Appendix H2

Supplemental Assessment of Pumping Required

TECHNICAL MEMORANDUM

Supplemental Assessment of Pumping Required for the Cadiz Groundwater Conservation, Storage and Recovery Project

Prepared for: Brownstein Hyatt Farber Schreck, LLP

September 20, 2011

GEOSCIENCE

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Technical Memorandum

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To:	Mr. Scott S. Slater, Esq. Brownstein Hyatt Farber Schreck, LLP 21 East Carrillo Street Santa Barbara, California 93101-2706
From:	Dennis E. Williams, Ph.D. President GEOSCIENCE Support Services, Inc.
Date:	September 20, 2011
Subject:	**Supplemental Assessment of Pumping Required for the Cadiz Groundwater Conservation, Storage and Recovery Project**

1.0 PURPOSE

The Cadiz Groundwater Conservation, Storage and Recovery Project (Project) is a water conservation supply and conjunctive use storage project that would actively manage the groundwater basin within the Fenner Watershed and the Orange Blossom Wash located in the Eastern Mojave Desert (see Figure 1). The Project will develop a new water supply and storage facility for the Santa Margarita Water District (SMWD) and other participating water agencies. The first phase of the Project, the Conservation Component, would extract and convey an average of approximately 50,000 acre-ft/yr of groundwater from a wellfield in Fenner Gap via a pipeline to the Colorado River Aqueduct (CRA) (see Figure 1). The long-term average annual natural recharge of the Fenner Watershed has been estimated to be approximately less than 5,000 acre-ft/yr to 40,000 acre-ft/yr (see Appendix D of GEOSCIENCE, 2011). This memorandum provides supplemental information to explain the strategy of pumping groundwater above the cumulative natural recharge rate in the Fenner, Orange Blossom, Cadiz, and Bristol Watersheds.

2.0 CONTROLLING FACTORS OF EVAPORATIVE LOSSES

The primary goal of the Project is to optimize the use of the underlying groundwater basin to maximize the reasonable and beneficial use of groundwater while minimizing environmental harm by capturing natural recharge and minimizing the present waste of water to evaporation at the Bristol and Cadiz Dry Lakes. Conservatively, there is approximately 17 to 34 million acre-ft of groundwater in storage in this alluvial aquifer system and of that approximately 4 to 10 million acre-ft of fresh groundwater (i.e., total dissolved solids concentration is less than 1,000 mg/L) in storage below the Fenner Gap alone (CH2M Hill, 2010). The elevation of the water table at Fenner Gap based on groundwater measurements collected in 2009, is approximately 610 ft above mean sea level (amsl), whereas the low areas of Bristol and Cadiz Dry Lakes are 580 and 545 ft amsl, respectively (see Figure 2). This difference in elevation provides the driving hydraulic gradient of fresh groundwater flowing to the dry lakes. It is the goal of the Project to capture this fresh groundwater flowing to the dry lakes, thereby conserving the water for beneficial use.

There are three factors that control the extent to which Cadiz can maximize capture of natural recharge which is flowing to the dry lakes. These factors are:

- Natural recharge rate,
- Location of the wellfields, and
- Rate and timing of pumping.

As the natural recharge is somewhat uncertain, Cadiz is evaluating a range of recharge rates in order to examine potential impacts from the operation of the Project. The location of the wellfields is limited to Cadiz's property and hydrogeology (i.e., productive areas of the basin). The wellfields (proposed new wellfield and existing Cadiz agricultural wellfield) are located near Fenner Gap which is distant from the dry lakes. The wellfields needs to flatten the hydraulic gradient to prevent loss by flow to the dry lakes. The location and timing of pumping rates will determine how quickly and what volumes of fresh groundwater can be conserved for beneficial use instead of being lost to evaporation. Higher rates of pumping earlier in the development of the Project will result in the establishment of a cone of depression and a more extended capture zone compared to lower rates of pumping. Cadiz desires to intercept as much fresh groundwater as practical and put this water to beneficial use, without creating adverse impacts or causing harm.

3.0 WATER SAVING FROM THE PROPOSED PROJECT PUMPING SCHEDULE

Cadiz proposes to pump an average of 50,000 acre-ft/yr over the 50-year term of the Project. As project participants require project water to meet drought or emergency demands, their annual delivery requirements may be variable in quantity as opposed to taking a constant delivery of water. To simulate the project, model simulations conducted by GEOSCIENCE (2011) varied pumping rates between 25,000 acre-ft/yr and 75,000 acre-ft/yr, but maintained a long-term average of 50,000 acre-ft/yr (see Figure 3). The variable pumping rates were based on projected deliveries of Table A water from Metropolitan Water District. Projected pumping was increased in years when projected deliveries would be lower and decreased during periods when projected delivery volumes would be greater. Given that the goal of the Project is to recover and conserve fresh groundwater for beneficial use, the net water savings from the pumping operation was calculated using the following equation:

$$NWS = REL - DS$$

Where:

NWS = Net Water Savings from the Project, acre-ft

REL = Reduction of Evaporative Loss from the Project, acre-ft

DS = Depletion of Storage under Project Conditions, acre-ft

3.1 Reduction of Evaporative Loss

Reduction of evaporative loss from the Project was calculated as the difference between the evaporative loss under no Project conditions (i.e., no pumping) and Project pumping conditions. Based on the results of the steady-state model calibration (GEOSCIENCE,2011), the projected cumulative loss of fresh groundwater to evaporation under no project conditions for the 32,000, 16,000, and

5,000 acre-ft/yr natural recharge cases, which over 100 years results in cumulative volumes of 3,200,000, 1,600,000, and 500,000 acre-ft, respectively (see Figure 4). Therefore, with no development of groundwater, these are the volumes of fresh groundwater that would be lost and not put to beneficial uses.

Figure 5 shows the model-predicted cumulative fresh groundwater loss for pumping under Project conditions of 50,000 acre-ft/yr as described in GEOSCIENCE (2011) for the 32,000, 16,000, and 5,000 acre-ft natural recharge cases (i.e., Project Scenario, Sensitivity Scenario 1 and Sensitivity Scenario 2, respectively). The total losses at the end of 50 years (i.e., end of Project pumping) are approximately 240,000, 55,000, and 30,000 acre-ft, respectively. At the end of 100 years, the losses are 990,000, 55,000 and 30,000 acre-ft, respectively.

Pumping an average of 50,000 acre-ft/yr reduces evaporative losses by 2,210,000 acre-ft (i.e., 3,200,000 acre-ft – 990,000 acre-ft = 2,210,000 acre-ft) for the 100-year period where natural recharge is 32,000 acre-ft/yr. The reduction of evaporative losses over a 100-year period for the 16,000 and 5,000 acre-ft/yr natural recharge scenarios are 1,545,000 (1,600,000 acre-ft – 55,000 acre-ft = 1,545,000 acre-ft) and 470,000 acre-ft (500,000 acre-ft – 30,000 acre-ft = 470,000 acre-ft), respectively. The following table summarizes the reduction of evaporative losses from the proposed Project pumping schedule at the end of 50 and 100 years.

Natural Recharge	Time	Scenario	Cumulative Evaporative Losses [acre-ft]	Cumulative Reduction of Evaporative Losses [acre-ft]
32,000 acre-ft/yr	At the End of 50 Years	No Pumping	1,600,000	1,360,000
		Project Scenario (Pumping 50,000 acre-ft/yr)	240,000	
	At the End of 100 Years	No Pumping	3,200,000	2,210,000
		Project Scenario (Pumping 50,000 acre-ft/yr)	990,000	
16,000 acre-ft/yr	At the End of 50 Years	No Pumping	800,000	745,000
		Sensitivity Scenario 1 (Pumping 50,000 acre-ft/yr)	55,000	
	At the End of 100 Years	No Pumping	1,600,000	1,545,000
		Sensitivity Scenario 1 (Pumping 50,000 acre-ft/yr)	55,000	
5,000 acre-ft/yr	At the End of 50 Years	No Pumping	250,000	220,000
		Sensitivity Scenario 2 (Pumping 50,000 acre-ft/yr)	30,000	
	At the End of 100 Years	No Pumping	500,000	470,000
		Sensitivity Scenario 2 (Pumping 50,000 acre-ft/yr)	30,000	

3.2 Depletion of Storage

The depletion of storage under Project conditions was calculated using the Cadiz Groundwater Model (GEOSCIENCE, 2011). The depletion of storage over the 50-year period for the 32,000, 16,000 and 5,000 acre-ft/yr natural recharge cases (i.e., Project Scenario, Sensitivity Scenario 1 and Sensitivity Scenario 2, respectively) are 1,090,000, 1,680,000 and 2,160,000 acre-ft, respectively (GEOSCIENCE, 2011). The depletion of storage over the 100-year period for the 32,000, 16,000 and 5,000 acre-ft/yr natural recharge cases are 220,000, 870,000 and 1,870,000 acre-ft, respectively. The depletion in storage at the end of 100 years is less than the depletion in storage for 50 years because the model assumes no pumping after 50 years.

3.3 Net Water Saving

The net water saving from the Project was calculated using the equation described above in Section 3.0. The following table summarizes the results.

Natural Recharge	Time	Cumulative Reduction of Evaporative Losses [acre-ft]	Cumulative Depletion of Storage [acre-ft]	Cumulative Net Water Saving from Project [acre-ft]
32,000 acre-ft/yr	At the End of 100 Years	2,210,000	220,000	1,990,000
16,000 acre-ft/yr	At the End of 100 Years	1,544,000	870,000	674,000
5,000 acre-ft/yr	At the End of 100 Years	470,000	1,870,000	-1,400,000

As shown in the table above, the 32,000 and 16,000 acre-ft/yr natural recharge scenarios, with an average pumping of 50,000 acre-ft/yr, would create a net savings of 1,990,000 and 674,000 acre-ft, respectively. These savings are calculated over a 100-year period, comparing the evaporative losses that would have occurred without the Project and the depletion in storage at the end of the 100-year period.

For example, the evaporative losses at the end of 100 years for the 32,000 acre-ft/yr natural recharge scenario is 3,200,000, whereas with the Project, the evaporative losses are reduced to 990,000 acre-ft and the depletion of storage after 100 year is 220,000 acre-ft. So, the net savings are 3,200,000 acre-ft that would have evaporated without the Project, less 990,000 acre-ft of evaporative losses that occur even with the Project, less 200,000 acre-ft of depleted storage with the Project, equals approximately 1,990,000 acre-ft of saved freshwater at the end of the 100-year period.

It is also interesting to note that the volumes of groundwater impacted by the migration of saline water due to project pumping (as calculated based on models runs reported in the GEOSCIENCE, 2011 report) are 173,000 and 215,000 acre-ft for the 32,000 and 16,000 acre-ft/yr natural recharge scenarios, respectively. So, even with these volumes, there is still a net savings of fresh groundwater by implementing the Project versus not implementing it. The only scenario that has a negative net savings is the 5,000 acre-ft/yr natural recharge scenario (i.e., Sensitivity Scenario 2), which is very conservative; however, there are no adverse impacts associated even with this scenario. For the scenarios of 32,000 and 16,000 acre-ft/yr natural recharge (i.e., Project Scenario and Sensitivity Scenario 1), implementation of the Project results in making beneficial use of large quantities of groundwater that that would otherwise evaporate from the dry lakes.

4.0 CONSERVED WATER FROM THE ALTERNATIVE PUMPING SCENARIOS

4.1 Description of Alternative Pumping Scenarios

Since the Cadiz project goal is to maximize the conservation of fresh groundwater and put this water to beneficial use, we examined the possibility of pumping at higher rates in the early half of the Project and reducing pumping in the last half of the Project. As Cadiz desires to implement conjunctive use of the groundwater basin by storing imported water during times of surplus and retrieving this stored water during times of drought or emergencies, then an earlier development of storage space in the basin will accommodate larger conjunctive use projects quicker, in addition to potentially capturing more fresh groundwater that is flowing to the dry lakes.

An alternative pumping schedule was developed that included pumping 75,000 acre-ft/yr for 25 years, then reducing the pumping rate to 25,000 acre-ft/yr for the remaining 25 years (see Figure 6). The purpose of the alternative pumping schedule is to examine:

- The potential benefits of capturing more water in transit to the dry lakes that could be put to beneficial use, and
- The potential impacts of this pumping distribution as compared to the pumping distribution presented in previous analyses (GEOSCIENCE, 2011).

Two model runs were made using the alternative pumping schedule:

- Sensitivity Scenario 3: Natural Recharge of 32,000 acre-ft/yr with Alternative Pumping Schedule

- Sensitivity Scenario 4: Natural Recharge of 16,000 acre-ft/yr with Alternative Pumping Schedule

Sensitivity Scenarios 3 and 4 can be compared to the Project Scenario and Sensitivity Scenario 1 (as described in GEOSCIENCE, 2011), respectively.

