Kern Fan Groundwater Storage Project

FEASIBILITY REPORT

Appendix I: Groundwater Technical Report

October 21, 2019
Updated April 13, 2020

Irvine Ranch Water District

Rosedale-Rio Bravo Water Storage District

Technical Memorandum

To: Mr. Dane Johnson
Irvine Ranch Water District

From: Jim Van de Water, P.G., CH.G.
Thomas Harder & Co. (TH&Co)

Date: 23-Feb-18

Re: Estimation of Groundwater Level Benefits Associated with the Kern Fan Groundwater Storage Project

1 INTRODUCTION

As per your request, Thomas Harder & Company (TH&Co) has prepared this technical memorandum to estimate potential groundwater level benefits associated with Irvine Ranch Water District's (IRWD's) Kern Fan Groundwater Storage Project. It is our understanding that IRWD is considering a phased project that includes acquisition of 1,280 acres of property in the Rosedale-Rio Bravo Water Storage District (RRBWSD) service area for construction of two recharge and recovery facilities ('Phase I' and 'Phase II'; see project concept figure from Dee Jaspar & Associates, Inc [2017][1] included as **Attachment A**). These facilities are to be supplied by Article 21 water via the Goose Lake Slough and a new conveyance canal connecting Phase II and the California Aqueduct. Long-term groundwater level benefits from the project would be associated with 'leave behind' water volumes from recharging the Article 21 water during wet years. IRWD has already monetized 'leave behind' groundwater benefits from the project in an initial funding request to the California Water Commission (CWC). However, the CWC has requested a model analysis to quantify potential groundwater level benefits from the project.

2 OBJECTIVE AND APPROACH

The objective of the analysis is to provide a model analysis to quantify potential groundwater level benefits from the project to IRWD to meet the request of the CWC. Our approach for quantifying potential groundwater level benefits from the project involves the construction of a numerical model of the proposed project area. The numerical model is used to analyze Article 21 'leave behind' benefits over a 50-year project operational scenario developed based on data provided by MBK Engineers[2]. Water is stored in the project in each of the three accounts: public or ecosystem ('ENV'), IRWD, and Rosedale. After accounting for the loss percentages (including evaporation), the leave behind percentages for these three accounts are as follows:

[1] Dee Jaspar & Associates, Inc. (DJ&A), 2017. *Kern Fan Groundwater Storage Project, Draft Concept Study*. August 10th.
[2] Electronic mail correspondence from IRWD to TH&Co, January 29, 2018.

ENV = 6.5%, IRWD = 9%, and Rosedale = 4%. These values are used as multipliers for historical operational data spanning 1922 through 2003 as provided by MBK Engineers to derive the recharge rates used as input to the model. The historical data, along with leave behind recharge rates, are listed in **Table 1**. For this analysis, the first 50 years of the record (i.e., 1922 to 1972) is used. As shown in this table, there are nine recharge events that occur over the 50-year time span. The average leave behind recharge rate for both phases combined is estimated to be approximately 1,850 acre-feet per year.

Specifically, groundwater level results from a 50-year project operational scenario of leave behind recharge are compared to groundwater levels for a 50-year period without project leave behind. The difference between these "with project" and "without project" scenarios is the groundwater level benefit of the project.

3 NUMERICAL MODEL

The United States Geological Survey (USGS) numerical groundwater flow model MODFLOW (Harbaugh, 2005)[3], one of the most widely-used and accepted groundwater flow models in the world, is used for the 50-year transient[4] analysis of the proposed project. The numerical approach afforded by MODFLOW is selected over an analytical approach (e.g., Mahdavi, 2015)[5] given its ability to more readily simulate the temporally- and spatially-variant properties and processes associated with the proposed project.

3.1 CONCEPTUAL MODEL

The conceptual model, which is based on our understanding of the hydrogeology of the study area and of the proposed project, provides the framework for the numerical model. TH&Co developed a hydrogeologic conceptual model for the nearby Kern Water Bank and Pioneer Project that provided the framework for an actively-maintained regional-scale calibrated numerical model that also includes the Study Area (TH&Co, 2011)[6]. Given that this analysis is limited to a comparison of "with project" and "without project" scenarios, several components of the regional-scale conceptual model which apply equally to both scenarios are not considered (i.e., precipitation, evapotranspiration, pumping for municipal, agricultural and private use and associated return flows, other recharge basins, and any other inflows and outflows not associated with the proposed project). The components of the regional-scale conceptual model applicable to this analysis are as follows:

- Geology: The Study Area is in the eastern portion of the Tulare Basin on the flat distal portions of the alluvial fan deposited by the Kern River. The land surface elevation of the Study Area is approximately 300 feet above mean sea level (ft amsl). The geologic units considered in this analysis are the 'Younger Alluvium and Flood Plain Deposits' and the 'Older Alluvium'. The Younger Alluvium and Flood Plain Deposits are Recent

[3] 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*.
[4] The term 'transient' as used here implies that the stresses on the groundwater system change over time, which in turn cause groundwater elevations to change over time.
[5] Mahdavi, A., 2015. *Transient-State Analytical Solution for Groundwater Recharge in Anisotropic Sloping Aquifer*. Water Resources Management, 29:3735–3748. May.
[6] TH&Co, 2011. *Hydrogeological Impact Evaluation Related to Operation of the Kern Water Bank and Pioneer Project*. December 5th.

(Holocene) sediments deposited in, and adjacent to, active stream and river channels and in the areas of historical lakebeds and form the ground surface. River channel sediments are predominantly sand and gravel whereas the Flood plain deposits contain a higher percentage of silt and clay. The thickness of the Younger Alluvium is approximately 150 feet thick in the Study Area. The Older Alluvium consists of Pleistocene (2 million to 10,000 years before present) sediments composed of unconsolidated alluvial fan deposits and stream and terrace deposits. Because it is difficult to distinguish between the 'Younger Alluvium and Flood Plain Deposits' and 'Older Alluvium', they are grouped together as 'Quaternary Alluvium'.

- Hydrogeology: The aquifer system in the Study Area is characterized by lenticular sand and gravel deposits of varying thickness and lateral extent that are separated by less permeable deposits of silt and clay. In the Study Area, the saturated sediments are likely unconfined and modeled as such; however, given the highly stratified nature of the sediments in the subsurface and aquifer test results, it appears that the aquifer likely becomes more confined with depth.
- Groundwater Recharge: Recharge of the groundwater system within the Study Area occurs through both natural and artificial mechanisms. Natural recharge occurs through subsurface underflow from upgradient areas and infiltration of streamflow within the Kern River channel. Areal recharge due to infiltration of precipitation in areas outside the Kern River channel is comparatively small. The Kern River is the primary natural surface water feature in the southern Tulare Basin and the Study Area (see **Figure 1**) and is used as a conveyance mechanism to transfer water from various upstream imported sources to downstream recharge projects. Artificial recharge occurs as managed recharge in the spreading basins associated with these projects, infiltration losses in unlined canals, return flow from agricultural irrigation, return flow associated with municipal and industrial water use in urban areas, and return flow from individual septic systems in unsewered areas. Recharge facilities that influence the Study Area include the KWB, the Pioneer Project, the 2800 Acres, the Berrenda Mesa Project, the West Kern Water District/Buena Vista Water Storage District (WKWD/BVWSD Recharge Basins, and the RRBWSD Recharge Basins). The basins have historically received imported water from the State Water Project via the California Aqueduct, imported water from the Central Valley Project (CVP) via the Friant-Kern Canal, and natural storm water flow from the Kern River. Of course, given the objective of this analysis, 'leave behind' water associated with artificial recharge via the Phase I and Phase II projects are critical components of the conceptual model.

3.2 Model Domain and Model Grid, Boundary Conditions, Initial Conditions, and Aquifer Parameters

This section presents the overall model design and input parameters. The input values used to simulate the proposed project recharge were presented in **Section 2**.

3.2.1 Model Domain and Model Grid

The basis of the numerical method coded into MODFLOW-2005 is the subdivision (discretization) of the model domain into rectangular prismatic cells, resulting in a model 'grid'. The Study Area coincides with the model domain, the areal extent of which is shown on **Figure 2**. The model extends vertically from the ground surface to a depth ranging from approximately 620 feet in the south to approximately 710 feet in the north. The thicknesses used for this single-layered model (**Figure 3**) are based on the model layering used in the multilayered regional-scale numerical model with consideration given to the head boundary conditions discussed below. In plan-view, the Study Area was subdivided into 50 rows and 70 columns consisting of uniform (square) cells dimensioned 1,000 feet by 1,000 feet. The model grid is shown in **Figure 4**.

3.2.2 Boundary Conditions

The boundary conditions used in the model include both head and flux boundaries and initial conditions.

3.2.2.1 Head boundaries

Time-variant head boundaries are prescribed in the southern and northern portions of the model domain to simulate the generally northwesterly flow of groundwater within the Study Area (**Figure 5**). The head boundaries are based on three wells in the southern (upgradient) portion and six wells in the northern (downgradient) portion for which extensive groundwater elevation records are available. For the upgradient boundary, which is strongly influenced by the ongoing recharge projects near the Kern River described earlier, the cyclical trend observed between 2004 and 2017 is repeated into the future to define this boundary throughout the 50-year simulation period. For the northern boundary, the decreasing trend observed between 2004 and 2017 is extrapolated for the first 20 years of the simulation and thereafter, based on the 20-year compliance period mandated by the Sustainable Groundwater Management Act for areas to the north/northwest of the Study Area, is maintained at a constant value for the final 30 years of the simulation based on the extrapolated values calculated for Year 20.

