Hydrogeology Modeling Workshop

CalAm/ESA – MPWSP

May 19, 2015

GEOSCIENCE Support Services, Inc., Ground Water Resources Development
P.O. Box 220, Claremont, CA 91711 | P: 909.451.6650 | F: 909.451.6638 | www.gssiwater.com

Overview

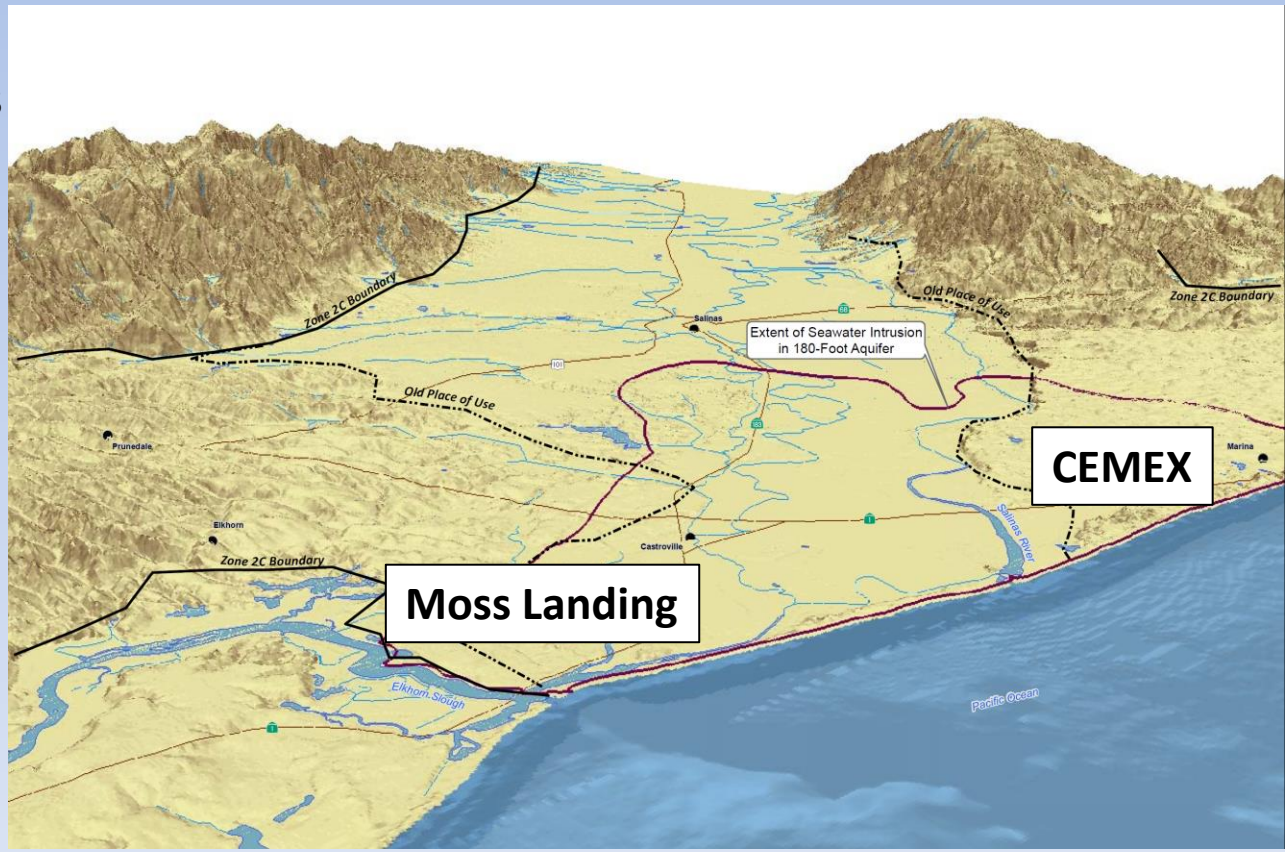
- Purpose and Scope of Hydrogeology Modeling
- Types of Model Input
  - Groundwater Models
  - Aquifer Parameters
  - Model Inflow Terms
  - Model Outflow Terms
- Major Assumptions of Predictive Model Scenarios
- Results Output

Overview

- **Purpose and Scope of Hydrogeology Modeling**
- Types of Model Input
  - Groundwater Models
  - Aquifer Parameters
  - Model Inflow Terms
  - Model Outflow Terms
- Major Assumptions of Predictive Model Scenarios
- Results Output

Purpose

- The purpose of this study was to evaluate the impacts of the proposed MPWSP on the Salinas Valley Groundwater Basin.
- Groundwater modeling was conducted to assess the impacts of MPWSP on the groundwater levels and the seawater intrusion.