4.2 Modeling Results from Alternative Pumping Scenarios

Figures 7, 8 and 9 show the groundwater elevations, regional drawdown and migration of the saline groundwater front for the Sensitivity Scenario 3 (natural recharge of 32,000 acre-ft/yr with alternative pumping schedule). Figure 10 shows the predicted drawdown for the Sensitivity Scenario 3 during the 100-year model simulation period at selected locations, including the center of the new wellfield, the existing Cadiz wellfield, the edge of Bristol Dry Lake, the center of Bristol Dry Lake, and the edge of Cadiz Dry Lake.

Figures 11, 12 and 13 show the groundwater elevations, regional drawdown, and migration of the saline groundwater front for the Sensitivity Scenario 4 (natural recharge of 16,000 acre-ft/yr with alternative pumping schedule). Figure 14 shows the predicted drawdown for the Sensitivity Scenario 4 during the 100-year model simulation period at selected locations, including the center of the new wellfield, the existing Cadiz wellfield, the edge of Bristol Dry Lake, the center of Bristol Dry Lake, and the edge of Cadiz Dry Lake.

Figure 15 shows the cumulative change in groundwater storage for Sensitivity Scenario 3 as compared to the Project Scenario. Similarly, Figure 16 shows the cumulative change in groundwater storage for Sensitivity Scenario 4 as compared to Sensitivity Scenario 1.

These figures show that differences between the pumping distributions are not very significant. The maximum drawdown is reached earlier but begins to recover when pumping is reduced (see Figures 10 and 14), which is the same situation for groundwater storage (see Figures 15 and 16). There is minimal change in the saline front, which is only 400 ft at its maximum.

Figure 17 shows the reduction in fresh groundwater losses to evaporation between the two pumping scenarios for the 32,000 acre-ft/yr natural recharge case. This shows that pumping at the higher rates early in the Project reduces evaporative losses by about 130,000 acre-ft in the first 50 years and about 70,000 acre-ft over the 100-year period. Figure 18 shows the reduction in fresh groundwater losses to evaporation between the two pumping scenarios for the 16,000 acre-ft/yr natural recharge case. Figure 18 shows a reduction of about 15,000 and 13,000 acre-ft over the 50- and 100-year periods, respectively.

This analysis clearly indicates the potential to recover and conserve additional fresh groundwater and put it to beneficial use, which will otherwise flow to the dry lakes and evaporate. In addition, pumping at a higher rate would create more storage space earlier, which would condition the basin for a larger conjunctive use project earlier than if pumping is limited to lower rates. This assessment shows that Cadiz has considerable flexibility to alter pumping rates early in the Project without causing significant adverse impacts.

5.0 FINDINGS

The following findings are based on the results from the supplemental assessment of pumping required for the Project:

- Conservatively, there is approximately 17 to 34 million acre-ft of groundwater in storage in the alluvial aquifer system, and approximately 4 to 10 million acre-ft of fresh groundwater (i.e., total dissolved solids concentration is less than 1,000 mg/L) in storage below the Fenner Gap alone. The elevation of the water table at Fenner Gap is approximately 610 ft above mean sea level (amsl), whereas the low areas of Bristol and Cadiz Dry Lakes are 580 and 545 ft amsl, respectively. This difference in elevation provides the driving hydraulic gradient of fresh groundwater flowing to the dry lakes.

- The location and timing of pumping rates will determine how quickly and what volumes of fresh groundwater can be conserved for beneficial use instead of being lost to evaporation. Higher rates of pumping earlier in the development of the Project will result in the establishment of a cone of depression and a more extended capture zone compared to lower rates of pumping.

- The 32,000 and 16,000 acre-ft/yr natural recharge scenarios, with an average pumping of 50,000 acre-ft/yr, would create a net savings of 1,990,000 and 674,000 acre-ft, respectively. These savings are calculated over a 100-year period, comparing the evaporative losses that would have occurred without the Project and the depletion in storage at the end of the 100-year period.

- The volumes of groundwater impacted by the migration of saline water are 173,000 and 215,000 acre-ft for the 32,000 and 16,000 natural recharge scenarios, respectively. Even considering these volumes, there is still a net savings of fresh groundwater by implementing the Project versus not implementing it.

- The only scenario that has a negative net savings is the 5,000 acre-ft/yr natural recharge scenario (i.e., Sensitivity Scenario 2), which is very conservative; however, there are no adverse impacts associated even with this scenario. For the scenarios of 32,000 and 16,000 acre-ft/yr natural recharge (i.e., Project Scenario and Sensitivity Scenario 1), implementation of the Project results in making beneficial use of large quantities of groundwater that would otherwise become evaporate from the surface of the dry lakes.

- For the natural recharge of 32,000 acre-ft/yr, pumping at the higher rates early (i.e., 75,000 acre-ft/yr in the first 25 years of the alternative pumping schedule) in the Project reduces evaporative losses by about 130,000 acre-ft in the first 50 years and about 70,000 acre-ft over the 100-year period. This indicates there is potential to conserve additional fresh groundwater and put it to beneficial use, which otherwise would migrate to the dry lakes where it will evaporate

- For the natural recharge of 16,000 acre-ft/yr, pumping at the higher rates early (i.e., 75,000 acre-ft/yr in the first 25 years of the alternative pumping schedule) in the Project reduces evaporative losses by about 15,000 and 13,000 acre-ft over the 50- and 100-year periods, respectively.

- Differences between the alternative pumping schedule and the proposed Project pumping schedule are not very significant. The maximum drawdown is reached earlier for the alternative pumping schedule but begins to recover when pumping is reduced, which is the same response as groundwater storage. There are minimal changes in the distribution of the saline front, which is only 400 ft at its maximum.

- Pumping at a higher rate would create more storage space earlier, which would condition the basin for a larger conjunctive use project earlier than if pumping is limited to lower rates. This assessment shows that Cadiz has the flexibility to alter pumping rates early in the Project without causing significant adverse impacts.

6.0 REFERENCES

CH2M Hill, 2010. *Cadiz Groundwater Conservation and Storage Project*. Prepared for Cadiz, Inc., July, 2010.

GEOSCIENCE Support Services, Inc., 2011. *Cadiz Groundwater Modeling and Impact Analysis. DRAFT*. Prepared for Brownstein Hyatt Farber Schreck, LLP. September 1, 2011.

Metropolitan Water District of Southern California (MWD), 2009. *Table of State Project Deliveries for the Period 1922 to 2003*.

FIGURES

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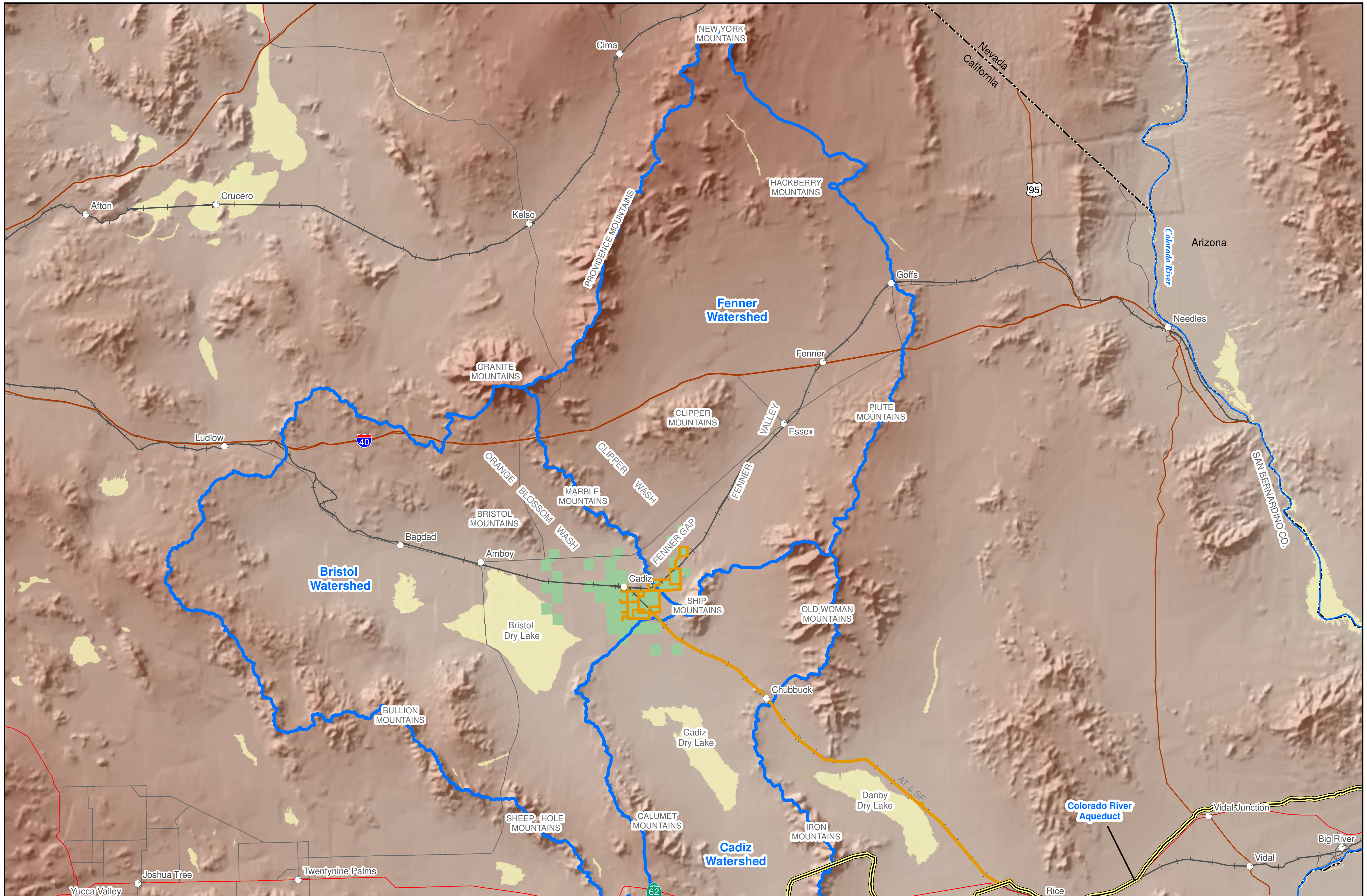
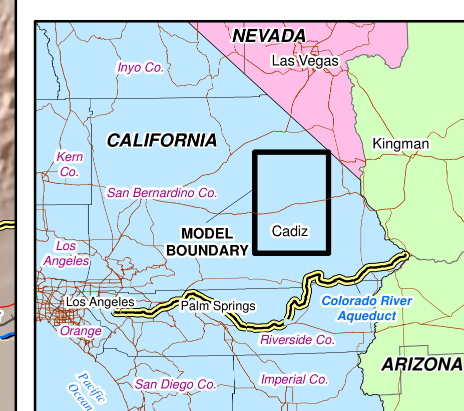
SUPPLEMENTAL ASSESSMENT OF PUMPING REQUIRED FOR THE
CADIZ GROUNDWATER CONSERVATION, STORAGE AND RECOVERY PROJECT

GENERAL PROJECT LOCATION



EXPLANATION

- Selected Watershed Boundaries
- Proposed Wellfield Development Areas and Pipeline
- Cadiz Owned Land
- Railroad
- State Boundary
- Colorado River Aqueduct



NORTH

0 10 20 Miles

20-Sep-11

Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.