The MODFLOW input 'package' used to simulate the head boundaries is the time-variant specified head (CHD) package.

3.2.2.2 Flux Boundaries

The flux boundaries are prescribed in the two proposed project areas (Phase I and Phase II) to simulate proposed recharge. Infiltration from the Goose Lake Slough is comparatively negligible and is therefore not considered in this analysis. Twenty-seven cells are used for the Phase I and Phase II project areas to approximate the 640-acre extent of each area. As such, the Phase I and Phase II project areas are both conservatively modeled at approximately 620 acres.[7] The locations of the flux boundaries are shown in **Figure 5**.

The MODFLOW input package used to simulate the flux boundaries is the recharge (RCH) package.

3.2.3 Initial Conditions

Initial conditions are the initial groundwater elevations which the transient 50-year model uses to begin its numerical calculations. As such, the initial conditions are effectively a boundary condition in time. To ensure that the response of groundwater elevations throughout the model domain is due solely to the simulated stresses and not errors in the initial head configuration (i.e., the initial conditions) that may not be a valid solution to the numerical model, initial conditions were established by repeated transient simulations with no flux boundaries until the simulated

[7] Using 28 cells to simulate the two project areas would have slightly overestimated their respective areas at 643 acres.

heads showed no appreciable change over time early in the simulation (e.g., the first 30 days). That is, the initial conditions for the model are based on a valid steady-state solution for the numerical model (Reilly and Harbaugh, 2004)[8].

3.2.4 Aquifer Parameters

Hydraulic conductivity and specific yield values for the model are those in the corresponding layer in TH&Co's existing regional-scale model. The distributions of these spatially-variant parameters are shown on **Figure 6** and **Figure 7**, respectively.

4 MODEL RESULTS

The model results are presented in terms of the difference between simulated groundwater elevations (i.e., "mounding") and simulated water budgets for the "with project" and "without project" scenarios. A quality check is also presented.

4.1 Model-Predicted Groundwater Elevations

Model-predicted groundwater elevations from two model 'observation wells' centered within the Phase I project (P1-A and P1-B) and one centered within the Phase II project (P2-A), as shown on **Figure 5**, are used for the analysis. The model-predicted groundwater elevations for the "with project" and "without project" scenarios are shown along with land surface elevations for each project area on **Figure 8a** and **Figure 8b**. The differences between these two scenarios are more clearly shown on **Figure 9a** and **Figure 9b**.[9] As shown on these figures, the approximate maximum change (increase) in groundwater elevations due to leave behind recharge occurs during Year 16 of the 50-year simulation and are as follows:

- Phase I Area: ~1.75 feet; and
- Phase II Area: ~2 feet.

The spatial distribution of the maximum mounding associated with the projects is shown on **Figure 10**.

4.2 Water Budget

The model water budget consists of the following three components:

1. Groundwater inflow and outflow ("underflow"), both of which are driven by the time-variant constant head boundaries;
2. Recharge (inflow only), which is driven by the recharge flux boundaries prescribed for each project area; and
3. the change in storage resulting from the underflow and recharge.

These components for the "with project" and "without project" are listed in **Table 2**. The effect of mounding, which decreases the hydraulic gradient south (upgradient) of the projects and increases it north (downgradient) of the projects, is reflected in the lower "Constant Head In" value and higher "Constant Head Out" value associated with the "with project" scenario. The "Recharge In" and "Recharge Out" values are self-evident for both scenarios. The total model-

[8] Reilly, T.E. and A.W. Harbaugh, 2004. *Guidelines for Evaluating Ground-Water Flow Models*. U.S. Geological Survey Scientific Investigations Report 2004-5038, 30 pp.

[9] Because the numerical model only considers saturated zone flow and does not considered unsaturated zone flow, the recharge is assumed to instantaneously reach the water table.

predicted recharge associated with 'leave behind' water over the 50-year simulation for both project areas is approximately 16,200 acre-feet. As there are two project areas and nine simulated recharge events, the average simulated recharge rate for each project area is approximately 900 acre-feet per year. Therefore, the total simulated recharge rate for both projects is approximately 1,800 acre-feet per year.

4.3 Quality Check

The "with project" and "without project" models ran within minutes with no convergence problems using industry-standard head and flow closure criteria of 0.01 feet and 864 ft^3/day, respectively. The maximum absolute percent discrepancy[10] for the "with project" and "without project" scenarios based on cumulative volumes was zero percent whereas for volumetric rates it was 0.01 percent. Both values are well within industry standards.

An analytical model that predicts mounding (Hantush, 1967)[11] for a single recharge project as provided by the USGS (Carleton, 2010)[12] gives an average mounding elevation for each project of approximately 1.5 feet based on input values used in the numerical model. The 1.5-foot value is in reasonable agreement with those obtained using the numerical model, especially when the combined effect ('superposition') of mounding predicted using the numerical model as shown on **Figure 10** is considered.

5 CONCLUSION

Based on the analysis presented here, the proposed project will result in measurable increases in groundwater elevations and therefore a groundwater level benefit.

6 REFERENCES

Carleton, G.B., 2010. *Simulation of Groundwater Mounding Beneath Hypothetical Stormwater Infiltration Basins*. U.S. Geological Survey Scientific Investigations Report 2010-5102, 64 pp.

Dee Jaspar & Associates, Inc. (DJ&A), 2017. *Kern Fan Groundwater Storage Project, Draft Concept Study*. August 10th.

Hantush, M.S., 1967. *Growth and Decay of Groundwater Mounds in Response to Uniform Percolation*. Water Resources Research, v.3, p. 227–234.

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*.

Mahdavi, A., 2015. *Transient-State Analytical Solution for Groundwater Recharge in Anisotropic Sloping Aquifer*. Water Resources Management, 29:3735–3748. May.

[10] Discrepancies arise due to the iterative procedure in the numerical model and are generally minimized using sufficiently small head and flow closure criteria.

[11] Hantush, M.S., 1967. *Growth and Decay of Groundwater Mounds in Response to Uniform Percolation*. Water Resources Research, v.3, p. 227–234.

[12] Carleton, G.B., 2010. *Simulation of Groundwater Mounding Beneath Hypothetical Stormwater Infiltration Basins*. U.S. Geological Survey Scientific Investigations Report 2010-5102, 64 pp.

Reilly, T.E. and A.W. Harbaugh, 2004. *Guidelines for Evaluating Ground-Water Flow Models*. U.S. Geological Survey Scientific Investigations Report 2004-5038, 30 pp.

Thomas Harder & Company, Inc. (TH&Co), 2011. *Hydrogeological Impact Evaluation Related to Operation of the Kern Water Bank and Pioneer Project*. December 5th.

TABLES

Historical Recharge Rates and Calculated 'Leave Behind' Recharge Rates

	Actual Historical Recharge (acre-feet per year)			Calculated 'Leave Behind' Recharge (acre-feet per year)			
Year	ENV	IRWD	Rosedale	ENV	IRWD	Rosedale	Total
1922	0	0	0	0	0	0	0
1923	0	0	0	0	0	0	0
1924	0	0	0	0	0	0	0
1925	0	0	0	0	0	0	0
1926	0	0	0	0	0	0	0
1927	0	0	0	0	0	0	0
1928	0	0	0	0	0	0	0
1929	0	0	0	0	0	0	0
1930	0	0	0	0	0	0	0
1931	0	0	0	0	0	0	0
1932	0	0	0	0	0	0	0
1933	0	0	0	0	0	0	0
1934	0	0	0	0	0	0	0
1935	0	0	0	0	0	0	0
1936	5,964	8,946	8,946	388	805	358	1,551
1937	5,964	9,014	8,879	388	811	355	1,554
1938	11,351	17,330	16,725	738	1,560	669	2,966
1939	0	0	0	0	0	0	0
1940	0	0	0	0	0	0	0
1941	0	0	0	0	0	0	0
1942	0	0	0	0	0	0	0
1943	9,272	7,570	7,016	603	681	281	1,565
1944	0	0	0	0	0	0	0
1945	8,464	7,429	7,964	550	669	319	1,537
1946	0	0	0	0	0	0	0
1947	0	0	0	0	0	0	0
1948	0	0	0	0	0	0	0
1949	0	0	0	0	0	0	0
1950	0	0	0	0	0	0	0
1951	73	130	133	5	12	5	22
1952	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0
1956	11,544	17,316	17,316	750	1,558	693	3,001
1957	0	0	0	0	0	0	0
1958	5,772	8,826	8,490	375	794	340	1,509
1959	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0
1969	20,157	13,054	12,195	1,310	1,175	488	2,973
1970	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0

