflow (AFY)						Change in Storage (AFY)	
			Subsurface Inflow	Streambed Percolation	Percolation of Precipitation	Percolation of Irrigation Water		MGB Boundary Inflows	Subsurface Inflow from Ocean	Total Inflow	MGB Boundary Outflows	Subsurface Outflow to Ocean	Groundwater Pumping		Phreatophyte Transpiration	Total Outflow		
						Delivered	Pumped						CVWD	Private			Year	Cumulative
1985	Dry	13.08	734	53	119	290	77	428	95	**1,798**	140	1,023	1,836	1,016	89	**4,105**	-2,307	**-2,307**
1986	Below Normal	24.28	1,087	827	4,152	257	111	170	113	**6,716**	75	786	2,032	1,184	89	**4,166**	2,551	**244**
1987	Dry	9.23	518	82	0	338	96	103	152	**1,289**	42	613	2,363	1,057	89	**4,163**	-2,875	**-2,631**
1988	Dry	15.55	873	102	564	303	107	56	194	**2,199**	41	519	2,342	1,193	89	**4,185**	-1,986	**-4,616**
1989	Dry	9.15	514	24	0	360	163	62	327	**1,451**	27	409	2,984	1,703	89	**5,213**	-3,762	**-8,378**
1990	Critical	7.96	447	4	0	341	209	73	485	**1,559**	22	334	3,413	2,249	89	**6,107**	-4,548	**-12,926**
1991	Dry	17.88	1,004	730	1,075	225	243	68	502	**3,846**	41	341	3,014	2,544	89	**6,028**	-2,183	**-15,109**
1992	Above Normal	22.66	1,087	971	3,373	196	249	96	316	**6,288**	57	391	1,560	2,442	89	**4,538**	1,750	**-13,359**
1993	Wet	33.33	1,087	1,340	6,641	174	282	186	106	**9,817**	84	698	1,261	2,744	89	**4,875**	4,942	**-8,417**
1994	Above Normal	13.22	742	323	151	188	318	115	92	**1,929**	49	487	1,307	3,174	89	**5,107**	-3,177	**-11,594**
1995	Wet	36.64	1,087	1,621	6,946	167	256	164	79	**10,320**	91	943	1,291	2,691	89	**5,106**	5,214	**-6,380**
1996	Wet	17.39	976	852	966	182	274	118	53	**3,422**	65	673	1,557	2,826	89	**5,210**	-1,788	**-8,167**
1997	Below Normal	16.10	904	910	693	194	276	71	45	**3,092**	54	574	1,317	2,810	89	**4,843**	-1,751	**-9,918**
1998	Wet	45.95	1,087	1,620	6,920	149	260	139	44	**10,218**	90	1,072	575	2,795	89	**4,621**	5,597	**-4,321**
1999	Wet	9.89	555	398	0	190	315	105	43	**1,606**	50	730	340	3,614	89	**4,823**	-3,217	**-7,538**
2000	Below Normal	17.45	980	757	933	223	303	70	54	**3,319**	53	572	1,410	3,552	89	**5,676**	-2,357	**-9,895**
2001	Wet	20.47	1,087	1,034	2,163	174	329	77	62	**4,926**	60	624	185	3,821	89	**4,778**	148	**-9,747**
2002	Dry	7.82	439	6	0	197	316	57	64	**1,080**	30	509	558	3,682	89	**4,868**	-3,787	**-13,534**
2003	Below Normal	21.81	1,087	516	2,820	189	291	60	61	**5,023**	52	541	402	3,296	89	**4,380**	643	**-12,891**
2004	Dry	9.53	535	2	0	211	302	56	69	**1,175**	30	421	999	3,446	89	**4,985**	-3,810	**-16,701**
2005	Wet	37.76	1,087	1,542	6,793	180	235	135	112	**10,083**	83	849	1,152	2,609	89	**4,781**	5,302	**-11,399**
2006	Wet	18.39	1,033	882	1,078	182	261	110	82	**3,628**	62	603	1,120	2,791	89	**4,665**	-1,037	**-12,436**
2007	Critical	7.38	414	8	0	210	299	72	150	**1,155**	31	466	1,418	3,120	89	**5,125**	-3,970	**-16,407**
2008	Dry	17.26	969	985	820	224	300	56	99	**3,454**	49	440	661	3,296	89	**4,535**	-1,081	**-17,487**
2009	Dry	13.22	742	12	139	210	259	58	283	**1,704**	35	384	1,627	2,679	89	**4,814**	-3,110	**-20,597**
2010	Above Normal	19.70	1,087	651	1,755	173	276	57	228	**4,227**	48	384	1,060	2,820	89	**4,401**	-173	**-20,770**
2011	Wet	24.97	1,087	996	4,491	162	273	104	157	**7,269**	65	564	1,224	2,756	89	**4,698**	2,571	**-18,199**
2012	Below Normal	9.80	550	6	0	211	270	83	143	**1,265**	35	407	1,013	2,829	89	**4,372**	-3,108	**-21,307**
2013	Critical	8.28	465	0	0	238	331	52	135	**1,222**	25	297	641	3,475	89	**4,527**	-3,305	**-24,612**
2014	Critical	5.82	327	10	0	255	392	50	224	**1,259**	20	247	1,048	4,137	89	**5,541**	-4,282	**-28,894**
2015	Critical	8.64	485	0	0	216	398	74	585	**1,757**	22	274	2,598	3,989	89	**6,972**	-5,215	**-34,109**
2016	Dry	9.95	559	0	0	222	382	82	808	**2,053**	23	269	2,759	3,796	89	**6,936**	-4,884	**-38,993**
2017	Above Normal	21.85	1,087	844	2,855	202	417	107	639	**6,151**	52	276	1,239	4,188	89	**5,844**	307	**-38,686**
2018	Below Normal	8.97	504	724	0	234	509	115	751	**2,837**	31	253	2,255	5,141	89	**7,769**	-4,932	**-43,617**
2019	Above Normal	18.18	1,021	1,011	1,009	192	418	112	712	**4,475**	48	232	945	4,283	89	**5,596**	-1,121	**-44,738**
2020	Below Normal	13.13	737	442	130	224	423	100	639	**2,695**	35	186	888	4,437	89	**5,635**	-2,940	**-47,678**

Notes AFY = acre-feet per year CVWD = Carpinteria Valley Water District MGB = Montecito Groundwater Basin

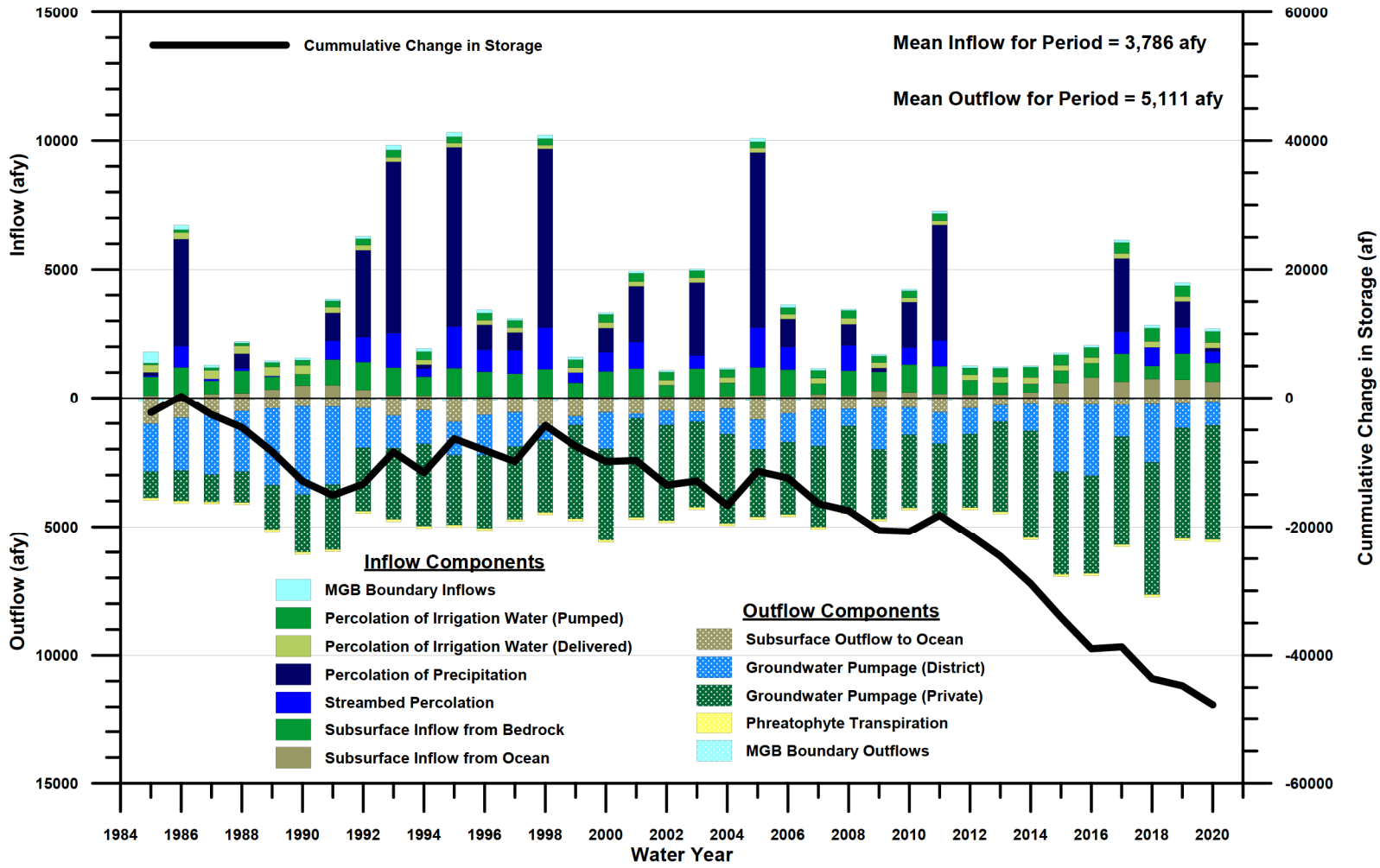


FIGURE 3-70

Historical Water Budget Summary (WY 1985 – 2020)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

Change in Storage. The change in the amount of groundwater in storage depends on the annual water supply surplus or deficiency, as expressed in the water budget equation. The historical water budget inventory shows the total annual water demand (outflows) was greater than the total recharge (inflows) by 1,324 AFY on average during the 36-year historical period (see Table 3-11 and Figure 3-71). This has resulted in a net depletion of groundwater in storage of approximately 47,678 AF at the end of the historical period, the vast majority of which has occurred during the current drought period of WY 2012 to 2020.

As discussed above, the water budget includes a component of inflow into the Basin from offshore across the boundary with the ocean. While there is likely some unknown volume of freshwater in storage offshore, the location of the seawater/freshwater interface is not known. Conservatively, assuming that any inflow from the offshore area represents seawater intrusion, increases in the volumes of change in storage presented in the water budget inventories (and in the groundwater model) that result from inflow across the boundary with the ocean would, therefore, not represent usable groundwater storage. This issue will be addressed further in the sustainable management criteria (SMC) section presented later in the Plan.

Table 3-11. Historical Water Budget Summary (Water Years 1985 to 2020)

Groundwater Budget Component		Annual Minimum (AFY)	Annual Maximum (AFY)	Annual Average (AFY)	Average %
Inflows					
Subsurface Inflow		327	1,087	805	21
Streambed Percolation		0	1,621	563	15
Percolation of Precipitation		0	6,946	1,572	42
Percolation of Irrigation Water	Delivered	149	360	219	6
	Pumped	77	509	284	7
MGB Boundary Inflow		50	428	101	3
Subsurface Inflow from Ocean Boundary		43	808	242	6
			Total Inflow	**3,786**	**100**
Outflows					
MGB Boundary Outflow		20	140	50	1
Subsurface outflow to Ocean Boundary		186	1,072	511	10
Groundwater Pumping	CVWD	185	3,413	1,455	28
	Private	1,016	5,141	3,005	59
Phreatophyte Transpiration		89	89	89	2
			Total Outflow	**5,111**	**100**
Change in Storage (AFY)		**Cumulative**		**Average**	
		-47,678		-1,324	

Notes

AFY = acre-feet per year

CVWD = Carpinteria Valley Water District

MGB = Montecito Groundwater Basin

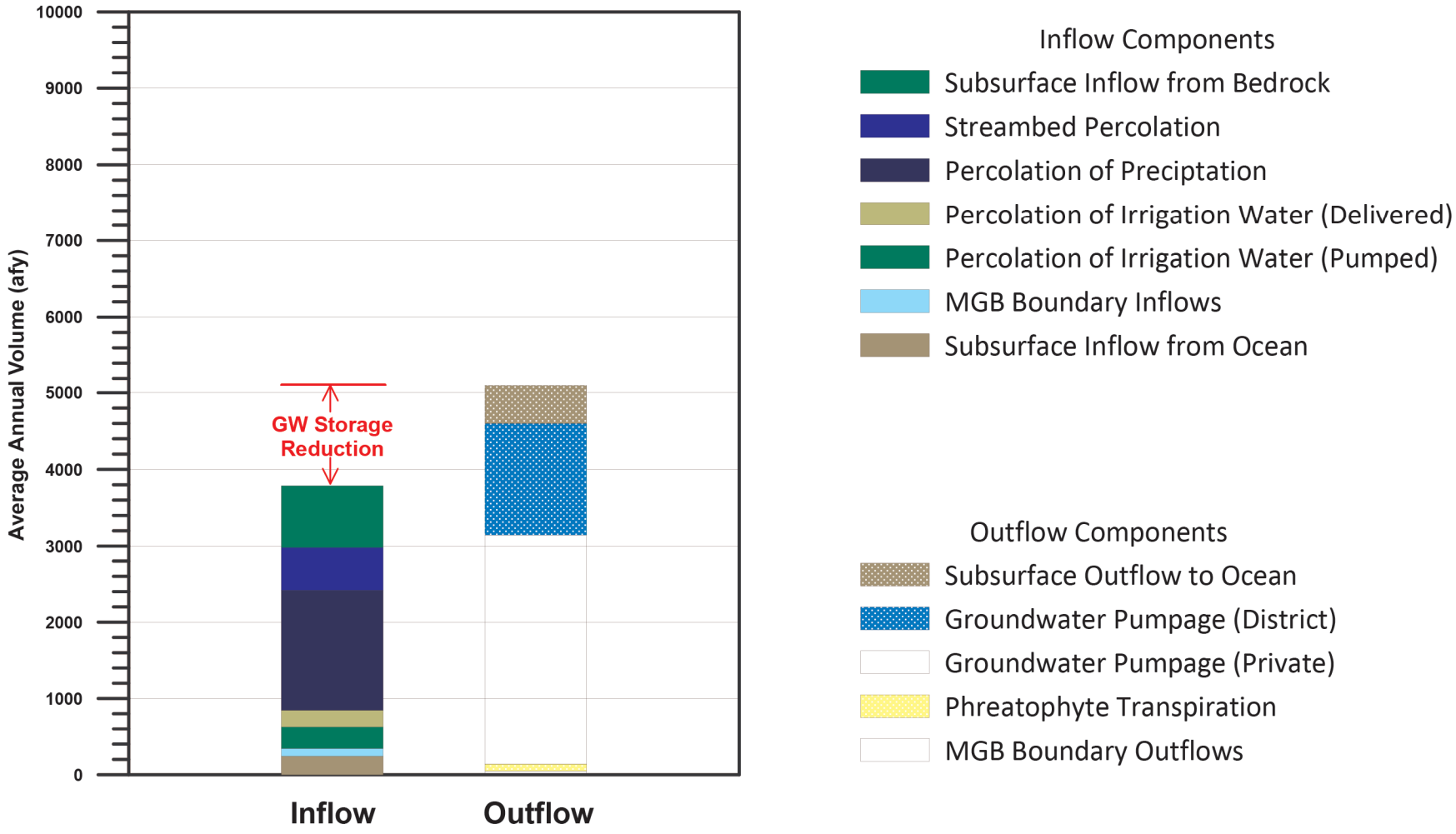


FIGURE 3-71

Historical Water Budget – Groundwater System Averages Paired Bar Chart (WY 1985 – 2020)

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

3.3.3.1 Reliability of Historical Surface Water Supplies [§ 354.18(c)(2)(A)]

§354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(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:

(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.

The historical reliability of the surface water supply has been a function of the availability of local and imported surface water, subject to the SWP allocation and operation of the Cachuma Project. The long-term reliability of the surface water from the local sources, including Cachuma Project water, is subject to climatic variability and is subject to requirements for dam releases to meet in-stream habitat and water rights requirements, regulated and determined by terms of the State Board Order (Title 22 of the CCR) and NMFS Biological Opinion (NMFS, 2000).

The variability of historical supply was discussed in Section 3.3.2.1, which documents the sources of surface water supply as surface water flows that enter the Basin from precipitation runoff within the watershed; water delivered from the Cachuma Project since 1956; and deliveries of imported SWP supplies since 1997.

The estimated average annual total surface water inflow into the entire Basin from all sources over the historical period is about 11,100 AFY. The largest component of this surface water inflow is local creek flow, which averaged 8,100 AFY during the historical period. The large difference between the minimum and maximum inflows in Table 3-9 reflects the climatic variability and the difference between dry and wet years in the Basin and contributing watershed. The annual average, minimum, and maximum volumes of local surface water sources (native and imported) during the historical period are presented in Table 3-9. The imported surface water averaged 3,010 AFY during the historical period.

During five exceptionally dry years during this period (1990, 2007, 2013, 2014, and 2015) less water was delivered. During these five years, the volume of water delivered from imported sources (Cachuma Project and SWP) was as little as 1,345 AFY delivered (2015) to 3,938 AFY delivered (1993) and averaged 2,841 AFY.

3.3.4 Current Water Budget [§ 354.18(c)(1)]

§354.18 Water Budget.

(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.

As discussed previously, the current water budget for the Basin includes the most recent information available and covers the period of WY 2012 to 2020. This period was selected because it encompasses the current and ongoing extended drought period that has resulted in the current groundwater conditions discussed in Section 3.2. The inflow and outflow components for the current water budget are the same as the historical water budget. The current water budget inventory is summarized in Table 3-12 and is presented graphically on Figure 3-72. A summary of the annual minimum, maximum and average volumes for each water budget component is presented in Table 3-13 and the inflow and outflow averages are presented graphically as a paired bar chart on Figure 3-73.

Mean annual rainfall during this period was 11.6 inches, approximately 68 percent of the historical water budget period mean. Mean annual inflow during the current period was estimated at approximately 2,635 AFY, representing approximately 70 percent of the historical period mean. Significant deep percolation of rainfall occurred only in WY 2017, with no deep percolation estimated to occur in WY 2012 to 2016 and in WY 2018.

Mean annual outflow is estimated at 5,910 AFY, representing approximately 116 percent of the historical period mean and approximately 224 percent of the amount of inflow during the period. CVWD mean pumping during the period was 1,487 AFY, consistent with the historical mean of 1,455 AFY. Estimated mean private pumping, however, was 4,030 AFY representing approximately 134 percent of the historical mean of 3,005 AFY.

The significant imbalance between inflows and outflows during the current water budget period has resulted in an estimated cumulative depletion of approximately 29,480 AF of groundwater storage during the period. As discussed in Section 3.2, water level conditions in the Basin reflect this depletion of storage, with current water levels as much as 50 to 60 feet below sea level in the central portion of the Basin (see Figure 3-23). As also discussed above, the groundwater model calculates that under current conditions, subsurface inflow from across the basin boundary with the ocean is occurring, with approximately 500 AFY of water coming into the Basin from offshore storage during this period.

Table 3-12. Current Water Budget Inventory (Water Years 2012 to 2020)

Water Year	Water Year Type	Rainfall (inches)	Inflow (AFY)								Outflow (AFY)						Change in Storage (AFY)	
			Subsurface Inflow	Streambed Percolation	Percolation of Precipitation	Percolation of Irrigation Water		MGB Boundary Inflows	Subsurface Inflow from Ocean	Total Inflow	MGB Boundary Outflows	Subsurface Outflow to Ocean	Groundwater Pumping		Phreatophyte Transpiration	Total Outflow		
						Delivered	Pumped						CVWD	Private			Year	Cumulative
2012	Below Normal	9.80	550	6	0	211	270	83	143	**1,265**	35	407	1,013	2,829	89	**4,372**	-3,108	**-3,108**
2013	Critical	8.28	465	0	0	238	331	52	135	**1,222**	25	297	641	3,475	89	**4,527**	-3,305	**-6,413**
2014	Critical	5.82	327	10	0	255	392	50	224	**1,259**	20	247	1,048	4,137	89	**5,541**	-4,282	**-10,695**
2015	Critical	8.64	485	0	0	216	398	74	585	**1,757**	22	274	2,598	3,989	89	**6,972**	-5,215	**-15,910**
2016	Dry	9.95	559	0	0	222	382	82	808	**2,053**	23	269	2,759	3,796	89	**6,936**	-4,884	**-20,794**
2017	Above Normal	21.85	1,087	844	2,855	202	417	107	639	**6,151**	52	276	1,239	4,188	89	**5,844**	307	**-20,486**
2018	Below Normal	8.97	504	724	0	234	509	115	751	**2,837**	31	253	2,255	5,141	89	**7,769**	-4,932	**-25,418**
2019	Above Normal	18.18	1,021	1,011	1,009	192	418	112	712	**4,475**	48	232	945	4,283	89	**5,596**	-1,121	**-26,539**
2020	Below Normal	13.13	737	442	130	224	423	100	639	**2,695**	35	186	888	4,437	89	**5,635**	-2,940	**-29,479**

Notes

AFY = acre-feet per year

CVWD = Carpinteria Valley Water District

MGB = Montecito Groundwater Basin

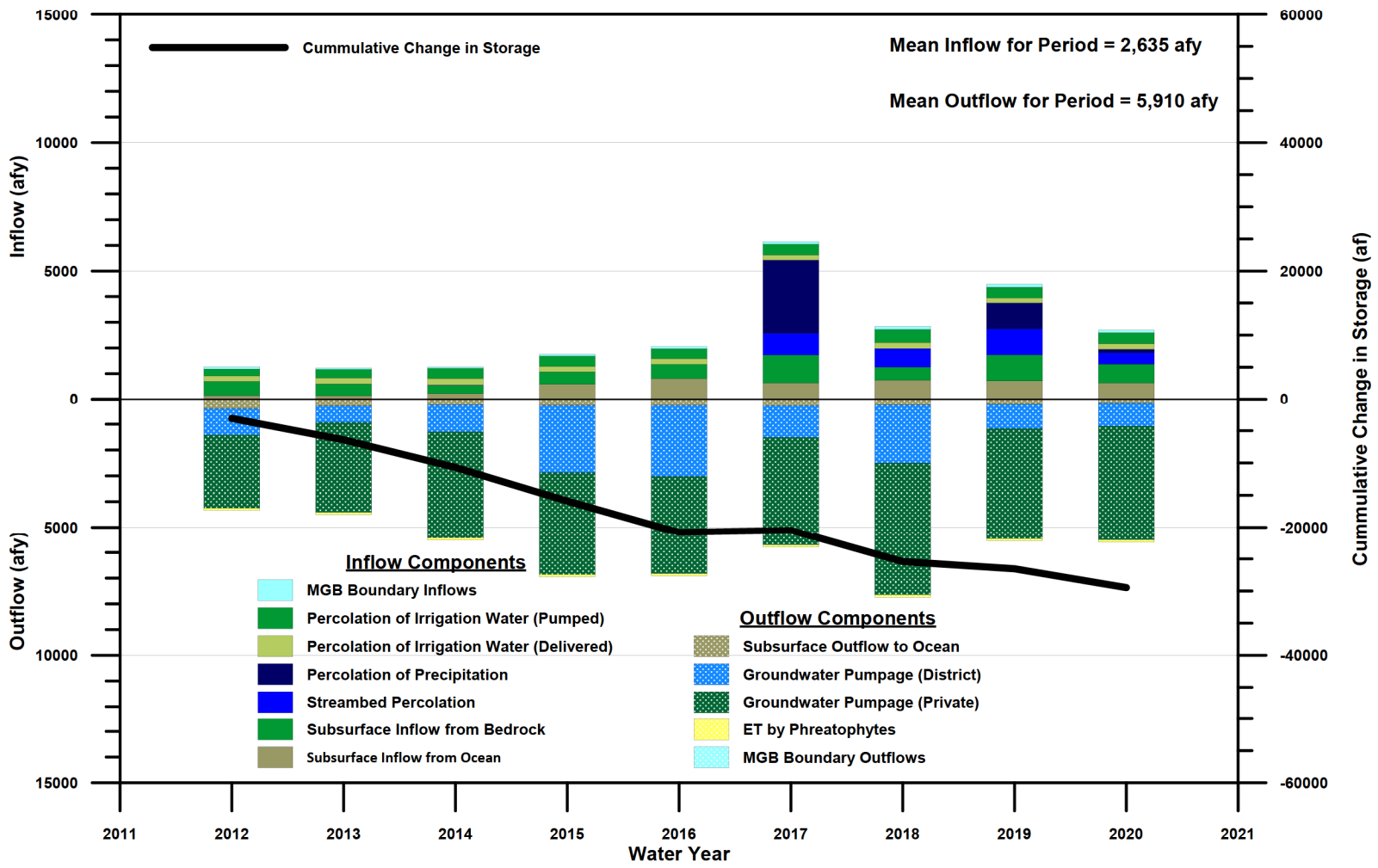


FIGURE 3-72

Current Water Budget Summary (WY 2012 – 2020)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

Table 3-13. Current Water Budget Summary (Water Years 2012 to 2020)

Groundwater Budget Component		Annual Minimum (AFY)	Annual Maximum (AFY)	Annual Average (AFY)	Average %
Inflows					
Subsurface Inflow		327	1,087	637	24
Streambed Percolation		0	1,011	337	13
Percolation of Precipitation		0	2,855	444	17
Percolation of Irrigation Water	Delivered	192	255	222	8
	Pumped	270	509	393	15
MGB Boundary Inflow		50	115	86	3
Subsurface Inflow from Ocean Boundary		135	808	515	20
			Total Inflow	**2,635**	**100**
Outflows					
MGB Boundary Outflow		20	52	32	1
Subsurface outflow to Ocean Boundary		186	407	271	5
Groundwater Pumping	CVWD	641	2,759	1,487	25
	Private	2,829	5,141	4,030	68
Phreatophyte Transpiration		89	89	89	2
			Total Outflow	**5,910**	**100**
Change in Storage (AFY)		**Cumulative**		**Average**	
		-29,479		-3,275	

Notes

AFY = acre-feet per year

CVWD = Carpinteria Valley Water District

MGB = Montecito Groundwater Basin

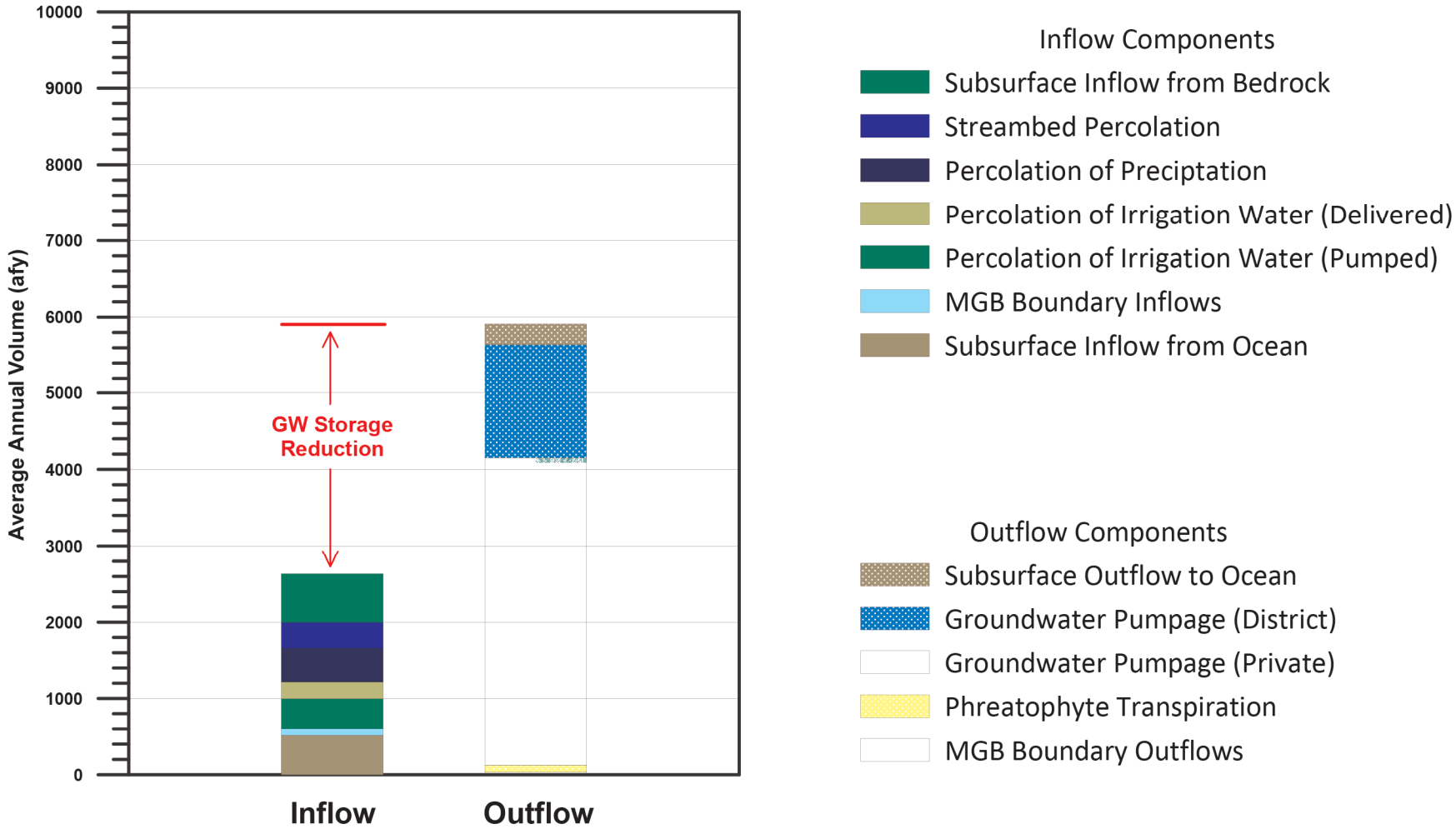


FIGURE 3-73

Current Water Budget – Groundwater System Averages Paired Bar Chart (WY 2012 – 2020)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

3.3.5 Projected Water Budget

3.3.5.1 Projected Water Budget Calculation Methods [§354.18(d)(1),(d)(2),(d)(3),(e), and (f)]

§354.18 Water Budget.

(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:

(1) Historical water budget information for mean annual temperature, mean annual precipitation, water year type, and land use.

(2) Current water budget information for temperature, water year type, evapotranspiration, and land use.

(3) Projected water budget information for population, population growth, climate change, and sea level rise.

(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.

(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.

GSP regulations require a water budget for current, historical, and projected basin conditions. Presented in this section is a description of the methodology utilized to prepare a 50-year projected water budget for the Basin. The projected water budget accounting is used to quantify the estimated future baseline conditions of supply, demand and aquifer response to GSP implementation. In general, the methodology involves applying DWR provided climate change data sets to the existing water budget methodology for the basin described in the previous sections.

Historical Base Period Selection Used to Represent Future Conditions

GSP regulations require the use of 50 years of historical precipitation, evapotranspiration, and stream flow information as the future baseline hydrology conditions, while taking into consideration the estimated climate change and sea level rise projections. The available historical data periods for the required information in the CGB are summarized below:

- Precipitation (Santa Barbara County Carpinteria Fire Station): WY 1949–2020
- Evapotranspiration (CIMIS Station 107): WY 1994–2020
- Streamflow (USGS Carpinteria Creek): WY 1941–2020

DWR-provided climate change datasets are used to "perturb" the historical data to represent projected future conditions and have been provided for the period covering WY 1916–2011; therefore, the common hydrology for the historical precipitation record and the DWR climate change datasets is for the 63-year period WY 1949–2011.

Commonly accepted criteria for selection of a base period for groundwater basin analysis is that the selected base period must include at least one period each of overall wet conditions and overall dry conditions (relative to average annual conditions) and have an average precipitation that is close to the average precipitation for the entire period of record (Theis, 1940; Bredehoeft et al., 1982). In addition, the beginning of the base period should be during a period of relatively dry conditions to eliminate the potential for any "in-transit" recharge water that might otherwise not be reflected in storage condition changes (Theis, 1940; Bredehoeft et al., 1982). Finally, to the extent possible, the selected base period should begin and end at comparable points on the historical cumulative departure from the mean annual precipitation in order to represent average precipitation over the base period.

The average annual precipitation for the entire period of record at the Carpinteria Fire Station gauge is 17.3 inches. Table 3-14 summarizes the available 50-year historical periods during the 63-year common period and their corresponding average annual precipitation values.

Table 3-14. 50-Year Base Period Annual Average Precipitation Summary

50-Year Period (Water Year)		Average Annual Precipitation (inches)
Start	End	
1949	1998	18.3
1950	1999	18.3
1951	2000	18.4
1952	2001	18.7
1953	**2002**	**18.3**
1954	2003	18.3
1955	2004	18.2
1956	2005	18.6
1957	2006	18.7
1958	2007	18.6
1959	2008	18.4
1960	2009	18.5
1961	2010	18.7
1962	2011	19.0

Note

Bold type indicates the selected 50-year historical base period.

As shown, there are fourteen 50-year periods within the common historical period to choose from. Plots of annual precipitation for both the historical period of record and the WY 1953–2002 period, and their respective cumulative departure from the mean curves, are presented on Figure 3-74 for comparison. As shown, the 1953–2002 period begins with a dry period and includes periods of overall dry, wet and alternating wet and dry conditions. In addition, of the fourteen available 50-year periods, the selected base period most closely begins and ends at comparable points on the historical cumulative departure curve; therefore, the 50-year period of WY 1953–2002 best satisfies the criteria for base period selection and it has been selected as the historical base period for the projected water budget calculations.

DWR Climate Change Datasets

DWR has provided climate change datasets related to the climatology, hydrology and water system operations for the entire state, packaged in the form of change factors for precipitation, reference evapotranspiration, streamflow and seal level rise centered around two future climate periods: 2030 and 2070. The datasets are based on climate projections for these two climate periods and include one central tendency scenario for 2030 and three scenarios for 2070: a central tendency and two extreme scenarios (one drier with extreme warming and one wetter with moderate warming). The central tendency scenarios for both 2030 and 2070 have been pre-selected by the Technical Committee as being reasonable and suitable for this projected water budget, rather than either of the extreme 2070 scenarios.

To use the DWR-provided monthly change factors, the corresponding historical data are multiplied by the change factors to obtain climate change perturbed data for use in the projected water budget calculations. DWR guidance indicates that the projected 2030 data are useful to evaluate projects and management actions to achieve sustainability in the early future, whereas the 2070 data are useful to show that sustainability will be maintained into the planning and implementation horizon (i.e., late future); therefore, 2030 change factors are applied to the future projected WY 2024–2043 period (20 years) and the 2070 change factors applied to the WY 2044–2073 period (30 years).

Precipitation. DWR precipitation change factors are provided statewide on a 6 km by 6 km grid resolution. The Basin boundaries intersect two of the grid cells: VICGrid_ID_10149 and VICGrid_ID_10150. In accordance with DWR guidance, an area-weighted time-series of monthly change factors was developed based on the relative areas of the Basin covered by each grid cell (ID 10149 covers 51.2 percent and ID 10150 covers 48.8 percent). The 2030 and 2070 area-weighted change factors were then applied as described above to the historical monthly precipitation for the base period to create a perturbed precipitation record for the projected water budget calculations (discussed in a following section).

Evapotranspiration. DWR evapotranspiration (ET) change factors are also provided statewide on the same 6 km by 6 km grid resolution as the precipitation factors, and an area-weighted time-series of monthly change factors was also developed for ET as described above for precipitation. The average annual ET climate change factor for the WY 2021–2030 period was 1.03 (increase of 3.1 percent) and for the WY 2031–2070 period was 1.08 (increase of 7.9 percent). It is noted that the only historical evapotranspiration data available in the area is from the California Irrigation Management Information System (CIMIS) Santa Barbara station (Station 107), which has a historical period of record limited to April 1993 through current; however, as described in the previous section, evapotranspiration information is used indirectly, rather than directly, in the existing water budget calculation methodology for the Basin (e.g., for calculations of deep percolation of precipitation); therefore, the lack of historical ET data in the Basin to directly apply change factors to is not problematic for the projected water budget calculations.

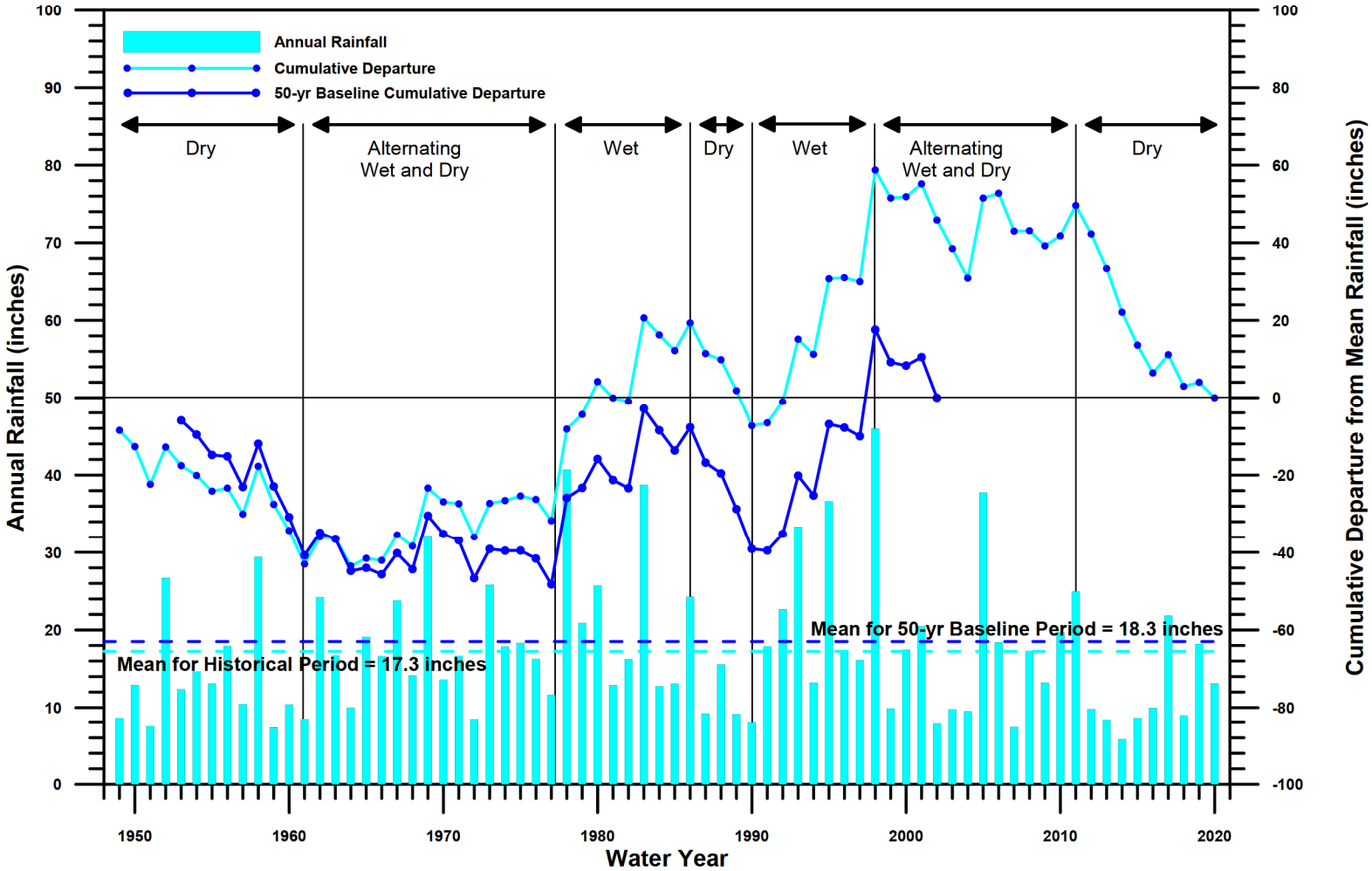


FIGURE 3-74

Historical Annual Rainfall – Carpinteria Station (WY 1949–2020)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

Streamflow. In addition to the precipitation and ET datasets, DWR provides both monthly and annual unimpaired streamflow change factors for basins outside of the Central Valley. The only stream gauge in the CGB with a substantial period of record is the USGS Carpinteria Creek gauge, located just downstream of the confluence of Carpinteria and Gobernador Creeks, with a period of record of WY 1941–2021. As described in the DWR Climate Change Guidance document, when applying monthly timeseries change factors, there is an assumption that an aspect of climate change will have a shifting effect on the timing of the streamflow hydrograph, which can result in changes in the annual discharge volume of the hydrograph. Accordingly, in addition to the monthly streamflow change factors, DWR has provided a spreadsheet-based second-order correction tool for unimpaired monthly streamflow to ensure that the total annual volume changes are consistent with the DWR climate change modeling results.

The monthly streamflow change factors and second-order correction tool have been applied to the Carpinteria Gauge monthly data to create a perturbed monthly time series for the projected water budget calculations. The monthly data have been aggregated annually and are plotted on Figure 3-75 along with the unperturbed historical data hydrograph for comparison. As shown, the perturbed streamflow data is only slightly greater than the unperturbed historical data, with a base-period mean of 3,161 AFY versus 3,126 AFY, respectively (an approximate 1 percent increase), with most of the increases occurring in wet years and little changes in normal and dry years.

Sea-Level Rise. The sea-level rise estimates developed by the National Research Council (NRC) have been adopted by DWR as guidance for incorporating sea-level rise into projected groundwater modeling simulations. By 2030 and 2070, sea level rise projections of 15 and 45 centimeters (approximately 5.9 and 17.7 inches, respectively), respectively, have been established. For the projected water budget, this information is incorporated into the ocean boundary conditions in the groundwater model projected future scenario (see Appendix F) and as with the historical water budget calculations discussed previously, subsurface inflows and outflows across the Basin boundary with the Pacific Ocean are calculated by the groundwater model.

SWP Contractor Deliveries. The CVWD imports surface water supplies from the Cachuma Project and the State Water Project (SWP, Table A). In addition to the unimpaired streamflow change factors for watershed outside the Central Valley, DWR has provided datasets on climate-transformed State Water Project (SWP) deliveries to SWP contractors. It is noted that the DWR-provided datasets are not in the form of change factors, as provided for the other parameters, but rather estimated total monthly deliveries to the Table A contractors. Furthermore, the Table A contractors includes all of the member agencies of the Cachuma Project, not just the CVWD; however, the 2020 UWMP developed estimates for anticipated SWP imports by the CVWD and associated deliveries to agricultural customers through 2045, which are used in the projected water budget calculations.

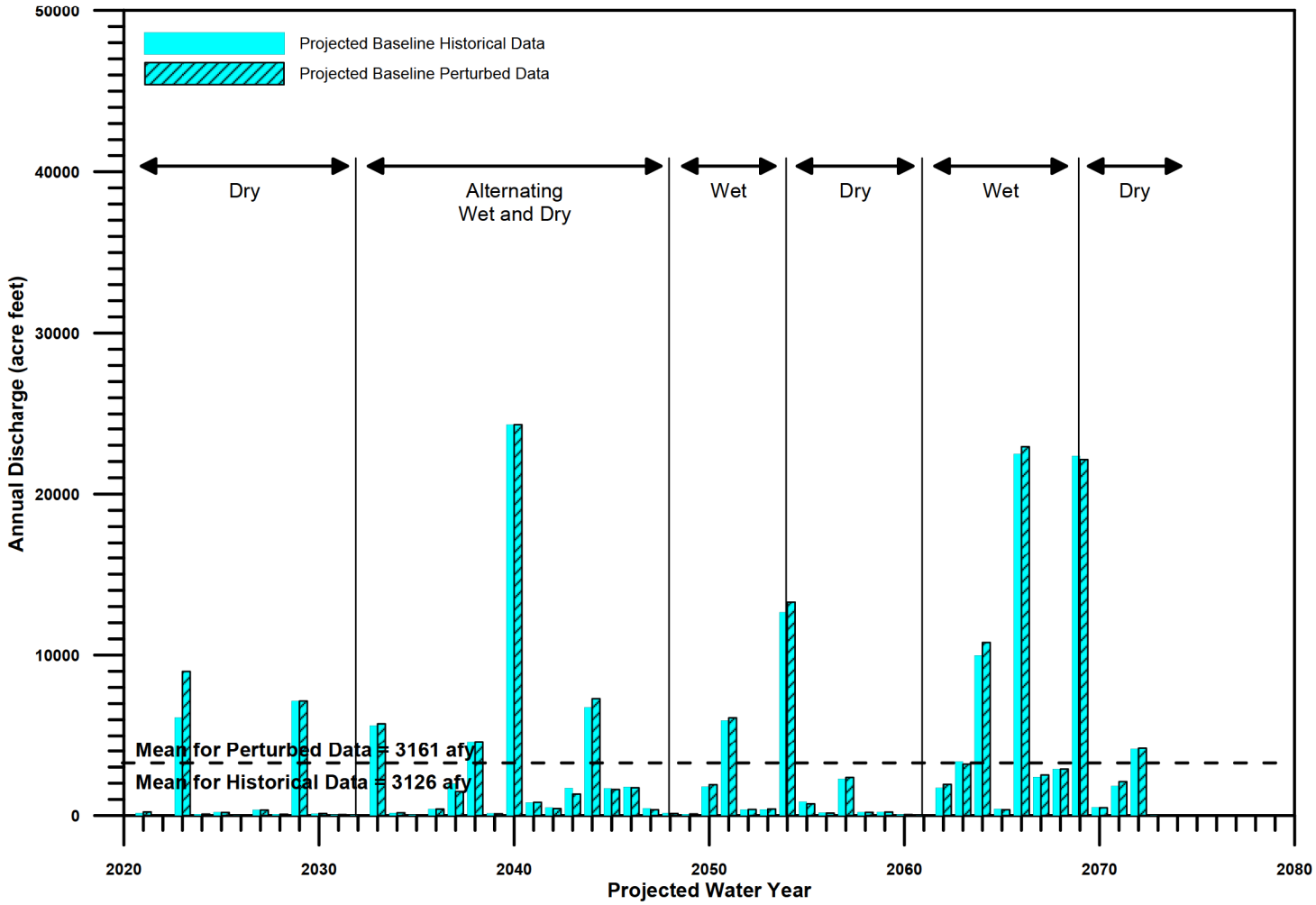


FIGURE 3-75

Projected Baseline Annual Streamflow at USGS Carpinteria Gage

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

Incorporation of Climate Change Factors into Projected Water Budget

The application of the DWR climate change datasets to the various components of existing CGB water budget methodology for creating the 50-year projected water project is summarized in the following sections.

Subsurface Inflow. Subsurface inflow is flow from consolidated rocks in the hill and mountain areas adjacent to the Basin's northern boundary. As discussed in the previous section, a direct relationship between subsurface inflow and annual precipitation was developed by GTC (1976) and has been adopted for the existing methodology. The perturbed monthly precipitation data is aggregated annually, and annual subsurface inflow calculated using the existing relationships. Monthly subsurface inflow is then calculated proportionally based on the monthly precipitation totals in relation to the estimated annual totals.

Deep Percolation of Precipitation. Percolation of precipitation is the most important source of recharge to the Basin, historically accounting for approximately 45 percent of the total inflow. There are two primary considerations in calculating the volume of precipitation that percolates beyond the root zone and contributes to the CGB groundwater body:

1. The total area of the various land uses and vegetative covers for each year of the base period, and
2. The calculation of deep percolation of precipitation in inches for each of the various land uses / vegetative covers for each year of the base period.

The total volume of deep percolation in AF is then calculated (i.e., inches of percolation x acreage) for each year of the base period.

Based on the above-noted recent Agricultural Water Management Plan and UWMP, projected land uses in the Basin are not anticipated to change appreciably from the current land uses; therefore, the land uses present in WY 2020 are assumed to exist for the projected water budget calculations.

Estimates of deep percolation in the Basin are made using relationships developed by Blaney in 1933 (cited in GTC, 1976). Blaney empirically tabulated the amounts of rain that percolated beyond the root zone, depending upon the land use, type of vegetation and amount of annual precipitation. Blaney's values of deep percolation versus annual rainfall have been plotted for land covers (i.e., Blaney Curves) similar to those in the CGB, and best-fit linear regression curves drawn through these points. Values of percolation of precipitation corresponding to annual rainfall and vegetative cover types in the CGB are then calculated using the regression curve equations.

Much of the infiltrating precipitation is held within the root zone because at the beginning of each rainy season there is an initial deficiency of soil moisture. During the summer months the capillary soil moisture is more or less completely depleted from the soil within the root zone by the processes of evaporation and transpiration. No deep percolation of rainfall can occur until the initial fall soil moisture deficiency is exceeded, which is represented as the y-intercept value in the Blaney regression curve equations. Once the initial soil moisture deficiency within the root zone has been satisfied, the excess precipitation will percolate downward until it eventually reaches the water table. To account for the effects of DWR-projected changes in ET on deep percolation, the monthly ET change factors are aggregated to develop annual average change factors, which are then applied to the y-intercept value in each Blaney curve equation (i.e., the y-intercept value represents the amount of annual precipitation that must be exceeded before any deep percolation occurs) for each year of the projected water budget.

Figures 3-76 through 3-78 show comparisons of the unperturbed Blaney curve calculated percolation of precipitation (in inches) versus the using the perturbed precipitation data and Blaney regression curve equations described above for the three Blaney land use types used in the Basin; native grass and weeds, irrigated deciduous crops and irrigated truck crops, respectively. As shown, the net effect of the perturbed

data and Blaney equations is an overall reduction in the amount of estimated deep percolation in every year of the projected base period.

For the projected monthly time series water budget calculations, the perturbed annual precipitation data are utilized directly in the perturbed Blaney curve equations to determine the annual volume of deep percolation, which is then distributed monthly based on the monthly proportion of the annual totals each year after the y-intercept value for each Blaney regression curve equation has been exceeded (i.e., deep percolation is assumed to occur during any given year only after the initial soil moisture deficiency has been exceeded).

Streambed Percolation. There are five principal streams in the Basin: Carpinteria, Gobernador, Santa Monica, Arroyo Parida, and Rincon Creeks. As discussed above, the USGS Carpinteria Creek gauge is the only relevant gauge in the Basin and has essentially continuous data since 1941 (there is a brief hiatus in the record for WY 1978). Records for Franklin Creek are limited to Water Years 1971 through 1978. Available data for the other drainages in the Basin are limited to miscellaneous measurements made by the USGS from 1941 to 1945.

Streambed percolation is assumed to occur only where the stream reaches cross the Recharge Area of the Basin. Once streamflow reaches the Confined Area, the amount of deep percolation to the main groundwater system is assumed to be insignificant. The 1976 GTC study included an analysis of annual runoff at the Carpinteria Creek gauge and seepage losses for streams in the Basin and developed annual runoff vs. streambed percolation relationships for each individual stream. These same relationships are utilized for the projected water budget utilizing the perturbed annual Carpinteria Creek gauge data. The monthly time series percolation values are distributed proportionally based on the amount of gauged monthly runoff each year.

Percolation of Irrigation Return Water. Percolation of irrigation return water in the Basin is dependent on a variety of factors, including climatic conditions, 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. For purposes of estimating deep percolation of irrigation return water in the Basin, the existing conservative estimate is that 20 percent of applied water (both pumped and delivered) percolates into the Basin (GTC, 1976). This conservative factor takes into account the relatively steeper slopes found in many portions of the Recharge Area, and hence greater percentages/amounts of runoff, as well as the relatively more efficient sprinkler-type irrigation commonly used in the Basin at the present time.

The irrigation totals include both pumped and delivered water. In this context, pumped water is the estimated private pumping. Delivered water is water that the CVWD delivers to irrigators in the Basin and is a combination of imported water from both the Cachuma Project and the SWP, and groundwater pumped by CVWD wells. It is noted that from a groundwater system mass-balance standpoint, the volumes of water delivered to agricultural parcels accounts for water that is imported into the Basin and contributes to basin recharge.

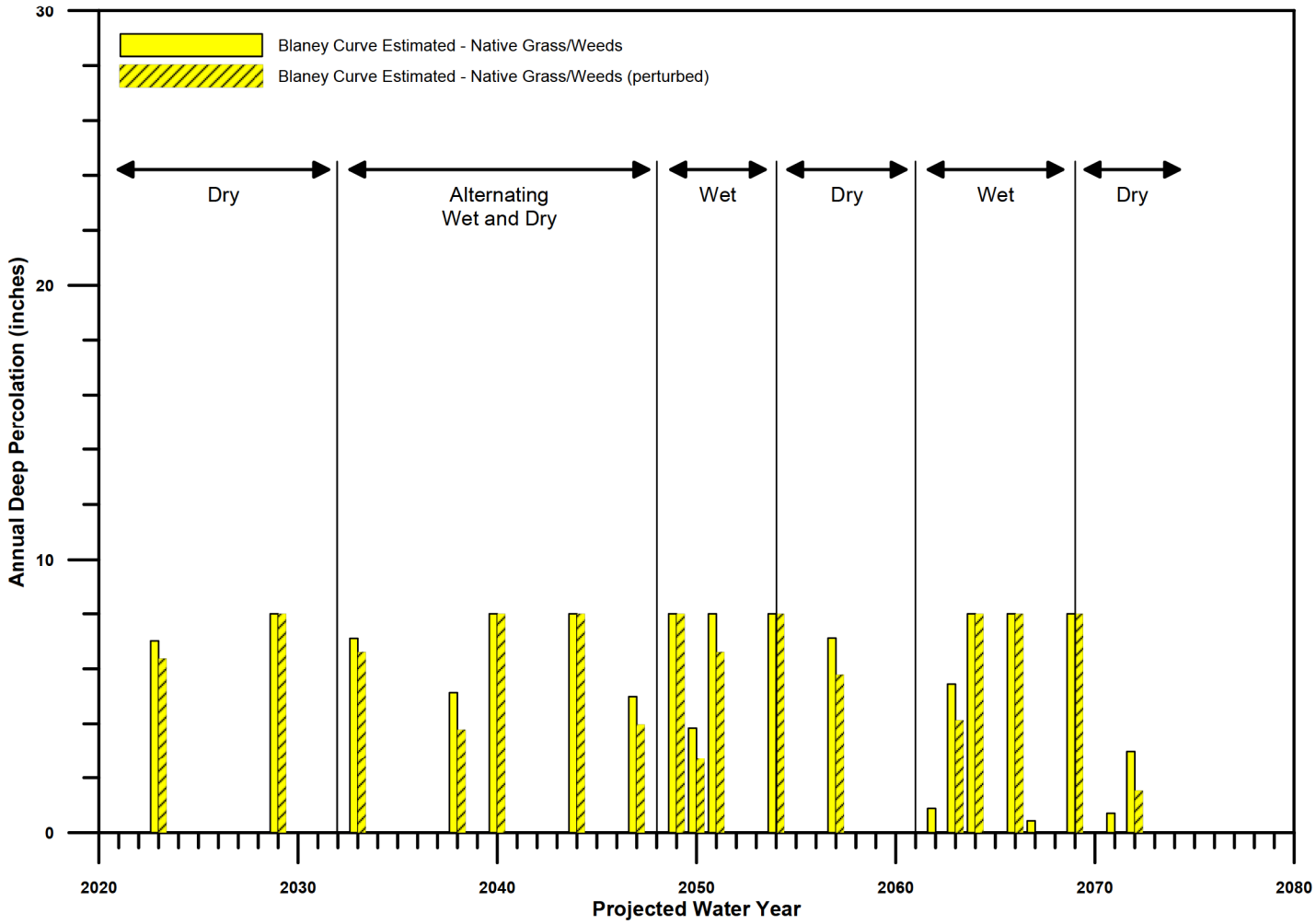


FIGURE 3-76

Projected Baseline Annual Deep Percolation Comparison – Native Grass/Weeds

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

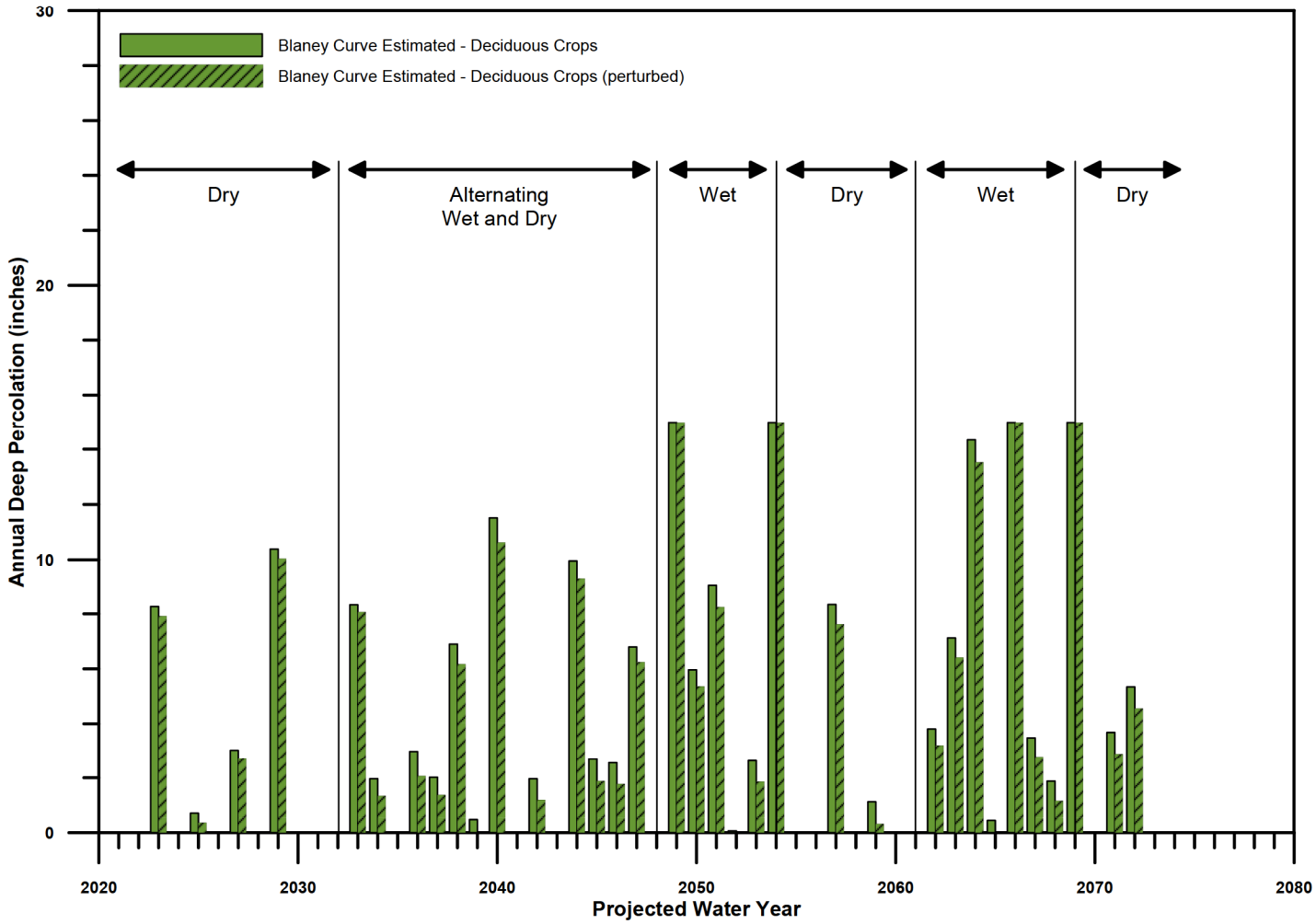


FIGURE 3-77

Projected Baseline Annual Deep Percolation Comparison – Deciduous Crops

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

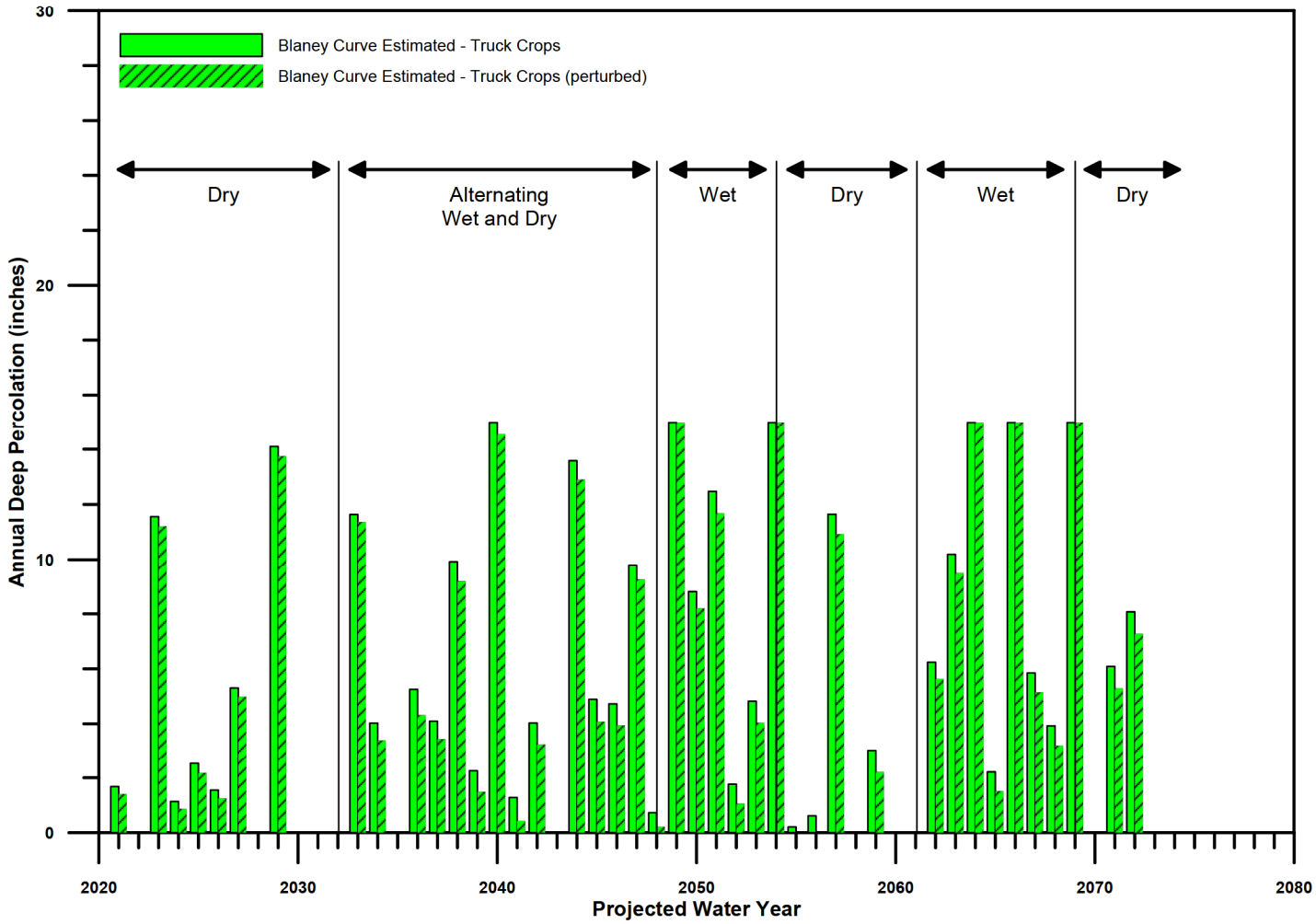


FIGURE 3-78

Projected Baseline Annual Deep Percolation Comparison – Truck Crops

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

As discussed previously, the 50-year historical period being utilized as baseline for the projected water budget is WY 1953–2002, whereas the historical water budget period for the GSP is WY 1985–2020; therefore, the common period for baseline pumping is limited to the 18-yr period of WY 1985–2002. As described in the DWR guidance document, when necessary, projected water budget components can be developed utilizing historical water year type averaging; therefore, for the Basin projected water budget, baseline annual estimates of private agricultural pumping based on water-year type averaging is developed from statistical analysis of the historical data. Similarly, the monthly time series data are distributed proportionally based on statistical analysis of the historical distributions for each water-year type. The effects of changes in ET on crop demands and associated pumping and delivered water is accounted for by applying DWR ET change factors to the baseline agricultural pumping and delivered water values to create a monthly time series of ET perturbed private pumping values.

The 2020 UWMP provides estimates of imported water deliveries to agricultural customers for normal, dry and multiple dry water year scenarios through 2045, which are used for the projected water budget calculations for delivered water based on water-year type. The UWMP estimates for 2045 are carried through WY 2073.

Evapotranspiration by Phreatophytes. Phreatophytes are plants whose roots extend into the water table and typically live in the vicinity of stream channels and in areas of high groundwater. Groundwater consumed by phreatophytes is dependent on many factors, including plant species, vegetative density, climate, soil types and conditions, and depth to groundwater. As discussed previously, direct measurements or detailed studies of consumptive use by phreatophytes in the CGB have not occurred to date; however, GTC (1976) roughly estimated phreatophyte extractions for the CGB by applying results of a 5-year study in San Diego County utilizing the Blaney-Criddle formula (Blaney and Criddle, 1962). Extractions by phreatophytes were estimated to be approximately 120 to 130 AFY from the 1930s through 1970, then reduced to approximately 100 AFY as a result of removal of phreatophytes from the Santa Monica and Franklin Creek channels as part of the flood control channelization projects. The existing water budget methodology for the Basin (inclusive of the Toro Canyon area) similarly assumes that extraction by phreatophytes is 100 AFY (and distributed evenly through each year). For the baseline projected water budget for the Basin, the same assumptions are made (but not including the Toro Canyon area because it is no longer in the Basin as defined by Bulletin 118), with projected increases in ET accounted for by applying DWR change factors to the monthly time series values.

Boundary Subsurface Inflows and Outflows. Groundwater inflows and outflows across the jurisdictional boundary with the MGB and the basin boundary with the Pacific Ocean are calculated by the re-calibrated groundwater flow model of the Basin from the projected future model scenario (see Appendix F).

Projected Hydrology [§354.18(c)(3)(A)]

§354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(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.

The monthly historical and perturbed precipitation data discussed above were aggregated to the annual level and plotted on Figure 3-79 for comparison. As shown, the historical inter-annual variability of precipitation is preserved in the perturbed data set, with some years having slightly less, and others having slightly more, precipitation than the historical. The long-term annual average for the perturbed data is slightly (4 percent) greater than the historical average at 19.1 inches versus 18.3 inches, respectively, reflecting the predicted overall slightly wetter future climate conditions.

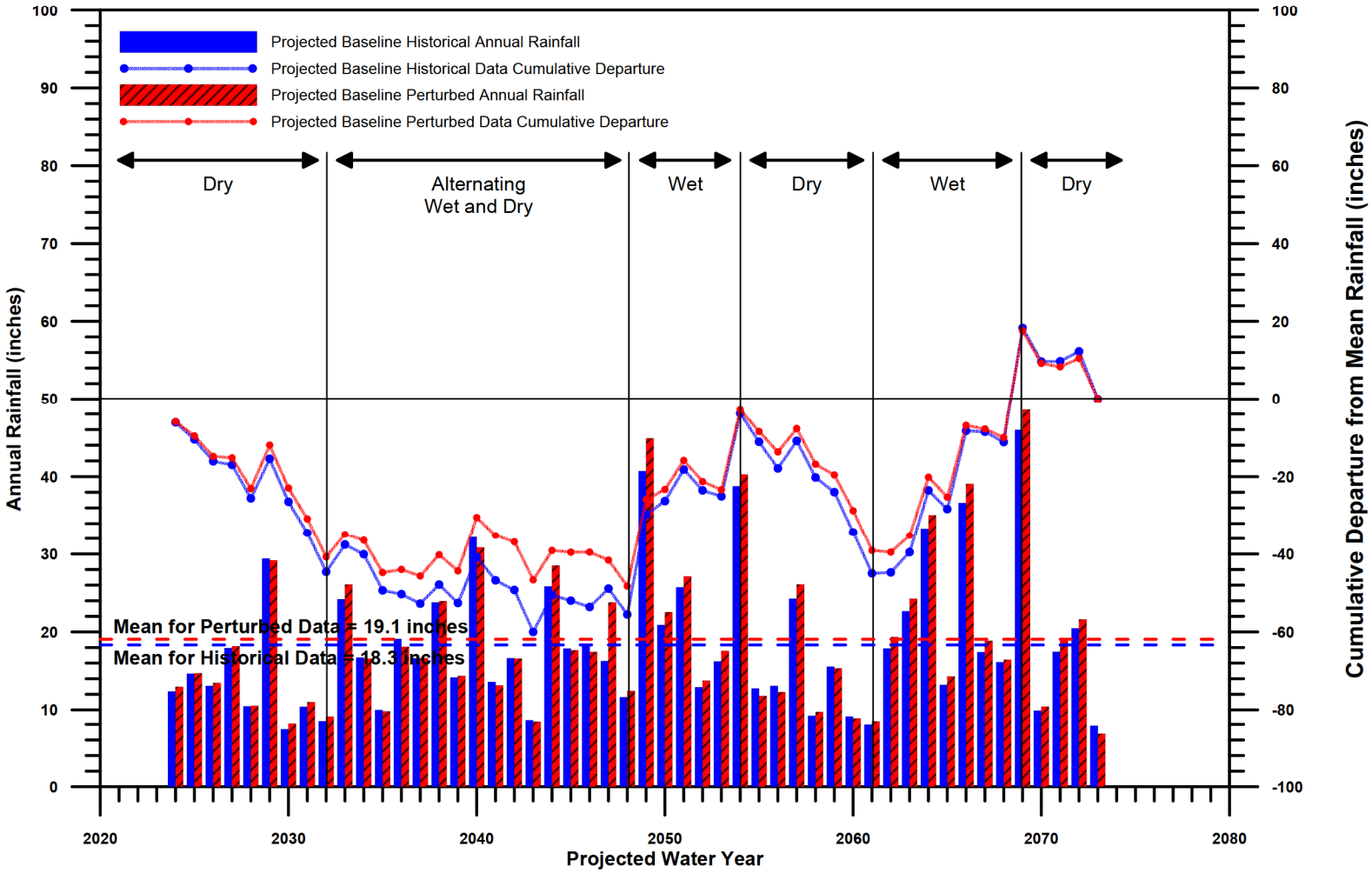


FIGURE 3-79

Projected Baseline Annual Rainfall

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

Projected Water Demand [§354.18(c)(3)(B)]

§354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(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:

(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.

Projected municipal pumping by the CVWD is based on the 2020 UWMP, which incorporates projected growth in demands through 2045. The UWMP provides estimated CVWD pumping during normal, single-dry, and multiple-dry water years, which are summarized in Table 3-15.

Table 3-15. Projected CVWD Pumping Summary

Water Year Type	Pumping per Projected Year (acre-feet)				
	2025	2030	2035	2040	2045
Normal	1,200	1,200	1,200	1,200	1,200
Single Dry	2,017	1,200	1,307	1,385	1,455
Multiple Dry					
Year 1	2,012	1,173	1,326	1,394	1,463
Year 2	2,152	1,255	1,418	1,492	1,565
Year 3	2,009	1,185	1,323	1,392	1,461
Year 4	1,835	1,070	1,209	1,272	1,335
Year 5	1,709	997	1,126	1,185	1,243

As shown, projected annual CVWD pumping through 2045 ranges between approximately 1,000 to 2,150 AFY, depending on the hydrologic conditions and planned use of the CVWD water supply portfolio. For purposes of the 50-year projected water budget, the UWMP projected pumping for 2045 is carried forward through 2073.

The annual time-series of CVWD pumping is accordingly based on water-year type averaging and distributed by well proportionally according the estimated per-well pumping capacities. Monthly pumping distribution curves developed from the historical pumping data by water-year type are used to distribute the estimated annual pumping on a monthly basis.

The 2016 Agricultural Water Management Plan does not provide useful information regarding projected agricultural pumping in the Basin; however, the UWMP indicates that significant changes in land use are not projected to occur, and agricultural demands have been kept flat at 2020 use in the UWMP; therefore, projected annual agricultural pumping is based on water-year type averaging from the historical data, using 2020 use as the baseline. Table 3-16 summarizes projected unperturbed baseline private pumping by water type.

Table 3-16. Projected Baseline Private Pumping Summary

Water Year Type	Projected Baseline Pumping (acre-feet per year)
Wet	2,676
Above Normal	2,840
Below Normal	3,005
Dry	3,134
Critical	3,333

To account for future increases in temperatures due to climate change, the projected annual irrigation demands for private pumping are scaled by a factor representing the average annual increase in future ET as calculated from ET climate change factors provided by DWR. As discussed previously, the average ET climate change factor for the WY 2020–2030 period was 1.03 (increase of 3.1 percent) and for the WY 2031–2070 period was 1.08 (increase of 7.9 percent); therefore, monthly agricultural irrigation demand is perturbed (increased) by the corresponding change factors to account for higher ET uptake (demand) of irrigation water. Projected monthly pumping is proportionally distributed to individual private wells that existed during the last year of the historical period (2020) based on each well's estimated monthly pumping during that period.

Projected Surface Water Supply [§354.18(c)(3)(C)]

§354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(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:

(C) 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.

Projected surface water supplies imported into the Basin by the CVWD are provided in the 2020 UWMP, which incorporates projected water supplies available to meet demands through 2045. As noted previously, the UWMP provides estimated CVWD pumping during normal, single-dry and multiple-dry water years, which

considers the available surface water supplies to meet projected demands. As such, available surface water supplies are incorporated into the CVWD pumping estimates are not directly utilized in the water budget calculations for the groundwater system. Table 3-17 summarizes projected surface water supplies.

Table 3-17. Projected Surface Water Supplies

Water Year Type	Surface Water Source	Projected Year (acre-feet)				
		2025	2030	2035	2040	2045
Normal	Cachuma Project	2,110	2,110	2,110	2,110	2,110
	State Water Project	876	876	876	876	876
Single Dry	Cachuma Project	2,110	2,110	2,110	2,110	2,110
	State Water Project	154	154	154	154	154
Multiple Dry						
Year 1	Cachuma Project	2,097	2,042	2,103	2,092	2,124
	State Water Project	171	174	137	139	142
Year 2	Cachuma Project	2,243	2,184	2,245	2,237	2,271
	State Water Project	183	186	147	149	151
Year 3	Cachuma Project	2,094	2,039	2,099	2,089	2,120
	State Water Project	171	174	137	139	141
Year 4	Cachuma Project	1,913	1,863	1,918	1,909	1,938
	State Water Project	156	159	125	127	129
Year 5	Cachuma Project	1,782	1,735	1,786	1,777	1,805
	State Water Project	145	148	117	119	120

3.3.5.2 Projected Water Budget

The inflow and outflow components for the projected water budget are the same as the historical and current water budgets discussed in previous sections. Based on the methodology described above, the resulting 50-year projected annual water budget for the Basin is summarized in Table 3-18 and is presented graphically on Figure 3-80. A summary of the annual minimum, maximum and average volumes for each water budget component is presented in Table 3-19 and the inflow and outflow averages are presented graphically as a paired bar chart on Figure 3-81.

Table 3-18. 50-Year Projected Water Budget Inventory (Water Years 2024–2073)

Water Year	Water Year Type	Rainfall (in)	Inflow (acre-feet per year)								Outflow (acre-feet per year)						Change in Storage	
			Subsurface Inflow	Streambed Percolation	Percolation of Precipitation	Percolation of Irrigation Water		MGB Boundary Inflows	Subsurface Inflow from Ocean	Total Inflow	MGB Boundary Outflows	Subsurface Outflow to Ocean	Groundwater Pumping		Phreatophyte ET	Total Outflow	Year	Cumulative
						Delivered	Pumped						CVWD	Private				
2024	Below Normal	12.95	727	0	151	173	398	118	618	**2,186**	45	226	1,200	3,099	91	**4,660**	-2,474	**-2,474**
2025	Below Normal	14.69	825	79	430	177	401	92	662	**2,666**	43	197	1,200	3,122	92	**4,655**	-1,989	**-4,463**
2026	Below Normal	13.47	756	0	217	178	399	81	701	**2,332**	37	177	1,200	3,107	92	**4,614**	-2,282	**-6,745**
2027	Above Normal	18.17	1,020	337	1,263	179	475	88	688	**4,050**	52	203	1,200	2,945	92	**4,492**	-442	**–7,187**
2028	Below Normal	10.53	591	0	0	180	399	84	732	**1,986**	31	170	1,200	3,108	92	**4,601**	-2,615	**-9,803**
2029	Wet	29.16	1,087	1,656	5,619	181	394	134	621	**9,690**	77	318	1,200	2,786	92	**4,473**	5,217	**-4,585**
2030	Critical	8.10	455	0	0	182	484	135	569	**1,824**	39	237	1,200	3,425	91	**4,992**	-3,168	**-7,753**
2031	Below Normal	11.02	619	0	0	183	399	95	671	**1,966**	35	196	1,307	3,108	92	**4,738**	-2,771	**–10,524**
2032	Dry	8.99	504	0	0	184	454	85	784	**2,011**	28	183	1,624	3,210	91	**5,135**	-3,124	**-13,648**
2033	Wet	26.08	1,087	1,561	4,610	185	389	132	645	**8,609**	75	326	1,200	2,752	91	**4,444**	4,165	**-9,483**
2034	Below Normal	16.57	930	48	890	186	399	119	591	**3,164**	52	241	1,200	3,111	92	**4,696**	-1,533	**-11,016**
2035	Below Normal	9.81	551	0	0	187	401	99	654	**1,893**	36	205	1,307	3,122	92	**4,762**	-2,869	**-13,885**
2036	Above Normal	18.10	1,016	403	1,225	189	477	90	673	**4,074**	53	215	1,200	2,960	92	**4,520**	-446	**-14,331**
2037	Below Normal	16.65	935	976	910	190	399	110	651	**4,171**	57	235	1,200	3,109	92	**4,692**	-521	**-14,852**
2038	Wet	23.95	1,087	1,466	3,620	191	393	136	571	**7,464**	76	313	1,200	2,778	92	**4,459**	3,005	**-11,848**
2039	Below Normal	14.35	806	0	351	192	400	118	561	**2,428**	49	248	1,200	3,119	92	**4,709**	-2,281	**-14,128**
2040	Wet	30.85	1,087	2,186	6,004	193	394	178	468	**10,511**	94	538	1,200	2,791	92	**4,716**	5,795	**-8,333**
2041	Below Normal	13.13	737	715	160	194	401	139	406	**2,753**	58	299	1,200	3,125	92	**4,774**	-2,022	**-10,355**
2042	Below Normal	16.57	930	436	881	195	400	108	476	**3,427**	57	262	1,385	3,119	92	**4,915**	-1,489	**-11,844**

Water Year	Water Year Type	Rainfall (in)	Inflow (acre-feet per year)								Outflow (acre-feet per year)						Change in Storage	
			Subsurface Inflow	Streambed Percolation	Percolation of Precipitation	Percolation of Irrigation Water		MGB Boundary Inflows	Subsurface Inflow from Ocean	Total Inflow	MGB Boundary Outflows	Subsurface Outflow to Ocean	Groundwater Pumping		Phreatophyte ET	Total Outflow	Year	Cumulative
						Delivered	Pumped						CVWD	Private				
2043	Dry	8.33	468	925	0	197	460	106	600	**2,754**	41	231	1,709	3,253	92	**5,325**	-2,571	**-14,415**
2044	Wet	28.52	1,087	1,665	5,360	198	406	153	487	**9,356**	85	463	1,200	2,876	96	**4,720**	4,636	**-9,779**
2045	Above Normal	17.65	991	1,010	983	199	497	144	386	**4,210**	72	337	1,200	3,083	96	**4,789**	-579	**-10,358**
2046	Above Normal	17.44	979	1,036	944	199	496	119	408	**4,182**	66	288	1,200	3,077	96	**4,727**	-546	**-10,904**
2047	Below Normal	23.79	1,087	364	3,395	199	408	101	457	**6,011**	58	287	1,200	3,180	94	**4,820**	1,191	**-9,713**
2048	Below Normal	12.44	698	0	37	199	408	121	429	**1,892**	55	327	1,455	3,180	94	**5,111**	-3,219	**-12,932**
2049	Wet	44.89	1,087	0	6,559	199	401	141	378	**8,765**	77	583	1,200	2,837	94	**4,792**	3,973	**-8,958**
2050	Wet	22.55	1,087	1,082	2,813	199	400	150	282	**6,012**	81	537	1,200	2,828	95	**4,740**	1,272	**-7,686**
2051	Wet	27.13	1,087	1,588	4,692	199	411	179	236	**8,391**	96	757	1,200	2,908	96	**5,057**	3,334	**-4,352**
2052	Below Normal	13.74	771	379	186	199	415	130	221	**2,300**	60	372	1,200	3,233	96	**4,961**	-2,661	**-7,013**
2053	Below Normal	17.56	986	415	974	199	416	91	272	**3,353**	58	287	1,200	3,239	96	**4,880**	-1,527	**-8,540**
2054	Wet	40.26	1,087	1,924	6,559	199	401	157	236	**10,564**	95	753	1,200	2,841	95	**4,985**	5,579	**-2,961**
2055	Below Normal	11.79	662	663	0	199	414	141	193	**2,272**	61	419	1,200	3,224	95	**5,000**	-2,728	**-5,689**
2056	Below Normal	12.29	690	0	0	199	415	89	281	**1,674**	45	273	1,455	3,235	96	**5,104**	-3,431	**-9,119**
2057	Wet	26.09	1,087	1,174	4,287	199	408	108	280	**7,543**	73	455	1,200	2,888	96	**4,712**	2,831	**-6,289**
2058	Dry	9.75	547	100	0	199	468	111	295	**1,720**	45	318	1,455	3,314	94	**5,226**	-3,507	**-9,795**
2059	Below Normal	15.31	860	139	431	199	420	88	383	**2,519**	48	244	1,556	3,270	96	**5,214**	-2,695	**-12,490**
2060	Dry	8.75	491	0	0	199	479	79	469	**1,717**	30	187	1,461	3,393	96	**5,168**	-3,451	**-15,941**
2061	Critical	8.37	470	0	0	199	508	75	566	**1,818**	27	166	1,335	3,593	96	**5,217**	-3,399	**-19,340**
2062	Above Normal	19.34	1,086	1,088	1,445	199	489	87	555	**4,948**	60	219	1,243	3,032	95	**4,649**	299	**-19,040**
2063	Wet	24.28	1,087	1,304	3,494	199	407	131	471	**7,093**	75	333	1,200	2,877	96	**4,581**	2,512	**-16,528**
2064	Wet	35.06	1,087	1,834	6,344	199	411	206	345	**10,427**	101	712	1,200	2,911	96	**5,020**	5,407	**-11,121**

Water Year	Water Year Type	Rainfall (in)	Inflow (acre-feet per year)								Outflow (acre-feet per year)						Change in Storage	
			Subsurface Inflow	Streambed Percolation	Percolation of Precipitation	Percolation of Irrigation Water		MGB Boundary Inflows	Subsurface Inflow from Ocean	Total Inflow	MGB Boundary Outflows	Subsurface Outflow to Ocean	Groundwater Pumping		Phreatophyte ET	Total Outflow	Year	Cumulative
						Delivered	Pumped						CVWD	Private				
2065	Below Normal	14.30	803	362	263	199	415	142	292	**2,476**	61	340	1,200	3,233	95	**4,930**	-2,454	**-13,575**
2066	Wet	39.06	1,087	2,161	6,559	199	415	188	260	**10,869**	104	825	1,200	2,938	97	**5,164**	5,705	**-7,870**
2067	Above Normal	18.85	1,058	1,200	1,301	199	493	155	193	**4,598**	83	504	1,200	3,057	96	**4,940**	-342	**-8,213**
2068	Below Normal	16.44	923	1,260	725	199	416	125	211	**3,860**	71	391	1,200	3,242	95	**4,999**	-1,140	**-9,352**
2069	Wet	48.56	1,087	2,146	6,559	199	408	175	187	**10,760**	103	885	1,200	2,885	96	**5,168**	5,593	**-3,760**
2070	Dry	10.44	586	487	0	199	479	137	155	**2,044**	58	416	1,200	3,390	96	**5,160**	-3,116	**-6,876**
2071	Above Normal	19.14	1,075	1,124	1,343	199	496	104	191	**4,531**	72	401	1,200	3,075	96	**4,843**	-313	**-7,188**
2072	Above Normal	21.63	1,087	1,421	2,268	199	498	119	188	**5,779**	78	483	1,200	3,085	96	**4,943**	836	**-6,353**
2073	Critical	6.78	381	0	0	199	510	106	260	**1,455**	38	295	1,455	3,607	96	**5,490**	-4,035	**-10,388**
50-year period 2024–2073	**Avg.**	19.07	866	734	1,877	194	430	122	438	**4,662**	61	358	1,263	3,094	94	**4,870**	-208	
	High	48.56	1,087	2,186	6,559	199	510	206	784	**10,869**	104	885	1,709	3,607	97	**5,490**	5,795	
	Low	6.78	381	0	0	173	389	75	155	**1,455**	27	166	1,200	2,752	91	**4,444**	-4,035	
	% of Total		19	16	40	4	9	3	9	**100**	1	7	26	64	2	**100**		

Notes

CVWD = Carpinteria Valley Water District

ET = Evapotranspiration

in = inches

MGB = Montecito Groundwater Basin

Table 3-19. 50-Year Projected Water Budget Summary (Water Years 2024–2073)

Groundwater Budget Component		Annual Minimum	Annual Maximum	Annual Average	Average %
Inflows (acre-feet per year)					
Subsurface Inflow		381	1,087	866	19
Streambed Percolation		0	2,186	734	16
Percolation of Precipitation		0	6,559	1,877	40
Percolation of Irrigation Water	Delivered	173	199	194	4
	Pumped	389	510	430	9
MGB Boundary Inflow		75	206	122	3
Subsurface Inflow from Ocean Boundary		155	784	438	9
			Total Inflow	4,662	100
Outflows (acre-feet per year)					
MGB Boundary Outflow		27	104	61	1
Subsurface outflow to Ocean Boundary		166	885	358	7
Groundwater Pumping	CVWD	1,200	1,709	1,263	26
	Private	2,752	3,607	3,094	64
Phreatophyte Transpiration		91	97	94	2
			Total Outflow	4,870	100
Change in Storage (acre-feet)		**Cumulative**		**Average**	
		-10,388		-208	

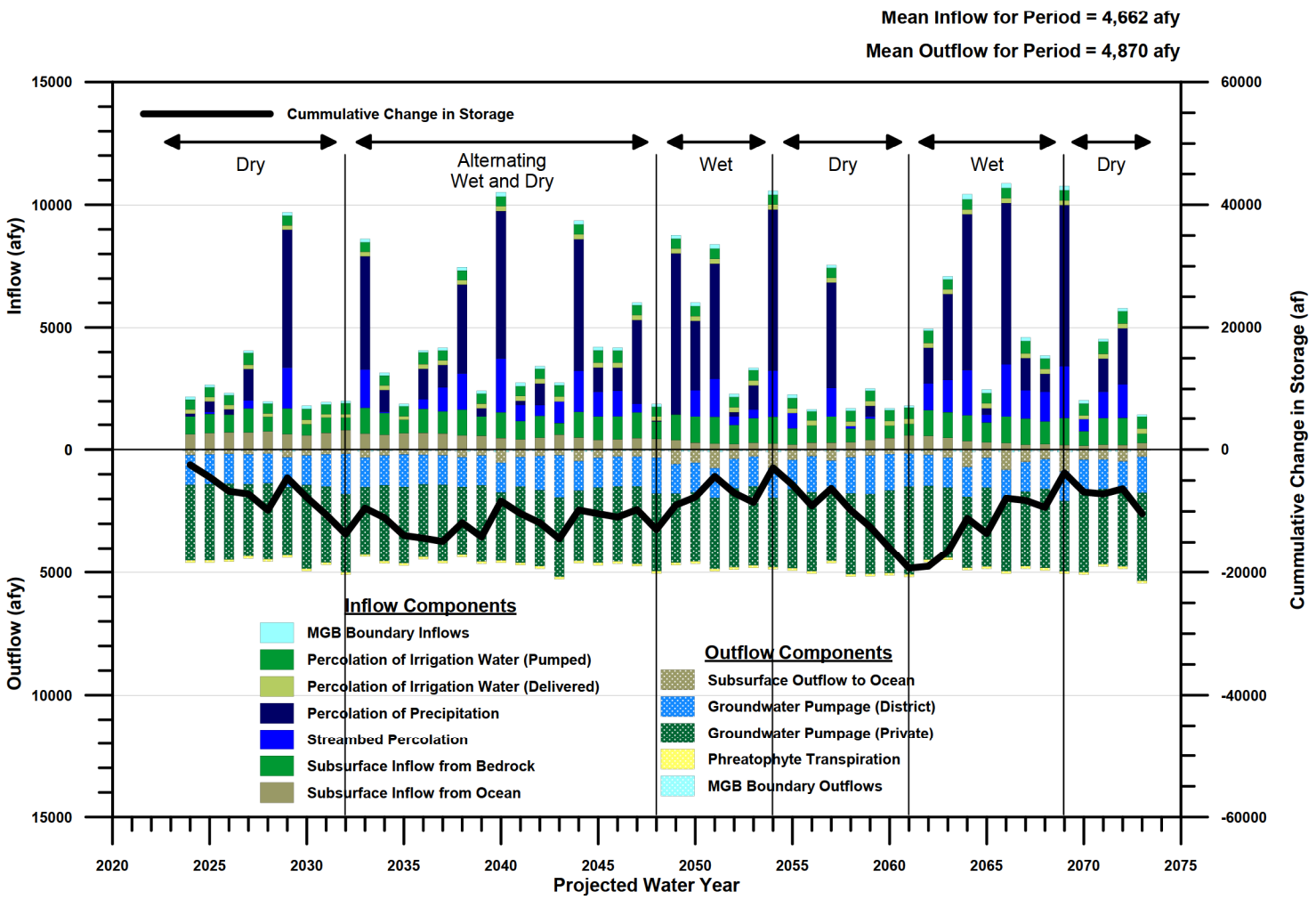


FIGURE 3-80

Projected Water Budget Summary (WY 2024–2073)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

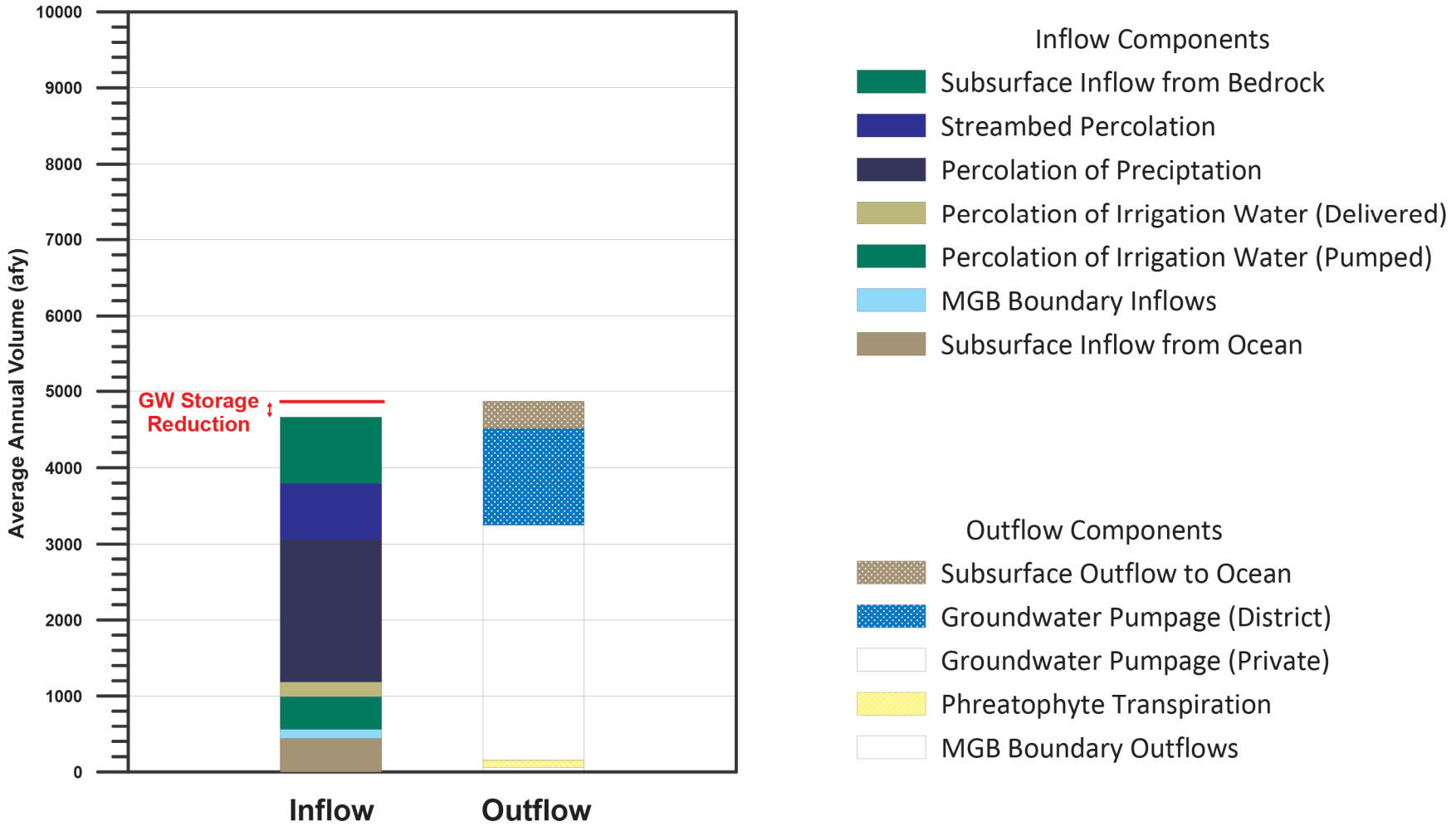


FIGURE 3-81

Projected Water Budget – Groundwater System Averages Paired Bar Chart (WY 2024–2073)

Carpinteria Groundwater Basin

Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

Projected mean annual rainfall for this 50-year period is 19.1 inches, which is approximately 12 percent greater than the 35-year historical water budget period mean of 17.0 inches. Mean annual inflow during the projected period is estimated at approximately 4,662 AFY, which is approximately 23 percent greater than the historical period mean.

Mean annual outflow is estimated at 4,870 AFY, representing approximately 95 percent of the historical period mean. Projected CVWD mean pumping is 1,263 AFY, which is 15 percent less than the historical mean of 1,455 AFY. Projected mean private pumping, however, is 3,094 AFY, which is slightly (3 percent) greater than the historical mean of 3,005 AFY.

The average imbalance between inflows and outflows of 208 AFY during the projected water budget period results in an estimated cumulative depletion of approximately 10,388 AF of groundwater storage during the 50-year period. As also discussed above for the historical and current water budget periods, the groundwater model calculates that under projected conditions, subsurface inflow from across the basin boundary with the ocean is simulated to be occurring, with approximately 440 AFY of water coming into the Basin from offshore areas during this period.

It is noted that the estimated imbalance between average annual inflows and outflows for the 50-year projected period of 208 AFY is significantly less than the 1,324 AFY imbalance estimated to have occurred during the 35-year historical period of WY 1985–2020. There are a couple key reasons for this:

- The average annual rainfall during the historical period of WY 1953–2002 that is being projected was 18.3 inches, which is approximately 8 percent greater than occurred during the WY 1985–2020 period of 17.0 inches. This is in part an artifact of the longer 50-year projected period having slightly more above normal and wet years less below normal and dry years than occurred during the shorter 35-year historical water budget period. DWR change factors for precipitation result in a further increase in the perturbed projected precipitation to 19.1 inches. The overall increased level of projected precipitation translates into commensurately increased levels of estimated Basin recharge for the period.
- Projected CVWD pumping based on the UWMP averages 1,263 AFY, which is slightly (15 percent) less than the 1,455 AFY that occurred during the historical period. This reflects changes in how the CVWD plans to utilize groundwater in the Basin as part of its overall water supply portfolio compared to past practices.

3.3.6 Basin Safe Yield Estimate [§354.18(b)(7)]

§354.18 Water Budget.

(b) The water budget shall quantify the following, either through direct measurements or estimates based on data:

(7) An estimate of sustainable yield for the basin.

The sustainable yield of a groundwater basin is typically defined as the annual quantity of groundwater that on average can be extracted from a groundwater basin without creating undesirable results, given existing land use conditions and existing wells in the Basin. Undesirable results include long-term declining water levels and depletion of groundwater storage. In a coastal basin such as the Carpinteria Groundwater Basin, long-term declining water levels are of particular concern due to the potential for seawater intrusion (as discussed previously, the southwestern portion of SU-1 is in believed to be in hydraulic contact with the Pacific Ocean.

3.3.6.1 Base Period Selection

The sustainable yield calculation is often based on a historical water budget "base period", which should represent long-term, average hydrologic conditions in the Basin as much as possible. Criteria for selection of an appropriate base period include at least one period each of overall wet conditions and overall dry conditions (relative to average annual conditions) and have an average precipitation that is close to the average precipitation for the entire period of record. In addition, the beginning of the base period should be during a period of relatively dry conditions to eliminate the potential for any "in-transit" recharge water that might otherwise not be reflected in storage condition changes. Finally, the base period should begin and end at comparable points on the cumulative departure from the mean annual precipitation curve in order to represent average precipitation over the base period.

The WY 1986–2015 historical period best satisfies these criteria. Mean annual rainfall for this selected base period was 17.6 inches compared to the long-term mean of 17.3 inches. This WY 1986–2015 base period (30 years) also reasonably represents current cultural conditions in the Basin. In addition, this period benefits from water-level data collection and relatively sophisticated analysis and quantification of private groundwater pumping in the Basin conducted by the CVWD during this period.

3.3.6.2 Water Budget for Base Period

As discussed in the previous section, the historical water budget for the Basin was prepared for the GSP to quantify the various sources of inflow and outflow in the Basin for the historical period of WY 1985–2020. The selected base period for sustainable yield of WY 1986–2015 is therefore a subset of the historical water budget period, and the average annual inflows, outflows and change in storage for this base period are summarized in Table 3-20.

Table 3-20. Sustainable Yield Base Period Water Budget Summary

Groundwater Budget Component		Annual Minimum	Annual Maximum	Annual Average	Average %
Inflows (acre-feet per year)					
Subsurface Inflow		327	1,087	811	22
Streambed Percolation		0	1,621	574	15
Percolation of Precipitation		0	6,946	1,749	47
Percolation of Irrigation Water	Delivered	149	360	217	6
	Pumped	96	398	267	7
MGB Boundary Inflow		50	186	90	2
Subsurface Inflow from Ocean Boundary		0	0	0	0
			Total Inflow	3,708	100
Outflows (acre-feet per year)					
MGB Boundary Outflow		20	91	50	1
Subsurface outflow to Ocean Boundary		247	1,072	538	11
Groundwater Pumping	CVWD	185	3,413	1,416	29
	Private	1,057	4,137	2,844	58
Phreatophyte Transpiration		89	89	89	2
			Total Outflow	4,937	100
Change in Storage (acre-feet per year)				-1,229	

As shown, average inflow during the 30-year period is approximately 3,710 AFY. It is noted that inflows from the Basin boundary with the Pacific Ocean are not included in the sustainable yield calculation, as it is conservatively assumed that such inflows (estimated at approximately 240 AFY) are saline and, therefore, do not represent usable water in the Basin. Average annual outflow during this period is approximately 4,940 AFY, indicating an average annual **overdraft of approximately 1,230 AFY** during this period.

A common approach is to assume that the sustainable yield of a groundwater basin is equal to the rate of average annual recharge. From a basin mass-balance standpoint, this makes intuitive sense, i.e., pumping must not exceed recharge on a long-term average basis in order to be sustainable; however, as addressed by Theis (1940) and Bredehoeft et al. (1982) and Bredehoeft (2002), the sustainable yield of a basin is not necessarily equal to the rate of recharge, but rather is actually dependent on the ability to *capture* recharge without causing undesirable results, such as seawater intrusion.

Projected Sustainable Yield

For the purpose of defining the projected sustainable yield under SGMA in conformance with this GSP, the following methodology is presented. As will be discussed in detail in Section 6, the CVWD is in the process of implementing a major water supply project named the Carpinteria Advanced Purification Project (CAPP). The CAPP is an indirect potable reuse project, that will inject highly treated recycled water into the Basin aquifer for recovery by District production wells. Funding has been procured, project design is substantially completed, and construction is scheduled such that the project is expected to come on line in 2026 to 2027. This project will inject 1,100 AFY of highly treated wastewater into the aquifer through the Headquarters and El Caro municipal wells. Because this project will be implemented during the SGMA horizon, it is appropriate to consider the effects of the CAPP when estimating future sustainable yield in the Basin.

Previous estimates performed for the Basin over past decades have ranged from about 3,600 to 4,000 AFY (PWR, 2012).

The methodology used to estimate the future sustainable yield is as follows. The newly updated Carpinteria Basin Groundwater Model was used to perform two forward 50-year simulations over the 2024–2073 simulation period, and water budget results are evaluated. In the baseline run, expected quantities of municipal and agricultural pumping were simulated consistent assumptions inherent the CVWD Urban Water Management Plan (UWMP) for municipal pumping, and consistent with assumptions about agricultural pumping documented in the future water budget methodology technical memo (PWR, 2022). The Sustainable Yield is calculated by summing the average annual pumping and subtracting any negative change in storage, as well as subtracting any inflow from the ocean (since this water is assumed to be brackish, representative of seawater intrusion, and not appropriate for use in a sustainable yield estimate). Thus sustainable yield is calculated using the following equation:

Sustainable Yield = Total Pumping +/- Change in Storage – Inflow from the Ocean

Table 3-21 presents the water budget results of the No project Baseline simulation, and the results of the simulation including the expected operation of the CAPP (labelled as CAPP 6 Scenario). Inspection of Table 3-21 indicates that the hydrologically-based inputs such as subsurface inflow, streambed percolation, irrigation return flow, and percolation of precipitation are unchanged; this is intuitive, since pumping operations will have no effect on meteorologically-based system inflows. The most significant difference between the baseline and CAPP project inflows is the inclusion of 1,054 AFY inflow from CAPP injection. This new source of inflow also leads to a reduction of CVWD pumping of native groundwater; this implies that during wet periods, CVWD will reduce pumping of native groundwater because of the new inflow source from CAPP. Another significant observation is that the subsurface inflow from the Ocean Boundary is reduced from 438 AFY to 323 AFY, a reduction of 26 percent. The quantity of inflow from the ocean boundary can be viewed as a proxy for conditions conducive to seawater intrusion. The increased water levels associated with the injection and operation of CAPP result in conditions that help mitigate against conditions leading to seawater intrusion. It is not expected that CAPP alone will prevent seawater intrusion, but it will help in the management of water levels along the coast.

Table 3-22 presents the comparison of sustainable yield calculations with and without implementation of CAPP. The no project sustainable yield calculation is 3,711 AFY; this is consistent sustainable yield estimates calculated by various researchers over the past decades, which have ranged between 3,600 AFY and 4,000 AFY (PWR, 2012). Significantly, the results indicate that implementation of CAPP will result in an increase in the sustainable yield of the Basin of over 1,000AFY (from 3,711 to 4,757 AFY). This result is not unexpected, since CAPP effectively adds nearly 1,100 AFY of recharge to the Basin that did not exist when the treated wastewater was simply allowed to outfall into the ocean.

Table 3-21. Water Budget Comparison: Baseline (No Project) vs. CAPP

Groundwater Budget Component		No Project Baseline	CAPP Scenario 6	Differences	
				acre-feet per year	%
Inflows (acre-feet per year)					
Subsurface Inflow		866	866	0	0%
Streambed Percolation		734	734	0	0%
Percolation of Precipitation		1,877	1,877	0	0%
Percolation of Irrigation Water	Delivered	194	194	0	0%
	Pumped	430	430	0	0%
MGB Boundary Inflow		122	115	-7	-6%
Subsurface Inflow from Ocean Boundary		438	323	-115	-26%
CAPP Injection		0	1,054	1,054	—
	Total Inflow	4,662	5,593	931	20%
Outflows (acre-feet per year)					
MGB Boundary Outflow		61	61	0	0%
Subsurface Outflow to Ocean Boundary		358	357	0	0%
Groundwater Pumping	CVWD	1,263	1,156	-107	-8%
	Private	3,094	3,094	0	0%
	CAPP Recovery	0	1,034	1,034	—
	Total	4,357	5,284	927	21%
Phreatophyte Transpiration		94	94	0	0%
	Total Outflow	4,870	5,797	927	19%
Inflows – Outflows (acre-feet per year)		(208)	(204)	4	1%

Table 3-22. Sustainable Yield Comparison: Baseline (No project) vs. CAPP

	Total Pumping	Change in Storage	Inflow from Ocean	Sustainable Yield
Baseline	4,357	208	438	3,711
CAPP	5,284	204	323	4,757

SECTION 4:

Monitoring Networks

SECTION 4: **Monitoring Networks**

4.1 Introduction to 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.

This section describes the existing monitoring networks within the Basin and includes an explanation of the implementation of the monitoring networks for the Carpinteria GSA's Plan and recommended improvements to the monitoring networks. Together, these monitoring networks will be able to track the GSA's progress toward achieving sustainability by documenting short-term, seasonal, and long-term trends in groundwater conditions. This section includes monitoring objectives, monitoring protocols, assessment and improvement of monitoring networks, representative monitoring sites, and data reporting requirements for each of the monitoring networks.

The monitoring networks presented in this section were developed based on existing sites monitored for decades by the Carpinteria Valley Water District (CVWD) (formerly the Carpinteria County Water District) prior to the passage of the Sustainable Groundwater Management Act (SGMA). During the 20-year Plan implementation period, it may be necessary to expand the existing monitoring networks to fully demonstrate sustainability and improve the Plan. Monitoring networks and data gaps are described for each of the six sustainability indicators. The data gaps will be addressed during Plan implementation to improve the Carpinteria GSA's ability to track progress and demonstrate sustainability.

The selection of wells used in the monitoring networks presented in this section draws on historical groundwater data compiled by the USGS, CVWD, CASGEM, and DWR. The criteria used to determine which wells to use in the monitoring networks are as follows:

- Period of record of historical measurements
- Available well construction information
- Spatial distribution relative to applicable sustainability indicators
- Groundwater use in proximity of wells
- Impacts on beneficial uses of groundwater in the Basin

4.2 Monitoring Network Objectives and Design Criteria

§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.

(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.

(2) Monitor impacts to the beneficial uses or users of groundwater.

(3) Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.

(4) Quantify annual changes in water budget components.

(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.

(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.

(2) Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.

(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) Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.

The objectives of the monitoring networks are to identify and select representative monitoring site (RMS) wells to collect data to support monitoring of groundwater conditions and detection of potential undesirable results, and to achieve the sustainability goal. As stated in the SGMA regulations, the monitoring networks will accomplish the following:

- "Demonstrate progress toward achieving measurable objectives described in this Plan.
- Monitor impacts to the beneficial uses or users of groundwater.
- Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.
- Quantify annual changes in water budget components."

The recommended monitoring networks for the Basin that are presented in this section are intended to monitor for the sustainability indicators and their associated undesirable results, which are listed below:

1. Chronic lowering of groundwater levels
2. Reduction of groundwater storage
3. Seawater intrusion
4. Degraded water quality
5. Land subsidence
6. Depletion of interconnected surface water

The approach for establishing the monitoring networks is to leverage historical or existing monitoring programs and incorporate, as needed, additional monitoring locations that have been made available by cooperating entities. The monitoring networks are limited to locations with data that are publicly available. The sections below include discussions of data gaps in each monitoring network and proposed locations and methods for filling those data gaps.

4.3 Existing Monitoring Networks

§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.

(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.

(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.

(c) The designation of a representative monitoring site shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area.

4.3.1 Groundwater Levels and Groundwater Quality

The SGMA regulations allow the Plan to use existing monitoring sites for the monitoring network. Monitoring of groundwater elevations in the Carpinteria Valley and within the Basin date back to the 1940s. Historical water level data were collected by the USGS and CVWD. In 1994, CVWD established a Groundwater Monitoring Program (GMP) pursuant to Assembly Bill (AB) 3030, which included collection of groundwater levels, groundwater and surface water quality data, precipitation data, and groundwater production data. The Basin GMP also established annual review of and reporting on the data collected. The well network first established through the GMP now includes all of the well types within the Basin, including municipal, private agricultural, and dedicated monitoring wells. A total of 69 wells are included in the existing monitoring networks for the Basin. Of these, 35 wells are monitored for water levels, 46 wells are monitored for basic water quality parameters, and 12 wells are monitored for both. As will be discussed in Section 4.4, several of these wells were selected as RMS wells for the sustainability indicators. Figure 4-1 presents the locations of the existing wells monitored for water levels in the Basin.

Water quality data are derived through the sampling of dedicated monitoring wells and at other selected wells throughout the Basin. Figure 4-1 presents the locations of the existing wells monitored for water quality. These wells have been monitored for total dissolved solids (TDS) and general chemistry (cation/anions) since 2000. Table 4-1 summarizes information for the existing monitoring well network.

Significant enhancements to the basin monitoring well network have been made in recent years. A cluster of three monitoring wells of discrete depths was drilled and installed in 2019 in the southwestern portion of SU-1 where the Rincon Creek Thrust Fault projects offshore and water bearing units of the Basin are believed to be possibly susceptible to seawater intrusion. These monitoring wells are identified as the Basin "Sentinel Wells," with MW-1, MW-2, and MW-3 completed discretely in the C, B, and A water bearing zones, respectively. Prior to the installation of these Sentinel Wells, the monitoring network did not include any wells that were suitably located or constructed with the purpose of early identification of seawater intrusion. A second cluster of depth-discrete monitoring wells, again completed in the A, B, and C zones, are currently scheduled to be installed in El Carro Park in the summer of 2023, near the central portion of the confined zone.

In April 2021, CVWD conducted an electrical resistivity tomography (ERT) investigation within the Basin. This investigation is discussed in detail in Section 3 of this GSP. The ERT surveys were part of a monitoring program to identify whether or not zones of elevated electrical conductivity exist, which may indicate the presence of seawater intrusion. The ERT profiles were located along the beach and within the Carpinteria Salt Marsh Reserve in the vicinity of the Basin, where it is believed there is vulnerability to seawater intrusion. While the investigation was inconclusive with respect to existing seawater intrusion, the ERT surveys provided a baseline of the subsurface electrical conductivity distribution for comparison with future ERT surveys for monitoring associated with the Plan. Four ERT profiles were collected along lines shown on Figure 3-35, and the ERT profile results are shown on Figures 3-36 through 3-39. Appendix E presents the full technical report documenting the survey.

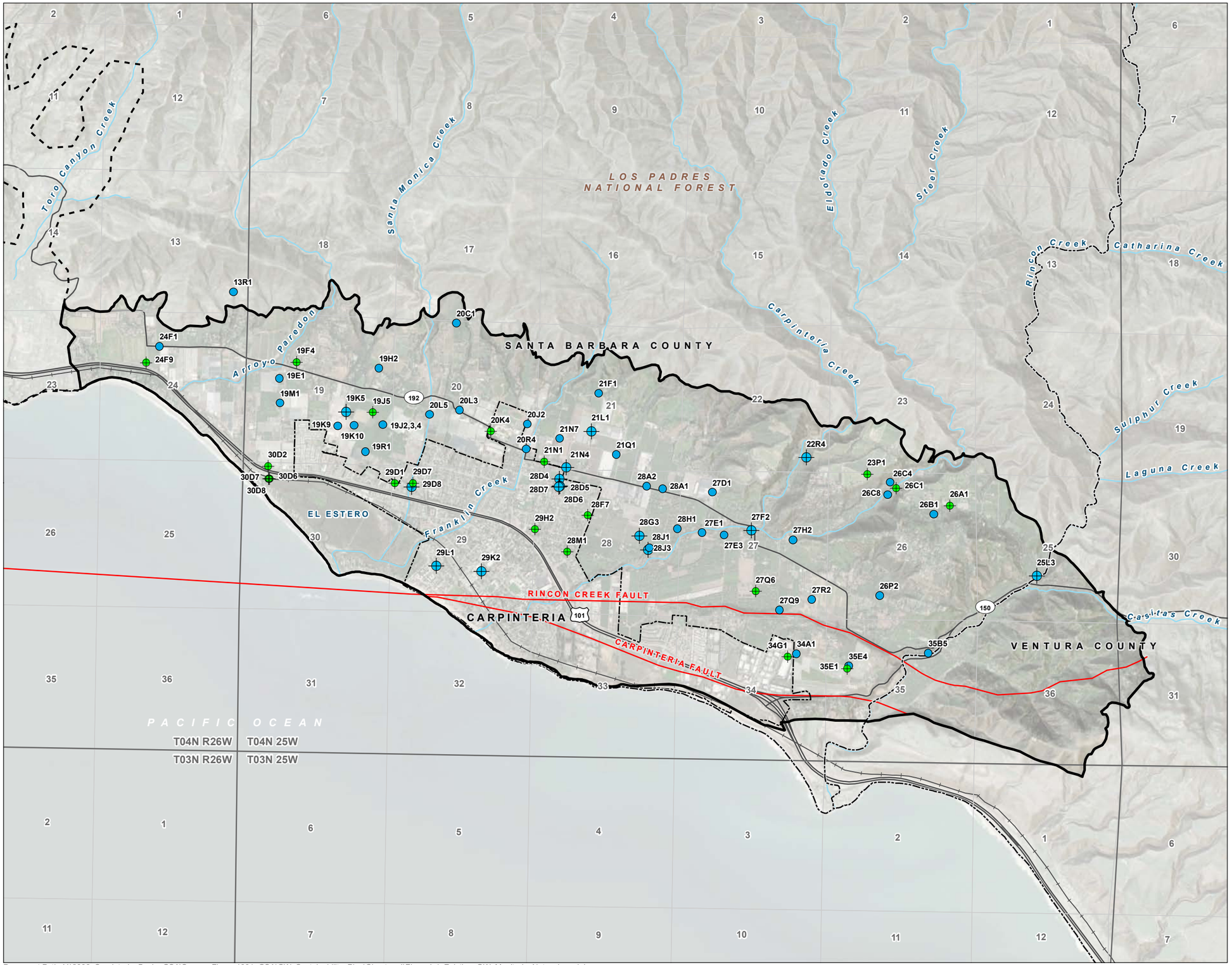


FIGURE 4-1

Existing Groundwater Monitoring Network

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Water Level Monitoring Well
- Water Quality and Water Level Monitoring Well
- Water Quality Monitoring Well
- Carpinteria Groundwater Basin

All Other Features

- City Boundary
- County Boundary
- Montecito Groundwater Basin
- Fault
- Railroad
- Major Road
- Watercourse

N

0 ½ 1
Miles

Date: November 20, 2023
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_4\Figure4-1_Existing_GW_MonitoringNetwork.mxd, iramos

Table 4-1. Existing Groundwater Monitoring Network Well Information Summary

Well Number	Short Name	Owner	Use[1]	Water Level Monitor	Water Quality Monitor	Year Drilled	Casing Depth (feet)	Water Level Data Start
4N/25W-19K5	19K5	Private	A	yes	yes	1921	98	1946
4N/25W-21L1	21L1	Private	A	yes	yes	1991	732	1992
4N/25W-21N4	21N4	Private	A	yes	yes	1947	406	1949
4N/25W-22R4	22R4	Private	A	yes	yes	1946	504	1949
4N/25W-25L3	25L3	Private	C	yes	yes	—	190	196
4N/25W-27F2	27F2	CVWD	A	yes	yes	1975	825	1975
4N/25W-28D4	28D4	CVWD	A	yes	yes	2010	1210	2010
4N/25W-28G3	28G3	Private	A	yes	yes	1994	300	1995
4N/25W-28J1	28J1	Private	I	yes	yes	1919	175	1940
4N/25W-29D8	29D8	CVWD	A	yes	yes	2002	958	2005
4N/25W-29K2	29K2	CVWD	M	yes	yes	1989	320	1992
4N/25W-29L1	29L1	Private	M	yes	yes	—	110	1946
4N/26W-13R1	13R1	Private	A	no	yes	1990	294	—
4N/25W-19E1	19E1	Private	A	no	yes	1992	400	—
4N/25W-19H2	19H2	Private	A	no	yes	2007	560	—
4N/25W-19J4	19J4	Private	A	no	yes	—	—	—
4N/25W-19K10	19K10	Private	A	no	yes	2017	602	—
4N/25W-19K9	19K9	Private	A	no	yes	—	—	—
4N/25W-19M1	19M1	Private	A	no	yes	—	204	—
4N/25W-19R1	19R1	Private	A	no	yes	—	146	—
4N/25W-20C1	20C1	Private	A	no	yes	2006	710	—
4N/25W-20J2	20J2	Private	A	no	yes	1984	377	—
4N/25W-20L3	20L3	Private	A	no	yes	1940	403	—
4N/25W-20L5	20L5	Private	A	no	yes	2008	860	—
4N/25W-20R4	20R4	Private	A	no	yes	1984	403	—
4N/25W-21F1	21F1	Private	I	no	yes	1991	450	—
4N/25W-21N7	21N7	Private	A	no	yes	2008	875	—
4N/25W-21Q1	21Q1	Private	A	no	yes	1991	740	—
4N/26W-24F1	24F1	Private	A	no	yes	1922	146	—
4N/25W-26B1	26B1	Private	A	no	yes	1944	552	—
4N/25W-26C4	26C4	Private	A	no	yes	1947	586	—
4N/25W-26C8	26C8	Private	A	no	yes	1947	360	—
4N/25W-26P2	26P2	Private	A	no	yes	1990	350	—
4N/25W-27D1	27D1	Private	A	no	yes	1990	870	—
4N/25W-27E1	27E1	Private	A	no	yes	1930	280	—
4N/25W-27E3	27E3	Private	A	no	yes	2016	805	—
4N/25W-27H2	27H2	Private	A	no	yes	2016	515	—
4N/25W-27Q9	27Q9	Private	A	no	yes	2003	800	—
4N/25W-27R2	27R2	Private	A	no	yes	—	421	—
4N/25W-28A1	28A1	Private	A	no	yes	1990	580	—
4N/25W-28A2	28A2	Private	A	no	yes	2017	800	—
4N/25W-28H1	28H1	Private	A	no	yes	1992	500	—
4N/25W-28J3	28J3	Private	A	no	yes	2016	860	—
4N/25W-34A1	34A1	Private	A	no	yes	—	250	—
4N/25W-35B5	35B5	Private	A	no	yes	1990	280	—
4N/25W-35E4	35E4	Private	A	no	yes	2002	460	—
4N/25W-19F4	19F4	Private	M	yes	no	1929	250	1941
4N/25W-19J5	19J5	Private	M	yes	no	1939	100	1941
4N/25W-20K4	20K4	CVWD	I	yes	no	1989	903	1989
4N/25W-21N1	21N1	Private	I	yes	no	1936	405	1938
4N/25W-23P1	23P1	Private	I	yes	no	1945	465	1948
4N/26W-24F9	24F9	Private	A	yes	no	1990	440	2022
4N/25W-26A1	26A1	Private	M	yes	no	1941	480	1946
4N/25W-26C1	26C1	Private	M	yes	no	—	250	1949
4N/25W-27Q6	27Q6	Private	M	yes	no	—	580	1989
4N/25W-28F7	28F7	CVWD	I	yes	no	1976	1100	1976
4N/25W-28M1	28M1	Private	M	yes	no	—	152	1941
4N/25W-29D1	29D1	Private	M	yes	no	—	147	1938
4N/25W-29D7	29D7	CVWD	DM	yes	no	1972	982	1977
4N/25W-29H2	29H2	Private	M	yes	no	1912	98	1941

Well Number	Short Name	Owner	Use[1]	Water Level Monitor	Water Quality Monitor	Year Drilled	Casing Depth (feet)	Water Level Data Start
4N/25W-30D2	30D2	Private	M	yes	no	1947	232	2015
4N/25W-34G1	34G1	Private	M	yes	no	1990	278	1991
4N/25W-35E1	35E1	Private	M	yes	no	1939	385	1949
4N/25W-28D5	28D5	CGSA	DM	yes	no	2023	1040	2023
4N/25W-28D6	28D6	CGSA	DM	yes	no	2023	925	2023
4N/25W-28D7	28D7	CGSA	DM	yes	no	2023	360	2023
4N/25W-30D6	30D6	CGSA	DM	yes	no	2019	1130	2019
4N/25W-30D7	30D7	CGSA	DM	yes	no	2019	870	2019
4N/25W-30D8	30D8	CGSA	DM	yes	no	2019	340	2019

Notes

[1] Use categories: A – Active production well; I – Inactive production well; M – Monitoring well; DM – Dedicated monitoring well

— = not applicable

CGSA = Carpinteria Groundwater Sustainability Agency

CVWD = Carpinteria Valley Water District

4.3.2 Streamflow Monitoring Network

In addition to groundwater samples, surface water samples are collected at six locations (i.e., Toro Creek, Arroyo Paredon Creek, Santa Monica Creek, Carpinteria Creek, Gobernador Creek, and Rincon Creek) (see Figure 4-2) when surface water flows occur during the sampling periods. The laboratory analytical program for the samples includes TDS and basic inorganic chemical constituents, including chloride and nitrates. Staff from CVWD perform the water quality sampling.

Until recently, there was only one active stream gage in the Basin with a significant period of record. The USGS Carpinteria Creek gage (Gage no. 11119500) is located immediately downstream of the confluence of Gobernador and Carpinteria Creeks (see Figure 4-2). This gage has a period of record from January 1941 through the current period, and data is available through the USGS National Water Information System (NWIS) web interface.

DWR installed a second streamflow gage on Carpinteria Creek in November 2021. The gage was installed as part of an outreach effort by SGMA's technical assistance team to install stream gaging stations in key groundwater basins in Southern California. The DWR Station ID for this gage is CPA, and it is located at the Calle Ocho Footbridge southwest of Carpinteria Avenue. Data from the Calle Ocho gage is available on DWR's California Data Exchange Center (CDEC); however, the gage has yet to be calibrated and placed into operation.

Researchers at the National Oceanic and Atmospheric Administration (NOAA) National Severe Storms Laboratory installed a non-contact stream gage on Rincon Creek in 2017. The gage was installed as part of NOAA's Automated Non-Contact Hydrologic Observations in Rivers (ANCHOR) project. The project focused on three non-contact technologies to improve the observational and monitoring capabilities in rivers: streamflow radar, scanning light detection and radar (LiDAR), and interferometric stream radar (ISRad). The gage on Rincon Creek used the LiDAR to measure speed, depth, and the flow rate. NOAA has compared discharge rates using this technology to USGS stream flow gages and determined them to be within 10 percent of the conventional gages. The ANCHOR project has been completed, but it has been confirmed that the LiDAR unit is still in place on Rincon Creek (as of September 23, 2022). NOAA researchers have indicated a willingness to assist the Carpinteria GSA in restoring the functionality of the gage for use in the Plan at nominal costs.[3] Reactivation of the LIDAR gage is not part of the monitoring network at this time but may be added later.

Precipitation data for the Basin is provided through the SBCFCD's gage at the Carpinteria Fire Station (SBCFCD Station No. 208). A period of recorded data from 1949 to the present exists for Gage No. 208. Precipitation data are available at the SBCFCD's website.[4] Figure 4-2 shows the locations of the streamflow gaging stations and the SBCFCD rain gage.

[3] Personal communication, J.J. Gourley, NOAA, September 28, 2022.
[4] County of Santa Barbara Public Works. Monthly & Yearly Rainfall. Available at https://www.countyofsb.org/2322/Monthly-Yearly-Rainfall.

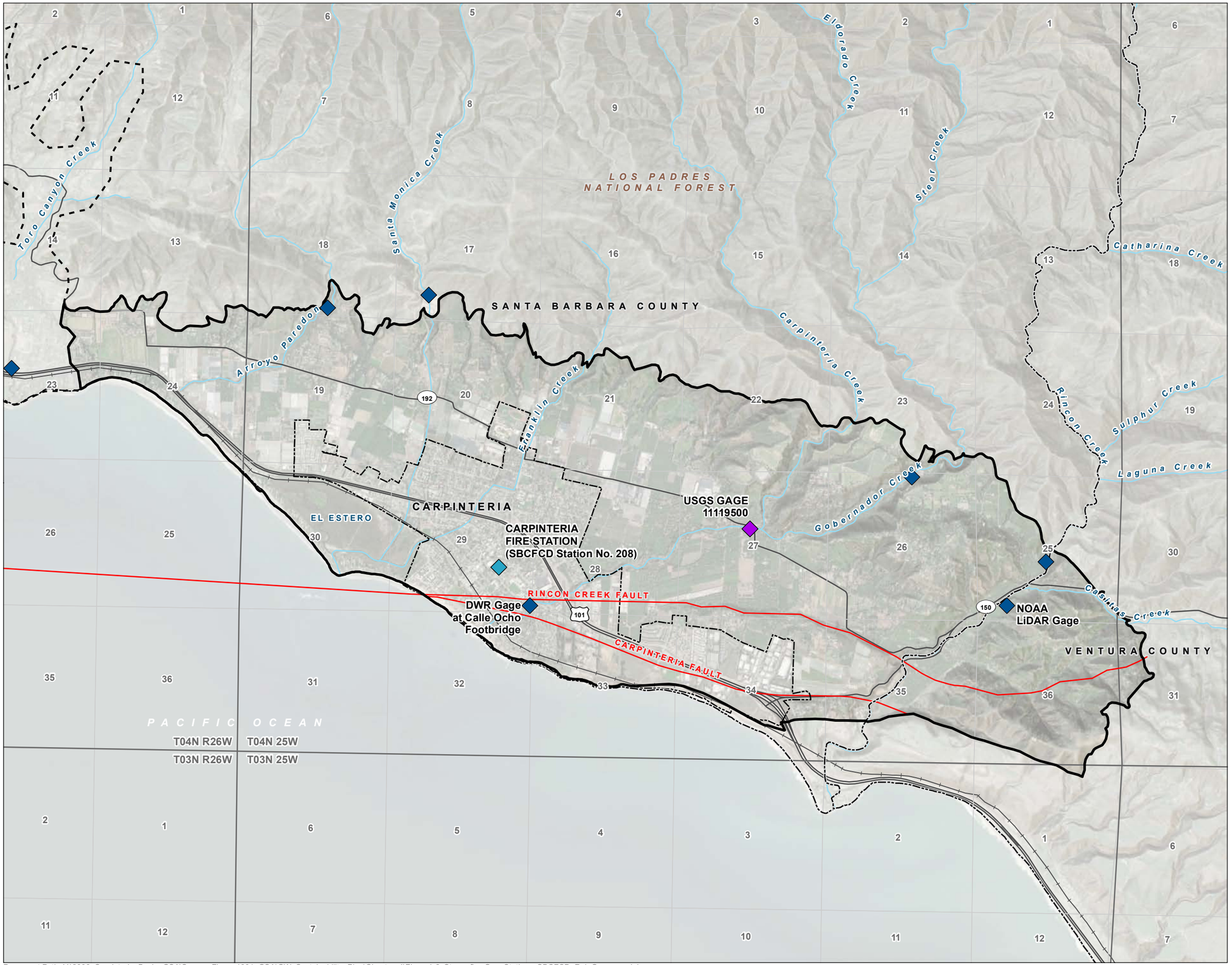


FIGURE 4-2

Existing Surface Water Monitoring Network

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Precipitation Station
- Surface Water Sample Location
- USGS Stream Gage
- Carpinteria Groundwater Basin

All Other Features

- City Boundary
- County Boundary
- Montecito Groundwater Basin
- Fault
- Railroad
- Major Road
- Watercourse

NOTES

SBCFCD: Santa Barbara County Flood Control District
USGS: United States Geological Survey

N

0 ½ 1
Miles

Date: November 20, 2023
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118, Pueblo Water Resources (2022)

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_4\Figure4-2_StreamflowGageStations_SBCFCD_RainGauge.mxd, iramos

4.4 Sustainability Indicator Monitoring Networks

§354.34 Monitoring Network.

(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.

(g) Each Plan shall describe the following information about the monitoring network:

(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.

(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.

(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.

A total of 35 wells are proposed for monitoring water level conditions within the Basin (see Figure 4-1). SGMA's best management practices (BMPs) document for water level monitoring networks recommends that for basins like the Carpinteria Basin, where pumping is between 1,000 and 10,000 AFY, there should be a density of two wells per 100 square miles (DWR, 2016b). The well density for the basin water level monitoring network significantly exceeds the BMP recommendation. There are 2.25 water level monitoring wells and water quality monitoring wells per square mile within the Basin. Table 4-1 presents a summary of information pertaining to these wells.

The proposed monitoring wells include active and inactive CVWD production wells, active and inactive private agricultural wells, and dedicated monitoring wells. The wells are spatially distributed throughout the confined and recharge areas of the Basin. Most of these wells have been monitored by CVWD prior to and during the AB 3030 GMP. CVWD continues to monitor water levels in these wells in the interim period between the termination of the AB 3030 program and implementation of the Plan and will continue to do so on behalf of the Carpinteria GSA. In recent years, CVWD and the Carpinteria GSA have made significant enhancements to the monitoring well network by drilling and installing two monitoring well clusters, with three wells each at depth discrete completion zones, which allow for monitoring in the upper, middle, and deepest portions of the Basin. The Sentinel Well cluster was installed in 2019, and the El Carro Park monitoring well cluster was installed in fall of 2023.

4.4.1 Chronic Lowering of Groundwater Levels

§354.34 Monitoring Network.

(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.

(B) Static groundwater elevation measurements shall be collected at least two times per year, to represent seasonal low and seasonal high groundwater conditions.

(g) Each Plan shall describe the following information about the monitoring network:

(1) Scientific rationale for the monitoring site selection process.

(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.

The SGMA regulations require a network of monitoring wells sufficient to demonstrate groundwater occurrence, flow directions, and vertical hydraulic gradients. To the degree possible, the four factors of (1) groundwater use, (2) aquifer characteristics that affect groundwater flow, (3) impacts to beneficial uses and users, and (4) adequate monitoring results to demonstrate an understanding of aquifer response, were central to the development of the water level monitoring network, within the limits of the available data.

To monitor conditions related to chronic lowering of groundwater levels, the groundwater monitoring network must be structured to accomplish the following:

- Track short-term, seasonal, and long-term trends in water elevation.
- Demonstrate groundwater elevations in mid-March and mid-October for the principal aquifer.
- Record groundwater elevations in key wells in which minimum thresholds and measurable objectives have been identified to track progress toward the sustainability goals for the Basin.

It is preferable that wells in the water level monitoring network be dedicated monitoring wells, but this is not always feasible. Municipal and agricultural wells are also used, and the data collected from such wells is screened so that pumping and residual drawdown-impacted water levels do not become part of the record. It is also important and preferable that well depth and construction details of the wells in the monitoring network are known and documented to ensure that the construction features and well depths do not compromise the data collected. As shown in Table 4-1, some of the well completion information is missing from wells included in the network. For consistency with past monitoring and for the sake of continuity with historical monitoring, the wells were included and well construction details will be ascertained (via video

surveys) if possible as part of GSP implementation. If well construction details cannot be ascertained, the Carpinteria GSA will consider whether a replacement monitoring site is needed.

The following criteria were considered in selecting wells for the water level RMS monitoring network:

- The well is part of an existing monitoring network
- The well was completed in a principal aquifer
- The well has is part of a network with adequate spatial coverage
- The position of the well with respect to upgradient and downgradient conditions
- The suitability of the well for tracking sustainability goals
- The available access for monitoring the well

Figure 4-3 presents the Basin RMS monitoring network for the chronic lowering of groundwater level sustainability indicator. Table 4-2 presents pertinent data for the nine water level and storage reduction RMS wells. These wells were selected based on spatial distribution within the Basin, acceptable period of record for historical data, access, and suitability for monitoring sustainability goals. Additional detail on these wells is provided in Section 5 in the discussion of sustainability management criteria (SMCs).

Table 4-2. Summary of Water Level and Storage Reduction RMS Wells

Well Number	Short Name	Owner	Use[1]	Year Drilled	Drilled Depth (feet)	Casing Depth (feet)	Log Type[2]	Water Level Data Start
4N/25W-19F4	19F4	Private	M	1930	250	Unknown	—	1941
4N/25W-20K4	20K4	CVWD	I	1989	1,988	903	D	1989
4N/25W-21L1	21L1	Private	A	1991	810	732	DE	1992
4N/25W-26A1	26A1	Private	M	1941	228 vs 480?	Unknown	D	1946
4N/25W-27F2	27F2	CVWD	A	1975	1,150	825	DE	1975
4N/25W-28F7	28F7	CVWD	A	1976	1,271	1,240/980	DE	1976
4N/25W-28J1	28J1	Private	A	1919	175	175	D	1940
4N/25W-29D7	29D7	CVWD	DM	1972	982	950	DE	1977
4N/25W-34G1	34G1	Private	M	1990	279	278	D	1991

Notes

[1] Use categories: A – Active production well; I – Inactive production well; M – Monitoring well; DM – Dedicated monitoring well

[2] Log type: D – Driller; E – E-log

— = not applicable

CVWD = Carpinteria Valley Water District

RMS = representative monitoring site

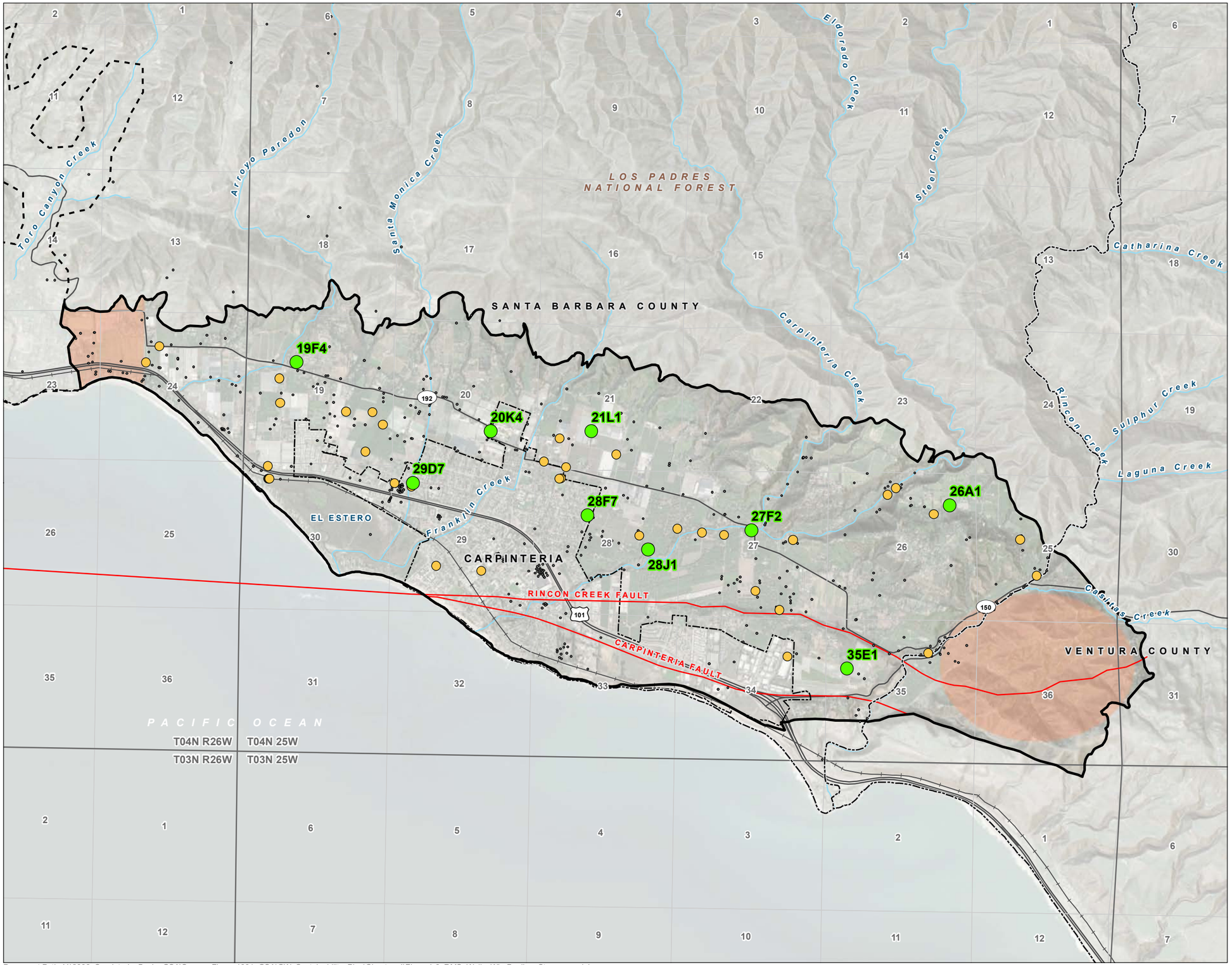


FIGURE 4-3

RMS Wells for Water Level Decline and Reduction of Storage

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Water Level RMS Well
- GSA Monitoring Well
- GSA Database Well
- Data Gap Area
- Carpinteria Groundwater Basin

All Other Features

- City Boundary
- County Boundary
- Montecito Groundwater Basin
- Fault
- Railroad
- Major Road
- Watercourse

NOTES

GSA: Groundwater Sustainability Agency
RMS: representative monitoring well

N

0 ½ 1
Miles

Date: November 20, 2023
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_4\Figure4-3_RMS_Wells_WL_Decline_Storage.mxd, iramos

4.4.1.1 Monitoring Protocols

§354.34 Monitoring Network.

(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.

The Carpinteria GSA selected monitoring protocols using guidelines in the SGMA regulations and BMPs published by DWR on monitoring protocols (DWR, 2010, 2016b). Appendix G contains monitoring protocols and data collection methods for groundwater level monitoring. These protocols incorporate SGMA BMPs, USGS data collection methods, and published CASGEM protocols.

Since completion of the Sentinel Well project, induction logs have been recorded on the deepest of the three Sentinel Wells (Sentinel Well MW-1) on a quarterly basis. The induction logs allow for assessment and tracking of the electrical conductivity (a measure of salinity) of all of the strata penetrated by the well and act as a comparative tool to monitor for the onset of seawater intrusion.

4.4.1.2 Assessment and Improvement of Monitoring Network

§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.

(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.

(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.

(2) Local issues and circumstances that limit or prevent monitoring.

(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.

(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.

(2) Highly variable spatial or temporal conditions.

(3) Adverse impacts to beneficial uses and users of groundwater.

(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.

This section summarizes several portions of the groundwater level monitoring network that constitute data gaps, focused primarily on those data gaps that could affect the ability of the Plan to achieve the sustainability goal. Per the SGMA regulations, a "'data gap' refers to a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation, and could limit the ability to assess whether a basin is being sustainably managed."

The following improvements would enhance the water level monitoring network:

1. **Collect information regarding well construction.** As shown in Table 4-1, there is missing well completion data for several of the wells in the monitoring network. As part of the Plan, the Carpinteria GSA should endeavor to eliminate unknown information about the wells by performing video surveys as funds and availability for access allow. At a minimum, it may be possible to determine the depth of the well casing with a depth sounder. Such activities would have to be coordinated with well owners.

2. **Install additional dedicated, depth-discrete well clusters.** The installation of the Sentinel Wells and the El Carro Park Monitoring Wells have improved the monitoring well network substantially. The Carpinteria GSA has plans to install additional depth-discrete monitor well clusters along the coast. This is discussed in Section 4.4.3.

3. **Install additional monitoring wells where data gaps exist.** The historical service area of CVWD, and the area referenced in the AB 3030 monitoring, does not include the western part of the Basin bordering the MGB or the eastern part of the Basin in Ventura County. Therefore, these areas do not have the same historical period of record as the wells in the central portion of the Basin. It is anticipated that wells will be identified in these areas to collect water level data during the SGMA implementation period.

4.4.2 Reduction of Groundwater Storage

§354.34 Monitoring Network.

(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.

(g) Each Plan shall describe the following information about the monitoring network:

(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.

(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.

(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.

Groundwater storage and water levels are directly correlated. Chronic lowering of groundwater levels is an indication of the Reduction of Groundwater Storage sustainability indicator. Change in groundwater storage will be monitored using the overall monitoring network presented in Figure 4-1 and Table 4-1, while the selected representative wells displayed in Figure 4-3 and detailed in Table 4-2 will be used to track the sustainability indicator reduction of groundwater storage.

4.4.2.1 Attainment of Monitoring Objectives and Other Requirements

§354.34 Monitoring Network.

(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:

(2) Reduction of Groundwater Storage. Provide an estimate of the change in annual groundwater in storage.

(g) Each Plan shall describe the following information about the monitoring network:

(1) Scientific rationale for the monitoring site selection process.

(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.

The requirements for documenting reduction in groundwater storage are similar to those for chronic lowering of groundwater levels, because these two sustainability indicators are interrelated. The 31 wells in the existing monitoring network will be used to contour groundwater elevations. The Carpinteria GSA will continue to use the existing groundwater level monitoring network to monitor conditions related to reduction of groundwater storage. The spatial and temporal density of groundwater elevation data necessary to document groundwater storage changes in the aquifers of the Basin is the same as that necessary to document groundwater elevation changes. The current network of wells is capable of documenting changes to both sustainability indicators.

4.4.2.2 Monitoring Protocols

§354.34 Monitoring Network.

(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.

The groundwater level monitoring network will be used to address the groundwater storage monitoring network needs. Therefore, the protocols described in Appendix G for the groundwater level monitoring network are applicable to the groundwater storage monitoring network.

4.4.2.3 Assessment and Improvement of Monitoring Network

§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.

(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.

(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.

(2) Local issues and circumstances that limit or prevent monitoring.

(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.

(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.

(2) Highly variable spatial or temporal conditions.

(3) Adverse impacts to beneficial uses and users of groundwater.

(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.

As has been demonstrated in the past, spatial and temporal density of the existing monitoring network is sufficient for determination of groundwater storage changes in the Basin. Nonetheless, the recommended improvement to the water level monitoring network of installing additional depth-discrete monitoring well clusters along the coast in the northwestern portion of the Basin also applies to the groundwater storage monitoring network. Additionally, the data gaps regarding a lack of monitoring wells identified in Ventura County and near the boundary with the MGB will also be addressed during the SGMA implementation period.

4.4.3 Seawater Intrusion Monitoring Network

§354.34 Monitoring Network.

(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.

(g) Each Plan shall describe the following information about the monitoring network:

(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.

(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.

(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.

Seawater intrusion into the Basin is considered one of the primary threats to groundwater resources with the potential to negatively impact beneficial uses and users. As discussed in Section 3, the primary producing zones of SU-1 north of the Rincon Creek Fault and in the vicinity of Serena Park are believed to be exposed to the Pacific Ocean and, therefore, are at potential risk for seawater intrusion.

Figure 4-4 presents the 8 RMS wells for the seawater intrusion sustainability indicator. A line connecting these wells represents the location of the chloride isocontour required as the SMC for seawater intrusion in the SGMA regulations. Additional depth-discrete monitor wells are planned along the coast in the general locations displayed on Figure 4-4. Additional discussions of the minimum thresholds and measurable objectives, as well as rationale for these RMS well locations, are presented in Section 5. Table 4-3 presents known information on the construction details of the 8 seawater intrusion RMS wells.

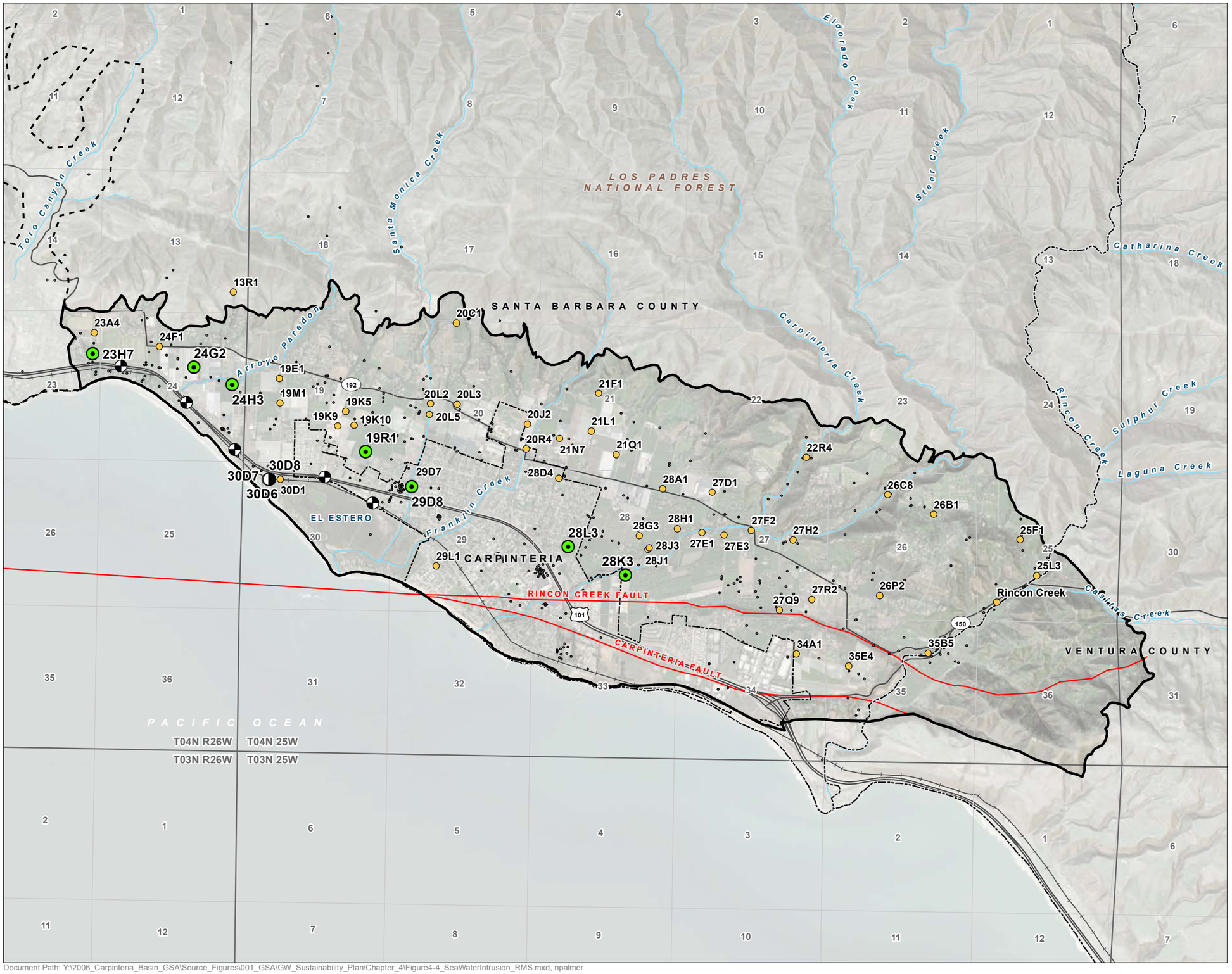


FIGURE 4-4

RMS Wells for Seawater Intrusion Monitoring

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Seawater Intrusion RMS Well
- Existing Monitoring Well
- Proposed Seawater Intrusion Monitor Well
- Water Quality Monitoring Well
- GSA Database Well

All Other Features

- City Boundary
- County Boundary
- Carpinteria Groundwater Basin
- Montecito Groundwater Basin
- Fault
- Railroad
- Major Road
- Watercourse

NOTES

GSA: Groundwater Sustainability Agency
RMS: representative monitoring well

N

0 ½ 1
Miles

Date: November 21, 2023
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_4\Figure4-4_SeaWaterIntrusion_RMS.mxd, npalmer

Table 4-3. Summary of Seawater Intrusion RMS Wells

Well Number	Short Name	Owner	Use[1]	Year Drilled	Drilled Depth (feet)	Casing Depth (feet)	Log Type[2]
4N/26W-23H7	23H7	Private	I	Unknown	Unknown	Unknown	—
4N/26W-24G2	24G2	Private	A	1990	450	Unknown	—
4N/25W-19M5	19M5	Private	—	Unknown	Unknown	Unknown	—
4N/25W-19P1	19P1	Private	A	2006	330	230	—
4N/25W-19R1	19R1	Private	A	Unknown	146	Unknown	—
4N/25W-29D8	29D8	CVWD	A	2002	978	958	DE
4N/25W-28L3	28L3	Private	I	Unknown	150	Unknown	—
4N/25W-28K3	28K3	Private	I	1993	505	500	—

Notes

[1] Use categories: A – Active production well; I – Inactive production well; M – Monitoring well; DM – Dedicated monitoring well

[2] Log type: D – Driller; E – E-log

— = not applicable

CVWD = Carpinteria Valley Water District

RMS = representative monitoring site

4.4.3.1 Attainment of Monitoring Objectives and Other Requirements

§354.34 Monitoring Network.

(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:

(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.

(g) Each Plan shall describe the following information about the monitoring network:

(1) Scientific rationale for the monitoring site selection process.

(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.

Monitoring objectives will be attained through regular collection of water quality samples from both the existing seawater intrusion monitoring wells (i.e., Sentinel Wells) and the RMS wells displayed in Figure 4-4.

In 2019, CVWD installed the sentinel monitoring well cluster near the northwestern margin of the Carpinteria Salt Marsh (El Estero), a location considered to be key for the collection of water level and water quality data related to evaluating the potential for seawater intrusion in the Basin. The installation and data collection from the Sentinel Wells is discussed in detail in Section 3 of this GSP.

The GSA has already applied for grant funding to install additional depth-discrete monitor well clusters at locations along the coast (see Figure 4-4). These will be included in the monitoring network for seawater intrusion in the Basin. The monitoring network for seawater intrusion has been established by the Carpinteria GSA and includes:

1. Continuous water level monitoring of the Sentinel Well cluster wells using pressure transducers and data loggers, with quarterly downloads of data and verification of transducer data by manual water level measurements.
2. Quarterly sampling of the Sentinel Wells and analysis for general mineral constituents, including chlorides and electrical conductivities.
3. Induction logging of the deepest Sentinel Well (MW-1) on a quarterly basis.
4. Repetition of the ERT surveying on a 5-year basis (with expanded lines to the northwest).

4.4.3.2 Monitoring Protocols

§354.34 Monitoring Network.

(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.

The BMPs for seawater intrusion monitoring specify that the protocols for the measurement of water levels and the collection and analysis of water quality samples should be adopted. Appendix G includes protocols for collection of water levels and water quality sampling. Additionally, while no specific protocols are described for geophysical techniques related to the identification and mapping of seawater intrusion, the BMPs indicate that professional judgement should be used to determine which geophysical methods are appropriate. The use of ERT surveys and induction surveys satisfy this general recommendation.

4.4.3.3 Assessment and Improvement of Monitoring Network

§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.

(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.

(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.

(2) Local issues and circumstances that limit or prevent monitoring.

(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.

(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.

(2) Highly variable spatial or temporal conditions.

(3) Adverse impacts to beneficial uses and users of groundwater.

(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.

The Sentinel Wells are the only depth discrete monitoring wells that are completed through the full thickness of basin aquifer materials in the Basin most vulnerable to seawater intrusion. Plans are in place to expand the seawater intrusion monitoring well network to new locations along the coast (see Figure 4-4). Discussions have already occurred, and potential well sites have been preliminarily screened for expansion of the well network in this localized portion of the Basin. Final site selection has not yet been completed, but additional monitoring well clusters are necessary to enhance monitoring for seawater intrusion in this susceptible portion of the Basin.

The possibility and utility of installing single wells dedicated solely for induction surveys, and completed through the entire thickness of the Basin, has also been considered. A single deep well completion would be less impactful and less expensive than a conventional three-well cluster, while still allowing for the collection of important and meaningful data. Therefore, for the cost of one three-well cluster, perhaps two or three deep, single casing wells could be constructed at various locations.

Repeated ERT surveys may be considered on an expanded network to improve the overall understanding, considering the stark contrast in electrical conductivities between the two existing ERT profiles.

4.4.4 Degraded Water Quality Monitoring Network

§354.34 Monitoring Network.

(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.

(g) Each Plan shall describe the following information about the monitoring network:

(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.

(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.

(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.

The groundwater quality monitoring network is intended to track long-term trends in water quality that may impact beneficial uses and users. This monitoring network will allow the Carpinteria GSA to address water quality issues should any trends toward degraded water quality caused by groundwater extraction or Plan implementation projects be identified.

4.4.4.1 Attainment of Monitoring Objectives and Other Requirements

§354.34 Monitoring Network.

(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:

(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.

(g) Each Plan shall describe the following information about the monitoring network:

(1) Scientific rationale for the monitoring site selection process.

(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.

Groundwater quality within the Basin has historically been monitored as part of CVWD's AB 3030 GMP program through the analysis of samples collected from 38 wells located throughout the Basin (see Figure 4-1). The laboratory analytical program for the samples includes TDS and basic inorganic chemical constituents, including chloride and nitrates. A detailed discussion of water quality within the Basin, including water quality characterization and identified trends, is provided in Section 3.1.3.3.

It is recommended that the Carpinteria GSA continue to track water quality using the existing groundwater monitoring network. Table 4-1 identifies existing water quality monitoring wells, and Figure 4-1 shows the locations of these wells. The existing groundwater quality data, and data to be derived through Plan implementation will be used to assess existing or future water quality trends and determine whether degradation of groundwater quality is caused by groundwater extractions and is, hence, a sustainability issue that must be addressed by the Carpinteria GSA.

Figure 4-5 presents the 14 wells selected as RMS wells for the water quality degradation sustainability indicator. Table 4-4 presents pertinent details regarding these 14 wells. Additional discussion regarding the rationale for selection of these wells, and recommended SMCs for degradation of water quality, are included in Section 5.

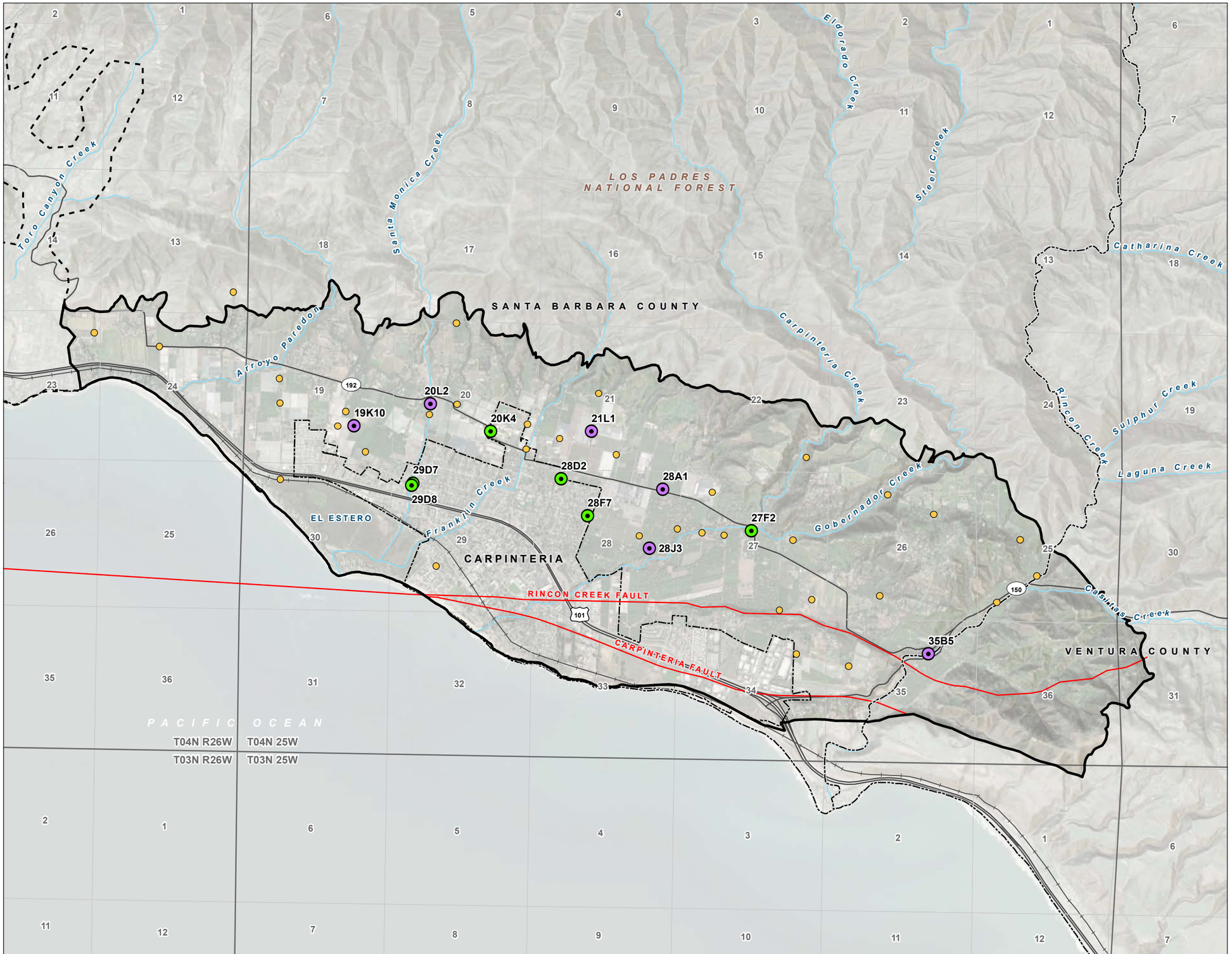


FIGURE 4-5

RMS Wells for Water Quality Degradation

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- Chloride, Boron, and TDS RMS Well
- Arsenic and Nitrate RMS Well
- Water Quality Monitoring Well
- Carpinteria Groundwater Basin

All Other Features

- City Boundary
- County Boundary
- Montecito Groundwater Basin
- Fault
- Railroad
- Major Road
- Watercourse

NOTES

GSA: Groundwater Sustainability Agency
RMS: representative monitoring well

N

0 ½ 1
Miles

Date: November 20, 2023
Data Sources: BLM, ESRI, USGS, Maxary Imagery (2020), DWR Bulletin 118

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_4\Figure4-5_RMS_Wells_WQ_Degradation.mxd, iramos

Table 4-4. Summary of RMS Wells for Water Quality Degradation

Well Number	Short Name	Owner	Use[1]	Water Quality Constituents	Year Drilled	Drilled Depth (feet)	Casing Depth (feet)	Log Type[2]
4N/25W-19K10	19K10	Private	A	Chloride, Boron, TDS	2017	602	602	—
4N/25W-20K4	20K4	CVWD	I	Arsenic and Nitrate	1989	1988	903	D
4N/25W-20L2	20L2	Private	I	Chloride, Boron, TDS	Unknown	434	Unknown	—
4N/25W-21L1	21L1	Private	A	Chloride, Boron, TDS	1991	810	732	DE
4N/25W-27F2	27F2	CVWD	A	Arsenic and Nitrate	1975	1150	825	DE
4N/25W-28D4	28D4	CVWD	A	Arsenic and Nitrate	2010	1220	1210	DE
4N/25W-28D5,6,7	28D5,6,7	CGSA	DM	Chloride, Boron, TDS	2023	1240	360, 925, 1040	DE
4N/25W-28F7	28F7	CVWD	A	Arsenic and Nitrate	1976	1271	1240/980	DE
4N/25W-28J1	28J1	Private	A	Chloride, Boron, TDS	1919	175	175	D
4N/25W-29D7	29D7	CVWD	A	Arsenic and Nitrate	1972	982	950	DE
4N/25W-29D8	29D8	CVWD	A	Arsenic and Nitrate	2002	978	958	DE
4N/25W-35B5	35B5	Private	A	Chloride, Boron, TDS	1990	285	280	D

Notes

[1] Use categories: A – Active production well; I – Inactive production well; M – Monitoring well; DM – Dedicated monitoring well

[2] Log type: D – Driller; E – E-log

— = not applicable

CGSA = Carpinteria Groundwater Sustainability Agency

CVWD = Carpinteria Valley Water District

RMS = representative monitoring site

TDS = total dissolved solids

4.4.4.2 Monitoring Protocols

§354.34 Monitoring Network.

(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.

CVWD staff have developed and implemented standard protocols for the purging and sampling of wells for water quality analysis. The protocols include documentation of well conditions, casing volumes, and required purge volumes; measurement and documentation of field water quality parameters (to document water quality stabilization); sample collection, handling, and identification; and chain-of-custody documentation. The Sampling and Analysis Plan (SAP) was developed in 2019 for specific application for water quality sampling of the Sentinel Wells and will be adopted for Carpinteria GSA sampling of all monitoring wells. The current sampling protocols and the SAP are consistent with the protocols for sampling groundwater quality provided in the BMP (DWR, 2016b). The SAP is included in Appendix G.

4.4.4.3 Assessment and Improvement of Monitoring Network

§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.

(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.

(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.

(2) Local issues and circumstances that limit or prevent monitoring.

(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.

(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.

(2) Highly variable spatial or temporal conditions.

(3) Adverse impacts to beneficial uses and users of groundwater.

(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.

The spatial distribution of existing groundwater quality monitoring wells across the Basin is sufficient to monitor and track water quality conditions. There is a minimum of one monitoring well in most sections of the Basin, excluding peripheral areas where no monitoring wells exist. Where feasible, water quality monitoring will be added to any wells added to the other monitoring networks in the portions of SU-1 that are deemed susceptible to potential seawater intrusion. The Carpinteria GSA will evaluate whether to add groundwater quality monitoring concurrent with the addition of any wells that may be added to the groundwater levels monitoring network in the interior portions of the Basin. Additional water quality monitoring wells would be considered an improvement to the Plan, not a filling of a data gap.

4.4.5 Land Subsidence Monitoring Network

§354.34 Monitoring Network.

(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.

(g) Each Plan shall describe the following information about the monitoring network:

(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.

(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.

(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.

Land subsidence has been observed in numerous areas throughout California for many decades. Subsidence is the gradual (or sudden) lowering of the land surface. One of the mechanisms that may lead to subsidence is aquifer matrix compaction caused by the withdrawal of groundwater. Subsidence-related impacts due to groundwater pumping have not been historically observed in the Basin.

No monitor well network is proposed to monitor land subsidence in the Basin. Subsidence will be monitored using satellite data curated by DWR, as discussed in Section 5.

4.4.5.1 Attainment of Monitoring Objectives and Other Requirements

§354.34 Monitoring Network.

(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:

(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.

(g) Each Plan shall describe the following information about the monitoring network:

(1) Scientific rationale for the monitoring site selection process.

(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.

Ground surface elevation monitoring has been conducted since 2015 for the Basin using remote sensing Interferometric Synthetic Aperture Radar (InSAR) data, which tracks vertical elevation changes and is used to measure total vertical displacement of the land surface. These satellite data are collected by the European Space Agency and processed by TRE ALTAMIRA under contract with DWR. Since June 2015, InSAR data and interferograms for numerous medium- and high-priority basins throughout California, including the Basin, have been made publicly available monthly (TRE ALTAMIRA, 2023). These data are used to evaluate and estimate monthly and annual land surface elevation changes since data collection was initiated in 2015.

Numerous boreholes drilled for the construction of water production wells and monitoring wells have penetrated the full thickness of the basin aquifers. State of California Professional Hydrogeologists and Certified Hydrogeologists have professionally logged these boreholes. The geologic properties and depositional structure of the aquifer materials present indicate that land subsidence due to groundwater withdrawal in the Basin is unlikely. Even though low or near low water level conditions occurred in the Basin in the early 1950s and early 1990s, and during the recent drought period, subsidence-related impacts to infrastructure (e.g., roads, bridges, pipelines, channels, power grid, etc.) have not been historically observed in the Basin (personal communications: Scott McGolpin, Public Works Director, County of Santa Barbara, September 20, 2022; Brian King, District Engineer, Carpinteria Valley Water District, September 20, 2022).

Based on these findings, a direct-measurement monitoring network for potential land subsidence is not recommended for the Plan. However, ground surface elevation monitoring using InSAR data will be implemented. Available InSAR coverage for the Basin is deemed sufficient and will be evaluated for indications of ongoing or permanent land subsidence.

4.4.5.2 Monitoring Protocols

§354.34 Monitoring Network.

(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.

The DWR BMP notes that no standard operating procedures exist for collecting land subsidence data (DWR, 2016b). DWR InSAR data will continue to be monitored annually throughout the Plan implementation period. If additional relevant data sets become available, they will be evaluated and incorporated into the monitoring program.

4.4.5.3 Assessment and Improvement of Monitoring Network

§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.

(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.

(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.

(2) Local issues and circumstances that limit or prevent monitoring.

(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.

(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.

(2) Highly variable spatial or temporal conditions.

(3) Adverse impacts to beneficial uses and users of groundwater.

(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.

The subsidence minimum thresholds are set to avoid significant and unreasonable subsidence that could substantially interfere with groundwater supply, land uses, infrastructure, and property interests. Available data indicate that subsidence does not appear to be occurring in the Basin that would affect groundwater supply, land uses, infrastructure, and property interests. The adequacy of the subsidence monitoring network in the Basin will be evaluated annually during preparation of the annual report.

4.4.6 Depletion of Interconnected Surface Water Monitoring Network

§354.34 Monitoring Network.

(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.

(g) Each Plan shall describe the following information about the monitoring network:

(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.

(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.

(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.

As discussed in Section 3, no interconnected surface water systems have been identified within the Basin. Therefore, no monitoring network for this sustainability indicator has been established at this time.

The GSA will continue to compile and track surface water flow data from the existing monitoring networks discussed in Section 4.3.1 and will review groundwater level data during the required Plan assessments to determine if interconnection is occurring under future conditions as a result of Plan implementation.

This sustainability indicator may be considered a data gap when evaluating conditions during implementation. During the SGMA implementation period, the GSA will assess the need for some additional monitoring locations. The stream segments between the bedrock mountain contributing watershed and the confined area in the southern portion of the Basin are relatively short, However, there is no data in the record that quantifies the water levels in the shallow alluvial deposits and the deeper strata of the principal aquifer in the Basin. If additional data collection and documentation is warranted, coupled shallow and deep piezometers may be considered in future implementation phases in the Basin.

4.4.6.1 Attainment of Monitoring Objectives and Other Requirements

§354.34 Monitoring Network.

(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:

(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.

(B) Identifying the approximate date and location where ephemeral or intermittent flowing streams and rivers cease to flow, if applicable.

(C) Temporal change in conditions due to variations in stream discharge and regional groundwater extraction.

(D) Other factors that may be necessary to identify adverse impacts on beneficial uses of the surface water.

(g) Each Plan shall describe the following information about the monitoring network:

(1) Scientific rationale for the monitoring site selection process.

(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.

This requirement is not considered to be applicable due to the lack of interconnected surface water systems in the Basin (see Section 3.2.6). If additional wells and piezometers are determined to be necessary during the SGMA implementation phase, standard monitoring objectives will be considered at that time.

4.4.6.2 Monitoring Protocols

§354.34 Monitoring Network.

(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.

Streamflow measurements are managed by the USGS and DWR, the operators of the two streamflow gages on Carpinteria Creek, following their internal protocols. If additional wells or piezometers are determined to be necessary during the SGMA implementation phase, standard monitoring protocols will be defined at that time.

4.4.6.3 Assessment and Improvement of Monitoring Network

§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.

(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.

(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.

(2) Local issues and circumstances that limit or prevent monitoring.

(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.

(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.

(2) Highly variable spatial or temporal conditions.

(3) Adverse impacts to beneficial uses and users of groundwater.

(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.

This requirement is not considered to be currently applicable due to the lack of interconnected surface water systems in the Basin (see Section 3.2.6). However, the following enhancements to the surface water flow monitoring network will be considered by the Carpinteria GSA:

1. Coordinate with DWR on the installation of additional streamflow monitoring gages within the Basin. As mentioned previously, DWR has indicated a willingness to investigate additional monitoring sites, particularly on Rincon Creek.
2. Coordinate with NOAA regarding the possible reactivation of the non-contact LiDAR gage previously used on Rincon Creek. The gage is still in place but will require the replacement of recording and transmitting equipment. As in the case with DWR, NOAA has expressed interest in assisting the Carpinteria GSA in reactivating this monitoring device.
3. Construct and monitor water levels in paired shallow piezometers and deeper piezometers in the principal aquifer strata to complement surface water flow data from the existing gages in areas where anticipated higher future groundwater levels may result in interconnection. Outside funding programs will be pursued to develop and support new stream flow monitoring.

4.5 Reporting Monitoring Data to the Department (Data Management System)

§352.6 Data Management System. Each Agency shall develop and maintain a data management system that is capable of storing and reporting information relevant to the development or implementation of the Plan and monitoring of the basin.

§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.

SGMA-related data for the Basin will be incorporated into the Data Management System (DMS). Entities in the Basin that collect and report data will have access and authorization to enter their data into the DMS. The data and information stored in the DMS will be available upon request, and will be uploaded to the DWR-supported SGMA data portal. Once incorporated into the SGMA portal, data will accessible on a web-based map viewer that displays data relevant to SGMA implementation, Plan development, and annual reporting to DWR. The map viewer accommodates data within and outside of GSA monitoring networks. Table 4-5 lists the types of data visualized on the map and available via the map's navigation menu. Appendix H includes details of the DMS.

Table 4-5. Summary of Data Available for Sustainability Indicators

Sustainability Indicator	Data Type
Groundwater Levels	Water Level Data and Well Construction Information
Groundwater in Storage	Water Level Data
Water Quality	Analytical Data from CVWD
Seawater Intrusion	Water Level Data, Analytical Data from CVWD, Induction Logs, and ERT Surveys
Land Subsidence	InSAR Data
Interconnected Surface Water	Stream Gages and Precipitation Data

Notes

CVWD = Carpinteria Valley Water District

ERT = electrical resistivity tomography

InSAR = Interferometric Synthetic Aperture Radar

Table 4-6 lists the data sources used to populate the DMS. Appendix H includes details of the data sources. Data templates are used to standardize the format of the data going into the DMS to support data consistency and provide for quality assurance/quality control (QA/QC) of the data. The templates are Excel documents that include rules restricting formatting and alphanumeric properties. The templates include pop-up windows to describe the type of data that should be entered in each column. As a second level of QA/QC, the compiled data are reviewed by the DMS development team before they are migrated into the database. This review is focused and limited in scope. It includes the following checks:

- Identifying outliers that may have been introduced during the original data entry process.
- Removing or flagging questionable data.
- Visualizing data in various software platforms outside the DMS to further assess the quality of the data.

The automated and manual data checks above make sure data is in an appropriate range but do not confirm the quality of the data for a single observation.

Table 4-6. Summary of Data Sources

Data Type	Source
Well and Site Info	DWR, Santa Barbara County Environmental Health, USGS, CVWD
Aquifer Properties	CVWD
Water Level Data	CVWD
Water Quality Data	CVWD, GeoTracker GAMA
Precipitation Data	Santa Barbara County Flood Control District
Groundwater Pumpage	CVWD
Land Subsidence	InSAR

Notes

CVWD = Carpinteria Valley Water District

DWR = California Department of Water Resources

InSAR = Interferometric Synthetic Aperture Radar

USGS = U.S. Geological Survey

Data stored in the DMS are separated into tables by categories. Figure 4-6 shows that each field within the tables holds a specific type of data, such as a number, text, or date. Table 4-7 provides brief descriptions of the main tables and sub tables. Figure 4-6 is color-coordinated to show the relationship between tables:

- Main tables (shown in blue) include point data with a unique identification and unique point location to be added to database (e.g., Well_Info and Station_Info).
- Sub-tables (shown in green) are related to the main table and hold additional details about the well or unique identifier (e.g., correlation of a well point with a water level or water quality).

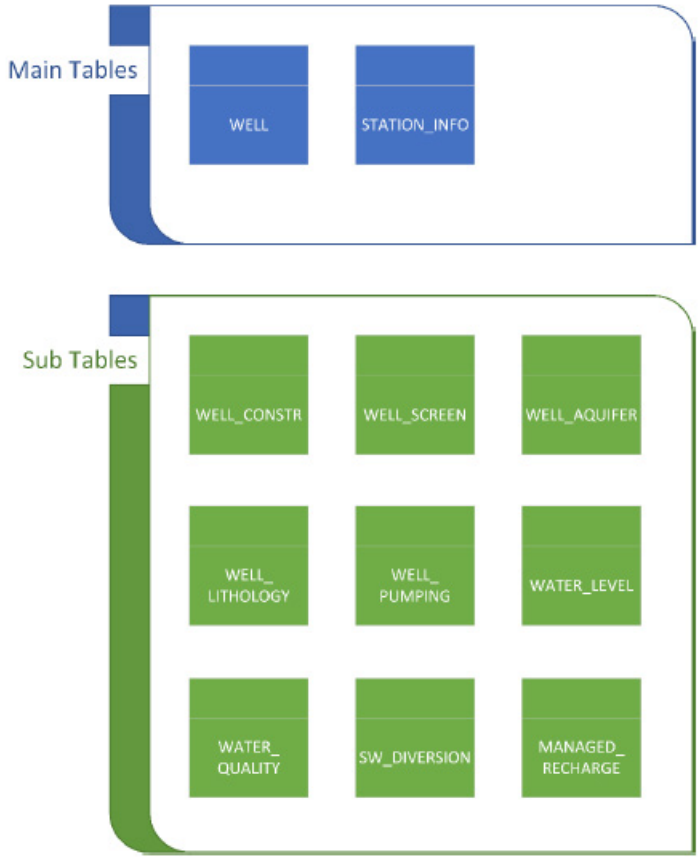


Figure 4-6. Carpinteria Groundwater Sustainability Plan Data Management Tables

Table 4-7. Data Management System Table Descriptions

Table	Description
Main Tables	
Station Info	Type of Station (well, gage, etc.) and Location Info
Well Info	General Information about Well, including Identifiers by Various Agencies
Sub Tables	
Agencies	Agency Associated with Well or Site
Sustainability Indicators	Minimum Thresholds and Measurable Objectives Set for Monitoring Network Sites Tracking Sustainable Management Criteria
Well Construction	Well Construction Information, including Depth, Diameter, Screens
Well Geologic Aquifer	Aquifer Parameter Info, such as Pump Test Info, Degree of Confinement, and Transmissivity
Well Geologic Lithology	Lithology at Well Site, Well Logs
Water Level	Water Level Measurements for Wells
Well Pumping	Pumping Measurements for Wells, annually or monthly
Managed Recharge	Aquifer Storage Volumes Annually or Monthly
Water Quality	Water Quality Data for Wells and Surface Water

SECTION 5:

Sustainable Management Criteria

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

5.1 Introduction to Sustainable Management Criteria [§354.22]

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

This section defines the conditions that constitute sustainable groundwater management and discusses the process by which the Carpinteria GSA will characterize undesirable results and establish minimum thresholds and measurable objectives for the six sustainability indicators in the Basin in accordance with the SGMA.

The methods and data used to develop the sustainable management criteria (SMCs) and how these criteria take into consideration current and future beneficial uses and groundwater users are described below. Defining the SMCs required technical analysis of historical data and input from the affected stakeholders in the Basin. The SMCs presented in this section are based on currently available data and application of the best available science. As noted in Section 3 of this Plan, several data gaps exist in the hydrogeologic conceptual model (HCM). The uncertainty created by these data gaps was considered when developing the SMCs. The SMCs are considered initial criteria and will be reevaluated and potentially modified in the future as new data become available.

The SMCs are grouped by sustainability indicator. The following six sustainability indicators are applicable in the Basin and could lead to significant and unreasonable effects caused by groundwater conditions occurring throughout the Basin:

- Chronic lowering of groundwater levels (Section 5.5)
- Reduction of groundwater storage (Section 5.6)
- Seawater intrusion (Section 5.7)
- Water quality degradation (Section 5.8)
- Land subsidence (Section 5.9)
- Interconnected surface water depletions (Section 5.10)

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

For each sustainability indicator discussion in this section, the same format is used for a consistent approach. Each SMC description includes the information required by § 354.22 et seq. of the SGMA regulations and outlined in the SMC BMP guidance (DWR, 2017), including the following:

- How the definition of what might constitute significant and unreasonable effects was developed.
- How undesirable results were identified, including:
  - The criteria for defining when and where the potential effects on beneficial uses and users of groundwater as described by the sustainability indicators cause undesirable results (when the effects are significant and unreasonable), based on a quantitative description of the combination of minimum threshold exceedances (§ 354.26 (b)(2))
  - The potential causes of undesirable results (§ 354.26 (b)(1))
  - The effects of these undesirable results on beneficial users and uses, and on land uses and property interests (§ 354.26 (b)(3))
- How minimum thresholds were developed, including the following:
  - The information and methodology used to develop minimum thresholds (§ 354.28 (b)(1))
  - The relationship between minimum thresholds and each sustainability indicator (§ 354.28 (b)(2))
  - The effect of minimum thresholds on neighboring basins (§ 354.28 (b)(3))
  - The effect of minimum thresholds on beneficial uses and users, and on land uses and property interests (§ 354.28 (b)(4))
  - How minimum thresholds relate to relevant federal, state, or local standards (§ 354.28 (b)(5))
  - The method for quantitatively measuring minimum thresholds (§ 354.28 (b)(6))
- How measurable objectives and interim milestones were developed, including the following:
  - The methodology for setting measurable objectives (§ 354.30)
  - The methodology for setting interim milestones (§§ 354.30 (a), 354.30 (e), and 354.34 (g)(3))

5.2 Definitions

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

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

Interconnected surface water refers to surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted.

Interim milestone refers to a target value representing measurable groundwater conditions, in increments of 5 years, set by an Agency as part of a Plan.

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

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

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

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

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

Uncertainty refers to a lack of understanding of the basin setting that significantly affects the Agency's[5] ability to develop SMCs and appropriate projects and management actions in the Plan,[6] or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed.

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

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

[5] The Carpinteria GSA is the Agency referred to in this definition.
[6] The Carpinteria Groundwater Sustainability Plan is the Plan referred to in this definition.

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

5.3 Sustainability Goal [§354.24]

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

This Plan's discussion of the sustainability goal consists of three parts, per § 354.24 of the SGMA regulations:

- A description of the sustainability goal (Section 5.3.1)
- A discussion of the measures that will be implemented to ensure the Basin will be operated within sustainable yield (Section 5.3.2, Section 6)
- An explanation of how the sustainability goal is likely to be achieved and maintained (Section 6)

5.3.1 Description of Sustainability Goal

The sustainability goal for the Basin is to manage the groundwater resources to ensure beneficial uses and groundwater users have access to a safe, reliable groundwater supply that meets current and future demand without causing undesirable results.

The sustainability goal adopted for the Basin is as follows:

> *In accordance with the Sustainable Groundwater Management Act (SGMA), the sustainability goal for the Carpinteria Groundwater Basin (Basin) is to ensure that beneficial uses and basin users have access to a safe and reliable groundwater supply that meets current and future demands without causing undesirable results. The absence of undesirable results, as defined by SGMA and the Groundwater Sustainability Plan (Plan), will indicate that the sustainability goal has been achieved. Sustainable groundwater management as implemented through the Plan is designed to ensure that:*
>
> 1. *Long-term groundwater elevations are adequate to support existing and future reasonable and beneficial uses throughout the Basin.*
> 2. *A sufficient volume of groundwater storage remains available during drought conditions and recovers during wet conditions (as defined using minimum thresholds expressed in terms of water levels).*
> 3. *Groundwater production, and projects and management actions undertaken through SGMA, do not degrade water quality conditions to support ongoing reasonable and beneficial uses of groundwater for agricultural, municipal, domestic, industrial, and environmental purposes.*

4. *Groundwater production, and projects and management actions undertaken in response to SGMA will mitigate against the significant advance of brackish or saline groundwater into areas of the aquifer currently used for production and supply.*

Groundwater resources will be managed through projects and management actions implemented under the Plan by the Carpinteria Groundwater Sustainability Agency (GSA). Management of the Basin will be supported by monitoring groundwater levels, groundwater in storage, groundwater quality, land surface elevations, interconnected surface water, and seawater intrusion. The Carpinteria GSA will adaptively manage any projects and management actions to ensure that the Plan is effective and undesirable results are avoided.

This Plan includes a monitoring program (Section 4) that addresses each of the sustainability indicators. If, based on the results of the monitoring program, minimum thresholds are exceeded such that undesirable effects are present or imminent, the Carpinteria GSA will identify management actions and projects that will be implemented to avoid an undesirable result (Section 6). Other projects and management actions may be implemented upon Plan adoption to address data gaps and collect important data regarding basin conditions.

5.3.2 Strategies for Meeting the Sustainability Goal

The sustainability strategies were developed and discussed at numerous public workshops and meetings. Implementation of the sustainability strategy will be addressed through the implementation of numerous projects and management actions during the 20-year implementation horizon. Details of these projects and management actions are presented in Section 6. The projects and management actions that make up the sustainability strategy were developed in collaboration with GSA staff.

The projects and management actions will be implemented while maintaining a principle of adaptive management. Adaptive management allows the Carpinteria GSA to assess the relative success or effectiveness of projects implemented in the Basin, and to make management decisions to redirect management efforts if new data indicate new actions will be more effective in achieving the goal of sustainable management.

5.4 General Process for Establishing Sustainable Management Criteria [§ 354.22-30]

§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.

§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.

§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.

§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.

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

5.4.1 Technical and Public Input

5.4.1.1 Technical Advisory Committee

During the course of Plan development, a Technical Coordination Committee (TCC) of consultants selected by the Carpinteria GSA met twice a month to discuss various iterative approaches to defining SMCs. The TCC consisted of the general manager of the CVWD, and representatives from GSI Water Solutions, Inc.; Pueblo Water Resources, Inc.; Montgomery & Associates, Inc.; and Bondy Groundwater Consulting, Inc. During the bimonthly meetings, iterative approaches to defining the SMCs for each of the sustainability indicators were discussed, and the technical merits and implications of each were analyzed until the TCC reached a general consensus on the approach.

5.4.1.2 Groundwater Sustainability Planning Advisory Committee

In addition to the TCC, a Groundwater Sustainability Public Advisory Committee (GSPAC) was created, consisting of seven groundwater users in the Basin and one GSA Board Director. Following an interview process conducted by the GSA Board of Directors, the GSPAC members were selected as being representative of the various beneficial uses and users of groundwater in the Basin because they have an interest in maintaining sustainable groundwater resources in the Basin for future generations, a healthy agricultural and business community, good water quality, and a healthy environment. Eight GSPAC meetings were held between February and October 2023 to present information and society stakeholder comment and input. These meetings were conducted in accordance with Brown Act requirements and were accessible to the public at large.

5.4.1.3 Public Workshops

The public input process was developed in conjunction with the GSA member agencies and included engagement with local stakeholders and interested parties on basin issues. Eight public workshops were held between October 2022 and September 2023, during which technical information supporting the development of the Plan was presented and stakeholders had opportunities to ask questions and provide feedback. These meetings were posted in advance and were accessible to the public at large.

5.4.1.4 Individual Agricultural Stakeholder Interviews

To assess whether significant undesirable results occurred in the Basin during the recent drought, GSA consultants conducted interviews with representatives of the beneficial users of groundwater in the Basin from April to June 2023. These users were primarily representatives of the agricultural community, but interviews were also conducted with management and staff from the CVWD.

5.4.2 Criteria for Defining Undesirable Results and Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives

The general process for establishing minimum thresholds and measurable objectives for each sustainability indicator and assessing significant and unreasonable conditions constituting undesirable results in the Basin was iterative and included the following:

- Evaluating historical data on groundwater elevations, water quality, and pumping volumes from wells monitored by the CVWD.
- Evaluating historical water budget information presented in Section 3.
- Holding a series of public workshops that outlined the Plan development process and introduced stakeholders to SMCs, measurable objectives, minimum thresholds, and related information.
- Soliciting public comment and input on several alternative minimum threshold and measurable objective options based on preliminary technical analysis presented at public workshops and GSPAC meetings.
- Evaluating public comment to understand stakeholder perceptions of significant and unreasonable effects relevant to SMCs. Public comments from outreach meetings were analyzed to assess if different areas in the Basin had different perspectives regarding what constitutes an undesirable result in the Basin and how minimum thresholds and measurable objectives should be established.
- Combining hydrogeologic data evaluation, public comment, outreach efforts, and considering the interests of beneficial uses and groundwater users, land uses, and property interests in the Basin to describe undesirable results and set preliminary conceptual minimum thresholds and measurable objectives.

- Performing groundwater model simulations that incorporate projects and management actions discussed in Section 6 to assess if the SMCs are achievable.
- Conducting public meetings to present recommended preliminary conceptual minimum thresholds and measurable objectives and receiving additional public input. Reviewing and considering public and GSPAC input on recommended preliminary SMCs with GSA staff.
- Recommending final SMCs to the Carpinteria GSA for approval.

A number of alternative options for minimum thresholds and measurable objectives were considered for each RMS after evaluation of the historical record of data at each well, assessment of trends of groundwater elevation decline and recovery, and input from stakeholders regarding their desired conditions. Details with respect to each sustainability indicator are discussed in Sections 5.5 through 5.10.

5.5 Chronic Lowering of Groundwater Levels Sustainable Management Criterion

This section describes the SMC for the chronic lowering of groundwater levels sustainability indicator. It defines undesirable results (Section 5.5.1), presents minimum thresholds (Section 5.5.2) and measurable objectives for each RMS in the monitoring network (Section 5.5.3), and provides interim milestones (Section 5.5.4).

5.5.1 Undesirable Results for Chronic Lowering of Groundwater Levels [§354.26]

§354.26 Undesirable Results.

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

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

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

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

The definition of undesirable results for the chronic lowering of groundwater levels sustainability indicator for the purposes of this Plan is as follows:

> *The Basin will be considered to have undesirable results if water levels in municipal supply wells decline to the point that it could impact water supply operations at CVWD, or if water levels in agricultural supply wells decline to the point that inadequate supply is available for historical farming operations, requiring fallowing or reduction of operations. The possible occurrence of undesirable results will be assessed if 33 percent or more RMSs for water levels within the Basin display exceedances of the minimum threshold groundwater*

elevation values for three consecutive fall measurements (bracketing 2 consecutive water years). For the current monitoring network of nine RMS wells, this equates to three wells with minimum threshold exceedances.

Details addressing specific minimum thresholds and measurable objectives are presented in Sections 5.5.2 and 5.5.3. Table 5-1 presents a summary of minimum thresholds and measurable objectives used in the definition of undesirable conditions for the chronic lowering of groundwater levels sustainability indicator and interim milestones for each RMS well.

Table 5-1. Summary of Minimum Thresholds, Measurable Objectives, and Interim Milestones for Carpinteria Groundwater Basin Chronic Lowering of Groundwater Levels Sustainability Indicator

RMS Well	MT (ft NAVD 88)	2029 IM (ft NAVD 88)	2034 IM (ft NAVD 88)	2039 IM (ft NAVD 88)	MO (ft NAVD 88)	Land Surface Elevation (ft NAVD 88)
19F4	−30	−18	−5	7	20	102
20K4	−77	−58	−39	−20	0	47
21L1	−85	−61	−37	−13	10	69
27F2	−92	−62	−32	−3	25	136
26A1	140	160	180	200	220	425
28J1	−40	−23	−5	13	30	103
28F7	−90	−64	−38	−12	15	65
29D7	−45	−34	−23	−12	0	28
35E1	12	21	30	41	50	243

Notes

ft = foot or feet

IM = interim milestone (see Section 5.5.4)

MO = measurable objective goal for 2044

MT = minimum threshold

NAVD 88 = North American Vertical Datum of 1988

RMS = representative monitoring site

5.5.1.1 Criteria for Establishing Undesirable Results [§354.26(b)(2)]

Significant and unreasonable chronic lowering of groundwater levels in the Basin are those that:

- Reduce the ability of existing municipal supply wells to produce adequate water for their users in the Basin.
- Cause significant financial burden to agricultural users who rely on the groundwater basin.
- Reduce the ability of domestic wells to produce adequate supply for domestic purposes.
- Interfere with other SGMA sustainability indicators.

According to CVWD records, two private domestic well exists within the basin boundary; therefore, conditions in domestic supply wells are not a significant factor to be considered.

Lowering of groundwater levels that are likely to cause undesirable results are characterized as follows:

- Groundwater levels in the basin aquifer remain below minimum thresholds (see Section 5.5.2) for 3 consecutive fall measurements that bracket two calendar years of average and above-average precipitation in 33 percent of representative wells.
- Existing municipal wells are unable to produce the quantities of groundwater needed to supply potable water to the District customers, or agricultural users are unable to maintain recent production to support the agricultural economy in the GSA, due to chronic lowering of groundwater levels caused by groundwater conditions occurring throughout the Basin (i.e., significant and unreasonable depletion of supply).

5.5.1.2 Possible Causes of Undesirable Results [§354.26(b)(1)]

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

- **Increased Rates of Pumping in the Basin Aquifer.** If the amount of pumping in the Basin were to increase to the point where it exceeds the long-term rate of recharge, then groundwater levels may decline, which could affect basin well production and result in depletion of supply.
- **Extended Drought.** Minimum thresholds are established based on reasonable anticipated future climatic conditions, based on the best available science and climatological models being used to characterize climate change currently in use. Extensive, unanticipated droughts more severe than those on record may lead to excessively low groundwater levels and undesirable results. Short-term impacts due to drought are anticipated in the SGMA regulations with recognition that management actions need sufficient flexibility to accommodate drought periods and ensure short-term impacts can be offset by increases in groundwater levels or storage during normal or wet periods.

As discussed in Section 3.2.1, basin well hydrographs illustrate that water levels rise and fall in response to changes in rainfall. Recent water levels have begun to recover from the recent severe drought observed between water years 2012 and 2020. Based on input from water users in the Basin and review of available water level data, no significant and unreasonable effects associated with groundwater level declines have been observed in the Basin, including the period since 2015, after SGMA came into effect. (This does not include other sustainability indicators, such as sea water intrusion, that may be associated with water level conditions.) A representative from the TCC conducted interviews with representatives from the agricultural community and the CVWD. These interviews did not generate any specific reports from stakeholders that wells have needed to be deepened or replaced, or that agricultural operations needed to be significantly curtailed, fields fallowed, or similar measures taken. DWR's database of dry domestic wells in the state was reviewed, and there was no data showing domestic wells going dry within the Basin. Local drillers were also consulted, and they indicated that there have not been a significant number of deeper replacement wells drilled in the Basin. If current and/or increased rates of pumping continue and drought conditions persist (see Section 3.3.5), undesirable results could occur in the future.

5.5.1.3 Effects of Undesirable Results on Beneficial Users and Land Uses [§354.26(b)(3)]

The primary effects of undesirable results on the beneficial users in the Basin would be a reduction of supply available for municipal and agricultural uses. The occurrence of three exceedances (bracketing a period of 2 years) in a network of nine RMS wells will result in an assessment of the occurrence of undesirable effects in the Basin. If the exceedances are clustered in a limited area, it indicates that significant unreasonable effects are being experienced by a localized group of landowners. An exceedance at a single RMS well will require investigation to determine the significance, extent, and possible causes of the observed conditions.

5.5.2 Minimum Thresholds for Chronic Lowering of Groundwater Levels [§354.28]

§354.28 Minimum Thresholds.

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

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

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

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

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

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

(B) Potential effects on other sustainability indicators.

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

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

Section 354.28(c)(1) of the SGMA regulations states that "The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results."

After the nine RMS wells had been selected and discussed with the TCC, the GSPAC, and at public workshops, numerous iterations of alternative draft minimum thresholds were developed based on the evaluation of historical groundwater elevations during the available period of record (i.e., consideration of average water levels during various time periods, long-term trends, and response to the recent drought), consideration of likely future use of groundwater, well construction data, assessment of remaining available saturated thickness, and public input from stakeholders. The following sections present details on the development of minimum thresholds for specific RMSs in the Basin.

5.5.2.1 Information and Methods Used for Establishing Chronic Lowering of Groundwater Levels Minimum Thresholds - §354.28(b)(1)

The primary source of data that was evaluated for the sustainability indicator of chronic lowering of groundwater levels is historical groundwater elevation data collected by CVWD and its predecessor agencies. Water level data has been collected under the AB 3030 program since 2000, and many wells have data extending back for decades before that period. The information used for establishing the measurable objectives and minimum thresholds for the chronic lowering of groundwater levels sustainability indicator included:

- Historical groundwater elevation data from wells monitored by the CVWD.
- Depths, locations, and available construction details of existing wells.
- Maps of current and historical groundwater elevation data.
- Input from stakeholders regarding significant and unreasonable conditions and desired current and future groundwater elevations communicated during public meetings and solicitation of public comment on various options for minimum thresholds and measurable objectives presented in the public forum.
- Results of modeling of various project scenarios of future groundwater level conditions.
- Results of oral interviews with stakeholders from the agricultural community in the Basin regarding their experiences and operations during the recent drought period.

The network of RMS wells selected for the chronic lowering of groundwater levels sustainability indicator for this Plan is presented in Figure 4-1. Figures 5-1 through 5-9 present the historical record of water level data for these wells (displayed using the bold line type on the graph), and data for other nearby wells in the same section (displayed using the thinner line types). The non-RMS well hydrographs are included to demonstrate that the RMS wells are representative of water levels in the nearby area. Figures 5-1 through 5-8 each include groundwater elevation hydrograph data (for either the RMS well or one of the surrounding wells) that extend back to the 1940s. During this period of record, three observed drought periods are identifiable from the lower water levels evident during these periods: from late 1940s through the 1950s and early 1960s, from the late 1980s through the early 1990s, and the recent drought period from about 2012 through 2022. In each of these periods, water levels are observed to decline and stay at lower levels for the periods just described in response to the drought conditions.

It is important to note that the context of the historical data, such as land use practices, availability of State Water Project surface water supplies, local population density, and other factors, are not consistent during each of these three drought periods. However, at the conclusion of each of these drought periods, it is evident from the hydrograph shapes that when rainfall resumed to normal amounts, water levels responded by rising back to the higher levels associated with non-drought periods. This is important to note because this pattern of water level response does not indicate a steady, inexorable decline of water levels in response to over-pumping such as those observed in the Central Valley of California. When the dominant sources of basin recharge (i.e., percolation of precipitation and percolation of streamflow) recover from the periodic drought conditions, water levels have responded by rising above the levels observed during the droughts. Recent low water levels observed in the RMS wells in the years from about 2018 to 2022 were used as an initial benchmark to consider during development of minimum thresholds by the TCC and the GSPAC.