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Figure 1

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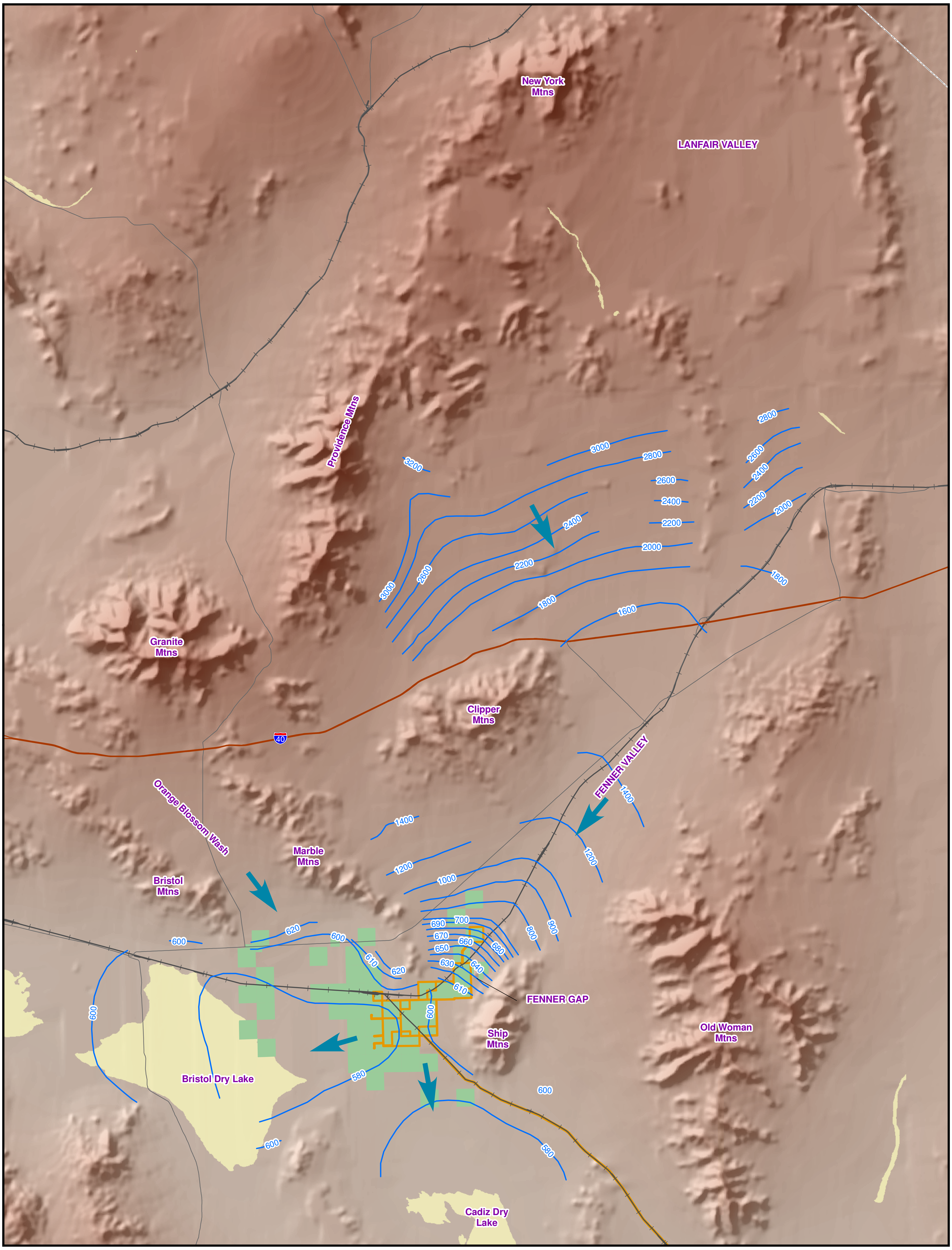
SUPPLEMENTAL ASSESSMENT OF PUMPING REQUIRED FOR THE
CADIZ GROUNDWATER CONSERVATION, STORAGE AND RECOVERY PROJECT



Proposed Wellfield Development Areas and Pipeline

Cadiz Owned Land

580 2009 Groundwater Elevations (ft amsl) (Source: CH2M-Hill, 2010)

Groundwater Flow Direction

NORTH

0 2.5 5 Miles

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2009 GROUNDWATER ELEVATIONS

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Figure 2

GIS_proj/brownstein_cadiz_model_analysis_9-11/0_TECH_MEMO_Scen3_Scen4_9-11/0_Fig_02_GW_elevs_2009_9-11.mxd

Cadiz Groundwater Conservation, Storage and Recovery Project
Annual Pumping for Project Conservation Scenario

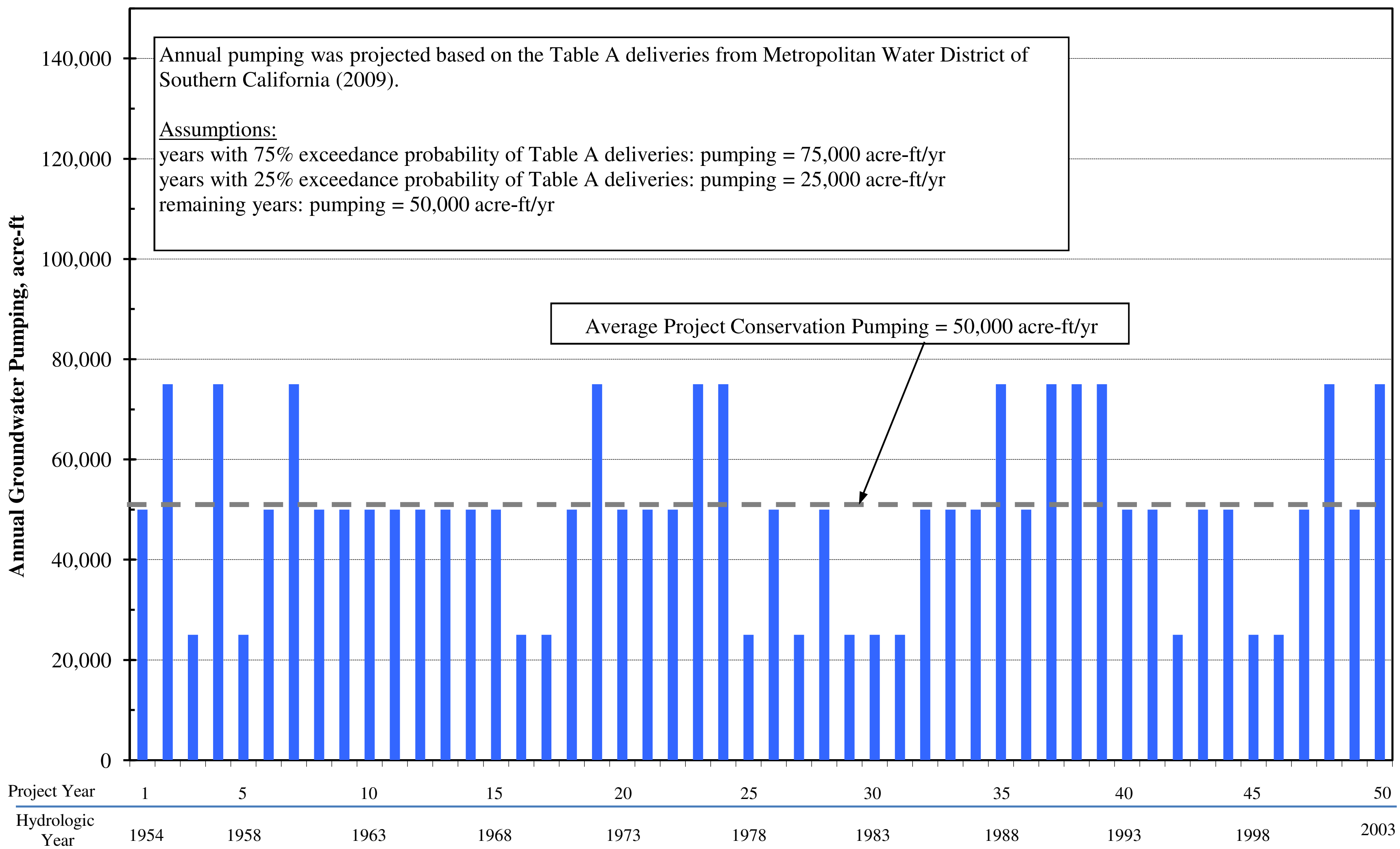


Figure 3

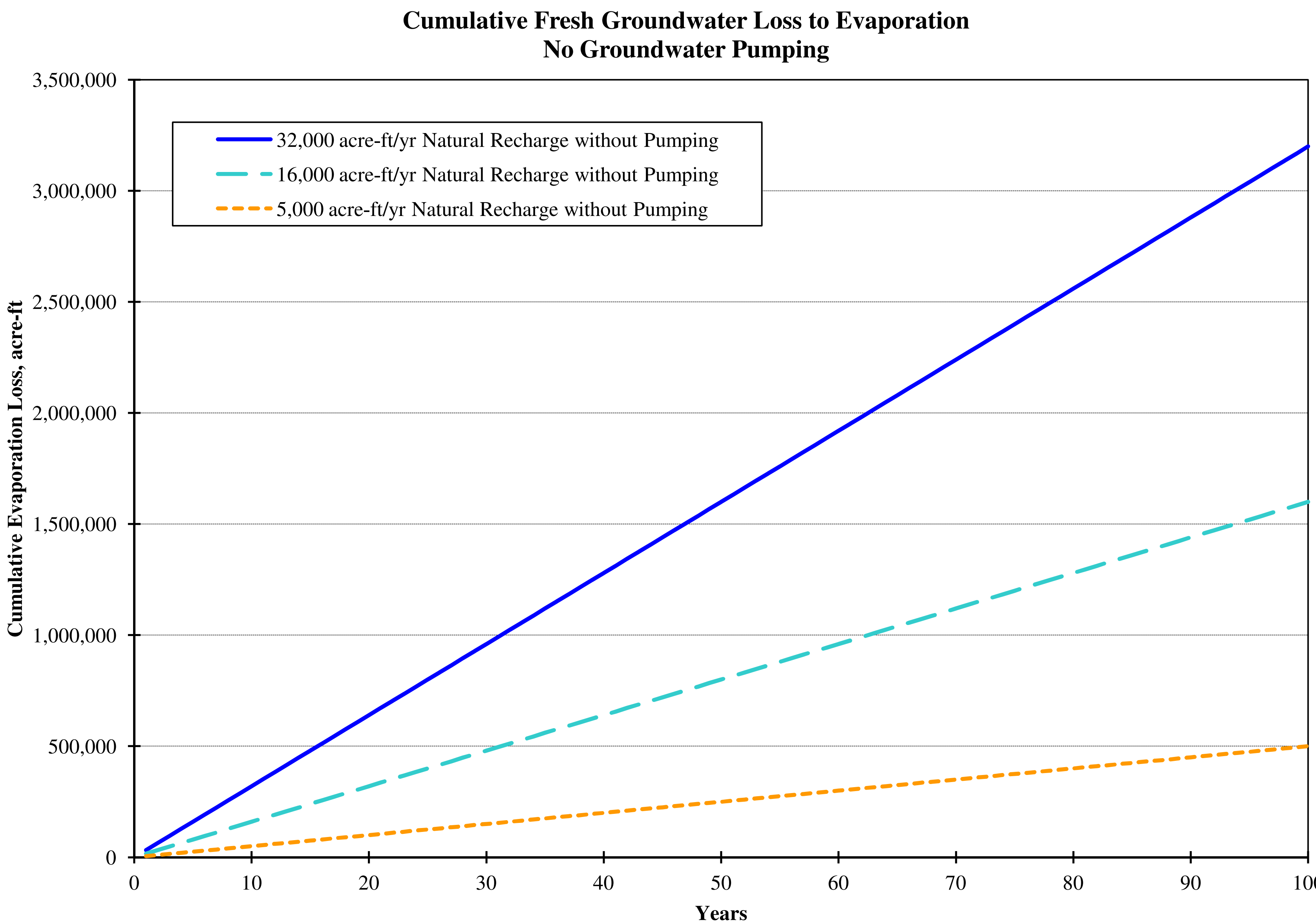

Cumulative Fresh Groundwater Loss to Evaporation
No Groundwater Pumping
Cumulative Evaporation Loss, acre-ft
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
0
10
20
30
40
50
60
70
80
90
100
Years
32,000 acre-ft/yr Natural Recharge without Pumping
16,000 acre-ft/yr Natural Recharge without Pumping
5,000 acre-ft/yr Natural Recharge without Pumping