Irvine Ranch Water District
Kern Fan Groundwater Storage Project

Table 1

Historical Recharge Rates and Calculated 'Leave Behind' Recharge Rates

	Actual Historical Recharge (acre-feet per year)			Calculated 'Leave Behind' Recharge (acre-feet per year)			
Year	ENV	IRWD	Rosedale	ENV	IRWD	Rosedale	Total
1972	0	0	0	0	0	0	0
1973	5,957	4,184	3,299	387	377	132	896
1974	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0
1978	7,726	20,081	19,907	502	1,807	796	3,106
1979	0	0	0	0	0	0	0
1980	8,213	21,962	20,562	534	1,977	822	3,333
1981	0	0	0	0	0	0	0
1982	544	1,763	1,078	35	159	43	237
1983	76	304	119	5	27	5	37
1984	1	7	1	0	1	0	1
1985	0	0	0	0	0	0	0
1986	13,745	0	0	893	0	0	893
1987	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0

Number of Recharge Years (over entire 82-year record) => 16
Average Recharge Rate during Recharge Years over entire 82-year record (acre-feet per year) => 1574

Number of Recharge Years (over first 50 years of 82-year record) => 9
Average Recharge Rate during Recharge Years over first 50 years of 82-year record (acre-feet per year) => 1853

Table 2

Model-Predicted Water Budget

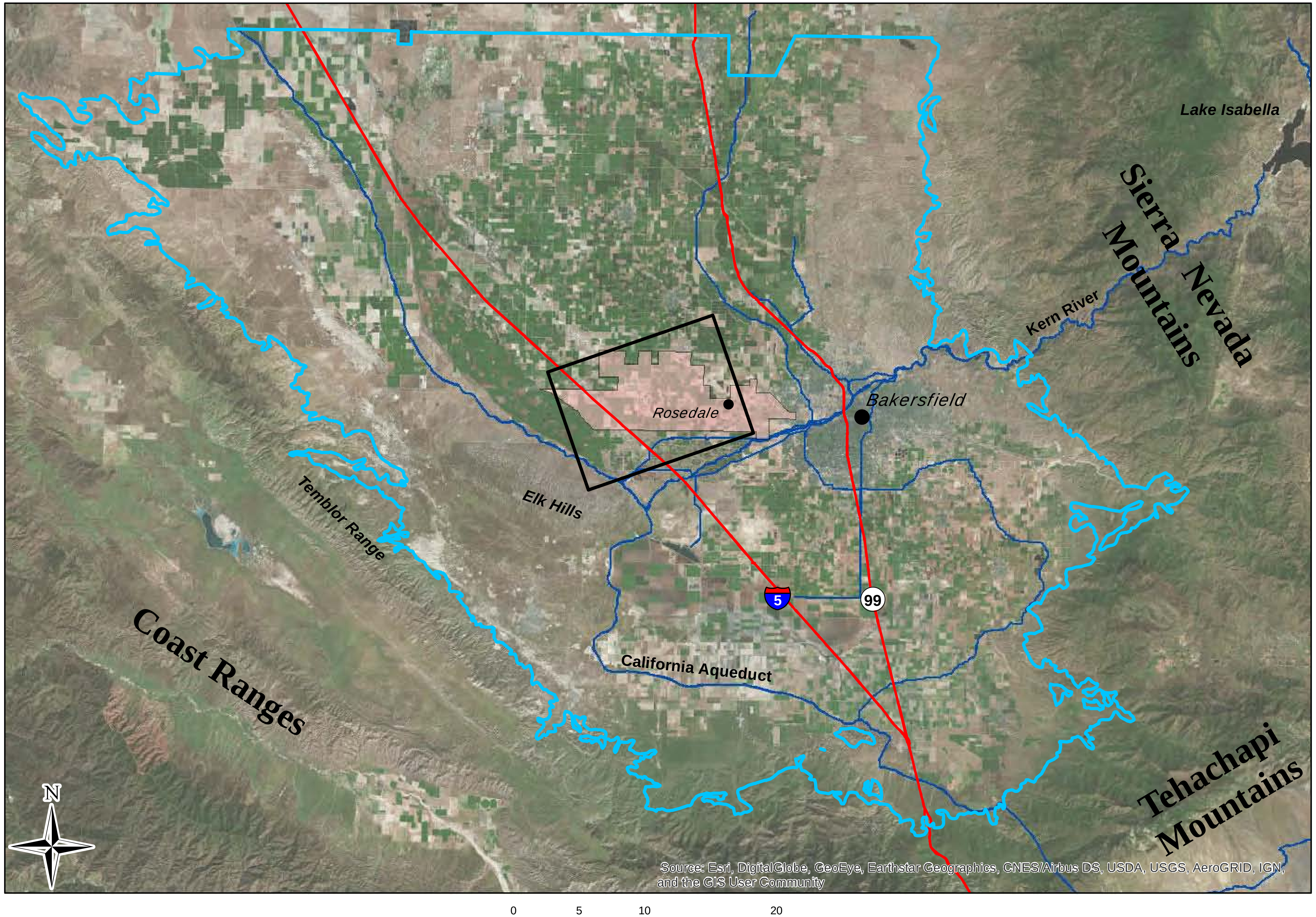
Component	"With Project" (acre-ft)	"Without Project" (acre-ft)	Difference (acre-ft)
Constant Head In	6,196,235	6,200,989	-4,754
Constant Head Out	6,875,078	6,864,254	10,825
Recharge In	16,213	0	16,213
Recharge Out	0	0	0
Storage In	4,741,121	4,739,241	1,880
Storage Out	4,078,243	4,075,752	2,491

FIGURES

Irvine Ranch Water District

22-Feb-18

Kern Fan Groundwater Storage Project



NAD 83 State Plane CA Zone 5

Map Features

- Tulare Basin
- Study Area
- Highways
- Rosedale-Rio Bravo Water Storage District
- Water Courses

Basemap Source: www.esri.com

Regional Setting

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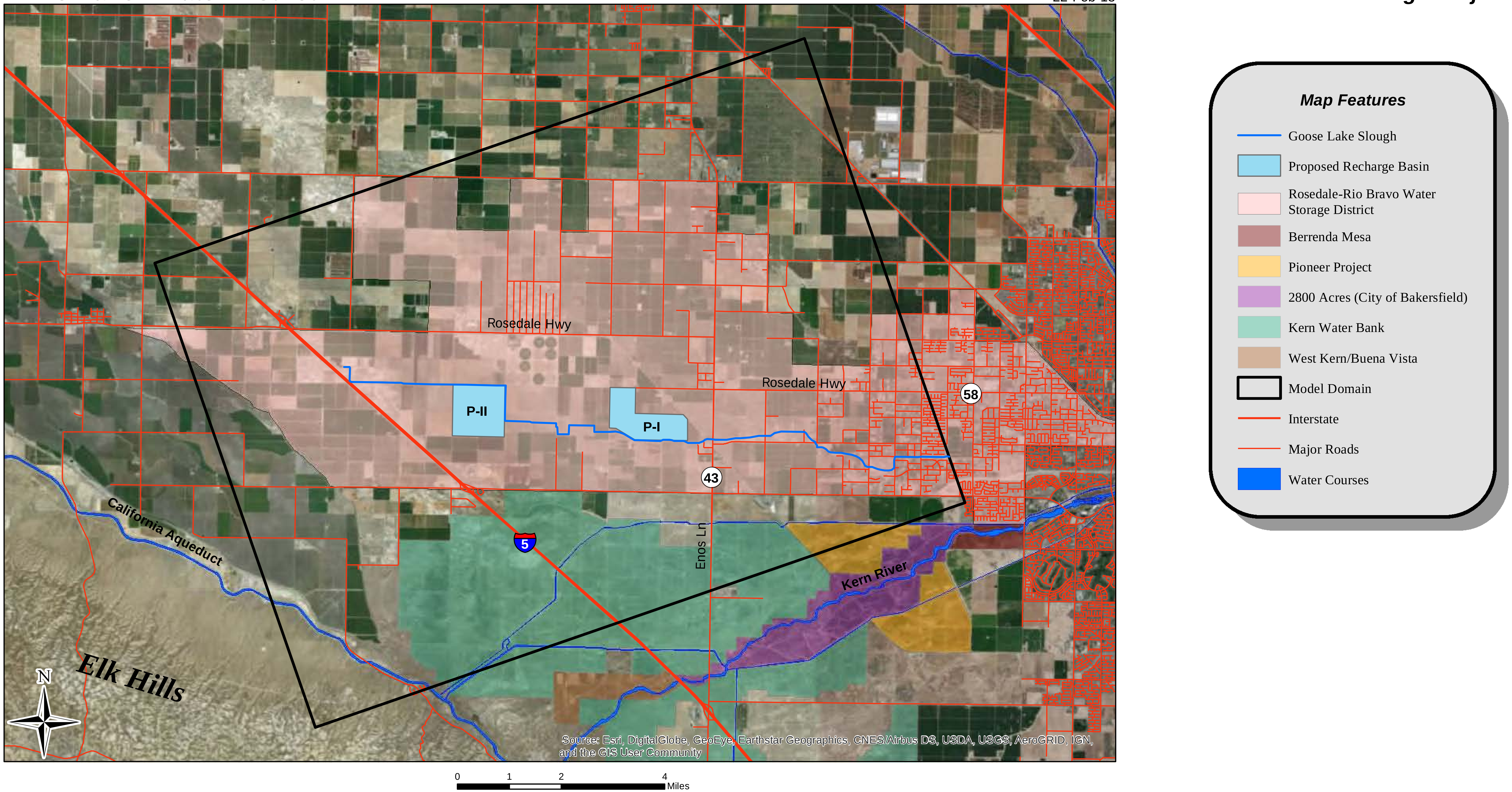
Regional Map