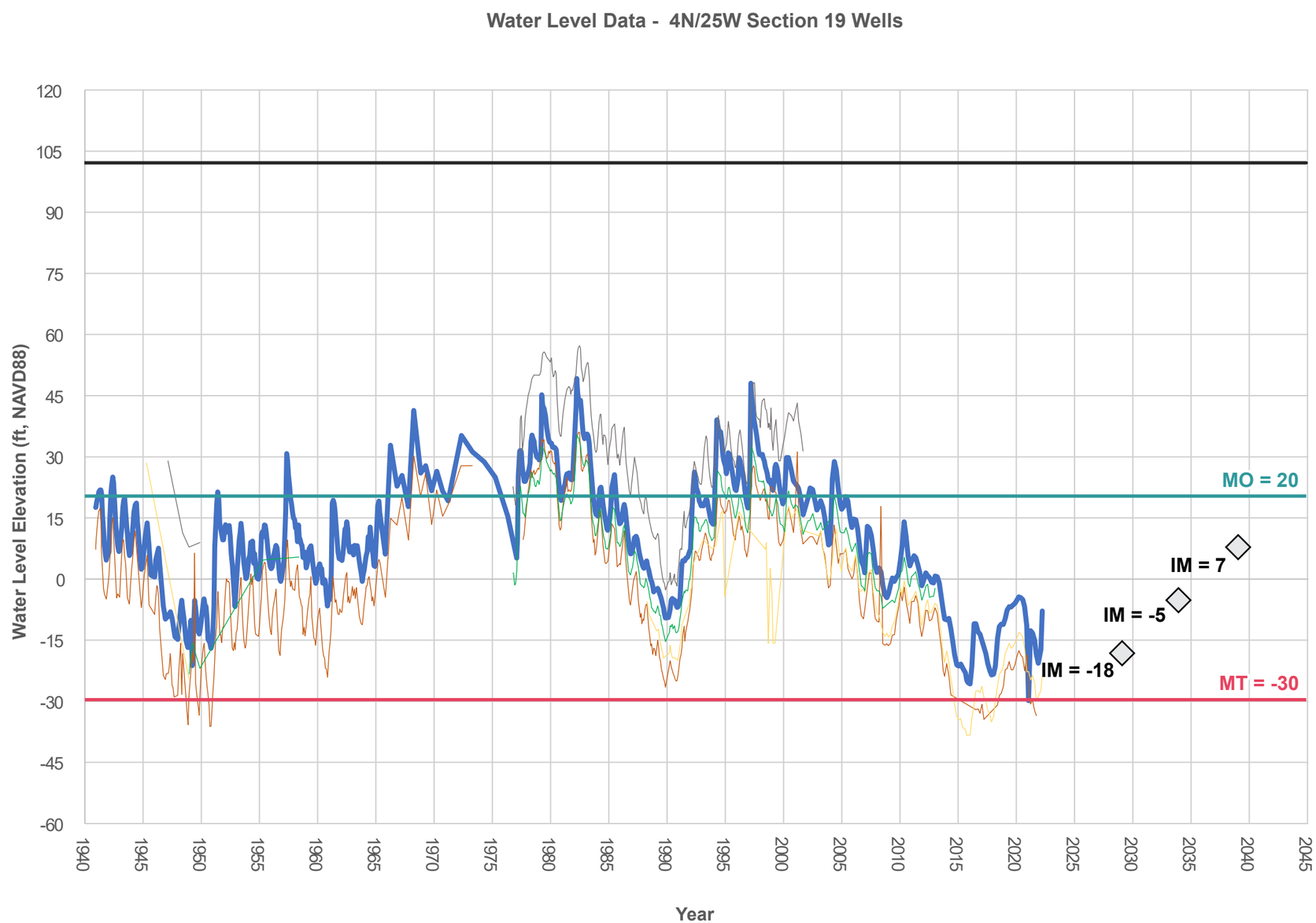


FIGURE 5-1

Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 19F4

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- MT (Minimum Threshold)
- MO (Measurable Objective)
- 19F4 (RMS)
- 19J5
- 19H1
- 19K5
- 19M3
- Land Surface Elevation (19F4)
- Interim Milestoneb (IM)

LOCATOR MAP

Y:\2006_Carpinteria_Basin_GSA\Source_Figures

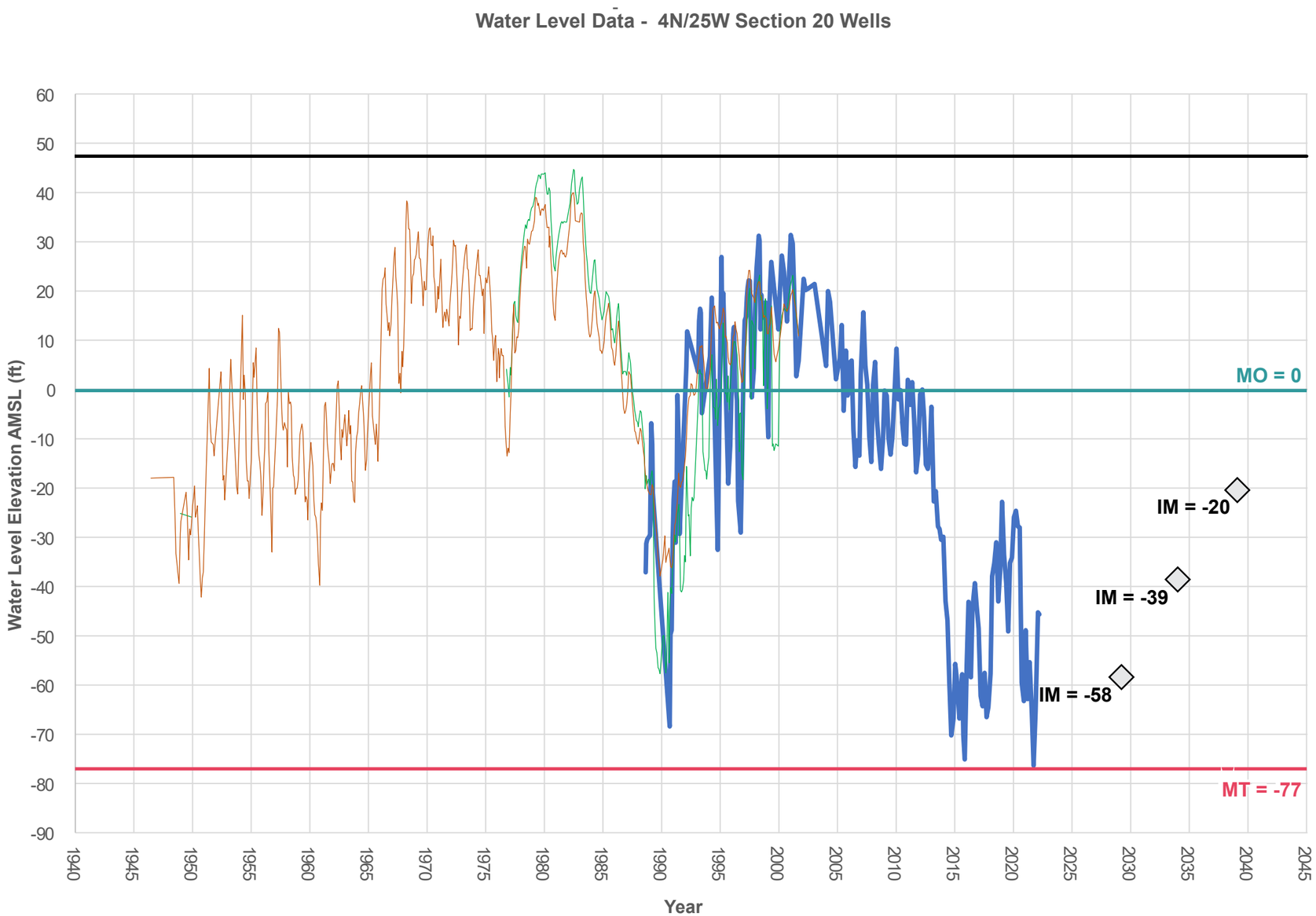


FIGURE 5-2

Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 20K4

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- MT (Minimum Threshold)
- MO (Measurable Objective)
- 20K4 (High School)(RMS)
- 20K3
- 20L4
- Land Surface Elevation (20K4)
- Interim Milestone (IM)

LOCATOR MAP

Y:\2006_Carpinteria_Basin_GSA\Source_Figures

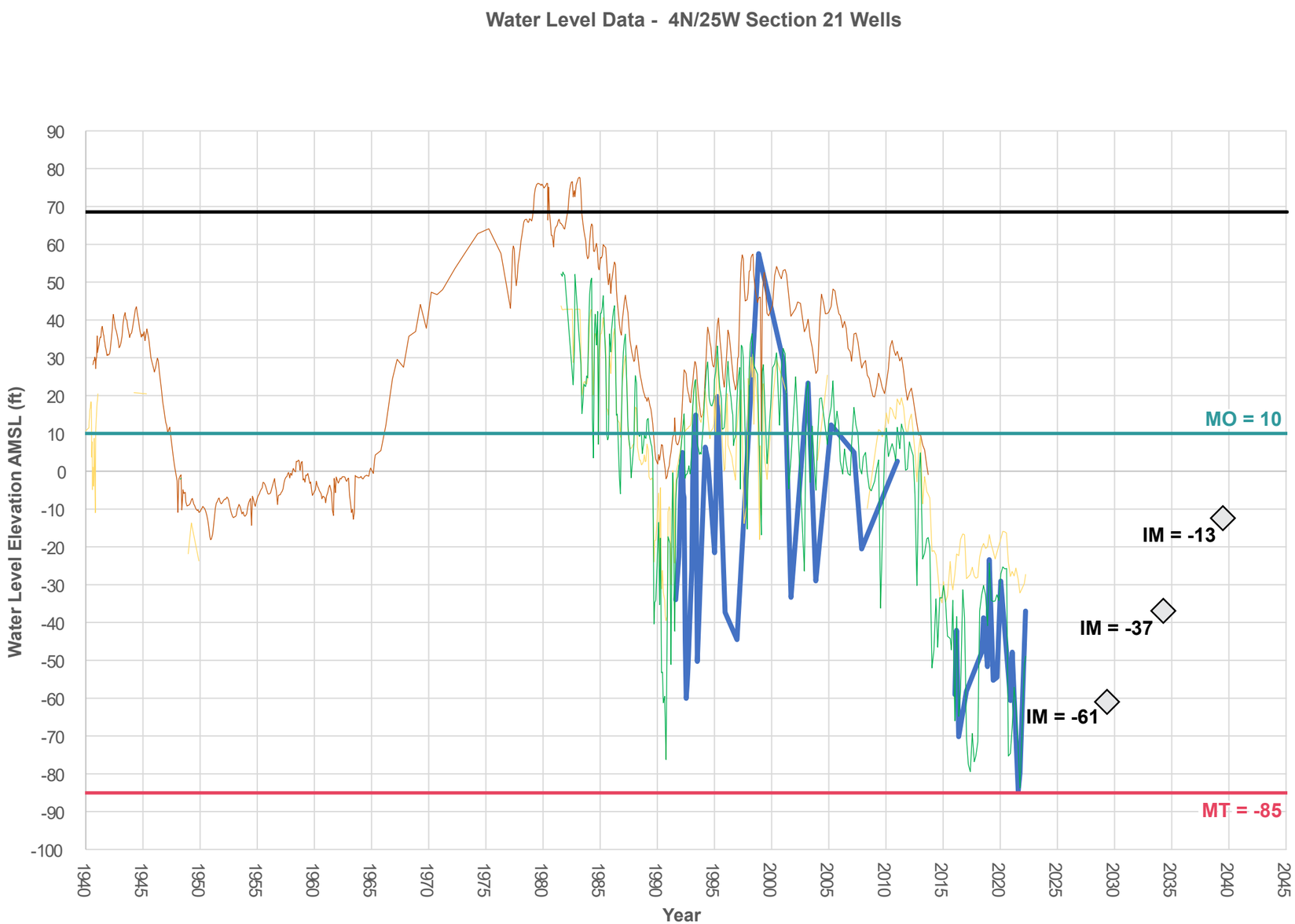


FIGURE 5-3

Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 21L1

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- MT (Minimum Threshold)
- MO (Measurable Objective)
- 21L1 (RMS)
- 21R1
- 21N1
- 21N4
- Land Surface Elevation (21L1)
- Interim Milestone (IM)

LOCATOR MAP

Y:\2006_Carpinteria_Basin_GSA\Source_Figures

FIGURE 5-4

Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 27F2

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- MT (Minimum Threshold)
- MO (Measurable Objective)
- 27F2 (Smillie)(RMS)
- 27F1
- 27R2
- 27Q6
- Land Surface Elevation (27F2)
- Interim Milestone (IM)

LOCATOR MAP

Y:\2006_Carpinteria_Basin_GSA\Source_Figures

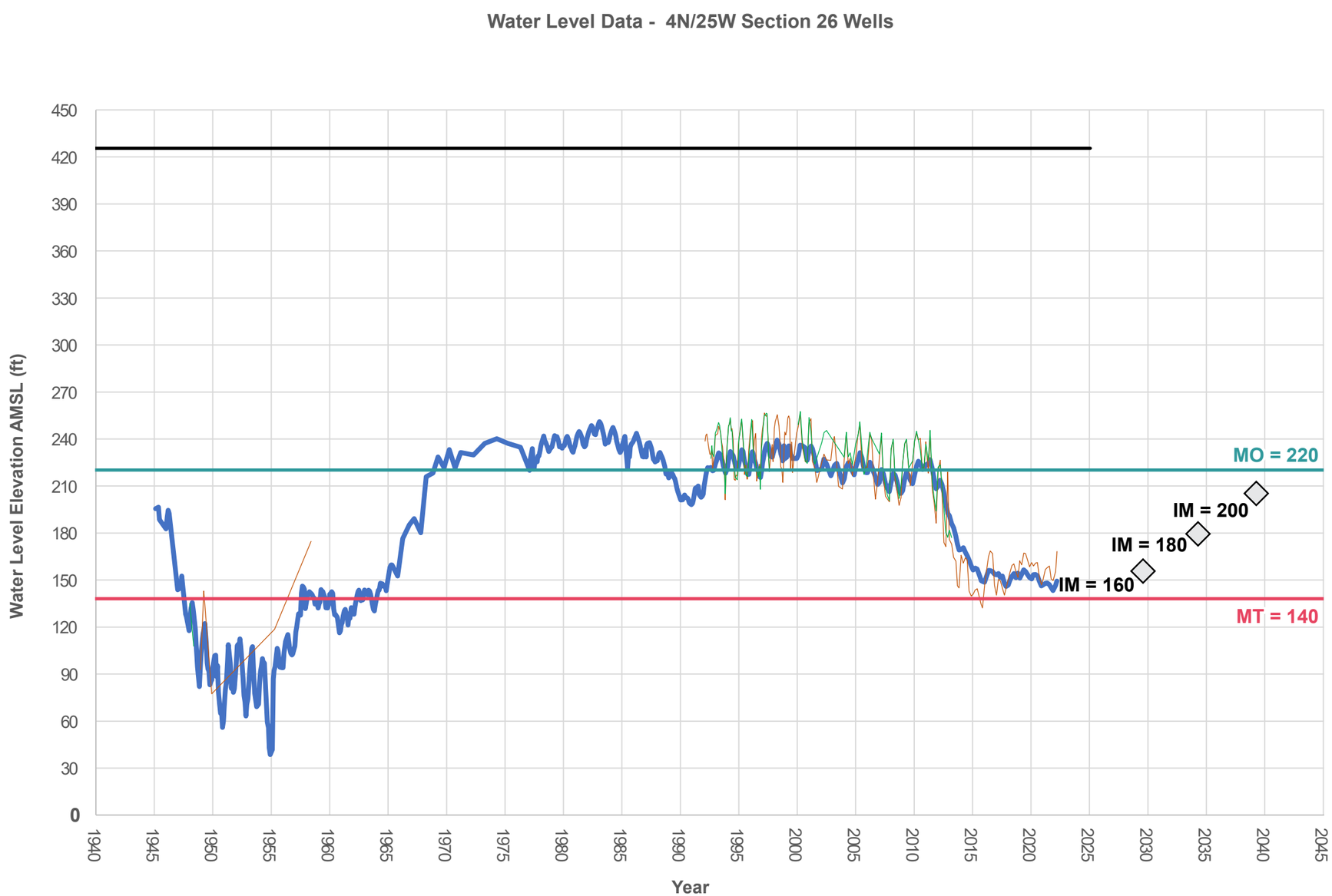


FIGURE 5-5

Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 26A1

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- MT (Minimum Threshold)
- MO (Measurable Objective)
- 26A1 (RMS)
- 26C1
- 26C6
- Land Surface Elevation (26A1)
- Interim Milestone (IM)

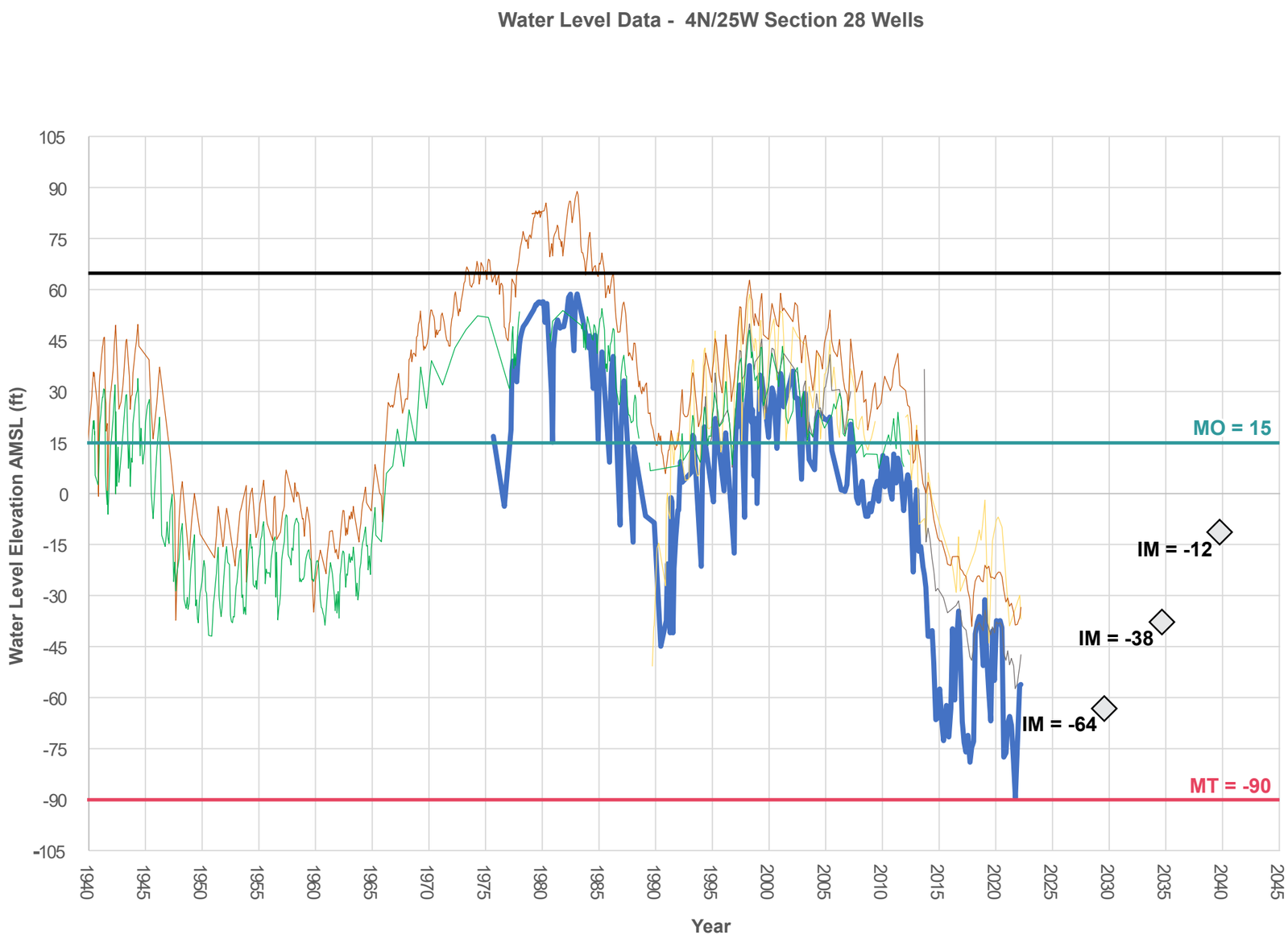
LOCATOR MAP

Y:\2006_Carpinteria_Basin_GSA\Source_Figures

FIGURE 5-6

Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 28F7

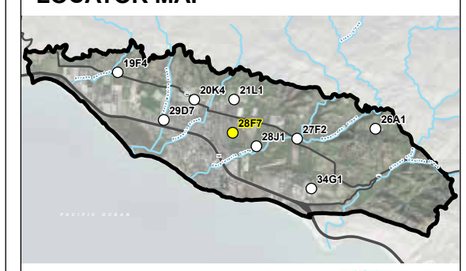
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



LEGEND

- MT (Minimum Threshold)
- MO (Measurable Objective)
- 28F7 (Lyons)(RMS)
- 28D2/D4 (El Carro #1, 2)
- 28G3
- 28J1
- 28M1
- Land Surface Elevation (28F7)
- Interim Milestone (IM)

LOCATOR MAP

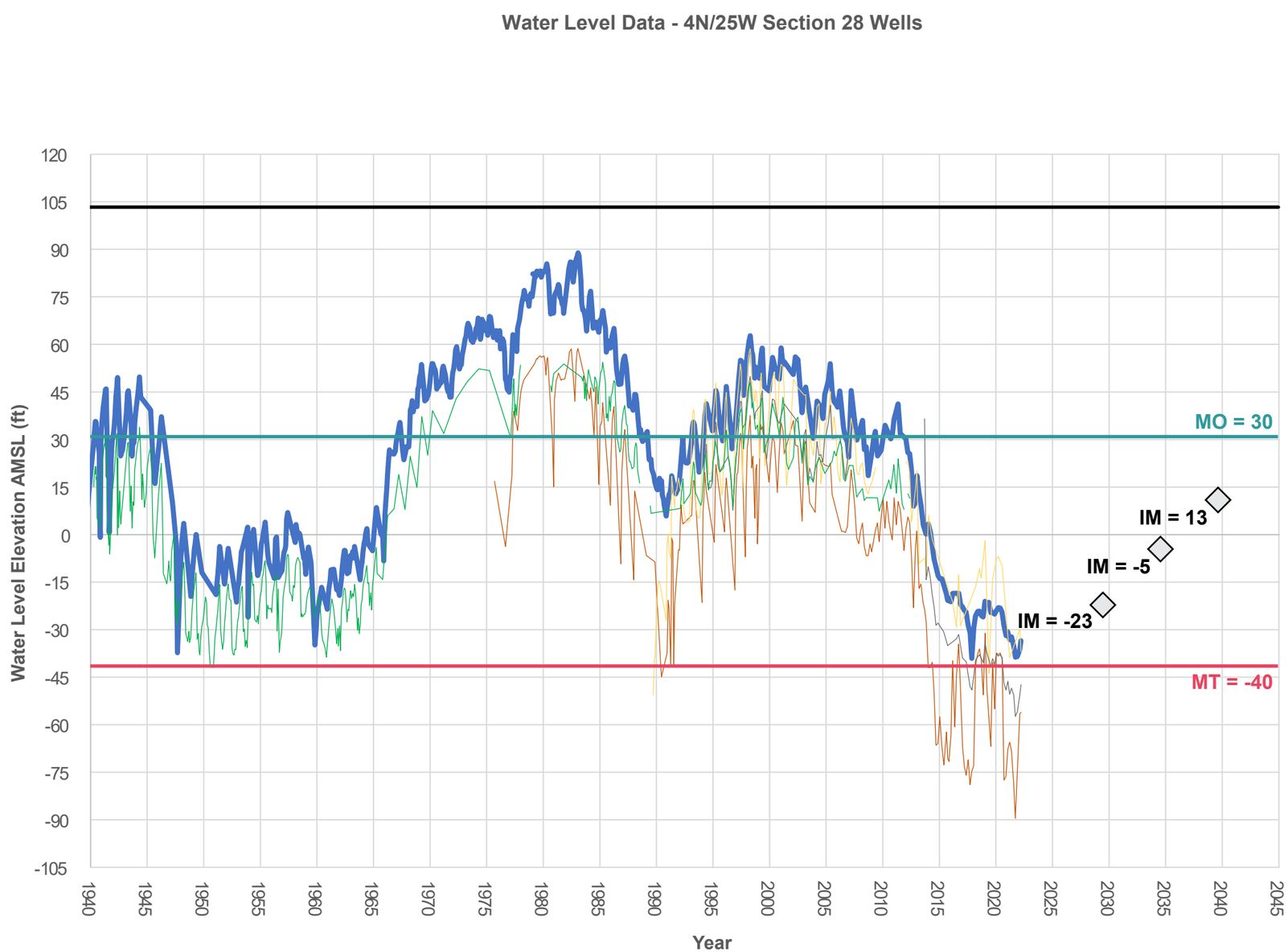


Y:\2006_Carpinteria_Basin_GSA\Source_Figures

FIGURE 5-7

Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 28J1

Carpinteria Groundwater Basin
Groundwater Sustainability Plan



LEGEND

- MT (Minimum Threshold)
- MO (Measurable Objective)
- 28F7 (Lyons)
- 28J1 (RMS)
- 28D2/D4 (El Carro #1, 2)
- 28M1
- 28G3
- Land Surface Elevation (28F7)
- Interim Milestone (IM)

LOCATOR MAP

Y:\2006_Carpinteria_Basin_GSA\Source_Figures

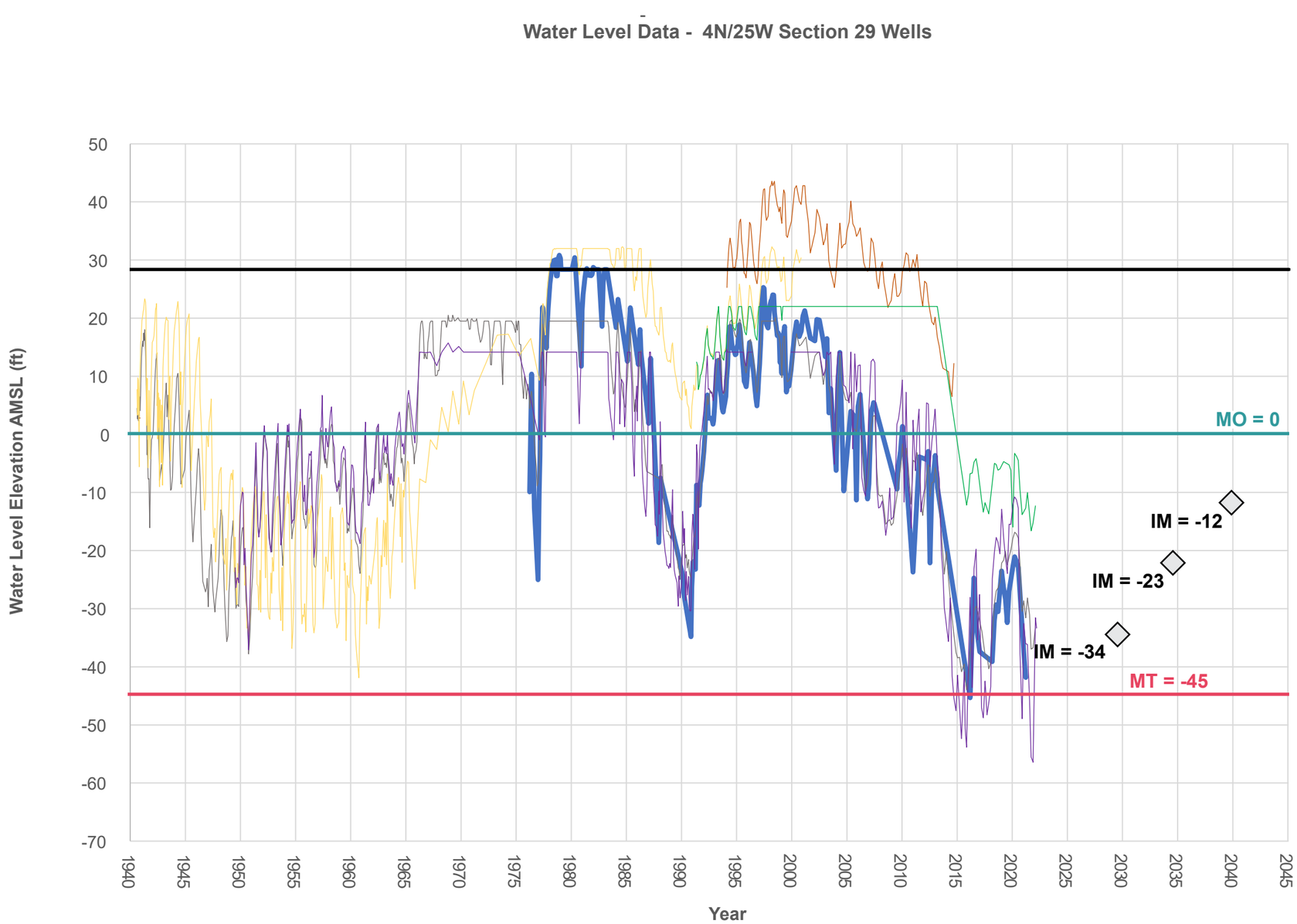


FIGURE 5-8

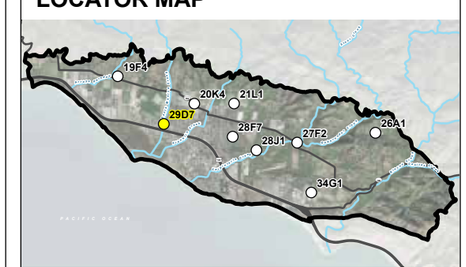
Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 29D7

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- MT (Minimum Threshold)
- MO (Measurable Objective)
- 229D7 (Santa Ynez)(RMS)
- 29D1
- 29R1
- 29H2
- 29K2
- 29L1
- Land Surface Elevation (29D7)
- Interim Milestone (IM)

LOCATOR MAP



Y:\2006_Carpinteria_Basin_GSA\Source_Figures

FIGURE 5-9

Groundwater Elevations, Minimum Threshold, and Measurable Objective for RMS Well 35E1

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

LEGEND

- MT (Minimum Threshold)
- MO (Measurable Objective)
- 35E1 (RMS)
- 35A3
- 35B6
- Land Surface Elevation (35E1)
- Interim Milestone (IM)

LOCATOR MAP

Y:\2006_Carpinteria_Basin_GSA\Source_Figures

To assess whether significant undesirable results occurred in the Basin during the recent drought, GSA consultants conducted interviews with representatives of the beneficial users of groundwater in the Basin from April to June 2023. These users were primarily representatives of the agricultural community, but interviews were also conducted with management and staff from the CVWD. Four agricultural representatives that were members of the GSPAC were interviewed,[7] as well as a prominent local manager of third-party agricultural properties.[8] After collecting basic information (e.g., acreage, crops, and length of time farming in the Basin) discussions turned to the impact on operations experienced during the recent drought. The GSPAC agricultural stakeholders provided information and perspectives on their individual operations, and Mr. Shade provided a good perspective on basin-wide conditions for the numerous different properties that he helps to manage.

Some interviewees had family farming interests in the Basin dating back a hundred or more years. The interviewees' total acreage farmed or managed ranged from 20 acres to about 600 acres. The dominant crop grown by the interviewees is avocados; other crops grown include raspberries, cherimoya, cannabis, and citrus. One important fact related to agriculture in the Basin is that most, if not all, agricultural users in the Basin are connected to the CVWD distribution network, and thus are not solely dependent on groundwater to irrigate their fields. Although groundwater is certainly a cheaper alternative for irrigation water supply compared to CVWD water, and water is one of the more significant operating expenses, most of the interviewees used a combination of CVWD water and pumped groundwater to irrigate their crops. In some cases, the CVWD water is used as a supplemental supply for additional volume, and in some cases, it is purchased to blend with groundwater to achieve a more desirable water quality for sensitive crops.

In addition, it was related during the interviews that some of the greenhouse operations in the western portion of the Basin near Arroyo Paredon, where documented conditions of relatively poor water quality exist, operate onsite reverse osmosis units to treat their water to adequate quality for any salt-sensitive crops grown in the greenhouses. In any case, the availability of CVWD water as a supplemental supply is an important factor in the management of agricultural properties in the Basin, as is the current practice of treating poorer quality groundwater onsite before irrigation application. These conditions were in place at the time of SGMA implementation in 2015. Therefore, they are not considered undesirable conditions, and it is not the goal of SGMA implementation in the Basin to achieve conditions wherein these practices are no longer required.

During discussions regarding the use of groundwater during the recent drought, a few significant facts were determined:

- No wells in the Basin are known to have gone dry because of a decline in water levels during the drought.
- Only one agricultural well in the Basin was identified as having had to lower the pump in the well because of a decline in water levels in the well during the drought. While it is acknowledged that well maintenance work such as this is an unwanted operational expense, it is not uncommon during the long-term use of agricultural wells, and it does not rise to the level of a significant and unreasonable undesirable condition in the Basin.
- No agricultural operations were required to implement reductions of crops, fallowing, or any other measures that caused them significant economic hardships.
- Between pumped groundwater, treated groundwater, and CVWD water, farmers in the Basin were able to maintain their operations and continue production through the drought.

[7] The four GSPAC members interviewed were Jim Bailard, Ivan Van Wingerden, Scott Van Der Kar, and Robert Abbott.
[8] The local manager interviewed was Rick Shade.

- The CVWD was able to maintain deliveries without significant operational constraints and deliver adequate water for municipal and agricultural customers during the drought.
- Given these observations of operations during the drought, it can be stated that no significant and unreasonable undesirable effects were experienced during the drought.

After it was established that significant and unreasonable effects had been avoided during the recent drought, the members of the TCC and the GSPAC discussed whether it might be advantageous to the beneficial users in the Basin (particularly the agricultural community) to use water level data from the drought as an acceptable level at which to set the minimum thresholds in the RMS wells. Proceeding from the supposition that no undesirable effects had been encountered at the groundwater levels observed during the drought, there was discussion and analysis about whether water levels lower than those observed during the recent drought could be suggested as minimum thresholds and, if so, how much lower than recent water levels would be acceptable. Because of the lack of private domestic wells in the Basin, the primary beneficial users in the Basin are the agricultural users and CVWD, the primary potable supply agency in the Basin. To estimate the level of impact on existing well users in the Basin from setting minimum thresholds lower than the recent lows, a well impact analysis was performed using the well data maintained by the CVWD. The methodology used in this well impact analysis is described below.

Existing data provided by the CVWD were used in the analysis. Water levels from the fall 2018 groundwater elevation contour map prepared for the CVWD's annual report were used as representative of the lowest recent water levels. These contours were then converted to a spatial raster dataset, and fall 2018 groundwater elevations were assigned to each of 177 wells in the CVWD database. Then the raster surface was lowered in increments of 5 feet from 5 to 50 feet below the fall 2018 water levels, and the lowered water levels were compared against physical well data in the database, including screen interval and total water column in each well. Although the construction data for the wells in the database is incomplete, it was possible to use the impact analysis to assess the potential of significant impact to existing wells. Two pieces of data from each well in the database were used in the analysis to identify proxy conditions that might indicate significant impacts to existing wells: (1) well screen interval and (2) total water column in the well. As the water surfaces were lowered from 5 to 50 feet below the fall 2018 levels, well data were evaluated to measure the increased number of wells with the lowered water levels intersecting the well screen, and wells in which the lowered water levels resulted in lowering of the water column to less than 75 percent of the original water column (75 percent was used as a proxy indicator of a significant level of decline that could lead to unreasonable results).

Results indicated that a groundwater elevation surface 20 feet lower than the fall 2018 surface would result in an approximately 10 percent increase in the number of wells with water levels intersecting the well screen (18 additional wells), and that these lowered groundwater elevations would result in a 4 percent increase in the number of database wells (7 database wells) having a water column less than 75 percent of the original well water column. After presenting this information in public workshops and GSPAC meetings, stakeholders expressed some concern about the implications of defining a minimum threshold that would be lower than the lowest water level observed during the drought. The well impact analysis was performed to aid in identifying undesirable results and selecting minimum thresholds for the chronic lowering of groundwater levels sustainability indicator. Ultimately, the Carpinteria GSA decided not to pursue the approach of defining minimum thresholds lower than recent low water levels.

The Carpinteria GSA staff and the members of the TCC then evaluated an approach to defining minimum thresholds that used a running average of groundwater elevations to define the thresholds. Running averages of water levels for 3, 5, and 10 years were evaluated to assess whether this approach would be useful in defining minimum thresholds for this sustainability indicator. Ultimately, the GSA opted not pursue this approach because the complexities of the statistical approach might be difficult to convey to the public.

In the final analysis, given that no significant undesirable effects were reported in the Basin during the low water level conditions observed in the recent drought, and for the purposes of simplicity and ease of communication, the minimum thresholds for the chronic lowering of groundwater levels sustainability indicator was set in each RMS well at the observed lowest water level during the recent drought conditions. To avoid the circumstance where an additional dry year would result in immediate undesirable results, the undesirable results criteria are defined such that if the minimum thresholds are exceeded for three consecutive fall measurements (bracketing 2 calendar years), then this occurrence will trigger action to address the undesirable results.

5.5.2.2 Relationships Between Minimum Thresholds and Other Sustainability Indicators [§354.28(b)(2)]

§354.28 Minimum Thresholds.

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

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

(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.

Section 354.28 of the SGMA regulations requires a discussion of the relationship between the minimum thresholds for each sustainability indicator. Groundwater level minimum thresholds can potentially influence other sustainability indicators, as described below:

- **Reduction of Groundwater Storage.** Changes in groundwater elevations are directly correlated to changes in the amount of stored groundwater. Pumping at, or less than, the sustainable yield will maintain long-term average groundwater levels in the Basin. Likewise, the groundwater level minimum thresholds will maintain an adequate amount of groundwater in storage during an extended period when pumping is equal to or less than the sustainable yield. Thus, maintaining groundwater levels at or above minimum thresholds will not result in long-term significant and unreasonable reduction of groundwater storage.

- **Seawater Intrusion.** Seawater intrusion may be induced if groundwater elevations in the Basin near the coast are maintained at low levels for significant periods of time. As a result of the density difference between seawater and fresh water, coastal groundwater elevations higher than sea level can still result in seawater intrusion at depth. Pumping demands for municipal and agricultural beneficial uses during the past decades have resulted in a depression in the groundwater elevation surface over the center of the Basin (Figures 3-19 through 3-23). The Sentinel monitoring well in the C-zone (the deepest productive zone in the Basin) was recently installed along the coast and has begun to detect increasing levels of chloride during the past few years. If water levels are maintained at or below the minimum thresholds for significant periods of time without any offsetting projects or management actions, this could lead to conditions of lower water levels at the coast that could induce or fail to halt seawater intrusion from occurring. However, as will be discussed in Section 6, a project is being planned that will mitigate this potential risk.
- **Water Quality Degradation.** Protecting groundwater quality is critically important to all groundwater users in the Basin, particularly for drinking water and agricultural uses. Maintaining groundwater levels generally protects against water quality degradation for constituents of interest in the Basin in municipal supply wells due to groundwater management actions. Water quality in the Basin could theoretically be affected through two processes:
    1. Low groundwater levels caused by pumping in an area could cause deeper, poor-quality groundwater to flow into existing supply wells. There is no evidence that this has occurred in the Basin, and it is not considered to be a threat to water quality in the Basin. Because minimum thresholds are set to avoid significant declines of groundwater elevations below historically observed levels, and the historical low water levels did not result in water quality degradation, this is not expected to occur.
    2. Changes in groundwater levels arising from management actions implemented by the GSA to achieve sustainability could change groundwater gradients, which could cause poor-quality groundwater or plumes to flow laterally towards supply wells that would not have otherwise been impacted. There is no evidence that this is occurring in the Basin.
- **Land Subsidence.** A significant and unreasonable condition for subsidence is permanent pumping-induced subsidence that substantially interferes with surface land use and damages infrastructure. One cause of subsidence is dewatering and compaction of clay and peat-containing sediments in response to lowered groundwater levels. The groundwater level minimum thresholds are set at recently observed historical groundwater elevations, during which time no subsidence was known to occur. Therefore, the groundwater level minimum thresholds that have been established are unlikely to induce additional subsidence.
- **Interconnected Surface Water Depletions.** As discussed in Sections 3.2.6 and 5.10, available data indicate that there are no interconnected surface water systems in the Basin,

The minimum thresholds set for chronic lowering of groundwater levels are protective of all beneficial uses and users of groundwater and are not anticipated to result in significant and unreasonable effects for the other sustainability indicators, assuming the projects and/or management actions presented in this Plan to address seawater intrusion are implemented.

5.5.2.3 Minimum Thresholds in Relation to Adjacent Basins [§354.28(b)(3)]

§354.28 Minimum Thresholds.

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

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

The Basin is bounded to the west by the MGW. The shared boundary between the basins is not extensive, and the HCM posits that a groundwater divide separates the groundwater between the MGB and the Carpinteria Basin, and no significant flow has been observed or documented between the MGB and the Carpinteria Basin. Water budget results from recent modeling indicate an average of 50 AFY inflow from the MGB to the Carpinteria Basin. The two GSPs appear to be consistent in their understanding of aquifer conditions along their common boundary. It is not anticipated that actions associated with the Plan will have any significant impact that could alter the hydraulic communication between the two basins.

Additionally, the Carpinteria GSA has developed and maintained a cooperative working relationship with the Montecito GSA based on previous communications between the respective water districts. Hydrogeologic conditions near the basin boundary will be monitored, and any issues observed that may potentially affect the MGB will be communicated to the Montecito GSA.

5.5.2.4 Impact of Minimum Thresholds on Beneficial Uses and Users [§354.28(b)(4)]

§354.28 Minimum Thresholds.

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

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

The groundwater level minimum thresholds have been selected to protect beneficial uses in the Basin while providing a reliable and sustainable groundwater supply. This section briefly addresses the effects of the minimum thresholds on the beneficial uses and users in the Basin.

Municipal Supply Uses and Users. Municipal supply is a primary beneficial use in the Basin. Representatives of the CVWD have maintained a leading role in the development of this Plan through assuming lead roles in the GSA and the GSPAC. Additionally, the CVWD and the GSA are the primary sponsors and administrators of any projects and management actions that are to be incorporated into basin management during the 20-year- SGMA implementation period. The groundwater elevation minimum thresholds place a practical limit on the potential future increase of groundwater pumping in the Basin. The minimum thresholds have been selected not to exceed conditions that were observed during the recent drought. The CVWD was able to provide supply to all customers during the recent drought. However, additional water supply projects are needed due to changing surface water supply reliability, and in part to achieve sustainability within the 20-year implementation time frame. As the primary sponsor of any such projects, the impact of the minimum thresholds on the municipal supply beneficial users could be the necessity of financial sponsorship and implementation of projects, which could result in assumption of debt and rate increases for the paying customers in their service base.

Agricultural Uses and Users. The agricultural stakeholders in the Basin have maintained an active role during the development of this Plan. The groundwater elevation minimum thresholds place a practical limit on the acceptable lowering of groundwater levels in the Basin, thus conceptually preventing increased agricultural production beyond the current level of agriculture in the region without projects to augment water supply to the Basin. In the absence of other mitigating measures, this has the practical effect of potentially limiting the amount of groundwater pumping in the Basin. Limiting the amount of groundwater pumping could limit the additional amount and type of crops that can be grown in the Basin, which could result in capping the economic viability for some properties. The groundwater elevation minimum thresholds could therefore create an upper limit for the Basin's agricultural economy. This could have various effects on beneficial users and land uses, such as the following:

- There could be an economic impact on agricultural employees and suppliers of agricultural production products and materials. Many parts of the local economy rely on a vibrant agricultural industry, and they too may be impacted if irrigated agriculture is not expanded beyond current levels.
- Growth of city, county, and state tax rolls could be slowed or reduced because of the limitations imposed on agricultural growth and associated activities.

However, it should be noted that the projects and management actions discussed in Section 6 will be pursued to allow for continued agricultural pumping at recent levels.

Domestic Uses and Users. As discussed previously in Section 2.5.1, the CVWD supplies water to nearly 100 percent of residential and domestic users in the Basin. A CVWD records search identified only a two private wells being used for domestic supply in the Basin (both locations are capable of connecting to the CVWD distribution network, if desired). Therefore, the minimum thresholds are not expected to have any impact on domestic well uses and users.

Ecological Uses and Users. Groundwater elevation minimum thresholds protect the groundwater resource and the existing ecological habitats that rely on it at current conditions because they are set to avoid long-term declines in groundwater levels. As noted previously in this section, groundwater level minimum thresholds may limit increases in municipal and agricultural groundwater uses. Ecological land uses and users may benefit from this maintenance of municipal and agricultural groundwater uses at recent levels.

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

§354.28 Minimum Thresholds.

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

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

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

5.5.2.6 Quantitative Measurement of Minimum Thresholds [§354.28(a) and (b)(6)]

§354.28 Minimum Thresholds.

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

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

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

Groundwater level minimum thresholds will be directly measured from existing RMS wells. The groundwater level monitoring program will be conducted in accordance with the monitoring plan outlined in Section 4 and will consist of collecting groundwater level measurements that reflect non-pumping (static) conditions. The groundwater level monitoring program will be designed and conducted to meet the requirements of the technical and reporting standards included in the SGMA regulations.

It is acknowledged that there are potential data gaps in the Carpinteria Basin with respect to groundwater dependent ecosystems (GDEs), which the GSA can continue to pursue. GDEs are affected by groundwater elevations in their vicinity. Two areas of potential GDEs were identified that may require additional investigation during the first 5-year SGMA implementation period.

5.5.3 Measurable Objectives for Chronic Lowering of Groundwater Levels Sustainability Indicator [§354.30]

§354.30 Measurable Objectives.

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

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

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

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

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

The measurable objectives for chronic lowering of groundwater levels provide a target to be managed toward during the 20-year Plan implementation period to ensure conditions that avoid the occurrence of undesirable results. Measurable objectives for chronic lowering of groundwater levels are aspirational objectives that provide operational flexibility above minimum threshold levels to ensure that the Basin can be managed sustainably over a reasonable range of climate and hydrologic variability. Measurable objectives are subject to change during the 20-year Plan implementation period, as new information and hydrologic data become available.

5.5.3.1 Methodology for Setting Measurable Objectives

Measurable objectives were established to meet the sustainability goal and were based on trends in historical groundwater level data; historical precipitation data; review of data and strategies with the TCC; and input from the GSPAC, other public stakeholders, and the GSA management. The measurable objective levels were set so that: (1) natural variations in groundwater levels as were observed in the past during wet and dry periods are considered, (2) there is enough groundwater in storage to get through a multi-year drought as was observed in water years 2012 to 2021 with 2 wet years in water years 2017 and 2019 without undesirable results, and (3) water levels typical of pre-drought conditions are used to establish measurable objectives (i.e., measurable objectives are not reflective of drought conditions). Table 5-1 includes the estimated elevations for the measurable objectives established for the basin aquifer.

5.5.3.2 Measurable Objectives for the Principal Aquifer

The measurable objectives for the Basin RMS wells were selected using available groundwater elevation monitoring data and climatic data. They represent average conditions before the recent drought, and conditions observed during non-drought periods in the hydrographs of each RMS well. Table 5-1 includes the measurable objectives for the chronic lowering of groundwater levels sustainability indicator.

5.5.4 Interim Milestones for Chronic Lowering of Groundwater Levels Sustainability Indicator [§354.30(e)]

§354.30 Measurable Objective.

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

Interim milestones are required to be included in the Plan. Interim milestones show how the Basin would move from current conditions to meeting the measurable objectives in the 20-year Plan implementation horizon. Table 5-1 includes interim milestones at 5-year intervals toward the established measurable objectives.

The interim milestones were established by calculating equal intervals between the minimum threshold and the measurable objective, and then assigning proportional increases in groundwater levels with time. This approach assumes a relatively uniform change in water levels during the 20-year period, but hydrologic conditions and project implementation may be significantly variable.

5.6 Reduction of Groundwater Storage Sustainable Management Criterion

This section describes the SMC for the reduction of groundwater storage sustainability indicator. It defines undesirable results (Section 5.6.1), presents minimum thresholds (Section 5.6.2) and measurable objectives for each RMS in the monitoring network (Section 5.6.3), and provides interim milestones (Section 5.6.4). A number of alternative options for both minimum thresholds and measurable objectives were considered for each RMS after evaluation of the historical record of data at each well, assessment of trends of groundwater elevation declines and recovery, and input from stakeholders regarding their desired conditions.

Based on well-established hydrogeologic principles, the reduction of groundwater storage sustainability indicator is directly correlated to the chronic lowering of groundwater levels sustainability indicator, as described below.

5.6.1 Undesirable Results for Reduction of Groundwater Storage [§354.26(a)]

§354.26 Undesirable Results.

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

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

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

(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.

Per Section 354.26 of the SGMA regulations, locally defined significant and unreasonable conditions for the reduction of groundwater storage sustainability indicator were assessed based on the review of available historical groundwater data, stakeholder input during the public process, analysis of available data, and discussions with GSA staff. Based on well-established hydrogeologic principles, it is understood that the reduction of groundwater storage sustainability indicator is directly correlated to the chronic lowering of groundwater levels sustainability indicator. Significant and unreasonable changes in groundwater storage in the Basin are those that:

- May lead to long-term reduction of groundwater storage
- Interfere with other sustainability indicators

Assessment of groundwater in storage was evaluated using the same RMS network and associated water level minimum thresholds and measurable objectives as the chronic lowering of groundwater levels SMC. As additional data are collected in the monitoring network described in Section 4, new RMS sites may be established during the 20-year SGMA implementation period, and SMCs may be amended as determined by the GSA as new data are collected.

For the purposes of this Plan, the definition of undesired conditions for the reduction of groundwater storage sustainability indicator is as follows:

> *The Basin will be considered to have undesirable results if water levels in municipal supply wells decline to the point that they are in the screen, which could impact water supply operations, or if water levels in agricultural supply wells decline to the point that inadequate supply is available for farming operations, requiring fallowing or reduction of operations. The potential occurrence of undesirable results will be investigated and assessed if 33 percent or more RMSs for water levels within the Basin display exceedances of the minimum threshold groundwater elevation values for three consecutive fall measurements (bracketing 2 calendar years).*

5.6.1.1 Criteria for Establishing Undesirable Results §354.2(b)(2)

The criteria for defining undesirable results were established after discussion and consultations with GSA staff, the TCC, the GSPAC, and public stakeholders. Significant and unreasonable reduction of groundwater storage in the Basin is reflected in conditions that:

- Reduce the ability of the CVWD to deliver adequate water supplies for all beneficial users and uses in their service area.
- Cause significant financial burden to those who rely on the resources of the groundwater basin for their economic livelihood.
- Interfere with other SGMA sustainability indicators.

5.6.1.2 Potential Causes of Undesirable Results

Conditions that could potentially lead to an undesirable result include the following:

- **Increased Rates of Pumping in the Basin Aquifer.** If the amount of pumping in the Basin were to increase to the point where it significantly exceeds the long-term rate of recharge, then groundwater levels and storage may decline, which could affect basin well production and result in depletion of supply for beneficial uses,
- **Extended Drought.** Minimum thresholds are established based on reasonable anticipated future climatic conditions, based on the best available science and climatological models being used to characterize climate change currently in use. Extensive, unanticipated droughts more severe than those on record may lead to excessively low groundwater levels and undesirable results. Short-term impacts due to drought are anticipated in the SGMA regulations with recognition that management actions need sufficient flexibility to accommodate drought periods and ensure short-term impacts can be offset by increases in groundwater levels or storage during normal or wet periods.

5.6.1.3 Effects of Undesirable Results on Beneficial Users and Land Uses §354.2(b)(3)

The effects of these undesirable results on the beneficial users and uses are the same effects as those discussed for the chronic lowering of groundwater levels sustainability indicator.

The primary effects of undesirable results on the beneficial users in the Basin will be a reduction of supply available for municipal and agricultural uses. Undesirable results may occur from allowing three consecutive exceedances of the minimum thresholds in a small geographic area. The occurrence of three exceedances (bracketing a period of 2 years) in a network of nine RMS wells will result in an assessment of the occurrence of undesirable effects in the Basin.

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

5.6.2 Minimum Thresholds for Reduction of Groundwater Storage [§354.28(a),(b)(1),(c)(2),(d), and (e)]

§354.28 Minimum Thresholds.

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

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

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

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

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

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

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

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

In accordance with the SGMA regulation cited above, GSAs have the option of defining the minimum threshold metric as a calculated volume of groundwater in storage. Management of the Basin as established in this Plan will monitor changes in groundwater levels in the RMS well network as a proxy for the change in the reduction of groundwater storage sustainability indicator. As allowed by §354.36(b)(1) of the SGMA regulations, groundwater elevation data at the RMS will be reported annually as a proxy to track changes in the amount of groundwater in storage.

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

As additional hydrogeologic data are collected during the 20-year SGMA implementation period, and as these data are used to update the water budget analysis in the Basin, these minimum thresholds may be revisited by the Carpinteria GSA.

5.6.2.1 Information and Methods Used for Establishing Reduction of Groundwater Storage Minimum Thresholds [§354.28(b)(1)]

As detailed in Section 5.5, the primary source of data used to establish the minimum thresholds for the reduction of groundwater storage sustainability indicator is well construction data and groundwater elevation data historically maintained by the CVWD. The information used for defining the minimum thresholds and measurable objectives for the reduction of groundwater storage sustainability indicator includes:

- Historical groundwater elevation data from wells monitored by the CVWD and predecessor agencies.
- Depths, locations, and construction details of existing wells.
- Maps of current and historical groundwater elevation data.
- Input from stakeholders regarding significant and unreasonable conditions and desired current and future groundwater elevations communicated during public meetings and solicitation of public comment on various options of minimum thresholds and measurable objectives presented in the public forum.
- Results of modeling various project scenarios of future groundwater level conditions.

Reduction of groundwater storage minimum thresholds will be assessed by collecting water level measurements at the RMS well sites in the monitoring network presented in Section 4 (see Figure 4-3). These data will be used to monitor groundwater elevations and assess changes in groundwater in storage.

5.6.2.2 Relationships Between Minimum Thresholds and Other Sustainability Indicators [§354.28(b)(2)]

§354.28 Minimum Thresholds.

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

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

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

- **Chronic Lowering of Groundwater Levels.** Because groundwater levels will be used as a proxy for estimating changes of groundwater in storage, the reduction of groundwater storage SMC will not impact this sustainability indicator.

- **Seawater Intrusion.** Seawater intrusion may be induced if groundwater storage in the Basin is depleted, as expressed by groundwater levels in the Basin along the coast at depressed elevations for significant periods of time. As a result of the density difference between seawater and native groundwater, seawater intrusion may be induced when groundwater elevations are above sea level. Pumping demands for municipal and agricultural beneficial uses during the past decades have resulted in a reduction of storage in the central portion of the Basin, evidenced by a depression in the groundwater elevation surface over the center of the Basin (see Figures 3-19 through 3-23). The Sentinel monitoring well in the C-zone of the aquifer recently installed along the coast has begun to detect increasing levels of chloride during the past few years. If water levels along the coast are maintained at low elevations for significant periods of time without any offsetting projects or management actions, this could lead to conditions that could induce seawater intrusion. Minimum thresholds for seawater intrusion are defined as chloride concentrations in currently active wells (see Section 5.7). However, projects are being planned that will mitigate this potential risk (see Section 6).
- **Water Quality Degradation.** The minimum threshold proxy of long-term stability in groundwater levels helps minimize the potential for experiencing degraded groundwater quality or exceeding regulatory limits for COCs in supply wells by maintain water levels equal to or higher than those recently observed in the Basin.
- **Land Subsidence.** Subsidence has not historically been a significant issue in the Basin. Future groundwater levels would likely have to be substantially lower than are predicted to occur in the future to result in significant subsidence. Should significant and unreasonable subsidence be observed as a result of groundwater management in the Basin, the minimum thresholds for the reduction of groundwater storage sustainability indicator may be revisited by the Carpinteria GSA to avoid this circumstance.
- **Interconnected Surface Water Depletions.** As discussed in Sections 3.2.6 and 5.10, available data indicate that there are no interconnected surface water systems in the Basin.

5.6.2.3 Effects of Minimum Thresholds on Adjacent Basins [§354.28(b)(3)]

§354.28 Minimum Thresholds.

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

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

The MGB lies to the west of the Carpinteria Basin. The minimum thresholds for the reduction of groundwater storage sustainability indicator are not anticipated to significantly affect conditions in the MGB. Additionally, the Carpinteria GSA has developed and maintained a cooperative working relationship with the Montecito GSA based on previous and ongoing communications between the GSAs and water districts. Hydrogeologic conditions near the basin boundary will be monitored, and any issues observed that may potentially affect the MGB will be communicated to the Montecito GSA.

5.6.2.4 Impact of Minimum Thresholds on Beneficial Uses and Users [§354.28(b)(4)]

§354.28 Minimum Thresholds.

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

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

The minimum thresholds for reduction of groundwater storage and lowering of groundwater levels have been established to be protective of beneficial uses in the Basin while providing a reliable and sustainable groundwater supply. This section briefly addresses the effects of the minimum thresholds on the beneficial uses and users in the Basin.

Municipal Supply Uses and Users. Municipal supply is a primary beneficial use in the Basin. Representatives of the CVWD maintained a leading role in the development of this Plan through assuming lead roles in the GSA and the GSPAC. Additionally, the CVWD and the GSA are the primary sponsors and administrators of any projects and management actions that are to be incorporated into basin management during the 20-year SGMA implementation period. The reduction of groundwater storage minimum thresholds establish a practical limit on the potential future increase of groundwater pumping in the Basin. The minimum thresholds have been selected not to exceed conditions that were observed during the recent drought, during which time the CVWD was able to supply all customers in its service area. However, additional water supply projects are likely to be required to achieve sustainability within the 20-year implementation time frame. As the primary sponsor of any such projects, the impact of the minimum thresholds on the municipal supply beneficial users could be the necessity of assuming financial sponsorship and implementation of projects, which could result in assumption of debt and the potential for rate increases for the paying customers in their service base.

Agricultural Uses and Users. The agricultural stakeholders in the Basin have maintained an active role during the development of this Plan. The groundwater elevation minimum thresholds place a practical limit on the acceptable lowering of groundwater levels in the Basin, thus conceptually not allowing increased agricultural production beyond the current level of agriculture in the region without projects to supplement water supply to the Basin. In the absence of other mitigating measures, this has the practical effect of potentially limiting the amount of groundwater pumping in the Basin. Limiting the amount of groundwater pumping could limit the additional amount and type of crops that can be grown in the Basin, which could result in capping the economic viability for some properties. The groundwater elevation minimum thresholds could therefore create an upper limit for the Basin's agricultural economy. This could have various effects on beneficial users and land uses, such as the following:

- There could be an economic impact on agricultural employees and suppliers of agricultural production products and materials. Many parts of the local economy rely on a vibrant agricultural industry, and they too may be impacted if irrigated agriculture is not expanded beyond current levels.
- Growth of city, county, and state tax rolls could be slowed or reduced because of the limitations imposed on agricultural growth and associated activities.

However, it should be noted that the projects and management actions discussed in Section 6 will be pursued to allow for continued agricultural pumping at recent levels and alternatives to reductions in agriculture pumping.

Domestic Uses and Users. As has been discussed previously, the CVWD supplies water to nearly 100 percent of residential and domestic users in the Basin. A CVWD records search identified only a single well being used for domestic supply in the Basin (that location is capable of connecting to the CVWD distribution network, if desired). Therefore, the minimum thresholds are not expected to have any impact on domestic use in the Basin beyond those applicable to the municipal supply of residential and domestic users beneficial use previously discussed.

Ecological Uses and Users. Groundwater elevation minimum thresholds protect the groundwater resource and the existing ecological habitats that rely upon it at current conditions because they are set to avoid long-term declines in groundwater levels. As noted previously, groundwater level minimum thresholds may limit increases in municipal and agricultural groundwater uses. Ecological land uses and users may benefit from this reduction in non-de minimis and agricultural groundwater uses.

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

§354.28 Minimum Thresholds.

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

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

No federal, state, or local standards exist for reduction of groundwater storage.

5.6.2.6 Measurement of Minimum Thresholds [§354.28(b)(6)]

§354.28 Minimum Thresholds.

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

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

The measurement program for evaluating the minimum thresholds for reduction of groundwater storage will rely on the groundwater elevation monitoring program described previously for chronic lowering of groundwater levels (see Section 5.5). Groundwater levels (as a surrogate for change of groundwater in storage) that drop below the minimum threshold values for three consecutive fall measurements may indicate the presence of undesirable results.

5.6.3 Measurable Objectives for Reduction of Groundwater Storage Sustainability Indicator [§354.30(a),(c),(d), and (g)]

§354.30 Measurable Objectives.

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

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

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

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

The sustainability indicators for reduction of groundwater storage utilize groundwater levels as a proxy for direct measurement of groundwater storage. The same minimum thresholds and measurable objectives that protect against significant and unreasonable reduction in groundwater storage are used as SMCs to protect against chronic lowering of groundwater levels (see Table 5-1). These levels were selected using available groundwater elevation monitoring data and climatic data during the period of record. Measurable objectives may change after plan adoption during the 20-year SGMA implementation period, as new information and hydrologic data become available.

5.6.3.1 Information and Methods Used for Establishing Reduction of Groundwater Storage Measurable Objectives §354.30(b)

Measurable objectives for the reduction of groundwater storage sustainability indicator were established to meet the sustainability goal and were based on trends in historical groundwater level data, historical precipitation data, and input from the GSPAC, other public stakeholders, and the GSA Committee. The measurable objective levels were set so that: (1) natural variations in groundwater levels as were observed in the past during wet and dry periods are considered, and (2) there is enough groundwater in storage to get through a multi-year drought as was observed in water years 2012 to 2021 with 2 wet years in water years 2017 and 2019 without undesirable results, and (3) water levels typical of pre-drought conditions are used to establish measurable objectives (i.e., measurable objectives are not reflective of drought conditions). Table 5-1 includes the estimated elevations for the measurable objectives established for the basin aquifer.

5.6.3.2 Measurable Objectives for the Principal Aquifer

The measurable objectives for the Basin RMS wells were selected using available groundwater elevation monitoring data and climatic data. The measurable objectives are selected to represent average conditions before the recent drought, and conditions observed during non-drought periods in the hydrographs of each

RMS well. The measurable objectives for this sustainability indicator are the same as those established for the chronic lowering of groundwater levels sustainability indicator. Table 5-1 includes the measurable objectives for the reduction of groundwater storage sustainability indicator.

5.6.4 Interim Milestones for Reduction of Groundwater Storage Sustainability Indicator [§354.30(e)]

§ 354.30 Measurable Objective.

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

Interim milestones are required to be included in the Plan. Interim milestones demonstrate how the Basin would move from current conditions to meeting the measurable objectives during the 20-year Plan implementation horizon. While no undesirable effects on groundwater in storage have been observed in the Basin as a result of lowering of groundwater levels to date, interim milestones are being proposed to ensure that the GSA is on track for eliminating the storage deficit going forward. The GSA intends to move forward with selected projects and management actions (see Section 6) soon after plan submittal to ensure that groundwater levels recover to levels above the established minimum thresholds when non-drought rainfall conditions return. Table 5-1 includes interim milestones at 5-year intervals toward the established measurable objectives.

The interim milestones were established by calculating equal intervals between the minimum threshold and the measurable objective, and assigning proportional increases in groundwater levels during this time period. This approach assumes a relatively uniform change in water level conditions during the 20-year period, but hydrologic conditions and project implementation may be significantly variable.

Regular updates to the water budget analysis during the 20-year SGMA implementation period will be evaluated to confirm that groundwater storage in the Basin is being maintained, and not declining to undesirable levels.

5.7 Seawater Intrusion Sustainable Management Criterion

Per Section 354.22 of the SGMA regulations, this section of the Plan describes the SMC for the seawater intrusion sustainability indicator. The definition of undesirable results is presented (Section 5.7.1), minimum thresholds (Section 5.7.2) and measurable objectives (Section 5.7.3) are presented for each RMS in the monitoring network, and interim milestones are presented (Section 5.7.4).

Unlike other SGMA basins that have documented conditions of seawater intrusion dating back decades (i.e., Santa Cruz Mid-County, Oxnard Plain, Salinas), evidence of seawater intrusion in the Basin is quite recent and is to date confined to data from a single monitoring well installed in 2019. No lengthy period of record of seawater intrusion exists in the Basin. However, the recent data are significant, and the GSA understands this sustainability indicator to be an important consideration for future groundwater management in the Basin, and a likely driver for future projects and management actions designed to avoid undesirable effects associated with seawater intrusion.

5.7.1 Undesirable Results for Seawater Intrusion [§354.26(a),(b)(2),(c), and (d)]

§354.26 Undesirable Results.

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

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

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

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

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

The GSA has established the definition of significant and unreasonable seawater intrusion into the Basin as:

> *Seawater moving inland to the point where groundwater produced from currently active wells exhibits increased concentrations of chloride above the established secondary maximum contaminant level (MCL) for drinking water of 250 ppm.*

To date, seawater intrusion is not known to have impacted any active wells in the Basin. It is one of the goals of this GSP to maintain this condition, and to avoid impacts to beneficial users from seawater intrusion. As discussed previously, to date, elevated chlorides have only been detected in the C-zone Sentinel well. Increased groundwater monitoring will be implemented along the coast in the western portion of the Basin to manage the potential occurrence of seawater intrusion in the Basin.

5.7.1.1 Criteria for Establishing Undesirable Results §354.2(b)(2)

The criteria for defining undesirable results were established after discussion and consultations with GSA staff, the TCC, the GSPAC, and public stakeholders. Significant and unreasonable seawater intrusion in the Basin is reflected in conditions allowing inland migration of brackish or saline groundwater to the geographic extent where it is expressed as increased chloride concentrations in currently active production wells in the Basin. A chloride isocontour along a line defined by currently active production wells nearest to the coast will be defined as the minimum threshold conditions. To monitor the isocontour, chloride concentrations in monitoring wells and production wells on both sides of the isocontour line must be monitored. Protective groundwater elevations at monitoring wells along the coast will be maintained via projects to prevent seawater intrusion from impacting active production wells.

Undesirable results would be conditions that:

- Reduce the ability of the CVWD to deliver adequate water supplies for all beneficial users and uses in their service area.
- Reduce the ability of agricultural stakeholders to maintain crops at recent levels as a result of increased salinity of irrigation water.
- Interfere with other SGMA sustainability indicators.

The practical effect of protecting against undesirable results arising from seawater intrusion is that it maintains groundwater quality along the coast at conditions comparable to current conditions, mitigating against the loss of economic productivity of agriculture in that area.

5.7.1.2 Potential Causes of Undesirable Results

Conditions that could potentially lead to an undesirable result include the following:

- **Increased Rates of Pumping in the Basin Aquifer.** If the amount of net pumping in the Basin were to increase significantly, it could lead to groundwater elevations inland from the coast that may exacerbate long-term conditions that allow inland migration of brackish and saline groundwater, if no offsetting projects or management actions are implemented to mitigate against migration of brackish or saline groundwater. If protective groundwater elevations are not maintained along the coast, this could potentially result in conditions leading to seawater intrusion.
- **Extended Drought.** Minimum thresholds are established based on reasonable anticipated future climatic conditions, based on the best available science and climatological models being used to characterize climate change currently in use. Extensive, unanticipated droughts more severe than those on record may lead to excessively low groundwater levels, that could allow seawater intrusion if no offsetting projects or management actions are implemented.

5.7.1.3 Effects of Undesirable Results on Beneficial Users and Land Uses §354.2(b)(3)

The primary negative effect on beneficial uses and users of seawater intrusion is that the Basin groundwater supply along the coast could exhibit increased salinity, impacting the use of groundwater for both municipal and agricultural purposes. The secondary maximum contaminant level (SMCL) for chloride is 250 mg/L; a SMCL indicates a taste and odor issue. Water with this chloride concentration is still drinkable. However, municipal supply could require higher levels of treatment, with the associated increased cost for supplying potable water to its customer base. Many of the agricultural operations in the western part of the Basin along the coast are greenhouse operations that either augment well water with District water to attain desired water quality or route their well water through a treatment unit to attain the desired quality. However, undesirable effects could force an increase in these practices, affecting the economics of the agriculture in the area.

Increased salinity of irrigation water could result in agricultural stakeholders experiencing reduced crop yields, or necessitating the purchase of additional CVWD water for blending with groundwater or for direct irrigation, depending on individual crop-specific tolerances of different plants.

5.7.2 Minimum Thresholds for Seawater Intrusion [§354.28(a),(b)(1),(c)(3),(d), and (e)]

§ 354.28 Minimum Thresholds.

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

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

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

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

(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:

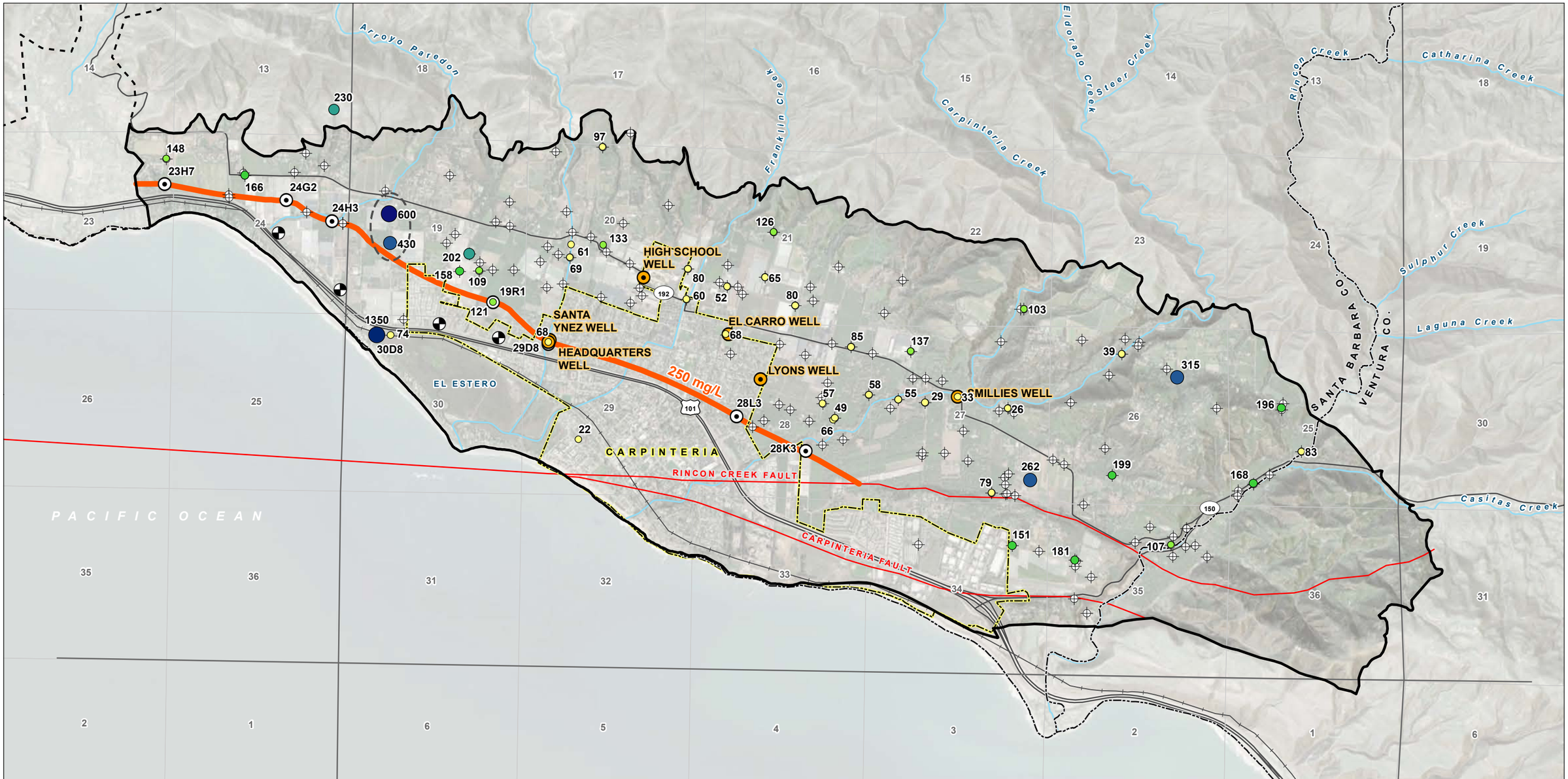
(A) Maps and cross-sections of the chloride concentration isocontour that defines the minimum threshold and measurable objective for each principal aquifer.

(B) A description of how the seawater intrusion minimum threshold considers the effects of current and projected sea levels.

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

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

Seawater intrusion minimum thresholds for the Basin are defined as a chloride isocontour of 250 mg/L sub-parallel to the coast along a line defined by currently active wells in the Basin (see Figure 5-10). The isocontour stops at the intersection with the Rincon Creek Fault, because uplifted fault blocks of bedrock along this fault truncate the productive sedimentary zones of the basin aquifer; therefore, seawater intrusion is not expected southeast of the Rincon Creek Fault. Construction of additional coastal monitoring wells similar to the Sentinel wells (A-, B-, and C-zone wells) are planned as part of the 5-year implementation plan to more definitively characterize water quality conditions in the aquifer along the coast. As of 2022, only the C-zone Sentinel well (perforated at 1020 to 1120 ft bgs) has indicated rising concentrations of chloride in the Basin. Additionally, the GSA recognizes that a seawater barrier project may need to be considered for longer term implementation, after additional hydrogeologic data are gathered from the expanded Sentinel well monitoring effort (see Section 6).



LEGEND

Maximum Chloride Concentration in mg/L (2015 - 2021)

- < 100
- 101 - 150
- 151 - 200
- 201 - 250
- 251 - 500
- > 500

- MT Isocontour at 250 mg/L
- CVWD District Well
- Proposed RMS Well (Active)
- Proposed Monitoring Well
- Existing Monitoring Well
- Active Well
- CVWD Database Well

All Other Features

- Carpinteria Groundwater Basin
- Montecito Groundwater Basin
- County Boundary
- City Boundary
- Fault
- Railroad
- Major Road
- Watercourse

FIGURE 5-10

Seawater Intrusion Isocontour SMC

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

N

0 1,500 3,000 4,500
feet

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_5\Figure5-10_Sea_Water_Intrusion_RMS.mxd, npalmer

5.7.2.1 Information and Methods Used for Establishing Seawater Intrusion Minimum Thresholds [§354.28(b)(1)]

The primary source of data used to establish the minimum thresholds for the seawater intrusion sustainability indicator is well construction data, groundwater elevation data, and water quality data historically maintained by the CVWD. The information used for defining the minimum thresholds and measurable objectives for the seawater intrusion sustainability indicator includes:

- Review of water quality data from wells monitored by the CVWD.
- Locations of currently active wells in the Basin.
- Review of data from the recently installed Sentinel wells.
- Regulatory criteria for chlorides.
- Historical coastal and basin-wide groundwater elevation data from wells monitored by the CVWD and predecessor agencies.
- Depths and locations of existing wells.
- Input from stakeholders regarding significant and unreasonable conditions communicated during public meetings and solicitation of public comment on various options of minimum thresholds and measurable objectives presented in the public forum.
- Information regarding potential future beneficial uses of groundwater between the coast and identified currently active wells.
- Estimates of potential inland groundwater velocities along the coast.

Figure 5-10 presents the maximum observed chloride concentrations from 2015 through 2021 at wells that have been monitored by the CVWD. Inspection of this figure indicates that chloride concentrations across the Basin are predominantly lower than the SMCL for chloride of 250 mg/L. One of the two notable exceptions includes the area in the western part of the Basin in the vicinity of Arroyo Paredon, which exhibits significantly elevated chloride concentrations in comparison to the rest of the Basin. However, this trend has been observed as part of the basin characterization of ambient groundwater quality (likely associated with surface water quality in Arroyo Paredon Creek) and is not understood to be a result of seawater intrusion. Agricultural operations in this area have continued through the recent drought for greenhouse crops, row crops, and orchards in this area, using both groundwater and District water to provide irrigation. Second, some wells in the eastern portion of the Basin in the vicinity of Shepherd Mesa have existing data in excess of 250 mg/L. This area is located north of the fault blocks that truncate the extension of the aquifer strata out beneath the ocean; therefore, it is not understood to be at risk of seawater intrusion. These data are understood to be part of the naturally variable water quality conditions in the Basin.

The Sentinel well cluster installed in 2019 has provided real-time data on conductivity, and quarterly sampling of chloride and total dissolved solids (TDS) (see Figure 3-32 through 3-34). These wells have provided the only chloride data to date that indicate elevated concentrations of chloride along the coast in the aquifer sediments. It is anticipated that among the first activities undertaken during the 5-year implementation will be installation of additional monitoring wells along the coast, to more robustly characterize chloride concentrations and associated water quality indicators in the area of concern along the coast.

SGMA allows for the utilization of groundwater elevations as a proxy criterion for minimum thresholds for seawater intrusion. This Plan does not choose to use this approach, opting to define the minimum thresholds as a chloride isocontour. However, the successful achievement of this minimum threshold will

depend on the maintenance of protective groundwater elevations along the coast to prevent inland migration of brackish groundwater.

Initial model runs were performed to demonstrate the feasibility of the barrier concept. As a result of the lack of data regarding aquifer parameters along the coast, these efforts were not carried through to the point of conceptual design, where the number of wells or necessary injection rates were calculated. After additional data are collected in the first 5-year SGMA implementation period, future modeling evaluations of projected conditions with respect to seawater intrusion will reference protective groundwater elevations using the Ghyben-Herzberg principle to calculate freshwater equivalent heads necessary to maintain the minimum thresholds against seawater intrusion while simulating projects and management actions to achieve this minimum threshold.

Seawater intrusion minimum thresholds will be assessed by collecting water samples at current and future coastal monitoring wells and at the RMS well sites in the monitoring network presented in Figure 4-4. This data and observed water levels from the wells will be used to monitor aquifer conditions and assess changes in conditions that could lead to seawater intrusion.

As an initial attempt to estimate groundwater flow velocities along the coast, a simple calculation was performed using available data for hydraulic conductivity, groundwater gradient, and velocity. Groundwater velocity can be estimated using the equation:

$V = Ki/n$ where

V = velocity (feet per day [ft/day])

K = Hydraulic Conductivity (ft/day)

i = Hydraulic gradient (unitless), and

n = effective porosity

Little data with respect to hydraulic conductivity or other physical characteristics of the productive strata of the basin aquifer are available. Estimates for hydraulic conductivity used in the groundwater model for the productive strata range from approximately 10 ft/day to about 50 feet per day, so this range of values is used in this analysis. The groundwater elevation contour map for fall 2020 was examined, and a hydraulic gradient of about 0.003 was calculated from the contours. An estimate of 0.15 is used as a typical estimate of effective porosity for sand. Using these values, calculated groundwater velocities ranging from 73 to 365 feet per year are obtained. These groundwater velocities indicate that there is likely time available in the initial 5-year SGMA implementation period to gather additional data to better characterize the water quality and aquifer conditions required to assess seawater intrusion conditions, and to properly design a barrier project, should the decision be taken to implement such a project. It is recognized that this is a simple calculation based on idealized assumptions. However, the equation is based on long-standing and commonly accepted hydrogeologic principles, and represents a reasonable first estimate of groundwater velocity along the coast.

There are several significant data gaps with respect to the understanding of the seawater intrusion sustainability indicator along the coast. Data density characterizing important details of the stratigraphic geometry of the productive zones of the aquifer will need to be improved. Data describing aquifer parameters such as transmissivity, storativity, and porosity for the A-zone, B-zone, and C-zone along the coast are not well characterized. The lack of this physical data results in significant uncertainty with respect to anticipated flow rates of potential injection wells, and the resulting chloride concentrations related to these projects and management actions. However, minimum thresholds have been established using the

best available data and understanding of the aquifer. The minimum thresholds may be revised as additional data are gathered during the 20 -year SGMA implementation period.

5.7.2.2 Relationships Between Minimum Thresholds and Other Sustainability Indicators [§354.28(b)(2)]

§ 354.28 Minimum Thresholds.

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

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

The minimum thresholds for seawater intrusion are defined in terms of chloride concentrations along an isocontour line classified by currently active wells in the Basin. These minimum thresholds could theoretically influence or be influenced by other sustainability indicators, as outlined below:

- **Chronic Lowering of Groundwater Levels.** Additional lowering of groundwater levels beyond current levels along the coast between the Rincon Creek fault and the boundary with the MGB could lead to conditions conducive to seawater intrusion if no offsetting projects or management were undertaken. Planning is underway for projects and management actions that will improve conditions to maintain groundwater elevations at protective levels along the coast (see the Carpinteria Advanced Purification Project and the Seawater Barrier Project, both discussed in Section 6).
- **Reduction of Groundwater Storage.** Minimum thresholds for reduction of groundwater storage are equivalent to those identified for chronic lowering of groundwater levels. Additional lowering of groundwater levels beyond current levels along the coast between the Rincon Creek fault and the boundary with the MGB could lead to conditions conducive to seawater intrusion. Planning has been initiated for projects and management actions that will improve conditions to maintain groundwater elevations at protective levels along the coast.
- **Water Quality Degradation.** The minimum thresholds for degraded water quality for nitrate, arsenic, and boron are not anticipated to have any relational impact with the seawater intrusion minimum thresholds. Unintruded RMS wells in the inland portion of the Basin are assigned a lower minimum threshold chloride concentration (142 mg/L) based on agricultural thresholds published in the Basin Plan (RWQCB et al., 2019) and observed recent chloride concentrations in those wells. If the seawater intrusion minimum thresholds are sustained through projects and management actions, this would indicate no significant landward migration of poorer quality groundwater. Regular monitoring of coastal and inland basin wells will be maintained to monitor this relationship.
- **Land Subsidence.** Subsidence has not historically been a significant issue in the Basin. Achieving seawater intrusion minimum thresholds will require similar or increased groundwater elevations along the coast, which would not be expected to result in subsidence in the Basin.
- **Interconnected Surface Water Depletions.** As discussed in Section 5.10, available data indicate that there are no interconnected surface water systems in the Basin.

5.7.2.3 Effects of Minimum Thresholds on Adjacent Basins [§354.28(b)(3)]

§ 354.28 Minimum Thresholds.

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

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

The MGB borders the Carpinteria Basin to the west. If seawater intrusion minimum thresholds are successfully achieved, this implies groundwater elevations along the coast similar to current conditions or increased groundwater elevations above current conditions along the coast. This could theoretically have a small effect by reducing groundwater inflow from the MGB because of increased groundwater elevations in the Carpinteria Basin.

The minimum threshold isocontour is set slightly inland, so it is possible that water quality conditions between the coast and the isocontour could change. The Carpinteria GSA has developed and maintained a cooperative working relationship with the Montecito GSA based on previous and ongoing communications between the GSAs and water districts. Hydrogeologic conditions near the basin boundary will be monitored during the initial 5-year SGMA implementation period, and any issues observed that may potentially affect the MGB will be communicated.

5.7.2.4 Impact of Minimum Thresholds on Beneficial Uses and Users [§354.28(b)(4)]

§ 354.28 Minimum Thresholds.

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

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

The area between the chloride concentration isocontour and the ocean (see Figure 5-10) is characterized by three areas with differing land uses (see Figure 2-2). The effects on beneficial uses and users for each of these are addressed separately.

In the southeastern portion of this area between Franklin Creek and the Rincon Creek fault, the area is primarily residential. There are no water supply wells in this area, and all residences are served potable water by the CVWD. Additionally, much of this area is likely protected from seawater intrusion by the geologic offset along the Rincon Creek fault, as discussed in Section 3. As a result of these circumstances, the seawater intrusion minimum threshold is not anticipated to have any impact on beneficial uses in the area.

The Carpinteria Salt Marsh Preserve estuary (El Estero estuary) is an ecological reserve and has no active wells. The seawater intrusion minimum threshold is not anticipated to have any impact on beneficial uses in this area. The area between the estuary and the isocontour is predominantly commercial/residential and is served by CVWD. As a result, the seawater intrusion minimum threshold is not anticipated to have any impact on beneficial uses in this area.

The area between the estuary and the MGB boundary and the isocontour is predominantly occupied by agricultural operations, most of which are greenhouse operations. (This includes the Arroyo Paredon watershed, which is known to have poorer groundwater quality than the rest of the Basin.) As documented during the agricultural interviews conducted for this Plan, many of the greenhouse agricultural operations either use CVWD water to blend, or run their pumped groundwater through reverse osmosis treatment units to maintain the desired water quality necessary for their individual crops. Because the isocontour line locations are defined by currently active wells based on CVWD records, the seawater intrusion minimum threshold is not anticipated to have any negative impact on beneficial uses in this area. Successful attainment of the minimum threshold will have a positive impact on beneficial users by maintaining water quality along the coast.

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

§ 354.28 Minimum Thresholds.

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

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

No federal, state, or local standards currently exist for seawater intrusion.

5.7.2.6 Quantitative Measurement of Minimum Thresholds [§354.28(b)(6)]

§ 354.28 Minimum Thresholds.

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

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

Minimum thresholds for seawater intrusion will be measured through biannual groundwater sampling for chlorides and general chemistry in the seawater intrusion RMS well network (see Figure 4-4), and through quarterly sampling of the existing Sentinel well cluster. In addition, all new monitoring wells installed along the coast (conceptual locations presented in Figure 5-10, with specific locations to be determined according to access and land availability) will be sampled quarterly and outfitted with transducers for continuous monitoring of groundwater elevations. Laboratory results from these samples will be used to determine chloride concentrations along the coast and the isocontour in relation to the minimum threshold isocontour. Groundwater sampling will be conducted in accordance with the sampling protocols outlined in Appendix G.

5.7.3 Measurable Objectives for Seawater Intrusion Sustainability Indicator [§354.30(a),(c),(d), and (g)]

§ 354.30 Measurable Objectives.

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

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

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

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

The measurable objective chloride isocontour has the same physical location as the minimum threshold isocontour displayed on Figure 5-10. Many of the wells defined as RMS wells along the isocontour line do not have any historical chloride data at the time of the development of this Plan. The maximum recent chloride data for a well along this line is 121 mg/L at well 19R1. Two wells north of the isocontour line along the extreme western portion of the line, north of 23H7 and 24G2, show recent chloride concentrations of 148 and 166 mg/L. Given these data, the GSA decided to establish the measurable objective for chloride along the isocontour line at 150 mg/L. This implies that it will be acceptable for chloride concentrations along the isocontour line to fluctuate between 150 and 250 mg/L during the 20-year SGMA implementation period.

However, a significant data gap exists with respect to the established minimum thresholds and measurable objectives along the isocontour line location. Of the eight wells identified as RMS wells for seawater intrusion, only two wells (19R1 and 29D8) have recent chloride data. At the time of this Plan development, the GSA has commenced outreach to the individual well owners to obtain permission to access and sample the wells to establish a baseline of data for chloride along the isocontour line.

5.7.4 Interim Milestones for Seawater Intrusion Sustainability Indicator [§354.30(e)]

§ 354.30 Measurable Objectives.

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

The measurable objective chloride isocontour of 150 mg/L is partially defined by RMS wells that currently have chloride concentrations below that threshold. Contrary to other coastal basins with seawater intrusion, the detection of elevated chlorides in groundwater in the Basin resulting from seawater intrusion are confined to a single location. There is a significant data gap with respect to geographic and lateral distribution of chlorides in groundwater along the coast. Additionally, projects and management actions included in this Plan are designed with the objective of preventing any current seawater intrusion from advancing inland. The strategy for defining measurable objectives for seawater intrusion is to maintain chloride concentrations at their current levels. With that approach, interim milestones for seawater intrusion are established equivalent to the measurable objective of 150 mg/L for each 5-year increment. These interim milestones may be revised as additional data on chloride in the coastal area is collected during the SGMA implementation period.

5.8 Water Quality Degradation Sustainable Management Criterion

This section describes the SMC for the water quality degradation sustainability indicator. It defines undesirable results (Section 5.8.1), presents minimum thresholds (Section 5.8.2) and measurable objectives for each RMS in the monitoring network (Section 5.8.3), and provides interim milestones (Section 5.8.4).

The purpose of the water quality degradation sustainability indicator in SGMA is to protect against any degradation of groundwater quality as a result of groundwater management under the Plan. SGMA is not intended to serve as a mandate to improve water quality within the Basin beyond conditions indicated by historical water quality data. This sustainability indicator takes into consideration protection of municipal drinking water supplies and agricultural uses of groundwater in the Basin. For municipal supply wells, federal and state regulatory standards (MCL and SMCL) established by the State Water Resources Control Board Division of Drinking Water and U.S. Environmental Protection Agency (EPA) were used to establish thresholds. For agricultural uses, thresholds were established after evaluating water quality objectives presented in the Basin Plan (RWQCB et al., 2019), and evaluating historical water qulaity data for Basin wells during the period of record. The Carpinteria GSA is not charged with managing groundwater quality unless it is indicated that water quality degradation is caused by groundwater pumping in the Basin, or the Carpinteria GSA implements a project that degrades water quality. Figure 4-5 displays the RMS well network established for degraded water quality.

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

§ 354.26 Undesirable Results.

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

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

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

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

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

SGMA regulations § 354.28(c)(2) states that "The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin."

Per SGMA regulations, the degraded groundwater quality undesirable result is a quantitative combination of groundwater quality minimum threshold exceedances. The undesirable results for the water quality degradation sustainability indicator as defined for the purposes of this Plan are as follows:

> *The Basin will be considered to have undesirable results if, for any 5-year period during SGMA implementation, an increase in groundwater quality minimum threshold exceedances as a result of groundwater management is observed at 33 percent or more of the representative monitoring sites in the Basin, in relation to 2015 basin conditions.*

The undesirable conditions for water quality degradation in the Basin are based on the goal of fewer than 33 percent of the RMSs for water quality exceedances that can occur as a result of Plan-related groundwater management activities during the next 5-year management period.

Specifics regarding the definition of the minimum thresholds used in defining the undesirable results are detailed in the following sections. Table 5-2 presents a summary of the minimum thresholds defined for the water quality degradation sustainability indicator.

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

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

5.8.1.1 Criteria for Establishing Undesirable Results

Criteria used to establish the undesirable results for water quality degradation sustainability indicator are observed water quality data and trends that:

- Reduce capacity of public water supply systems or unreasonably increase costs for public or private water supply.
- Result in constituent concentrations above regulatory primary drinking water standards at supply wells.
- Reduce crop production.

5.8.1.2 Potential Causes of Undesirable Results

Conditions that could potentially lead to an undesirable result include the following:

- **Changes to Basin Pumping Patterns or Quantities**. If the rates or locations of groundwater pumping change as a result of projects or management actions implemented under this Plan, these changes could induce movement of groundwater toward supply wells with concentrations of COCs at concentrations above historical background concentrations at supply wells.
- **Groundwater Recharge**. Active recharge with imported water or captured runoff could alter groundwater flow patterns, potentially resulting in movement of COCs toward supply wells at concentrations above historical background at supply wells. Recharge of poorer water quality water than native groundwater could lead to an undesirable result (note that permitting requirements generally preclude this circumstance).

5.8.1.3 Effects of Undesirable Results on Beneficial Users and Uses

As defined in this Plan, undesirable results are established to prevent water quality degradation within the Basin because of the implementation of any projects or management action conducted for the management of groundwater in the Basin under this Plan. This limits the potential impacts of undesirable water quality on beneficial users in the Basin. However, potential effects of undesirable results include:

- Increased water treatment costs for public or private supply wells
- Reduced agricultural production

5.8.2 Minimum Thresholds for Water Quality Degradation [§354.28(b)(1)

§ 354.28 Minimum Thresholds.

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

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

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

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

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

Section 354.28(c)(4) of the SGMA regulations states that "The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin." The purpose of the minimum thresholds for COCs in the Basin is to avoid increased degradation of groundwater quality from baseline concentrations since enactment of SGMA in January 2015. Minimum thresholds established for contaminants and for salts and nutrients are presented in the following subsections and summarized in Table 5-2.

Table 5-2. Minimum Thresholds for the Water Quality Degradation Sustainability Indicator

Constituent	MT	RMS Locations	Rationale
Arsenic	10 µg/L	5 CVWD supply wells	MCL is the federal regulation for drinking water CVWD is the only potable water supplier in Basin
Nitrate (as N)	10 mg/L	5 CVWD supply wells	MCL is the federal regulation for drinking water CVWD is the only potable water supplier in Basin
TDS	1,000 mg/L	5 CVWD supply wells and 6 monitoring wells	MT set at SMCL
Chloride	142 mg/L	5 CVWD supply wells and 6 monitoring wells	MT set at the Basin Plan's "no problem" agricultural threshold
Boron	0.75 mg/L	5 CVWD supply wells and 6 monitoring wells	MT set at Basin Plan agricultural threshold for other coastal basins

Notes

µg/L = micrograms per liter

CVWD = Carpinteria Valley Water District

MCL = maximum contaminant level

mg/L = milligrams per liter

MT = minimum threshold

N = nitrogen

RMS = representative monitoring site

SMCL = secondary maximum contaminant level

TDS = total dissolved solids

5.8.2.1 Information and Methods Used for Establishing Water Quality Degradation Minimum Thresholds §354.28(b)(1)

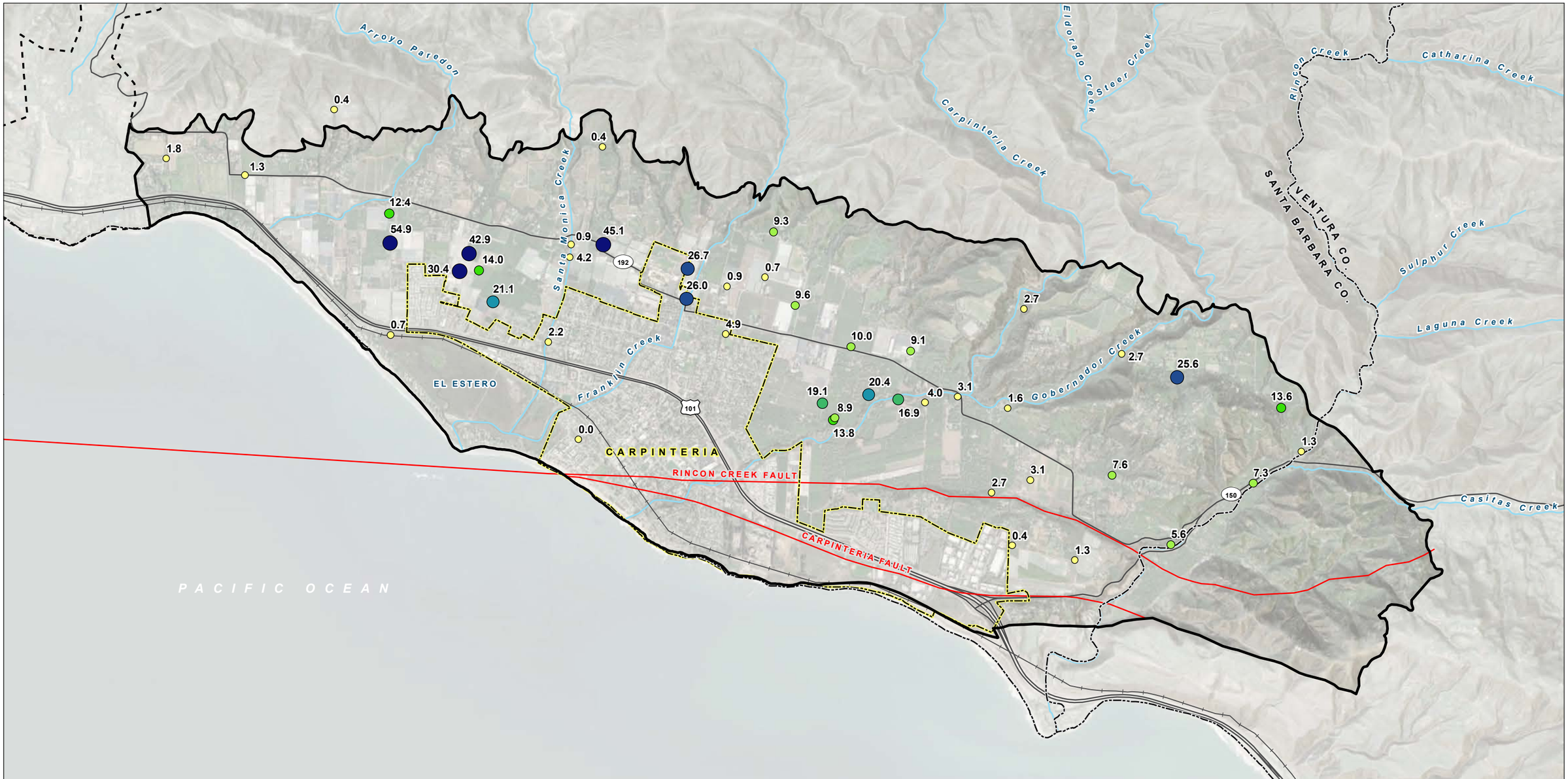
The information used for establishing the water quality degradation minimum thresholds included:

- Historical groundwater quality data from production and agricultural wells in the Basin
- Federal and state primary and secondary drinking water quality standards (Title 22 of the CCR)
- RWQCB Basin objectives for groundwater quality (2019) for TDS
- Feedback about significant and unreasonable conditions from GSPAC members, GSA staff members, and public stakeholders

Based on the review of groundwater quality in Section 3, water quality in the basin is generally good. There is a recognized area of the Basin in the west near Arroyo Paredon where the groundwater is observably more highly mineralized and of poorer quality than in other parts of the Basin (see Figures 5-11 through 5-14). Water quality objectives established under SGMA are not intended to improve ambient water quality conditions in this area. The primary COCs that exist for agricultural wells and public supply wells are:

- Nitrate
- Arsenic
- TDS
- Chloride
- Boron

Figures 5-11 through 5-14 display the maximum concentration of each nitrate, TDS, chloride, and boron in sampled groundwater from 2015 through 2021. (No data for arsenic is presented because it was not detected in basin groundwater samples during this period.) These data are considered as representative of recent ambient groundwater quality conditions in the Basin. These data were considered when establishing minimum thresholds for the water quality degradation sustainability indicator. For the COCs that have established primary MCLs (nitrate and arsenic), the minimum threshold is set equivalent to the primary MCL. For TDS, the minimum threshold is established at the SMCL of 1,000 mg/L. For boron, the minimum threshold is established at 0.75 mg/L, based on review of historical data and RWQCB Basin Plan Median Groundwater objectives for the Central and Southern Coast. Table 5-2 presents the minimum thresholds for the COCs.



LEGEND

Maximum Nitrate* Concentrations in mg/L (2015 - 2021)

- < 5
- >5 - 10
- >10 - 15
- >15 - 20
- >20 - 25
- >25 - 30
- >30

All Other Features

- Carpinteria Groundwater Basin
- Montecito Groundwater Basin
- County Boundary
- City Boundary
- Fault
- Railroad
- Major Road
- Watercourse

NOTE

*Data represents NO3 (as N) values.

FIGURE 5-11

Maximum Nitrate Concentrations (2015 - 2021)

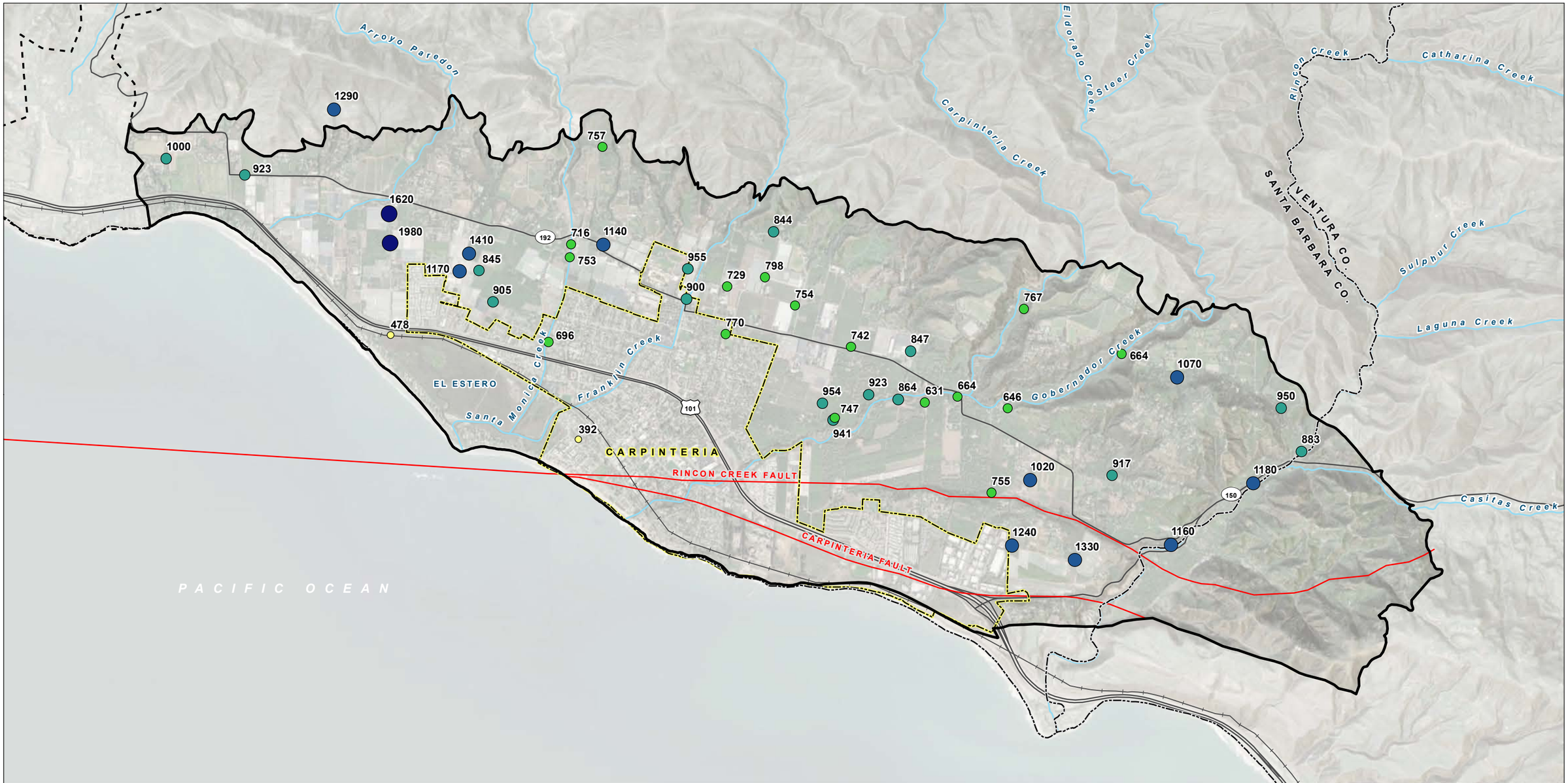
Carpinteria Groundwater Basin
Groundwater Sustainability Plan

N

0 1,500 3,000 4,500
feet

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_5\Figure5-11_Max_Nitrate.mxd, iramos



LEGEND

Maximum TDS Concentrations in mg/L (2015 - 2021)

- < 500
- 501 - 600
- 601 - 800
- 801 - 1000
- 1001 - 1500
- > 1500

All Other Features

- Carpinteria Groundwater Basin
- Montecito Groundwater Basin
- County Boundary
- City Boundary
- Fault
- Railroad
- Major Road
- Watercourse

FIGURE 5-12

Maximum TDS Concentrations (2015 - 2021)

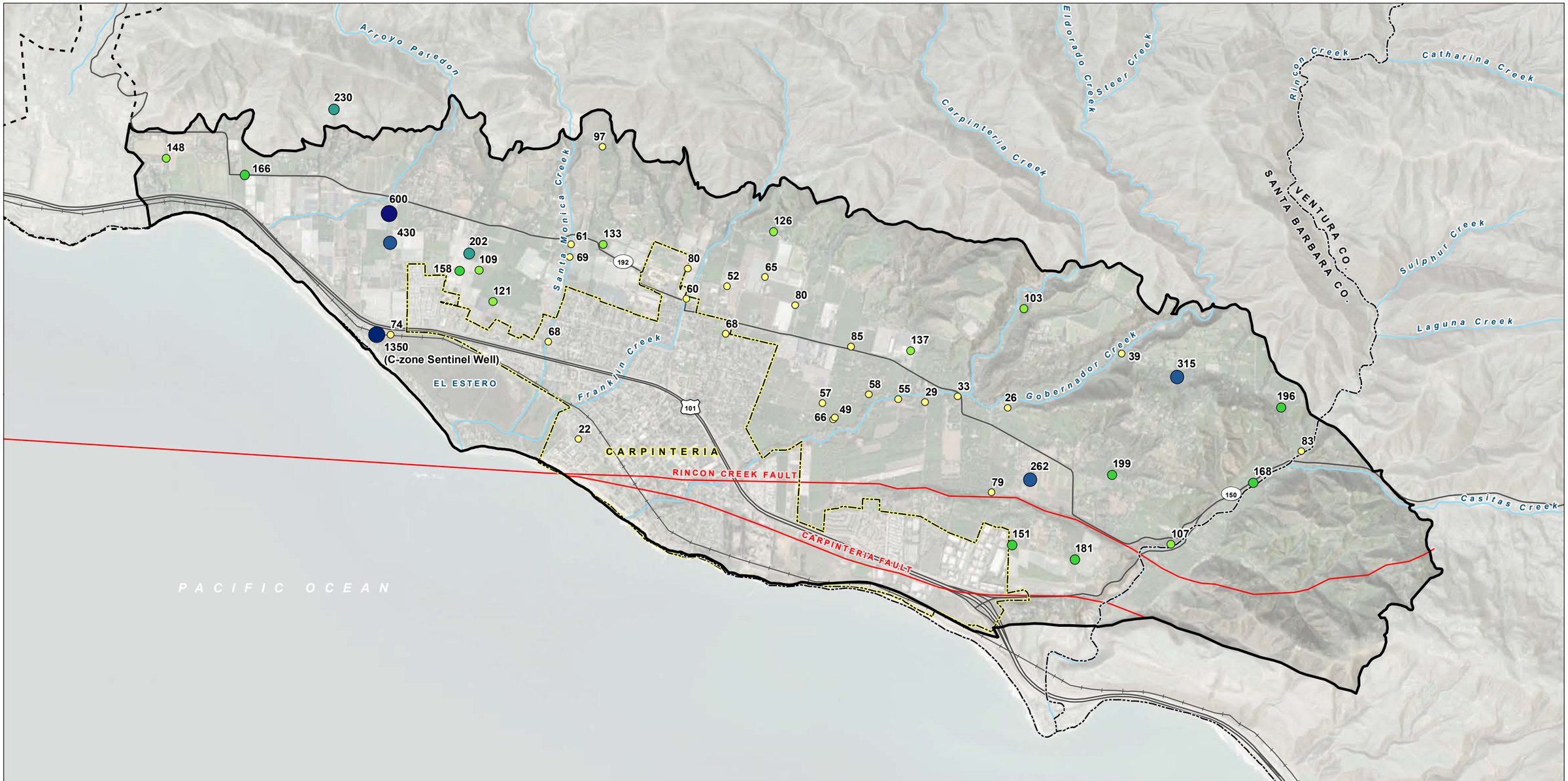
Carpinteria Groundwater Basin
Groundwater Sustainability Plan

N

0 1,500 3,000 4,500
feet

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_5\Figure5-12_Max_TDS.mxd, iramos



LEGEND

Maximum Chloride Concentration in mg/L (2015 - 2021)

- < 100
- 101 - 150
- 151 - 200
- 201 - 250
- 251 - 500
- > 500

All Other Features

- Carpinteria Groundwater Basin
- Montecito Groundwater Basin
- County Boundary
- City Boundary
- Fault
- Railroad
- Major Road
- Watercourse

FIGURE 5-13

Maximum Chloride Concentrations (2015 - 2021)

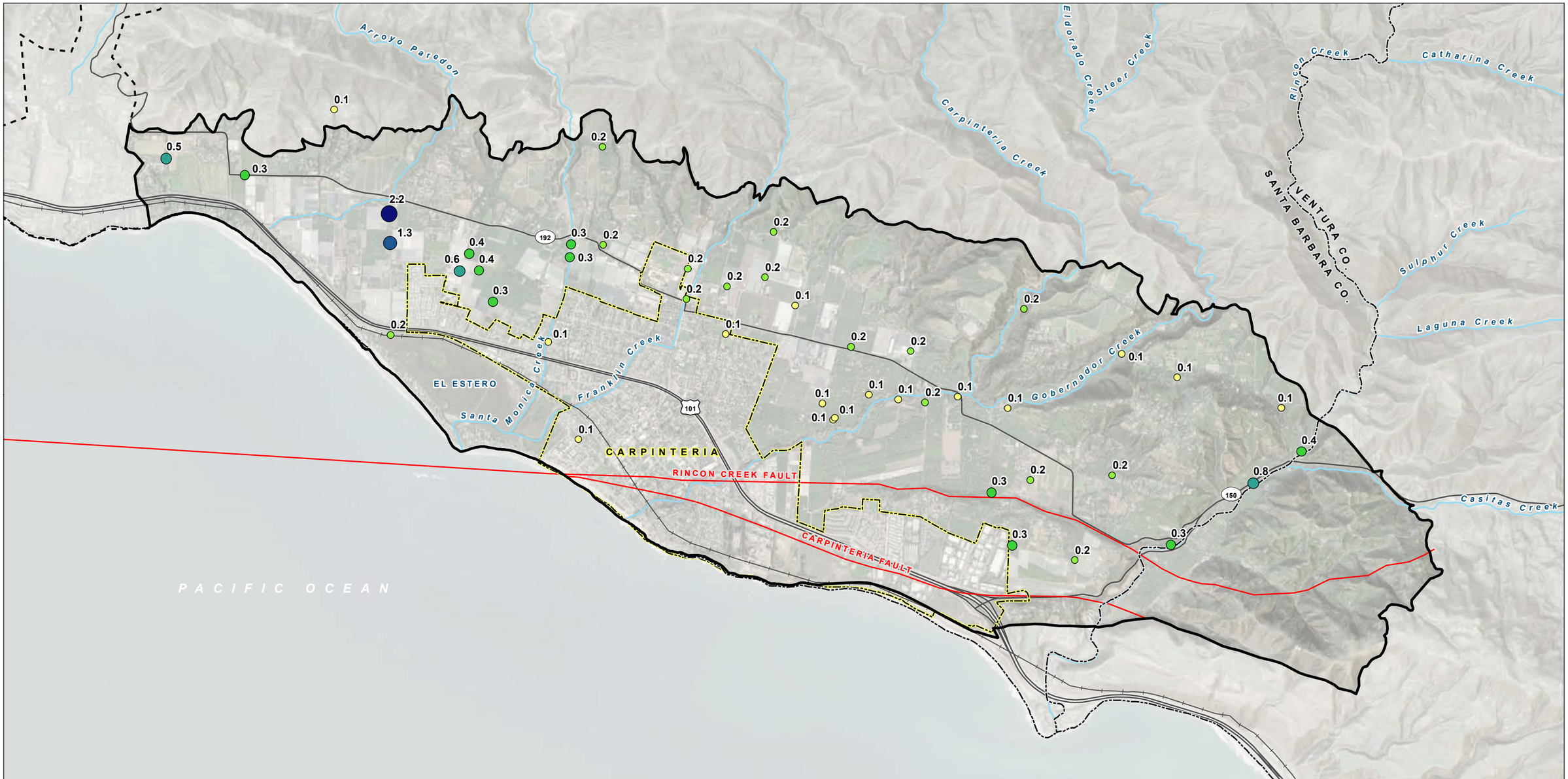
Carpinteria Groundwater Basin
Groundwater Sustainability Plan

N

0 1,500 3,000 4,500
feet

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_5\Figure5-13_Max_Chloride.mxd, iramos



LEGEND

Maximum Boron Concentration in mg/L (2015 - 2021)

- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.5 - 0.8
- 0.9 - 1.5
- 1.6 - 2.2

All Other Features

- Carpinteria Groundwater Basin
- Montecito Groundwater Basin
- County Boundary
- City Boundary
- Fault
- Railroad
- Major Road
- Watercourse

FIGURE 5-14

Maximum Boron Concentrations (2015 - 2021)

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

N

0 1,500 3,000 4,500
feet

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_5\Figure5-14_Max_Boron.mxd, iramos

5.8.2.2 Relation of Minimum Thresholds to Other Sustainability Indicators §354.28(b)(2)

The groundwater quality minimum thresholds were set for each of the five constituents in Table 5-2. These minimum thresholds were derived from analysis of existing ambient water quality data measured in the Basin and applicable regulatory criteria.

No actions regarding the minimum thresholds for water quality will impact other sustainability indicators. However, preventing migration of poor-quality groundwater (for example, actions required to prevent additional migration of contaminant plumes) could theoretically limit activities needed to achieve minimum thresholds for other sustainability indicators, as discussed below:

- **Chronic Lowering of Groundwater Levels.** Groundwater quality minimum thresholds could influence groundwater level minimum thresholds by limiting the types of water that can be used for recharge to raise groundwater levels or locations where it could be recharged. Water used for recharge cannot exceed any of the groundwater quality minimum thresholds.
- **Reduction of Groundwater Storage.** Nothing in the groundwater quality minimum thresholds promotes pumping in excess of the sustainable yield. The groundwater quality minimum thresholds will not result in impact on the groundwater storage minimum threshold.
- **Seawater Intrusion.** The seawater intrusion sustainability indicator is defined by water quality data (chloride concentrations). However, this is limited to the coast, along the front of potential seawater intrusion between the western basin boundary and the Rincon Creek Fault (see Figure 4-4). The water quality monitoring network (see Figure 4-4) is distributed throughout the Basin as a whole (see Figure 4-5). The minimum thresholds established for the water quality degradation sustainability indicator throughout the Basin will not specifically impact the seawater intrusion SMCs.
- **Land Subsidence.** Nothing in the groundwater quality minimum thresholds promotes a condition that will lead to additional subsidence. Therefore, the groundwater quality minimum thresholds will not impact the land subsidence sustainability indicator.
- **Interconnected Surface Water Depletions.** As discussed in Sections 3.2.6 and 5.10, available data indicate that there are no interconnected surface water systems in the Basin.

5.8.2.3 Effects of Minimum Thresholds on Neighboring Basin

The minimum thresholds established for water quality in the Carpinteria Basin will have no impact on hydraulic conditions at the MGB boundary. Therefore, there is no anticipated effect from the water quality minimum thresholds on conditions in the MGB.

5.8.2.4 Effects of Minimum Thresholds on Beneficial Users and Uses

§354.28 Minimum Thresholds.

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

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

The practical effect of the minimum thresholds for the water quality degradation sustainability indicator is that they collectively deter any significant long-term changes to groundwater quality in the Basin due to groundwater management. Therefore, basin management that prevents the undesirable results from occurring will not constrain the use of groundwater, nor have a negative effect on the beneficial users and uses of groundwater.

Municipal Uses and Users. The water quality degradation minimum thresholds generally benefit the urban water users in the Basin. Limiting the number of additional wells where COCs could exceed MCLs or SMCLs ensures an adequate supply of quality groundwater for municipal use. Management of the Basin to prevent occurrences of these minimum thresholds may also result in lowered costs for water treatment. Existing federal, state, public health, or municipal regulations may require that a well not be used if MCLs are exceeded and may supersede any actions related to SGMA-related minimum threshold exceedances. Wells in violation of federal, state, and local water quality regulations will have to comply with the specific regulations.

Agricultural Land Uses and Users. The groundwater quality minimum thresholds generally benefit the agricultural water users in the Basin by maintaining groundwater quality suitable for use in agriculture. For example, limiting the number of additional agricultural supply wells that may exceed COC concentrations (for example, TDS) that could reduce crop production ensures that a supply of usable groundwater will exist for beneficial agricultural use.

Domestic Land Uses and Users. The water quality degradation minimum thresholds generally benefit the single domestic water user in the Basin by maintaining current and acceptable water quality.

Ecological Land Uses and Users. Although the water quality degradation minimum thresholds do not directly benefit ecological uses, it can be inferred that the water quality degradation minimum thresholds will indirectly benefit ecological water uses in the Basin because these thresholds limit future increases in concentrations of COCs from what they are now, or prior to what they were when SGMA was enacted in January 2015.

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

§354.28 Minimum Thresholds.

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

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

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

5.8.2.6 Measurement of Minimum Thresholds [§354.28(b)(6)]

§354.28 Minimum Thresholds.

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

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

Degraded groundwater quality data will be directly measured from analytical laboratory results for samples collected from RMS wells. Exceedances of regulatory standards and minimum thresholds will be assessed on an annual basis in accordance with the monitoring program (see Section 4). Groundwater quality sampling will be monitored under existing CVWD/GSA programs.

5.8.3 Measurable Objectives for Water Quality Degradation Sustainability Indicator [§354.30(a),(b),(c),(d), and (g)]

§354.30 Measurable Objectives.

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

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

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

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

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

Groundwater quality should not be degraded as a result of actions taken under this Plan. Groundwater quality for COCs across the Basin should be maintained within the ranges indicated by historical data. Therefore, the measurable objectives for the water quality degradation sustainability indicator are the same as the minimum thresholds.

5.8.3.1 Information and Methods Used for Establishing Water Quality Degradation Measurable Objectives [§354.30(b)]

Available historical water quality collected by the CVWD were used in establishing both the minimum thresholds and the measurable objectives for the five water quality COCs discussed in the Plan. Regulatory criteria and water quality objectives were also considered when defining these SMCs.

Because protecting groundwater quality is important to the beneficial users and uses of the groundwater resource, the measurable objective for the water quality degradation sustainability indicator is the same as the minimum thresholds. The GSA will review any exceedance to determine its significance to groundwater management in the Basin, and any potential responses.

5.8.4 Interim Milestones for Water Quality Degradation Sustainability Indicator § 354.28(a)(e)

§354.30 Measurable Objective.

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

Interim milestones show how the Carpinteria GSA anticipates moving from current conditions to meeting the measurable objectives. No significant and unreasonable results have been observed in the Basin in association with degraded groundwater quality. For water quality, measurable objectives are set at the minimum thresholds. Interim milestones are set for each 5-year interval following Plan adoption. The interim milestones for water quality degradation are the same as the minimum threshold for each COC for 5, 10, and 15 years after plan adoption.

5.9 Land Subsidence Sustainable Management Criterion

This section describes the SMC for the land subsidence sustainability indicator. It defines undesirable results (Section 5.9.1), presents minimum thresholds (Section 5.9.2) and measurable objectives for each RMS in the monitoring network (Section 5.9.3), and provides interim milestones (Section 5.9.4).

5.9.1 Undesirable Results for Land Subsidence [§354.26(a)]

§354.26 Undesirable Results.

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

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

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

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

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

Land subsidence is the phenomenon of the land surface elevation in a given area declining from previous elevations. This phenomenon may be caused by several factors, including declines of groundwater elevations and subsequent compaction of sediments. Land subsidence has not historically been an issue in the Basin. No instances of damage to property or infrastructure in the area are known.

Locally defined significant and unreasonable undesirable results for the land subsidence sustainability indicator are land surface elevation change rates that cause impacts to infrastructure, groundwater supply, land use, or property interests.

Monitoring of this sustainability indicator will not be based on groundwater data. Conditions will be monitored using satellite-measured subsidence data (Interferometric Synthetic Aperture Radar [InSAR] data) collected and maintained by DWR.

For clarity, this SMC references the combination of two related component concepts of subsidence to define significant and unreasonable conditions:

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

By regulation, the land subsidence undesirable result is a quantitative combination of these two components. For the Basin, no long-term subsidence impacts on infrastructure (i.e., commercial buildings, homes, and utility infrastructure) because of groundwater management is considered acceptable. The undesirable results for the land subsidence sustainability indicator as defined for the purposes of this Plan are as follows:

> The Basin will be considered to have undesirable results if measured subsidence using InSAR data, between June of one year and June of the subsequent year, is greater than 0.1 foot in any one year, or a cumulative 0.5 foot in any 5-year period, as a result of groundwater management under the Plan, or any long-term permanent subsidence that is attributable to groundwater management.

Therefore, the ground surface subsidence undesirable results include the following:

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

5.9.1.1 Criteria for Establishing Undesirable Results § 354.26(b)(2)

The criteria used to establish the undesirable results for land subsidence sustainability indicator are based on the satellite-measured subsidence data (InSAR data) collected by DWR.

5.9.1.2 Potential Causes of Undesirable Results § 354.26(b)(1)

Conditions that may lead to an undesirable result include:

- A shift in pumping locations, which could lead to a substantial decline in groundwater levels.
- Shifting a significant amount of pumping and causing groundwater levels to fall in an area that is susceptible to subsidence, such as certain areas underlying the City of Carpinteria, could trigger subsidence in excess of the minimum threshold.

5.9.1.3 Effects of Undesirable Results on Beneficial Users and Land Uses § 354.26(b)(3)

The effects of these undesirable results on the beneficial users and uses include damage to critical infrastructure, and damage to private or commercial structures that would adversely affect their uses. Staying above the minimum threshold will avoid the subsidence undesirable conditions.

5.9.2 Minimum Thresholds for Land Subsidence § 354.28(c)(5)

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

Based on an analysis of potential errors in the InSAR data, as discussed in the following section, the subsidence minimum threshold is:

> The InSAR-measured subsidence between June of one year and June of the subsequent year shall be no more than 0.1 foot in any single year and a cumulative 0.5 foot in any 5-year period at any location in the Basin, resulting in no measurable permanent subsidence.

5.9.2.1 Information and Methods Used for Establishing Land Subsidence Minimum Thresholds § 354.28(b)(1)

Minimum thresholds were established to protect groundwater supply, land uses, and property interests from substantial subsidence that may lead to undesirable results. Changes in surface elevation are measured using InSAR data available from DWR. The general minimum threshold is the absence of measurable long-term land subsidence as a result of pumping in the Basin. The InSAR data provided by DWR, however, are subject to measurement error. The statewide level errors for the total vertical displacement measurements between June 2015 and June 2021 are as follows:

1. The error between InSAR data and continuous GPS data is 16 mm (0.052 feet) with a 95 percent confidence level.
2. The measurement accuracy when converting from the raw InSAR data to the maps provided by DWR is 0.048 feet with 95 percent confidence level. (TRE ALTAMIRA, 2023)

For the purposes of this Plan, the errors for InSAR data are considered the sum of errors 1 and 2, for a combined total error of 0.1 foot. Thus, measured land surface change of greater than 0.1 foot will be assessed as potential subsidence. As discussed previously, land surface elevations can fluctuate naturally. Therefore, subsidence will be monitored at the same time each year to reduce the effect of general fluctuations of elevation on observed data.

5.9.2.2 Relation of Minimum Thresholds to Other Sustainability Indicators § 354.28(b)(2)

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

- **Chronic Lowering of Groundwater Levels.** The land subsidence minimum thresholds are not expected to result in significant or unreasonable lowering of groundwater elevations. Continued decline of water levels beyond historically observed conditions could potentially lead to subsidence. However, it has not been an issue in the Basin to date.
- **Reduction of Groundwater Storage.** The land subsidence minimum thresholds will not affect the amount of pumping and will not result in a significant or unreasonable change in groundwater storage. Continued decline of groundwater in storage beyond historically observed conditions could potentially lead to subsidence. However, it has not been observed to be an issue in the Basin to date.
- **Seawater Intrusion.** The land subsidence sustainability indicator is not expected to have any effect on the seawater intrusion sustainability indicator, which is measured by chloride concentrations, and which relies on maintaining or increasing current water levels.

- **Water Quality Degradation.** The land subsidence minimum thresholds will not change the groundwater flow directions or rates and, therefore, will not result in a significant or unreasonable change in groundwater quality.
- **Interconnected Surface Water Depletions.** As discussed in Sections 3.2.6 and 5.10, available data indicate that there are no interconnected surface water systems in the Basin.

5.9.2.3 Effect of Minimum Thresholds on Neighboring Basins § 354.28(b)(3)

The land subsidence minimum thresholds are set to prevent any long-term subsidence that could harm infrastructure. Therefore, the subsidence minimum thresholds will not prevent the MGB from achieving sustainability.

5.9.2.4 Effects of Minimum Thresholds on Beneficial Users and Land Uses § 354.28(b)(4)

The land subsidence minimum thresholds are set to prevent subsidence that could harm infrastructure, so it is defined to protect beneficial users and uses in the Basin. Available data indicate that there is currently no subsidence occurring in the Basin that affects infrastructure. Staying above the minimum threshold will avoid the land subsidence undesirable result and protect the beneficial uses and users from impacts to infrastructure and interference with surface land uses.

5.9.2.5 Relevant Federal, State, or Local Standard § 354.28(b)(5)

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

5.9.2.6 Method for Quantitative Measurement of Minimum Thresholds § 354.28(b)(6)

Minimum thresholds will be assessed using DWR-supplied InSAR data.

5.9.3 Measurable Objectives for Land Subsidence § 354.30(a)-(g)

The measurable objective for subsidence is the same as the minimum threshold because land subsidence cannot be detected via InSAR at rates less than selected for the minimum threshold.

5.9.3.1 Information and Methods Used for Establishing Land Subsidence Measurable Objectives § 354.3(b)

The measurable objectives are set based on maintaining current conditions and changes are measured by DWR-supplied InSAR data.

5.9.4 Interim Milestones for Land Subsidence Sustainability Indicator § 354.28(a)(e)

Interim milestones show how the GSAs anticipate moving from current conditions to meeting the measurable objectives. Interim milestones are set for each 5-year interval following Plan adoption. Land subsidence measurable objectives are set at current conditions of no long-term subsidence. There is no change between current conditions and sustainable conditions. Therefore, the interim milestones are identical to the minimum thresholds and measurable objectives.

5.10 Interconnected Surface Water Depletions Sustainable Management Criterion

Natural hydraulic connections can exist between shallow groundwater systems and overlying streams. These surface water bodies can be gaining (receiving discharge from the alluvial aquifer) or losing (discharging water to the alluvial aquifer). These relationships change in magnitude and direction across wet and dry cycles, and may change in response to changes in surface water operations or groundwater management practices. Interconnected surface water depletions occur when there are decreased gains or increased losses in volumes of streamflow caused by lowered groundwater elevations associated with groundwater use. At certain levels, depletions may have adverse impacts on beneficial uses of the surface water and may lead to undesirable results.

The HCM of the Basin present an analysis and discussion of interconnected surface water (see Section 3.2.6). Under normal surface water hydrologic conditions, the surface water flow regime is typical of uncontrolled streams along the southern coast, with flashy flows resulting from winter storm events emanating from the contributing watershed in the bedrock mountains upstream and flowing across the Basin toward the ocean. Data are presented in Figures 3-19 through 3-23 documenting that groundwater elevations in the principal aquifer are below the stream channels in the unconfined area of the Basin under all water year types. In the confined portion of the Basin, the principal aquifer is separated from the stream channel by the fine-grained sediments of the confining layer. Thus, it is concluded that there are no interconnected surface water systems in the Basin.

Because available data indicate that there are no interconnected surface water systems in the Basin, no SMCs are established for the depletion of interconnected surface water depletions sustainability indicator.

5.11 Management Areas

The GSA has no plans at this time to separate the Basin into different management areas.

SECTION 6:

Projects and Management Actions

SECTION 6: **Projects and Management Actions [Article 5, SubArticle 5]**

6.1 Introduction [§354.42, 354.44(a),(c), and (d)]

§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.

§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.

(c) Projects and management actions shall be supported by best available information and best available science.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

SGMA regulations require each Groundwater Sustainability Plan to include a description of projects and management actions necessary to achieve the basin sustainability goals and to respond to changing conditions in the basin. This section describes the projects and management actions that the Carpinteria GSA believes will, when implemented, help the Basin attain sustainability in accordance with § 354.42 and § 354.44 of SGMA regulations. The concepts for the proposed projects and management actions were developed during working sessions with GSA staff, meetings with the Carpinteria GSA TCC, meetings with the GSA GSPAC, and in public workshops between April and August, 2023. In the context of this GSP, projects are defined as activities supporting groundwater sustainability that require significant funding, infrastructure, and engineering support. Groundwater management actions generally refer to activities that support groundwater sustainability through policy and regulations without significant infrastructure requirements or capital investments. The effectiveness of the projects and management actions will be assessed based on the ability to avoid undesirable results as discussed in Section 5 of this Plan.

The Carpinteria GSA has developed a portfolio of potential projects and management actions that can be implemented in a phased manner as the conditions in the Basin dictate. Based on the results of the analysis that was performed in conjunction with the development of this Plan, the Carpinteria GSA concludes that the sustainability goals described in this Plan and required under the provisions of SGMA can be achieved through the implementation, as needed, of the projects and management actions described in Sections 6.3 through 6.14. This GSP categorizes listed projects as either Tier 1 projects or Tier 2 projects. Tier 1 projects are priority projects expected to be implemented within the first 5-year SGMA implementation period; three projects are identified as Tier 1 projects. Tier 2 projects are non-priority projects also identified for possible future consideration. It is expected that all management actions discussed in this section will be evaluated and implemented as appropriate in the first 5-year SGMA implementation period.

The Carpinteria GSA plans to continually monitor and assess its progress toward meeting the sustainable management criteria described in Section 5. Under conditions where minimum thresholds are projected to be achieved, the Carpinteria GSA will perform assessments to determine whether the trends are related to groundwater pumping, drought conditions, or other factors. If groundwater level data are trending toward reaching minimum thresholds as a direct consequence of groundwater pumping in the Basin, then the Carpinteria GSA will determine which additional project(s) and/or management action(s) to implement to address these conditions.

Management actions and potential future projects discussed in this section have been developed to address sustainability goals, measurable objectives, and undesirable results identified for the Basin in Section 5. Inclusion of projects and management actions in this Plan does not forego obligations under local, state, or federal regulatory programs. While the Carpinteria GSA has an obligation to oversee progress toward groundwater sustainability, it is not the primary regulator of land use, water quality, or environmental project compliance. The GSA will work with the County of Santa Barbara and the City of Carpinteria land use staff and other outside regulatory agencies, as needed, to ensure that projects and management actions undertaken pursuant to SGMA are in compliance with all applicable laws. The Carpinteria GSA may choose to collaborate with land use and regulatory agencies on specific overlapping interests, such as well permitting, water supply considerations, water quality monitoring, and oversight of projects developed within the Basin.

The projects and management actions in this Plan are designed to achieve several outcomes, including:

- Achieving groundwater sustainability within 20 years of Plan adoption.
- Preventing or reducing the impacts of seawater intrusion in the Basin.
- Ensuring that projects and management actions benefit all uses and users of groundwater.
- Developing sources of funding for GSA operations. Funds will also be used for future Basin monitoring and the implementation of projects and management actions that are identified by the GSA to be appropriate.
- Providing controls and incentives to manage groundwater pumping, if needed, to support sustainability goals.
- Supporting the health of groundwater-dependent ecosystems in the Basin.

The projects and management actions described in this section provide a framework for achieving sustainability. However, not all details for proposed projects are known at the time of adoption of this GSP. Specific details will need to be finalized and negotiated before many of the projects and management actions can be implemented. Costs for implementing projects and management actions may come from grant funding or from GSA operating revenues, depending on the project.. The array of projects and management actions developed by the GSA included in this section demonstrate that options and alternative paths exist to reach sustainability, and it may not be necessary to implement all the projects and management actions to maintain sustainability over the long term. Importantly, the projects and management actions included herein should be considered as a list of options that will be refined during Plan implementation, during which stakeholders will be provided additional opportunities to participate in the public process before projects and management actions are implemented.

SGMA regulation § 354.44 requires that projects and management actions described in the Plan include a discussion of the following:

- Relevant measurable objectives being addressed
- The expected benefits of the action
- The circumstances under which management actions or projects will be implemented
- How the public will be notified
- Relevant regulatory and permitting considerations
- Implementation schedules
- Legal authority required to take the actions
- Estimated costs

A summary of the projects and management actions identified by the Carpinteria GSA are listed below. Tier 1 projects are expected to be implemented within the first 5-year SGMA implementation period. Tier 2 projects will be evaluated and ranked during the first 5-year period for potential future implementation. Some projects or management actions may occur if drivers other than sustainability, such as water supply management flexibility, necessitate the implementation.

Tier 1 Projects

- Carpinteria Advanced Purification Project (CAPP)
- Sentinel Monitoring Well Network Expansion Project
- Local Infrastructure Water System Interties

Tier 2 Projects

- Carpinteria Seawater Intrusion Barrier Project
- Aquifer Storage and Recovery (ASR) Projects
- Recharge Enhancement Projects (Recharge Basins and Creek De-lining)
- Local Inter-Agency Water Delivery and Water Banking Agreements

Potential Management Actions

- Municipal Pumping Re-Distribution
- Well Registration and Metering Program
- Water Use Efficiency Programs
- Groundwater Model Revisions and Updates
- Address Data Gaps
  - Perform Video Surveys in Representative Wells that Currently Do Not Have Adequate Construction Records to Confirm Well Construction
  - Identify wells in the Ventura County portion of the Basin that can be monitored for water levels or water quality
  - Survey and Investigate Potential Groundwater Dependent Ecosystems (GDEs) in the Basin
  - Geophysical monitoring along the coast every 5 years to evaluate seawater intrusion.
- Perform Tier 2 Project and Management Action Feasibility and Ranking Study

As work on supplemental water supply and resource management efforts is ongoing, additional projects and/or management actions may be identified and added to the list in future Plan updates.

6.2 Project and Management Action Implementation Approach [§354.44(b)(6)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(6) An explanation of how the project or management action will be accomplished. If the project 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.

The amount of groundwater pumping in the Basin in recent years has exceeded the historically-estimated sustainable yield of about 3,600 to 4,000 AFY, as discussed in Section 3.3. Declining groundwater levels were documented in many areas during the recent drought. As a result, the Carpinteria GSA will initiate implementation of Tier 1 projects and selected management actions within the first 5-year SGMA implementation period. The effect of these activities will be reviewed and discussed in the Basin Annual Reports required under SGMA. Additional projects and management actions may be considered and implemented as necessary to avoid undesirable results.

In general, the management actions are intended to apply to all areas within the Basin. The management actions reflect basic Plan implementation requirements, such as necessary studies and early planning work, extraction measurement, monitoring, reporting and outreach, monitoring and filling data gaps, Annual Reports and Plan updates. The Carpinteria GSA anticipates that new policies, ordinances, and regulations may be necessary to implement some of the potential projects and management actions. Developing and adopting these policies, ordinances, and regulations would likely require substantial planning and negotiations among the Carpinteria GSA, local public, and various Basin stakeholders. Outreach and negotiations will be used to define and gain approvals for the scope and detail associated with GSA-imposed requirements after Plan adoption. Public meetings and hearings will be held, as needed, during the process of determining when and where in the Basin projects and management actions may be implemented to maximize their benefits to the Basin. Implementation of some of these actions may require compliance with CEQA and other legal requirements.

A feasible approach to funding implementation of the Plan will be developed in accordance with all state laws and applicable public process requirements. Public meetings and hearings will be held to hear input from the public, interested stakeholders, and groundwater pumpers. All input will be considered and incorporated into the decision-making process. The Carpinteria GSA will annually assess the progress that the implemented projects and management actions have made in stabilizing groundwater levels and meeting the sustainability metrics described in this Plan, and include discussion of this assessment in Annual Reports. The Carpinteria GSA will reassess the need for continuing and/or expanding planned actions. At a minimum, the reassessment process will be done as part of the required 5-year review and reporting on the Plan to DWR.

6.3 Carpinteria Advanced Purification Project (CAPP) [§354.44(b)(1), (d)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(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.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

6.3.1 Project Description

The CAPP is a Tier 1 project. The objective of the CAPP is to develop a new sustainable locally controlled future water supply for the Basin through implementation of an Indirect Potable Reuse (IPR) project. Planning, design, and funding for this project have been administered by the CVWD. The recent drought and projected changes to the area's existing water supplies highlight several water resource vulnerabilities and the need for a local, reliable water supply. Water supply issues include State Water Project (SWP) conveyance system capacity limitations, decreased reliability, and increasing costs to sustain reliability; potential yield reductions for the Cachuma Project, increased competition for Lake Cachuma storage, and vulnerability of Cachuma Project conveyance systems; and stricter groundwater management resulting from SGMA implementation. These vulnerabilities support the need for a local, reliable, and drought-resistant recycled water project.

In 2016, the District, along with Carpinteria Sanitary District (CSD) and City of Carpinteria (City), completed a *Recycled Water Facilities Plan* (RMS, 2016) that obtained partial funding by the California State Water Resources Control Board. This plan recommended alternatives for a recycled water project with groundwater recharge. The recommended project consists of producing approximately 1,100 AFY (1.0 million gallons per day [MGD]) of purified water from the CSD Wastewater Treatment Plant (WWTP) for injection into the local groundwater basin. After adequate retention time in the aquifer, the injected water ultimately will be recovered through existing CVWD production wells (Headquarters well and El Caro well) and used for District potable water supply. The ultimate project assumes an expansion of treatment capacity from 1.0 MGD to 1.5 MGD based on projected future increases in WWTP flows. The ultimate implementation of the CAPP includes the following facilities (see Figure 6-1):

- Advanced Water Purification Facility (AWPF) consisting of equalization tank, microfiltration (MF), reverse osmosis (RO), and an advanced oxidation process (AOP)
- Purified Water Pump Station, to be located on the WWTP site
- 6,100 linear feet (LF) of 12-inch conveyance pipeline from the Purified Water Pump Station to a well lateral split point, including CalTrans installation for the Linden Avenue overpass over U.S. Highway 101
- 2,000 LF of 8-inch conveyance pipeline from the well lateral split point to individual injection wells
- Up to three 14-inch injection wells with backwash pumps and a 42,000 gallon backwash tank

- Approximately 1,400 LF of 12-inch well backwash discharge piping to existing sanitary sewers.
- Six clustered monitoring wells
- Existing CVWD Headquarters and El Carro production wells

The CAPP is not a proposed project planned for possible future development; the project is moving forward as of the adoption of the GSP. Funding from numerous sources has been secured, Final design underway, construction elements have been scheduled, and the project is anticipated to be completed and ready for startup by 2027.

FIGURE 6-1

Carpinteria Advanced Purification Project (CAPP) Facilities

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_6

6.3.2 Relevant Measurable Objective(s) [§354.44(b)(1)]

§354.44 Projects and Management Actions.

(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.

Development of IPR projects through use of advanced treated wastewater as a water supply source is a proven technology with current projects either implemented or in the planning stages throughout California. Implementation of the CAPP would essentially introduce a new source of water supply to the Basin. Although in many years the project is likely to be operated using a put-and-take strategy, during wet years when surface water sources are plentiful, it is possible that the operation of the CAPP will result in a reduction of District pumping of native groundwater. Even during the put-and-take years, project operations would have the effect of raising water levels locally in the vicinity of the injection wells and reducing the pumping of native groundwater. Therefore, implementation of the CAPP will improve conditions relevant to the measurable objectives for the chronic decline of groundwater levels and the reduction of groundwater in storage sustainability indicators. Preliminary application of the Basin groundwater model indicates that implementation of the CAPP will result in small increases in groundwater elevations along the coast, and an ancillary reduction of inland flows from beneath the ocean. As such, implementation of the CAPP will also help produce conditions to achieve the measurable objectives for seawater intrusion in the Basin.

6.3.3 Implementation Triggers [§354.44(b)(1)(A)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

Implementation of the CAPP is proceeding at the time of the publication of this GSP. Therefore, there are no future triggers which will activate development of this project in the future.

6.3.4 Public Notice Process [§354.44(b)(1)(B)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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.

Notification to the public regarding the concept for this project and the need to implement this project to avoid undesirable conditions in ongoing groundwater management was provided during the public process associated with the development of this GSP. Additionally, during project development and the CEQA & permitting process, public notification consistent with the requirements of CEQA was carried out.

6.3.5 Permitting and Regulatory Process [§354.44(b)(3)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

The CVWD completed the CEQA review process for the CAPP in January 2019 and is currently completing the permitting phase of the project at the time of the adoption of this GSP. An addendum to the Environmental Impact Report (EIR) will likely be necessary as final design is completed. Construction of the CAPP will require a coastal development permit (CDP) and a conditional use permit (CUP) issued by the City of Carpinteria. Title 22, National Pollutant Discharge Elimination System and waste discharge requirement (WDR) permits issued by the SWRCB and the RWQCB will be required for the operation of the CAPP.[9]

[9] Personal communication, R. McDonald, CVWD GM, to D. O'Rourke, GSI Water Solutions, Inc. September 24, 2023.

6.3.6 Implementation Timeline [§354.44(b)(4)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

Planning for the CAPP in its current conception began with a regional reuse study and an IPR facilities study in 2015–2016. CVWD and CSD agreed to the terms of the project in 2017. Preliminary design was completed in 2018. The EIR was completed in 2019. Grant funding was pursued in 2020–2021, and awarded in 2022. At the time of the adoption of this GSP, it is anticipated that final design will be in progress and construction will begin in 2025, and the CAPP startup is anticipated to occur in 2027.

6.3.7 Anticipated Benefits [§354.44(b)(5)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

The CAPP is expected to recharge the Basin with approximately 1,100 AFY of advanced purified water into two injection well locations in the central area of the Basin. to provide new supply and to locally increase groundwater elevations in the Basin. This new source of recharge to the Basin will result in increased water levels in the area that has been shown to historically have a depression in water levels during dry periods. Additionally, management of water levels at the injection site in conjunction with overall water supply availability will lead to reduced withdrawal, by CVWD, of native groundwater over time. Because of this water levels and groundwater in storage will benefit.

A detailed groundwater modeling study of the CAPP was performed to support planning for this GSP. A Technical Memo prepared by Pueblo Water Resources is included in Appendix F. These modeling results indicate the following:

- The CAPP will result in increased water levels over Baseline scenario results,
- SMCs for the Water Level Decline and Reduction in Storage sustainability indicators will be successfully achieved at the RMS wells.
- Implementation of the CAPP will result in an increase in sustainable yield of the Basin of approximately 1,000 AFY.
- Increased water levels resulting from implementation of the CAPP result in reduced inflow from the ocean, thereby mitigating against conditions that could lead to sweater intrusion (although the CAPP by itself is not expected to protect against seawater intrusion.)

6.3.8 Legal Authority [§354.44(b)(7)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

California state law gives Water Districts the authority to implement actions deemed necessary to supply sufficient water for present and future beneficial use. CVWD has legal authority to pursue and implement the CAPP.

6.3.9 Cost & Funding [§354.44(b)(8)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

The CAPP is projected to cost about $50 million to permit and construct to deliver the 1,100 AFY of water to the Basin. The project will be funded through a combination of grant funding and low-interest loans, as detailed in Table 6-1.

Table 6-1. Carpinteria Advanced Purification Project (CAPP) Funding Summary

	Status
Grant Program	
U.S. Bureau of Reclamation Title XVI	August 2022: Awarded $9.7M July 2023: Will apply for additional funds (25 percent of capital costs; ~$2.7M)
DWR Integrated Regional Water Management	Fall 2022: Awarded $1.1M; Agreement expected summer 2023
SWRCB Water Recycling Funding Program	September 2022: Awarded $10.8M February 2023: Will request additional funds (35 percent of construction costs; ~$2.5M)
DWR SGMA Planning	Awarded $0.7M for monitoring well; will construct in 2023
Loan Program	
California State Revolving Fund, Low-Interest Loan	Working on final agreement for up to $30M
Water Infrastructure Finance and Innovation Act	Back-up Loan Program for $30M

Notes

DWR = California Department of Water Resources

M = million

SGMA = Sustainable Groundwater Management Act

SWRCB = State Water Resources Control Board

6.4 Sentinel Monitoring Well Network Expansion Project [§354.44(b)(1), (d)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(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.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

6.4.1 Project Description

The Sentinel Monitoring Well Network Expansion Project is Tier 1 project. In 2019, the CVWD sponsored the construction of a cluster of three monitoring wells for the purpose of characterizing groundwater conditions in the A-zone, B-zone, and C-zone along the coast side of the Basin west of the Rincon Fault (see Figure 6-2). The wells are identified as the Sentinel Wells and were installed for the following objectives:

- Determine baseline water quality conditions at this key location within the Basin;
- Allow for the regular collection of water level and water quality data through routine monitoring;
- Establish a mechanism to track transient water quality changes in distinct water bearing zones through induction logging; and
- Serve as an early warning indicator for seawater intrusion into the basin.

The Sentinel Wells are incorporated into the District's existing Groundwater Monitoring Network (see Figure 4-1). The wells are completed in the three principal water bearing zones within the basin, the "A", "B", and "C" zones (see Figure 3-31).

As discussed in Section 3.2.3, at the time of installation of the Sentinel wells in 2019, water quality samples collected from the A zones contained chloride concentrations below the Secondary MCL of 250 mg/L (see Figure 3-34). Samples collected from the B-zone initially had chloride concentrations above the Secondary MCL, but more recently had concentrations below the SMCL (see Figure 3-33). Samples collected from the C-zone initially had concentrations below the SMCL, but have been increasing since 2020 to concentrations higher than the SMCL (see Figure 3-32).

The nearest CVWD production well to the Sentinel Wells is the Headquarters Well, which pumps from the A-zone and B-zone, and which is located about 1 mile to the east of the Sentinel Wells. The CVWD El Caro Well, which pumps form all three Basin aquifer zones, is located about 2 miles east of the Sentinel Wells. In summer 2023, a well cluster with monitor wells screening each of the three zones was installed in El Carro Park as part of this monitor well network expansion. These wells will characterize hydrogeologic conditions father inland from the coast for basin-wide context.

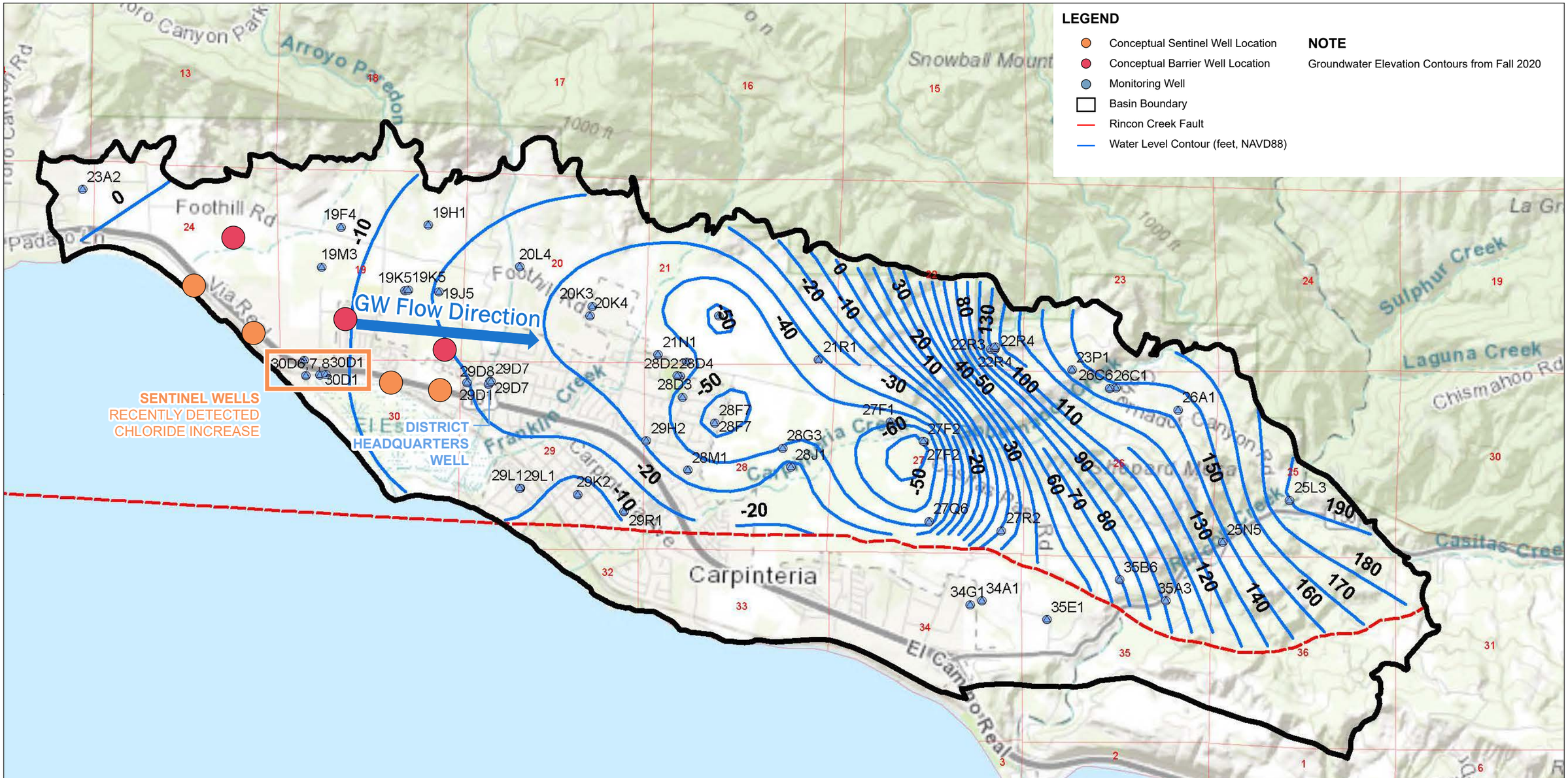


FIGURE 6-2

Conceptual Sentinel Well and Seawater Intrusion Barrier Locations

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_6

Neither the physical parameters of the three aquifer zones (thickness, transmissivity, porosity, storativity, etc.) nor the water quality in this area along the coast are well characterized. The GSA recognizes the importance of collecting additional data in this area along the coast to monitor water quality parameters that could indicate the presence or movement of brackish groundwater farther inland to the Basin. To that end, the GSA applied for grant funding to assist with the planning and implementation of this project, but the grant application was denied in 2022.

It is anticipated that the Sentinel Well Monitoring Network expansion may be implemented in phases, depending on funding availability and other factors. The initial phase would prioritize the area between the Sentinel Wells and the CVWD Headquarters well, because the groundwater elevations in the central portion of the Basin indicate a depression in the groundwater surface that could cause migration of poorer quality groundwater in that direction, toward currently operating District wells. A second phase would target the area along the coast to the northwest of the existing Sentinel well (see Figure 6-2). (The well locations presented in Figure 6-2 are conceptual; specific siting considerations will be analyzed prior to final well design.)

6.4.2 Relevant Measurable Objective(s) [§354.44(b)(1)]

§354.44 Projects and Management Actions.

(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 Sentinel Well Network Expansion project is intended to provide supporting data to characterize water quality conditions in areas at potential risk from seawater intrusion, and thus to identify conditions to maintain the MOs and avoid the MTs (identified as a chloride isocontour line in Figure 5-10) associated with the Seawater Intrusion sustainability indicator.

6.4.3 Implementation Triggers [§354.44(b)(1)(A)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

Water quality samples have been collected from the existing Sentinel Wells since 2019. There have been samples collected from both the B-zone and the C-zone that have exceeded the Secondary MCL for chloride of 250 mg/L. These are the data that have triggered the recognition that additional characterization of hydrogeologic conditions along the coast is necessary. No additional triggers are anticipated that would drive a need to implement this project differently than described in this GSP.

6.4.4 Public Notice Process [§354.44(b)(1)(B)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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.

Notification to the public regarding the concept for this project and the need to implement this project to avoid undesirable conditions in ongoing groundwater management was provided during the public process associated with the development of this GSP. As this project progresses, and specific well locations are identified, appropriate public notification will be maintained in conformance with the GSA Stakeholder Communication and Engagement Plan (Appendix C), and compliance with other permit conditions associated with well installation will be maintained.

6.4.5 Permitting and Regulatory Process [§354.44(b)(3)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

County or City permits are required for monitor well installation depending on the location in the Basin. Since these wells are strictly for the purpose of monitoring, with no associated pumping or production, it is not anticipated that permitting will pose a significant hurdle to project implementation.

6.4.6 Implementation Timeline [§354.44(b)(4)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

The original Sentinel Well cluster was installed in 2019. The El Caro Park monitoring well cluster was installed in summer 2023. As mentioned in Section 6.4.1, it is anticipated to prioritize new Sentinel well locations between the existing Sentinel wells and the CVWD Headquarters well due to the documented groundwater flow direction in this area. It is anticipated that, at a minimum, one to two monitor well clusters will be installed between the existing Sentinel Wells and the CVWD Headquarters well during the initial 5-year SGMA Implementation period. Additional monitor well clusters northwest of the existing Sentinel wells will be considered after completion of the first phase.

6.4.7 Anticipated Benefits [§354.44(b)(5)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

Anticipated benefits of this project include:

- Improved characterization of physical aquifer conditions in the area for all three producing zones, potentially including zone thickness, transmissivity, storativity, porosity, where in the basin the producing zones either pinch-out or become undifferentiated, and other hydrogeologic parameters.
- Improved characterization of ambient groundwater chemistry along the coastal areas of the Basin
- Ability to monitor transient groundwater conditions on a continuous basis to document the potential migration of saline water from the coast to inland areas of the Basin.
- Collection of data that could be useful in future updates to the Basin groundwater model used to support groundwater management decisions in the future.

6.4.8 Legal Authority [§354.44(b)(7)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

The GSA has legal authority to pursue projects and management actions necessary to implement sustainable groundwater management within the Basin boundaries.

6.4.9 Cost & Funding [§354.44(b)(8)]

The installation of the El Carro Monitor wells in summer 2023 has provided a recent estimate of drilling costs for a well cluster of individual wells screening the A-zone, B-zone, and C-zone.

- Drilling costs are estimated to be $750,000 for each cluster of three monitor wells.
- Associated engineering, consulting, and permitting costs are anticipated to be about $150,000 for each well cluster.

Thus the anticipated costs to install two new Sentinel well clusters during the initial 5-year SGMA implementation period is $1.8 million. The GSA will continue to pursue potential grant funding opportunities during the implementation period.

6.5 Local Infrastructure Water System Interties [§354.44(b)(1), (d)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(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.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

6.5.1 Project Description

The infrastructure component (Intertie Project) of this GSP project is a Tier 1 project with a projected cost of ~$21 million. The Intertie will be a bidirectional high-capacity pipeline allowing water to be delivered between Santa Barbara County and Ventura County. The Intertie Project will construct an interconnection between CVWD's pipeline network, including transmission lines connected to the State Water Project, and the network of the neighboring Casitas Municipal Water District (CMWD) located to the west of the

Carpinteria Basin in Ventura County; This component includes ~1.5 miles of 16-inch diameter pipeline, two booster pump stations and water treatment facilities for chlorination/chloramination (Figure 6-3). Construction of the Intertie Project is expected to occur during the initial 5-year SGMA implementation period. CVWD pipeline infrastructure is already connected to the Montecito Water District (MWD) through a regional transmission pipeline called the South Coast Conduit-part of the Cachuma Project. It is anticipated that installation of this pipeline infrastructure will allow for greater flexibility in basin management, including exchanges of water between agencies and potential water banking arrangements (discussed in more detail in Section 6.9).

6.5.2 Relevant Measurable Objective(s) [§354.44(b)(1)]

§354.44 Projects and Management Actions.

(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 construction of this pipeline intertie project will allow for greater flexibility in the management of the Carpinteria Basin, the Montecito Basin, and the CMWD during times of drought, emergency management situations (such as pipeline failures, etc.), and during times of ordinary basin management. The ability to move surface water and groundwater supplies among these three agencies is anticipated to provide a factor of safety to the water supplies in the region by allowing water exchanges from one agency to another, and as a related effect, this infrastructure may the reduce the necessity for groundwater pumping in the Carpinteria Basin. Thus, the utilization of this infrastructure could contribute to the successful attainment of the measurable objectives for the chronic groundwater level decline and reduction in storage sustainability indicators.

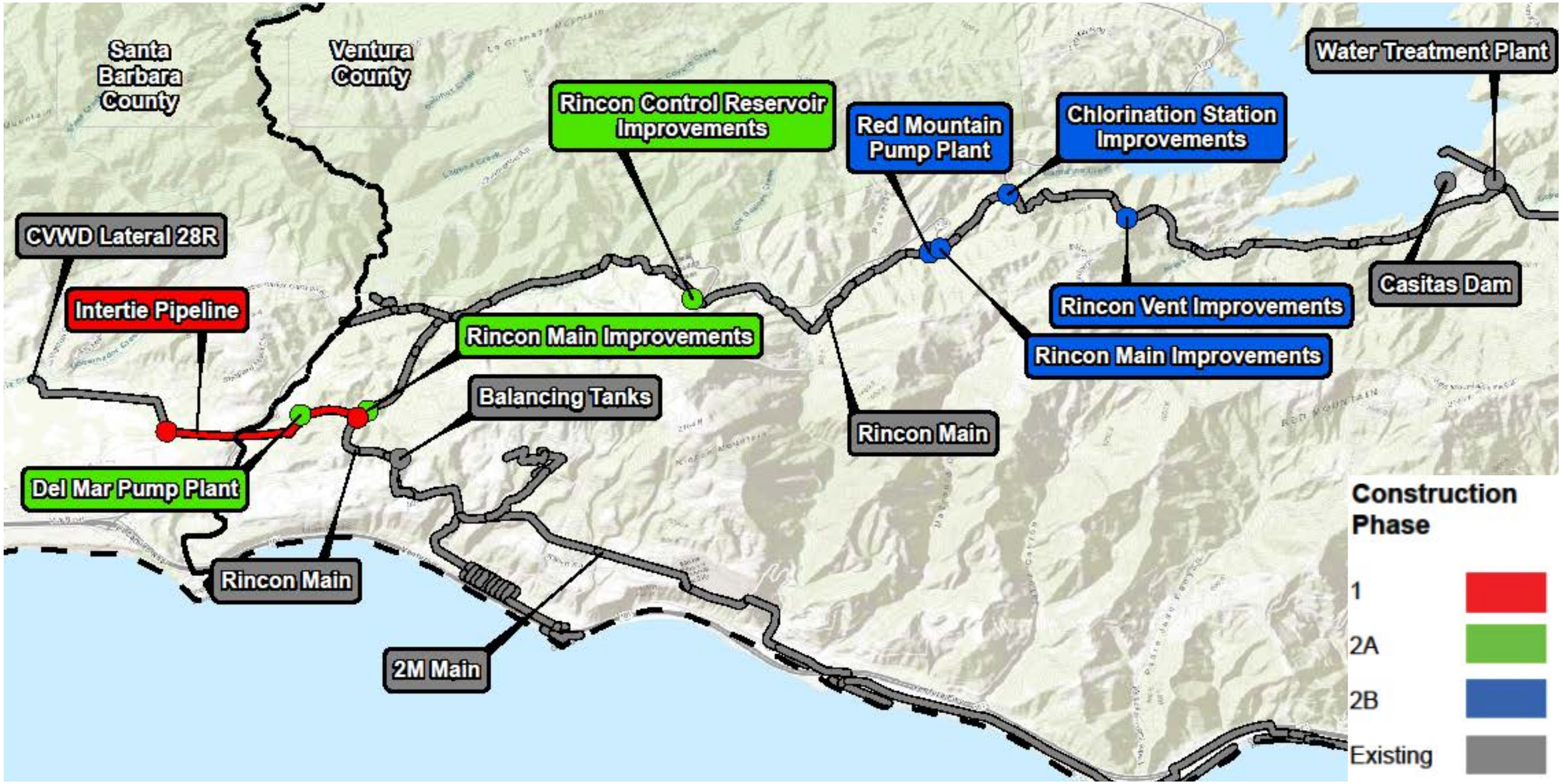


FIGURE 6-3

Casitas Municipal Water District Ventura-Santa Barbara Counties Intertie Project Overview Map

Carpinteria Groundwater Basin Groundwater Sustainability Plan

Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_3

6.5.3 Implementation Triggers [§354.44(b)(1)(A)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

Implementation of the Intertie Project is proceeding at the time of the publication of this GSP. Grant funding has been secured, and conceptual project design has been documented as part of the grant application process. Therefore, there are no future triggers that will activate the development of this project. As a Tier 1 project, it is anticipated to be implemented during the initial 5-year SGMA implementation period.

6.5.4 Public Notice Process [§354.44(b)(1)(B)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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.

Initial notification to the public regarding the concept and implementation of this project was provided during the public process associated with the development of this GSP. As the project proceeds to final design and construction, appropriate public notification will be maintained in conformance with the GSA Stakeholder Communication and Engagement Plan (Appendix C), and compliance with other permit conditions associated with project implementation will be maintained.

6.5.5 Permitting and Regulatory Process [§354.44(b)(3)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

Any public works project that involves construction of pipelines and pump stations in the public right-of-way will require planning and permitting prior to implementation, and will require compliance with applicable regulations, including CEQA. These permitting and regulatory compliance issues will be addressed during the preliminary design/engineering and permitting phases prior to the construction of the project.

6.5.6 Implementation Timeline [§354.44(b)(4)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

Funding for the Intertie Project with the CMWD has been procured, and the construction of the Intertie Project is anticipated to occur within the initial 5-year SGMA implementation plan.

6.5.7 Anticipated Benefits [§354.44(b)(5)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

The anticipated benefits of local water banking agreements would be additional storage placed into the aquifer above the level currently realized during wet weather periods. These projects, if pursued, would improve conditions contributing to the successful attainment of the measurable objectives for the chronic groundwater level decline and reduction in storage sustainability indicators.

6.5.8 Legal Authority [§354.44(b)(7)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

The GSA has legal authority under SGMA to pursue projects and management actions necessary to effect sustainable groundwater management within the basin boundaries. California state law gives Water Districts the authority to implement actions deemed necessary to supply sufficient water for present and future beneficial use.

6.5.9 Cost & Funding [§354.44(b)(8)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

Project costs and proposed mechanisms for funding a recharge enhancement project will be assessed in a desktop study evaluating Tier 2 projects during the first 5-year SGMA implementation period. Project cost estimates for any specific project would be addressed during the study, planning, preliminary design/engineering, and permitting phases of all projects that are identified by the GSA for potential future consideration.

6.6 Carpinteria Seawater Intrusion Barrier Project [§354.44(b)(1), (d)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(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.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

6.6.1 Project Description

This is a Tier 2 project, anticipated for implementation after the initial 5-year SGMA implementation period.

As discussed previously in Section 3.2.6, water quality sampling at the Sentinel wells has indicated some samples with elevated concentrations of chlorides in the B-zone and C-zone over the past 3 to 4 years. These data may be indicative of seawater intrusion. However, to date this phenomenon is limited to a single well cluster location. Additional hydrogeologic investigation along the coast is necessary to more fully characterize the extent of any sea water intrusion.

With the proximity to the ocean to the Basin, seawater has the potential to migrate into the aquifers and mix with native groundwater, impacting municipal and agricultural use. To prevent seawater intrusion, a seawater intrusion barrier project is proposed as a potential Tier 2 project to consider for sustainable management, after data collected during the Sentinel Network Expansion project is analyzed. A seawater intrusion barrier is a series of injection wells positioned like a dam between the ocean and the groundwater aquifer. These wells inject water along the barrier to maintain water levels near the ocean high enough to keep the seawater from migrating into the aquifer.

This project is not expected to proceed to implementation during the initial 5-year SGMA implementation period. It is acknowledged by the GSA that current data regarding many important details of the project such as potential source water, current groundwater quality, number and design of injection wells necessary, are incomplete or lack definition. As discussed in Section 6.4, it is expected that the Sentinel Well Network Expansion will be completed first, and data from that project will inform the further analysis of a seawater intrusion barrier project.

6.6.2 Relevant Measurable Objective(s) [§354.44(b)(1)]

§354.44 Projects and Management Actions.

(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 relevant measurable objective for a seawater intrusion barrier project is the measurable objective for the seawater intrusion sustainability indicator. The project would increase groundwater elevations near the coast, thus mitigating against conditions that could contribute to seawater intrusion.

6.6.3 Implementation Triggers [§354.44(b)(1)(A)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

Additional engineering and hydrogeologic analysis of this project will be undertaken as appropriate after collection of the data expected to arise from the Sentinel Well Network Expansion project. Project implementation would proceed after thorough engineering and hydrogeologic analysis.

6.6.4 Public Notice Process [§354.44(b)(1)(B)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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.

Notification to the public regarding the concept for this project and the need to implement this project to avoid undesirable conditions in ongoing groundwater management was provided during the public process associated with the development of this GSP. As this project progresses, and specific well locations are identified, appropriate public notification will be maintained in conformance with the GSA Stakeholder Communication and Engagement Plan (Appendix C), and compliance with other permit conditions associated with well installation will be maintained.

6.6.5 Permitting and Regulatory Process [§354.44(b)(3)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

Any project that involves injection of water into an aquifer is subject to the regulatory process administered under the authority of the SWRCB or RWQCB. County and City permits are required for monitor well installation in the Basin. There will be a number of local, county, and state permits, rights of way, and easements necessary depending on the selected pipeline alignments, stream and road crossings, etc.

6.6.6 Implementation Timeline [§354.44(b)(4)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

Detailed evaluation and analysis of a seawater intrusion barrier project will proceed after the completion of the Sentinel Well network expansion project.

6.6.7 Anticipated Benefits [§354.44(b)(5)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

A seawater intrusion barrier project will benefit beneficial users in the Basin by providing mitigation against groundwater conditions that could contribute to seawater intrusion. The project would benefit municipal, industrial, and agricultural users in the Basin.

6.6.8 Legal Authority [§354.44(b)(7)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

The GSA has legal authority under SGMA to pursue projects and management actions necessary to maintain sustainable groundwater management within the Basin boundaries.

6.6.9 Cost & Funding [§354.44(b)(8)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

At the time of the adoption of this GSA, there is insufficient information to generate a cost estimate as to the design, construction, and implementation of this project. Project details necessary for a cost estimate such as number of wells, anticipated injection rates, pipeline lengths and routes, and source water are significant cost elements that are not currently defined. As discussed previously, further engineering analysis will be performed after data from the Sentinel Well Network expansion project are considered.

6.7 Aquifer Storage and Recovery Projects [§354.44(b)(1), (d)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(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.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

6.7.1 Project Description

Aquifer storage and recovery is a Tier 2 project. ASR would provide for the injection of supplemental surface water supplies, to the extent they are available, into the natural structure of the basin aquifer for use as an underground storage reservoir. The source water for injection must be drinking water quality. Water stored in the Basin as a result of an ASR project could provide a drought supply for the District service area or could be used in conjunction with other projects and management actions in the Basin to achieve sustainability.

Potential ASR projects have been considered in the Basin in the past. In 2003, Injection/Storage/Recovery testing of the Headquarters well was performed by the District. Approximately 12 million gallons of water were injected, and 19 million gallons of water were recovered during this field study, and it was determined that no fatal flaw exists that would prevent the construction of an ASR project in the Basin (Padre, 2003). During the development of the Carpinteria Basin Groundwater model (Pueblo, 2012), a model simulation was performed that indicated that an ASR project would be feasible in the Basin and could benefit storage and water levels in the Basin. In 2012, the District performed successful injection testing on the El Caro #2 production well at an injection rate of about 400 gpm.

With the ongoing progress of the CAPP being the District's primary infrastructure project in the near term, there is currently no specific ASR project identified, However, both the CVWD Headquarters well and the El Caro well were designed to be convertible to an ASR well if such a strategy is feasible. Those two wells have now been dedicated for use in the CAPP, but future production well replacements by the District may incorporate an ASR design factor for future flexibility in the sustainable management of the Basin.

Prior to implementing an ASR project, the GSA would perform supplemental hydrogeologic and engineering investigations and initiate a pilot testing program. Pilot testing involves injecting water into the Basin's aquifers and recovering it to assess injection and recovery capacities and monitor water quality impacts to native groundwater resources and recovered water quality, as was done by the District in 2003 at the Headquarters well and in 2012 at El Caro Well #2. Information generated by pilot test evaluations will help quantify the degree to which ASR is a feasible part of GSA strategy to improve the sustainable management of the Basin.

6.7.2 Relevant Measurable Objective(s) [§354.44(b)(1)]

§354.44 Projects and Management Actions.

(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.

Because an ASR project would contribute periodic storage to the aquifer during the operation of the project, this project would improve hydrogeologic conditions contributing to the successful attainment of the measurable objectives for the chronic groundwater level decline and reduction in storage sustainability indicators. If an ASR project is sited near the coastal portion of the aquifer north of the Rincon fault, it is possible that ASR operations might contribute to conditions helping to achieve the measurable objective for the seawater intrusion sustainability indicator.

6.7.3 Implementation Triggers [§354.44(b)(1)(A)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

There is no anticipated implementation trigger identified that would cause this project to design or construction during the initial 5-year SGMA implementation phase. ASR projects will continue to be evaluated by the GSA as appropriate to the management of the Basin, and as future funding sources to support such a project may become available. Other drivers such as water supply management flexibility by CVWD may trigger implementation of ASR well development and operations.

6.7.4 Public Notice Process [§354.44(b)(1)(B)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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.

Notification to the public regarding the concept for this project and the need to implement this project to avoid undesirable conditions in ongoing groundwater management was provided during the public process associated with the development of this GSP. If this project progresses, appropriate public notification will be maintained in conformance with the GSA Stakeholder Communication and Engagement Plan (Appendix C), and compliance with other permit conditions associated with well installation will be maintained.

6.7.5 Permitting and Regulatory Process [§354.44(b)(3)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

Any ASR project would require planning and permitting prior to implementation, and all would require compliance with applicable regulations, including CEQA. Any project that involves injection of water into the Basin aquifer is subject to regulatory requirements promulgated by the SWRCB and RWQCB. These permitting and regulatory compliance issues for any specific project would be addressed during the study, planning, preliminary design/engineering, and permitting phases of any project that is identified by the GSA for potential future consideration.

6.7.6 Implementation Timeline [§354.44(b)(4)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

Because an ASR project is currently not identified as a Tier 1 project, there is no anticipated timeline identified for this project's implementation. The GSA has no near-term plans to initiate construction of an ASR project.

6.7.7 Anticipated Benefits [§354.44(b)(5)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

An ASR project would result in an increase in basin groundwater storage, increased water levels, and possibly an ancillary impact on water levels along the coast that could mitigate against conditions conducive to seawater intrusion. It would also provide drought supplies, which would reduce the dependence on pumping of native groundwater by CVWD during drought periods.

6.7.8 Legal Authority [§354.44(b)(7)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

The GSA has legal authority under SGMA to pursue projects and management actions necessary to effect sustainable groundwater management within the Basin boundaries. California state law gives Water Districts the authority to implement actions deemed necessary to supply sufficient water for present and future beneficial use. CVWD has legal authority to pursue and implement an ASR project shout it determine to be necessary for the sustainable management of the groundwater basin.

6.7.9 Cost & Funding [§354.44(b)(8)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

Project costs and proposed mechanisms for funding for any specific project would be addressed during the study, planning, preliminary design/engineering, and permitting phases of all projects that are identified by the GSA for potential future consideration.

6.8 Recharge Enhancement Projects [§354.44(b)(1), (d)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(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.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

6.8.1 Project Description

Recharge enhancement projects are identified as a Tier 2 project.

Infiltration of precipitation and infiltration of streamflow are the two most significant sources of recharge to the Basin aquifer. Recharge enhancement projects are proposed as projects that would increase the amount of natural recharge into the Basin through a) the "de-lining" of channelized sections of Santa Monica and Franklin Creeks, or b) direction of precipitation runoff to constructed recharge basins. Projects employing a strategy of enhancing natural recharge could help to reduce the storage deficit and maintain long-term water supply reliability.

Santa Monica and Franklin Creeks were channelized into concrete-lined box channels as part of the Carpinteria Valley Watershed Project in 1974. The purpose of this project was to mitigate against local flooding in the valley by increasing streamflow velocity and channel discharge capacity to move stormwater runoff to the ocean more quickly than occurred under natural channel conditions. This strategy was commonplace during this time period. More recently, watershed management strategies have recognized that prior projects may not be beneficial to biological resources in the region and may have the effect of reducing recharge to the Basin aquifer. During the development of the Basin groundwater model, Pueblo Water Resources estimated that during the 1985–2008 base period, annual increase in recharge via the mechanism of streambed percolation would range from effectively 0 AFY in very dry years to 520 AF in the wettest year, and would average 165 AFY over that time period (PWR, 2012). (It should be noted that this was only a modeling analysis, and did not include engineering analysis factors such as cost estimates, construction feasibility, etc.). It should be noted that SBCFCD would need to be a cooperative partner in any project which potentially affects flood conditions in the Basin.

To enhance natural recharge in the Basin, localized construction of groundwater recharge basins to percolate runoff of natural precipitation is discussed. A groundwater recharge basin is a bermed basin structure designed for the purpose of efficiently allowing water collected in the basin to infiltrate through the ground surface, percolate through the vadose zone, and ultimately recharge the underlying aquifer. The concept of this type of recharge enhancement project is to direct natural runoff to a constructed recharge

basin rather than allowing it to flow to the creeks and out to the ocean. Infiltration can be accomplished in surface basins, typically having an area of 1 to 5 acres, or potentially through flooding of agricultural fields or flood plains, use of drywells, or other strategies. Smaller projects might provide additional benefit, but unit costs are likely to be somewhat greater. A variation of GSA owned and operated spreading basins may be incentivizing private landowners to spread runoff from precipitation, tailwater or other available water. This type of project will be analyzed along with traditional enhanced recharge projects. Larger projects may require more infrastructure and/or maintenance costs, and land purchase costs.

The initial phase of this project would include the completion of an engineering feasibility study to identify the possible number and location of a series of recharge basin facilities, based on hydrogeologic and watershed conditions. The subject study may include an evaluation of the potential benefits to the GSA. It is anticipated that a desktop level feasibility analysis and ranking study of all Tier 2 projects will be performed during the initial 5-year SGMA implementation period to inform decisions on implementation of future projects.

6.8.2 Relevant Measurable Objective(s) [§354.44(b)(1)]

§354.44 Projects and Management Actions.

(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.

Because enhancement recharge projects would contribute periodic storage to the aquifer during wet weather periods, this project would contribute to conditions contributing to the successful attainment of the measurable objectives for the chronic groundwater level decline and reduction in storage sustainability indicators.

6.8.3 Implementation Triggers [§354.44(b)(1)(A)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

There is no anticipated implementation trigger identified that would cause this project to proceed to design or construction during the initial 5-year SGMA implementation phase. It is anticipated that a desktop feasibility study addressing this project will be completed in the initial 5-year SGMA implementation period. Recharge enhancement projects will continue to be evaluated by the GSA as appropriate to the management of the Basin, and as future funding sources to support such a project may become available.

6.8.4 Public Notice Process [§354.44(b)(1)(B)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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.

Notification to the public regarding the concept for this project and the need to implement this project to avoid undesirable conditions in ongoing groundwater management was provided during the public process associated with the development of this GSP. If this project progresses, appropriate public notification will be maintained in conformance with the GSA Stakeholder Communication and Engagement Plan (Appendix C), and compliance with other permit conditions associated with project implementation will be maintained.

6.8.5 Permitting and Regulatory Process [§354.44(b)(3)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

Any recharge enhancement project would require planning and permitting prior to implementation, and all would require compliance with applicable regulations, including CEQA. Any project that involves construction or de-lining of Franklin and Santa Monica Creeks would require coordination with the Santa Barbara Flood Control District and the NRCS. Permitting and regulatory compliance issues for any specific project would be addressed during the study, planning, preliminary design/engineering, and permitting phases of any project that is identified by the GSA for potential future consideration.

6.8.6 Implementation Timeline [§354.44(b)(4)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

Because a recharge enhancement project is currently not identified as a Tier 1 project of the GSP, there is no anticipated timeline identified for this project's implementation. The GSA has no near-term plans to initiate construction of a recharge enhancement project.

6.8.7 Anticipated Benefits [§354.44(b)(5)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

The anticipated benefits of enhancement recharge projects would contribute additional storage to the aquifer than currently is realized during wet weather periods. These projects, if pursued, would improve conditions contributing to the successful attainment of the measurable objectives for the chronic groundwater level decline and reduction in storage sustainability indicators.

6.8.8 Legal Authority [§354.44(b)(7)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

The GSA has legal authority under SGMA to pursue projects and management actions necessary to effect sustainable groundwater management within the Basin boundaries. California state law gives Water Districts the authority to implement actions deemed necessary to supply sufficient water for present and future beneficial use.

6.8.9 Cost & Funding [§354.44(b)(8)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

Project costs and proposed mechanisms for funding a recharge enhancement project will be assessed in a desktop study evaluating Tier 2 projects during the first 5-year SGMA implementation period. Project cost estimates for any specific project would be addressed during the study, planning, preliminary design/engineering, and permitting phases of all projects that are identified by the GSA for potential future consideration.

6.9 Local Inter-Agency Water Delivery and Water Banking Agreements [§354.44(b)(1), (d)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(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.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

6.9.1 Project Description

The regional infrastructure tie-in project discussed in Section 6.5 will allow for transmission of surface or groundwater supplies between CVWD and CMWD CVWD pipeline infrastructure is already connected to the MWD through a regional transmission pipeline called the South Coast Conduit-part of the Cachuma Project. Water delivery and water banking agreements with CMWD and MWD are not in place as of the adoption of this GSP; only preliminary conceptual discussions have been broached, and any development and operation of such an agreement is considered as a Tier 2 project for this GSP to be further evaluated prior to implementation.

The project concept is as follows. The Carpinteria Basin has available storage space in the aquifer as indicated by a depth to water in many parts of the aquifer in excess of 100 feet, and has the potential to either construct a new ASR well or convert an existing well to use as an ASR well to place stored water into the aquifer. A pipeline distribution network will be capable of moving water between Districts. MWD and CMWD have no available storage space or infrastructure to get stored water into the aquifer. During wet and normal years when higher allotments of State water and Cachuma water are available for delivery, the three Districts may have rights to more water than they are able to utilize in a timely fashion. During these times, it may be beneficial for any of the parties to transmit unused surface water allotments to the Carpinteria Basin for temporary storage in their available aquifer space. An alternative to direct physical aquifer recharge could be in operation in lieu of recharge, wherein the transmitted water could be delivered directly to District users in lieu of an equivalent reduction in Basin pumping. Under this project concept, CVWD would negotiate an agreement with the neighboring Districts to agree to store their water for eventual delivery back to the neighboring Districts when called for, in exchange for agreement for the neighboring Districts to leave behind a portion of the stored water for CVWD's use. The percentage of "leave behind" water would be subject to future negations among the neighboring Districts.

6.9.2 Relevant Measurable Objective(s) [§354.44(b)(1)]

§354.44 Projects and Management Actions.

(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.

Because any local water banking agreements negotiated with neighboring districts would include a percentage of the stored water to be left behind in the Carpinteria aquifer, operation of a water banking project would include an additional component of recharge to the Basin that is not currently realized. Because water banking projects would contribute periodic storage to the aquifer over and above what the aquifer currently receives, this project would contribute to conditions conducive to the successful attainment of the measurable objectives for the chronic groundwater level decline and reduction in storage sustainability indicators, and the increased water levels might help achieve the measurable objectives for the seawater intrusion sustainability indicator.

6.9.3 Implementation Triggers [§354.44(b)(1)(A)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

There is no anticipated implementation trigger identified that would cause this project to proceed to design or construction during the initial 5-year SGMA implementation phase. It is anticipated that a desktop feasibility study addressing this project will be completed in the initial 5-year SGMA implementation period, and that preliminary discussions with neighboring districts would proceed. Consideration of this project will continue to be evaluated by the GSA as appropriate to the management of the Basin, as discussions with neighboring basins continue, and as future funding sources to support such a project may become available.

6.9.4 Public Notice Process [§354.44(b)(1)(B)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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.

Notification to the public regarding the concept for this project and the need to implement this project to avoid undesirable conditions in ongoing groundwater management was provided during the public process associated with the development of this GSP. If this project progresses, appropriate public notification will be maintained in conformance with the GSA Stakeholder Communication and Engagement Plan (Appendix C), and compliance with other permit conditions associated with project implementation will be maintained.

6.9.5 Permitting and Regulatory Process [§354.44(b)(3)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

Any water banking project would require planning and permitting prior to implementation, and all would require compliance with applicable regulations, including CEQA. Any project that involves injection of water into the Basin aquifer for storage is subject to regulatory requirements promulgated by the SWRCB and RWQCB. These permitting and regulatory compliance issues for any specific project would be addressed during the study, planning, preliminary design/engineering, and permitting phases of any project that is identified by the GSA for potential future consideration.

6.9.6 Implementation Timeline [§354.44(b)(4)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

As discussed in Section 6.5, funding for the Intertie Project with the CMWD has been procured, and the construction of the Intertie Project is anticipated to occur within the initial 5-year SGMA implementation plan. Because the water banking agreement of the project is currently not identified as a Tier 1 project of the GSP, there is no anticipated timeline identified for this project's implementation. The GSA has no near-term plans to initiate the water banking component of this project, but will continue to communicate with the neighboring agencies regarding mutually beneficial agreements..

6.9.7 Anticipated Benefits [§354.44(b)(5)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

The anticipated benefits of local water banking agreements would be additional storage placed into the aquifer above the level currently realized during wet weather periods. These projects, if pursued, would improve conditions contributing to the successful attainment of the measurable objectives for the chronic groundwater level decline and reduction in storage sustainability indicators, and possibly the seawater intrusion sustainability indicator.

6.9.8 Legal Authority [§354.44(b)(7)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

The CVWD and the GSA have legal authority under SGMA to pursue projects and management actions necessary to effect sustainable groundwater management within the Basin boundaries. California state law gives Water Districts the authority to implement actions deemed necessary to supply sufficient water for present and future beneficial use.

6.9.9 Cost & Funding [§354.44(b)(8)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

Project costs and proposed mechanisms for funding a recharge enhancement project will be assessed in a desktop study evaluating Tier 2 projects during the first 5-year SGMA implementation period. Project cost estimates for any specific project would be addressed during the study, planning, preliminary design/engineering, and permitting phases of all projects that are identified by the GSA for potential future consideration.

6.10 Municipal Pumping Re-Distribution Management Action [§354.44(b)(1), (d)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

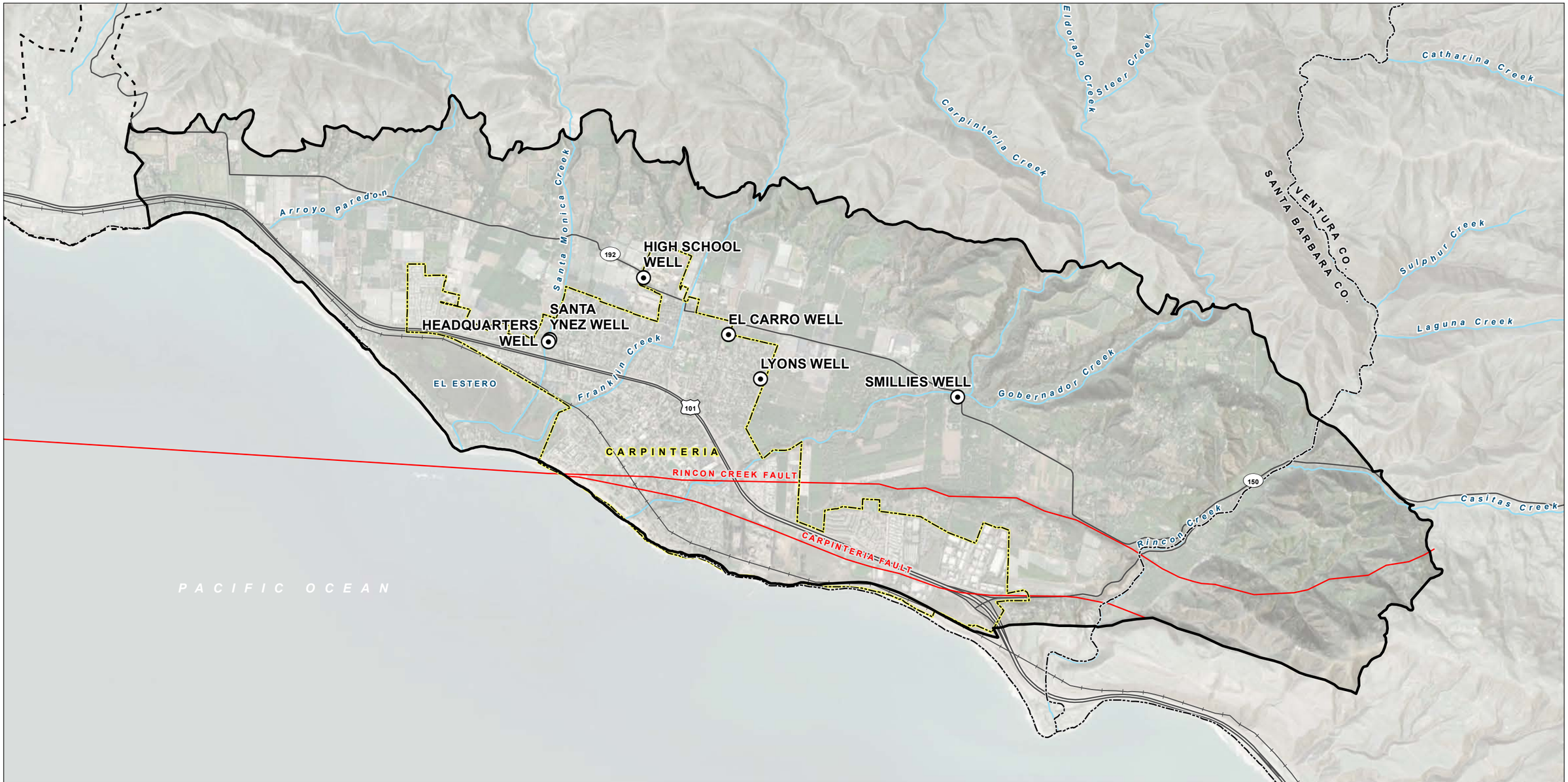
(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

6.10.1 Project Description

The CVWD provides virtually all of the potable water used by municipal and industrial users in the Basin. CVWD currently produces approximately 25 to 30 percent of the total groundwater pumping in the Basin from three wells: the Headquarters Well, the El Carro Well, and the Smillie well (see Figure 6-4). Two of the District's wells, the High School Well and the Lyons Well, are not currently used to produce groundwater for the District. The Headquarters well is the closest well to the coast that is north of the Rincon Fault. Due to the detection of increasing chlorides in the Sentinel monitoring wells, there is newfound concern regarding the possibility of seawater intrusion impacting water quality conditions at the Headquarters well, among other possible private wells that could be impacted. Several other projects discussed in this section (Sentinel Well Network Expansion, Seawater Barrier Project) have the objective of managing potential seawater intrusion along the coast. This project of Municipal Pumping Re-Distribution is also presented with the objective of maintaining conditions along the coast to minimize the potential impact from seater intrusion.



LEGEND

- CVWD District Well

All Other Features

- Carpinteria Groundwater Basin
- Montecito Groundwater Basin
- County Boundary
- City Boundary
- Fault
- Railroad
- Major Road
- Watercourse

FIGURE 6-4

CVWD Production Wells

Carpinteria Groundwater Basin
Groundwater Sustainability Plan

N

0 1,500 3,000 4,500
feet

CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Document Path: Y:\2006_Carpinteria_Basin_GSA\Source_Figures\001_GSA\GW_Sustainability_Plan\Chapter_6\Figure6-4_CVWD_Production_Wells.mxd, npalmer

Reduction of pumping at the Headquarters well could minimize future water level declines in this area, and thereby mitigate against conditions that might contribute to future seawater intrusion. The project concept for this project is to reduce overall pumping at the Headquarters well and make up that same quantity of required municipal production by increasing pumping at the El Caro well and the Smillie well or some other future inland well. Ultimately, new District wells could be drilled at either the Lyons or High School sites, or possibly at alternate sites yet to be acquired by the District, to re-distribute Headquarters well pumping to other locations than the currently active wells.

6.10.2 Relevant Measurable Objective(s) [§354.44(b)(1)]

§354.44 Projects and Management Actions.

(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 purpose of potential redistribution of municipal production from the Headquarters well is to contribute to conditions required to achieve the Measurable Objective for the Seawater Intrusion.

6.10.3 Implementation Triggers [§354.44(b)(1)(A)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

It is anticipated that the District will begin to evaluate this action to assess any constraints or costs associated with its operation early in the initial 5-year SGMA implementation period, and implement the concept as appropriate after that. Therefore, there is no future implementation trigger to consider.

6.10.4 Public Notice Process [§354.44(b)(1)(B)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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.

Notification to the public regarding the concept for this project and the need to implement this project to avoid undesirable conditions in ongoing groundwater management was provided during the public process associated with the development of this GSP. If this project progresses, appropriate public notification will be maintained in conformance with the GSA Stakeholder Communication and Engagement Plan (Appendix C), and compliance with other permit conditions associated with project implementation will be maintained.

6.10.5 Permitting and Regulatory Process [§354.44(b)(3)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

Because this management action involves the internal operational decisions of the CVWD, it is not expected to involve any additional permitting or regulatory requirements to implement. If new wells are ultimately constructed by the District, there will be normal county and city drilling permits to procure.

6.10.6 Implementation Timeline [§354.44(b)(4)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

This project has no significant design requirements or construction costs to implement. As such, it is anticipated that the District will begin to evaluate this action early in the initial 5-year SGMA implementation

period. Any constraints or costs associated with its operation will be assessed, and the management strategy will be implemented as appropriate after that.

6.10.7 Anticipated Benefits [§354.44(b)(5)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

The anticipated benefits of this management action are to minimize declines in groundwater elevation in the coastal area of the aquifer north of the Rincon Fault. This will mitigate against conditions that could contribute to seawater intrusion.

6.10.8 Legal Authority [§354.44(b)(7)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

California Water Code § 10726.2 provides GSAs the authority to purchase, among other things, land, water rights, and privileges in the furtherance of sustainable groundwater management in the Basin.

6.10.9 Cost & Funding [§354.44(b)(8)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

Because some portion of any offset pumping from the Headquarters well can be performed at existing wells with existing infrastructure, there is not expected to be any significant construction or operational costs associated with implementation of this strategy, unless and until it may be determined that new municipal well construction may be required.

6.11 Well Registration and Metering Program Management Action [§354.44(b)(1), (d)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(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.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

6.11.1 Management Action Description

The CVWD currently delivers water to both municipal and agricultural customers in the Basin. However, most of the agricultural pumping in the Basin is done by private well owners. The GSA will evaluate a program that may require that all groundwater production wells, including wells used by agricultural pumpers, be registered with the GSA, and that all wells be equipped with a meter to measure pumping extractions from the wells throughout the year. If the wells have a meter, the meter should be calibrated on a regular schedule in accordance with manufacturer standards and any programs developed by the GSA. Well registration is intended to establish an accurate count of all the active wells in the Basin. Well metering is intended to improve estimates of the amount of groundwater extracted from the Basin. The District has identified only a single de minimis pumper in the Basin, so this pumping category is not significant.

The GSA will consider requiring all private groundwater pumpers to report extractions at an interval to be determined by the GSA, and use a water-measuring method satisfactory to the GSA in accordance with Water Code § 10725.8. If the GSA moves forward with this program, it is anticipated that the GSA would develop and adopt guidelines and a regulatory framework to implement this program, which may also include a system for reporting and accounting for water conservation initiatives, voluntary irrigated land fallowing (temporary and permanent), stormwater capture projects (for recharge), or other activities that individual pumpers may elect to implement. The information collected will be used to account for annual pumping in the basin, to provide additional information to be used by the GSA for analyzing projected conditions, updating the HCM, and completing Annual Reports and 5-year GSP assessment reports for DWR.

Agriculture irrigators have voiced concerns regarding the costs associated with the requirement for meters. Although the cost associated with installing and maintaining meters is a legitimate concern, meters can improve the overall management of water and improve the efficiency of the groundwater supply system. The resulting improvement of water efficiency provides a return on the investment. Research and on-the-ground observations have demonstrated that greater water use efficiency directly benefits pumpers by lowering pumping and distribution costs and reducing water use. Research at the Irrigation Technology Center at Texas A&M University has demonstrated that water measurement by itself can reduce crop irrigation water use by 10 percent. When measurement was combined with education about on-farm irrigation management, water use was reduced by 20 to 40 percent (TWRI, 2001).

Although the GSA does not have permitting authority for issuing permits for new well construction within the Basin (permits for new wells are required to be obtained from the Santa Barbara County Department of Public Health Environmental Health Services), the GSA will consider requiring registration of all new wells and the installation of meters on those wells. The GSA will work with the County as the well permitting authority to evaluate the applicability of CEQA for new wells, or categories thereof, in the Basin.

6.11.2 Relevant Measurable Objective(s) [§354.44(b)(1)]

§354.44 Projects and Management Actions.

(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 Well Registration and Well Meter Installation Programs, if adopted, will be designed and implemented for the specific purpose of obtaining data that will allow an enhanced understanding of the total volume of water being extracted from the Basin, both spatially and temporally. The information that will be gained through this management action will provide the basis for future refinements in the Basin HCM and the water budget (see Sections 3.1 and 3.2). The installation of metering on non-de minimis wells, particularly in conjunction with a fee program, is projected to result in a reduction in the volume of groundwater extracted on an annual basis. These reductions would result in progress toward achieving or maintaining relevant measurable objectives in the Basin, including:

- **Groundwater Elevation Measurable Objectives:** Well Registration and Well Meter Installation Programs will focus on reducing pumping through an enhanced understanding of actual water usage by the pumper. Less pumping will result in higher groundwater elevations.
- **Groundwater Storage Measurable Objectives:** This measurable objective is based on water levels in Basin RMS wells, which are correlated with Basin storage and pumping. The implementation of Well Registration and Well Meter Installation Programs will focus on providing the water user with an enhanced understanding of actual water usage that will encourage reduced pumping and will help achieve the goal of reducing total extractions to the long-term sustainable yield.

6.11.3 Implementation Triggers [§354.44(b)(1)(A)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

The management action described in this section will be evaluated during the first 5-year SGMA implementation period. Public input from private well owners will be considered before any action is taken regarding adoption and enforcement of this action.

6.11.4 Public Notice Process [§354.44(b)(1)(B)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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.

Notification to the public regarding the concept for this project and the need to implement this project to avoid undesirable conditions in ongoing groundwater management was provided during the public process associated with the development of this GSP. If this project progresses, appropriate public notification will be maintained in conformance with the GSA Stakeholder Communication and Engagement Plan (Appendix C), and compliance with other permit conditions associated with project implementation will be maintained.

6.11.5 Permitting and Regulatory Process [§354.44(b)(3)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

To implement this management action, the GSA will develop a program that requires all non-de minimis extractors to report extractions and use a water-measuring method satisfactory to the GSA in accordance with Water Code § 10725.8. The GSA may adopt a regulation governing the Well Registration and Well Meter Installation Program.

6.11.6 Implementation Timeline [§354.44(b)(4)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

The management action described in this section will be evaluated during the first 5-year SGMA implementation period. Public input from private well owners will be considered before any action is taken regarding adoption and enforcement of this action. It is possible that this program may be initiated during the first 5-year SGMA implementation period.

6.11.7 Anticipated Benefits [§354.44(b)(5)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

The management action described in this section will be designed and implemented for the specific purpose of obtaining data that will allow an enhanced understanding of the total volume of water being extracted from the Basin, from both a spatial and temporal perspective. The information that will be gained through this management action will provide the basis for future refinements in the Basin HCM and the water budget (see Sections 3.1 and 3.3, respectively). In addition, the information acquired though the implementation of the management action described in this section will help guide the GSA in determining the optimal strategy for sequencing the implementation of the future management actions and projects should they be necessary.

Additionally, studies have shown that the installation of meters on wells can directly result in reduced groundwater pumping by 10 percent or more. For perspective, assuming the meter installation program achieves a 5 percent reduction in agricultural pumping, the resulting benefit would be approximately 150 AFY.

6.11.8 Legal Authority [§354.44(b)(7)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

The legal authority to empower the GSA to require well registration and groundwater extraction by pumpers in the Basin is included in SGMA. Water Code § 10725.8 authorizes a GSA to require through its GSP that the use of every groundwater extraction facility (except those operated by de minimis extractors) be measured.

6.11.9 Cost & Funding [§354.44(b)(8)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

Planning-level costs for developing and establishing the Well Registration and Well Meter Installation Programs will be estimated during the Tier 2 Project and Management action feasibility evaluation expected to occur early in the initial 5-year SGMA implementation period. (Estimates for implementation of this program in other Santa Barbara County basins range from approximately $75,000 to $100,000 and are separate from development of this GSP.) According to SGMA § 10725.8(b), costs associated with individual measurement devices are to be borne by the well owner/operator, so the cost exposure to GSA for implementing a Well Registration and Well Metering Program can be distributed among all well owners. Depending on the method of extraction measurement that the GSA approves, the costs associated with the selected method to measure and record groundwater extractions within the Basin may vary widely, based on the requirements for equipment, infrastructure, installation, and for operations and maintenance. GSA members that provide public water supplies (i.e., CVWD) already fund and operate metering facilities on their wells; therefore, costs associated with the acquisition and installation of metering equipment will be borne by the owners of wells used for agricultural irrigation and other non-de minimis well owners.

Potential sources of funding for the Well Registration and Well Meter Installation Programs components may include well owners, state and/or federal grants, reimbursement via groundwater extraction fees, transaction fees from extraction credit trades, and other mechanisms as may be identified by the GSA.