Figure 4

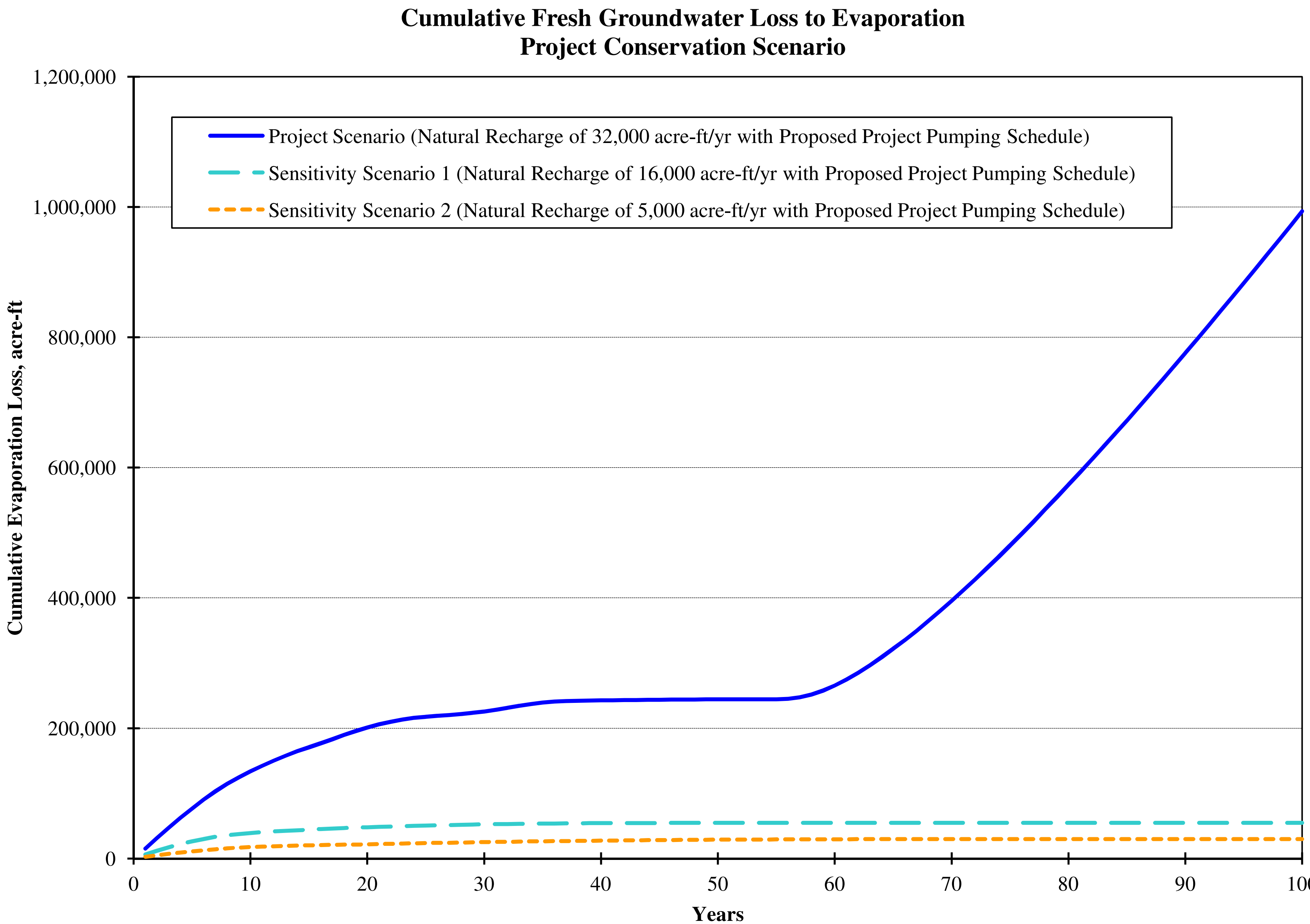

Cumulative Fresh Groundwater Loss to Evaporation
Project Conservation Scenario
Project Scenario (Natural Recharge of 32,000 acre-ft/yr with Proposed Project Pumping Schedule)
Sensitivity Scenario 1 (Natural Recharge of 16,000 acre-ft/yr with Proposed Project Pumping Schedule)
Sensitivity Scenario 2 (Natural Recharge of 5,000 acre-ft/yr with Proposed Project Pumping Schedule)
Cumulative Evaporation Loss, acre-ft
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
0
10
20
30
40
50
60
70
80
90
100
Years

Figure 5

Cadiz Groundwater Conservation, Storage and Recovery Project
Annual Pumping for Alternative Pumping Scenario

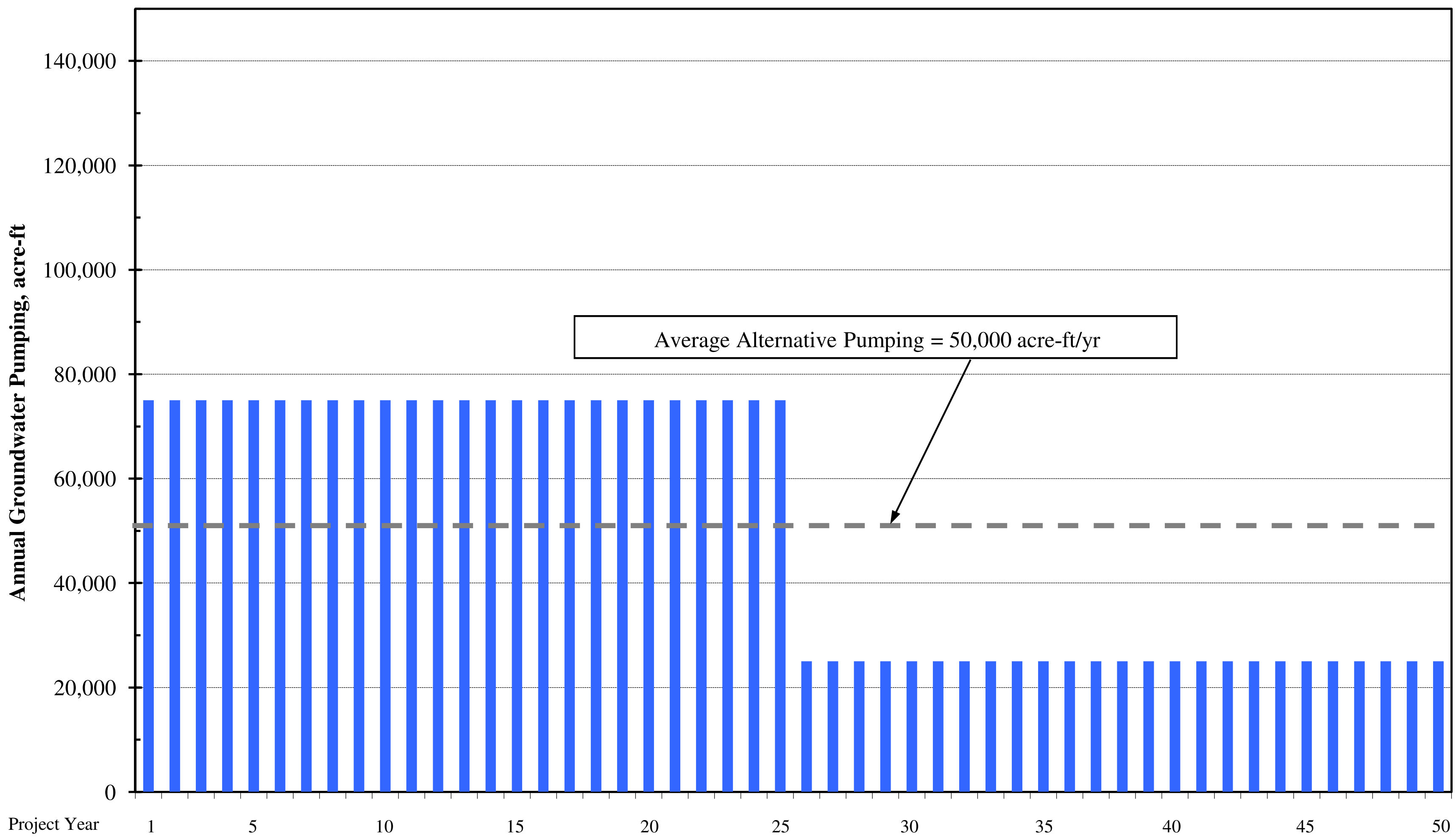
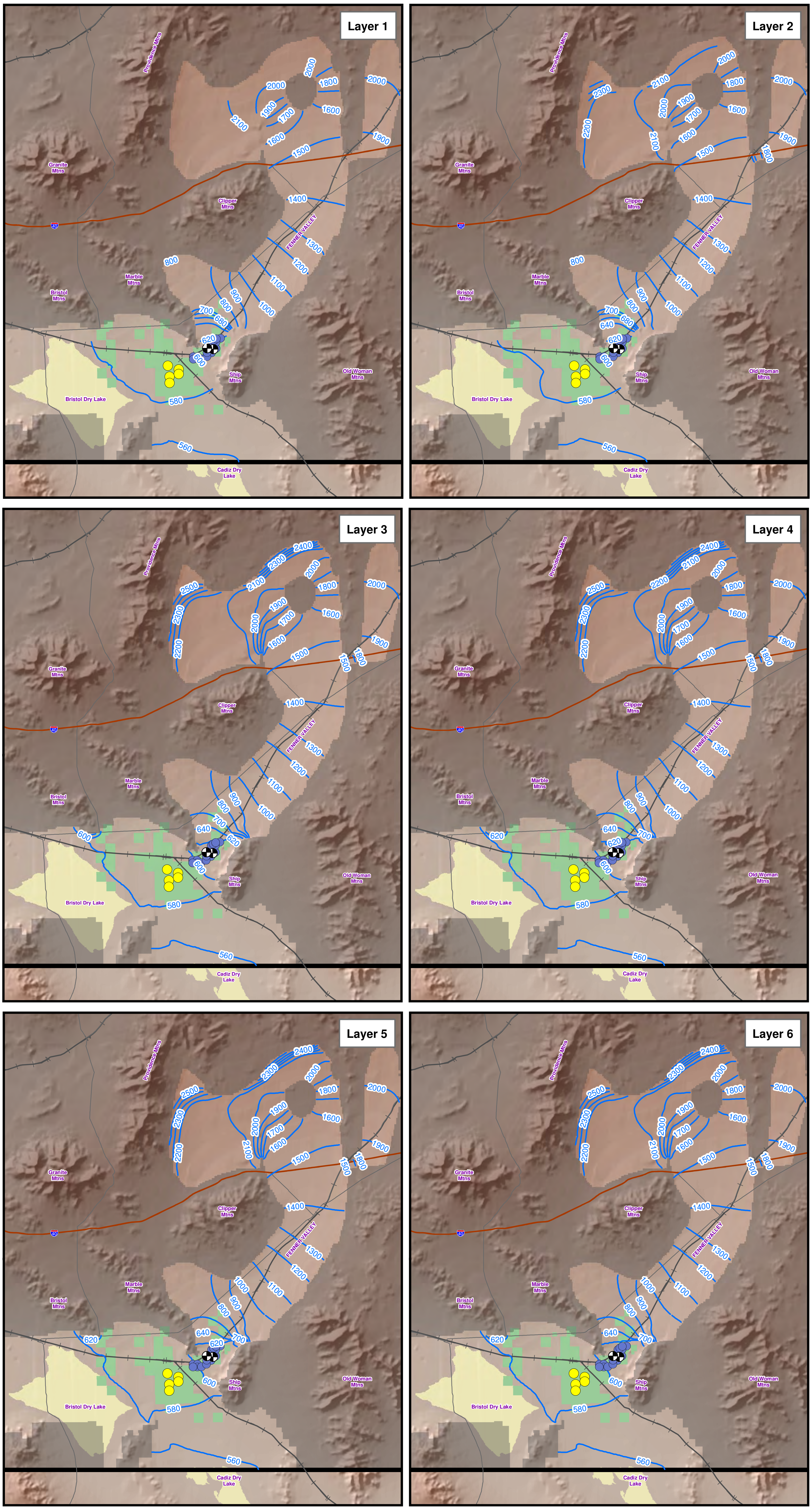


Figure 6

SUPPLEMENTAL ASSESSMENT OF PUMPING REQUIRED FOR THE
CADIZ GROUNDWATER CONSERVATION, STORAGE AND RECOVERY PROJECT



EXPLANATION

Groundwater Model Boundary

No Flow Model Cell

700 Groundwater Elevations (ft amsl)

Existing Cadiz Agricultural Well

Proposed New Well

Proposed High Capacity Well

Cadiz Owned Land

Sensitivity Scenario 3

Natural Recharge of
32,000 acre-ft/yr

Wellfield Configuration A
(5 Existing Cadiz Wells
and 17 New Wells)

MODEL-CALCULATED GROUNDWATER ELEVATIONS AT THE END OF 100 YEARS

SENSITIVITY SCENARIO 3

20-Sep-11

Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.