Figure 1

Irvine Ranch Water District

22-Feb-18

Kern Fan Groundwater Storage Project



NAD 83 State Plane CA Zone 5

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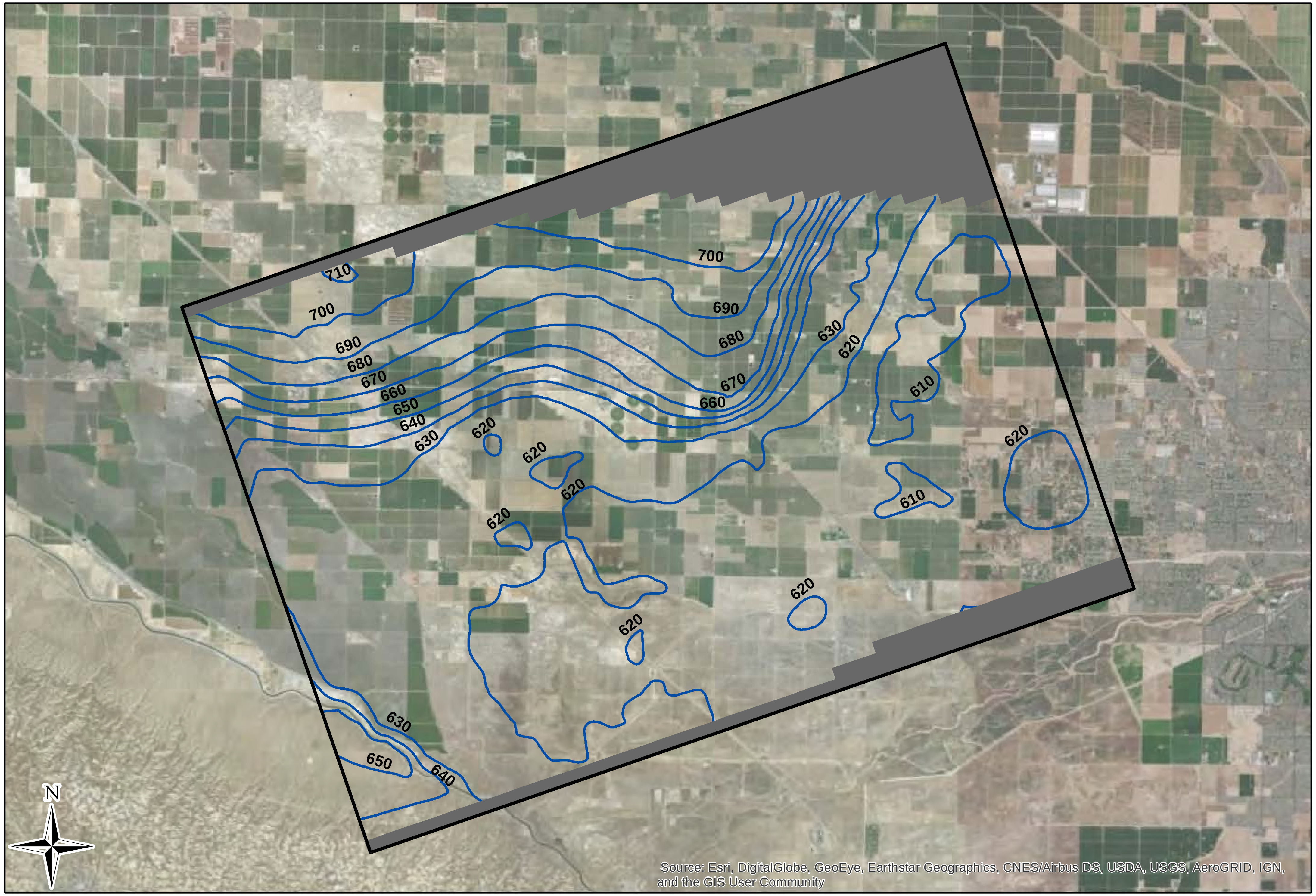
Study Area

Figure 2

Irvine Ranch Water District

22-Feb-18

Kern Fan Groundwater Storage Project



Map Features

- Layer Thickness Contour (ft)
- No Flow Zone
- Model Domain

0 1 2 4 Miles

NAD 83 State Plane CA Zone 5

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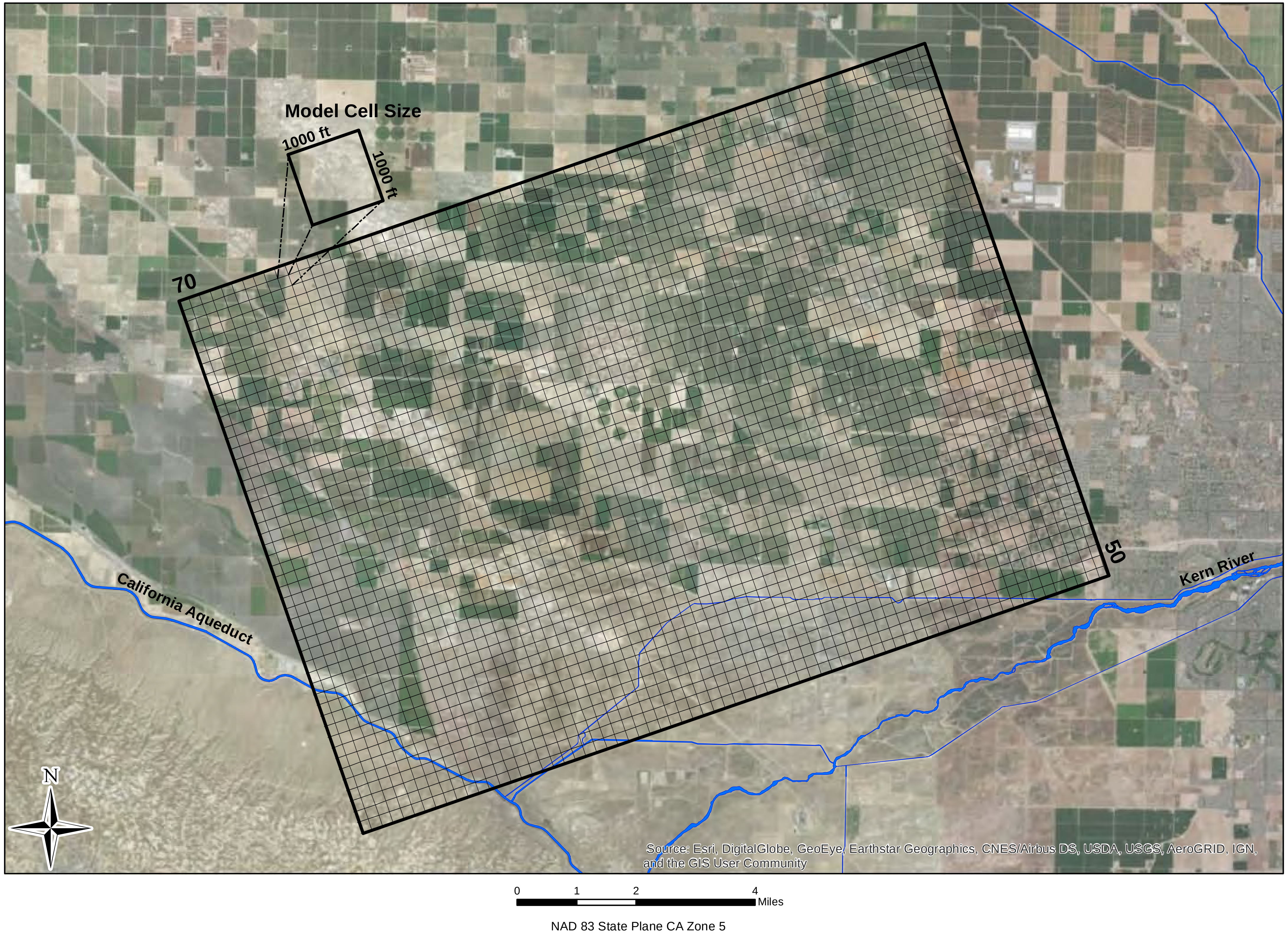
Layer Thickness