6.12 Water Use Efficiency Programs Management Action [§354.44(b)(1), (d)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(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.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

6.12.1 Project Description

The GSA has included the implementation of Water Use Efficiency Programs for public water agencies, and agricultural groundwater pumpers in the identified management actions. The Water Use Efficiency Programs are generally described as follows:

- **Urban and Domestic Water Use Efficiency Programs:** Initiatives that promote increasing water use efficiency by achieving reductions in the amount of water used for municipal, commercial, industrial, landscape irrigation, rural domestic, and aesthetic purposes. These programs can include incentives, public education, technical support, and other efficiency-enhancing programs.
- **Agricultural Water Use Efficiency Programs:** Initiatives that promote increasing water use and irrigation efficiency and achieving reductions in the amount of water used for agricultural irrigation. These programs can include incentives, public education, technical support, training, implementation of BMPs, and other efficiency-enhancing programs.

Urban and agricultural water use efficiency has been practiced in the Basin for more than two decades and has been effective in limiting water use within the Basin. Existing programs promote responsible design of landscapes and appropriate choices of appliances, irrigation equipment, and the other water-using devices to enhance the efficient use of water. In recent years, many agencies in the state have passed regulations that require efficient plumbing devices, appliances, and landscape designs. CVWD may sponsor programs that encourage and/or require customers to conserve.

The water use efficiency management actions to be developed for implementation by municipal and agricultural pumpers will promote expansion and supplementation of the existing water use efficiency programs that currently exist. These programs will also be developed to be aligned with the requirements of water conservation mandates that have been put in place by the State of California. Effective urban water use efficiency measures could include the following:

- High Water Use Outreach (High Use Reports)
- Meter Audits to Proactively Detect Leaks (Leak Reports)
- Rebates on Water-Saving Fixtures (i.e., clothes/dish washers)
- Rebates on Sustainable Landscape Conversion Programs (i.e., Cash for Grass)

- Water Awareness Outreach Events (i.e., at library/outdoor market events)
- Enhanced Efficient Irrigation/BMPs
- EPA's WaterSense Program Alignment (Fix-a-Leak Week)

As described in Section 3, groundwater pumping from the Basin for agricultural irrigation represents a significant demand. For this reason, the GSA will strongly encourage and incentivize pumpers to implement the most effective water use efficiency methods applicable, often referred to as BMPs. Provisions of the Agricultural Water Conservation Act (amending Division 6, Part 2.55 of the Water Code and passed into law in November 2009 regarding agricultural water conservation and management) can be used to inform GSA decisions and water use efficiency programs. While these new laws do not require water use objectives or savings thresholds, they do encourage more efficient use of water by the agricultural sector. It is anticipated that key stakeholders and industry leaders in the Basin will assist the GSA in facilitating workshops and technical training programs or support the implementation of other programs designed to communicate the latest best water use practices for their industry. Effective BMPs could result in the following:

- Enhanced efficient irrigation/BMPs.
- Irrigation audits and delivery of technical support for optimizing water use.
- Development of new weather stations and automated data for landowners.
- Encourage use of soil amendments (i.e., compost) to improve health of soils, plant health, and reduce water use.
- Encourage cover cropping and no-till/reduced tillage for increased water percolation/infiltration and less runoff, decreased soil moisture loss and less bare soil.
- More optimal irrigation practices by monitoring crop water use with soil and plant monitoring devices and tie monitoring data to evapotranspiration estimates.
- Encourage conversion from high water demand crops to lower water demand crops.
- Use satellite spectral/remote sensing data to refine irrigation practices.
- Encourage urban greening, shade trees, and grass to increase evapotranspiration rates for cooling and to reduce heat buildup from surfaces such as roofs, roads, and sidewalks.

Many growers already use BMPs, but it is expected that Basin-wide, improvements can be made. A goal of promoting BMPs is to broaden their use to more growers in the Basin. Promoting BMPs will include broad outreach to groundwater pumpers in the Basin to emphasize the importance of using BMPs and communicate their positive benefits for mitigating declining groundwater levels and avoiding potential mandated limitations in groundwater extraction on their properties.

The GSA will also collaborate with other entities that can offer resources and technical assistance to the water users in the Basin. The organizations may include the USDA, NRCS, Conservation Technical Assistance Program; California Water Efficiency Partnership; Santa Barbara Water Wise Program; and the California Polytechnic State University Irrigation Training and Research Center, or others.

6.12.2 Relevant Measurable Objective(s) [§354.44(b)(1)]

§354.44 Projects and Management Actions.

(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 measurable objectives benefiting from the implementation of Water Use Efficiency Programs include:

- **Groundwater Elevation Measurable Objectives:** Water use efficiency programs will focus on reducing pumping through water conservation. Less pumping can likely result in higher groundwater elevations.
- **Groundwater Storage Measurable Objectives:** This measurable objective is based on water levels at RMS wells in the Basin. Therefore, the implementation of water use efficiency programs will focus on identifying BMPs that will reduce pumping and will help achieve the goal of reducing total extractions to the long-term sustainable yield.
- **Degradation of Water Quality:** Improvements to water quality may occur as a result of Water Use Efficiency Programs that reduce irrigation return flows to the aquifer, thereby potentially limiting the amount of nitrate and TDS infiltrating to the aquifer.

6.12.3 Implementation Triggers [§354.44(b)(1)(A)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

The GSA will initiate evaluation and application of this management action within the first 5-year SGMA implementation period.

6.12.4 Public Notice Process [§354.44(b)(1)(B)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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.

Notification to the public regarding the concept for this project and the need to implement this project to avoid undesirable conditions in ongoing groundwater management was provided during the public process associated with the development of this GSP. If this project progresses, appropriate public notification will be maintained in conformance with the GSA Stakeholder Communication and Engagement Plan (Appendix C), and compliance with other permit conditions associated with project implementation will be maintained.

6.12.5 Permitting and Regulatory Process [§354.44(b)(3)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

There is no permitting or regulatory process associated with the implementation of water use efficiency programs.

6.12.6 Implementation Timeline [§354.44(b)(4)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

This project has no significant design requirements or construction costs to implement. As such, it is anticipated that the District will begin to evaluate this action early in the initial 5-year SGMA implementation period. Any constraints or costs associated with its operation will be assessed, and the management strategy will be implemented as appropriate after that.

6.12.7 Anticipated Benefits [§354.44(b)(5)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

The anticipated benefits of this management action are to minimize declines in groundwater elevation in the coastal area of the aquifer north of the Rincon Fault. This will mitigate against conditions that could contribute to seawater intrusion.

6.12.8 Legal Authority [§354.44(b)(7)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

The GSA has the legal authority to implement conservation and efficiency programs in the Basin.

6.12.9 Cost & Funding [§354.44(b)(8)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

It is anticipated that the cost of implementation of conservation and efficiency programs in the Basin will be borne through standard operational expenses of the GSA and the CVWD.

6.13 Groundwater Model Revisions and Updates Management Action [§354.44(b)(1), (d)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(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.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

6.13.1 Project Description

The CVWD groundwater model of the basin aquifer was developed in 2012, and updated in 2022–2023 as part of the effort to produce this GSP. However, groundwater models are usually viewed as living tools, subject to additional revision and modification as new data become available. Although no future scopes regarding groundwater model revisions are currently under consideration, a number of items can be identified that might improve the usefulness of the modeling tool in the future. These might include:

- Incorporation of the current streamflow routing package (SFR2) to represent streams in the Basin. This would allow modeled estimates of streamflow losses to the aquifer, rather than the prescribed definition of recharge via streamflow percolation calculated outside of the model and directly defined.
- Development of a SEAWAT or equivalent model capable of representing density-dependent flow to simulate transient water quality conditions along the coast, and the expected efficacy of a seawater intrusion barrier project.
- Incorporation of updated aquifer parameters after the completion of the Sentinel Monitoring Well Network Expansion.

An updated model could be used to refine assessment of travel times in the coastal areas at risk of seawater intrusion, simulate migration of brackish groundwater along the coast under various scenarios, evaluate the hydrogeologic implications of re-distribution of municipal pumping, assess expected increased storage associated with recharge enhancement or water banking or ASR, assess reductions in pumping associated with metering and conservation programs, and many other potential applications associated with sustainable management of the basin.

6.13.2 Relevant Measurable Objective(s) [§354.44(b)(1)]

§354.44 Projects and Management Actions.

(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.

An updated groundwater model will contribute to the understanding of various projects and management actions designed to achieve measurable objectives for the water level decline, reduction of groundwater storage, and seawater intrusion sustainability indicators.

6.13.3 Implementation Triggers [§354.44(b)(1)(A)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

It is anticipated that the District will begin to consider revisions to the model after the completion of the Sentinel Monitoring Well Network Expansion project, when there is expected to be a significant amount of new data to consider.

6.13.4 Public Notice Process [§354.44(b)(1)(B)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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.

Model revisions will be sponsored by the GSA and do not require public notice to proceed. However, it is expected that any updates will be presented in a public forum associated with the 5-year update to this GSP.

6.13.5 Permitting and Regulatory Process [§354.44(b)(3)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

Model revisions are not subject to any permitting or regulatory process. will be sponsored by the GSA and do not require public notice to proceed. However, it is expected that any updates will be presented in a public forum associated with the 5-year update to this GSP.

6.13.6 Implementation Timeline [§354.44(b)(4)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

It is anticipated that the District will begin to consider revisions to the model after the completion of the Sentinel Monitoring Well Network Expansion project, when there is expected to be a significant amount of new data to consider.

6.13.7 Anticipated Benefits [§354.44(b)(5)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

The anticipated benefits of this management action are to obtain better understanding of the dynamics of the basin aquifer, and better understanding of the implications and expected outcomes of projects and management actions designed to achieve sustainability..

6.13.8 Legal Authority [§354.44(b)(7)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

No legal authority is necessary for model revisions or associated planning activities.

6.13.9 Cost & Funding [§354.44(b)(8)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

The GSA's groundwater modeling consulting firm will provide a scope and fee for model revisions when the scope has been identified sometime prior to the 5-year GSP update.

6.14 Address Data Gaps [§354.44(b)(1), (d)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(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.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

6.14.1 Project Description

Various data gaps have been identified during the development of this GSP. These include:

- Lack of monitoring wells in Ventura County the Basin and near the boundary with MWD on the west end of the basin
- Information on two potential areas of GDEs
- Unknown well screen and depth information for some private wells
- Lack of hydrogeologic data in fault block area near RMS well 35E1
- Lack of hydrogeologic data along the coast (addressed in Sentinel Well Network Expansion project)
- Stream flows in Arroyo Paredon and Rincon Creeks
- Stream loss data in all unlined streams

It is expected that the GSA will pursue information to eliminate or clarify conditions regarding these and other data gaps that may be identified during SGMA implementation.

6.14.2 Relevant Measurable Objective(s) [§354.44(b)(1)]

§354.44 Projects and Management Actions.

(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.

Addressing the identified data gaps will lead to a more complete understanding of the hydrogeologic system in the Basin. This improved understanding will lead to better basin management, and help to achieve all measurable objectives associated with the sustainability indicators discussed in Section 5.

6.14.3 Implementation Triggers [§354.44(b)(1)(A)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

It is expected that the GSA will proceed with activities to address data gaps in the initial 5-year SGMA implementation period.

6.14.4 Public Notice Process [§354.44(b)(1)(B)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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.

No public notice is required for data collection activities performed by the GSA.

6.14.5 Permitting and Regulatory Process [§354.44(b)(3)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

No public notice is required for data collection activities performed by the GSA, unless they involve the construction of new monitor wells. In this case, County and City permit conditions may apply.

6.14.6 Implementation Timeline [§354.44(b)(4)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

It is expected that the GSA will proceed with activities to address data gaps in the initial 5-year SGMA implementation period.

6.14.7 Anticipated Benefits [§354.44(b)(5)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

Addressing the identified data gaps will lead to a more complete understanding of the hydrogeologic system in the Basin. This improved understanding will lead to better basin management, and help to achieve all measurable objectives associated with the sustainability indicators discussed in Section 5.

6.14.8 Legal Authority [§354.44(b)(7)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

The GSA has the legal authority to pursue data collection efforts within the Basin..

6.14.9 Cost & Funding [§354.44(b)(8)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

It is anticipated that the GSA will bear some minor costs in staff time and/or consultant fees to negotiate with landowners regarding well access, drill new monitoring wells, review available well data, and other actions in support of this management action. If new monitoring wells are constructed, there will be associated costs for contractor fees, permitting, etc., that will be administered by the GSA.

6.15 Perform Tier 2 Project and Management Action Feasibility and Ranking Study [§354.44(b)(1), (d)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(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.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

6.15.1 Project Description

Other than the Tier 1 projects discussed in this section of the GSP (i.e., CAPP, Sentinel Well Network Expansion, Infrastructure Tie-in), several Tier 2 projects are presented. The project and management action feasibility and ranking study management action discussed in this section is to perform an engineering study to assess the feasibility, costs, and benefits of Tier 2 projects and GSA management actions presented in this chapter. This is anticipated to be a desktop engineering study to evaluate the costs and implications of each Tier 2 project and basin management actions in greater detail than is possible during the development of this GSP. This is a necessary first step to gather more data and information prior to investing public funds in infrastructure projects. It is anticipated that at the conclusion of this study, a more robust understanding of costs and benefits associated with each action will allow for prioritization of these actions during the long-term SGMA implementation period.

6.15.2 Relevant Measurable Objective(s) [§354.44(b)(1)]

§354.44 Projects and Management Actions.

(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.

Additional study and understanding of potential future management actions is a necessary first step to prioritization of future groundwater management activities in the Basin. Implementation of each of these secondary management activities will lead to better basin management and help to achieve all measurable objectives associated with the sustainability indicators discussed in Section 5. Relevant measurable objectives associated with individual Tier 2 projects or management actions are discussed in the individual sections detailing each of these activities in Sections 6.6 through 6.14 of this GSP.

6.15.3 Implementation Triggers [§354.44(b)(1)(A)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

It is expected that the GSA will proceed with the ranking study discussed herein within the first 1 to 2 years of the initial 5-year SGMA implementation period. No specific triggers are necessary to instigate this study.

6.15.4 Public Notice Process [§354.44(b)(1)(B)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(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.

No public notice is required for engineering studies performed by the GSA.

6.15.5 Permitting and Regulatory Process [§354.44(b)(3)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

No permitting process is required for engineering studies performed by the GSA.

6.15.6 Implementation Timeline [§354.44(b)(4)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

It is expected that the GSA will proceed with the ranking study discussed herein within the first 1 to 2 years of the initial 5-year SGMA implementation period. No specific triggers are necessary to instigate this study.

6.15.7 Anticipated Benefits [§354.44(b)(5)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

Additional study and understanding of potential future management actions is a necessary first step to prioritization of future groundwater management activities in the Basin. Implementation of each of these secondary management activities will lead to better basin management and help to achieve all measurable objectives associated with the sustainability indicators discussed in Section 5. Specific measurable objectives associated with individual project or management action are discussed in the individual sections detailing each of the activities in Sections 6.16 through 6.13 of this GSP.

6.15.8 Legal Authority [§354.44(b)(7)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

The GSA has the legal authority to pursue engineering studies within the Basin.

6.15.9 Cost & Funding [§354.44(b)(8)]

23 Cal. Code Regs §354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(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.

It is anticipated that the GSA will bear some costs in staff time and/or consultant fees to develop and implement this feasibility/ranking study. The actual costs will depend on the specific scope of work negotiated with the selected engineering consulting firm, but for the purposes of this GSP, costs are anticipated to be approximately $30,000 to $50,000.

SECTION 7:

Implementation Plan

SECTION 7: Implementation Plan [§354.44(b)(6)]

§354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(6) An explanation of how the project or management action will be accomplished. If the project 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.

7.1 Introduction

This section provides a conceptual roadmap for the Carpinteria GSA's efforts to implement this Plan after adoption and discusses implementation efforts in accordance with SGMA regulations § 354.44(b)(6). This implementation plan is based on the Carpinteria GSA's current understanding of the Basin's conditions and anticipated administrative considerations that affect the management actions described in Section 6. Understanding of basin conditions and administrative considerations will evolve over time, based on future refinement of the hydrogeologic setting, groundwater flow conditions, and input from basin stakeholders.

Implementation of this Plan requires robust administrative and financing structures, with adequate staff and funding to support compliance with SGMA. The Plan calls for the Carpinteria GSA to routinely provide information to the public about Plan implementation, progress towards sustainability, and the need to use groundwater efficiently. The Plan calls for a website to be maintained as a communication tool for posting data, reports, and meeting information.

Section 6 identifies the following three tiers of projects and management actions that may be considered for implementation by the Carpinteria GSA:

- Tier 1 projects are expected to be implemented within the first 5-year SGMA implementation period.
- Tier 2 projects will be considered after the first 5-year period and prior to the 20-year implementation deadline.
- Tier 3 management actions will be evaluated individually after Plan adoption, and implemented as appropriate under the direction of the GSA.

These projects and management actions can be implemented as the conditions in the Basin dictate. It is important to note that the Teir 2 projects and some of the management actions described in Section 6 may not be necessary if the implementation of Tier 1 projects and management actions result in conditions within the Basin that are trending toward meeting the Carpinteria GSA sustainability goals and measurable objectives. However, the Carpinteria GSA may determine that the implementation of Tier 2 projects is desirable for reasons other than reaching sustainability within the Basin and may elect to implement selected initiatives at any time.

Based on the results of the analysis performed in conjunction with the development of this Plan, the Carpinteria GSA concludes that the sustainability goals described in this Plan, and required under the provisions of SGMA, can be achieved through the implementation, as needed, of the Tier 1 projects (see Sections 6.3 through 6.5), and some combination of and management actions (see Sections 6.9 through 6.14). Therefore, the Carpinteria GSA does not plan at this time to implement any of the Tier 2 projects

and/or to initiate the construction of any project infrastructure for the specific goal of achieving sustainability until such time as evidence indicates that the Tier 2 projects will be necessary for sustainable groundwater management. The six management actions described below will be evaluated for cost and efficacy early in the initial 5-year SGMA implementation period, and implemented as determined appropriate by the Carpinteria GSA:

- Administrative Approach and Implementation Timing (Section 7.2)
- Permitting of Wells (Section 7.3)
- Annual Reporting (Section 7.4)
- Five-Year Plan Evaluation and Update (Section 7.5)
- Management Action Implementation (Section 7.6)
- Carpinteria GSA Annual Budget Estimates (Section 7.7)
- Funding Sources (Section 7.8)

7.2 Administrative Approach and Implementation Timing

The Carpinteria GSA will likely hire consultant(s), assign a member agency to conduct or manage the effort, and/or hire staff to implement the Plan. If consultants are hired, it is anticipated that qualified professionals will be identified and hired through a competitive selection process. It is also anticipated that the lead for a particular task will keep the Carpinteria GSA informed via periodic updates to the Carpinteria GSA Committee and the public. As needed, the Carpinteria GSA would likely conduct specific studies and analyses necessary to improve understanding of basin conditions. The Carpinteria GSA would likely then use new information on basin conditions to identify, evaluate, and/or improve management actions to achieve sustainability. This Plan calls for actions considered by the Carpinteria GSA to be vetted through a public outreach process, whereby groundwater pumpers and other stakeholders will have opportunities to provide input to the decision-making process.

Using authorities outlined in California Water Code §§ 10725 to 10726.9, the Carpinteria GSA will ensure the maximum degree of local control and flexibility consistent with this Plan to commence management actions. Because the amount of groundwater pumping in the Carpinteria area in recent years has been more than the estimated sustainable yield of approximately 3,600 to 4,000 AFY (see Section 3.3), and groundwater levels were observed to decline in some areas during the drought, the Carpinteria GSA will begin to implement selected projects and management actions within 1 year after Plan adoption. The Carpinteria GSA plans to continually monitor and assess its progress toward meeting the SMCs (see Section 5). Under conditions in which minimum thresholds are being approached, the Carpinteria GSA will perform assessments to determine whether the trends are related to groundwater pumping, drought conditions, or other factors. If groundwater level data are trending toward reaching minimum thresholds as a direct consequence of groundwater pumping in the Basin, then the Carpinteria GSA may consider the implementation of additional projects or management actions.

7.3 Permitting of Wells

In accordance with Paragraph 9 of Governor Newsom's Executive Order N-7-22 and the Santa Barbara County Board of Supervisors Urgency Ordinance No. 5158 dated May 24, 2022, the County Department of Environmental Health Services shall not approve a permit for a new groundwater well or for alteration of an existing well in a medium- or high-priority basin subject to the SGMA without first obtaining written verification from the GSA that groundwater extraction by the proposed well:[10]

1. Would not be "inconsistent with any sustainable groundwater management program" established by the Plan adopted by that GSA, and
2. Would not decrease the likelihood of achieving a sustainability goal for the basin covered by the Plan.

Paragraph 9 of Executive Order N-7-22 does not apply to permits for wells that will provide less than 2 AFY of groundwater for individual domestic users, or that will exclusively provide groundwater to public water supply systems as defined in § 116275 of the Health and Safety Code.

At the time of the adoption of this Plan, the Governor's Executive Order, though intended as a temporary response to the recent drought, remains in place. Discussions in the state legislature have proposed various alternatives for permanent legislation addressing similar subject matter, but none have been passed at this time. The practical effect of the executive order and the Urgency Ordinance is to authorize to the GSA to approve or deny any significant groundwater development in the Basin in compliance with the Plan.

SGMA focuses on sustainability of the basin but does not consider water rights. SGMA directly states that its intent is not to change or affect water rights. The GSA does not have the authority, nor should it be administering programs that prevent landowners from exercising their water rights. Because of this, the Plan will consider well verification letters required by the Executive Order in the context of how the new well will affect the GSA's ability to implement future programs such as pumping curtailment for all or groundwater replenishment.

7.4 Annual Reporting

The Carpinteria GSA will submit an annual report to DWR by April 1 of each year following the adoption of the Plan. The annual report will include the following components for the preceding water year as required by DWR (CCR § 356.2):

(a) General information, including an executive summary and a location map depicting the basin covered by the report.

(b) A detailed description and graphical representation of the following conditions of the basin managed in the Plan:

(1) Groundwater elevation data from monitoring wells identified in the monitoring network shall be analyzed and displayed as follows:

(A) Groundwater elevation contour maps for each principal aquifer in the basin illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions.

(B) Hydrographs of groundwater elevations and water year type using historical data to the greatest extent available…

[10] New wells are those resulting in new or additional groundwater production from the Basin, or those resulting in new or additional production capacity. Replacement wells are those not resulting in new or additional groundwater production or production capacity in the Basin.

(2) Groundwater extraction for the preceding water year… and a map that illustrates the general location and volume of groundwater extractions.
(3) Surface water supply used or available for use…
(4) Total water use…
(5) Change in groundwater in storage…

(c) A description of progress towards implementing the Plan, including achieving interim milestones, and implementation of projects or management actions since the previous annual report.

7.5 Five-Year Evaluation and Update

The Carpinteria GSA will evaluate its Plan at least every 5 years, and whenever the Plan is evaluated a written assessment will be provided to DWR. The assessment will describe whether Plan implementation, including implementation of projects and management actions, are meeting the sustainability goal in the Basin, and will include the following:

3. A description of current groundwater conditions for each applicable sustainability indicator relative to measurable objectives, interim milestones, and minimum thresholds.
4. A description of the implementation of any projects or management actions, and the effect on groundwater conditions resulting from those projects or management actions.
5. Elements of the Plan, including the basin setting, management areas, or the identification of undesirable results and the setting of minimum thresholds and measurable objectives, will be reconsidered and revisions proposed, if necessary.
6. An evaluation of the basin setting in light of significant new information or changes in water use, and an explanation of any significant changes. If the Carpinteria GSA's evaluation shows that the Basin is experiencing overdraft conditions, the Carpinteria GSA will include an assessment of measures to mitigate that overdraft.
7. A description of the monitoring network within the Basin, including whether data gaps exist, or any areas within the Basin are represented by data that does not satisfy the requirements of the SGMA regulations (23 CCR §§ 352.4 and 354.34(c)). The description will include the following:
   a. An assessment of monitoring network function with an analysis of data collected to date, identification of data gaps, and the actions necessary to improve the monitoring network, consistent with the requirements of § 354.38.
   b. If the Carpinteria GSA identifies data gaps, the Plan will describe a program for the acquisition of additional data sources, including an estimate of the timing of that acquisition, and for incorporation of newly obtained information into the Plan.
   c. The Plan will prioritize the installation of new data collection facilities and analysis of new data based on the needs of the Basin.
8. A description of significant new information that has been made available since Plan adoption or amendment, or the last 5-year assessment. The description will also include whether new information warrants changes to any aspect of the Plan, including the evaluation of the Basin setting, measurable objectives, minimum thresholds, or the criteria defining undesirable results.
9. A description of relevant actions taken by the Carpinteria GSA, including a summary of regulations or ordinances related to the Plan.
10. Information describing any enforcement or legal actions taken by the Carpinteria GSA in furtherance of the sustainability goal for the Basin.
11. A description of completed or proposed Plan amendments.

12. Where appropriate, a summary of coordination that occurred between GSAs in hydrologically connected basins and local land use agencies.
13. Other information the Carpinteria GSA deems appropriate, along with any information required by DWR to conduct a periodic review as required by California Water Code § 10733 (CCR § 356.4).

7.6 Management Action Implementation

Details of the projects and management actions identified by the Carpinteria GSA for possible implementation are presented in Section 6. The Tier 1 projects will be initiated or completed within the initial 5-year SGMA implementation period. Funding for the Tier 1 CAPP and the Casitas Water District tie-in have been secured through state grants, low-interest loans, or other funding mechanisms; it is anticipated that funding for the Tier 1 project Sentinel Well Network Expansion will be pursued through grant and low interest loan funding as well.

The Tier 2 projects may be considered for implementation in the future as conditions in the Basin dictate and the effectiveness of the other management actions are assessed. Management actions discussed in Section 6 will be individually evaluated early in the initial 5-year SGMA implementation period, and implemented as considered appropriate by the GSA. It is important to note that the management actions and projects included in Tiers 2 and 3 management actions and Tier 3 projects may not be necessary if the implementation of Tier 1 management actions result in basin conditions that trend toward meeting the Carpinteria GSA sustainability goals and measurable objectives. However, the Carpinteria GSA may determine that the implementation of Tier 2 projects is desirable for reasons of basin management other than reaching sustainability within the Basin and may elect to implement such projects at any time. (As an example, installation of an ASR well may not be specifically required to meet SMCs, but would increase the ability to store water and thus improve the flexibility available in basin management. Table 7-1 provides an estimate of the planning-level costs associated with the Tier 1 and Tier 2 projects. Table 7-2 provides an estimate of planning-level costs associated with the management actions. The Carpinteria GSA will develop more specific planning-level costs for potential projects and management actions as they are implemented or identified for consideration by the Carpinteria GSA in the future.

Table 7-1. Conceptual Planning-Level Cost Estimate for Potential Project Implementation

Activity	Planning Level Estimate[1]	
	Low	High
Tier 1 Projects (External Funding Sources)		
Carpinteria Advanced Purification Project[2]	$40 million	$50 million
Sentinel Monitoring Well Network Expansion[3]	$2 million	$5 million
Casitas Water District Tie-In[2]	$21 million	$25 million
Tier 2 Projects		
Seawater Barrier Intrusion Project[4]	$4 million	$8 million
Aquifer Storage and Recovery Well[4]	$2 million	$4 million
Recharge Enhancement Projects[4]	$500,000	$30 million
TOTAL	**$69.5 million**	**$122 million**

Notes

[1] The estimates in this table are planning-level cost estimates that are subject to refinement and revision by the Carpinteria GSA after Plan adoption.

[2] External grant and low-interest loan funding already secured.

[3] External grant and low-interest funding will be pursued.

[4] Tier 2 projects are not anticipated to be implemented during the initial 5-year SGMA implementation period.

Table 7-2. Conceptual Planning-Level Cost Estimate for Potential Management Action Implementation

Activity	Planning Level Estimate[1]			
	Annual Cost	Event Cost	5-year Total	Average Annualized Cost (5 years)
Management Actions (GSA Implementation Costs)				
Municipal Pumping Re-Distribution	$15,000	$0	$75,000	$15,000
Local Water Banking Agreements with Neighboring Districts	$20,000	$0	$100,000	$20,000
Well Registration/Metering Program/Monitor Well Network Expansion	$50,000	$0	$250,000	$50,000
Water Conservation and Efficiency Programs	$15,000	$0	$75,000	$15,000
Groundwater Model Updates	$0	$150,000	$150,000	$30,000
Address Data Gaps	$10,000	$0	$50,000	$10,000
Total Annual Cost to Implement Management Actions	—	—	—	**$140,000**

Notes

[1] The estimates in this table are planning-level cost estimates that are subject to refinement and revision by the Carpinteria GSA after Plan adoption.

— = not applicable

7.7 Annual Budget Estimates

The Carpinteria GSA will incur costs for internal management and operation of the Carpinteria GSA, including monitoring of the conditions in the Basin and Plan implementation. The conceptual estimated staff and administration costs of plan implementation are presented herein. Additional variable costs may include engineering and other consulting services, permits and fees, California Environmental Quality Act compliance, legal expenses, and other administrative costs associated with the implementation of the Tier 1 management actions, along with the potential for additional costs associated with the potential future implementation of the Tier 2 management actions and/or Tier 3 projects. Additionally, the Carpinteria GSA will incur costs associated with the preparation of required annual reports to DWR and the required 5-year Plan evaluation and, if necessary, updates to the Plan. Table 7-3 provides an estimate of the conceptual planning-level costs for Carpinteria GSA annual management and operation.

Table 7-3. Conceptual Planning-Level Cost Estimate for Carpinteria GSA Annual Management and Operation

Activity	Planning Level Estimate[1]	
	Low	High
Carpinteria GSA Staffing	$100,000	$140,000
Consulting Services	$10,000	$30,000
Administrative Professional Services[2]	$62,000	$66,000
Basin Monitoring	$20,000	$22,000
Legal	$21,000	$22,000
Miscellaneous Expenses	$10,000	$15,000
Annual Reporting	$40,000	$50,000
Debt Service[3]	$80,000	$110,000
TOTAL	**$353,000**	**$455,000**

Notes

[1] The estimates in this table are planning-level cost estimates that are subject to refinement and revision by the Carpinteria GSA after Groundwater Sustainability Plan adoption. Costs for some items are shared between the GSA and the Carpinteria Valley Water District.

[2] Includes services such as accounting, audits, insurance, and public outreach.

[3] Debt service indicates current payments on existing projects and management actions, GSA formation, etc.

Basin = Carpinteria Groundwater Basin

GSA = Groundwater Sustainability Agency

7.8 Funding Sources

Early in the initial 5-year SGMA implementation period, the Carpinteria GSA will develop and begin administration of a fee program for the purpose of funding the management actions required to implement the Plan and the day-to-day administrative costs of operating the GSA. It is anticipated that this program will be separate from any project-specific funding for capital projects. The fee program is likely to be based on groundwater pumping in the Basin; the precise method of determination of non-metered groundwater pumping is not yet established, but initial discussions have begun with basin agricultural stakeholders during the development of this Plan. The Carpinteria GSA may consider measures to fund Plan implementation using a combination of groundwater extraction charges, including monthly fixed charges and variable pumping fees, assessments/parcel taxes, parcel fees, and grants. Because of constitutional limitations imposed through California Propositions 13, 218, and 26, there are strict rules about what constitutes a fee, charge, assessment, or tax. The Santa Barbara County Water Agency and grants from DWR have funded the majority of the Plan development costs to date, and it is expected that grants available from general obligation bonds, such as Proposition 68, may be available to help fund future Plan implementation.

On May 14, 2021, Governor Newsom rolled out his California Comeback Plan, marking unprecedented and notable one-time funding investments (State of California, 2021). This came after a year of unprecedented moments from a global pandemic, record-breaking wildfires, and increased momentum to build equity across multiple segments of society. Of particular interest to the Carpinteria GSA is potential funding from AB 350, a bill to create a 3-year grant program to assist farmers and ranchers in critically over-drafted basins with conservation management planning. As part of this measure, the Governor is proposing $300 million in funds for implementation and planning of the SGMA.

After Plan adoption, the Carpinteria GSA may perform a preliminary financing plan options evaluation to determine a funding structure to fund the proposed Carpinteria GSA activities and expected financial commitments throughout Plan implementation. Development of the funding mechanism(s) is critical to facilitate successful implementation of the Plan consistent with the requirements of SGMA. A key success factor is preparing a cost allocation that is equitable to Carpinteria GSA members and stakeholders. After the evaluation of financing plan options, a preliminary financing model may be developed to determine revenue required to fund the operating plan, to establish reserve balances, and to evaluate required adjustments to the fee structure over time.

SECTION 8:

References and Technical Studies

SECTION 8: **References and Technical Studies**

§ 354.4 General Information.

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

Blaney Harry F. and W.D. Criddle. 1962. *Determining Consumptive Use and Irrigation Water Requirements*. U.S. Department of Agriculture, Agriculture Research Service. Technical Bulletin No. 1275.

Blaney, Harry F. 1933. Consumptive Use of Water by Native Plants Growing in Moist Areas.

Bredehoeft, J.D. 2002. "The Water Budget Myth Revisited: Why Hydrogeologists Model." *Ground Water*, Vol. 40, No. 4, July–August 2002, pp 340–345.

Bredehoeft, J.D., S.S. Papadopulos, and H.H. Cooper 1982. "Groundwater: The Water Budget Myth." In *Scientific Basis of Water-Resource Management*, Studies in Geophysics, Washington, DC: National Academy Press, pp. 51-57.

CMWD. 2021. *2020 Urban Water Management Plan*. Prepared by the Casitas Municipal Water District. Adopted by the Board of Directors on June 23, 2021. Available at https://www.casitaswater.org/home/showpublisheddocument/4108/637607539377570000.

City of Carpinteria. 2003. *City of Carpinteria General Plan/Local Coastal Land Use Plan & Environmental Impact Report*. State Clearinghouse Number 1997121111. April 2003. Available at https://carpinteriaca.gov/wp-content/uploads/2023/09/cd_General-Plan.pdf.

Driscoll, F.G. 1995. *Groundwater and Wells*. Second Edition. Published by Johnson Screens, St. Paul, MN.

Dudek. 2019. Santa Barbara County Integrated Regional Water Management Plan, Update 2019. Prepared by Dudek Consultants. Prepared for the Santa Barbara County IRWM Cooperating Partners.

DWR. 2004. Carpinteria Groundwater Basin, Basin No. 3-018. California's Groundwater Bulletin 118. Central Coast Hydrologic Region. Available at https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/2003-Basin-Descriptions/3_018_Carpinteria.pdf. Last update February 27, 2004.

DWR. 2010. California Statewide Groundwater Elevation Monitoring (CASGEM) Program Procedures for Monitoring Entity Reporting. December.

DWR. 2016a. *Best Management Practices for the Sustainable Management of Groundwater – Water Budget*. Available at https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-4-Water-Budget_ay_19.pdf.

DWR. 2016b. *Best Management Practices for the Sustainable Management of Groundwater – Monitoring Protocols, Standards, and Sites*. Available at https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-1-Monitoring-Protocols-Standards-and-Sites_ay_19.pdf.

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

DWR. 2020. SGMA Data Viewer. California Department of Water Resources. Available at https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#currentconditions.

DWR. 2022. Disadvantaged Communities Mapping (DAC) Tool. Available at https://gis.water.ca.gov/app/dacs/. Accessed July 20, 2022.

DWR. 2023. Carpinteria Groundwater Basin, Basin No. 3-018. Central Coast Hydrologic Region. Available at https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/2003-Basin-Descriptions/3_018_Carpinteria.pdf. Last updated August 11, 2023.

Evenson, R.E., Wilson, H.D., Jr., and Muir, K.S. 1962. *Yield of the Carpinteria and Goleta Ground Water Basins, Santa Barbara County, California, 1941 – 58*. U.S. Geological Survey Open-File Report.

GTC. 1976. *Hydrogeologic Investigation of Carpinteria Ground Water Basin*. Prepared for Carpinteria County Water District. Geotechnical Consultants, Inc.

GTC. 1986. *Hydrogeologic Update, Carpinteria Groundwater Basin*. Prepared for Carpinteria County Water District. Geotechnical Consultants, Inc.

Harbaugh, A.W. 2005. MODFLOW-2005, the U.S. Geological Survey Modular Ground-Water Model – the Ground-Water Flow Process: U.S. Geological Survey Techniques and Methods 6-A16.

Niswonger, R.G., S. Panday, and M. Ibaraki. 2011. MODFLOW-NWT, A Newton Formulation for MODFLOW-2005: U.S. Geological Survey Techniques and Methods 6–A37, 44 p.

NMFS. 2000. *Biological Opinion, U.S. Bureau of Reclamation Operation and Maintenance of the Cachuma Project on the Santa Ynez River in Santa Barbara County, California*. Issued September 11, 2000. Issued by the National Marine Fisheries Service (NMFS).

Padre. 2003. *Aquifer Storage and Recovery Demonstration Project*. Prepared for Carpinteria Valley Water District by Padre Associates.

PWR. 2022. Future Water Budget Methodology Technical Memo. Prepared by Pueblo Water Resources, Inc.

PWR. 2012. *Carpinteria Groundwater Basin, Hydrogeologic Update and Groundwater Model Project*. Prepared by Pueblo Water Resources, Inc. Prepared for Carpinteria Valley Water District.

RMS. 2016. Carpinteria Valley Recycled Water Facilities Plan, Final Report. Carpinteria Valley Water District, City of Carpinteria, and Carpinteria Sanitary District. Prepared by RMS Water and Environment. April 2016.

RWQCB et al. 2017. *Water Quality Control Plan for the Central Coastal Basin*. September 2017 Edition. Prepared by the Regional Water Quality Control Board, Central Coast Region, State Water Resources Control Board, and California Environmental Protection Agency.

RWQCB et al. 2019. *Water Quality Control Plan for the Central Coastal Basin*. June 2019 Edition. Prepared by the Regional Water Quality Control Board, Central Coast Region, State Water Resources Control Board, and California Environmental Protection Agency. Available at https://www.waterboards.ca.gov/centralcoast/publications_forms/publications/basin_plan/docs/2019_basin_plan_r3_complete_webaccess.pdf.

RWQCB. 2017. Agricultural Order No. R3-2017-0002, Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands. State of California, California Regional Water Quality Control Board Central Coast Region.

RWQCB. 2021. Agricultural Order No. R3-2021-0040, General Waste Discharge Requirements for Discharges from Irrigated Lands. State of California, California Regional Water Quality Control Board Central Coast Region. April 15, 2021.

Santa Barbara County. 2012. *Santa Barbara County 2011 Groundwater Report*. Prepared by Dennis Gibbs for Santa Barbara County Public Works Department, Water Resources Division.

Santa Barbara County. 2021. *Santa Barbara County Groundwater Basins Summary Report*.

State of California. 2021. California Roars Back: Governor Newsom Presents $100 Billion California Comeback Plan. Office of Governor Gavin Newsom. Available at https://www.gov.ca.gov/2021/05/14/california-roars-back-governor-newsom-presents-100-billion-california-comeback-plan/. May 14, 2021.

Sullwold, H.H. 1996. *Carpinteria Groundwater Basin, A Geological Up-date*. Prepared for Carpinteria Valley Water District.

The Nature Conservancy. 2018. *Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans*.

Theis, C.V. "The Source of Water Derived from Wells: Essential Factors Controlling the Response of an Aquifer to Development." *Civil Engineer*, Vol. 10: pp. 277–280, 1940.

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

TRE ALTAMIRA. 2023. *InSAR Land Surveying and Mapping Services to DWR Supporting SGMA*. October 2023 Updated Technical Report.

TWRI. 2001. *Potential Water Savings in Irrigated Agriculture in the Lower Rio Grande Basin of Texas*. Texas Water Resources Institute (TWRI).

Upson, J.E. and H.G. Thomasson. 1951. *Geology and Ground-Water Resources of the South-Coast Basins of Santa Barbara County, California*. U.S. Geological Survey Water Supply Paper 1108. https://doi.org/10.3133/wsp1108.

WCVC. 2019. *WCVC Integrated Regional Water Management Plan*, *Final Draft*. Adopted in 2014, Amended in 2019. Watersheds Coalition of Ventura County (WCVC). Available at https://watershedscoalition.org/2019-irwm-plans/.

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.	26:50	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.	437:440	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.	56	2.3			
(b)			The organization and management structure of the Agency, identifying persons with management authority for implementation of the Plan.	57	2.4			
(c)			The name and contact information, including the phone number, mailing address and electronic mail address, of the plan manager.	57	2.4.1			
(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.	58	2.4.2			
(e)			An estimate of the cost of implementing the Plan and a general description of how the Agency plans to meet those costs.	60, 433:436	2.4.3, 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.					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
§ 354.8.			**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.	59:60	2.5	2-1		
	(2)		Adjudicated areas, other Agencies within the basin, and areas covered by an Alternative.	60	2.5			
	(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.	59, 61	2.5.1	2-1		
	(4)		Existing land use designations and the identification of water use sector and water source type.	61:67	2.5.1.1:2.5.1.3	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.	77:81	2.5.3.4	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.	59:61	2.5:2.5.1	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.	68:73	2.5.2			
(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.	68:73	2.5.2			
(e)			A description of conjunctive use programs in the basin.	74	2.5.2.7			
(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.	74:75	2.5.3			
	(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	75:76	2.5.3.2			
	(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.	76	2.5.3.3			

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)		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.	77, 81	2.5.3.4			
	(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.	81	2.5.3.5			
(g)			A description of any of the additional Plan elements included in Water Code Section 10727.4 that the Agency determines to be appropriate.	81:82	2.5.4		2-3	
			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.	83:84	2.6.1			
(b)			A list of public meetings at which the Plan was discussed or considered by the Agency.	500	Appendix C			
(c)			Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.	893:914	Appendix I			
(d)			A communication section of the Plan that includes the following:					
	(1)		An explanation of the Agency's decision-making process.	493	Appendix C			
	(2)		Identification of opportunities for public engagement and a discussion of how public input and response will be used.	494:495, 499	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.	494:496	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.	496:499	Appendix C			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.8, 10728.4, and 10733.2, Water Code					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
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.	86:91, 581:853	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.	92:93	3.1.2			
	(2)		Lateral basin boundaries, including major geologic features that significantly affect groundwater flow.	98	3.1.3.1			
	(3)		The definable bottom of the basin.	98	3.1.3.1			
	(4)		Principal aquifers and aquitards, including the following information:					
		(A)	Formation names, if defined.	97	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.	97:111	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.	110	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.	112:116	3.1.3.3			
		(E)	Identification of the primary use or uses of each aquifer, such as domestic, irrigation, or municipal water supply.	116	3.1.3.4			
	(5)		Identification of data gaps and uncertainty within the hydrogeologic conceptual model	118	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.	104:109	3.1	3-10:3-15		

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(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.	87:88, 90	3.1.1	3-1		
	(2)		Surficial geology derived from a qualified map including the locations of cross-sections required by this Section.	92:94	3.1.2	3-4		
	(3)		Soil characteristics as described by the appropriate Natural Resources Conservation Service soil survey or other applicable studies.	93, 96	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.	103, 111	3.1.3.2	3-9		
	(5)		Surface water bodies that are significant to the management of the basin.	89:90	3.1.1.2	3-2		
	(6)		The source and point of delivery for imported water supplies.	66:67	2.5.1.2	2-4		
			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.	118:124	3.2.1	3-19:3-23		
	(2)		Hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers.	125:131; 501:545	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.	132:133	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.	132, 134:147	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.	148:149	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.	148, 150:151	3.2.5	3-42		

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.	152:157	3.2.6	3-43:3-46		
(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.	158:179	3.2.7	3-47:3-61		
			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.	180:247	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.	189:191, 207	3.3.2		3-9	
	(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.	191:200	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.	200:201	3.3.2			
	(4)		The change in the annual volume of groundwater in storage between seasonal high conditions.	210:213, 216:219	3.3.3:3.3.4	3-70:3-73	3-10:3-13	
	(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.	245:247	3.3.6			
	(6)		The water year type associated with the annual supply, demand, and change in groundwater stored.	204, 210, 215:216	3.3.3:3.3.4		3-10, 3-12	
	(7)		An estimate of sustainable yield for the basin.	243:247	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.	215:219	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:					

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 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.	214	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.	204:213	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.	204:214	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.	220:233	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.	234:235	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.	235:236	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:					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(1)		Historical water budget information for mean annual temperature, mean annual precipitation, water year type, and land use.	186:187, 189, 194:196, 210, 221	3.3.2:3.3.3			
	(2)		Current water budget information for temperature, water year type, evapotranspiration, and land use.	186:187, 189, 194:196, 215:216	3.3.2, 3.3.4			
	(3)		Projected water budget information for population, population growth, climate change, and sea level rise.	222, 224, 234	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.	180:203	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.	180:203	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.	359	5.11			

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)			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.	359	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.	359	5.11			
	(3)		The level of monitoring and analysis appropriate for each management area.	359	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.	359	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.	359	5.11			
			Note: Authority cited: Section 10733.2, Water Code.					
			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.	294:295	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.	297:298	5.4.2			
(b)			The description of undesirable results shall include the following:					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(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.	298:300, 320:322, 329:331, 340:342, 355:356	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.	299:300, 321:322, 330:331, 342, 356	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.	300, 322, 331, 342, 356	5.5.1, 5.6.1, 5.7.1, 5.8.1, 5.9.1			
(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.	301:302, 323:324, 332:336, 343:345, 357	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.	359	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.	301:314, 323:324, 332:336, 343:349, 357	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.	302, 312:314, 324, 334:336, 345, 357	5.5.2, 5.6.2, 5.7.2, 5.8.2, 5.9.2			

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(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.	314:315, 324:325, 336, 350, 357:358	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.	316, 325, 337, 350, 358	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.	316:317, 326:327, 337:338, 351, 358	5.5.2, 5.6.2, 5.7.2, 5.8.2, 5.9.2			
	(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.	317, 327, 338, 352, 358	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.	318, 327, 338, 352, 358	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.	301:314	5.5.2			
		(B)	Potential effects on other sustainability indicators.	314:315	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.	323:324	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:					

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)	Maps and cross-sections of the chloride concentration isocontour that defines the minimum threshold and measurable objective for each principal aquifer.	332:333	5.7.2	5-10		
		(B)	A description of how the seawater intrusion minimum threshold considers the effects of current and projected sea levels.	332:336	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.	343:345	5.8.2			
	(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.	355:358	5.9.1:5.9.2			
		(B)	Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives.	355:358	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.	359	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.	359	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.	323:324	5.6.2			

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(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.	359	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.	319:320, 328:329, 339:340, 353:354, 357:358	5.5.3:5.5.4, 5.6.3:5.6.4, 5.7.3:5.7.4, 5.8.3:5.8.4, 5.9.3:5.9.4			
(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.	299, 303:311, 319:320, 328:329, 333, 339:340, 344, 353:354, 357:358	5.5.3, 5.6.3, 5.7.3, 5.8.3, 5.9.3	5-1:5-10	5-1:5-2	
(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.	319:320, 328:329, 339:340, 353:354, 358	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.	328	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.	319:320, 328:329, 339:340:353:354, 358	5.5.3, 5.6.3, 5.7.3, 5.8.3, 5.9.3			

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)			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.					
§ 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.	249:351	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.	251	4.2			
	(2)		Monitor impacts to the beneficial uses or users of groundwater.	251	4.2			
	(3)		Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.	251	4.2			
	(4)		Quantify annual changes in water budget components.	251	4.2			
(c)			Each monitoring network shall be designed to accomplish the following for each sustainability indicator:					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(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.	259:261	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.	259:260	4.4.1			
	(2)		Reduction of Groundwater Storage. Provide an estimate of the change in annual groundwater in storage.	260:261, 264	4.4.2	4-3	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.	267:269	4.4.3	4-4	4-3	
	(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.	273:276	4.4.4	4-5	4-4	
	(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.	279:280	4.4.5			
	(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.	282	4.4.6			
		(B)	Identifying the approximate date and location where ephemeral or intermittent flowing streams and rivers cease to flow, if applicable.	282	4.4.6			
		(C)	Temporal change in conditions due to variations in stream discharge and regional groundwater extraction.	282	4.4.6			
		(D)	Other factors that may be necessary to identify adverse impacts on beneficial uses of the surface water.	282	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.	250:251	4.2			
(e)			A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.	251:257	4.3	4-1:4-2	4-1	

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)			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.	251	4.2			
	(2)		Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.	251, 258	4.2, 4.4			
	(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.	251, 258:259, 267, 273	4.2, 4.4			
	(4)		Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.	251:255	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.	251, 258, 260	4.2, 4.4			
	(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.	259:260, 264, 267, 273:274, 279	4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5			
	(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.	299, 303:311, 320, 328:329, 333, 339:340, 343:344, 353:354, 357:358	5.5.2:5.5.3, 5.6.2:5.6.3, 5.7.2:5.7.3, 5.8.2:5.8.3, 5.9.2:5.9.3	5-1:5-10	5-1:5-2	
(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.	253:255, 257, 259:261, 264, 267:269, 273:276, 279:280	4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5	4-1:4-5	4-1:4-4	
(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.	262, 265, 271, 277, 280	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.	282:285	4.4.6			

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
			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.	259:261, 267:269, 274:276	4.4.1, 4.4.3, 4.4.4	4-3:4-5	4-2:4-4	
(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.	265:266	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.	265:266	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.	259:261, 267:269, 274:276	4.4.1, 4.4.3, 4.4.4	4-3:4-5	4-2:4-4	
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2 and 10733.2, Water Code					
§ 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.	263:264, 266, 272:273, 278, 281	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.	263:264, 266, 272:273, 278, 281	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.	254:255, 263:264, 266, 272:273	4.4.1, 4.4.2, 4.4.3		4-1	

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(2)		Local issues and circumstances that limit or prevent monitoring.	263:264, 266, 272:273	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.	263:264, 266, 268, 272:273	4.4.1, 4.4.2, 4.4.3		4-4	
(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.	263:264, 266, 272:273, 278, 281	4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5			
	(2)		Highly variable spatial or temporal conditions.	263:264, 266, 272:273, 278, 281	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.	263:264, 266, 272:273, 278, 281	4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5			
	(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.	263:264, 266, 272:273, 278, 281	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.					

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
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.	360:426	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:					
		(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.	364, 368, 375:376, 381, 385, 389, 393:394, 398, 403, 408, 413:414, 417, 421, 424	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, 6.14.3, 6.15.3			

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)	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.	369, 376, 381, 385:386, 390, 394, 399, 404, 408, 414, 418, 421, 425	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, 6.14.4, 6.15.4			
	(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.	369, 376, 382, 386, 390, 394, 399, 404, 408:409, 414, 418, 421, 425	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, 6.14.5, 6.15.5			
	(4)		The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.	370, 377, 382, 386, 390:391, 395, 399:400, 404:405, 409, 414:415, 418, 422, 425	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, 6.14.6, 6.15.6			

Article 5.			Plan Contents for Sample Basin	GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(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.	370, 377, 382, 386:387, 391, 395, 400, 405, 409, 415, 419, 422, 426	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, 6.14.7, 6.15.7			
	(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.	365:367, 373:375, 378:380, 384, 388, 392:393, 397, 401:403, 406:407, 411:412, 416, 420, 423	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, 6.14.1, 6.15.1	6-1:6-4		
	(7)		A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.	371, 378, 383, 387, 391, 395, 400, 405, 410, 415, 419, 422, 426	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, 6.14.8, 6.15.8			

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.	371:372, 378, 383, 387, 391:392, 396, 401, 405, 410, 415, 419, 423, 426, 432:434, 436	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, 6.14.9, 6.15.9, 7.6, 7.8		6-1, 7-1:7-2	
	(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.	364, 388, 392:393	6.2, 6.7, 6.8			
(c)			Projects and management actions shall be supported by best available information and best available science.	361:364	6.1:6.2			
(d)			An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.	364, 416, 420	6.2, 6.13, 6.14			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2, 10727.4, and 10733.2, Water Code.					

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:

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: Kelly Long
CHAIR, BOARD OF SUPERVISORS

ATTEST: Michael Powers
Clerk of the Board of Supervisors
Lou Key
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: _____
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 GSA
GROUNDWATER SUSTAINABILITY AGENCY

Carpinteria Groundwater Sustainability Agency

Stakeholder Communications and Engagement Plan

Updated October 2023

Table of Contents

1. Sustainable Groundwater Management Act 1
2. Carpinteria Groundwater Sustainability Agency 1
3. Carpinteria Groundwater Sustainability Plan 2
4. CGSA Decision Making Process 3
5. Communications and Engagement 4
   5.1. Stakeholder Identification 4
   5.2. Situation Analysis 5
   5.3. Communications Goals for GSP Development 5
   5.4. Communications Objectives 5
   5.5. Key Messages 6
6. Communications and Engagement Implementation 6
   6.1. Tactical Approach 7
   6.2. Make Information Accessible 7
   6.3. Conduct Focused Workshops and Meetings 8
   6.4. Meet Stakeholders Where They Are 8
   6.5. Collect and Respond to Input 9
7. Conclusion 9
Attachment A 10

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.

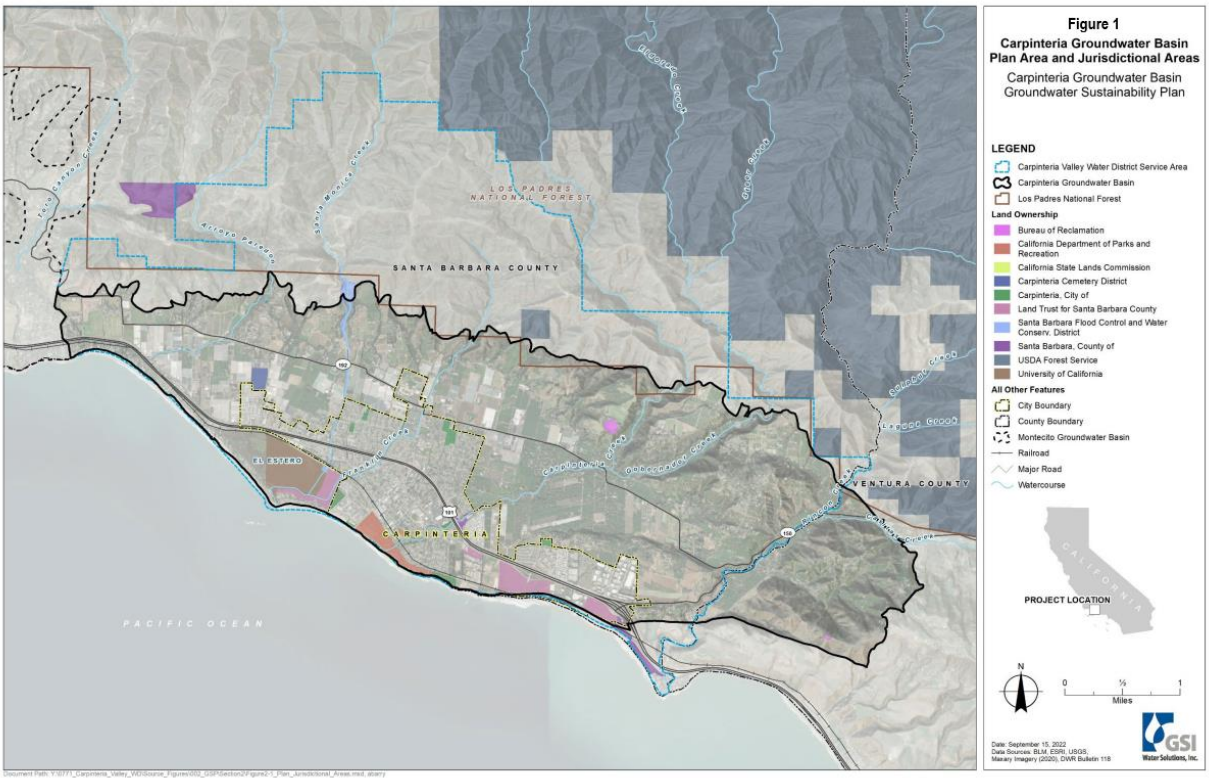


Figure 1. The Carpinteria Groundwater Basin is bounded on the north by the Santa Ynez Mountains and on the south by the Pacific Ocean. The eastern boundary is located near Laguna Ridge in Ventura County, and the western boundary is contiguous with the service area of the Carpinteria Valley Water District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

- 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

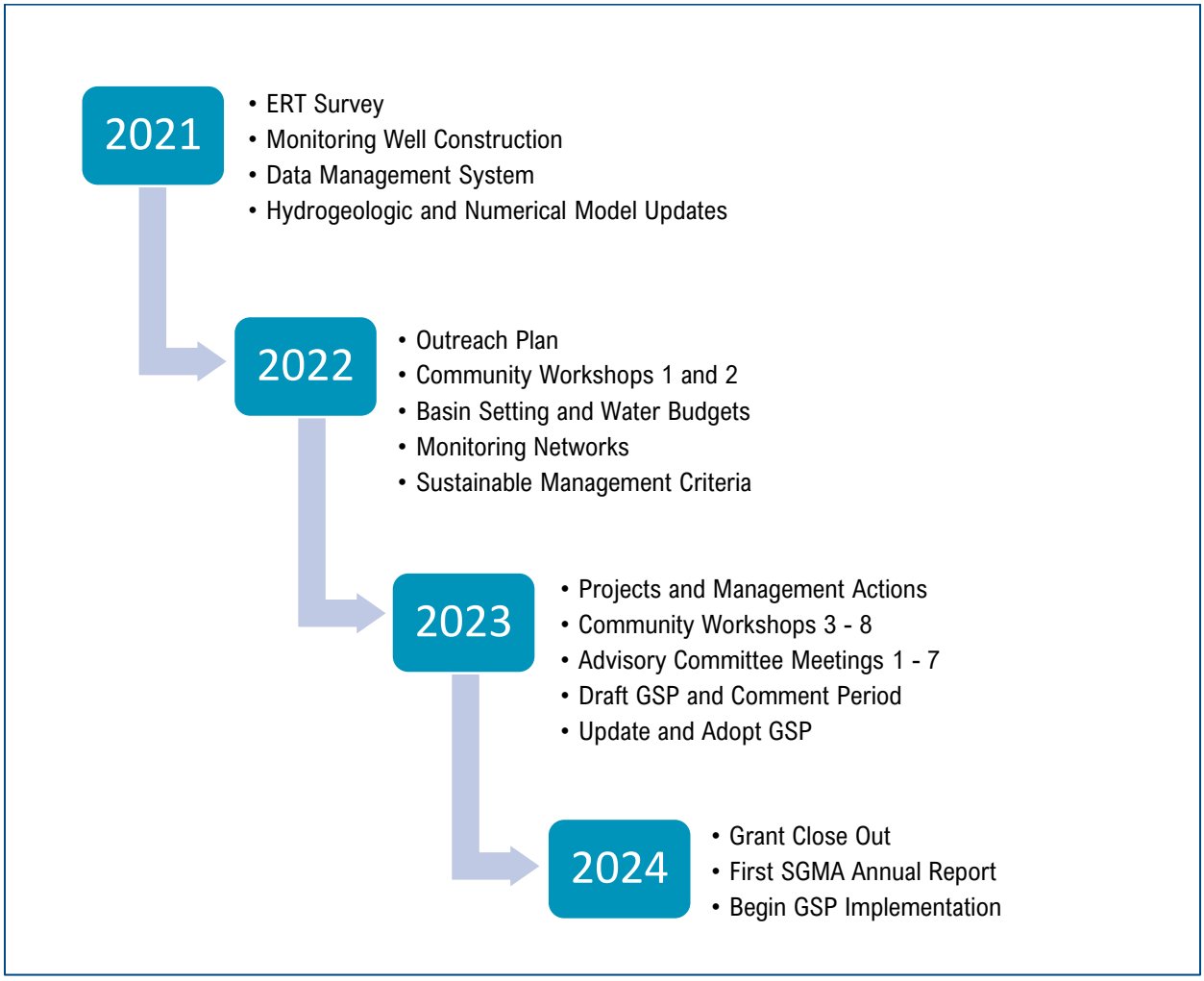


Figure 2

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**

- 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.

- **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.

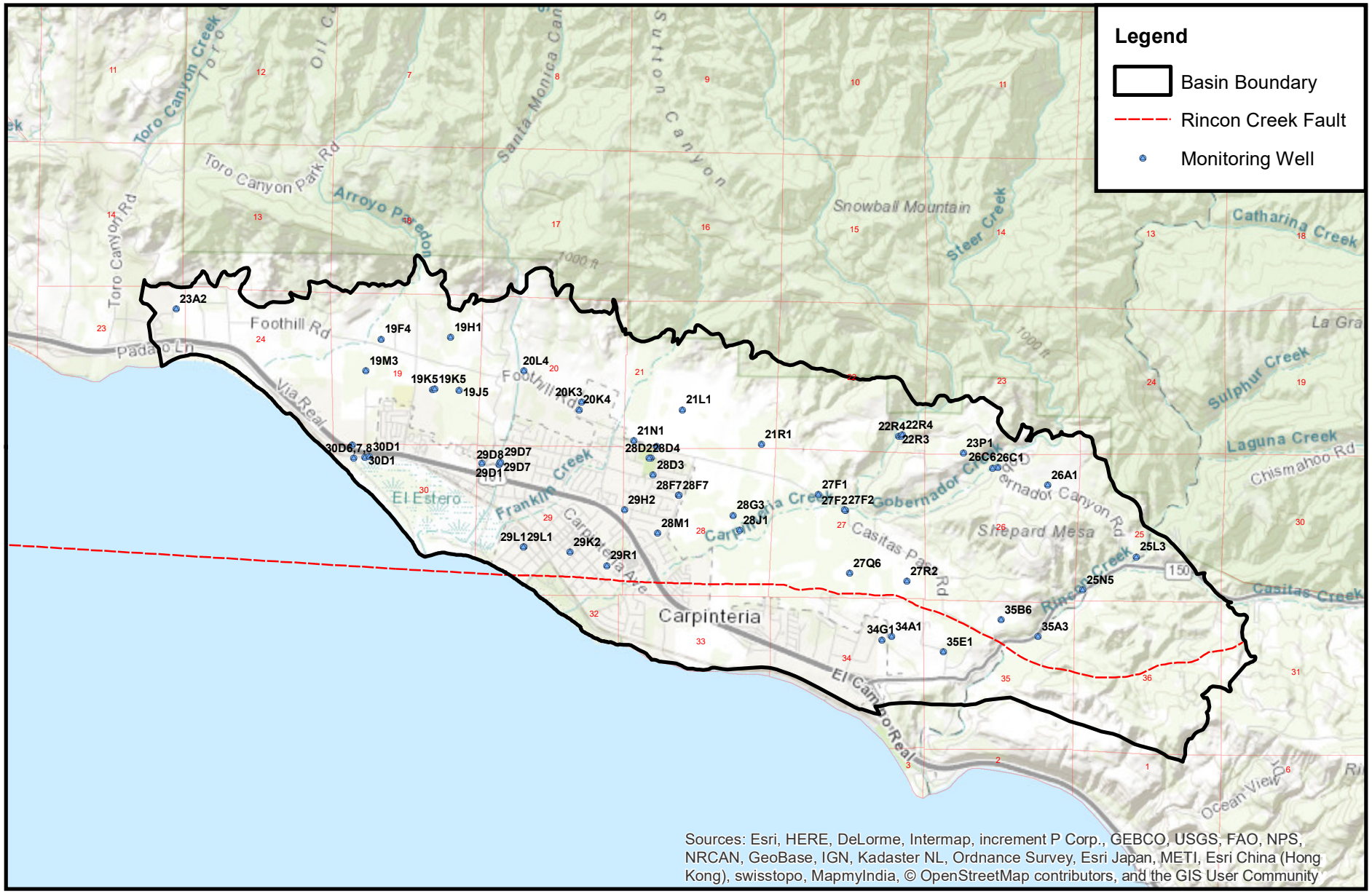
Attachment A

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

APPENDIX D

Groundwater Elevation Hydrographs



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

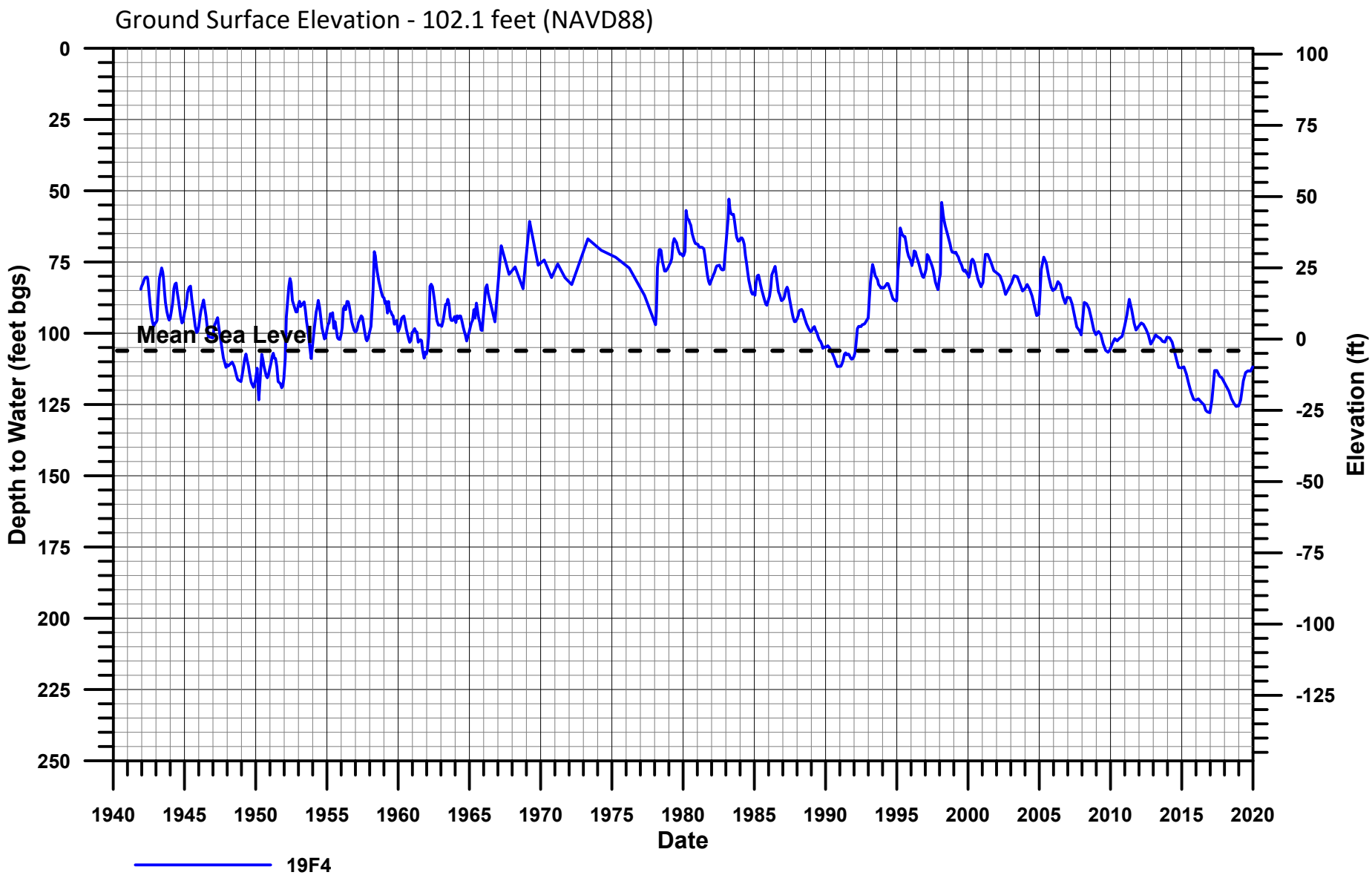
CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

N
W E
S

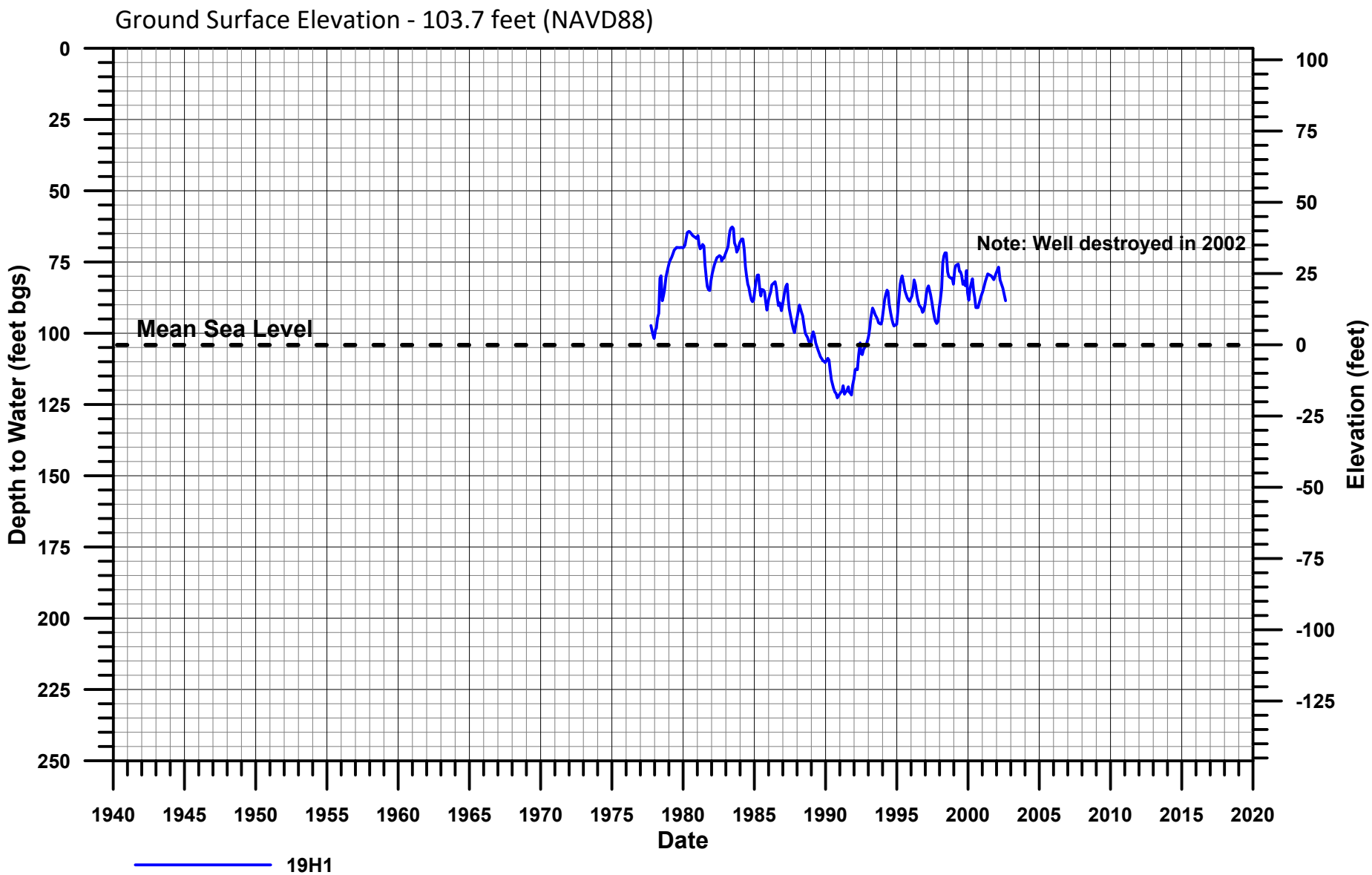
1 inch = 5,000 feet

0 5,000 10,000 Feet

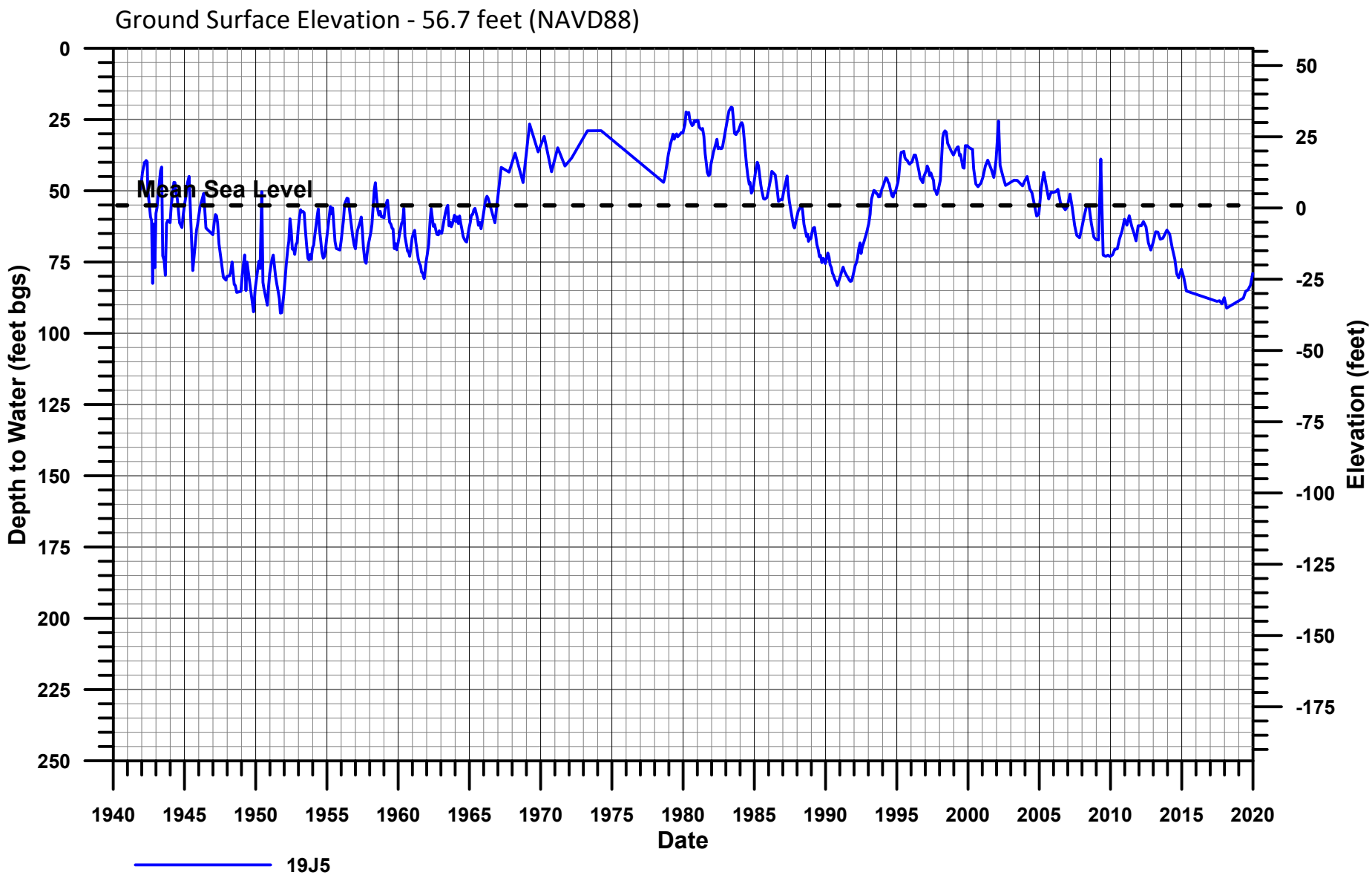
Monitoring Well Location Map
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



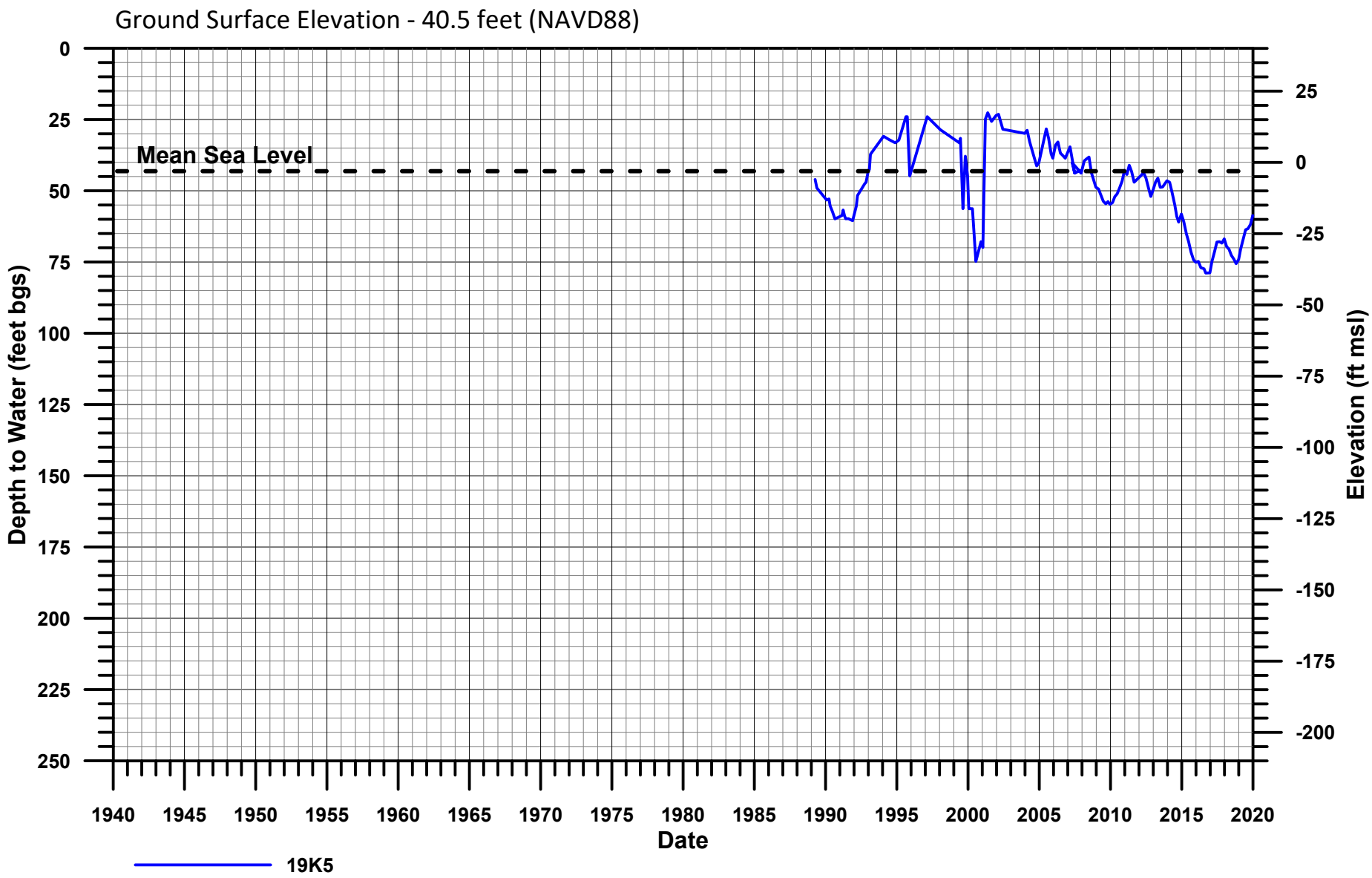
Water Level Data - 4N/25W-19F4
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



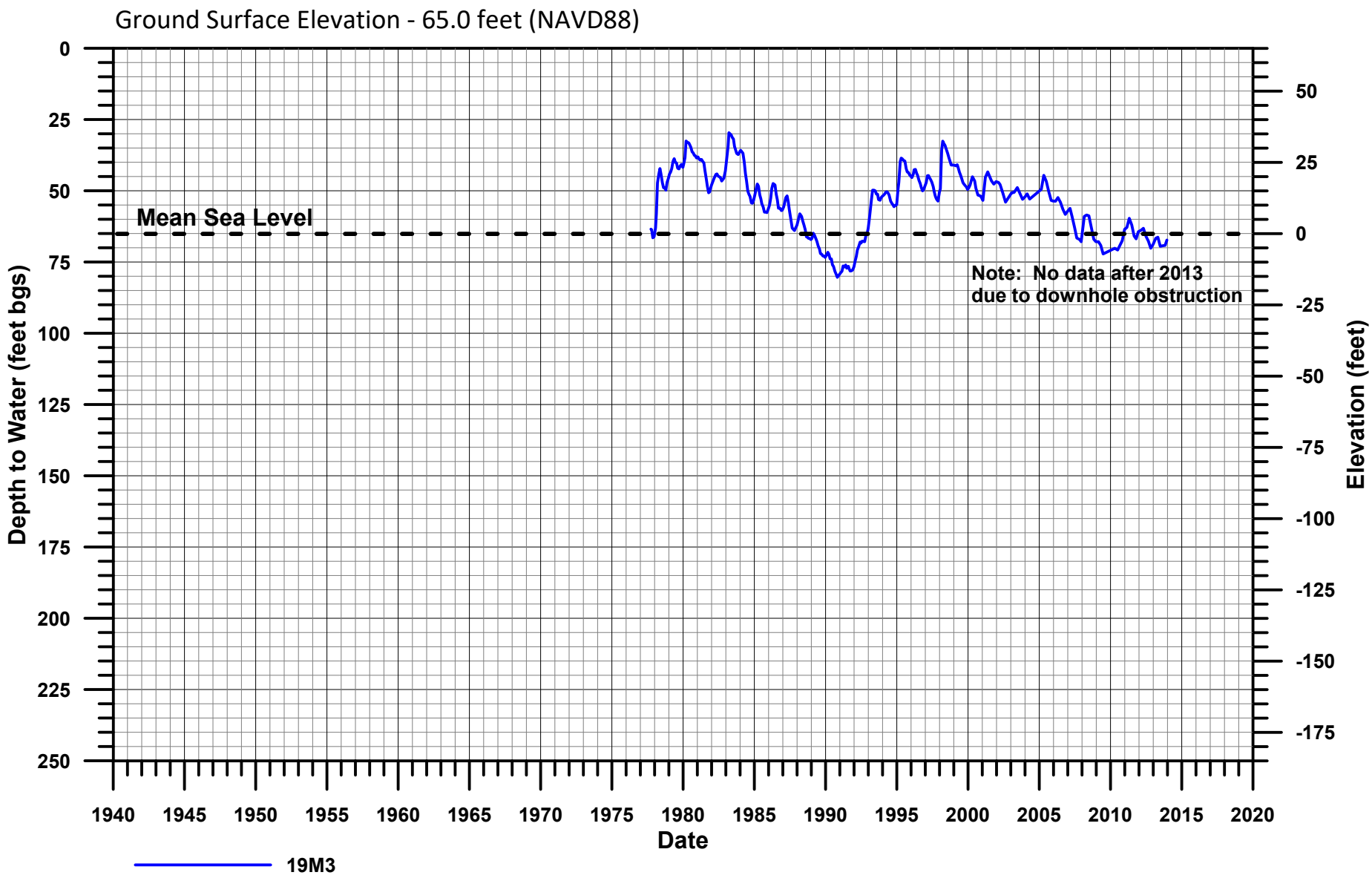
Water Level Data - 4N/25W-19H1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



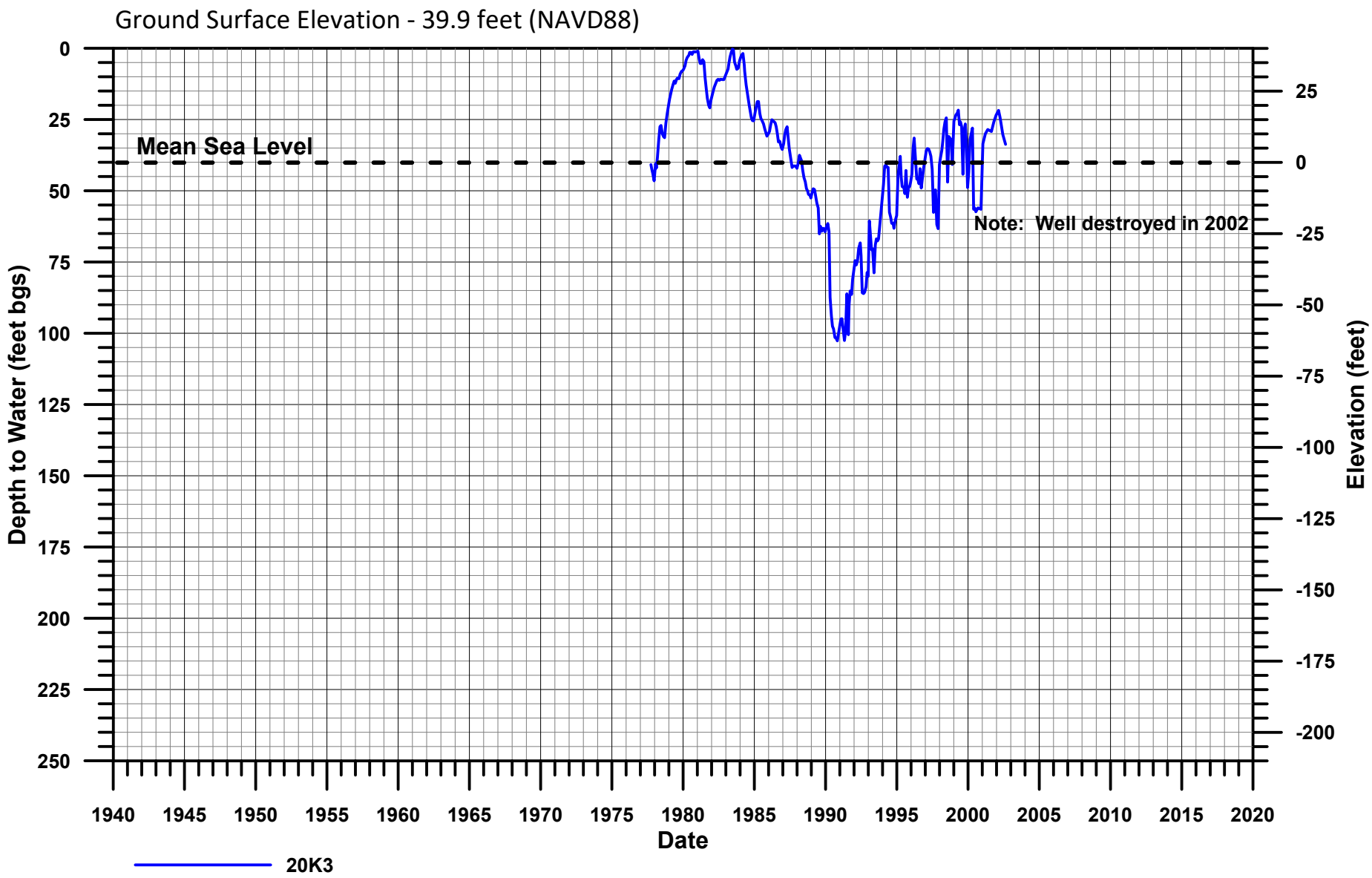
Water Level Data - 4N/25W-19J5
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



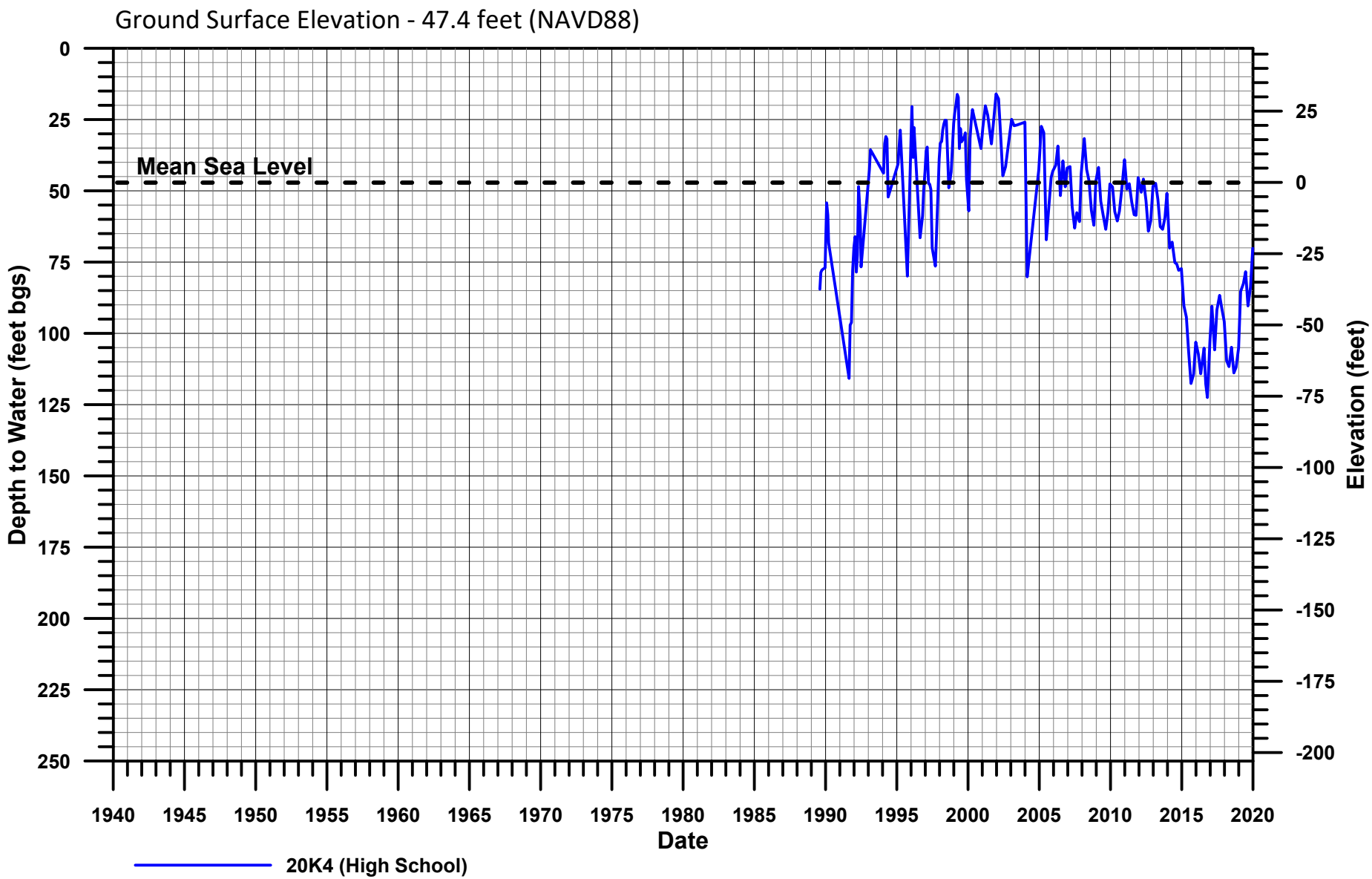
Water Level Data - 4N/25W-19K5
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



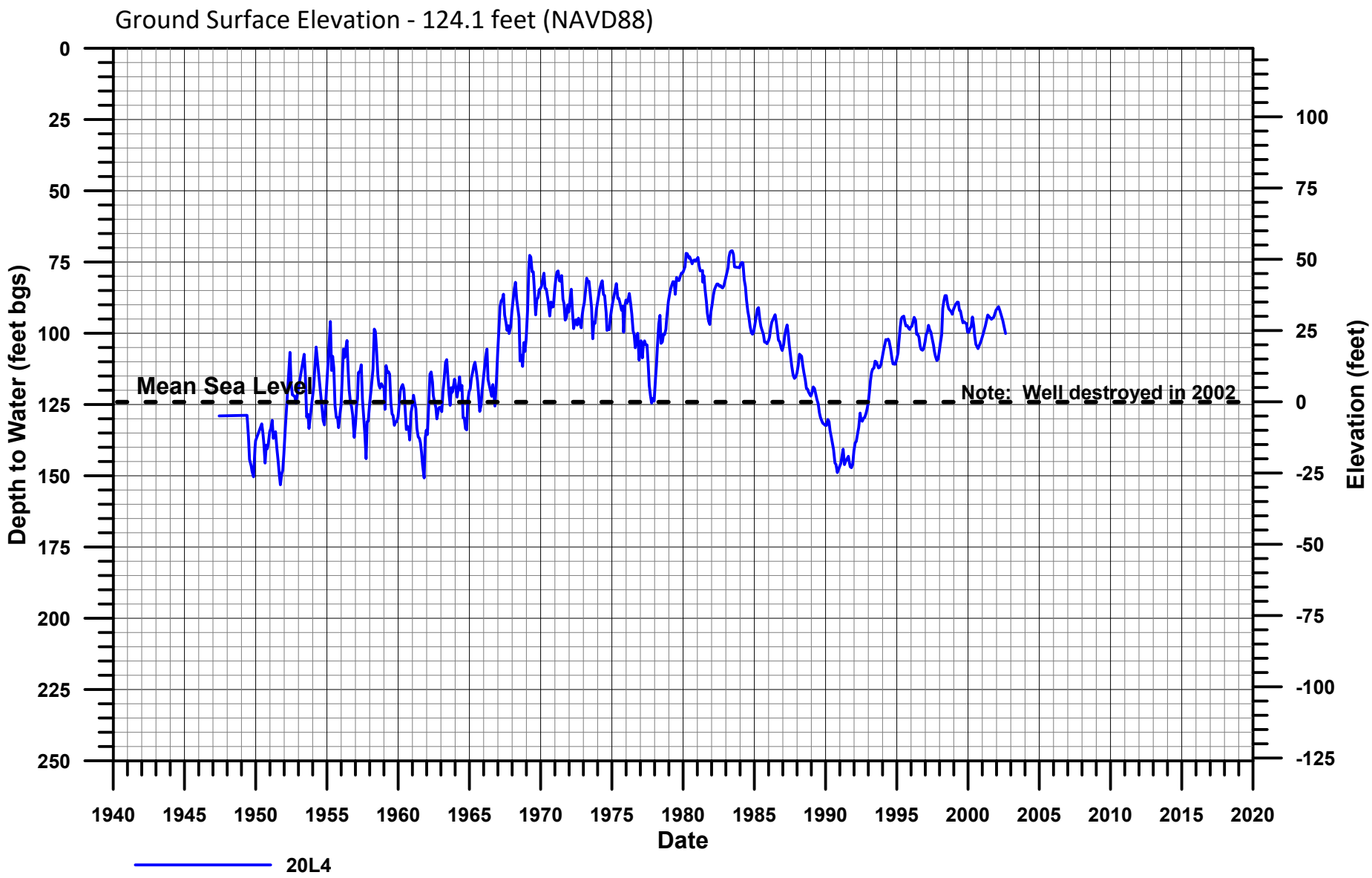
Water Level Data - 4N/25W-19M3
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



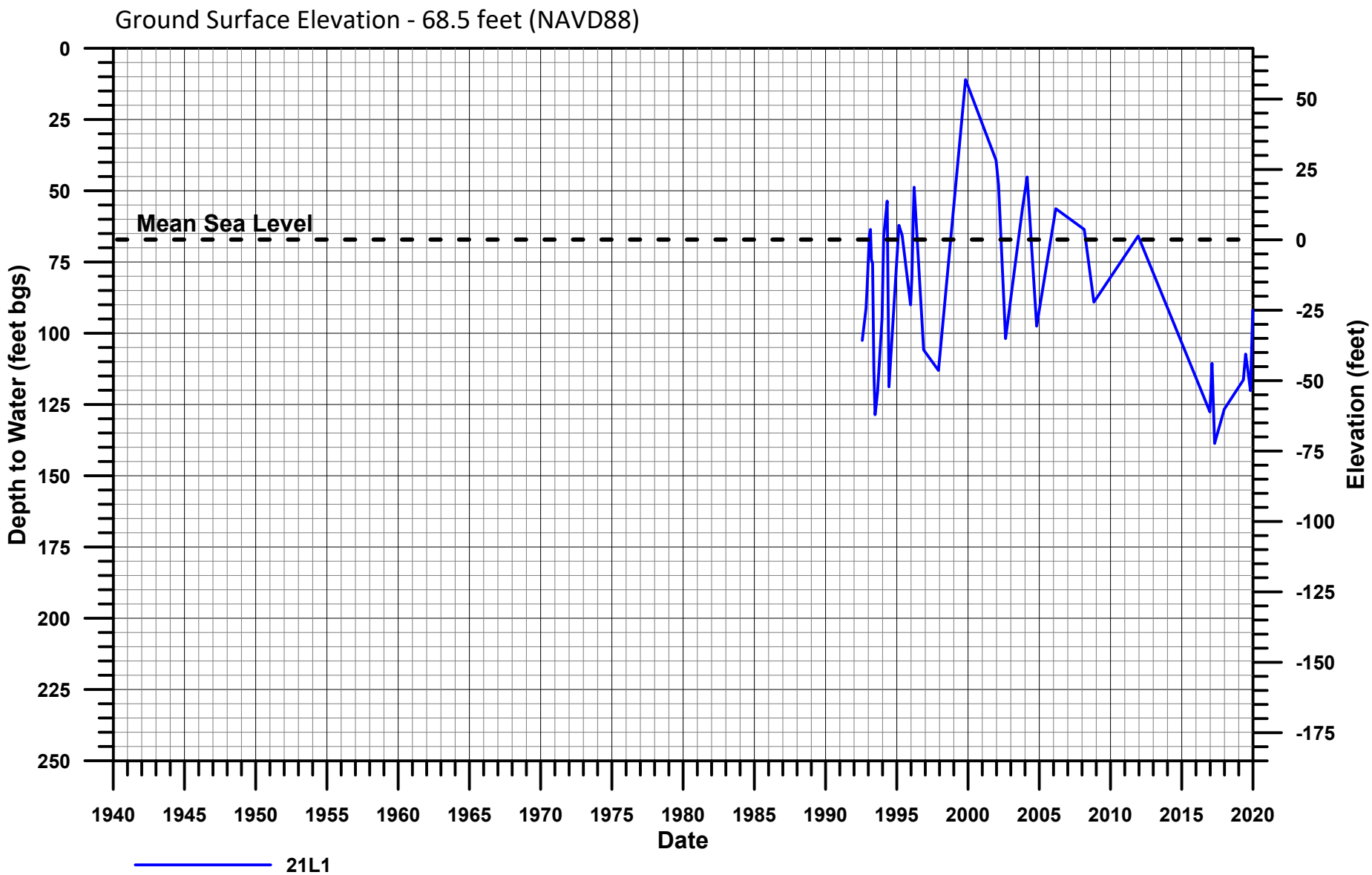
Water Level Data - 4N/25W-20K3
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



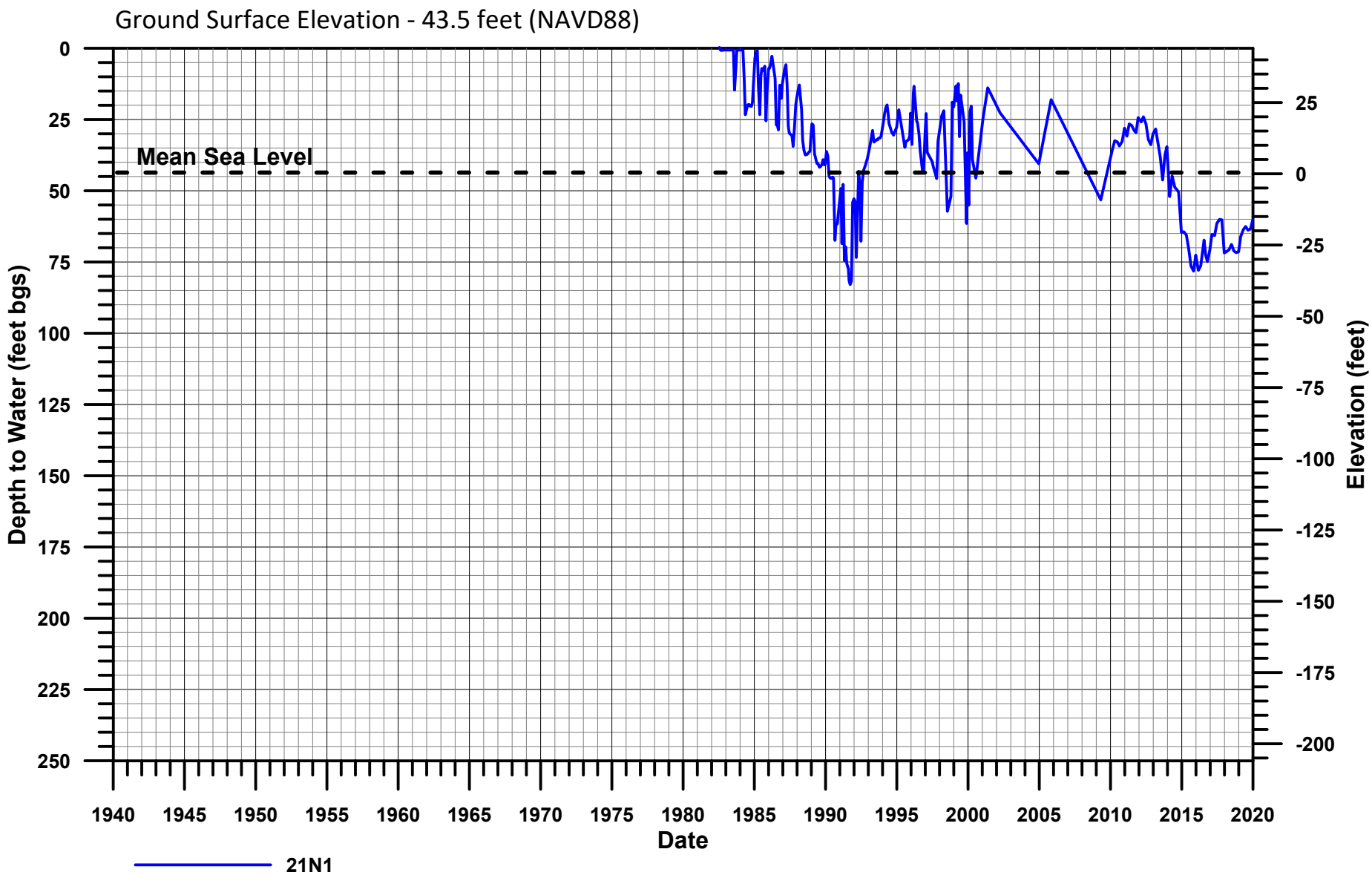
Water Level Data - 4N/25W-20K4 (HIGH SCHOOL)
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



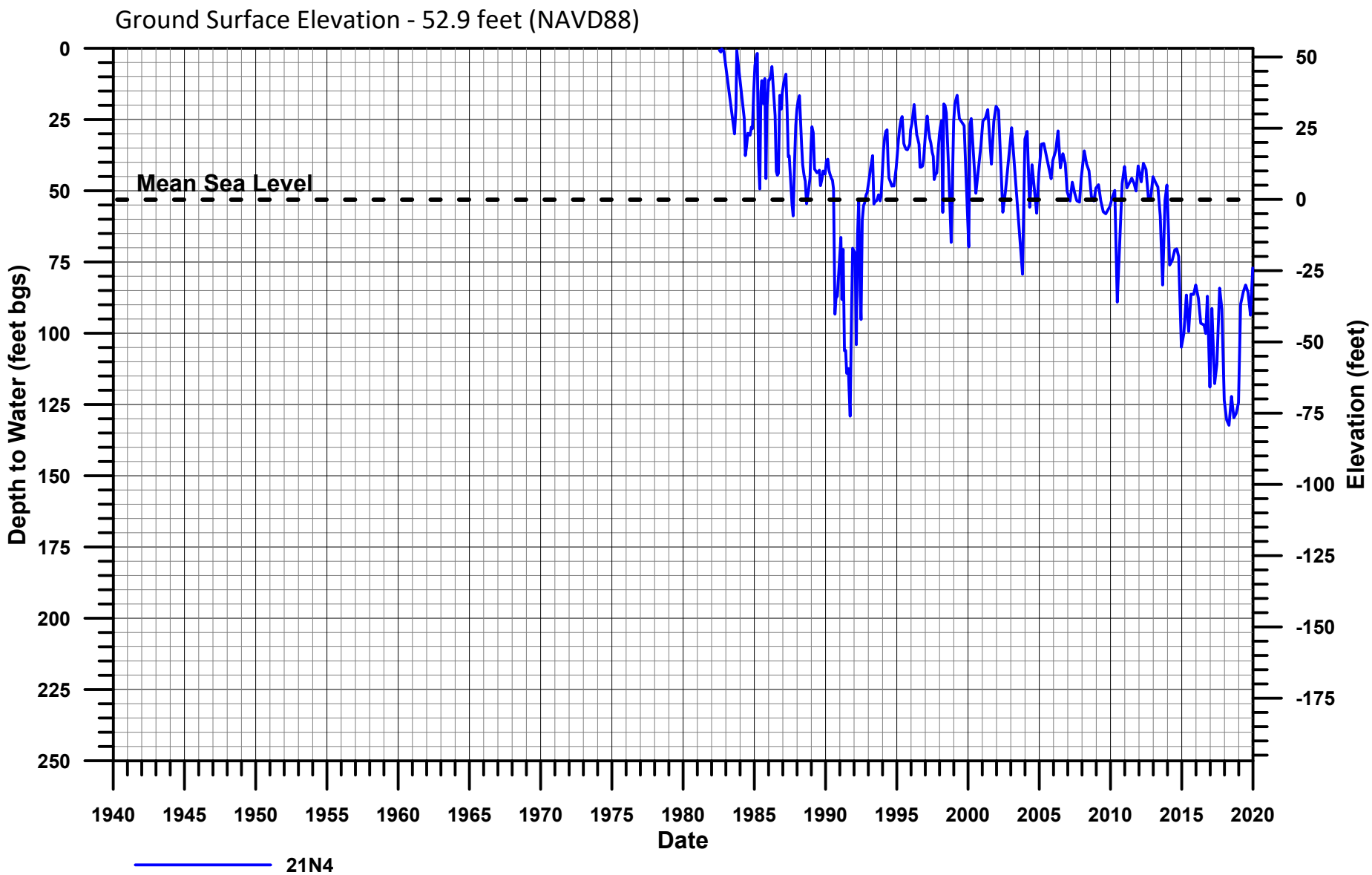
Water Level Data - 4N/25W-20L4
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



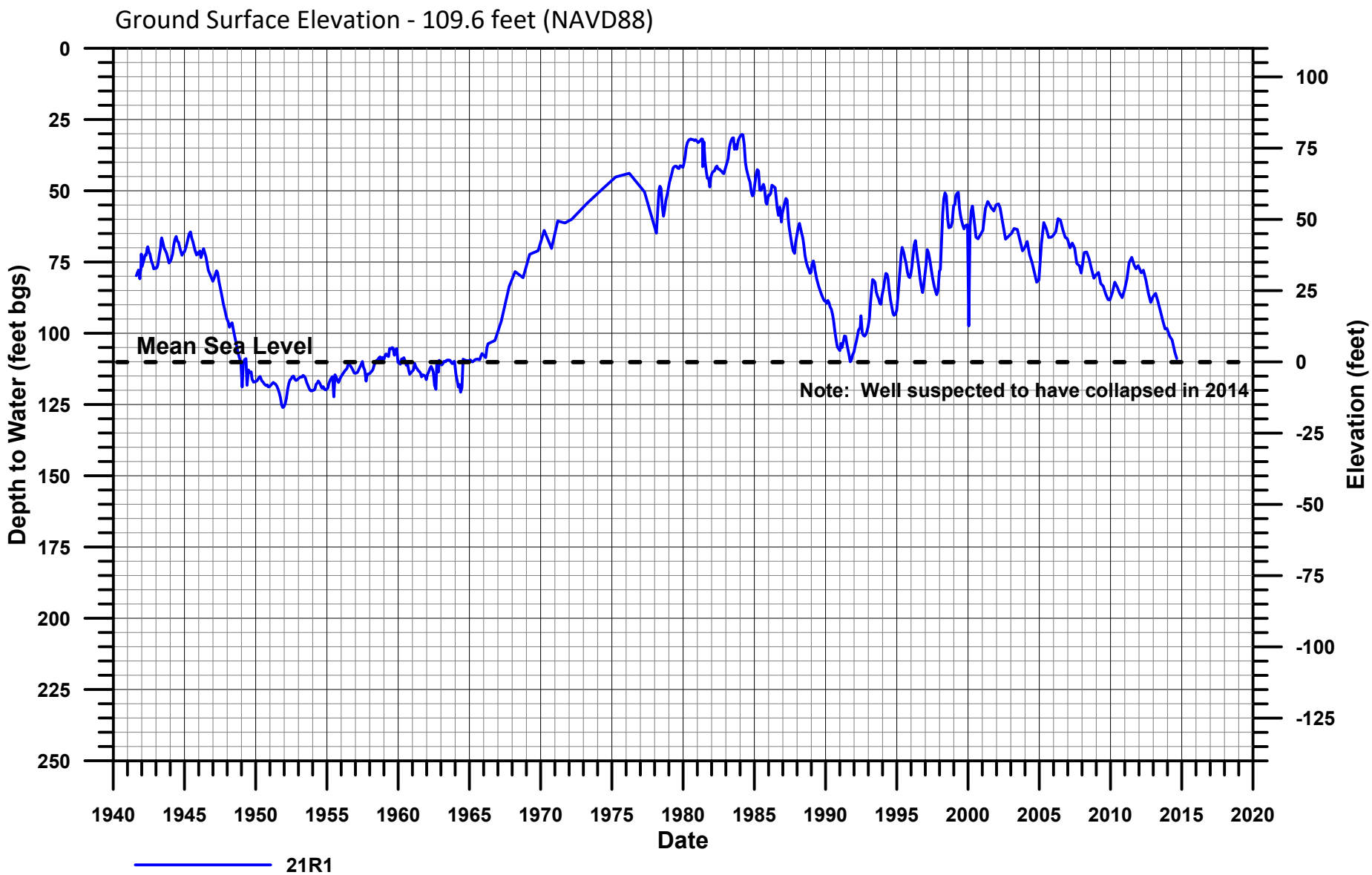
Water Level Data - 4N/25W-21L1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



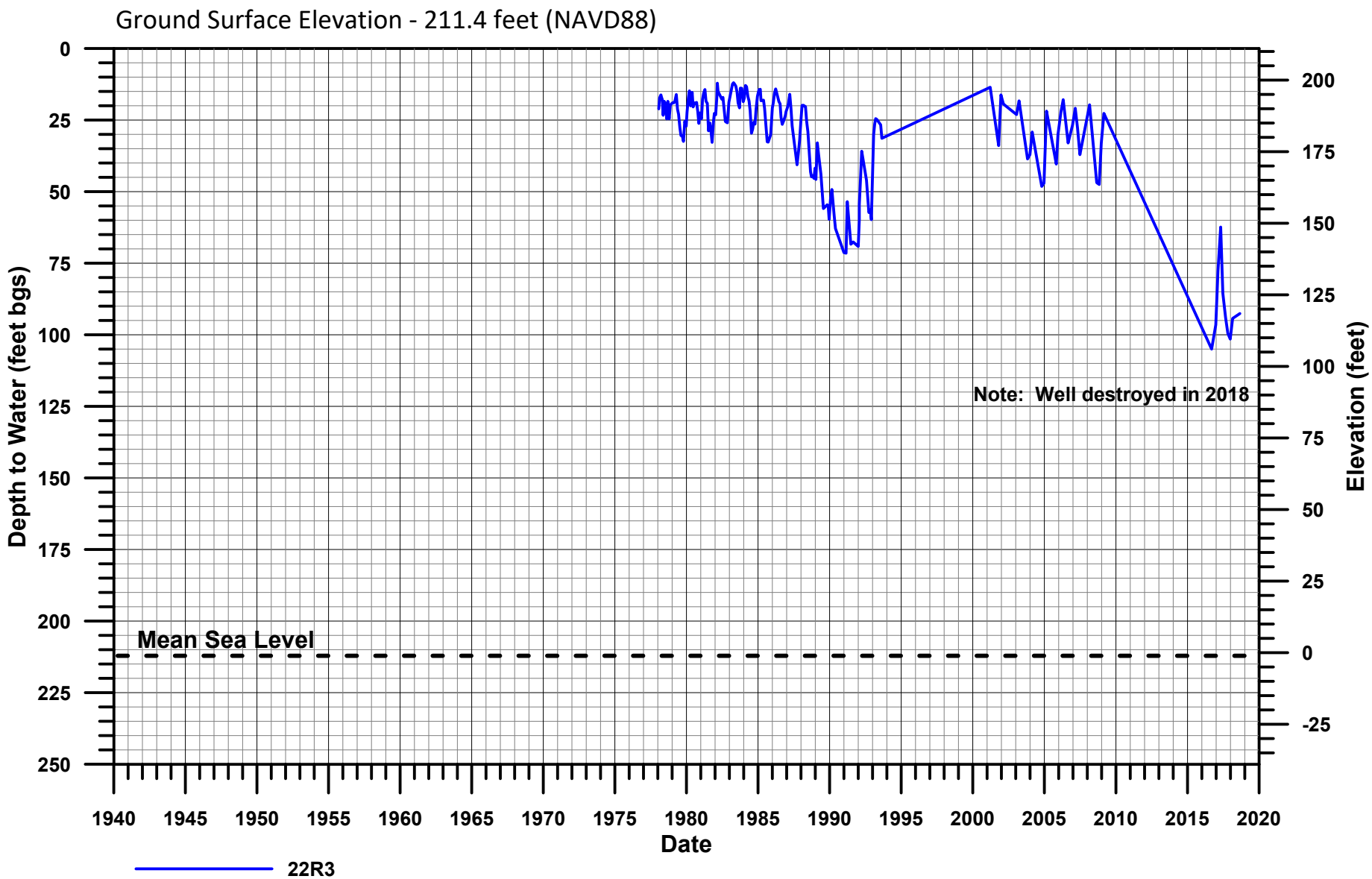
Water Level Data - 4N/25W-21N1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



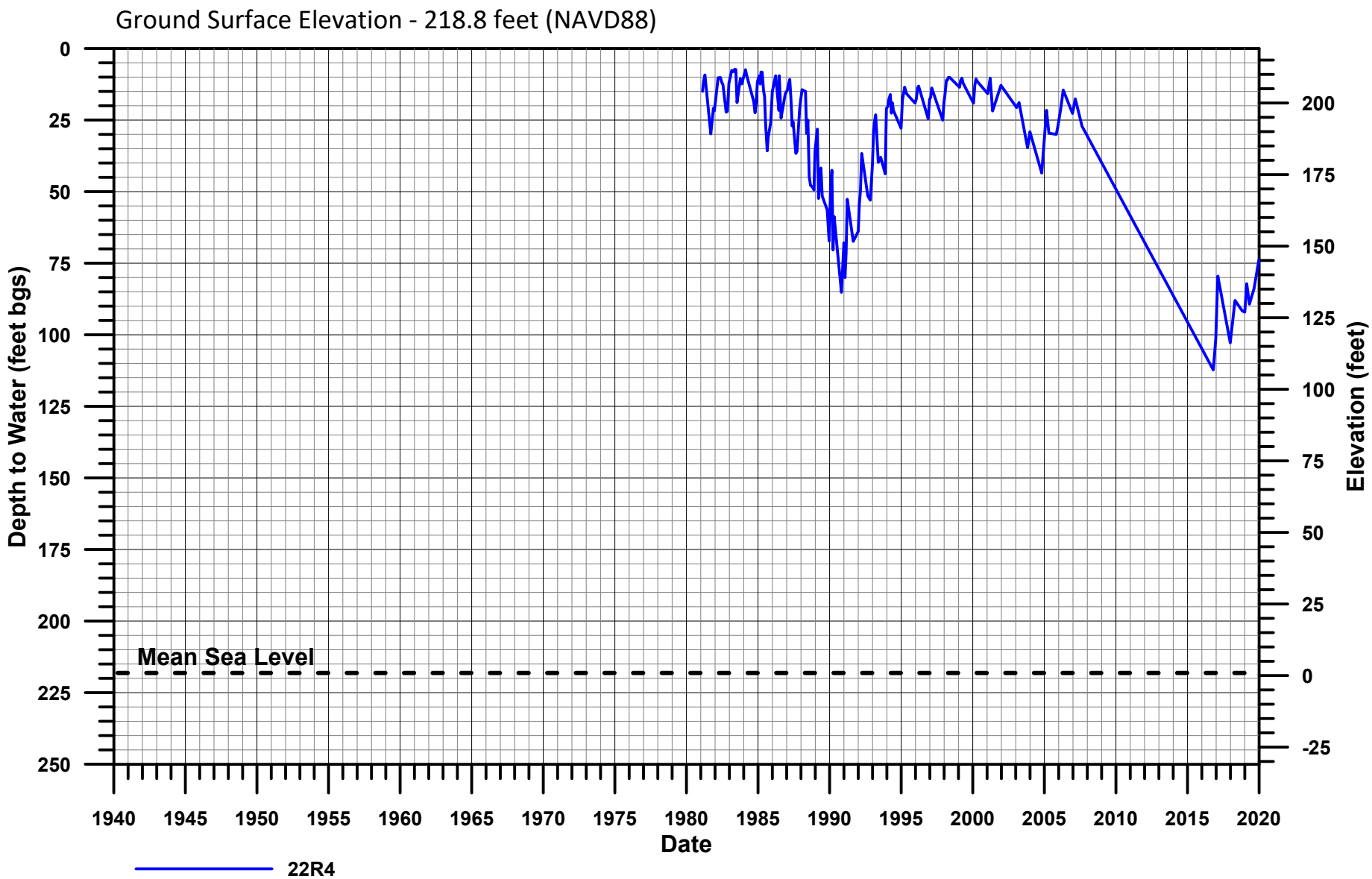
Water Level Data - 4N/25W-21N4
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



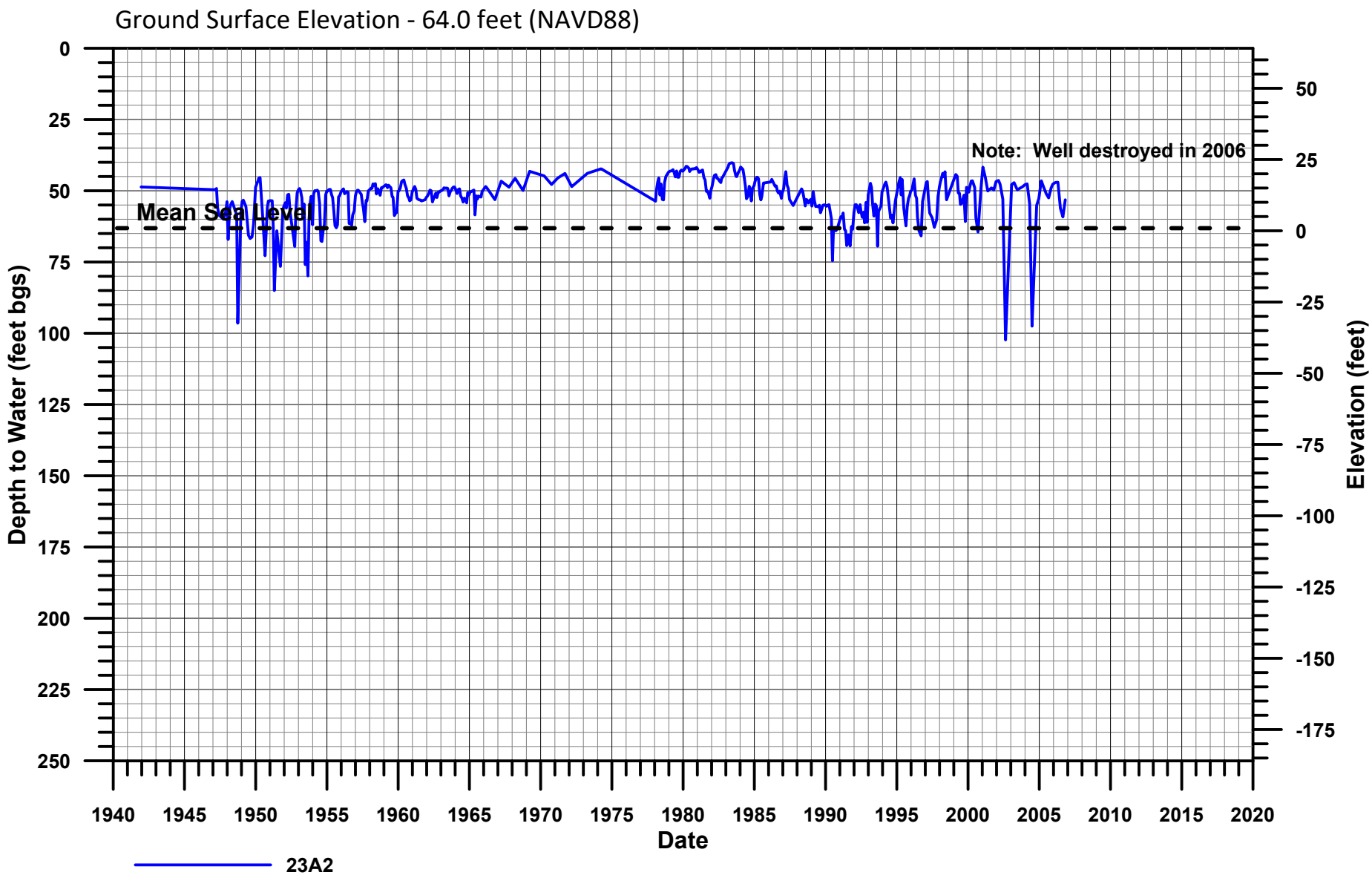
Water Level Data - 4N/25W-21R1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



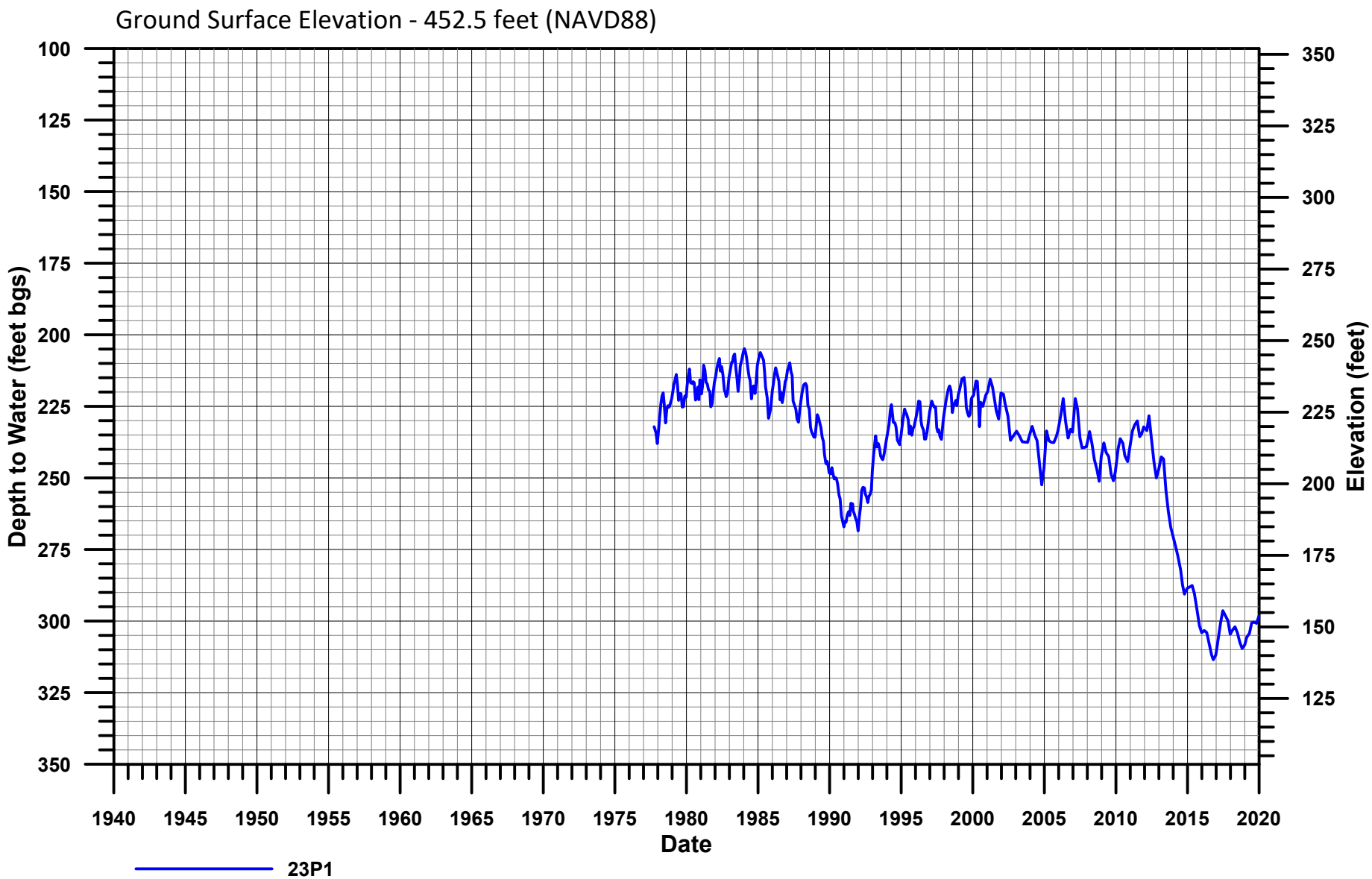
Water Level Data - 4N/25W-22R3
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



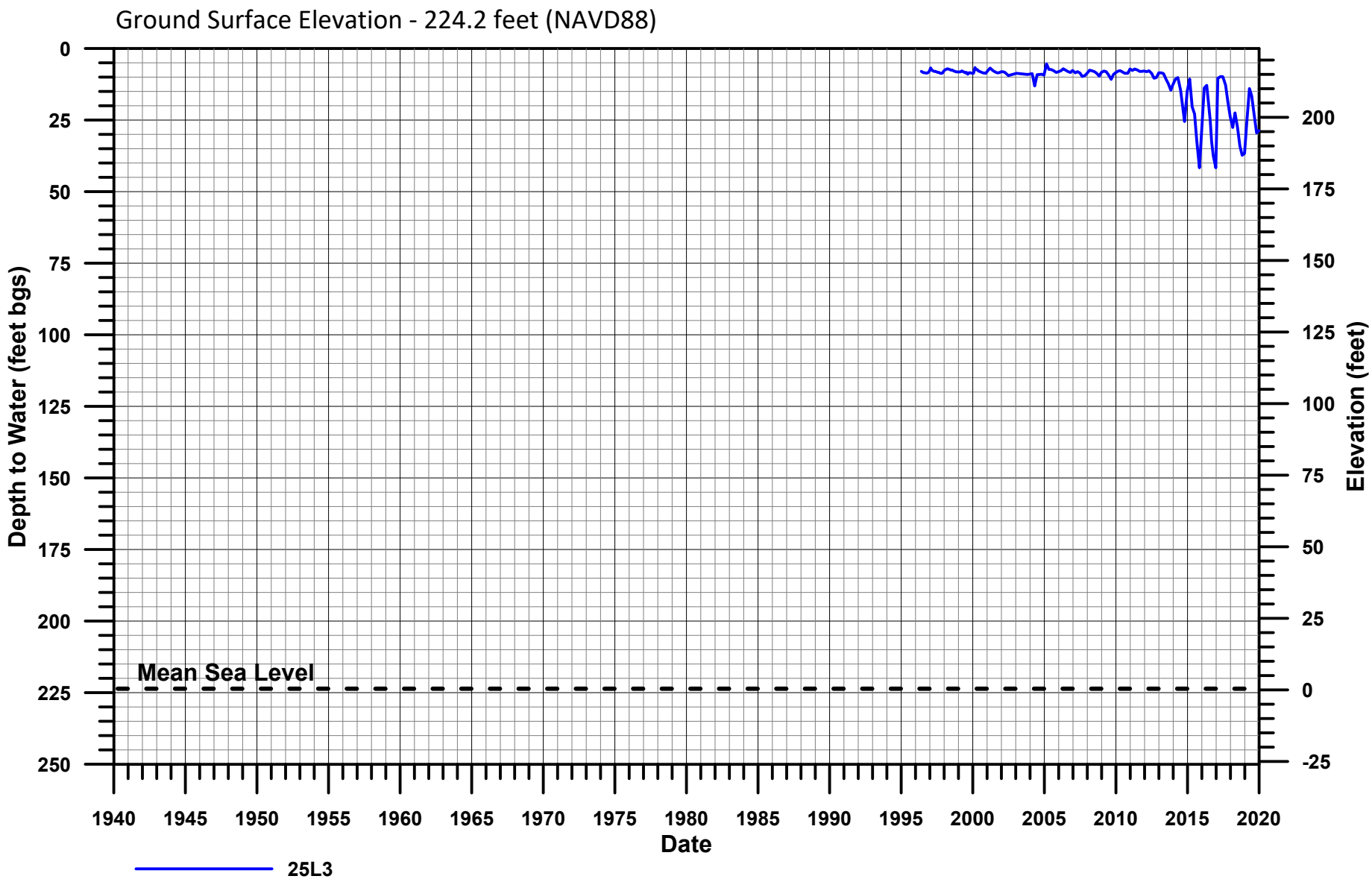
Water Level Data - 4N/25W-22R4
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



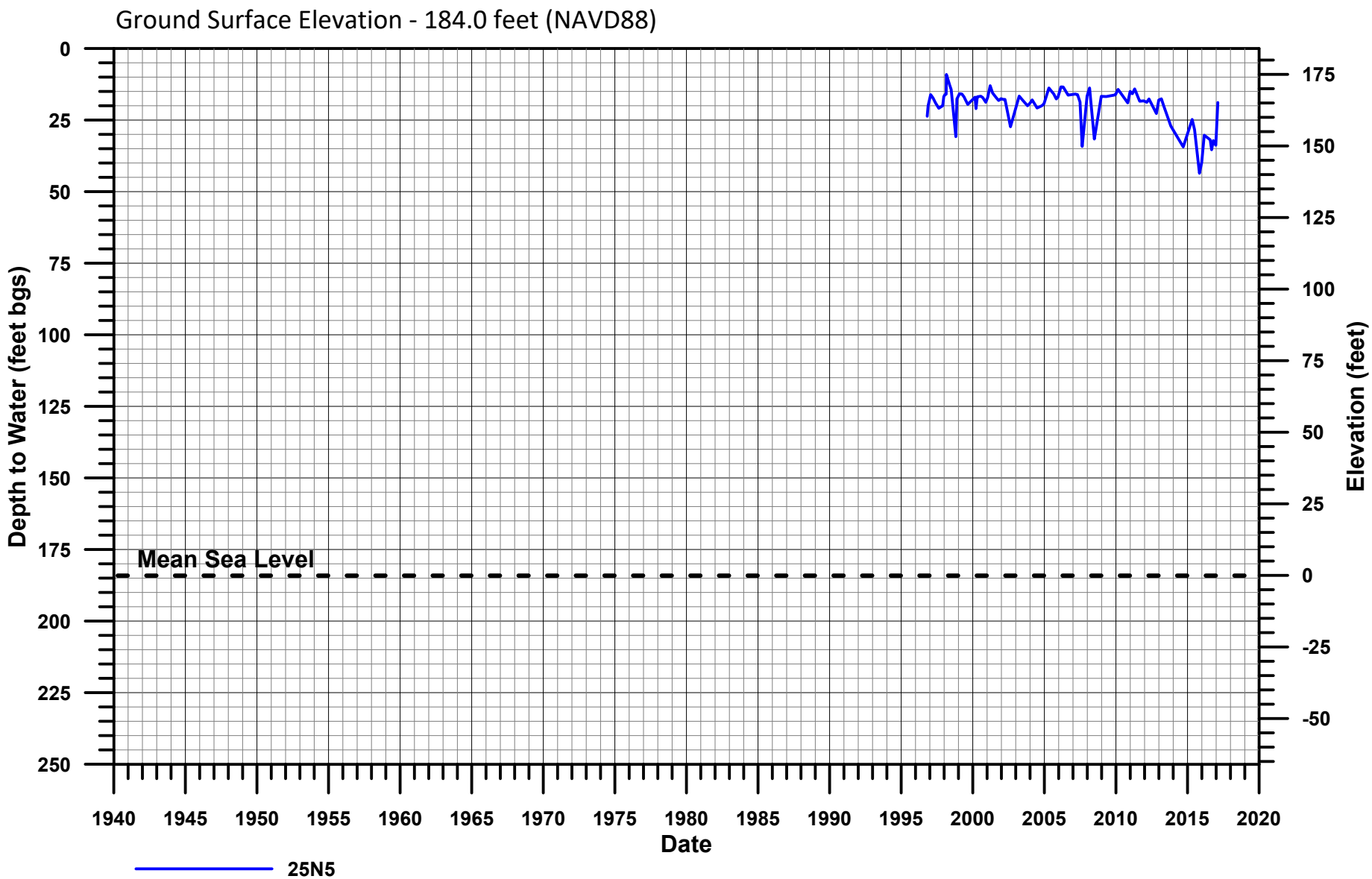
Water Level Data - 4N/25W-23A2
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



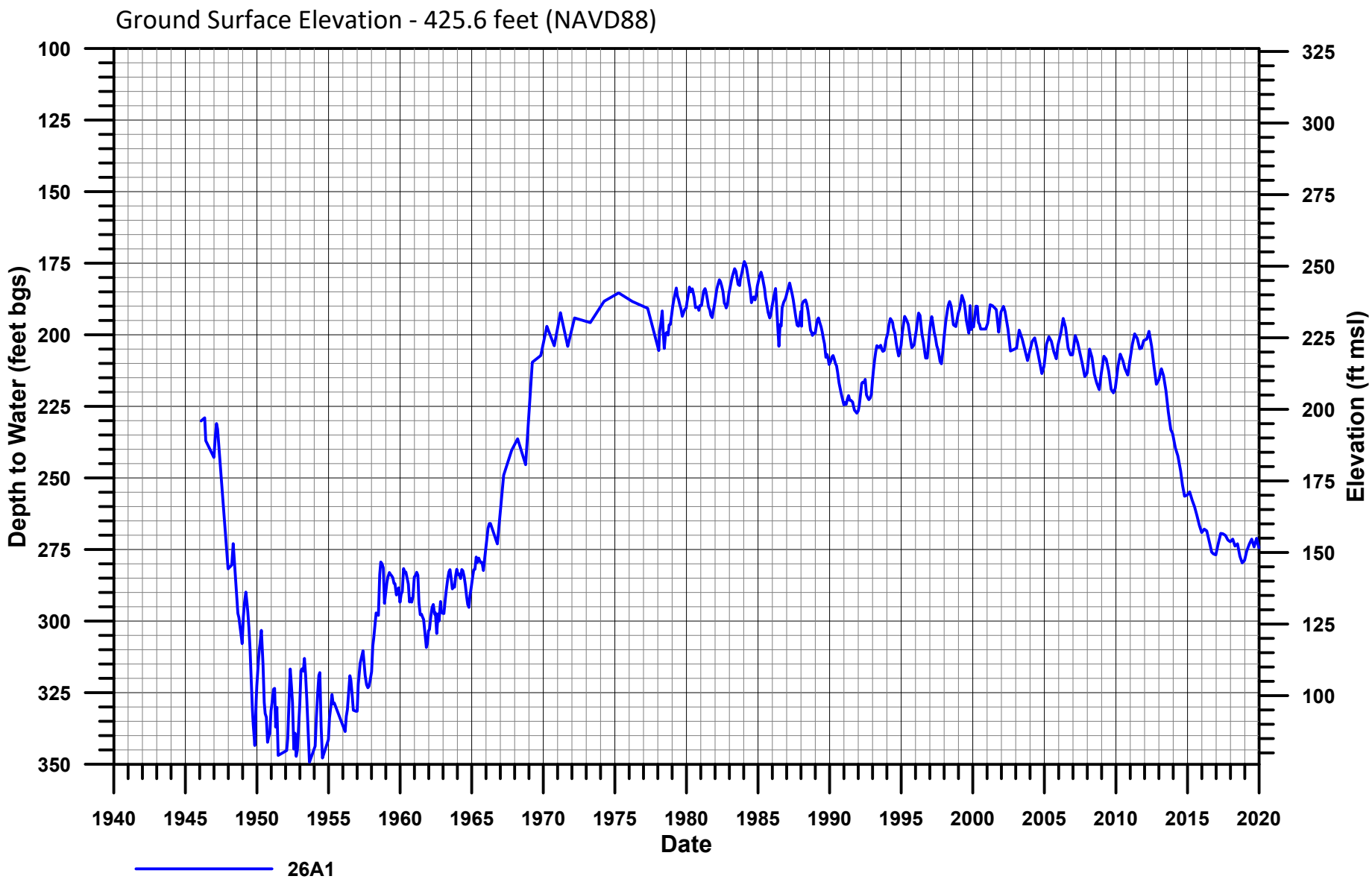
Water Level Data - 4N/25W-23P1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



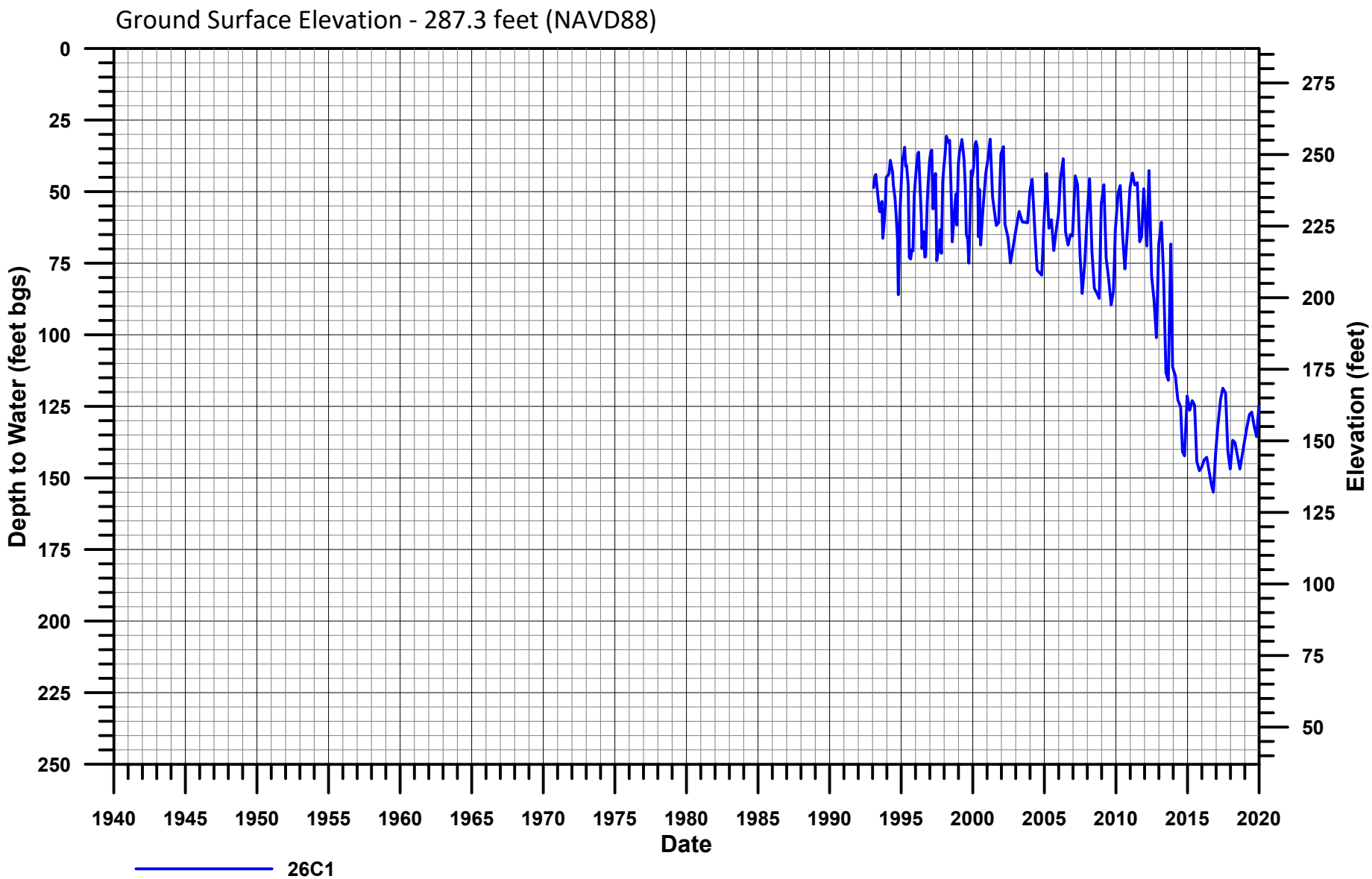
Water Level Data - 4N/25W-25L3
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



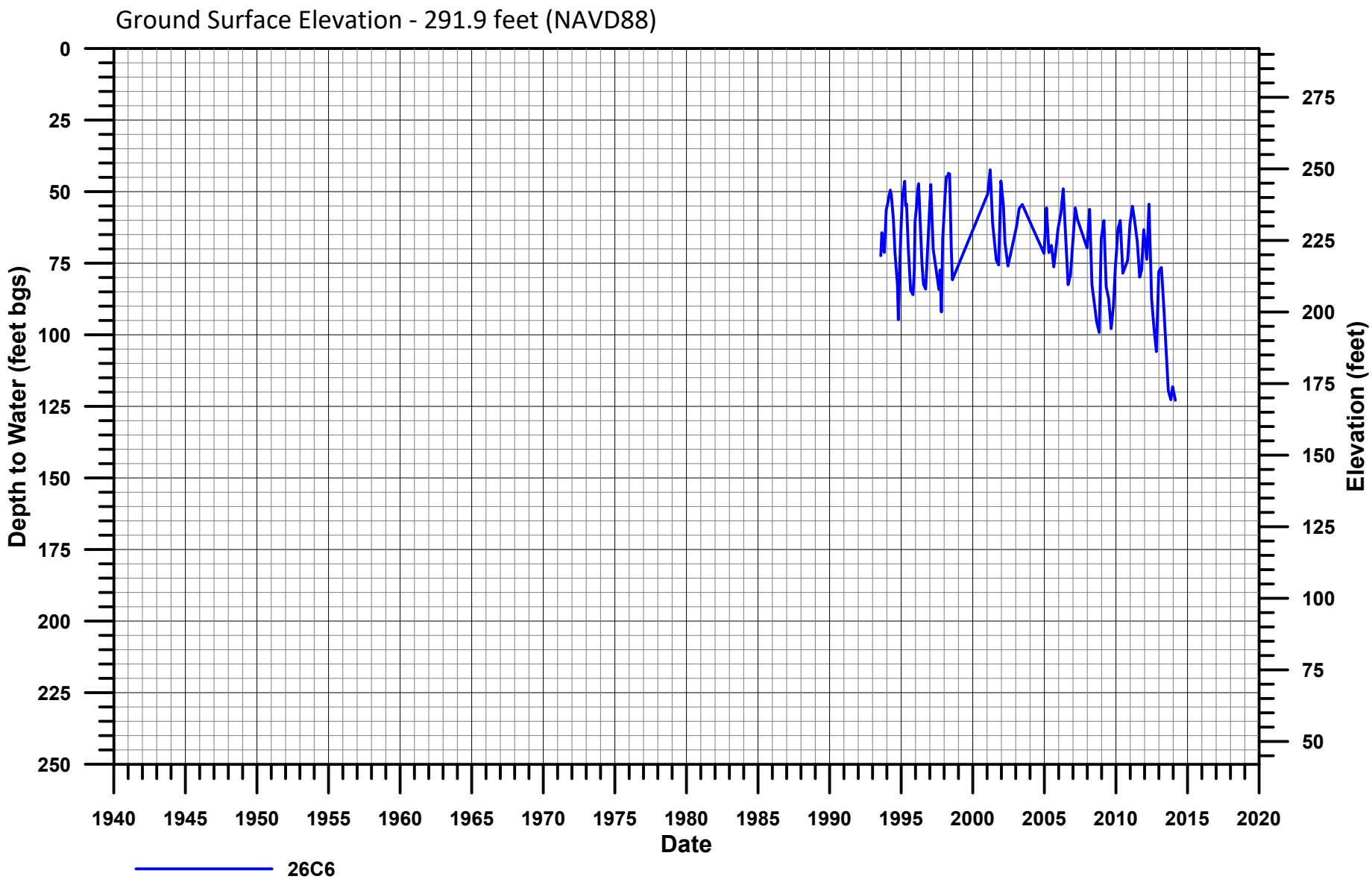
Water Level Data - 4N/25W-25N5
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



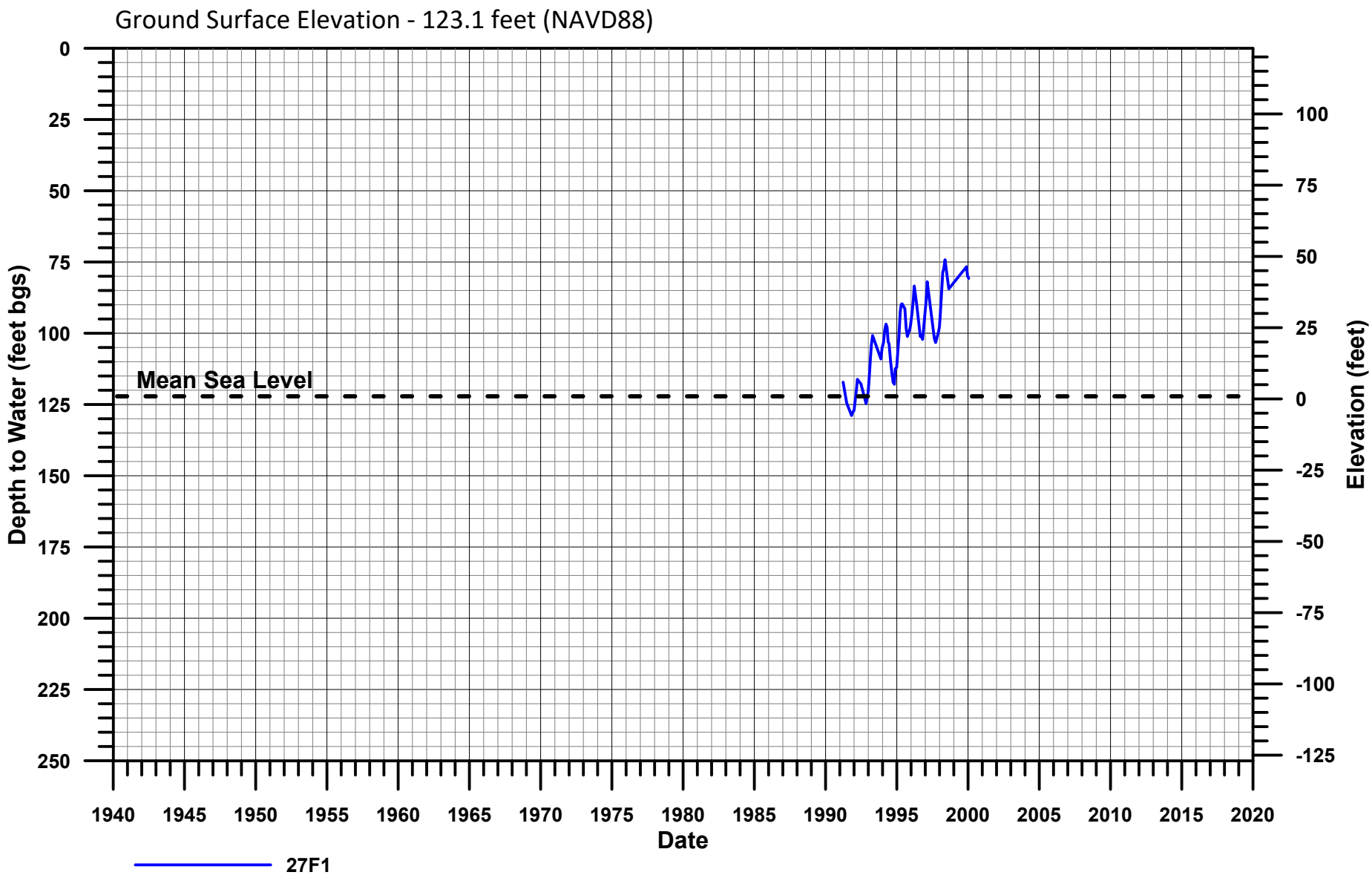
Water Level Data - 4N/25W-26A1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



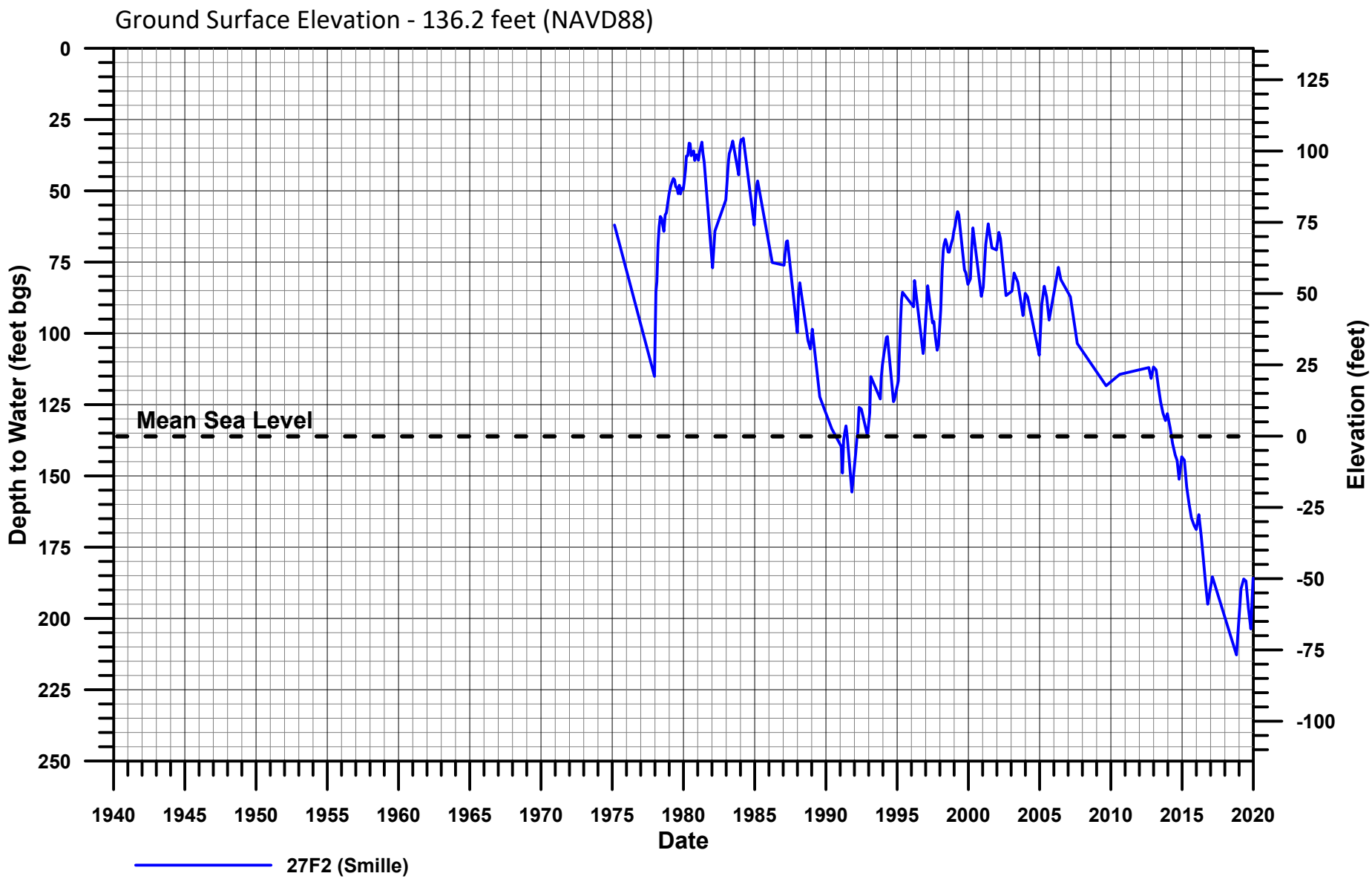
Water Level Data - 4N/25W-26C1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



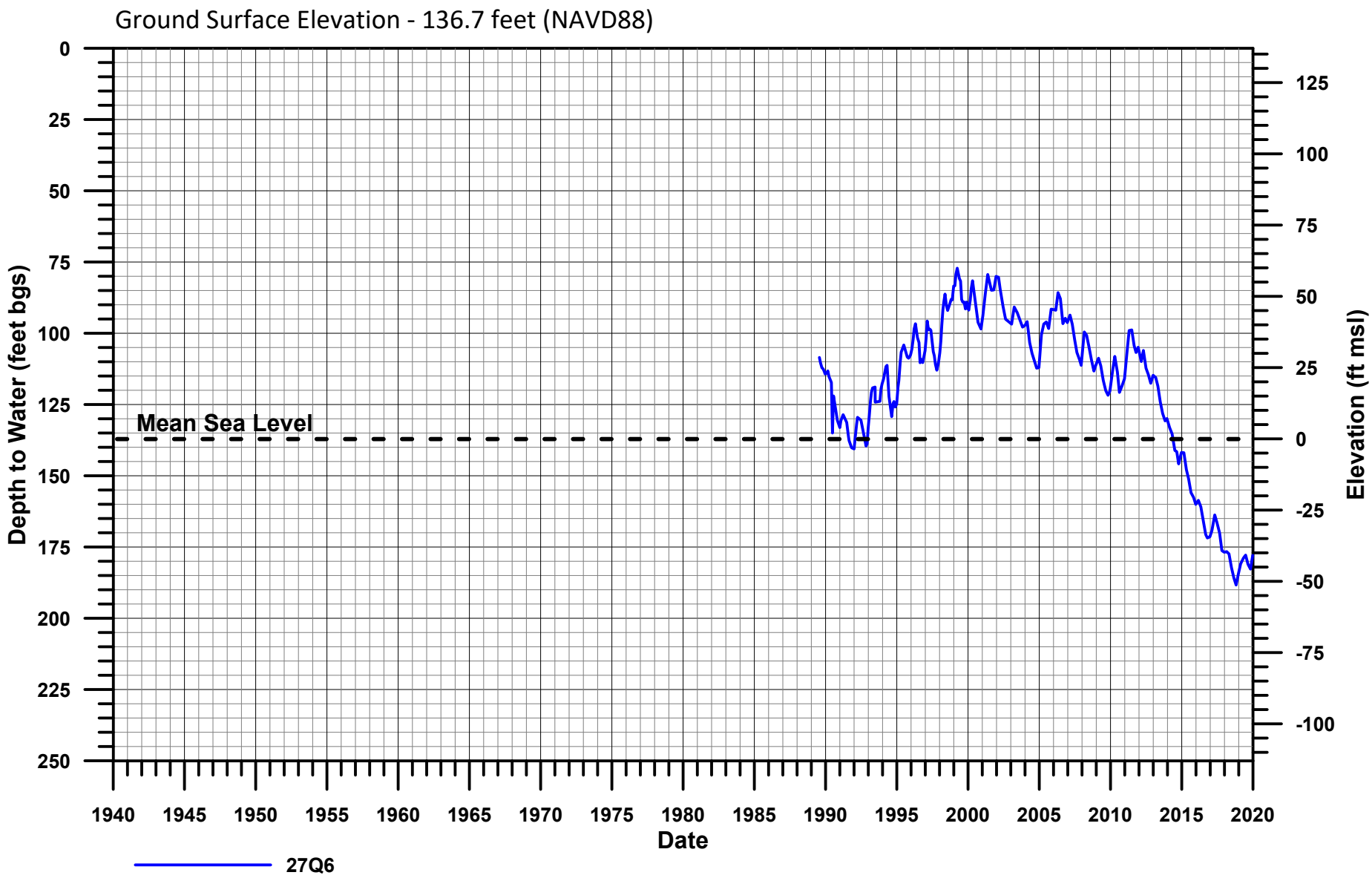
Water Level Data - 4N/25W-26C6
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



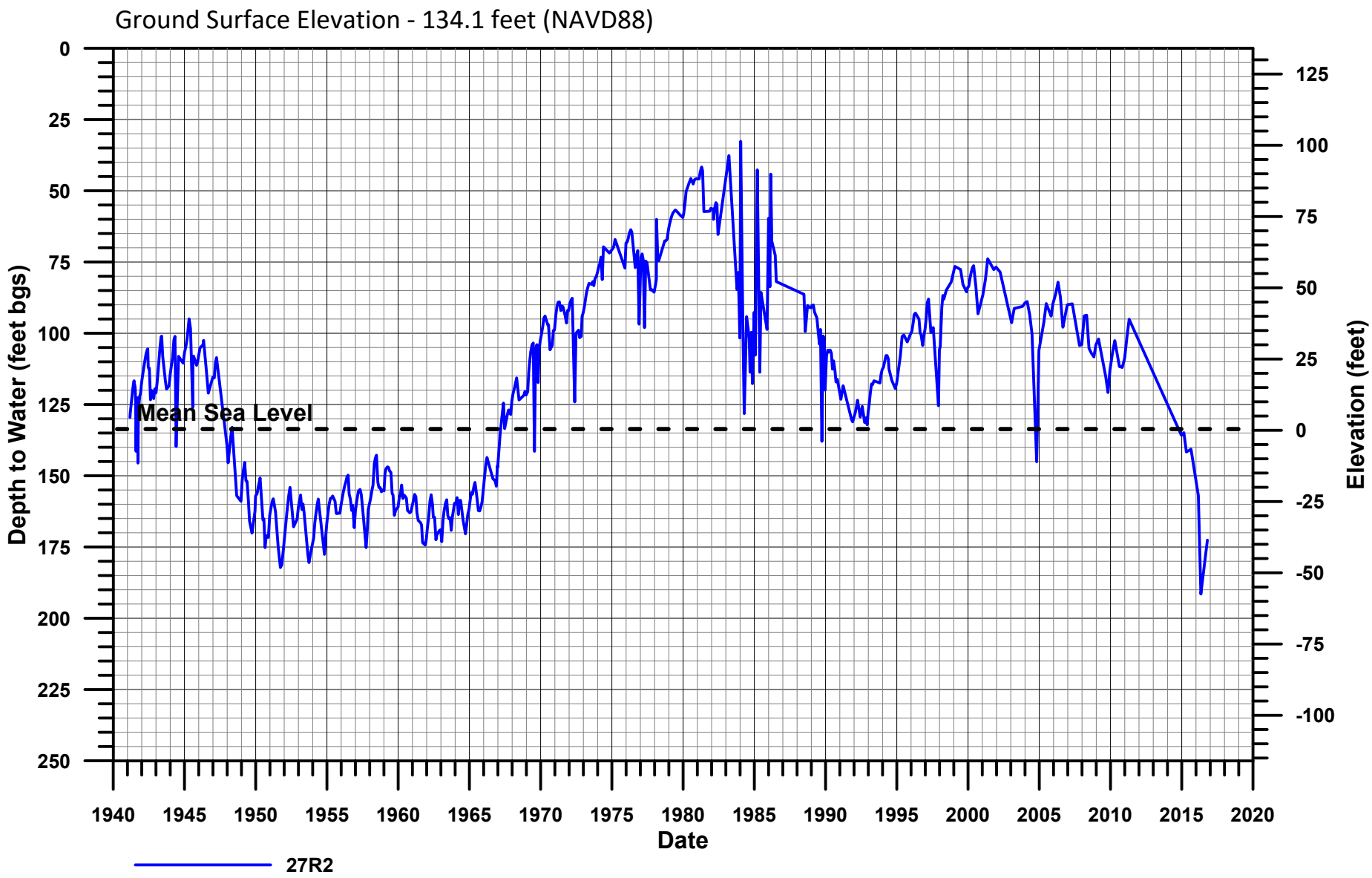
Water Level Data - 4N/25W-27F1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



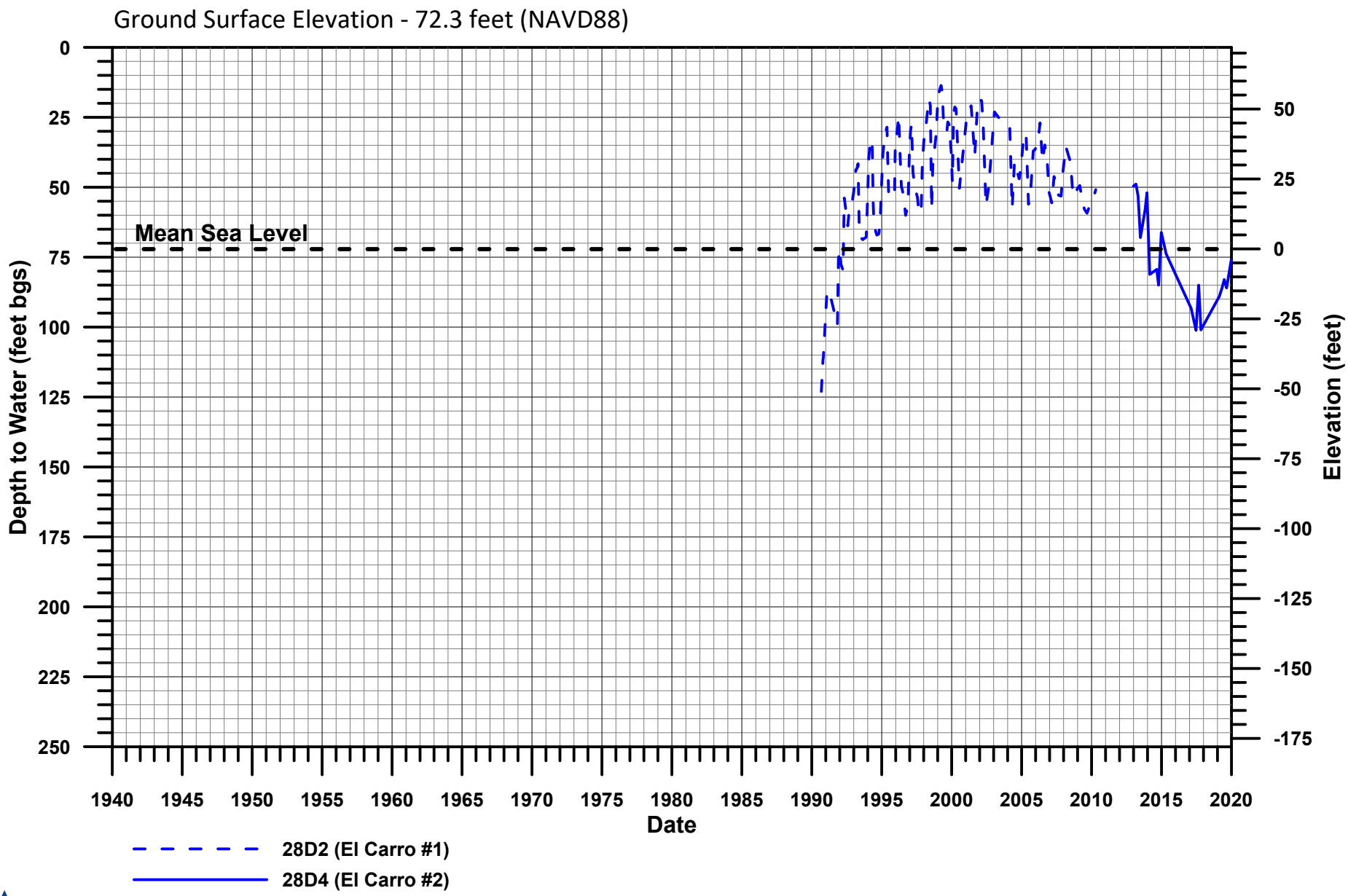
Water Level Data - 4N/25W-27F2 (SMILLE)
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



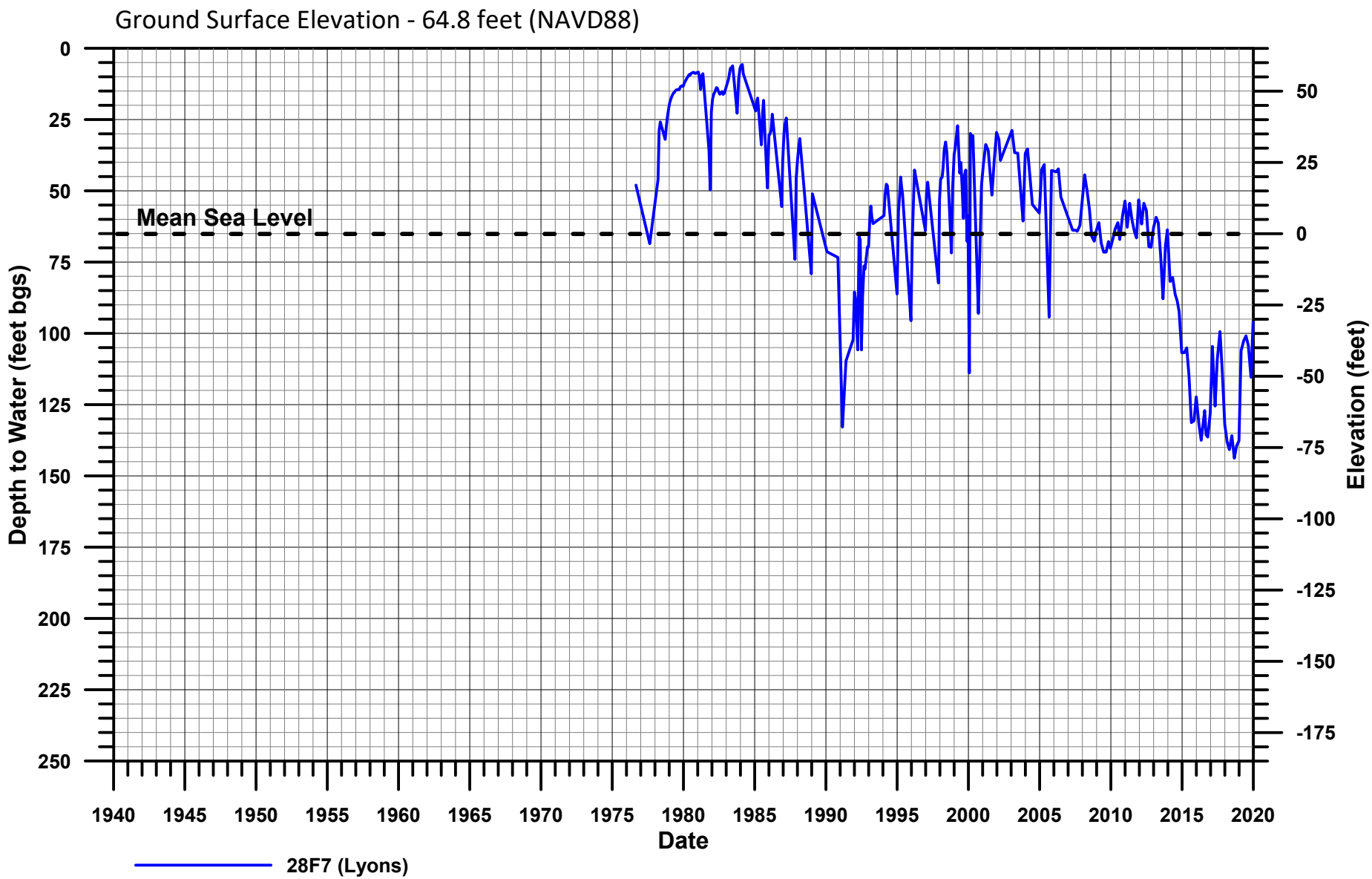
Water Level Data - 4N/25W-27Q6
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



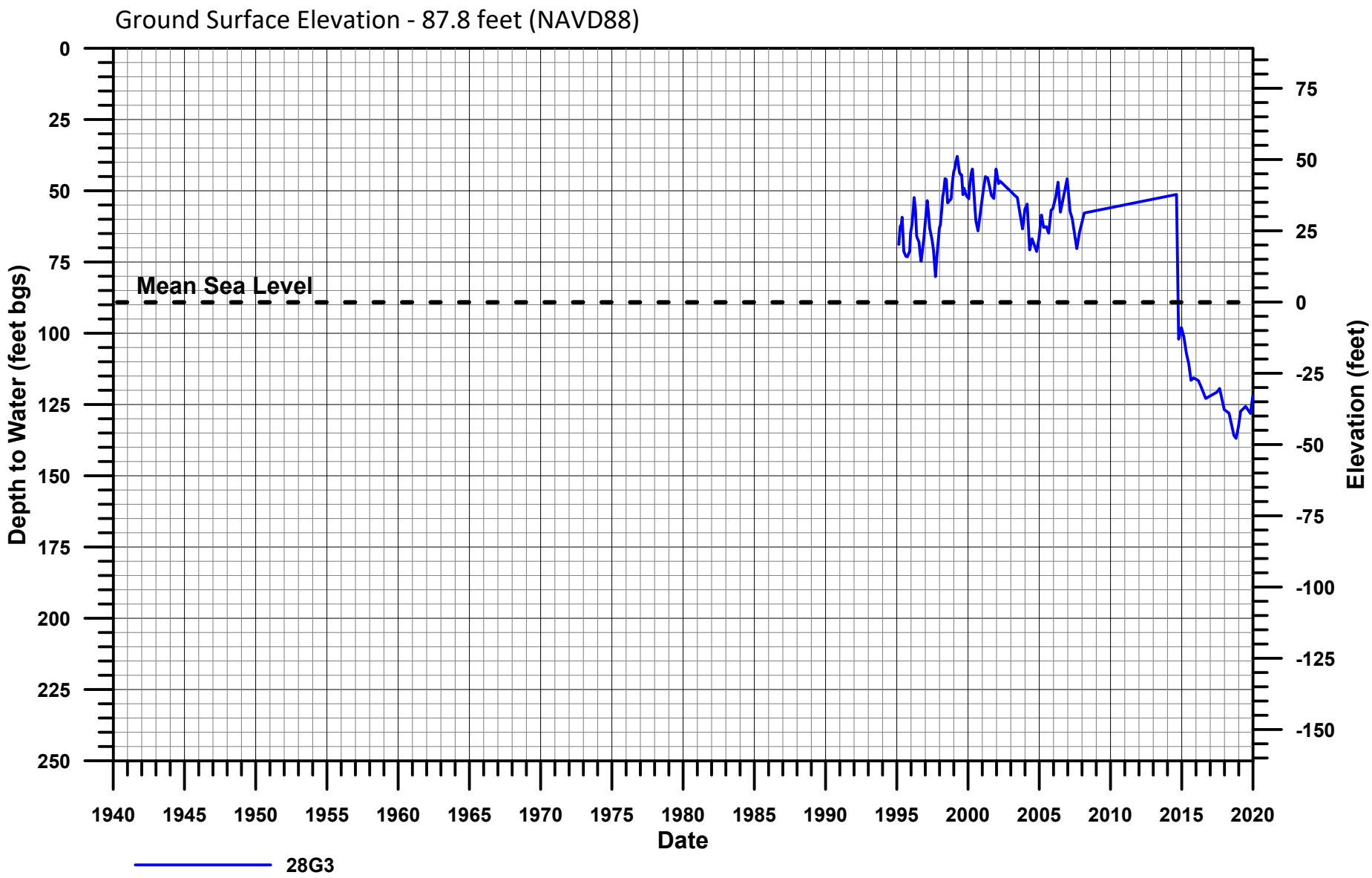
Water Level Data - 4N/25W-27R2
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



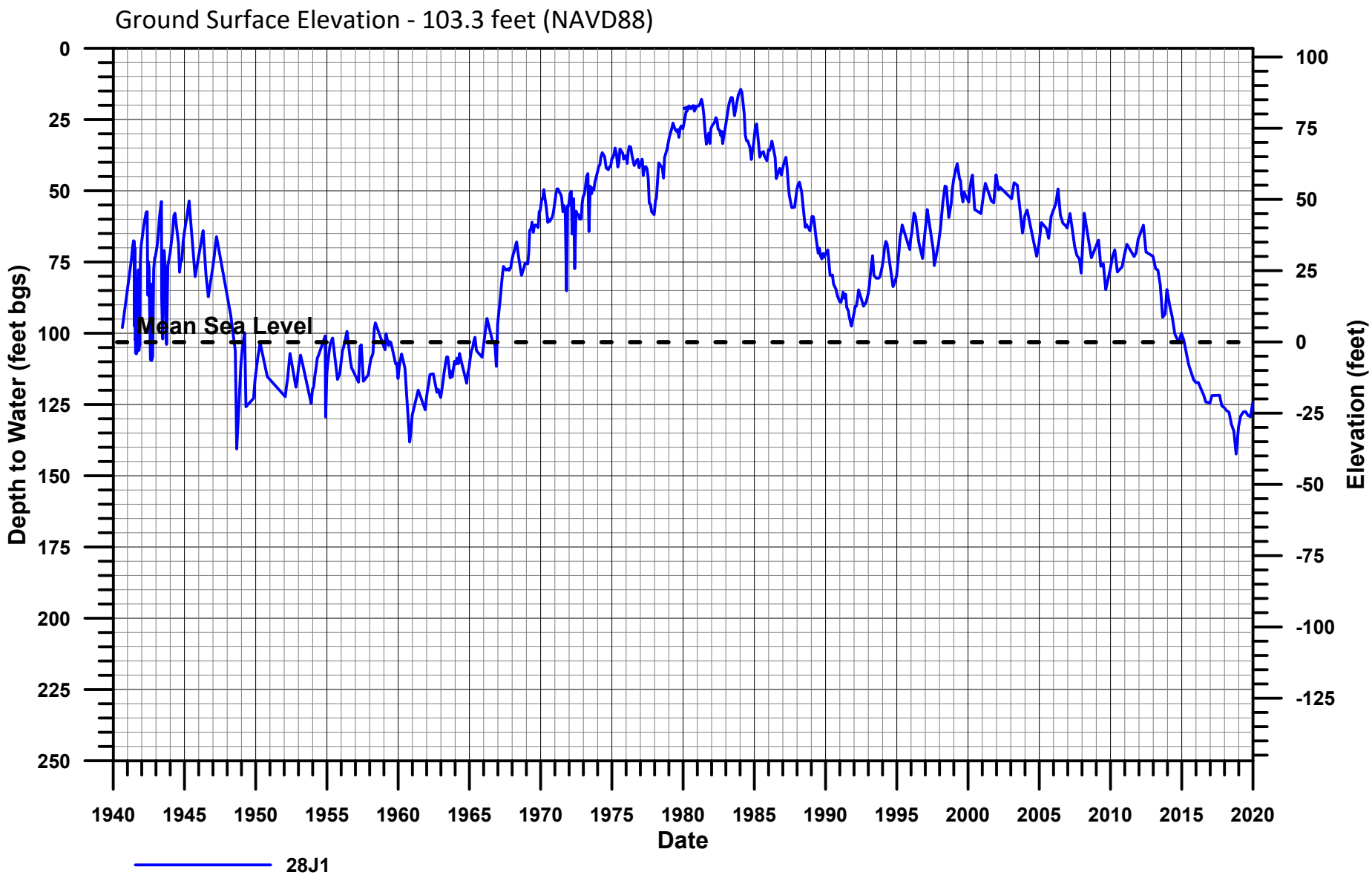
Water Level Data - 4N/25W-28D2/4 (EL CARRO)
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



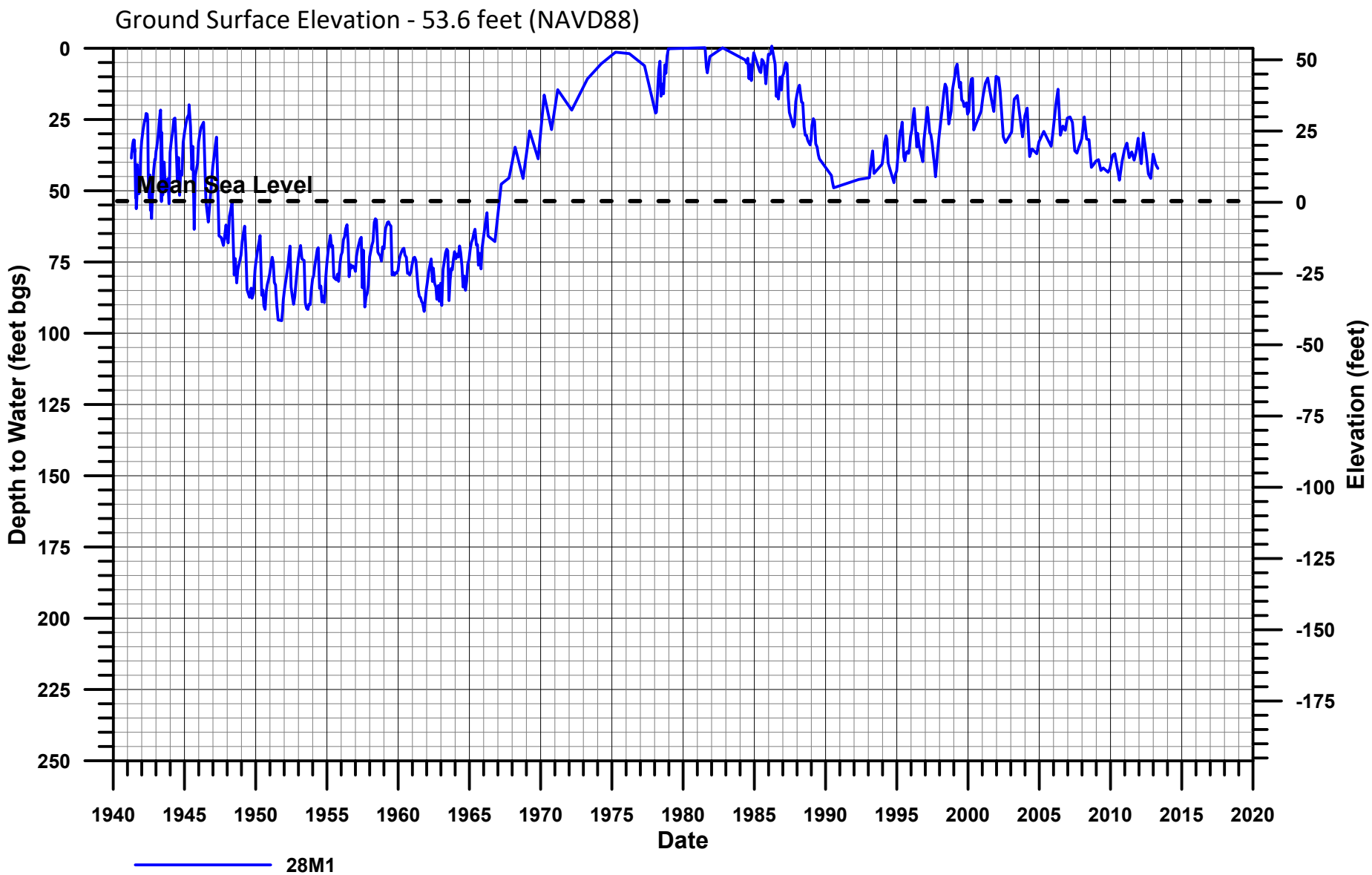
Water Level Data - 4N/25W-28F7 (LYONS)
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



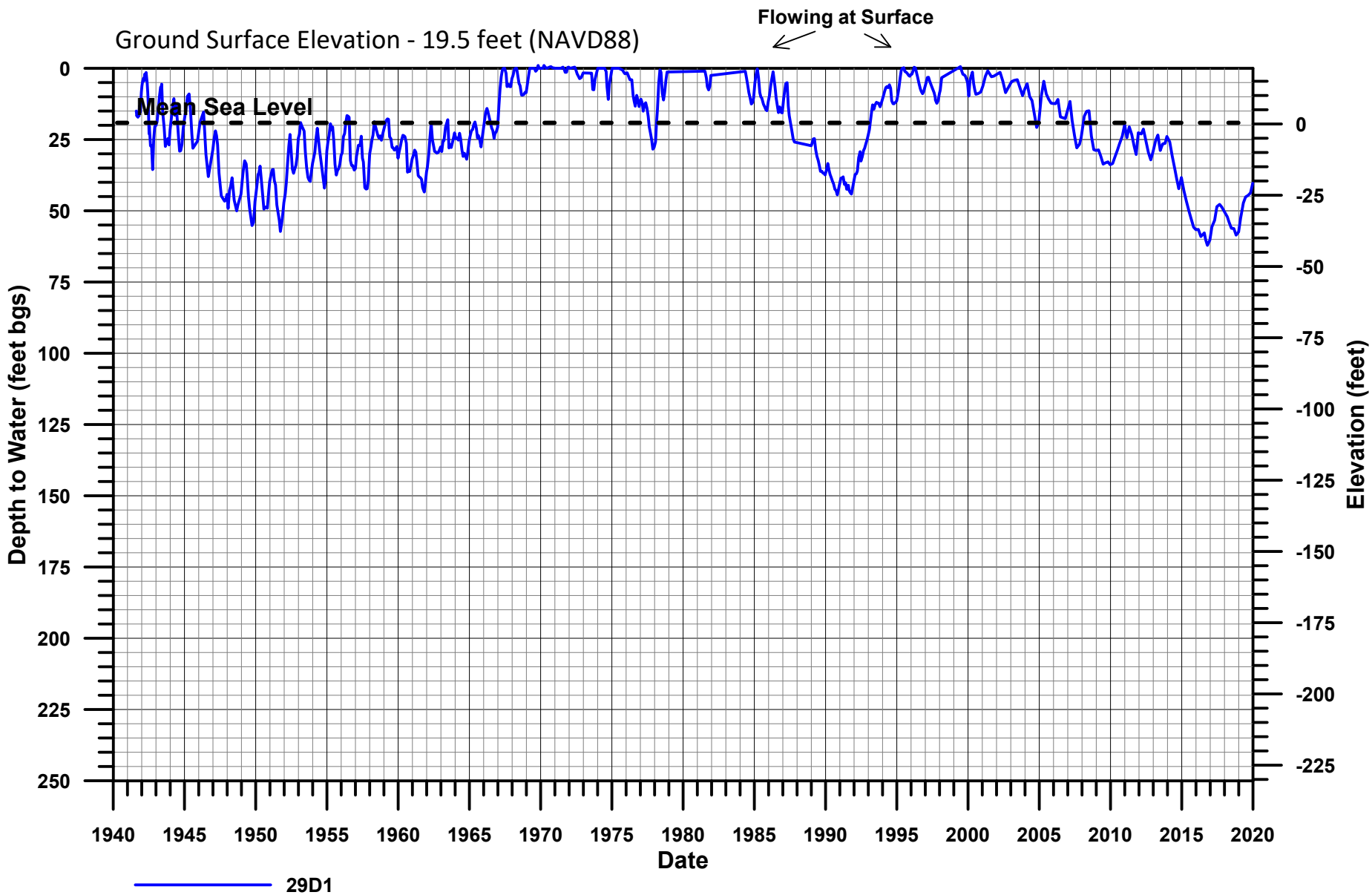
Water Level Data - 4N/25W-28G3
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



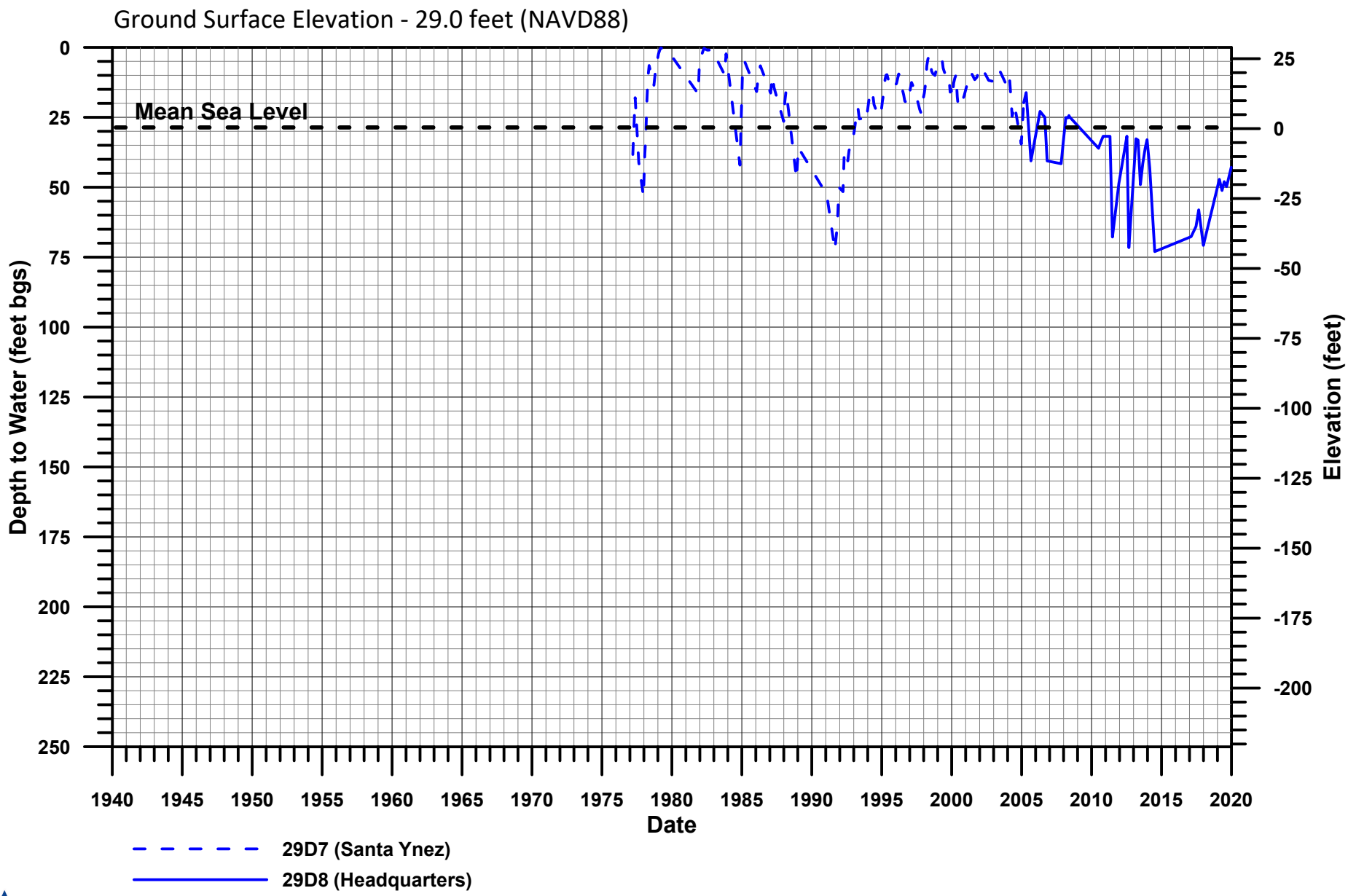
Water Level Data - 4N/25W-28J1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



Water Level Data - 4N/25W-28M1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan

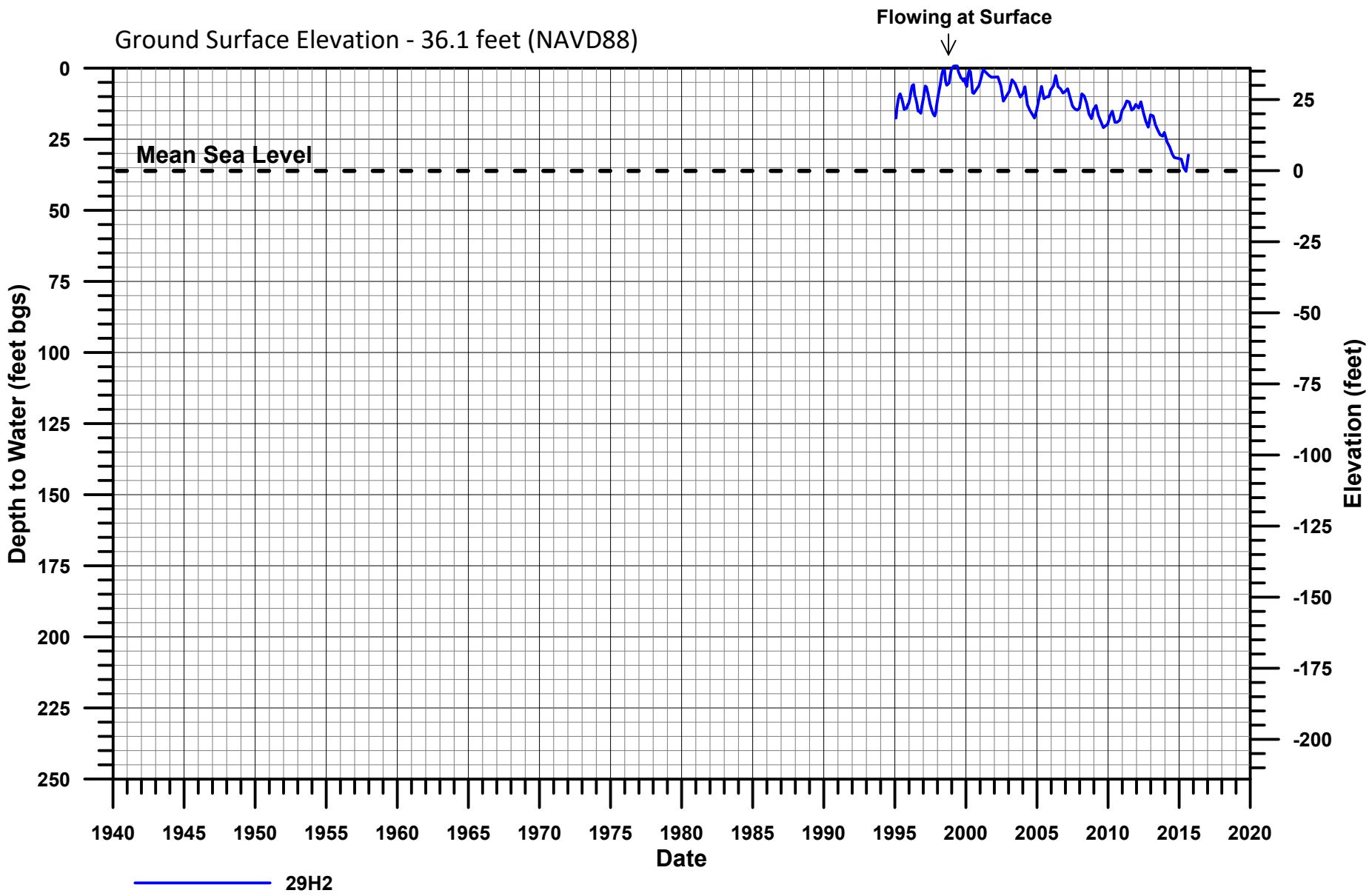


Water Level Data - 4N/25W-29D1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan

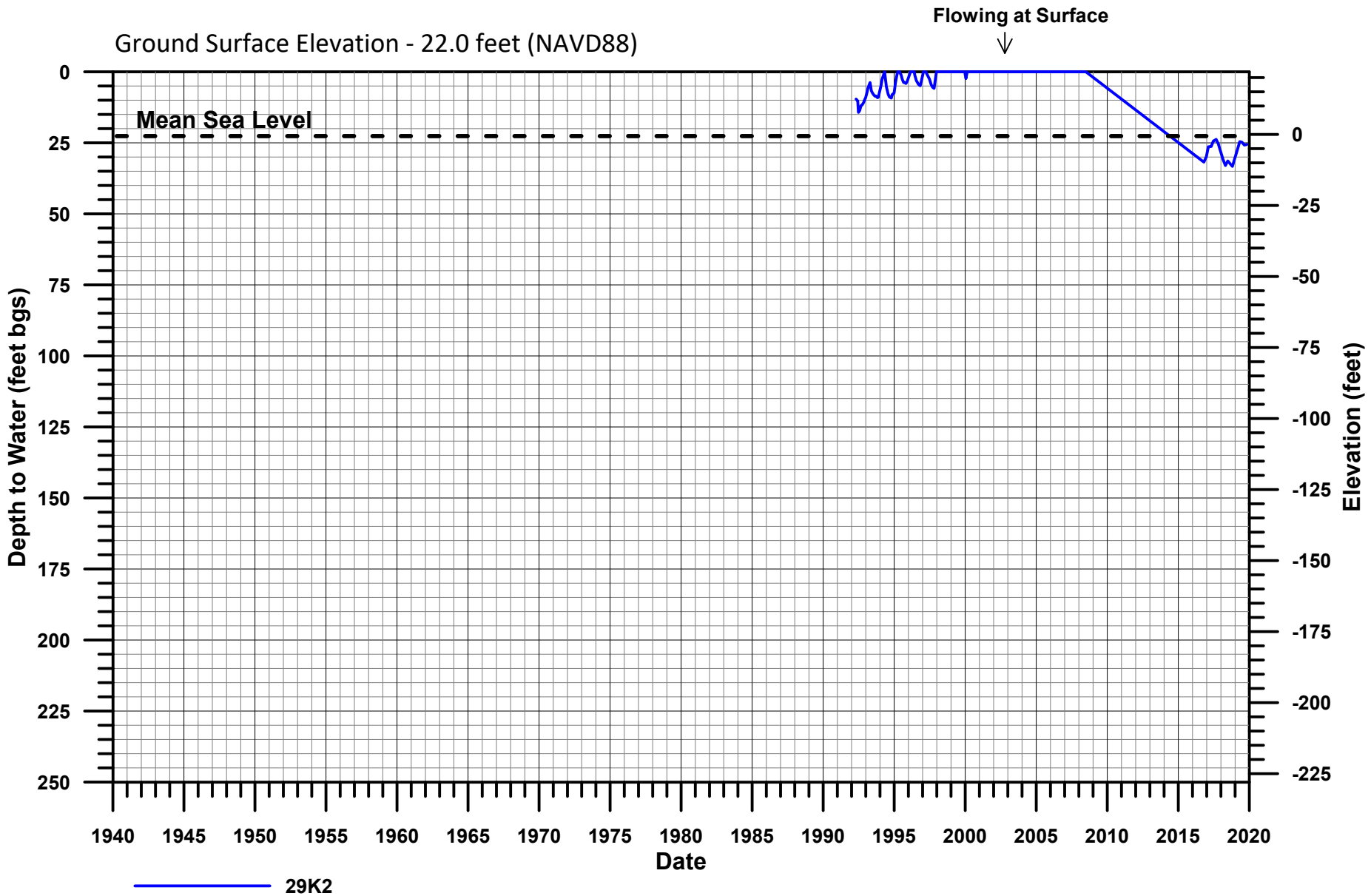


Water Level Data - 4N/25W-29D7/8 (HEADQUARTERS SITE)
Carpinteria Groundwater Basin
Groundwater Sustainability Plan

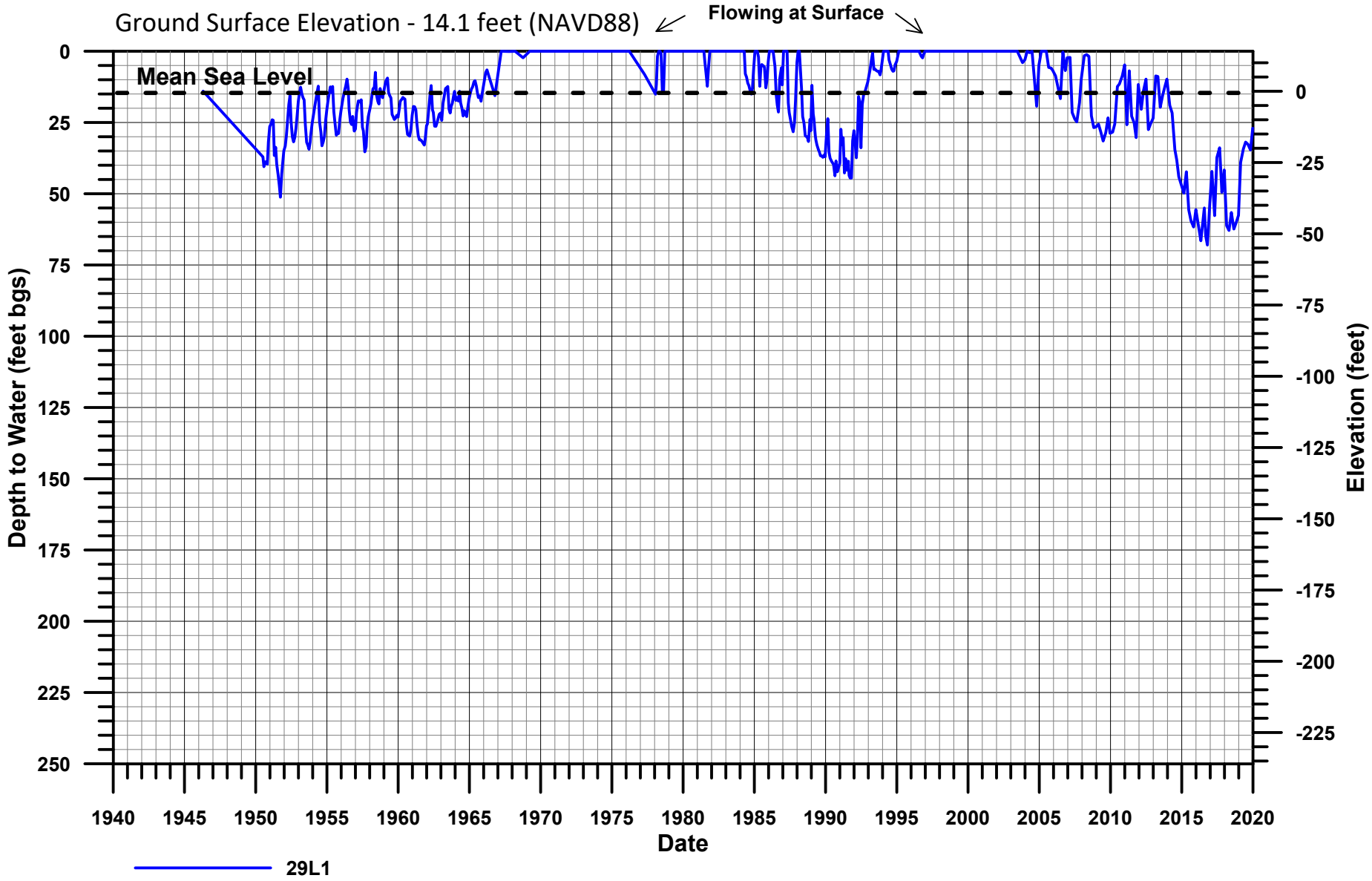
CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY



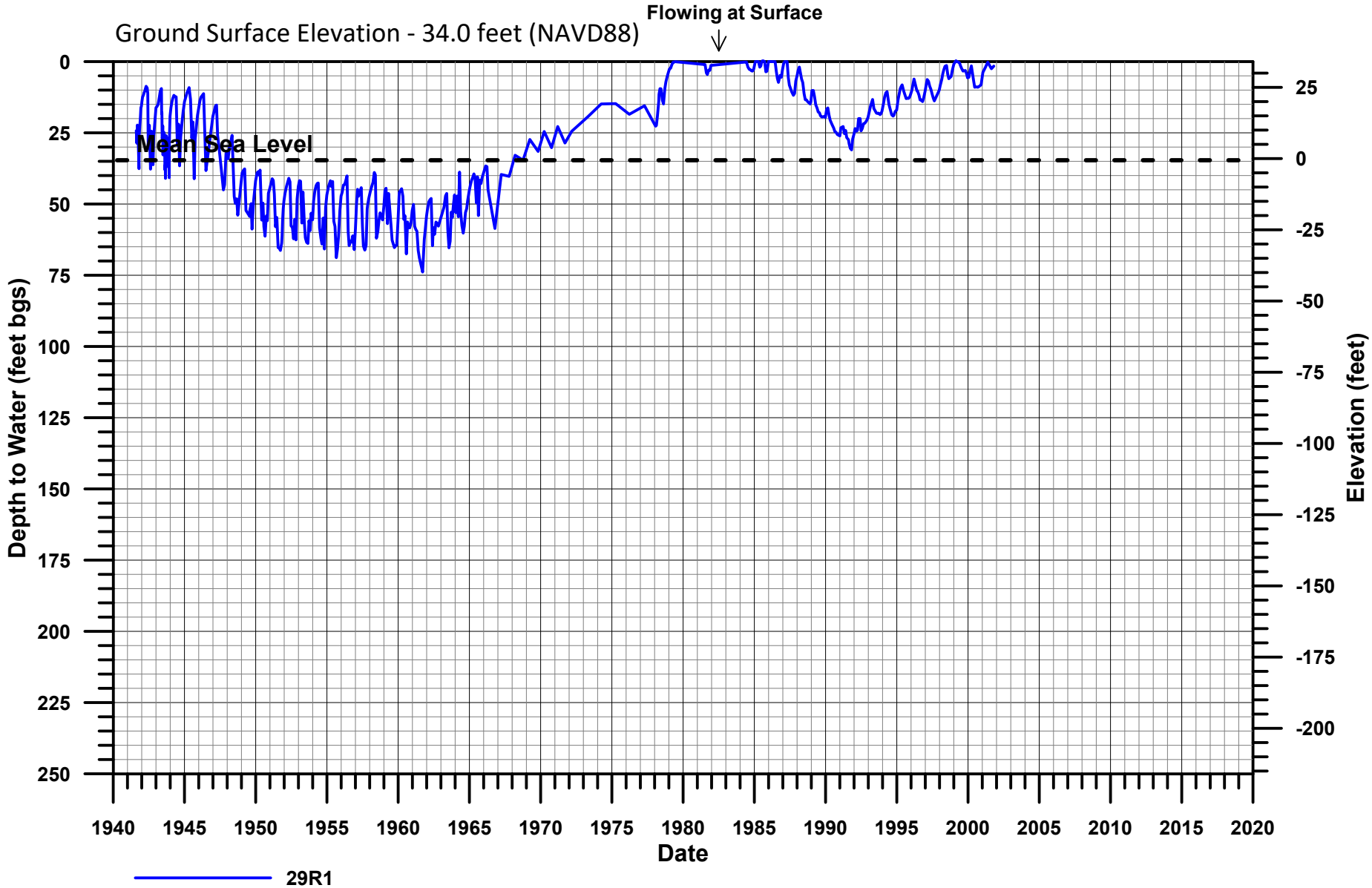
Water Level Data - 4N/25W-29H2
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



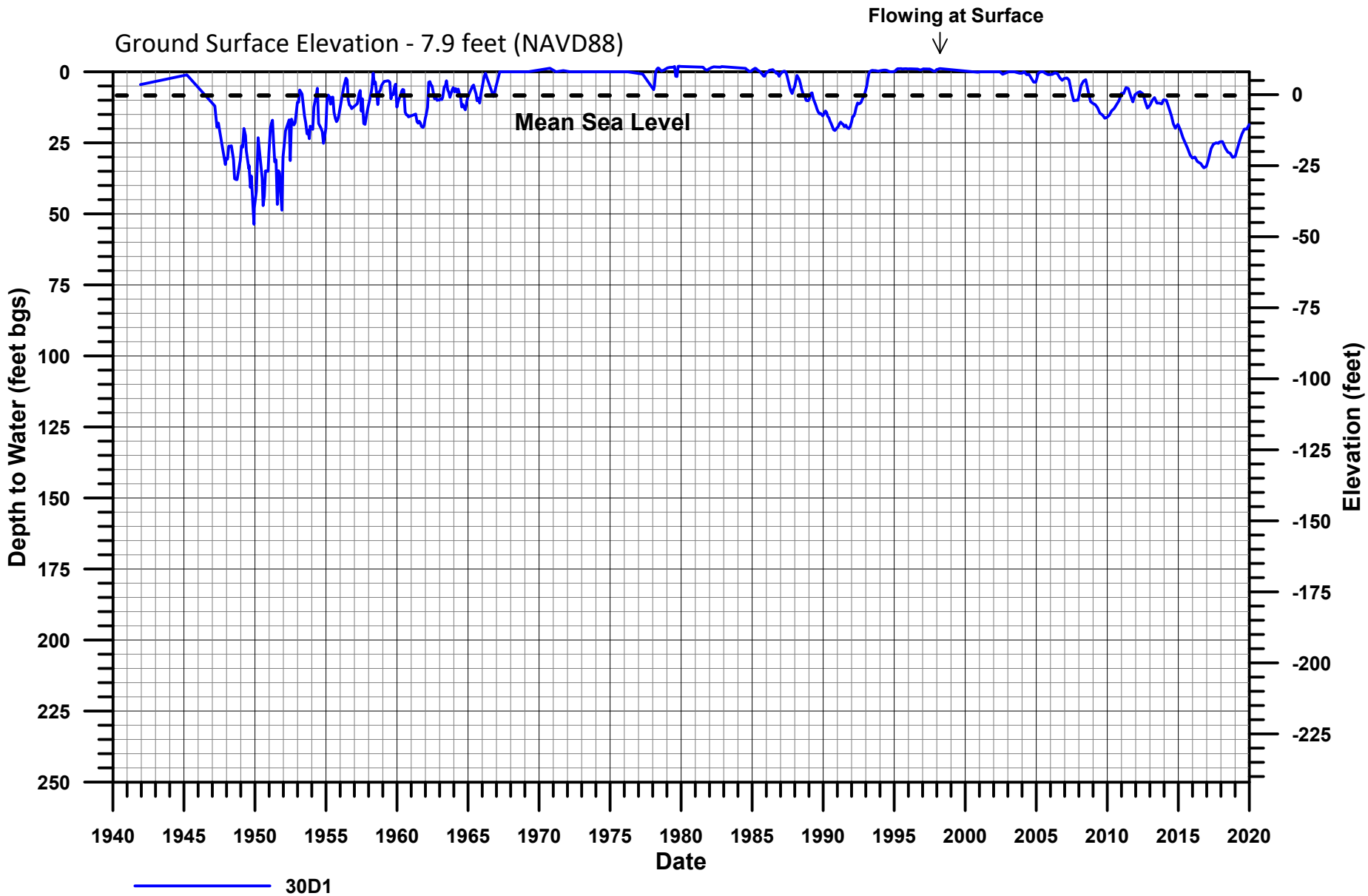
Water Level Data - 4N/25W-29K2
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



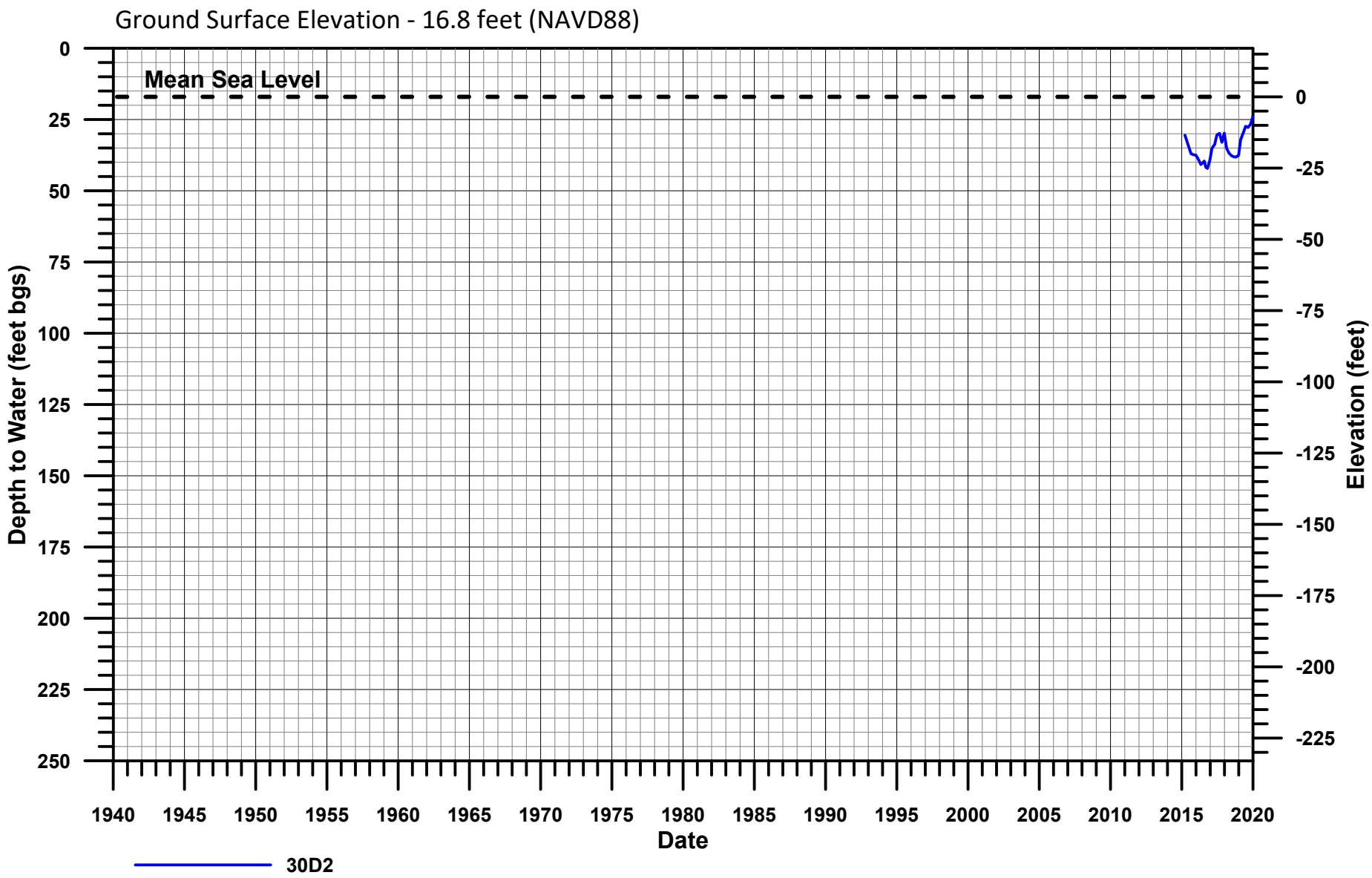
Water Level Data - 4N/25W-29L1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



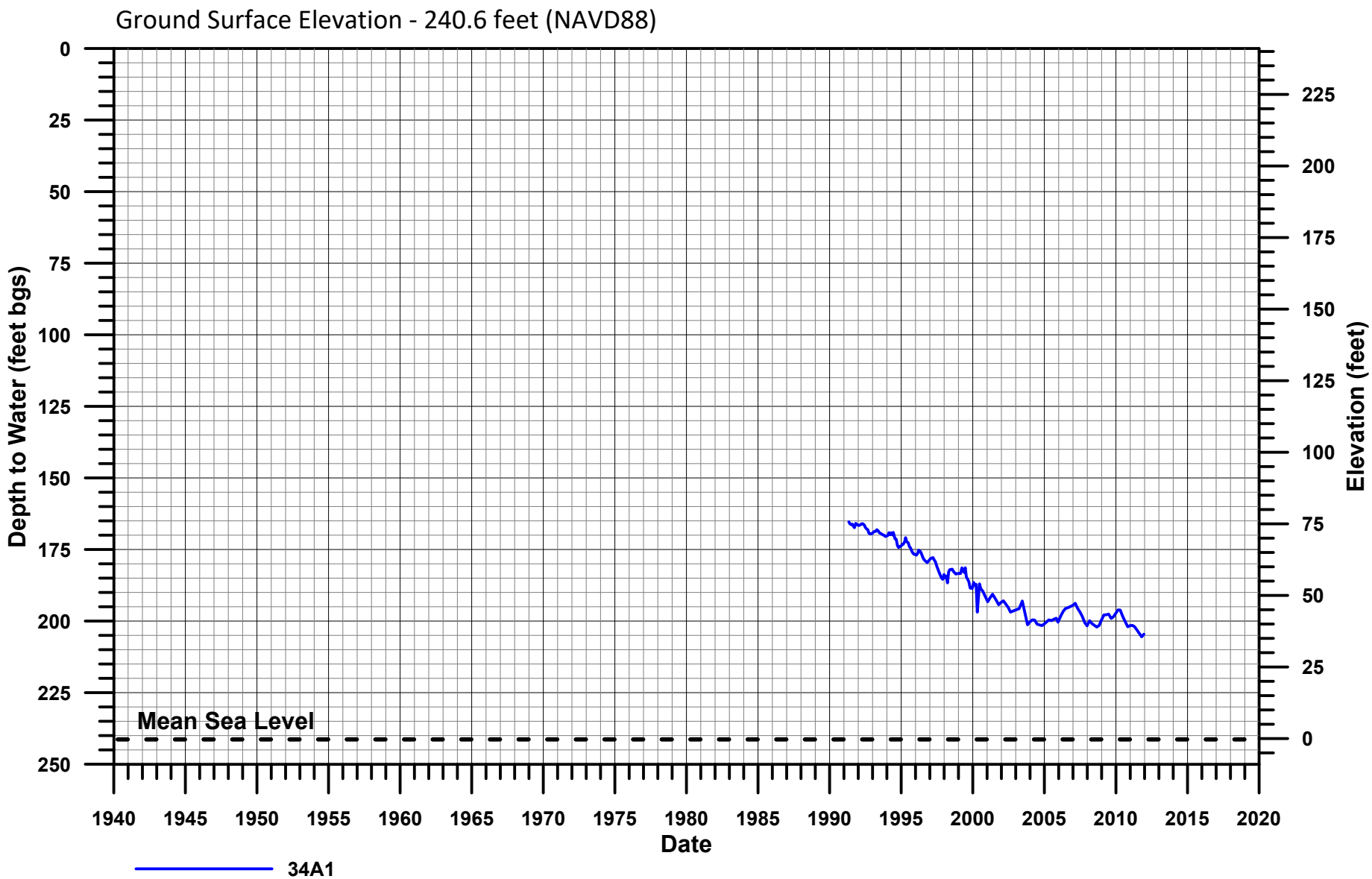
Water Level Data - 4N/25W-29R1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



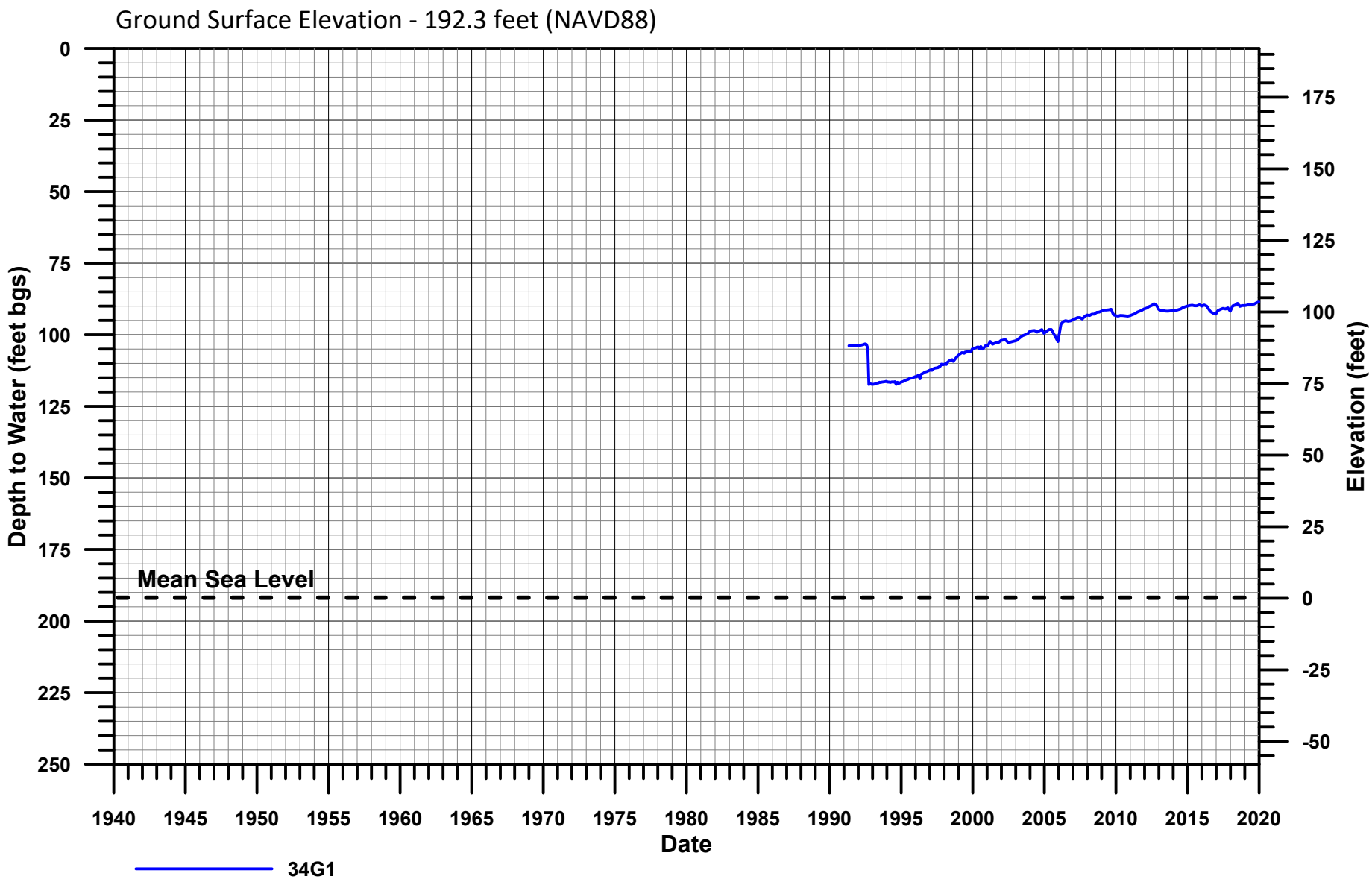
Water Level Data - 4N/25W-30D1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



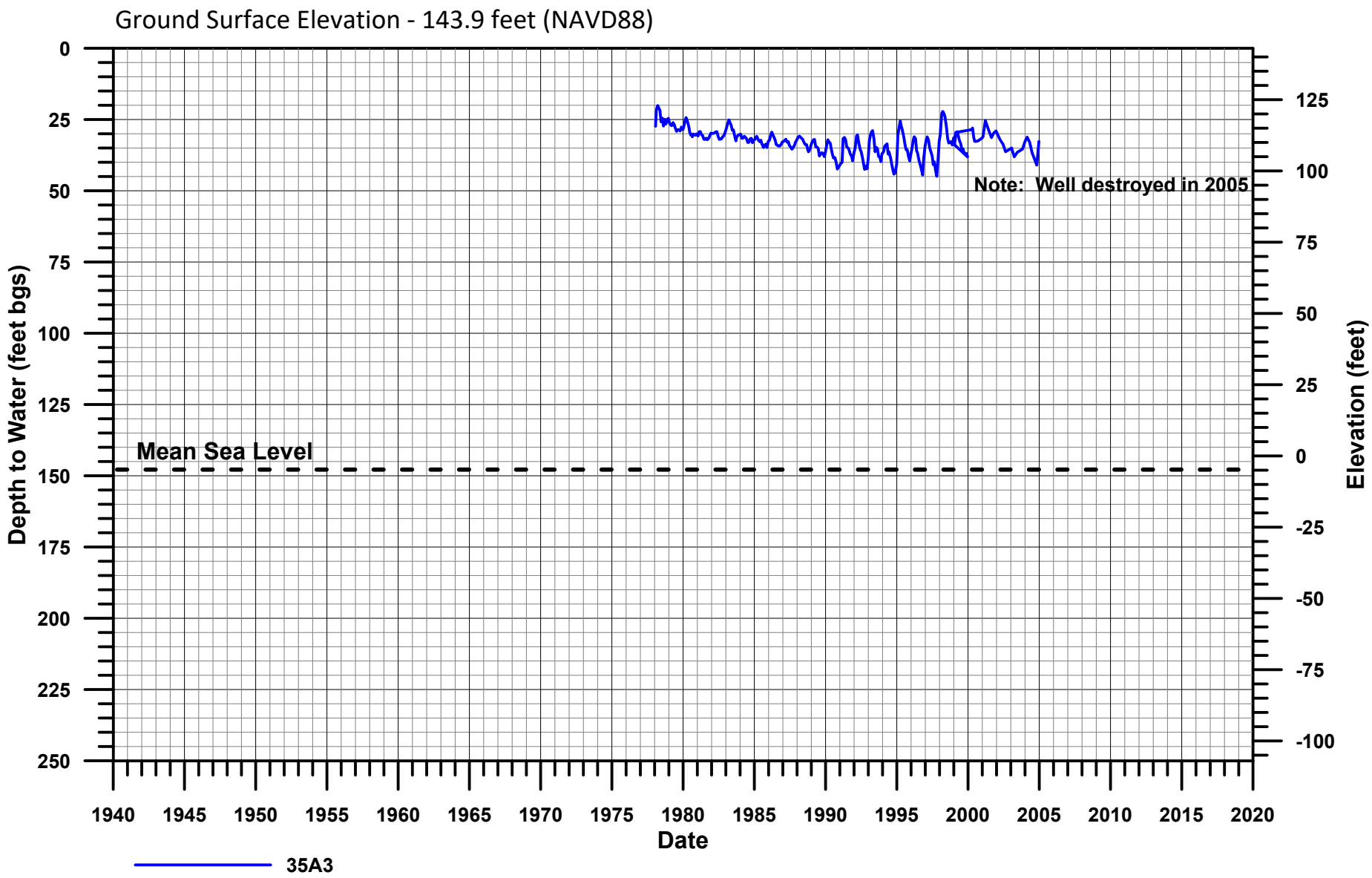
Water Level Data - 4N/25W-30D2
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



Water Level Data - 4N/25W-34A1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan

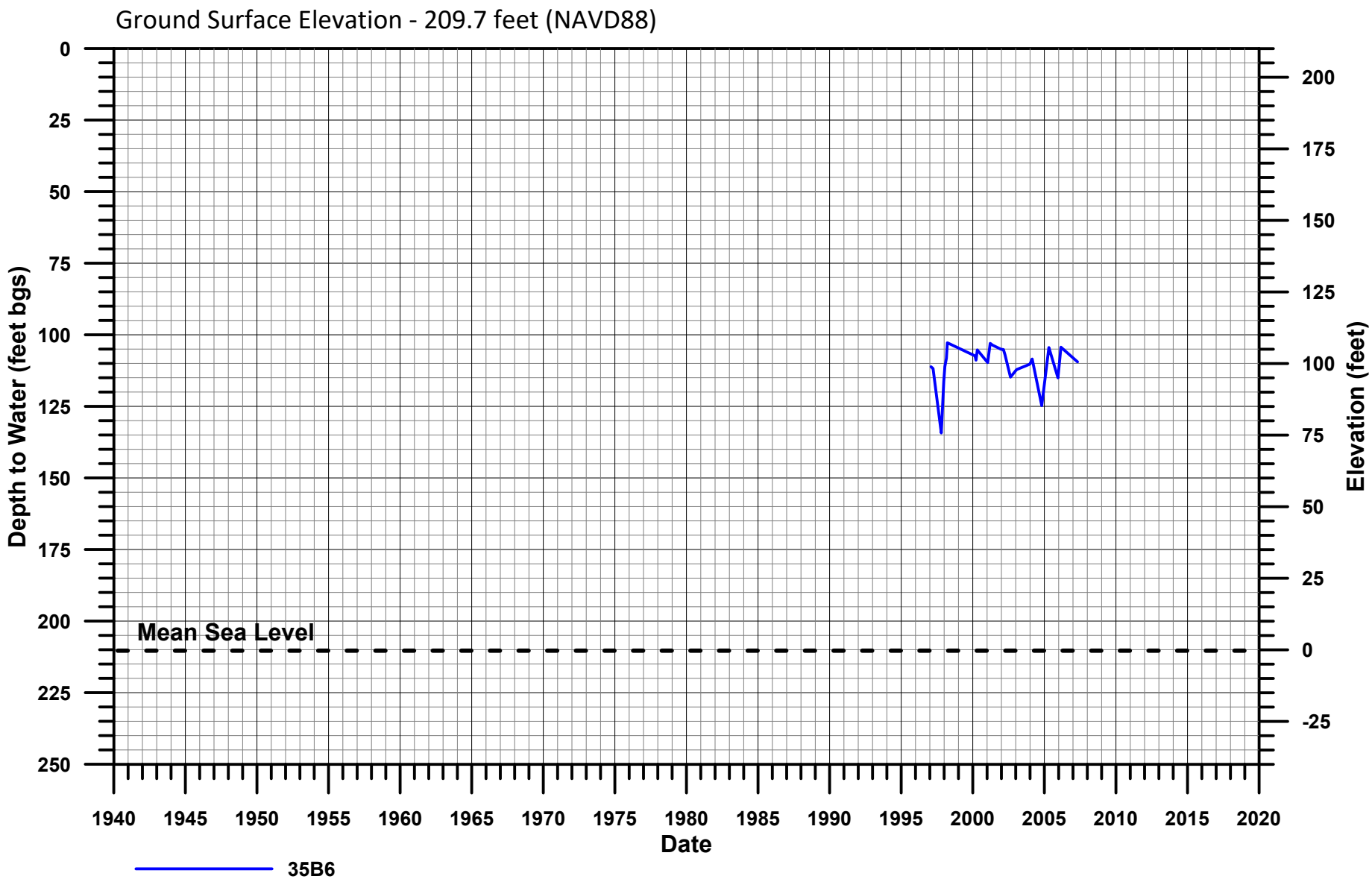


Water Level Data - 4N/25W-34G1
Carpinteria Groundwater Basin
Groundwater Sustainability Plan

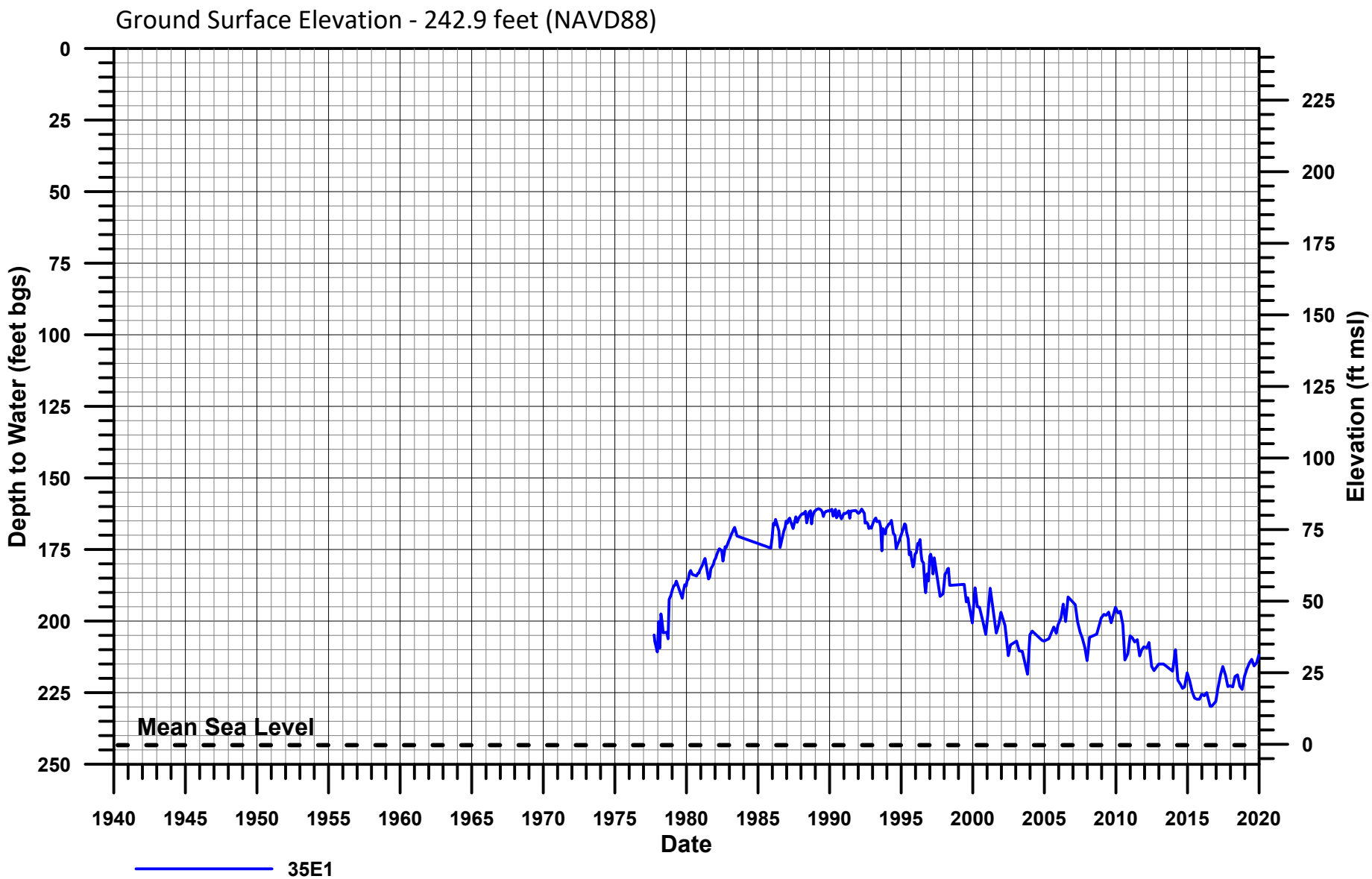


CARPINTERIA GSA
GROUNDWATER SUSTAINABILITY AGENCY

Water Level Data - 4N/25W-35A3
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



Water Level Data - 4N/25W-35B6
Carpinteria Groundwater Basin
Groundwater Sustainability Plan



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.

TABLE OF CONTENTS

EXECUTIVE SUMMARY i
1.0 INTRODUCTION 1
1.1. Scope of Services 1
1.2. Background 2
2.0 GEOPHYSICAL METHODOLOGIES 4
2.1. Electrical Resistivity Tomography (ERT) 4
2.2. Survey Global Positioning System (GPS) Locations 4
3.0 GEOPHYSICS FIELD SURVEYS AND DATA PROCESSING 6
3.1. ERT Field Surveys 6
3.2. ERT Data Processing 6
4.0 RESULTS AND INTERPRETATION 8
4.1. Results 8
4.2. Geophysical Interpretation 9
5.0 CONCLUSIONS 12
6.0 CARPINTERIA ERT LIMITATIONS 13
7.0 RECOMMENDATIONS 14
8.0 CLOSURE 15
REFERENCES 16

LIST OF TABLES

Table 1-1. Summary of sentinel well completions. 2
Table 3-1. ERT field survey details for the April 2021 program. 6
Table 3-2. Summary table of data reduction/filtering and model RMS error. 7
Table 4-1. Summary statistics for the four ERT profiles including minimum, maximum, mean, and standard deviation of the recovered model electrical conductivities. 8

LIST OF FIGURES

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

LIST OF DRAWINGS

Figure 1 Carpinteria ERT Survey Basemap
Figure 2 Carpinteria Saltwater Intrusion: ERT-01
Figure 3 Carpinteria Saltwater Intrusion: ERT-02
Figure 4 Carpinteria Saltwater Intrusion: ERT-03

Figure 5 Carpinteria Saltwater Intrusion: ERT-04

Figure 6 Carpinteria Saltwater Intrusion: 3D Model

LIST OF APPENDICES

APPENDIX A ERT DEPTH OF INVESTIGATION (DOI) ANALYSIS

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.

As a mutual protection to our client, the public, and ourselves all documents and drawings are submitted for the confidential information of our client for a specific project. Authorization for any use and/or publication of this document or any data, statements, conclusions or abstracts from or regarding our documents and drawings, through any form of print or electronic media, including without limitation, posting or reproduction of same on any website, is reserved pending BGC's written approval. A record copy of this document is on file at BGC. That copy takes precedence over any other copy or reproduction of this document.

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.

As a mutual protection to our client, the public, and ourselves all documents and drawings are submitted for the confidential information of our client for a specific project. Authorization for any use and/or publication of this document or any data, statements, conclusions or abstracts from or regarding our documents and drawings, through any form of print or electronic media, including without limitation, posting or reproduction of same on any website, is reserved pending BGC's written approval. A record copy of this document is on file at BGC. That copy takes precedence over any other copy or reproduction of this document.

Yours sincerely,

BGC ENGINEERING INC.
per:

PROFESSIONAL GEOLOGIST
MARTIN PETER ZALESKI
No.2509
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Oct 7, 2021

Landon Woods, M.Sc., P.Geo. (AB, BC)
Geoscientist - Geophysics

Martin Zaleski, M.Sc., CEG
Senior Engineering Geologist

Reviewed by:

Paul Bauman, M.Sc., P.Geoph., P.Eng. (AB, BC, SK, ON)
Principal Geophysicist

EE/PB/gc/sjk

REFERENCES

de Groot-Hedlin, C. & Constable, S. (1990). Occam's inversion to generate smooth, two-dimensional models from magnetotelluric data. Geophysics, 55, 1613-1624.

Edwards, L.S. (1977). A modified pseudosection for resistivity and IP. Geophysics, 42, 1020–1036.

Goebel, M., Pidlisecky, A., and Knight, R. (2017). Resistivity imaging reveals complex pattern of saltwater intrusion along the Monterey coast. Journal of Hydrology, 551, 746-755.

Keary, P., Brooks, M., & Hill, I. (2002). An introduction to Geophysical Exploration (3rd Edition). MA, USA: Blackwell Publishing.

Loke, M.H. & Barker, R.D. (1996). Rapid least-squares inversion of apparent resistivity pseudosections by a quasi-Newton method. Geophys Prospect, 131–152.

Minor, S.A., Kellogg, K.S., Stanley, R.G., Gurrola, L.D., Keller, E.A., and Brandt, T.R. (2009). Geologic Map of the Santa Barbara Coastal Plain Area, Santa Barbara County, California. U.S. Geological Survey Scientific Investigations Map 3001, scale 1:25,000.

Oldenburg, D.W., and Li, Y. (1999). Estimating depth of investigation of dc resistivity and IP surveys. Geophysics, 64, 403-416.

Pueblo Water Resources Inc. (2012). Carpinteria Groundwater Basin: Hydrogeological Update and Groundwater Model Project (Report 06-0125), Ventura, Ca.

Pueblo Water Resources Inc. (2020). Monitoring Well Completion Report: Carpinteria Groundwater Basin Sentinel Wells (Report 18-0061), Ventura, Ca.

Reynolds, J.M. (2011). An Introduction to Applied and Environmental Geophysics (2nd Edition). West Sussex, UK: John Wiley and Sons.

Zonge, K., Wynn, J., & Urquhart, S. (2005). Resistivity, Induced Polarization, and Complex Resistivity. Near Surface Geophysics (pp. 265-300). USA: Society of Exploration Geophysicists (SEG).

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)

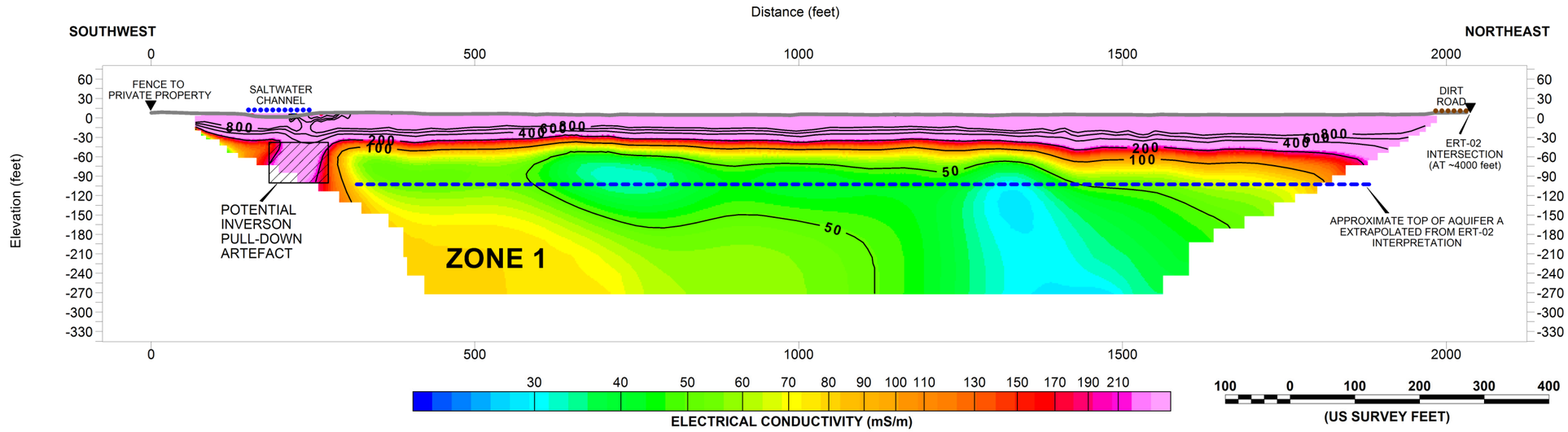
Notes:

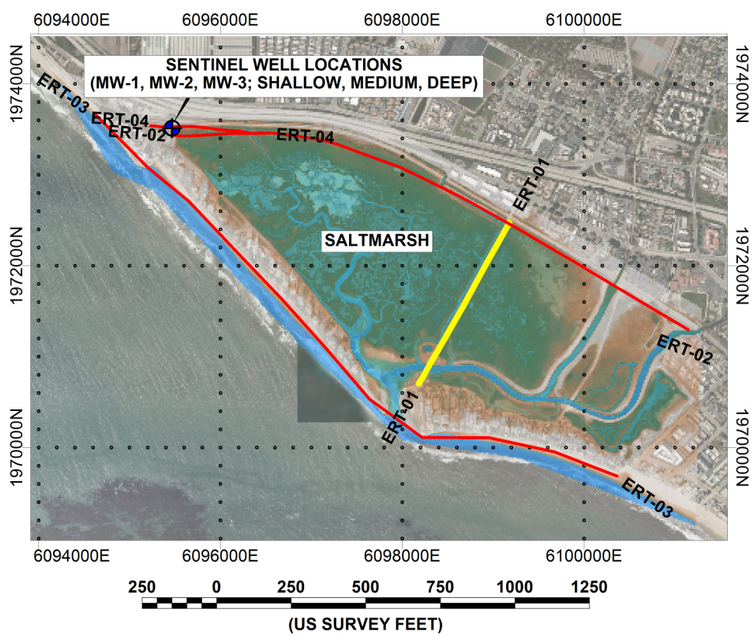
1. This Figure should be read in conjunction with BGC's report titled "Electrical resistivity tomography (ERT) investigation to map saltwater intrusion in Carpinteria, California", and dated October, 2021.
2. The ERT surveys were collected as part of a saltwater intrusion study at Carpinteria, California 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:	FIGURE TITLE:		
LGW	CARPINTERIA ERT SURVEY BASEMAP		
CHECKED BY:	CLIENT:		
AFM	CARPINTERIA VALLEY WATER DISTRICT (CVWD)		
APPROVED BY:	SCALE:	PROJECT NO:	FIGURE NO:
LGW	AS SHOWN	2252001	1

BGC ENGINEERING INC.

File Path: BGC Engineering Inc\Geophysics - Files\2.0_Current BGC Projects\2252001 - Carpinteria\3.0_Data_Processing\4.0_OasisMaps\2252001-Pueblo-Carpinteria_BaseMap-A.map





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

LEGEND:

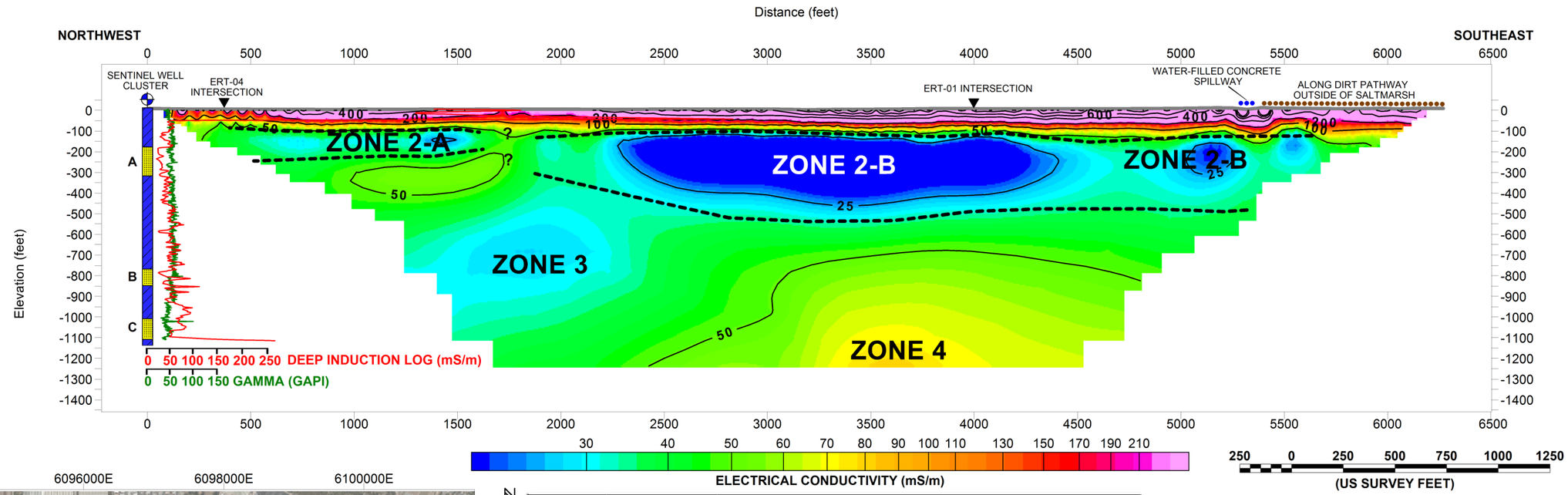
CROSS-SECTION
- ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
- NOTABLE WATER CROSSING (> 15 m)
- NOTABLE OBSERVED SURFACE FEATURE

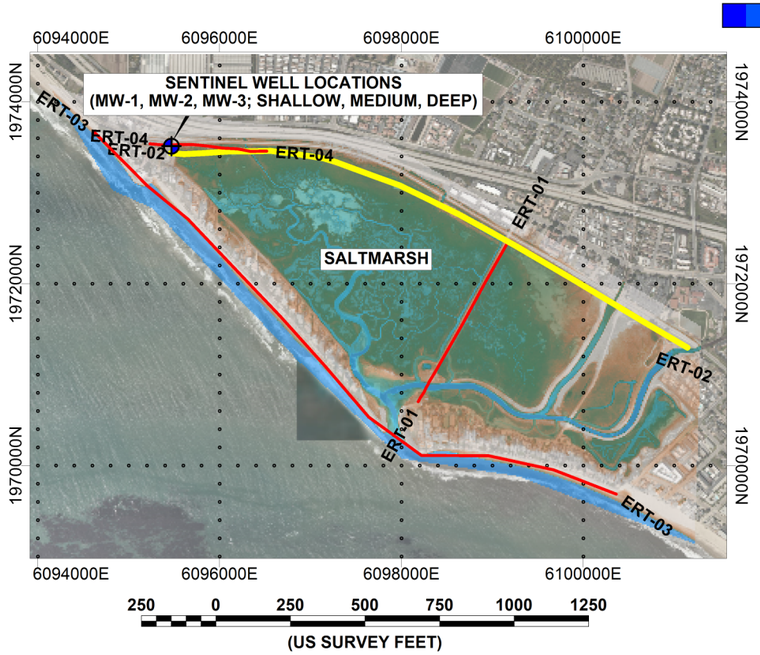
INSET
- DISPLAYED 2021 ERT PROFILE LOCATION
- OTHER 2021 ERT PROFILE LOCATIONS
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

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

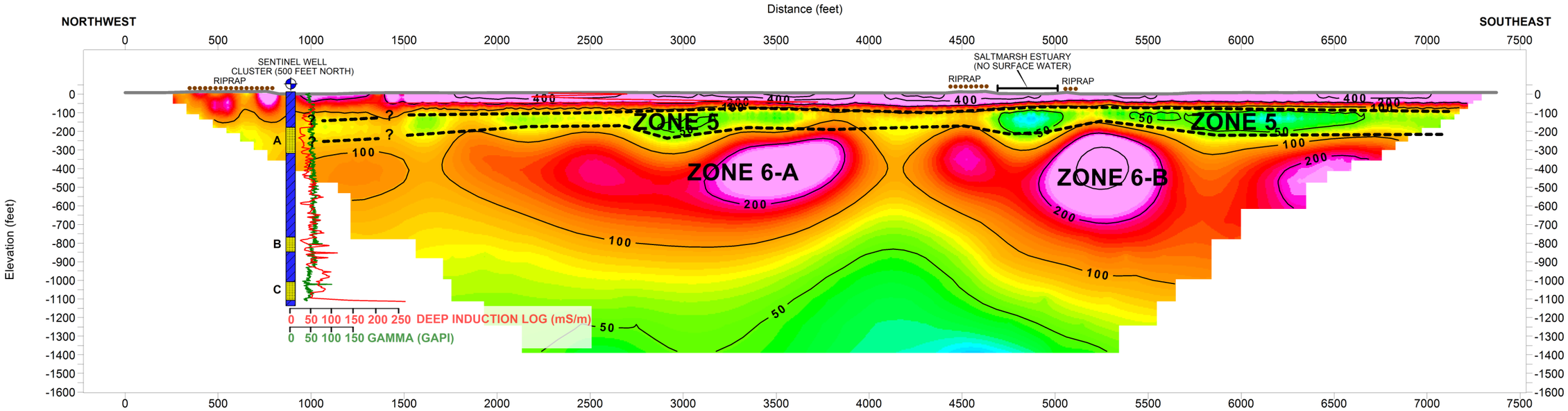
LEGEND:
CROSS-SECTION
- ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
- FEBRUARY 2021 DEEP CONDUCTIVITY LOG IN mS/m (PACIFIC SURVEYS)
- FEBRUARY 2021 GAMMA LOG IN GAPI (PACIFIC SURVEYS)
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
- INTERPRETED AQUIFER A BOUNDS
- NOTABLE WATER CROSSING (> 15 m)
- NOTABLE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

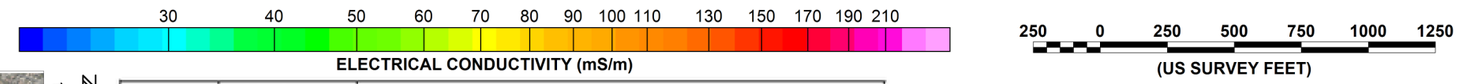
INSET
- DISPLAYED 2021 ERT PROFILE LOCATION
- OTHER 2021 ERT PROFILE LOCATIONS
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

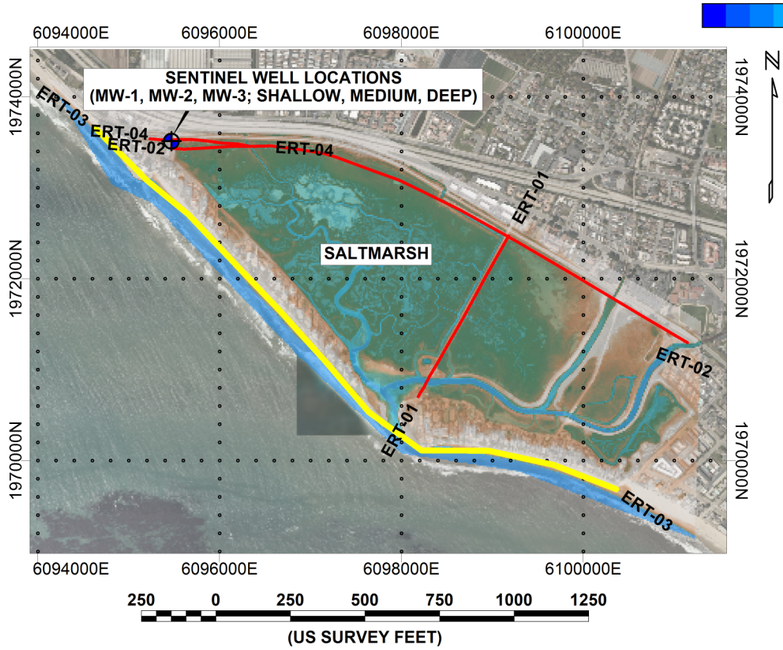
Notes:
1. This Figure should be read in conjunction with BGC's report titled "Electrical resistivity tomography (ERT) investigation to map saltwater intrusion in Carpinteria, California", and dated October, 2021.
2. The ERT surveys were collected as part of a saltwater intrusion study at Carpinteria, 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:	CLIENT:		
PDB	CARPINTERIA VALLEY WATER DISTRICT (CVWD)		
APPROVED BY:	SCALE:	PROJECT NO:	FIGURE NO:
LGW	AS SHOWN	2252001	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







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)

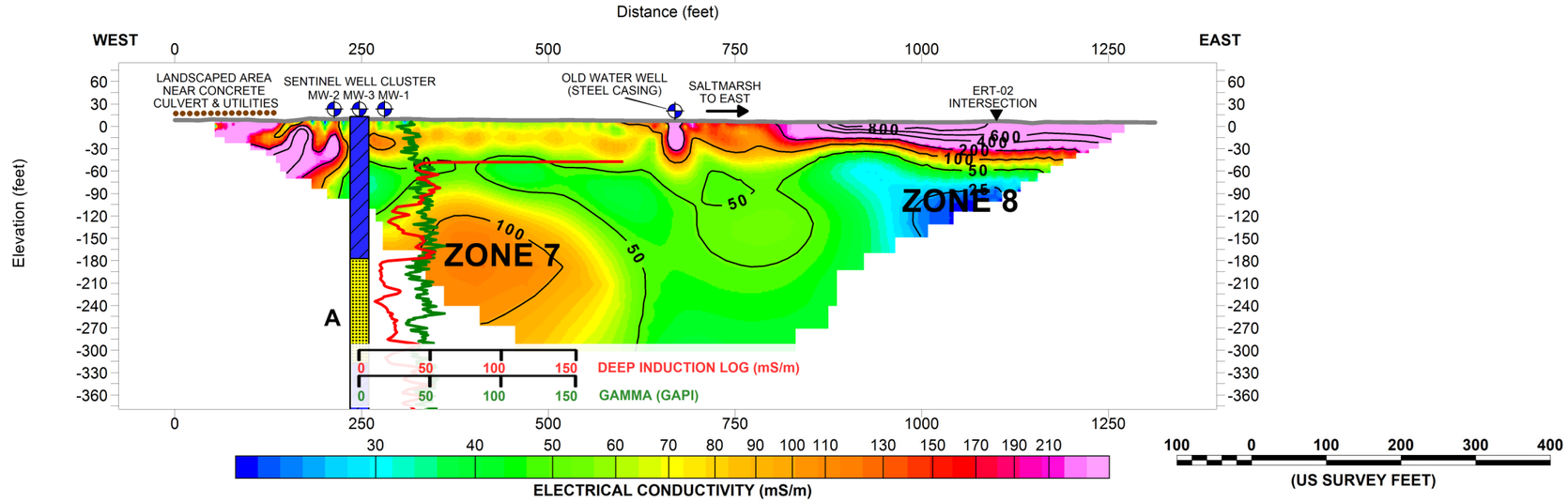
LEGEND:
CROSS-SECTION
- ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
- FEBRUARY 2021 DEEP CONDUCTIVITY LOG IN mS/m (PACIFIC SURVEYS)
- FEBRUARY 2021 GAMMA LOG IN GAPI (PACIFIC SURVEYS)
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
- INTERPRETED AQUIFER A BOUNDS
- NOTABLE WATER CROSSING (> 15 m)
- NOTABLE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

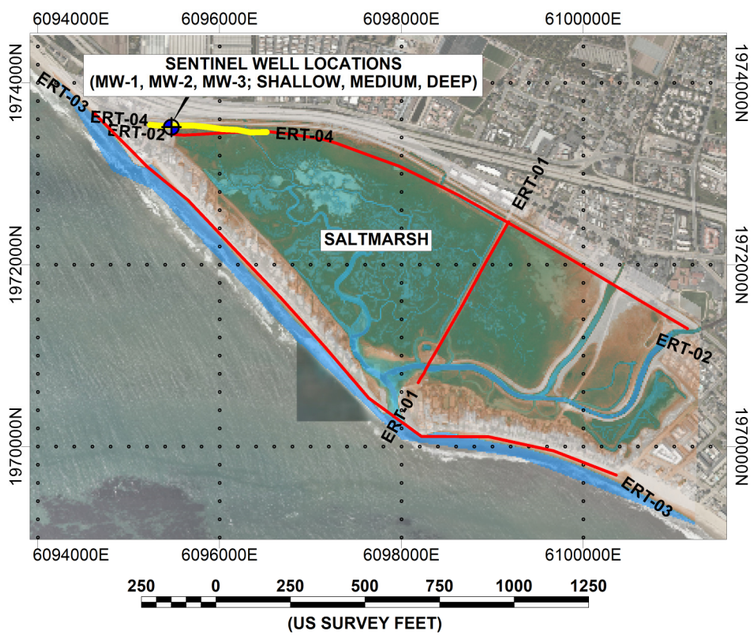
INSET
- DISPLAYED 2021 ERT PROFILE LOCATION
- OTHER 2021 ERT PROFILE LOCATIONS
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

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

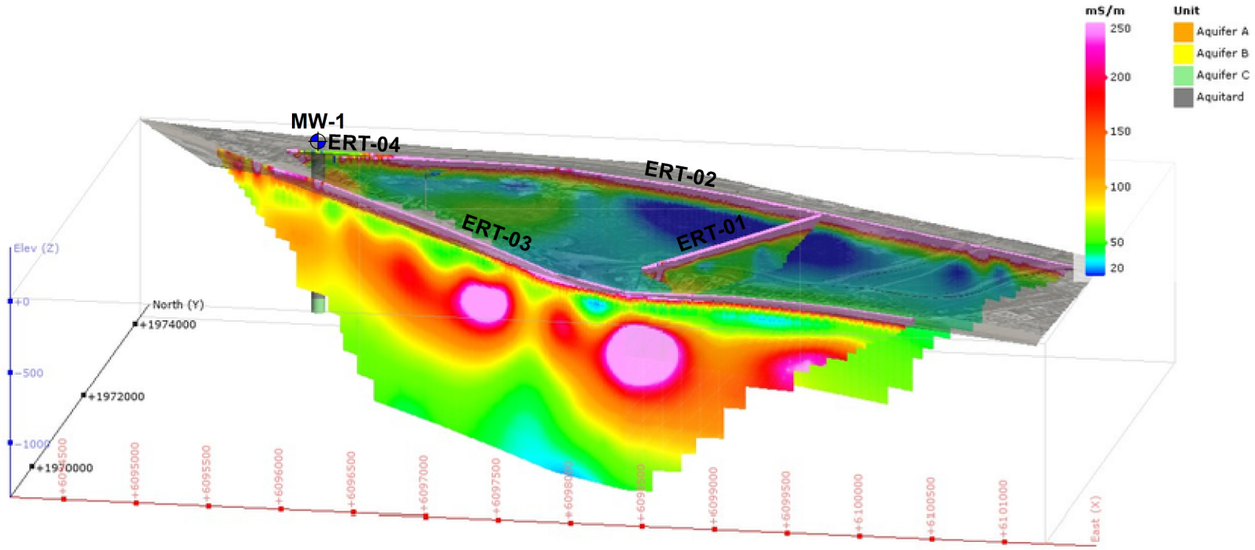
LEGEND:
CROSS-SECTION
- ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
- FEBRUARY 2021 DEEP CONDUCTIVITY LOG IN mS/m (PACIFIC SURVEYS)
- FEBRUARY 2021 GAMMA LOG IN GAPI (PACIFIC SURVEYS)
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
- INTERPRETED AQUIFER A BOUNDS
- NOTABLE WATER CROSSING (> 15 m)
- NOTABLE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

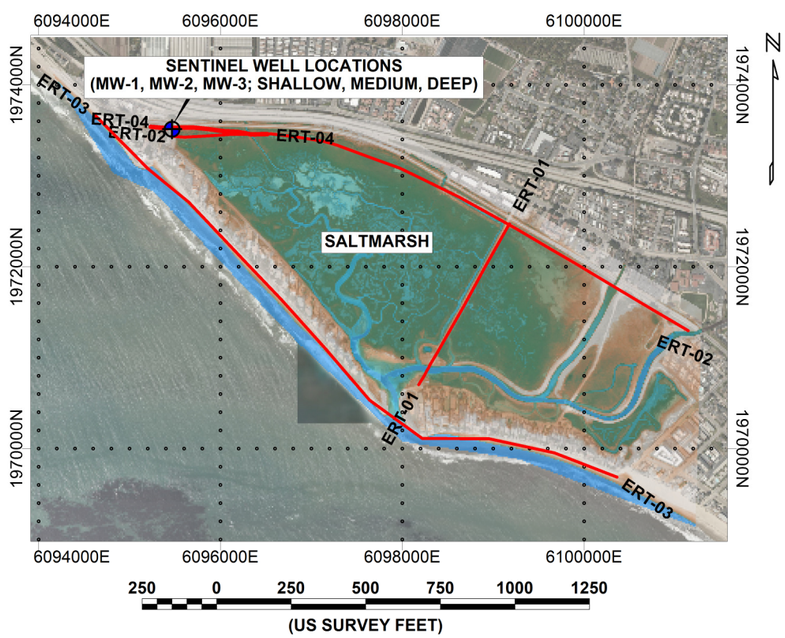
INSET
- DISPLAYED 2021 ERT PROFILE LOCATION
- OTHER 2021 ERT PROFILE LOCATIONS
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

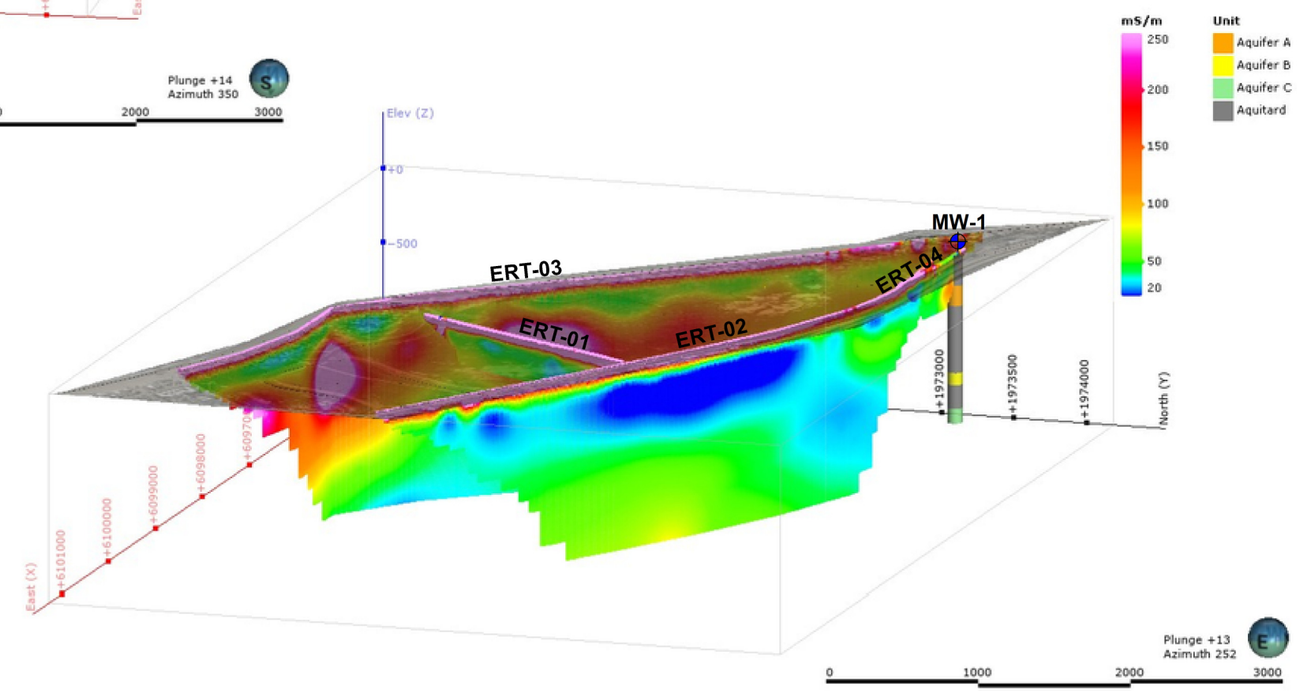
Notes:
1. This Figure should be read in conjunction with BGC's report titled "Electrical resistivity tomography (ERT) investigation to map saltwater intrusion in Carpinteria, California", and dated October, 2021.
2. The ERT surveys were collected as part of a saltwater intrusion study at Carpinteria, 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	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







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

File Path: BGC Engineering Inc\Geophysics - Files\2.0_Current BGC Projects\2252001 - Carpinteria\3.0_Data_Processing\4.0_OasisMaps\2252001-Pueblo-Carpinteria_ERT-3D-A.map

APPENDIX A
ERT DEPTH OF INVESTIGATION (DOI) ANALYSIS

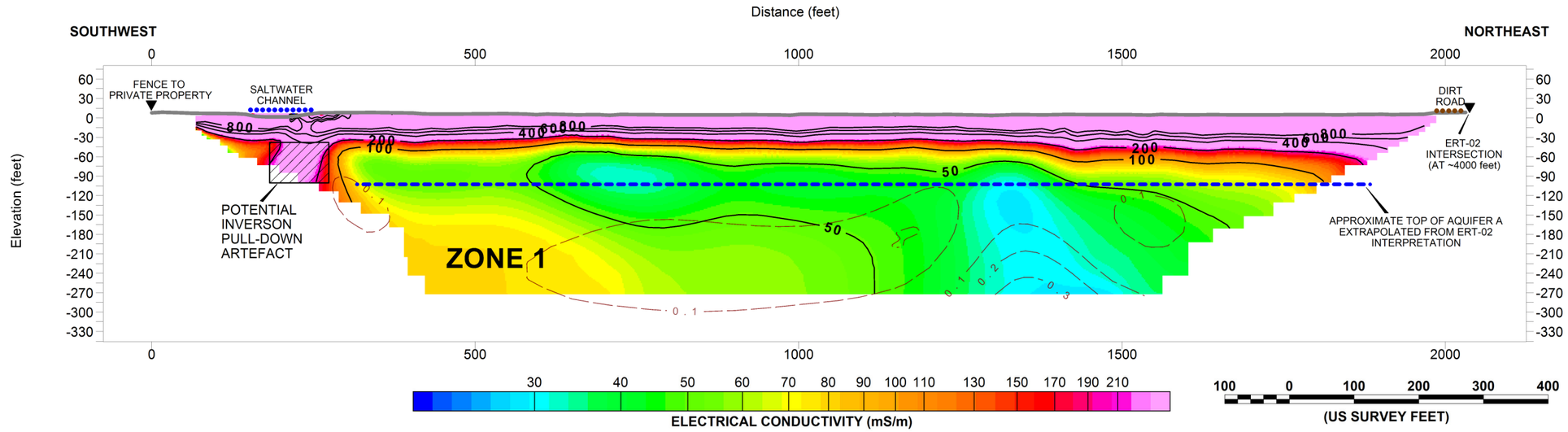
A.1 Depth of investigation (DOI) Analysis

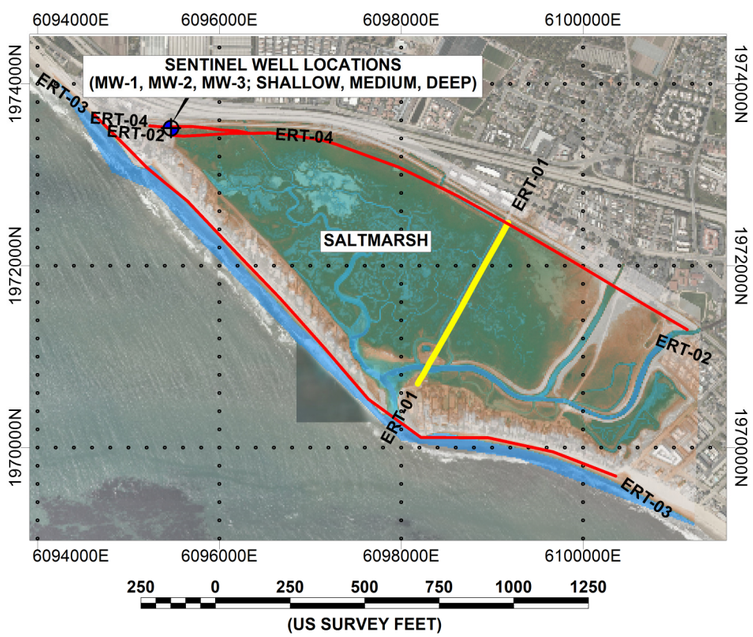
A depth of investigation (DOI) analysis was conducted on the combined array inversions (i.e., gradient + dipole-dipole) as outlined in Oldenburg and Li (1999) to identify zones within the recovered ERT model sections which may be less constrained by measured data, and therefore potentially less reliable.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

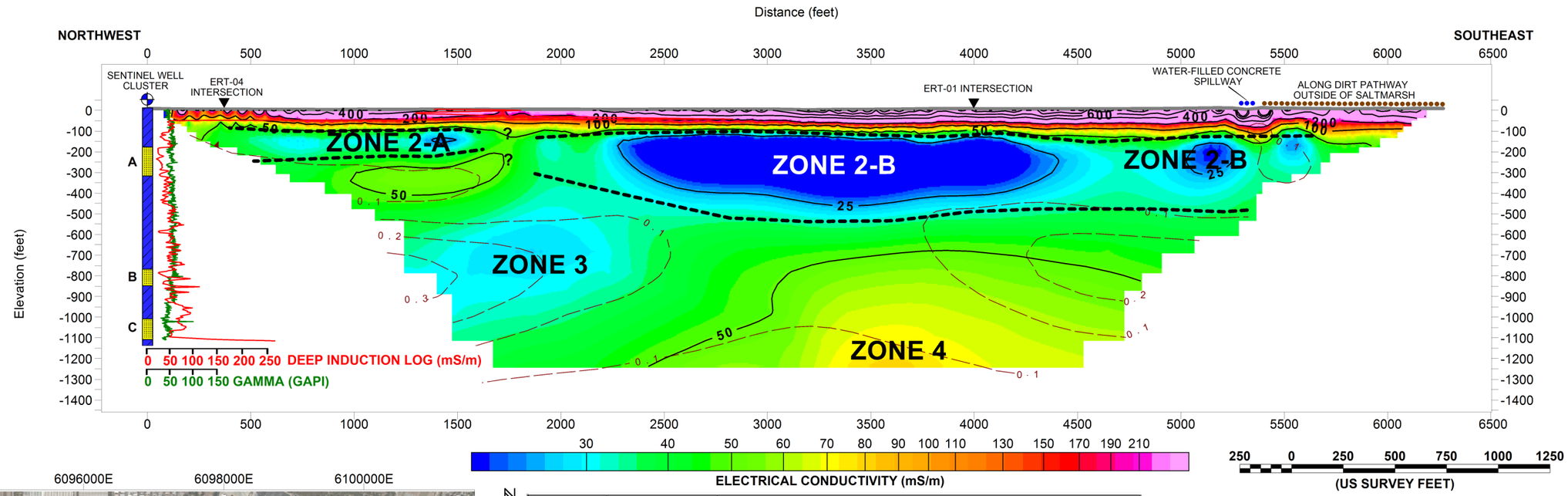
CROSS-SECTION
- ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
- DEPTH OF INVESTIGATION INDEX CONTOUR
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
- NOTABLE WATER CROSSING (> 15 m)
- NOTABLE OBSERVED SURFACE FEATURE

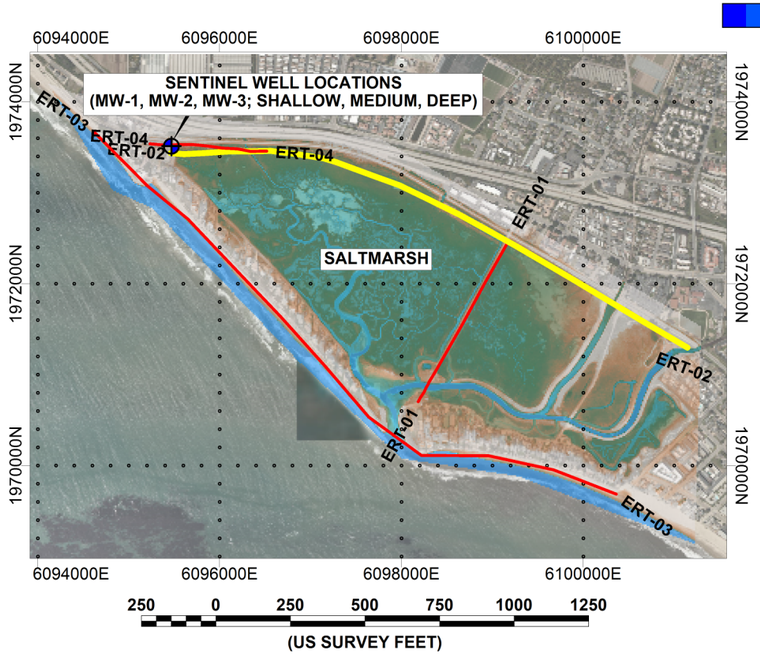
INSET
- DISPLAYED 2021 ERT PROFILE LOCATION
- OTHER 2021 ERT PROFILE LOCATIONS
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

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

File Path: BGC Engineering Inc\Geophysics - Files\2.0_Current BGC Projects\2252001 - Carpinteria\3.0_Data_Processing\4.0_OasisMaps\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:

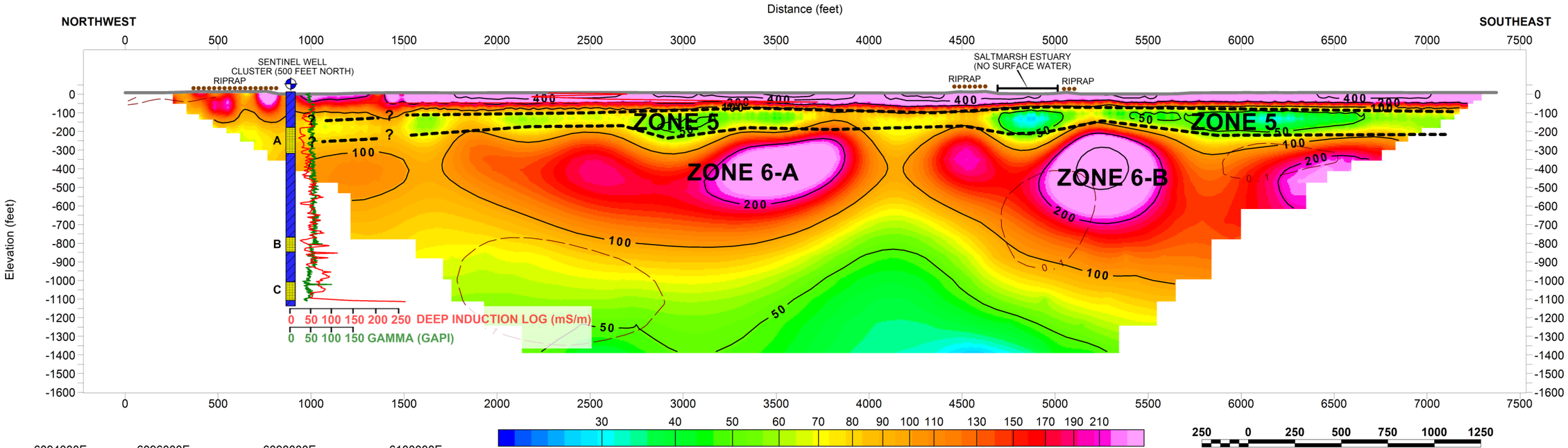
CROSS-SECTION
- ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
- DEPTH OF INVESTIGATION INDEX CONTOUR
- FEBRUARY 2021 DEEP CONDUCTIVITY LOG IN mS/m (PACIFIC SURVEYS)
- FEBRUARY 2021 GAMMA LOG IN GAPI (PACIFIC SURVEYS)
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
- INTERPRETED AQUIFER A BOUNDS
- NOTABLE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

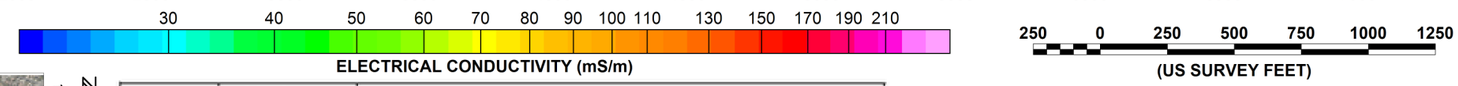
INSET
- DISPLAYED 2021 ERT PROFILE LOCATION
- OTHER 2021 ERT PROFILE LOCATIONS
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

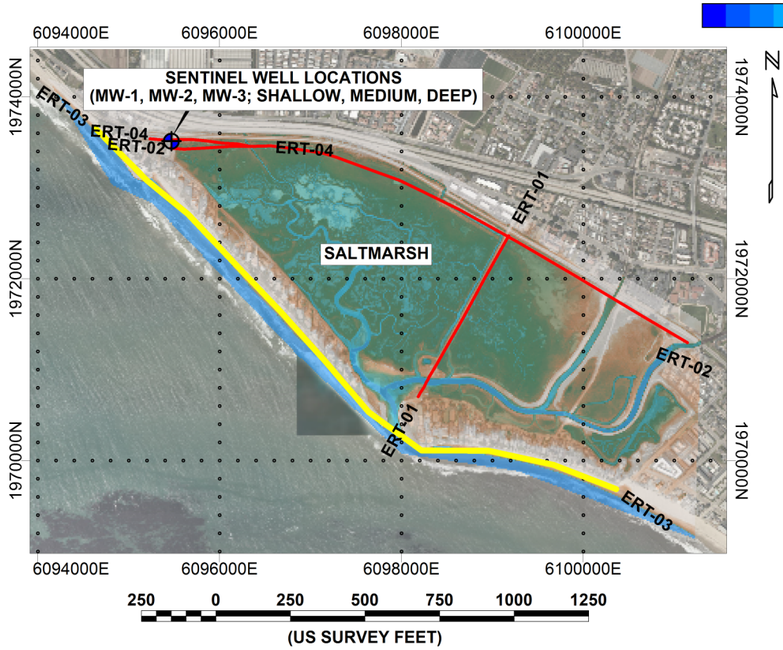
Notes:
1. This Figure should be read in conjunction with BGC's report titled "Electrical resistivity tomography (ERT) investigation to map saltwater intrusion in Carpinteria, California", and dated October, 2021.
2. The ERT surveys were collected as part of a saltwater intrusion study at Carpinteria, 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:	CLIENT:		
PDB	CARPINTERIA VALLEY WATER DISTRICT (CVWD)		
APPROVED BY:	SCALE:	PROJECT NO:	FIGURE NO:
LGW	AS SHOWN	2252001	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







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:

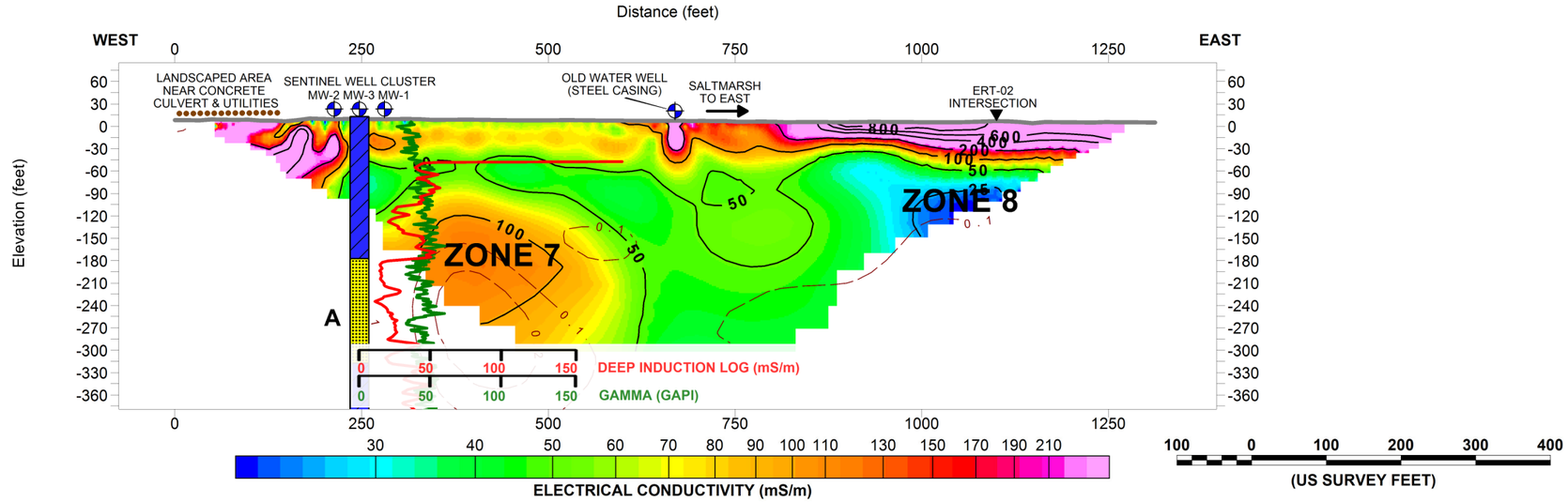
CROSS-SECTION
- ELECTRICAL CONDUCTIVITY CONTOUR (mS/m)
- DEPTH OF INVESTIGATION INDEX CONTOUR
- FEBRUARY 2021 DEEP CONDUCTIVITY LOG IN mS/m (PACIFIC SURVEYS)
- FEBRUARY 2021 GAMMA LOG IN GAPI (PACIFIC SURVEYS)
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)
- INTERPRETED AQUIFER A BOUNDS
- NOTABLE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

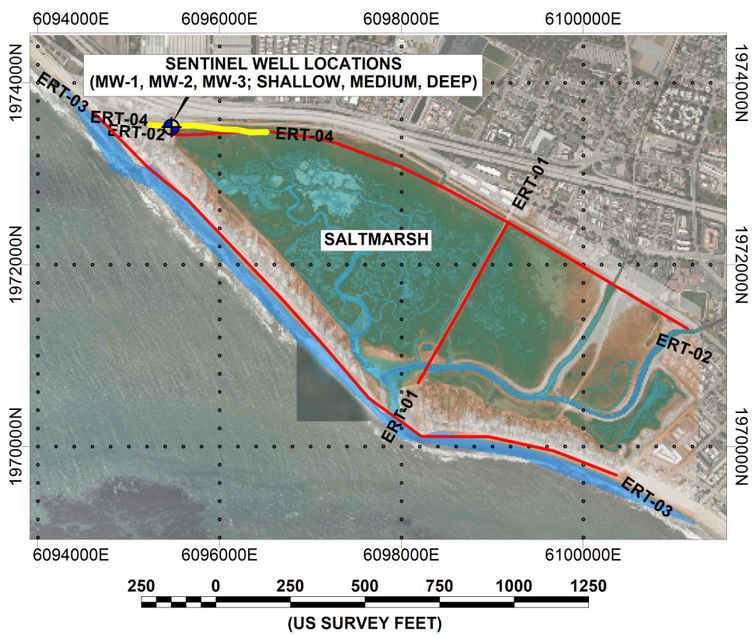
INSET
- DISPLAYED 2021 ERT PROFILE LOCATION
- OTHER 2021 ERT PROFILE LOCATIONS
- SENTINEL WELL LOCATION (PUEBLO WATER RESOURCES)

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

December 12, 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

1 INTRODUCTION AND BACKGROUND 1
1.1 Purpose and Scope 1
1.2 Project Area 1
1.3 Previous Investigations 4
2 NUMERICAL MODEL DEVELOPMENT 5
2.1 Model Code Selection 5
2.1.1 Selection Process/Rationale 5
2.1.2 Treatment of Groundwater Conditions (Confined / Unconfined) 5
2.2 Model Extent and Discretization 5
2.2.1 Lateral discretization and grid spacing 5
2.2.2 Vertical discretization 5
2.2.3 Time Frame, Stress Periods, and Timesteps 8
2.2.4 Lateral and Vertical Active Extent 8
2.3 Initial Heads 15
2.4 Boundary Conditions 17
2.4.1 Faults and Flow Barriers 17
2.4.2 Ocean Boundary Condition 19
2.5 Representation of Groundwater Budget 22
2.5.1 Mountain-front Recharge 22
2.5.2 Recharge Components 24
2.5.3 Groundwater Extraction 28
3 MODEL CALIBRATION AND HISTORICAL SIMULATION RESULTS 30
3.1 Comparison of Model Simulation to Water Budget Components Used in GSP 30
3.1.1 Mountain-front Recharge 30
3.1.2 Recharge Inputs 32
3.1.3 Groundwater Pumping 36
3.2 Calibration Dataset and Techniques 38
3.2.1 Target Variable 38
3.2.2 Adjusted Variables 38
3.2.3 Distribution of Hydraulic Properties 40
3.2.4 Prior Information Equations / Regularization 42
3.3 Calibration Results 44
3.3.1 Estimated Hydraulic Properties 44
3.3.2 Global Statistics / Plots 54
3.3.3 Calibration Hydrographs 59

3.3.4 Simulated Contours 68
3.4 Sensitivity Analyses, Mass Balance, and Convergence 75
3.4.1 Specific Yield Sensitivity Analysis 75
3.4.2 Ocean General Head Boundary Height Sensitivity Analysis 75
3.4.3 Ocean General Head Boundary Conductance Sensitivity Analysis 76
3.4.4 Mass Balance Error 76
3.4.5 Convergence 79
3.5 Model Output Used for GSP Water Budgets 79
3.5.1 Flows to/from Offshore 80
3.5.2 Flows to/from Montecito Groundwater Basin 84
4 PREDICTIVE SCENARIO DEVELOPMENT AND ANALYSIS 86
4.1 Predictive Baseline 86
4.1.1 Scenario Assumptions 86
4.1.2 Predictive Simulation Results 100
4.2 CAPP Project Scenario and Particle Tracking 128
4.2.1 Scenario Assumptions 128
4.2.2 Predictive Simulation Results 130

Tables

Table 1. Model Layering Description 6
Table 2. Percentage of Each Recharge Component Assigned to Each Zone 27
Table 3. Adjusted Parameter Bounds 40
Table 4. Aquifer Test Horizonal Hydraulic Conductivity Estimates and Calibrated Model Values 53
Table 5. Global Calibration Statistics 55
Table 6. Flows to and from Offshore by Water Budget Period and Water Year Type, Acre-feet per Year 81
Table 7. Flows to and from Montecito Basin by Water Budget Period and Water Year Type, Acre-feet per Year 84
Table 8. Projected Flows to and From Offshore by Water Year Type, Acre-feet per Year 120
Table 9. Projected Flows to and From Montecito Basin by Water Year Type, Acre-feet per Year 126
Table 10. CAPP_6 Projected Flows to and from Offshore by Water Year Type, Acre-feet per Year 131
Table 11. CAPP_6 Projected Flows to and from Montecito Basin by Water Year Type, Acre-feet per Year 137

Figures

Figure 1. Project Area 3
Figure 2. Schematic Cross Section Through Storage Units 1 and 2 7
Figure 3. Model Layer Bottom Elevations 10
Figure 4. 3D Visualization of Active Model Cells and Location of Cross Sections (2x Vertical Exaggeration) 11
Figure 5. Row 46 East-West Cross Section of Active Model Cells (2x Vertical Exaggeration) 12
Figure 6. Column 70 North-South Cross Section of Active Model Cells (2x Vertical Exaggeration) 13
Figure 7. Column 122 North-South Cross Section of Active Model Cells (2x Vertical Exaggeration) 14
Figure 8. Initial Heads 16
Figure 9. Horizontal Flow Barriers and Quasi-3D Confining Beds 18
Figure 10. Ocean and Mountain-front Recharge Boundary Condition 21
Figure 11. Mountain-front Recharge Injection Wells 23
Figure 12. Model Recharge Zones 26
Figure 13. MNW2 Production Well Locations 29
Figure 14. Simulated Monthly Mountain-front Recharge 31
Figure 15. Simulated Recharge Components for Recharge Zones 1 Through 4 33
Figure 16. Simulated Recharge Components for Recharge Zones 5 Through 8 34
Figure 17. Simulated Recharge Components for Recharge Zones 9, 11, and 12 35
Figure 18. Simulated Monthly Groundwater Pumping 37
Figure 19. Pilot Point and Observation Well (PEST Well) Locations 41
Figure 20. Pilot Point and Observation Well (PEST Well) Locations 43
Figure 21. Calibrated Model Horizonal Hydraulic Conductivity Values 45
Figure 22. Calibrated Model Vertical Hydraulic Conductivity Values 47
Figure 23. Calibrated Model Conductivity Anisotropy Values 48
Figure 24. Calibrated Model Specific Storage Values 50
Figure 25. Calibrated Model Specific Yield Values 52
Figure 26. Observed and Simulated Values Against 1:1 Line 56
Figure 27. Mean Residual By Layer 57
Figure 28. Root Mean Squared Error by Layer 58
Figure 29. Calibration Hydrograph for SU-1 Private Well 27Q6, Feet NAVD88 60
Figure 30. Calibration Hydrograph for SU-1 Private Well 28J1, Feet NAVD88 61
Figure 31. Calibration Hydrograph for SU-1 Lyons Municipal Well (28F7), Feet NAVD88 62
Figure 32. Calibration Hydrograph for SU-1 Monitoring Well Sentinel C (30D6), Feet NAVD88 63
Figure 33. Calibration Hydrograph for SU-1 Monitoring Well Sentinel B (30D7), Feet NAVD88 64
Figure 34. Calibration Hydrograph for SU-1 Monitoring Well Sentinel A (30D8), Feet NAVD88 65
Figure 35. Calibration Hydrograph for SU-2 Private Well 35E1, Feet NAVD88 66
Figure 36. Calibration Hydrograph for SU-1 Private Well 23P1, Feet NAVD88 67

Figure 37. Simulated Groundwater Elevation Contours, May 1990 69
Figure 38. Simulated Groundwater Elevation Contours, August 1990 70
Figure 39. Simulated Groundwater Elevation Contours, May 2008 71
Figure 40. Simulated Groundwater Elevation Contours, August 2008 72
Figure 41. Simulated Groundwater Elevation Contours, May 2020 73
Figure 42. Simulated Groundwater Elevation Contours, August 2020 74
Figure 43. Model Mass Balance Error per Stress Period 77
Figure 44. Model Cumulative Balance Error 78
Figure 45. Carpinteria Basin Flow to and from Offshore 82
Figure 46. Carpinteria Basin Net Flow from Offshore by Layer 83
Figure 47. Carpinteria Basin Flow to and from Montecito Basin 85
Figure 48. Historical Annual Rainfall at the Carpinteria Fire Station WY 1949-2020 [Pueblo, 2022] 88
Figure 49. Historical and Projected Mountain-Front Recharge 90
Figure 50. Historical and Projected Zone 1 Total Recharge 92
Figure 51. Historical and Projected Pumping 94
Figure 52. Projected MNW2 Well Locations 95
Figure 53. Projected Sea Level Rise 97
Figure 54. Ocean General Head Boundary 10/1/2030 98
Figure 55. Ocean General Head Boundary 10/1/2070 99
Figure 56. Historical and Projected Hydrograph for SU-1 Private Well 27Q6, Feet NAVD88 102
Figure 57. Historical and Projected Hydrograph for SU-1 Private Well 28J1, Feet NAVD88 103
Figure 58. Historical and Projected Hydrograph for SU-1 Lyons Municipal Well (28F7), Feet NAVD88 104
Figure 59. Historical and Projected Hydrograph for SU-1 Monitoring Well Sentinel C (30D8), Feet NAVD88 105
Figure 60. Historical and Projected Hydrograph for SU-1 Monitoring Well Sentinel B (30D7), Feet NAVD88 106
Figure 61. Historical and Projected Hydrograph for SU-1 Monitoring Well Sentinel A (30D8), Feet NAVD88 107
Figure 62. Historical and Projected Hydrograph for SU-2 Private Well 35E1, Feet NAVD88 108
Figure 63. Simulated Groundwater Elevation Contours, May 2033 110
Figure 64. Simulated Groundwater Elevation Contours, August 2033 111
Figure 65. Simulated Groundwater Elevation Contours, May 2043 112
Figure 66. Simulated Groundwater Elevation Contours, August 2043 113
Figure 67. Simulated Groundwater Elevation Contours, May 2063 114
Figure 68. Simulated Groundwater Elevation Contours, August 2063 115
Figure 69. Simulated Groundwater Elevation Contours, May 2073 116
Figure 70. Simulated Groundwater Elevation Contours, August 2073 117
Figure 71. Carpinteria Basin Projected Flow to and from Offshore 121
Figure 72. Carpinteria Basin Projected Net Flow from Offshore by Layer 122

Figure 73. Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 2 123
Figure 74. Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 4 124
Figure 75. Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 6 125
Figure 76. Carpinteria Basin Projected Flow to and from Montecito Basin 127
Figure 77. Municipal Pumping and Indirect Potable Reuse Recharge in CAPP_6 Scenario and Predictive Baseline 129
Figure 78. CAPP_6 Carpinteria Basin Projected Flow to and from Offshore 132
Figure 79. CAPP_6 Carpinteria Basin Projected Net Flow from Offshore by Layer 133
Figure 80. CAPP_6 Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 2 134
Figure 81. CAPP_6 Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 4 135
Figure 82. CAPP_6 Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 6 136
Figure 83. Carpinteria Basin Projected Flow to and from Montecito Basin 138
Figure 84. Particle Tracking Results, Layer 2 140
Figure 85. Particle Tracking Results, Layer 4 141
Figure 86. Particle Tracking Results, Layer 6 142

Appendices

Appendix A. Calibration Hydrographs
Appendix B. Table of Observation Well Screenings
Appendix C. Table of Production Well Screenings
Appendix D. Projected Hydrographs

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).

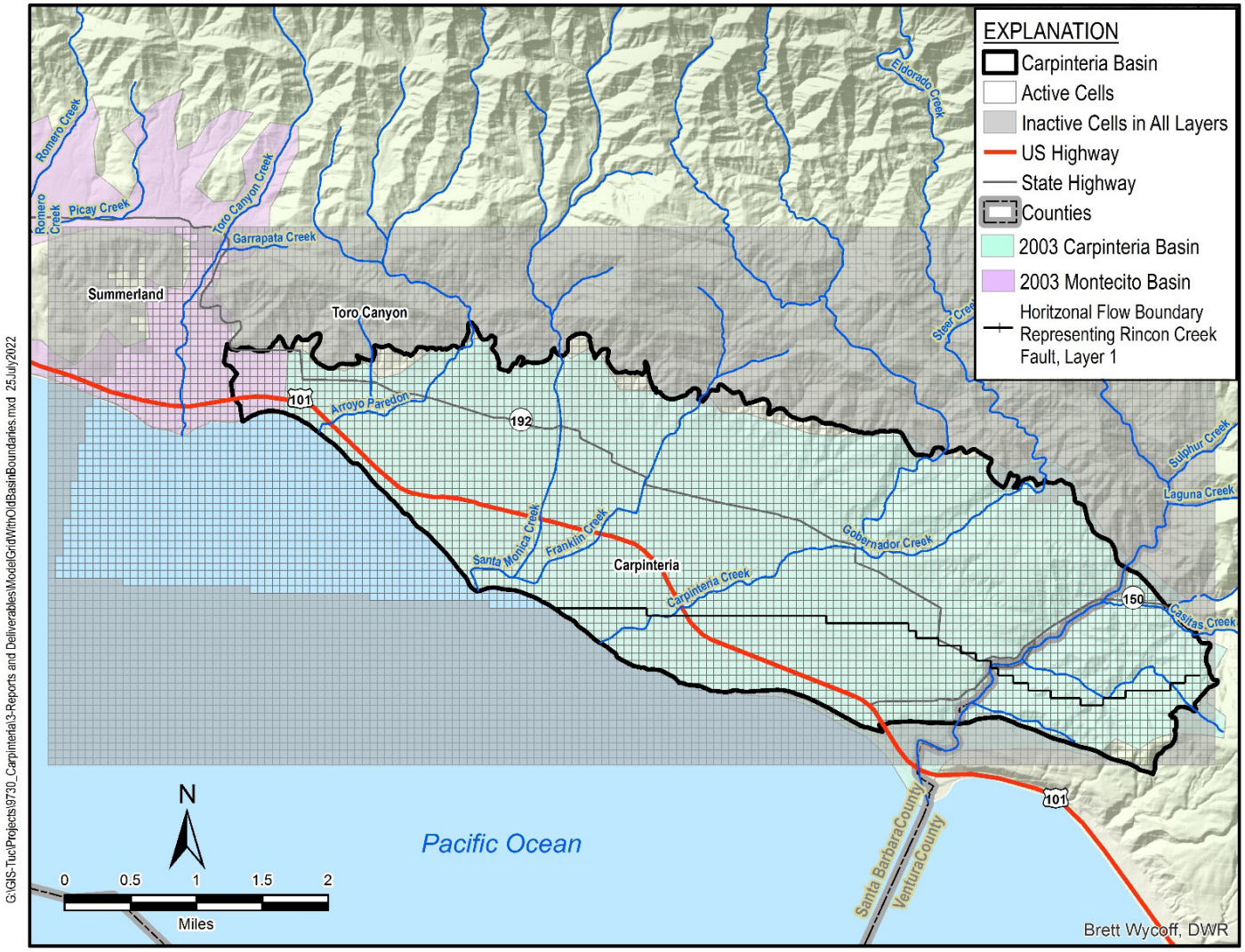


Figure 1. Project Area

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

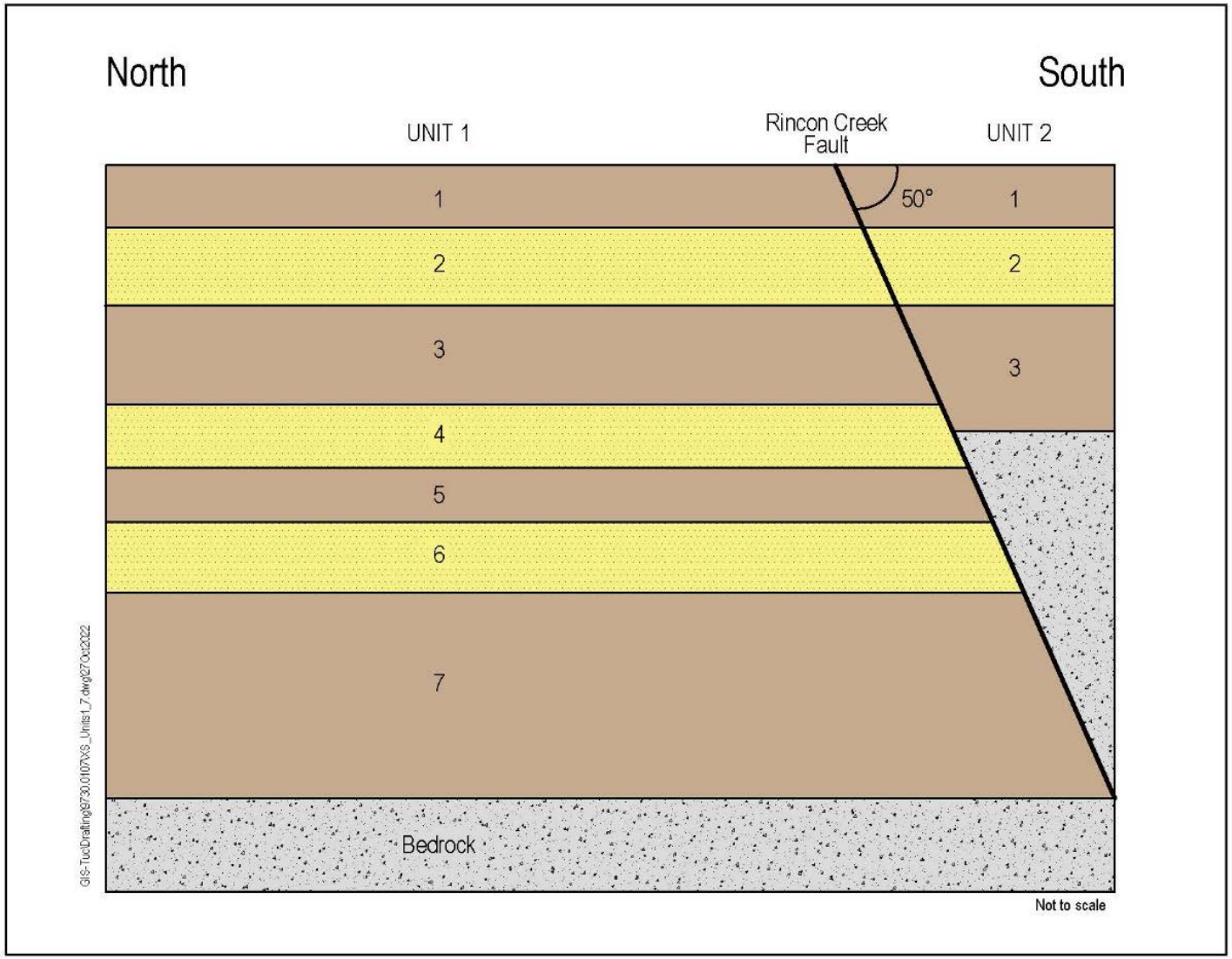


Figure 2. Schematic Cross Section Through Storage Units 1 and 2

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

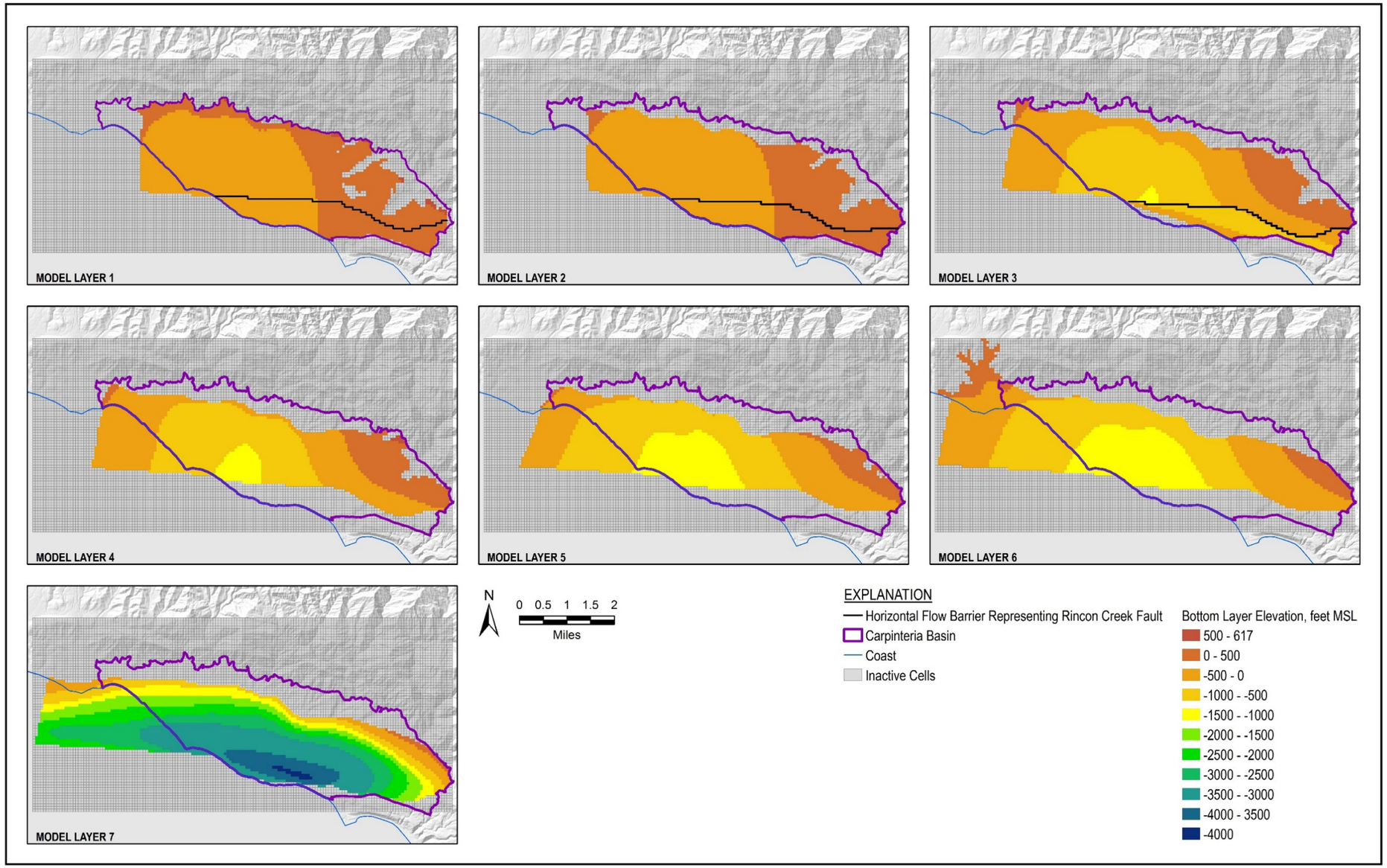
areas of the Basin expanded from the 2012 model. A schematic diagram illustrating the model layering in each storage unit is presented on Figure 2. Within SU-1, layers 2, 4, and 6 represent high producing zones.

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.

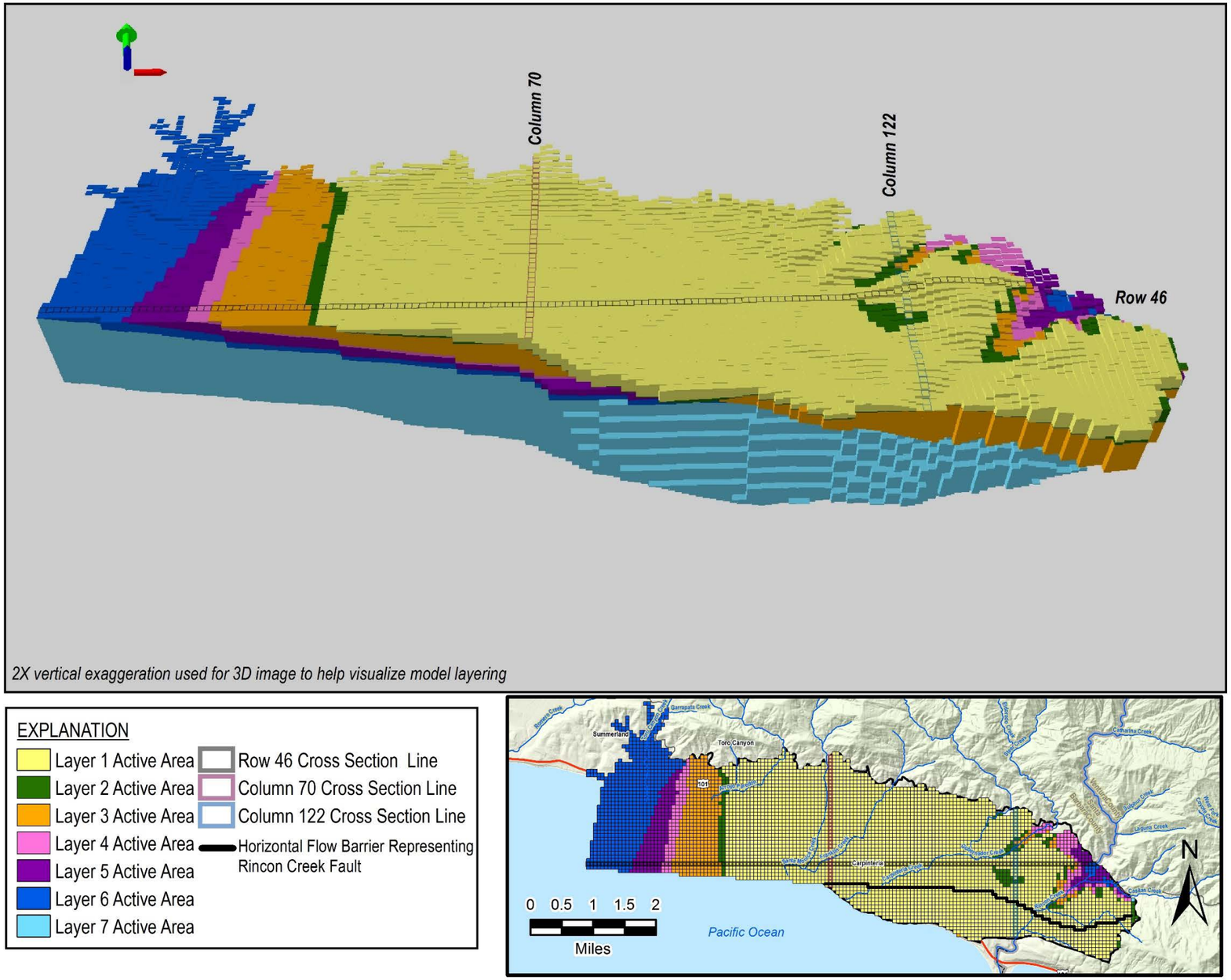
Figure 6 presents a north-south cross section through model grid column 70; this cross section runs through the central-western portion of the Basin through SU-2. Here the layering is simple "layer cake" stratigraphy, reflecting the alluvial basin-fill nature of Basin stratigraphy in SU-1.

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.



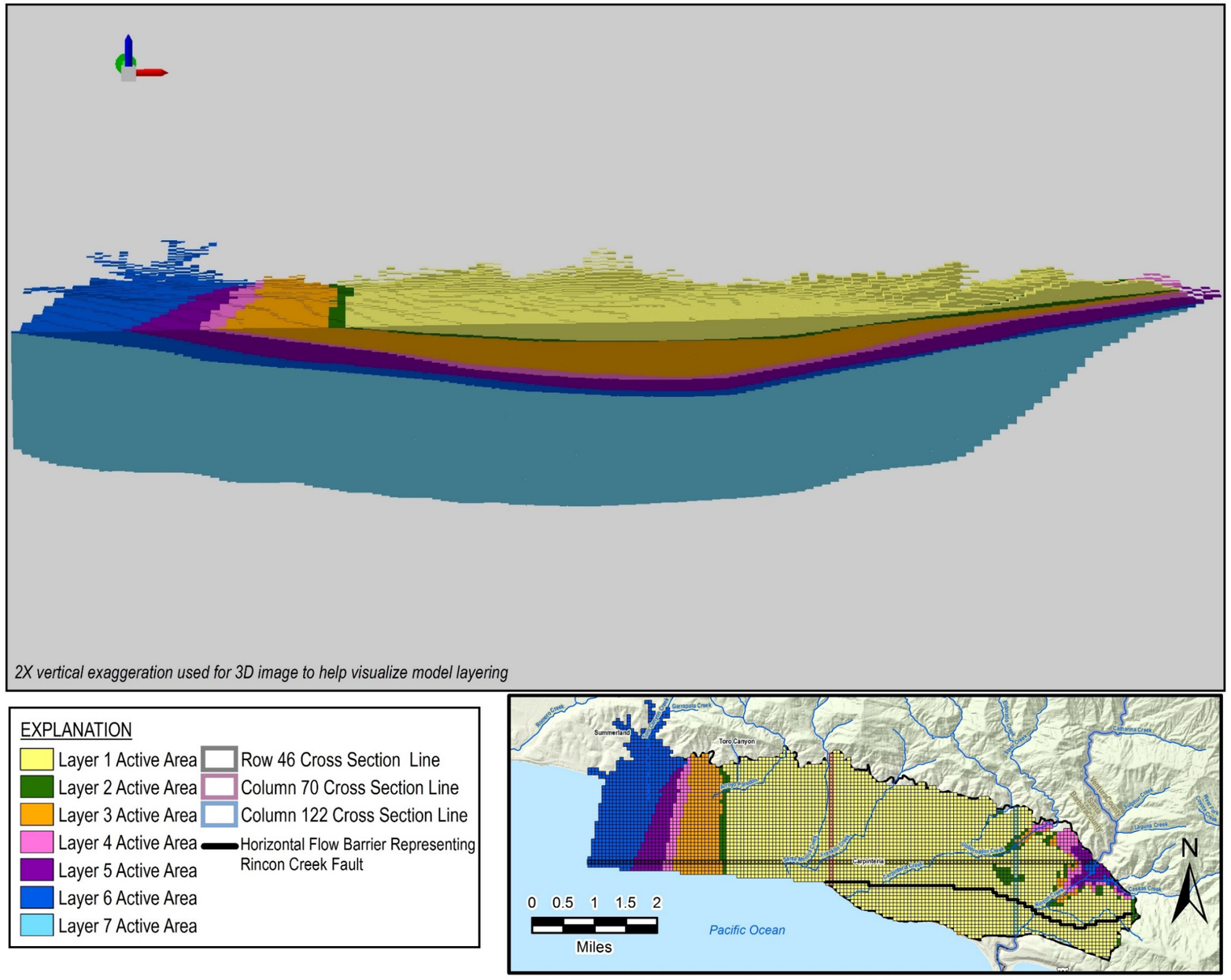
G:\GIS-Tuc\Projects\9730_Carpinteria\3-Reports and Deliverables\Calibration Memo Figures\F2_BotElev.mxd, 25July2022

Figure 3. Model Layer Bottom Elevations



G:\GIS-Tuc\Projects\9730_Carpinteria\3-Reports and Deliverables\Calibration Memo Figures\ArcScene\ArcSceneTopView.mxd 24June2022

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



G:\GIS-Tuc\Projects\9730_Carpinteria\3-Reports and Deliverables\Calibration Memo Figures\ArcScene\CrossSection_Row46.mxd 24June2022

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

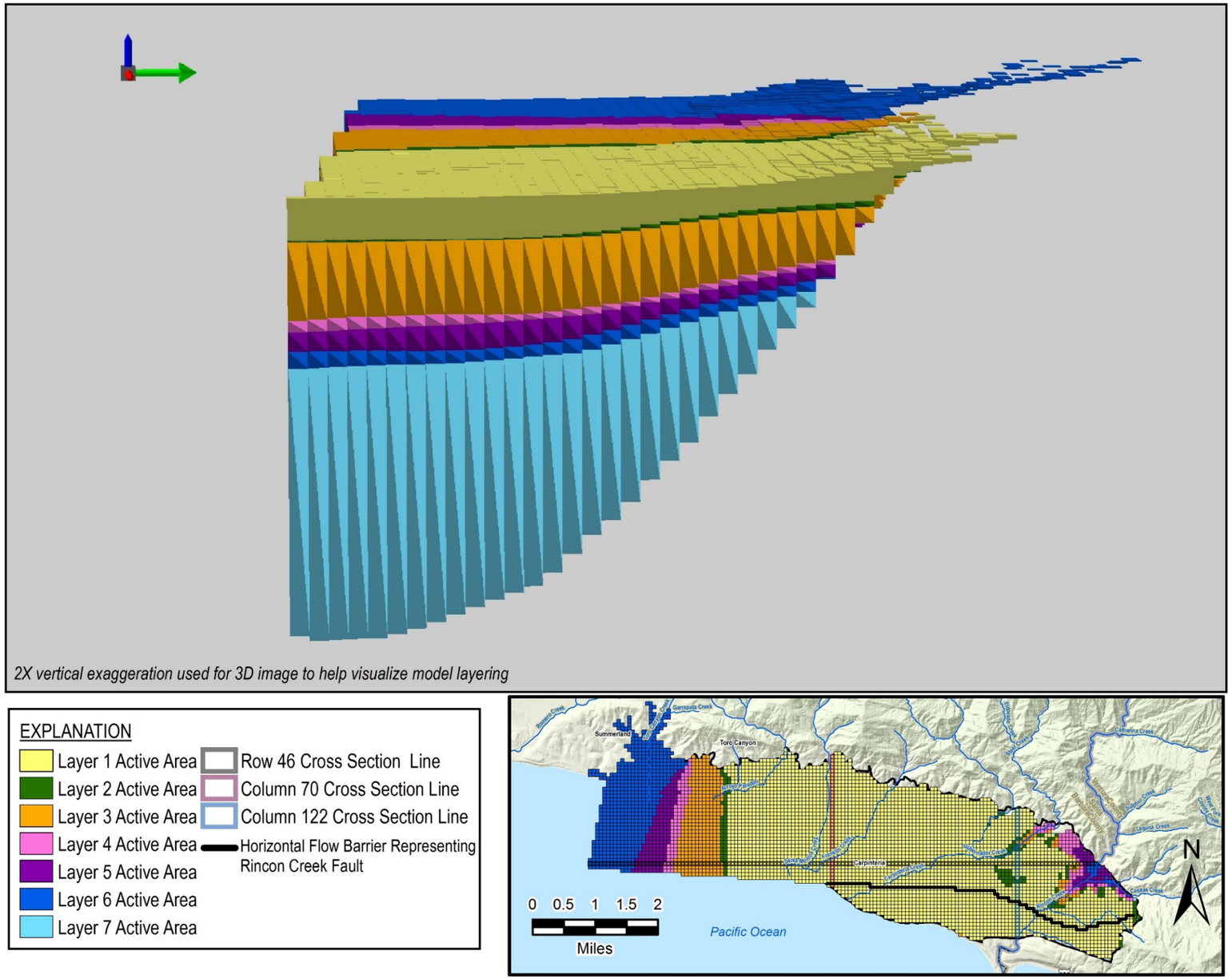
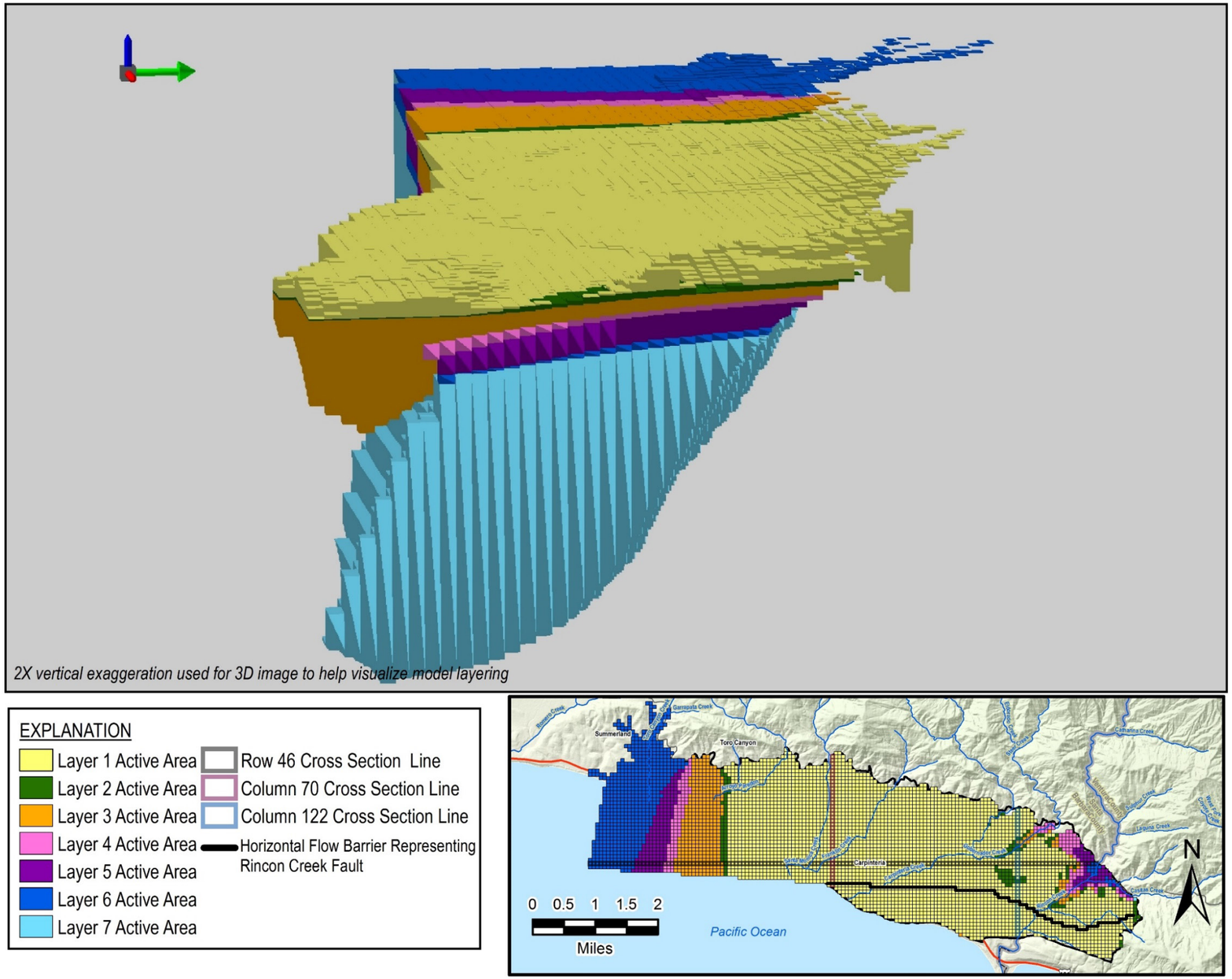


Figure 6. Column 70 North-South Cross Section of Active Model Cells (2x Vertical Exaggeration)

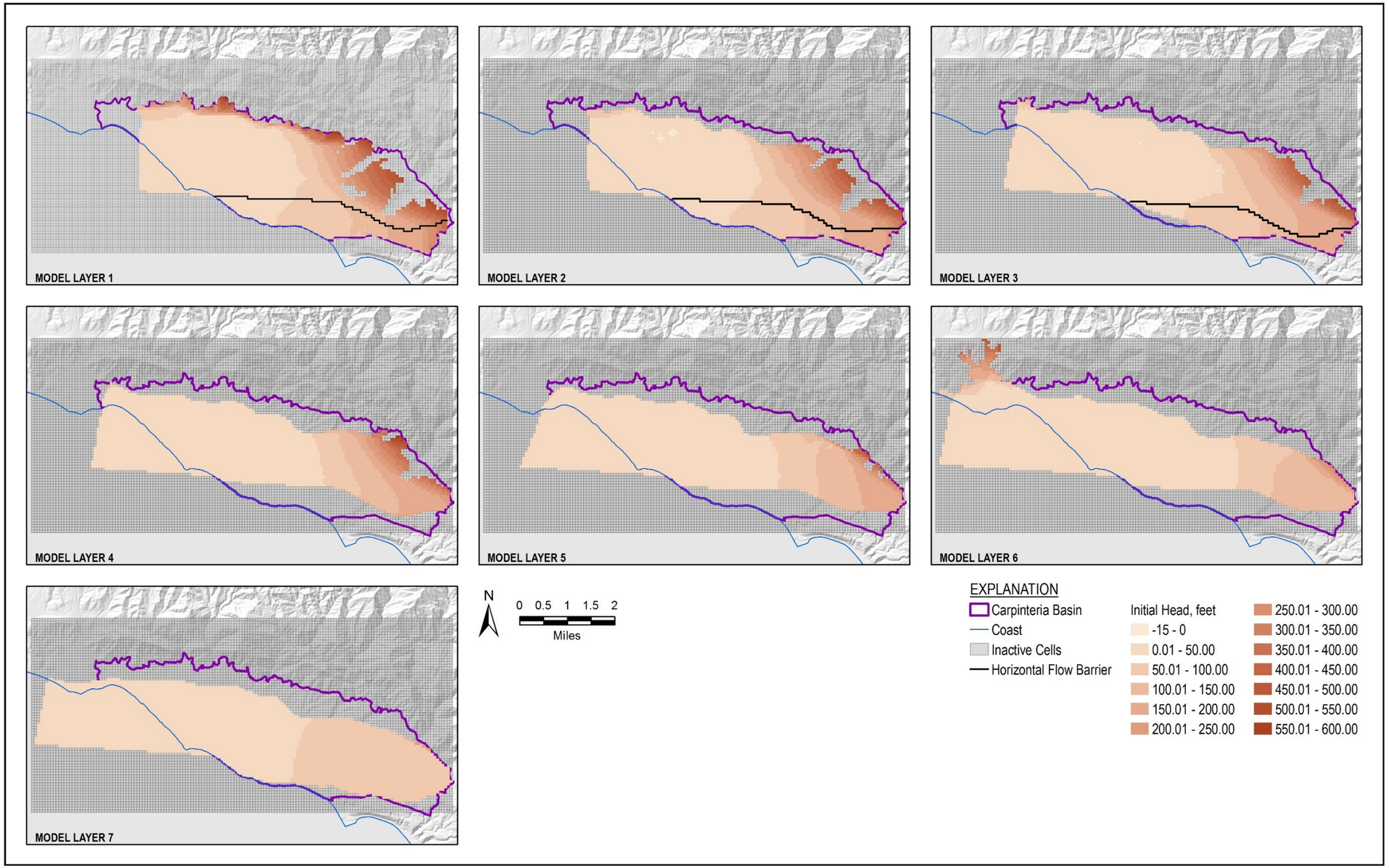


G:\GIS-Tuc\Projects\9730_Carpinteria\3-Reports and Deliverables\Calibration Memo Figures\ArcScene\CrossSection_Col122.mxd 24June2022

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.



G:\GIS-Tuc\Projects\9730_Carpinteria\3-Reports and Deliverables\Model_Result_Figures\Initial_Heads_GSPModel2_IHF.mxd, 13sept2022

Figure 8. Initial Heads

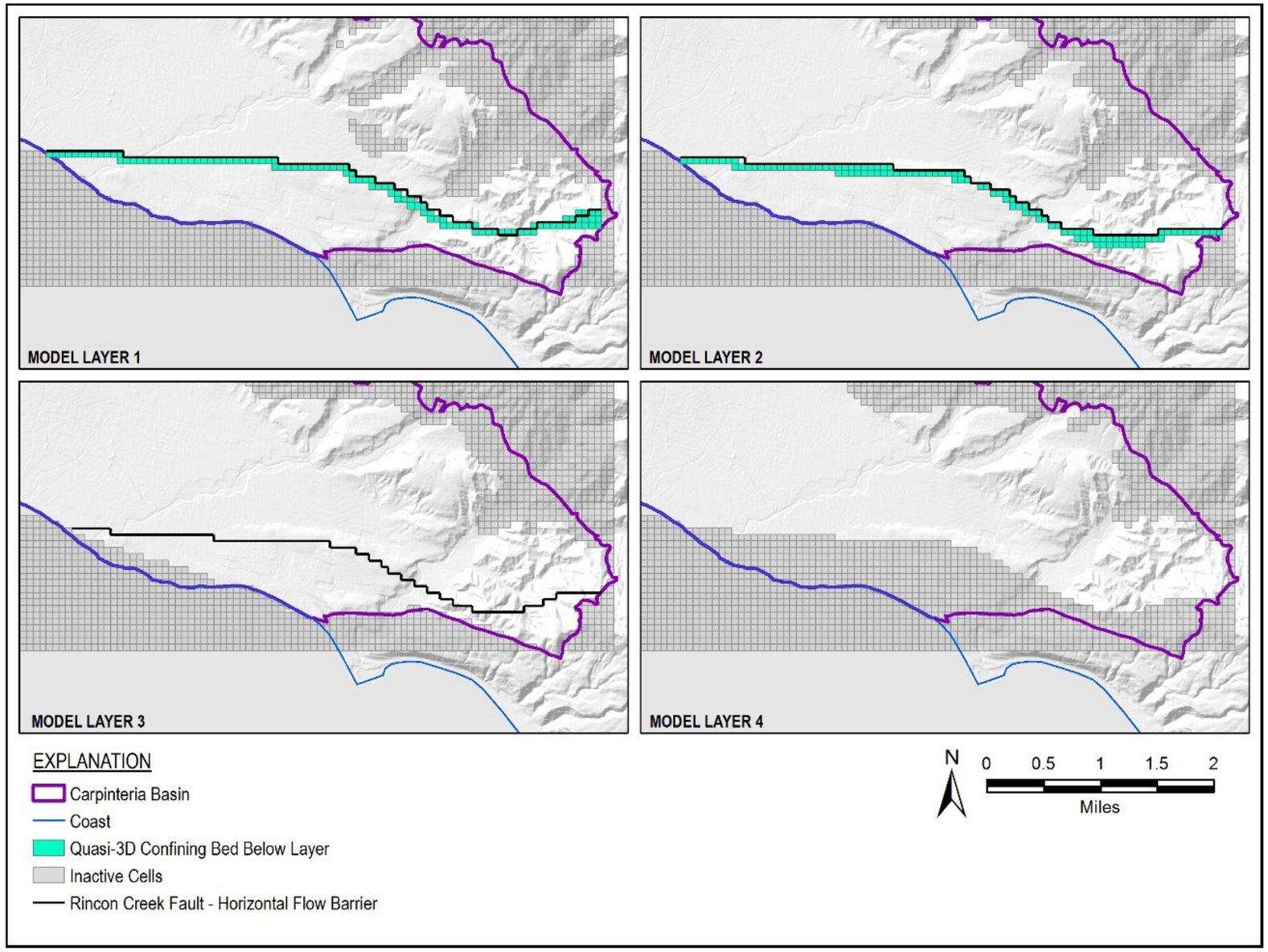
2.4 Boundary Conditions

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.



Document Path: G:\GIS-Tuc\Projects\9730_Carpinteria\3-Reports and Deliverables\Calibration Memo Figures\F7_HFB_ConfiningBed.mxd, 26July2022

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:

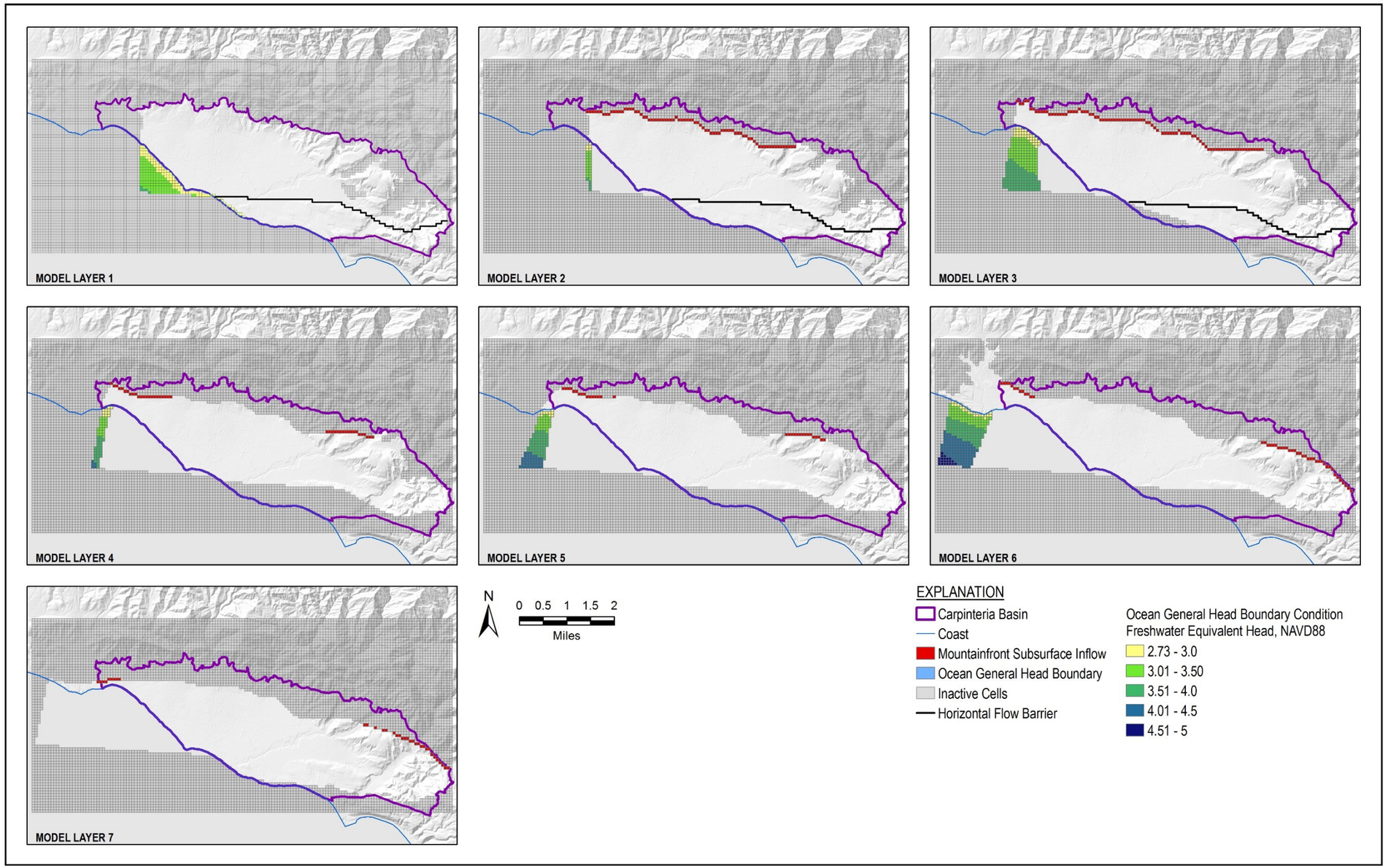
H_{Fw}= Freshwater equivalent head
ρ_{sw} = Density of seawater
ρ_{fw} = Density of freshwater
H_{Sw}= Measured saltwater head (ocean top)
Z = Top of model cell where general head boundary condition exists

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.



G:\GIS-Tuc\Projects\9730_Carpinteria\3-Reports and Deliverables\Calibration Memo Figures\F6_BoundaryConditions_GHBHeight.mxd, 03Feb2023

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.

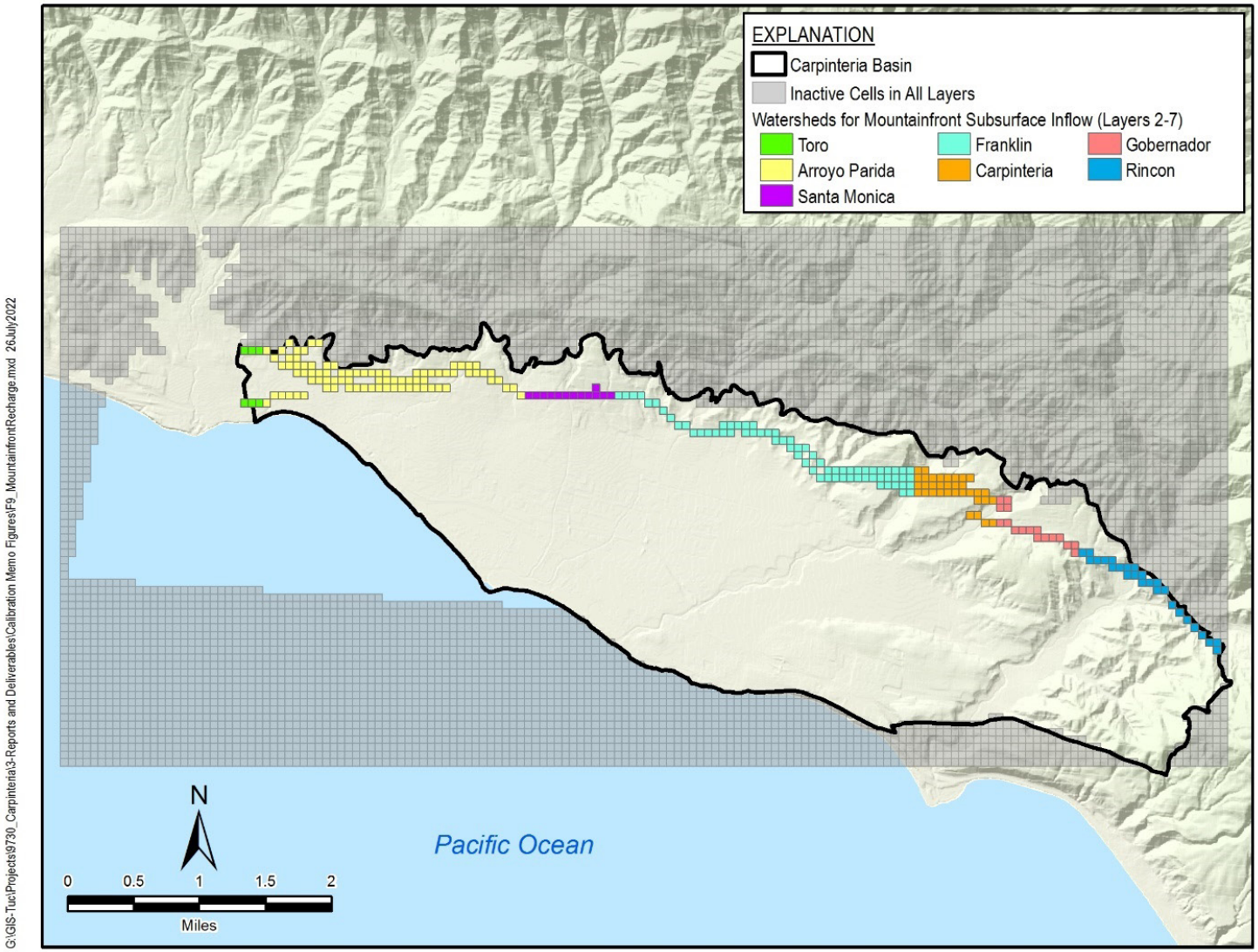


Figure 11. Mountain-front Recharge Injection Wells

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.

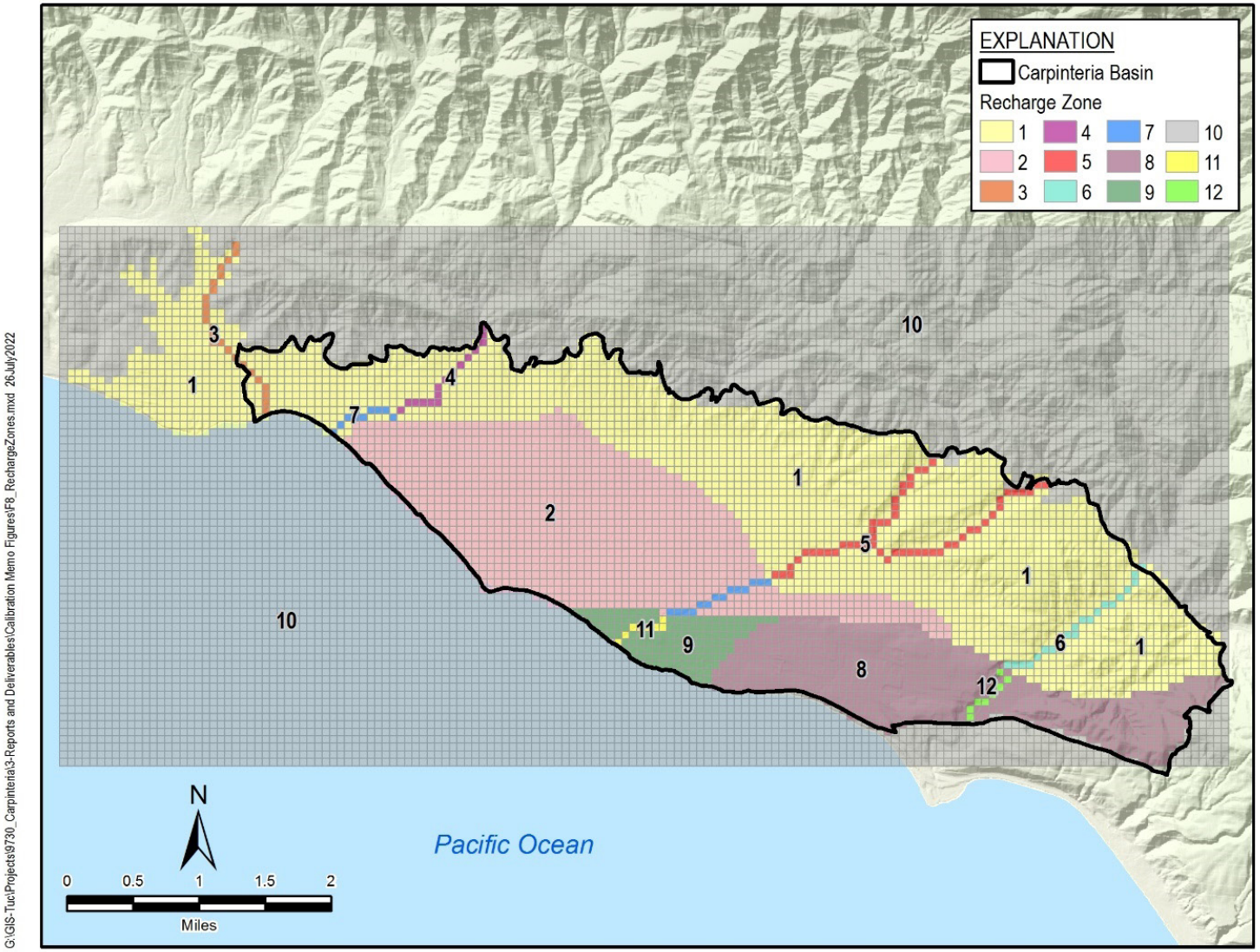


Figure 12. Model Recharge Zones

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.

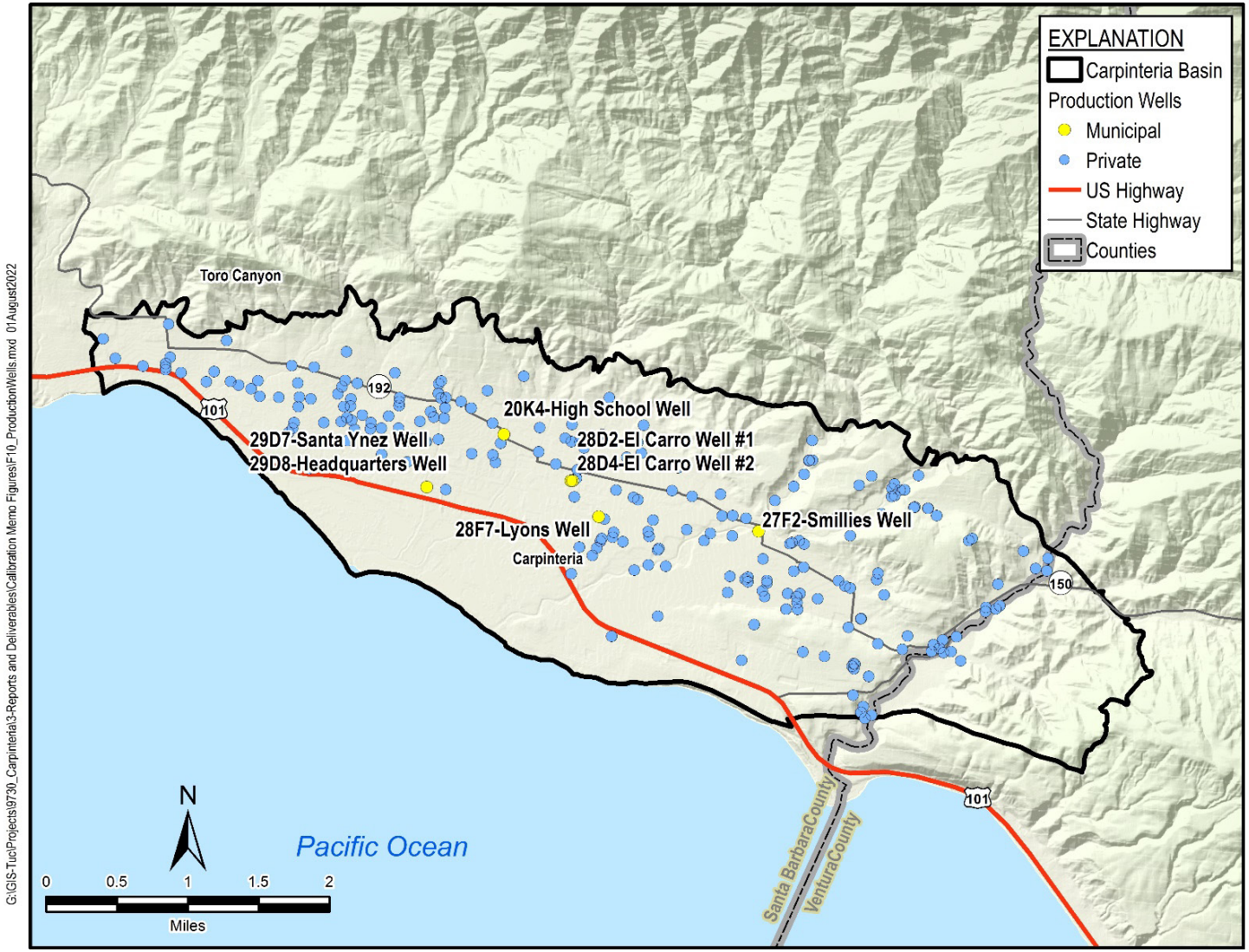


Figure 13. MNW2 Production Well Locations

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.

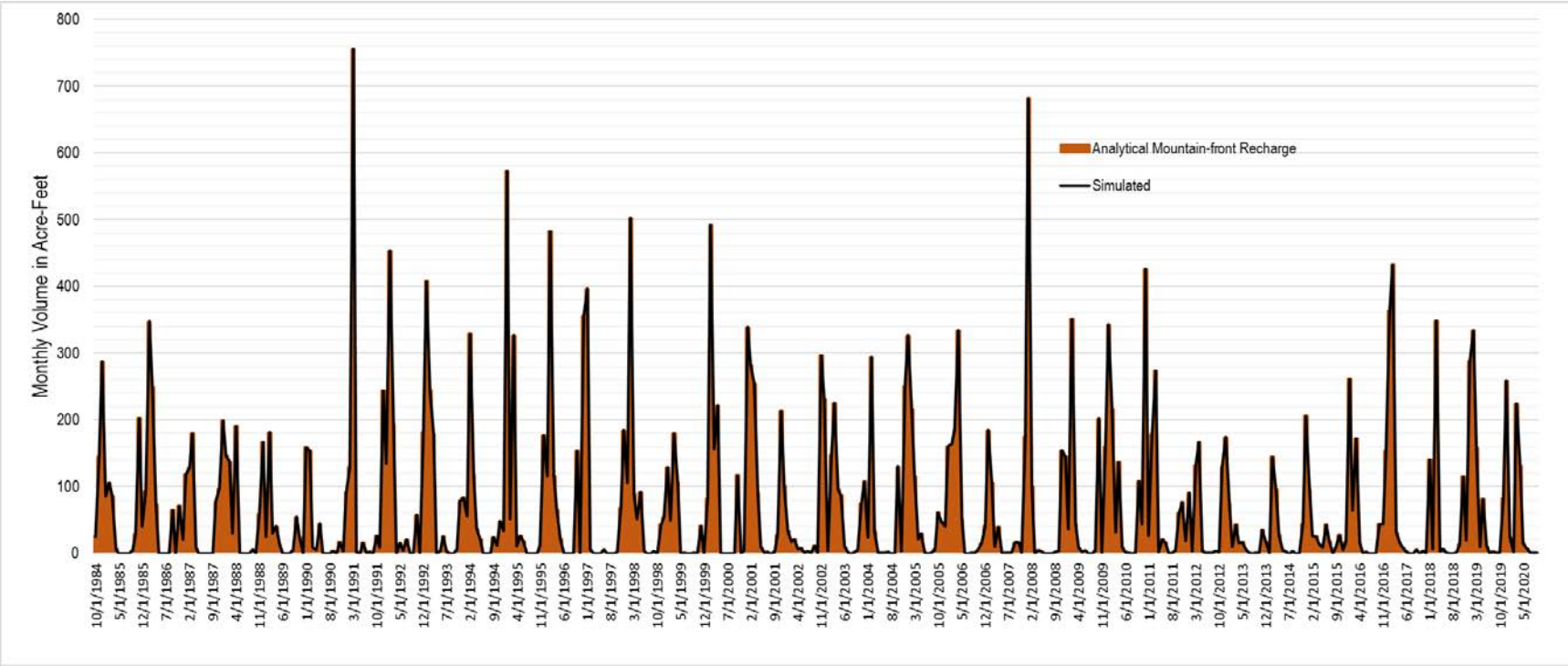


Figure 14. Simulated Monthly Mountain-front Recharge

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.

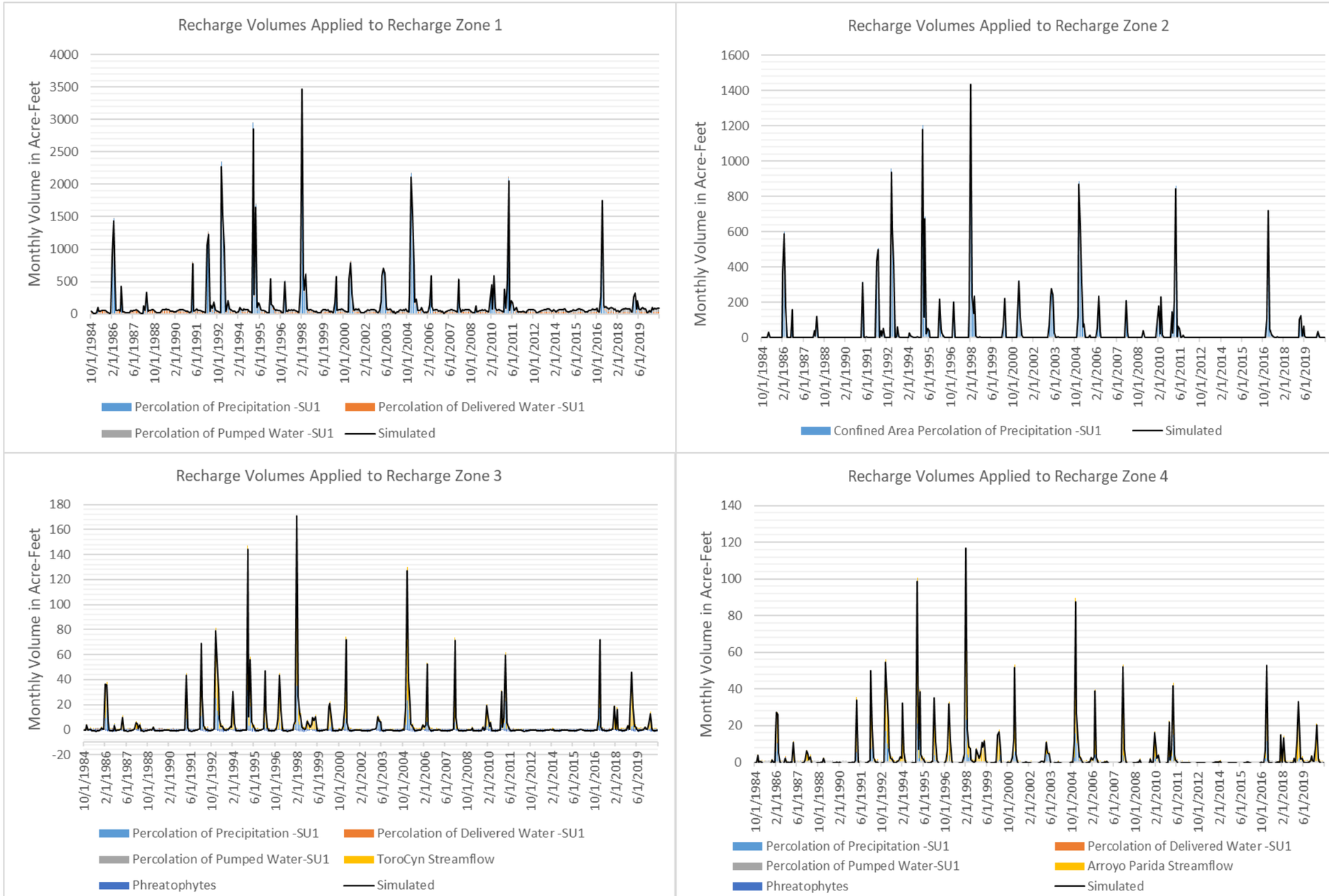


Figure 15. Simulated Recharge Components for Recharge Zones 1 Through 4

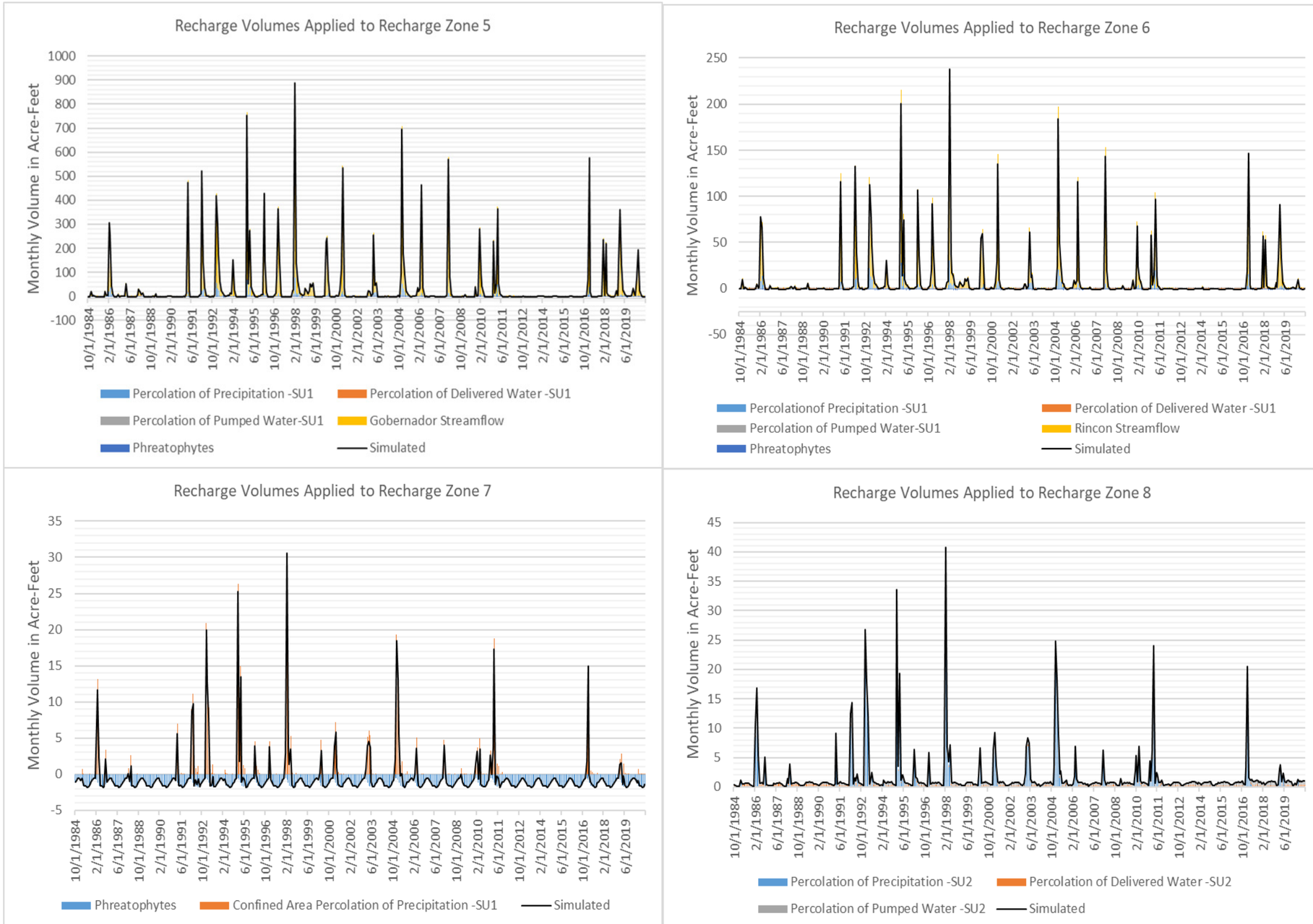


Figure 16. Simulated Recharge Components for Recharge Zones 5 Through 8

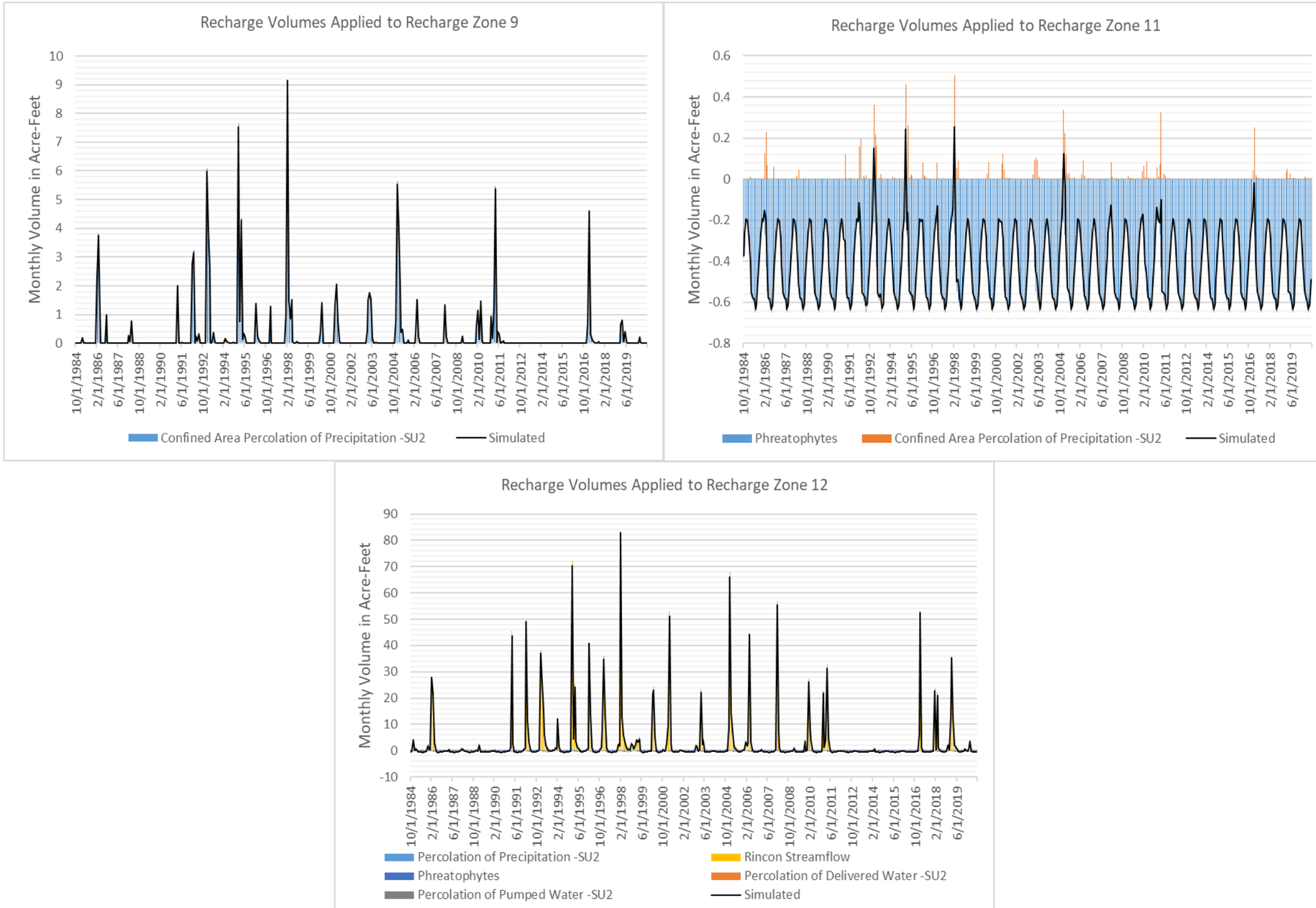


Figure 17. Simulated Recharge Components for Recharge Zones 9, 11, and 12

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.

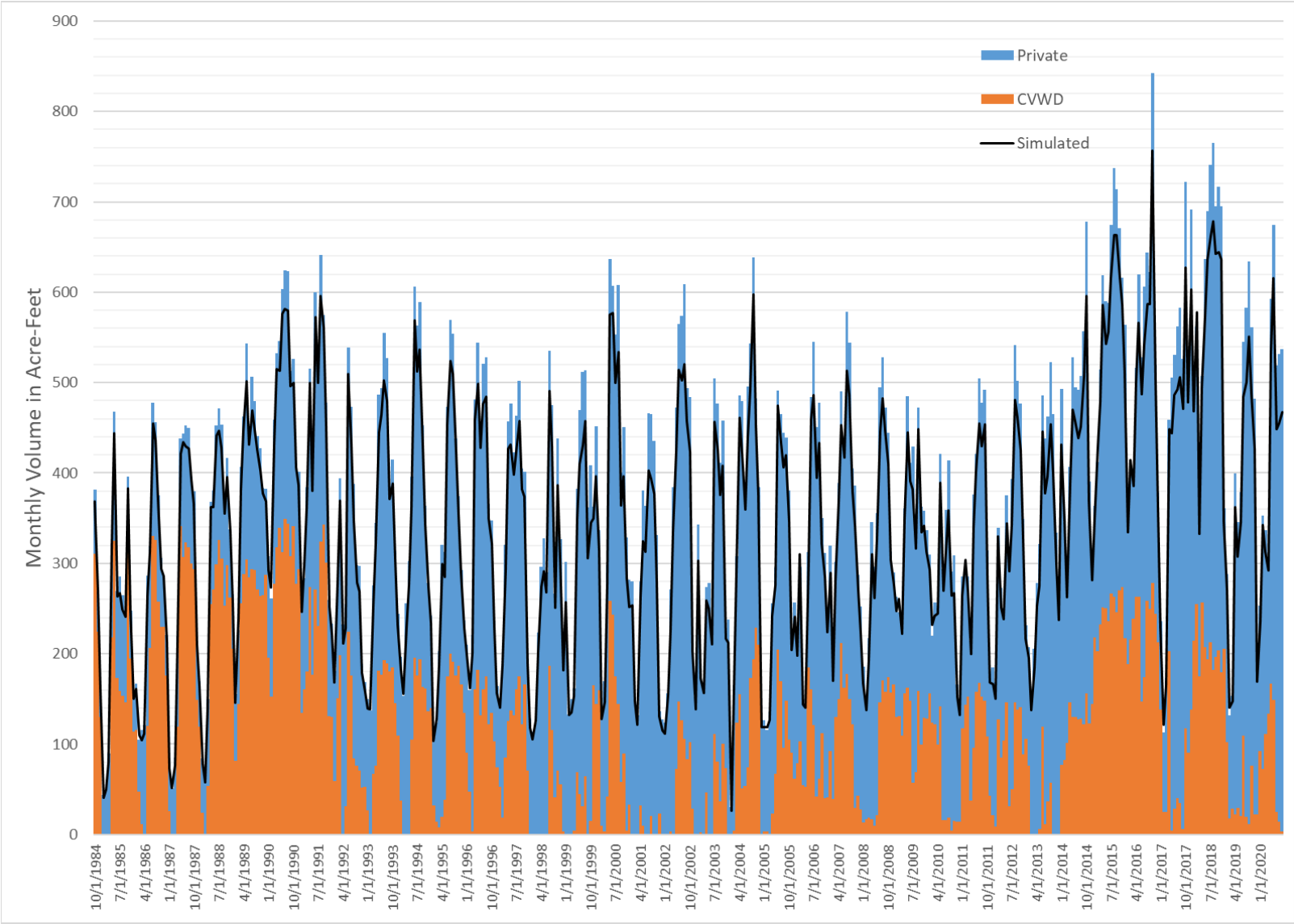


Figure 18. Simulated Monthly Groundwater Pumping

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)
- Rincon Creek Fault horizontal flow barrier (HFB) hydraulic conductivity
- Rincon Creek Fault quasi-3D confining bed hydraulic conductivity

As in the 2012 annual model calibration (HydroMetrics WRI, 2012), Kx, Kz, and Ss were variables adjusted at pilot points. Rather than directly manipulating Kz, anisotropy (Kx/Kz) was used in order to maintain appropriate relationships between Kx and Kz.

Rincon Creek Fault conductivities were adjusted with uniform values for each layer, which was also the case for the 2012 annual model calibration. The conductivities of the horizontal flow barriers in layers 2 and 3 were kept equal to conductivities of the overlying quasi-3D confining layers.

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 at pilot points helped the model better reflect the unconfined conditions at these locations and 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
Horizontal Hydraulic Conductivity	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
Rincon Creek Fault Horizontal Flow Barrier Hydraulic Conductivity	Inherited from 2012 annual model	0.000001 (feet/day)	1,000 (feet/day)
Rincon Creek Fault Quasi-3D Confining Bed Hydraulic Conductivity	Inherited from 2012 annual model	0.000001 (feet/day)	1,000 (feet/day)

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.

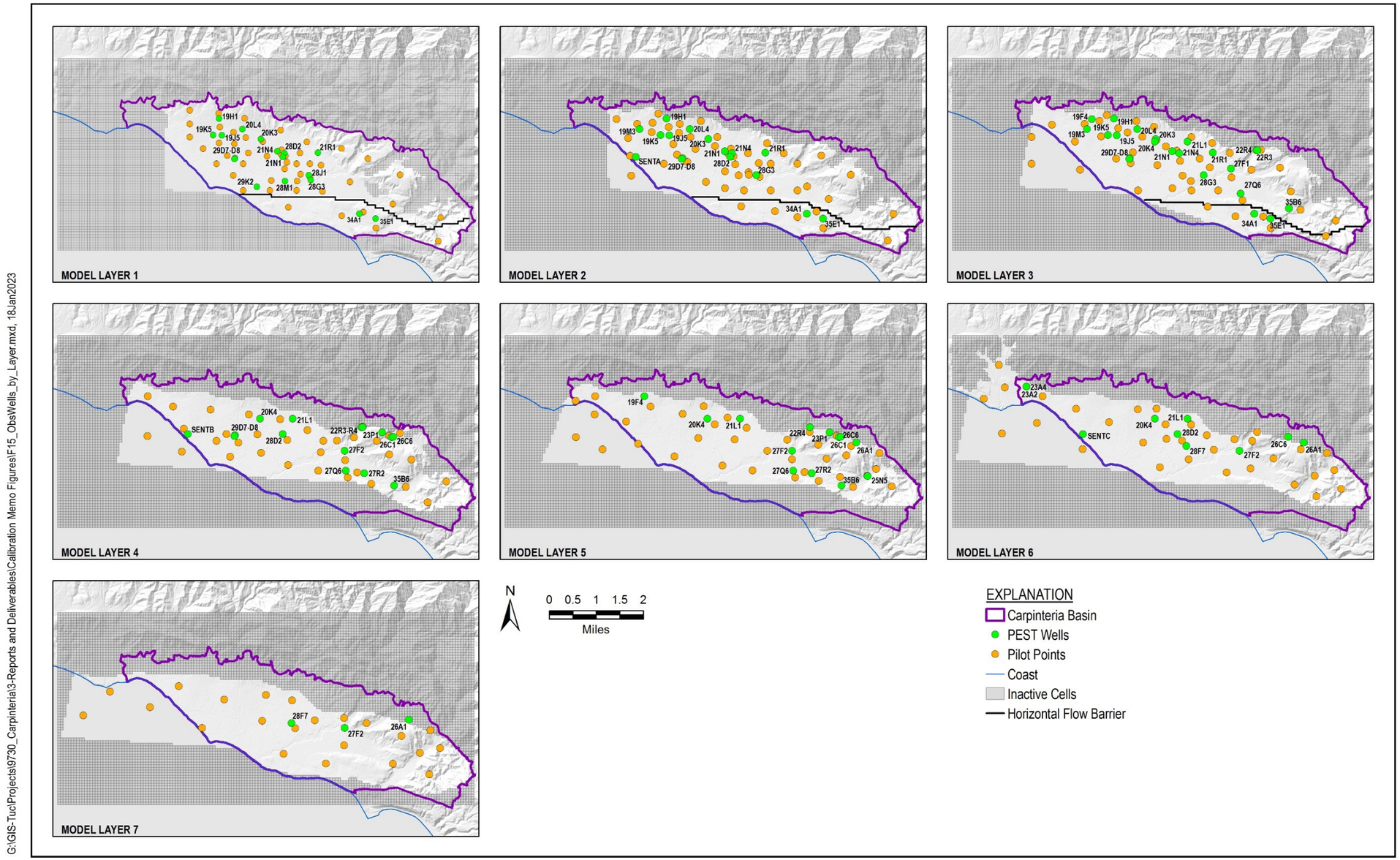
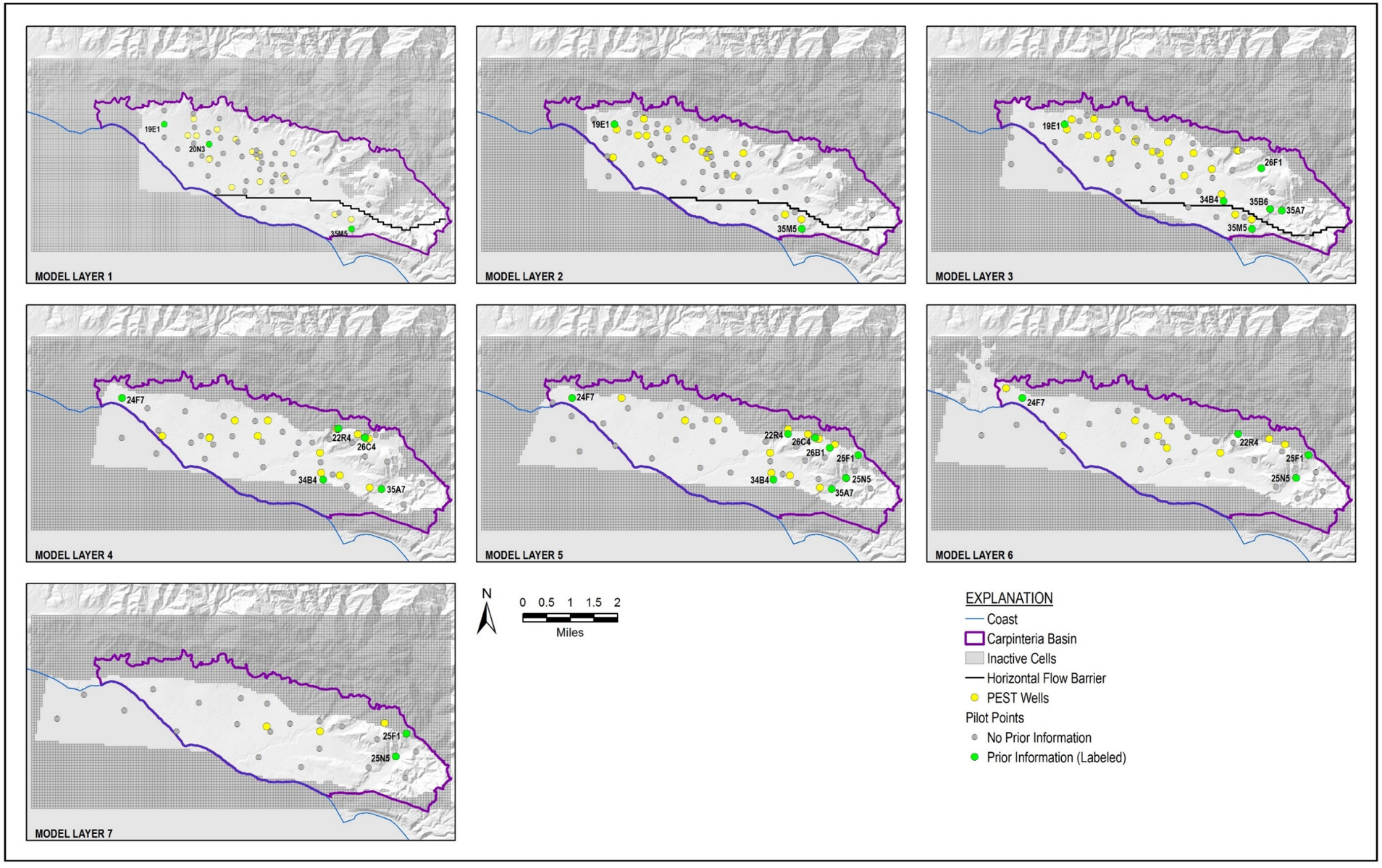


Figure 19. Pilot Point and Observation Well (PEST Well) Locations

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.



G:\GIS-Tuc\Projects\9730_Carpinteria\3-Reports and Deliverables\Calibration Memo Figures\F15_ObsWells_by_Layer_V2.mxd, 18Jan2023

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.

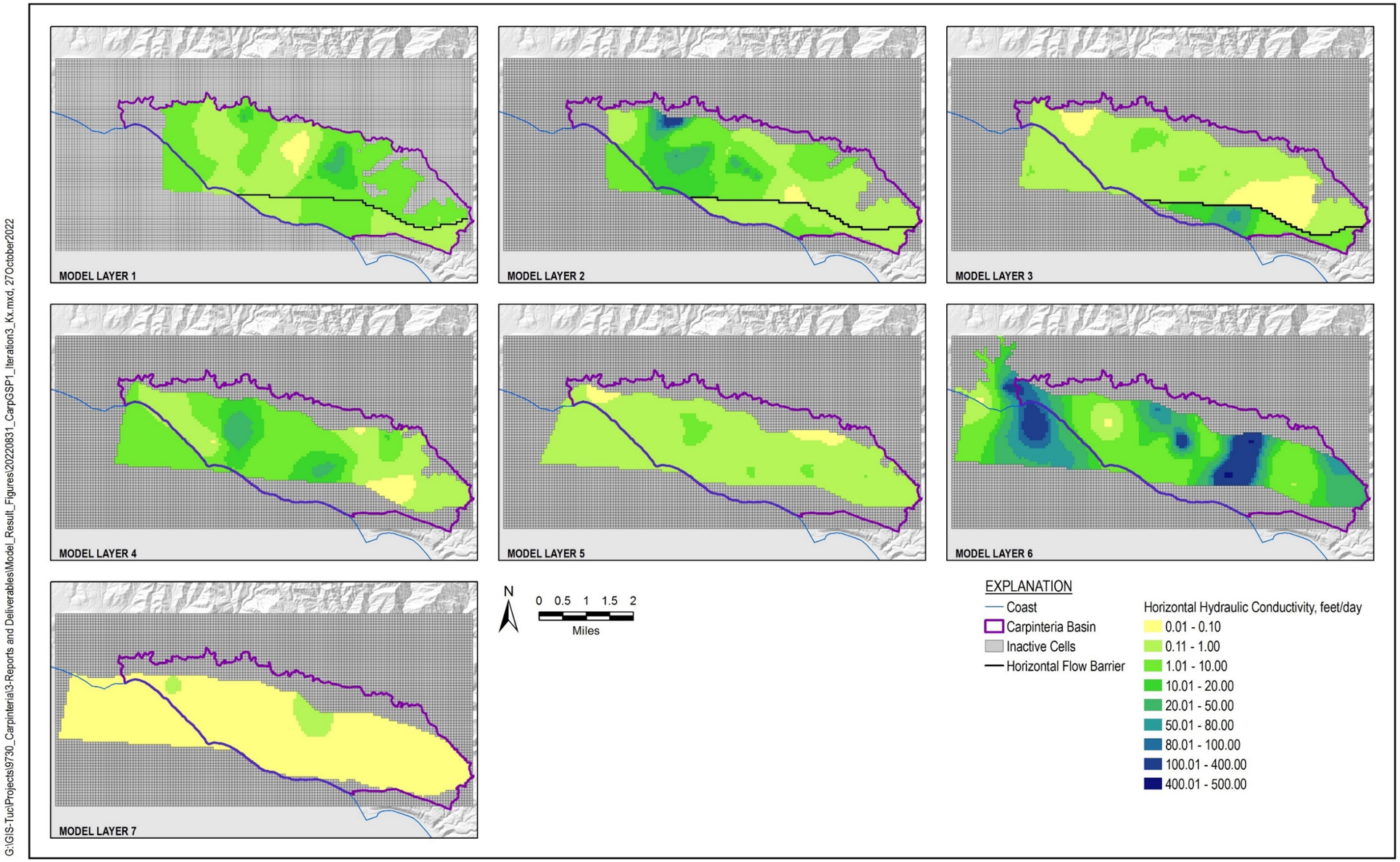
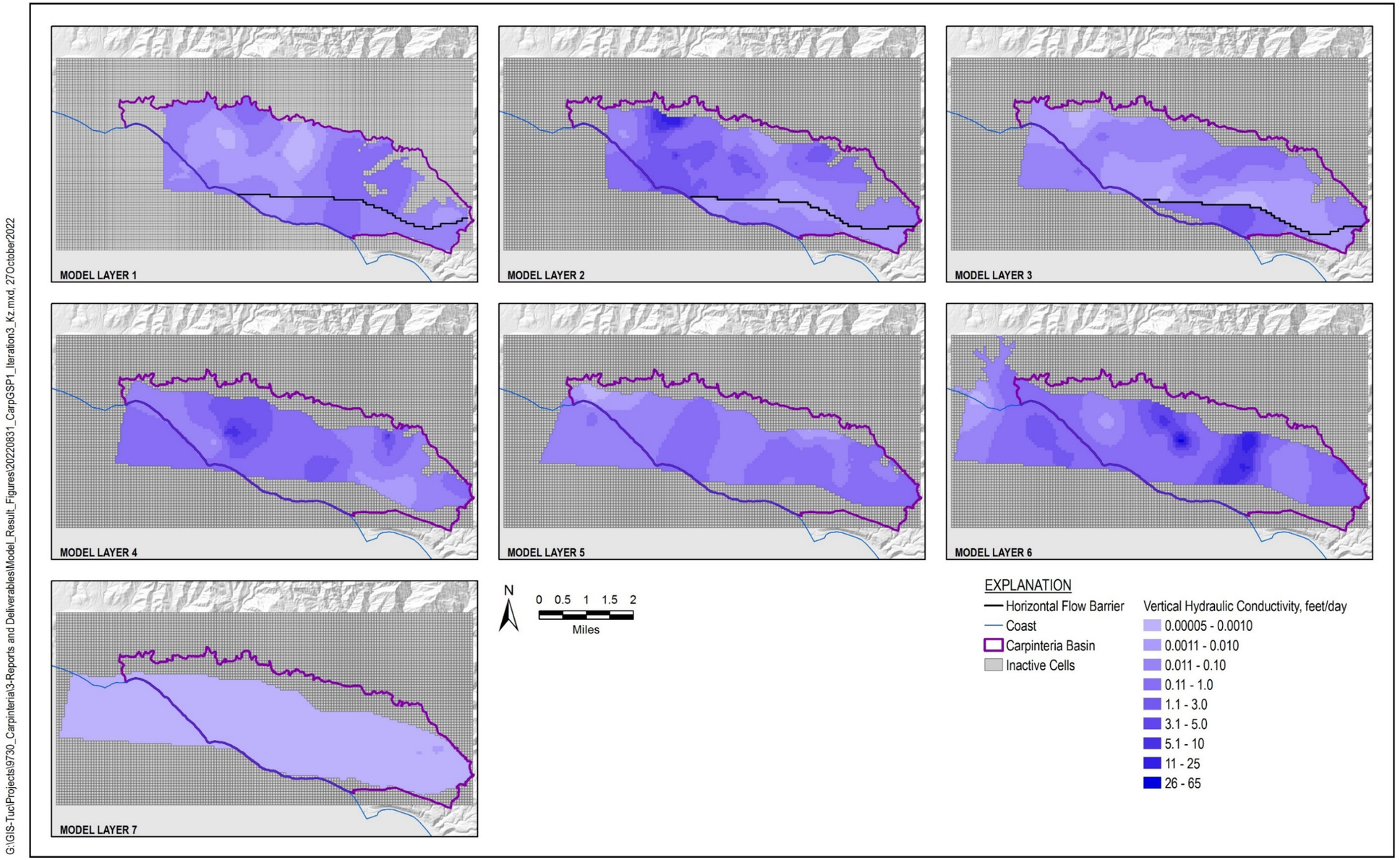


Figure 21. Calibrated Model Horizonal Hydraulic Conductivity Values

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).



G:\GIS-Tuc\Projects\9730_Carpinteria\3-Reports and Deliverables\Model_Result_Figures\20220831_CarpGSP1_Iteration3_Kz.mxd, 27October2022

Figure 22. Calibrated Model Vertical Hydraulic Conductivity Values

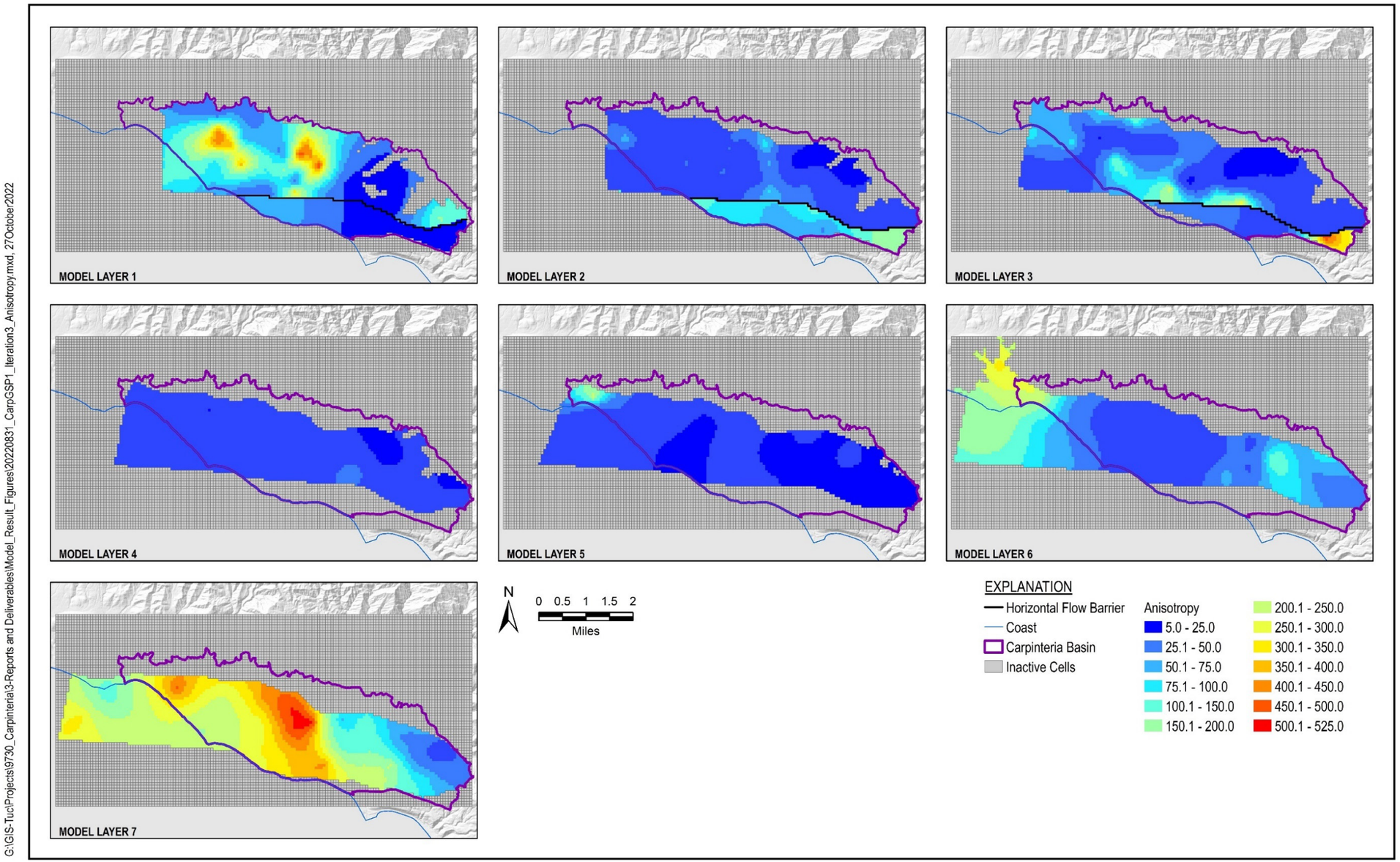
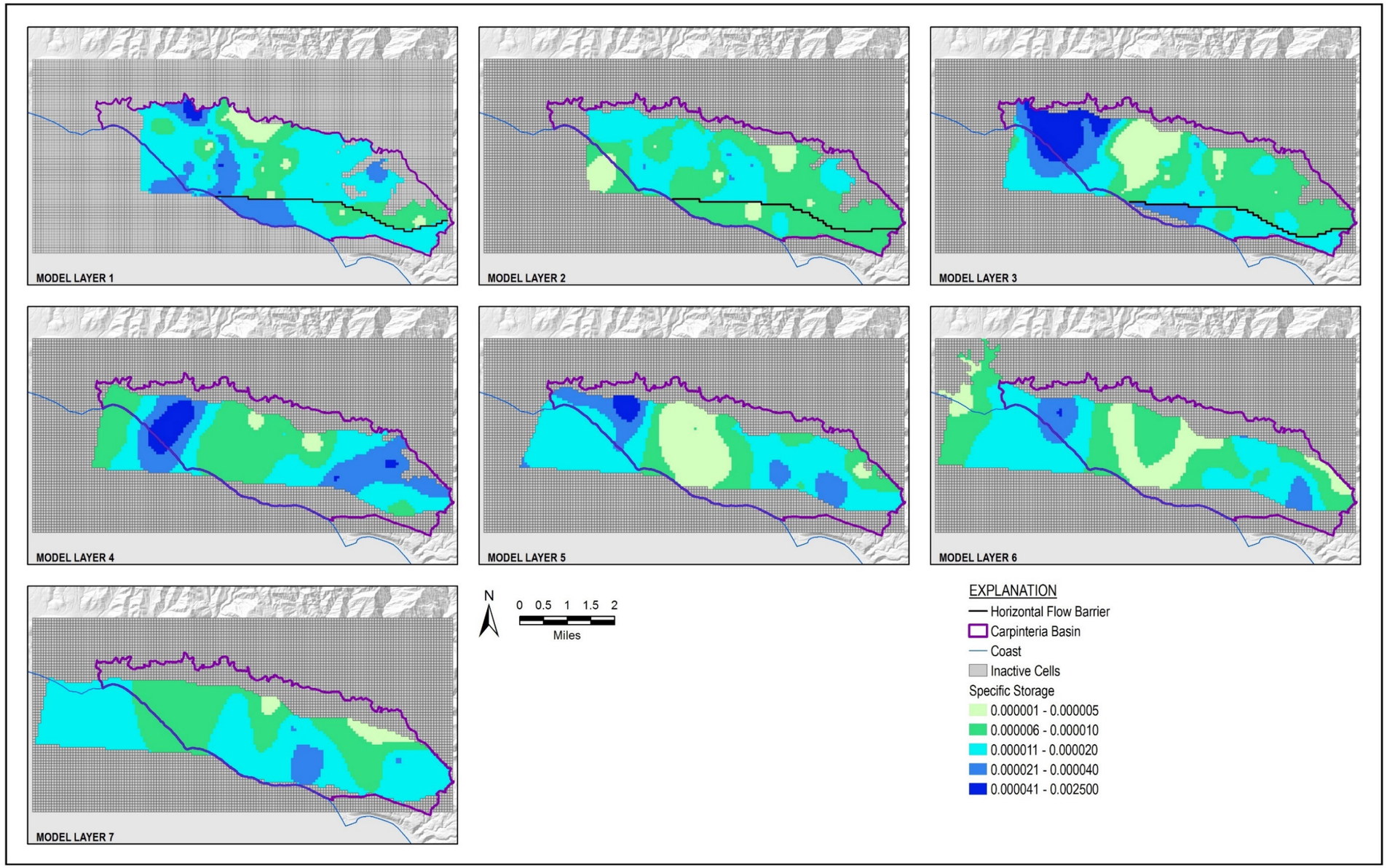


Figure 23. Calibrated Model Conductivity Anisotropy Values

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.



G:\GIS-Tuc\Projects\9730_Carpinteria\3-Reports and Deliverables\Model_Result_Figures\20220831_CarpGSP1_Iteration3_Ss.mxd, 08Sept2022

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.

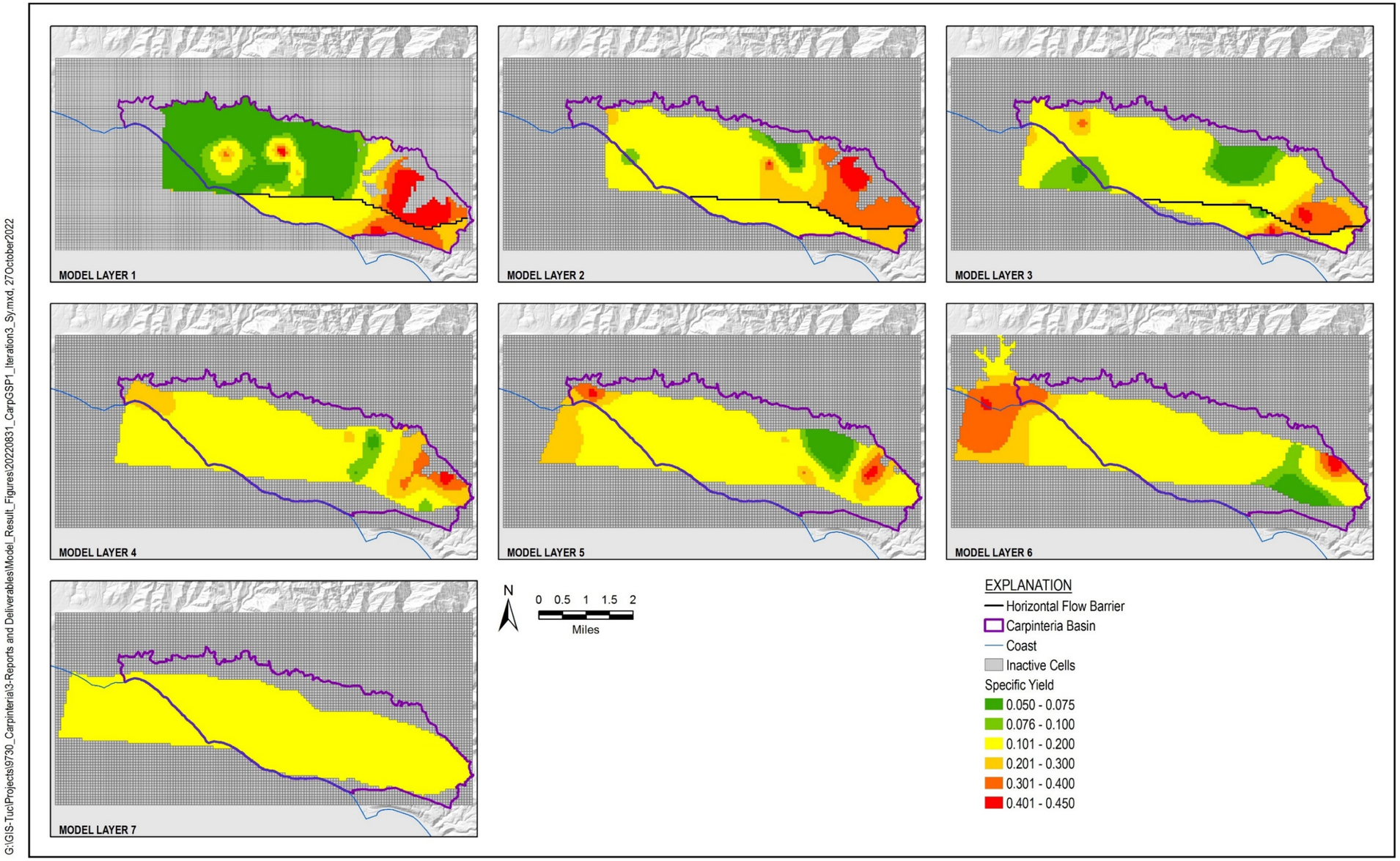


Figure 25. Calibrated Model Specific Yield Values

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

3.3.1.6 Rincon Creek Fault Conductivities

The model appears sensitive to conductivities represented for the Rincon Creek Fault with hydraulic conductivities of the horizontal flow barrier (HFB) and quasi-3D confining bed changing during calibration. Calibration resulted in the following hydraulic conductivities:

- Layer 1 HFB: 0.89 feet per day
- Layer 2 HFB and Quasi-3D Confining Bed Above Layer 2: 0.22 feet per day f
- Layer 3 HFB and Quasi-3D Confining Bed Above Layer 3: 2.6 x 10^{-5} feet per day

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%

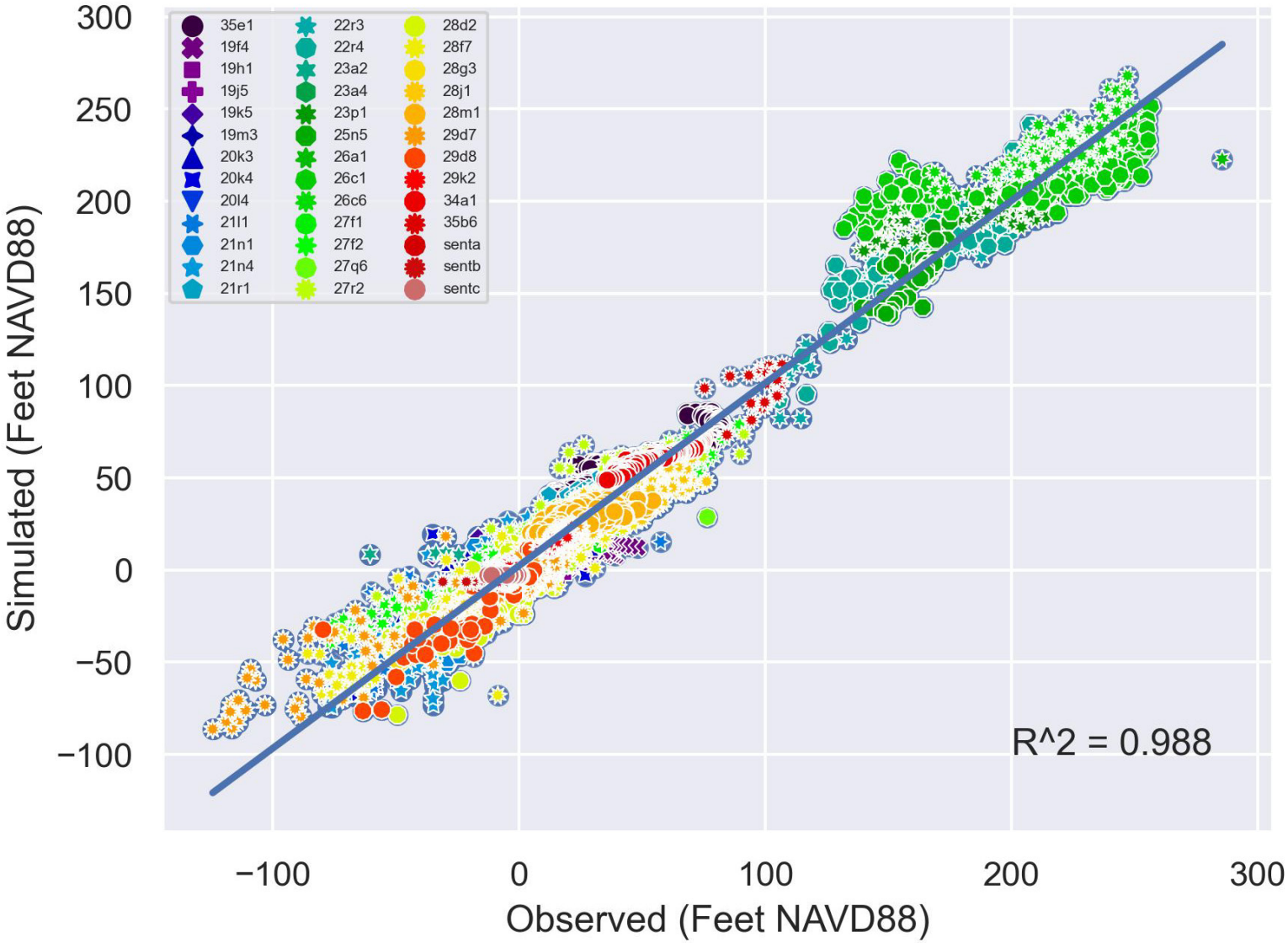
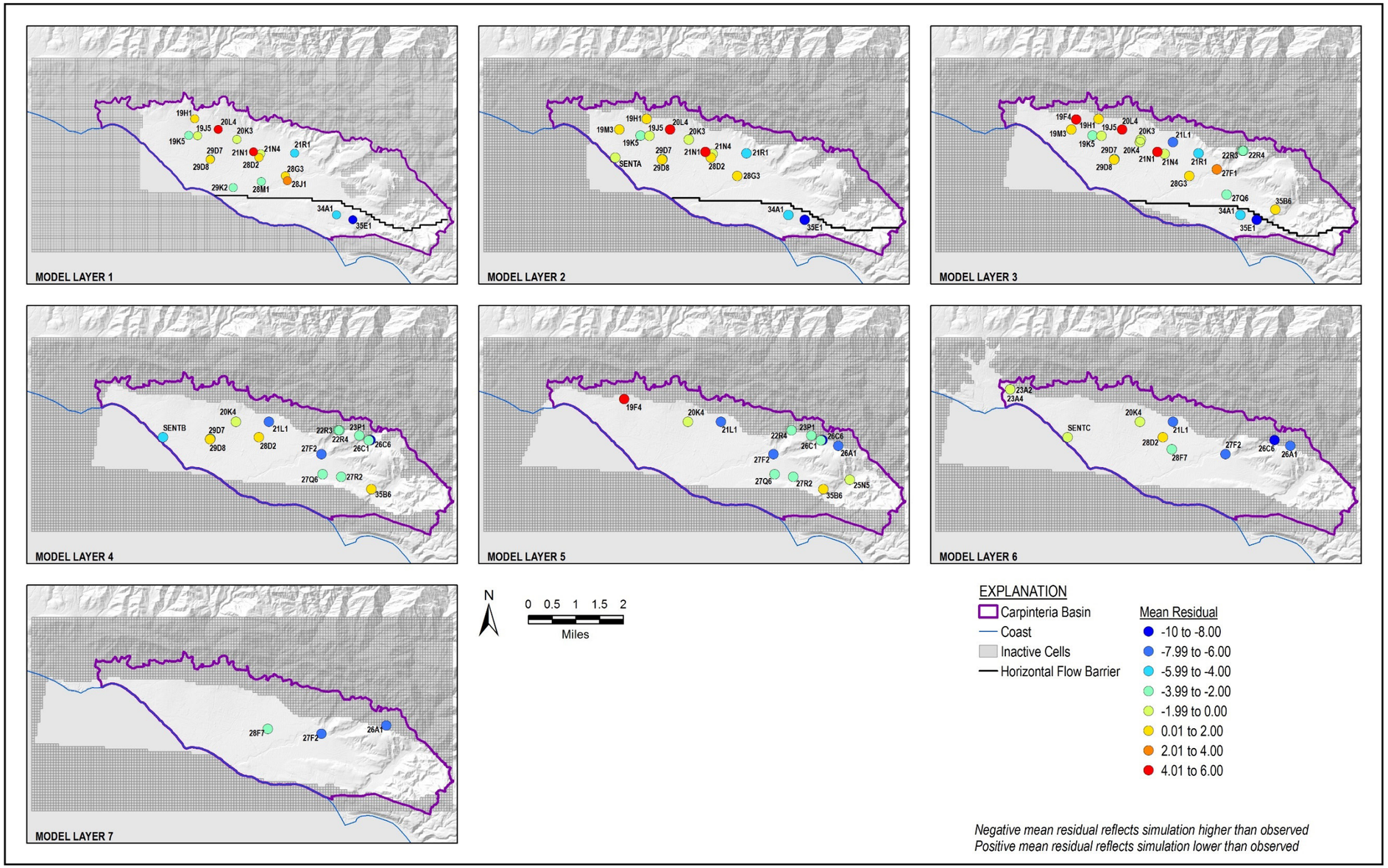


Figure 26. Observed and Simulated Values Against 1:1 Line



G:\GIS-Tuc\Projects\9730_Carpinteria\3-Reports and Deliverables\Calibration Memo Figures\MeanError_ByLayer.mxd, 23Feb2023

Figure 27. Mean Residual By Layer

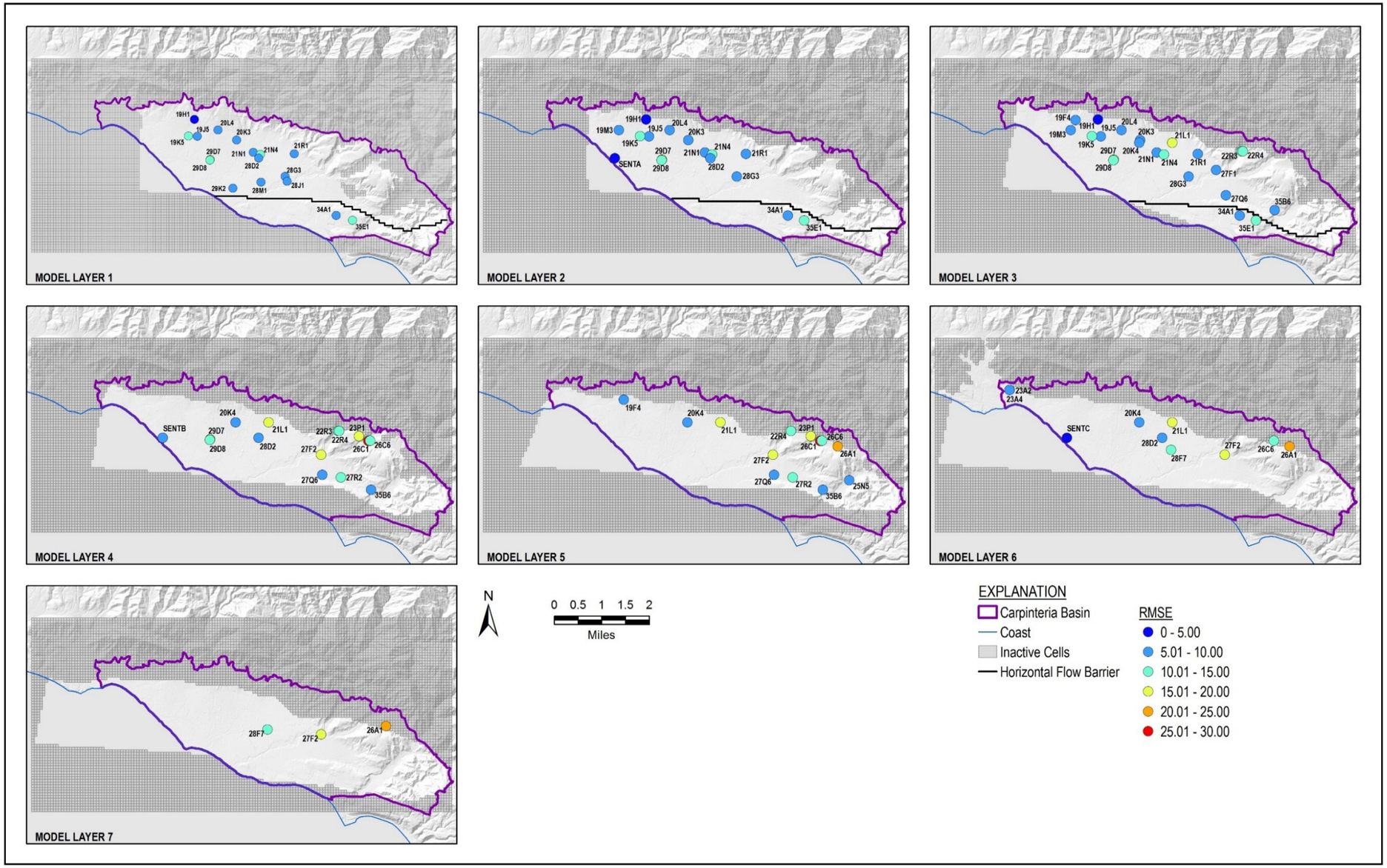


Figure 28. Root Mean Squared Error by Layer

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.