NORTH
0 5.5 11
Miles

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Figure 7

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SUPPLEMENTAL ASSESSMENT OF PUMPING REQUIRED FOR THE
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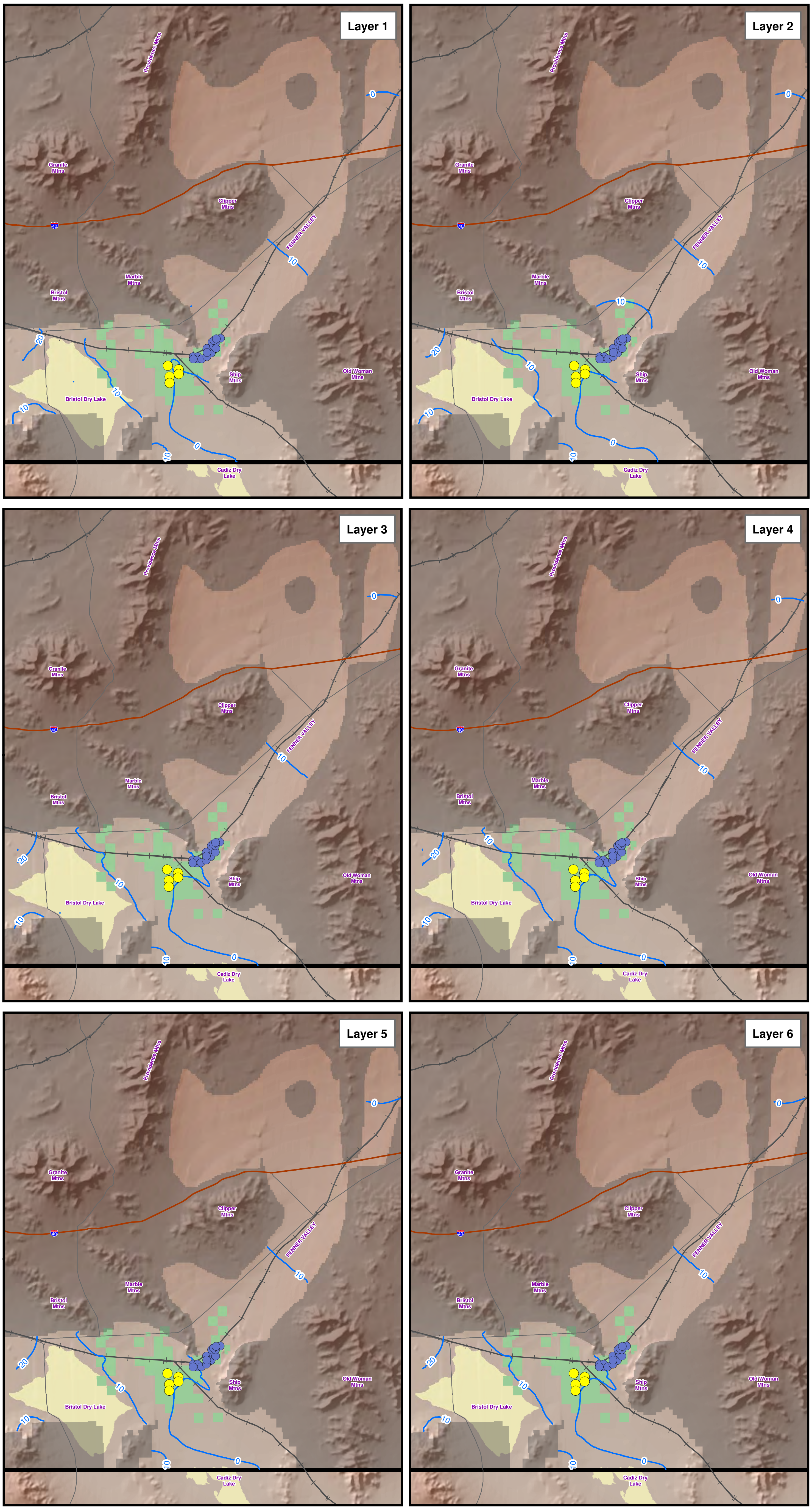

EXPLANATION

Groundwater Model Boundary

No Flow Model Cell

40 Regional Drawdown (ft)

Existing Cadiz Agricultural Well

Proposed New Well

Proposed High Capacity Well

Cadiz Owned Land

Sensitivity Scenario 3

Natural Recharge of 32,000 acre-ft/yr

Wellfield Configuration A (5 Existing Cadiz Wells and 17 New Wells)

REGIONAL DRAWDOWN AT THE END OF 100 YEARS

SENSITIVITY SCENARIO 3

20-Sep-11

Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.

NORTH

0 5.5 11 Miles

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Figure 8

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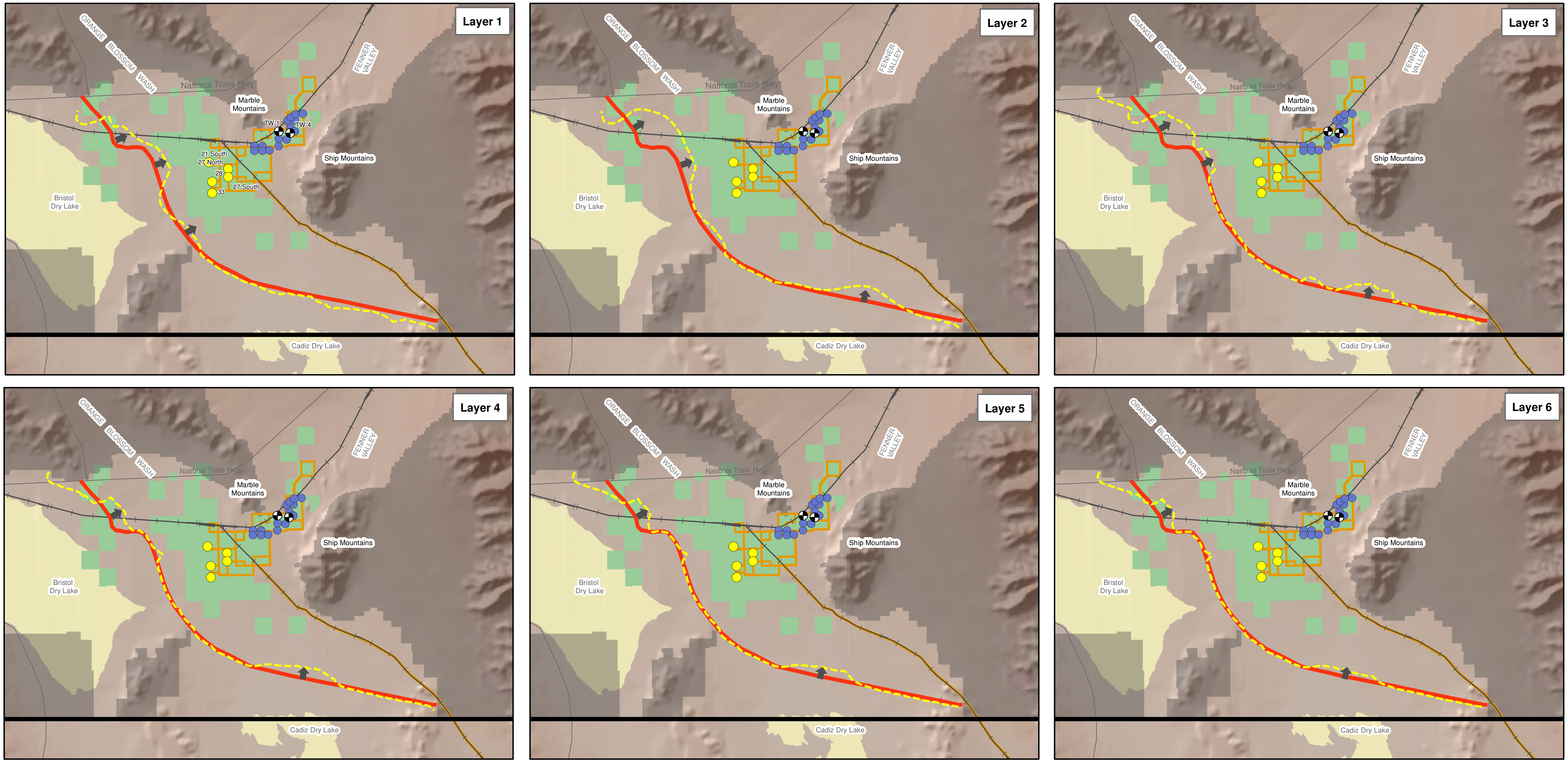

Groundwater Model Boundary

No Flow Model Cell

Cadiz Owned Land

Proposed Wellfield Development Areas and Pipeline

Existing Cadiz Agricultural Well

Proposed New Well

Proposed High Capacity Well

Direction of Saline Water / Freshwater Interface Movement

Current Saline Water / Freshwater Interface (TDS = 1,000 mg/L)

Model-Generated Saline Water / Freshwater Interface (TDS = 1,000 mg/L)

At the End of 100 Years (end of model simulation)

Sensitivity Scenario 3

Natural Recharge of 32,000 acre-ft/yr

Wellfield Configuration A (5 Existing Cadiz Wells and 17 New Wells)

MODEL-GENERATED SALINE WATER AND FRESHWATER INTERFACE (TDS = 1,000 mg/L)

SENSITIVITY SCENARIO 3

NORTH

0 6 12 Miles

20-Sep-11

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Figure 9

GIS_proj/brownstein_cadiz_model_analysis_9-11/0_TECH_MEMO_Scen3_Scen4_9-11/0_Fig_09_6panel_saline_32k_scen3_q75_100yr_9-11.mxd

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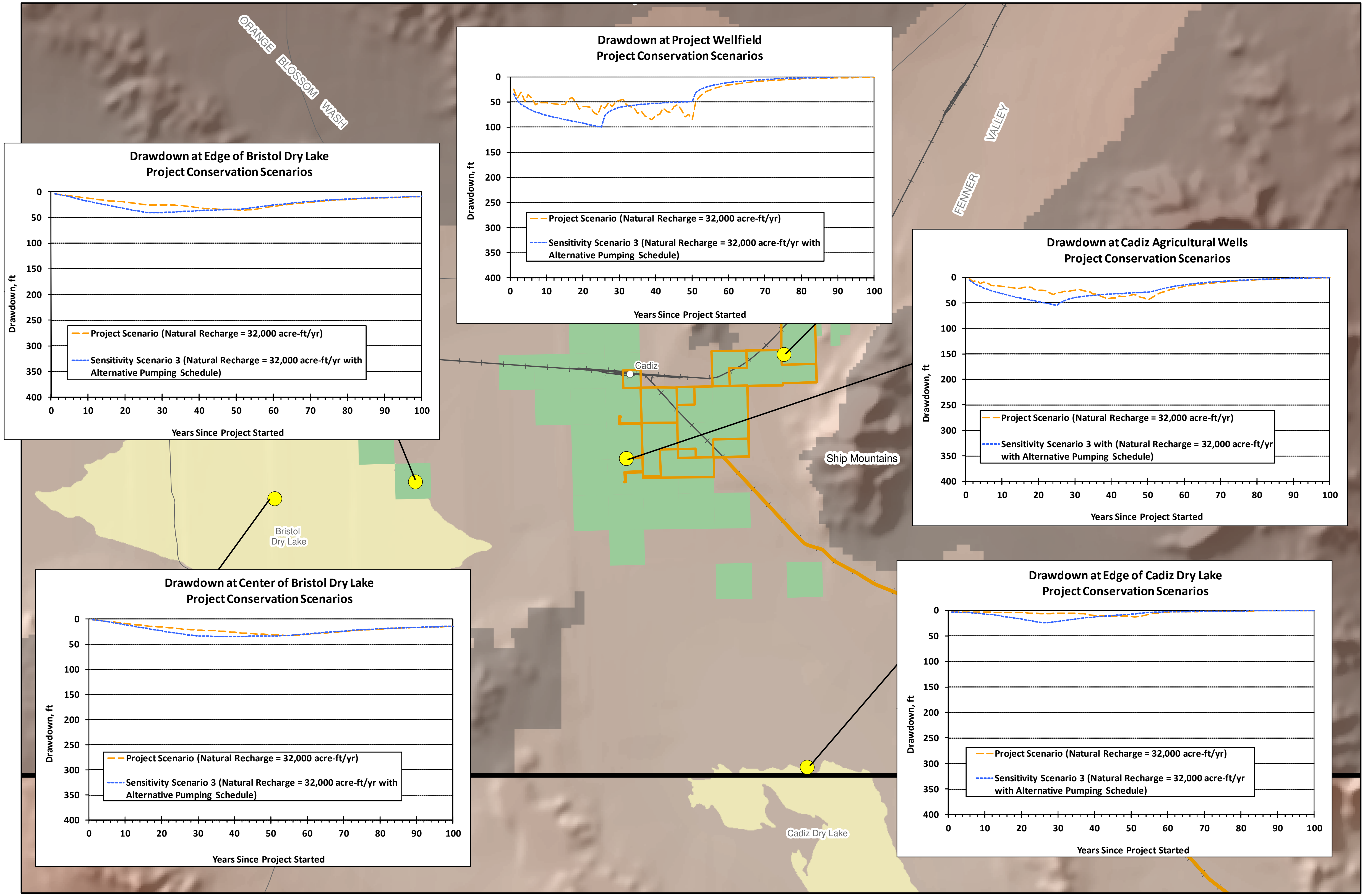
SUPPLEMENTAL ASSESSMENT OF PUMPING REQUIRED FOR THE CADIZ GROUNDWATER CONSERVATION, STORAGE AND RECOVERY PROJECT



MODEL-CALCULATED DRAWDOWN AT SELECTED LOCATIONS PROJECT SCENARIO VERSUS SENSITIVITY SCENARIO 3

EXPLANATION

- Location with Drawdown Over Time
- Cadiz Owned Land
- Proposed Wellfield Development Areas and Pipeline
- No Flow Model Cell

Sensitivity Scenario 3

Natural Recharge of 32,000 acre-ft/yr

Wellfield Configuration A (5 Existing Cadiz Wells and 17 New Wells)

20-Sep-11

Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.