Figure 3

Irvine Ranch Water District

Kern Fan Groundwater Storage Project

22-Feb-18



Map Features

- Model Grid Cell
- Model Domain
- Water Courses

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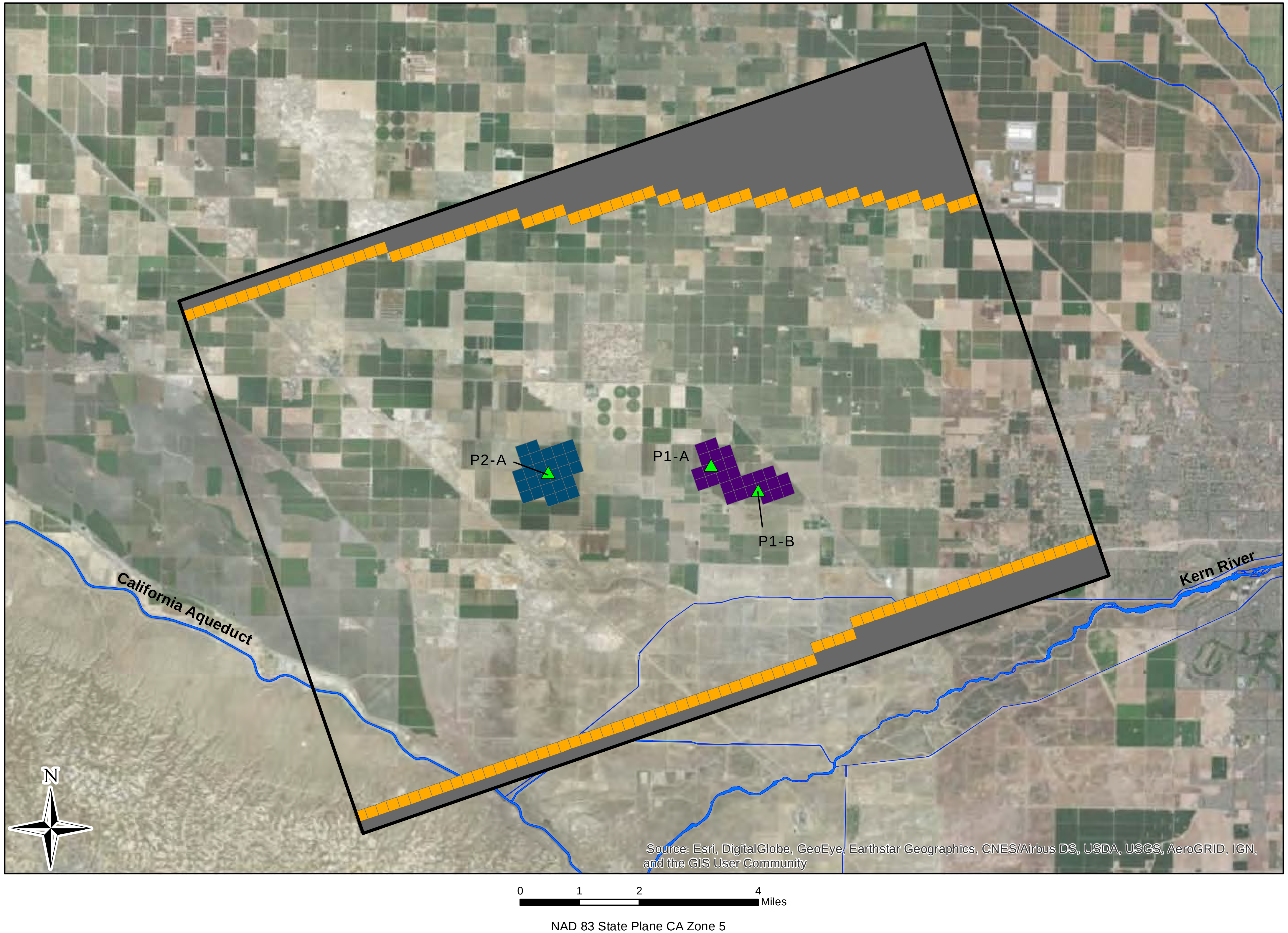
Model Grid

Figure 4

Irvine Ranch Water District

22-Feb-18

Kern Fan Groundwater Storage Project



Map Features

- Observation Well
- Specified Head Cell (Head Boundary)
- P-I Basin (Flux Boundary)
- P-II Basin (Flux Boundary)
- No Flow Zone (Flux Boundary)
- Model Domain
- Water Courses

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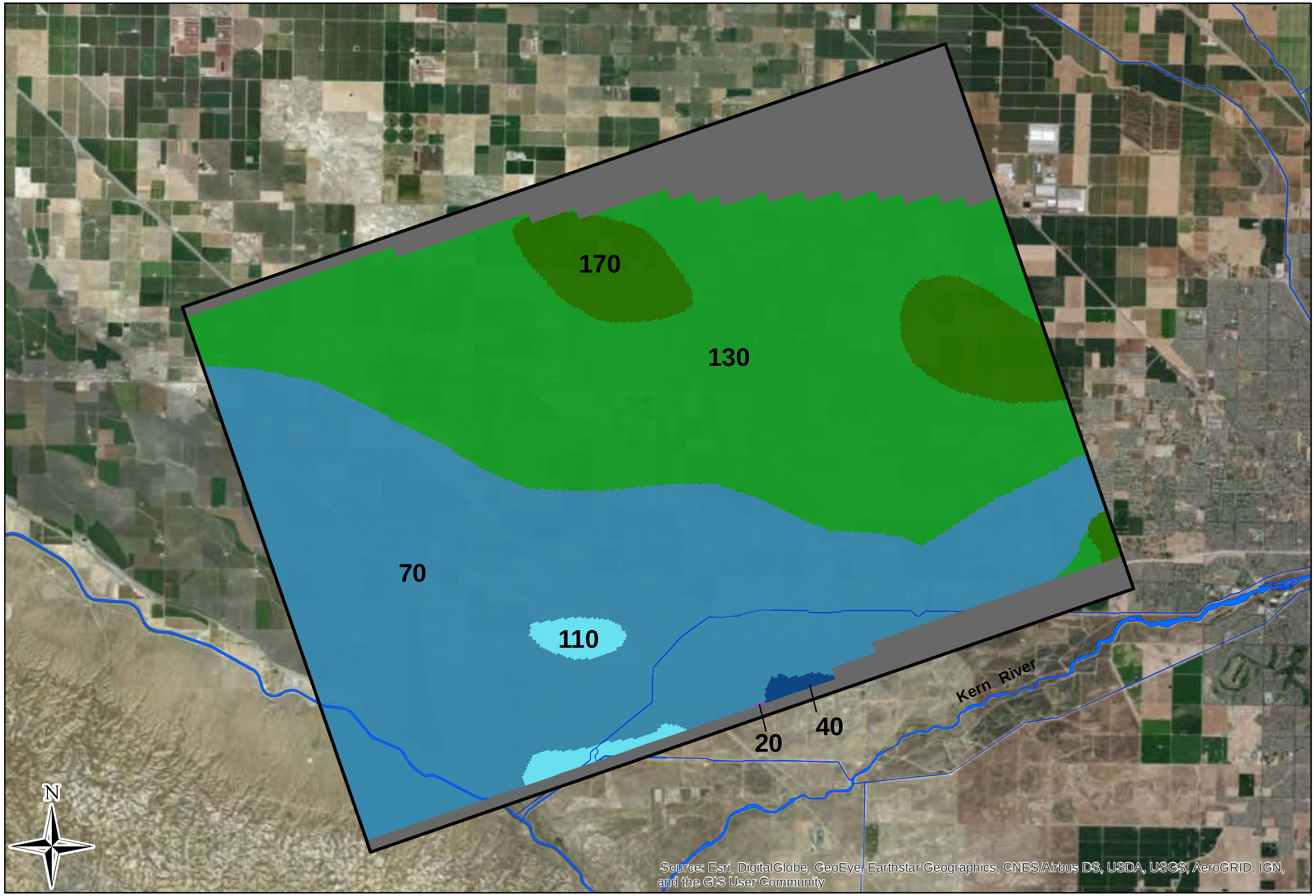
Head and Flux Boundaries

Figure 5

Kern Fan Groundwater Storage Project

Irvine Ranch Water District

22-Feb-18



Map Features

Hydraulic Conductivity (ft/day)

- 20, 1
- 40, 1
- 70, 1
- 110, 1
- 130, 1
- 170, 3.3
- 170, 4.5
- No Flow Zone
- Model Domain
- Water Course