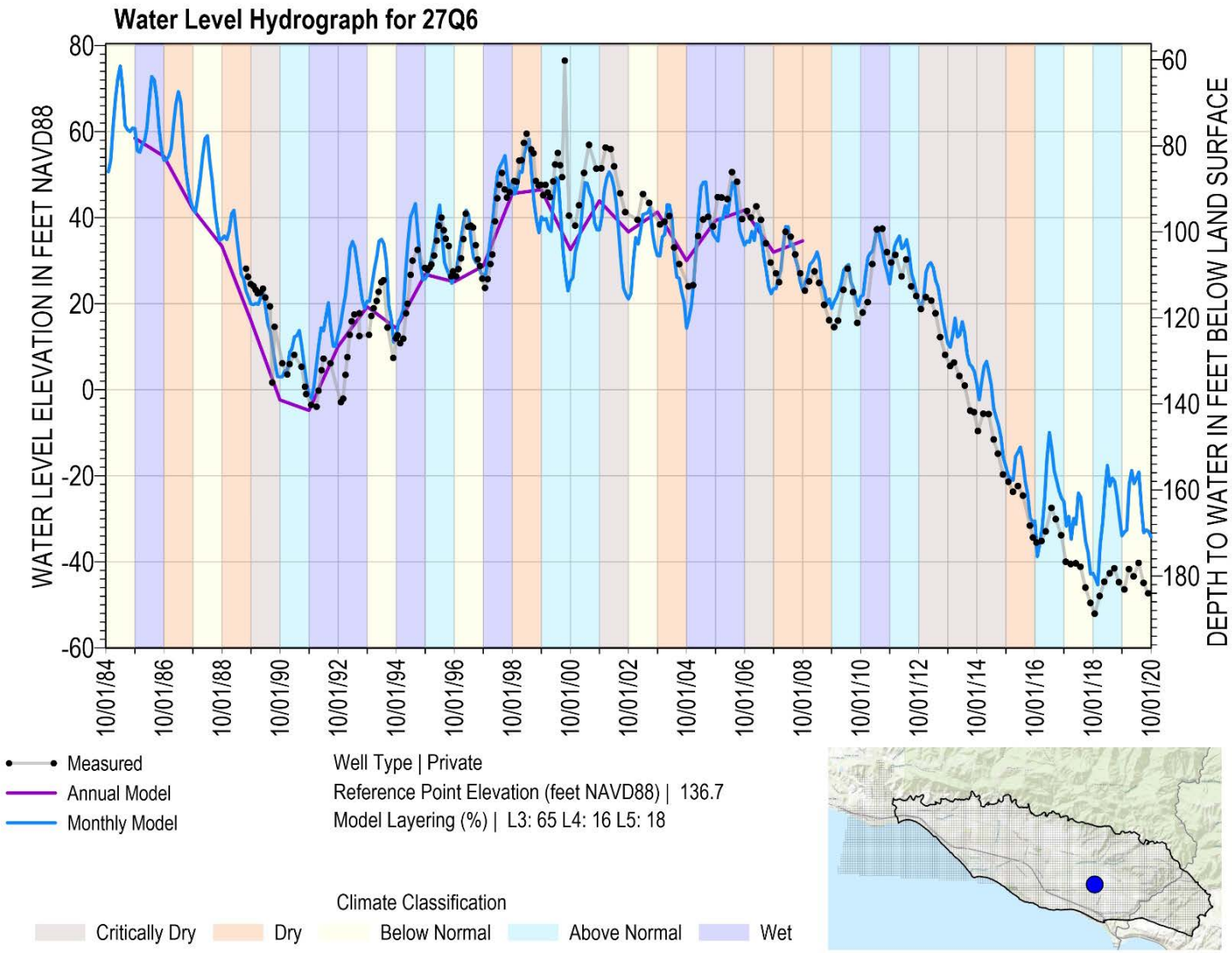


Figure 29. Calibration Hydrograph for SU-1 Private Well 27Q6, Feet NAVD88

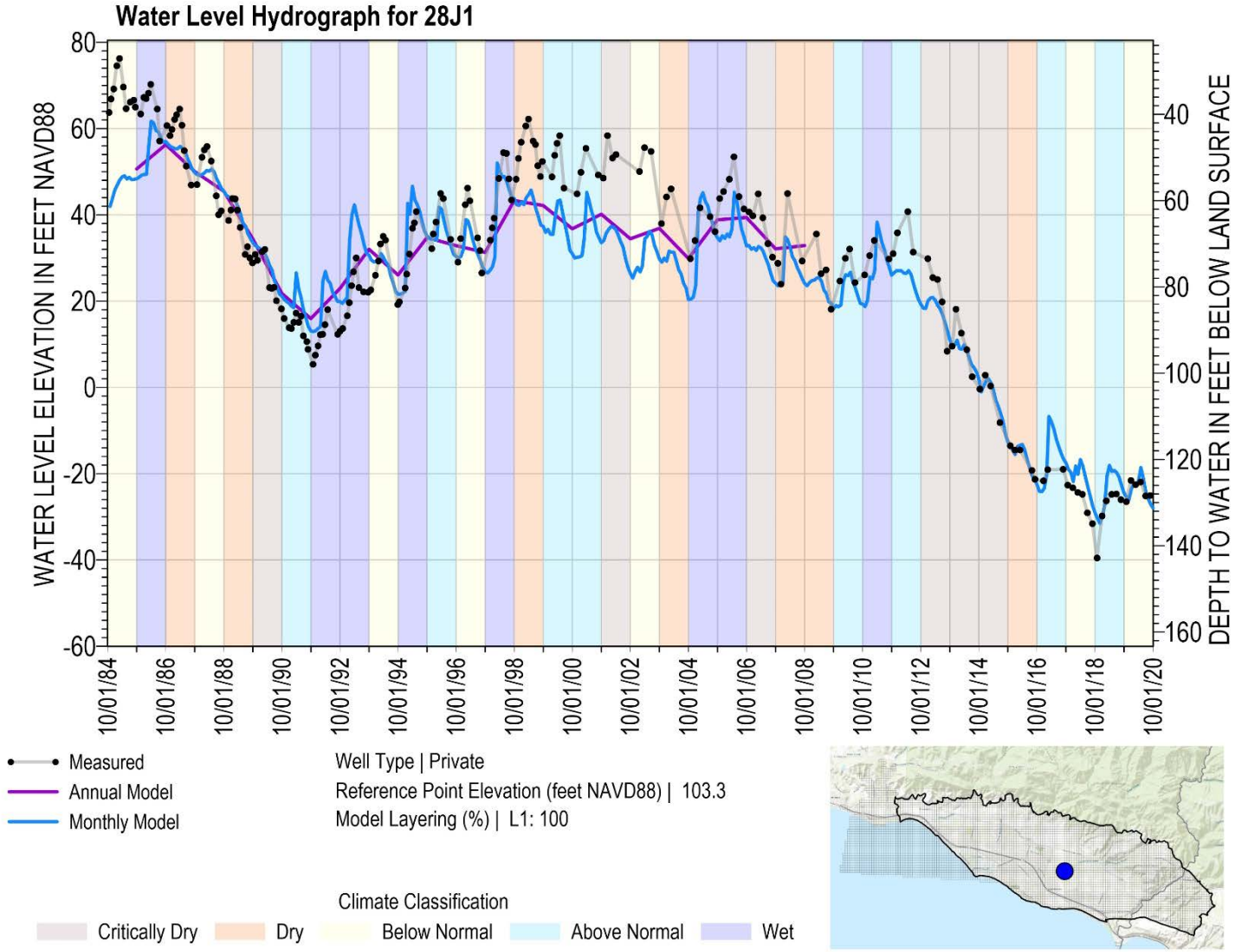


Figure 30. Calibration Hydrograph for SU-1 Private Well 28J1, Feet NAVD88

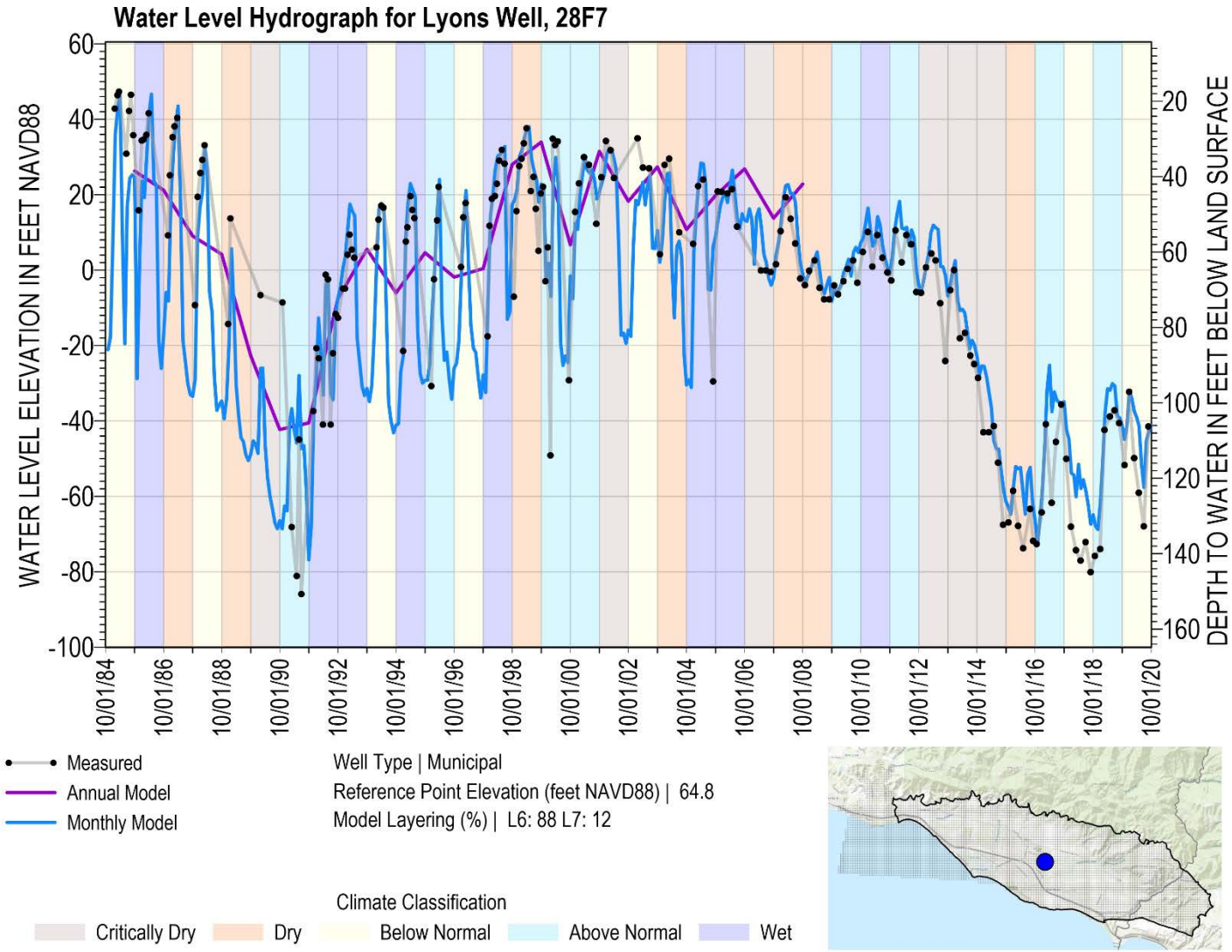


Figure 31. Calibration Hydrograph for SU-1 Lyons Municipal Well (28F7), Feet NAVD88

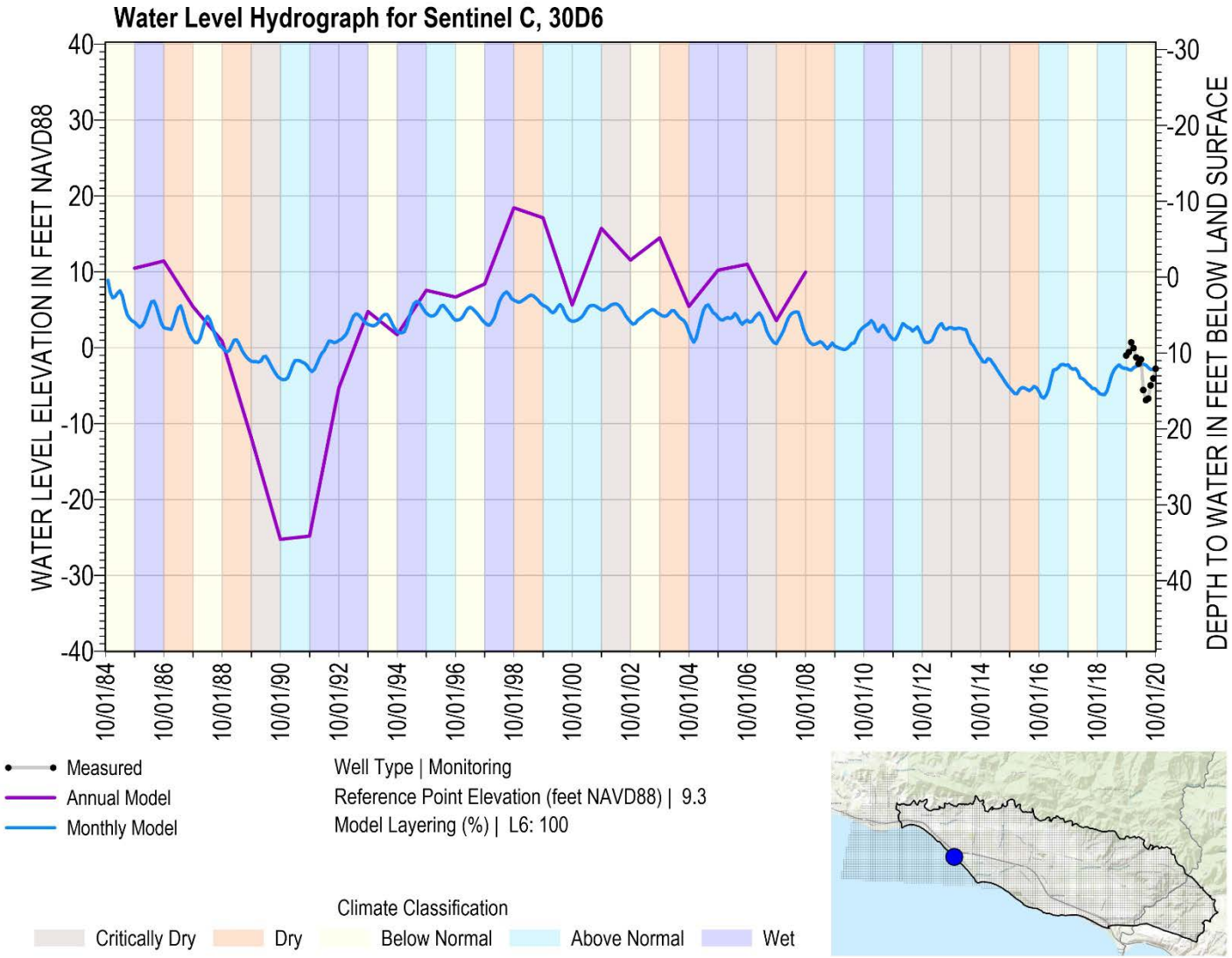


Figure 32. Calibration Hydrograph for SU-1 Monitoring Well Sentinel C (30D6), Feet NAVD88

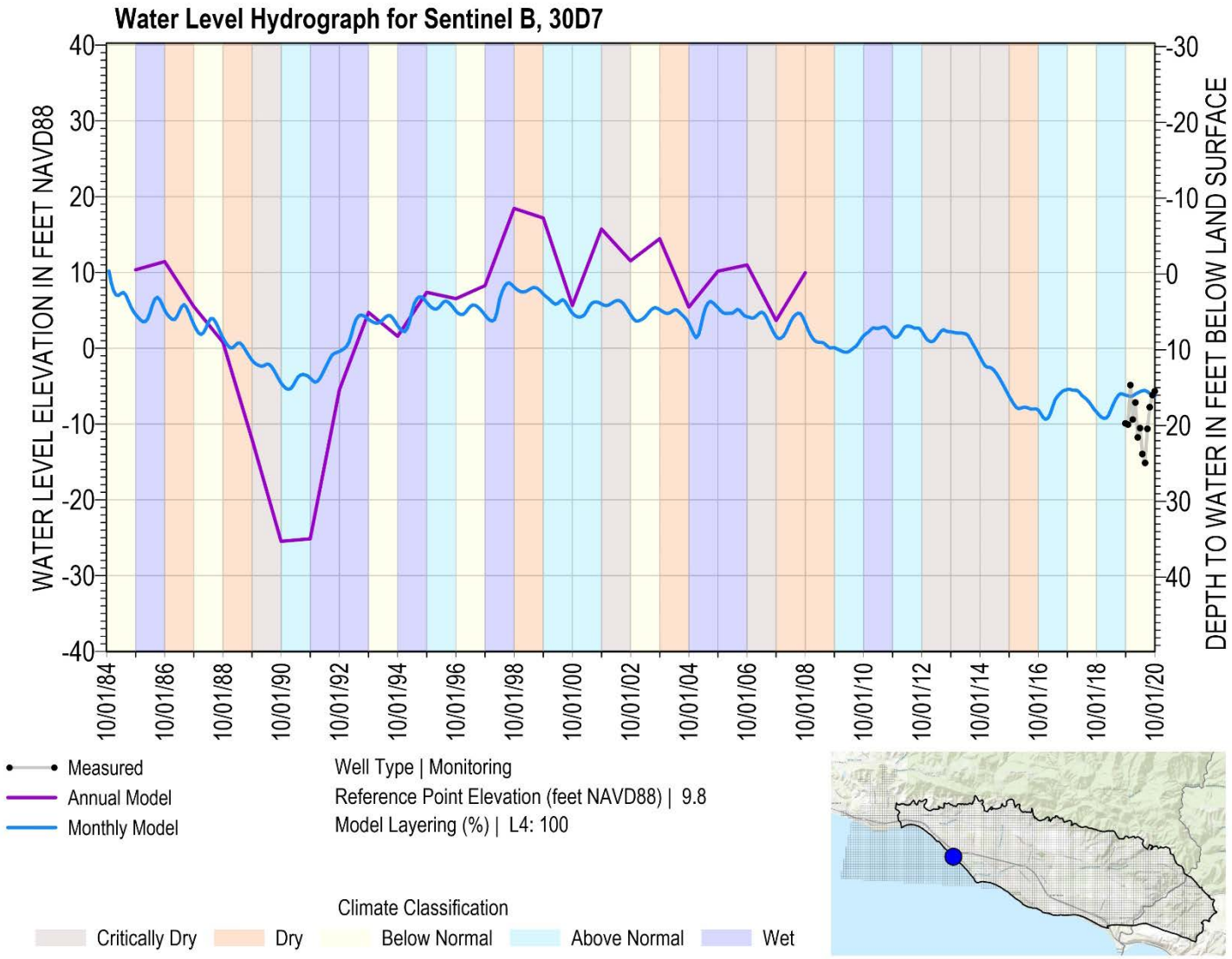


Figure 33. Calibration Hydrograph for SU-1 Monitoring Well Sentinel B (30D7), Feet NAVD88

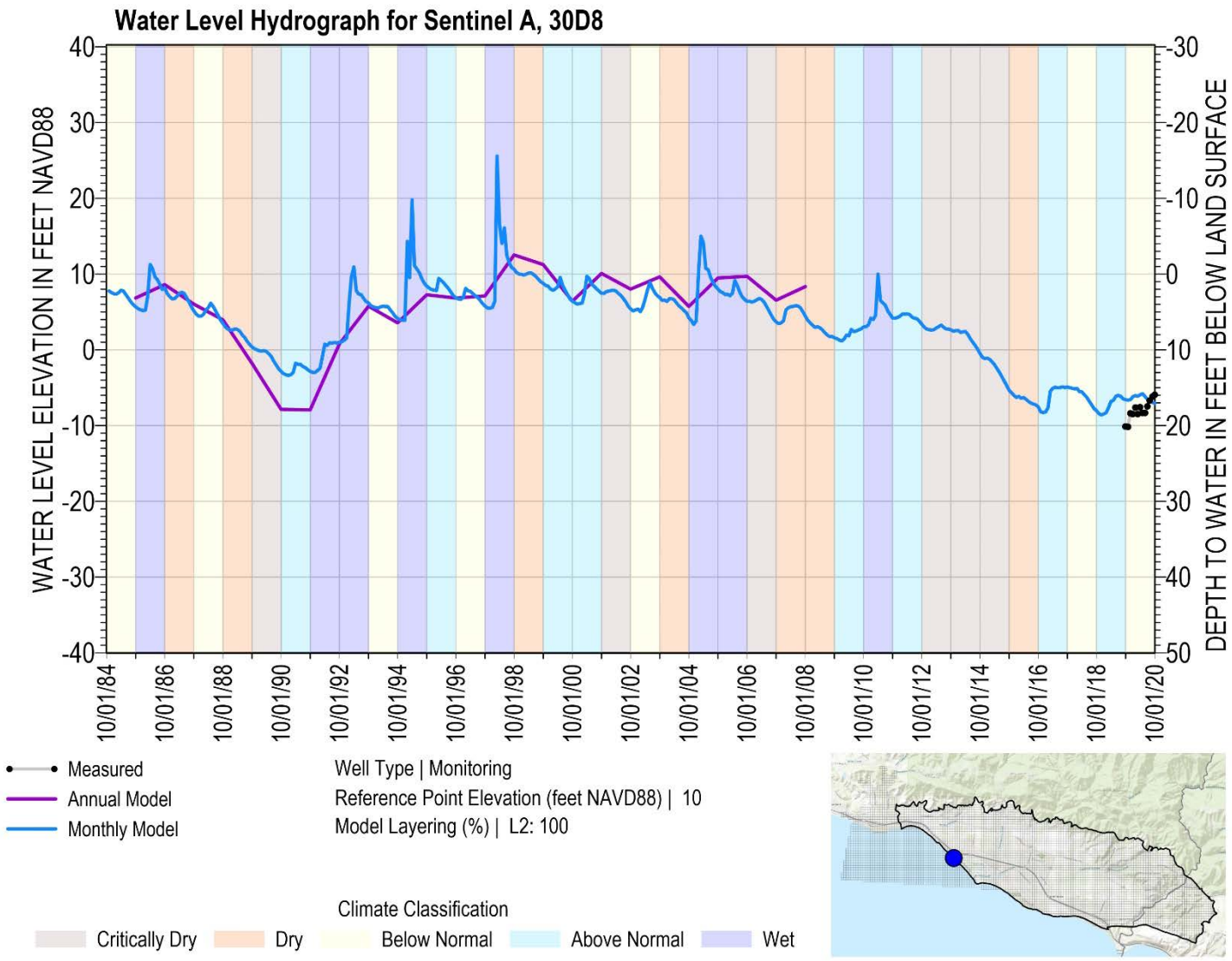


Figure 34. Calibration Hydrograph for SU-1 Monitoring Well Sentinel A (30D8), Feet NAVD88

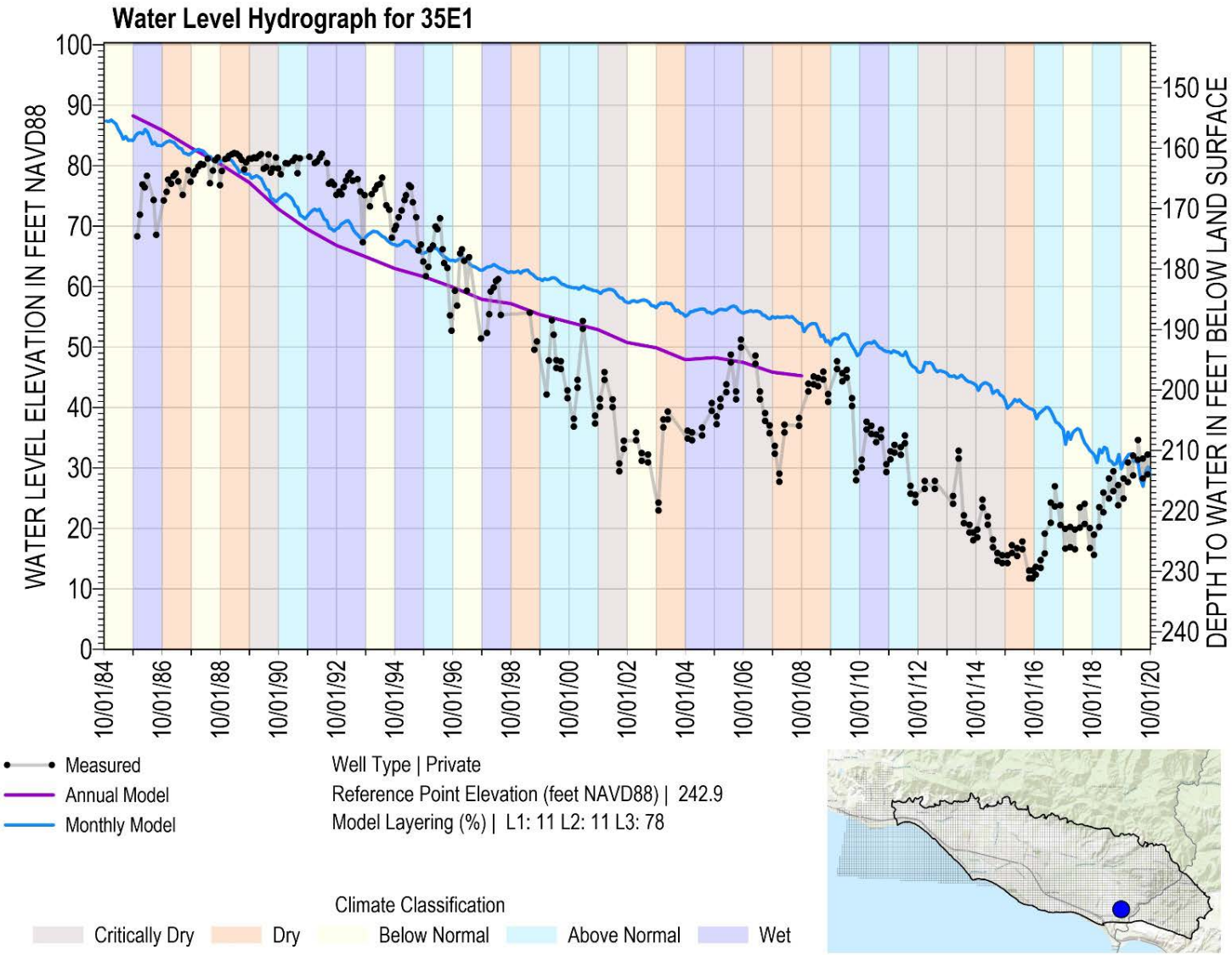


Figure 35. Calibration Hydrograph for SU-2 Private Well 35E1, Feet NAVD88

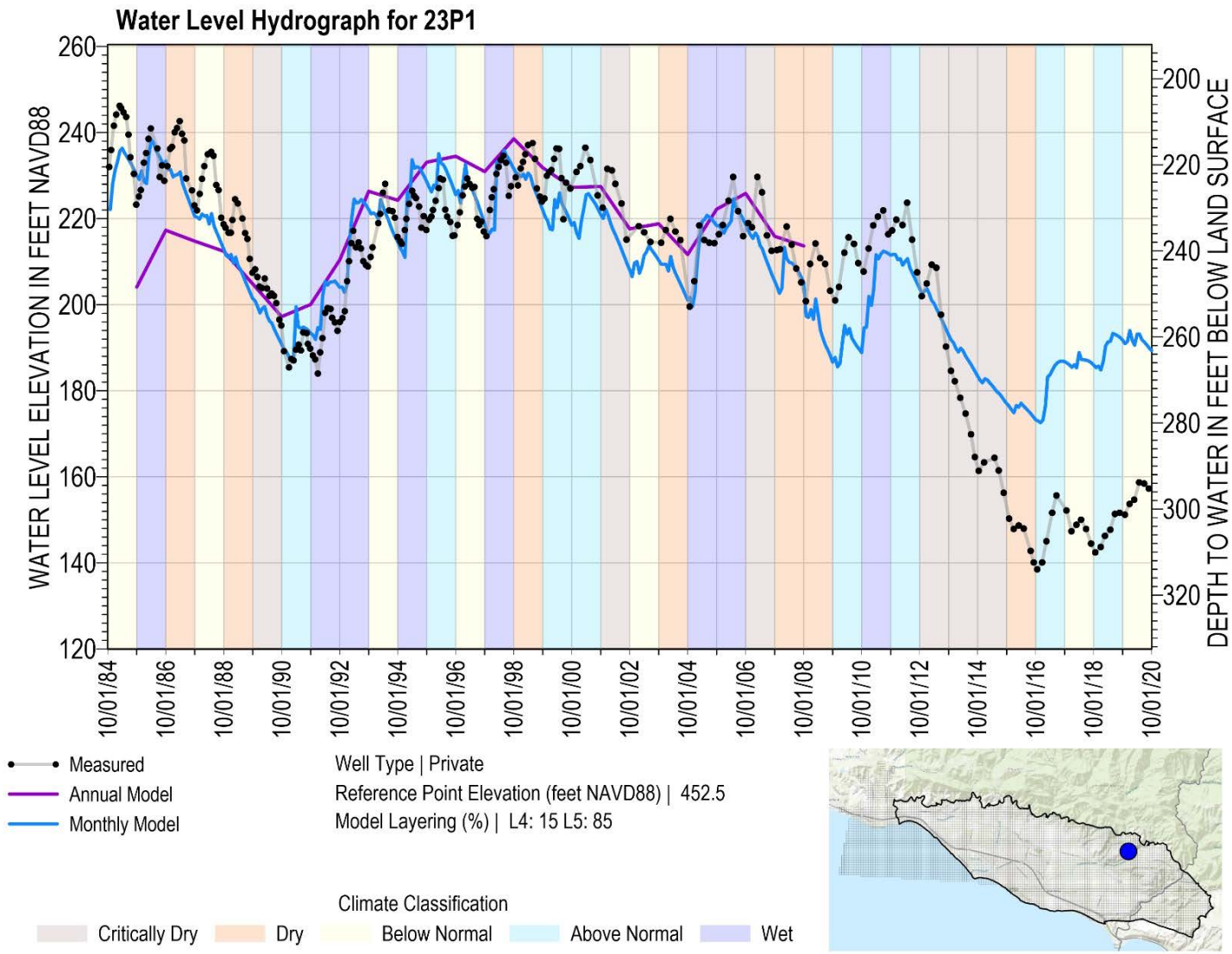
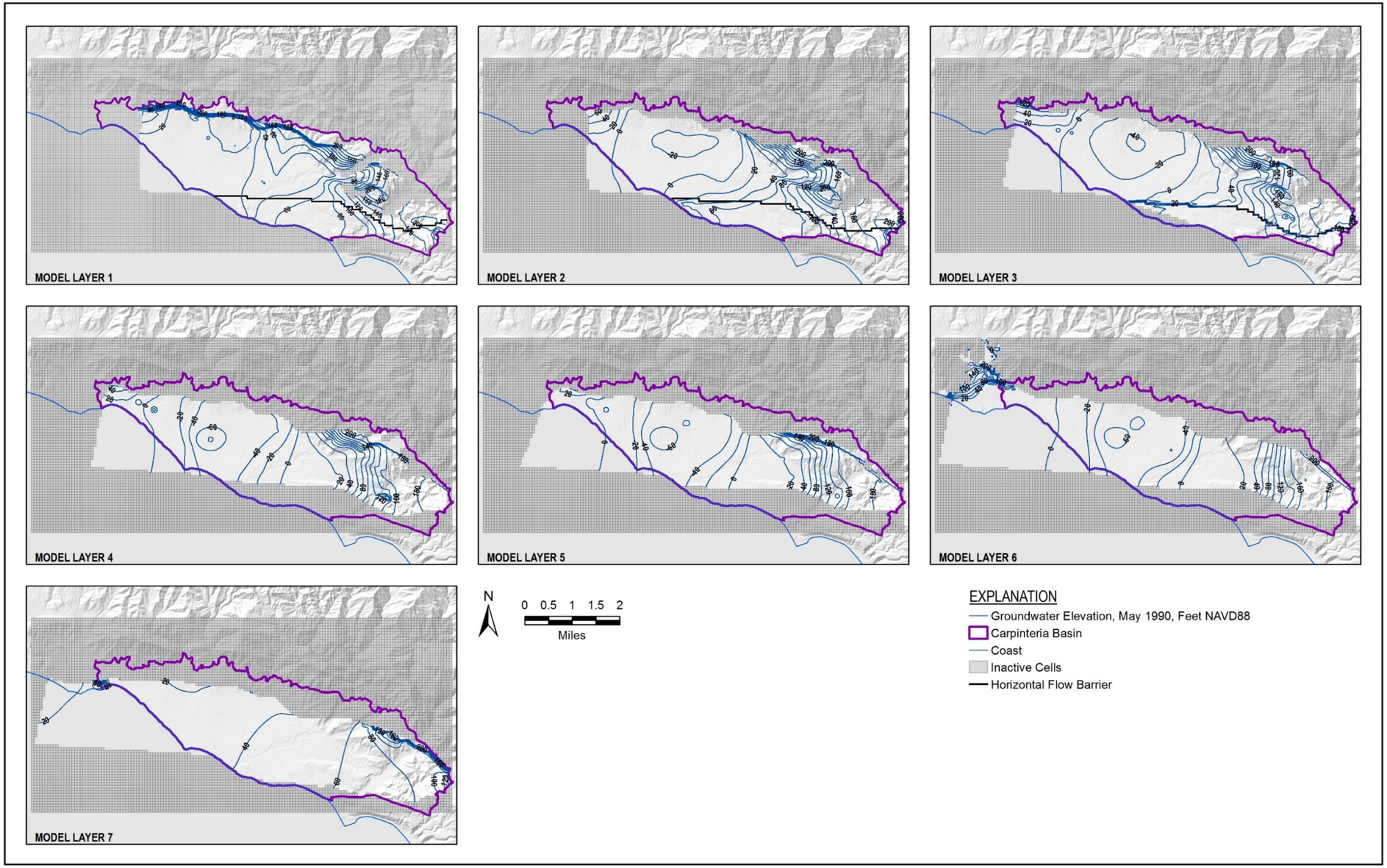


Figure 36. Calibration Hydrograph for SU-1 Private Well 23P1, Feet NAVD88

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).



G:\GIS-Tuc\Projects\9730_Carpinteria\3-Reports and Deliverables\Model_Result_Figures\Srf_GWL_L1_to_L7_1990_05_01.mxd, 21Feb2023

Figure 37. Simulated Groundwater Elevation Contours, May 1990

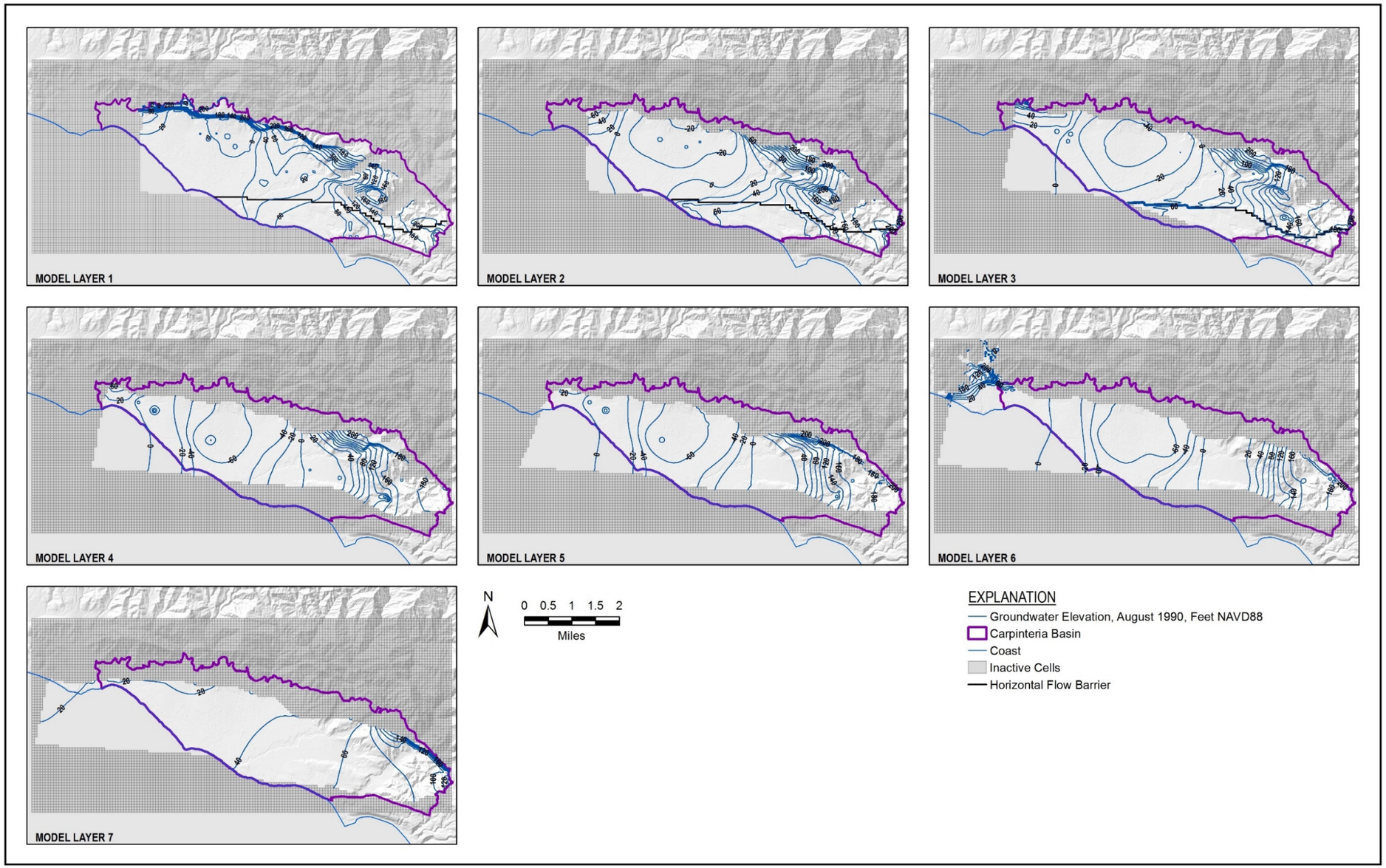


Figure 38. Simulated Groundwater Elevation Contours, August 1990

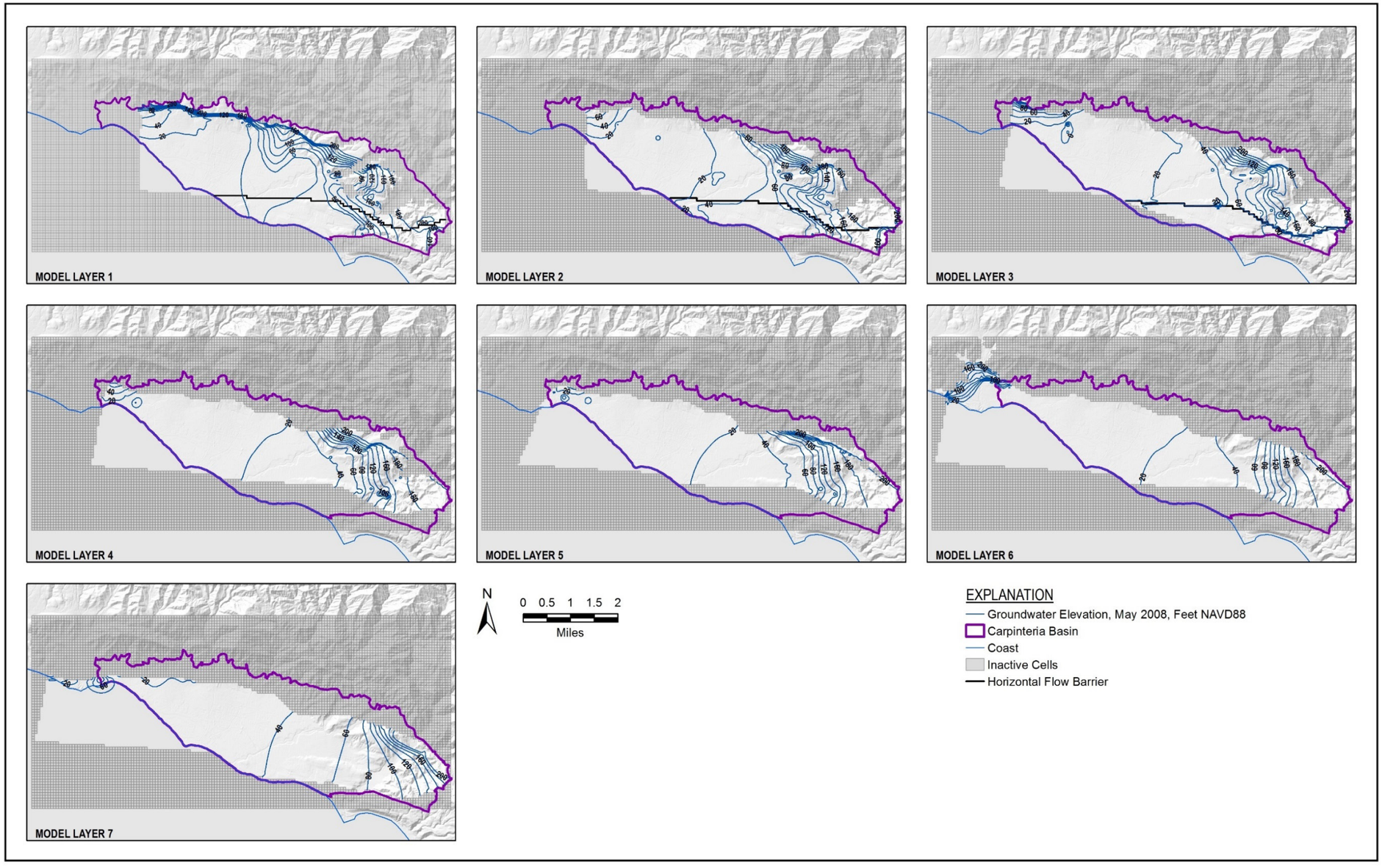


Figure 39. Simulated Groundwater Elevation Contours, May 2008

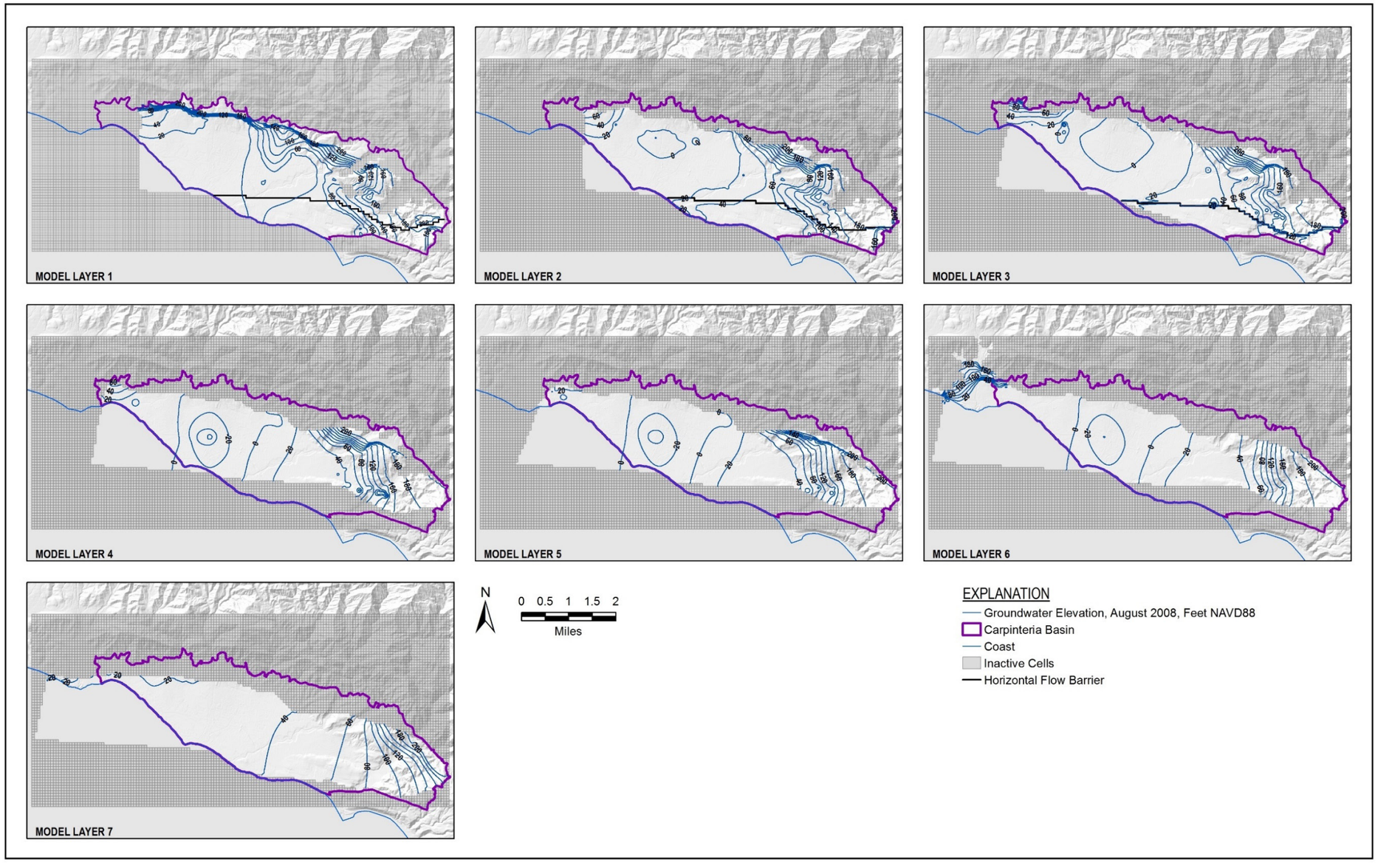
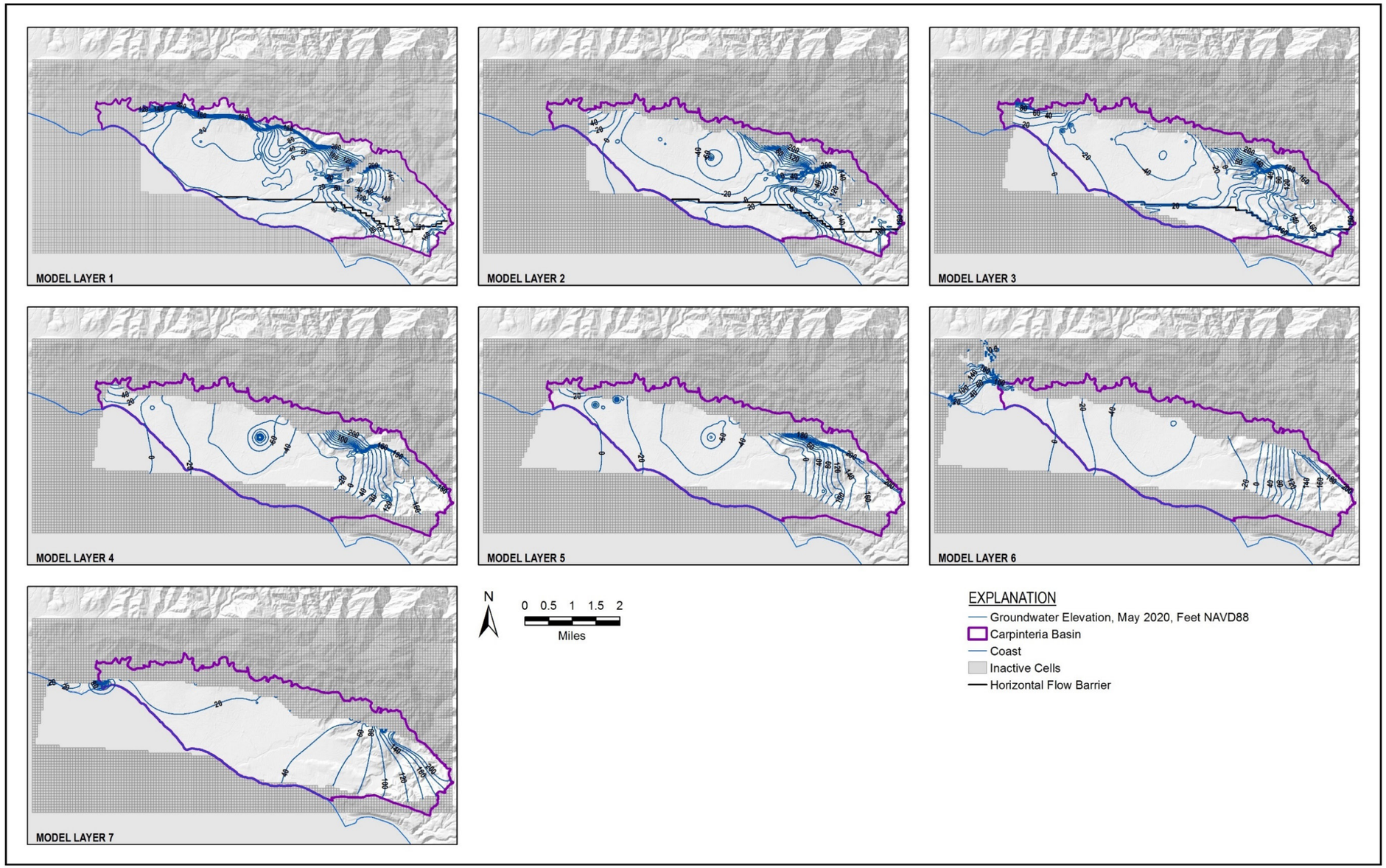
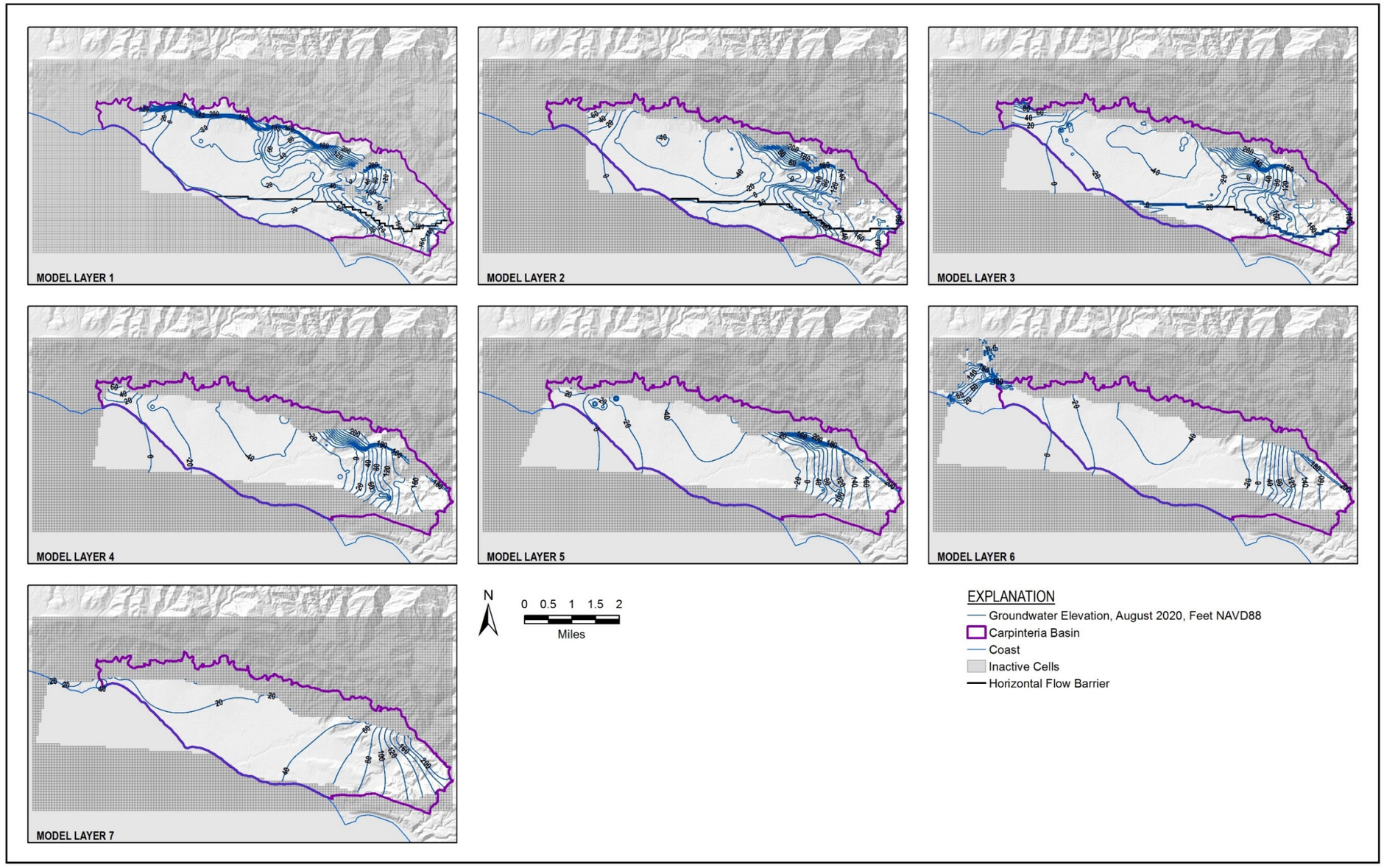


Figure 40. Simulated Groundwater Elevation Contours, August 2008



G:\GIS-Tuc\Projects\9730_Carpinteria\3-Reports and Deliverables\Model_Result_Figures\Srf_GWL_L1_to_L7_2020_05_01.mxd, 22Feb2023

Figure 41. Simulated Groundwater Elevation Contours, May 2020



G:\GIS-Tuc\Projects\9730_Carpinteria\3-Reports and Deliverables\Model_Result_Figures\Srf_GWL_L1_to_L7_2020_08_01.mxd, 22Feb2023

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.

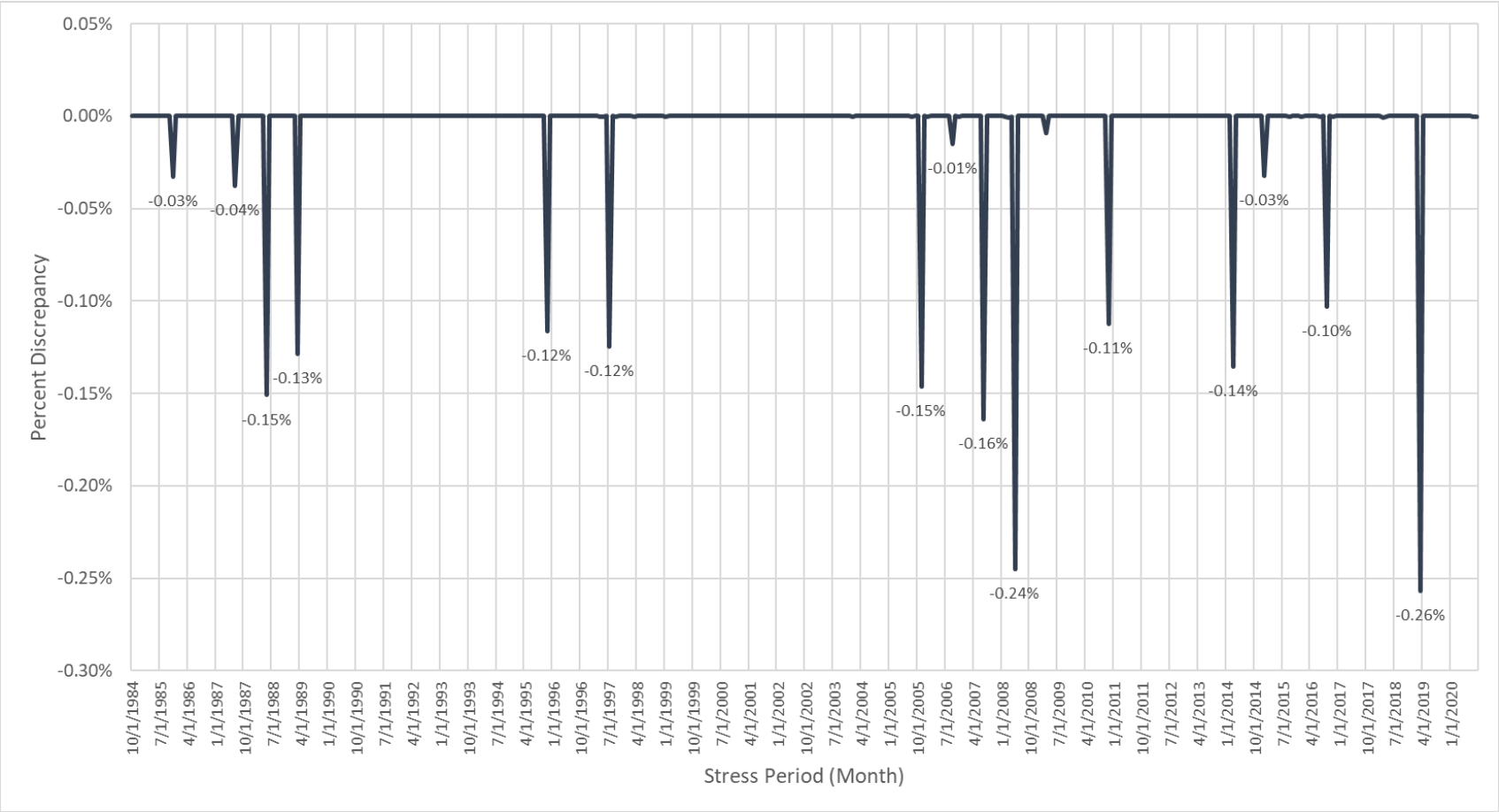


Figure 43. Model Mass Balance Error per Stress Period

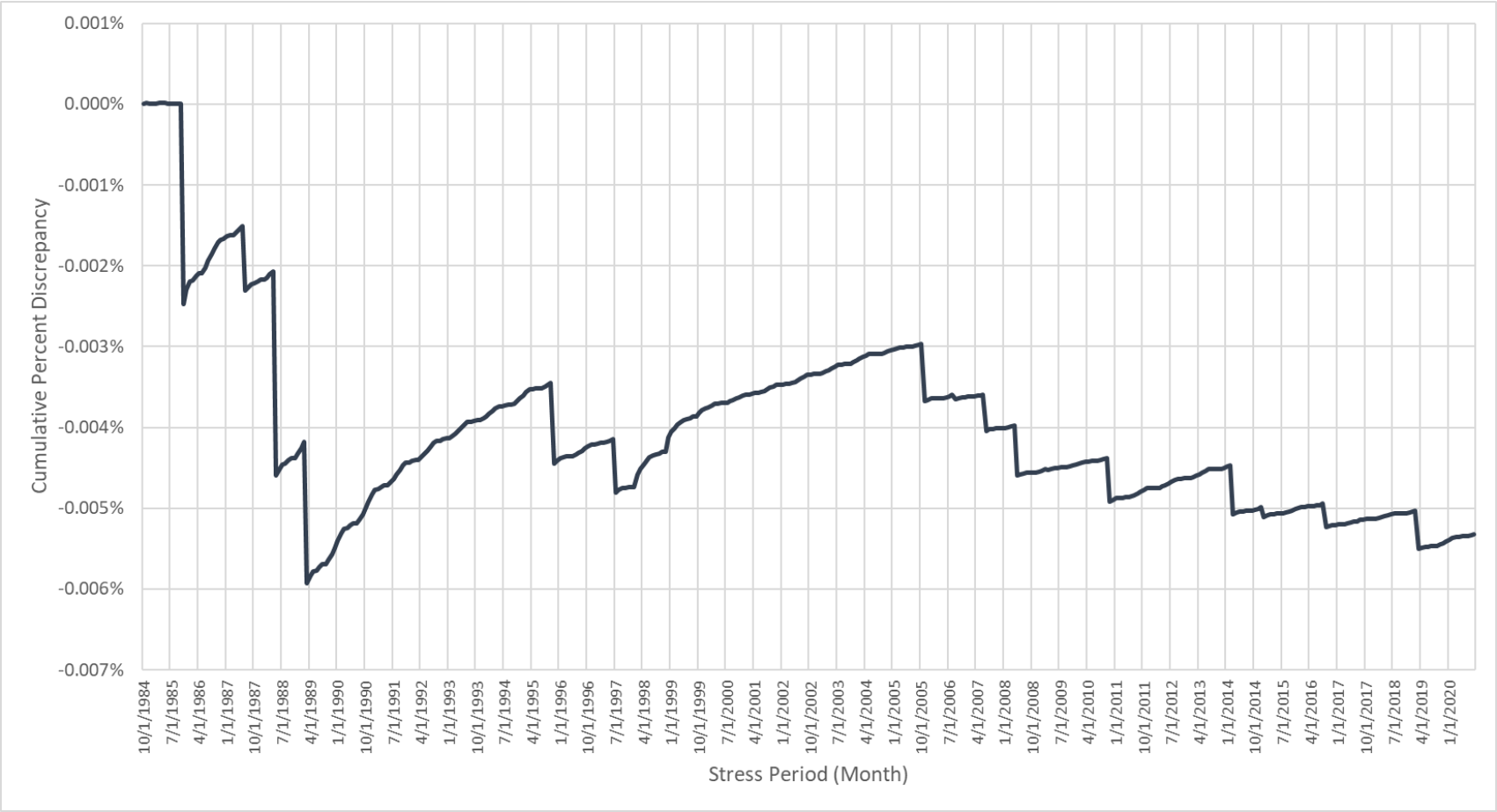


Figure 44. Model Cumulative Balance Error

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

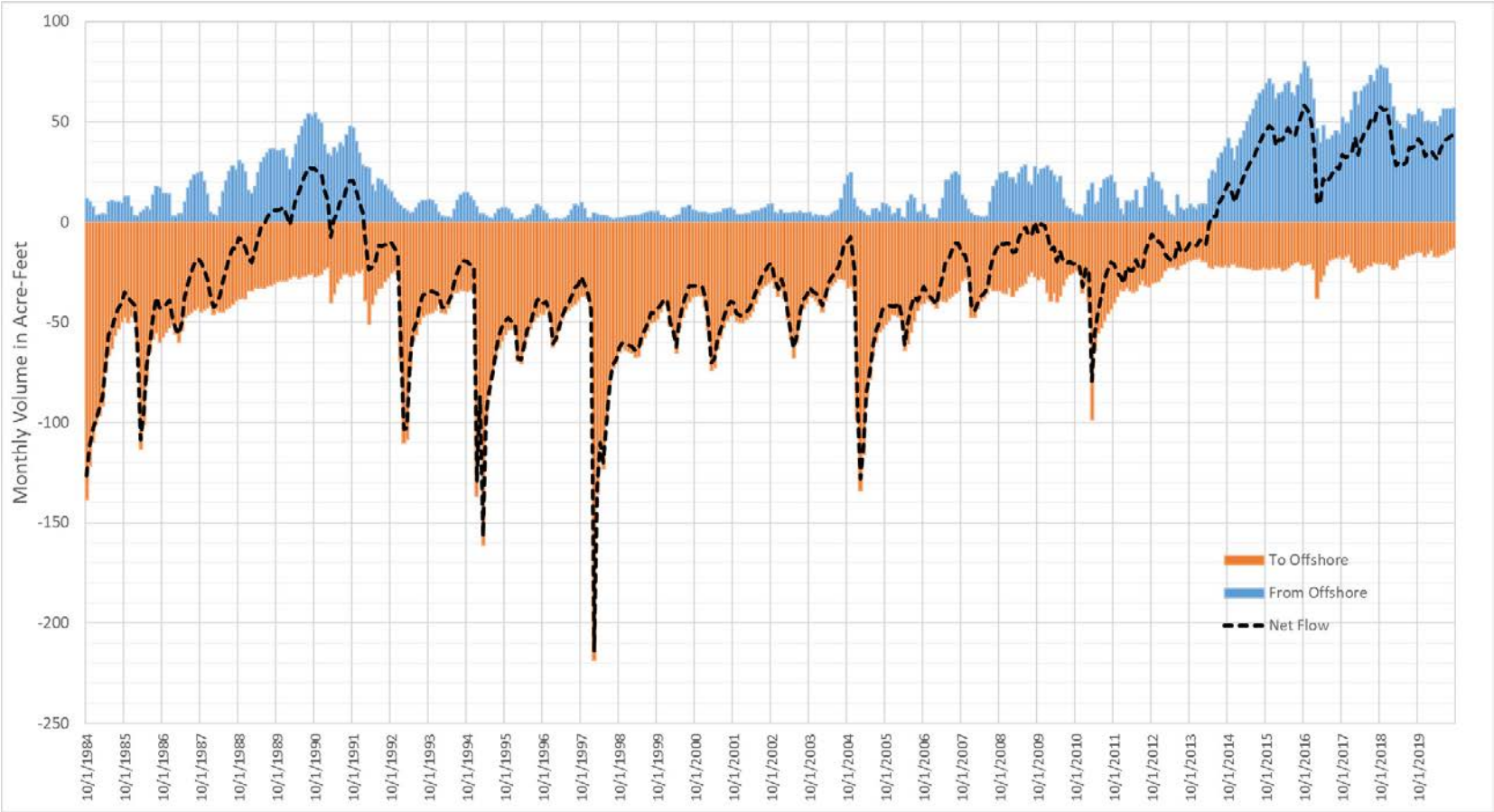


Figure 45. Carpinteria Basin Flow to and from Offshore

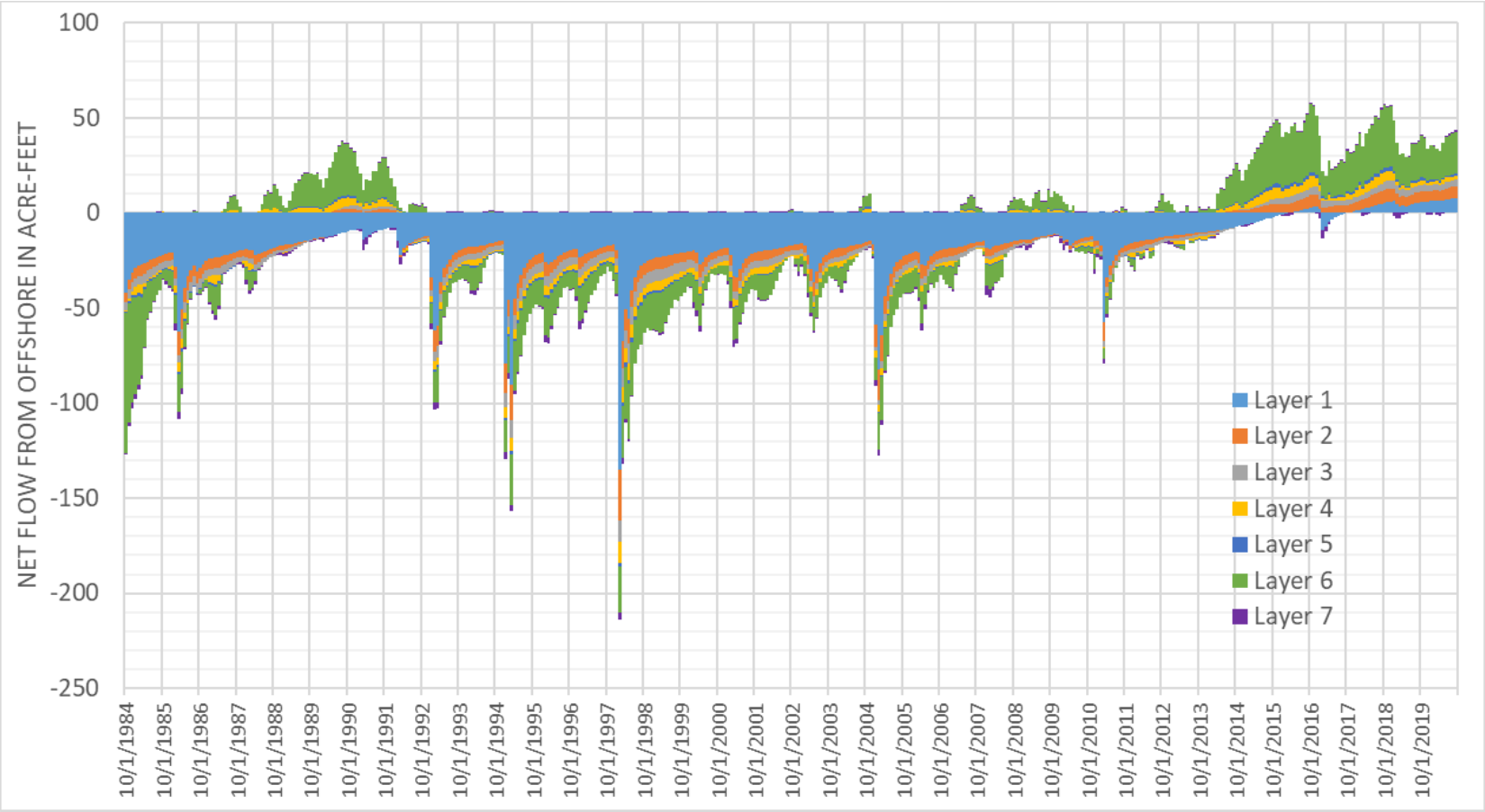


Figure 46. Carpinteria Basin Net Flow from Offshore by Layer

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

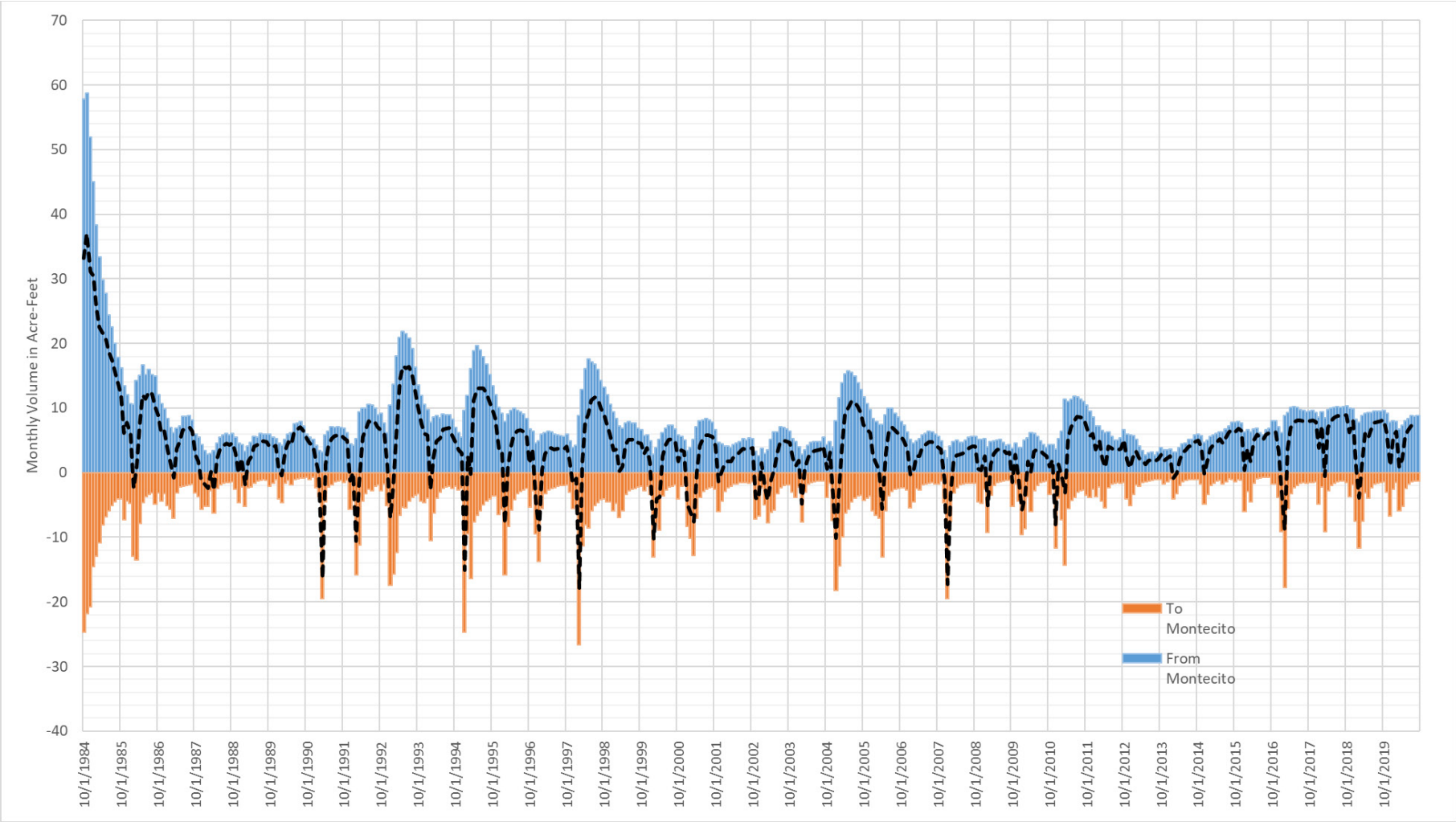


Figure 47. Carpinteria Basin Flow to and from Montecito Basin

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.

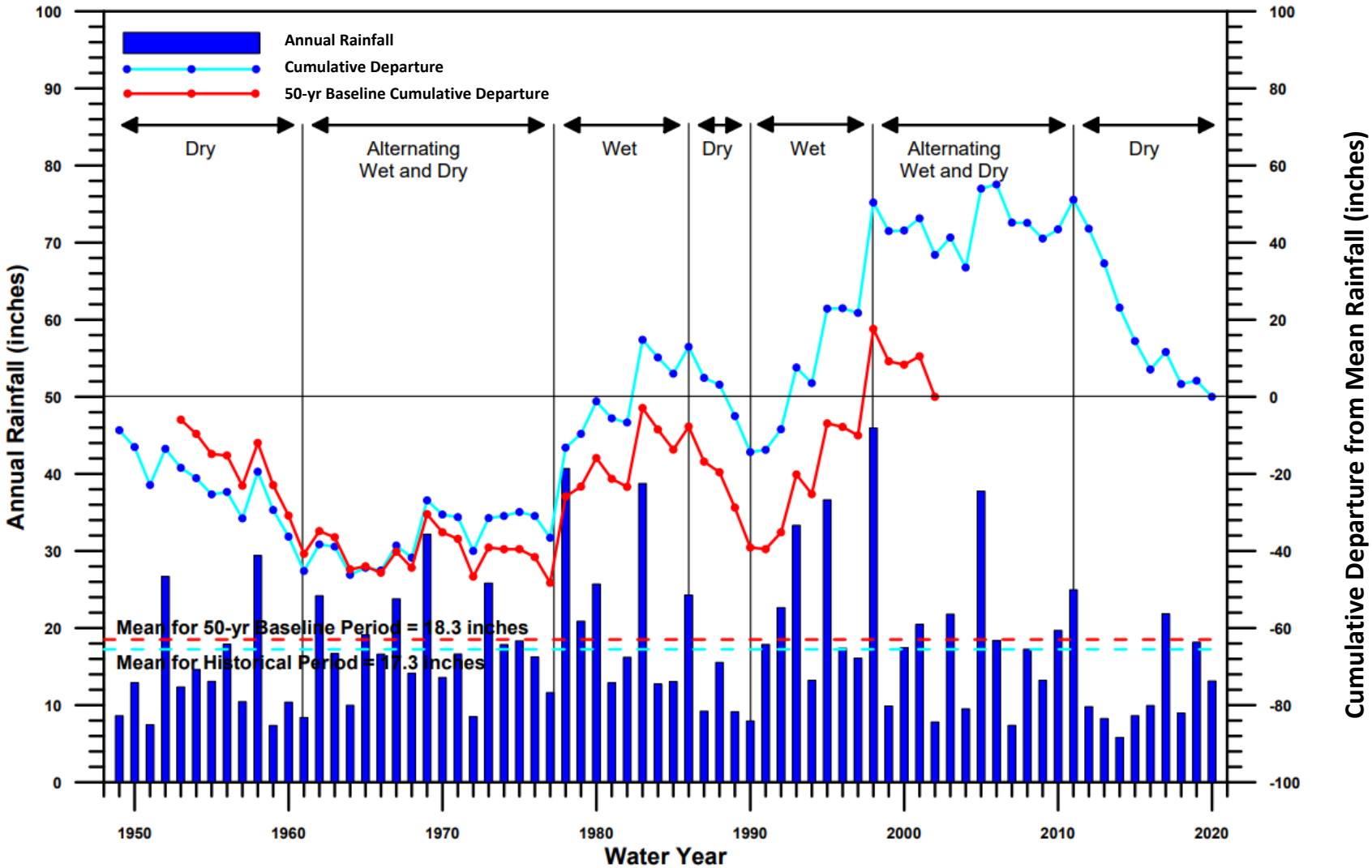


Figure 48. Historical Annual Rainfall at the Carpinteria Fire Station WY 1949-2020 [Pueblo, 2022]

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.

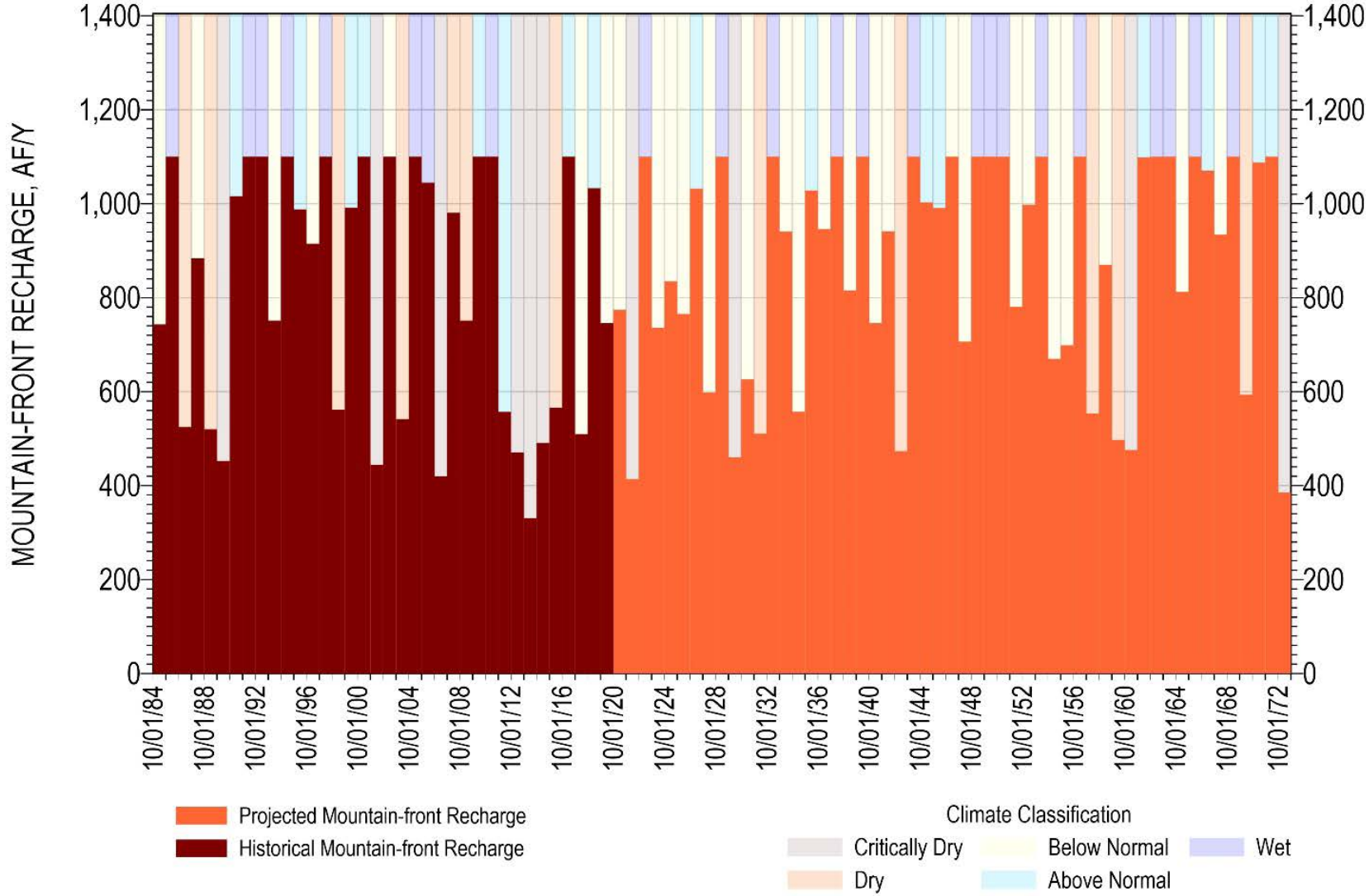


Figure 49. Historical and Projected Mountain-Front Recharge

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.

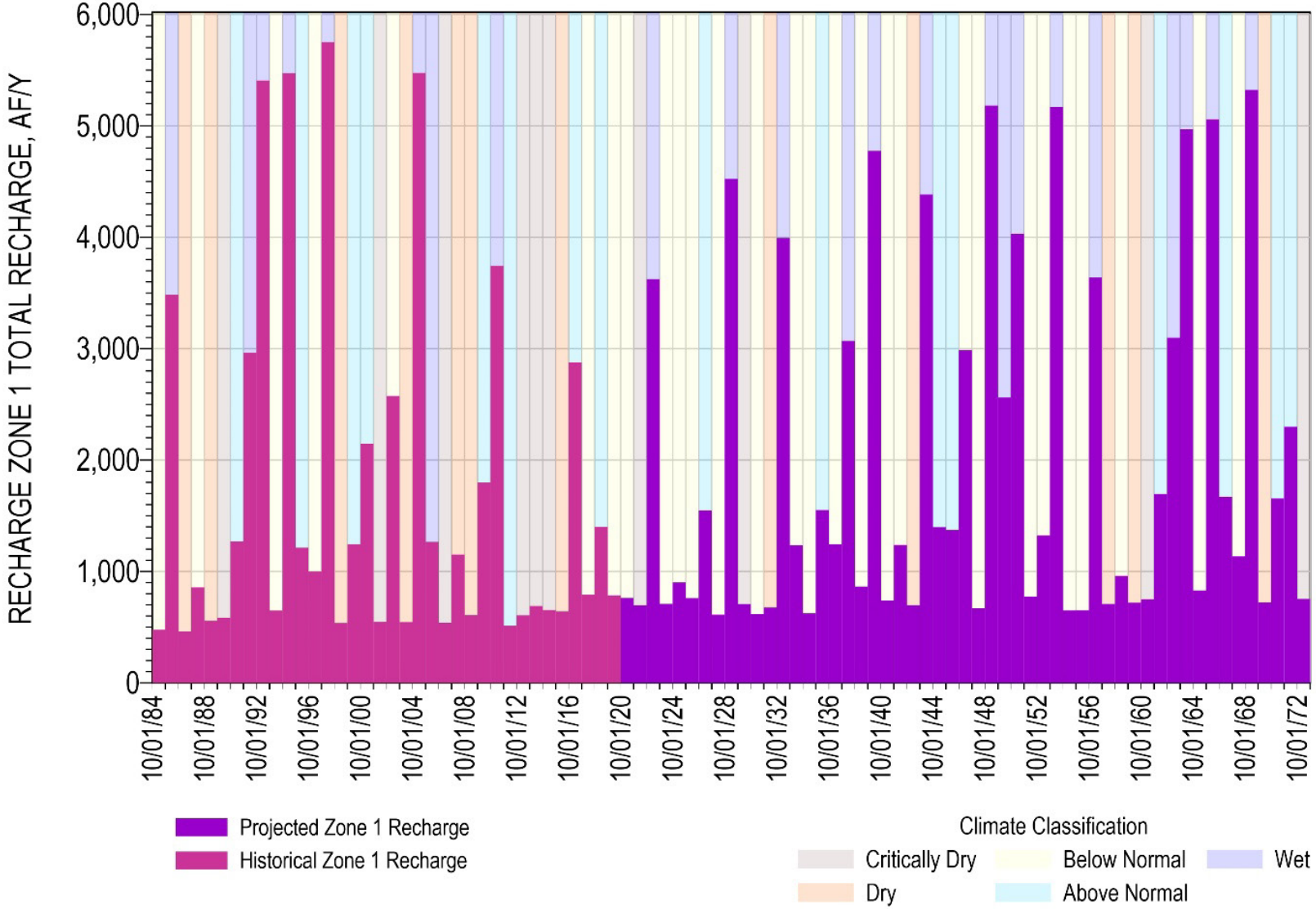


Figure 50. Historical and Projected Zone 1 Total Recharge

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.

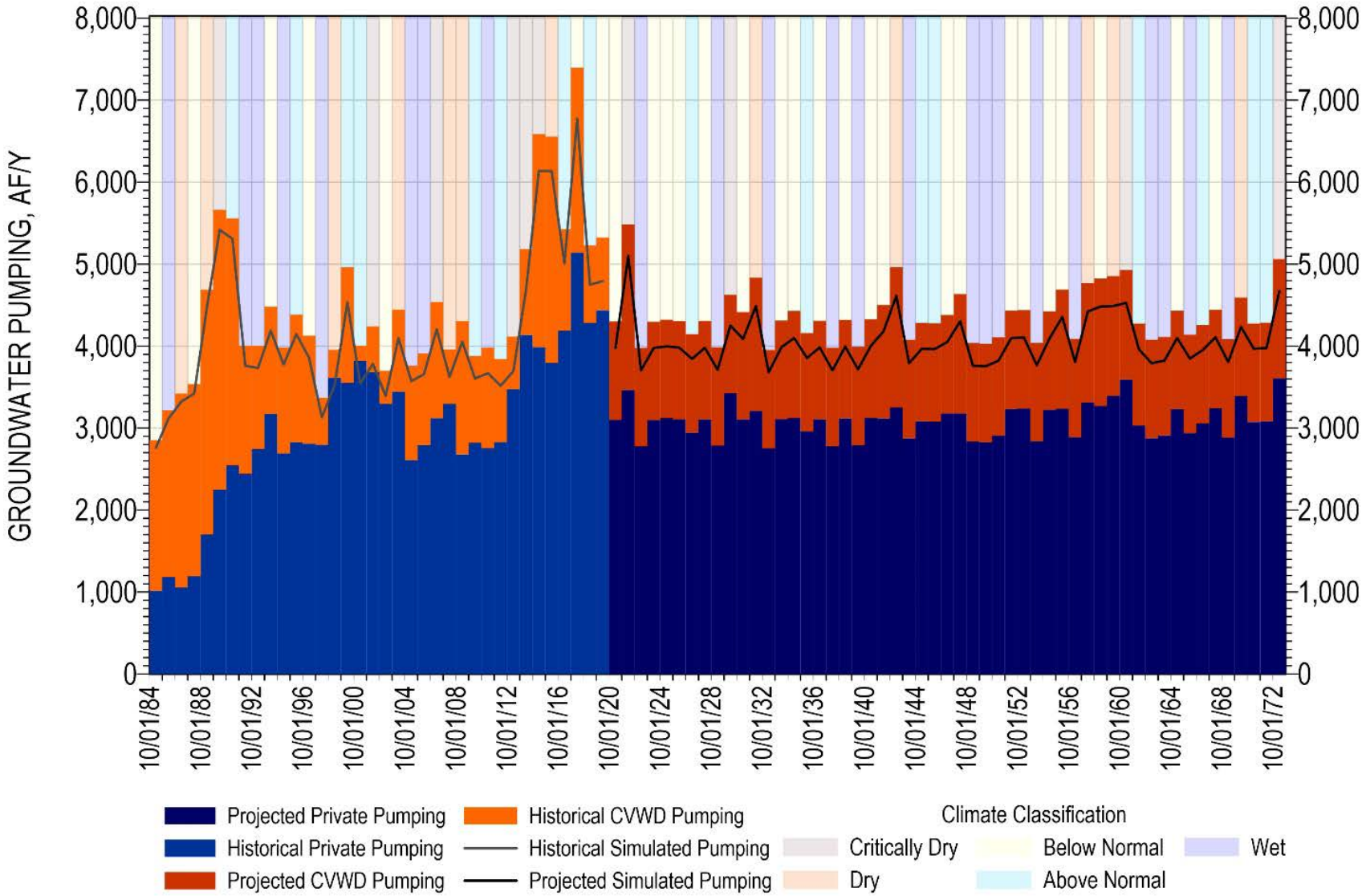


Figure 51. Historical and Projected Pumping

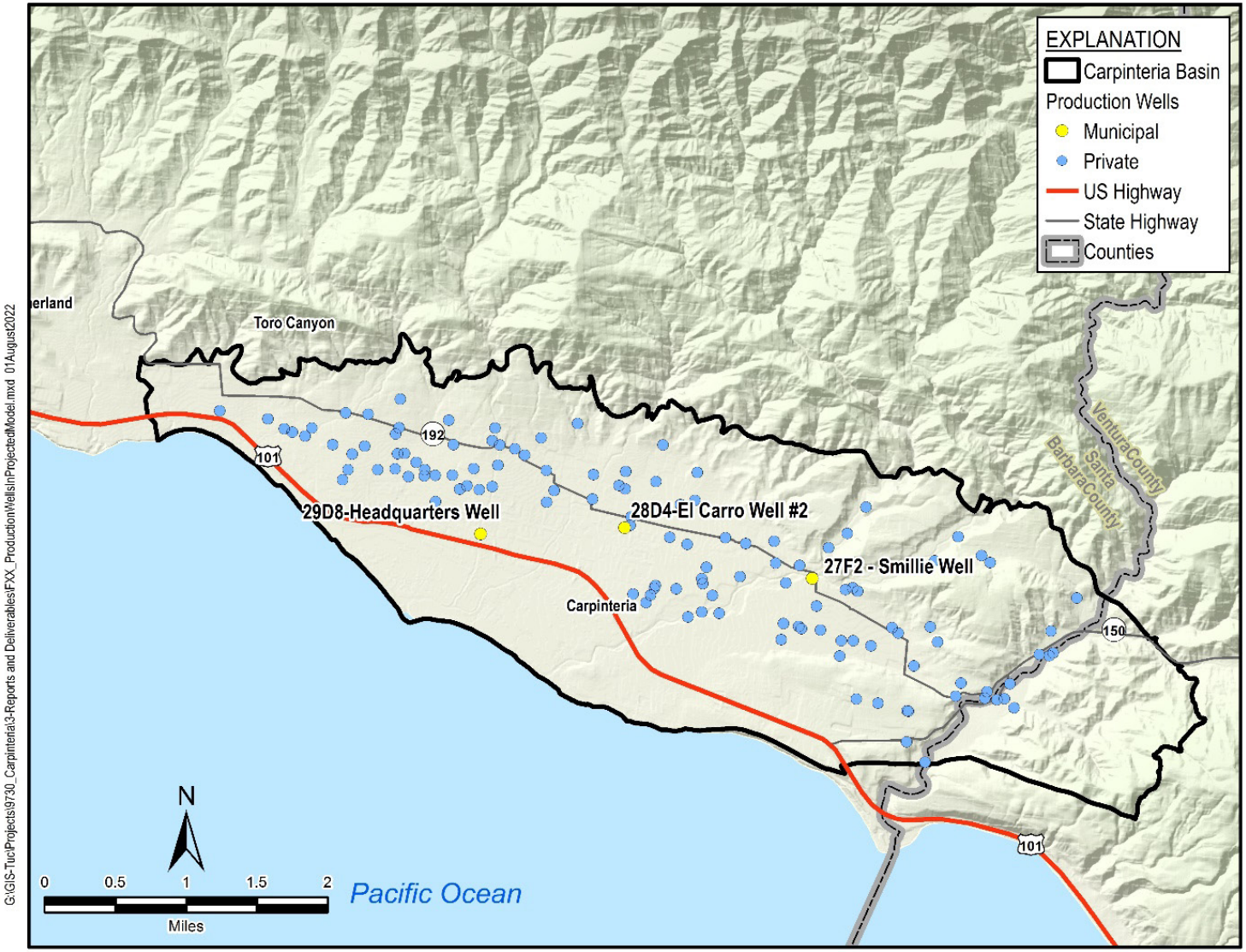


Figure 52. Projected MNW2 Well Locations

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.

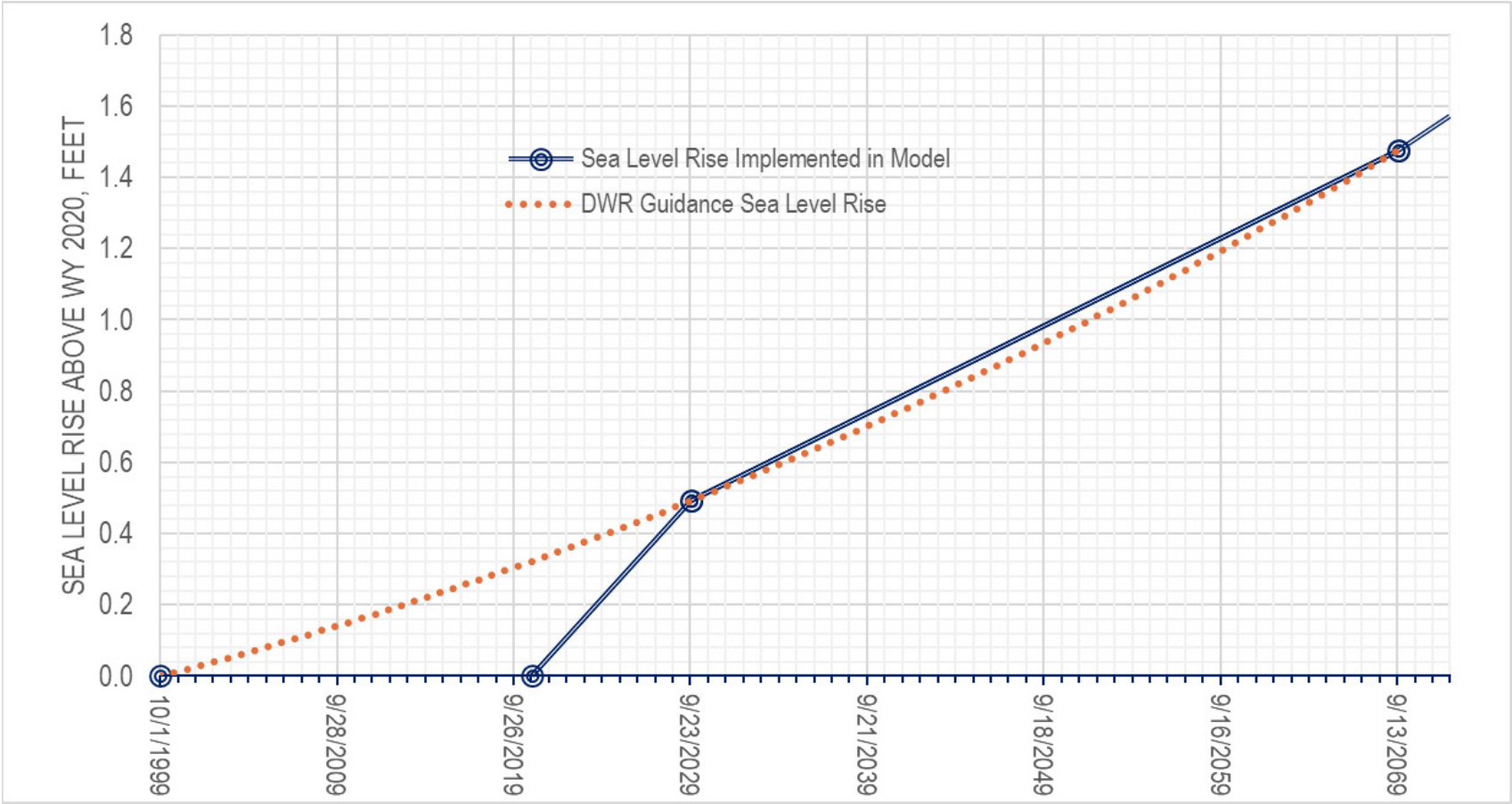


Figure 53. Projected Sea Level Rise

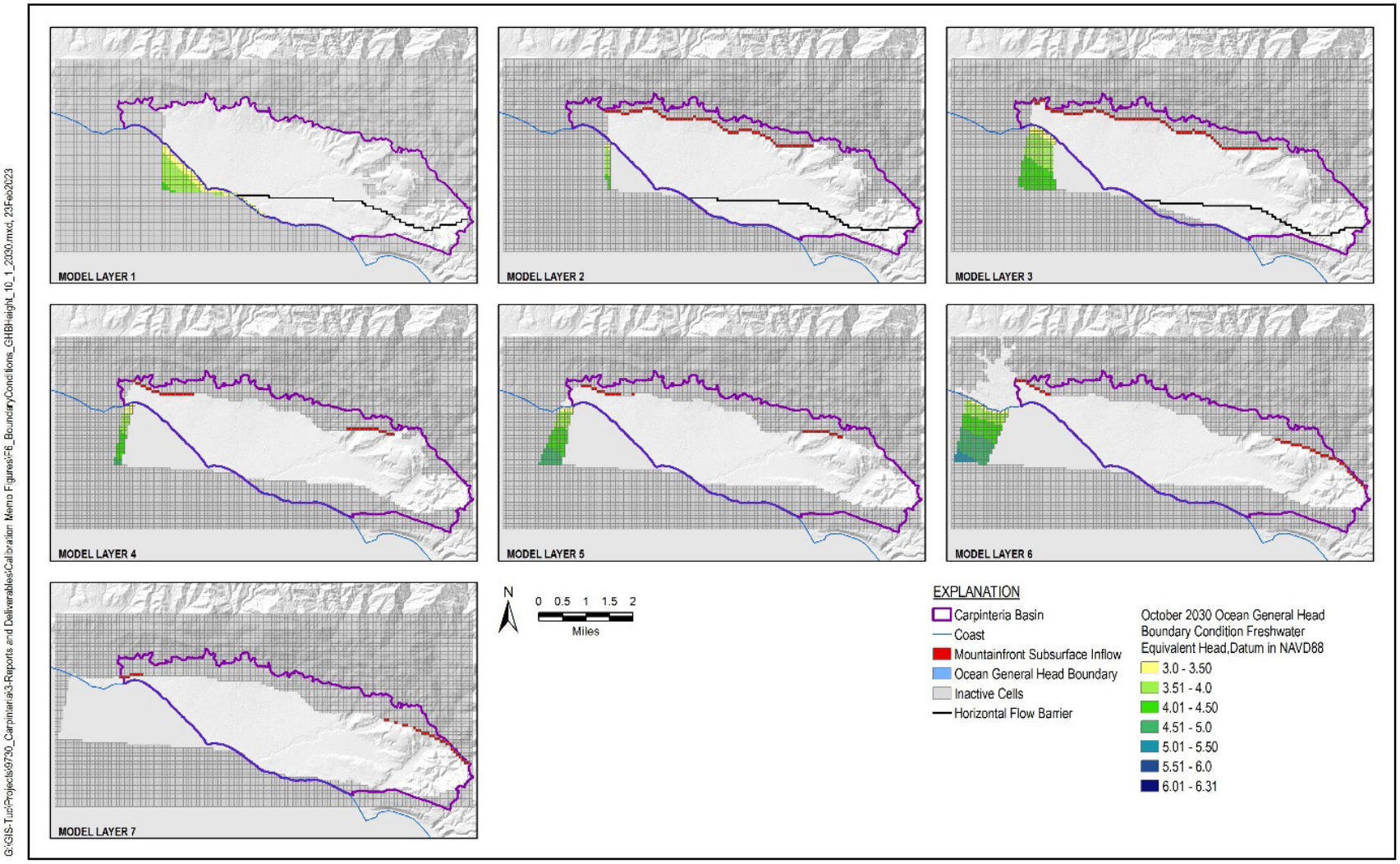


Figure 54. Ocean General Head Boundary 10/1/2030

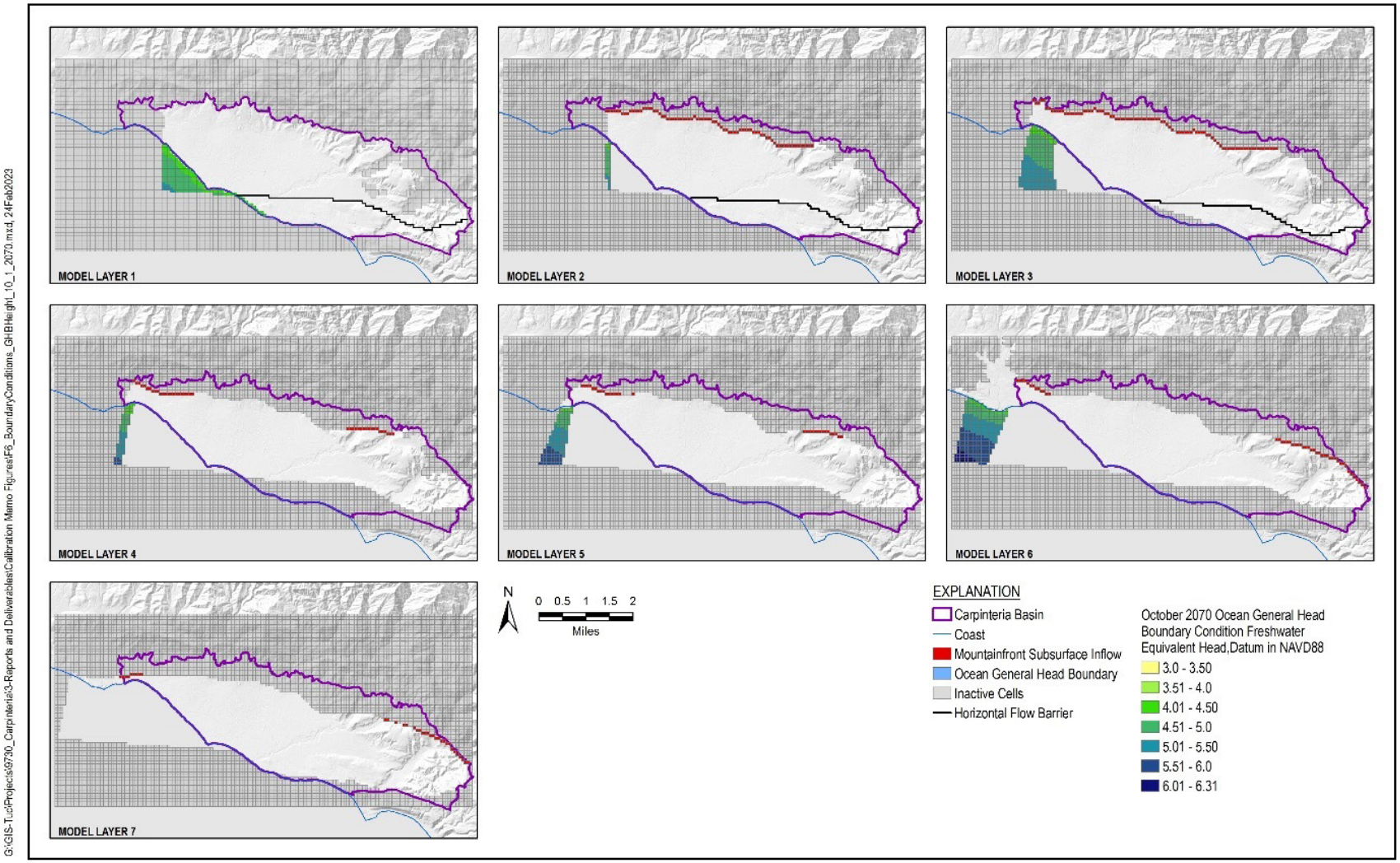


Figure 55. Ocean General Head Boundary 10/1/2070

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.

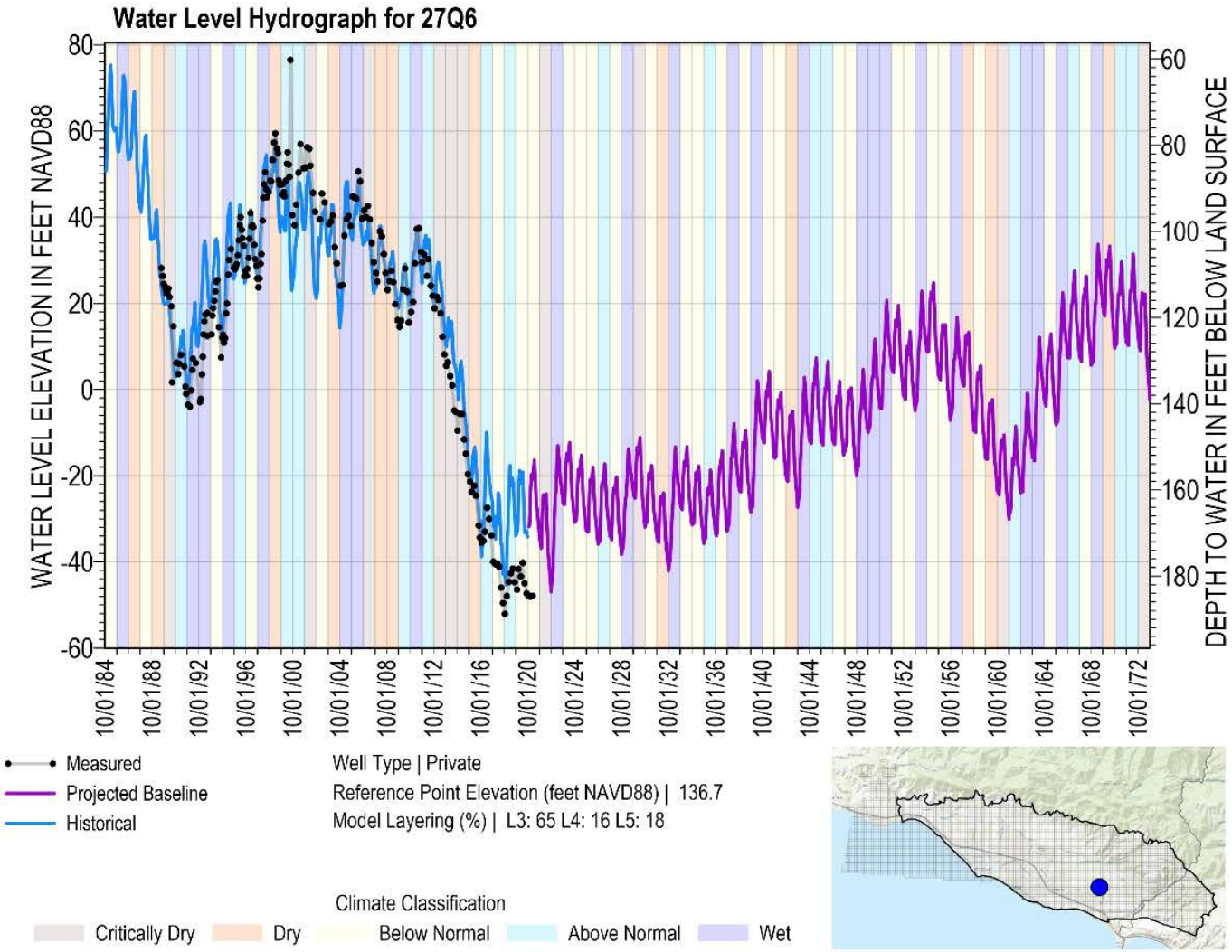


Figure 56. Historical and Projected Hydrograph for SU-1 Private Well 27Q6, Feet NAVD88

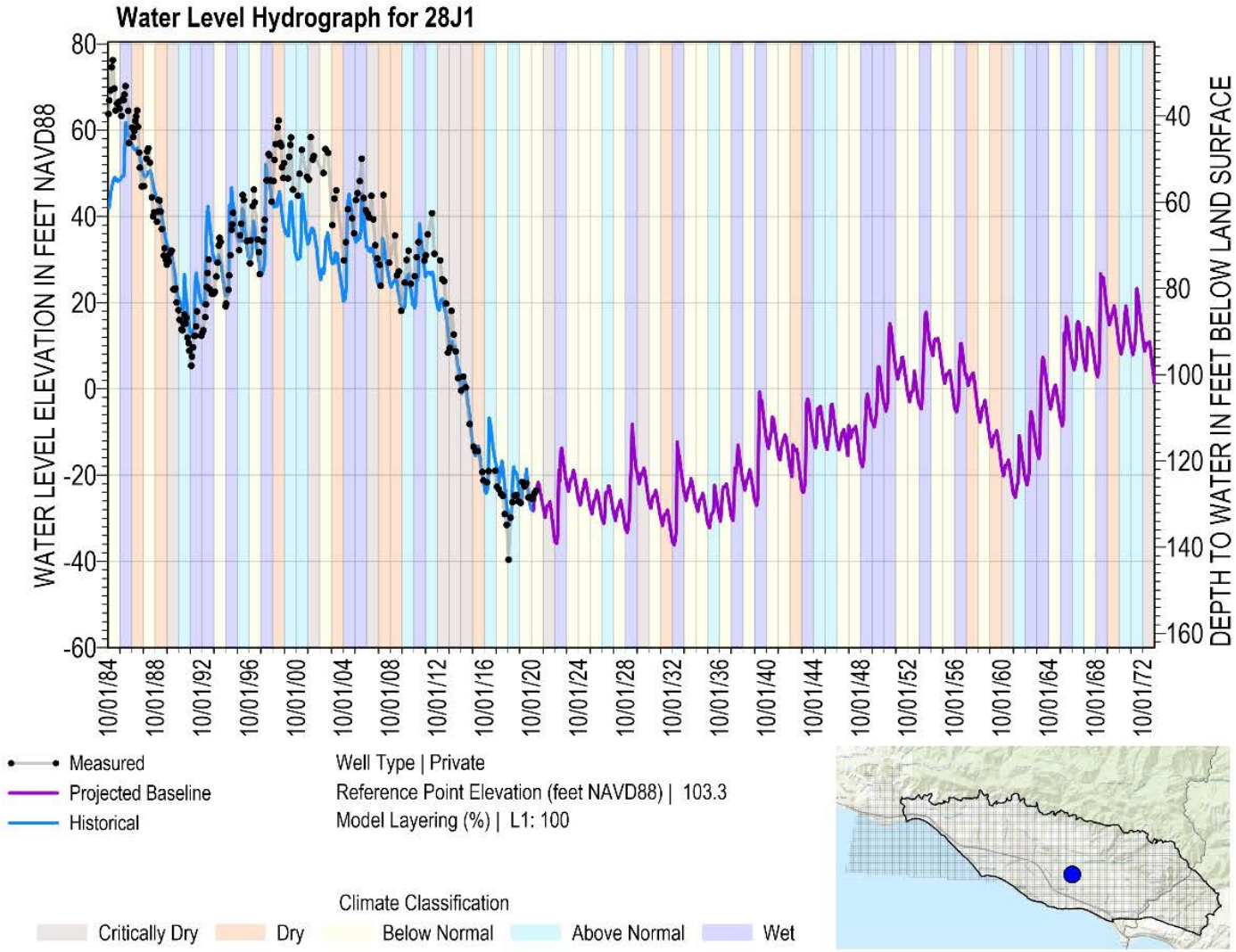


Figure 57. Historical and Projected Hydrograph for SU-1 Private Well 28J1, Feet NAVD88

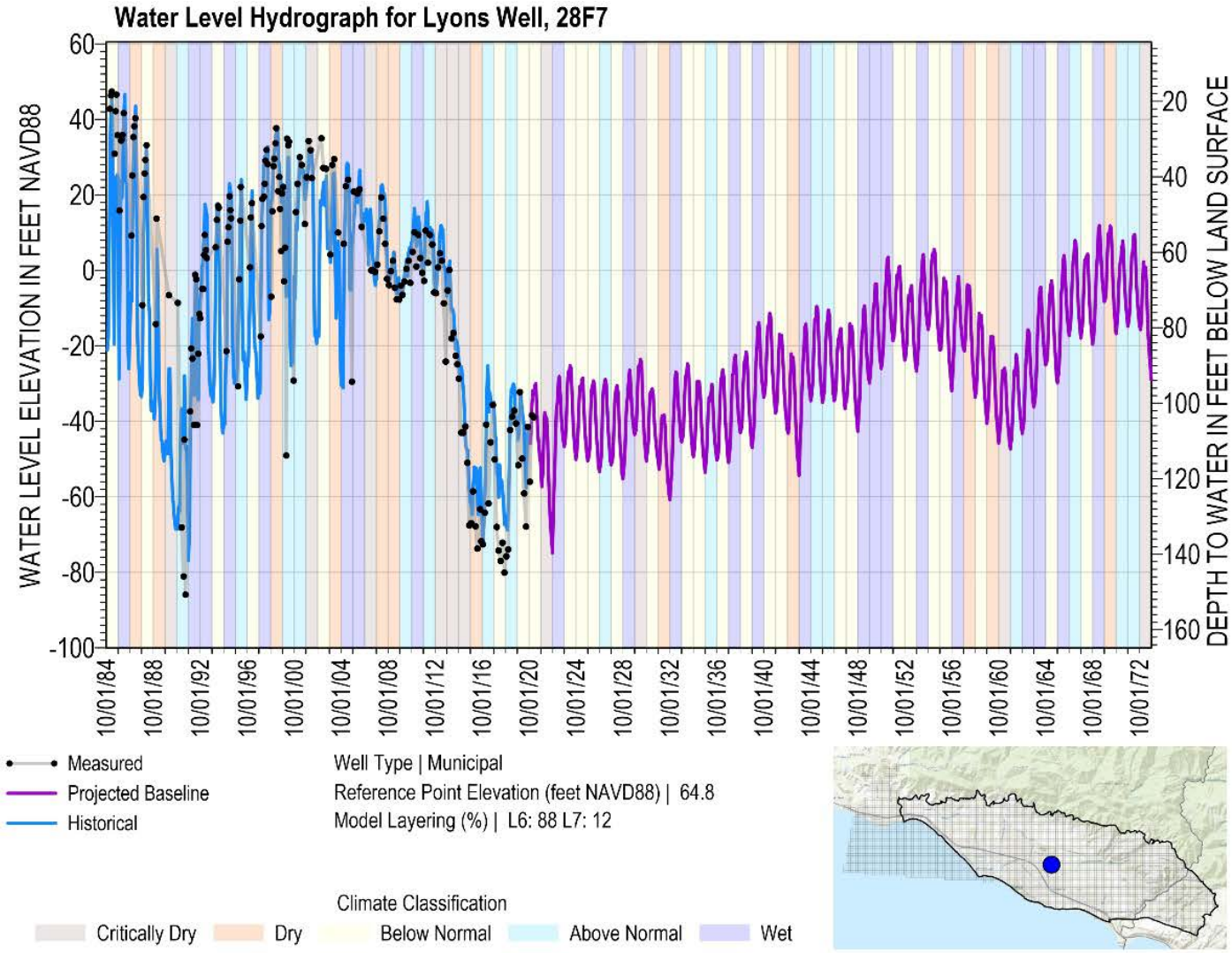


Figure 58. Historical and Projected Hydrograph for SU-1 Lyons Municipal Well (28F7), Feet NAVD88

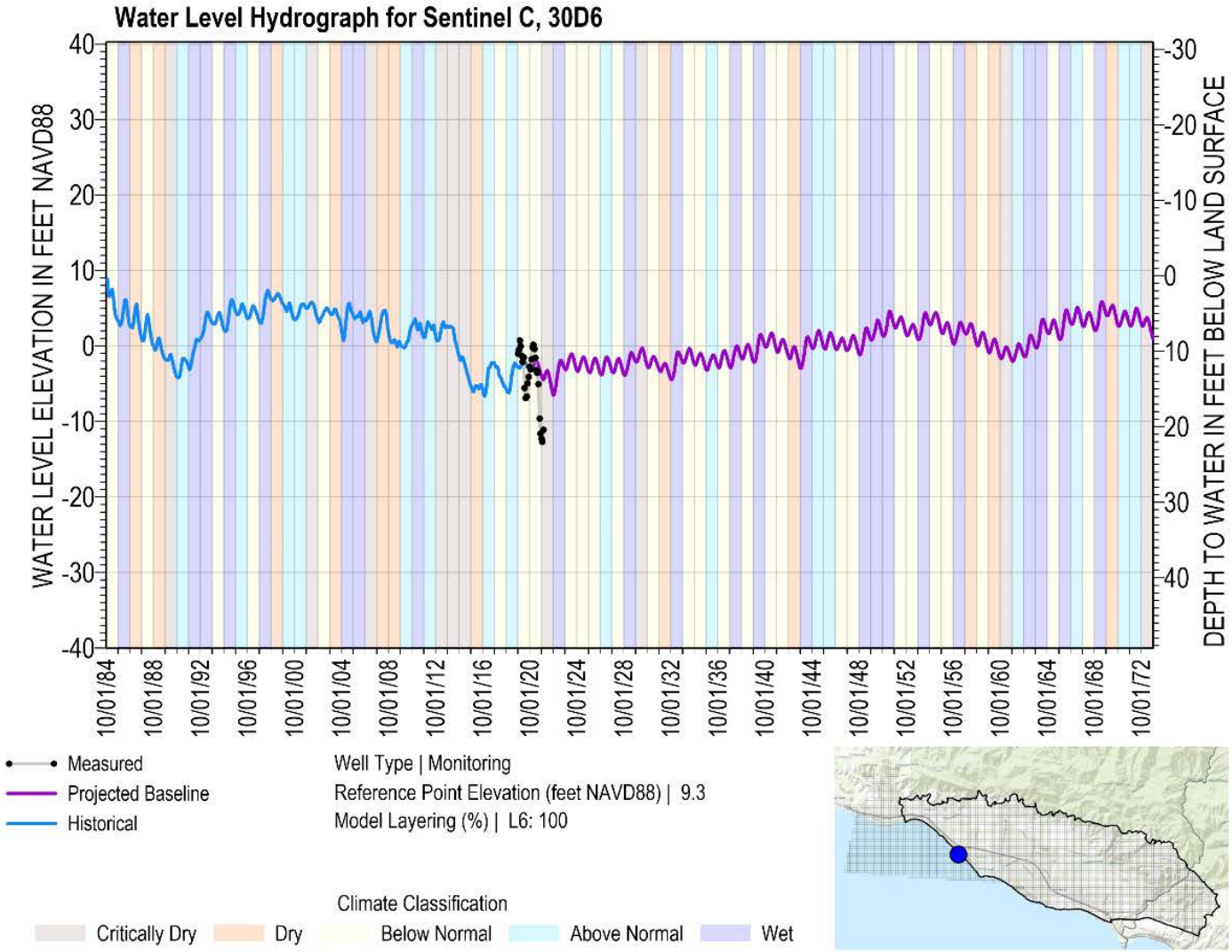


Figure 59. Historical and Projected Hydrograph for SU-1 Monitoring Well Sentinel C (30D8), Feet NAVD88

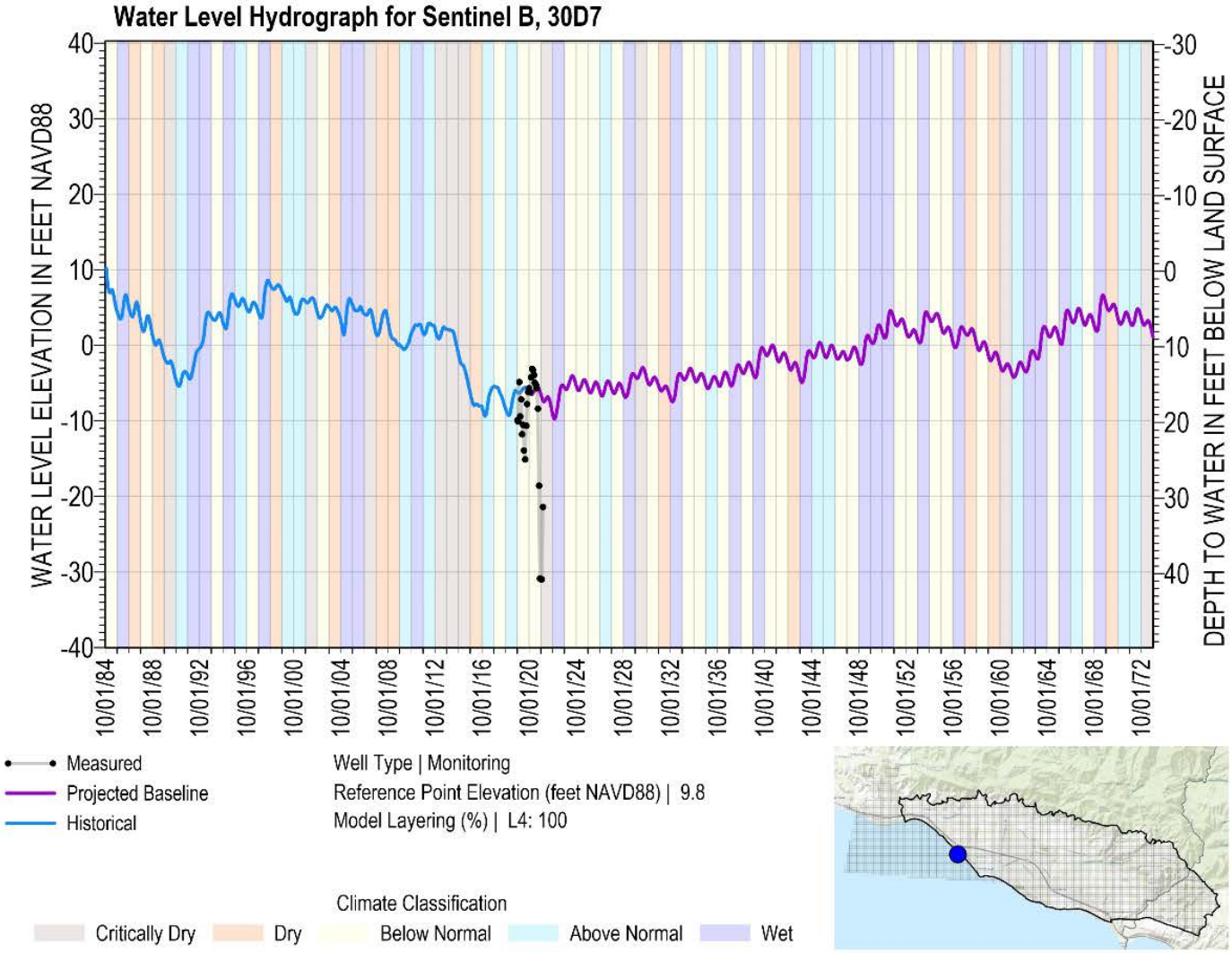


Figure 60. Historical and Projected Hydrograph for SU-1 Monitoring Well Sentinel B (30D7), Feet NAVD88

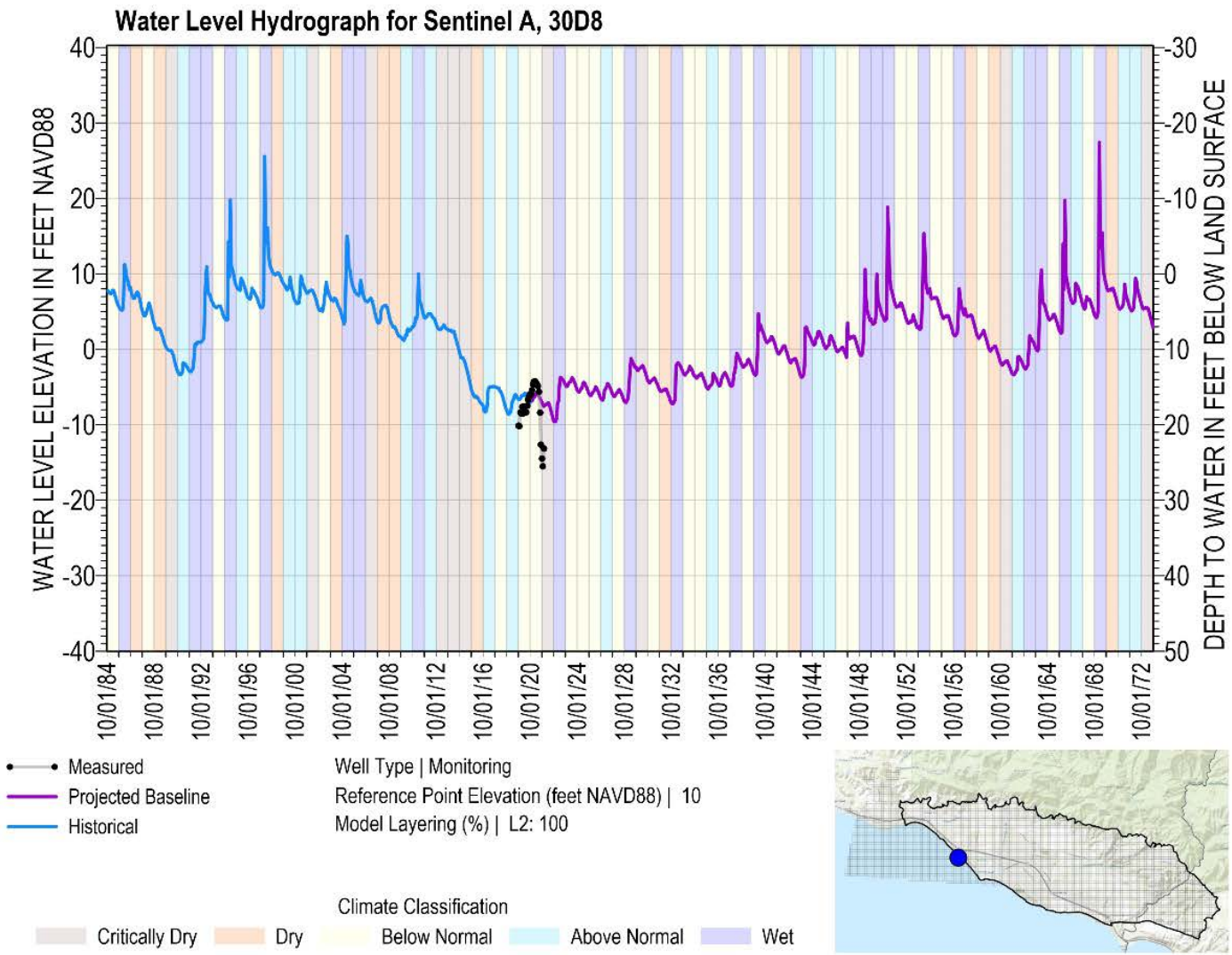


Figure 61. Historical and Projected Hydrograph for SU-1 Monitoring Well Sentinel A (30D8), Feet NAVD88

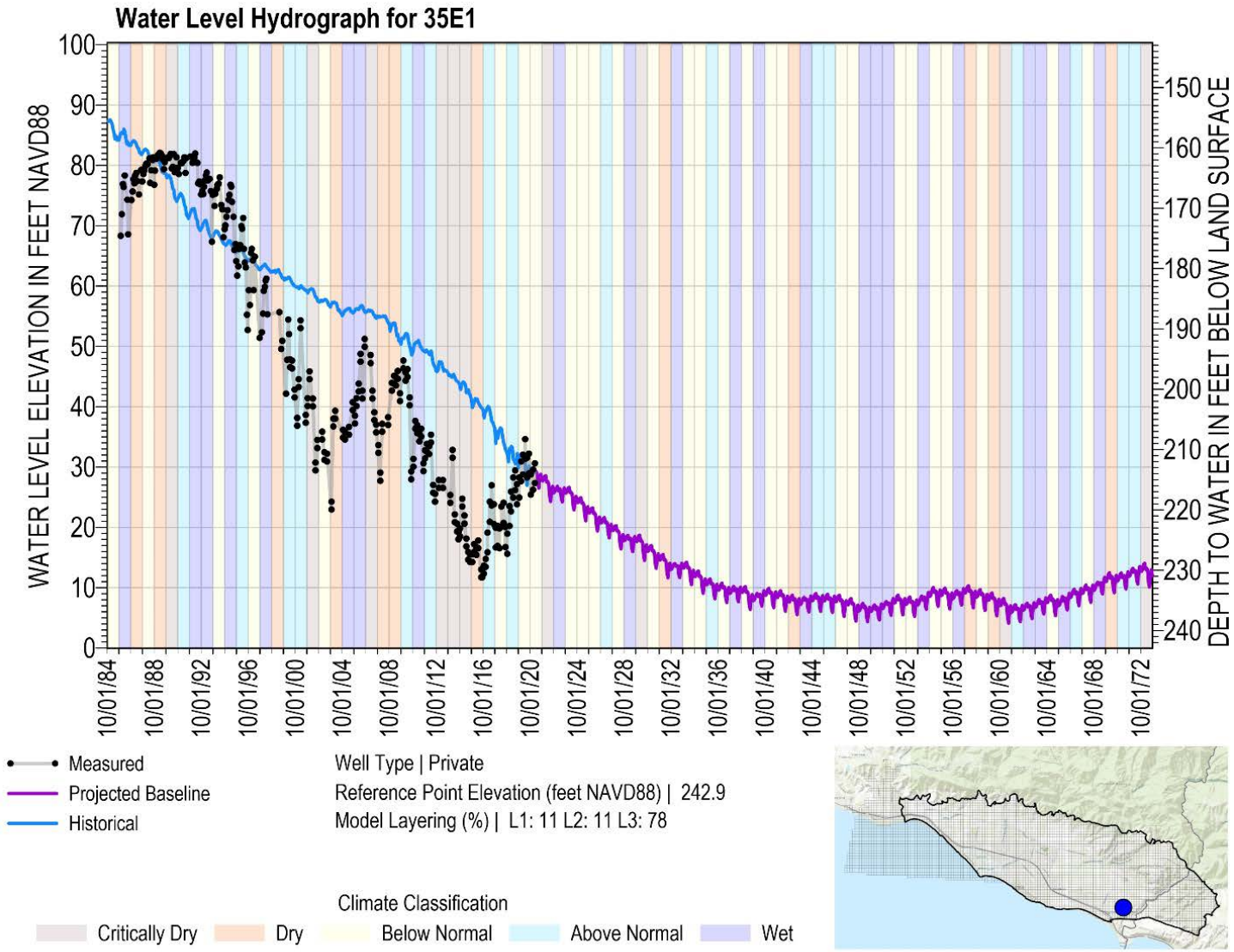


Figure 62. Historical and Projected Hydrograph for SU-2 Private Well 35E1, Feet NAVD88

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.

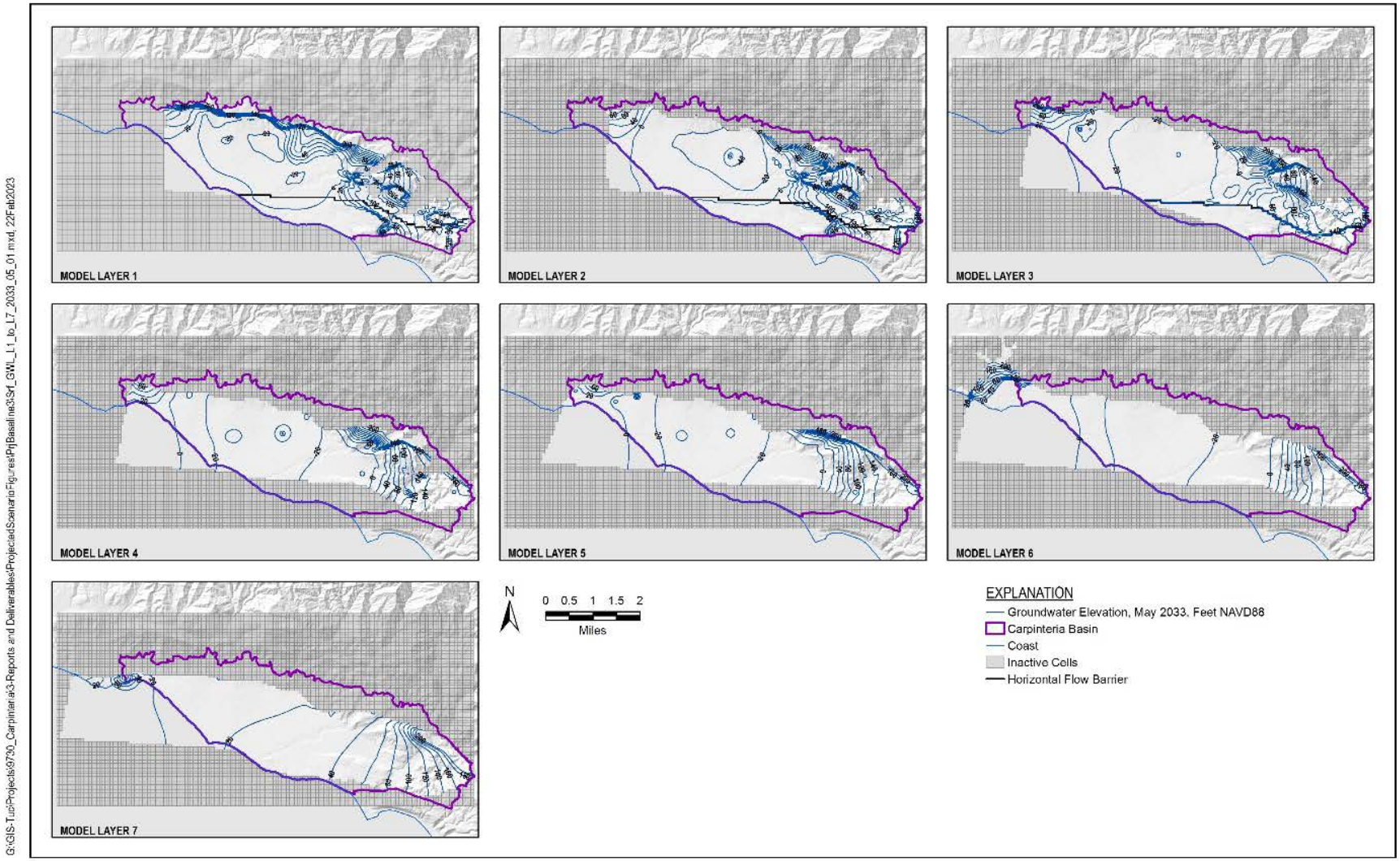


Figure 63. Simulated Groundwater Elevation Contours, May 2033

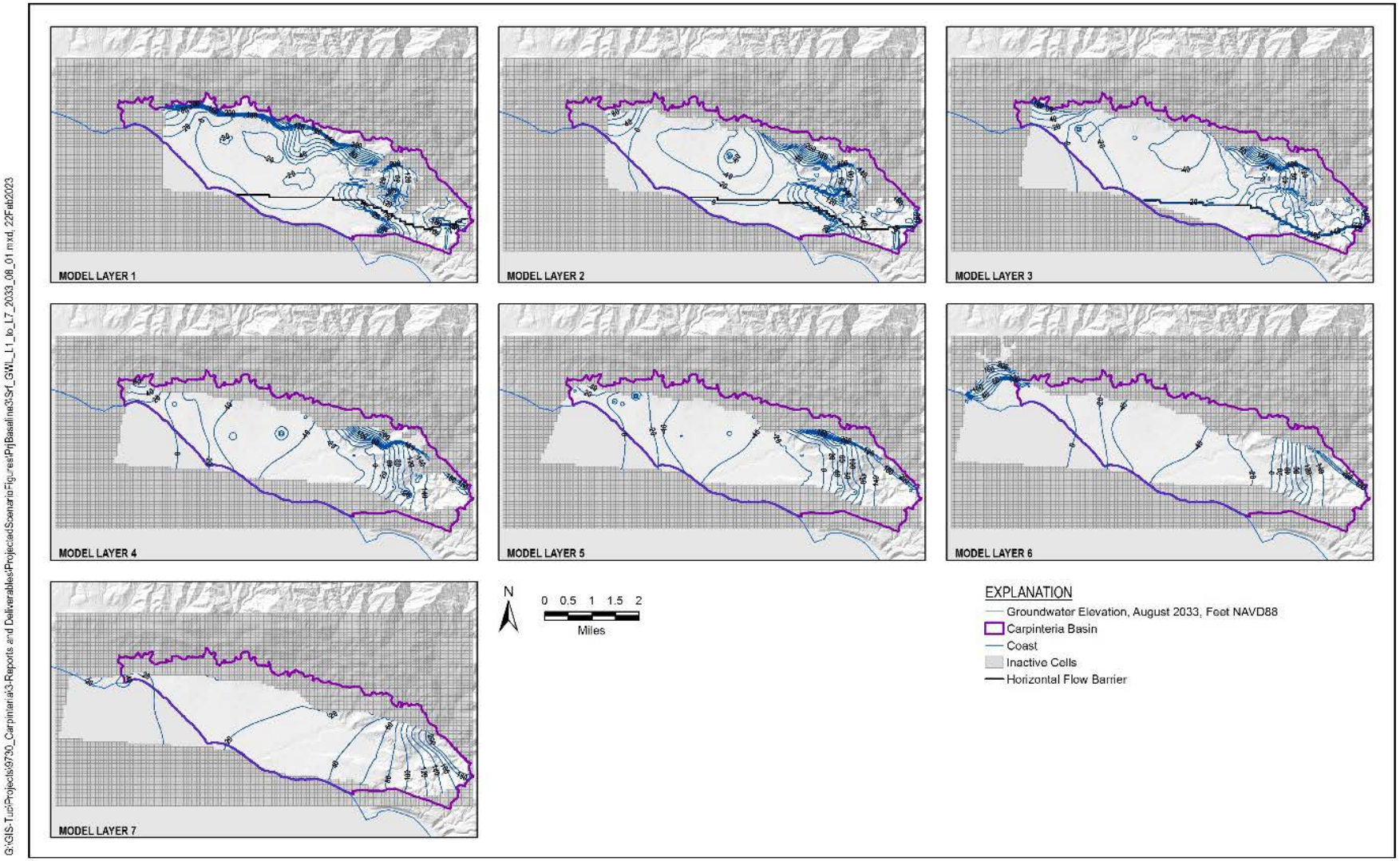


Figure 64. Simulated Groundwater Elevation Contours, August 2033

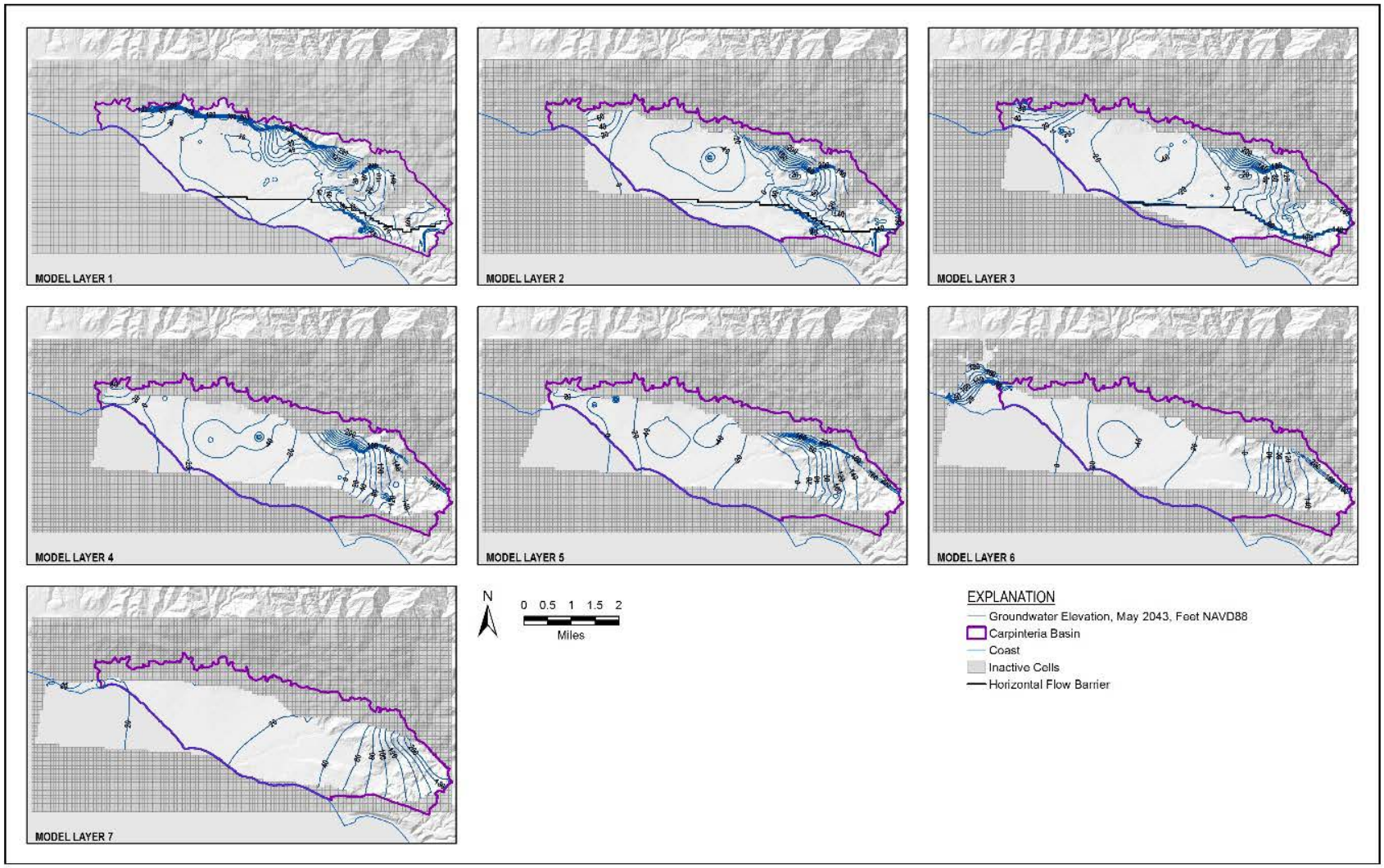


Figure 65. Simulated Groundwater Elevation Contours, May 2043

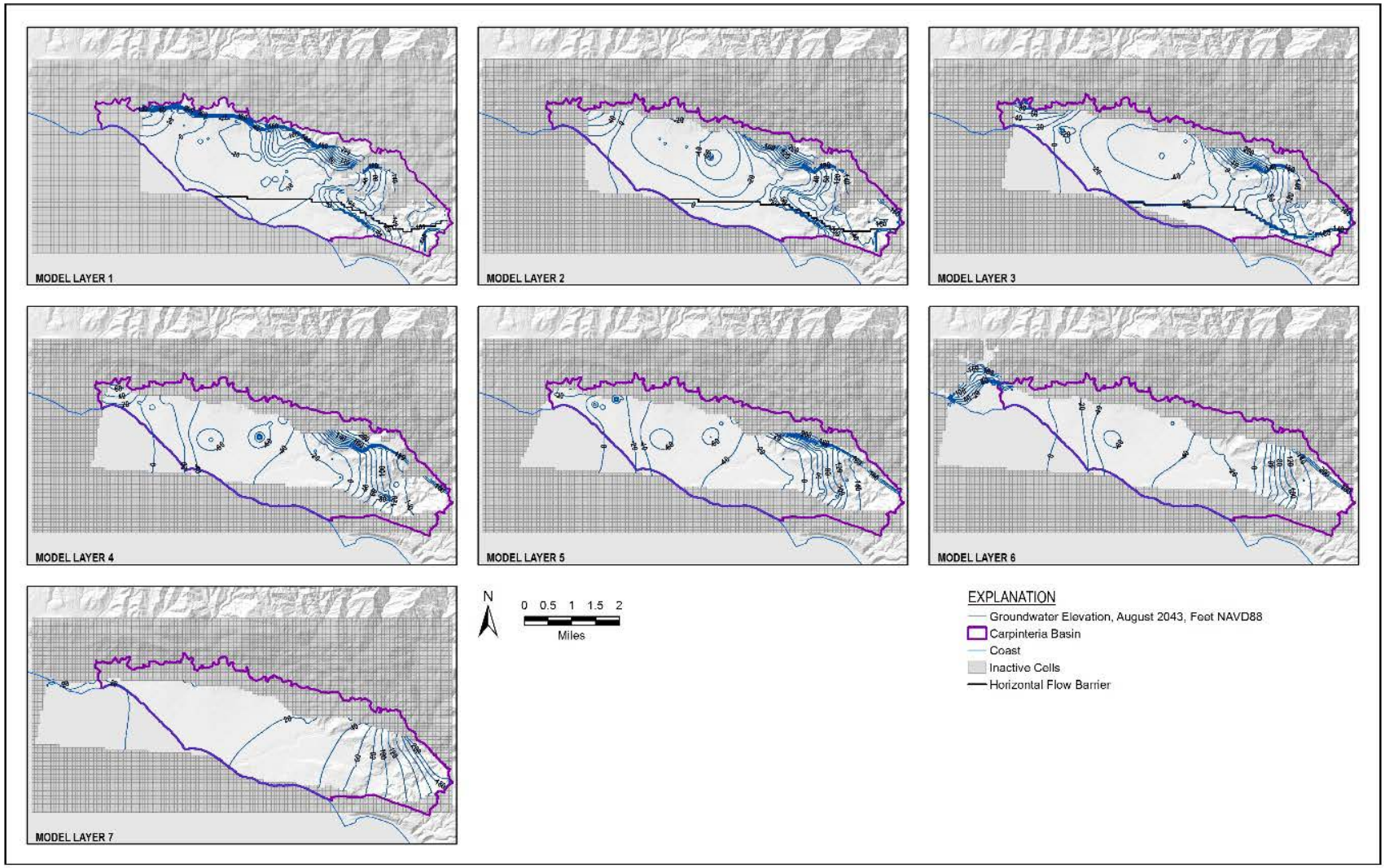


Figure 66. Simulated Groundwater Elevation Contours, August 2043

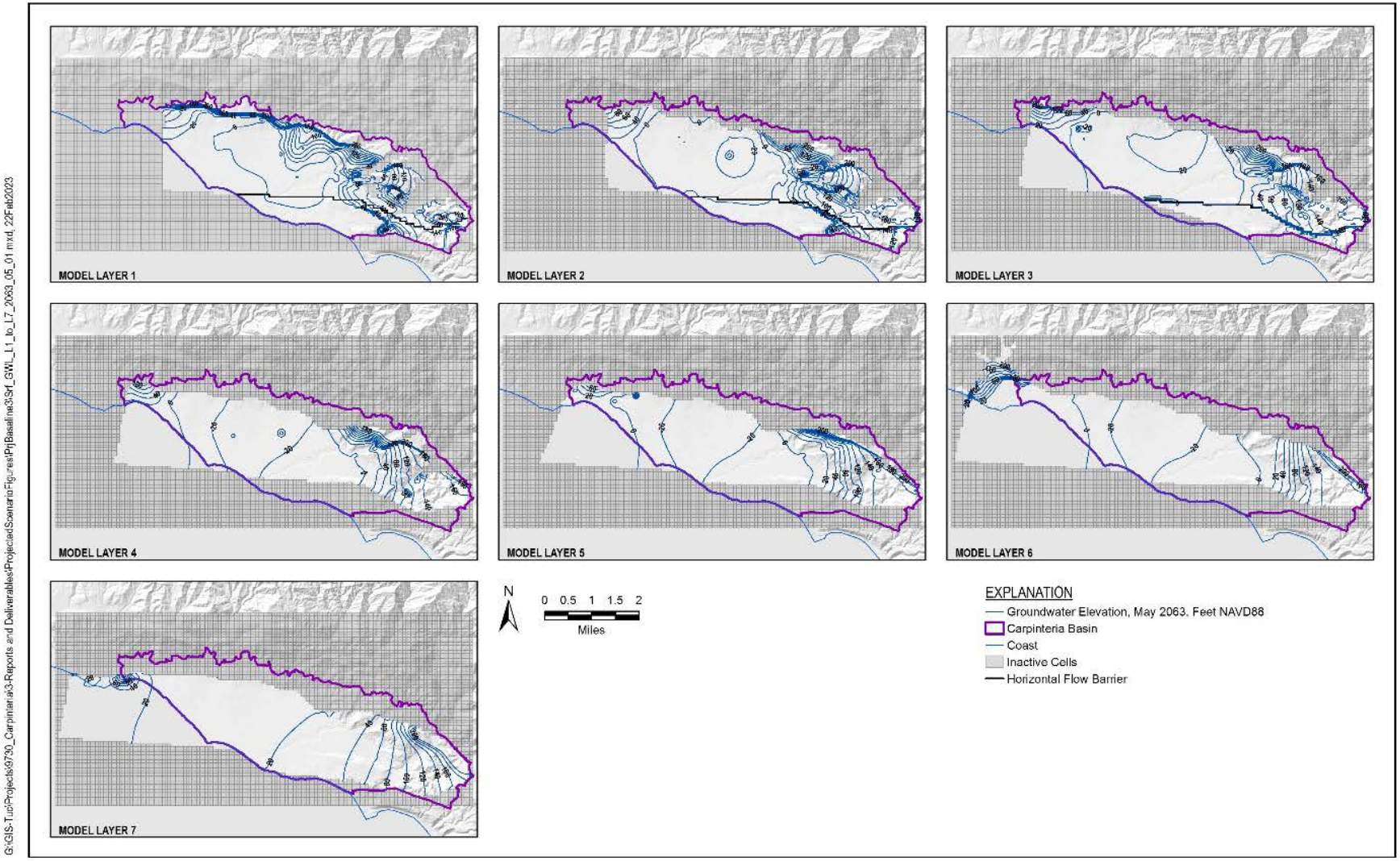


Figure 67. Simulated Groundwater Elevation Contours, May 2063

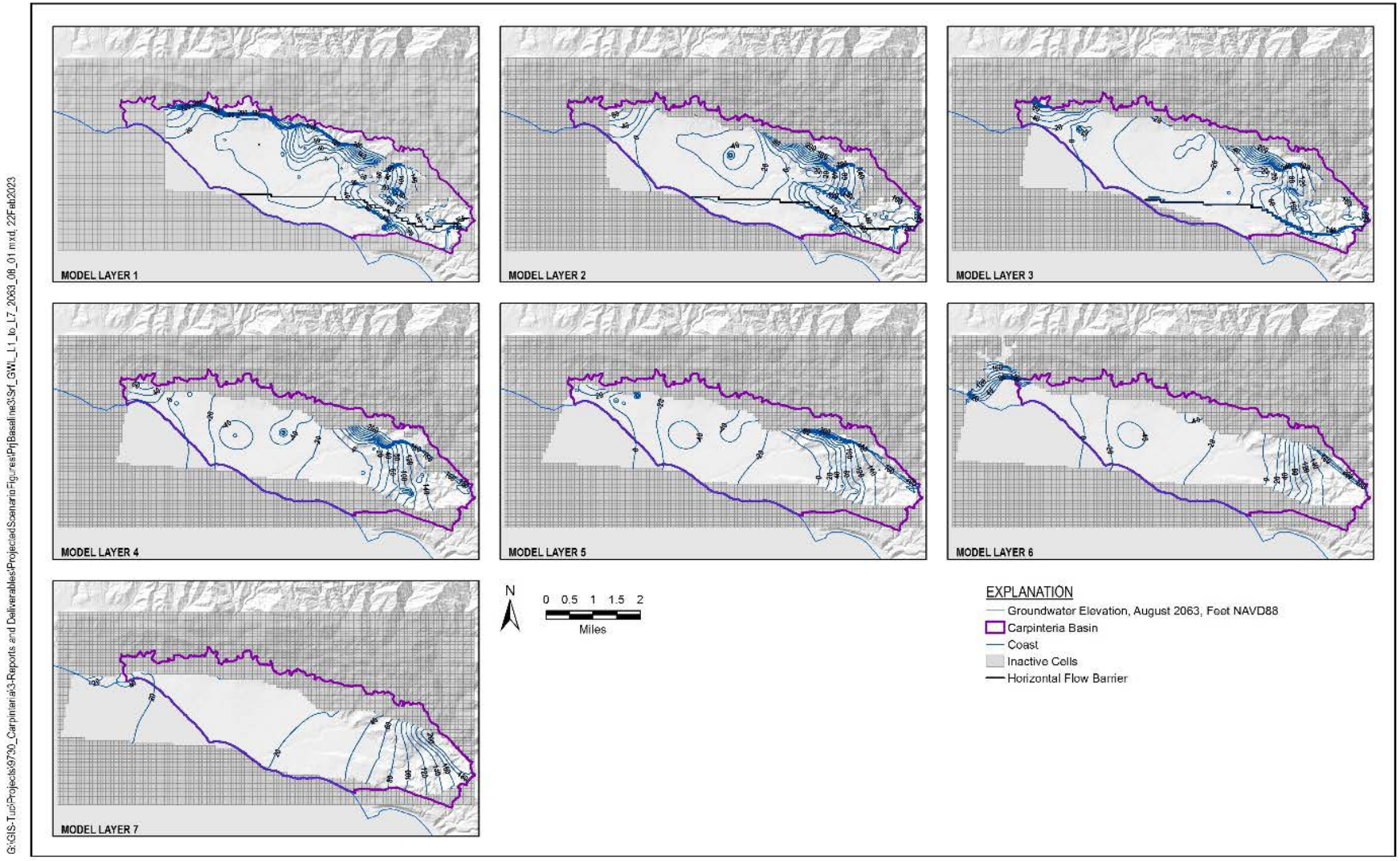


Figure 68. Simulated Groundwater Elevation Contours, August 2063

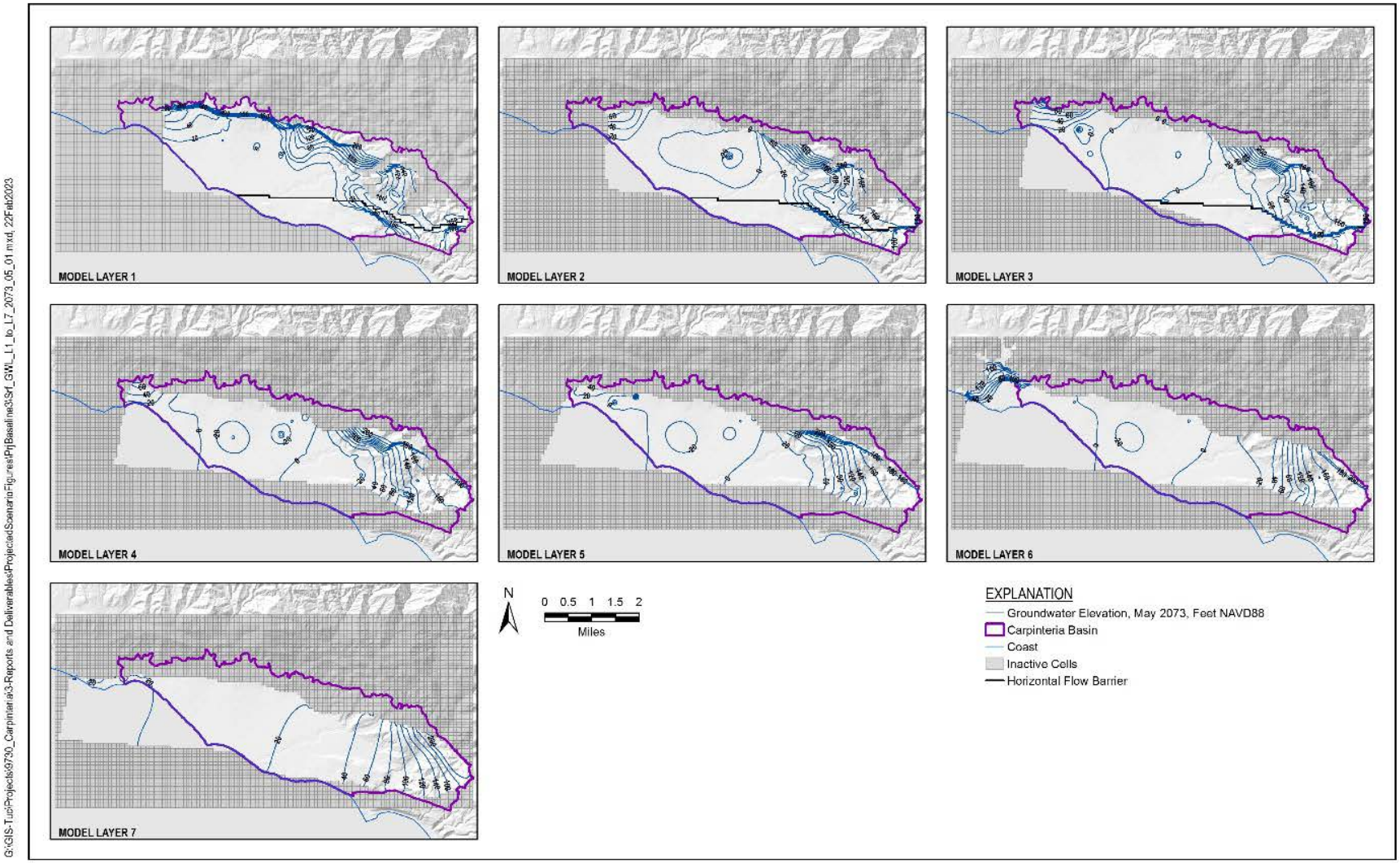


Figure 69. Simulated Groundwater Elevation Contours, May 2073

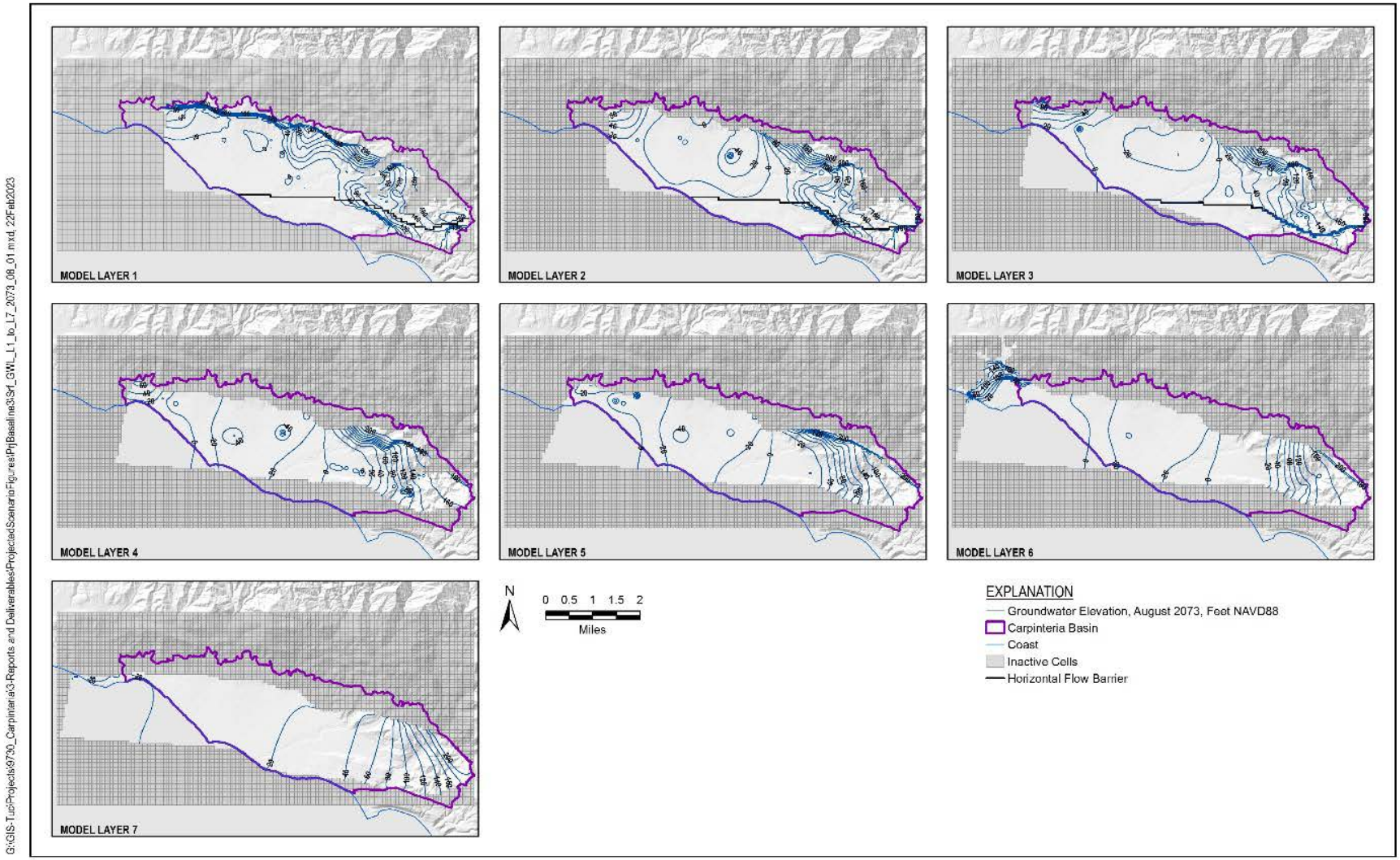


Figure 70. Simulated Groundwater Elevation Contours, August 2073

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

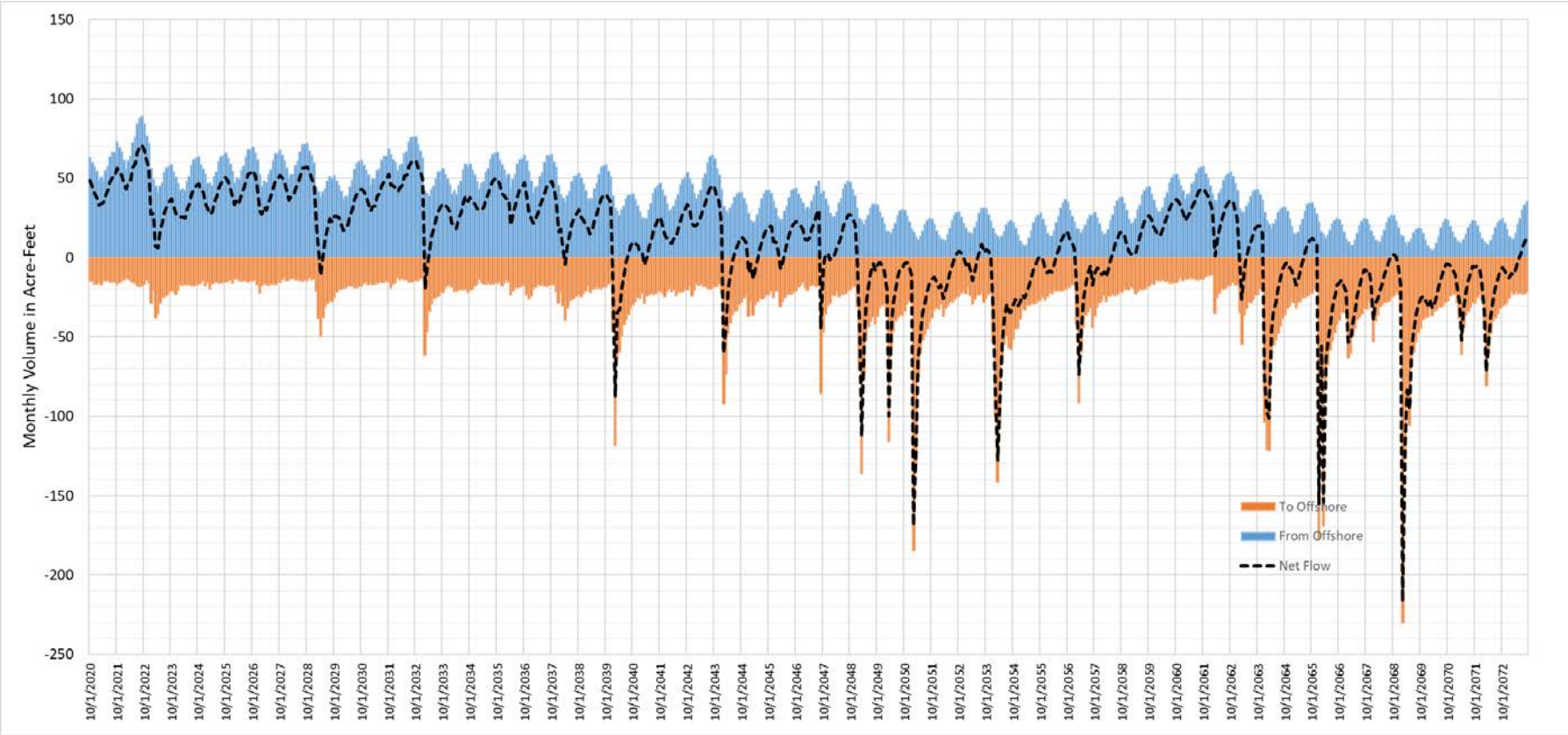


Figure 71. Carpinteria Basin Projected Flow to and from Offshore

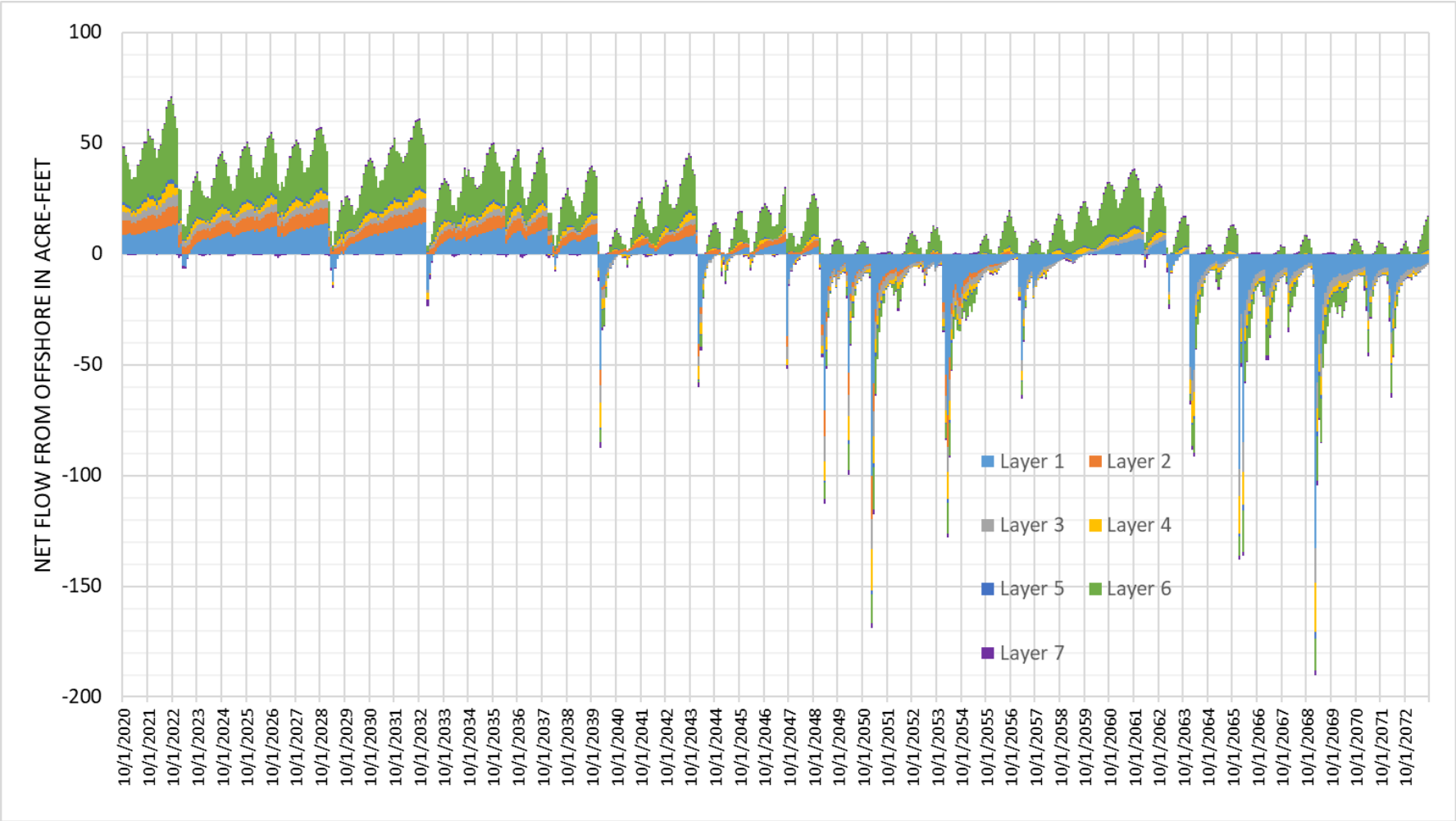


Figure 72. Carpinteria Basin Projected Net Flow from Offshore by Layer

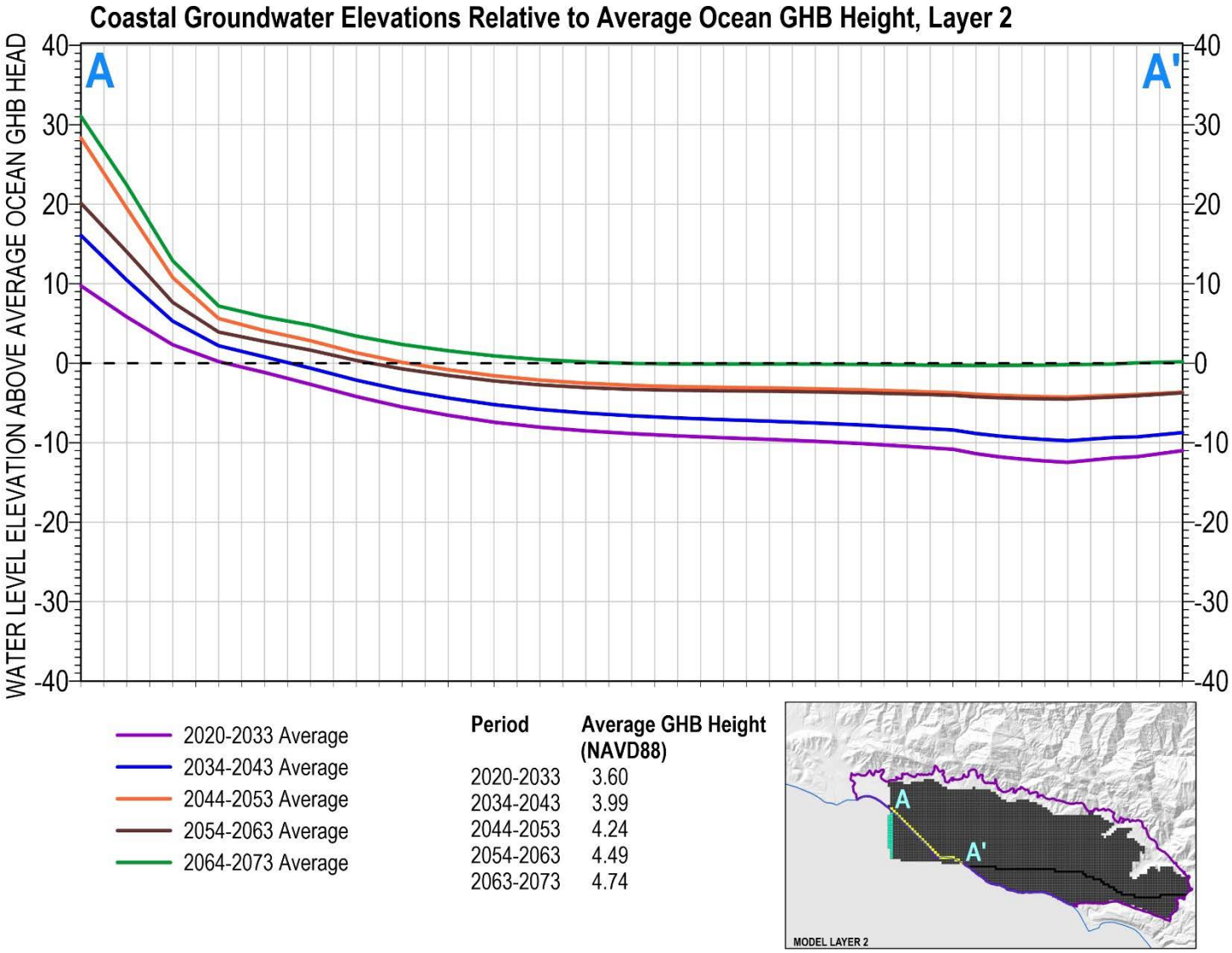


Figure 73. Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 2

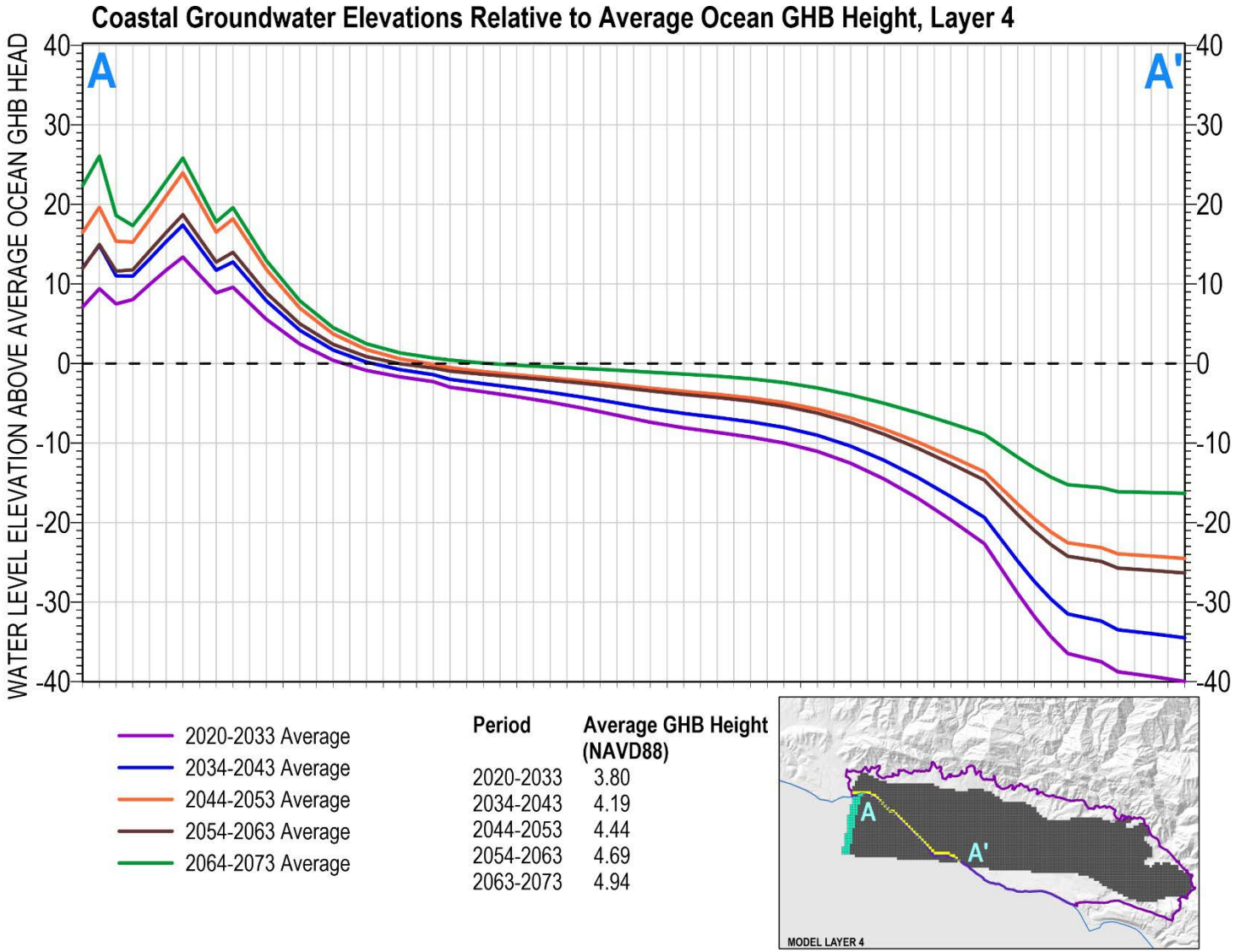


Figure 74. Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 4

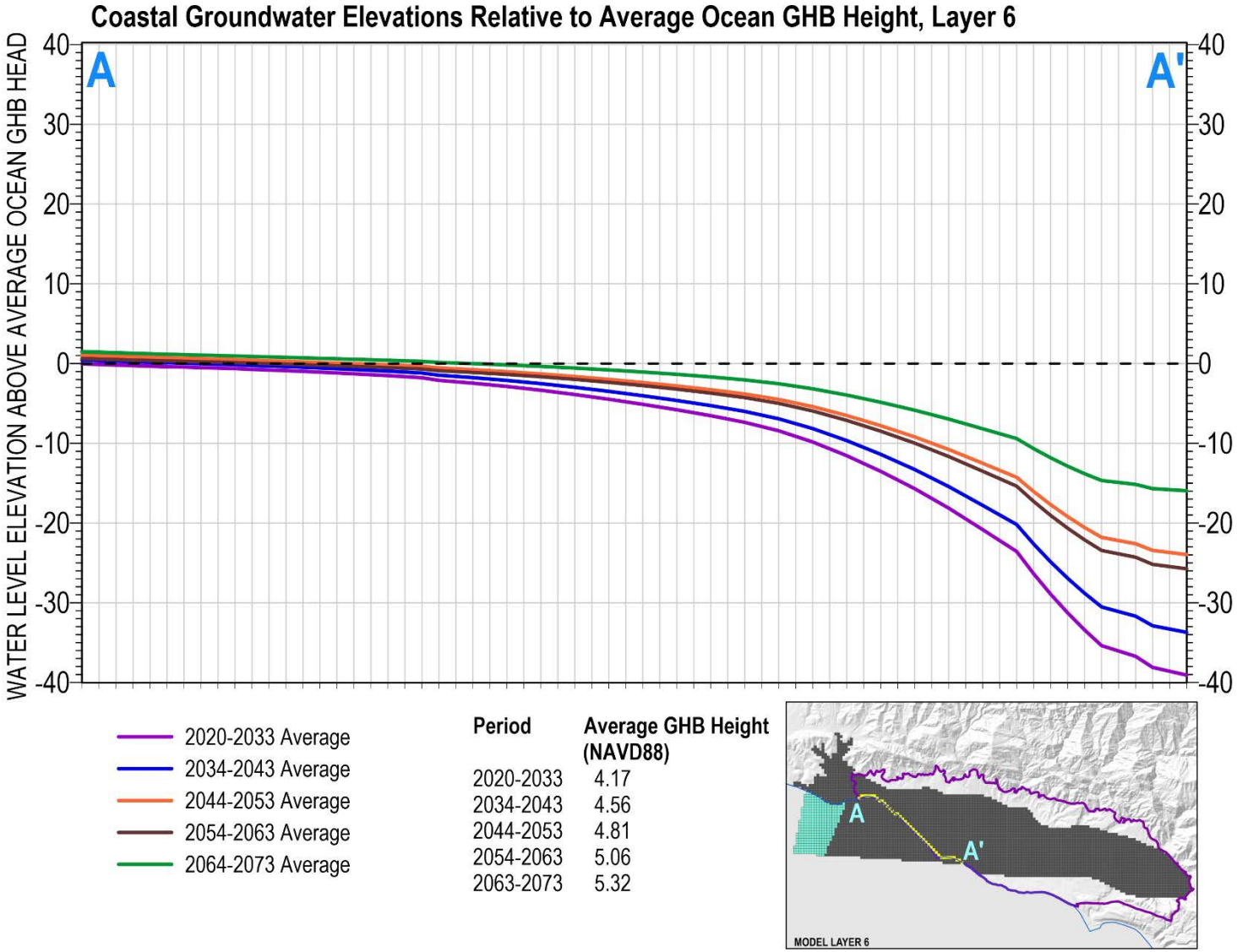


Figure 75. Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 6

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

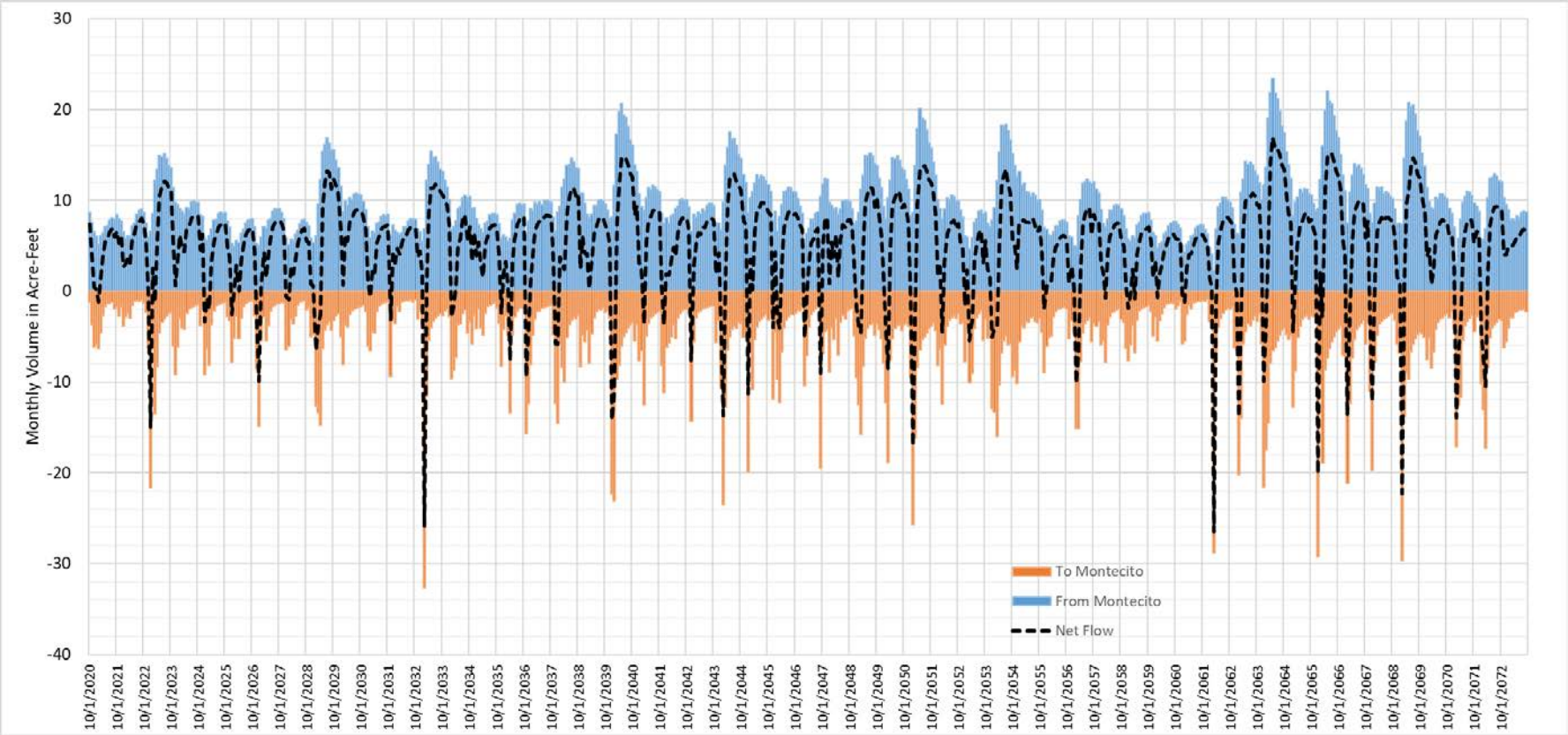


Figure 76. Carpinteria Basin Projected Flow to and from Montecito Basin

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.