NORTH

0 3 6 Miles

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Figure 10

GIS_proj/brownstein_cadiz_model_analysis_9-11/0_TECH_MEMO_Scen3_Scen4_9-11/0_Fig_10_DD_32k_hydrographs_9-11.mxd

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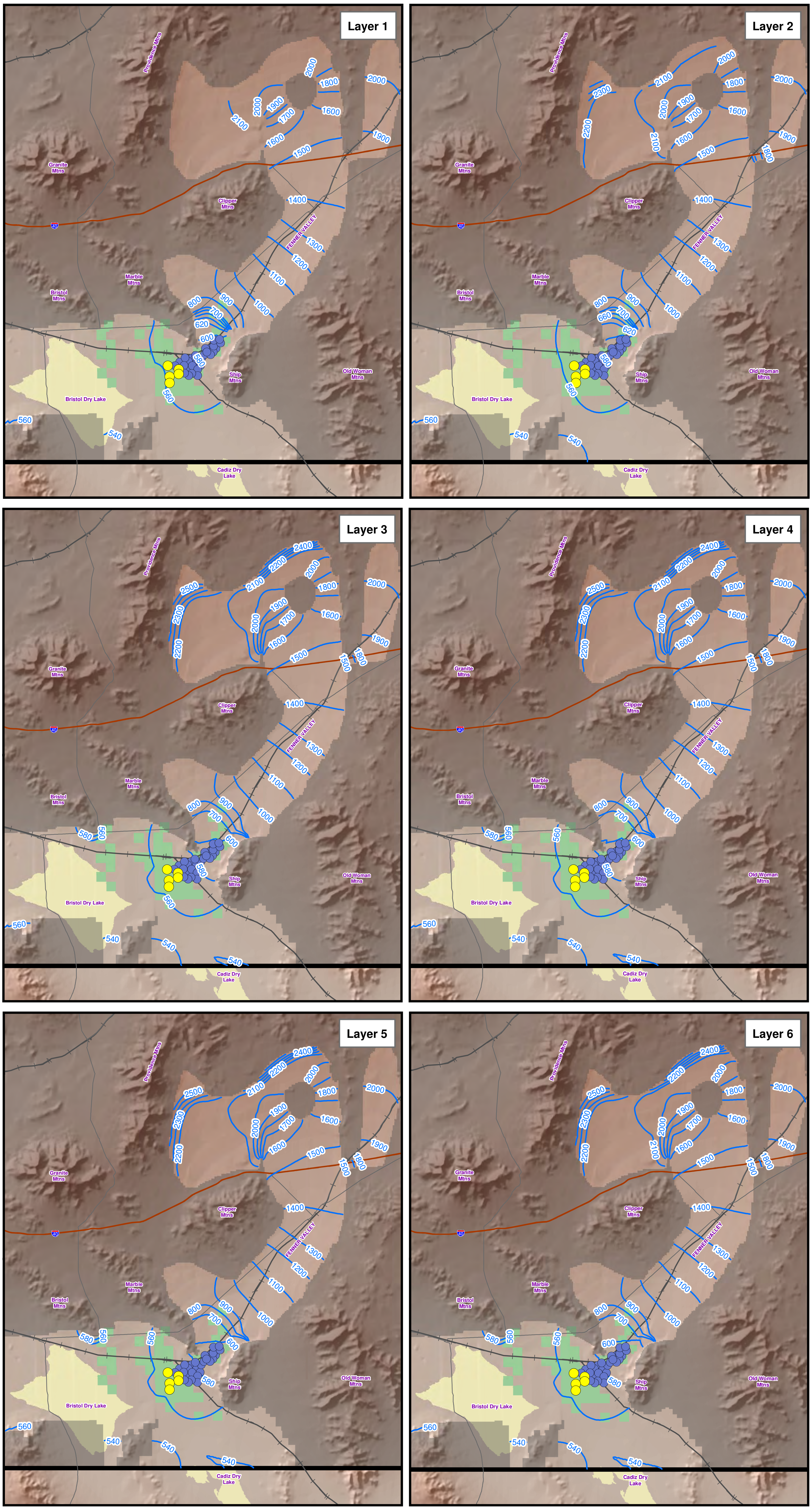
FARBER SCHRECK, LLP

SUPPLEMENTAL ASSESSMENT OF PUMPING REQUIRED FOR THE
CADIZ GROUNDWATER CONSERVATION, STORAGE AND RECOVERY PROJECT



EXPLANATION

Groundwater Model Boundary

No Flow Model Cell

700 Groundwater Elevations (ft amsl)

Existing Cadiz Agricultural Well

Proposed New Well

Cadiz Owned Land

Sensitivity Scenario 4

Natural Recharge of 16,000 acre-ft/yr

Wellfield Configuration B (5 Existing Cadiz Wells and 29 New Wells)

MODEL-CALCULATED GROUNDWATER ELEVATIONS AT THE END OF 100 YEARS

SENSITIVITY SCENARIO 4

20-Sep-11

Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.

NORTH

0 5.5 11 Miles

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Figure 11

GIS_proj/brownstein_cadiz_model_analysis_9-11/0_TECH_MEMO_Scen3_Scen4_9-11/0_Fig_11_16k_Scen4_gw_elev_100yr_9-11.mxd

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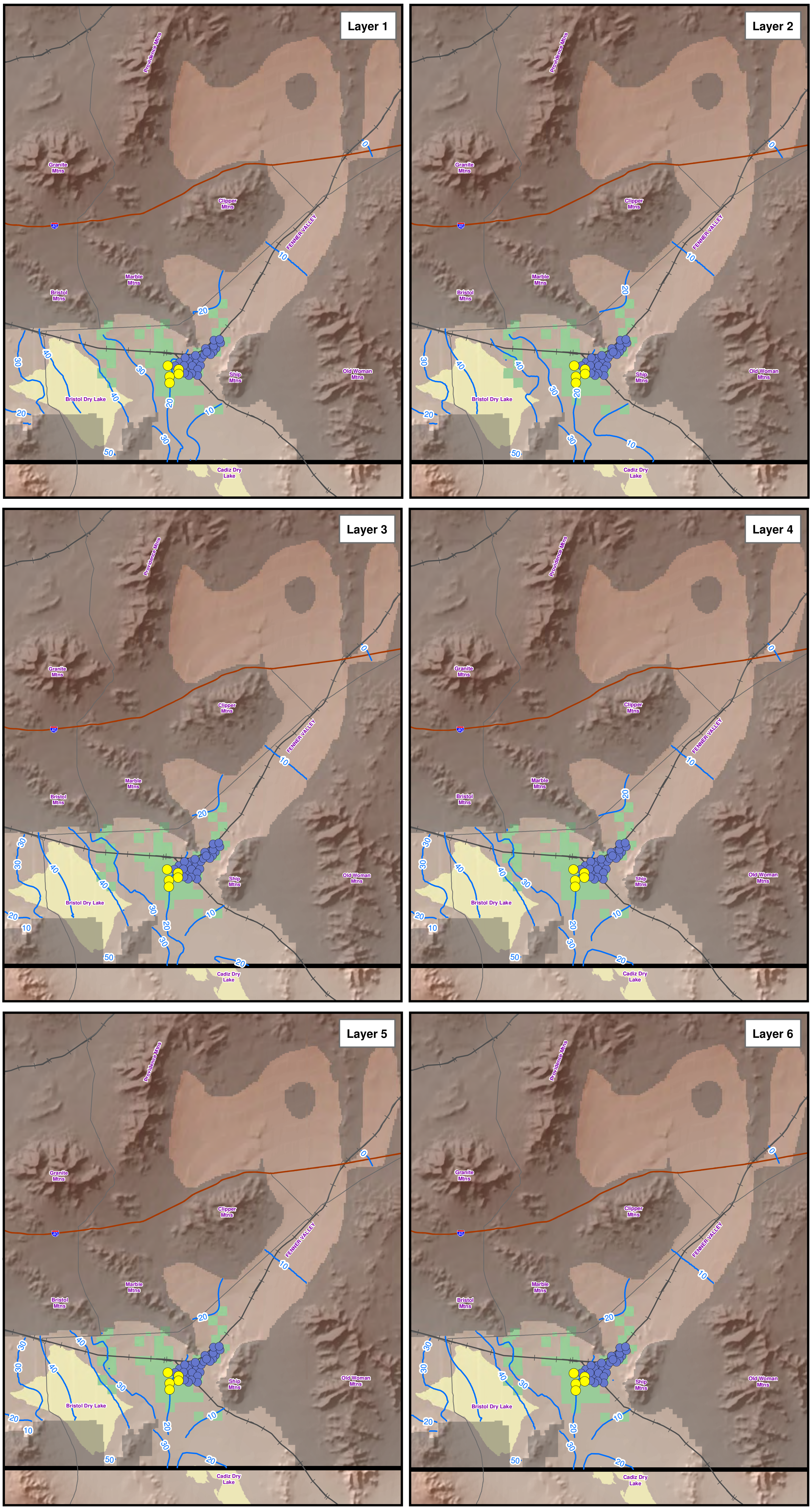
SUPPLEMENTAL ASSESSMENT OF PUMPING REQUIRED FOR THE
CADIZ GROUNDWATER CONSERVATION, STORAGE AND RECOVERY PROJECT



EXPLANATION

Groundwater Model Boundary

No Flow Model Cell

40 Regional Drawdown (ft)

Existing Cadiz Agricultural Well

Proposed New Well

Cadiz Owned Land

Sensitivity Scenario 4

Natural Recharge of 16,000 acre-ft/yr

Wellfield Configuration B
(5 Existing Cadiz Wells
and 29 New Wells)

REGIONAL DRAWDOWN AT THE END OF 100 YEARS

SENSITIVITY SCENARIO 4

20-Sep-11

Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.

NORTH

0 5.5 11 Miles

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Figure 12

GIS_proj/brownstein_cadiz_model_analysis_9-11/0_TECH_MEMO_Scen3_Scen4_9-11/0_Fig_12_16k_Scen3_dd_100yr_9-11.mxd

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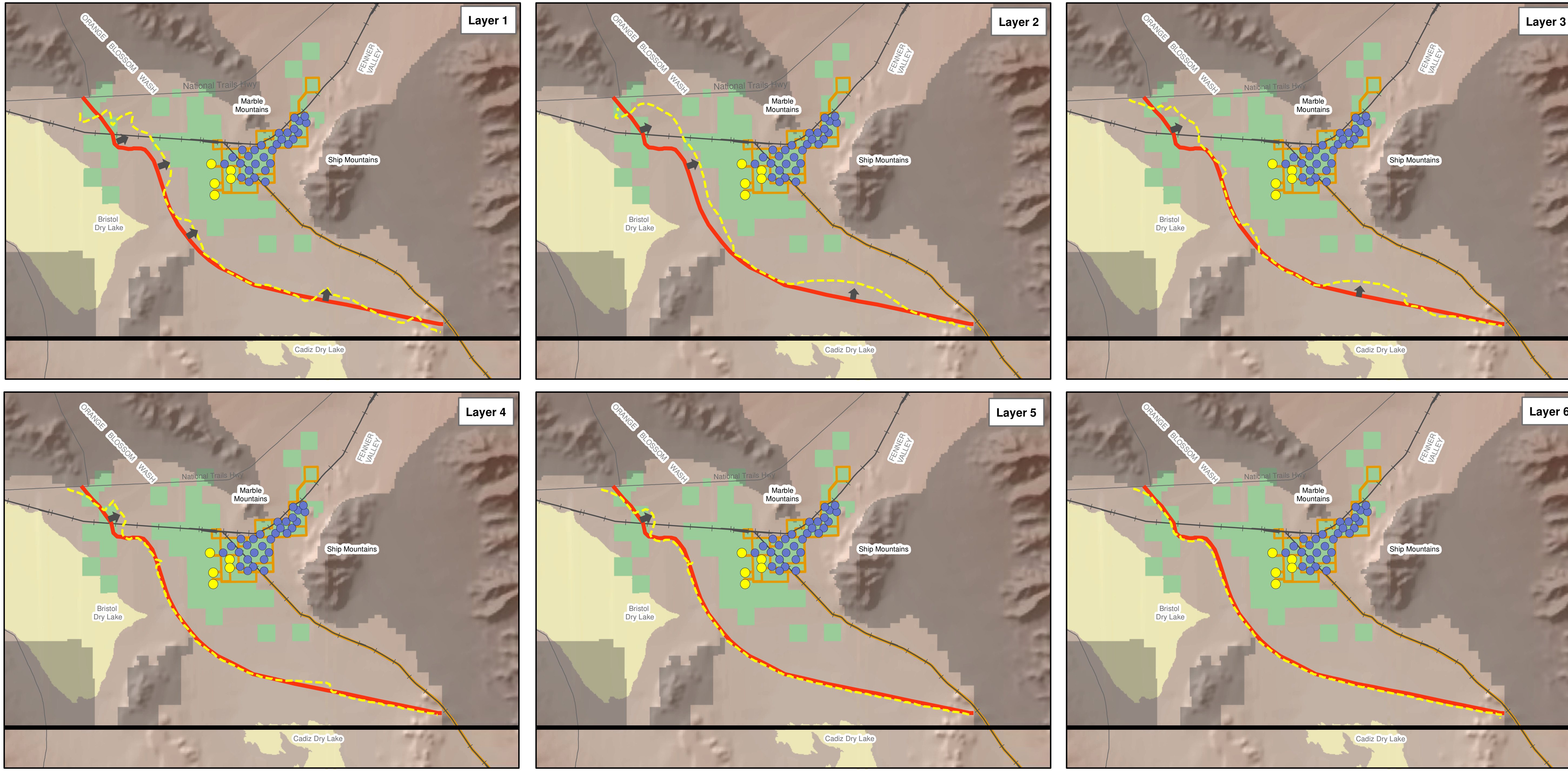
SUPPLEMENTAL ASSESSMENT OF PUMPING REQUIRED FOR THE CADIZ GROUNDWATER CONSERVATION, STORAGE AND RECOVERY PROJECT