0 1.25 2.5 5 Miles

NAD 83 State Plane CA Zone 5

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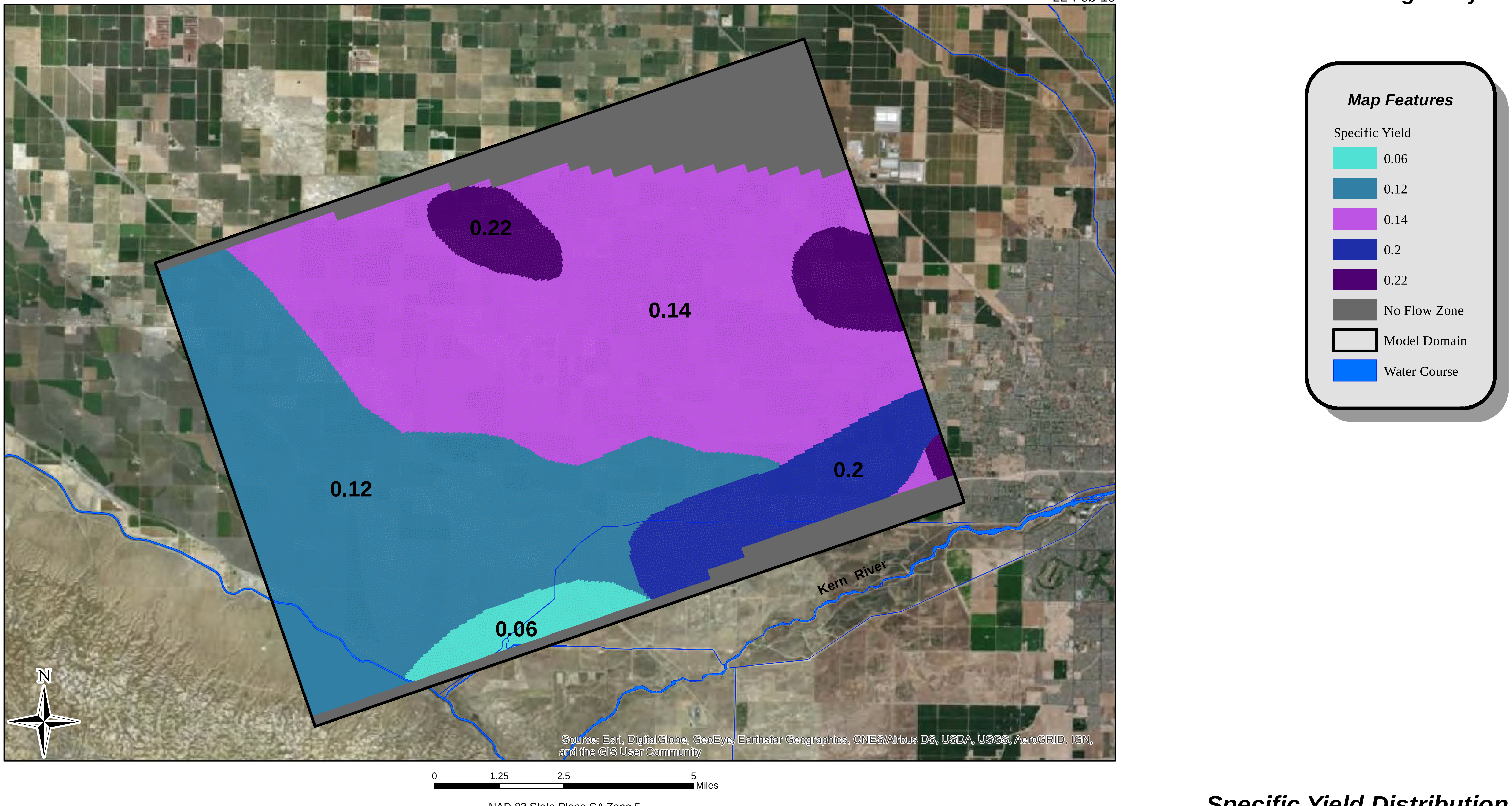
Hydraulic Conductivity Distribution

Figure 6

Irvine Ranch Water District

Kern Fan Groundwater Storage Project

22-Feb-18



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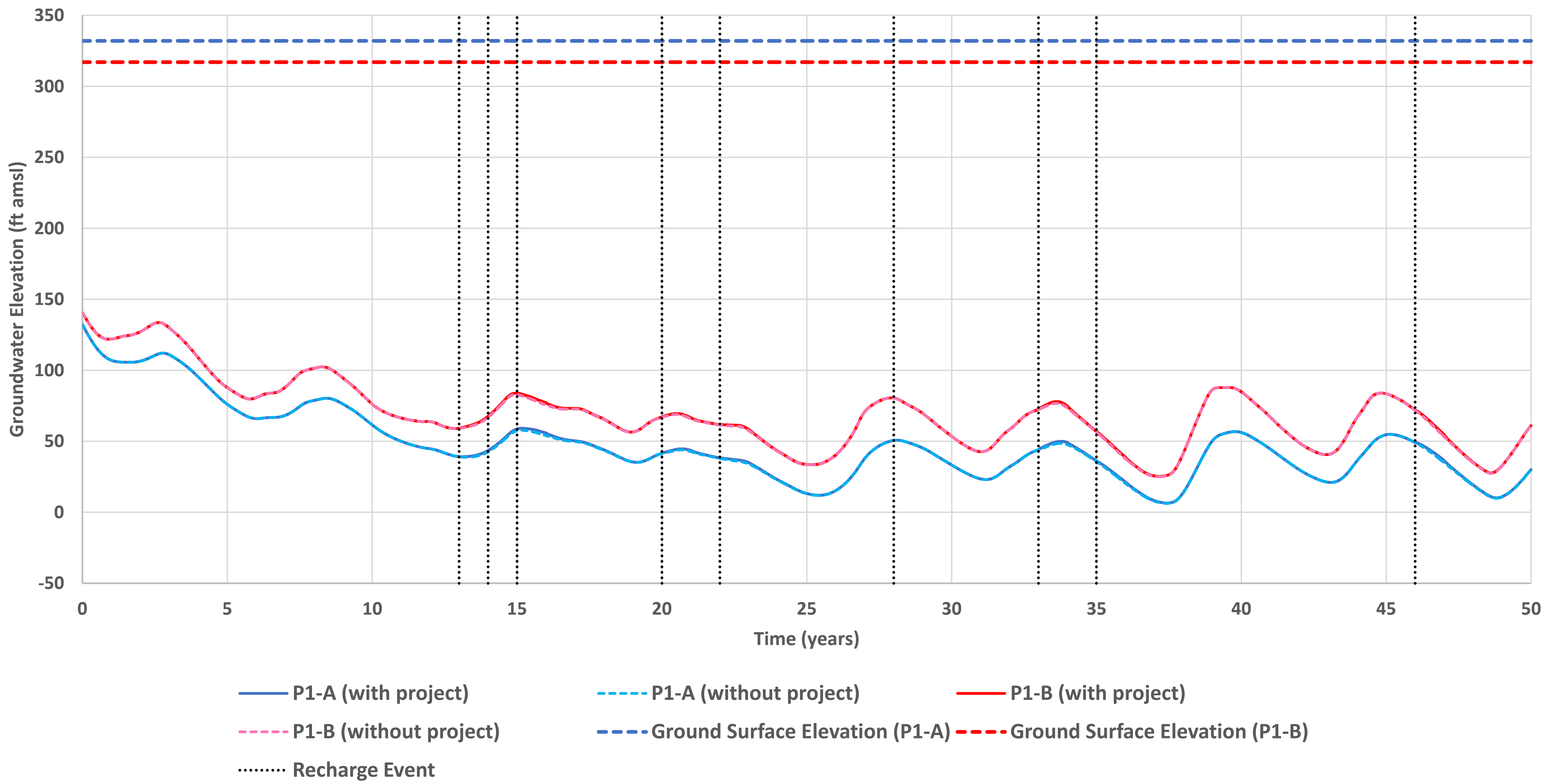
Groundwater Consulting

Specific Yield Distribution

Figure 7

Irvine Ranch Water District
Kern Fan Groundwater Storage Project

Figure 8a
Model-Predicted Groundwater Elevations
Phase I Area



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2/23/2018
Hydrographs.xlsx | Phase I