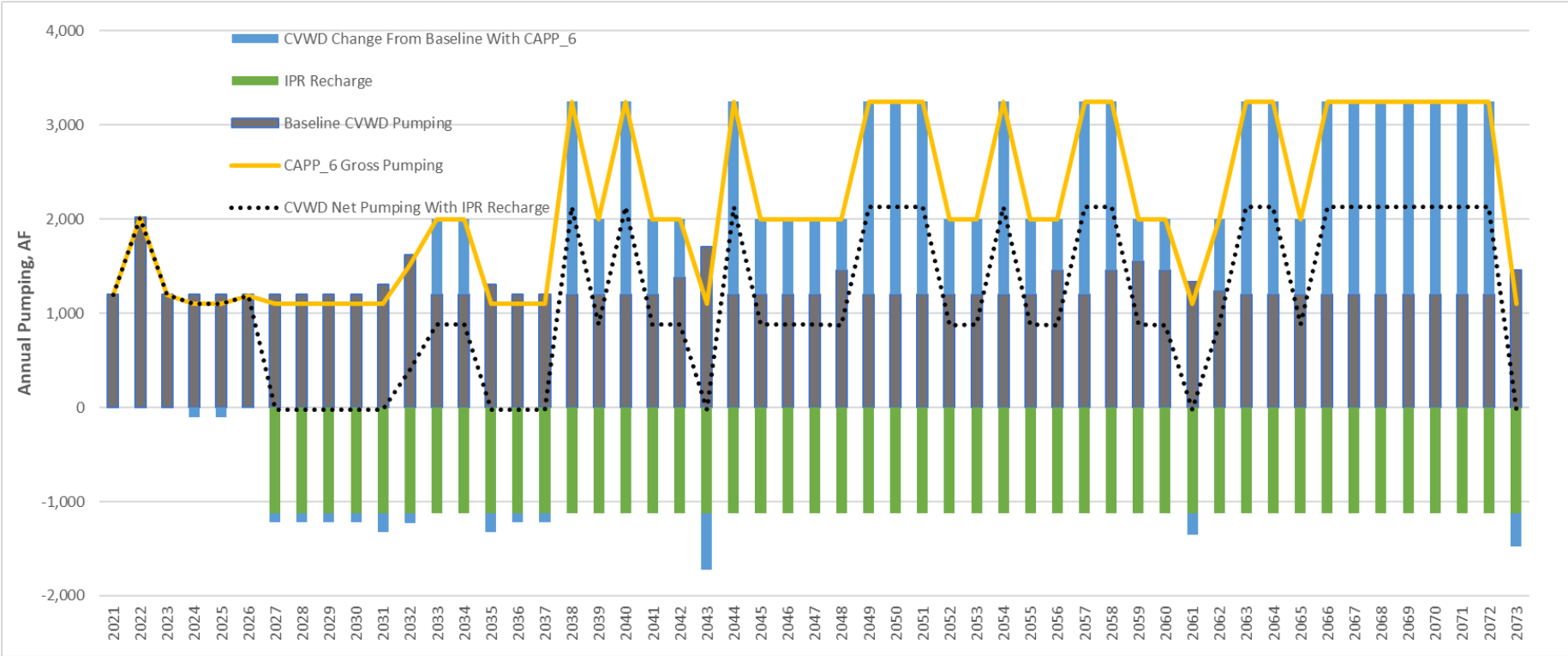


Figure 77. Municipal Pumping and Indirect Potable Reuse Recharge in CAPP_6 Scenario and Predictive Baseline

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

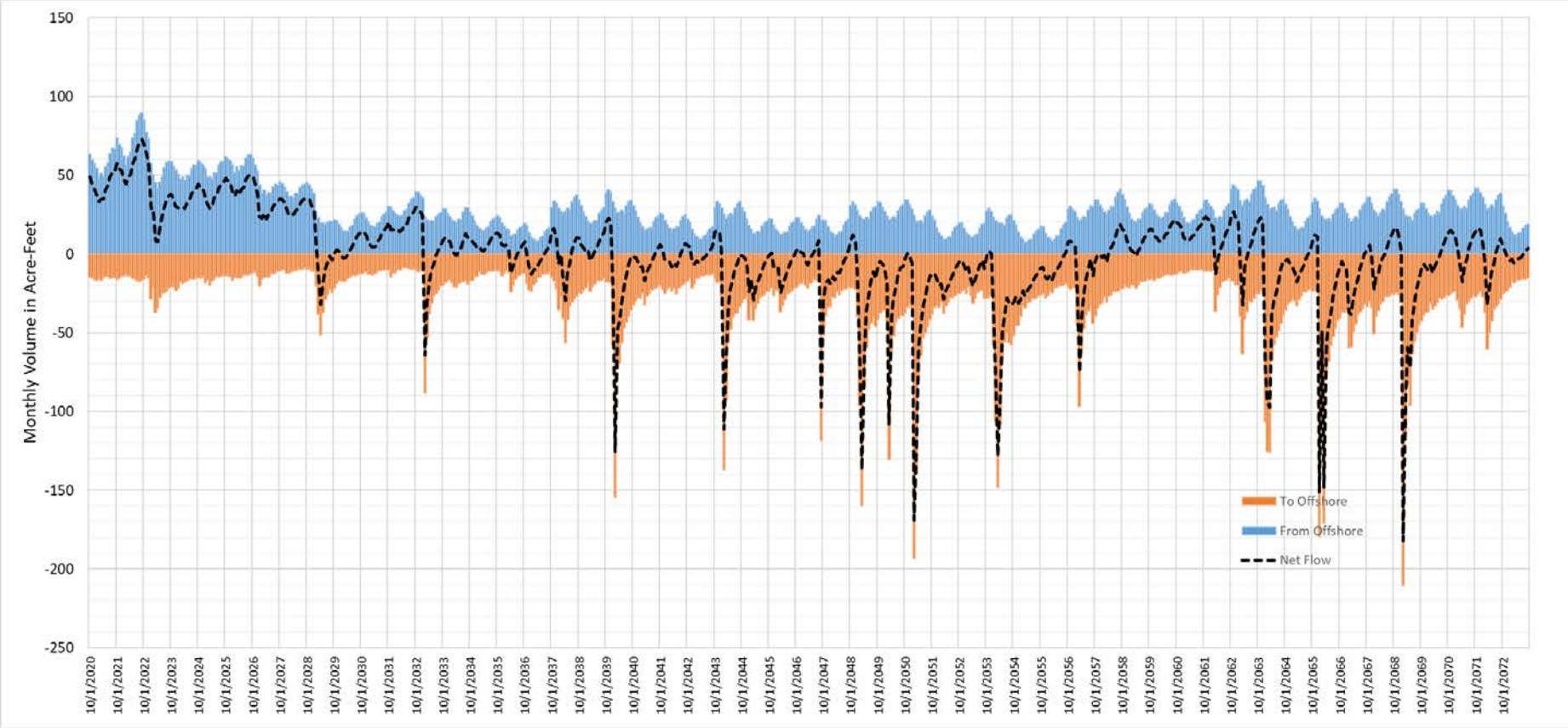


Figure 78. CAPP_6 Carpinteria Basin Projected Flow to and from Offshore

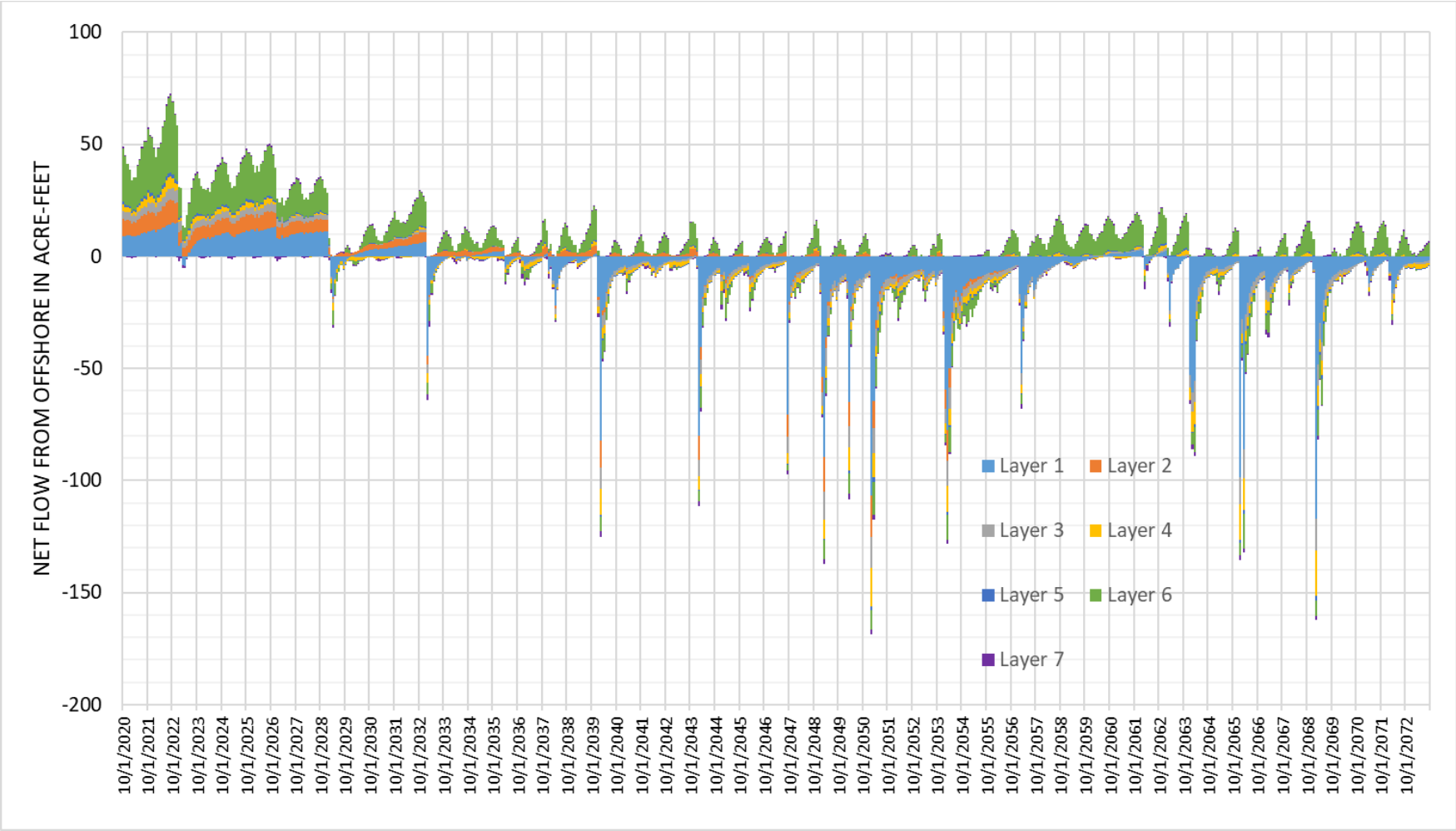


Figure 79. CAPP_6 Carpinteria Basin Projected Net Flow from Offshore by Layer

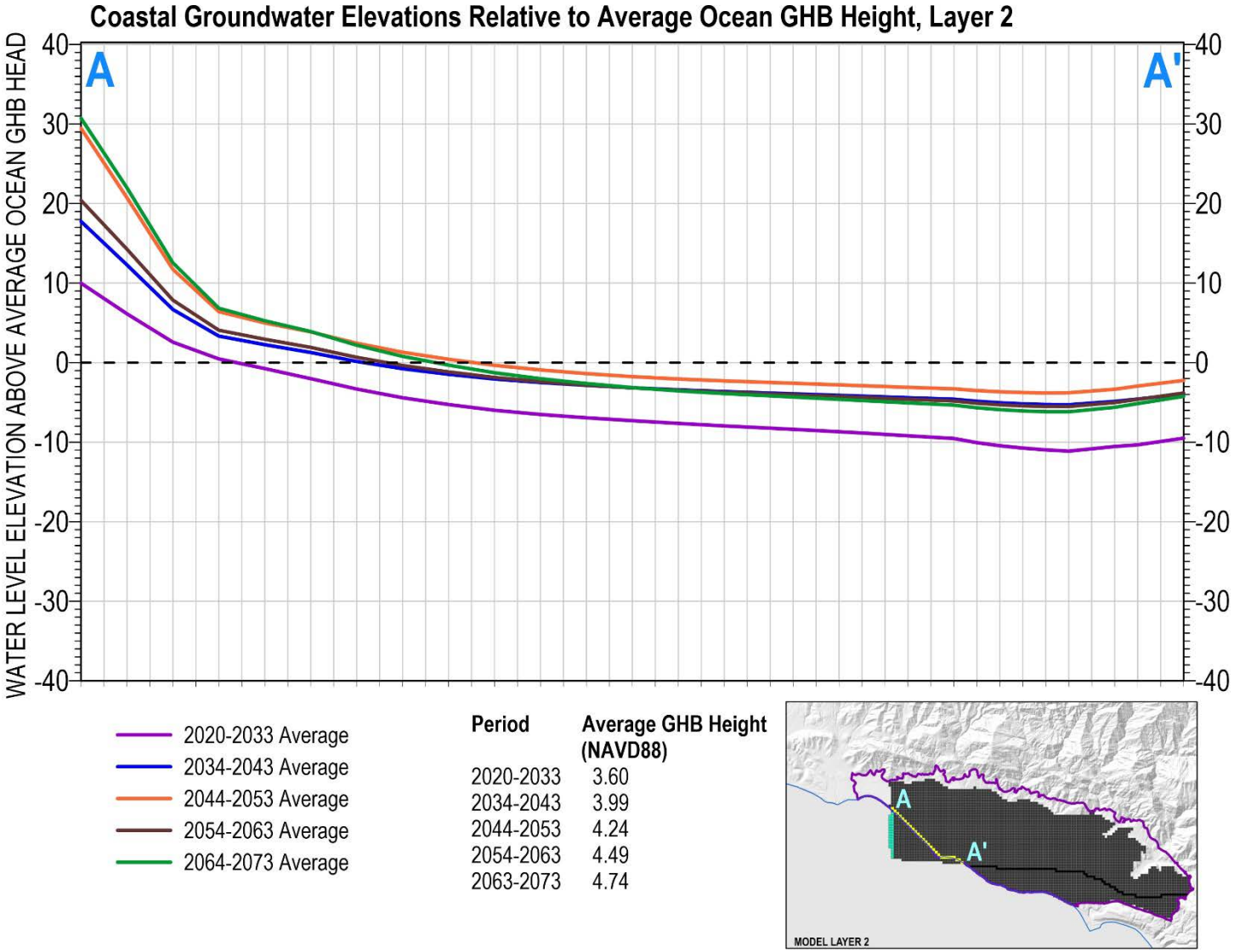


Figure 80. CAPP_6 Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 2

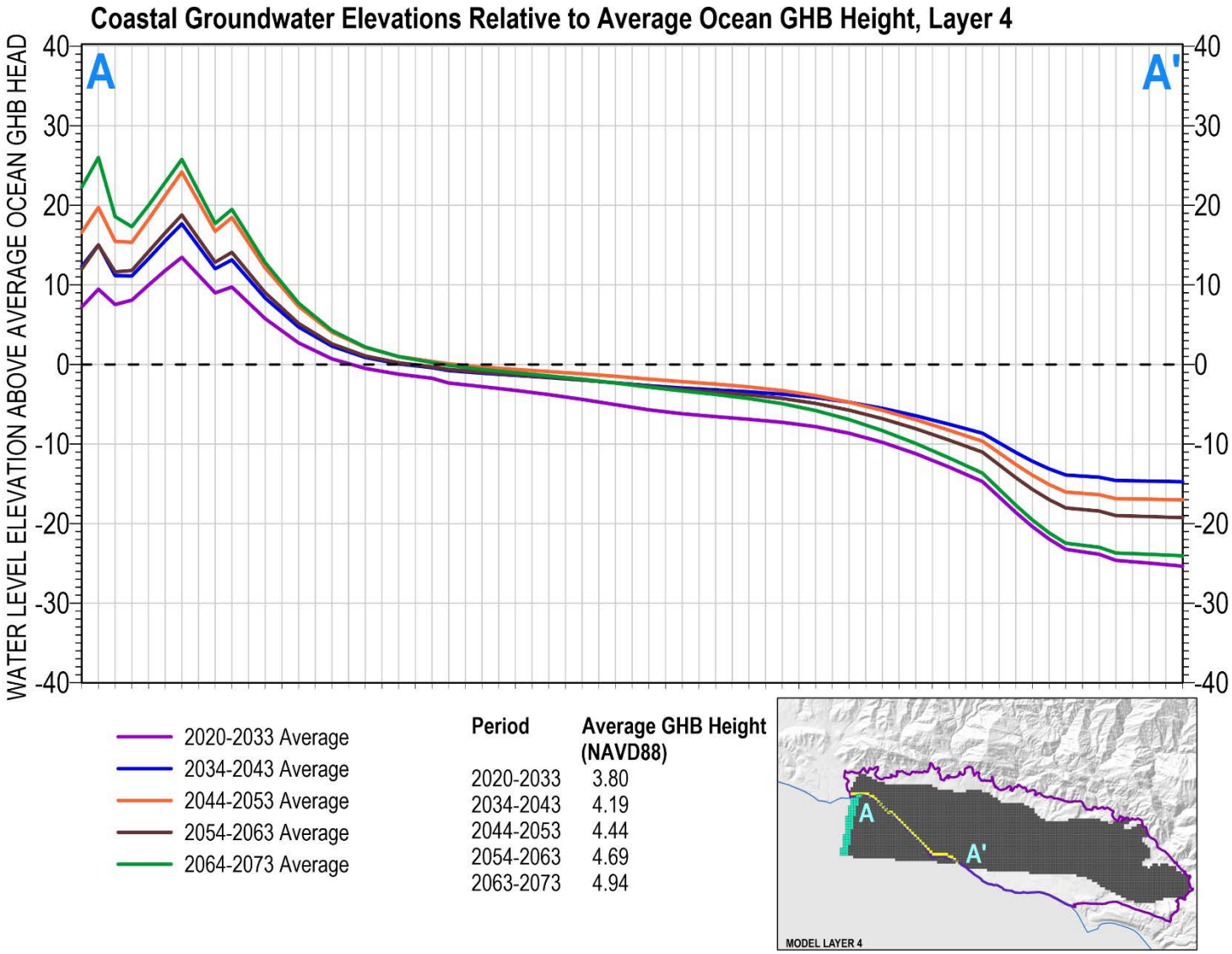


Figure 81. CAPP_6 Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 4

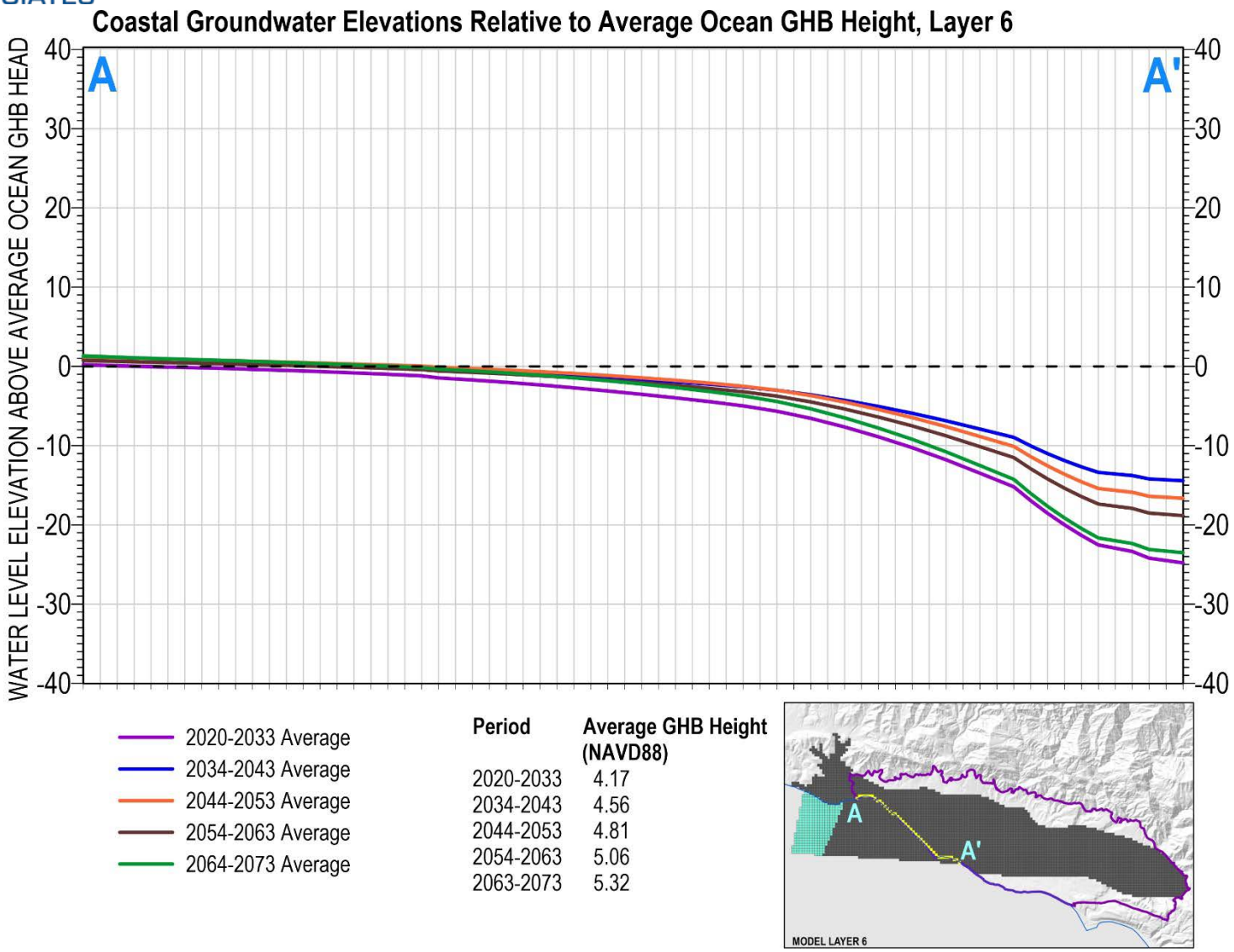


Figure 82. CAPP_6 Coastline Groundwater Elevations Relative to Average General Head Boundary Elevations, Layer 6

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

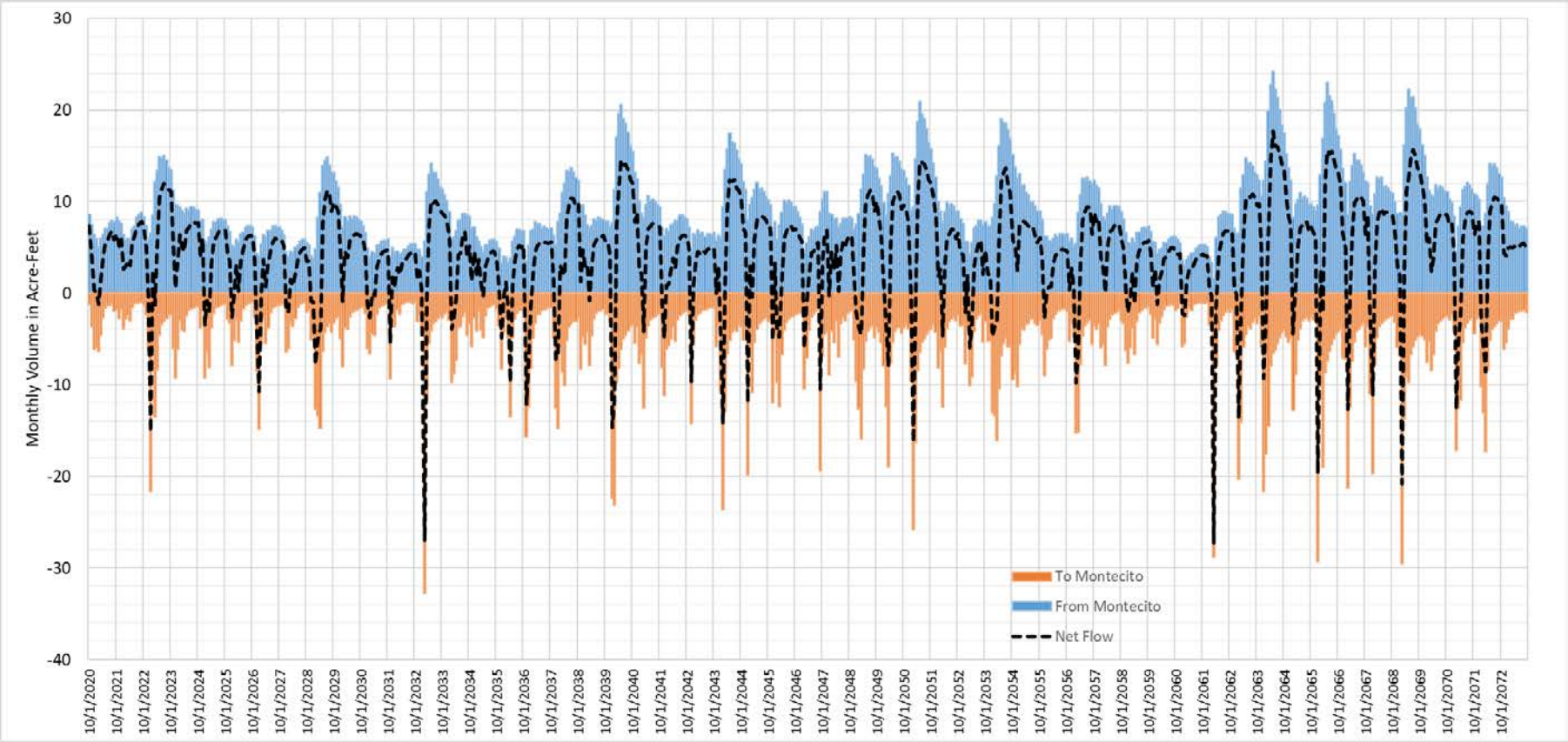


Figure 83. Carpinteria Basin Projected Flow to and from Montecito Basin

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).

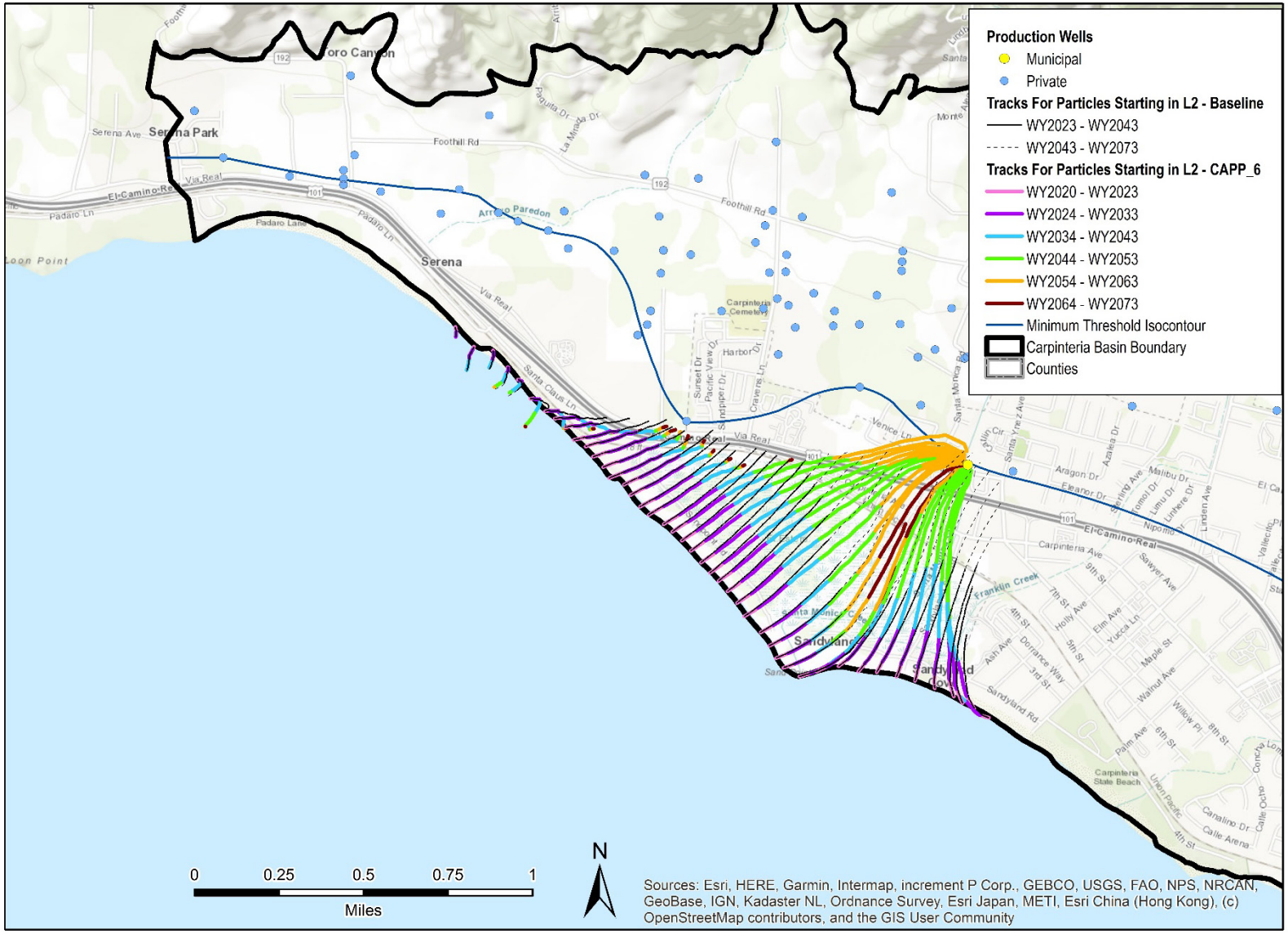


Figure 84. Particle Tracking Results, Layer 2

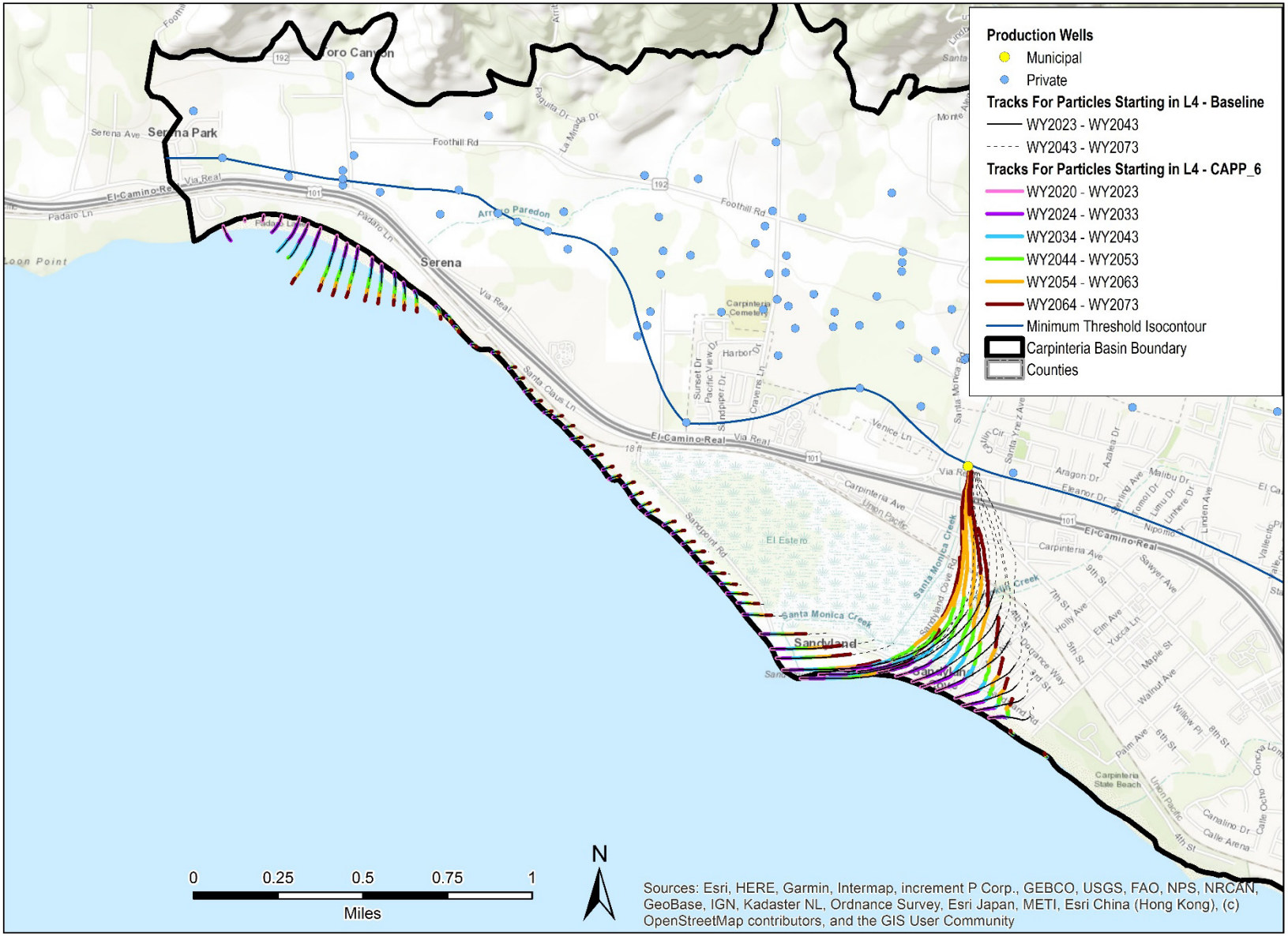


Figure 85. Particle Tracking Results, Layer 4

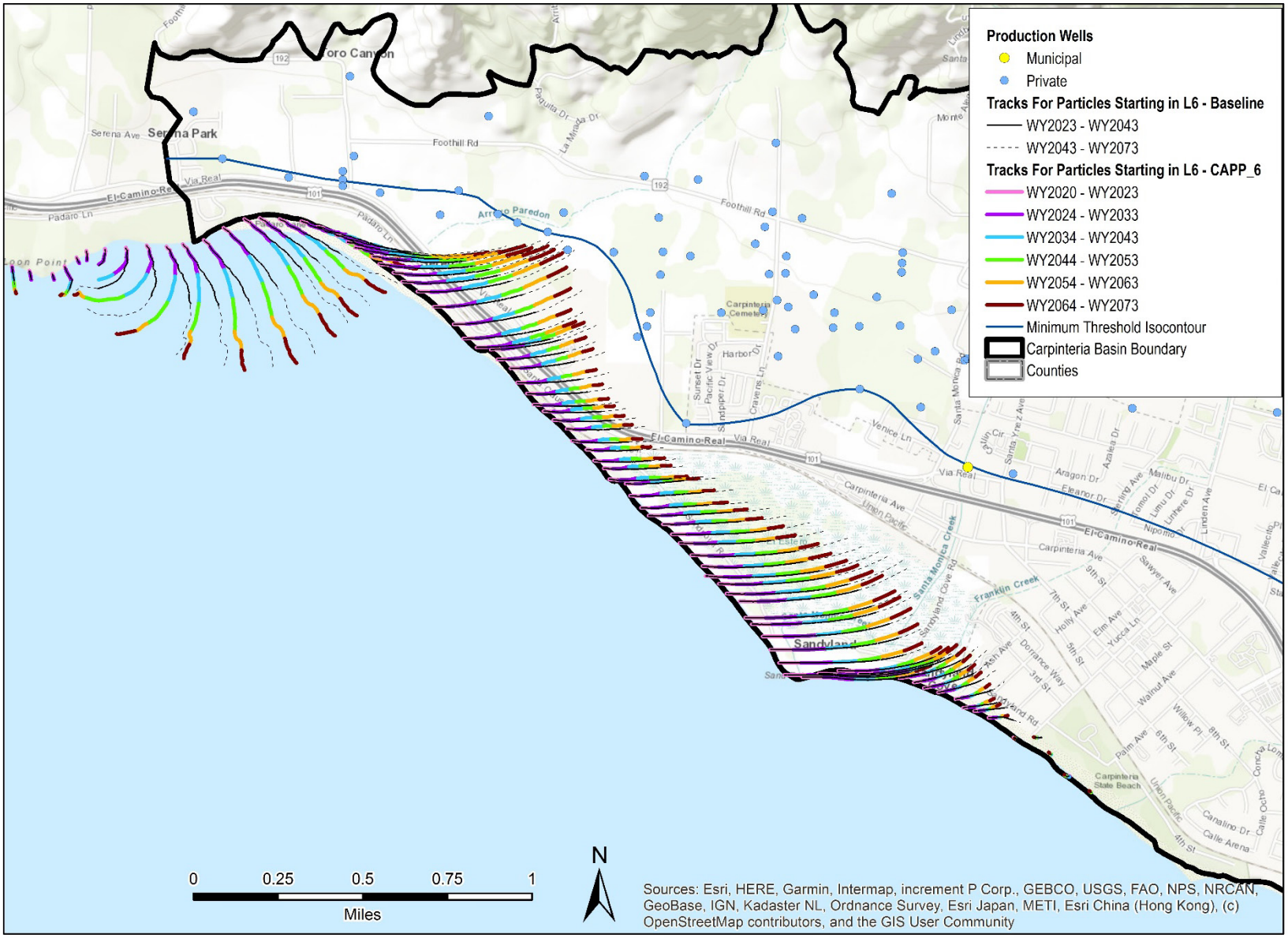


Figure 86. Particle Tracking Results, Layer 6

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

REFERENCES

Anderson, M. P., & Woessner, W. W., 1992. The role of the postaudit in model validation. Advances in Water Resources, 15(3), 167-173.

California Natural Resources Agency (CNRA), 2018. State of California Sea-Level Rise Guidance, 2018 Update

Department of Water Resources (DWR), 2020. California's Groundwater Update 2020 (Bulletin 118), https://data.cnra.ca.gov/dataset/calgw_update2020, Retrieved July 2022

_____, 2022. Sustainable Management Groundwater Act (SGMA) Data Viewer, https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer, Retrieved July 2022

GSI Water, 2022, Carpinteria Groundwater Basin Draft Groundwater Sustainability Plan

Guo, W, and Langevin, C.D., 2002, User's Guide to SEAWAT: A Computer Program for Simulation of Three-Dimensional Variable-Density Ground-Water Flow: U.S. Geological Survey Techniques and Methods 6–A7, 77 p.

HydroMetrics Water Resources Inc. (WRI), 2012. Carpinteria Valley Groundwater Model Development, Prepared for Pueblo Water Resources

Konikow, L.F., Hornberger, G.Z., Halford, K.J., and Hanson, R.T., 2009. Revised multi-node well (MNW2) package for MODFLOW ground-water flow model: U.S. Geological Survey Techniques and Methods 6–A30, 67 p.

National Oceanic and Atmospheric Administration (NOAA), 2022. Datums for 9411270, Rincon Island, Pacific Ocean CA, https://tidesandcurrents.noaa.gov/datums.html?id=9411270, Retrieved August 2022

Niswonger, R.G., Panday, S., Ibaraki, M., MODFLOW-NWT, 2011. A Newton formulation for MODFLOW-2005

Pueblo Water Resources (Pueblo Water), 2012. Carpinteria Groundwater Basin Hydrogeologic Update and Groundwater Model Project, Final Report

_____, 2017. IPR Groundwater Modeling Assessment, Prepared for Carpinteria Valley Water District, June 2017

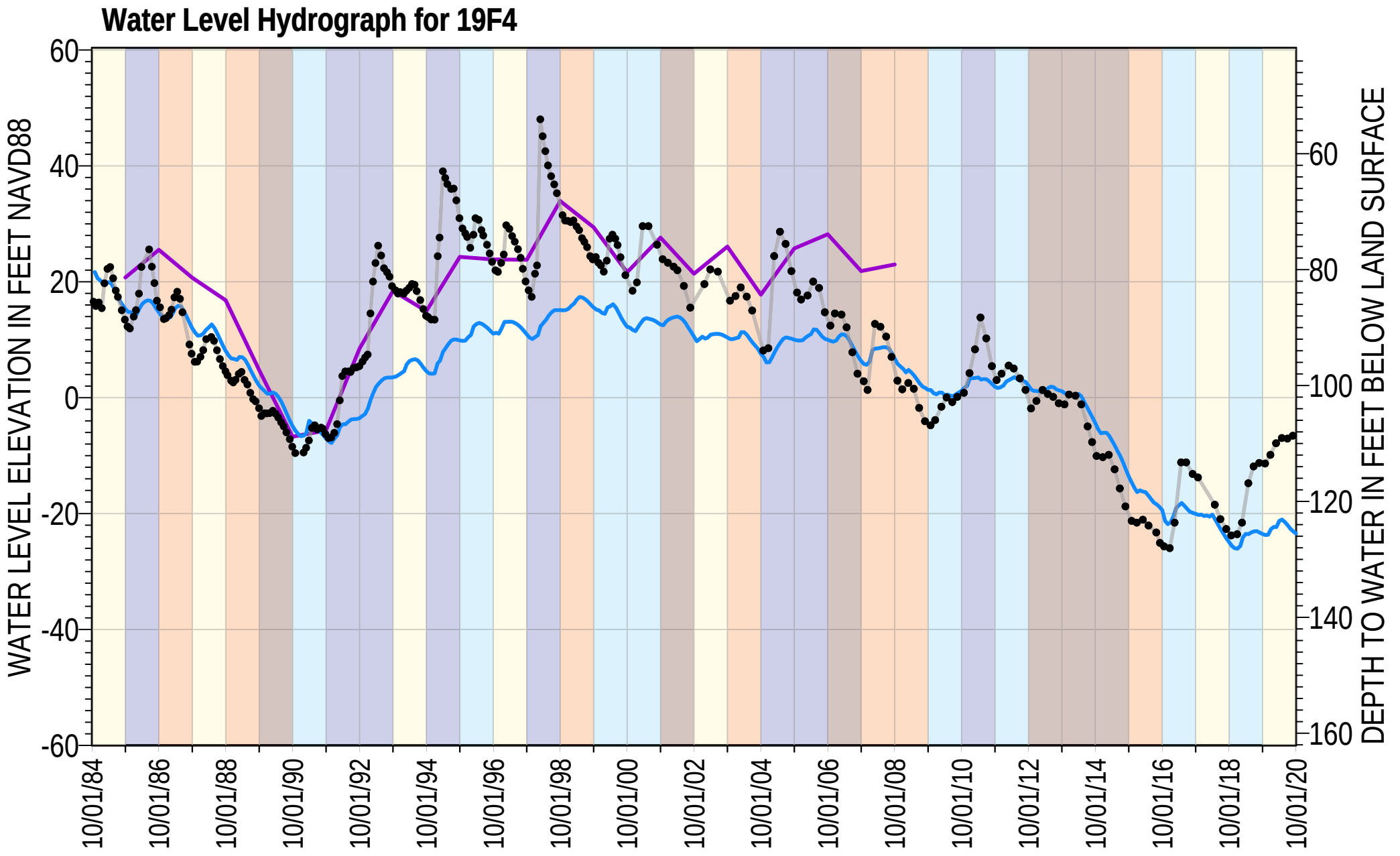
_____, 2022. Carpinteria Groundwater Basin GSP Development Project; Projected Water Budget Methodology, Prepared for Carpinteria Valley Water District, April 11 2022

_____, 2023. Carpinteria Groundwater Basin GSP Development Project; Projected Groundwater Modeling of the Carpinteria Advanced Purification Project (CAPP) Technical Memorandum, Prepared for Carpinteria Valley Water District, October 5 2023

United States Geological Survey (USGS), Upson, J.E. and Thomasson, H.G., 1951, Geology and Ground-Water Resources of the South-Coast Basin of the Santa Barbara County, California, United States Geological Survey Water Supply Paper 1108

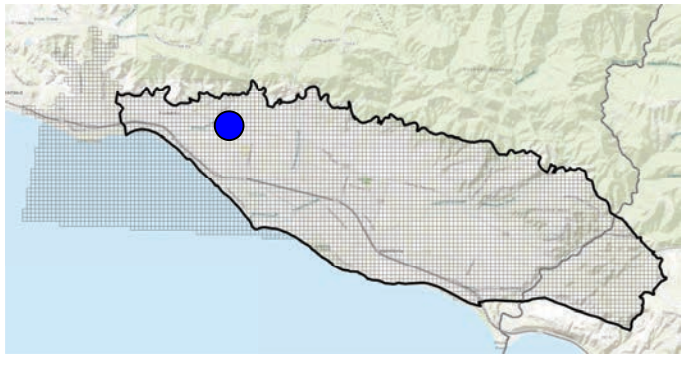
Woodard and Curran, 2021, Carpinteria Valley Water District 2020 Urban Water Management Plan, Prepared for Carpinteria Valley Water District, October 2021

APPENDIX A CALIBRATION HYDROGRAPHS



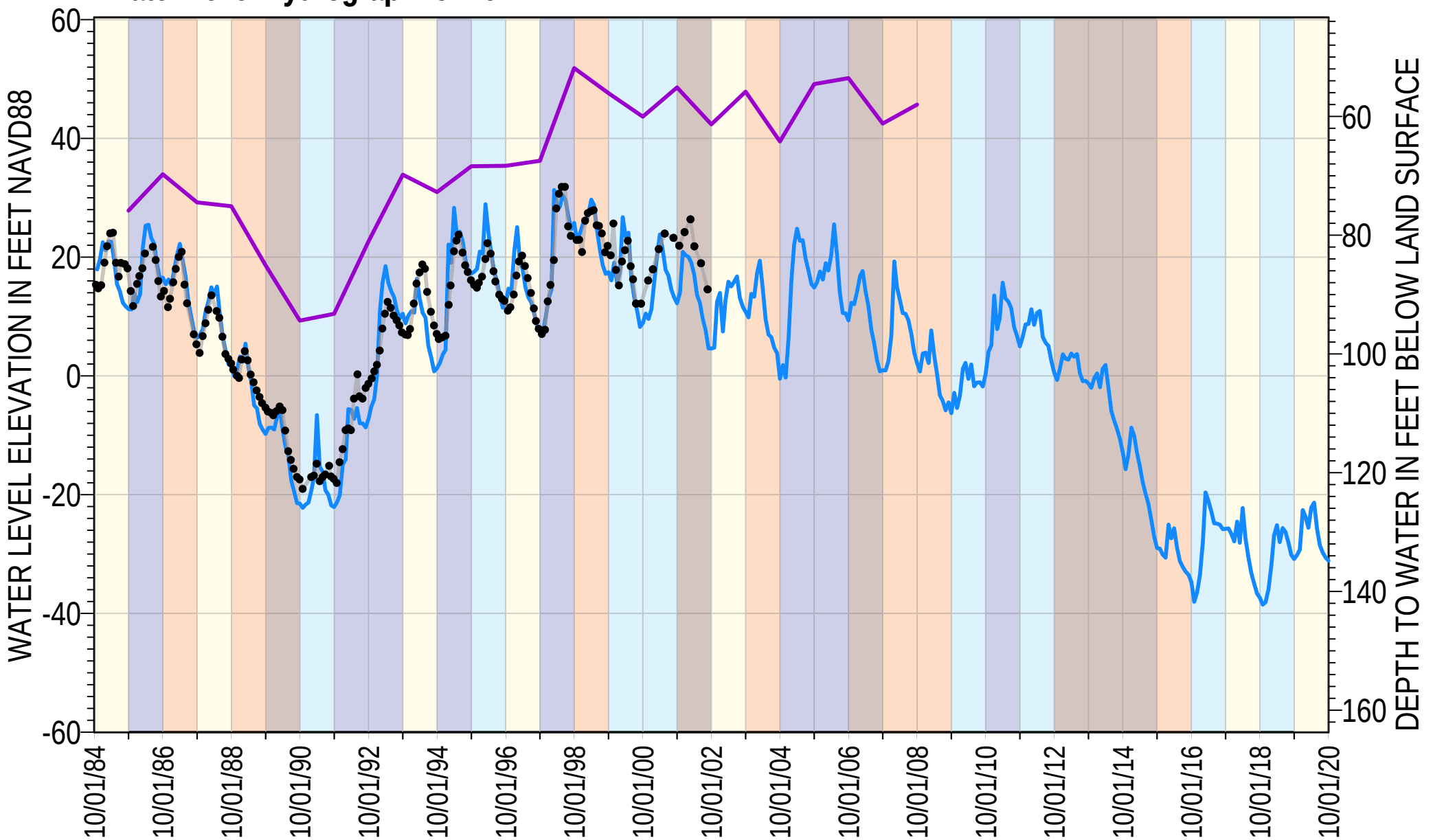
Measured
Annual Model
Monthly Model

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



Measured

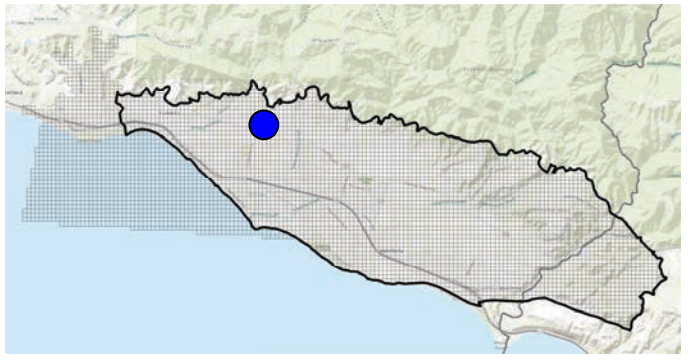
Annual Model

Monthly Model

Well Type | Private

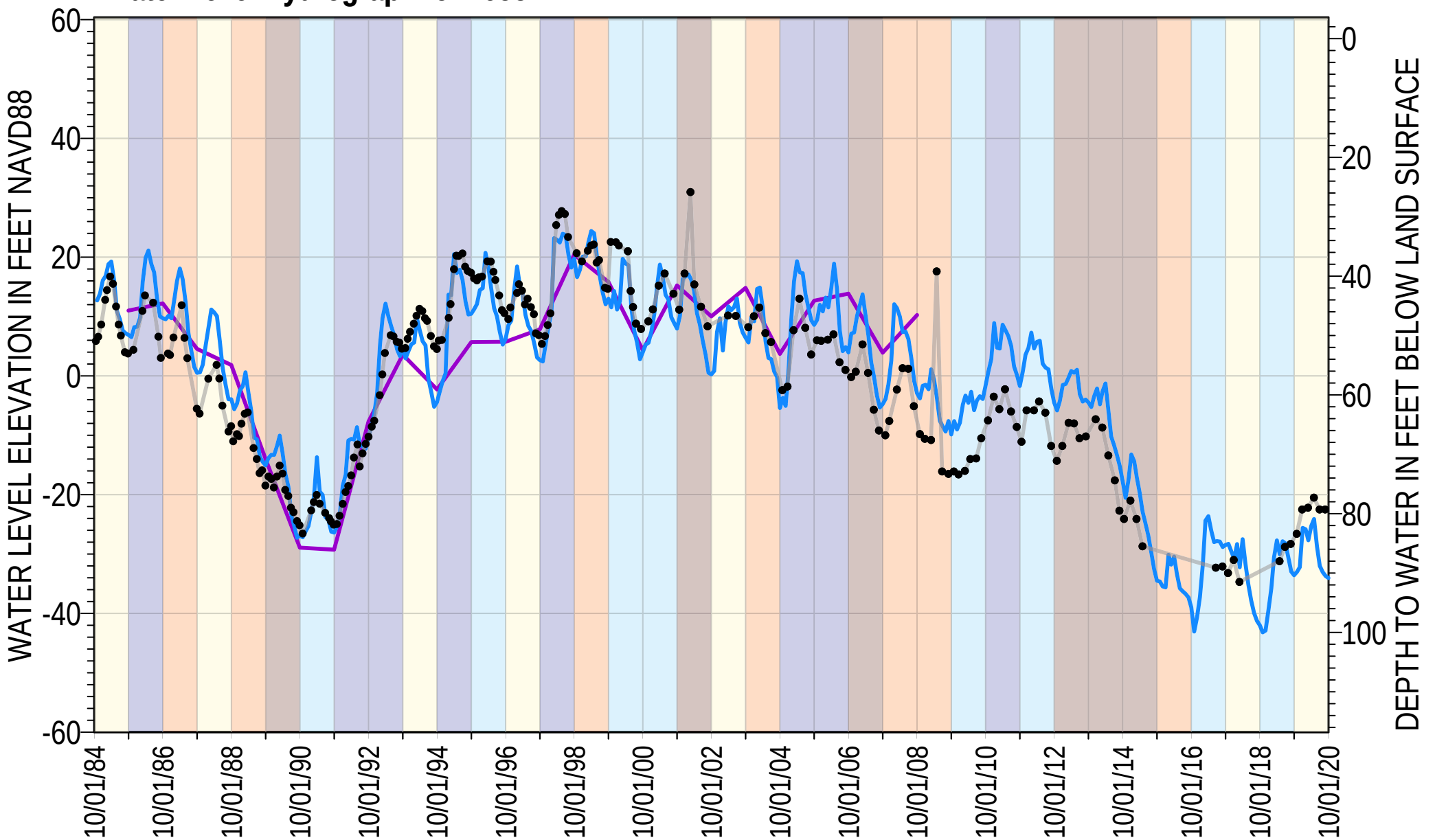
Reference Point Elevation (feet NAVD88) | 103.7

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



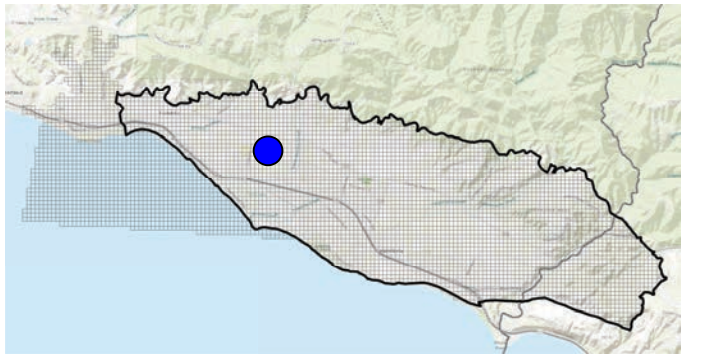
Climate Classification

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



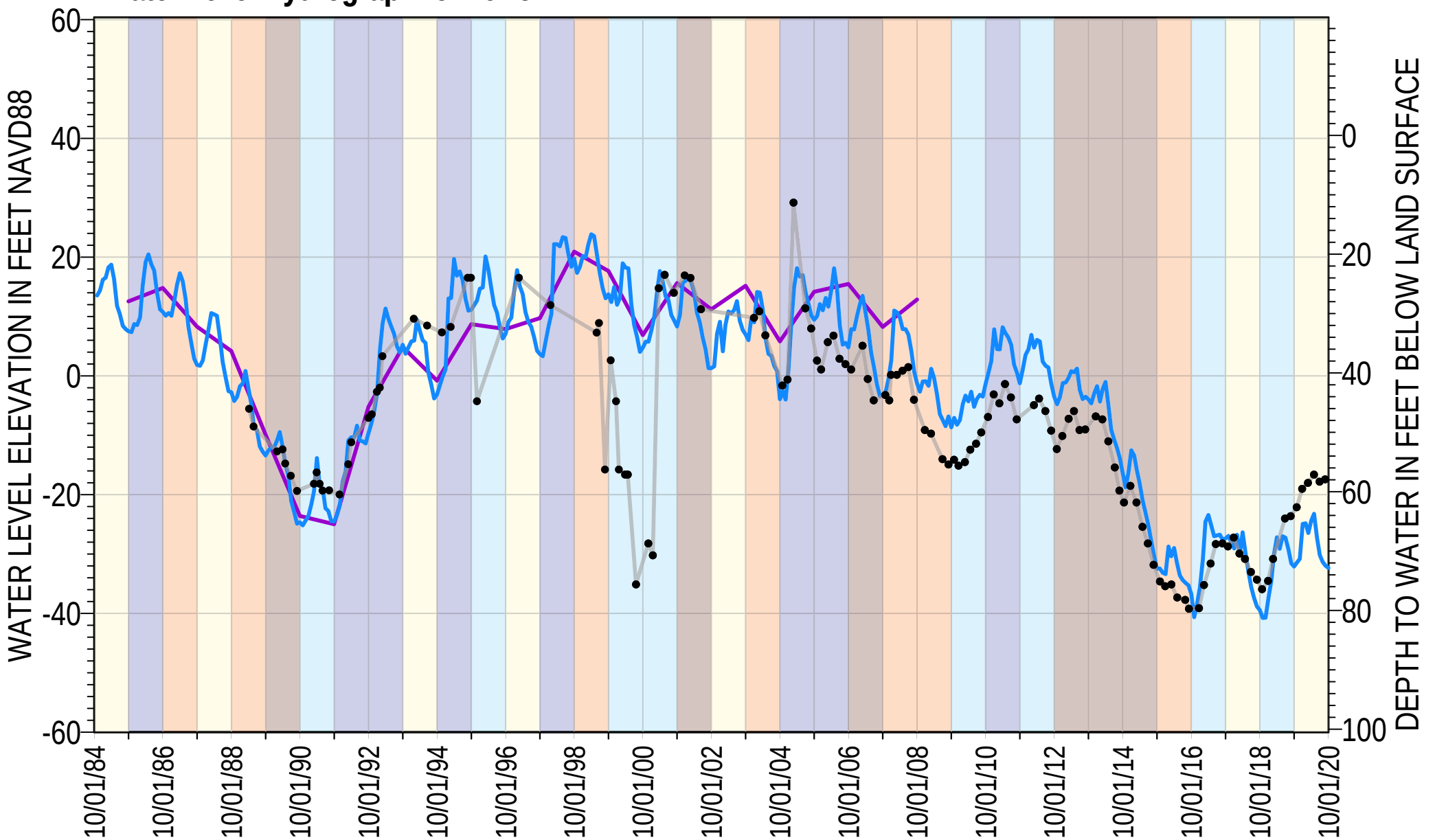
Measured
Annual Model
Monthly Model

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



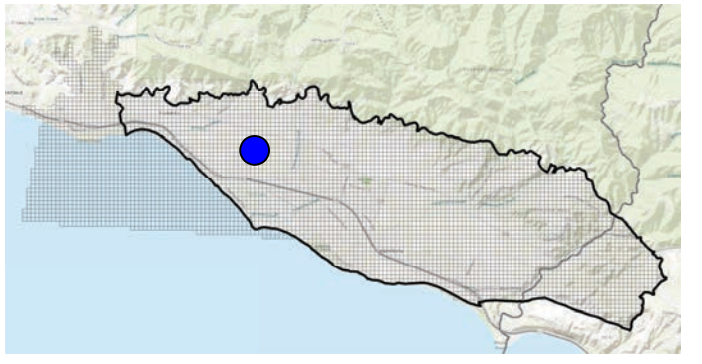
Climate Classification

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



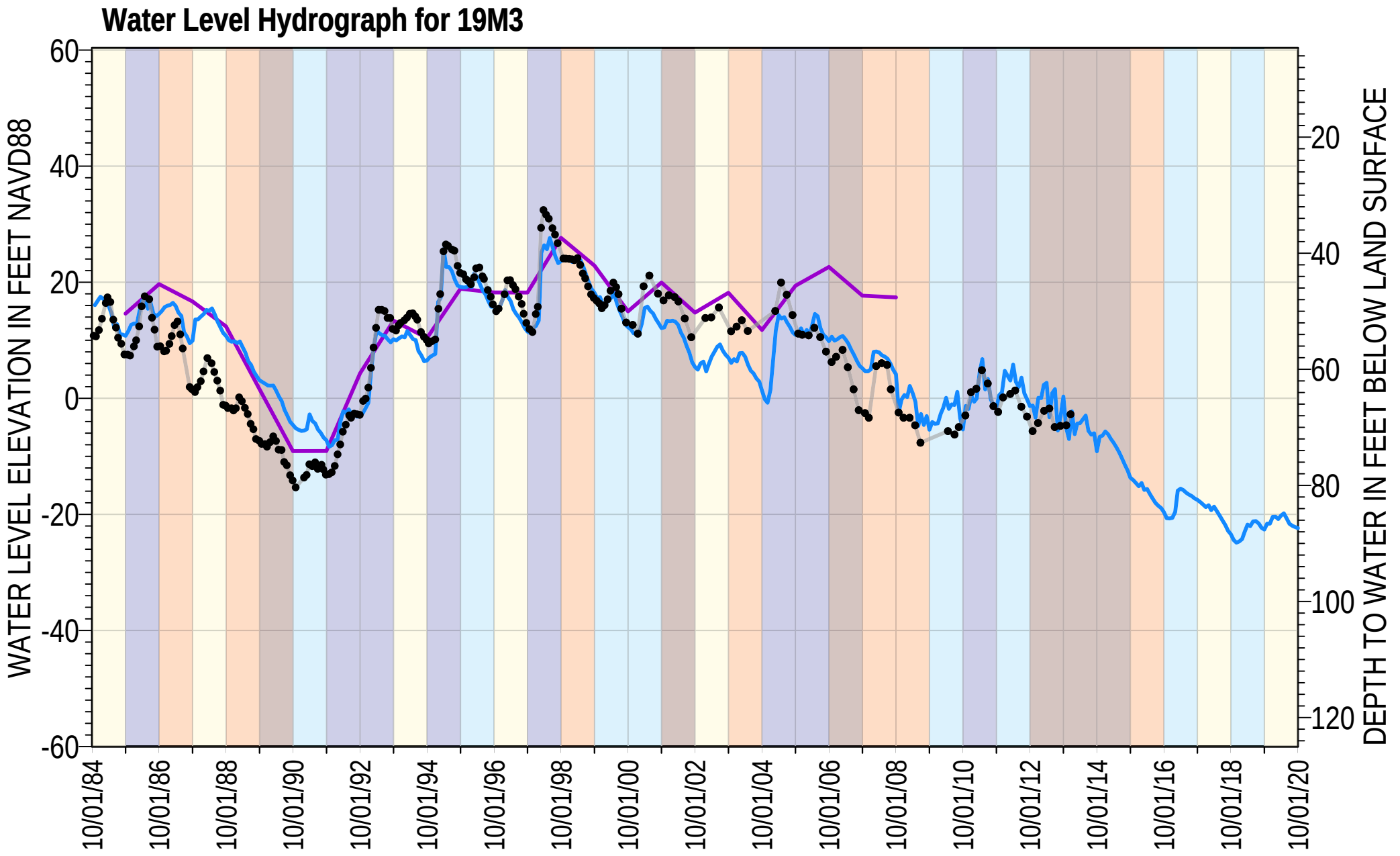
Measured
Annual Model
Monthly Model

Well Type | Private
Reference Point Elevation (feet NAVD88) | 40.5
Model Layering (%) | L1: 12 L2: 18 L3: 71



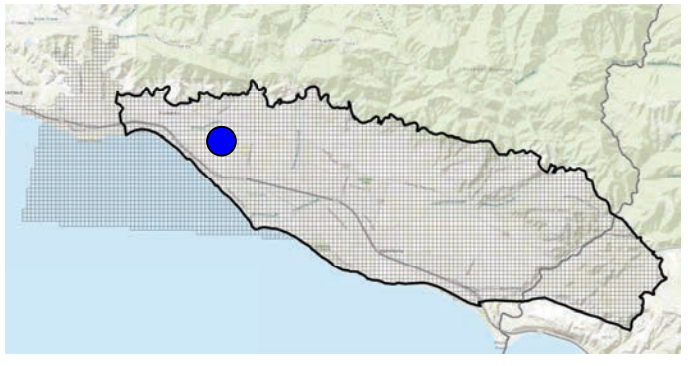
Climate Classification

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



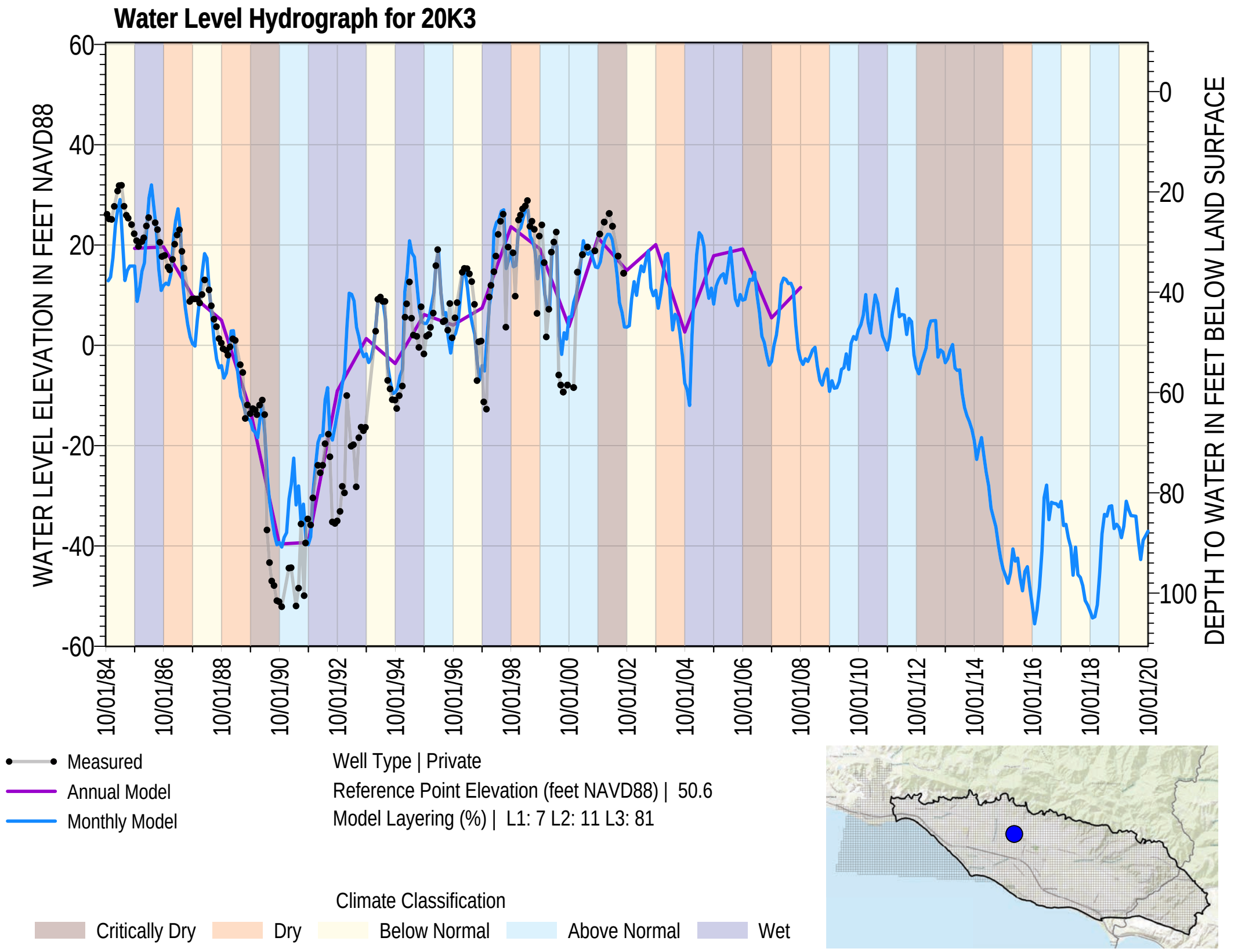
Measured
Annual Model
Monthly Model

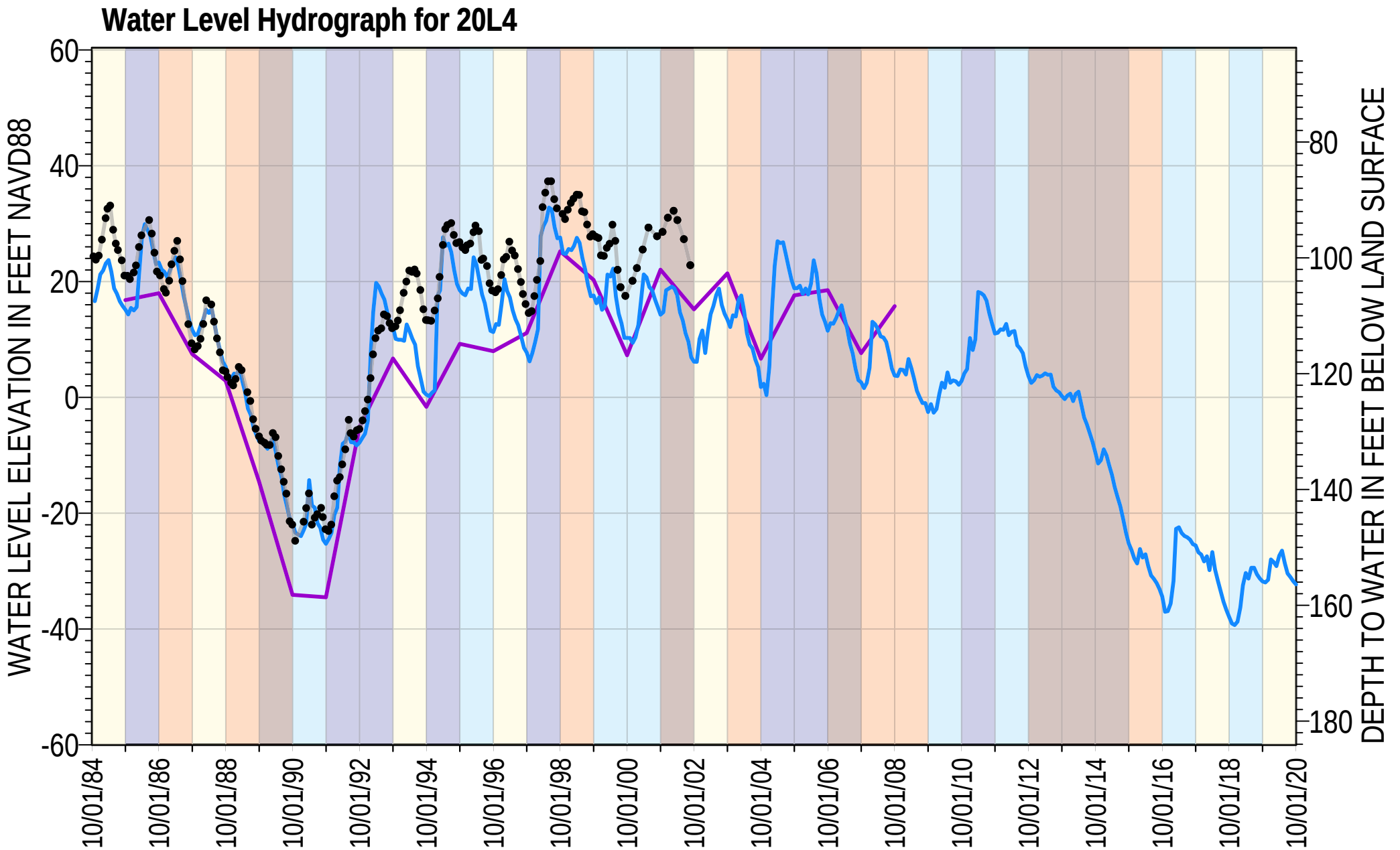
Well Type | Private
Reference Point Elevation (feet NAVD88) | 65
Model Layering (%) | L2: 7 L3: 93



Climate Classification

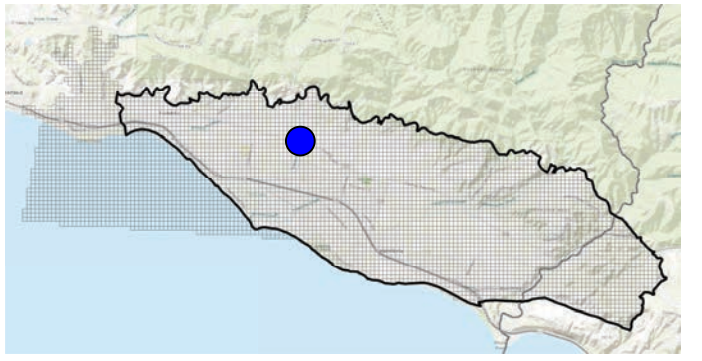
Critically Dry | Dry | Below Normal | Above Normal | Wet


Water Level Hydrograph for 20K3
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) | 50.6
Model Layering (%) | L1: 7 L2: 11 L3: 81
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet



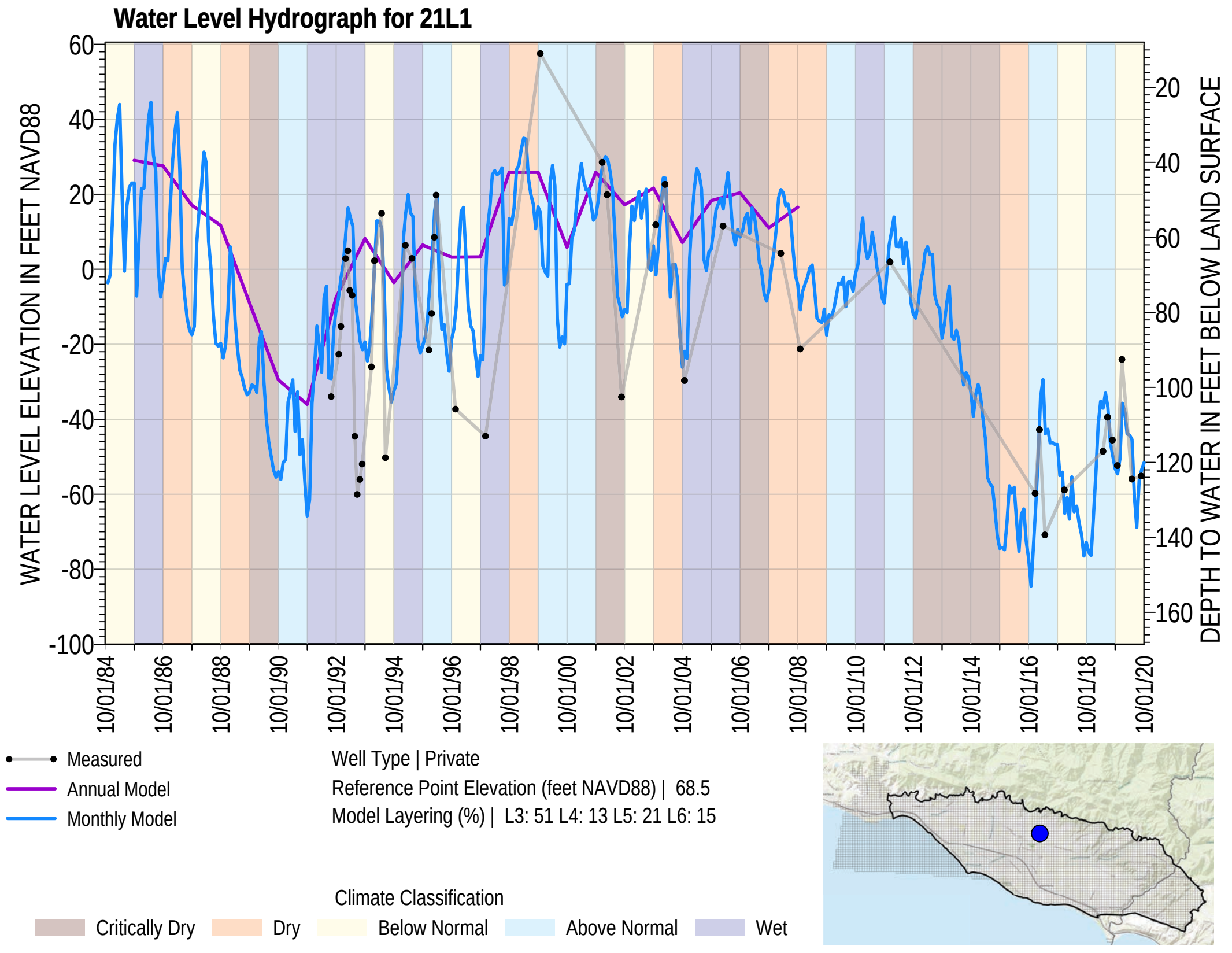
Measured
Annual Model
Monthly Model

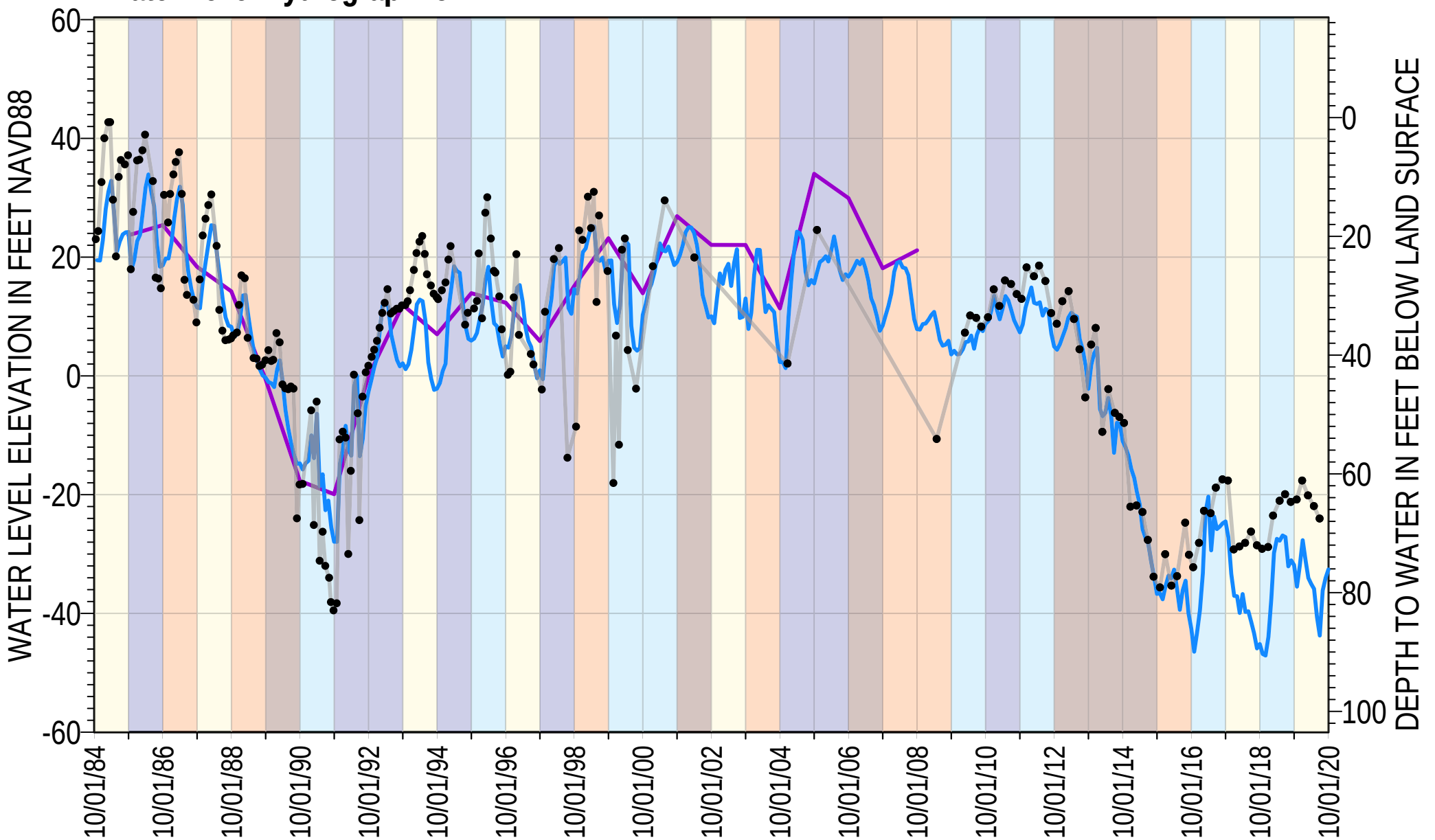
Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 124.1
Model Layering (%) | L1: 78 L2: 18 L3: 4



Climate Classification

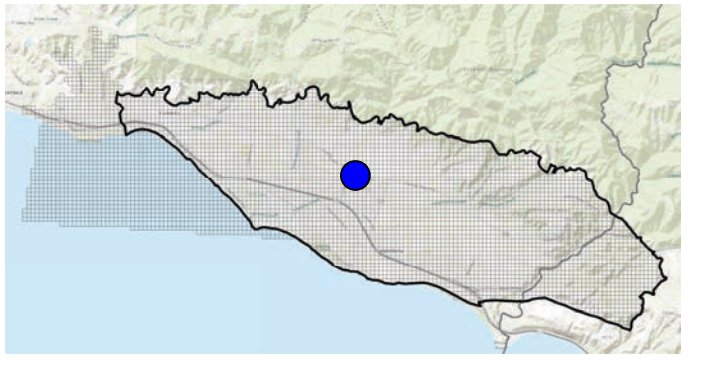
Critically Dry | Dry | Below Normal | Above Normal | Wet


Water Level Hydrograph for 21L1
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 | 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



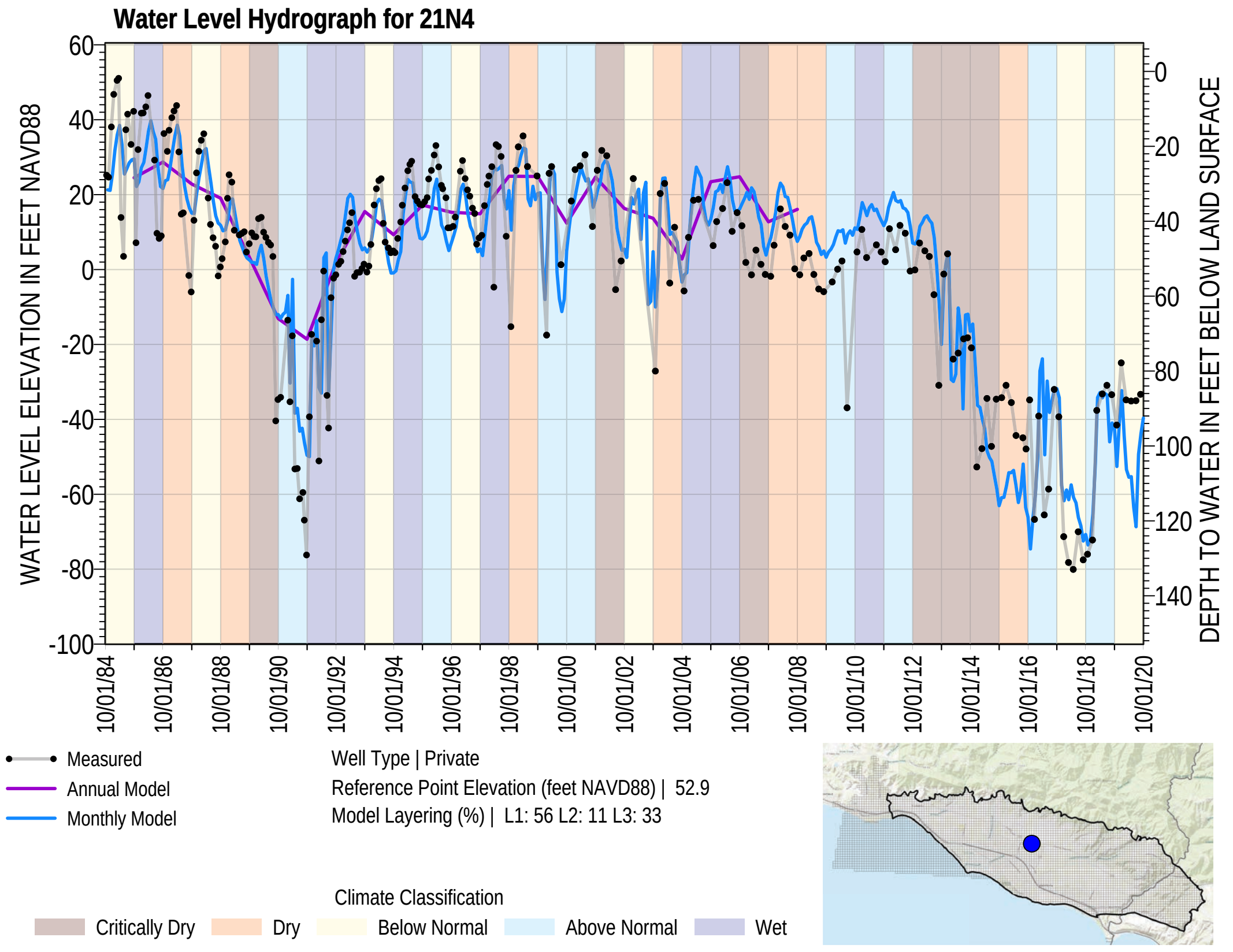
Measured
Annual Model
Monthly Model

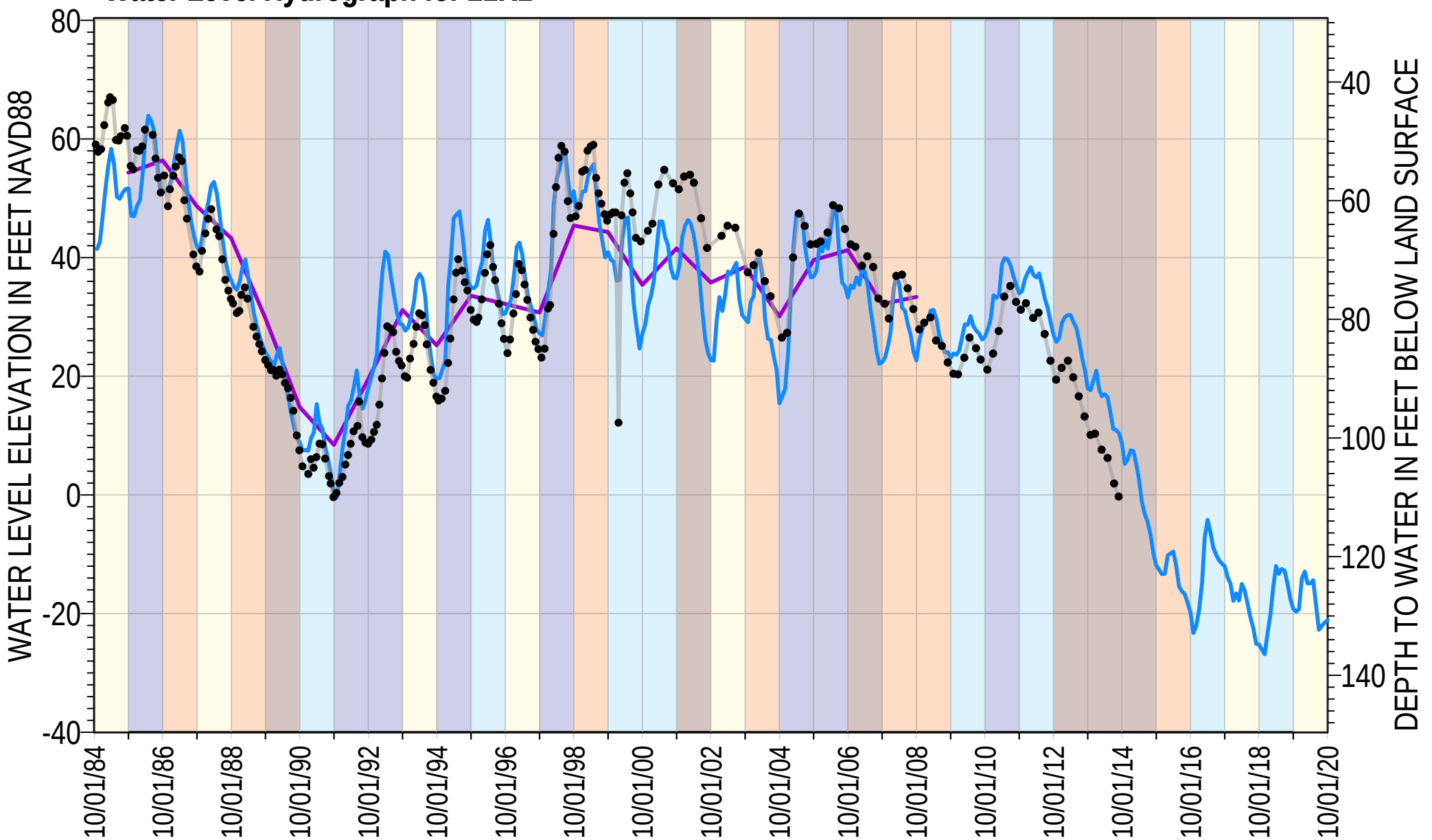
Well Type | Private
Reference Point Elevation (feet NAVD88) | 43.5
Model Layering (%) | L1: 56 L2: 12 L3: 32



Climate Classification

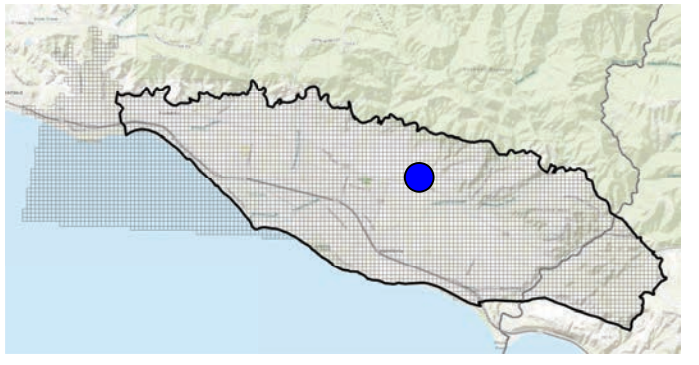
Critically Dry | Dry | Below Normal | Above Normal | Wet


Water Level Hydrograph for 21N4
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
-80
-100
0
20
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) | 52.9
Model Layering (%) | L1: 56 L2: 11 L3: 33
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet



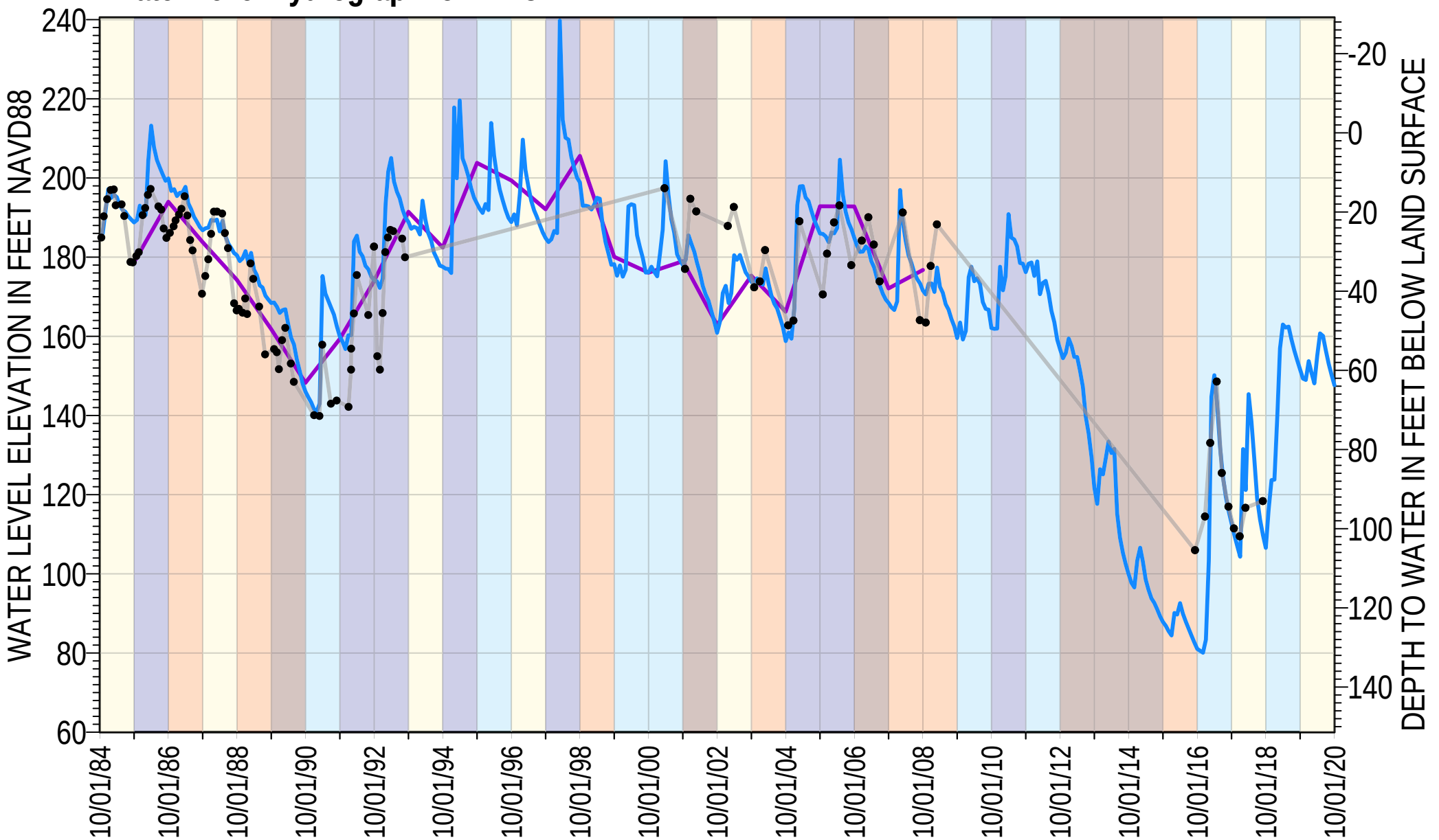
Measured
Annual Model
Monthly Model

Well Type | Private
Reference Point Elevation (feet NAVD88) | 109.6
Model Layering (%) | L1: 35 L2: 6 L3: 59



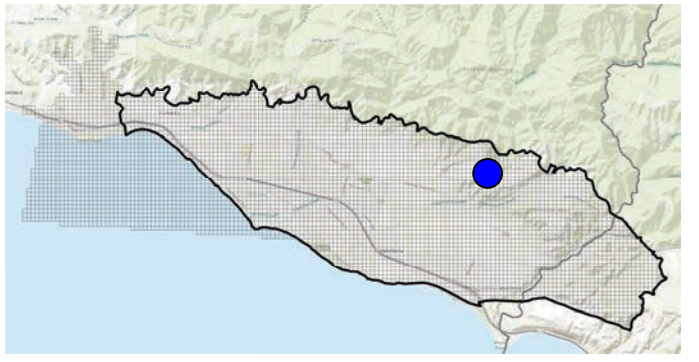
Climate Classification

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



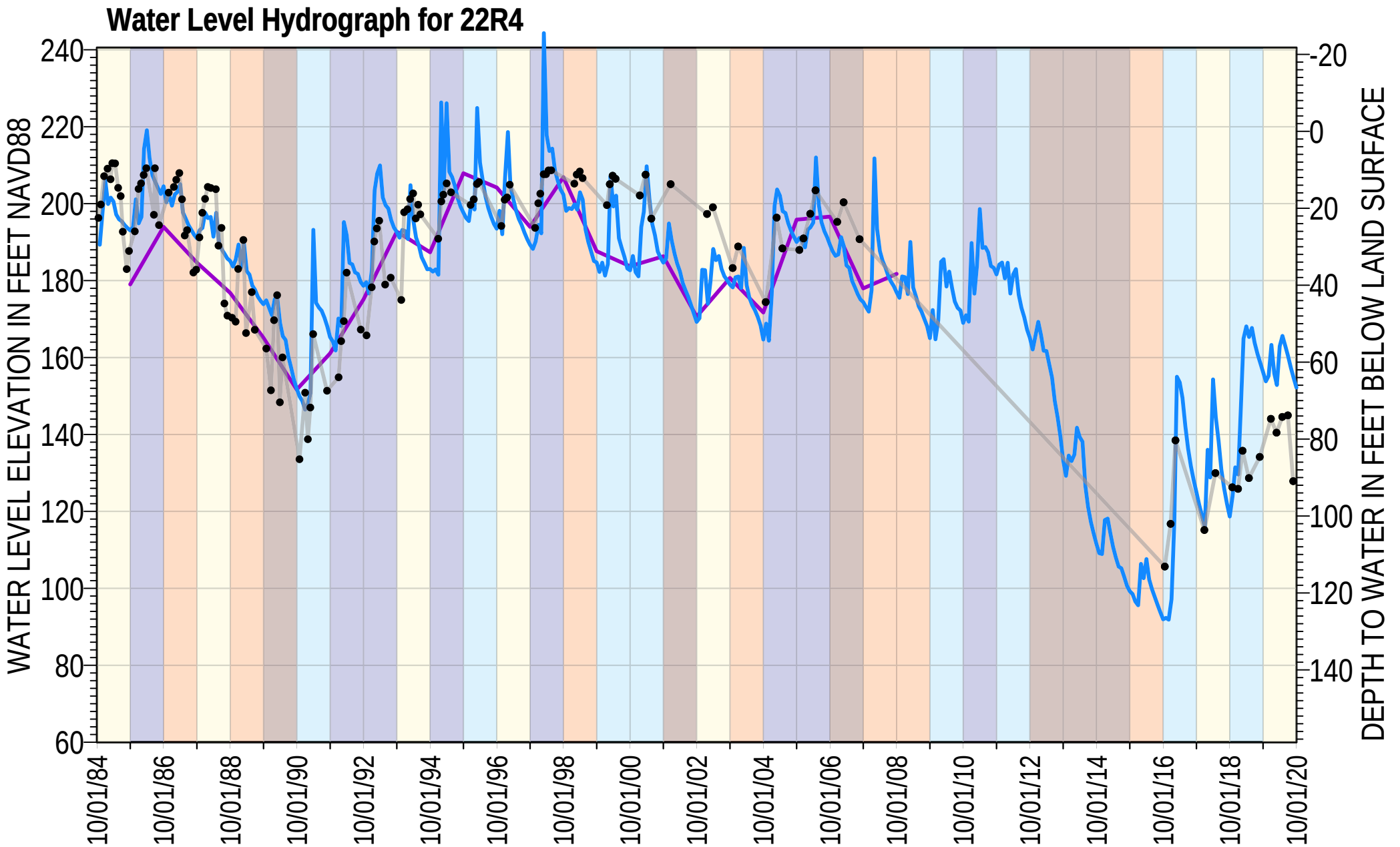
Measured
Annual Model
Monthly Model

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



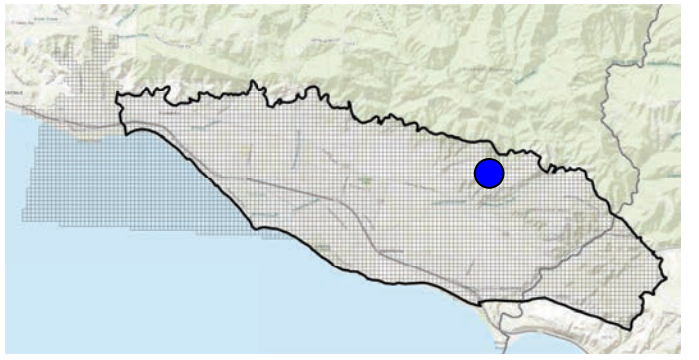
Climate Classification

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



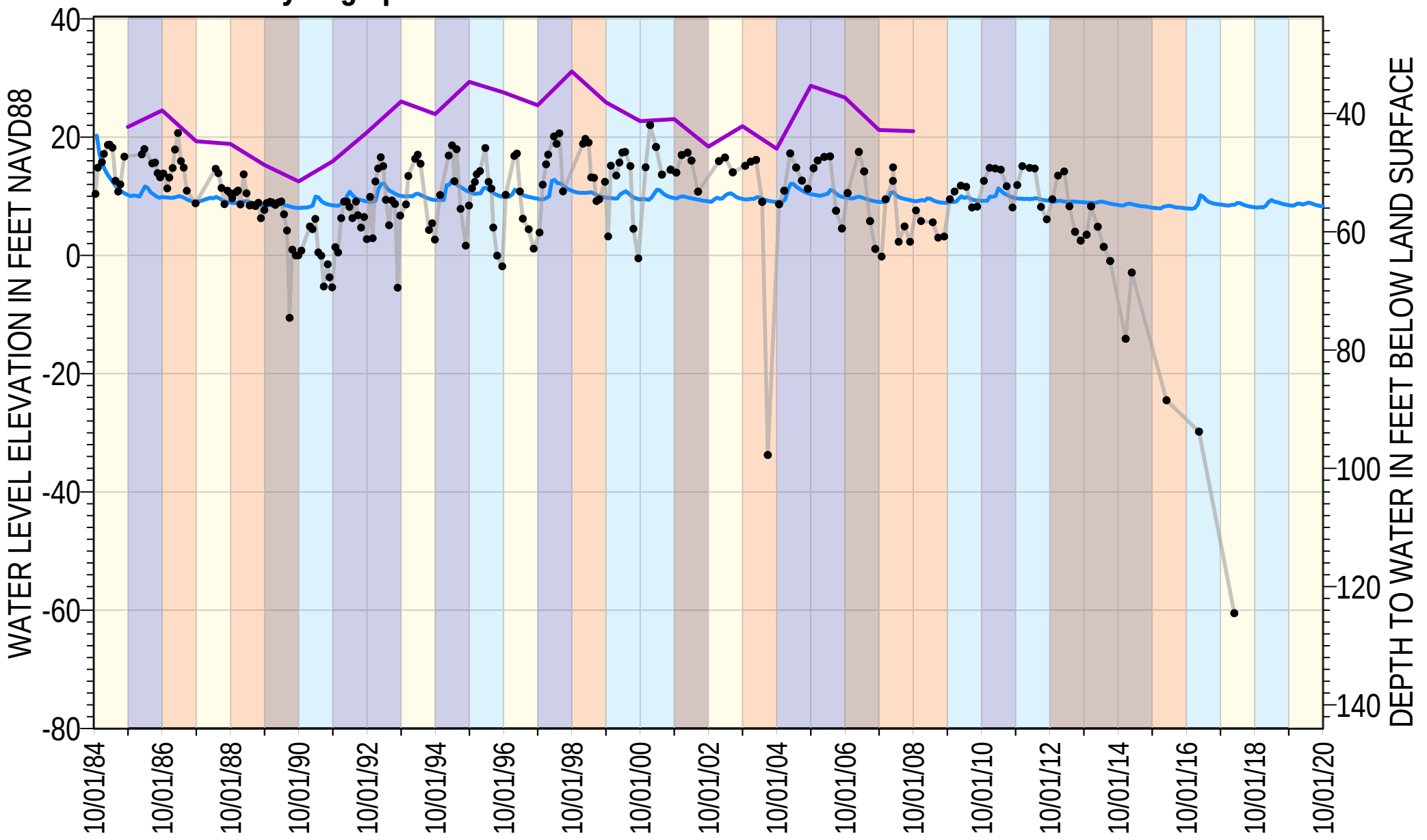
Measured
Annual Model
Monthly Model

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



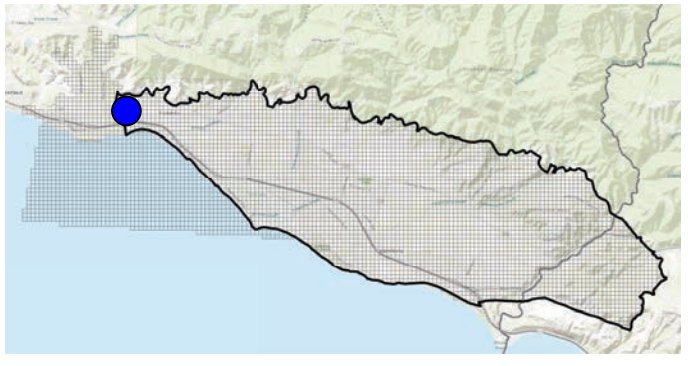
Climate Classification

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



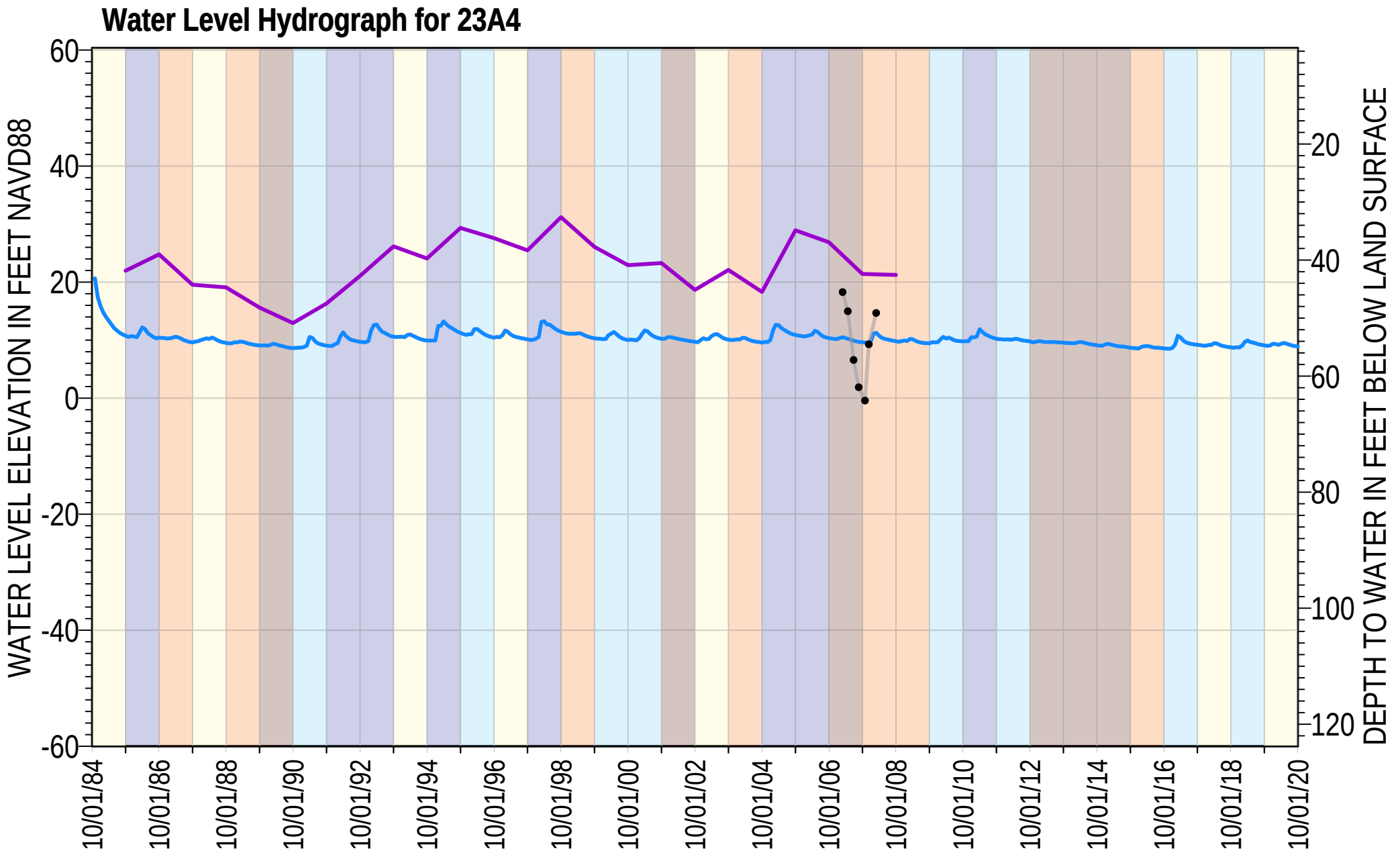
Measured
Annual Model
Monthly Model

Well Type | Private
Reference Point Elevation (feet NAVD88) | 64
Model Layering (%) | L6: 100



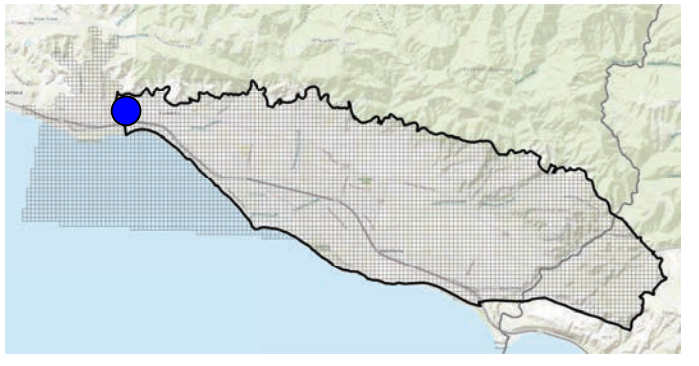
Climate Classification

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



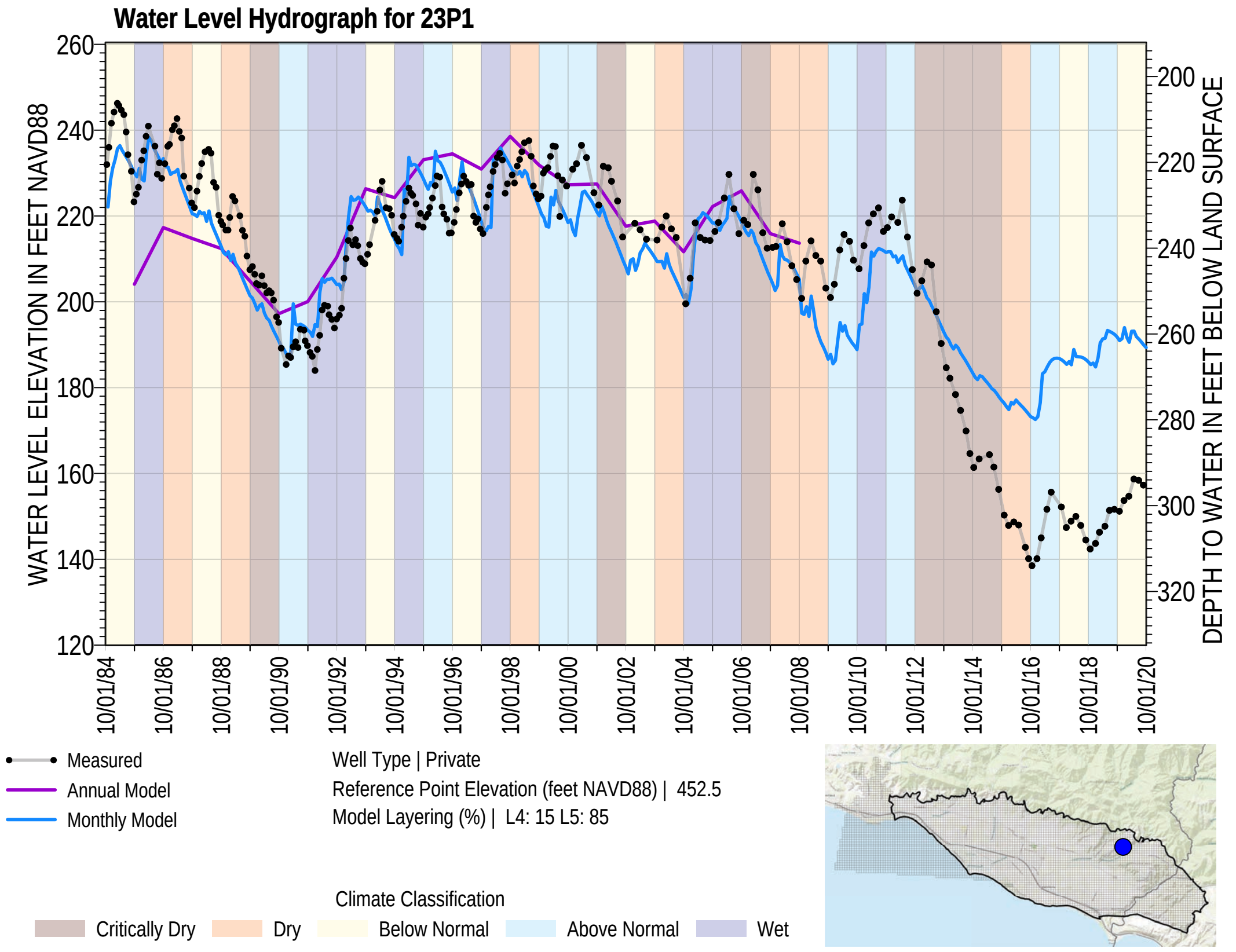
Measured
Annual Model
Monthly Model

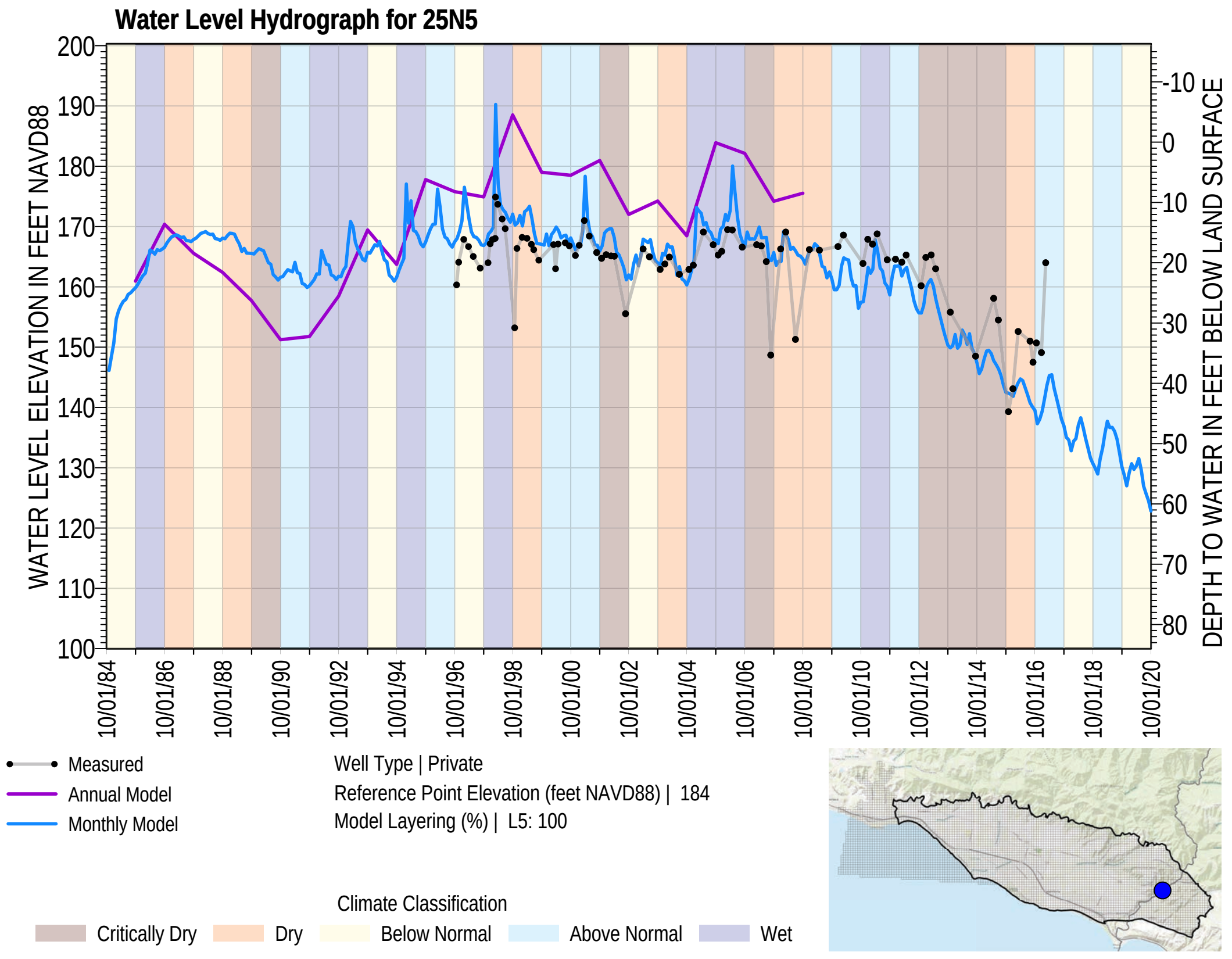
Well Type | Private
Reference Point Elevation (feet NAVD88) | 63.8
Model Layering (%) | L6: 100

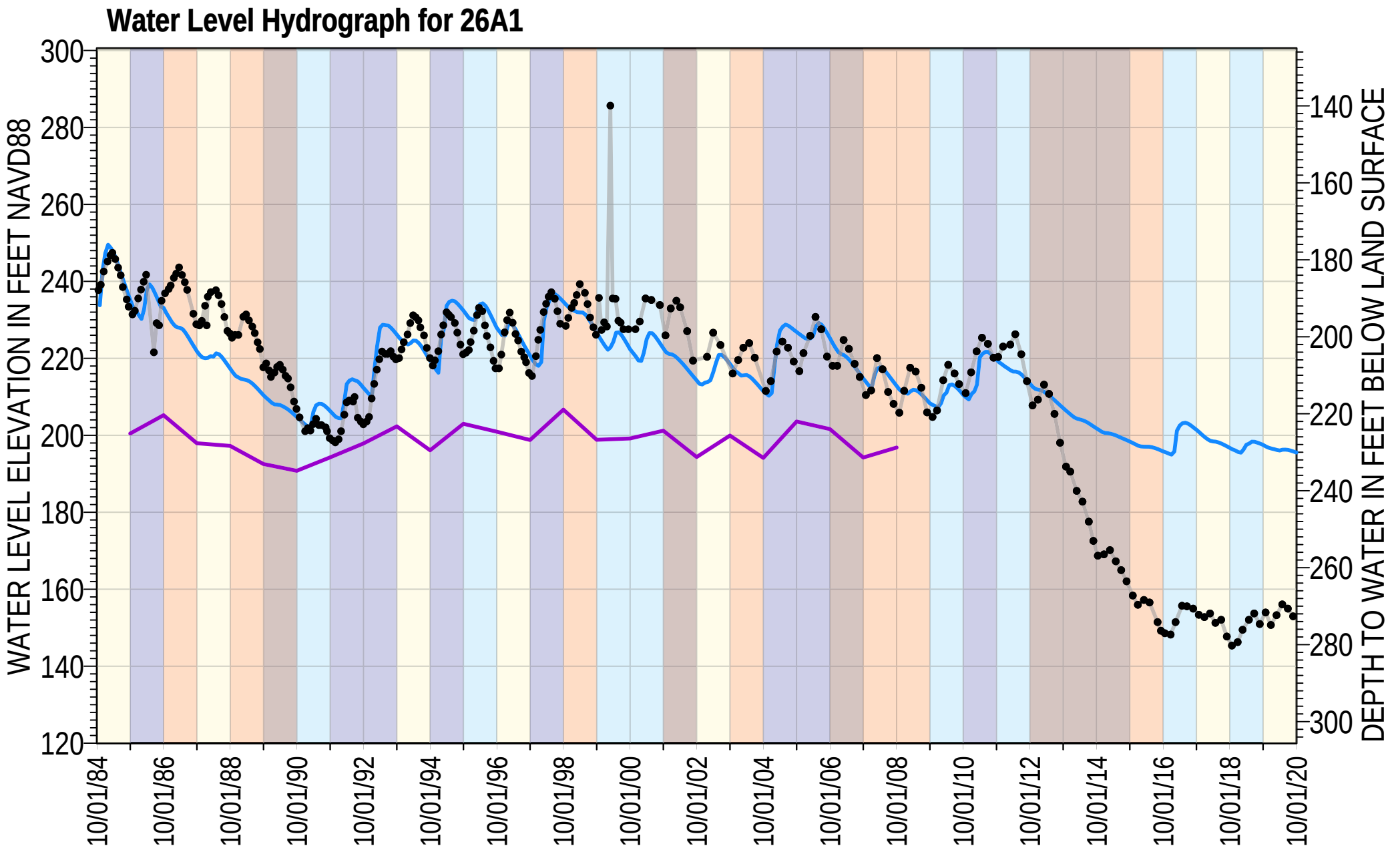


Climate Classification

Critically Dry Dry Below Normal Above Normal Wet

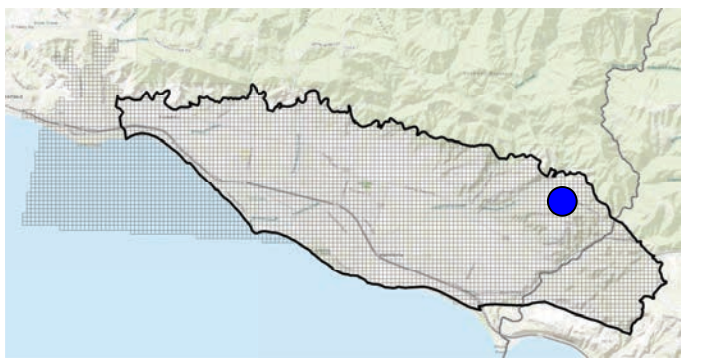

Water Level Hydrograph for 23P1
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
260
240
220
200
180
160
140
120
200
220
240
260
280
300
320
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
10/01/10
10/01/12
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) | 452.5
Model Layering (%) | L4: 15 L5: 85
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet


Water Level Hydrograph for 25N5
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
200
190
180
170
160
150
140
130
120
110
100
-10
0
10
20
30
40
50
60
70
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) | 184
Model Layering (%) | L5: 100
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet



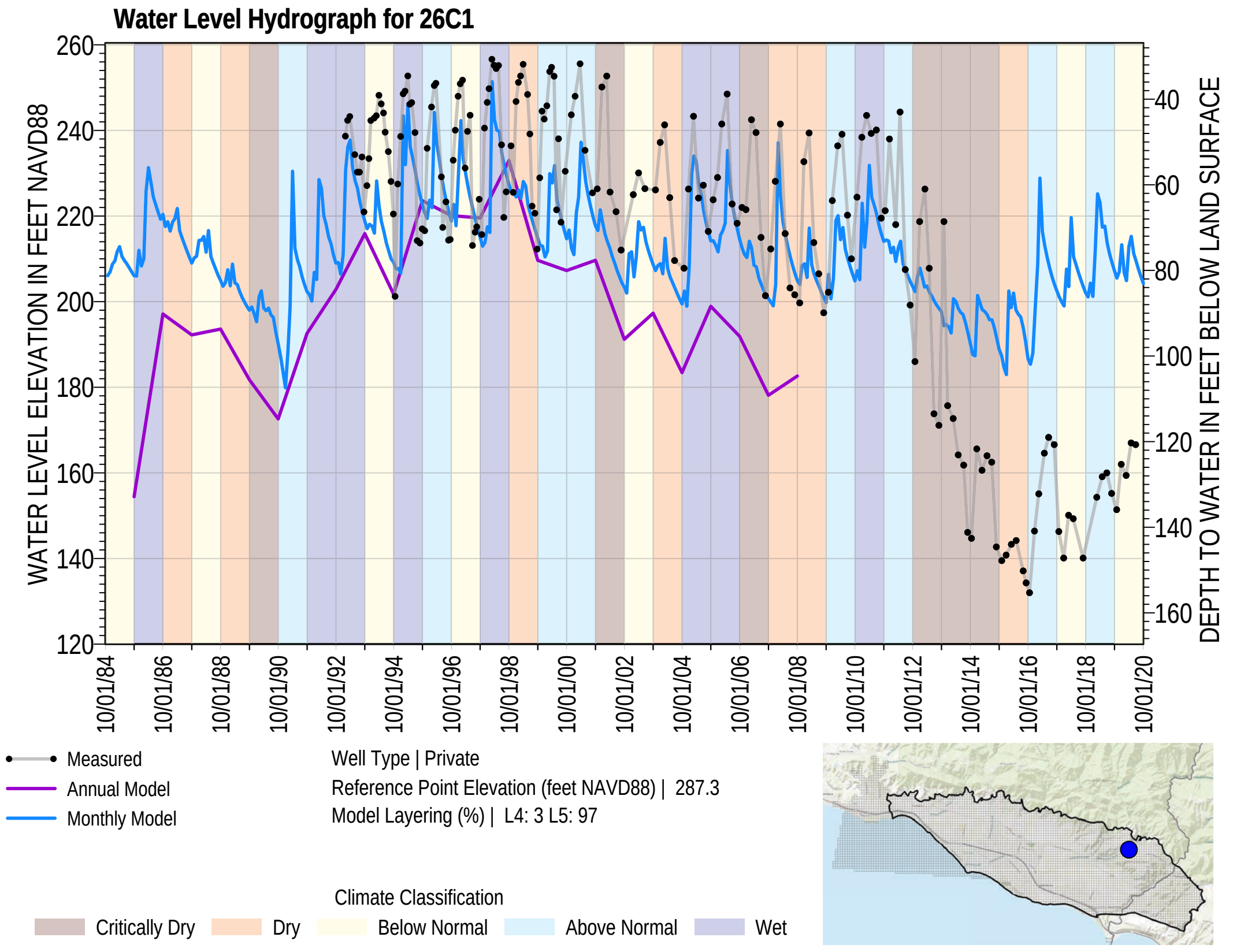
Measured
Annual Model
Monthly Model

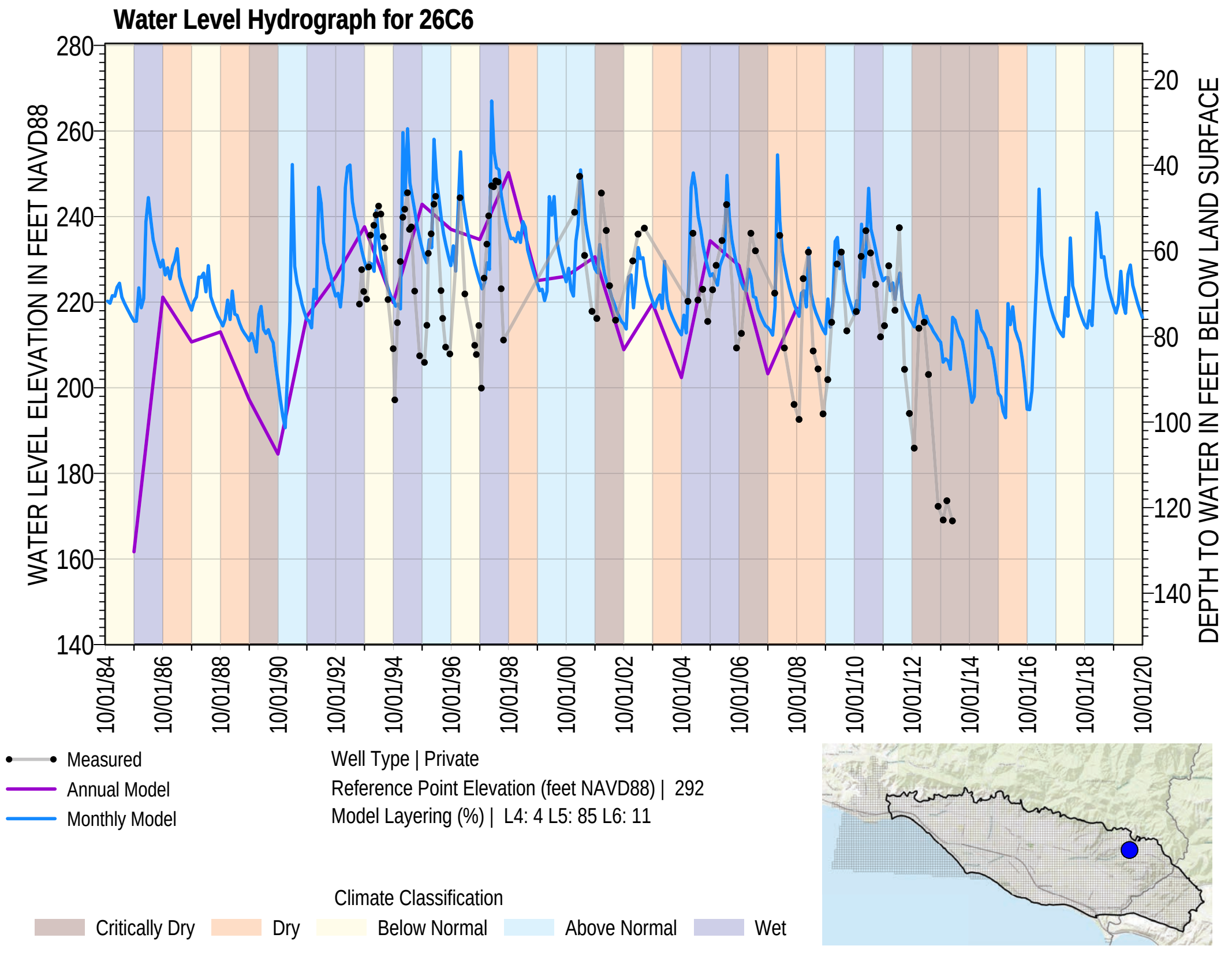
Well Type | Private
Reference Point Elevation (feet NAVD88) | 425.6
Model Layering (%) | L5: 61 L6: 31 L7: 8

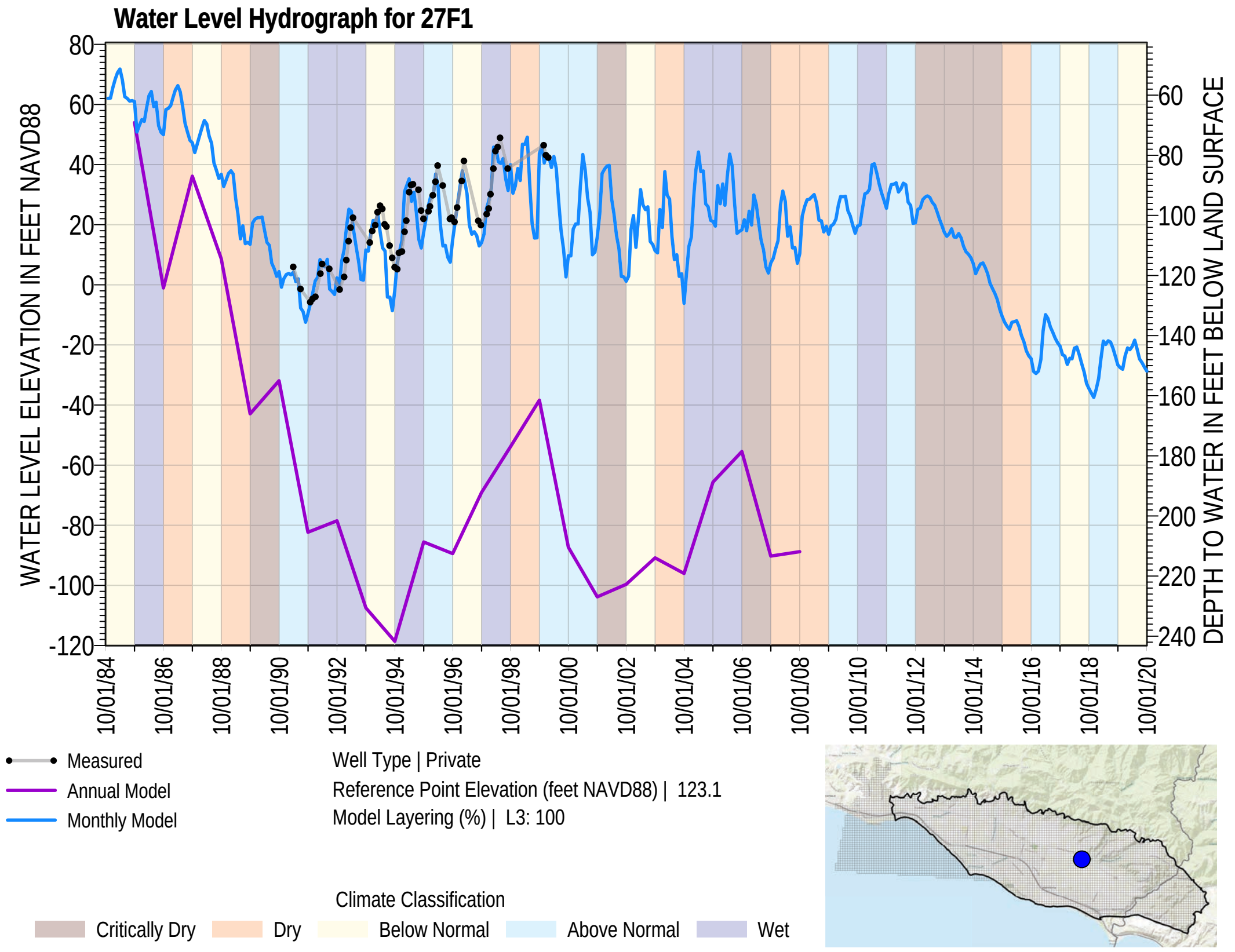


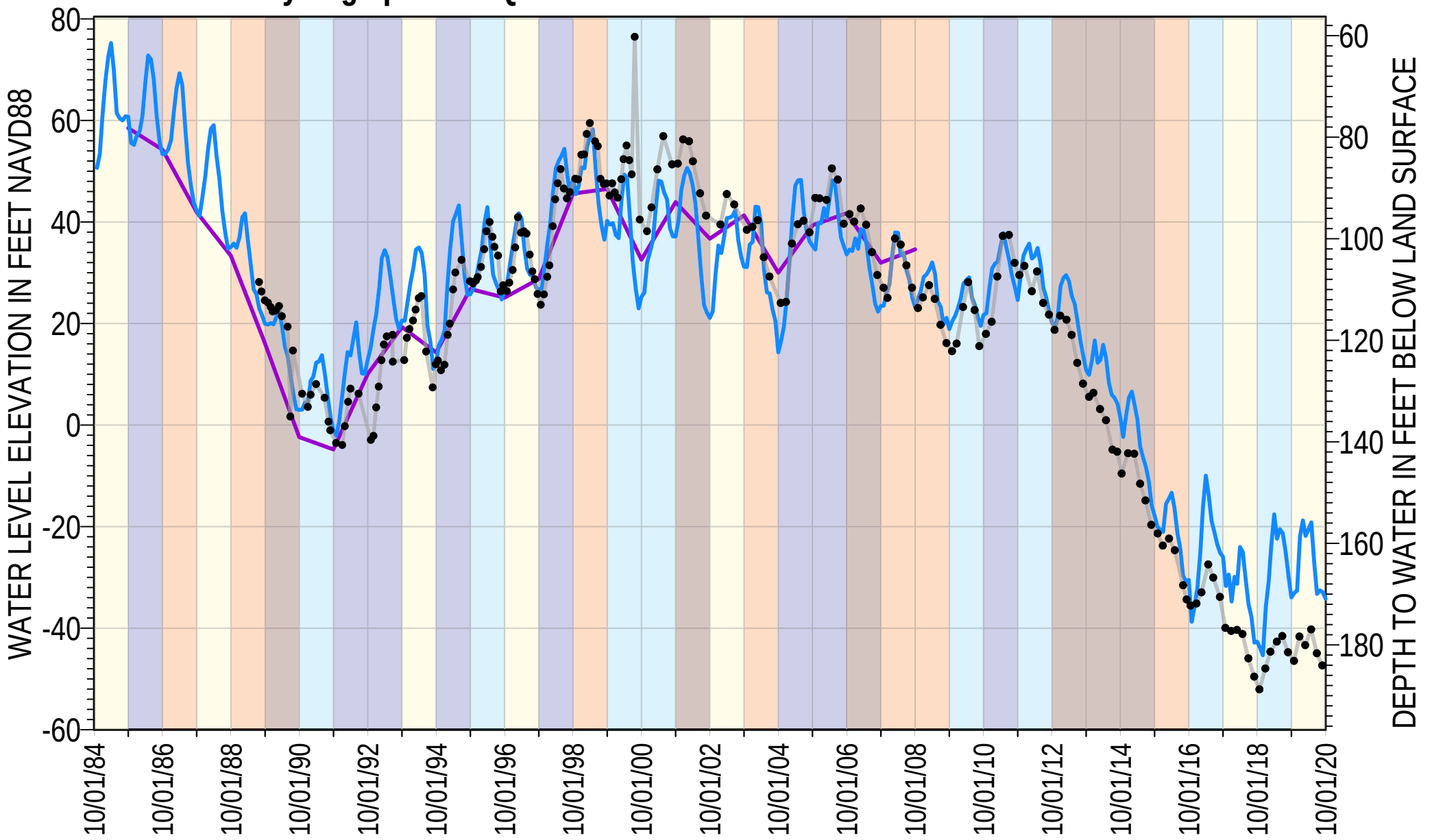
Climate Classification

Critically Dry Dry Below Normal Above Normal Wet


Water Level Hydrograph for 26C1
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
260
240
220
200
180
160
140
120
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 | Private
Reference Point Elevation (feet NAVD88) | 287.3
Model Layering (%) | L4: 3 L5: 97
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

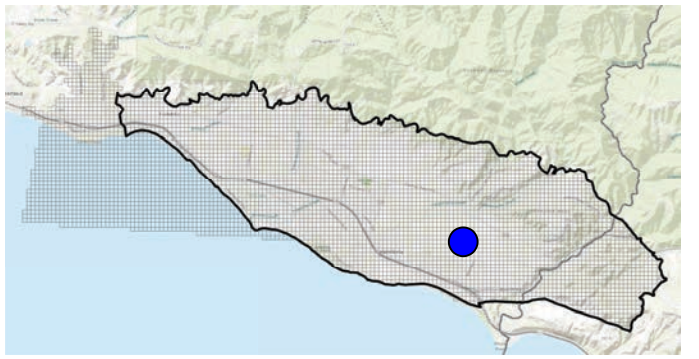

Water Level Hydrograph for 26C6
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
280
260
240
220
200
180
160
140
20
40
60
80
100
120
140
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
10/01/10
10/01/12
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) | 292
Model Layering (%) | L4: 4 L5: 85 L6: 11
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet


Water Level Hydrograph for 27F1
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
80
60
40
20
0
-20
-40
-60
-80
-100
-120
60
80
100
120
140
160
180
200
220
240
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) | 123.1
Model Layering (%) | L3: 100
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet



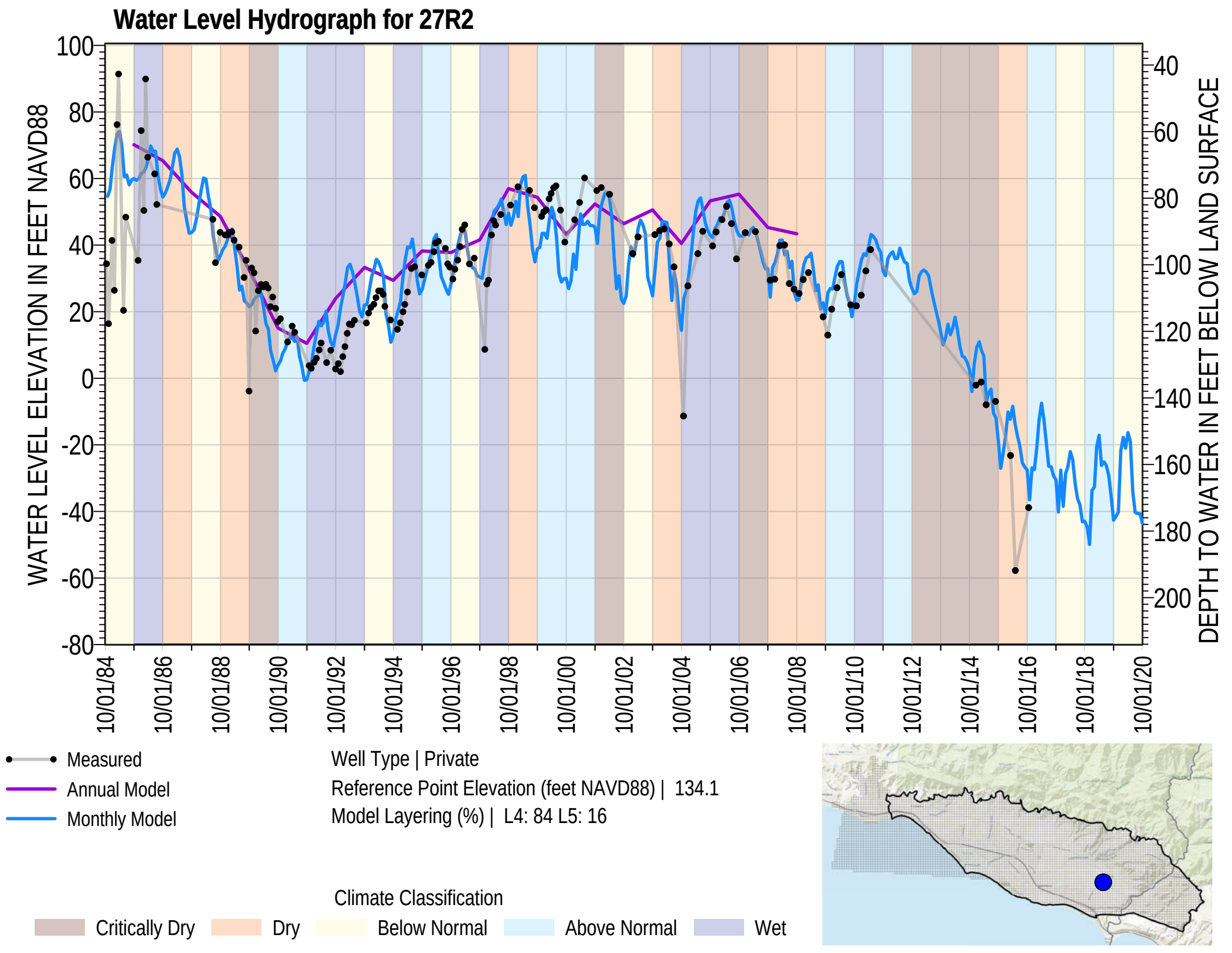
Measured
Annual Model
Monthly Model

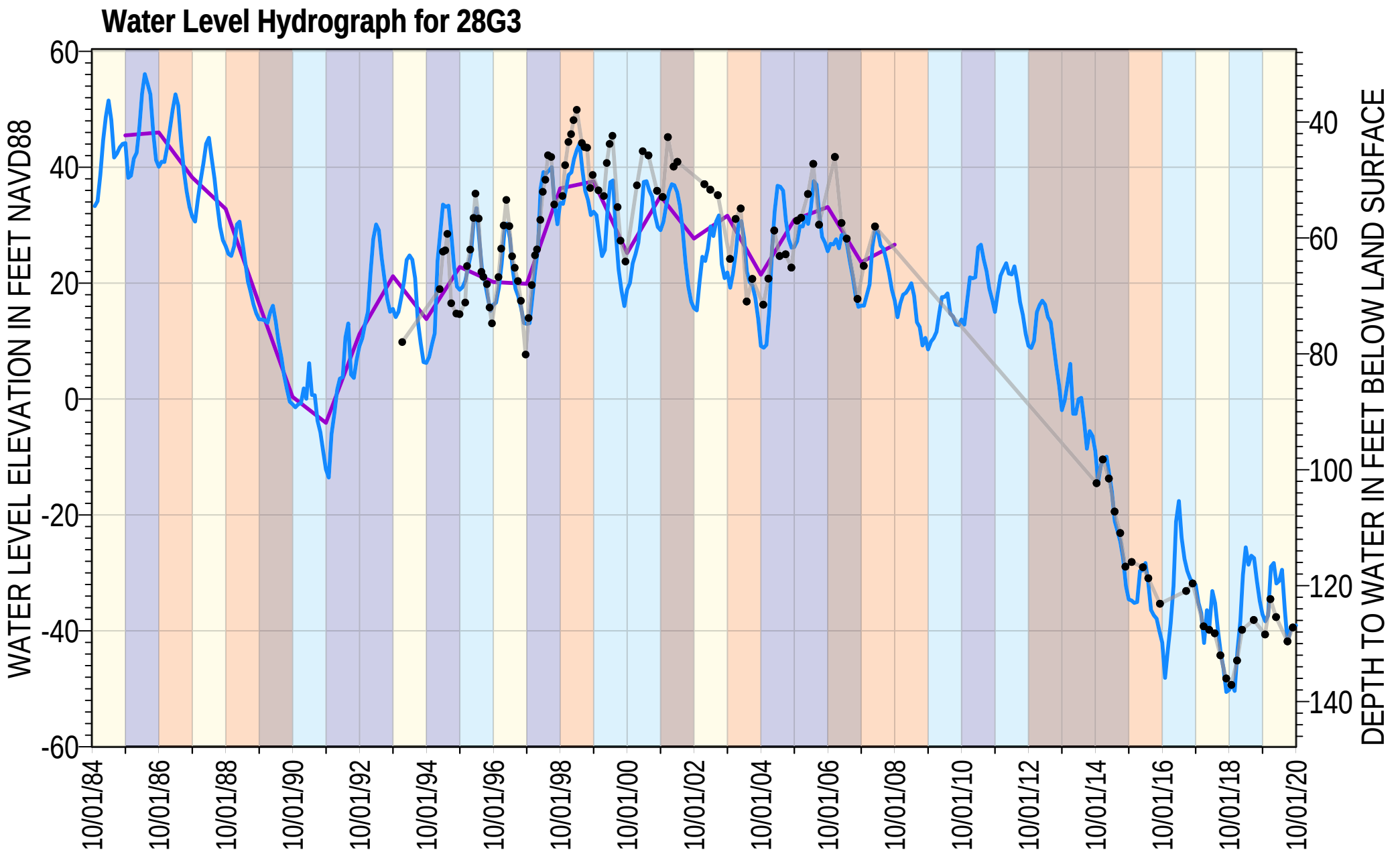
Well Type | Private
Reference Point Elevation (feet NAVD88) | 136.7
Model Layering (%) | L3: 65 L4: 16 L5: 18



Climate Classification

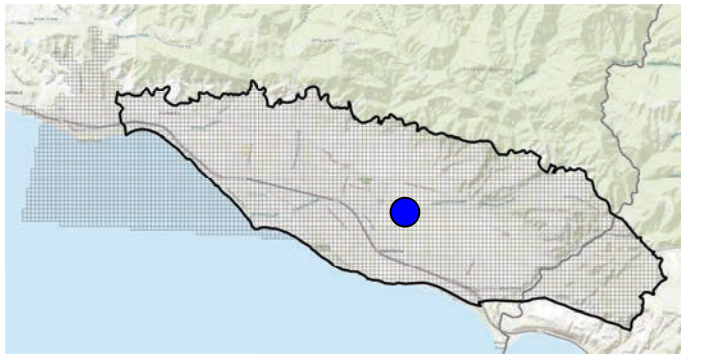
Critically Dry | Dry | Below Normal | Above Normal | Wet


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



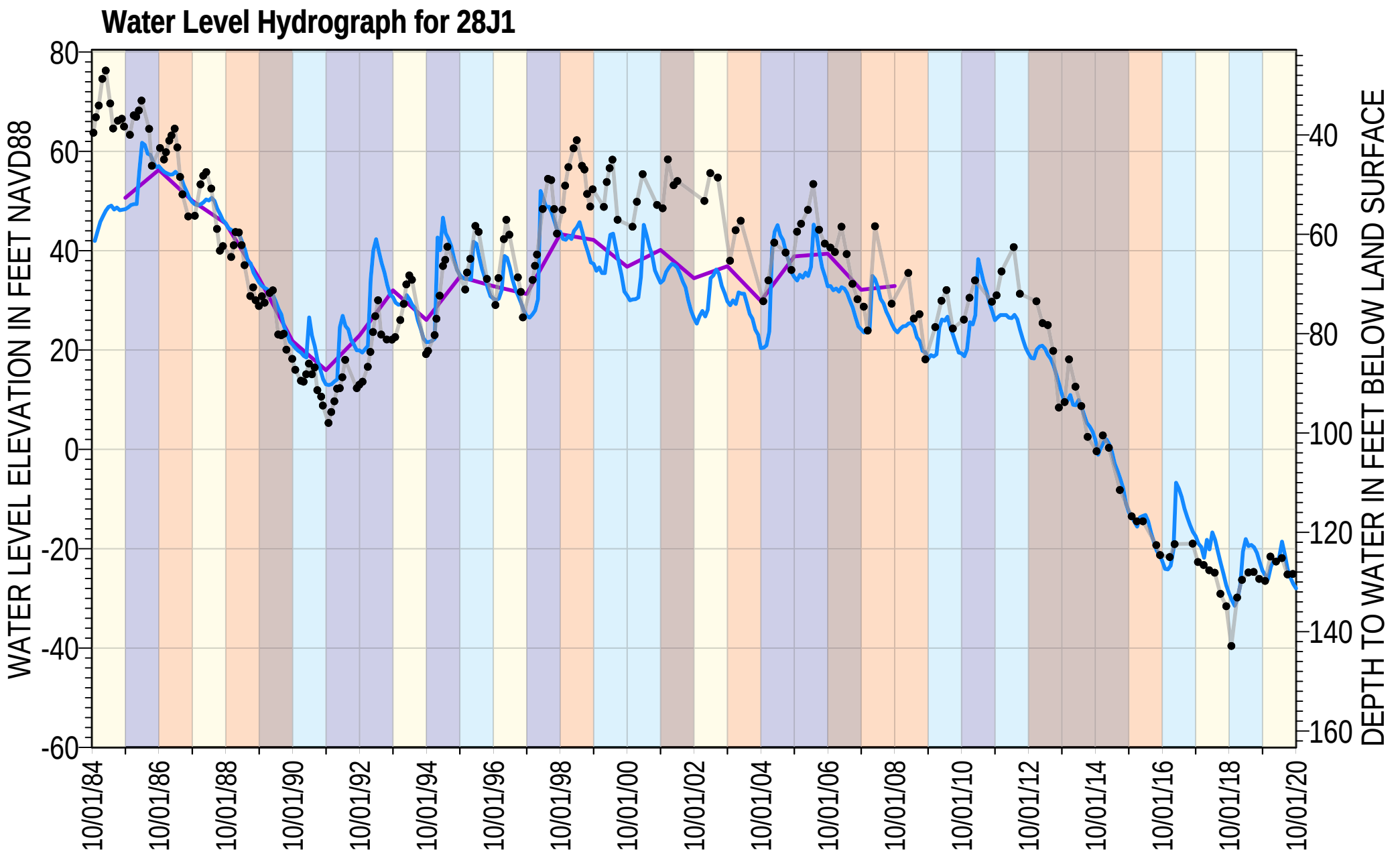
Measured
Annual Model
Monthly Model

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



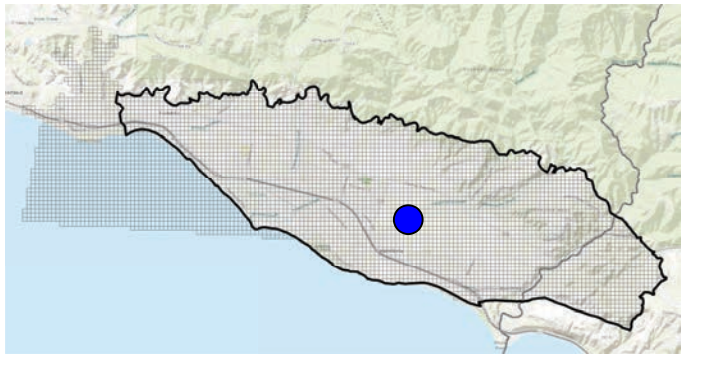
Climate Classification

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



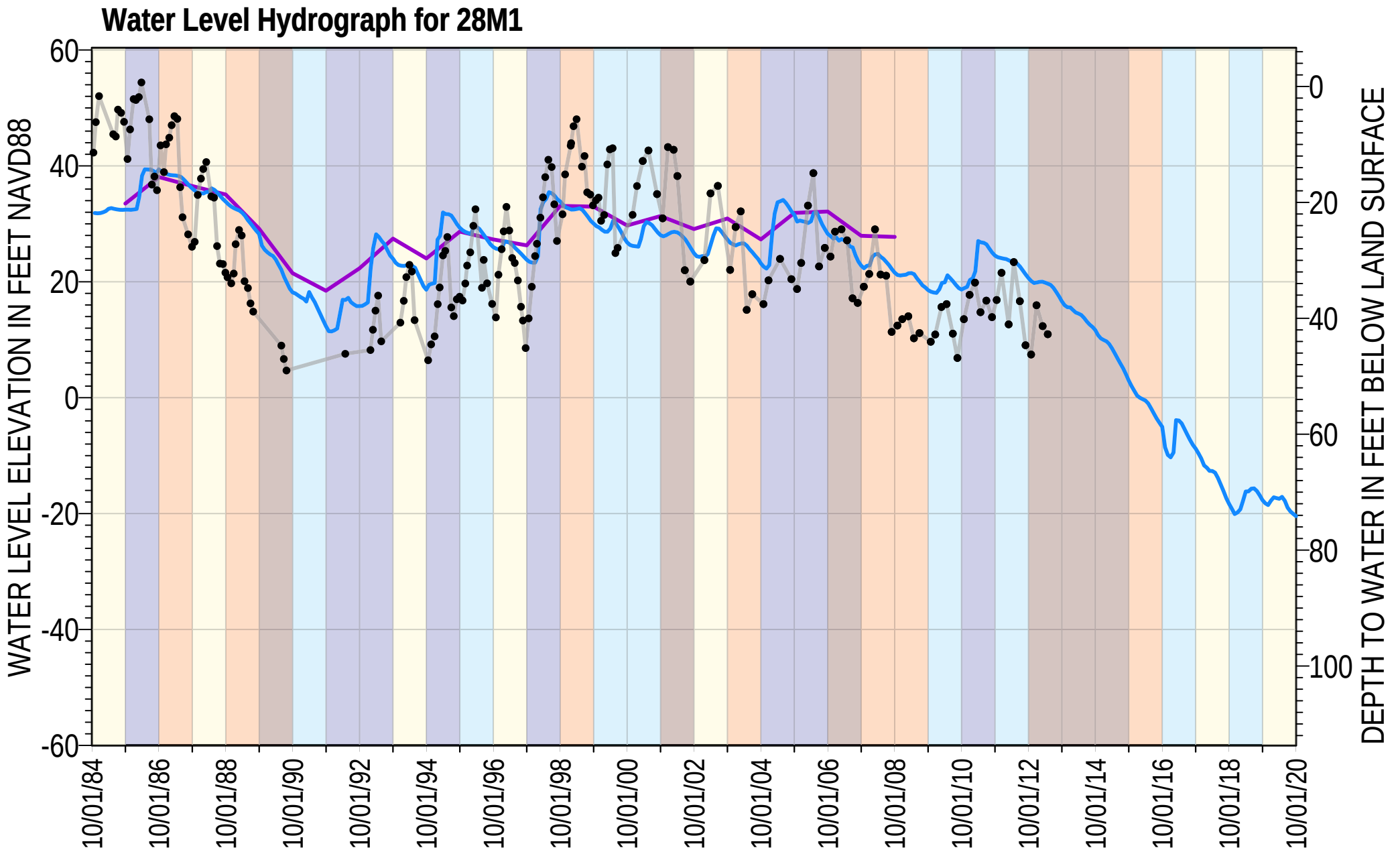
Measured
Annual Model
Monthly Model

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



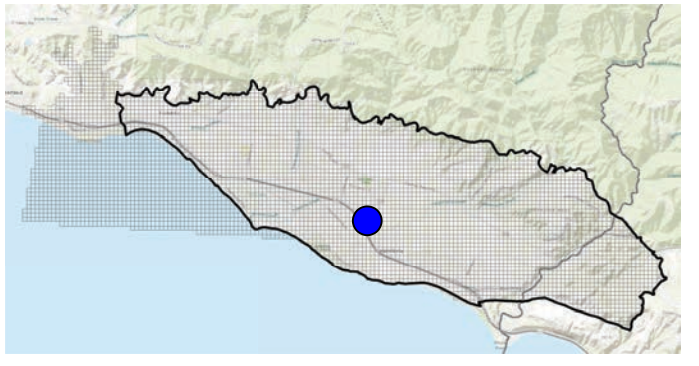
Climate Classification

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



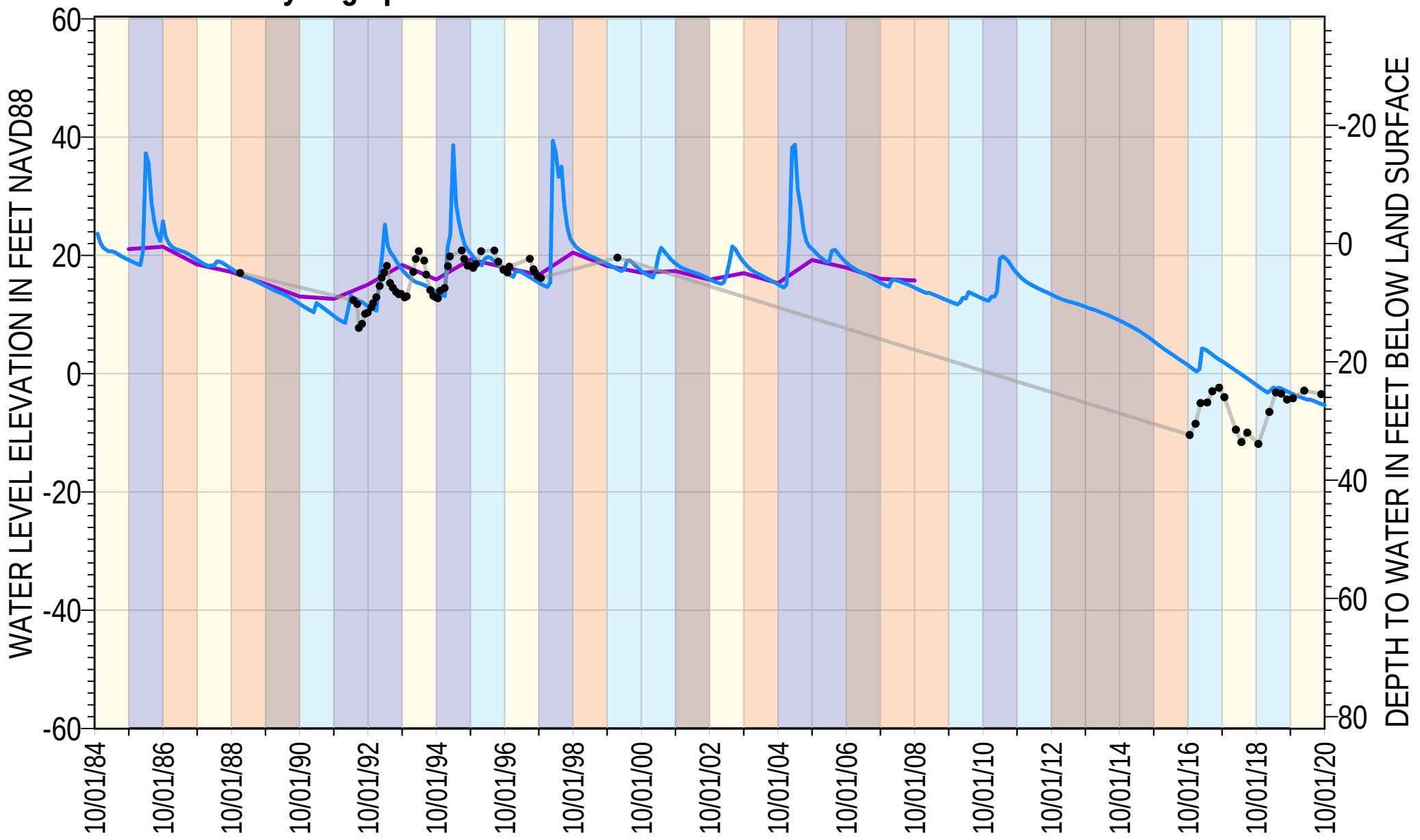
Measured
Annual Model
Monthly Model

Well Type | Private
Reference Point Elevation (feet NAVD88) | 53.7
Model Layering (%) | L1: 100



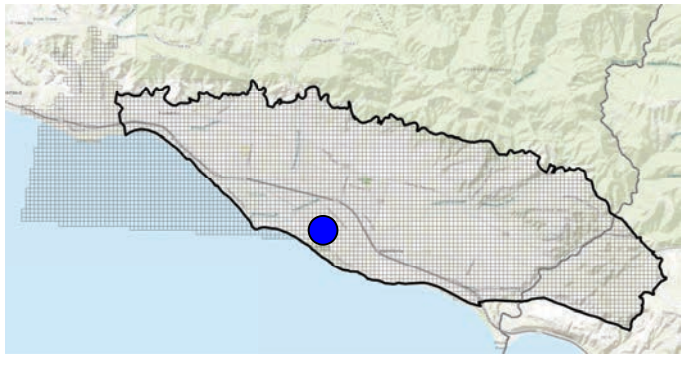
Climate Classification

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



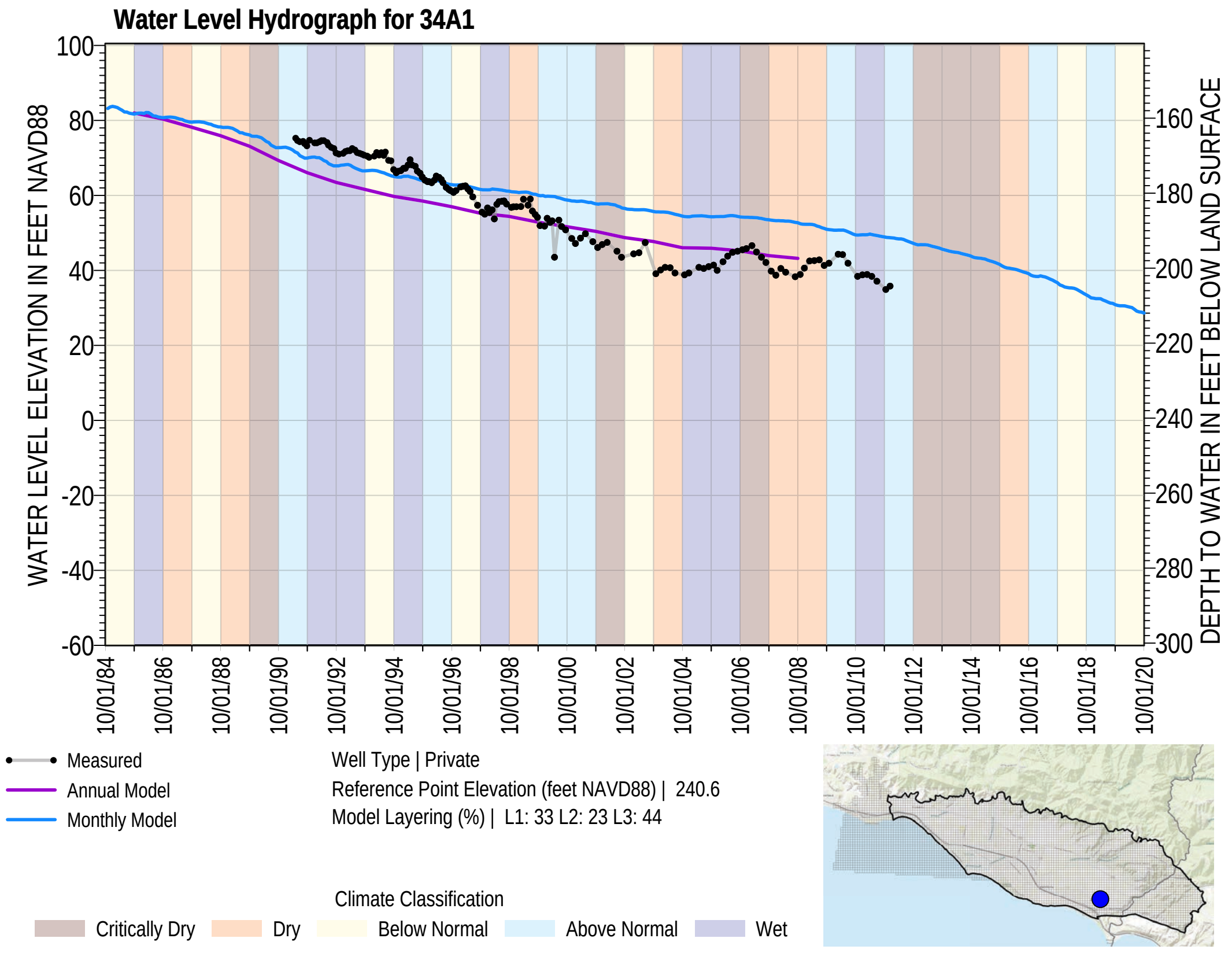
Measured
Annual Model
Monthly Model

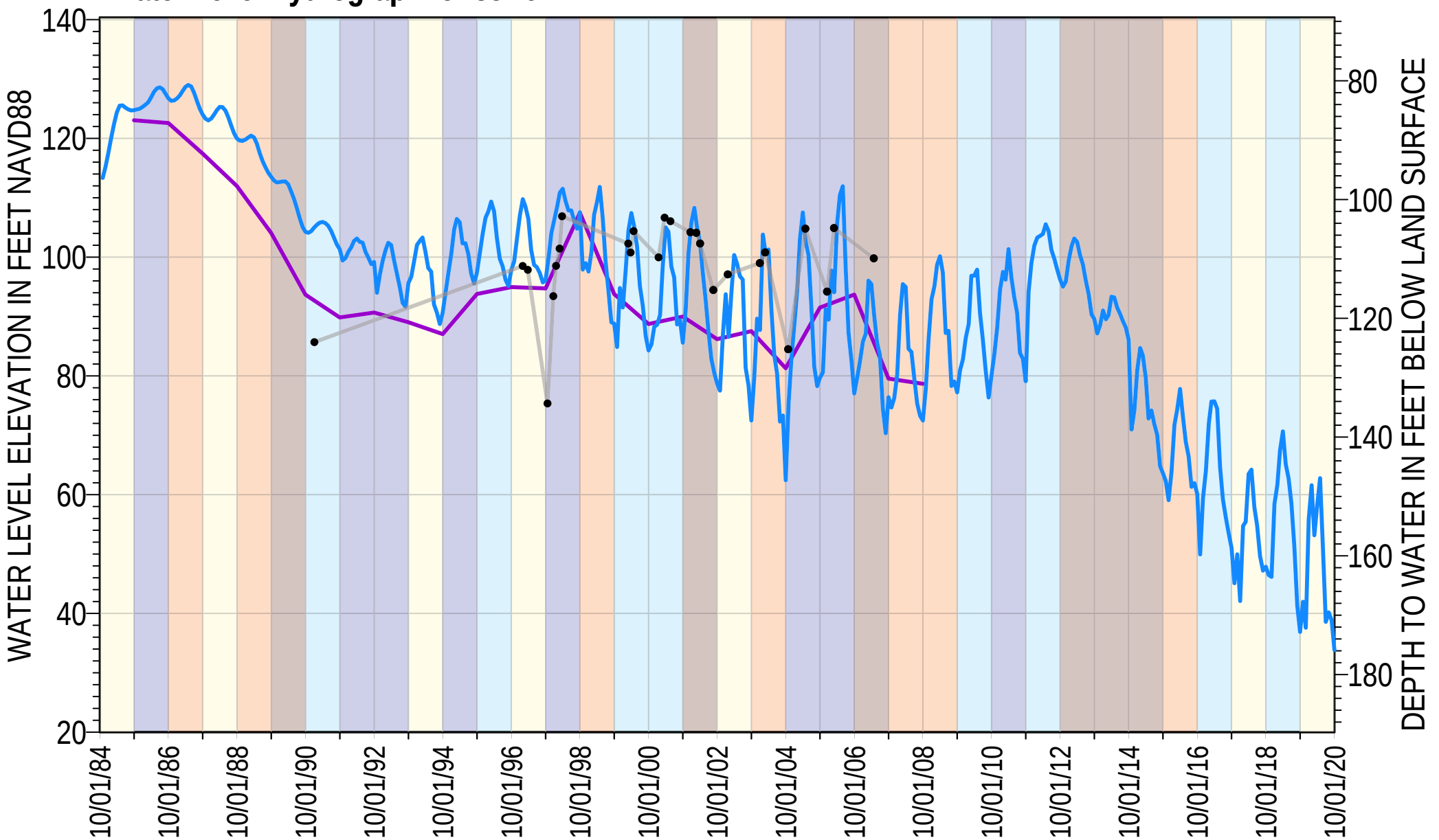
Well Type | Private
Reference Point Elevation (feet NAVD88) | 22
Model Layering (%) | L1: 100



Climate Classification

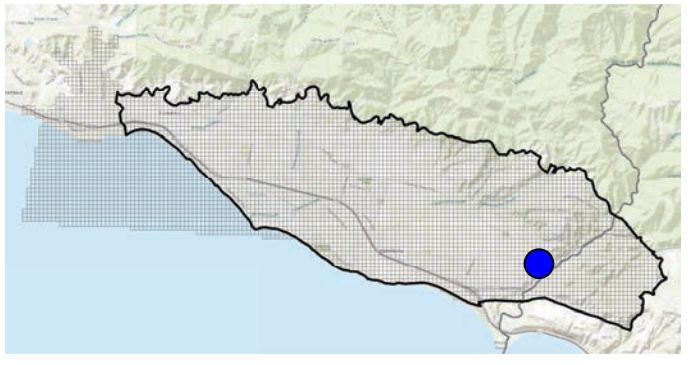
Critically Dry | Dry | Below Normal | Above Normal | Wet


Water Level Hydrograph for 34A1
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
100
80
60
40
20
0
-20
-40
-60
160
180
200
220
240
260
280
300
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) | 240.6
Model Layering (%) | L1: 33 L2: 23 L3: 44
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet



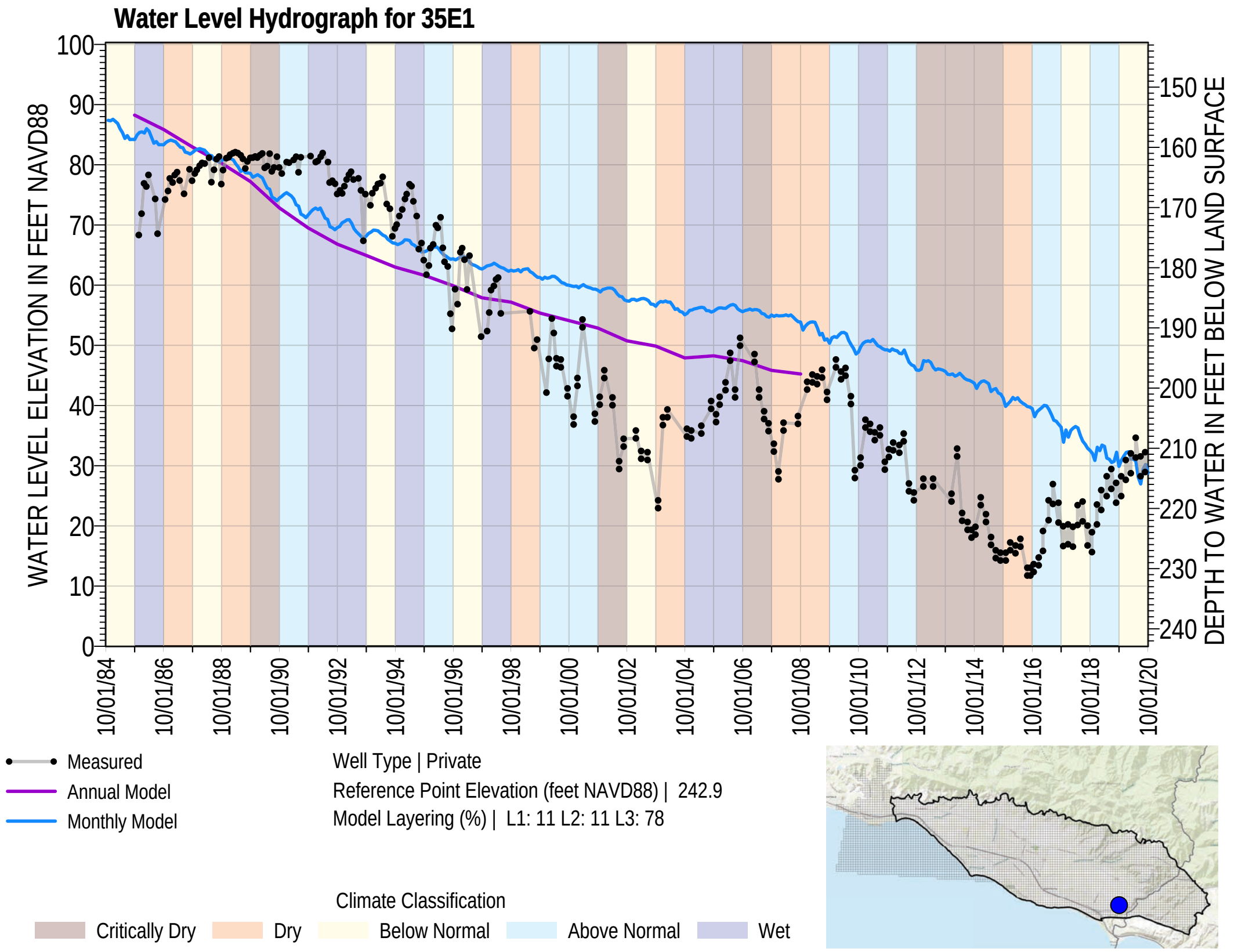
Measured
Annual Model
Monthly Model

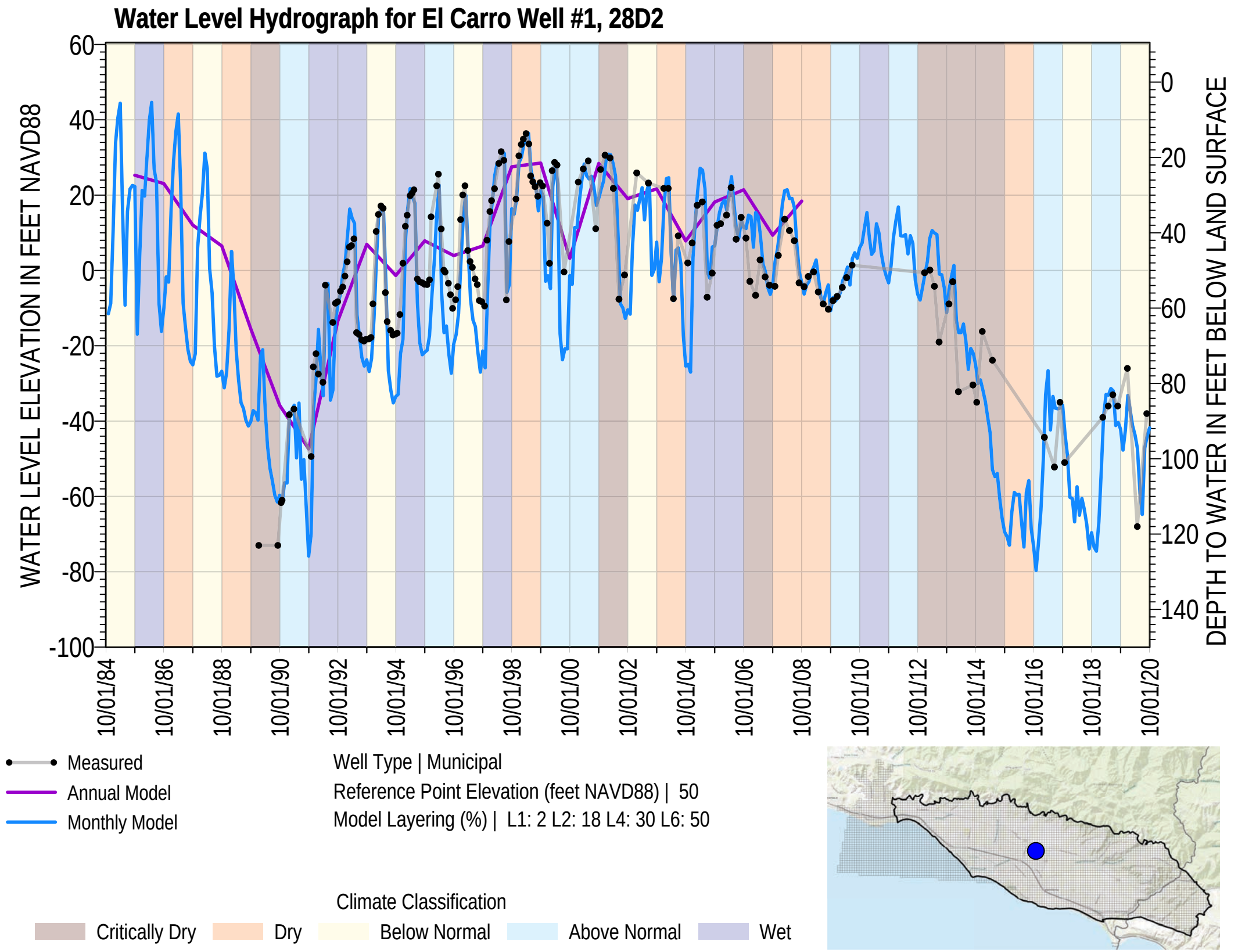
Well Type | Private
Reference Point Elevation (feet NAVD88) | 209.7
Model Layering (%) | L3: 37 L4: 24 L5: 40

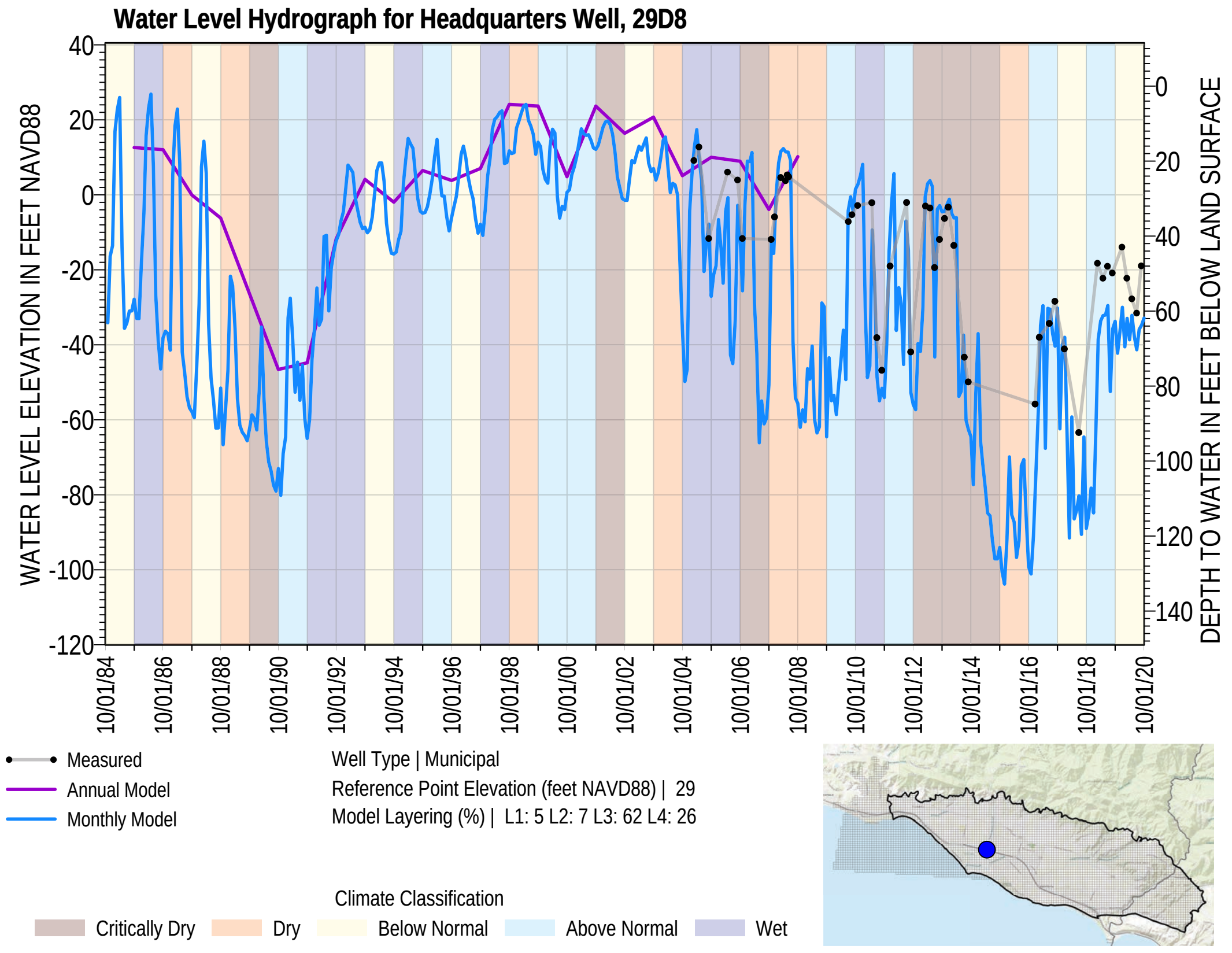


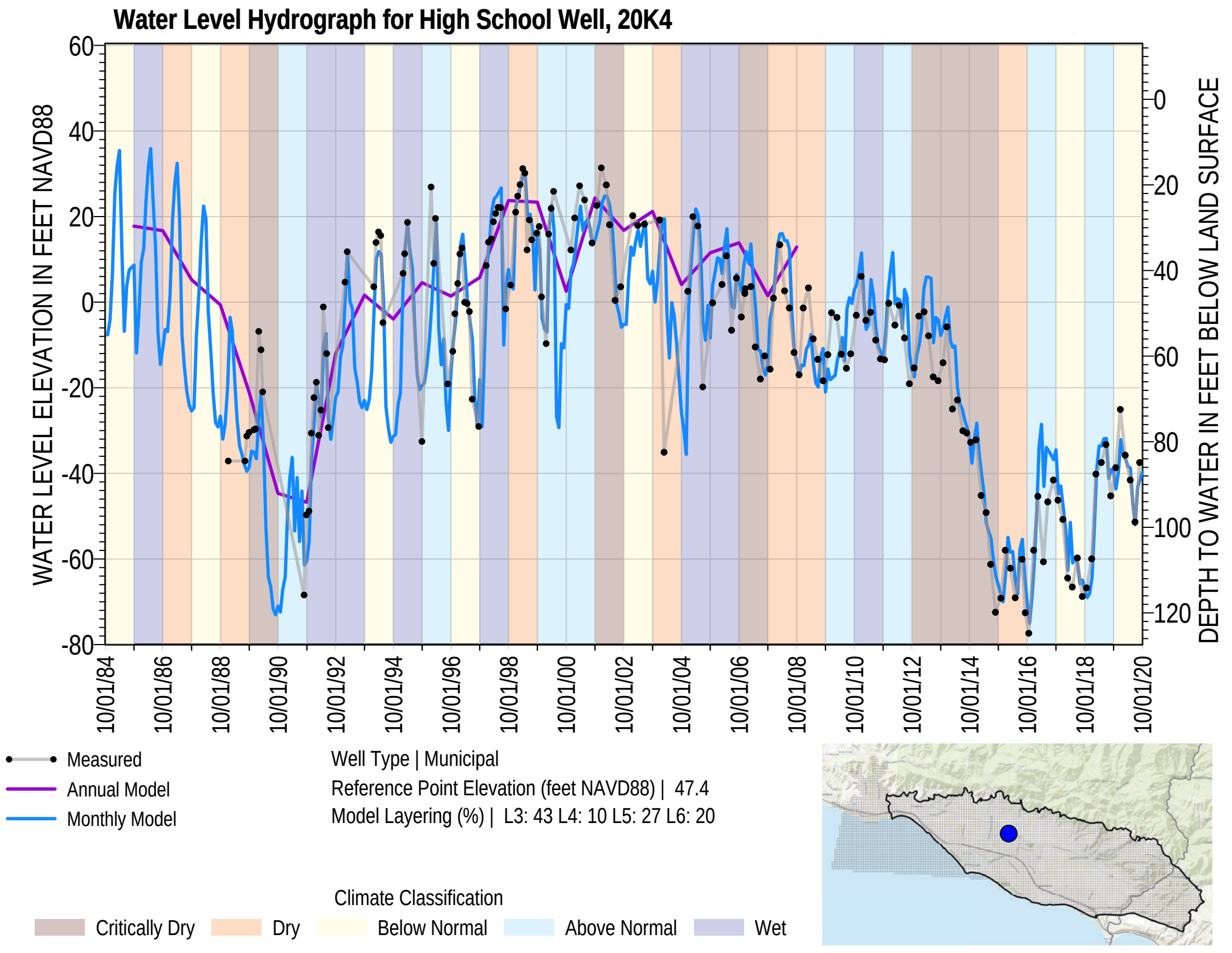
Climate Classification

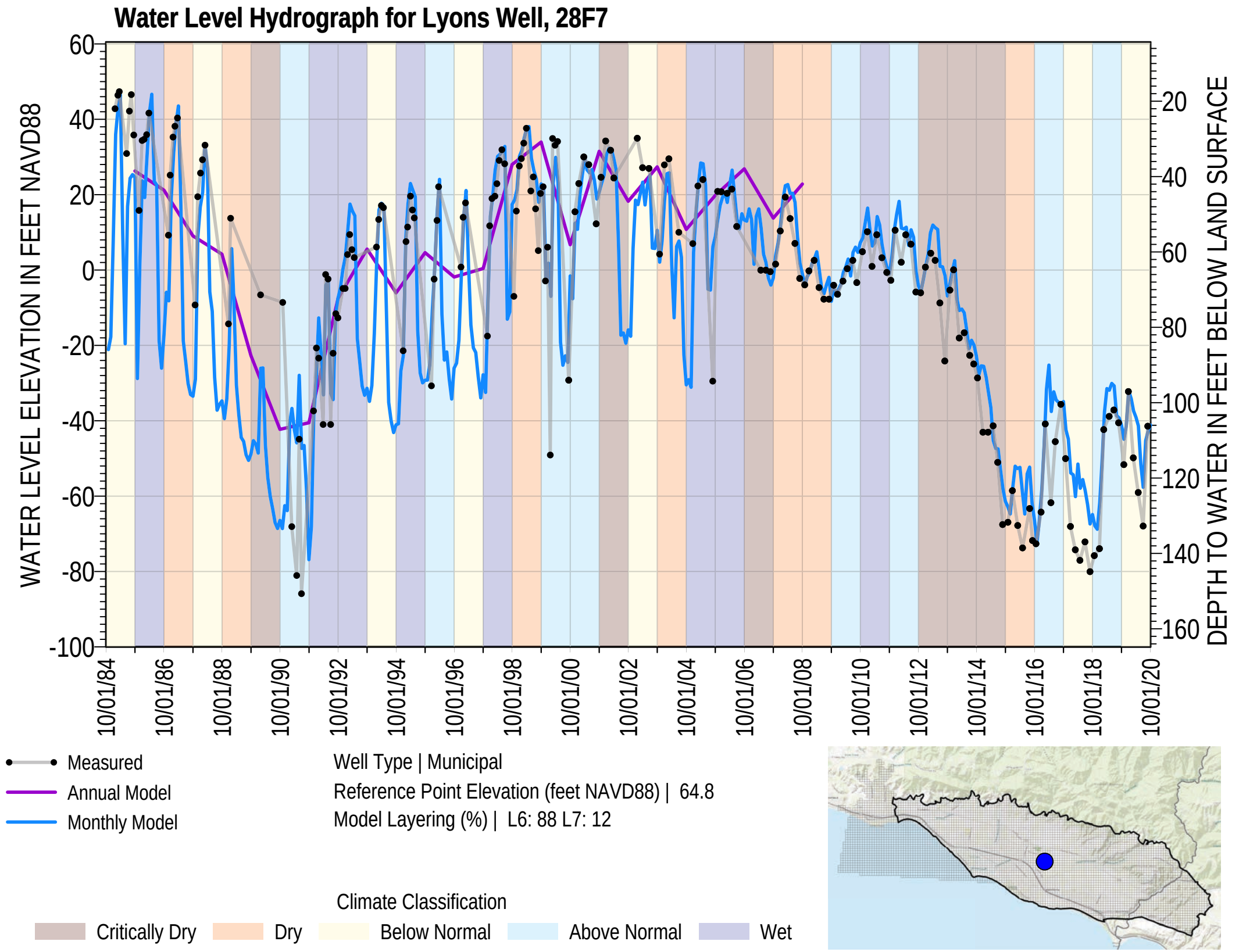
Critically Dry | Dry | Below Normal | Above Normal | Wet

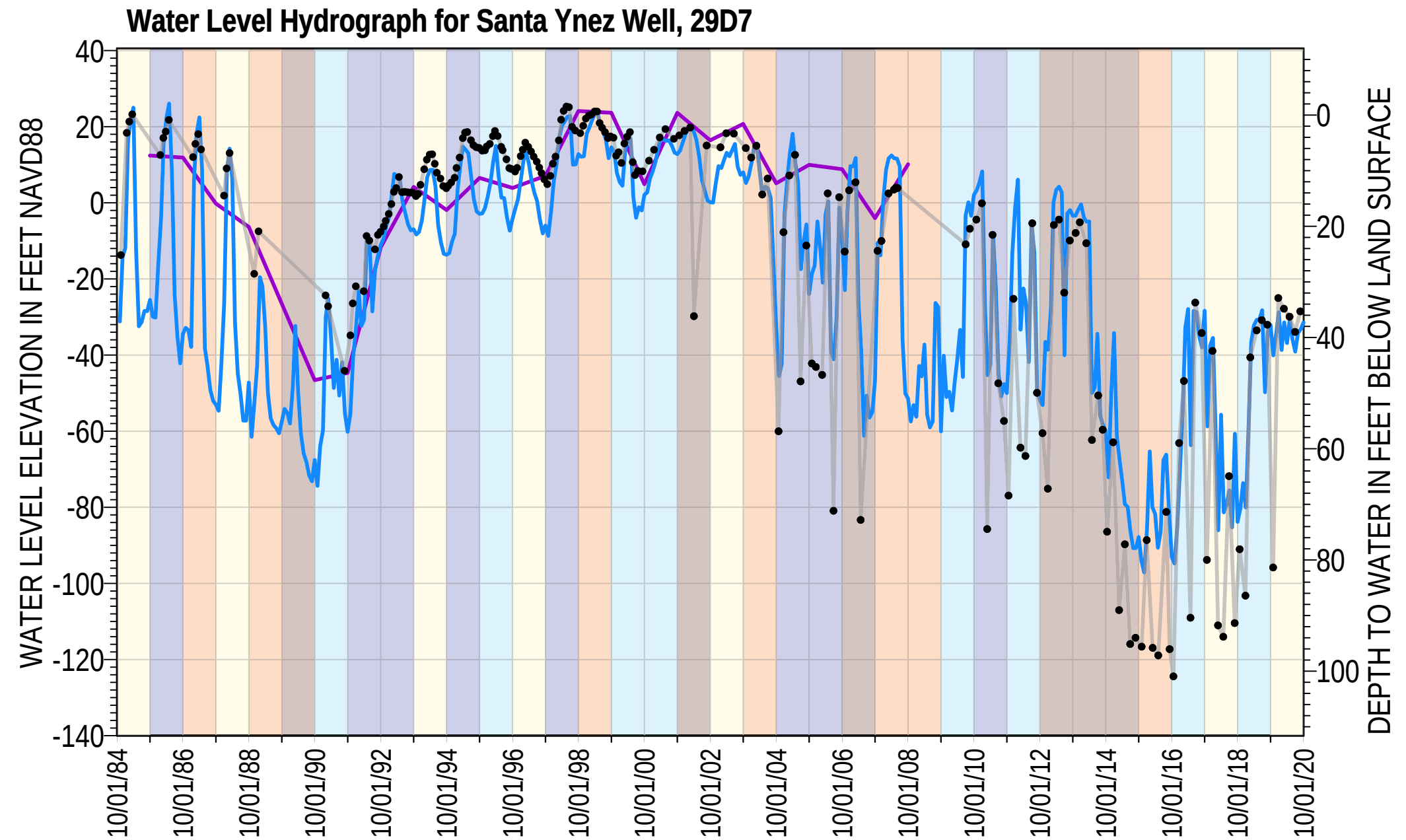

Water Level Hydrograph for 35E1
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
100
90
80
70
60
50
40
30
20
10
0
150
160
170
180
190
200
210
220
230
240
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
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) | 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
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
-80
-100
0
20
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 | 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
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
10/01/86
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) | 29
Model Layering (%) | L1: 5 L2: 7 L3: 62 L4: 26
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

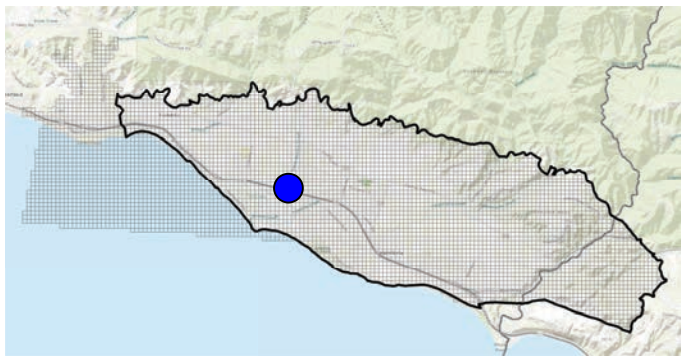

Water Level Hydrograph for High School Well, 20K4
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
-80
0
20
40
60
80
100
120
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
10/01/10
10/01/12
10/01/14
10/01/16
10/01/18
10/01/20
Measured
Annual Model
Monthly Model
Well Type | 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



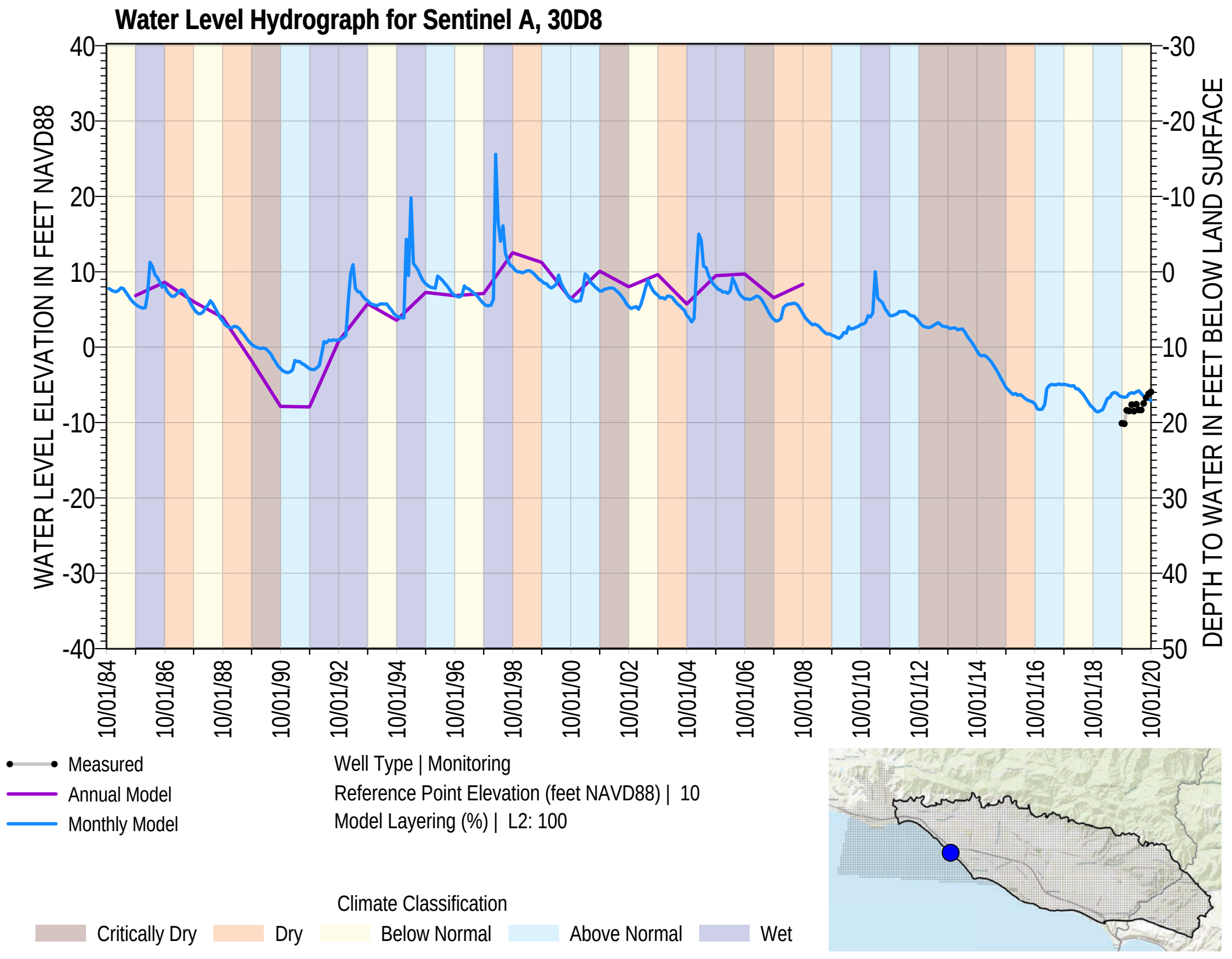
Measured
Annual Model
Monthly Model

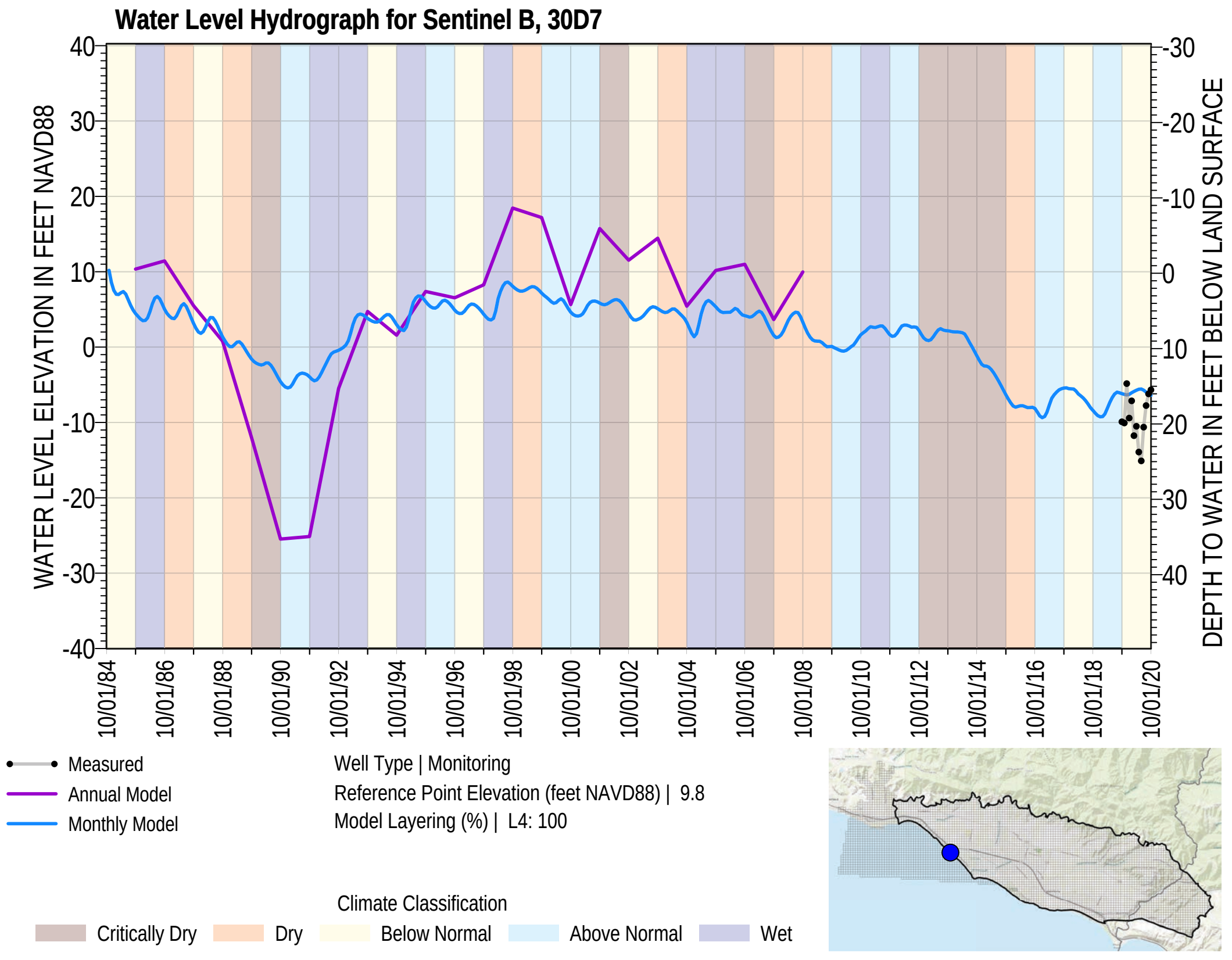
Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 28.4
Model Layering (%) | L1: 34 L2: 1 L3: 59 L4: 5