Groundwater Model Boundary

No Flow Model Cell

Cadiz Owned Land

Proposed Wellfield Development Areas and Pipeline

Existing Cadiz Agricultural Well

Proposed New Well

Direction of Saline Water / Freshwater Interface Movement

Current Saline Water / Freshwater Interface (TDS = 1,000 mg/L)

Model-Generated Saline Water / Freshwater Interface (TDS = 1,000 mg/L)

At the End of 100 Years (end of model simulation)

<u>**Sensitivity Scenario 4**</u>

Natural Recharge of 16,000 acre-ft/yr

Wellfield Configuration B (5 Existing Cadiz Wells and 29 New Wells)

MODEL-GENERATED SALINE WATER AND FRESHWATER INTERFACE (TDS = 1,000 mg/L)

SENSITIVITY SCENARIO 4

NORTH

0 6 12 Miles

20-Sep-11

Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.

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Figure 13

GIS_proj/brownstein_cadiz_model_analysis_9-11/0_TECH_MEMO_Scen3_Scen4_9-11/0_Fig_13_6panel_saline_16k_scen4_q75_100yr_9-11.mxd

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SUPPLEMENTAL ASSESSMENT OF PUMPING REQUIRED FOR THE
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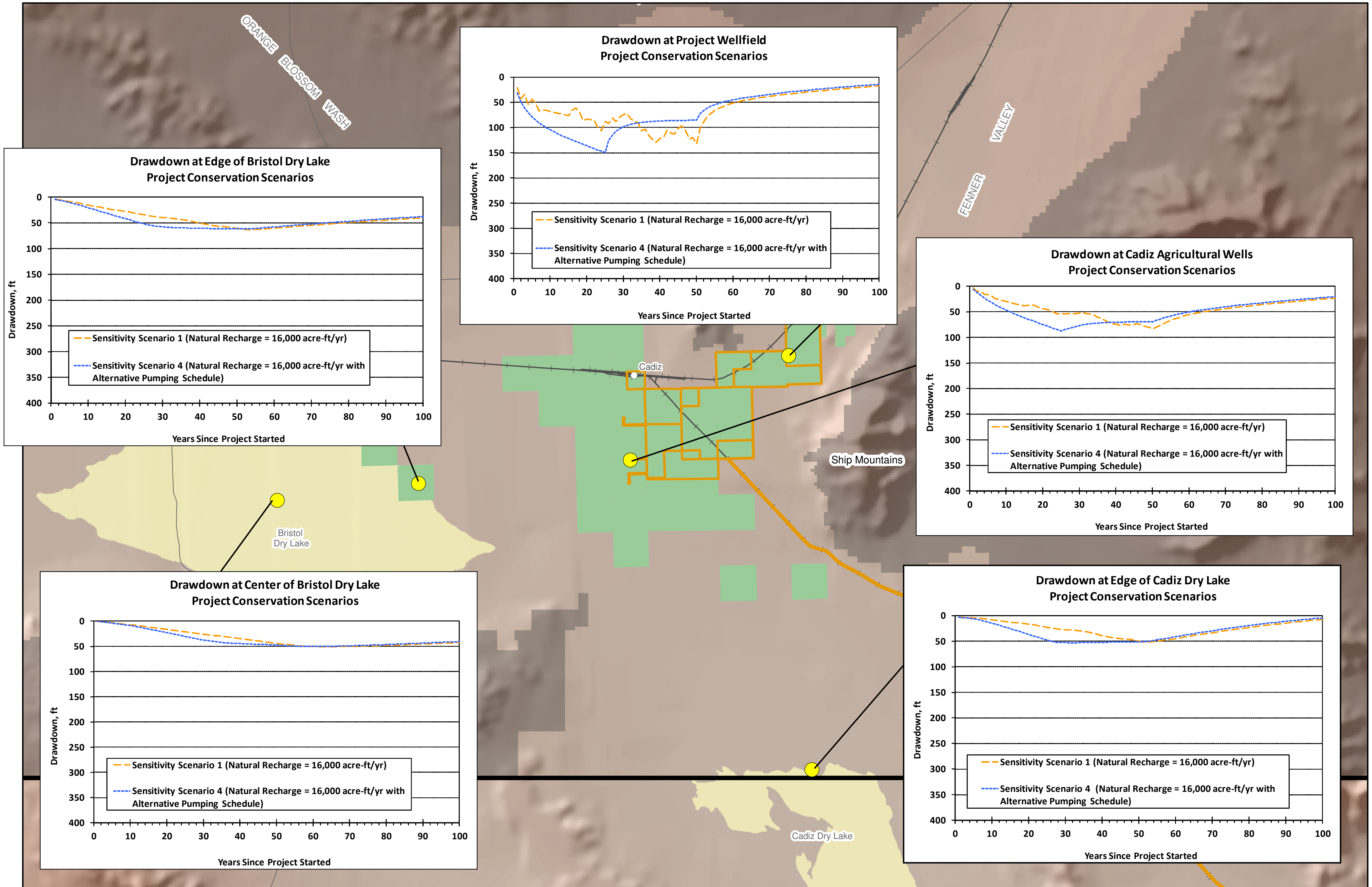

MODEL-CALCULATED DRAWDOWN AT SELECTED LOCATIONS SENSITIVITY SCENARIO 1 VERSUS SENSITIVITY SCENARIO 4

EXPLANATION

- Location with Drawdown Over Time
- Cadiz Owned Land
- Proposed Wellfield Development Areas and Pipeline
- No Flow Model Cell

Sensitivity Scenario 4

Natural Recharge of 16,000 acre-ft/yr

Wellfield Configuration B (5 Existing Cadiz Wells and 29 New Wells)

20-Sep-11

Prepared by: DWB. Map Projection: State Plane 1983, Zone 5.

NORTH

0 3 6 Miles

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Figure 14

GIS_proj/brownstein_cadiz_model_analysis_9-11/0_TECH_MEMO_Scen3_Scen4_9-11/0_Fig_14_DD_16k_hydrographs_9-11.mxd

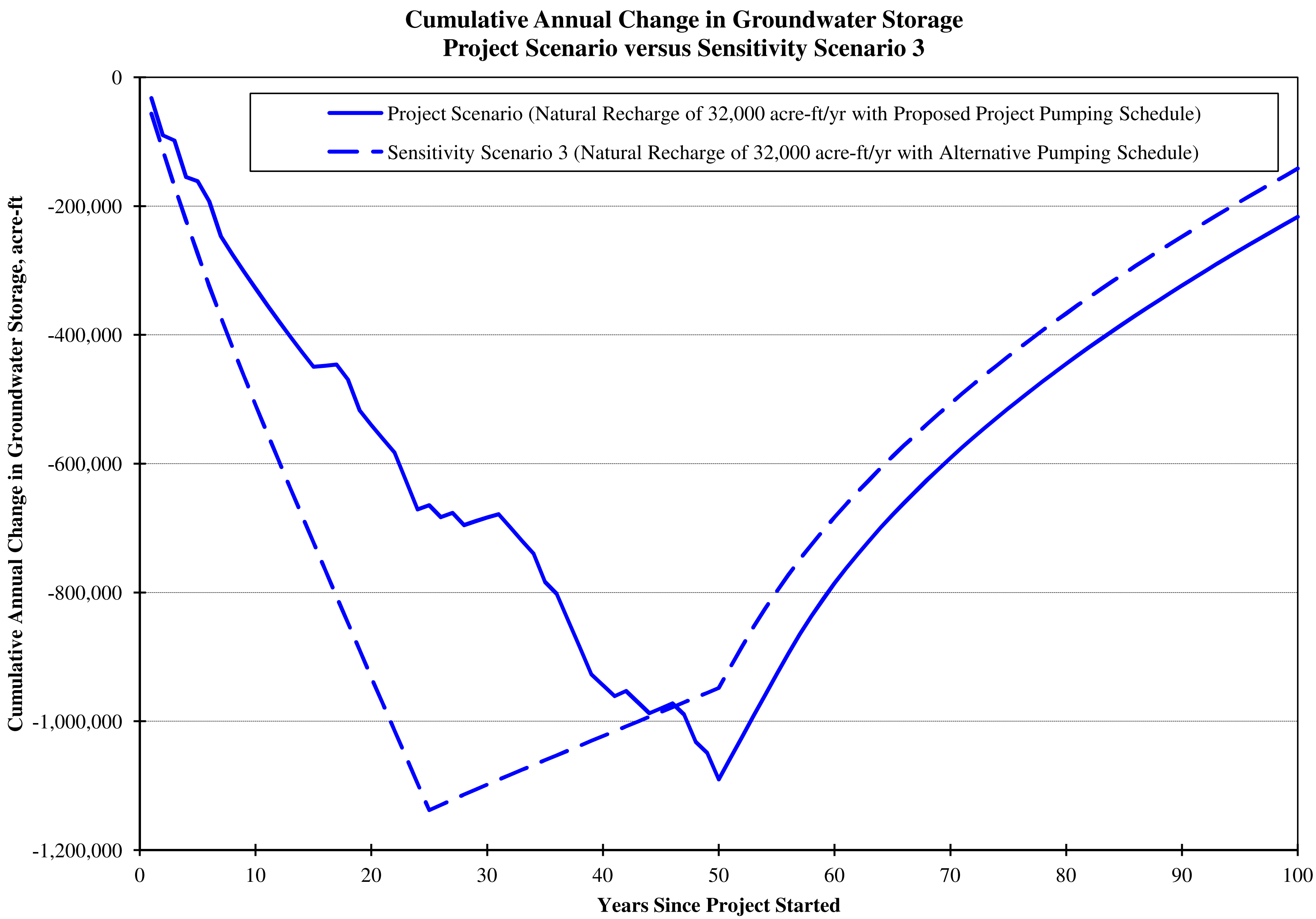
Cumulative Annual Change in Groundwater Storage
Project Scenario versus Sensitivity Scenario 3
Project Scenario (Natural Recharge of 32,000 acre-ft/yr with Proposed Project Pumping Schedule)
Sensitivity Scenario 3 (Natural Recharge of 32,000 acre-ft/yr with Alternative Pumping Schedule)
Cumulative Annual Change in Groundwater Storage, acre-ft
0
-200,000
-400,000
-600,000
-800,000
-1,000,000
-1,200,000
0
10
20
30
40
50
60
70
80
90
100
Years Since Project Started