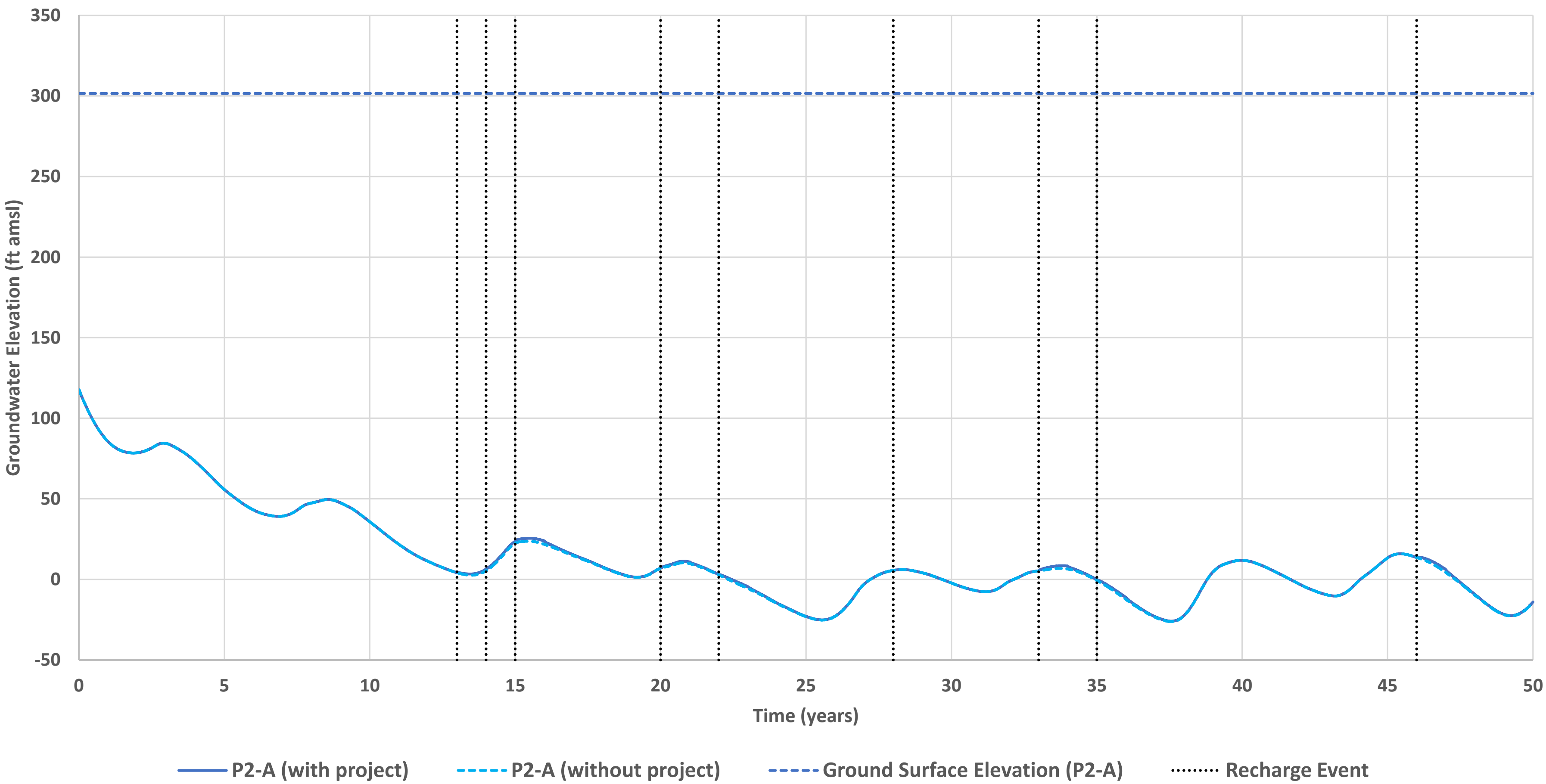
Figure 8b

Irvine Ranch Water District

Kern Fan Groundwater Storage Project

Model-Predicted Groundwater Elevations

Phase II Area



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2/23/2018

Hydrographs.xlsx | Phase II

Irvine Ranch Water District
Kern Fan Groundwater Storage Project

Figure 9a
Change in Model-Predicted Groundwater Elevations Phase I Area

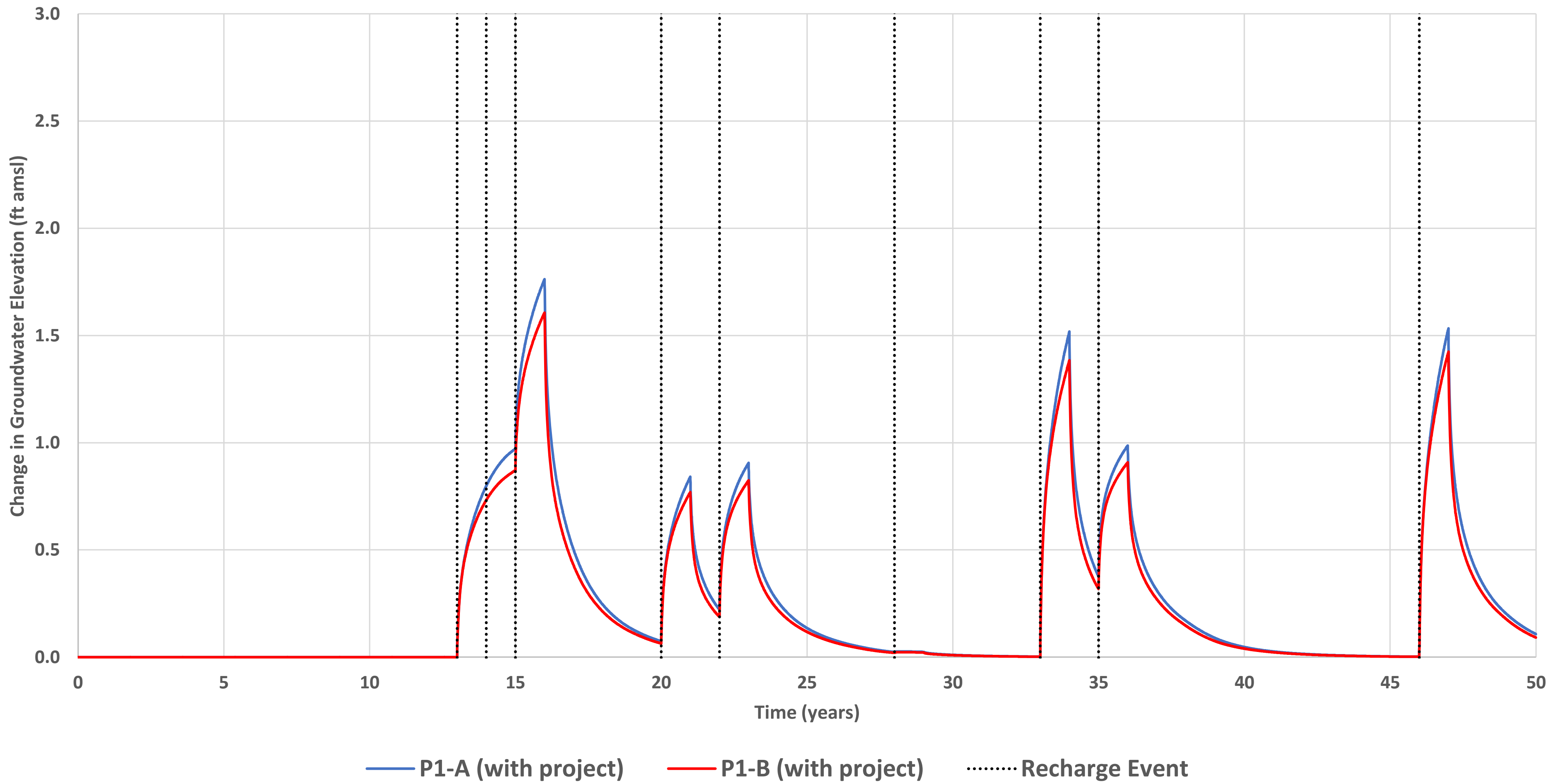
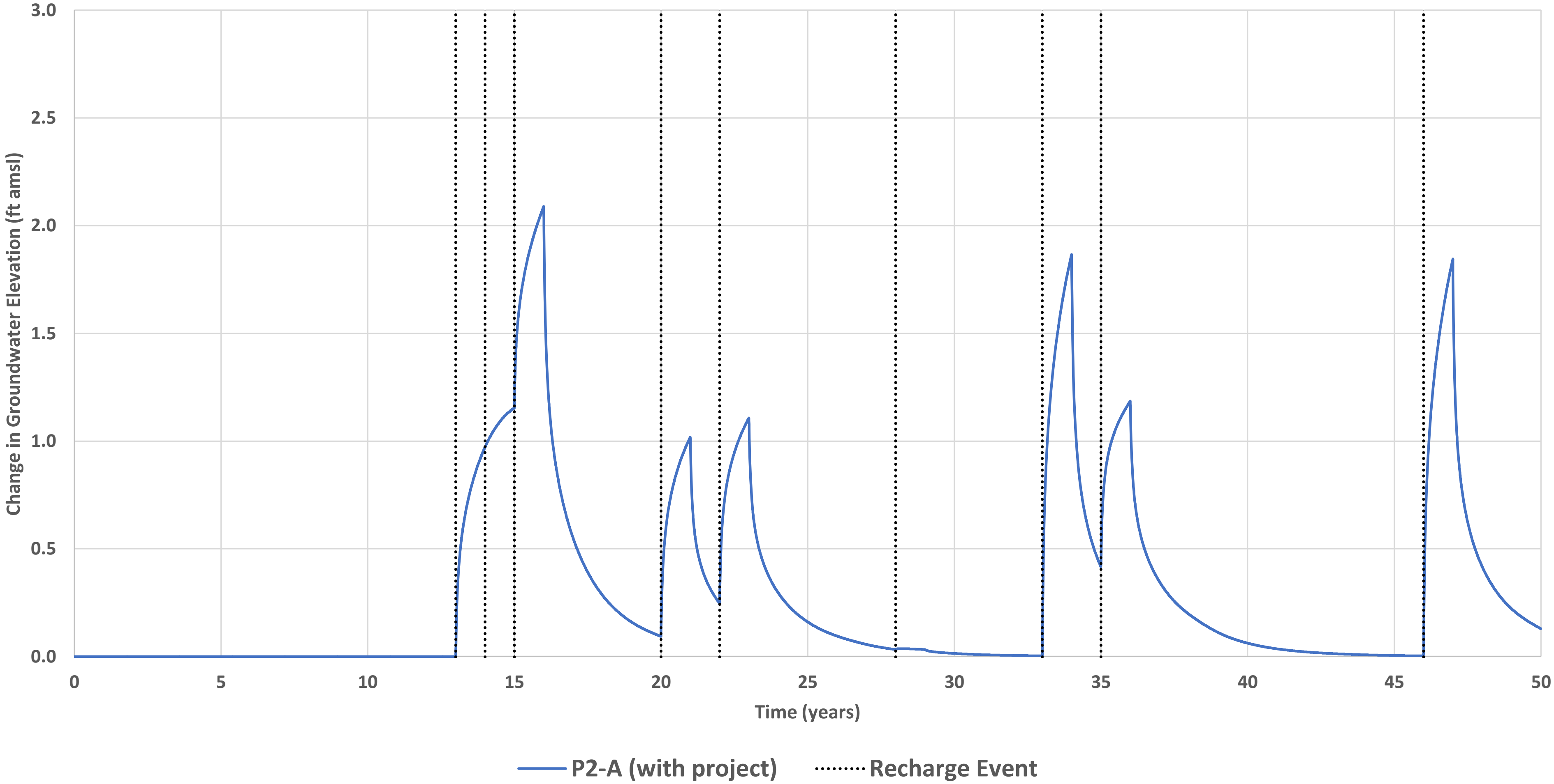