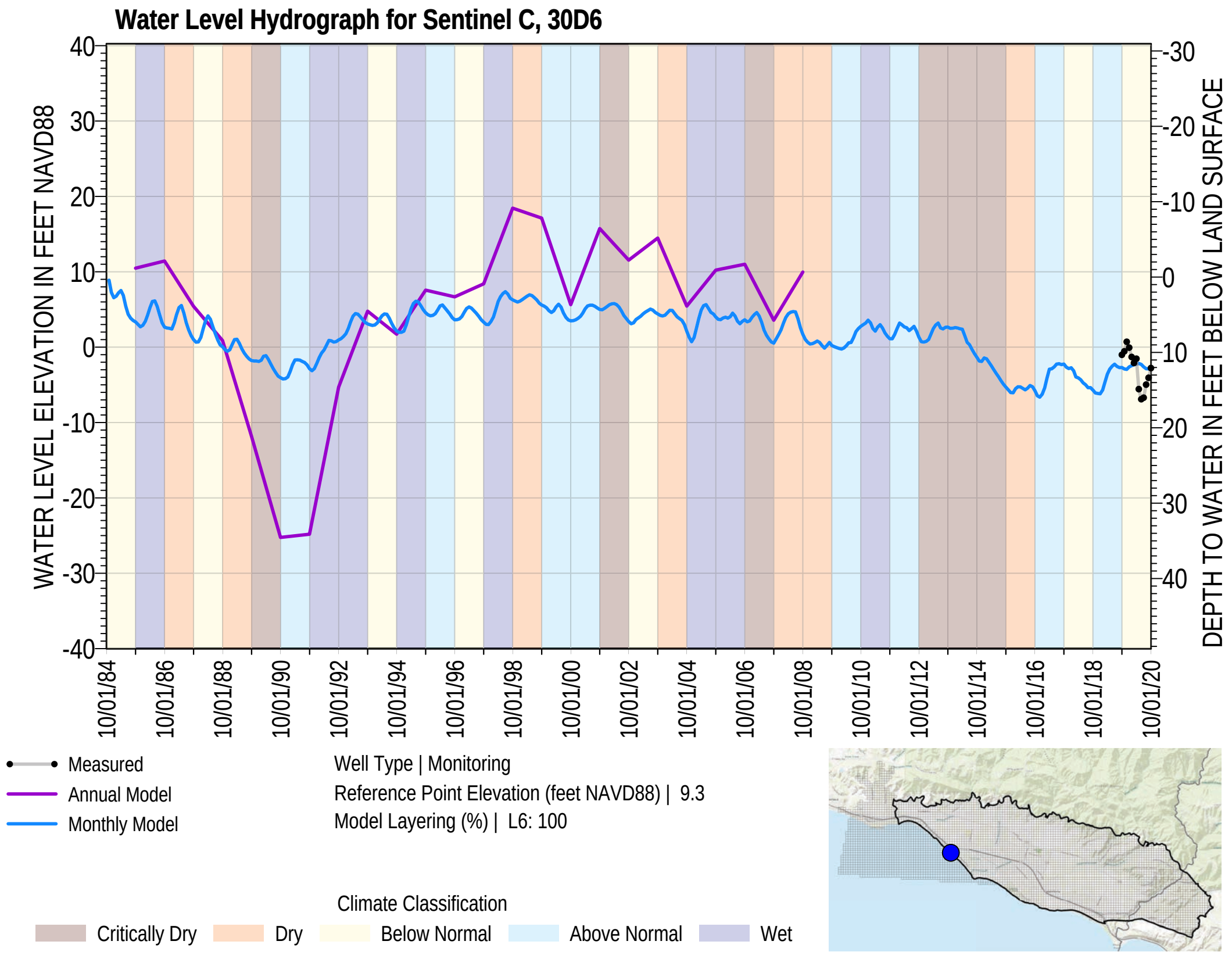


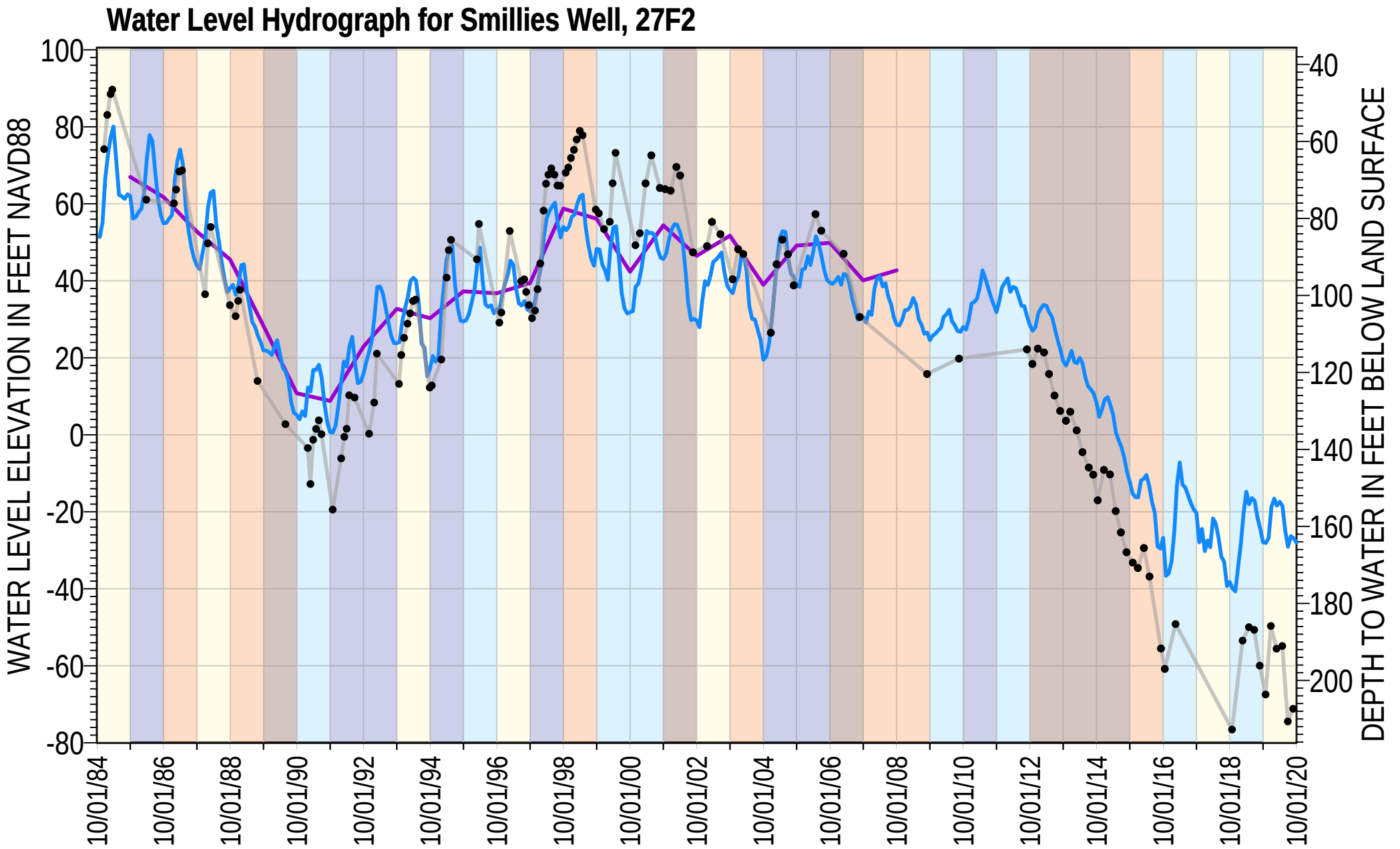
Climate Classification

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

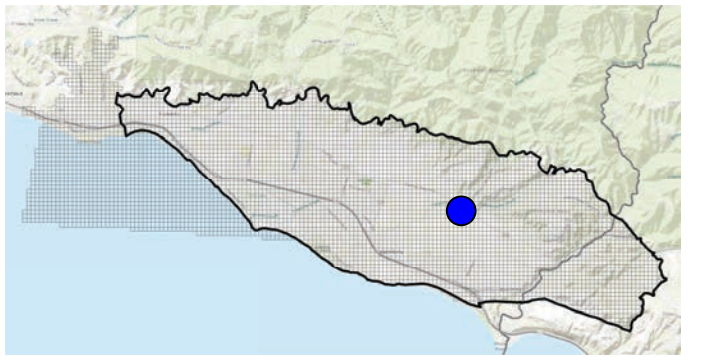

Water Level Hydrograph for Sentinel B, 30D7
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
40
30
20
10
0
-10
-20
-30
-40
-30
-20
-10
0
10
20
30
40
10/01/84
10/01/86
10/01/88
10/01/90
10/01/92
10/01/94
10/01/96
10/01/98
10/01/00
10/01/02
10/01/04
10/01/06
10/01/08
10/01/10
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) | 9.8
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



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%

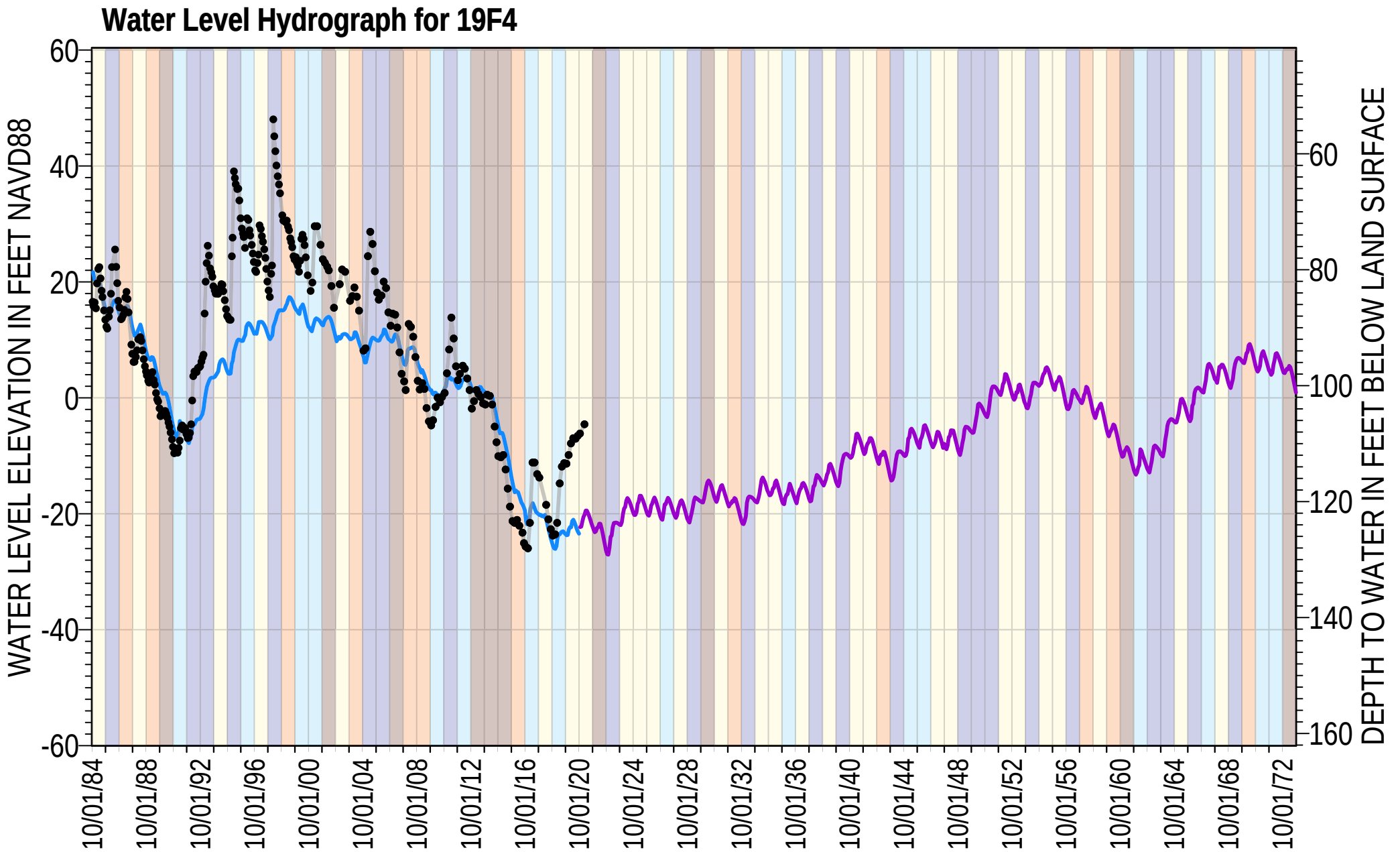
Well	Screening Elevations Implemented in Model	Model Layering							
		Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Percent Removed to Bedrock
20L3	-48--331	18%	5%	77%	0%	0%	0%	0%	0.0%
20L5	-300--320 |-460--620 |-700--760	0%	0%	75%	6%	19%	0%	0%	0.0%
20M1	13--99	100%	0%	0%	0%	0%	0%	0%	0.0%
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							
		Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Percent Removed to Bedrock
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%

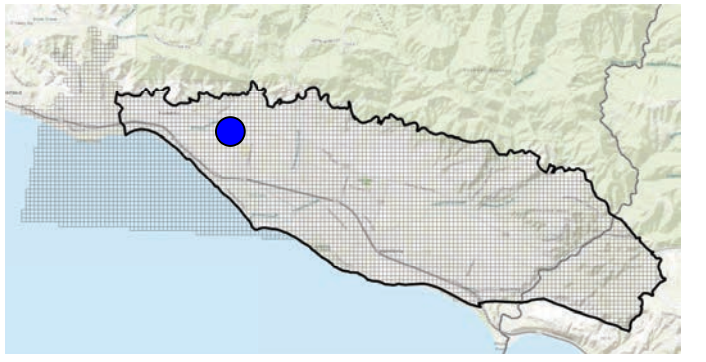
Well	Screening Elevations Implemented in Model	Model Layering							
		Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Percent Removed to Bedrock
29D8	Assigned as Single Node Well	0%	0%	0%	0%	100%	0%	0%	0.0%
33A1	-200--400	0%	32%	68%	0%	0%	0%	0%	0.0%
33C1	-280--400	0%	25%	75%	0%	0%	0%	0%	0.0%
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%

APPENDIX D PROJECTED HYDROGRAPHS



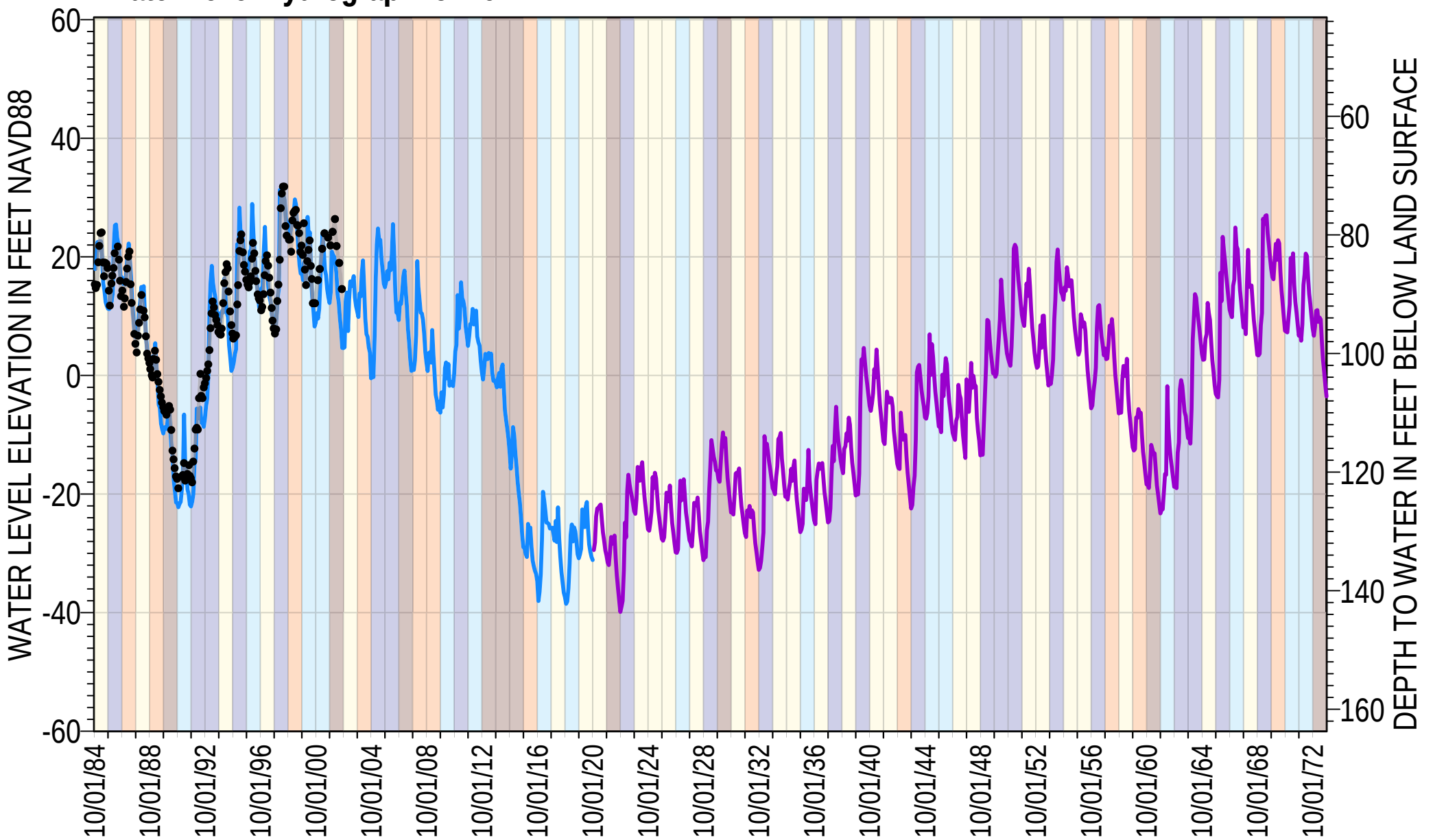
Measured
Projected Baseline
Historical

Well Type | Private
Reference Point Elevation (feet NAVD88) | 102.1
Model Layering (%) | L3: 78 L5: 22



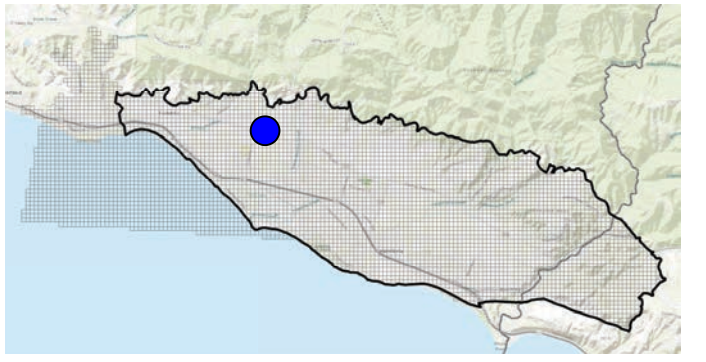
Climate Classification

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



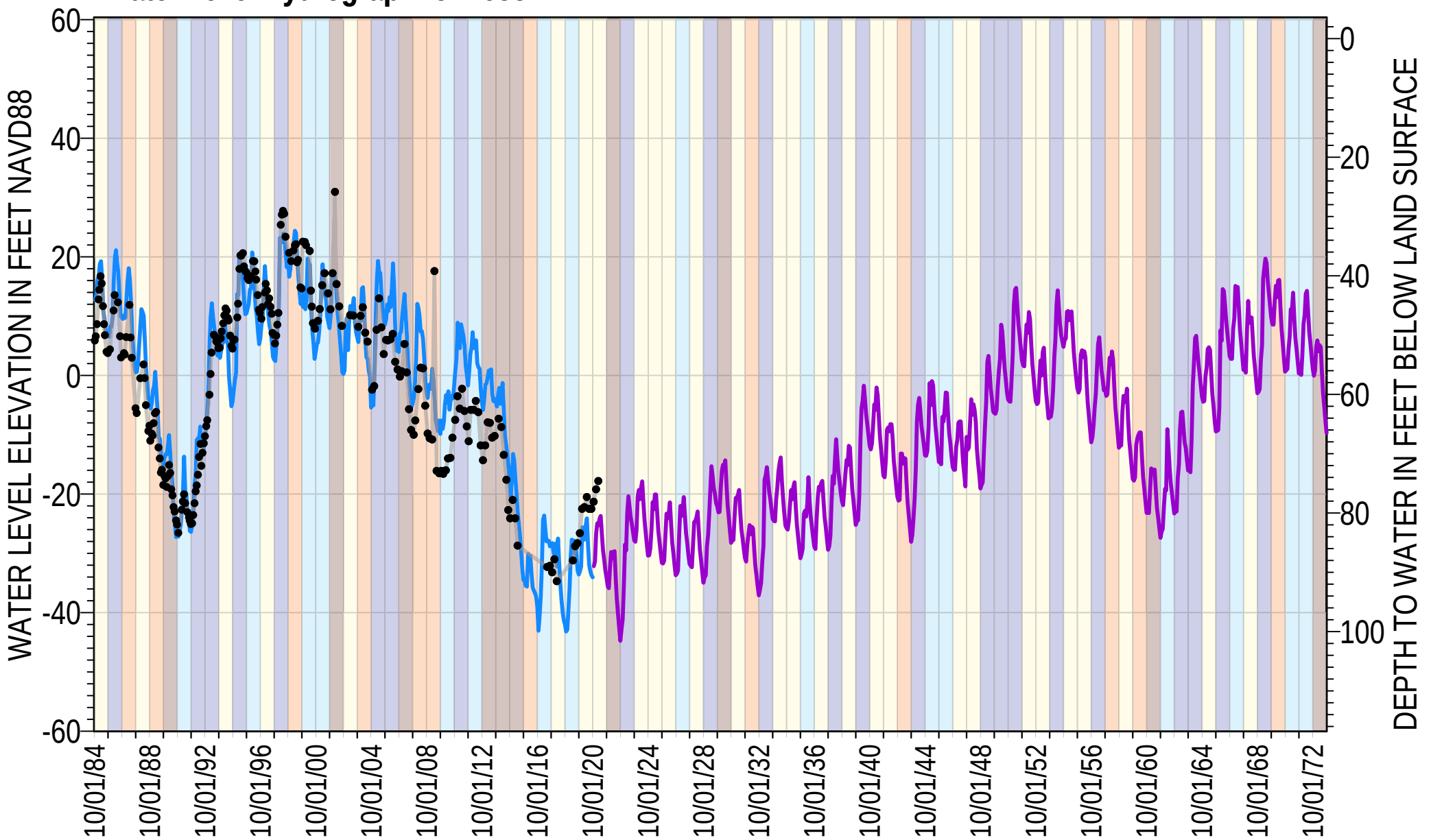
Measured
Projected Baseline
Historical

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



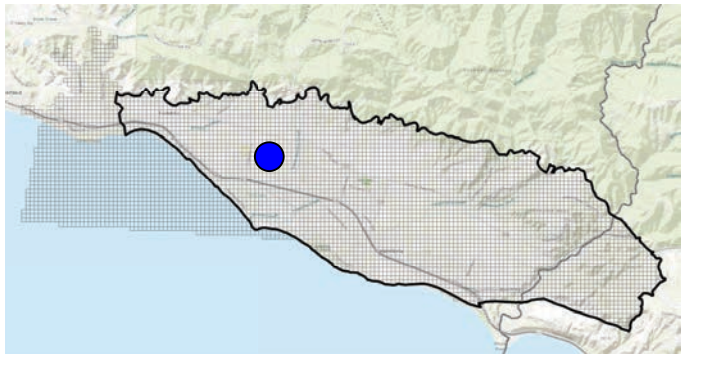
Climate Classification

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



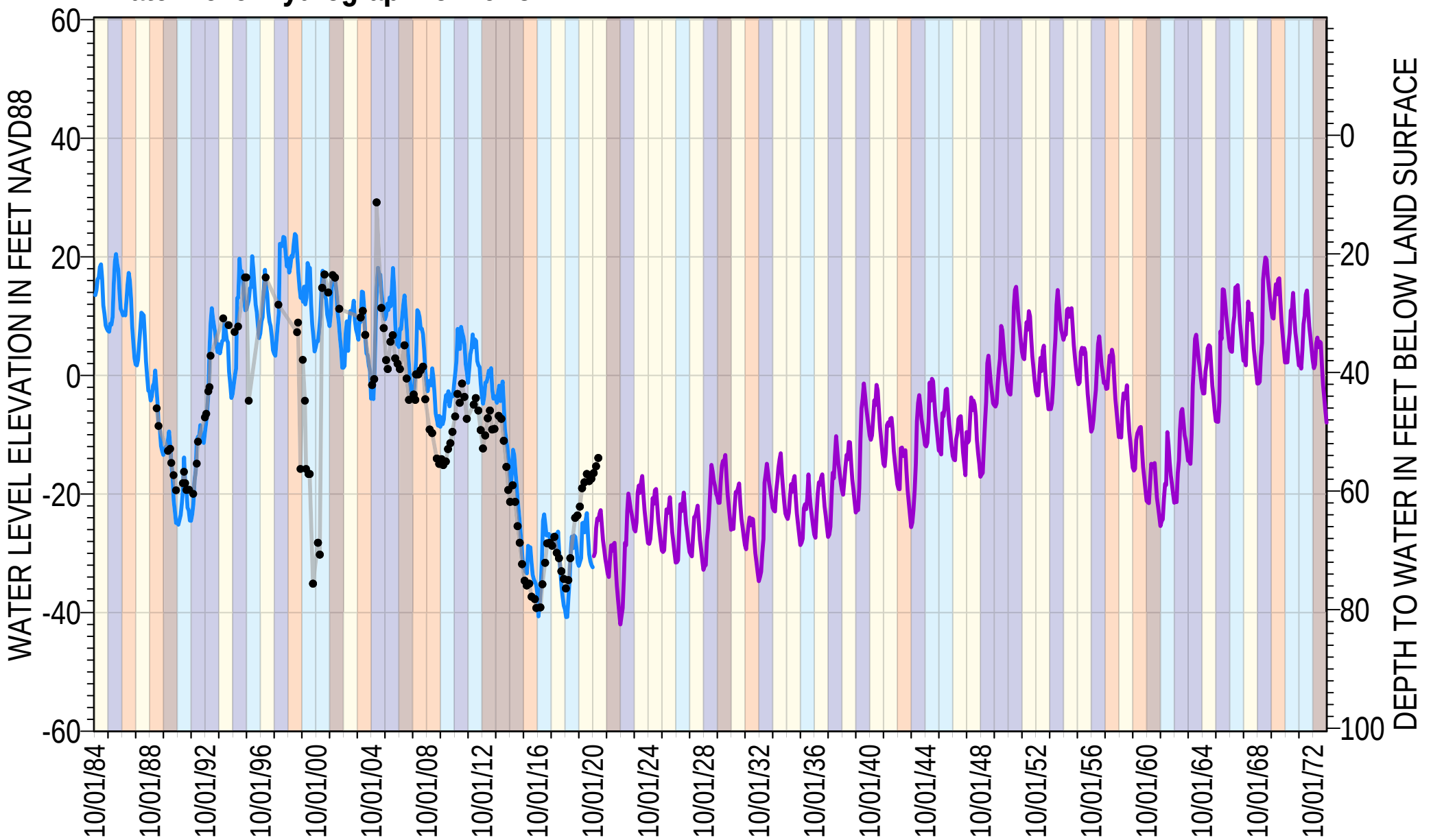
Measured
Projected Baseline
Historical

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



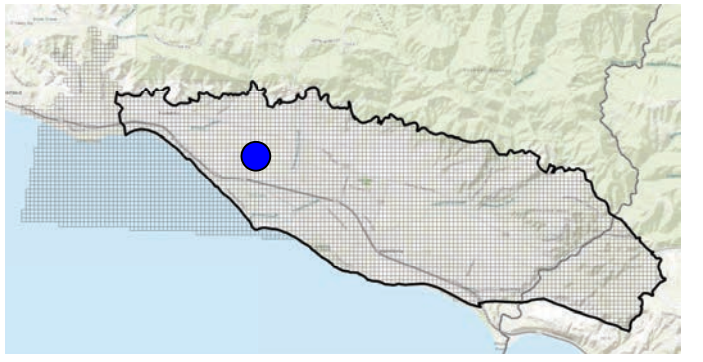
Climate Classification

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



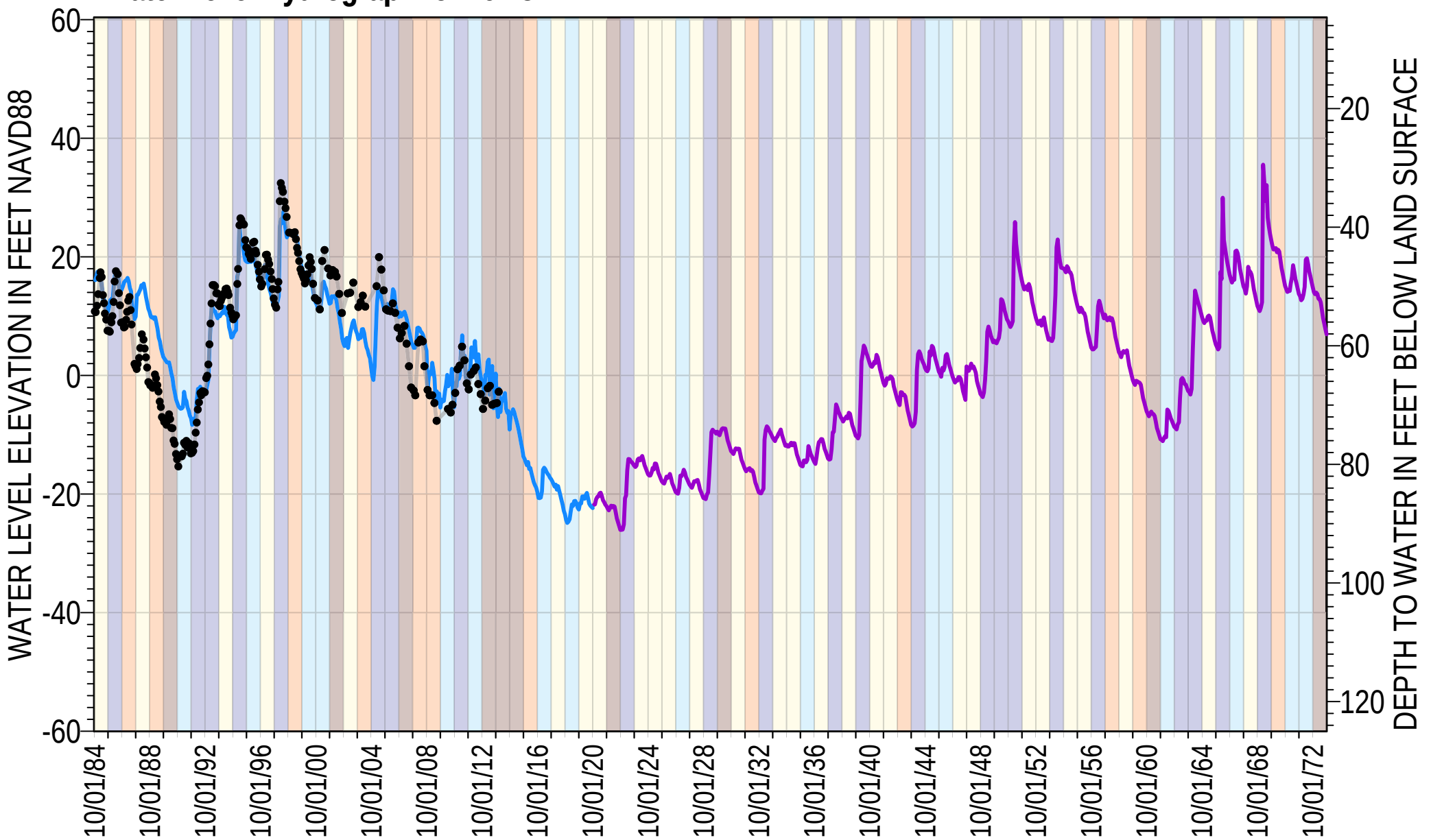
Measured
Projected Baseline
Historical

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



Measured

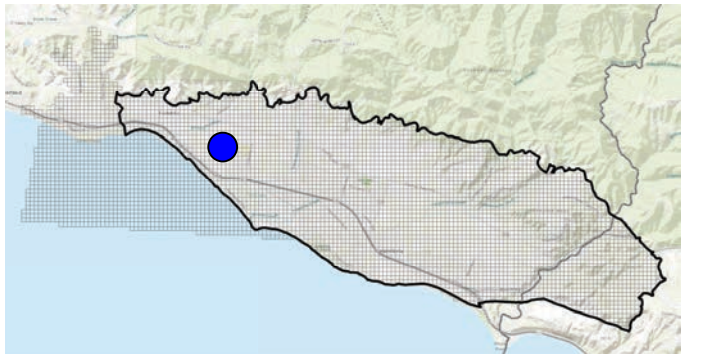
Projected Baseline

Historical

Well Type | Private

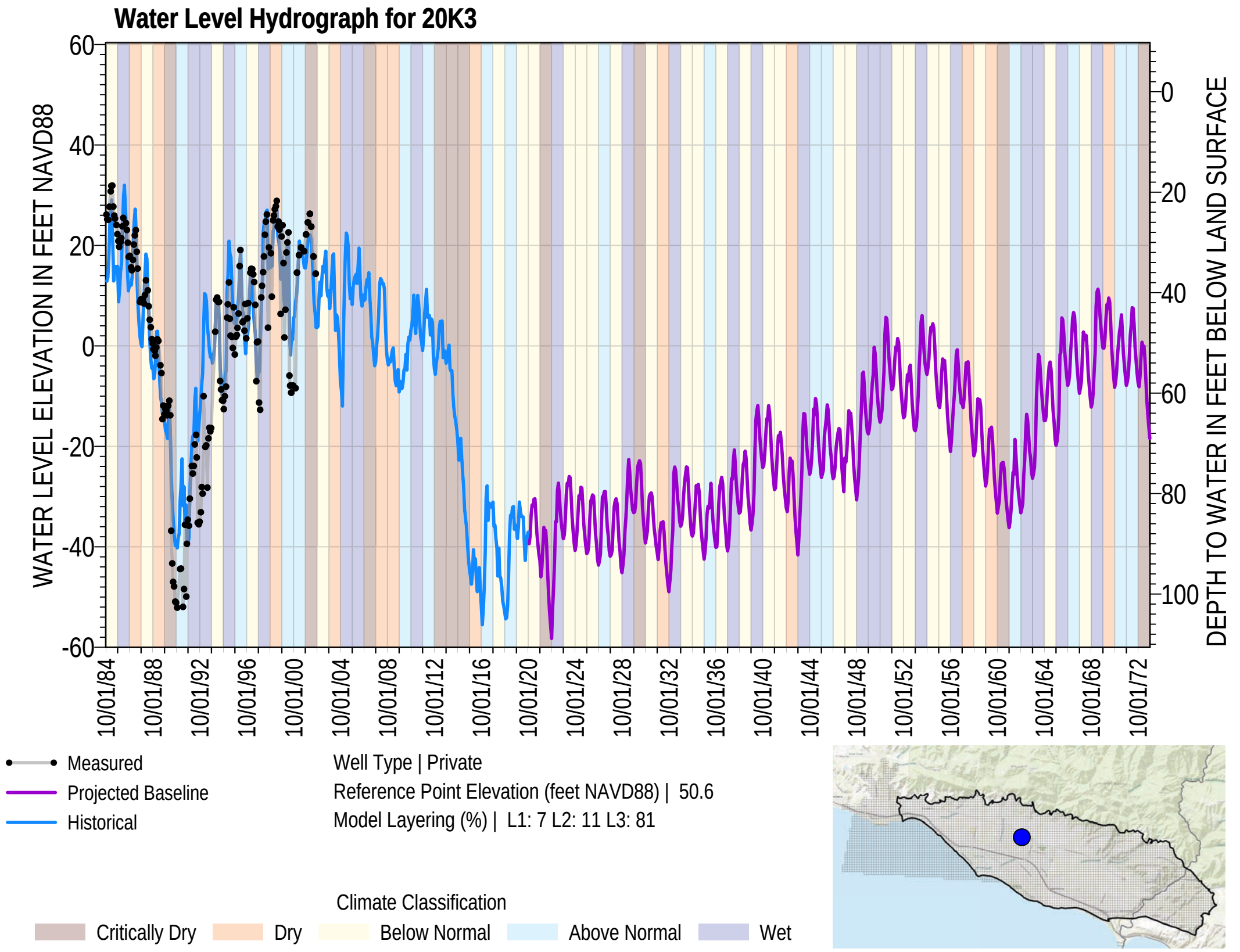
Reference Point Elevation (feet NAVD88) | 65

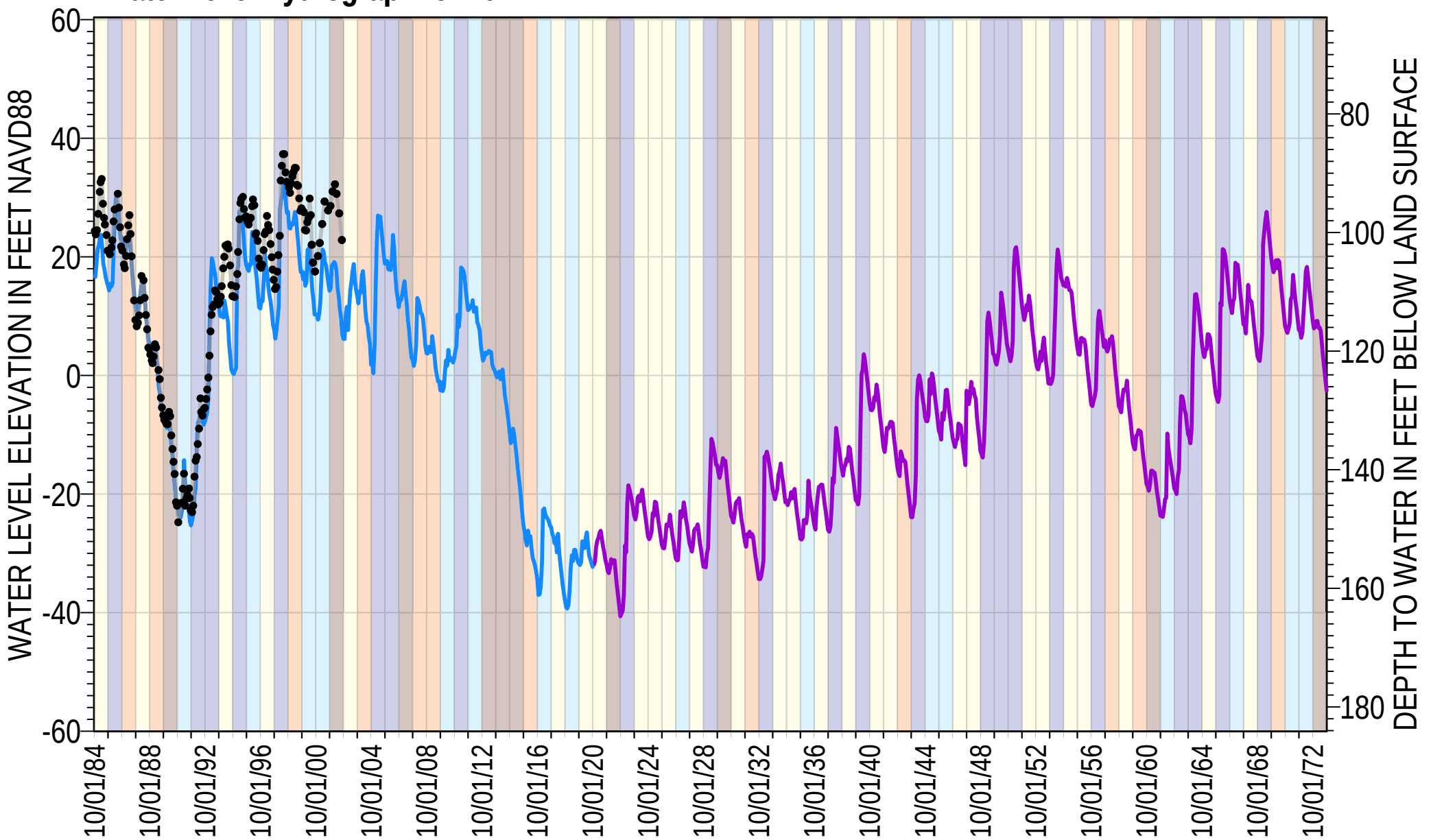
Model Layering (%) | L2: 7 L3: 93



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



Measured

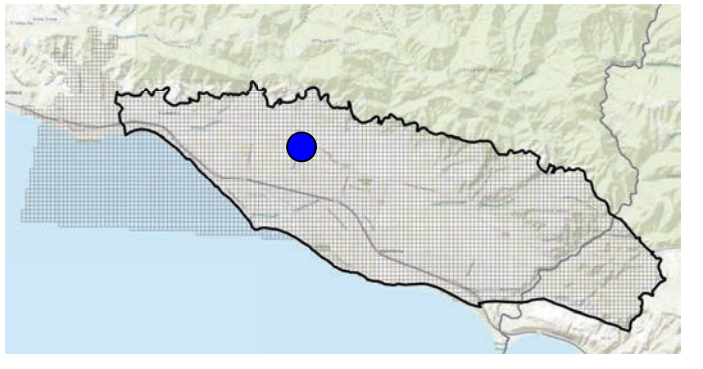
Projected Baseline

Historical

Well Type | Municipal

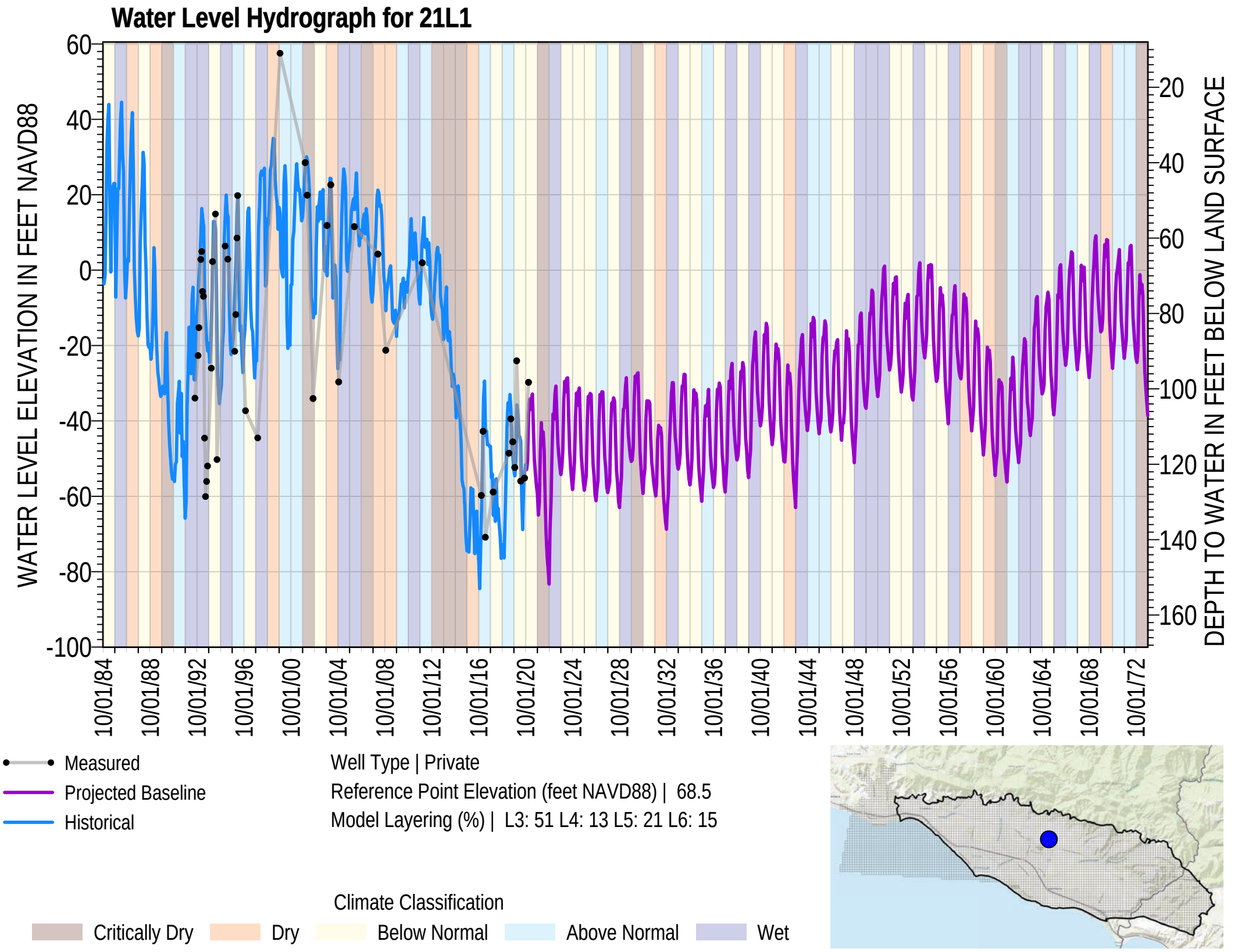
Reference Point Elevation (feet NAVD88) | 124.1

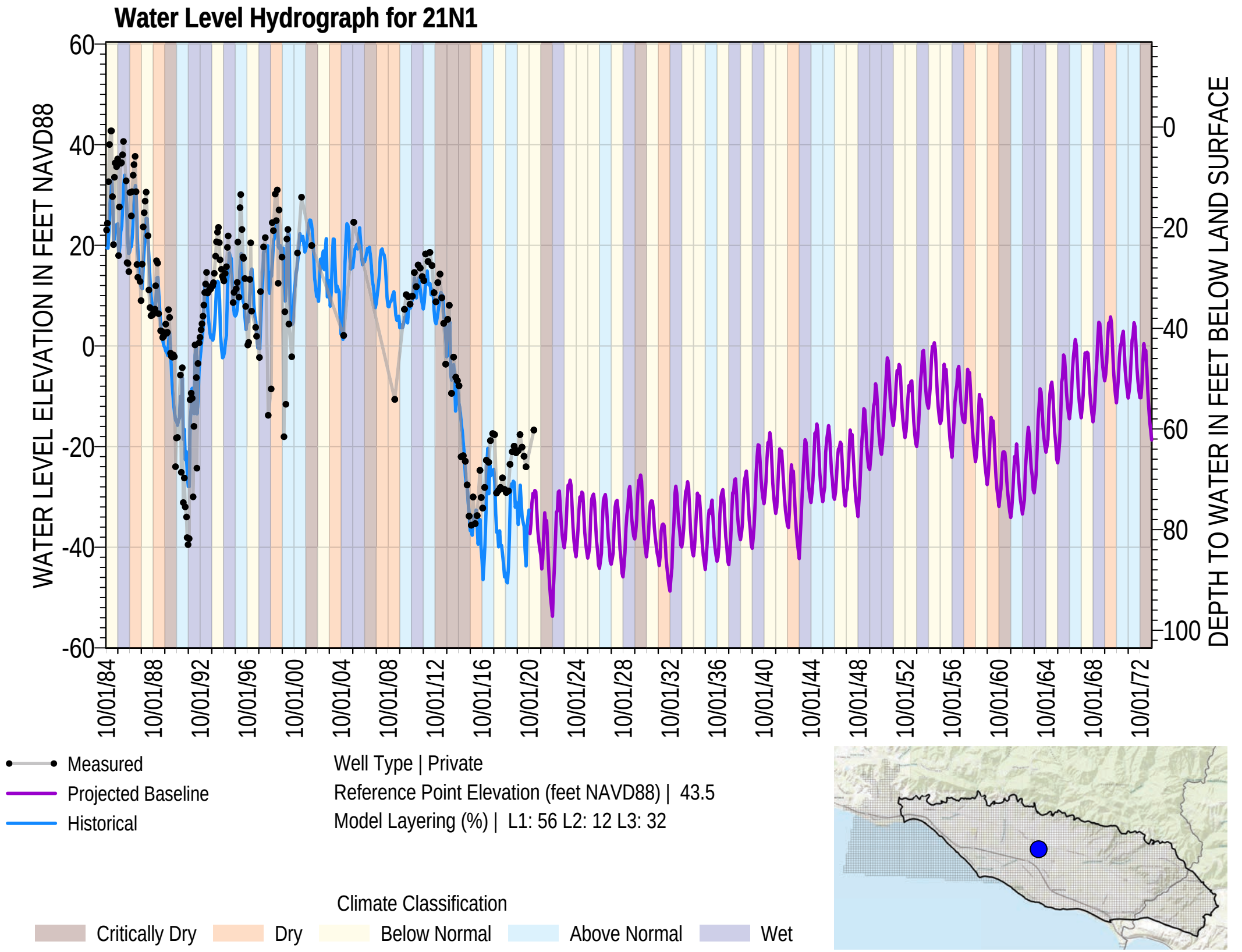
Model Layering (%) | L1: 78 L2: 18 L3: 4

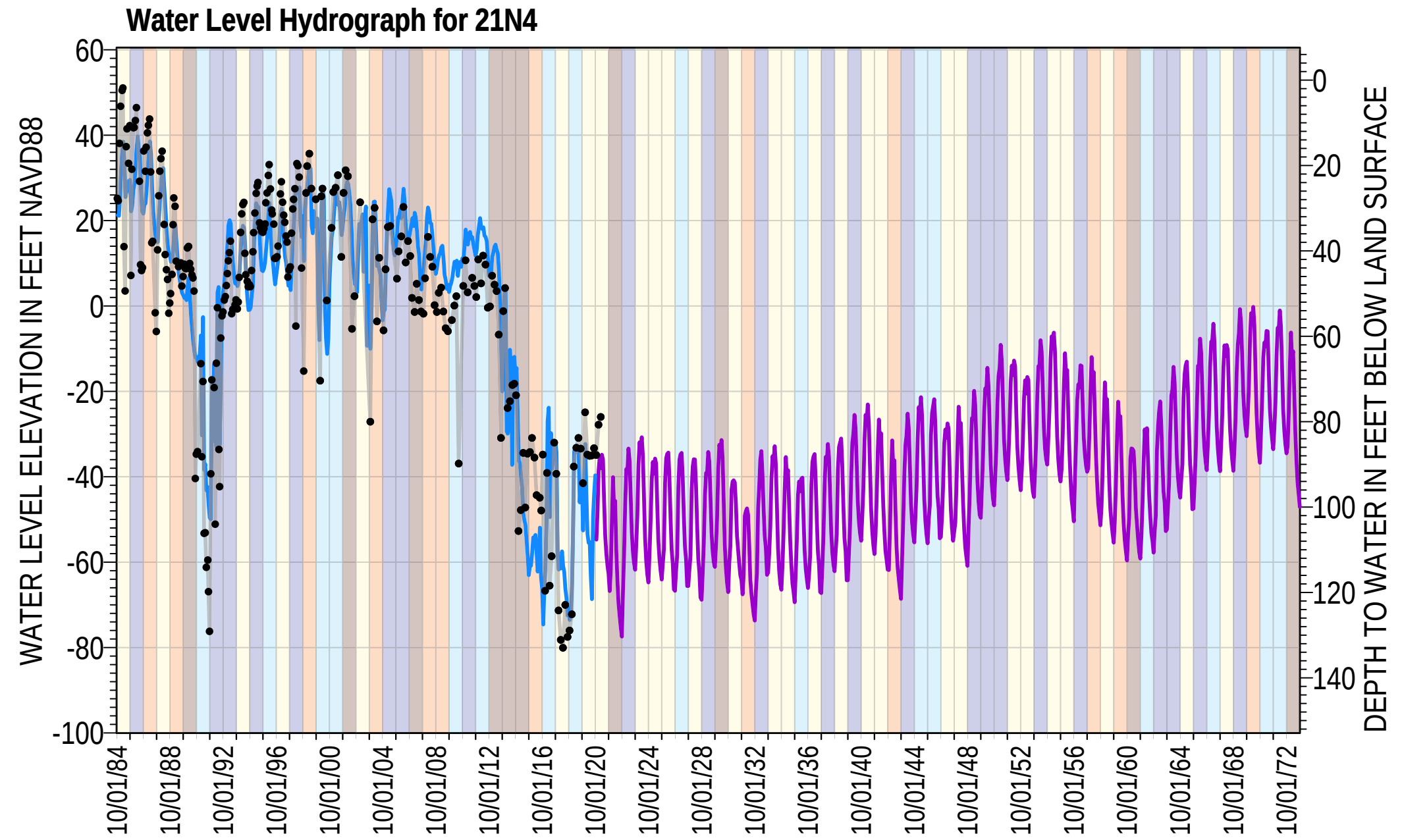


Climate Classification

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

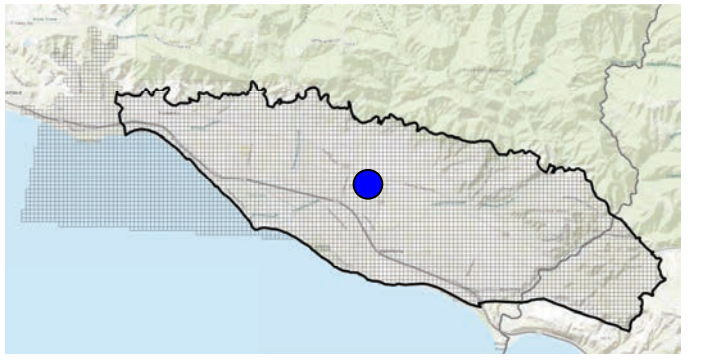

Water Level Hydrograph for 21L1
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
-80
-100
20
40
60
80
100
120
140
160
10/01/84
10/01/88
10/01/92
10/01/96
10/01/00
10/01/04
10/01/08
10/01/12
10/01/16
10/01/20
10/01/24
10/01/28
10/01/32
10/01/36
10/01/40
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) | 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
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) | 43.5
Model Layering (%) | L1: 56 L2: 12 L3: 32
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet



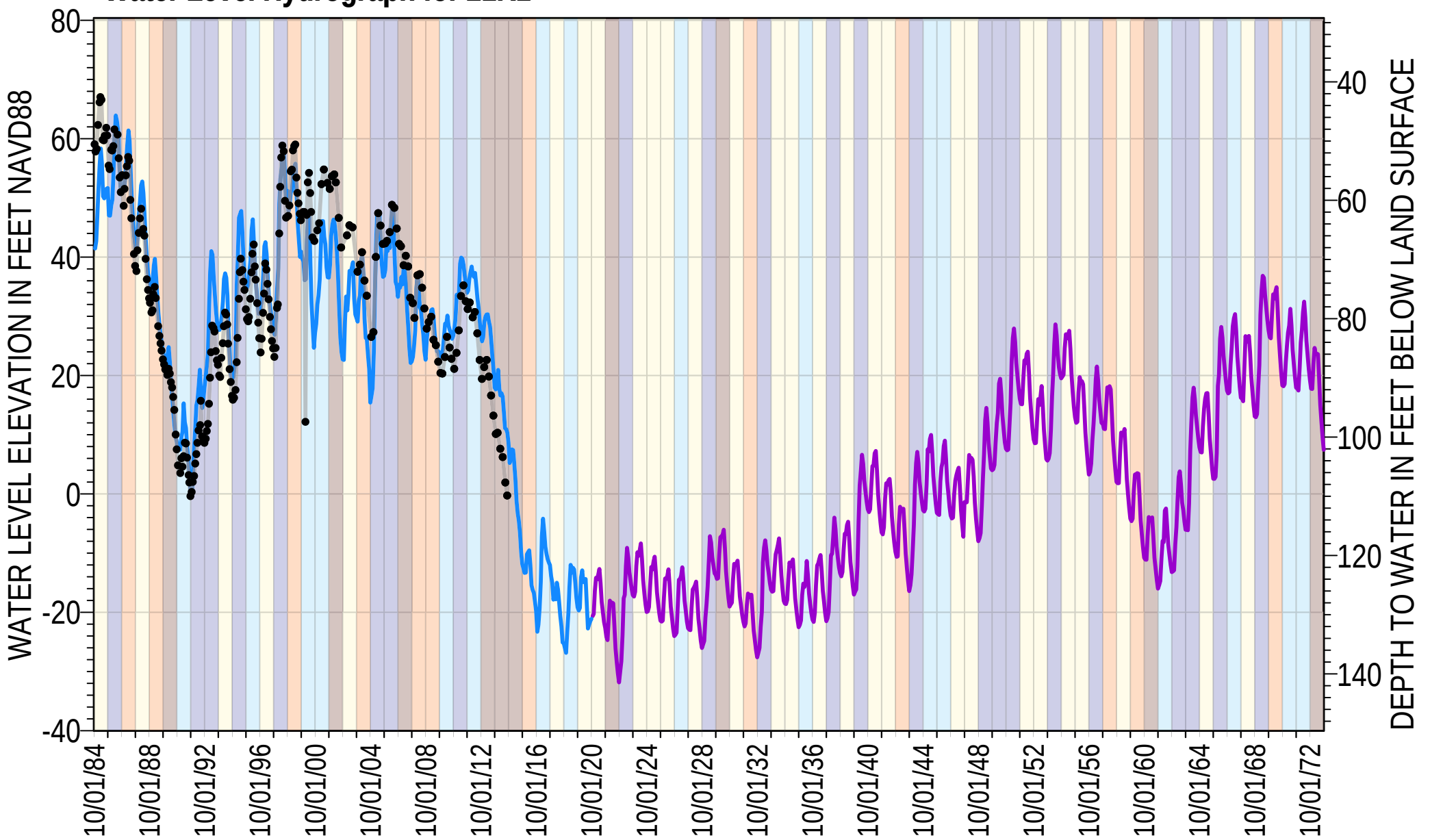
Measured
Projected Baseline
Historical

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



Measured

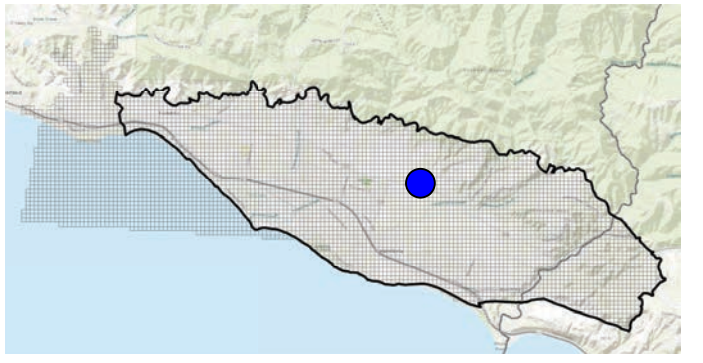
Projected Baseline

Historical

Well Type | Private

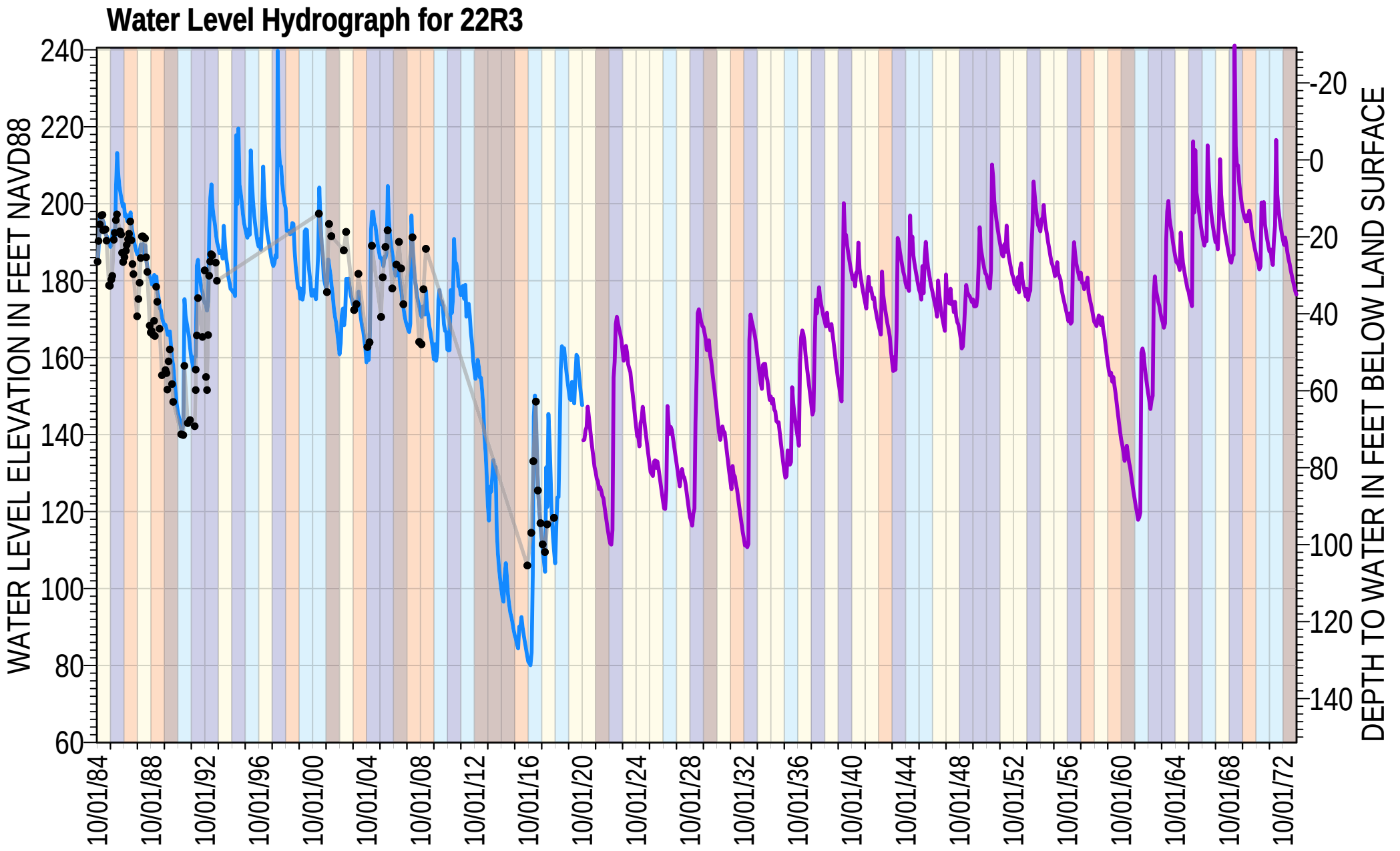
Reference Point Elevation (feet NAVD88) | 109.6

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



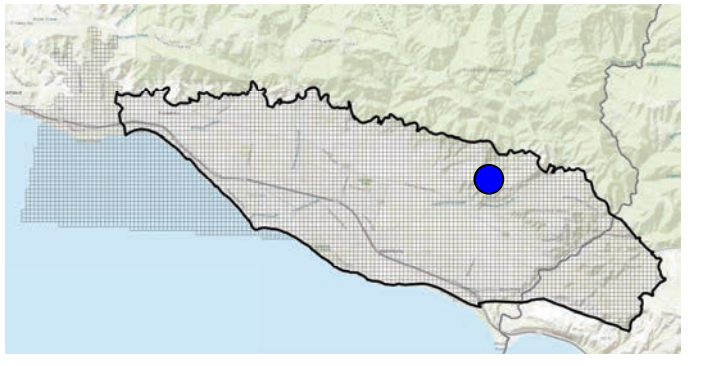
Climate Classification

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



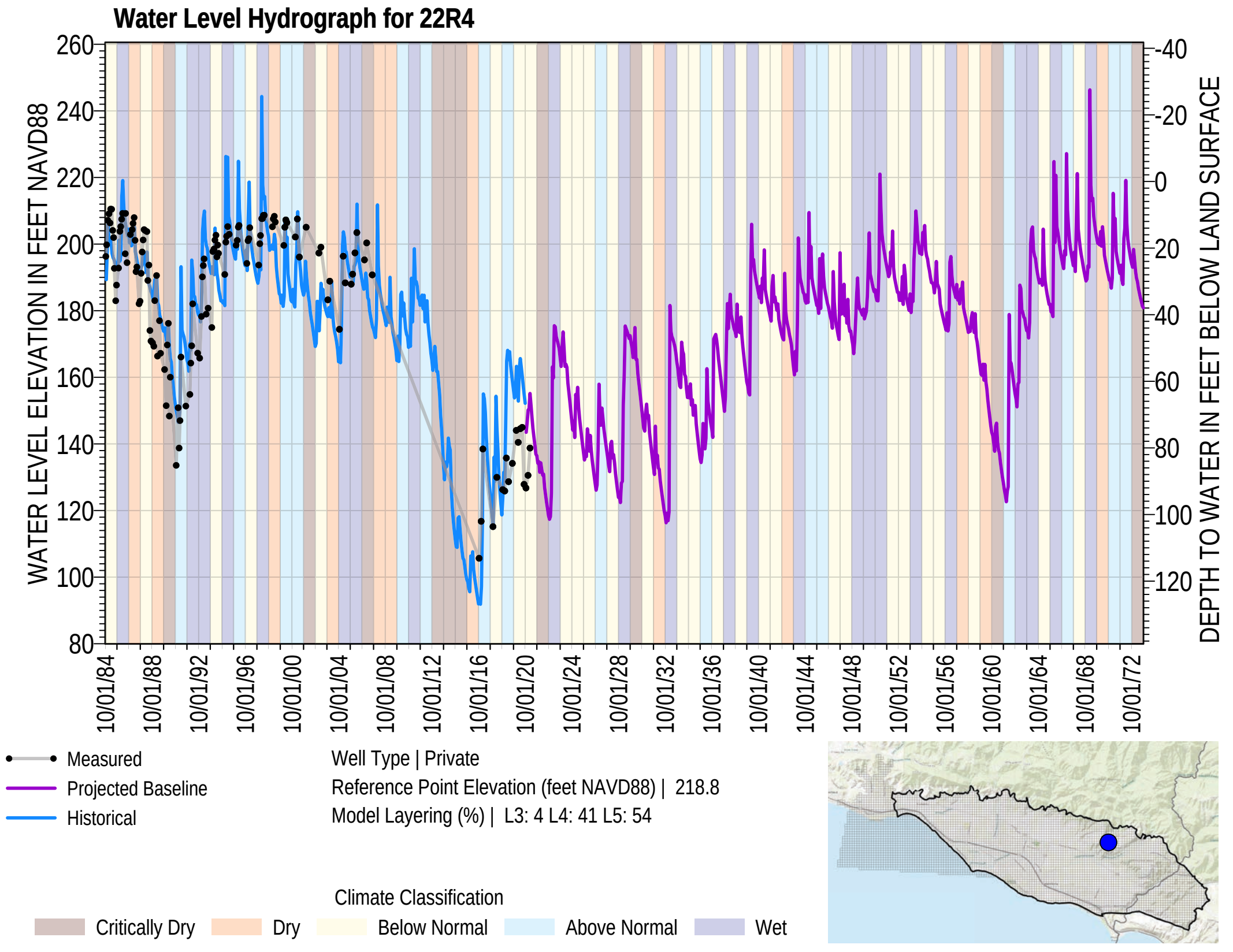
Measured
Projected Baseline
Historical

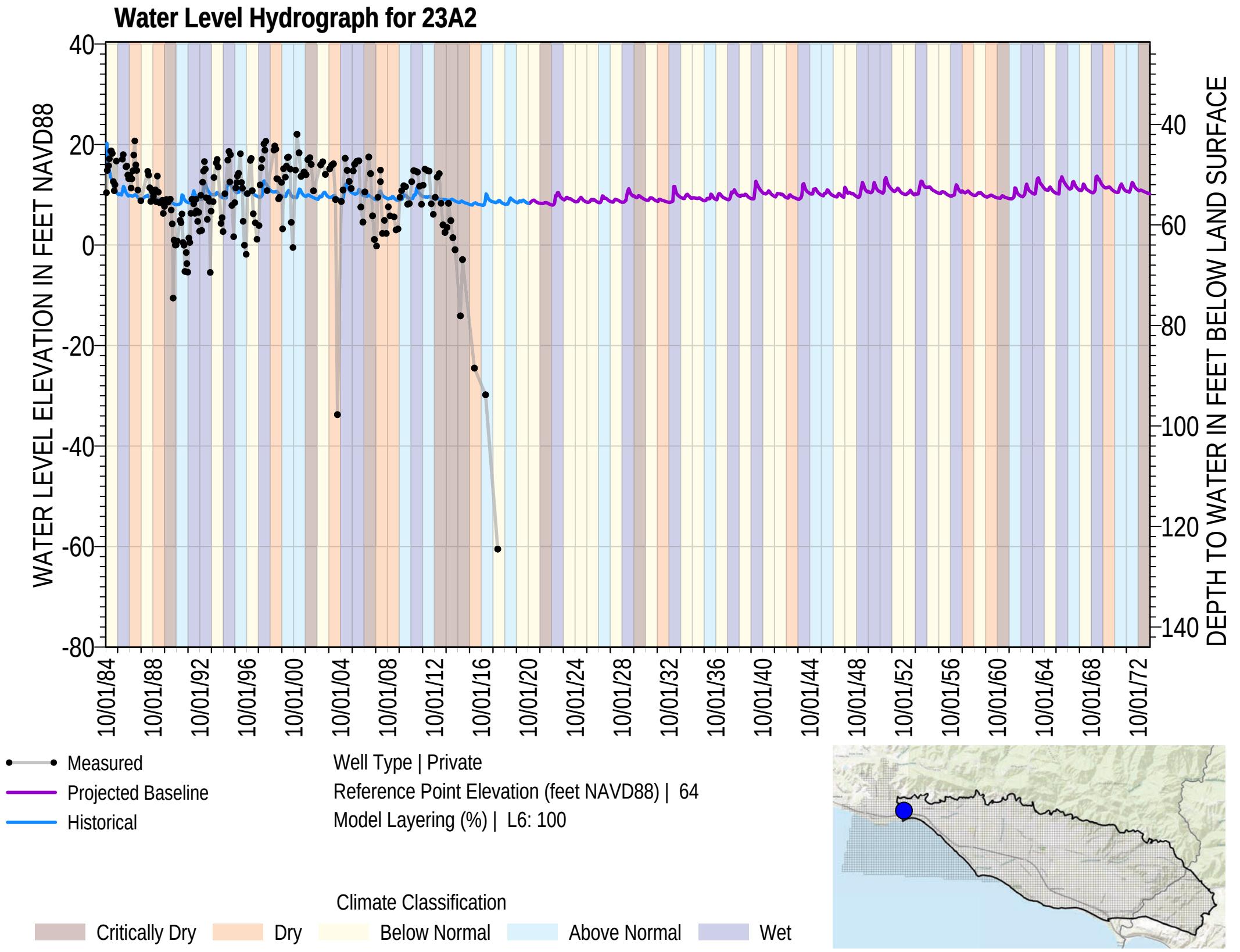
Well Type | Private
Reference Point Elevation (feet NAVD88) | 211.4
Model Layering (%) | L3: 70 L4: 30

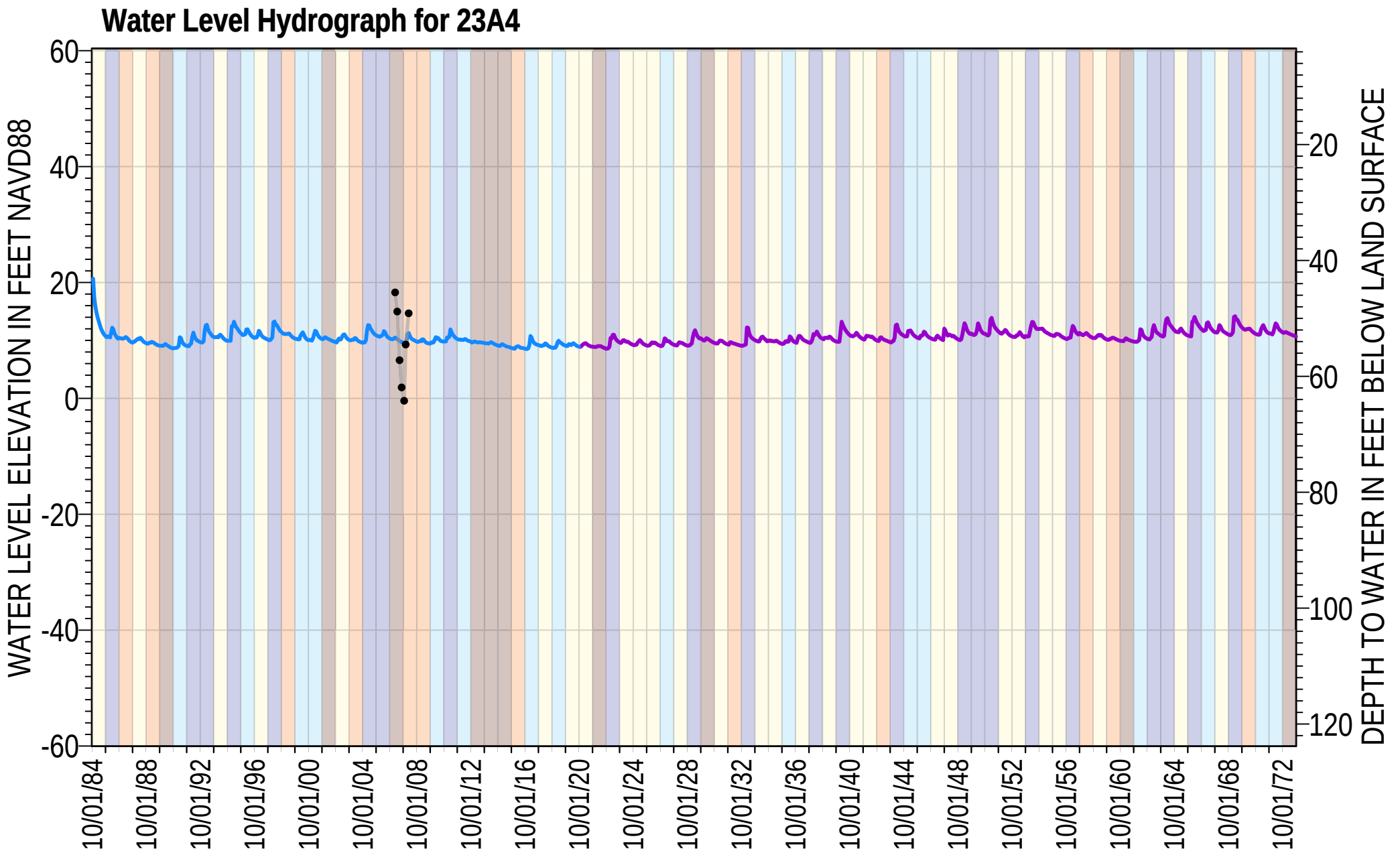


Climate Classification

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

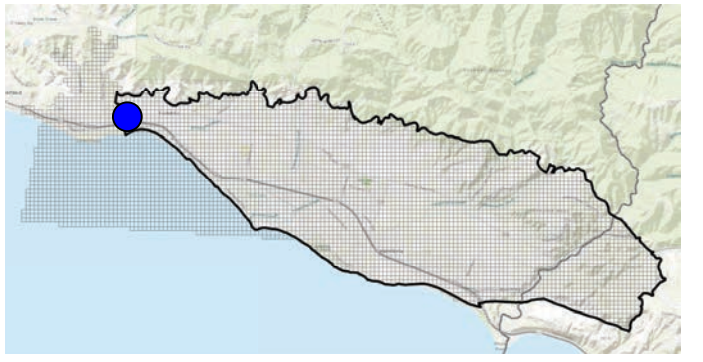

Water Level Hydrograph for 22R4
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
260
240
220
200
180
160
140
120
100
80
-40
-20
0
20
40
60
80
100
120
10/01/84
10/01/88
10/01/92
10/01/96
10/01/00
10/01/04
10/01/08
10/01/12
10/01/16
10/01/20
10/01/24
10/01/28
10/01/32
10/01/36
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) | 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
10/01/88
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) | 64
Model Layering (%) | L6: 100
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet



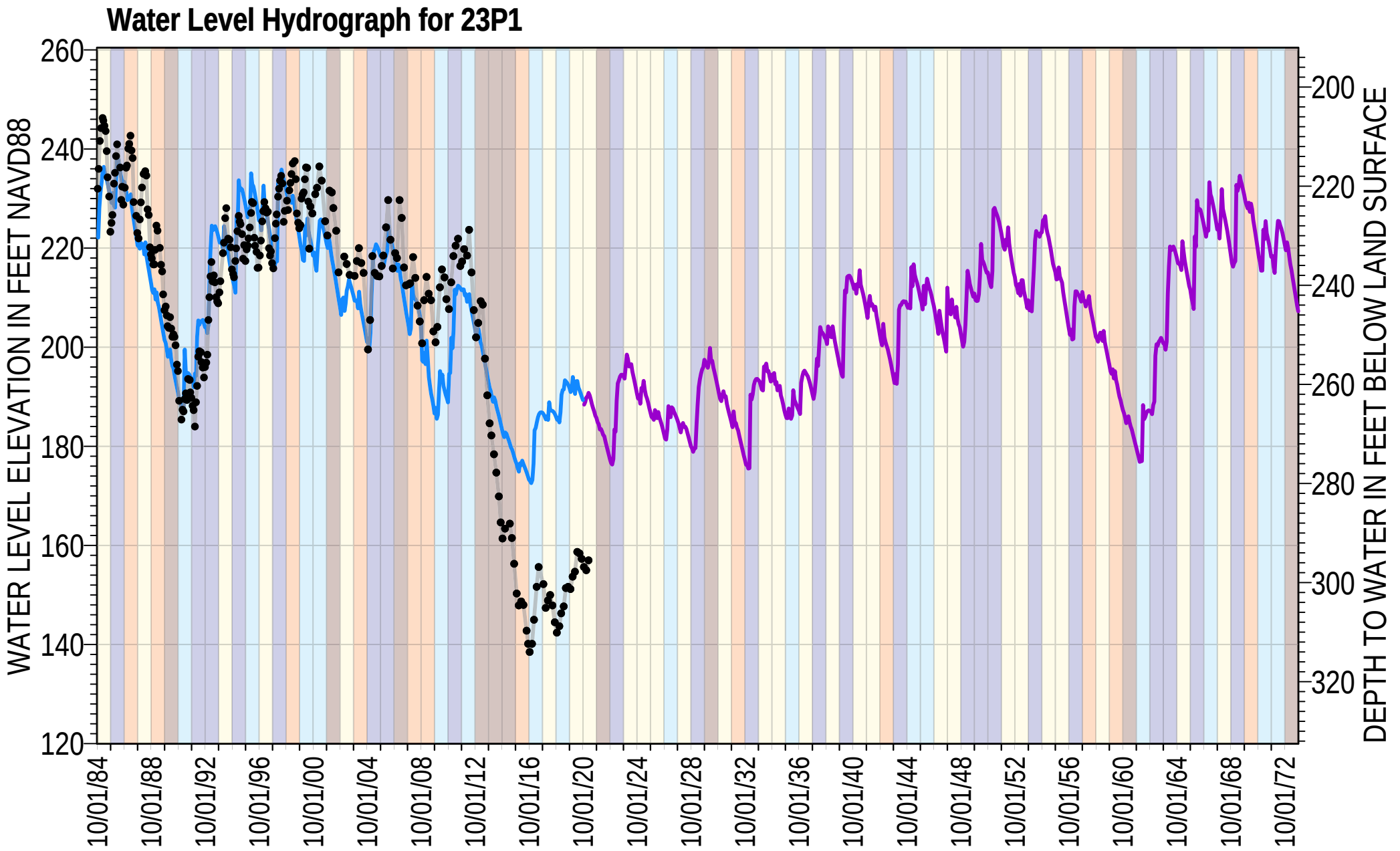
Measured
Projected Baseline
Historical

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



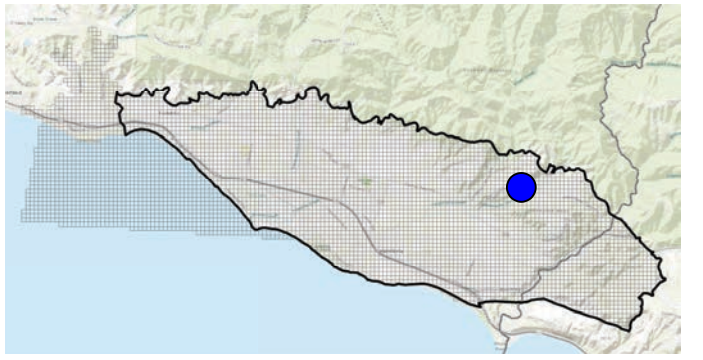
Climate Classification

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



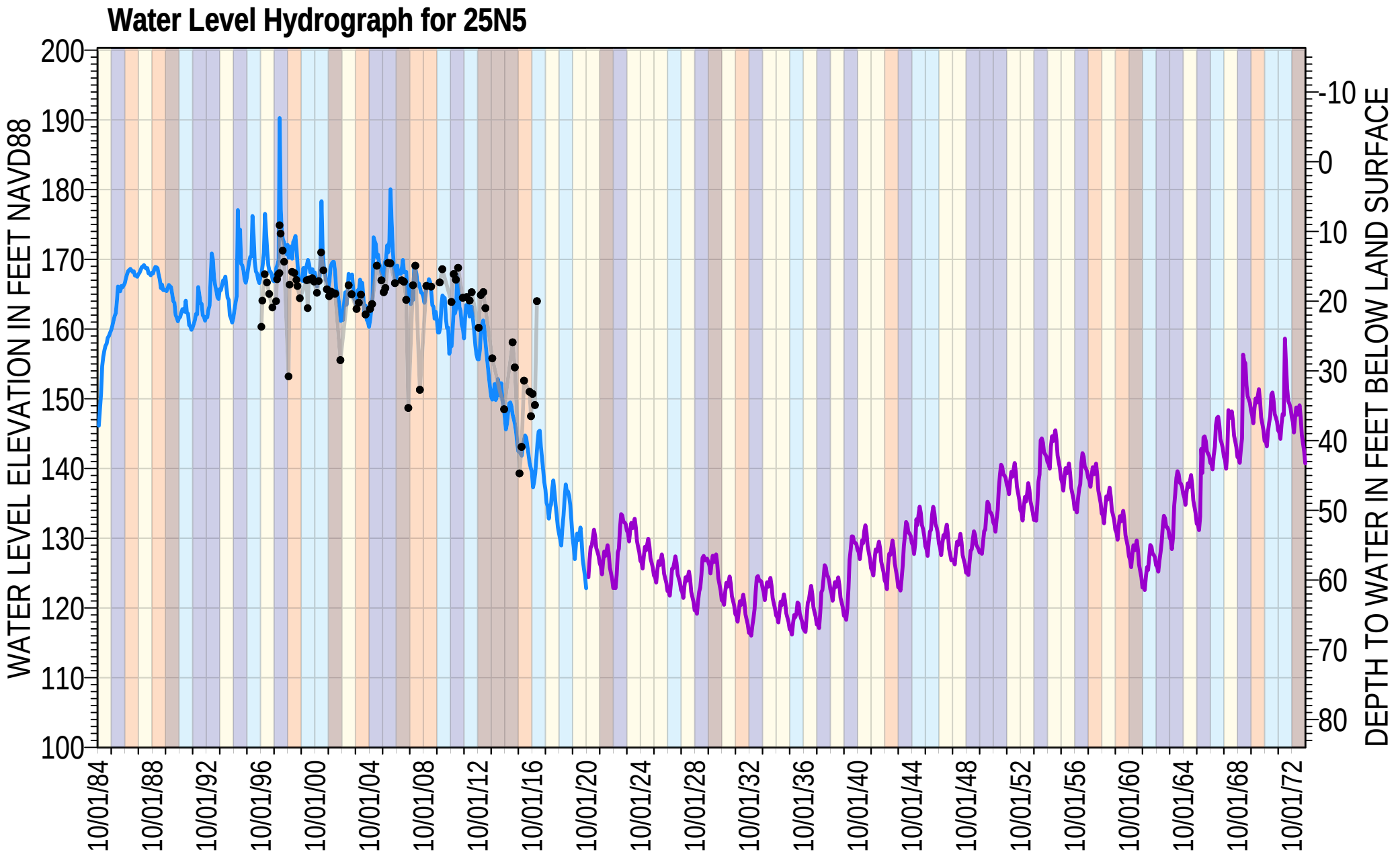
Measured
Projected Baseline
Historical

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



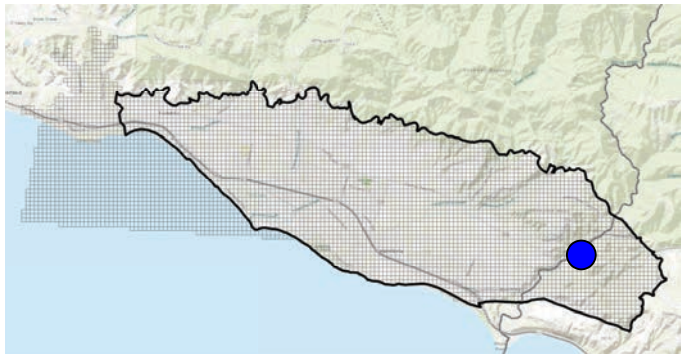
Climate Classification

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



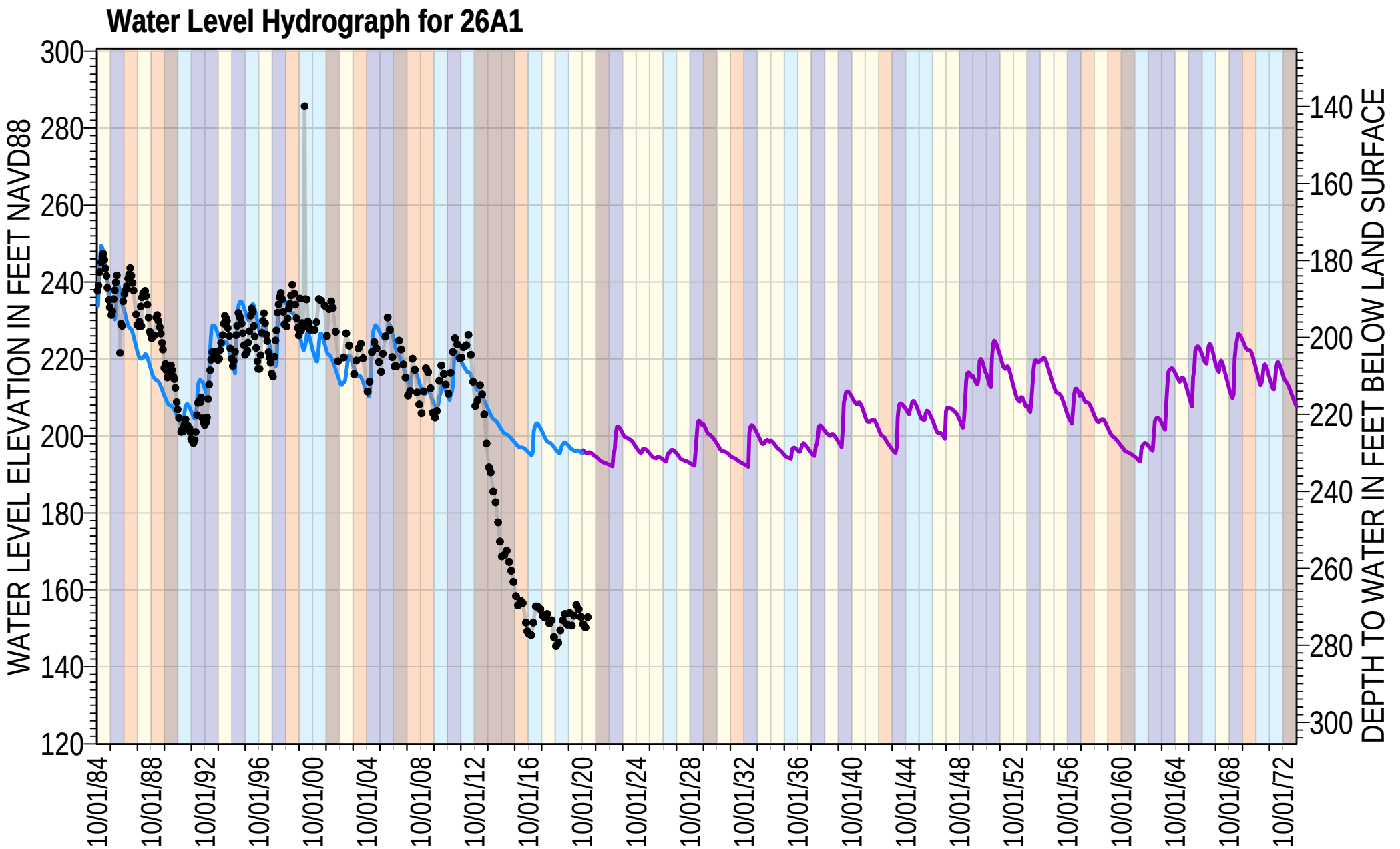
Measured
Projected Baseline
Historical

Well Type | Private
Reference Point Elevation (feet NAVD88) | 184
Model Layering (%) | L5: 100



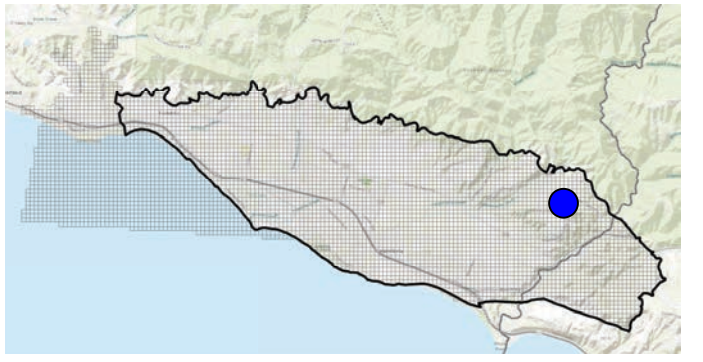
Climate Classification

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



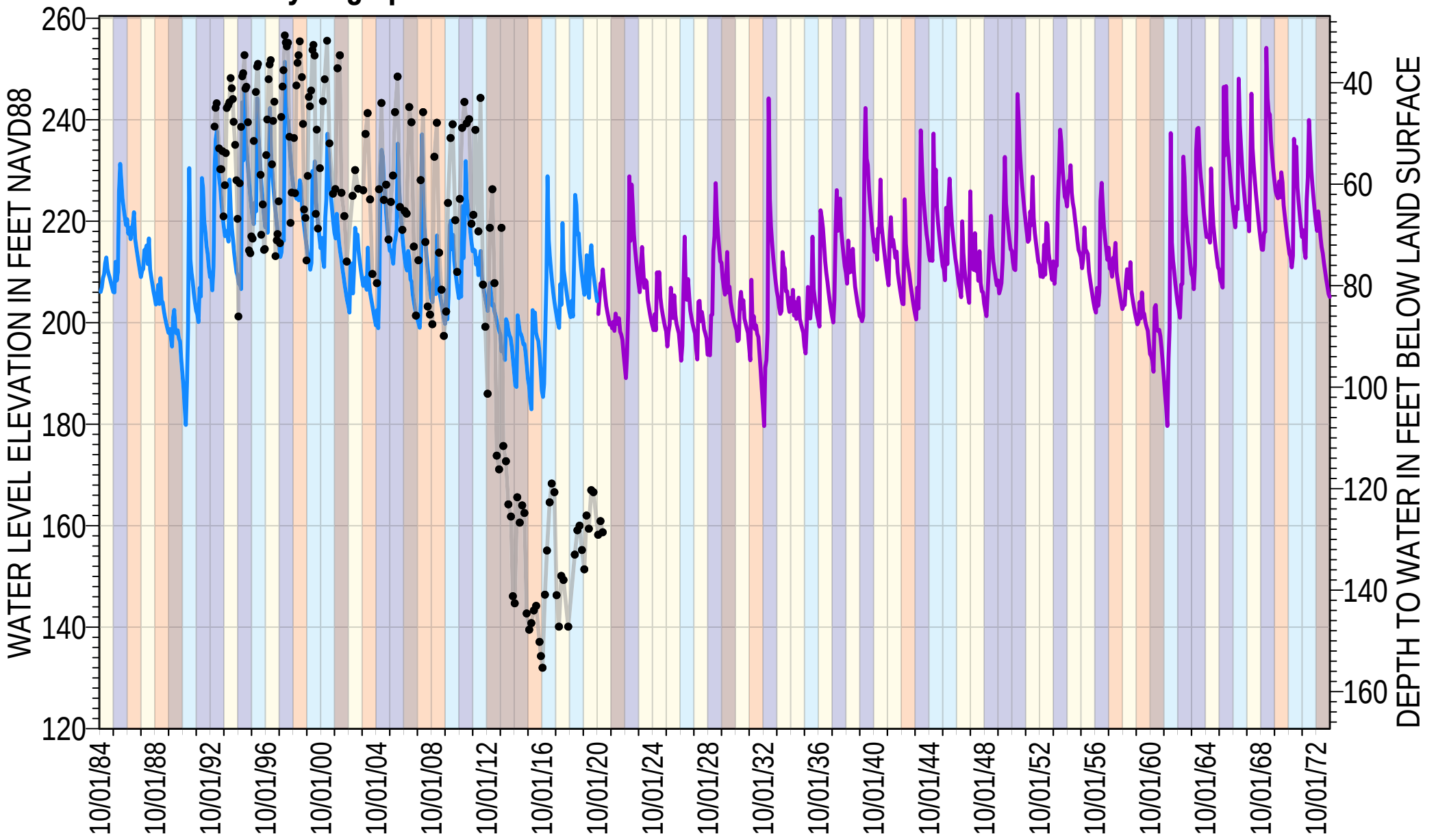
Measured
Projected Baseline
Historical

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



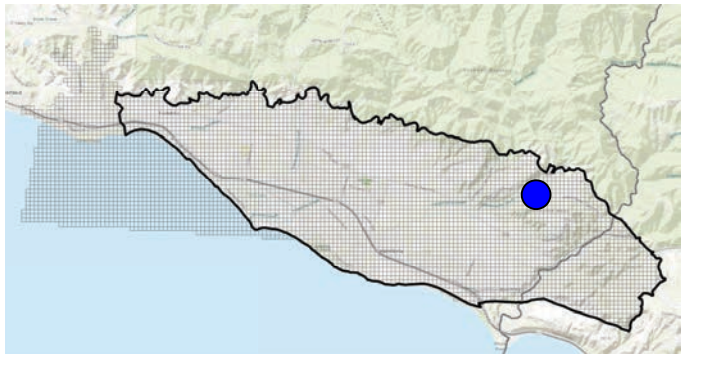
Climate Classification

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



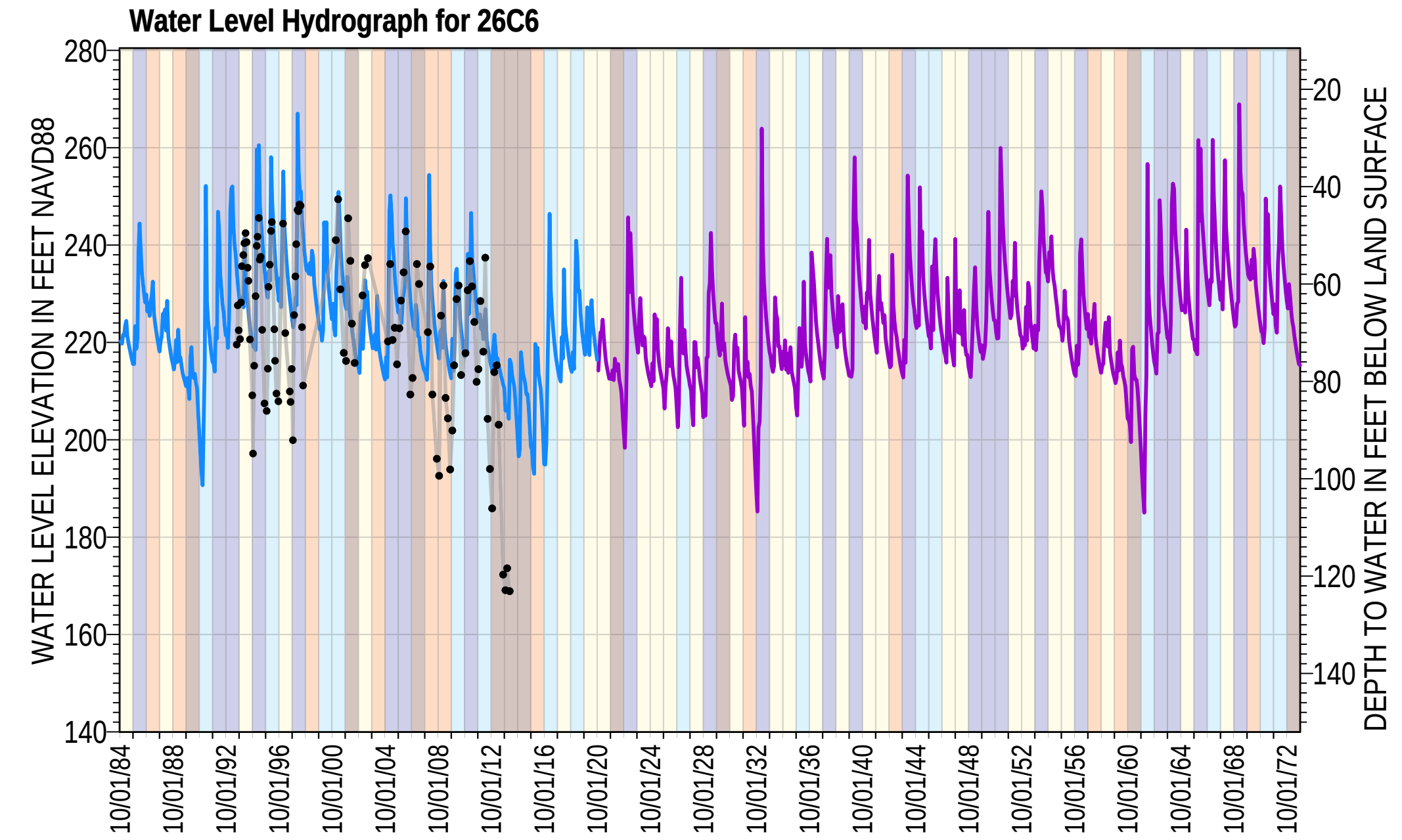
Measured
Projected Baseline
Historical

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



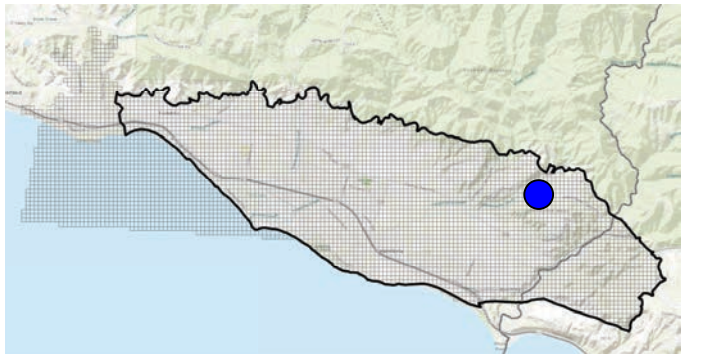
Climate Classification

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



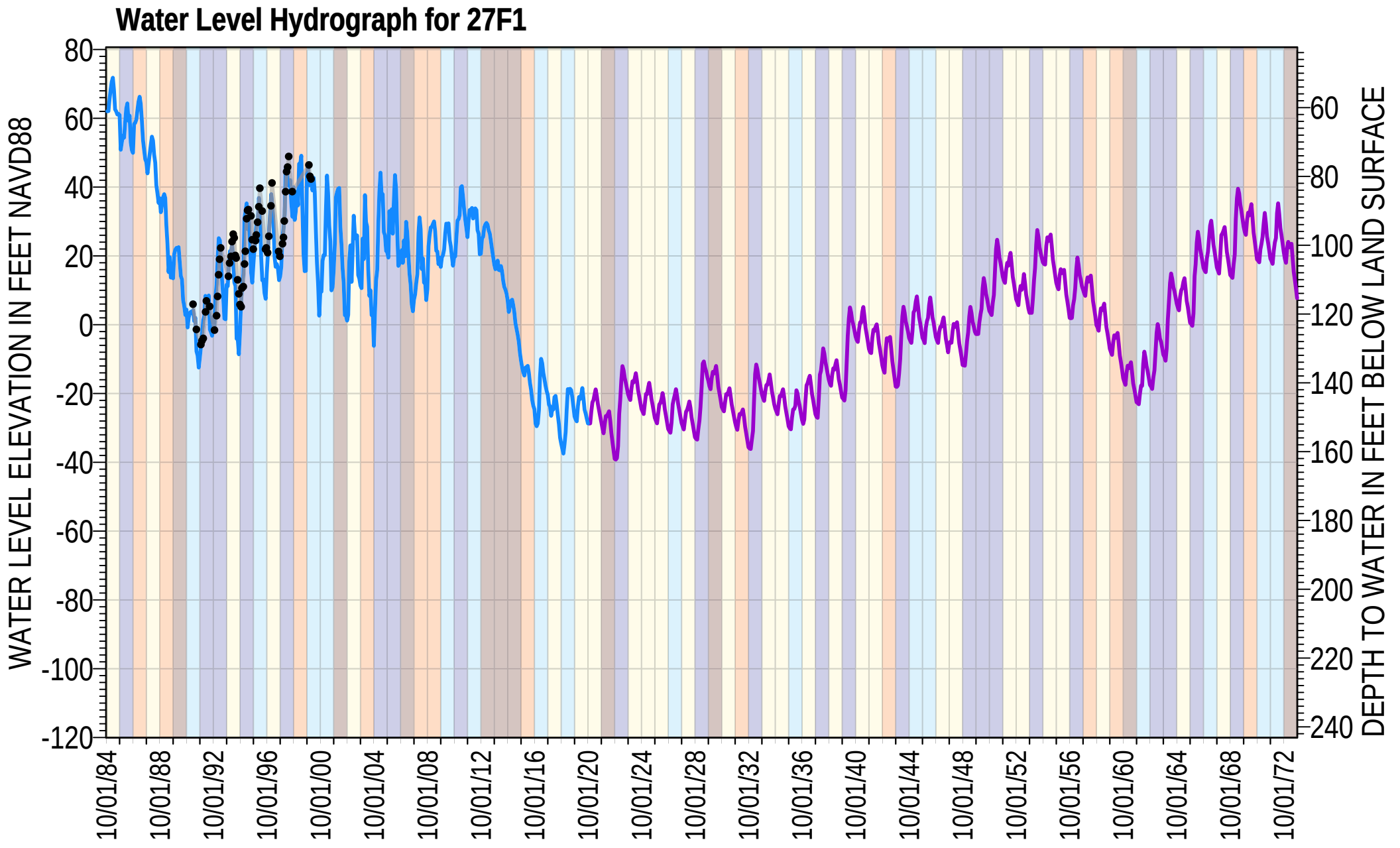
Measured
Projected Baseline
Historical

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



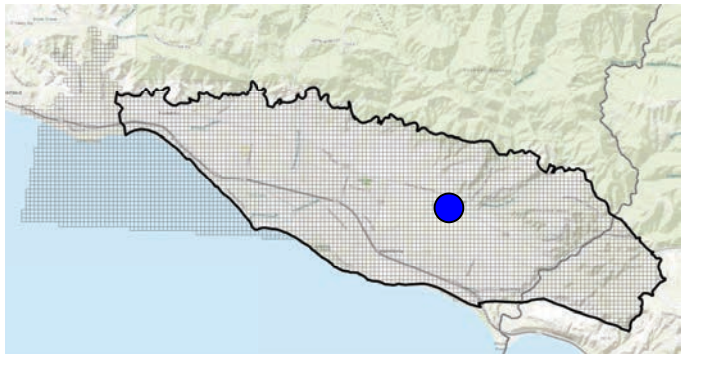
Climate Classification

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



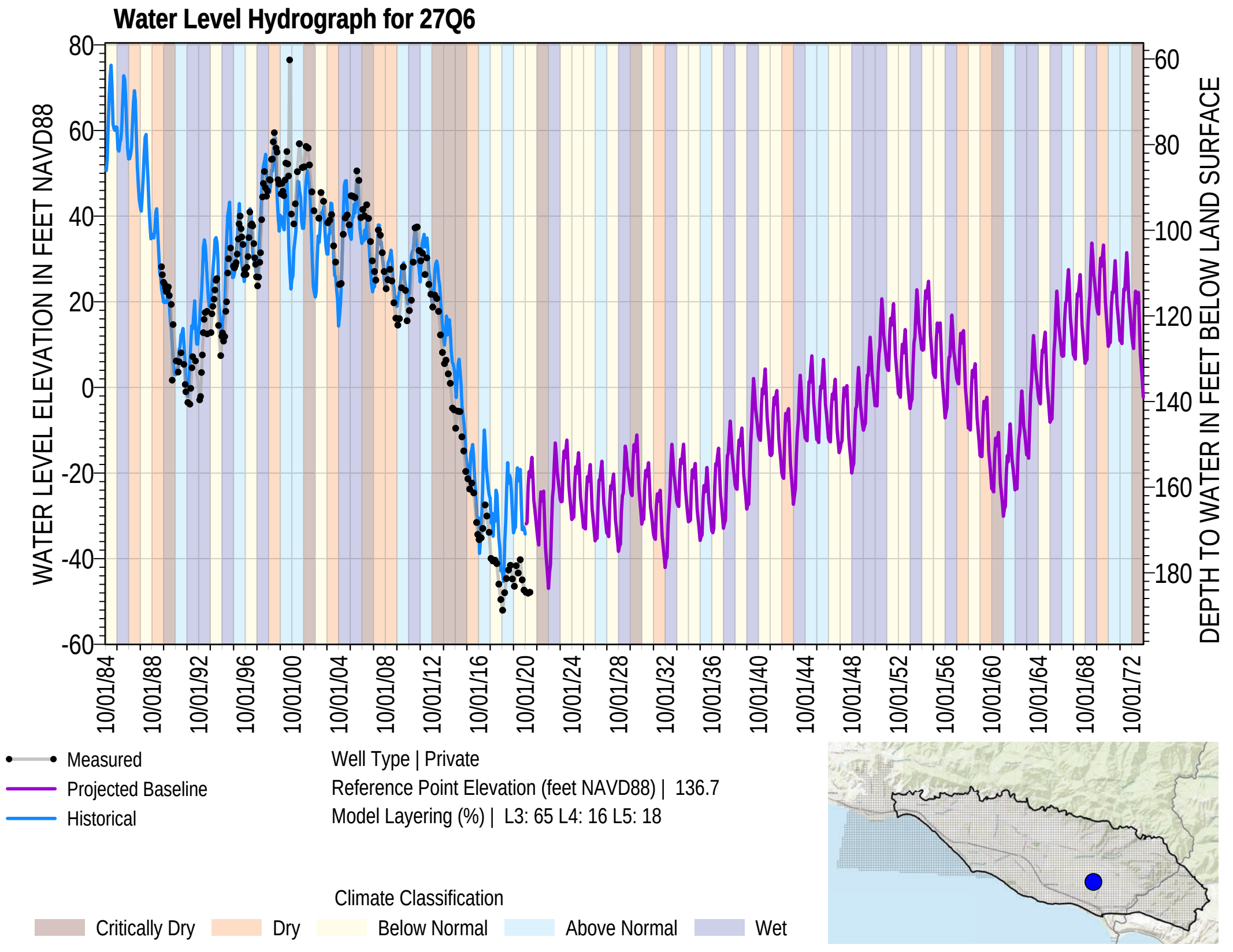
Measured
Projected Baseline
Historical

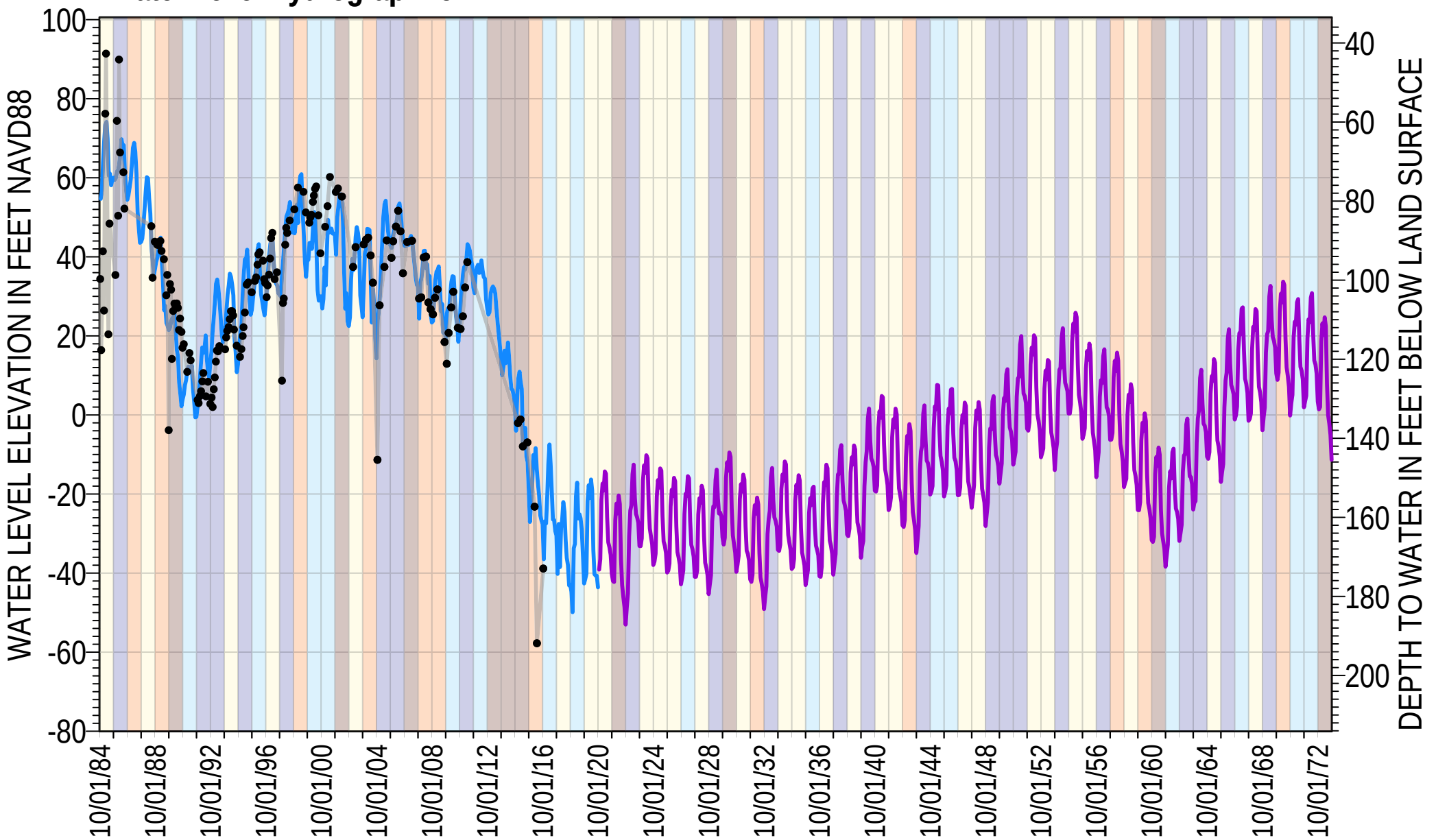
Well Type | Private
Reference Point Elevation (feet NAVD88) | 123.1
Model Layering (%) | L3: 100



Climate Classification

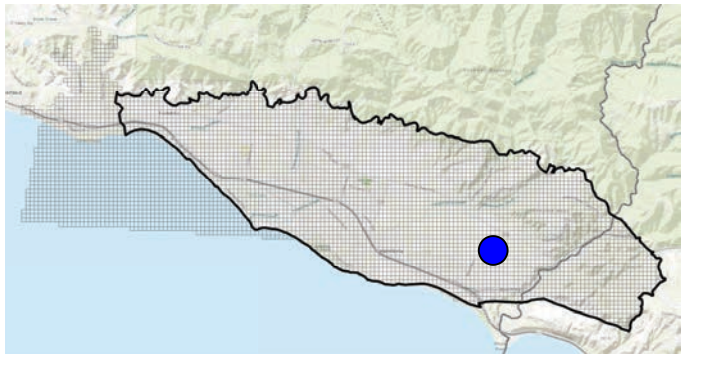
Critically Dry | Dry | Below Normal | Above Normal | Wet


Water Level Hydrograph for 27Q6
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
80
60
40
20
0
-20
-40
-60
60
80
100
120
140
160
180
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) | 136.7
Model Layering (%) | L3: 65 L4: 16 L5: 18
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet



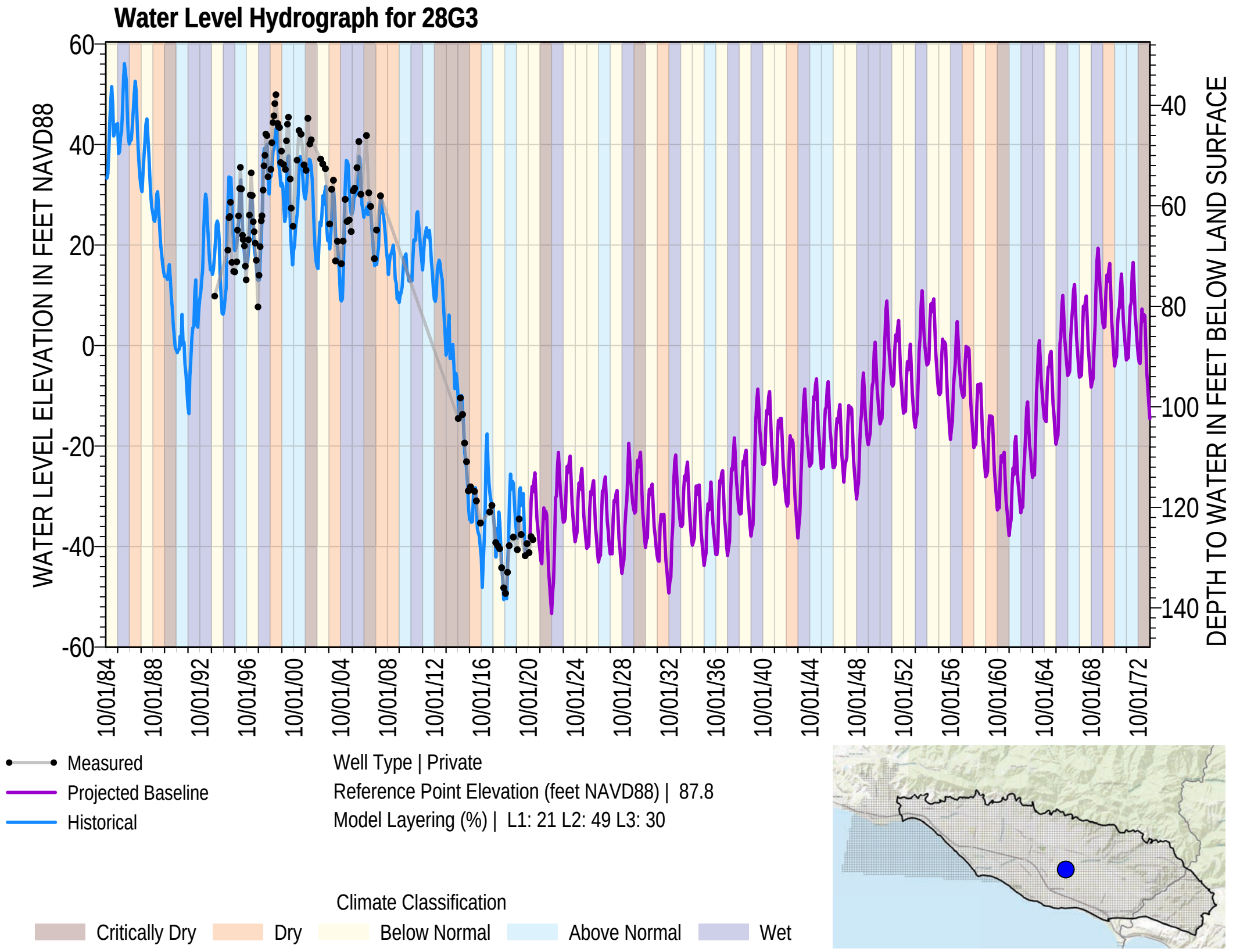
Measured
Projected Baseline
Historical

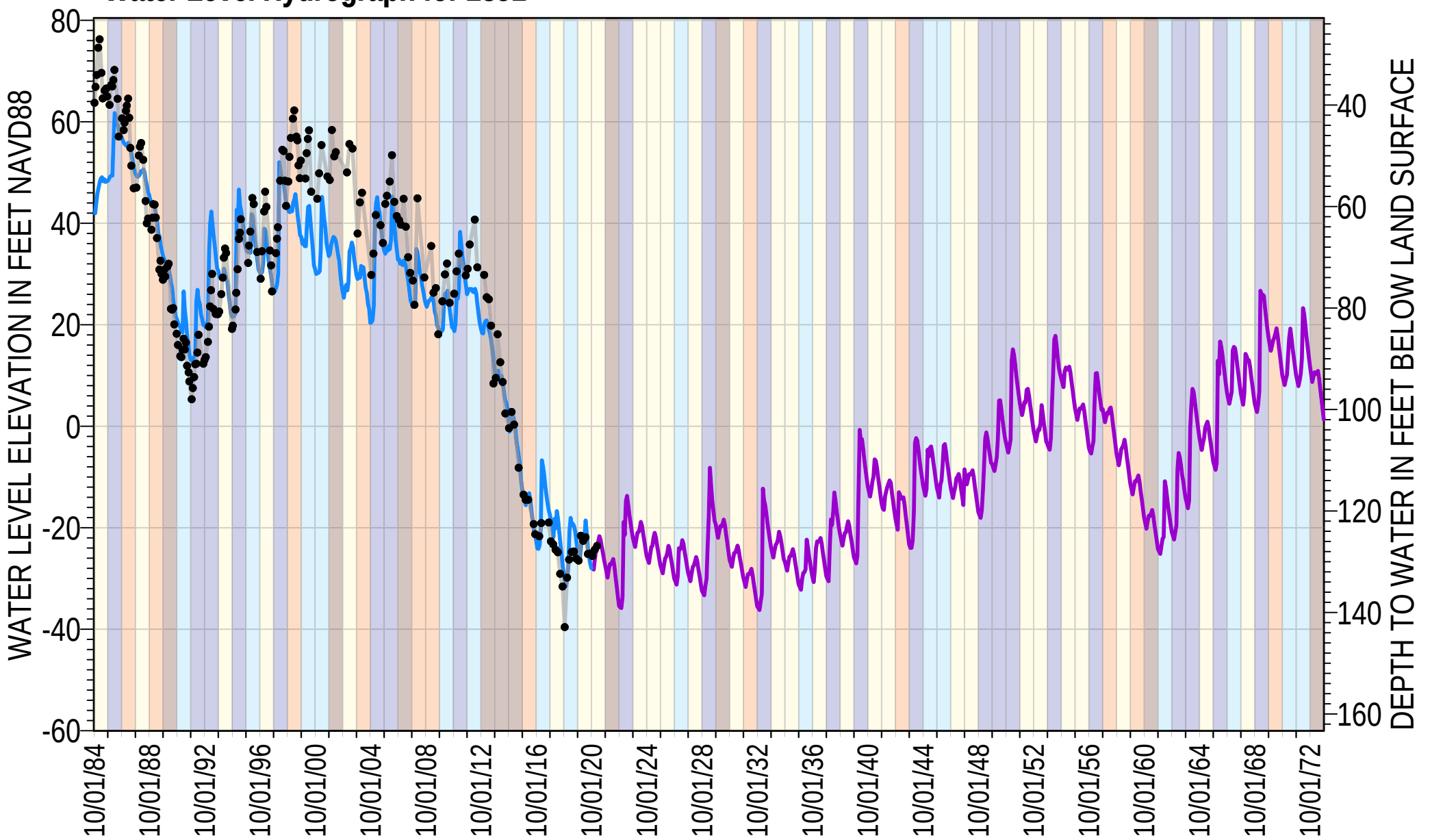
Well Type | Private
Reference Point Elevation (feet NAVD88) | 134.1
Model Layering (%) | L4: 84 L5: 16



Climate Classification

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


Water Level Hydrograph for 28G3
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
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 | 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

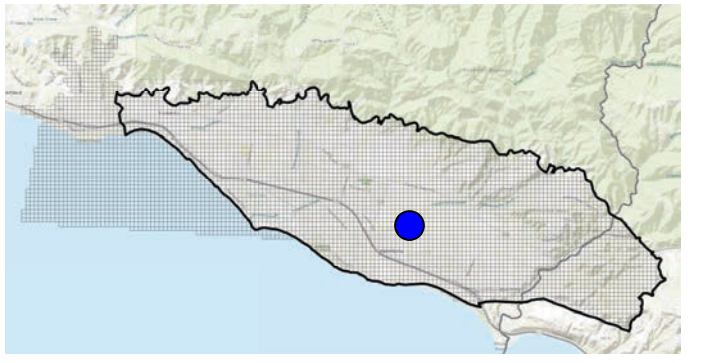
Projected Baseline

Historical

Well Type | Private

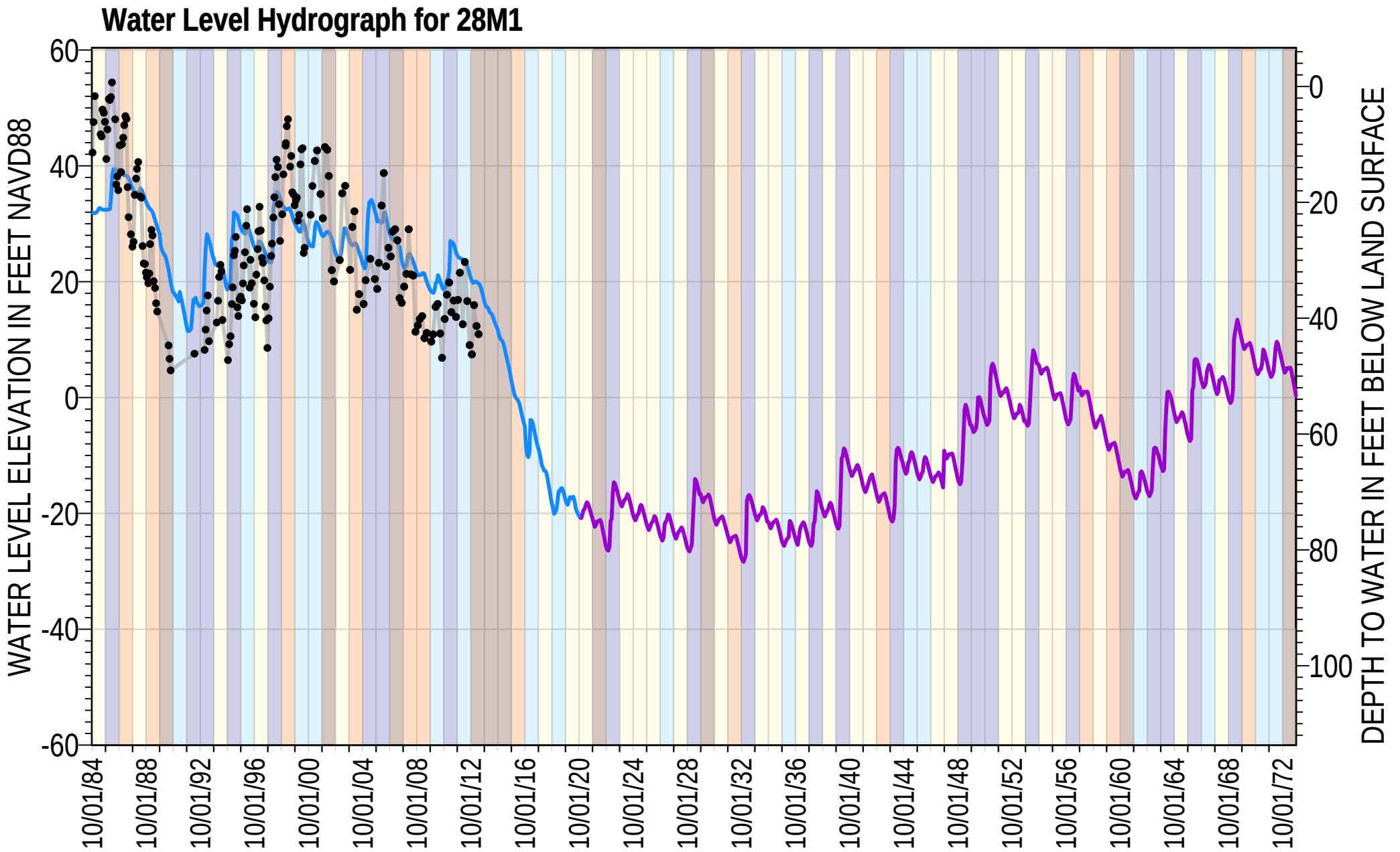
Reference Point Elevation (feet NAVD88) | 103.3

Model Layering (%) | L1: 100



Climate Classification

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



Measured

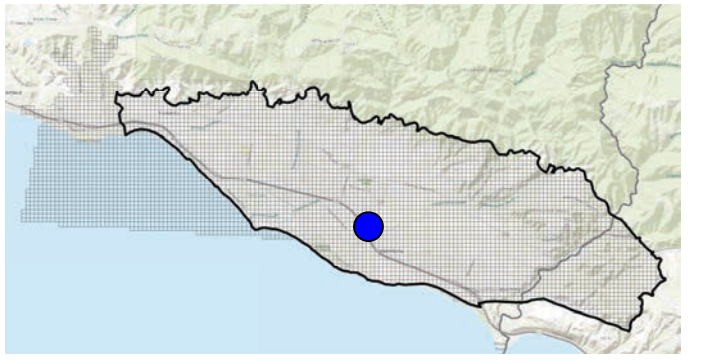
Projected Baseline

Historical

Well Type | Private

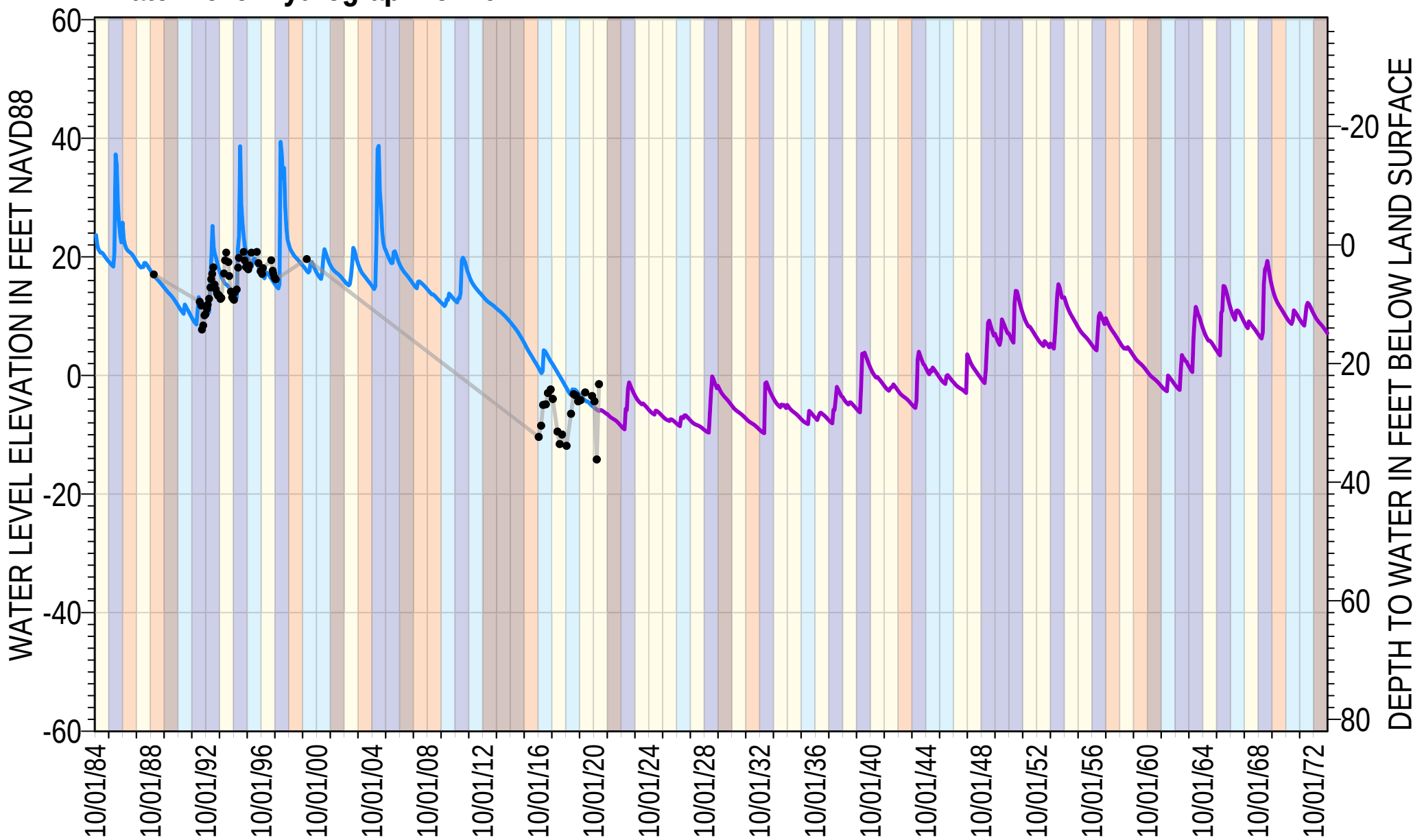
Reference Point Elevation (feet NAVD88) | 53.7

Model Layering (%) | L1: 100



Climate Classification

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



Measured

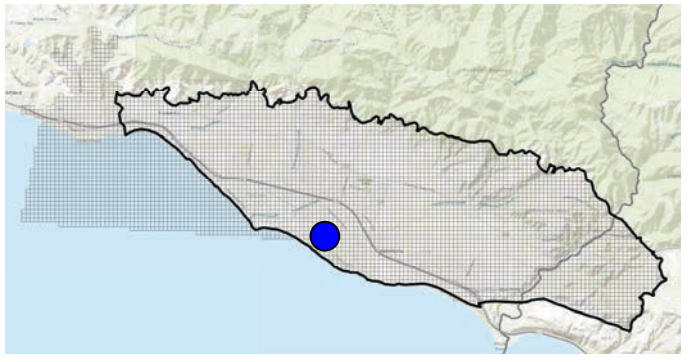
Projected Baseline

Historical

Well Type | Private

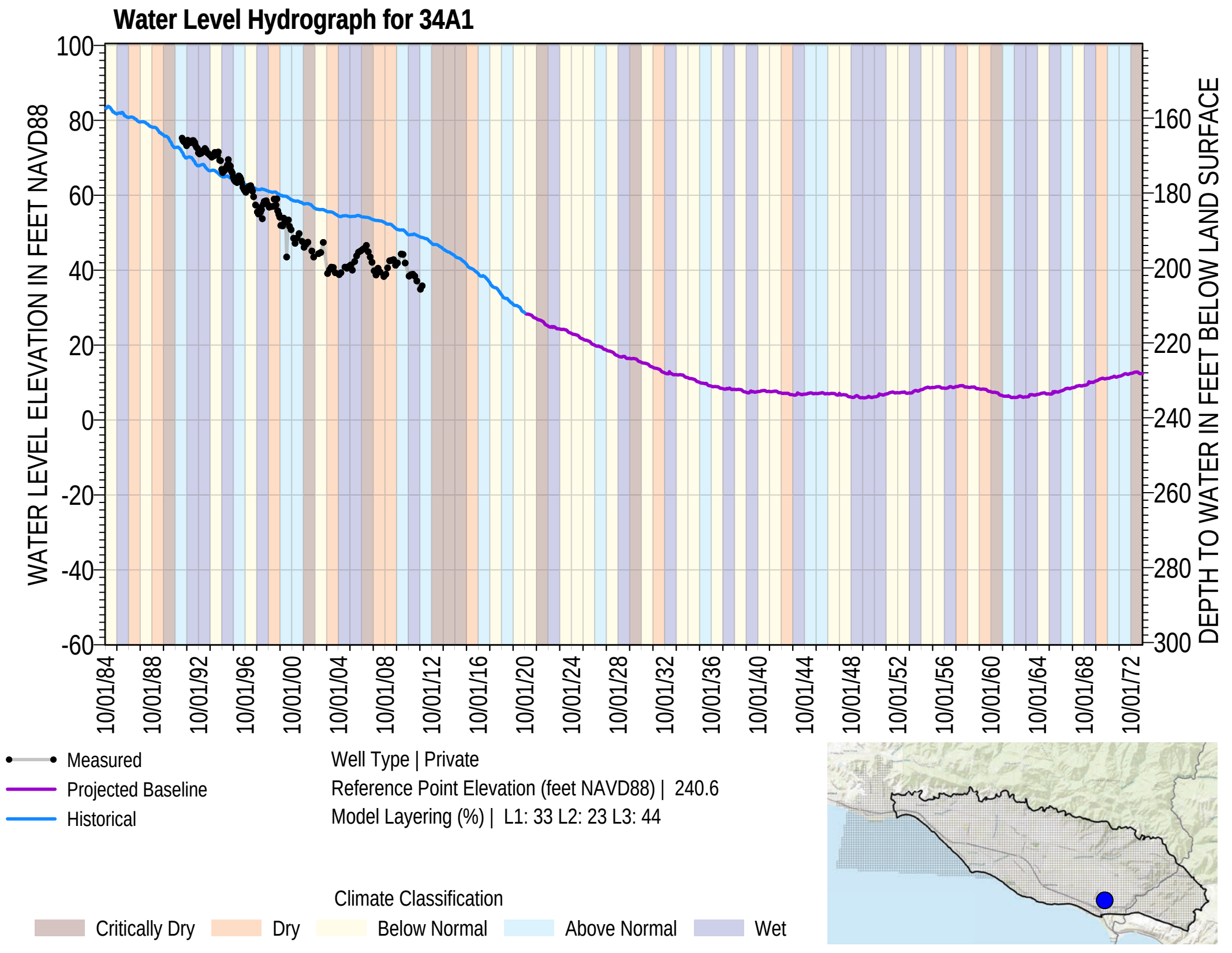
Reference Point Elevation (feet NAVD88) | 22

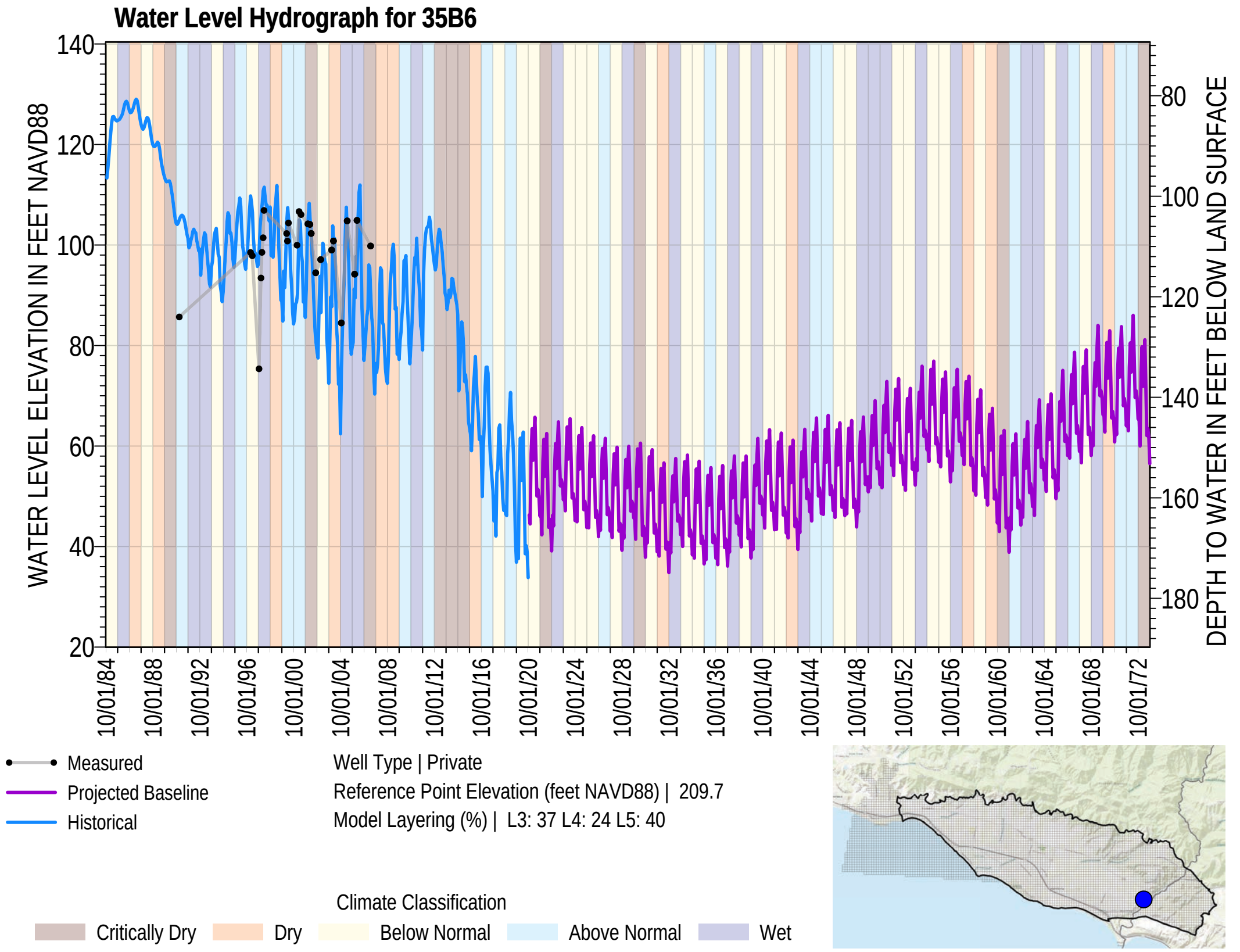
Model Layering (%) | L1: 100

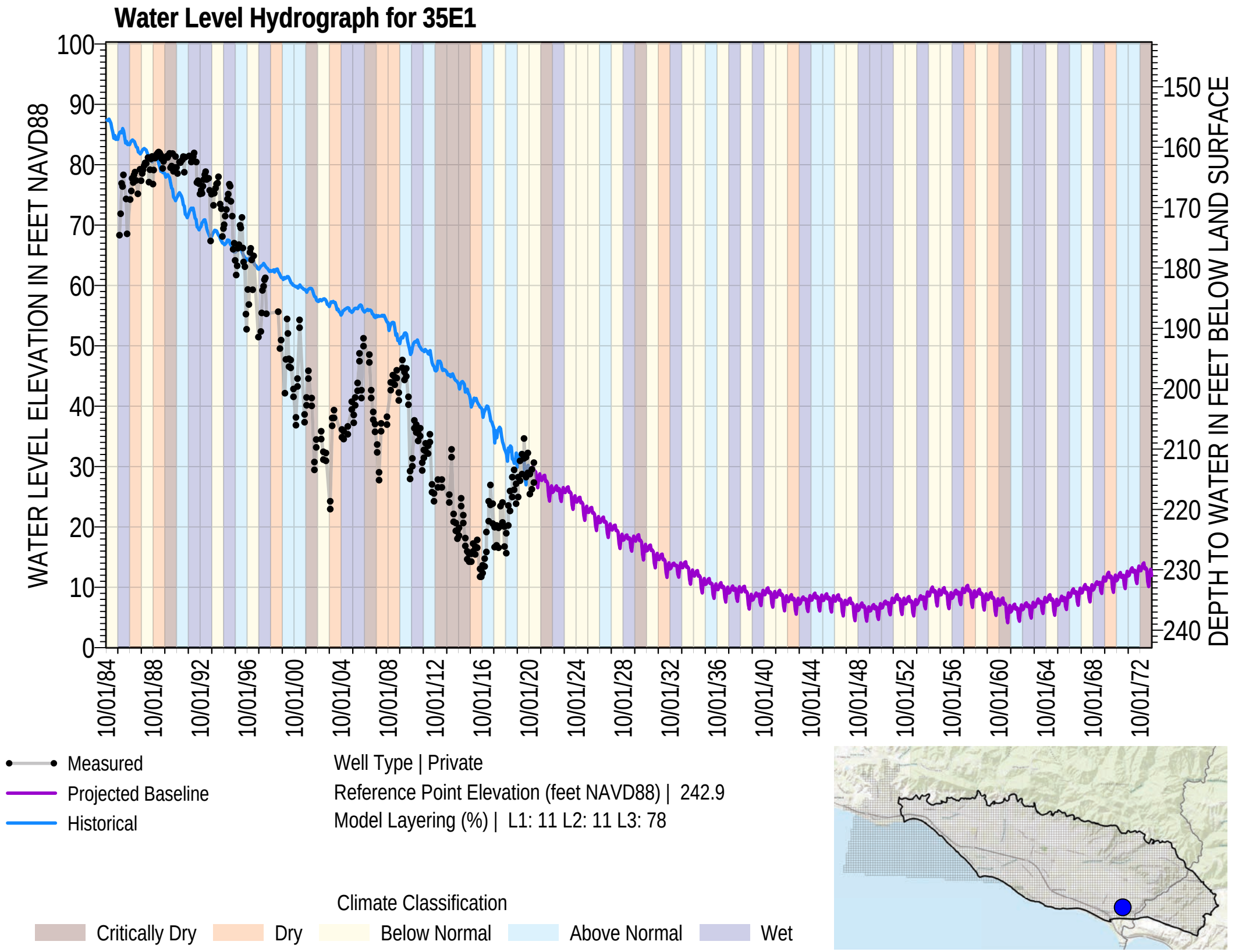


Climate Classification

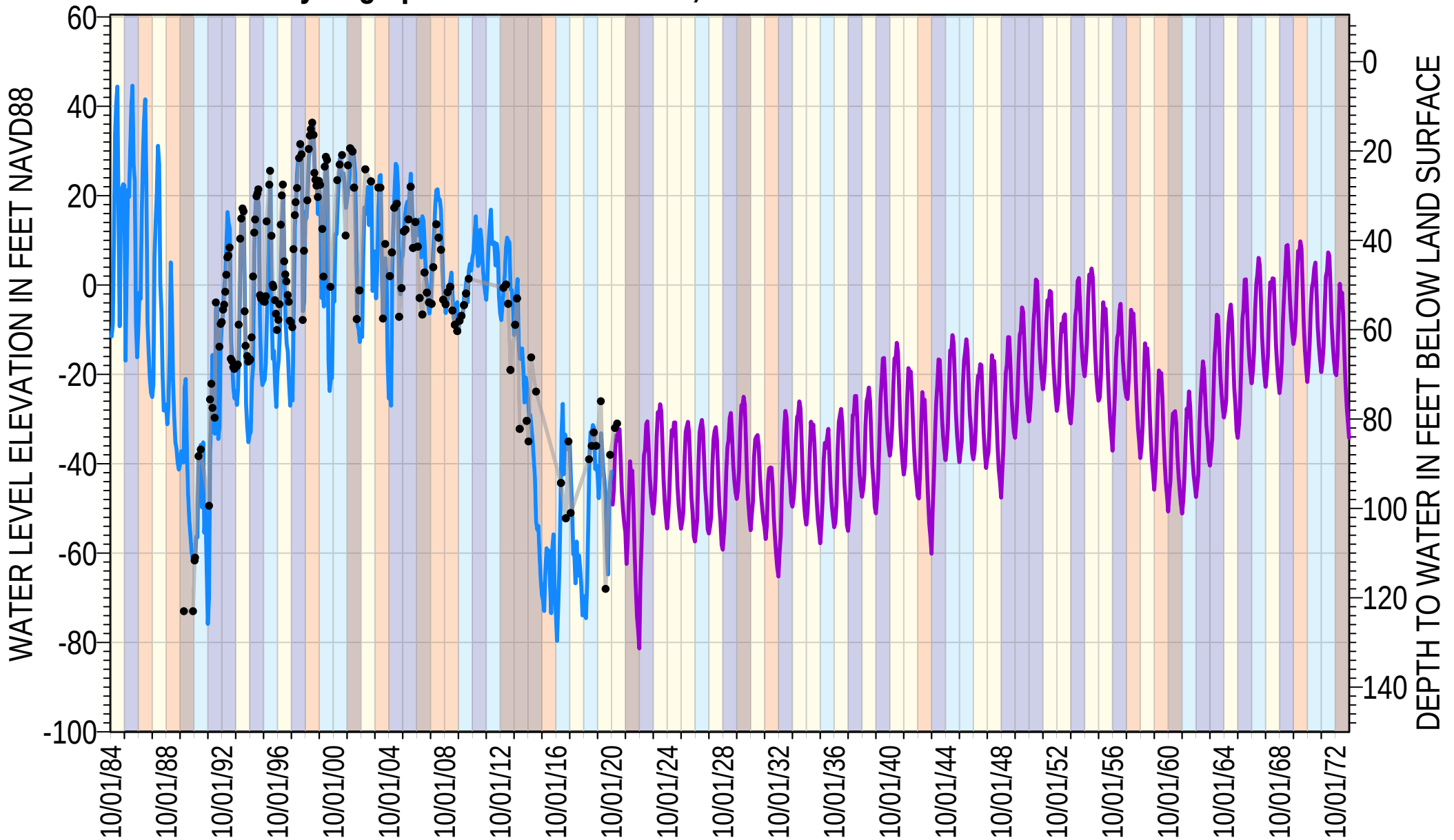
Critically Dry | Dry | Below Normal | Above Normal | Wet


Water Level Hydrograph for 34A1
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
100
80
60
40
20
0
-20
-40
-60
160
180
200
220
240
260
280
300
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) | 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
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
140
120
100
80
60
40
20
80
100
120
140
160
180
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) | 209.7
Model Layering (%) | L3: 37 L4: 24 L5: 40
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

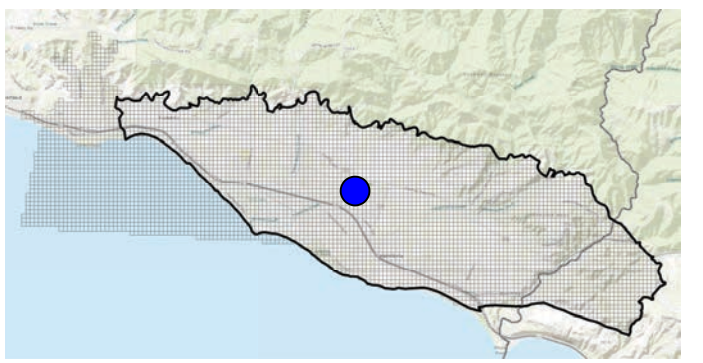

Water Level Hydrograph for 35E1
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
100
90
80
70
60
50
40
30
20
10
0
150
160
170
180
190
200
210
220
230
240
10/01/84
10/01/88
10/01/92
10/01/96
10/01/00
10/01/04
10/01/08
10/01/12
10/01/16
10/01/20
10/01/24
10/01/28
10/01/32
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

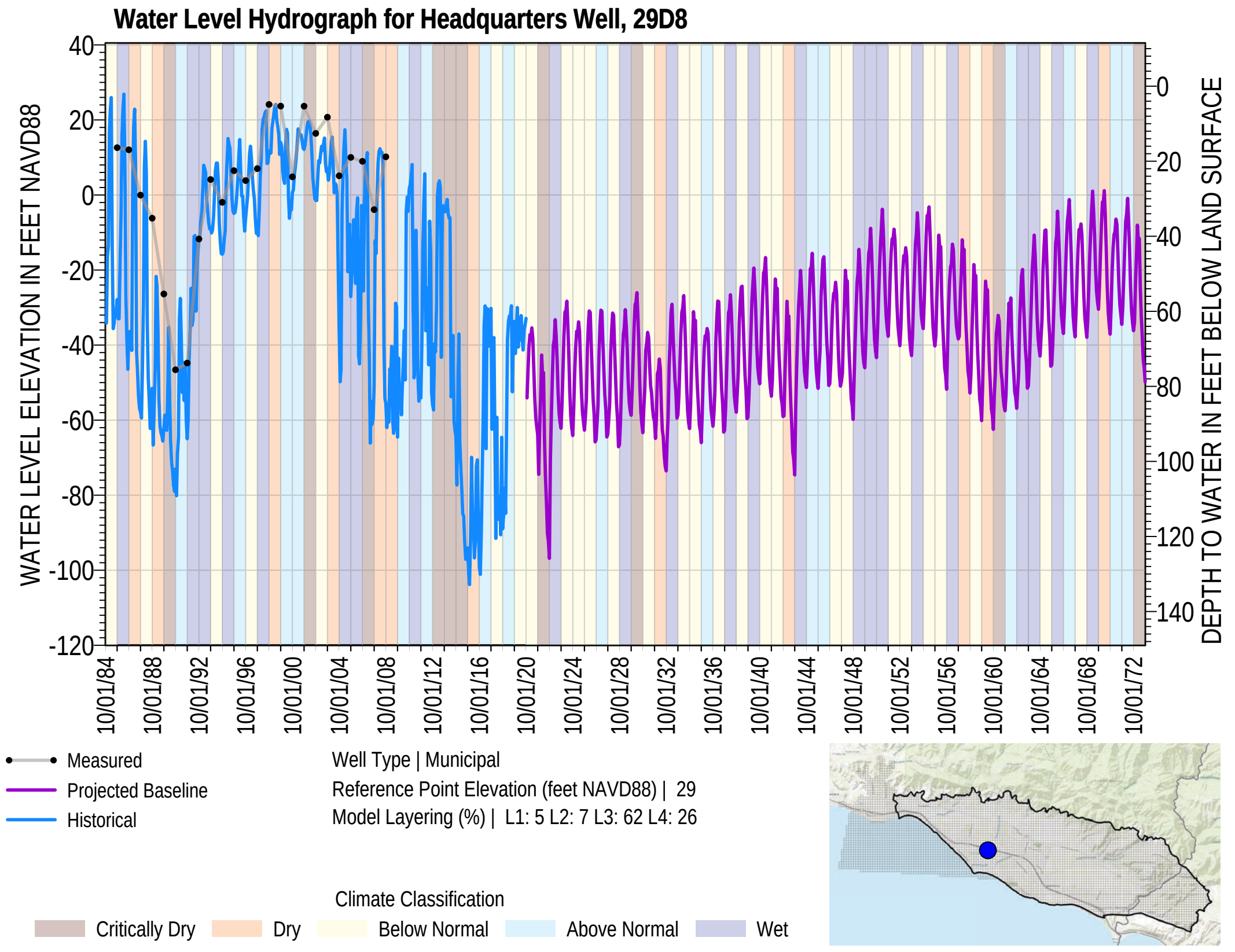
Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 50
Model Layering (%) | L1: 2 L2: 18 L4: 30 L6: 50

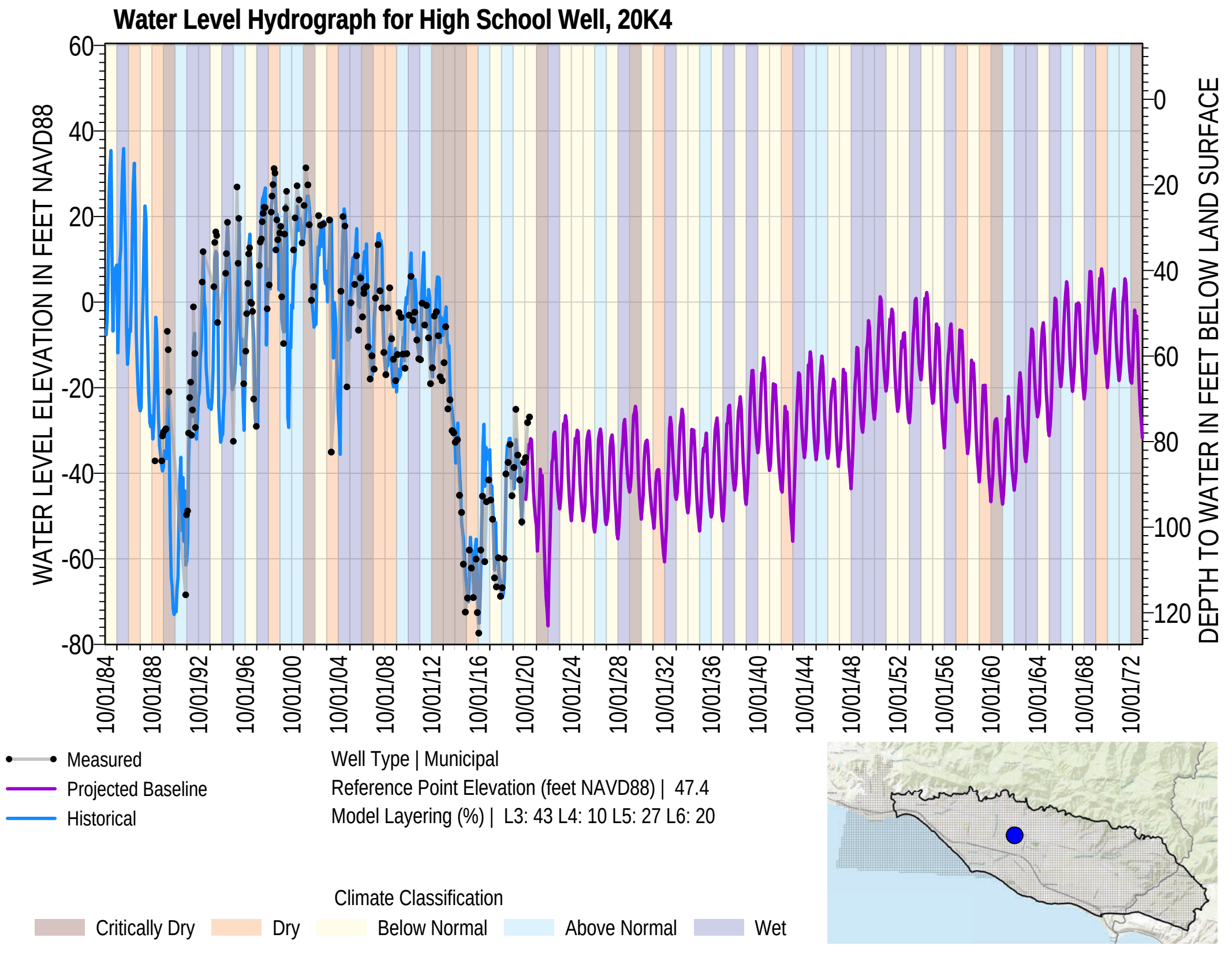


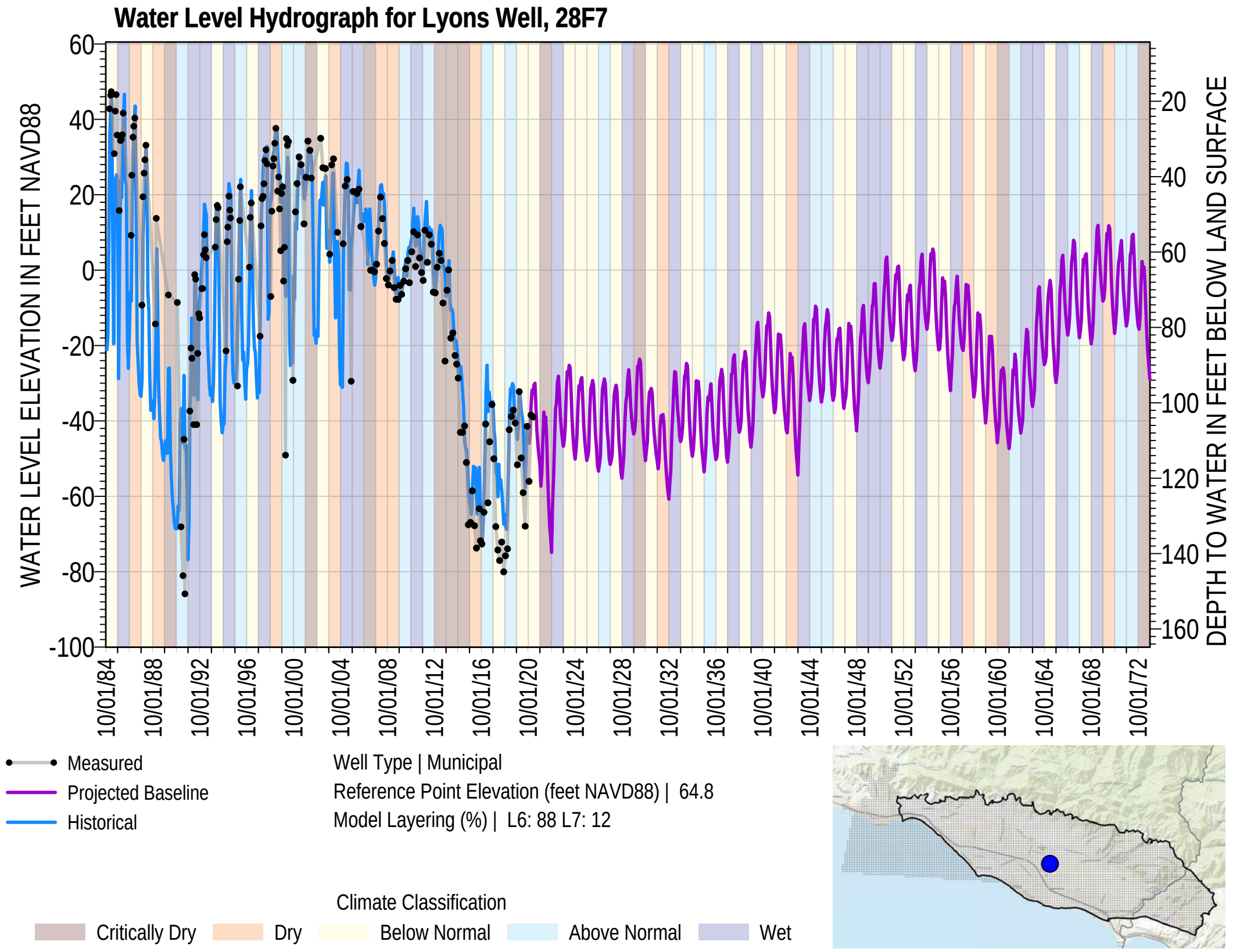
Climate Classification

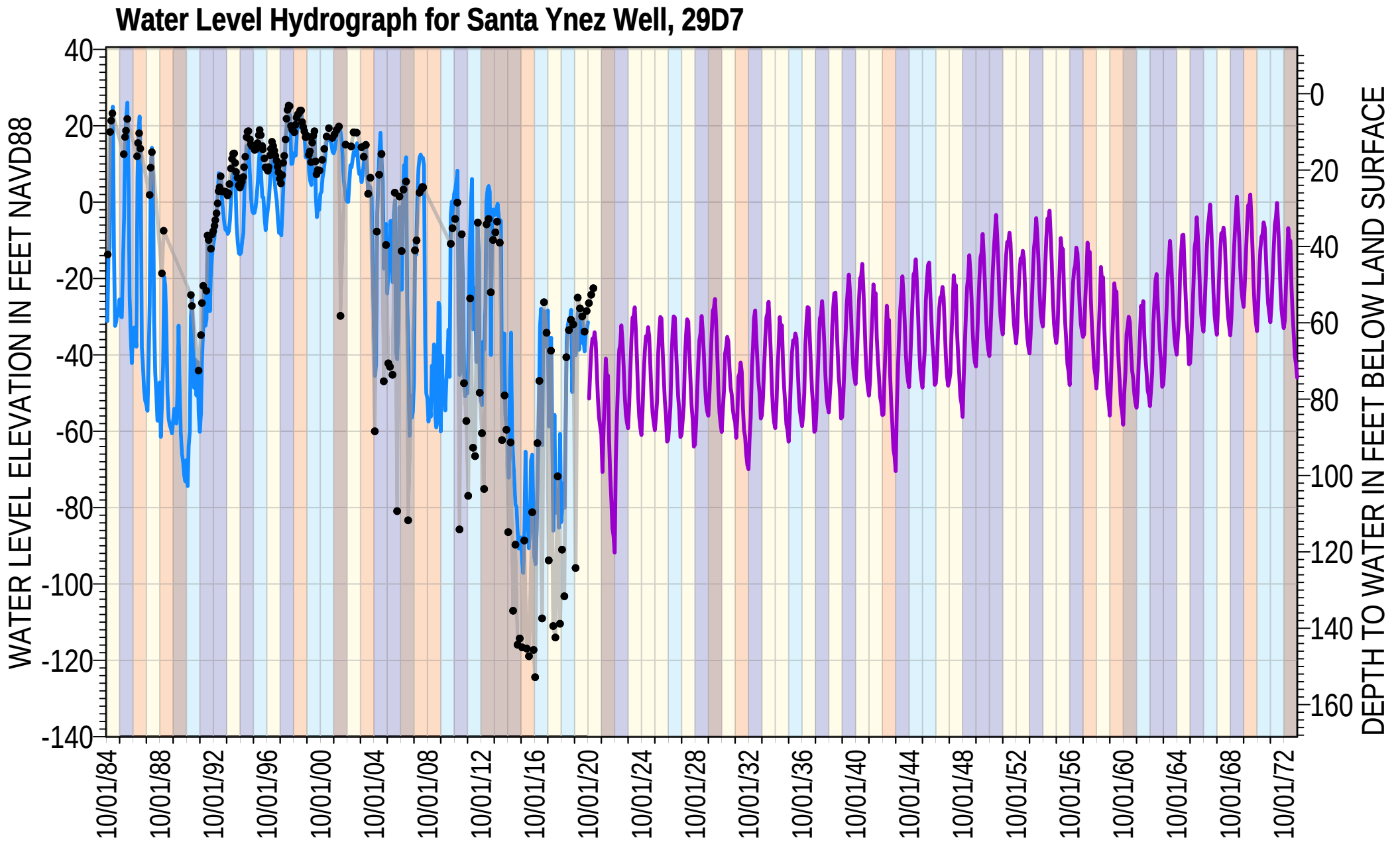
Critically Dry | Dry | Below Normal | Above Normal | Wet

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
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
60
40
20
0
-20
-40
-60
-80
0
20
40
60
80
100
120
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) | 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
10/01/88
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) | 64.8
Model Layering (%) | L6: 88 L7: 12
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

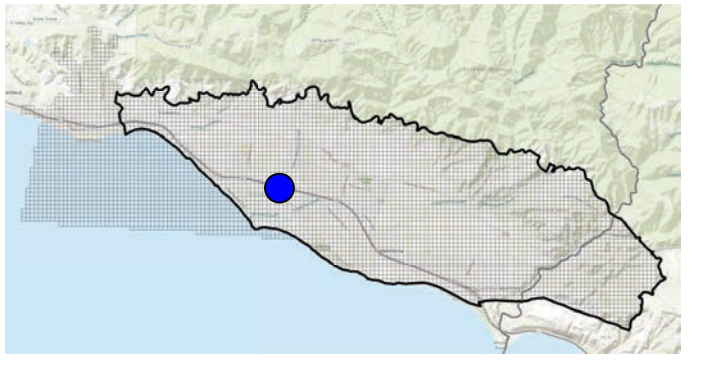


Measured
Projected Baseline
Historical

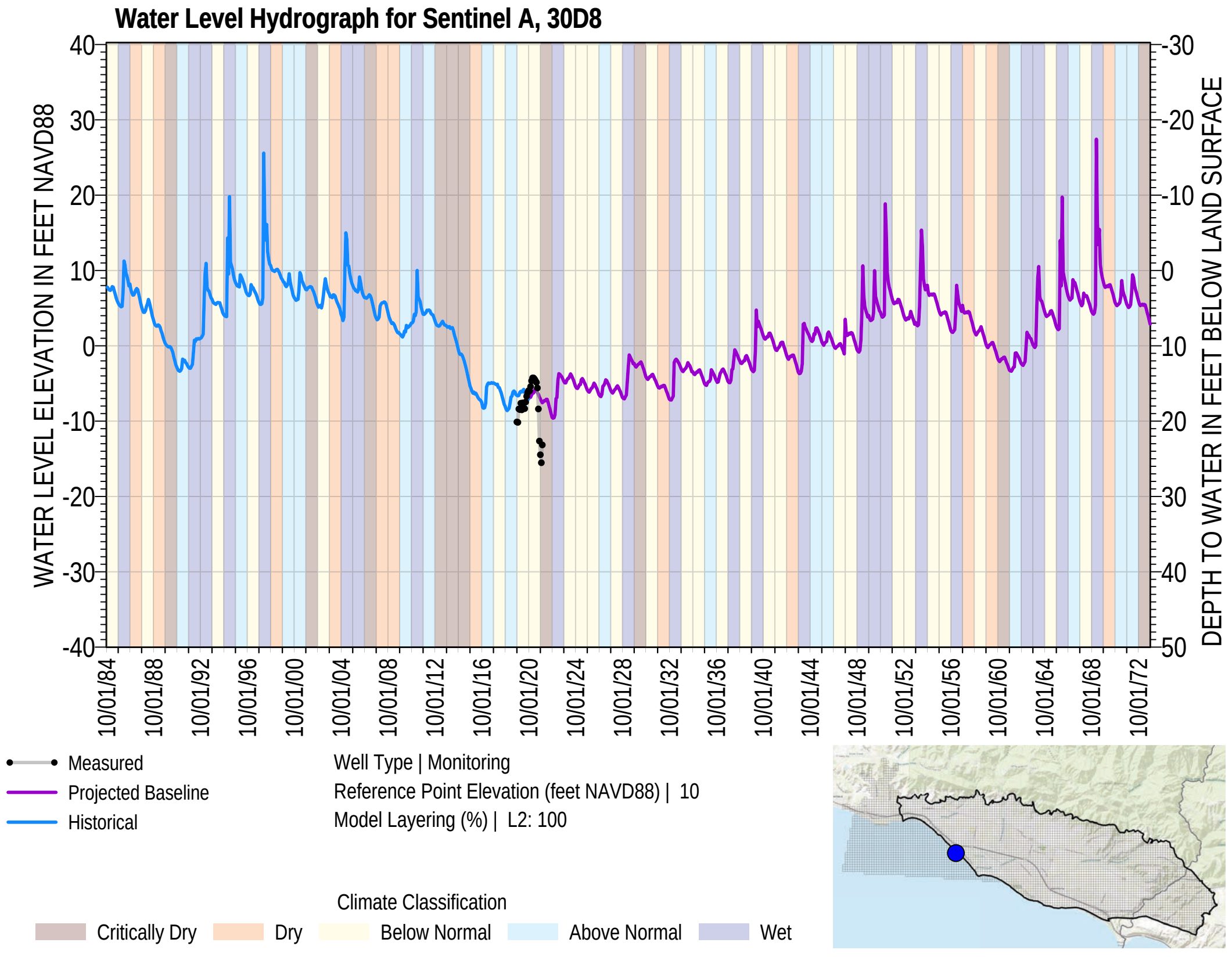
Well Type | Municipal
Reference Point Elevation (feet NAVD88) | 28.4
Model Layering (%) | L1: 34 L2: 1 L3: 59 L4: 5

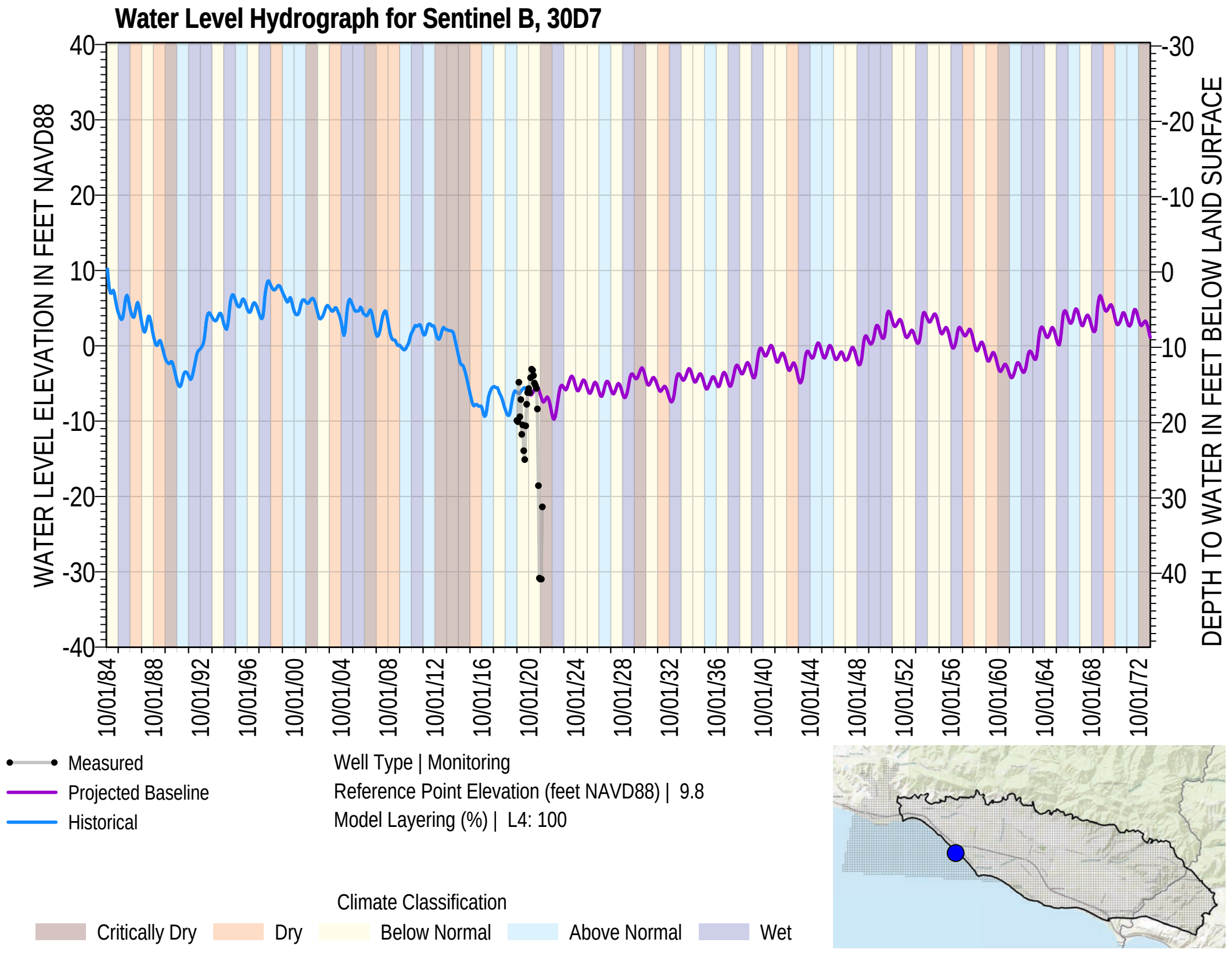
Climate Classification

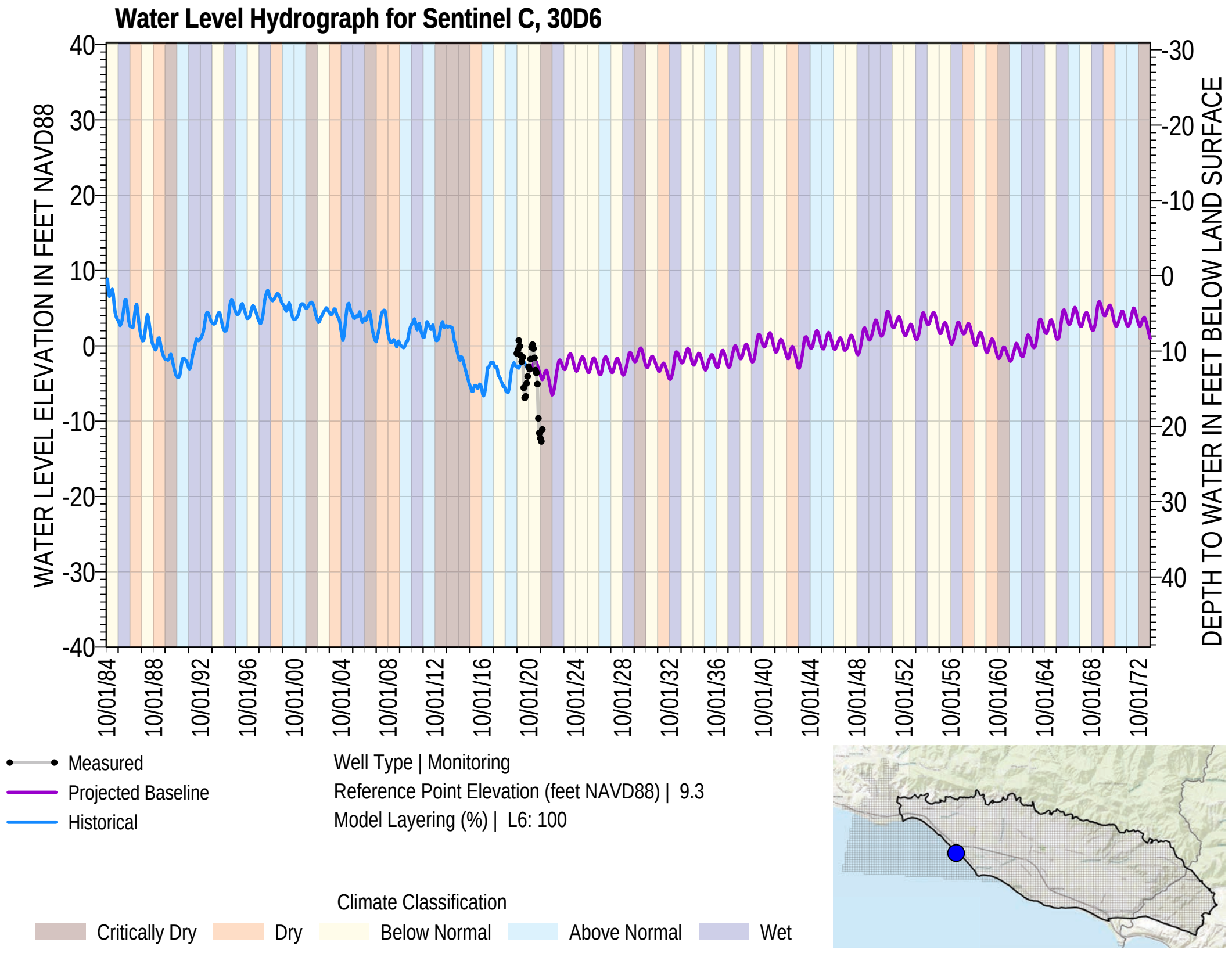
Critically Dry | Dry | Below Normal | Above Normal | Wet

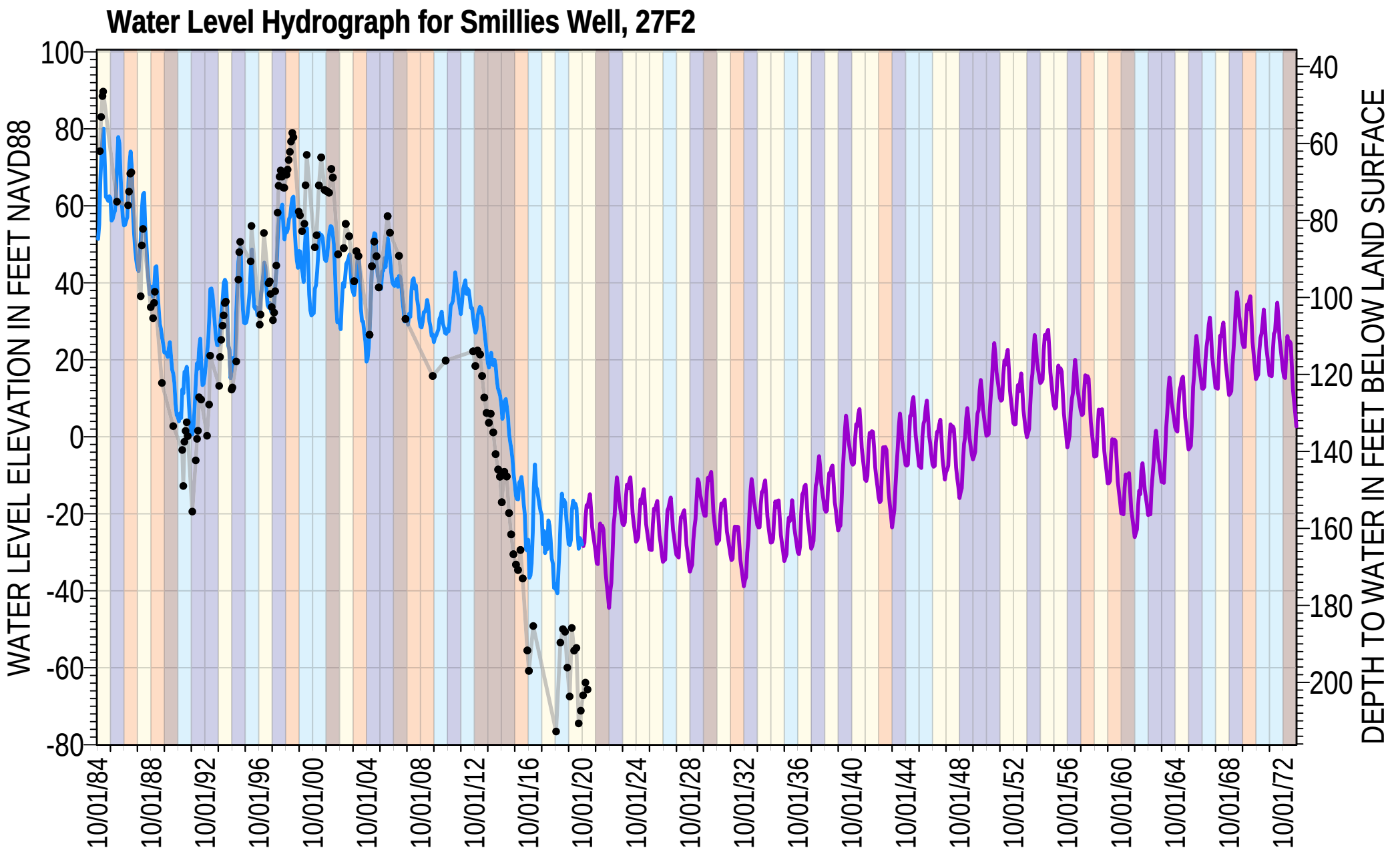


DOES NOT MAKE FILE CORRECTLY


Water Level Hydrograph for Sentinel A, 30D8
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
10/01/88
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 | Monitoring
Reference Point Elevation (feet NAVD88) | 10
Model Layering (%) | L2: 100
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet

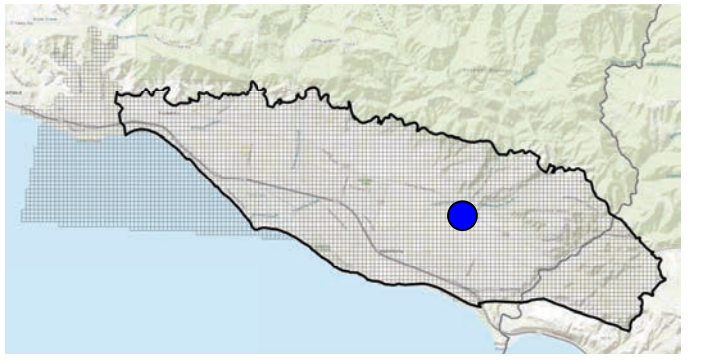

Water Level Hydrograph for Sentinel B, 30D7
WATER LEVEL ELEVATION IN FEET NAVD88
DEPTH TO WATER IN FEET BELOW LAND SURFACE
40
30
20
10
0
-10
-20
-30
-40
-30
-20
-10
0
10
20
30
40
10/01/84
10/01/88
10/01/92
10/01/96
10/01/00
10/01/04
10/01/08
10/01/12
10/01/16
10/01/20
10/01/24
10/01/28
10/01/32
10/01/36
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 | 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
10/01/88
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 | Monitoring
Reference Point Elevation (feet NAVD88) | 9.3
Model Layering (%) | L6: 100
Climate Classification
Critically Dry
Dry
Below Normal
Above Normal
Wet



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

TECHNICAL MEMORANDUM
Pueblo Water Resources, Inc.
4478 Market St., Suite 705 Tel: 805.644.0470
Ventura, CA 93003 Fax: 805.644.0480

To:	Carpinteria Groundwater Sustainability Agency	Date:	October 5, 2023
Attention:	Robert McDonald, P.E. General Manager	Project No:	18-0102
Copy to:	Dave O'Rourke, P.G., C.Hg., P.E. Project Manager (GSI Water Solutions, Inc.)		
From:	Robert Marks, P.G., C.Hg.		
Subject:	Carpinteria Groundwater Basin Groundwater Sustainability Plan, Groundwater Modeling of CAPP Injection Wells **DRAFT**		

INTRODUCTION

GENERAL STATEMENT

Presented in this Technical Memorandum (TM) is a summary of groundwater modeling simulation results performed of the Carpinteria Advanced Purification Project (CAPP) injection wells. The subject analysis was performed to evaluate various operational scenarios for the CAPP injection wells under the Carpinteria Groundwater Basin (CGB) Groundwater Sustainability Plan (GSP) projected future groundwater model scenario to evaluate how acceptable groundwater level mounding can be achieved by the project under the 50-year projected future scenario and the associated impacts to water levels and water budget for the basin. This TM discusses the hydrogeologic setting, the groundwater model scenario used, and the results of three simulated project operational scenarios.

BACKGROUND

The Carpinteria Valley Water District (CVWD) Recycled Water Facilities Plan identified Groundwater Replenishment (GWR) in the Carpinteria Groundwater Basin (CGB) via Indirect Potable Reuse (IPR) injection wells as the preferred end use of water from a new Advanced Water Purification Facility (AWPF) sourced from the Carpinteria Wastewater Treatment Plant (CWWTP). Work performed previously by Pueblo Water Resources, Inc. (PWR) in support of the CAPP project has included an injection well siting study and groundwater modeling of initial project operational scenarios under historical basin conditions of Water Year 1985 – 2008 (WY 1985 – 2008). The results of this previous work identified several potential IPR injection well sites in the basin that were physically suitable to support well construction and permanent injection well facilities.

Five properties were identified in the basin by the well siting study that were of sufficient distance from existing production wells for initial planning purposes (600 feet separation was initially assumed) and could also accommodate IPR injection well sites. The potential IPR well

sites identified are shown on **Figure 1**. As shown, the potential IPR wells sites were concentrated in a relatively small area of the basin in the Confined Area of the basin and are located between two of CVWD's most productive municipal supply wells, the Headquarters Well (29D7) and the El Carro #2 Well (28D2)[1], which will be used to recover the injected AWPF product water. The final CAPP injection well site selection process has since been completed and the planned locations of the IPR injection wells are shown on **Figure 2**. The primary purpose of the subject groundwater modeling was to evaluate water level responses to various CAPP well operational scenarios under the GSP's 50-year projected future groundwater model scenario and to develop basin response and water budget information for a final selected CAPP operational scenario for inclusion in the GSP.

FINDINGS

HYDROGEOLOGIC SETTING

Regional Setting

The CGB has been studied extensively over the last 60 years in previous investigations, most notably by the United States Geological Survey (USGS), *Geology and Ground Water Reservoirs of the South-Coast Basin of Santa Barbara County, California,* USGS Water Supply Paper 1108, J.E. Upson, 1951, Geotechnical Consultants, Inc. (GTC), *Hydrogeologic Investigation of Carpinteria Ground Water Basin*, dated June 1976, and most recently by Pueblo Water Resources, Inc. (PWR), *Hydrogeologic Update and Groundwater Model Project*, dated June 2012. These documents have extensively documented the stratigraphy, structure, and hydraulic characteristics of the aquifer systems of the CGB.

As described in these documents, the CGB is located on the south flank of the Santa Ynez Mountains, one of the east-west trending ridges of the Transverse Range Geomorphic Province. The basin represents the north limb of a structural syncline that has been filled with water bearing sediments. The principal aquifer occurs primarily within the Pleistocene- and upper Pliocene-aged Carpinteria and Casitas Formations. These principal zones include the A, B, C, and D Zones, with the A Zone representing the shallowest major aquifer and the D Zone being the deepest. Geologically, the A Zone likely represents the basal conglomerate of the Carpinteria Formation, whereas the B, C, and D Zones are contained within the Casitas Formation. The base of the D Zone is considered to represent the effective base of freshwater in the basin (GTC) and is generally 1,200 to 1,700 feet below sea level in the basin.

Lithologically, primary water bearing deposits in the basin consist of interbedded unconsolidated and semi-consolidated sand, gravel, silt and clay (and combinations thereof) deposits. The coarser grained sandy/gravelly strata in these deposits comprise the individual primary productive aquifer zones in the Confined Area (i.e., A through D Zones). These primary producing zones are generally on the order of 50 to 100 feet thick each. Finer grained strata of silt and clay are generally thicker and form a series of aquitards between the primary producing

[1] The only other active CVWD well is the Smille Well (27F2), located in the Unconfined Area of the basin. The Lyons Well (28F7) is on standby status, High School (20K4) is inactive.

zones. These aquitards are laterally extensive in the basin and confine water held in the primary aquifers under artesian pressure and define the lateral extents of the Confined Area in the basin. The CVWD's two primary production wells in the basin (HQ and EC#2) are completed in the A through C Zones, which are also the target aquifers for the CAPP IPR injection wells.

Hydrostratigraphy

The hydrostratigraphy of the potential IPR well sites can be established from the aquifer structural contours for the basin, which indicate the following approximate (+/- 50 ft depending on site) stratigraphic delineation at the IPR injection wells sites:

Table 1. CAPP IPR Injection Well Site Stratigraphy

Aquifer Zone	Depths (ft bgs)	Thickness (ft)
A	280 – 340	60
B	930 – 990	60
C	1100 – 1200	100

Well Performance and Capacities

Wells completed in the target A, B, and C Zones generally produce water at rates ranging from approximately 500 gpm to 1,500 gpm, with specific capacities[2] in the range of 3 to 16 gallons per minute per foot of drawdown (gpm/ft). Pumping test data for the HQ and EC #2 wells following their construction both indicated sustainable production rates of approximately 1,500 gpm, with 24-hour specific capacities of approximately 7 and 9 gpm/ft, respectively.

Both the HQ and EC #2 wells have also been analyzed for injection capacity and performance as part of previous investigation of Aquifer Storage and Recovery (ASR) technology in the basin by CVWD[3,4]. These investigations included the performance of pilot/demonstration injection testing using potable water at each well. Analysis of the various factors affecting injection capacities (e.g., water level mounding, backflushing capacity, hydrofracturing potential, etc.) and the pilot injection testing data resulted in estimated long-term sustainable injection capacities for the HQ and EC#2 wells of approximately 300 and 400 gpm, respectively. Accordingly, an average per-well injection rate of 350 gpm (0.5 million gallons per day [mgd]) has been adopted for the CAPP IPR injection wells.

[2] Specific capacity is the ratio of well discharge rate to drawdown. Units are typically expressed as gallons per minute per foot of drawdown (gpm/ft). The value is useful for normalizing and comparing performance between different wells and for predicting the performance of a given well at differing discharge rates.
[3] Padre Associates, Inc. (2003), *Aquifer Storage and Recovery Demonstration Project*, report prepared for Carpinteria Valley Water District.
[4] Pueblo Water Resources, Inc. (2013), *EC #2 ASR Demonstration Project; Summary of Operations*, draft Technical Memorandum prepared for Carpinteria Valley Water District.

GROUNDWATER MODEL DESCRIPTION

The three-dimensional calibrated groundwater flow model used is the Carpinteria Groundwater Basin Model, which was originally developed by the CVWD in 2012 and is documented in a report prepared by PWR[5] (with assistance from HydroMetrics Water Resources, Inc.). In summary, the USGS model code MODFLOW-NWT (Niswonger et al., 2011) is used and the model domain encompasses the basin boundaries covering an area of approximately 36 square miles. The model grid consists of 72 rows and 156 columns with a uniform grid spacing of 300 feet. The model consists of seven active layers in the project area and include:

- Layer 1: Shallow aquifer
- Layer 2: A Zone
- Layer 3: Aquitard
- Layer 4: B Zone
- Layer 5: Aquitard
- Layer 6: C Zone
- Layer 7: Undifferentiated deposits

The original groundwater model was calibrated to a 24-year base period consisting of WY 1985 – 2008 with annual stress periods. For the GSP, the model has been updated by Montgomery & Associates (M&A) and recalibrated to the 36-year base period of WY 1985 – 2020 period and also temporally re-discretized with monthly stress periods (documentation of the model update is presented in a TM by M&A contained in **Appendix F** of the GSP). The updated and recalibrated model was then utilized by M&A to construct a projected future model scenario based on the 50-year projected water budget developed for the GSP (refer to **Chapter 3.3.5**) and is documented in the TM by M&A (**Appendix F** of the GSP). The projected future model scenario covers the 53-year period of WY 2021 – 2073 and extends 50 years past the GSP adoption date of January 2024.

CAPP GROUNDWATER MODELING SCENARIOS

A total of three CAPP operational scenarios were simulated for the GSP, as summarized below:

1. IPR Injection Only: Added the two IPR wells injecting at 0.5 mgd each starting in WY 2027 and continuously throughout the remainder of the projected future base period (WY 2027 – 2073) to evaluate water-level responses at the IPR wells.

[5] Pueblo Water Resources, Inc. and HydroMetrics Water Resources, Inc., (2012), *Carpinteria Groundwater Basin Hydrogeologic Update and Groundwater Model Project, Final Report*, prepared for Carpinteria Valley Water District.

2. IPR "Put-and-Take": Same as Scenario 1 but increased the pumping rates of both the HQ and EC#2 wells by 0.5 mgd each to match the injection rates. This represents a potential long-term CAPP operational strategy.

3. "Water-Level Management": This scenario represents a hybrid approach of Scenarios 1 and 2 and considers how the CAPP could interact with CVWD water supply demands, groundwater basin response to injection, and groundwater storage in the basin over time by using the MODFLOW groundwater model in conjunction with CVWD's water supply and demand model. The objective of this scenario is to maintain water levels in the aquifer system at the IPR injection wells sites at or below ground surface at all times to maximize the water-level and groundwater storage befits of CAPP to the basin while also meeting CVWD's demands over time.

Simulation Results – Predicted Water Levels at Injection Wells

Scenario 1 – "Injection Only". Model simulated water levels for Scenario 1 at the two CAPP IPR wells are presented on **Figures 3 (IPR-1) and 4 (IPR-2)**. As shown, the No-Project baseline scenario water levels at these IPR well locations vary between about 25 to 75 feet below ground surface (bgs), depending on the hydrologic and basin conditions. Scenario 1 shows the model simulated water levels at these locations with injection at the two wells, but no changes to CVWD pumping. As shown, within about 10 years after project startup in 2027, water levels in the aquifer rise above the ground surface, which is considered technically infeasible due to the potential for groundwater "daylighting" at the ground surface, which in addition to potentially causing nuisances at the ground surface in the project area, could also result in losing water from the basin, which would be counter to the intent of the CAPP groundwater recharge project.

Based on these results, it appears that IPR injection only without additional pumping of the HQ and EC #2 wells is likely infeasible under most conditions and CVWD will need to increase the municipal pumping rates most years commensurately with the injection rates of recycled water in order to maintain water levels below ground surface (i.e., to avoid artesian conditions and the potential "daylighting" of injected water at the ground surface).

Scenario 2 – "Put-and-Take". Model simulated water levels for Scenario 2 at the two CAPP IPR wells are presented on **Figures 5 (IPR-1) and 6 (IPR-2)**. In this scenario, pumping of the HQ and EC #2 wells was increased above their baseline pumping levels by 0.5 mgd each to match the rates of injection (1.0 mgd combined). As shown, operated in this way, water levels at the IPR injection wells are approximately 15 to 25 feet higher than No-Project baseline levels and are essentially maintained at or below ground surface throughout the simulation period, indicating that this would be a technically feasible project operation; however, it appears that there are many years during this scenario where injection water levels are well below ground surface, indicating that CVWD could potentially reduce pumping of HQ and EC #2 to some extent and allow water levels in the aquifer to increase, while still being maintained below ground surface.

Scenario 3 – "Water-Level Management". For this scenario, CVWD's water supply and demand model was utilized to develop variable well pumping schedules for the HQ and EC #2 wells in an effort to both maintain water levels in the aquifer as needed at or below ground surface at the injection well sites, while also meeting CVWD demands. Several iterations of this scenario were performed to achieve these objectives, and the final iteration is identified as CAPP-6 because it was the sixth iteration that was needed to successfully balance the needs of both the CVWD water supplies and demand portfolio as well as maintaining water levels at the IPR injection well sites at or below ground surface.

Model simulated water levels for Scenario 3 (CAPP-6 iteration) at the two CAPP IPR wells are presented on **Figures 7 and 8**. As shown, water levels are generally higher than under Scenario 2 - "Put & Take" but still maintained at or below ground surface at all times. In particular, when operated in this manner, significant water level increases occur in the aquifer system at the IPR well sites shortly after project start up, and they generally stay relatively high throughout the 50-year period. This CAPP-6 scenario is the final groundwater modeling scenario of the CAPP project and is to be incorporated into the GSP as a potential groundwater management project for the basin.

Simulation Results – Predicted Water Levels at RMS Wells

Nine (9) water-level Representative Monitoring Site (RMS) monitoring wells the chronic reduction of groundwater levels and reduction of ground water in storage sustainability indicators have been adopted for the GSP (refer to **Chapters 4** of the GSP) and their locations are shown on **Figure 9**. The water level impacts of the final CAPP scenario (CAPP-6 "Water-Level Management scenario) at the RMS wells are shown on **Figures 10 through 18** and briefly discussed below:

19F4 (Figure 10). 19F4 is located on the west side of the basin. As shown, the CAPP project is projected to have a beneficial impact on water levels in this area of the basin, especially during the first 20 years or so of project operation. Also shown on the hydrograph figures are the Minimum Threshold (MT) and Measurable Objective (MO) levels that have been established for the RMS wells (refer to **Chapter 5** of the GSP). As shown, the predicted water levels at this well are maintained above the established MT level throughout the 50-year planning horizon. In particular, the MT is met by January 2044 (demarked by the yellow line on the figures), which is 20 years following GSP adoption and a requirement of SGMA for the basin to meet.

20K4 (Figure 11). 20K4 is located on the central portion of the basin near the CAPP project injection wells. As shown, the CAPP project has significant impact on water levels in the area of the basin, as expected. Water levels at this well are projected to meet the MT level throughout the 50-year period, and also meeting the MO many years.

21L1 (Figure 12). 21L1 is also located in the central portion of the basin, east of 20K4, and similar results are observed at this RMS well. The MT water level is projected to be met at all times during the scenario, but not quite reaching the MO level.

26A1 (Figure 13). 26A1 is located in the northern upland area of the basin, near Shepard Mesa and the northern basin boundary. As shown, CAPP is projected to have virtually no impact on water levels in this area of the basin; however, this result is to be expected given the relatively high elevation in this area (ground surface elevation at 26A1 is 425 feet compared to the CAPP injection wells at elevations of about 25 feet), i.e., water levels in the CAPP project area would need to be well above ground surface in order to have a significant effect on water levels in this upland, high elevation area of the basin.

27F2 (Figure 14). 27F2 is the CVWD's Smille municipal production well located in the Recharge Area of the basin approximately 1.5 miles east of the CAPP injection wells. As shown, the CAPP project has a measurable impact on water levels at this well during the initial 15 years of project operation, and projected water levels are well above the MT throughout the 50-year period and approach the MO many years.

28F7 (Figure 15). 28F7 is the CVWD's inactive Lyons municipal production well, located in the central portion of the basin east of the CAPP injection wells. Similar to other wells in this area of the basin, CAPP has a significant beneficial impact on water levels at this well during the initial 15 years or so of project operation and water levels are maintained above the MT at all times over the 50-year planning horizon, but never quite reaching the MO level.

28J1 (Figure 16). 28J1 is also located in central portion of the basin near Carpinteria Creek and similar results are observed at this well, although somewhat attenuated due to the greater distance from the CAPP injection wells. Water levels are projected to be above the MT level at all times during the 50-year period but do not rise to the MO level.

29D8 (Figure 17). 29D8 is the CVWD's former Santa Ynez production well that had been converted to a monitoring well and located within 100 feet of the HQ well (the HQ well replaced the Santa Ynez well), which is utilized as both a municipal production well of native groundwater as well as a CAPP recharge recovery well under the CAPP scenario. As shown, a variable response is observed in the CAPP scenario water levels compared to the No-Project scenario. This is to be expected, given that this well is pumped to recover the CAPP injected water and maintain water levels at the injection wells. Importantly, the projected water levels meet the MT at this well by 2044 and are mostly maintained above the MT for the remainder of the 50-year period (there are a few years when water levels are briefly at or slightly below the MT).

34G1 (Figure 18). 35E1 is the only RMS well located south of the Rincon Creek Fault in Storage Unit No. 2 (refer to **Figure 9**). As shown, the impacts of the CAPP project are relatively muted in this area of the basin, reflecting the barrier to flow created by the fault; however, a relatively small positive impact is observed and projected water levels meet the MT by 2044 and are maintained at or above the MT level for the rest of the 50-year period.

Simulation Results – Impacts to Groundwater Basin Water Budget

A description of the methodology that was utilized to prepare a 50-year projected water budget for the basin is presented in **Section 3.3.5** of the GSP. As described, the projected

water budget accounting is used to quantify the estimated future baseline conditions of supply, demand and aquifer response to GSP implementation over a 50-year planning horizon. In general, the methodology involves applying California Department of Water Resources (DWR) provided climate change data sets to the historic water budget methodology for the basin described in **Section 3.3.3** of the GSP. The resulting baseline 50-year projected annual water budget inventory for the basin is presented graphically on **Figure 3-79** of the GSP and a comparable graphical water budget inventory that includes the impacts of CAPP on the projected water budget is presented as **Figure 19** in this TM.

The changes in inflow and outflow components of the projected water budget associated with CAPP injection and recovery are shown in purple on the individual annual bars on **Figure 19**. The overall pattern in the water budget inventory does not change appreciably compared to the No-Project baseline presented on **Figure 3-79** of the GSP, but the magnitudes of both inflow and outflow are increased each year starting in WY 2027 commensurate with CAPP injection (inflow) and recovery (outflow). The solid black line showing the cumulative change in storage does have a slightly different shape and pattern than the No-Project baseline, however. In particular, an overall increase in storage during the initial 20 years or so of project operation is observed. The overall trend is still relatively flat, and there is still a modest cumulative deficit in storage at the end of the 50-year period of about 10,000 acre-feet (af).

A side-by-side comparison of the 50-year average water budgets for the No-Project baseline and CAPP scenario for the basin is presented in **Table 2** below:

Table 2. Projected Water Budget Comparison

Groundwater Budget Component		No Project Baseline	CAPP Scenario 6	Differences	
				afy	%
Inflows (acre-feet per year)					
Subsurface Inflow		866	866	0	0%
Streambed Percolation		734	734	0	0%
Percolation of Precipitation		1877	1877	0	0%
Percolation of Irrigation Water	Delivered	194	194	0	0%
	Pumped	430	430	0	0%
MGB Boundary Inflow		122	115	-7	-6%
Subsurface Inflow from Ocean Boundary		438	323	-115	-26%
CAPP Injection		0	1054	1054	--
	Total Inflow	**4,662**	**5,593**	**931**	**20%**
Outflows (acre-feet per year)					
MGB Boundary Outflow		61	61	0	0%
Subsurface Outflow to Ocean Boundary		358	357	0	0%
Groundwater Pumping	CVWD	1263	1156	-107	-8%
	Private	3094	3094	0	0%
	CAPP Recovery	0	1034	1034	--
	TOTAL	4357	5284	927	21%
	Total Outflow	**4,870**	**5,797**	**927**	**19%**
Inflows - Outflows (acre-feet per year)		**(208)**	**(204)**	**4**	**1%**

As shown, implementation of CAPP has no effect on the majority of basin inflow (recharge) components, with the exception of flows across the basin boundaries with the Pacific Ocean and the Montecito Groundwater Basin (MGB). The net effect of CAPP injection is an overall increase in basin water levels and storage, particularly during the initial 20 years or so of project operations, which reduces the amount of inflow across these boundaries due to a reduction in groundwater gradients across the boundaries. Most significantly, CAPP reduces the amount of inflow into the basin from the boundary with Pacific Ocean by approximately 26 percent. Assuming inflow from the boundary with Pacific Ocean represents saline water that is unusable for beneficial uses, this can be inferred to represent a reduction in the potential for seawater intrusion that could otherwise occur into the basin.