Figure 15

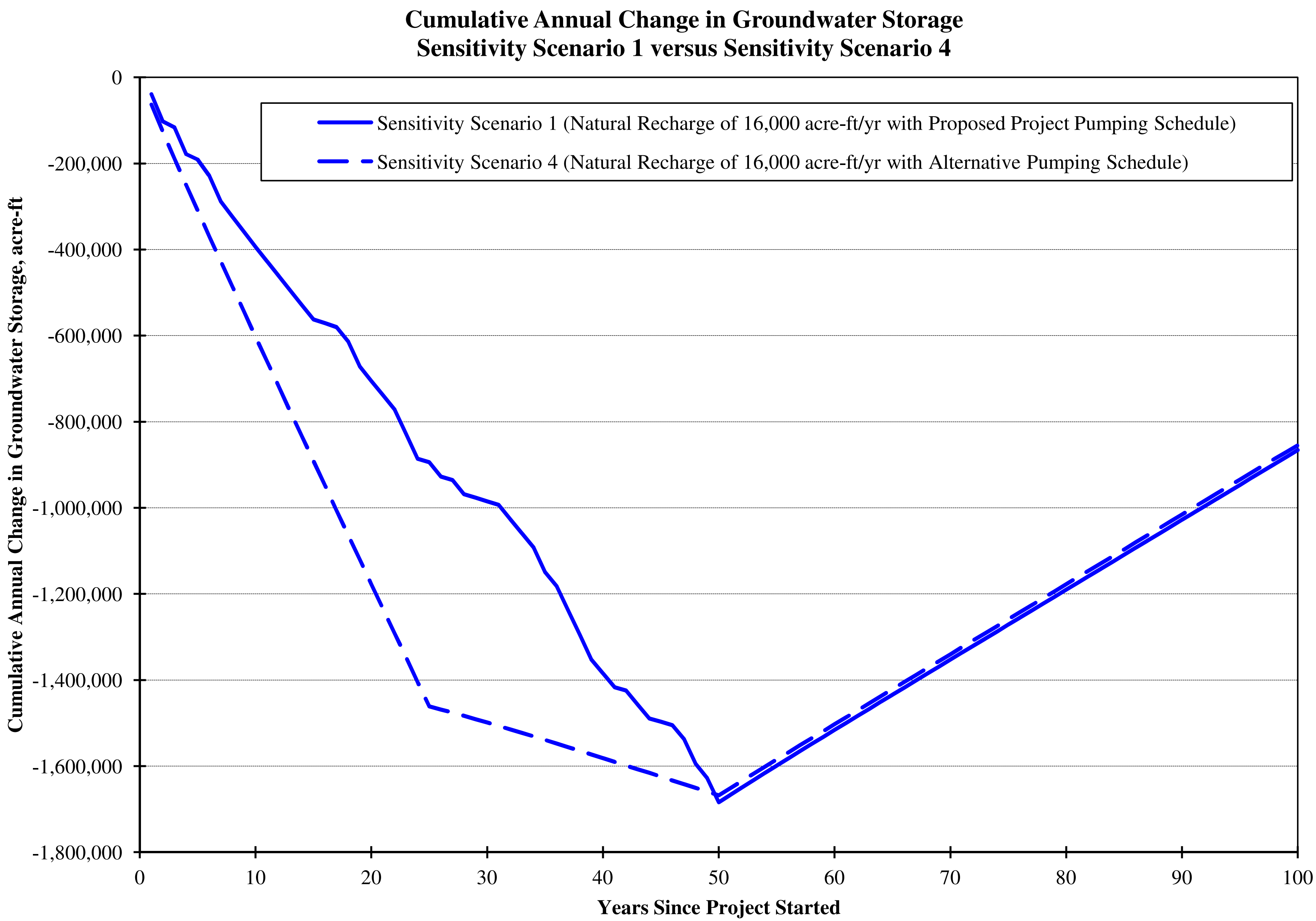
Cumulative Annual Change in Groundwater Storage
Sensitivity Scenario 1 versus Sensitivity Scenario 4
Sensitivity Scenario 1 (Natural Recharge of 16,000 acre-ft/yr with Proposed Project Pumping Schedule)
Sensitivity Scenario 4 (Natural Recharge of 16,000 acre-ft/yr with Alternative Pumping Schedule)
Cumulative Annual Change in Groundwater Storage, acre-ft
0
-200,000
-400,000
-600,000
-800,000
-1,000,000
-1,200,000
-1,400,000
-1,600,000
-1,800,000
0
10
20
30
40
50
60
70
80
90
100
Years Since Project Started

Figure 16

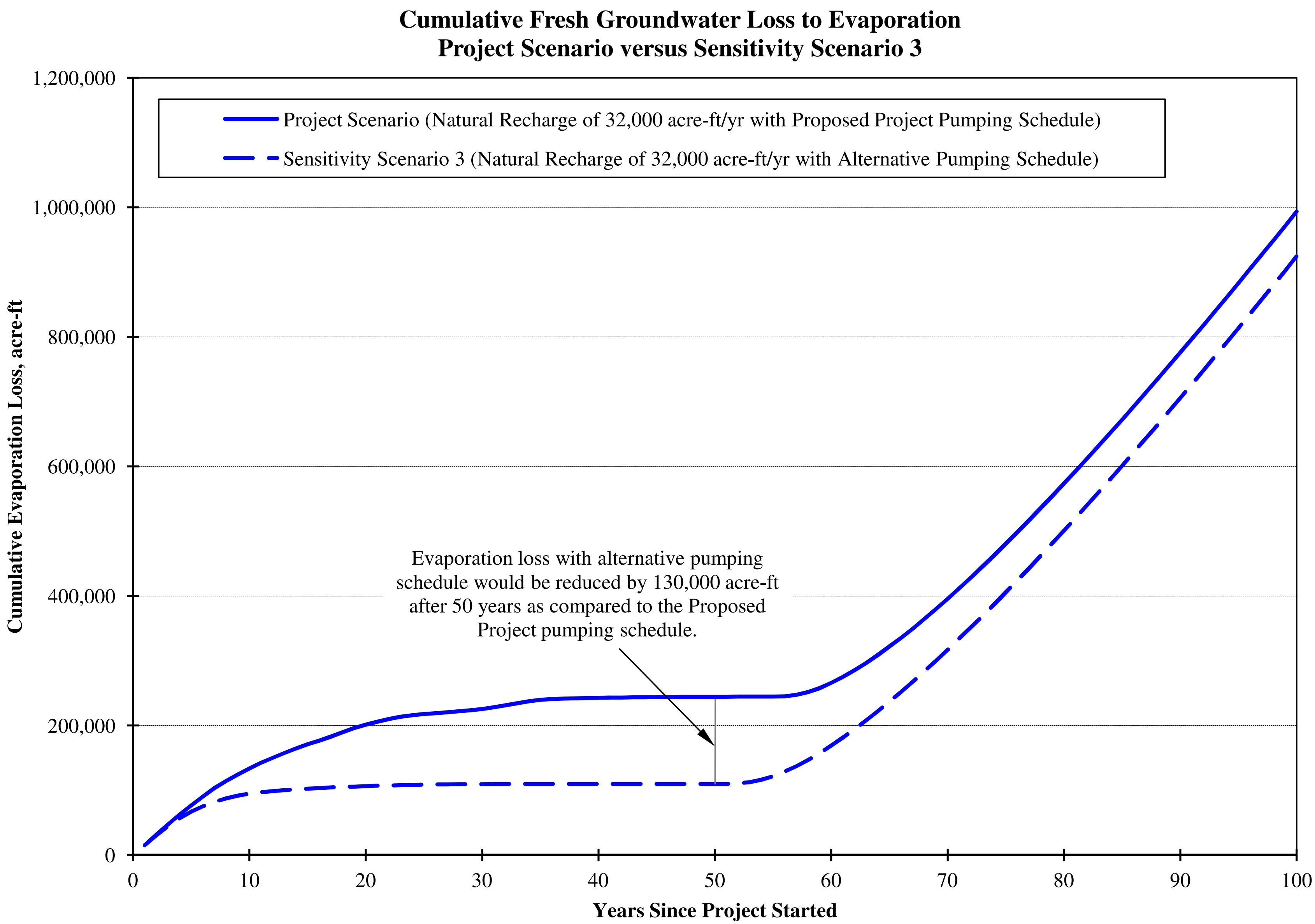
Cumulative Fresh Groundwater Loss to Evaporation
Project Scenario versus Sensitivity Scenario 3
Project Scenario (Natural Recharge of 32,000 acre-ft/yr with Proposed Project Pumping Schedule)
Sensitivity Scenario 3 (Natural Recharge of 32,000 acre-ft/yr with Alternative Pumping Schedule)
Evaporation loss with alternative pumping schedule would be reduced by 130,000 acre-ft after 50 years as compared to the Proposed Project pumping schedule.
Cumulative Evaporation Loss, acre-ft
Years Since Project Started
0
200,000
400,000
600,000
800,000
1,000,000
1,200,000
0
10
20
30
40
50
60
70
80
90
100

Figure 17

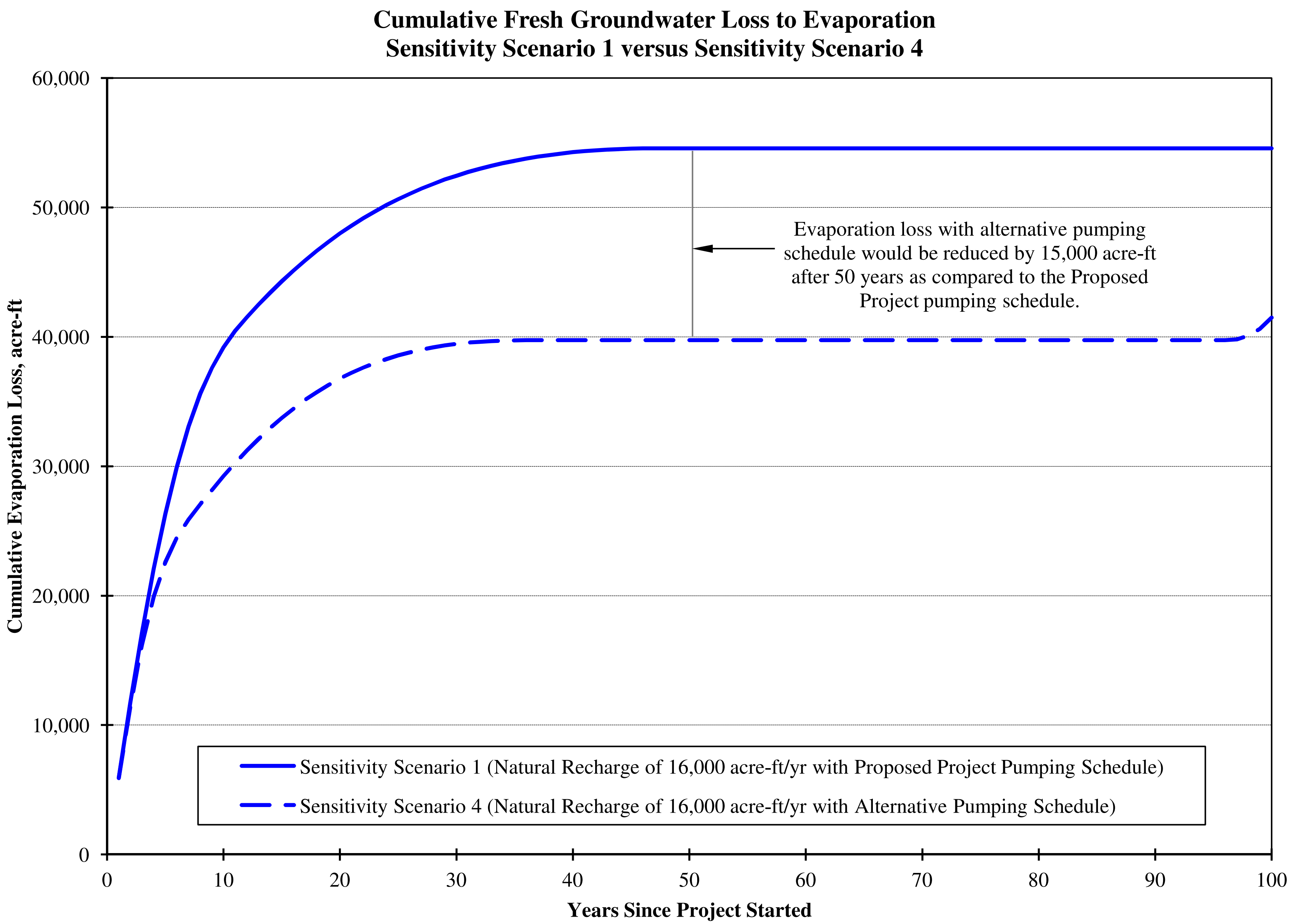
Cumulative Fresh Groundwater Loss to Evaporation
Sensitivity Scenario 1 versus Sensitivity Scenario 4
Cumulative Evaporation Loss, acre-ft
60,000
50,000
40,000
30,000
20,000
10,000
0
0
10
20
30
40
50
60
70
80
90
100
Years Since Project Started
Evaporation loss with alternative pumping schedule would be reduced by 15,000 acre-ft after 50 years as compared to the Proposed Project pumping schedule.
Sensitivity Scenario 1 (Natural Recharge of 16,000 acre-ft/yr with Proposed Project Pumping Schedule)
Sensitivity Scenario 4 (Natural Recharge of 16,000 acre-ft/yr with Alternative Pumping Schedule)

Figure 18