Figure 9b
Change in Model-Predicted
Groundwater Elevations
Phase II Area

Irvine Ranch Water District
Kern Fan Groundwater Storage Project



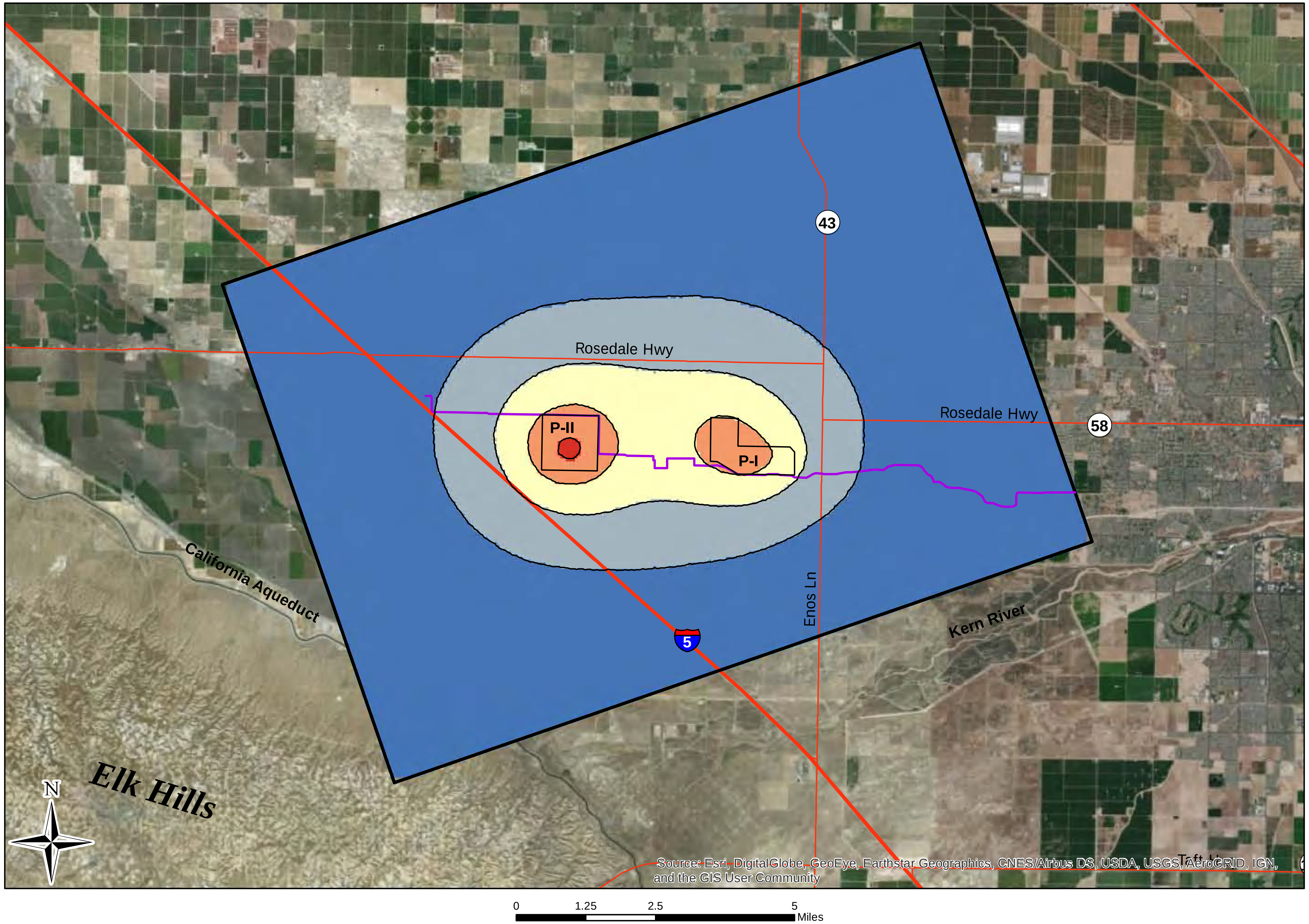
Thomas Harder & Co.
Groundwater Consulting

2/23/2018
Hydrographs | Phase II

Irvine Ranch Water District

22-Feb-18

Kern Fan Groundwater Storage Project



NAD 83 State Plane CA Zone 5

Map Features

- Goose Lake Slough
- Proposed Recharge Basin
- Model Domain
- Interstate
- Major Roads
- Water Courses

Difference in Head (ft)

- 0 - 0.5
- 0.51 - 1
- 1.1 - 1.5
- 1.6 - 2
- 2.1 - 2.5

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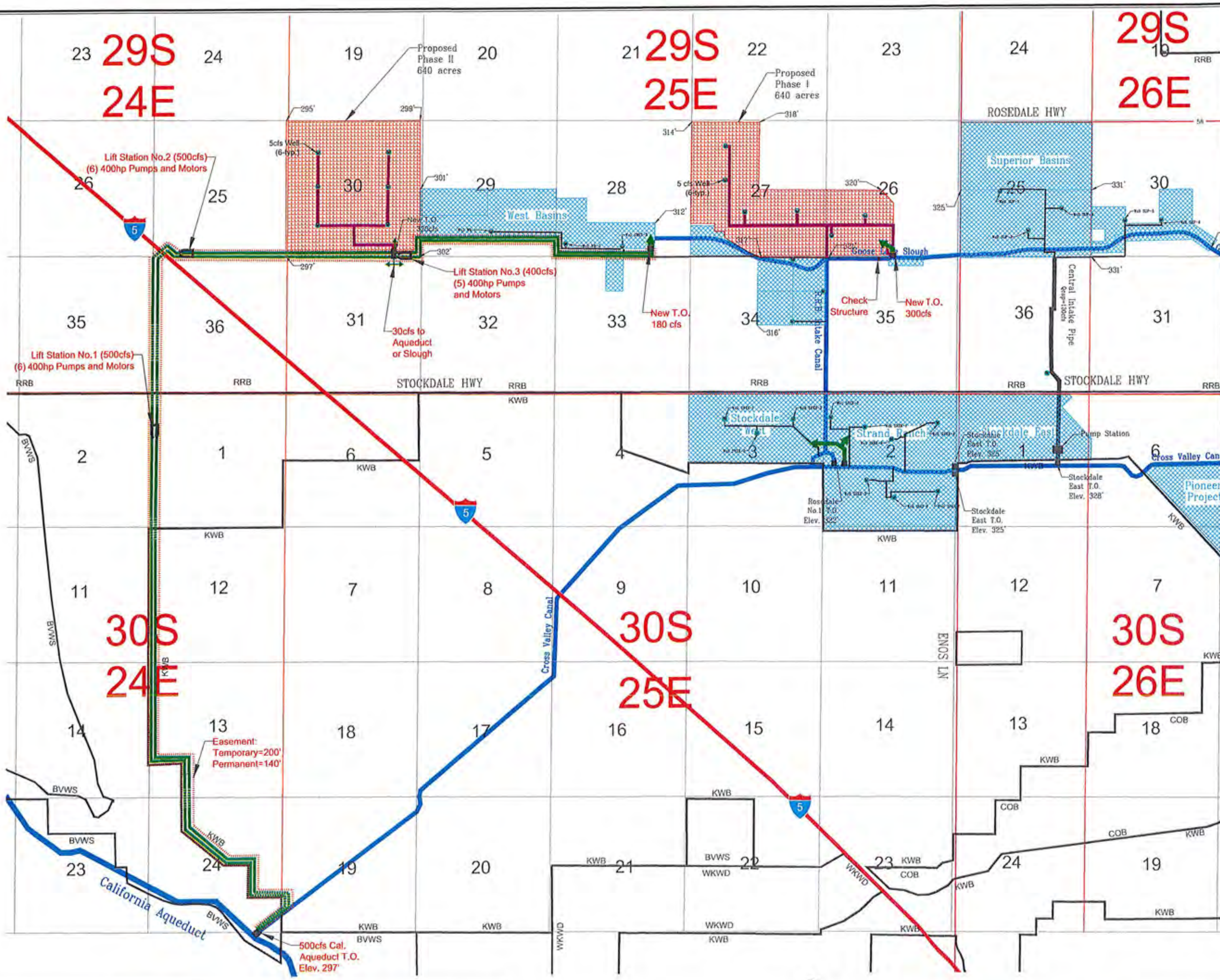
Difference Map

Figure 10

ATTACHMENT A

Project Concept Map

(from Dee Jasper & Associates, Inc., 2017)



Kern Fan Groundwater Storage Project Feasibility Study Map

LEGEND

- Canals/other Waterways
- Diversion/Conveyance
- Pipe Sections (Underground)
- Easement
- Water District Boundary
- Major Roads
- Recovery/Conveyance
- Well
- Proposed Properties
- Current Properties
- Water Coverage

N

SCALE: 1" = 1200'

DATE: August 2017

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