Basin outflows are similarly unaffected by CAPP, with the exception of CVWD pumping of native groundwater, which is reduced overall by 8 percent by the water-level management strategy of Scenario 3 (CAPP 6 iteration). CAPP recovery pumping represents an increase in outflow from the basin, but it is commensurate on a one-for-one basis with the amount of injection / recharge. The average net difference between inflows and outflows over the 50-year projected future planning horizon with CAPP is comparable to the No-Project baseline at approximately 200 acre-feet per year (afy).

CONCLUSIONS

Based on the findings presented herein and our experience with similar projects, we offer the following conclusions:

- Scenario 1 - “Injection Only” is considered technically infeasible, as it would result in excessive water level conditions under all but the lowest basin water level conditions (i.e., drought conditions).

- Scenario 2 - “Put-and-Take” appears technically feasible, and only requires that CVWD increase its pumping rates above No-Project baseline pumping commensurate with the amount being injected in order to maintain acceptable water level conditions. The existing CVWD wells have sufficient excess capacity to accomplish this type of operation and it, therefore, does not appear that the CAPP project would require additional production recovery wells to be successful.

- Scenario 3 – “Water-Level Management” appears technically feasible and would provide tangible benefits to the basin in addition to providing a supplemental source of supply for the CVWD. Specific benefits of CAPP to the basin include:

    1. Increases in water levels at most RMS monitoring wells, particularly during the first 15 years or so of project operation during the time when the basin needs to meet SGMA-required MT levels.

    2. Reduction in the amount of inflow into the basin across the boundary with the Pacific Ocean, which can be inferred to represent a reduction in the amount of seawater intrusion that would otherwise occur.

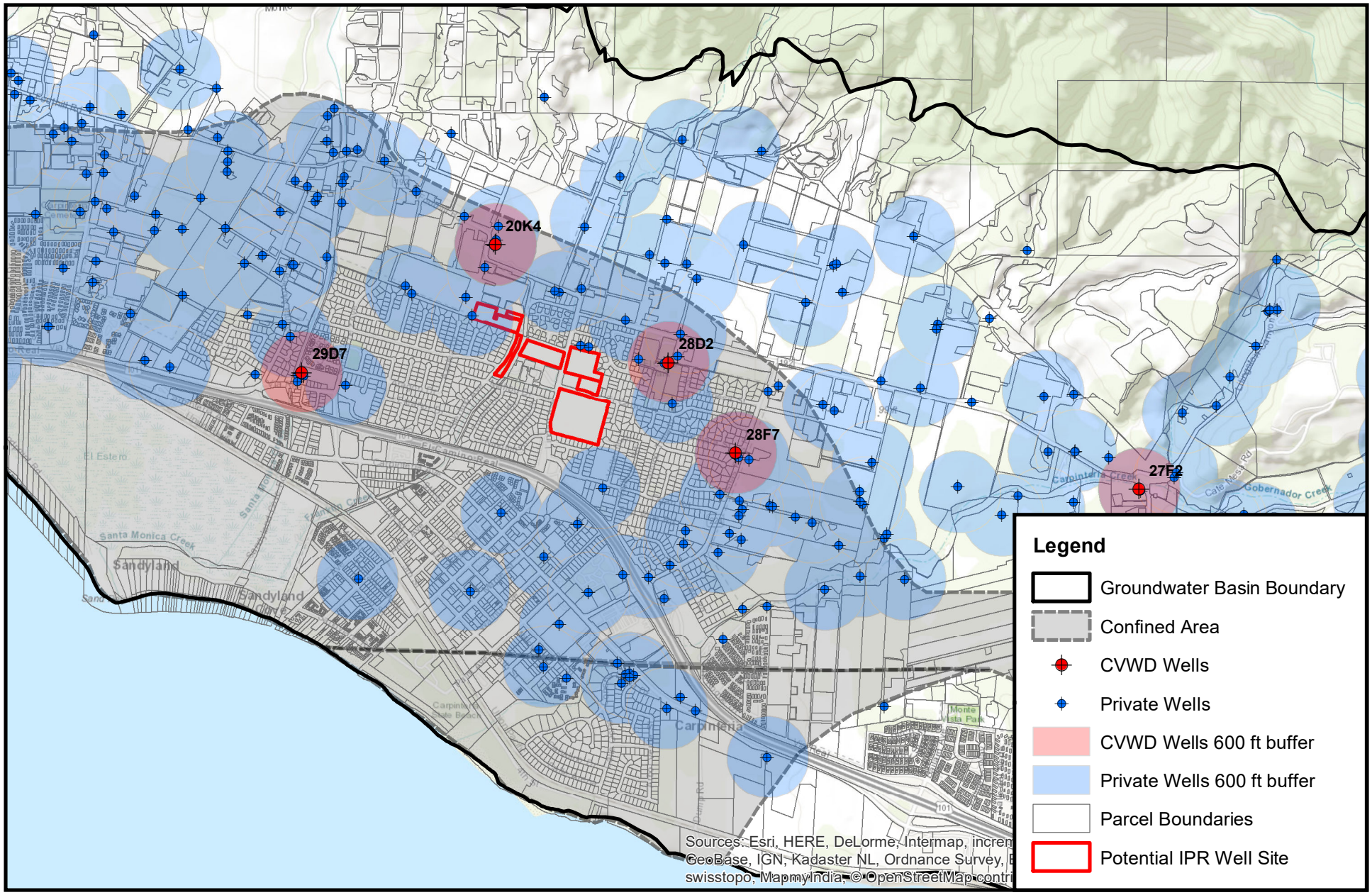
    3. Allows for a modest reduction in CVWD pumping of native groundwater while also continuing to meet CVWD demands.

CLOSURE

This technical memorandum has been prepared exclusively for the Carpinteria Groundwater Sustainability Agency for the specific application to the Carpinteria Groundwater Basin GSP. The findings and conclusions presented herein were prepared in accordance with generally accepted hydrogeologic practices. No other warranty, express or implied, is made.

FIGURES

October 2023
Project No. 18-0102



PUEBLO water resources

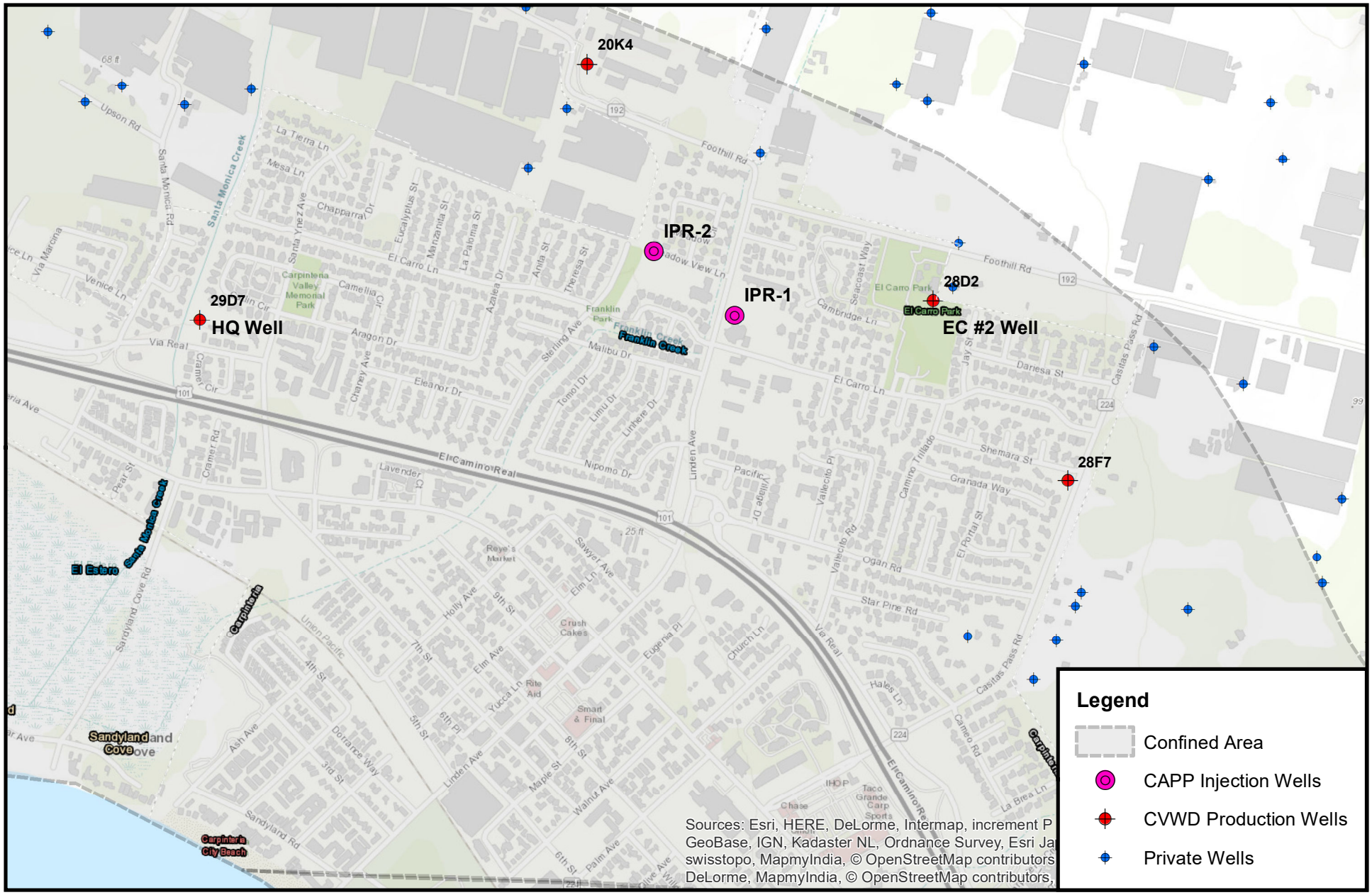
N W E S

1 inch = 2,000 feet

0 2,000 4,000 Feet

FIGURE 1. POTENTIAL IPR INJECTION WELL SITE LOCATION MAP
Carpinteria Groundwater Basin GSP - Groundwater Modeling of CAPP
Carpinteria Groundwater Sustainability Agency

October 2023
Project No. 18-0102



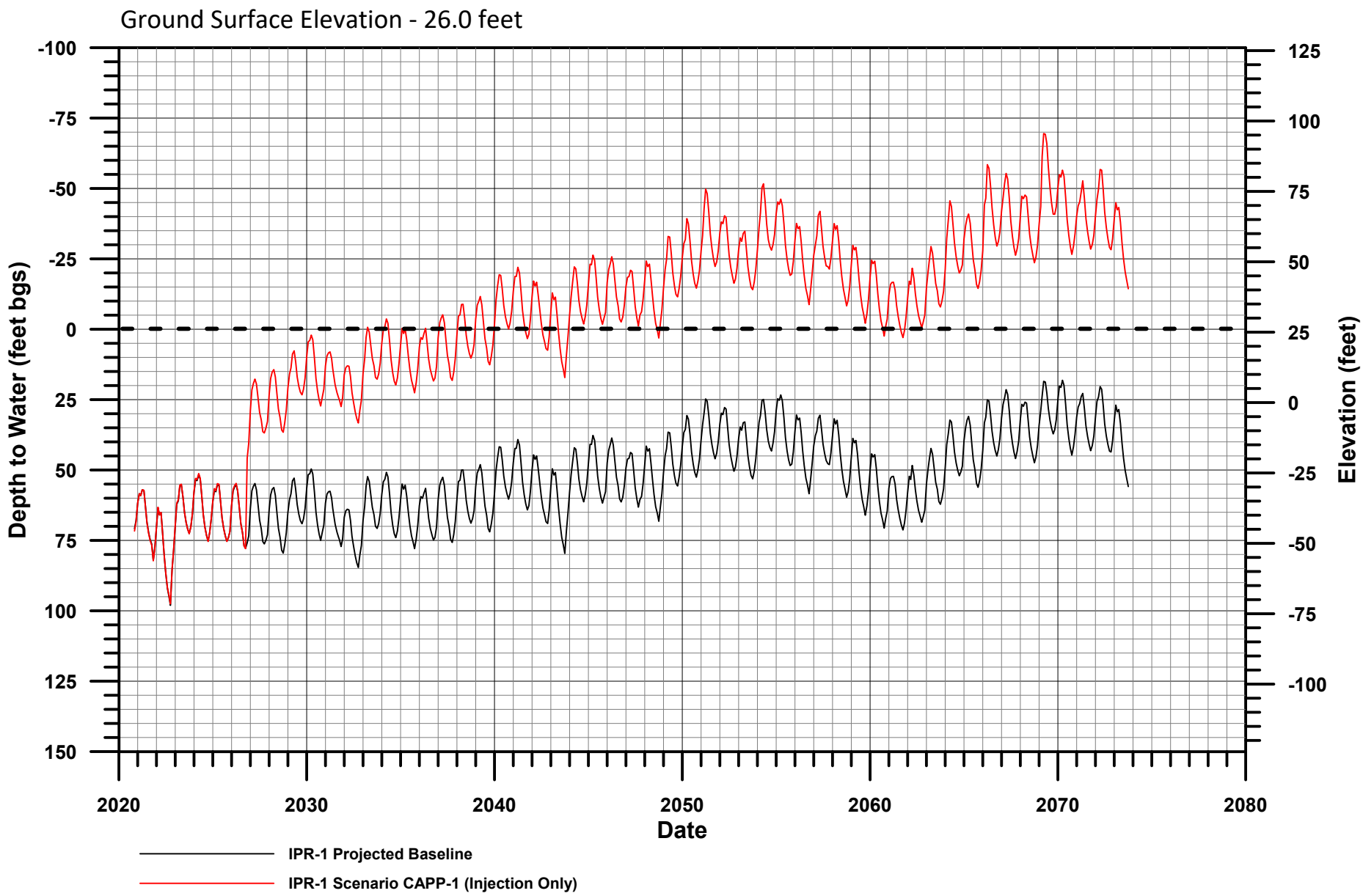
PUEBLO water resources

N W E S

1 inch = 1,000 feet

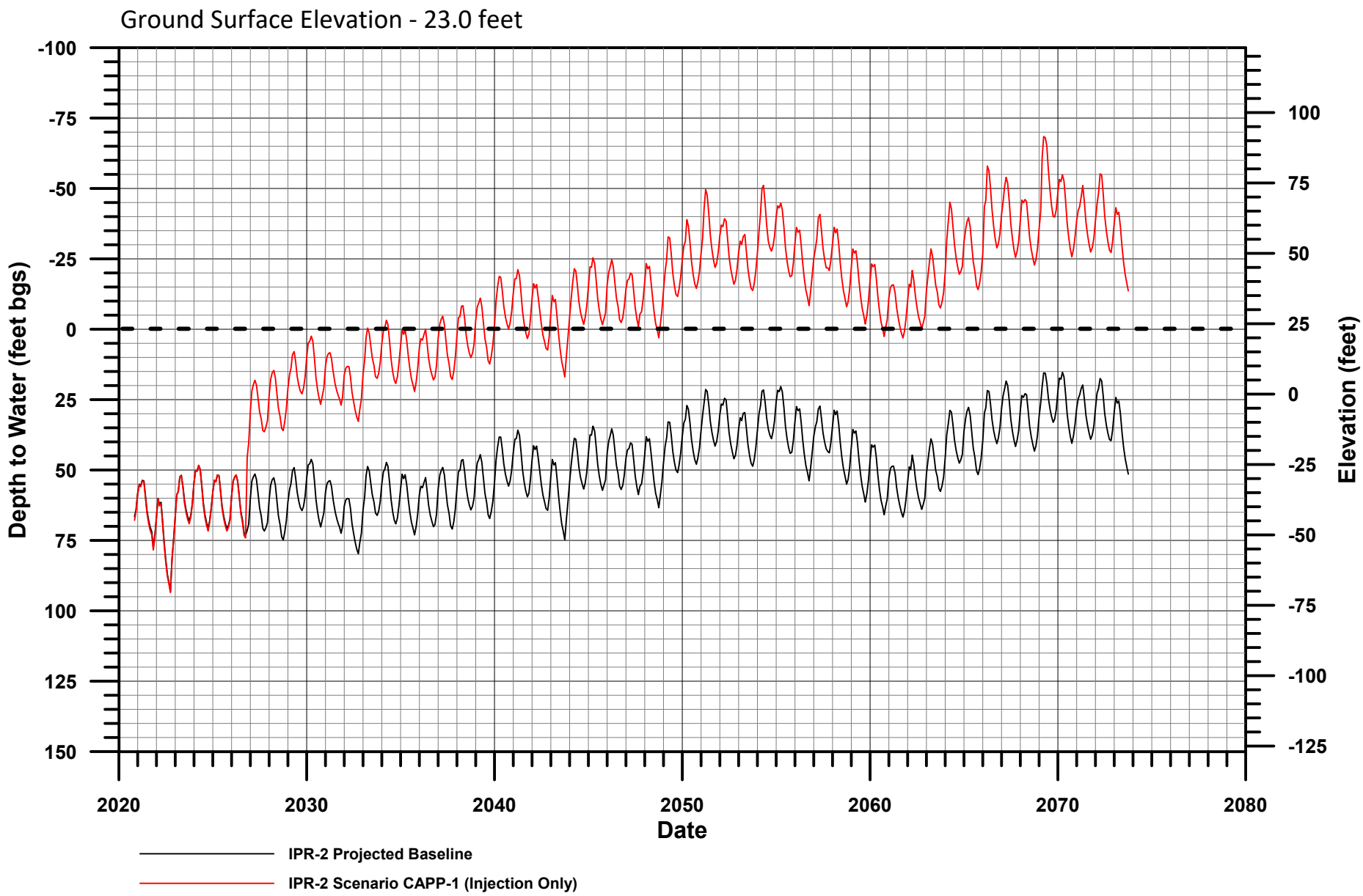
0 1,000 2,000 Feet

FIGURE 2. SELECTED IPR INJECTION WELL SITE LOCATION MAP
Carpinteria Groundwater Basin GSP - Groundwater Modeling of CAPP
Carpinteria Groundwater Sustainability Agency



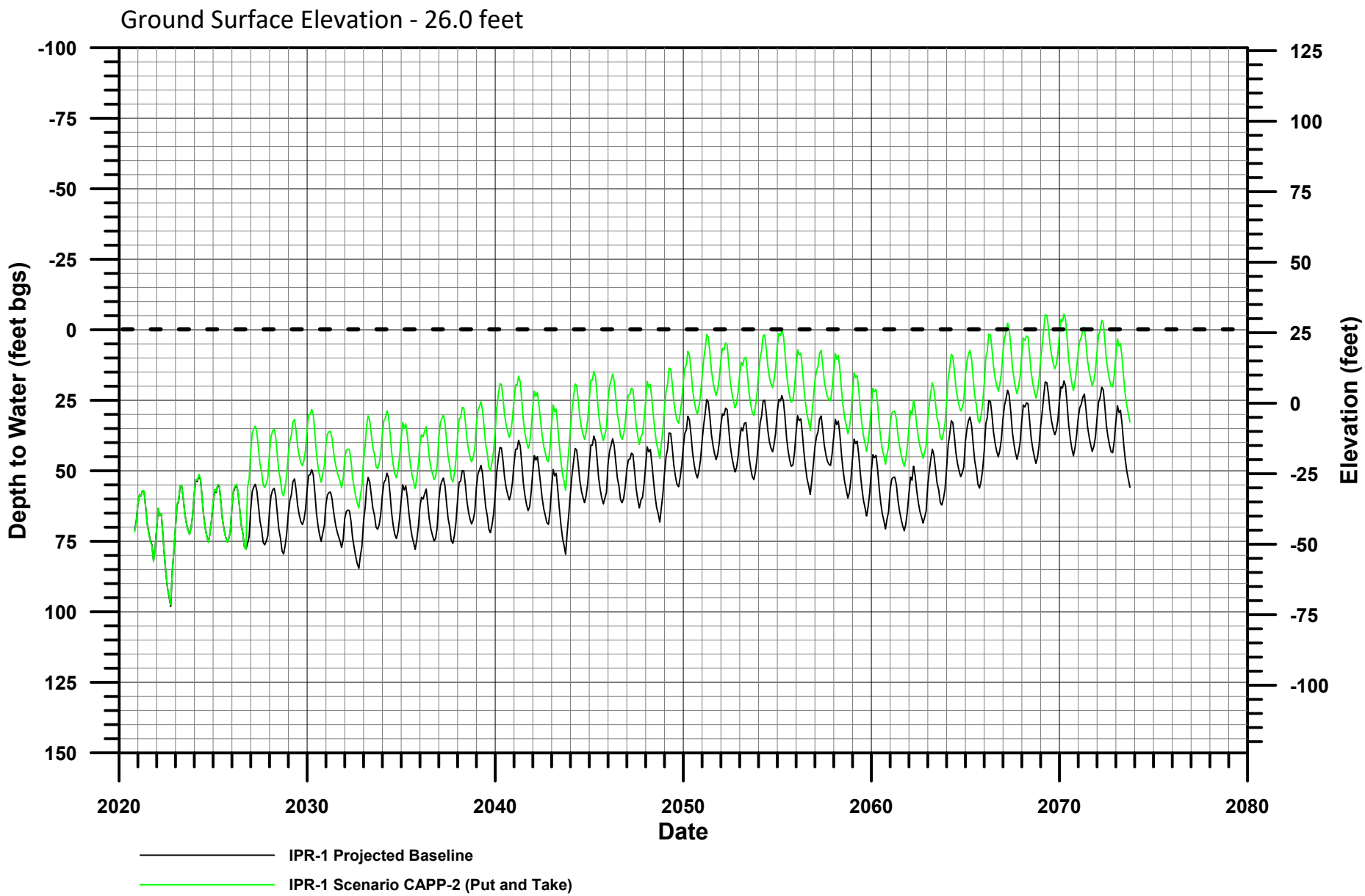
PUEBLO water resources

FIGURE 3. MODEL SIMULATED WATER LEVELS - IPR-1 (SCENARIO 1)
Carpinteria Groundwater Basin GSP - Groundwater Modeling of CAPP
Carpinteria Groundwater Sustainability Agency



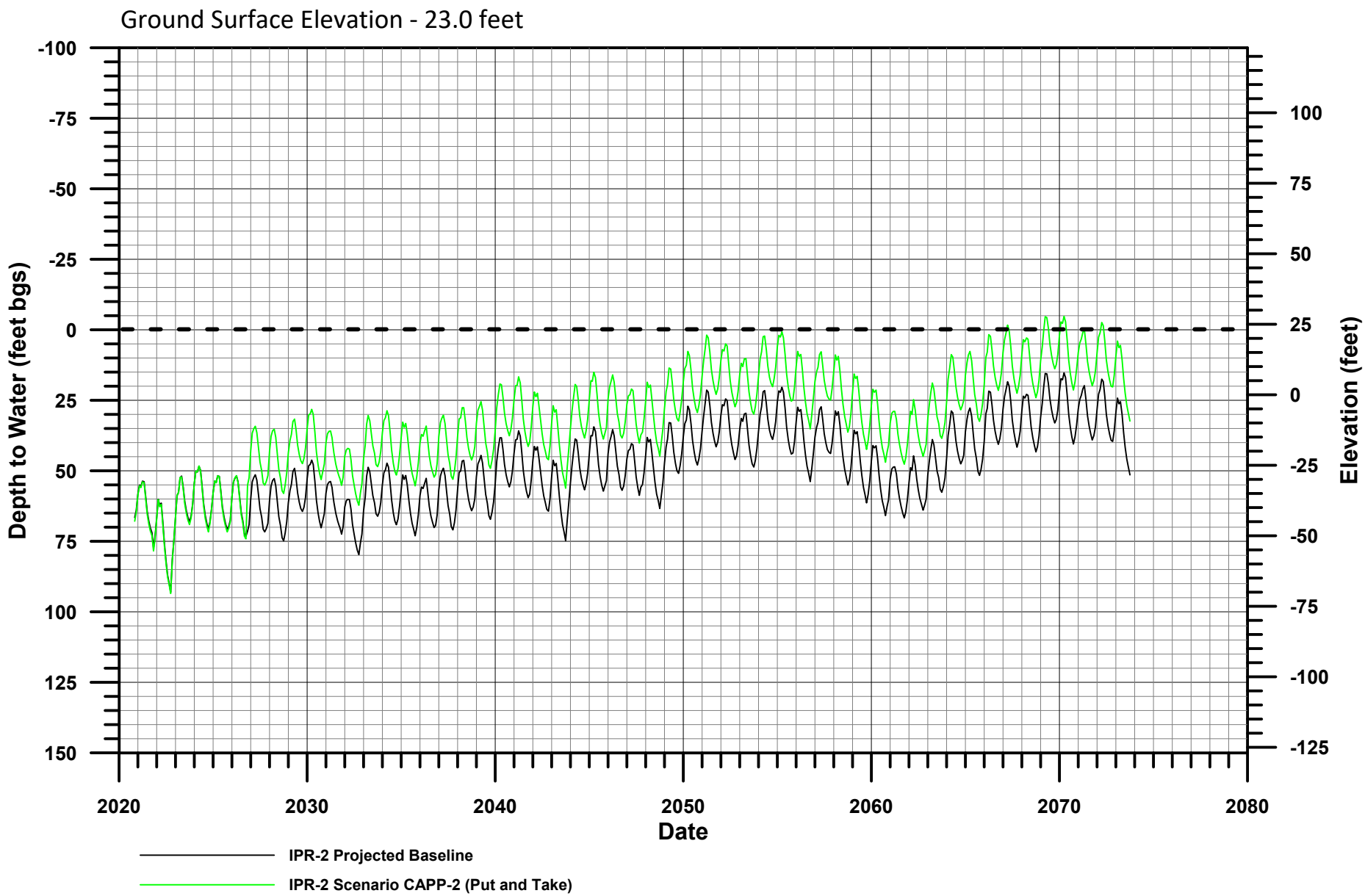
PUEBLO water resources

FIGURE 4. MODEL SIMULATED WATER LEVELS - IPR-2 (SCENARIO 1)
Carpinteria Groundwater Basin GSP - Groundwater Modeling of CAPP
Carpinteria Groundwater Sustainability Agency



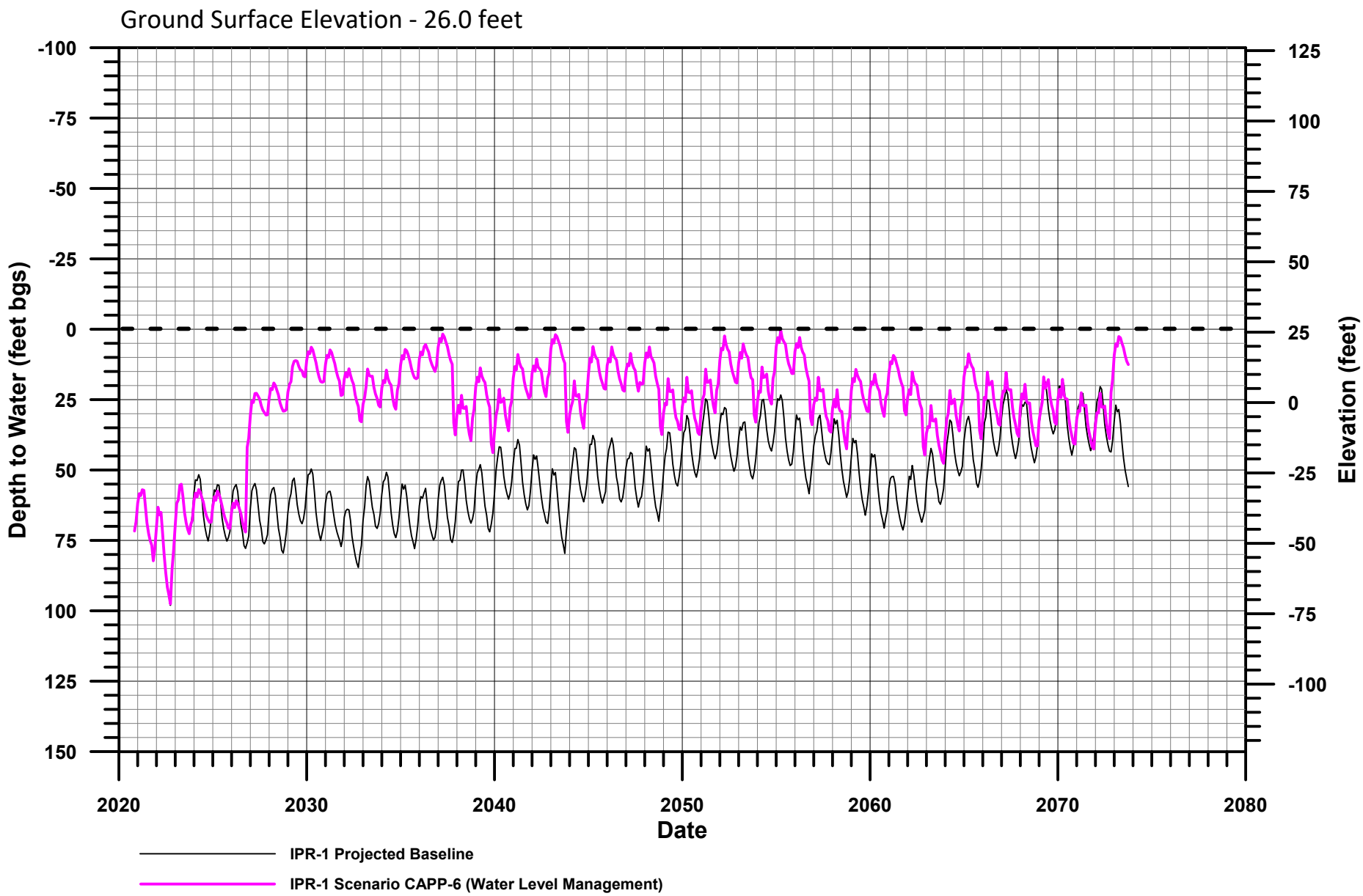
PUEBLO water resources

FIGURE 5. MODEL SIMULATED WATER LEVELS - IPR-1 (SCENARIO 2)
Carpinteria Groundwater Basin GSP - Groundwater Modeling of CAPP
Carpinteria Groundwater Sustainability Agency



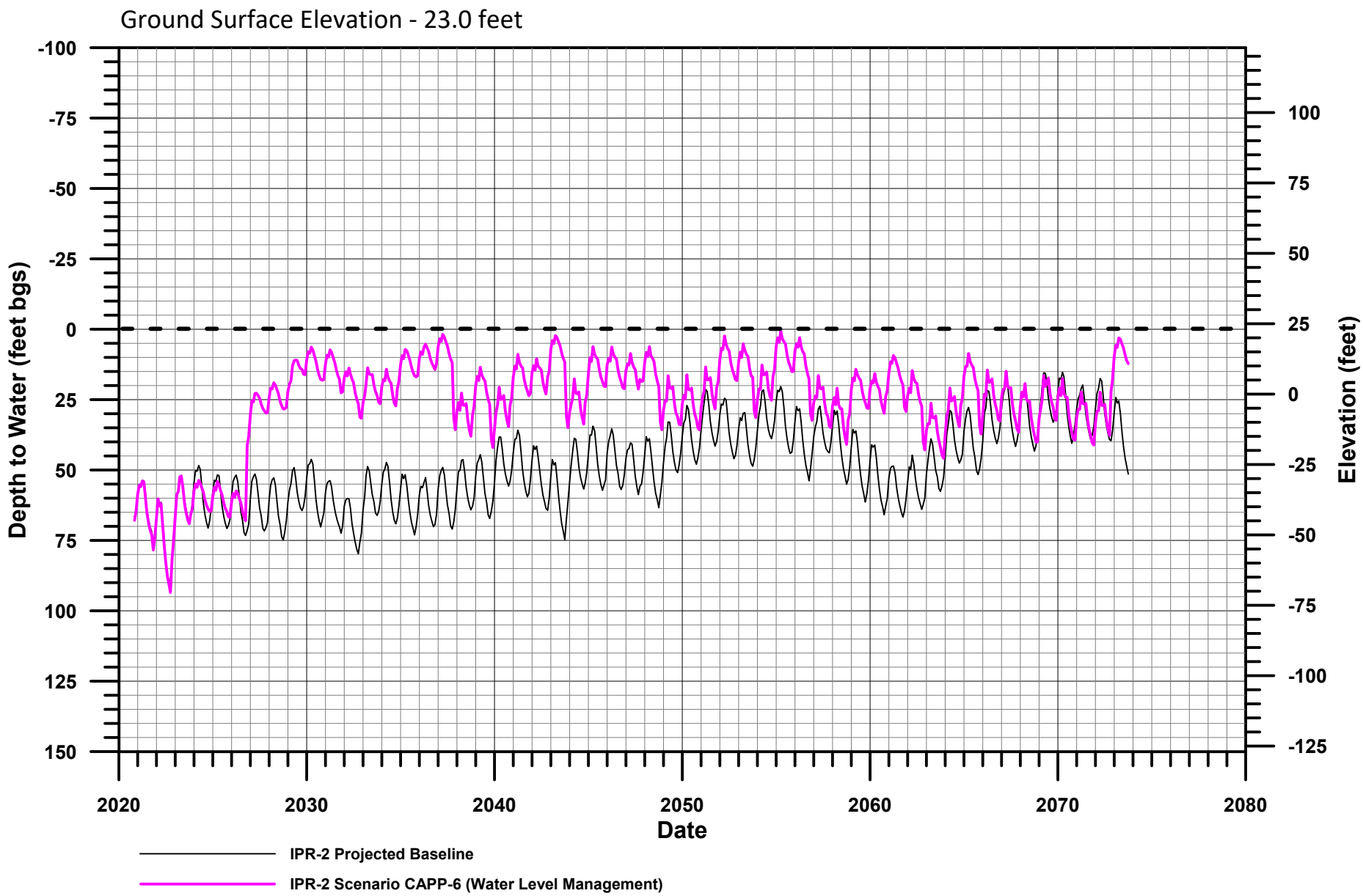
PUEBLO water resources

FIGURE 6. MODEL SIMULATED WATER LEVELS - IPR-2 (SCENARIO 2)
Carpinteria Groundwater Basin GSP - Groundwater Modeling of CAPP
Carpinteria Groundwater Sustainability Agency



PUEBLO water resources

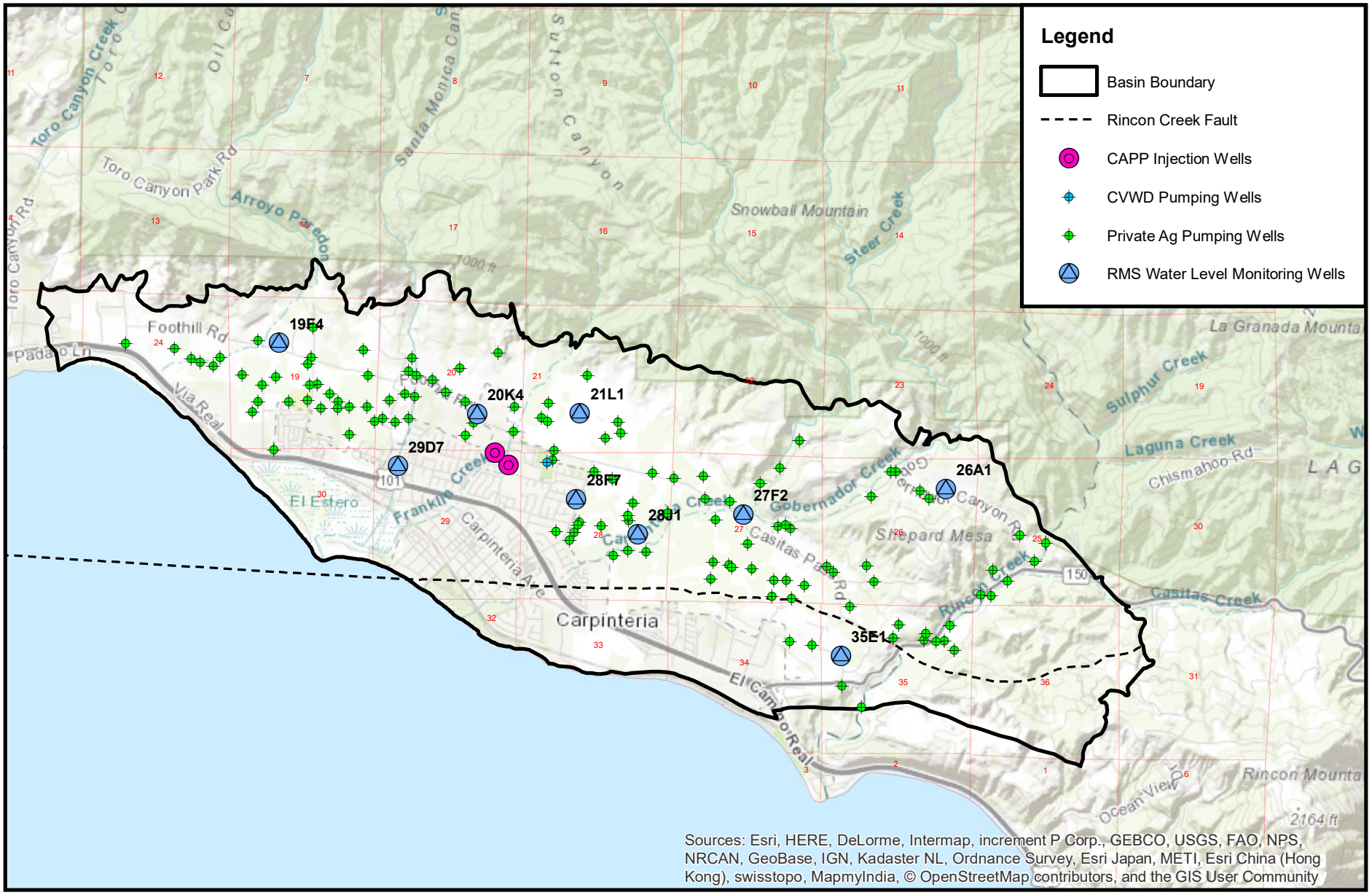
FIGURE 7. MODEL SIMULATED WATER LEVELS - IPR-1 (SCENARIO 3)
Carpinteria Groundwater Basin GSP - Groundwater Modeling of CAPP
Carpinteria Groundwater Sustainability Agency



PUEBLO water resources

FIGURE 8. MODEL SIMULATED WATER LEVELS - IPR-2 (SCENARIO 3)
Carpinteria Groundwater Basin GSP - Groundwater Modeling of CAPP
Carpinteria Groundwater Sustainability Agency

October 2023
DRAFT



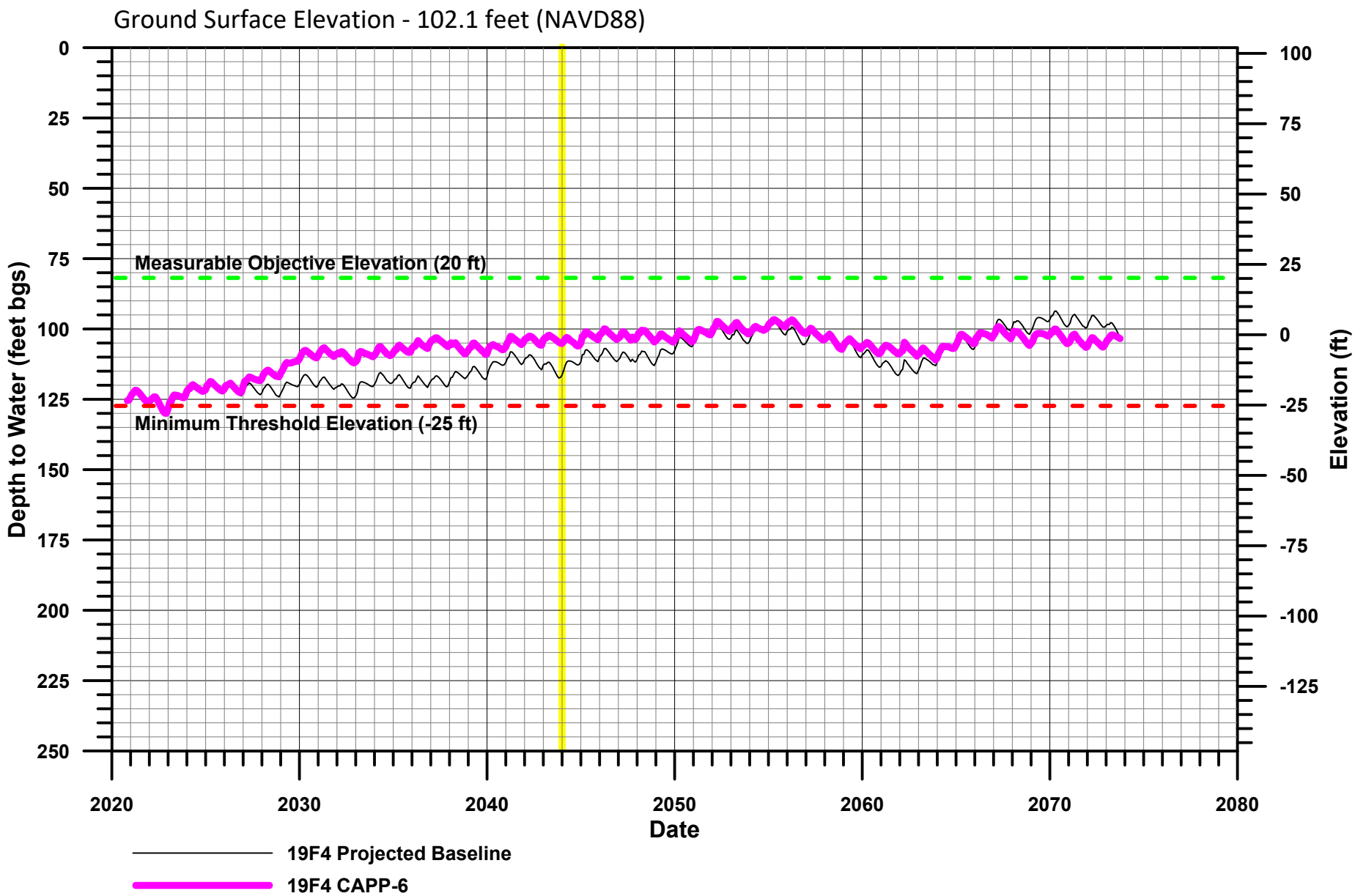
PUEBLO water resources

N W E S

1 inch = 5,000 feet

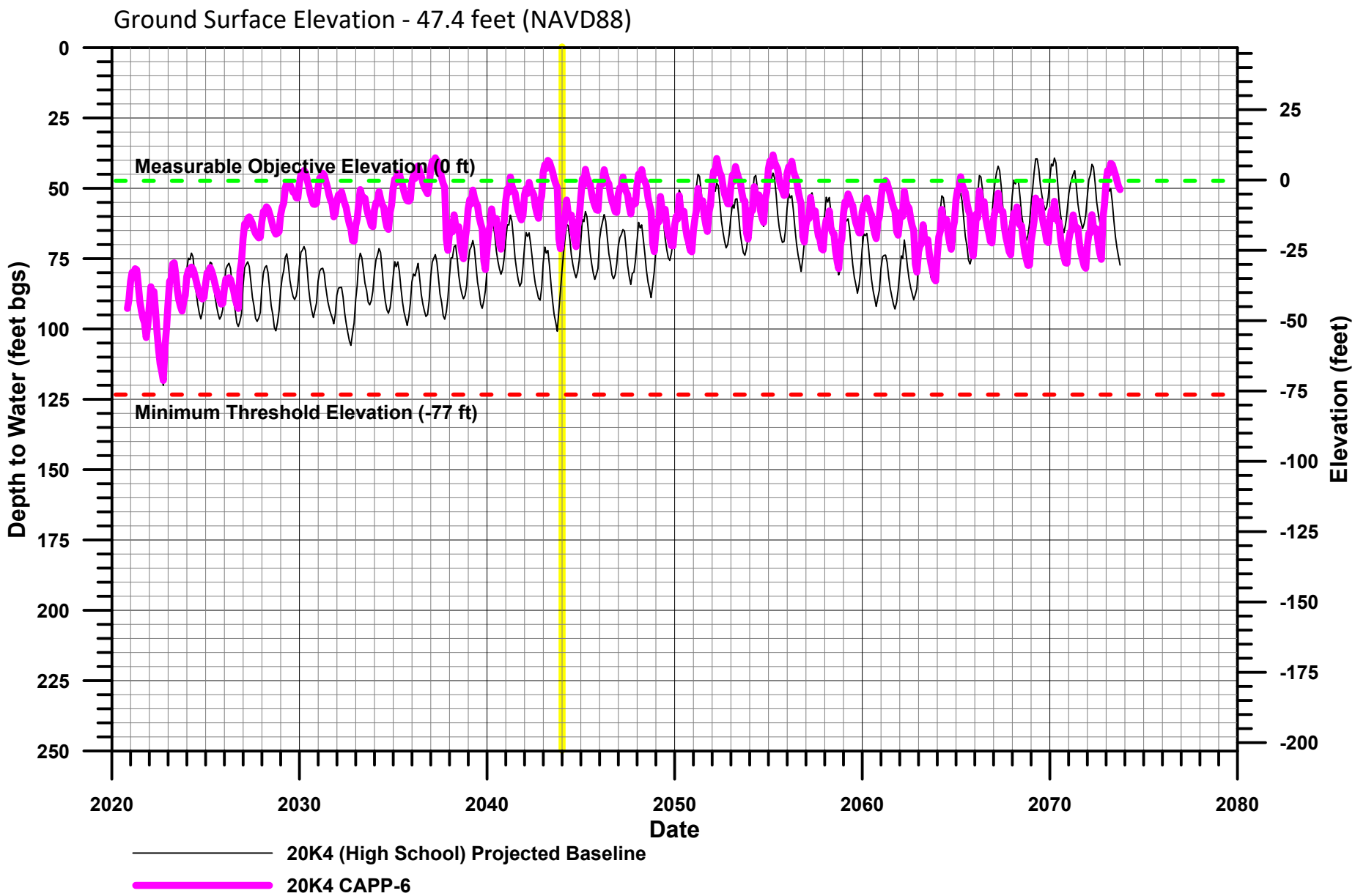
0 5,000 10,000 Feet

FIGURE 9. RMS WELL LOCATION MAP
Carpinteria Groundwater Basin GSP - Groundwater Modeling of CAPP
Carpinteria Groundwater Sustainability Agency



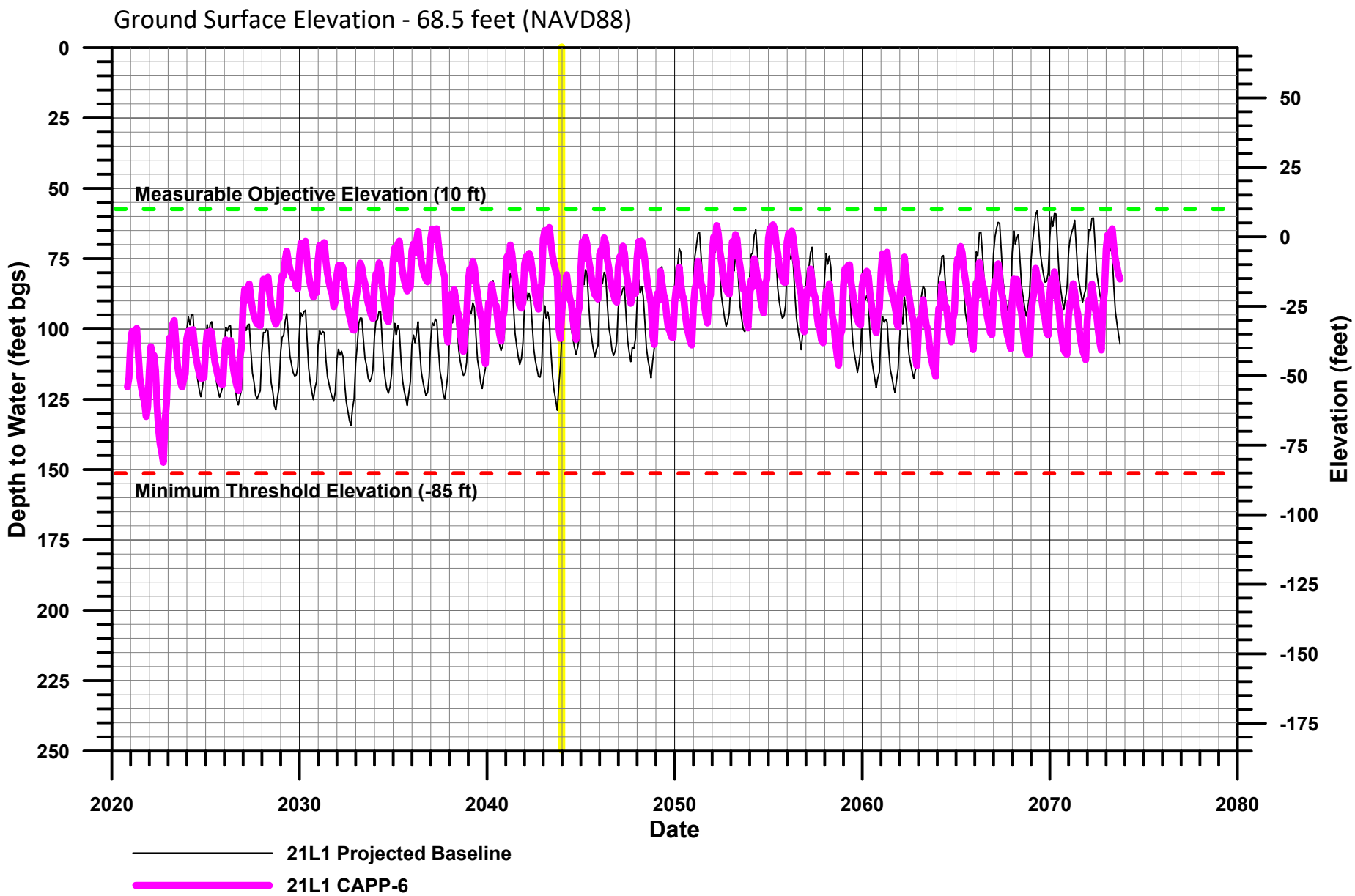
PUEBLO water resources

FIGURE 10. MODEL SIMULATED WATER LEVELS - 4N/25W-19F4
Carpinteria Groundwater Basin GSP - CAPP Groundwater Modeling
Carpinteria Groundwater Sustainability Agency



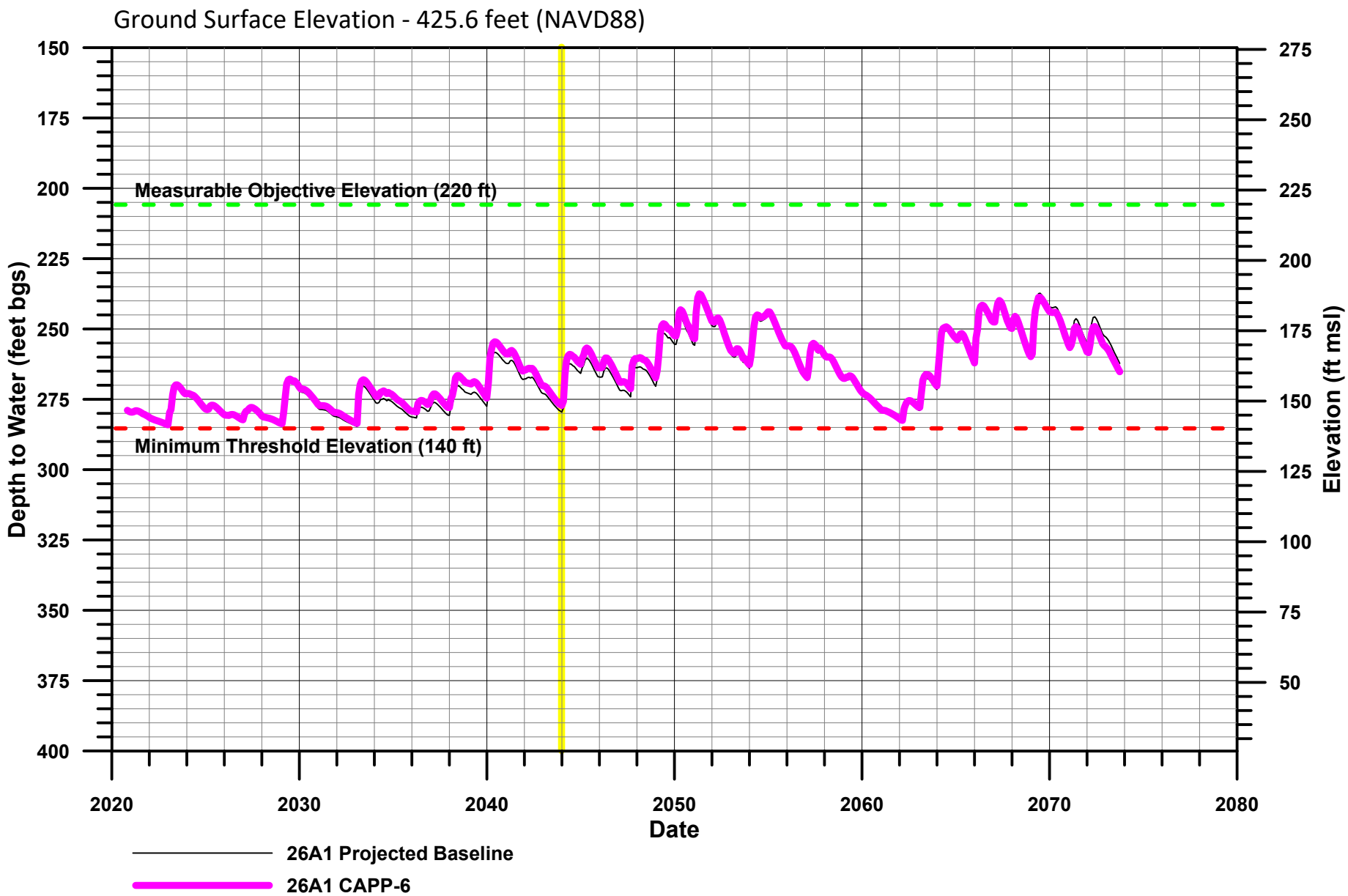
PUEBLO water resources

FIGURE 11. MODEL SIMULATED WATER LEVELS - 4N/25W-20K4
Carpinteria Groundwater Basin GSP - CAPP Groundwater Modeling
Carpinteria Groundwater Sustainability Agency



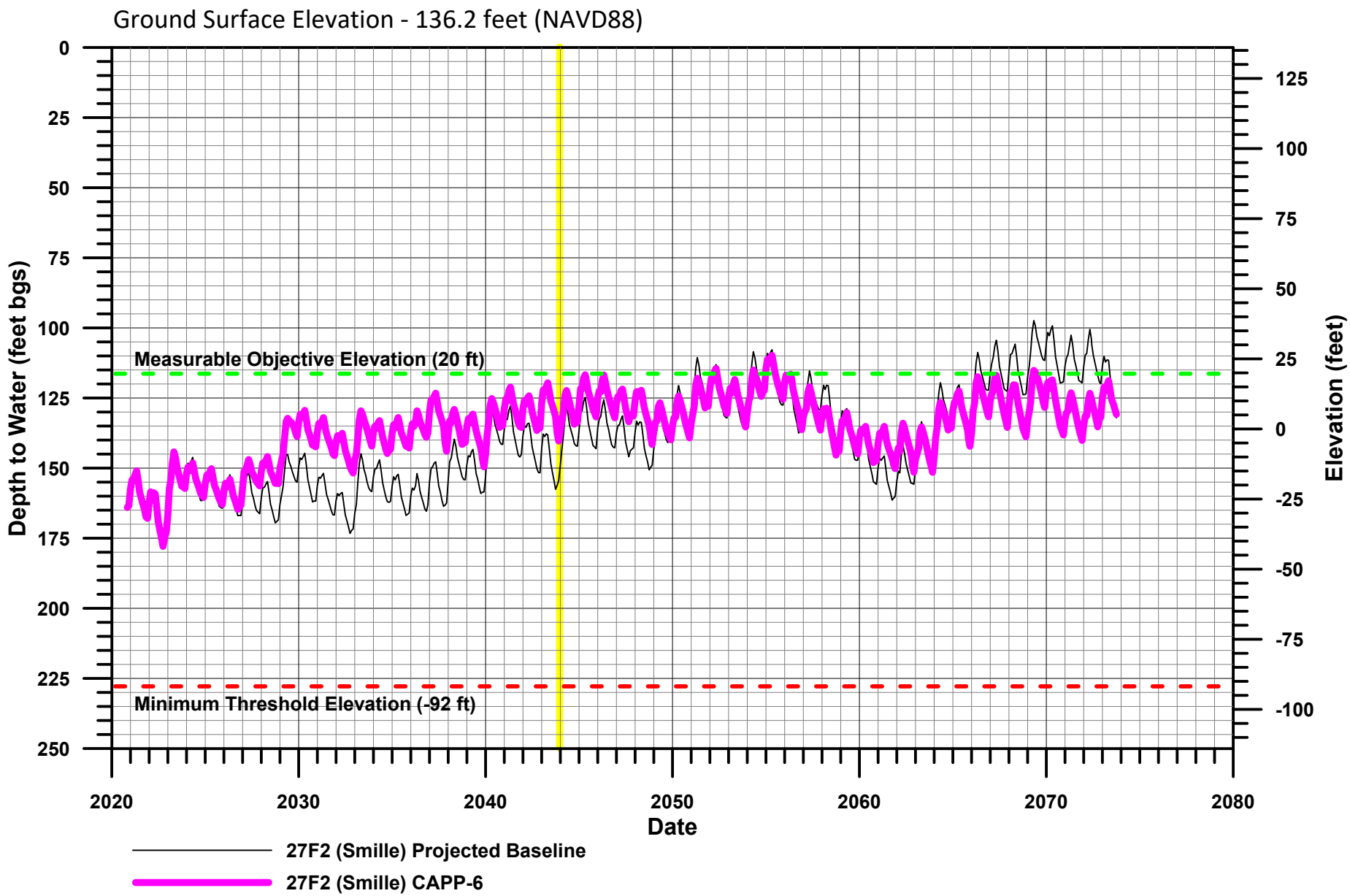
PUEBLO water resources

FIGURE 12. MODEL SIMULATED WATER LEVELS - 4N/25W-21L1
Carpinteria Groundwater Basin GSP - CAPP Groundwater Modeling
Carpinteria Groundwater Sustainability Agency



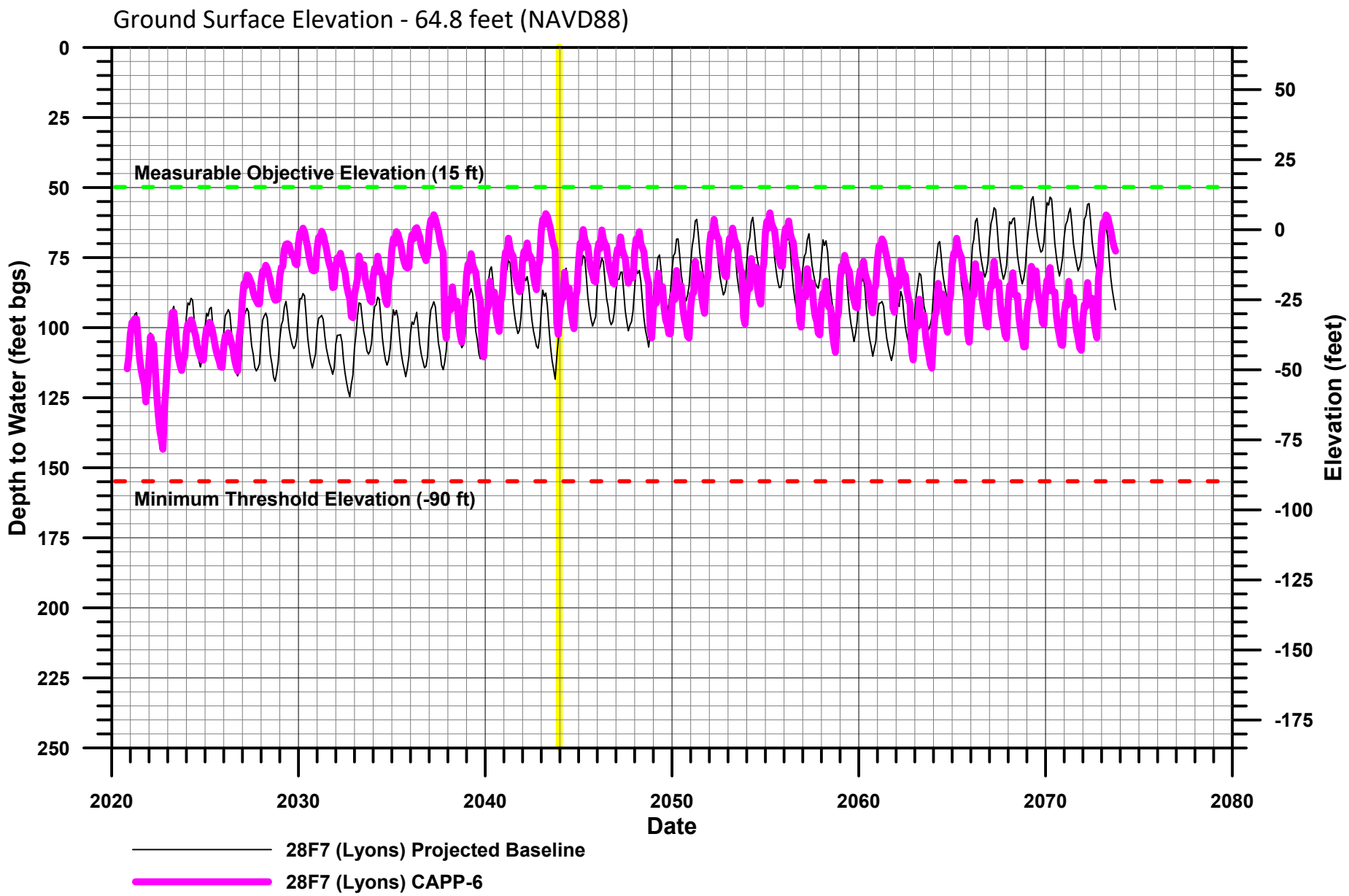
PUEBLO water resources

FIGURE 13. MODEL SIMULATED WATER LEVELS - 4N/25W-26A1
Carpinteria Groundwater Basin GSP - CAPP Groundwater Modeling
Carpinteria Groundwater Sustainability Agency



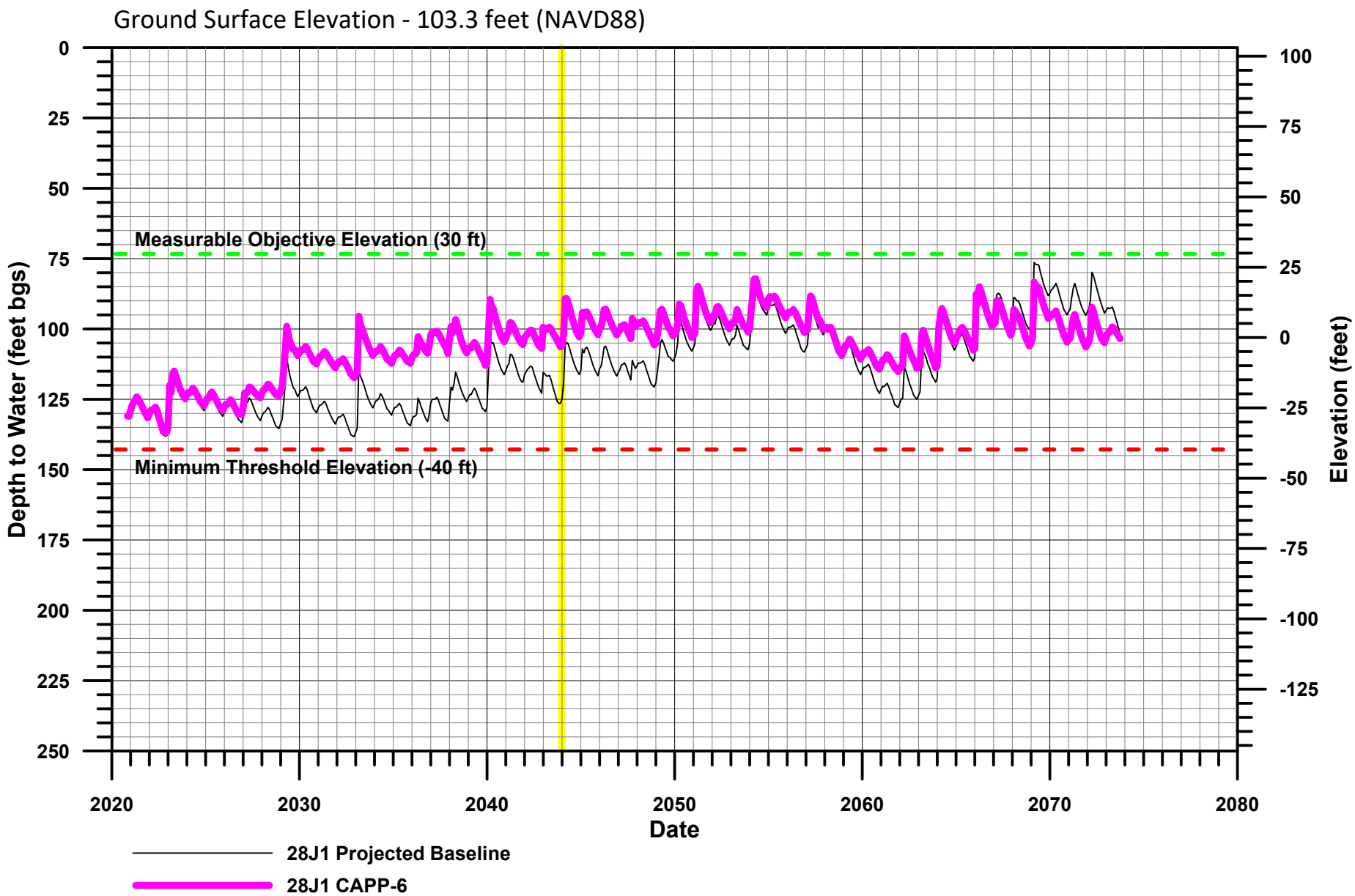
PUEBLO water resources

FIGURE 14. MODEL SIMULATED WATER LEVELS - 4N/25W-27F2
Carpinteria Groundwater Basin GSP - CAPP Groundwater Modeling
Carpinteria Groundwater Sustainability Agency



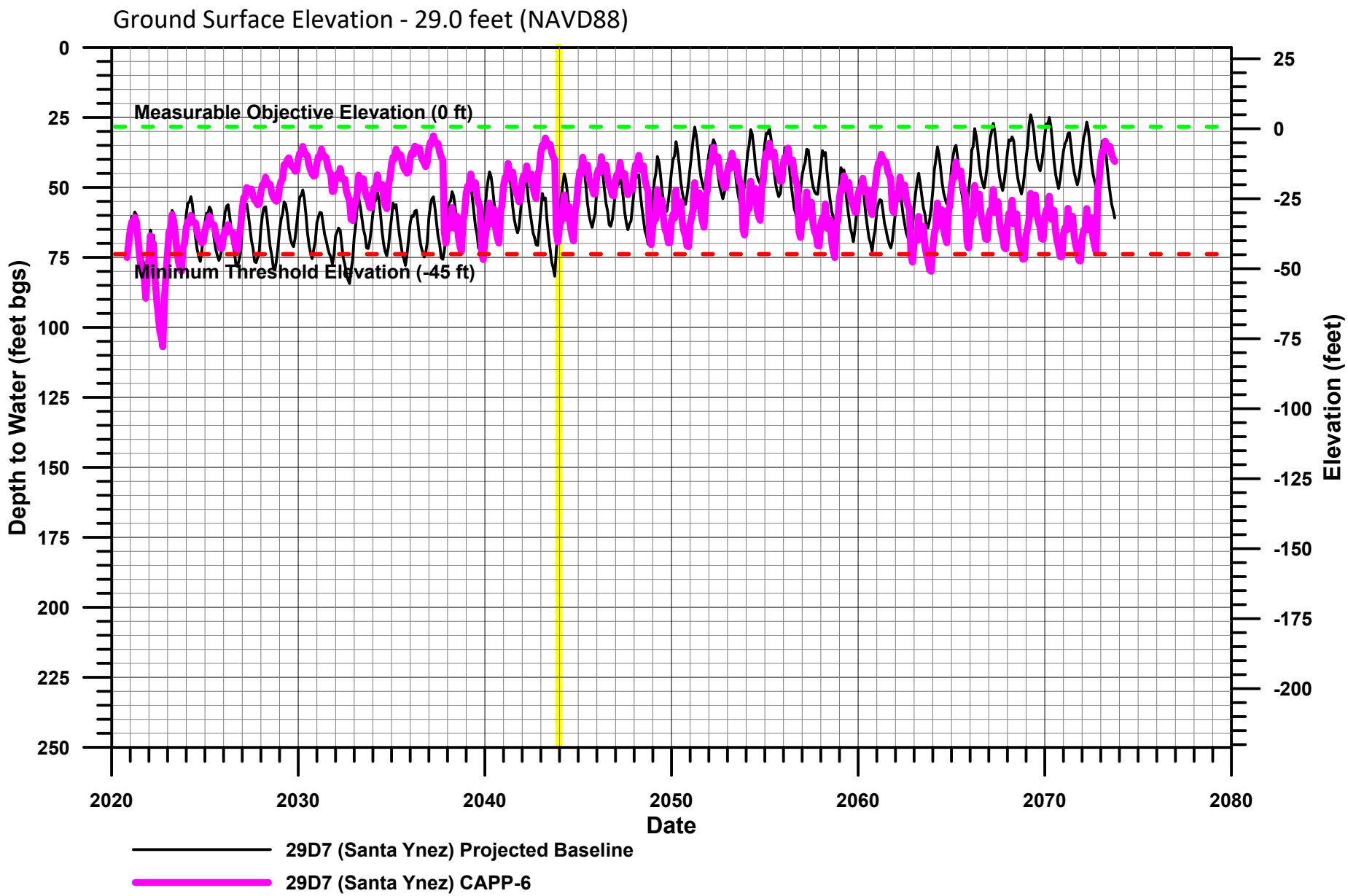
PUEBLO water resources

FIGURE 15. MODEL SIMULATED WATER LEVELS - 4N/25W-28F7
Carpinteria Groundwater Basin GSP - CAPP Groundwater Modeling
Carpinteria Groundwater Sustainability Agency



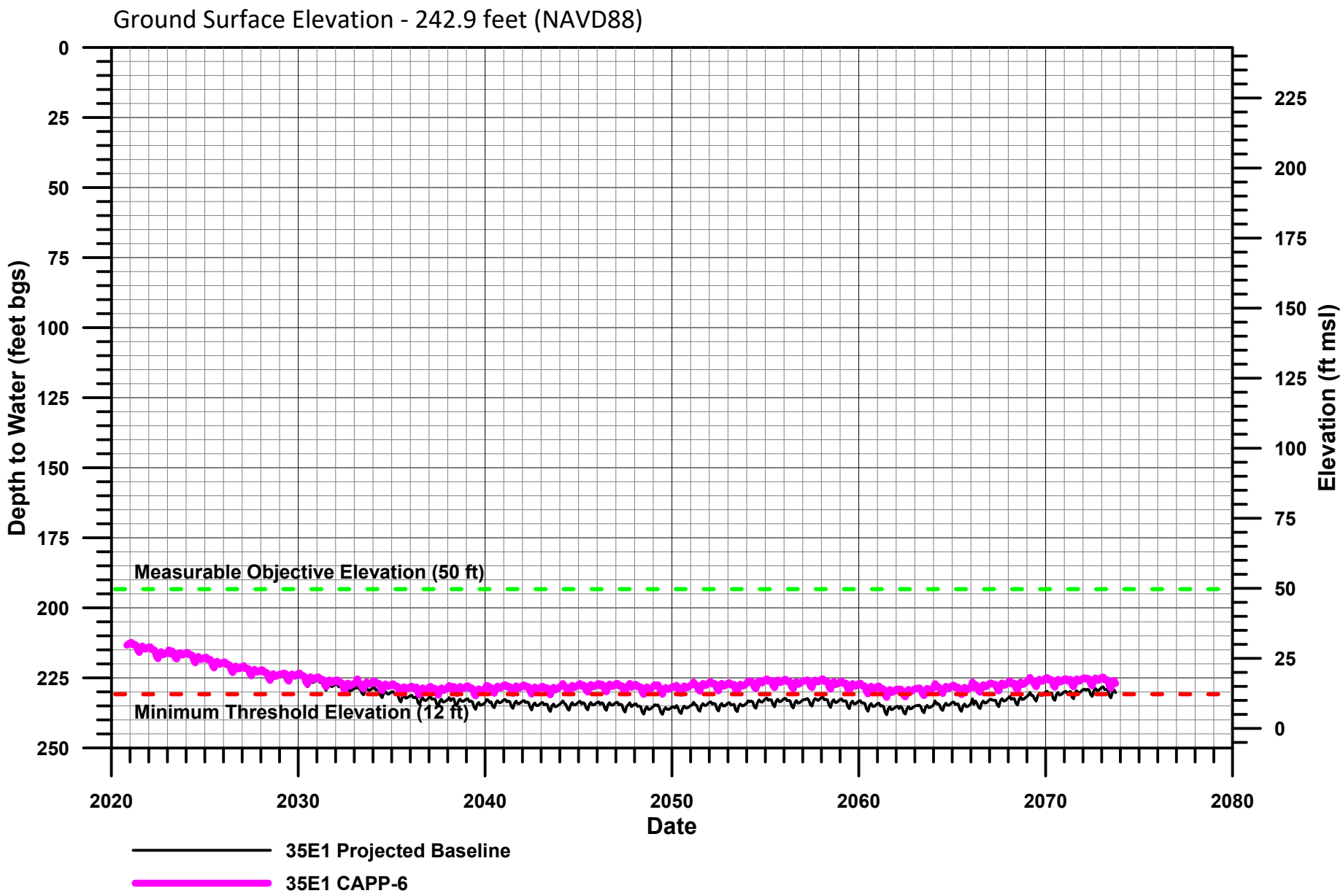
PUEBLO water resources

FIGURE 16. MODEL SIMULATED WATER LEVELS - 4N/25W-28J1
Carpinteria Groundwater Basin GSP - CAPP Groundwater Modeling
Carpinteria Groundwater Sustainability Agency



PUEBLO water resources

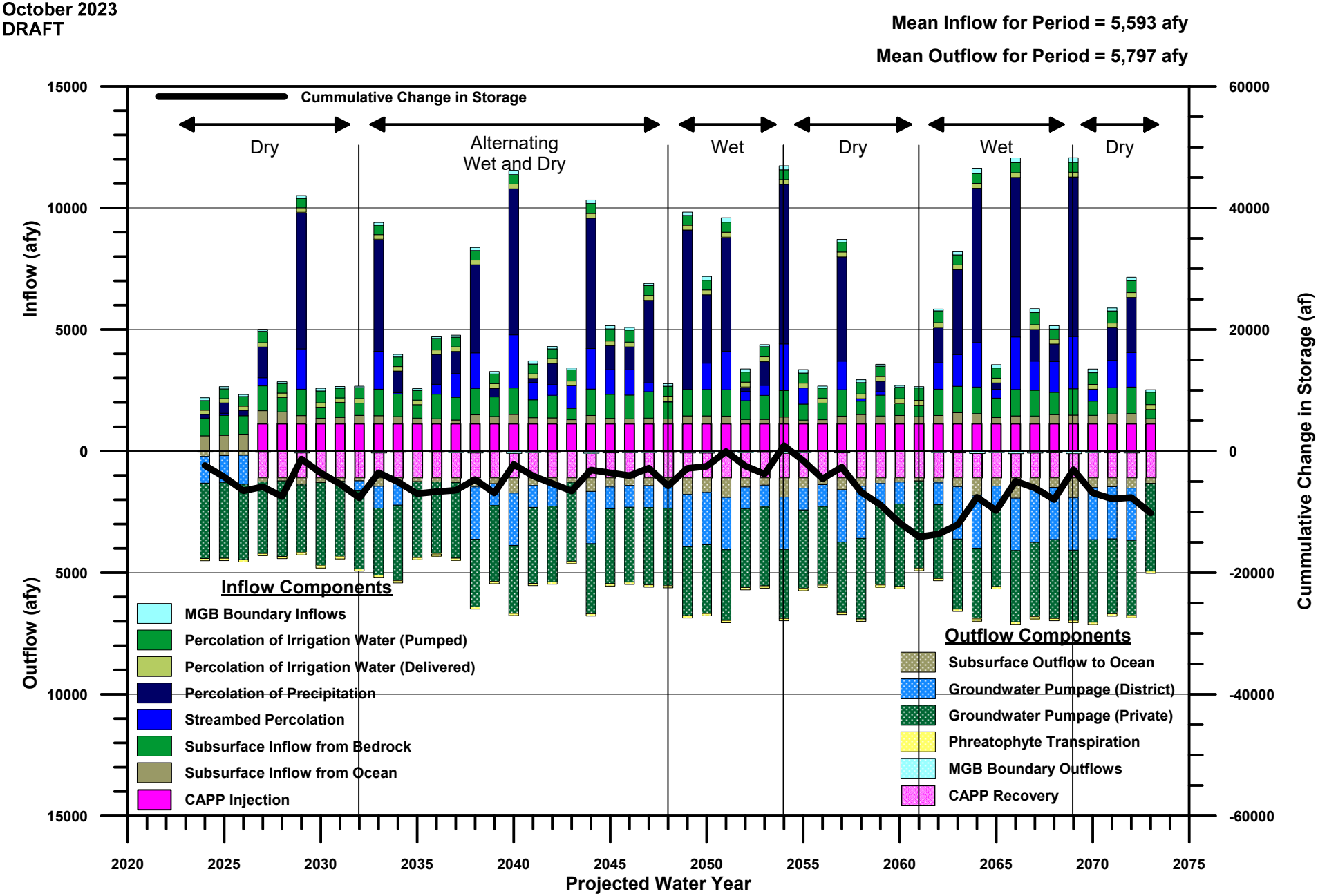
FIGURE 17. MODEL SIMULATED WATER LEVELS - 4N/25W-29D7
Carpinteria Groundwater Basin GSP - CAPP Groundwater Modeling
Carpinteria Groundwater Sustainability Agency



PUEBLO water resources

FIGURE 18. MODEL SIMULATED WATER LEVELS - 4N/25W-35E1
Carpinteria Groundwater Basin GSP - CAPP Groundwater Modeling
Carpinteria Groundwater Sustainability Agency

October 2023
DRAFT



PUEBLO water resources

FIGURE 19. PROJECTED WATER BUDGET SUMMARY - CAPP 6 SCENARIO
Carpinteria Groundwater Basin GSP - CAPP Groundwater Modeling
Carpinteria Groundwater Sustainability Agency

APPENDIX G

Groundwater Monitoring Protocols

Carpinteria Valley Water District

1301 Santa Ynez Avenue • Carpinteria, CA 93013
Phone (805) 684-2816 • Fax (805) 684-3170

BOARD OF DIRECTORS

June Van Wingerden
President
Matthew Roberts
Vice President
Lynne Ducharme
Robert Lieberknecht
Alonzo Orozco

GENERAL MANAGER

Charles B. Hamilton

CASGEM Groundwater Monitoring Plan

Carpinteria Valley Water District

September 2011

TABLE OF CONTENTS

CASGEM GROUNDWATER MONITORING PLAN

1.0 WELL NETWORK **1**

2.0 MONITORING SCHEDULE **1**

3.0 DESCRIPTION OF FIELD METHODS **1**

3.1 Establishing Reference Points 1

3.2 Instructions on Measuring Depth to Water 2

3.3 Methods to Ensure Measurements of Static Groundwater Conditions 3

4.0 MONITORING PLAN RATIONALE **3**

4.1 History of Groundwater Monitoring in Basin 3

4.2 Principle Features of Basin 3

4.3 Selection of Wells 5

FIGURES:

Figure 1 Well Network Map

Figure 2 Storage Units 1 and 2

Figure 3 Structural Contours – Aquifer A

Figure 4 Cross Section Location Map

Figure 5 Hydrogeologic Cross Section A-A'

Figure 6 Hydrogeologic Cross Section B-B'

Figure 7 Hydrogeologic Cross Section C-C'

Figure 8 Hydrogeologic Cross Section D-D'

Figure 9 Confined and Recharge Areas

Figure 10 Water Level Contours – Storage Unit 1

Figure 11 Data Collection Form

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.

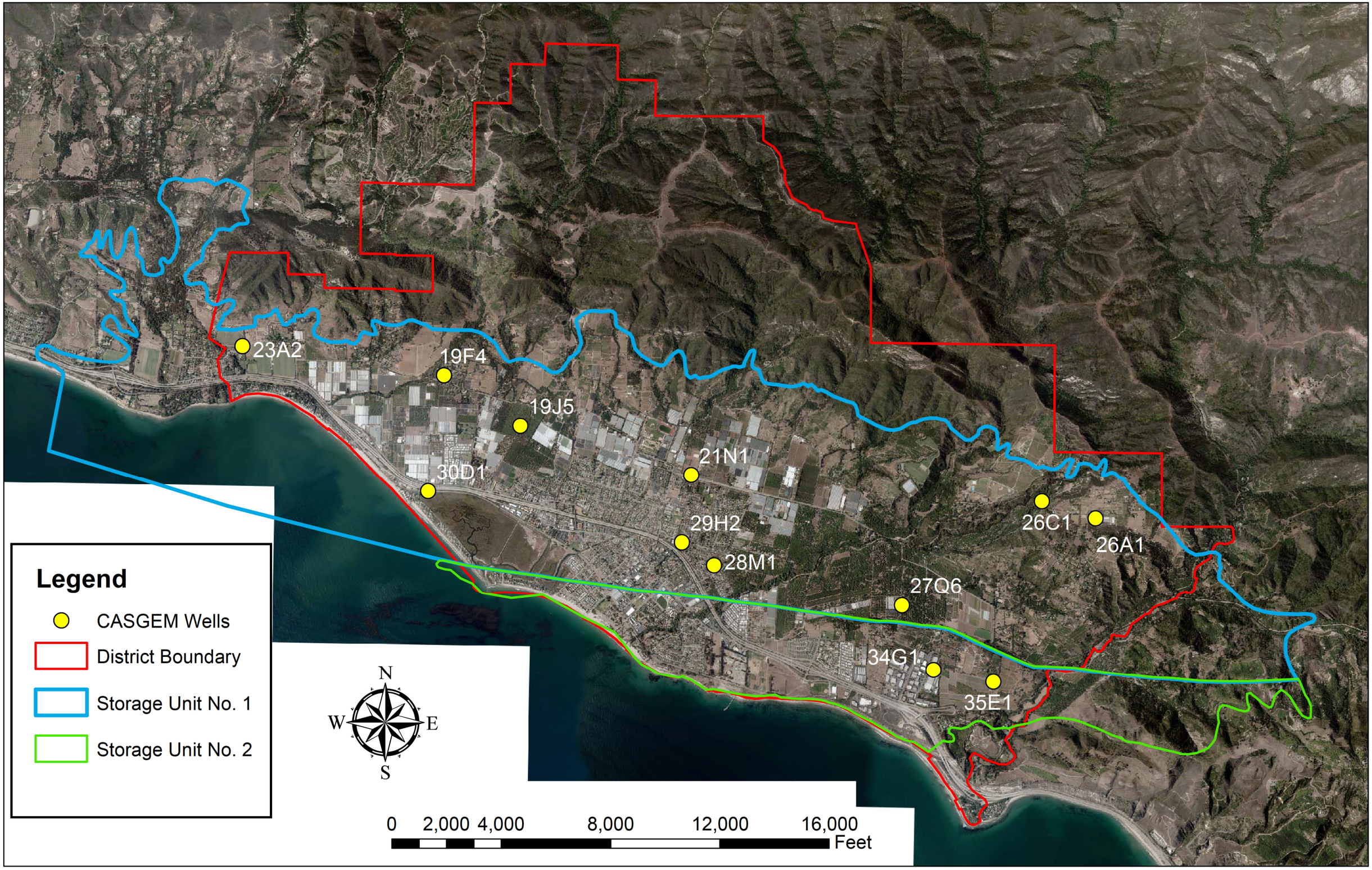
4.3 Selection of Wells

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

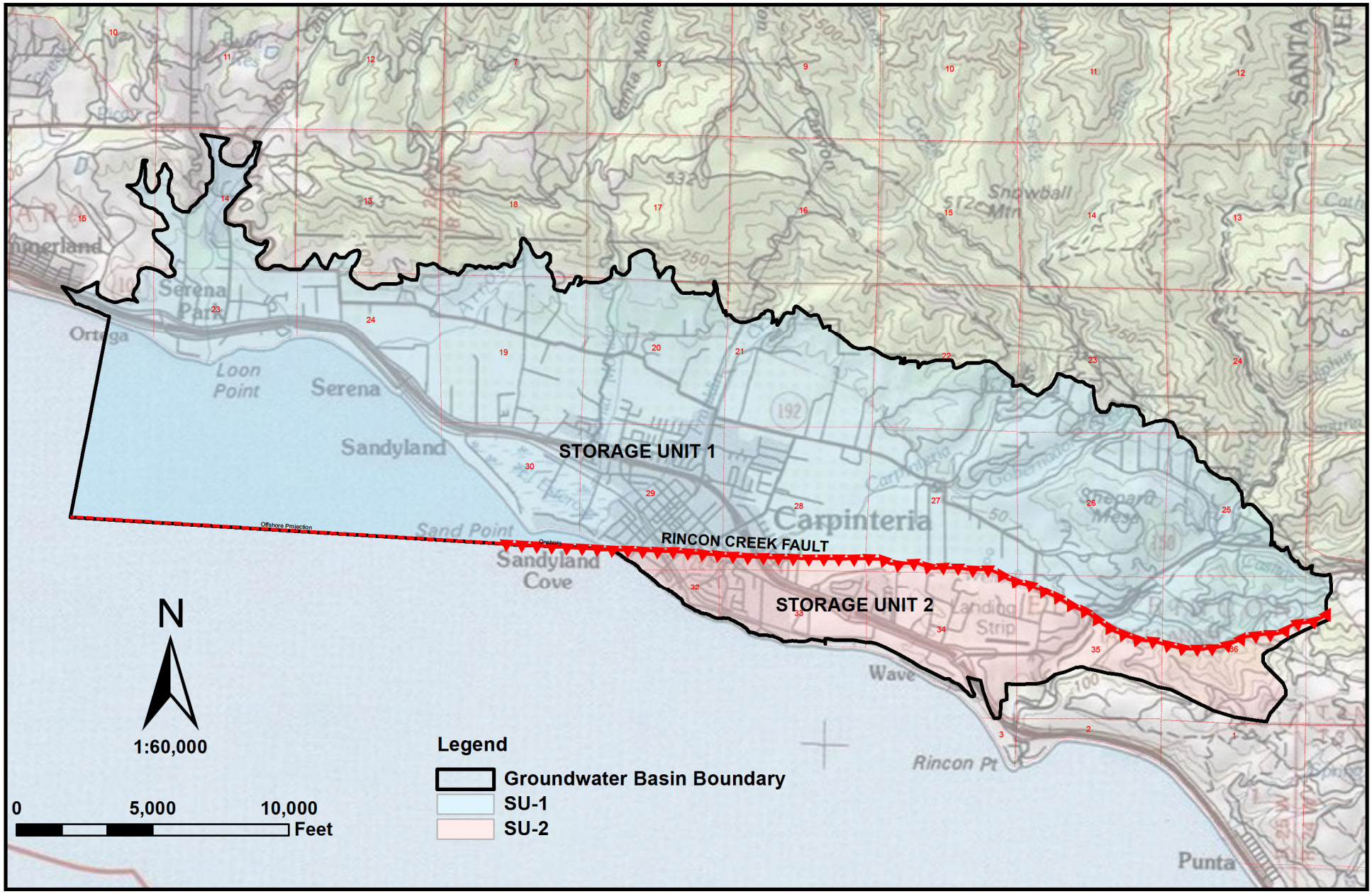


Created by CVWD Engineering
September 2011

CASGEM Well Network
Carpinteria Valley Water District

FIGURE 1

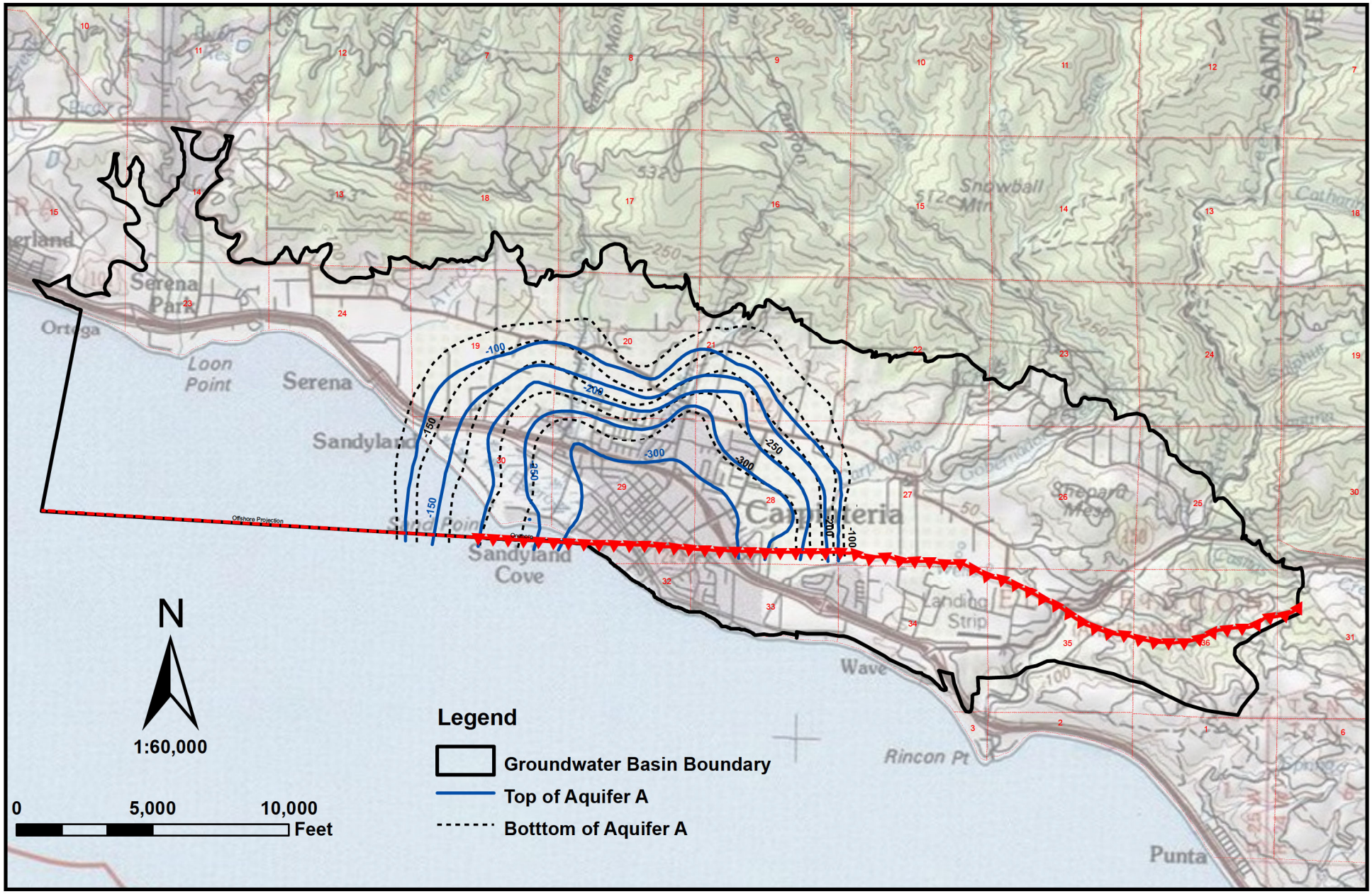
February 2011
Project No. 06-0125



PUEBLO water resources

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

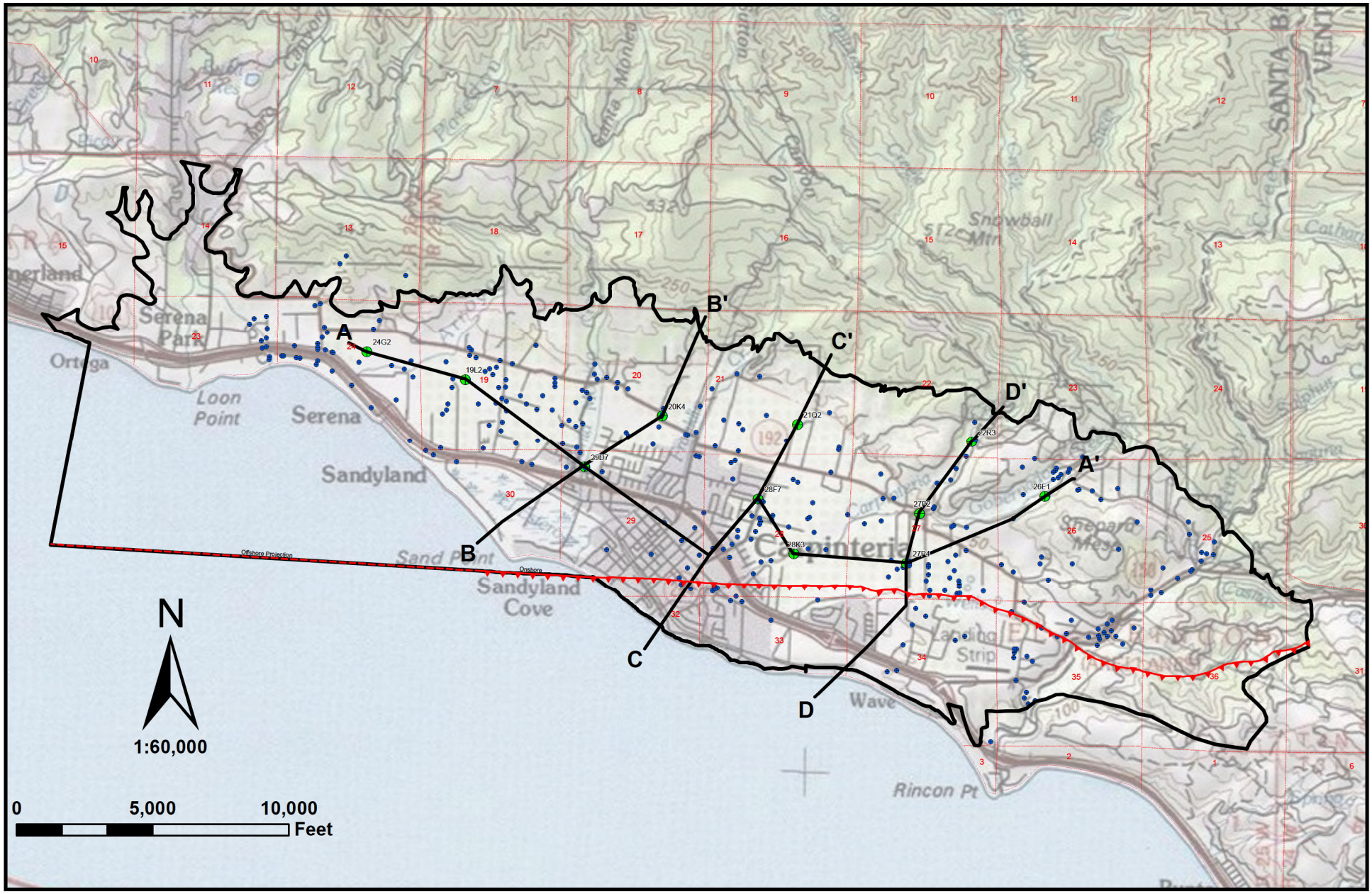
February 2011
Project No. 06-0125



PUEBLO water resources

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

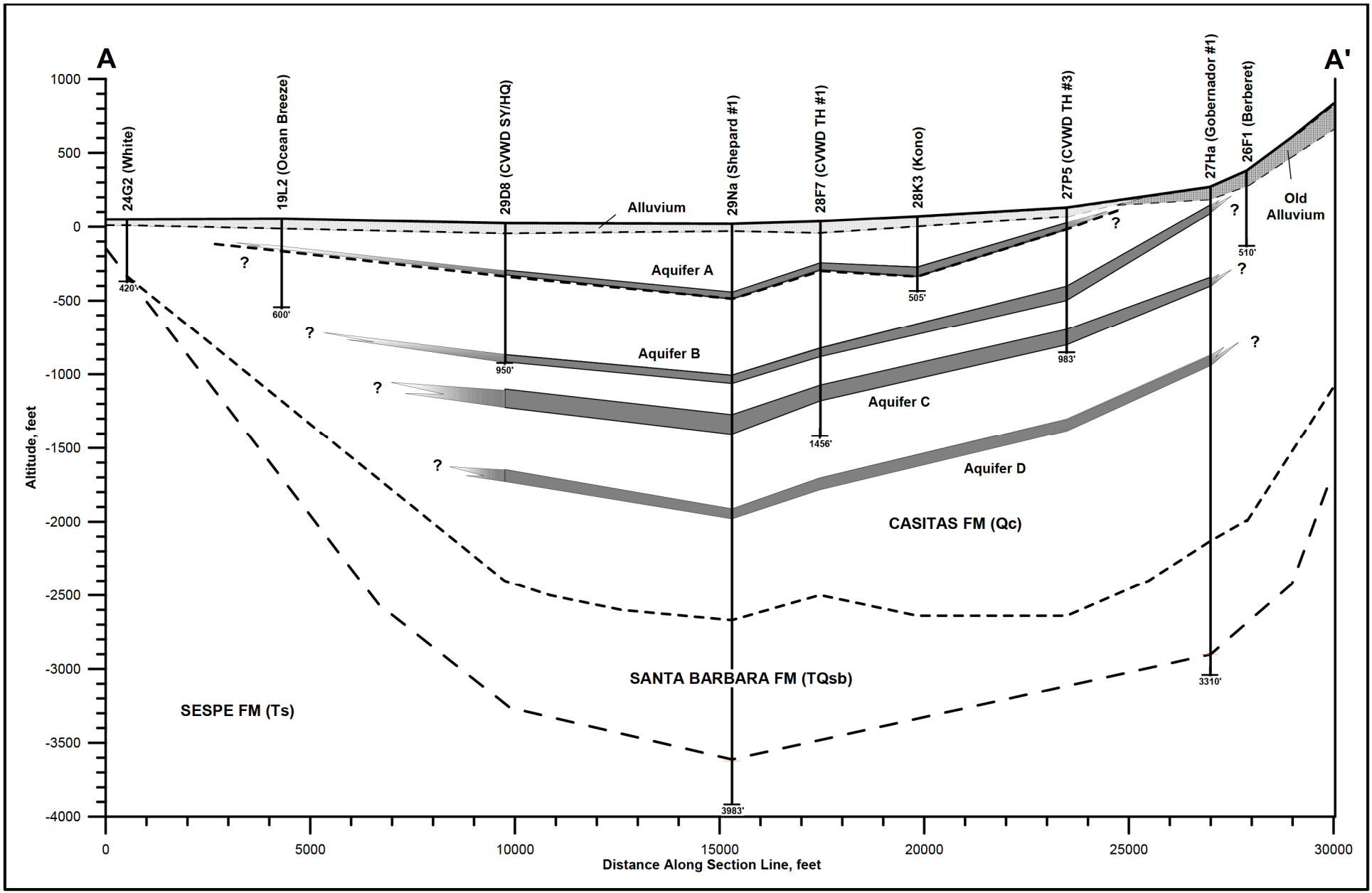
February 2011
Project No. 06-0125



PUEBLO water resources

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

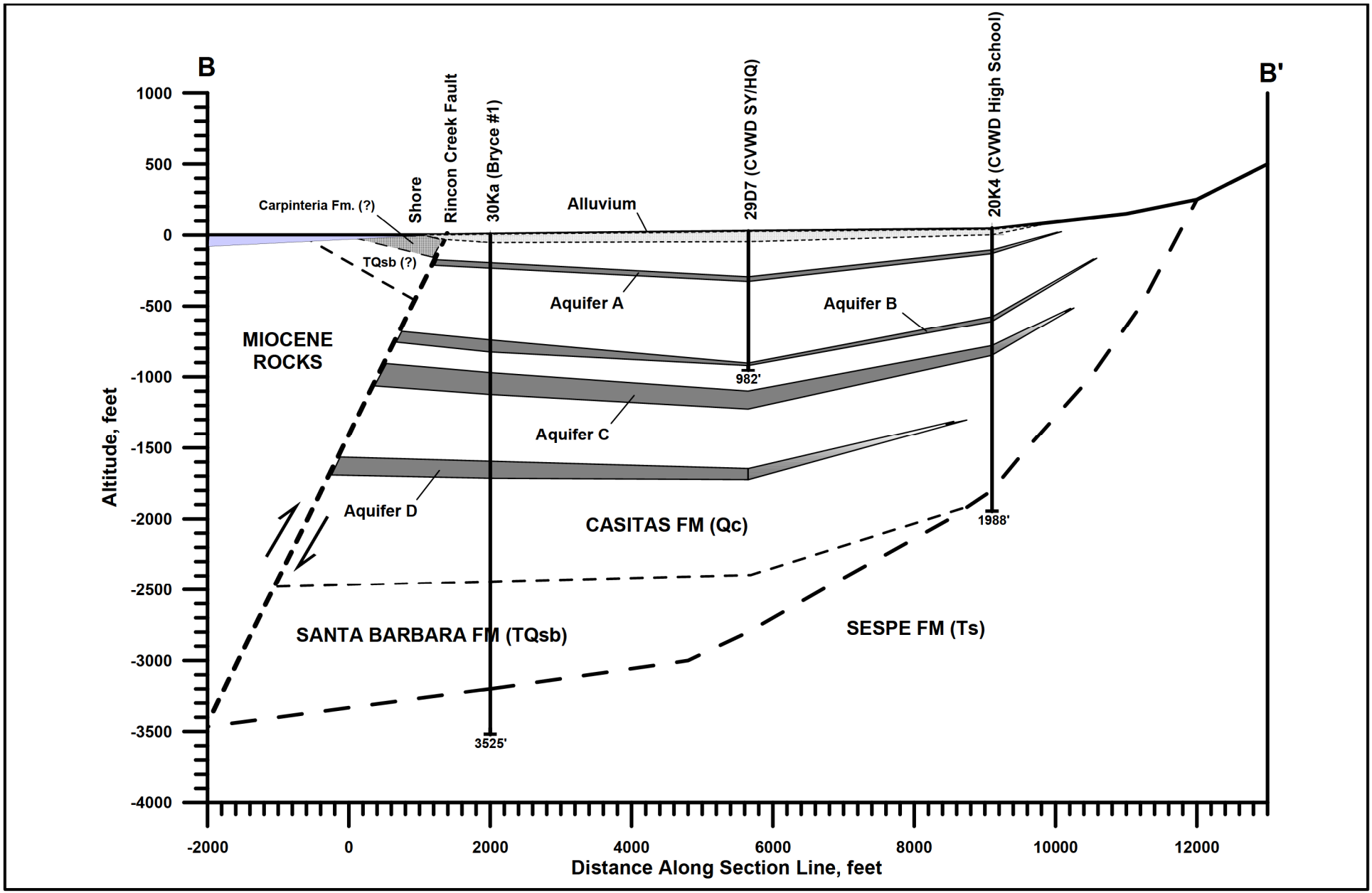
February 2011
Project No. 06-0125



PUEBLO water resources

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

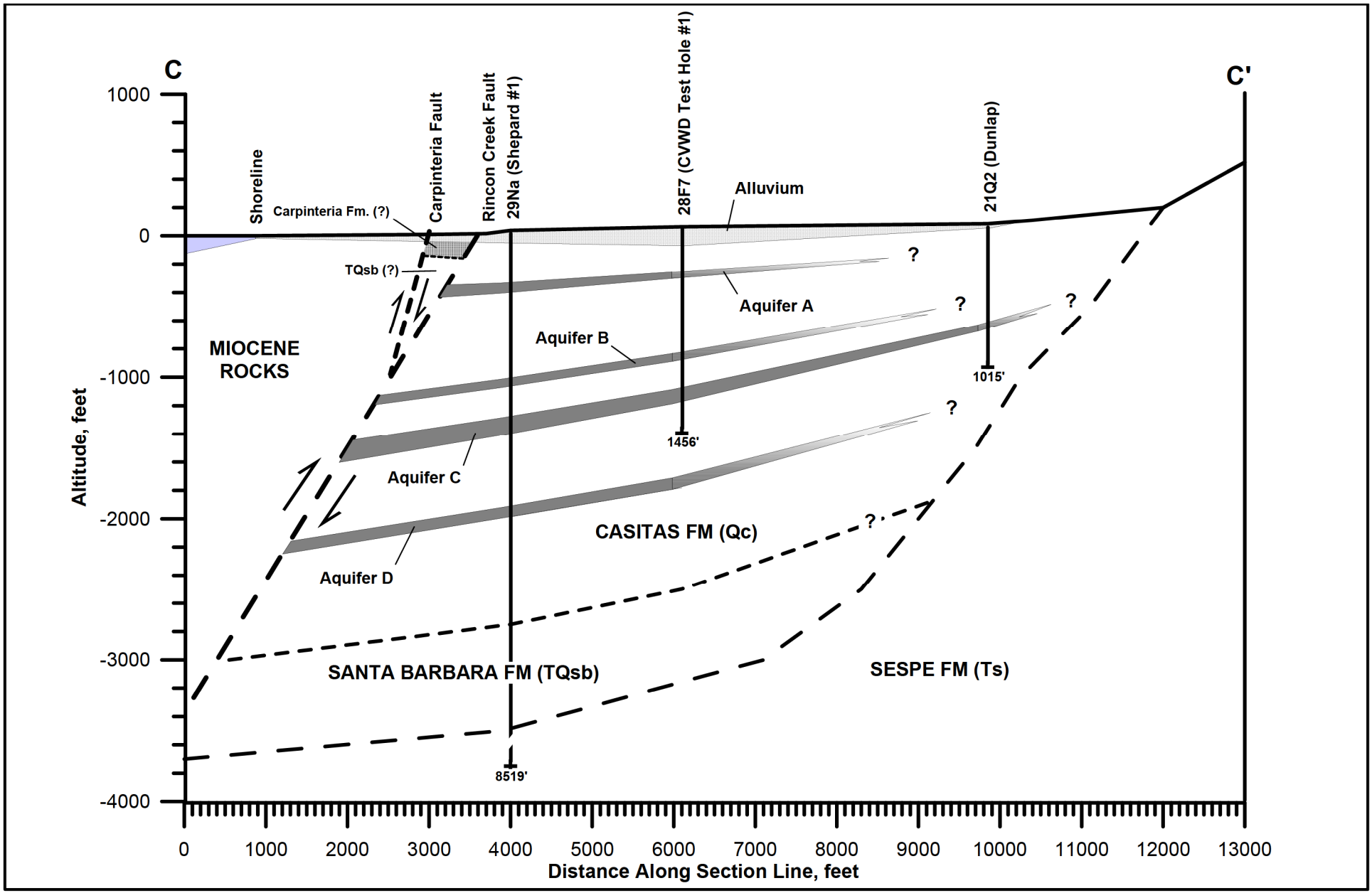
February 2011
Project No. 06-0125



PUEBLO water resources

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

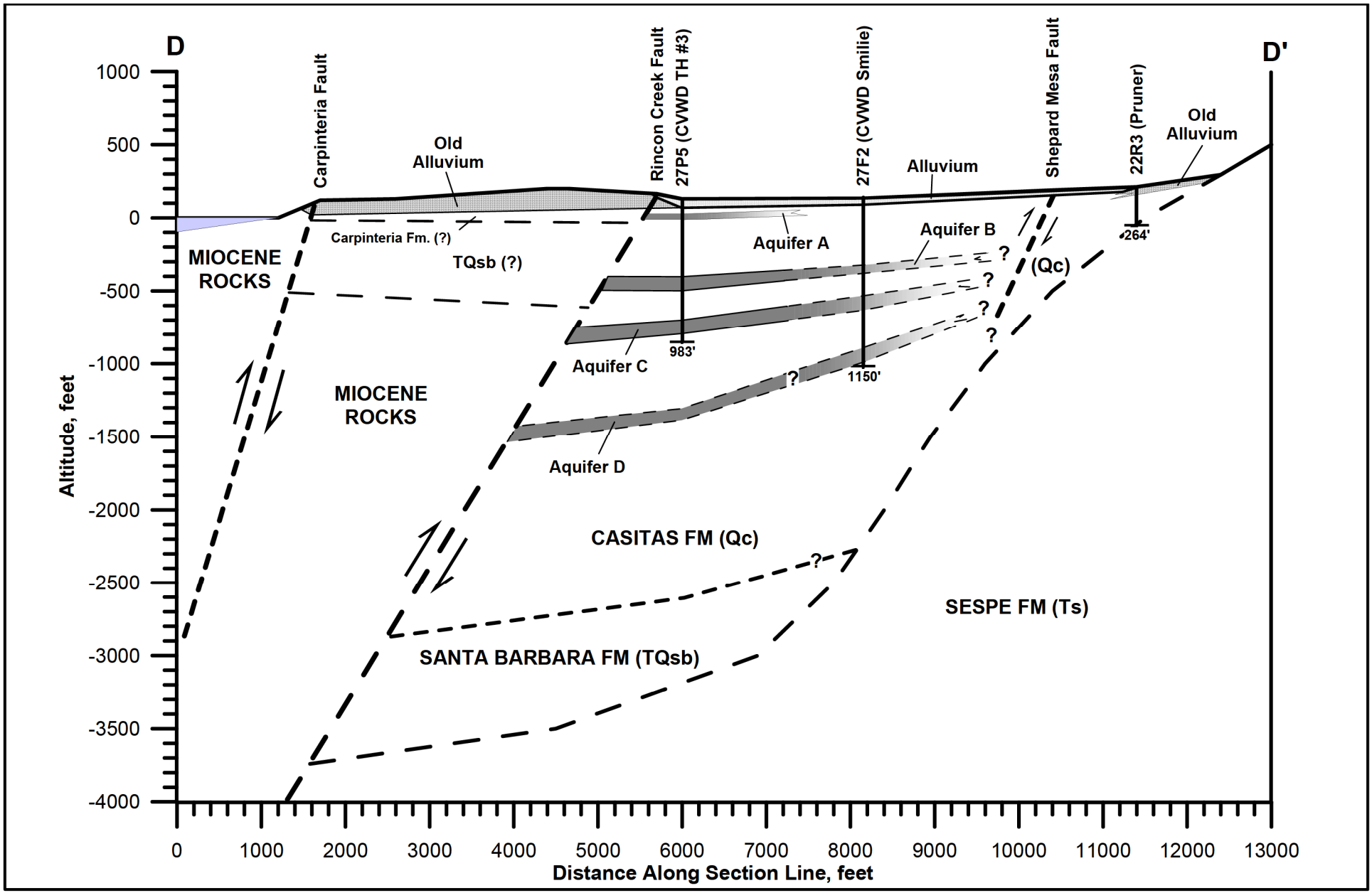
February 2011
Project No. 06-0125



PUEBLO water resources

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

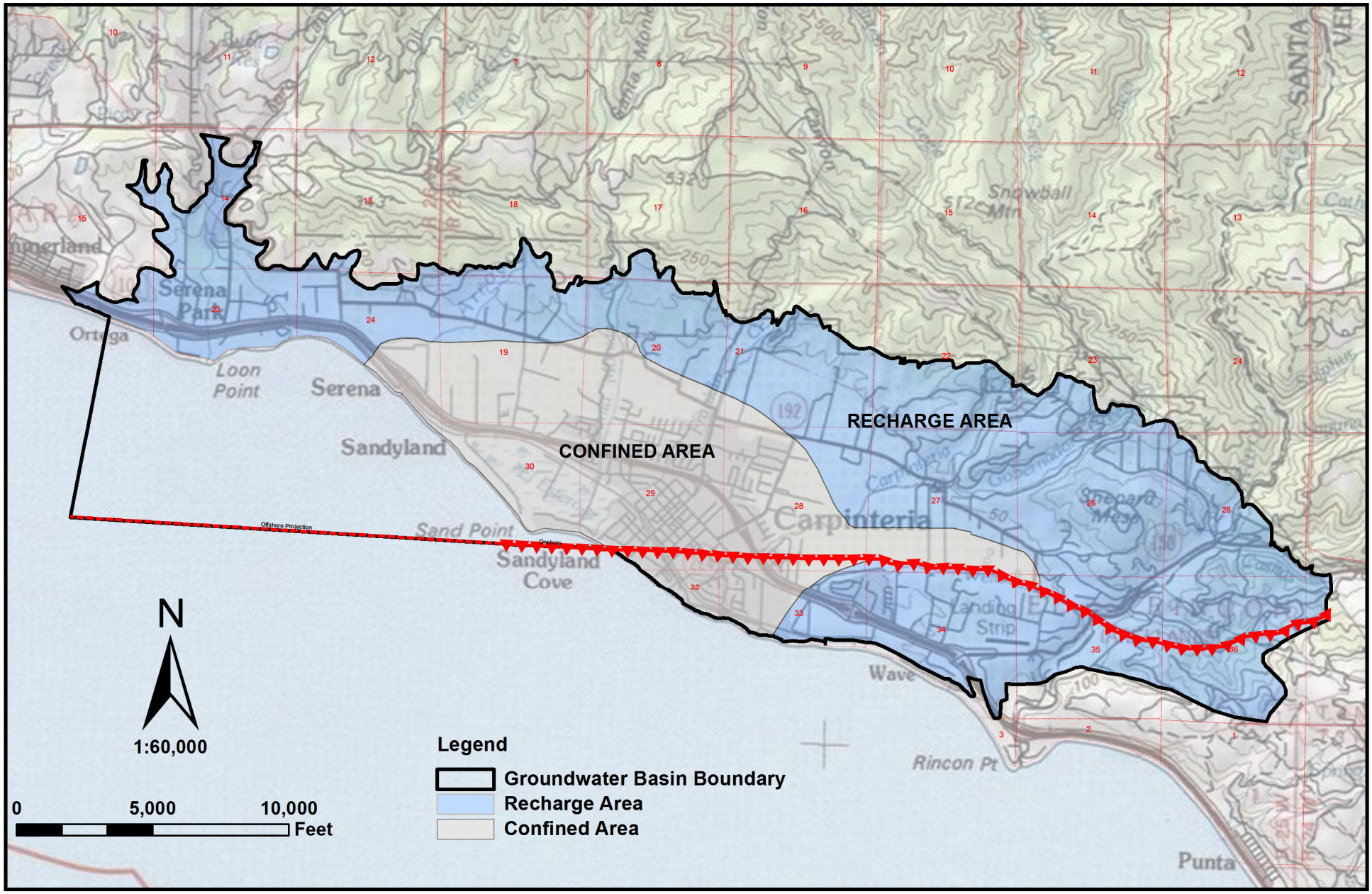
February 2011
Project No. 06-0125



PUEBLO water resources

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

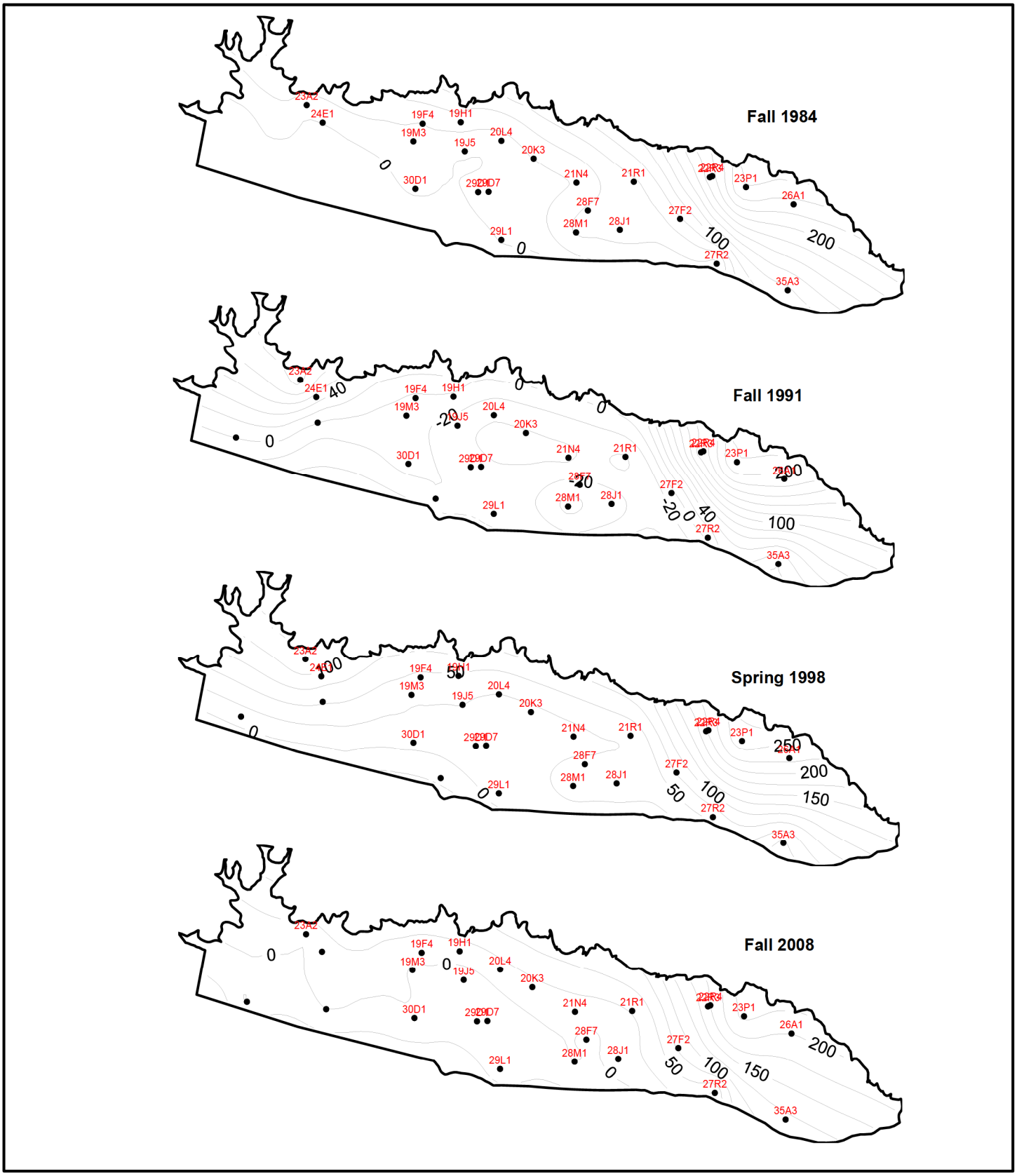
February 2011
Project No. 06-0125



PUEBLO water resources

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

February 2011
Project No. 06-0125



PUEBLO water resources

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
235 # 12/28/2010	237 - 63.5	238 -	239 - PUNCHED
DEPTH HELD / CUT / Below MP 64 5	MP USED A / MEAS BY MS / REMARKS		
235 # 02/24/2011	237 - 62.9	238 -	239 - PUNCHED
DEPTH HELD / CUT / Below MP 63 9	MP USED A / MEAS BY MS / REMARKS		
235 # 04/26/2011	237 - 59.7	238 -	239 - PUNCHED
DEPTH HELD / CUT / Below MP 60 7	MP USED A / MEAS BY MS / REMARKS		
235 # 06/29/2011	237 - 62.0	238 -	239 - PUNCHED
DEPTH HELD / CUT / Below MP 63 0	MP USED A / MEAS BY MS / REMARKS		
235 # 08/30/2011	237 - 65.9	238 -	239 - PUNCHED
DEPTH HELD / CUT / Below MP 66 9	MP USED A / MEAS BY MS / REMARKS		
235 # / /	237 - .	238 -	239 - PUNCHED
DEPTH HELD / CUT / Below MP	MP USED / MEAS BY / REMARKS		
235 # / /	237 - .	238 -	239 - PUNCHED
DEPTH HELD / CUT / Below MP	MP USED / MEAS BY / REMARKS		

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

(C) _____ _____ ft. Above Below LSD

ALTITUDE OF 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						
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						
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						
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						
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						
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						
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						
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						
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						
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						
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						
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						
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						
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						
	Arroyo Paredon Creek							
	Carpinteria Creek							
	Gobernador Creek							
	Rincon Creek							
	Santa Monica Creek							
	Toro Creek							

APPENDIX H

Data Management System

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.

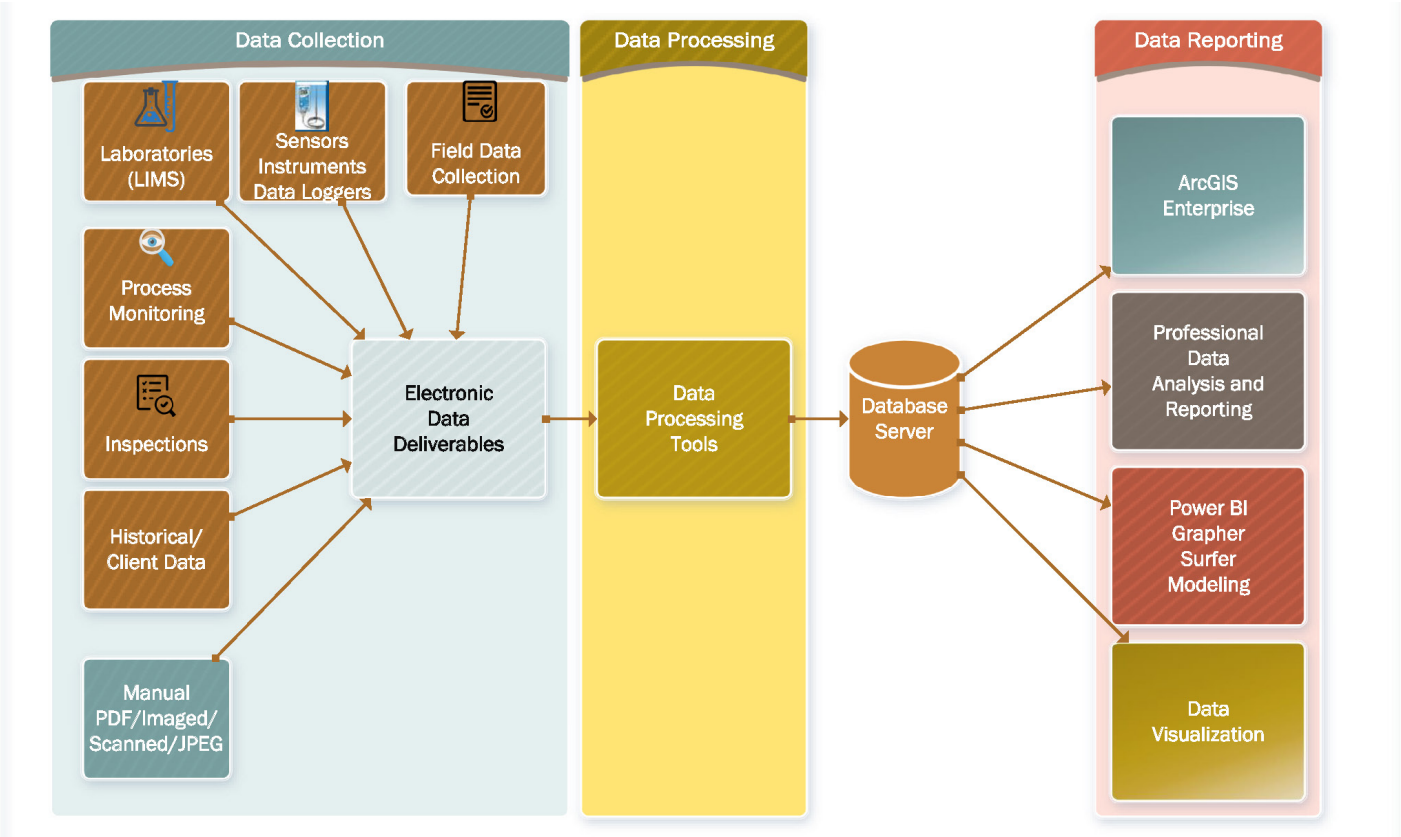


Figure 1. Database Process Flowchart

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

Carpinteria Groundwater Basin Groundwater Sustainability Plan Comments and Responses

Commenter	Section	Page/ Figure/ Table	Comment	Response
Dan Wilson (NOAA's NMFS)	General Comment	NA	NOAA's National Marine Fisheries Service (NMFS) is the federal agency responsible for managing, conserving, and protecting living marine resources in inland, coastal, and offshore waters of the United States. We derive our mandates from numerous statutes, including the Federal Endangered Species Act (ESA). The purpose of the ESA is to conserve threatened and endangered species and their ecosystems. On October 6, 2023, the Carpinteria Basin Groundwater Sustainability Agency (hereafter, "GSA") released their draft Groundwater Sustainability Plan (draft GSP) for public review and comment (Carpinteria Groundwater Sustainability Agency 2023). The Carpinteria Creek and Rincon Creek watersheds, which fall within the boundary of the draft GSP, support federally endangered southern California (SC) steelhead (Oncorhynchus mykiss). Carpinteria Creek and Rincon Creek also contain SC steelhead designated critical habitat (Federal Register 2005), and Intrinsic Potential Habitat (Boughton and Goslin 2006) for the species (see enclosure), and are identified in NMFS' Southern California Steelhead Recovery Plan as high priority Core 1 recovery populations/watersheds (Federal Register 2005; NMFS 2012). (Arroyo Paredon has also been documented as supporting O. mykiss, and is identified as a Core 3 population/watershed in NMFS' Southern California Steelhead Recovery Plan [NMFS 2012, Table 2-1, p. 2-7, Table 7-1, p. 7-5]). NMFS (2012) identified groundwater extraction in both the Carpinteria Creek and Rincon Creek watersheds as a "Very High Threat" to the steelhead populations in these watersheds (NMFS 2012, Table 10-2, p. 10-10). To address this threat, NMFS (2012) identified two recovery actions for these watersheds: 1) conduct groundwater extraction analysis and assessment; and 2) develop and implement a groundwater monitoring and management program (NMFS 2012, Table 10-12, p. 10-44 – 10-45, Table 10-13, p. 10-49). NMFS' 2023 "Five-Year Review: Summary and Evaluation of Southern California Steelhead" identified groundwater extraction from Carpinteria Creek and Rincon Creek as a threat to these two steelhead populations (NMFS 2023, pp. 61, 65). NMFS 5-Year Review also specifically noted: "Significantly, the passage of the Sustainable Groundwater Management Act (SGMA) has provided a new regulatory mechanism for managing groundwater resources that have been identified as a major issue in the restoration of core recovery populations within the Southern California Steelhead DPS." (NMFS 2023, p. 115) Surface water and groundwater appear to be hydraulically linked in the Carpinteria groundwater basin, which includes Carpinteria Creek and Rincon Creek, and this linkage is critically important in creating seasonal habitat for steelhead. Where groundwater supplements streamflow, the influx of cold, clean water is critically important for maintaining water quality (e.g., temperature and dissolved oxygen) and flow volume. Pumping water from this aquifer- stream complex has the potential to affect endangered steelhead and its habitat by diminishing groundwater accretion to creeks overlying the Carpinteria groundwater basin, or accelerating surface water loss from these creeks. NMFS is concerned that groundwater extraction in the Carpinteria groundwater basin may be currently impacting steelhead instream habitat in this way.	The GSA thanks NMFS for their comments. We are aware of the historical presence of steelhead trout and other sensitive species in the basin creeks, and have added text to Section 3.2.7 to reflect this. Although data gaps exist, the best available data do not indicate that groundwater supplements streamflow in the Basin; this would imply gaining streams, where streamflow increases as the stream flows through the Basin due to aquifer discharge to the creeks. The GSP is a groundwater management plan. There are numerous factors that affect instream flow conditions, including rainfall in the contributing watershed, temperature, evapotranspiration, etc. It is not within the purview of this GSP to manage these contributing factors, or to mandate instream flow conditions. The purpose of the GSP is to propose a groundwater management framework that does not negatively impact flow conditions in a significant or unreasonable fashion. Responses to individual comments are included below.

Commenter	Section	Page/ Figure/ Table	Comment	Response
Dan Wilson (NOAA's NMFS)	Section 3	NA	Interconnected Surface Water: The draft GSP appears to inappropriately conclude there is no interconnected surface water (ISW) within the Carpinteria groundwater basin. The conclusion appears based upon the argument "that in the Recharge Area, basin creeks are all losing creeks and represent principal sources of recharge to the basin", which is inconsistent with the definition of ISW found within the SGMA regulations. SGMA regulations (23 CCR §§ 354.22, 354.26 (d), 354.28(a) and 354.28(e)) defines ISW as "surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted." Losing streams can meet the above definition, and appear to do so within the Carpinteria basin. For instance, the groundwater system water budget computed in Chapter 3 acknowledges streamflow percolation to the underlying aquifer occurs within the basin, and has occurred in all but three years during 36-year historical water budget period (Table 3-9). The current water budget (Table 3-13), based upon the water years 2012-2020, also notes significant streambed percolation, as does the narrative on page 3-139. Assuming a continuous saturated zone was present when streamflow percolated to groundwater, surface water and groundwater were at some point interconnected. If data exists that suggests a saturated zone between surface water and groundwater has never existed during the analyzed period of record, the GSP should present that data. The draft GSP does not identify minimum thresholds or measurable objectives for depletion of interconnected surface water. Absent a clear demonstration that interconnected surface water or undesirable results related to interconnected surface water depletion are not present or are unlikely to occur, the GSA must develop initial sustainable management criteria as required by SGMA regulations. (23 CCR §§ 354.26(d); also see "DWR Best Management Practices for the Sustainable Management of Groundwater: Sustainable Management Criteria (DRAFT), November 2017", available at: https://water.ca.gov/ Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents) NMFS recommends the GSA follow guidance from California Department of Fish and Wildlife (2019) and develop conservative streamflow depletion thresholds as a cautionary principle until the surface flow/groundwater dynamic in the Carpinteria basin is better studied and understood.	Text regarding this conclusion has been expanded in Section 3.2.6 to explain our reasoning more clearly. We reference DWR's classification identifying gaining, losing, *and disconnected* streams (Figure 3-43). It is not simply that the streams are losing streams, which we base our conclusion on, but the fact that even under the wettest conditions (as exemplified by spring 2005 water levels), there is still a significant observable distance between the channel bottom elevation (from DEM data) and the water table elevation. We maintain that the results of the analysis display that the distance between the channel bottom and the water table indicates the lack of a continuous saturated aquifer between the channel and the water table, and thus indicates a condition of disconnected streams (Figure 3-43c). A disconnected stream, by definition, has no interconnected surface water. Because this analysis indicates a hydraulic disconnection between the streams and the aquifer, we have not identified MTs or MOs for this sustainability indicator. A disconnected stream still percolates infiltrated water to recharge the aquifer during storm events. The inclusion in the water budget of recharge by stream percolation does not negate the conclusion of a disconnected stream. SGMA requires use of the best available data and science in analyses supporting the GSP. The DEM data has a high degree of confidence. The groundwater elevation contours are based on approximately 40 wells, including several located along basin creeks; although there is by necessity interpolation involved in generating these surfaces, there is still a high degree of confidence in this data. It is acknowledged that there is not much surface water streamflow data available in the basin. This is recognized as a data gap in Section 6.14 and identified as an area where additional data could be helpful to basin management.

Commenter	Section	Page/ Figure/ Table	Comment	Response
Dan Wilson (NOAA's NMFS)	NA	NA	Characterization of Undesirable Results: The draft GSP defines the undesirable result for depletion of interconnected surface water using the SGMA regulatory definition, i.e., "depletion of interconnected surface water that has significant and unreasonable adverse impacts on beneficial uses of surface water." We recommend the GSA also define what adverse impacts are considered "significant and unreasonable" with regard to beneficial uses of surface water identified by the State Water Board (2019 Central Coast Basin Plan, found at https://www.waterboards.ca.gov/centralcoast/publications_forms/publications/basin_plan/) (i.e., cold freshwater habitat; rare, threatened, or endangered species; migration of aquatic organisms; and spawning reproduction, and/or early development). Also, per SGMA regulation (23 CCR §§ 354.26 (a) and 354.26(b)), the draft GSP should describe the processes and criteria used to develop the ISW depletion undesirable result, the cause that would, or has led, to the undesirable result, and the criteria informing when and where the effects cause the undesirable result	Discussion of the analysis documented in Section 3.2.6 has been expanded from the original draft text to more clearly explain the methodology and conclusions. Because this analysis indicates a hydraulic disconnection between the streams and the aquifer, we have not defined MTs, MOs, or undesirable results for this sustainability indicator.
Dan Wilson (NOAA's NMFS)	NA	NA	Future Studies and Monitoring: We recommend the GSA identify ISW depletion as a data gap, and propose studies and monitoring that will improve understanding of groundwater/surface water dynamics and how pumping impacts surface water beneficial uses. The mechanism by which stream-dwelling organisms are impacted by groundwater pumping is habitat degradation caused by the draw-down of surface flows (Barlow and Leake 2012). The impacts can be both physical (e.g., pool volume shrinks as water surface elevation declines) and chemical (e.g., water quality can suffer as pools and riffles lose connectivity). Thus, the appropriate method to determine whether pumping is having "significant and unreasonable adverse impacts" on beneficial uses of surface water is to understand the level of impact (i.e., volume of streamflow depletion) and how habitat quality and functionality change because of that impact.	It is acknowledged that there are data gaps in surface water flows of Rincon Creek and Arroyo Paredon Creek. This has been discussed in Section 6.14 of the Plan. However, data used to determine that the groundwater is disconnected from the surface water included the HCM, historical water levels, and ground surface elevations. The GSA has high confidence in each of these of these data sets
Dan Wilson (NOAA's NMFS)	Sections 5 and 6	NA	Steelhead as a Public Trust Resource: When developing sustainable management criteria, and projects and management actions, the draft GSP appears to be missing adequate analysis and consideration of public trust resources, as required by the Public Trust Doctrine. A recent California Court of Appeal decision (Environmental Law Foundation v. State Water Resources Control Board (2018) 26 Cal.App.5th 844) held that the public trust doctrine must be considered—and public trust resources protected whenever feasible—in any decision governing groundwater withdrawals hydrologically connected to public trust surface waters. As noted above, SC steelhead, listed as endangered under the ESA, inhabit many of the navigable waterways (including Carpinteria Creek and Rincon Creek and tributaries) overlying the Carpinteria groundwater basin, and should be considered a public trust resource. The final GSP should adequately explain how proposed sustainable management criteria protect public trust resources like instream habitat utilized by endangered steelhead.	It is recognized that steelhead are an environmental public trust resource in the Basin. Text has been added to Section 3.2.7 to document listed species in the Basin. Our analysis, as described in Section 3.2.6, indicates that the groundwater is not hydrologically connected to the surface water, due to the observed distance between channel bottom elevation and groundwater elevation during the wettest periods. Therefore, SMCs were not developed for the interconnected surface water sustainability indicator.
Heather A. Pert (CDFW)	General Comment	NA	The California Department of Fish and Wildlife (CDFW) is providing comments on the Carpinteria Groundwater Sustainability Agency's (CGSA) Draft Groundwater Sustainability Plan (Draft GSP). The Draft GSP on the Carpinteria groundwater basin (Basin) was prepared pursuant to the Sustainable Groundwater Management Act (SGMA). As trustee agency for the State's fish and wildlife resources, CDFW has jurisdiction over the conservation, protection, and management of fish, wildlife, native	The GSA thanks CDFW for their comments. We are aware of the historical presence of steelhead trout and other sensitive species in the basin creeks, and have added text to Section 3.2.7 to reflect this. Individual comments are addressed below.

Commenter	Section	Page/ Figure/ Table	Comment	Response
			plants, and the habitat necessary for biologically sustainable populations of such species (Fish & Game Code §§ 711.7 and 1802). Development and implementation of groundwater sustainability plans (GSPs) under SGMA represents a new era of California groundwater management. CDFW has an interest in the sustainable management of groundwater, as many sensitive ecosystems and species depend on groundwater and interconnected surface waters, including ecosystems on CDFW-owned and managed lands within SGMA-regulated basins. SGMA and its implementing regulations afford ecosystems and species-specific statutory and regulatory consideration, including the following as pertinent to GSPs: • GSPs must **identify and consider impacts to groundwater dependent ecosystems (GDEs)** [23 CCR § 354.16(g) and Water Code § 10727.4(l)]; • Groundwater Sustainability Agencies must **consider all beneficial uses and users of groundwater**, including environmental users of groundwater [Water Code §10723.2 (e)]; • GSPs must **identify and consider potential effects on all beneficial uses and users of groundwater** [23 CCR §§ 354.10(a), 354.26(b)(3), 354.28(b)(4), 354.34(b)(2), and 354.34(f)(3)]; • GSPs must **establish sustainable management criteria that avoid undesirable results** within 20 years of the applicable statutory deadline, including **depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water** [23 CCR § 354.22 et seq. and Water Code §§ 10721(x)(6) and 10727.2(b)], and **describe monitoring networks** that can identify adverse impacts to beneficial uses of interconnected surface waters [23 CCR § 354.34(c)(6)(D)]; and, • GSPs must **account for groundwater extraction for all water use sectors** including managed wetlands, managed recharge, and native vegetation [23 CCR §§ 351(al) and 354.18(b)(3)]. Furthermore, the Public Trust Doctrine imposes a related but distinct obligation to consider how groundwater management affects public trust resources, including navigable surface waters and fisheries. Groundwater hydrologically connected to surface waters are also subject to the Public Trust Doctrine to the extent that groundwater extractions or diversions affect or may affect public trust uses (*Environmental Law Foundation v. State Water Resources Control Board* (2018), 26 Cal. App. 5th 844; *National Audubon Society v. Superior Court* (1983), 33 Cal. 3d 419). Accordingly, groundwater plans should consider potential impacts to and appropriate protections for interconnected surface waters and their tributaries, and interconnected surface waters that support fisheries, including the level of groundwater contribution to those waters. In the context of SGMA statutes and regulations, and Public Trust Doctrine considerations, groundwater planning should carefully consider and protect environmental beneficial uses and users of groundwater, including fish and wildlife and their habitats, groundwater dependent ecosystems, and interconnected surface waters.	

Commenter	Section	Page/ Figure/ Table	Comment	Response
Heather A. Pert (CDFW)	General Comment	NA	CDFW supports ecosystem preservation and enhancement in compliance with SGMA and its implementing regulations based on CDFW expertise and best available information and science. CDFW offers the following comments and recommendations below to assist CGSA in identifying and evaluating impacts on biological resources including GDEs within the adjacent groundwater basins. CDFW may provide additional suggestions for CGSA's consideration as the Draft GSP is revised.	Thank you for the comments. They are duly noted and maintained for the record. Individual comments on the GSP are addressed below.
Heather A. Pert (CDFW)	Section 1	11	1. **Comment #1: Interconnected Surface Water (Executive Summary 2.4 of Draft GSP)** The Draft GSP states that there are no interconnected surface waters in the Basin. a. **Issue**: Page ES-11 of the Draft GSP states, "*[i]t is concluded that there are no interconnected surface water systems in the Basin (see Section 3.2.7).*" b. **Concern**: The Hydrogeologic Conceptual Model (HCM) used to determine that there are no interconnected surface waters is based on a Geotechnical Consultants, Inc. report (Draft GSP, pg. ES-5) from 1976. CDFW is concerned CGSA's reliance on a nearly 50-year-old report to determine the absence of interconnected surface waters within the Basin may be inadequate. The Draft GSP acknowledges that the HCM has data gaps regarding the structure and aquifer parameters of Storage Unit #2 (the Basin is separated into Storage Unit #1 and Storage Unit #2) and a historical lack of hydrogeologic investigation in the Ventura County portion of the Basin (Draft GSP, pg. 3-33). c. **Recommendation**: CDFW recommends the CGSA commence additional studies and propose a schedule for the next 5 years to fill in the data gaps associated with the HCM. Examples of informative studies that could be used include the installation and data analysis of monitoring wells near potential interconnected surface waters and pairing multiple-completion wells with additional streamflow gages. This will facilitate an improved understanding of surface water-groundwater interconnectivity and subsurface recharge channels. CDFW recommends CGSA determine their approach to resolve these data gaps, including a timeline to do so, in the GSP prior to its adoption. CDFW recommends that this data be used to supplement and/or update the HCM to evaluate if there are interconnected surface waters.	The GSA does not believe that the Geotechnical Consultants, Inc. report is flawed simply because it was produced in the 1970s. The hydrogeologic conditions that are documented in that report are comparable to conditions in the present day. Significant work has been done in 2022 to update the basin setting including the HCM using available new data. The desktop analysis presented in Section 3.2.6 uses DEM land surface data and groundwater elevation contours derived from over 30 wells across the Basin, including wells proximate to the basin creeks. This is the best available data available at present, and it is considered to have a high degree of confidence. This analysis indicates that the basin creeks are hydraulically disconnected from the groundwater in the aquifer (Figure 3-43 [Part C]), even during wet weather periods. it is acknowledged that there are data gaps in surface water flows of Rincon Creek and Arroyo Paredon Creek. This has been discussed in Section 6.14 of the Plan. However, data used to determine that the groundwater is disconnected from the surface water included the HCM, historical water levels, and ground surface elevations. The GSA has high confidence in each of these of these data sets

Commenter	Section	Page/ Figure/ Table	Comment	Response
Heather A. Pert (CDFW)	Section 3	29	2. **Comment #2: Prepare Groundwater Dependent Ecosystem Assessment (Section 4 and Section 5 of Draft GSP)** The Draft GSP does not include minimum thresholds, measurable objectives, or sustainable management criteria to protect GDEs. a. **Issue**: Page 5-29 of the Draft GSP states, "it is acknowledged that there are potential data gaps in the Carpinteria Basin with respect to groundwater dependent ecosystems (GDEs), which the GSA can continue to pursue. GDEs are affected by groundwater elevations in their vicinity. Two areas of potential GDEs were identified that may require additional investigation during the first 5-year SGMA implementation period." b. **Concern**: CDFW is concerned with the Draft GSP's disregard for the potential GDEs along the Arroyo Paredon Creek and Rincon Creek in the Basin and has not established interim minimum thresholds, measurable objectives, or sustainable management criteria to protect GDEs from undesirable results. These potential GDEs consist of mixed riparian and coastal oak woodland habitats. Mixed riparian habitat is considered highly valuable within the Basin because it provides habitat for many plant and wildlife species, filters pollutants, provides bed and bank stabilization/erosion control, and moderates hydrologic flows during the wet season. Coastal oak woodland habitat is also considered to be of high biological value for its varying degree of canopy coverage that provide complex understory environments of shrubs, grasses, and forbs that provide wildlife habitat. CDFW understands that there are data gaps that CGSA needs to pursue; however, the lack of establishing interim minimum thresholds may adversely impact GDEs during the first five years of the SGMA implementation period. c. **Recommendation**: CDFW highly recommends that the CGSA provide appropriate consideration to GDEs by developing minimum thresholds, measurable objectives, and sustainable management criteria to prevent undesirable results to GDEs. To fill in data gaps, CDFW recommends the installation of shallow groundwater monitoring wells near GDEs to ensure that groundwater use is not affecting soil saturation at the root depths of GDEs.	The GSA used NCCAG data for potential GDEs developed by The Nature Conservancy (TNC), along with groundwater elevation contours generated from historical data, as a basis for its analysis of potential GDEs. The use of a 30-foot depth to water criteria for screening out NCCAG polygons is a methodology that has been employed by other GSPs that have been accepted by DWR. This analysis, described in Section 3.2.7, screens out any of the NCCAG polygons in the confined area of the Basin because they are separated from the principal aquifer by the fine-grained sediments of the confining layer. Most of the NCCAG polygons in the recharge area had depth to water of greater than 30 feet indicated by the data, and so were screened out. This analysis identified four areas with potential GDEs identified (two along Arroyo Paredon, and two along Rincon Creek [Figures 3-52 and 3-53]), that are identified as requiring additional characterization during the initial 5-year SGMA implementation period.

Commenter	Section	Page/ Figure/ Table	Comment	Response
Heather A. Pert (CDFW)	Section 1	11	3. **Comment #3: Terrestrial and Aquatic Special-Status Species Occurrence (Executive Summary-2.6 of Draft GSP)** The Draft GSP does not document terrestrial and aquatic special status species occurrences within the Basin. a. **Issue**: Page ES-11 of the Draft GSP states, "GDEs are defined under SGMA as "ecological communities of species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." b. **Concern**: CDFW is concerned with the Draft GSP's lack of documentation on terrestrial and aquatic species occurring in the Basin. The Basin has GDEs and habitat that supports the federal Endangered Species Act (FESA) listed and the California Endangered Species Act (CESA) candidate-listed southern California steelhead (*Oncorhynchus mykiss* or steelhead); California red-legged frog (*Rana draytonil*), which is listed as a threatened species under the FESA and is a California species of special concern (SSC); least Bell's vireo (*Vireo belli pusillus*), which is listed as an endangered species under the FESA and CESA; and southwestern willow flycatcher (*Empidonax traillii extimus*), which is listed as an endangered species under the FESA and CESA. According to CDFW's California Natural Diversity Database (CNDDB; CDFW 2023), additional CDFW SSC's occurring in the area include yellow warbler (Setophaga petechia), yellow-breasted chat (*Icteria virens*), Cooper's hawk (*Accipiter cooperi*), arroyo chub (*Gila orcuttii*), southwestern pond turtle (*Actinemys pallida*) (On October 3, 2023, the U.S. Fish and Wildlife Service proposed to list southwestern pond turtle, a species from central and southern California and Baja California, Mexico, as threatened species under the FESA. If the proposal is finalized, it would add the southwestern pond turtle to the List of Endangered and Threatened Wildlife and extend the Act's protections to the species.), and two-striped garter snake (*Thamnophis hammondii*). These species utilize habitats identified in the Draft GSP as known GDEs and potential GDEs. c. **Recommendation**: CDFW recommends the CGSA utilize the CNDDB occurrence data and also add and address the following species in the Final GSP: steelhead, least Bell's vireo, southwestern willow flycatcher, California red-legged frog, yellow warbler, yellow-breasted chat, Cooper's hawk, arroyo chub, southwestern pond turtle, and two-striped garter snake.	The GSA thanks CDFW for their comments. We are aware of the historical presence of steelhead trout and other sensitive species in the basin creeks, and have added text to Section 3.2.7 to reflect this. References have been added to the text to document the species listed in this comment.
Heather A. Pert (CDFW)	General Comment	NA	4. **Comment #4: Draft GSP vs. Final GSP** Streamlining the comparison of the Draft GSP and Final GSP. a. **Issue**: CGSA may need to revise the GSP before it is finalized and adopted. b. **Recommendation**: CDFW recommends the CGSA provide a red-lined version of the Final GSP to understand the changes made between the Draft GSP and Final GSP. Alternatively, CDFW recommends the CGSA provide a summary of changes made and comments addressed by the CGSA in preparation of a Final GSP.	A red-lined version of the final GSP will be made available upon request.
Heather A. Pert (CDFW)	Section 3	NA	5. **Comment #5: Cannabis Cultivation** Accounting for current and future cannabis cultivation water uses within the Carpinteria River Basin.	No specific analysis targeting cannabis cultivation is included in the GSP. Cannabis water use is included in projected water use for agriculture in future water budget analysis and groundwater

Commenter	Section	Page/ Figure/ Table	Comment	Response
			a. **Issue**: The Draft GSP does not evaluate potential groundwater effects from cannabis cultivation for current and future groundwater management trends. Without this evaluation, the effects of this water intensive crop may be overlooked throughout Carpinteria River Valley. b. **Concern**: CDFW has identified Carpinteria River Valley as a priority watershed for cannabis permitting, enforcement, and compliance. The majority of cannabis projects within this area are clustered in the Santa Monica Creek and Carpinteria Creek HUC 12 watersheds. This includes steelhead streams Arroyo Paredon, Carpinteria, and Gobernador creeks (NMFS 2013). Since the implementation of legal cannabis cultivation, CDFW has received 45 applications within the Carpinteria River Valley, specifically in the HUC 12 watersheds listed above. Cannabis cultivation is a water intensive crop that can have a significant impact on environmental beneficial users of groundwater. Cannabis groundwater wells provide water for the irrigation of water-intensive cannabis cultivation (assuming six gallons of water per day per plant; Bauer et al. 2015). Some of the cannabis grows can range from 1- 8 acres, with multiple licenses on a property (resulting in several acres of cultivation). CDFW is concerned that by not accounting for existing cannabis use, which is water intensive and likely to increase overtime, the GSP may underestimate groundwater demand in the Carpinteria River Valley. Groundwater and interconnected surface water depletion are a major concern for fish and wildlife beneficial users in the Carpinteria River Valley. Designating Carpinteria Valley as a medium priority cannabis watershed requires groundwater to be monitored and sustainably managed for the benefit of all beneficial users, including groundwater dependent vegetated communities and interconnected surface waters that are necessary to support riparian and aquatic habitat and the sensitive species therein (e.g., steelhead). Decreased stream flow may contribute to direct mortality if fish eggs are exposed, covered with silt, or left without sufficient oxygenated water. Water degraded in temperature or chemical composition can displace or limit fish populations. Additionally, phreatophytic vegetation is a critical contributor to nesting and foraging habitat for a wide range of species and can be sensitive by depth to groundwater threshold impacts. This sensitivity to groundwater level thresholds means that localized pumping and recharge actions altering groundwater levels can impact the health and extent of phreatophyte vegetation. Both decreasing (drying out) or increasing (drowning) groundwater elevation has the potential to stress phreatophytes depending on the plant species, groundwater elevation, and duration (e.g., short term wetness/dryness versus prolonged wetness/dryness) (Froend and Sommer 2015; Naumburg et al. 2005). Accounting for current and future cannabis cultivation within the Carpinteria River Basin is also particularly critical to the survival and recovery of steelhead. c. **Recommendation**: CDFW recommends CGSA review existing information on cannabis cultivation within Carpinteria River Valley and recommends it be factored into the Final GSP when evaluating groundwater management in current and future trends.	model runs. Details regarding assumptions made for projected agricultural use are included in Section 3.3 and Appendix F. Cannabis in Carpinteria is exclusively grown in green houses. An Acreage cap of 186 acres has been set by the County of Santa Barbara. Approximately 29 acres remains unutilized of the cap.

Commenter	Section	Page/ Figure/ Table	Comment	Response
Heather A. Pert (CDFW)	General Comment	NA	In conclusion, the Draft GSP does not comply with all aspects of SGMA statute and regulations, and CDFW deems the Draft GSP inadequate to protect fish and wildlife beneficial users of groundwater for the following reasons: 1. The Draft GSP does not identify reasonable measures and schedules to eliminate data gaps. [CCR § 355.4(b)(2)] (See Comments # 1, 2, 3, and 5); 2. The sustainable management criteria and projects and management actions are not commensurate with the level of understanding of the basin setting, based on the level of uncertainty, as reflected in the Draft GSP. [CCR § 355.4(b)(3)] (See Comments # 1, 2, 3, and 5); and, 3. The interests of the beneficial uses that are potentially affected by the use of groundwater in the Basin, have not been considered. [CCR § 355.4(b)(4)] (See Comments # 1, 2, and 3).	1. Data gaps are identified in Section 6.14. A management action is presented to undertake actions to reduce data gaps. A specific work plan for this action is not presented as part of the GSP, but is expected to be produced in the initial 5-year SGMA implementation period. 2. The GSA used the best available data on the physical characteristics of the Basin, and data and methodology endorsed by The Nature Conservancy for analysis regarding GDEs. As additional or better data become available, the GSA is committed to using it. 3. The GSA believes that beneficial uses and users of groundwater have been considered, and are documented in Section 5 of the GSP for each sustainability indicator.
Nate Irwin (Santa Barbara Channelkeeper)	General Comment	NA	Thank you for this opportunity to comment on the draft Carpinteria Groundwater Sustainability Plan. Santa Barbara Channelkeeper is a 501c3 environmental non-profit organization dedicated to protecting and restoring the Santa Barbara Channel and its watersheds through science-based advocacy, education, field work and enforcement. We work from the Gaviota Coast to the Ventura River, and out to the Channel Islands. The Carpinteria Groundwater Sustainability Plan (CGSP) strives to allow for the Carpinteria Basin to achieve sustainability within 20 years of plan adoption. We are excited to see the positive effects that will come from the city of Carpinteria investing in the Carpinteria Advanced Purification Project, and applaud the effort the city is making to develop a plan to sustainably manage groundwater in the Carpinteria Basin. After a brief initial review of the plan, we believed it was important to highlight two areas we identified: the conclusion of no interconnected surface waters and degraded water quality in the basin. We respectfully submit the following comments and recommend that these issues are re-evaluated because of their importance in sustainably managing groundwater in the Carpinteria Basin.	Thank you for the general comments. They are duly noted and maintained for the record. Individual comments on the GSP are addressed below.
Nate Irwin (Santa Barbara Channelkeeper)	NA	NA	Interconnected Surface Waters We believe that there are interconnected surface waters in the Carpinteria Groundwater Basin. Protecting the species and ecosystems that rely on these interconnected surface waters is imperative to the overall health of the basin. The CGSP highlights that "no interconnected surface water systems have been identified within the Basin. Therefore, no monitoring network for this sustainability indicator has been established at this time." Several creeks in the Carpinteria Basin are experiencing the undesirable result (under the definition provided in § 10721(x) of SGMA) of depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water. Rincon Creek, Carpinteria Creek, Franklin Creek and Santa Monica Creek are examples of this undesirable result occurring through groundwater extraction. According to the City of Carpinteria Creeks Preservation Program, creeks in Carpinteria have been substantially degraded by the "(a)lteration of natural hydrologic and geomorphologic processes due to withdrawals and inputs of surface and ground	In Section 3.2.6, the GSA presents analysis using the best available data that indicate that the creeks in the Basin are hydraulically disconnected from the underlying aquifer; i.e., there is no continuous zone of saturation between the surface water and the water table, even under wet year conditions. The GSA is aware that some creeks in the Basin have been "degraded," this is assumed to be a reference to the concrete lining of Santa Monica and Franklin Creeks. This project was implemented in the 1980s for the purposes of flood control and benefit of local property owners. The potential de-lining of these creeks is presented as a potential recharge enhancement project (Section 6.8). An engineering feasibility and ranking study is recommended as a management action in the early part of the initial 5-year implementation period (Section 6.15). It is documented in Figure 3-44 that groundwater elevations in the primary aquifer are higher than the channel elevation in the confined area of the basin in Santa Monica Creek and Franklin Creek. However, in the Confined Zone of the Basin, the principal aquifer is separated from the creek channels by the fine-grained sediments of the confining layer. The confining layer is not used for any significant groundwater production, and is not considered a primary aquifer. Since there is no pumping in the confining layer, it is not considered manageable under SGMA.

Commenter	Section	Page/ Figure/ Table	Comment	Response
			waters." (City of Carpinteria creeks preservation program final document volume One. (2005) Available at: https://carpinteriaca.gov/wp-content/uploads/2020/03/cd_creeks-report.pdf (Accessed: 31 October 2023). ("City of Carpinteria, (2005)"). This document also emphasizes the fact that local creeks are intimately linked to groundwater, most importantly surface water flows from local creeks as an important source of groundwater recharge, most notably during high creek flows. (City of Carpinteria, (2005)) According to the CGSP, water elevations were higher than the creek bottom elevations along Santa Monica and Franklin Creeks within the confined area during the spring of "wet year 2005." This signifies that these creeks are interconnected to groundwater during wet years, leading to streamflow depletion when pumping is occurring near these streams. Well pumping along creeks creates what is called a "cone of depression" in the water levels around a well. (Barlow, M., and Leake, A. Streamflow depletion by wells—Understanding and managing the effects of groundwater pumping on streamflow. U.S. Geological Survey Circular, 1376, 84 p. Available at: http://pubs.usgs.gov/circ/1376/(2012). ("Barlow, (2012)") This area of depression pulls water from streams into the cone, reducing streamflow. (Barlow, (2012)) Santa Monica and Franklin Creeks are below groundwater during wet years, and water captured through pumping consists of two possible sources—a reduction in the natural discharge (or outflow) rate of groundwater from the aquifer or an increase in the natural or artificial recharge (or inflow) rate to the aquifer. (*Id.*) The water that would normally support ecosystems downstream is instead captured in the cone of depression of the well, reducing streamflow. The Carpinteria Salt Marsh relies on flows from Franklin and Santa Monica Creek, primarily during high flow periods. (Carpinteria Salt Marsh Preserve (no date) - University of California Natural Reserve System. Available at: https://carpinteria.ucnrs.org/agenciesandgroups.html (Accessed: 01 November 2023)). Groundwater pumping should be monitored and addressed under the CGSP to ensure interconnected surface waters can support ecosystems like the Carpinteria Salt Marsh, and species, such as the endangered Southern California steelhead. NOAA's Southern California Steelhead Recovery Plan (SCSRP) points to groundwater extraction and small surface diversions significantly altering flow regimes along the Conception Coast, "particularly in the lower stream reaches, and thus adversely affect(ing) both upstream and downstream fish passage and spawning and rearing opportunities."7 A Critical Recovery Action for Carpinteria and Rincon Creek under the SCSRP is to "(h)alt the unnatural dry-season reduction in the amount and extent of surface water to restore natural or pre-impact over-summering habitat characteristics and condition for steelhead."8 The SCSRP advises that Rincon and Carpinteria Creek should conduct a groundwater extraction assessment and analysis, and develop and implement a groundwater monitoring and management program. (*Id.*)	Groundwater pumping will be documented annually in the SGMA-required annual reports.

Commenter	Section	Page/ Figure/ Table	Comment	Response
Nate Irwin (Santa Barbara Channelkeeper)	NA	NA	**Degraded Water Quality -** Degraded water quality is an issue that should be addressed as a Tier 1 priority in the CGSP. There are increasing levels of TDS, chloride and Nitrate in many of the basin's monitoring wells. Franklin Creek, Rincon Creek and Carpinteria Creek are on the State Water Boards TDML list.10 These trends are highlighting an increase in important health indicators, making water quality a sustainability issue that must be addressed by the GSA. According to the State Water Resources Control Board, the state drinking water standard for Nitrate is below 45 mg/L, specifically designed to protect infants,11 and the Contaminant Level (MCL) for chloride is below 250 mg/L.12 According to the CGSP, wells 19E1, 19K5, 19M1, 22R4 27E1, 28H1, 34B4, and 22R4 are all showing increasing trends in concentration of these contaminants. Franklin Creek is on the Central Coast Water Boards impaired waters list due to excessive levels of nitrate and phosphorus.13 This is due to fertilizer application, runoff from agricultural lands and urban lands, as well as base flow of nitrate impacted groundwater into streams within the Franklin Creek watershed.14 These water quality impairments are issues that need to be addressed and re-examined as tier 1 priorities.	All primary and secondary MCLs, including for nitrate, TDS, and chloride, are met for water delivered by CVWD for potable supply within their service area. Surface water quality in the creeks may be impacted by runoff from agricultural lands. Addressing this circumstance is beyond the mandate of SGMA or the scope of this GSP. This issue likely falls under the jurisdiction of the Regional Water Quality Control Board.
Curtis Cloud Thornton	Executive Summary	1	I strongly disagree with the statements of the district representatives that reclaimed water from the sanitation department will be —pure—. It is a foolish statement. Water is dynamic and pure is an impossible label for water. Spending tens of thousands of dollars on your information campaign offering propaganda is probably why no one is interested. It seems to me that the project is about to reach the fifty million dollar mark. I regret not speaking up about this sooner. As purely a layman with forty years experience as a researcher for Driscoll's and horticulturalist using water to produce hundreds of different varieties of fields and greenhouse flowers from San Diego country to San Mateo county Ive relied on and had experience with almost a hundred sources of water in the state. From creek water in Pescadero and the discharged water from Newbury park in Santa Rosa creek to hydroponic rose growing operations in Watsonville to the well water from several locations in Salinas to Driscoll's research facilities with three sources of water including water from the Oxnard sanitation facility. I ran the Colorama Nursery on Via Real from 2001 to 2016 using exclusively Carpinteria district water. The water PH, frequently 8, and constantly high was toxic for some crops and reclaimed water has notoriously high PH. Now I'm only pointing out the harm from plants not my or others kidney stones that are caused by hard water.The public should be made aware of the facts about the high PH and the toxic concentrations of boron in the reclaimed water since reverse osmosis does not remove it. Also the amount of hormones and pharmaceuticals from human waste that will be pumped into our drinking water and the possible harm to mental health and early child development. I appreciate the opportunity to address this issue with my community and hope you're open to an honest evaluation of the negative aspects of this project and its effects on our most valuable resource.Curtis Cloud Thornton	The CAPP is proceeding in compliance with all applicable legislation and permitting considerations. However, the specifics of the implementation of the CAPP are beyond the scope of this GSP.
Curtis Thornton (Children's Environmental Health Network)	Section 6	9	https://www.nrdc.org/sites/default/files/2023-05/pfas-mcl-affordability-letter-20230528.pdf https://www.nrdc.org/sites/default/files/2023-05/pfas-mcl-affordability-letter-20230528.pdf	Thank you for the reference. The GSA is aware of the ongoing regulatory actions regarding PFAS. These investigations are occurring under the authority of the RWQCB.

Commenter	Section	Page/ Figure/ Table	Comment	Response
Curtis Thornton (Children's Environmental Health Network)	General Comment	9	https://www.nrdc.org/sites/default/files/2023-06/nrdc-pfda-iris-review-comments-20230609.pdf https://www.nrdc.org/sites/default/files/2023-06/nrdc-pfda-iris-review-comments-20230609.pdf	References noted.
Curtis Thornton (Children's Environmental Health Network)	General Comment	9	https://www.researchgate.net/publication/368054703_PHARMACEUTICALS_IN_WATER_CYCLE_A_REVIEW_ON_RISK_ASSESSMENT_AND_WASTEWATER_AND_SLUDGE_TREATMENT https://www.researchgate.net/publication/368054703_PHARMACEUTICALS_IN_WATER_CYCLE_A_REVIEW_ON_RISK_ASSESSMENT_AND_WASTEWATER_AND_SLUDGE_TREATMENT https://www.researchgate.net/publication/368054703_PHARMACEUTICALS_IN_WATER_CYCLE_A_REVIEW_ON_RISK_ASSESSMENT_AND_WASTEWATER_AND_SLUDGE_TREATMENT https://www.researchgate.net/publication/370079113_Water_Contamination_by_Estrogenic_Compounds_Review_Policy_Gaps_and_Recommendations_for_US_Federal_Regulation https://www.researchgate.net/publication/370079113_Water_Contamination_by_Estrogenic_Compounds_Review_Policy_Gaps_and_Recommendations_for_US_Federal_Regulation	References noted.
Suzette Chafey	General Comment	1	Trusting City of Carpinteria to do the logical, reasonable, affordable and sustainable plan to protect and support the community and agriculture.	Thank you for the comments. They are duly noted and maintained for the record. Individual comments on the GSP are addressed below.
Kim Jones (land owner)	Section 7	1	The current method of funding based on acreage with no regard to water usage, is not fair. The need for this plan is because we are using more water than the basin can sustainably provide. While the plan has language about having an equitably method of funding, it is not required and there is no reason to believe that the current funding method will change without expensive legal action by citizens to demand a fair and equitable funding method.	The methods that the GSA will use to generate fees in the future for ongoing GSA activities through the 20-year SGMA implementation period have not yet been determined. It is anticipated that these methods will be finalized in the first 1 to 2 years of the initial 5-year SGMA implementation period.
Pete and Chuck Dal Pozzo (Dal Pozzo Ranch LLC)	Section 7	9	Section 7.8 of the Draft Groundwater Sustainability Plan states that the fee program is likely to be based on non-metered (estimated) pumping.; However, there should be an option for those stakeholders who would rather report their pumping using well meters instead of an estimated pumping amount; This option would give those stakeholders who desire to use meters a far more accurate way of reporting their pumping. It would also give the Carpinteria GSA and the Carpinteria Groundwater Basin a head start on all the benefits of well metering as described in sections 6.10.1 and 6.10.2.	The GSA will consider using metered data for those private pumpers who wish to install and utilize meters for their wells. Other indirect methods will also be considered.

Commenter	Section	Page/ Figure/ Table	Comment	Response
Alison Johnson	Section 5	8	Concerns and questions: Are all property owners aware and/or duly informed what a water use budget may do the their property value? Potential home buyers considering Carpinteria may be told, Oh, you don't want to buy in Carp! The Water District controls your water use. You do not! This will translate into fewer home sales, less property taxes and therefore less money for our city.Do you (as a panel, with the most knowledge)present our dire situation directly to the City Council and potentially make serious warnings/recommendations to the Council to halt any future developments until this budget is one-hundred percent fully understood by all the residents and businesses already established here in Carpinteria? You represent this town with your 'future' mastery of groundwater use implications. No new developments should be considered until any and all implications of the water budget is completely understood by everyone here. Wouldn't it be wise, as "ground water guardians"; to recommend installing open pavers at the train station Parking Lot #3 to help capture precious ground water? (The ballot to rezone the lot had seriously confusing wording and the votes cast most likely misread them. The numbers were very close). Pro-active actions, like a moratorium on future development, installing open pavers, etc. are what we need to do now for the enduring future of this extraordinary small and special city.	The District uses both delivered surface water from the State Water Project and the Cachuma Project, in addition to groundwater, to provide supply to its service area. CVWD has determined it has sufficient water supplies in its 2020 Urban Water Management Plan. Projects and management actions discussed in Section 6 of the GSP are intended to avoid undesirable results in the future. Conservation and efficiency programs are discussed as a management action in Section 6.12. Discussions of specific local zoning ordinances are not within the scope of this GSP.
Bill Harz	Section 3	0	Not considered that we live in a active seismic area. last Fridays 4.0 earthquake reminded me of a hydrology article I read a number of years ago concerning the Ventura's ground water basin. It mentioned after the 1872 lone pine earthquake that a number of water wells in the Oxnard plain went artisan, one well shot out cobbles the size of hens eggs. This I believe represented that the shaking from almost 100 miles away caused a loss of storage capacity in the aquifer. I mention this as an additional need to be conservative in calculating safe yields in our aquifer.	It is understood that seismic activity may affect water levels in wells, but the effects are generally temporary, and water levels commonly return to static conditions after the earthquake event.
Noah Boland (Heal the Ocean)	General Comment	359	I found some typos throughout the text. It is noted that prior to 2019 seawater intrusion had not historically been detected in existing wells in the basin; however, before 2019 there were no monitoring wells along the coast were designed detected seawater intrusion. The CVWD El Caro Well, which pumps all three Basin aquifer zones, is located about two miles east of the Sentinel Wells.	This comment correctly notes that there were no sentinel wells along the coast prior to 2019. However, the statement that no seawater intrusion has been observed historically (in wells existing at the time) is accurate. Expansion of the Sentinel Monitoring Well network is recommended as a Tier 1 project. These will provide a notification before seawater advances to active private wells or municipal wells.
Alan Soicher	Section 6	27	Recommend to develop and start implementing a Groundwater Recharge Plan as a Tier 1 action (first five years) in the Carpinteria Basin. This would involve expanding significantly on the “desktop level feasibility analysis and ranking study” described under Section 6.7 Recharge Enhancement Projects. The Groundwater Recharge Plan would include a thorough identification of all possible recharge enhancements in the basin, identification of the potential impacts of those enhancements, engineering feasibility analysis, cost-benefit analysis, and identification of funding mechanisms and partnerships needed for implementation. The planning effort would be followed by initiation of high priority actions identified in the Groundwater Recharge Plan during the first five years of GSP implementation. Please see article in November 2, 2023 Coastal View News (page 5) for more information on this topic, and please include the text of the article by reference in this comment.	The first step in assessing the potential success of recharge projects is an engineering desktop study evaluating project feasibility, likely costs, benefits, and potential constraints to implementation. Such a study is recommended to be conducted as a management action during the initial 5-year SGMA implementation period (Section 6.15). Land availability for recharge basins, real estate costs, source water availability, and potential impacts to neighboring residential areas can be assessed in a desktop study, prior to proceeding with project implementation. In the view of the GSA and Technical Advisory Committee, assigning these projects to Tier 1 status is premature without such a feasibility study.

Commenter	Section	Page/ Figure/ Table	Comment	Response
Alan Soicher	Section 3	67	Recommend to re-evaluate the applicability of the methodology used in Section 3.2.6 for assessing interconnected surface water systems, and to update the methodology as needed to address the hydrogeomorphic conditions and processes specific to the Carpinteria Basin. Section 4.4.6 (page 4-34) notes that characterization of interconnected surface water systems may be a data gap in the Carpinteria GSP. The re-evaluation of the applicability of the methodology may lead to establishment of criteria in Section 5.10 for interconnected surface water, and is likely to have implications for Section 3.2.7 regarding Groundwater Dependent Ecosystems (GDE).	Text regarding this conclusion has been expanded in Section 3.2.6 to explain our reasoning more clearly. We reference DWR's classification identifying gaining, losing, *and disconnected* streams (Figure 3-43). It is not simply that the streams are losing streams, which we base our conclusion on, but the fact that even under the wettest conditions (as exemplified by spring 2005 water levels), there is still a significant observable distance between the channel bottom elevation (from DEM data) and the water table elevation. We maintain that the results of the analysis display that the distance between the channel bottom and the water table indicates the lack of a continuous saturated aquifer between the channel and the water table, and thus indicates a condition of disconnected streams (Figure 3-43c). A disconnected stream, by definition, has no interconnected surface water. Because this analysis indicates a hydraulic disconnection between the streams and the aquifer, we have not identified MTs or MOs for this sustainability indicator. Lack of surface water flow data in the basin is identified as a data gap in Section 6.14.
Paul Kops	Section 7	9	It's unconstitutional to charge any of the fees mentioned in Section 7.8 groundwater extraction charges, monthly fixed charges and variable pumping fees, assessments/parcel taxes, and parcel fees. There are many water well owners who are not big Marijuana farms. Those big farms are solely responsible for the excessive extraction of groundwater. But the GSA wants to penalize the little guy, the small independent farmer. It's not fair at all. Anyone with a legal well already paid the fees and taxes to have it tested, built, and registered. It's unlawful only to charge water well owners, too, as these fees would not specifically benefit any well owners. Sustainably would benefit all residents of Carpinteria, so if there are any fees, then every resident should have to pay. And if everyone is paying, then it's a tax, which would require a majority vote on the ballots to pass. And we all already pay the Carpinteria GSA special property tax, so how much more funding do you need? I believe it would be an outrageous overreach of the local government to force these few small individuals to pay for something that doesn't directly benefit them. The rules of Prop 13, 218, and 26 clearly explain how none of these funding sources mentioned above are illegal.	The SGMA legislation empowers GSAs to assess fees for ongoing management and SGMA project implementation costs and maintenance. The specific methods and mechanisms for assessing future GSA fees have not been determined. Public input will be solicited and considered, and GSA legal counsel will provide advice to ascertain that all GSA administration is in compliance with state law and local regulations. GSA fees apply to all users of groundwater including the Carpinteria Valley Water District. These fees are paid by the rate payers of Carpinteria.
Jim Bailard	General Comment	NA	Enclosed are my comments on the draft GSP. My comments include three sections: a) general thoughts and comments relating to broad issues and specific sections of the report, b) general conclusions and recommendations stemming from a), and finally c) brief comments and typos related to specific pages of the report. The report represents a substantial effort on the part of the Agency and its contractors and will provide a guide for moving forward in the management of the valley's groundwater. It was a pleasure serving as a member of the Advisory Committee.	Comments received and responses are provided below.

Commenter	Section	Page/ Figure/ Table	Comment	Response
Jim Bailard	Section 3	NA	1. Modeling and measurements indicate that the groundwater supply has been out of balance for several decades with a significant deficit between water extraction and re-supply. 2. The State's recommended groundwater model may be too simplistic to adequately incorporate predicted climate change effects. The perturbed precipitation input data methodology is unable to include the "flashiness" of future rainfall patterns with shorter, more intense rainfall events and longer periods of intense drought. A probabilistic model (e.g., Monte Carlo Simulation) might be more useful in answering questions about future groundwater supplies and guiding future management actions. 3. Model predictions of future groundwater supplies may be overly optimistic. In spite of clear evidence of a long-term deficit in groundwater supplies, model predictions show a surplus of water at the end of the simulation period even when mitigating actions are not included. This result seems unlikely. 4. Private pumping volumes are not well known in spite of being an important component of the groundwater budget. The installation of meters on all active would provide this valuable and needed data. 5. Groundwater modeling suggests that seawater intrusion has been a problem in the basin for decades. Recent measurements show brackish water in the lowest aquifer zone near the coast. The intrusion process is poorly understood. Additional geological measurements are needed coupled with the development of a 3-D, variable density, groundwater model. 6. Basin groundwater levels are currently depressed leaving little buffer against ongoing/future periods of drought.	1. It is noted that the water budget results indicate a historical deficit between recharge and discharge, which has been exacerbated by the recent drought. 2. The GSA consultants followed DWR guidance in modeling potential projected impacts of climate change on the hydrology of the central coast. Flashiness is represented in a non-linear perturbation to the historical hydrologic record, but it does not allow for the creation of rain events where none exist in the hydrologic record, or the elimination of rain events that occurred. Monte Carlo modeling analysis may be considered in future modeling analysis sponsored by the GSA. 3. The methodology for estimating future pumping is documented in Appendix F and utilizes assumptions consistent with District planning documents, including the general plan, the water resources plan, and the urban water management plan, 4. Metering will be considered for active wells in the Basin. Other methods of estimation will also be considered. 5. There is no modeling evidence suggesting decades of seawater intrusion. Increased chlorides in the Sentinel well data is only observed over the past 3 to 4 years. A density-dependent flow model will be considered during ongoing assessment of the conditions along the coast in the Basin. 6. Basin groundwater conditions are observed to be lowered in response to the recent drought. Groundwater responds to weather patterns much more slowly than surface water, and will continue to be monitored during the 20-year SGMA implementation period. This GSP is intended to provide a platform to maintain the knowledge base of hydrologic conditions in the Basin, and to provide the framework to establish adaptive management of groundwater in the Basin through annual reports, projects, and management actions.
Jim Bailard	Section 4	NA	1. Evidence of seawater intrusion indicates the need for continued/additional monitoring actions. Depressed groundwater levels are the underlying cause of the intrusion. A water injection barrier will likely be needed to counteract this problem but is not considered an immediate priority in the report. The report calls for additional monitoring coupled with future modeling, design and construction of the barrier if warranted. This slow-go approach seems risky. 2. A 3-D seawater intrusion model (e.g., SEAWAT) would be helpful in guiding future monitoring efforts and assessing the need and timing for a water injection barrier.	1. Additional monitoring is recommended as a Tier 1 project. The possibility of needing a seawater intrusion barrier project is recognized, but additional data is needed along the coast before any serious design considerations can be commenced. 2. A density-dependent flow model may be sponsored by the GSA in the future.
Jim Bailard	Section 5	NA	1. The report is inconsistent in its discussion of groundwater supply imbalance and seawater intrusion. In Section 5, these items are treated as issues of potential concern that may become more serious in the future. Later, in Section 6, both issues are treated as significant ongoing problems that require mitigation actions. Model results and monitoring data support the later position. 2. A probabilistic groundwater model might help the district identify better management plans and actions for the basin. The current model produces single, deterministic outcomes that leave the district with limited information relating to MO's, MT's and required management actions. A more useful product would be probabilities of various negative conditions occurring in the future in response to various projects and management actions. The idea would be to select an acceptable low probability value and take action to achieve that goal. Obviously, this approach cannot be pursued at this time, but the district might encourage the State Department of Water Resources to develop such a model for future use.	1. Unlike other coastal basins that have observed seawater intrusion for decades (e.g., Salinas, Oxnard), the observation of data that indicate seawater intrusion are, at this writing, confined to a single well and have been observed for approximately the past 3 years. Expansion of the sentinel well monitoring network is prioritized as a Tier 1 project to gather additional data along the coast. 2. Multiple probabilistic model runs were not scoped for this version of the GSP but will be considered for future analysis.

Commenter	Section	Page/ Figure/ Table	Comment	Response
Jim Bailard	Section 6	NA	1. The text states that the Carpinteria GSA may choose to collaborate with other land use and regulatory agencies on future matters involving water supplies. It would seem that a more proactive stance is warranted since these issues go to the heart of the district's mission. 2. The CAPP is clearly needed at this time. It will help restore depleted groundwater supplies by increasing the rate of basin replenishment. 3. Monitoring and modeling suggest the water injection barrier project may be needed in the near future yet it is listed as a Tier 2 priority that may never be needed. It will be great if such an optimistic outcome takes place but it seems unlikely. Perhaps a combination of CAPP, shifting of CVWD pumping sites and reduction in private well pumping will do the trick. Given present uncertainties, it would seem prudent to begin making preparations for a barrier project. 4. Proposed management actions make no mention of increasing near-term groundwater levels as a buffer against future droughts. Such action would seem warranted given the present uncertainty of future rainfall patterns. 5. Proposed management actions do not prioritize the development of a 3-D model for seawater intrusion. This seems short-sighted given that such a model could be used to guide deployment of additional monitoring wells, refinement of the chlorinity iso-contour MT, and assessment of the need and timing for the water injection barrier project.	1. The text is intended to indicate the GSA's willingness to collaborate with other agencies, if all participants are in agreement. 2. The CAPP is proceeding and is prioritized as a Tier 1 project to be implemented in the initial 5-year SGMA implementation period. It is currently anticipated to be operational by 2026. 3. A seawater intrusion barrier project is assigned to Tier 2 status to allow for the expansion of the sentinel well monitoring network expansion to collect needed data. Sentinel well expansion may be viewed as preparatory for a barrier project if needed. Proceeding to implementation of a barrier project without collecting additional data would be premature. 4. Most if not all of the projects and management actions have the primary or ancillary goal of preventing the unreasonable decline of groundwater levels and reduction of groundwater in storage. 5. The management actions in Section 6.12 identify groundwater model updates, including development of a density-dependent flow model to simulate seawater intrusion, and incorporation of an interactive stream package to calculate surface water/groundwater interaction based on flow and aquifer conditions rather than direct definition of stream percolation.
Jim Bailard	Section 7		1. The discussion of private property water rights is confusing. The report calls for a hands-off approach, but leaves a lot of questions unanswered. For example, do private well owners have the right to pump as much groundwater as they choose in spite of negative consequences to the basin? If that's the case, how can the GSA manage groundwater supplies in a sustainable manner? If pumping limits must be set, how would this be done? Lots of unanswered questions.	SGMA addresses the sustainability of a groundwater basin, which can include reductions in pumping for all if necessary. "Water rights" addresses which users have the rights and what percentage of available groundwater each user has rights to. Under SGMA, the approach would be to work together to establish a fair division of available resources if necessary and include projects and management actions to get to and maintain sustainability. Under the "water rights" rubric division of groundwater resources would be handled in a legal forum, such as a court of law.

Commenter	Section	Page/ Figure/ Table	Comment	Response
Jim Bailard	General Comments	NA	A. The GSA should require water meters be installed on all active wells. B. Predictions of future groundwater supplies should be viewed with caution due to limitations in the current groundwater model. Conservative management of groundwater supplies are warranted until better information is available. C. The report should use a more consistent approach in its discussion of water supply imbalance and seawater intrusion. These issues should be presented as significant problems that need mitigation in the near term, not as issues that may become serious in the future. D. The GSA should urge the California Department of Water Resources to develop a better groundwater model (perhaps probability-based) for use in GSP updates. E. The CAPP project should be completed as quickly as possible. F. The GSA should consider increasing near-term groundwater supplies as a hedge against ongoing/future droughts. G. The development of a 3-D seawater intrusion model should be prioritized as a near-term task. H. Priority should be given to pre-project tasks for a water injection barrier project allowing timely implementation if needed. I. Clarity should be sought in determining the GSA's ability to manage future groundwater extraction by private land owners. J. The GSA should consider taking a more proactive approach in influencing local land use decisions as they relate to water supply issues.	A. Metering is one option being considered to better measure private pumping in the Basin, as described in Section 6.10. B. It is the intent of SGMA to foster sustainable groundwater management over the 20-year planning horizon. C. Both of these issues are identified as significant management issues to be monitored and addressed during the SGMA implementation period. It is unclear at this point to what extent these issues were exacerbated by the recent drought, and to what extent they will continue into the future. Groundwater systems respond slowly to changing conditions, and the SGMA annual reports will document conditions, projects, and management actions on an annual basis during the 20-year planning horizon. D. It is the responsibility of the GSA to maintain and update the basin groundwater model, and appropriate revisions are expected in the future. E. The CAPP is scheduled for completion by 2026. F. Many of the projects and management actions, including water banking, ASR, and recharge projects, are intended to increase local supplies. G. A 3-D density-dependent flow model will be considered in the future. It would be most effective to consider this after completion of the Sentinel Well Network Expansion, when additional data along the coast is available. H. The Sentinel Well Network Expansion project is prioritized as a Tier 1 project. This is essentially a pre-project task required before consideration of a barrier project. I. This is a legal and policy consideration that will be considered during the implementation period. J. Comment noted. The GSA will strive for the most efficient management of the groundwater basin in concert with other local agencies.
Jim Bailard	Section 1	NA	Add a subsection near the front of the report listing definitions for all acronyms.	A list of Abbreviations and Acronyms is included at the beginning of the Plan. It is a standard list following accepted document production that provides the abbreviations and acronyms used and their definitions. Abbreviations and acronyms are defined in the Executive Summary and then in the report as a whole on first use and sometimes again. While a glossary with extended definitions for common terms is not provided for the Plan and will not be created, the "Definitions" section at the beginning of the Plan provides full definitions from the California Water Code and the CCR for many terms used in the Plan.
Jim Bailard	Section 3	Page 3-9 - Figure 3-4	Should there be a key for the various soil types? All Figures: Pages with figures need page numbers added.	A legend has been included for the various geologic formations presented in the figure. Page numbers are added to figures for the final GSP.
Jim Bailard	Section 3	Page 3-100- pt Paragraph	Second sentence should say"..... two single wet years in 2017 and 2019." Page 3-117 - Last Paragraph: Perhaps State Water Project should be spelled out instead of SWP?	Text revised.
Jim Bailard	Section 3	Page 3-127 - Last Paragraph	The last sentence says"... with the ocean is believed to be occurring, ..". This should be changed to "... with the ocean is occurring, ...".	Text is revised.
Jim Bailard	Section 4	Page 4-4 -1st Paragraph	RMS & SGMA should be spelled out/defined. Page 4-9- pt Paragraph: TDS should be spelled out/defined.	The definition for RMS has been added to Section 4 where it is first used. The definition for SGMA has been added to Section 4 where it is first used. TDS is defined in Section 4.3.1, so no change made.

Commenter	Section	Page/ Figure/ Table	Comment	Response
Jim Bailard	Section 4	Page 4-11- pt Paragraph	BMP's should be spelled out/defined. Also, well density information should use consistent units - i.e., either #wells/sq-mile or #wells/100 sq-mile, not both.	The definition of BMP has been added to Section 4.4. The first units is expressed as documented in the original reference, which references pumping volume. The second units is more appropriate for a basin of area 12.7 square miles.
Jim Bailard	Section 4	Page 4-11- 2nd Paragraph	AB 3030 GMP should be spelled out/defined.	The definition for AB has been added to Section 4.3.1. GMP is already defined in Section 4.3.1, so no change made.
Jim Bailard	Section 4	Page 4-17 - 2nd Paragraph	East and west are reversed. MGD lies along the Basin's western boundary and Ventura County along its east boundary.	Corrected.
Jim Bailard	Section 4	Page 4-19 - Last Paragraph	It might be useful to mention what the specific data gaps are along the east and west boundaries. Also, how will these data gaps be addressed?	Text revised.
Jim Bailard	Section 4	Page 4-20 - 2nd Paragraph	The text speaks of a potential for seawater intrusion. In fact, Chapter 3 indicates that intrusion is already happening and has been for decades. Should the Chapter 4 text be changed to reflect this fact?	There is no evidence that seawater intrusion has been occurring for decades in the Carpinteria Basin. To date evidence has been observed in one well. Text is left as originally written.
Jim Bailard	Section 4	Page 4-33 - Middle of the Page	The text speaks of low groundwater conditions during the 1950's and early 1990's. Current conditions in many areas are also bad. Should this be stated?	A reference to the recent drought period is added.
Jim Bailard	Section 5	Page 5-2, Section 5.2	This subsection dealing with the definition of acronyms is extremely useful and should be replicated in other chapters. Acronyms should be defined whenever they are first encountered. It might be more efficient to provide a separate section at the front of the report defining all acronyms used in the report.	A list of Abbreviations and Acronyms is included at the beginning of the Plan. It is a standard list following accepted document production that provides the abbreviations and acronyms used and their definitions. Abbreviations and acronyms are defined in the Executive Summary and then in the report as a whole on first use and sometimes again. While a glossary with extended definitions for common terms is not provided for the Plan and will not be created, the "Definitions" section at the beginning of the Plan provides full definitions from the California Water Code and the CCR for many terms used in the Plan.
Jim Bailard	Section 5	Page 5-13, Figures 5-1 thru 5-8	An argument could be made that starting the timeline at 1940 gives an optimistic impression that groundwater supplies are doing pretty well. The 1940's and early S0's were a time when groundwater was the principal source of irrigation water for the valley. Once the Cachuma Reservoir came online in the mid-1950's, water supplies became more plentiful and groundwater levels rebounded reaching a maximum around 1985. After that, conditions changed and groundwater levels began to drop (ignoring ups and downs caused by wet and dry years) reflecting an imbalance between basin re-charge and pumped extraction. By contrast, if the timeline were changed to 1985 (i.e., the start of the historical precipitation model period), it would give a perhaps more realistic picture of current conditions.	The graphs start in the 1940s because that is the beginning of the period of record for water level data in some of the wells. It is recognized that land and water use conditions have changed over time.

Commenter	Section	Page/ Figure/ Table	Comment	Response
Jim Bailard	Section 5	Page 5-23, l51 Paragraph	This is another illustration of overly optimistic predictions. The text states that no undesirable effects occurred during the current drought period hence MT's can safely be set at the lowest levels observed during this time period. In fact, current water levels appear to cause ongoing seawater intrusion and there exists little room for continued drought. The CAPP project will greatly help to mitigate the current over-draft situation. Additional priority should be given to increasing groundwater levels in the short/medium term.	Undesirable results for the chronic lowering of groundwater levels are defined in Section 5.5.1 as those that impact the ability to provide potable water supply, or that indicate insufficient supply for agricultural operations as reported during interviews with agricultural representatives in the Basin. These conditions were not reported during the recent drought. Seawater Intrusion undesirable results are defined as impacting currently active wells, which has not been observed. However, seawater intrusion is repeatedly identified as a significant issue to be addressed in ongoing groundwater management in the Basin.
Jim Bailard	Section 5	Pages- 32, Middle of Page	Another example of rosy thinking. The text implies that groundwater levels could decline if increased pumping puts the basin out of balance. In fact, the basin water supply has been out of balance for the past 35 years. There are other places in the chapter where this comment applies.	Comment noted.
Jim Bailard	Section 5	Page 5-39, Bottom of Page	This paragraph does a much better job discussing the current seawater intrusion situation, describing it as an ongoing process that will require further monitoring and management action.	Seawater intrusion is recognized in the GSP as a significant issue to be monitored and addressed in the basin management, including a Tier 1 project for sentinel well network expansion.
Jim Bailard	Section 5	Page 5-45, Lower Page	Change, "An estimate of 0.15 used ..." to "An estimate of 0.15 was used ...". Page 5-48, Bottom of Page: Additional ERT surveys may have been mentioned in Chapter 4. If so, should they be mentioned here for consistency?	Calculations are generally referenced in the present tense. The ERT surveys are informative, but do not directly apply to the measurement of minimum thresholds, which this paragraph discusses.
Jim Bailard	Section 6	Page 6-2, Middle of Page	Land use decisions can have a significant impact on overall water use, including groundwater supplies. Shouldn't the GSA or CVWD take a more active position in providing input and feedback relating to water supplies?	The GSA intends to work with other agencies working toward groundwater sustainability.
Jim Bailard	Section 6	Page 6-14, Figure 6-2	The note in the top right corner of this figure doesn't show up properly in the digital document. I assume it will be corrected in the final printed report.	The legend for Figure 6-2 has been moved to the blank space.
Jim Bailard	Section 6	Page 6-15, Middle of Page	iso-contour is misspelled.	Isocontour (without a hyphen) is used in the rest of the Plan and is accepted use (see quote from SWCA in Section 5.7.2). No change made.
Jim Bailard	Section 6	Page 6-31, Middle of Page	The Intertie Project is mentioned in the text as being Tier 1 but it doesn't show up in the earlier list.	The text describing this project is revised from the Public Draft. The public draft included both the infrastructure intertie project and the potential water banking agreements in the same section, which was confusing. These are now addressed as separate projects in Section 6.5 and Section 6.9.
Jim Bailard	Section 6	Page 6-31, Middle of Page	Is the term "wheel" a specialized water resources word? Would "direct" be a better word?	“Water wheeling” is casual industry parlance. Text revised.
Jim Bailard	Section 7	Page 7-1, First Paragraph	The text refers to the Groundwater Sustainability Plan as the "Plan". Other sections refer to it as the GSP. Best to choose one or the other and be consistent.	GSP and Plan are used throughout the document and are both acceptable as definitions for Groundwater Sustainability Plan. A definition for GSP has been added to the Acronym list and GSP is now defined on first use in the text. Text has been added to the acronym list under the entries “GSP” and “Plan” to clarify this.

Commenter	Section	Page/ Figure/ Table	Comment	Response
James Bishop (Central Coast Regional Water Quality Control Board)	General Comment	NA	The Central Coast Regional Water Quality Control Board (Central Coast Water Board) is a state agency that implements state and federal water quality laws within the central coast region. The Carpinteria groundwater basin falls within the jurisdictional area of the central coast region and, as such, the Central Coast Water Board has an interest in monitoring, preserving, and restoring water quality within the area. Central Coast Water Board staff reviewed portions of the draft Carpinteria Groundwater Basin Groundwater Sustainability Plan1 (GSP) and submits this letter to comment on water quality-related components of the draft plan.	Thank you for the comments. They are duly noted and maintained for the record. Individual comments on the GSP are addressed below.
James Bishop (Central Coast Regional Water Quality Control Board)	Section 4	NA	Section 4: Monitoring Networks Section 4.3.1 describes a proposed groundwater quality monitoring network. It is unclear if this monitoring network includes wells that can monitor the water quality impacts of projects and management actions proposed in the GSP, such as aquifer storage and recovery (ASR) and indirect potable reuse (IPR). If the GSA implements these activities, water quality impacts associated with the activity need to be evaluated within the context of the GSP to determine if GSA management actions are having a detrimental impact on basin-scale water quality. Projects or management actions adopted by a GSA within its GSP should not cause degradation of water quality that could lead to an undesirable result. Central Coast Water Board staff recommend that the monitoring wells associated with any ASR or IPR projects be included in the GSP water quality monitoring network. A GSA should consider the best available water quality information for the basin, including data used to develop the hydrogeologic conceptual model, geochemistry of geological formations (for the potential of mobilization of natural constituents), and groundwater uses in the vicinity of the representative monitoring sites and the basin as a whole when determining which constituents to monitor for and evaluate for minimum thresholds. Section 4.4.4 describes the constituents to be included in the water quality monitoring network proposed by the GSP. Constituents include arsenic, nitrate, total dissolved solids, chloride, and boron. Central Coast Water Board staff recommend that sodium also be added as a constituent to be monitored in the water quality monitoring network because some of the projects and management actions proposed by the GSA in Section 6 have the potential to load sodium to groundwater, impairing agricultural beneficial use of groundwater. For example, the GSP proposes to implement IPR, which utilizes recycled water. Recycled water commonly contains substantial amounts of sodium (and chloride). Sodium may increase in the basin because of this project. Similarly, ASR projects using treated surface water from Lake Cachuma may have substantial amounts of sodium present. ASR projects along the south coast of Santa Barbara County that use Lake Cachuma water may have sodium concentrations that exceed the recommended guidelines for irrigation water (Table 3-1 of the Water Quality Control Plan for the Central Coastal Basin2 [Basin Plan]). For example, the sodium concentration in water from Lake Cachuma reported by other ASR projects in the area (e.g., City of Santa Barbara) is approximately 90 mg/L, which exceeds the threshold of 69 mg/L for “increasing problems” for irrigation water described in Table 3-1. Monitoring and evaluation of sodium loading to the basin is important because sodium can have a detrimental impact on the agricultural beneficial use. Given the substantial amount of agriculture that occurs within the Carpinteria groundwater basin boundary, it’s important to ensure that the agricultural beneficial use is protected. Simply monitoring total dissolved solids (as opposed to monitoring the constituents that make up TDS such as sodium, chloride, etc.) may not be adequate for understanding the	The GSA considered that including both TDS and chloride as constituents to be monitored would be adequate to characterize any changes in water quality due to potential salt loading. However, all wells currently monitored for water quality in the Basin are analyzed for the general chemistry suite of common cations and anions. Sodium is included in this suite, and so it will be analyzed, and the data will be included in annual reports.

Commenter	Section	Page/ Figure/ Table	Comment	Response
			potential impairment of the agricultural beneficial use. While salts are generally considered detrimental to agricultural productivity, not all salt-forming ions impact plant growth uniformly. Gypsum is commonly used as an agricultural amendment and contributes substantial amounts of sulfate, which increases measurements of total dissolved solids. However, gypsum isn't particularly harmful to plants. By contrast, chloride and sodium can be particularly toxic to plants and comprise a large fraction of the salts composition in recycled water.	
James Bishop (Central Coast Regional Water Quality Control Board)	Section 5	NA	**Section 5: Sustainable Management Criteria** Section 5.8 describes the water quality degradation sustainable management criteria. As previously stated, Central Coast Water Board staff recommend including sodium as a constituent in the water quality monitoring network and similarly recommends that sodium be included in the water quality sustainable management criteria for the same reasons previously described (e.g., projects or management actions proposed in the GSP may contribute substantial amount of sodium to the groundwater basin).	All groundwater samples collected for analytical laboratory analysis will be analyzed for sodium as part of the monitoring program. This data will be tracked in the annual reports. The current SMCs for TDS and chloride provide adequate spatial characterization of salinity of groundwater in the Basin. The establishment of a specific SMC for sodium will be considered in coming years as these data are evaluated, and as revisions to the GSP are prepared in the future. Projects and management actions identified in the GSP will be evaluated with respect to antidegradation of groundwater quality.
James Bishop (Central Coast Regional Water Quality Control Board)	Section 6	NA	**Section 6: Projects and Management Actions** Section 6.7 describes proposed recharge enhancement projects identified as "Tier 2" projects that would be implemented after Tier 1 projects are underway. Central Coast Water Board staff acknowledge that these Tier 2 projects are in the preliminary planning stages and detail is not yet available. As such, the intent of these comments is not to point out deficiencies in planning for these projects but rather to make the GSA aware of water quality concerns that Central Coast Water Board staff may have if these projects were to move forward. One of the recharge enhancement projects proposed is to "de-line" portions of Franklin and Santa Monica Creek to facilitate recharge through the bed of the creeks, which are currently concrete lined for much of their reaches. This proposed management action may have both water quality benefits and negative impacts to local surface water bodies. Some of the possible benefits are reductions in stream nutrient concentrations by denitrification in the hyporheic zone and recharging nitrate-laden water. This would potentially result in reductions in nitrogen downstream, which is relevant to Franklin Creek since it has a nitrogen total maximum daily load allocation, and also in the Carpinteria saltmarsh. However, de-lining the bottom of these streams that have been straightened, channelized, and disconnected from the floodplain may result in substantial amounts of scour, sediment transport, and sediment deposition in the Carpinteria saltmarsh, particularly during winter high-flow events when flow velocities are at their peak and scour potential is greatest. Increases in sediment loading and turbidity that result from de-lining could impact the beneficial uses identified in the Basin Plan for Franklin and Santa Monica creeks and the Carpinteria saltmarsh. Central Coast Water Board staff recommends that if the GSA pursues this type of recharge enhancement project, it considers the potential water quality impacts in addition to the water supply benefits. In addition, Central Coast Water Board staff request that we be contacted regarding any California Environmental Quality Act notices regarding these proposed recharge enhancement projects so that the Central Coast Water Board can provide input and comments.	As noted in the RWQCB's letter, this project is in the early conceptual planning stages. A full assessment of water quality impacts will be considered prior to moving forward with this project.