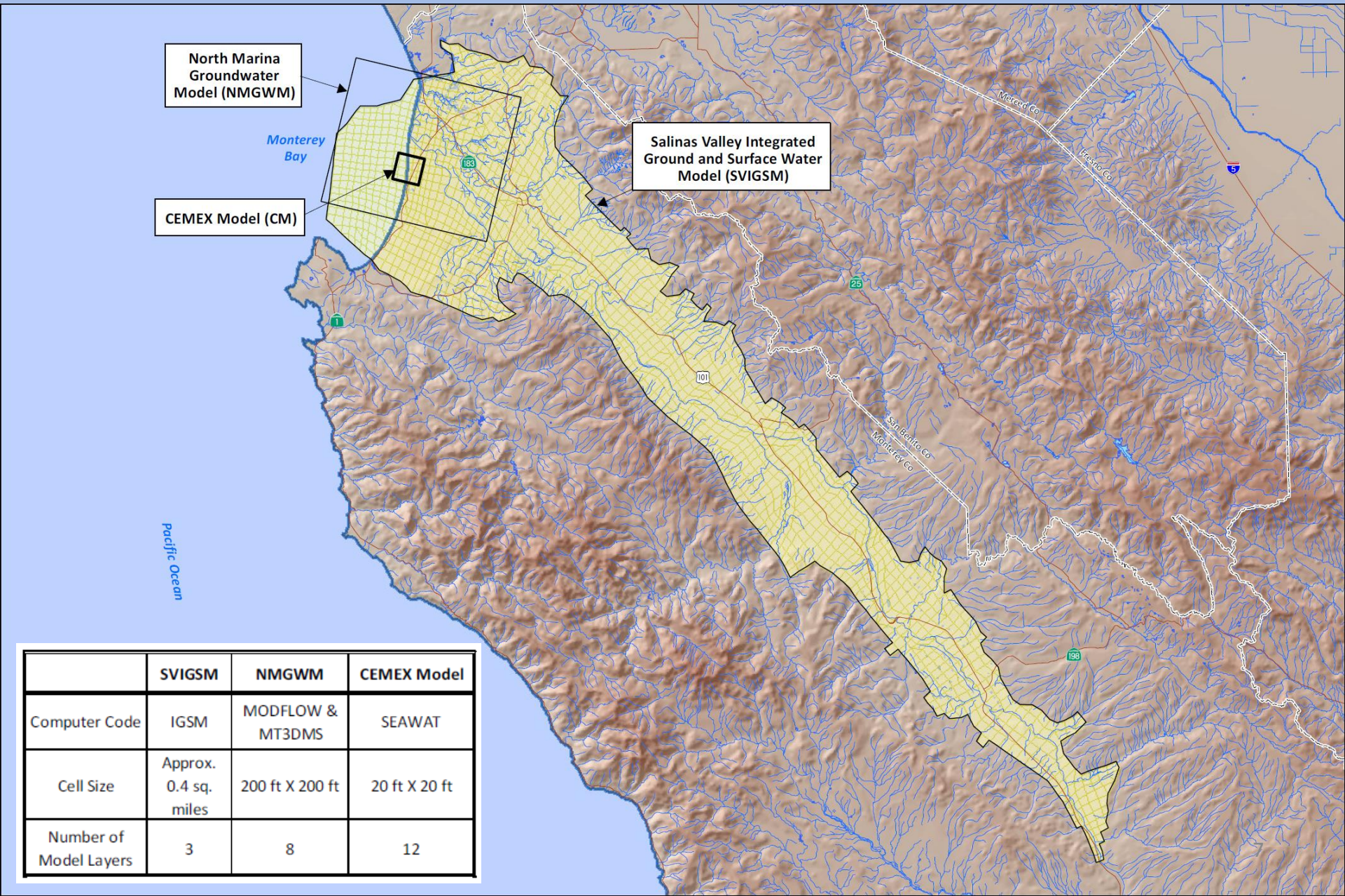
Scope of Work

- Collecting and Analyzing Historical Geohydrologic Data,
- Updating and Recalibrating the NMGWM,
- Updating and Recalibrating the SVIGSM,
- Developing a Focused CEMEX Model for the CEMEX Site,
- Developing and Running Various MPWSP Scenarios, and
- Preparing the Modeling Report.

Overview

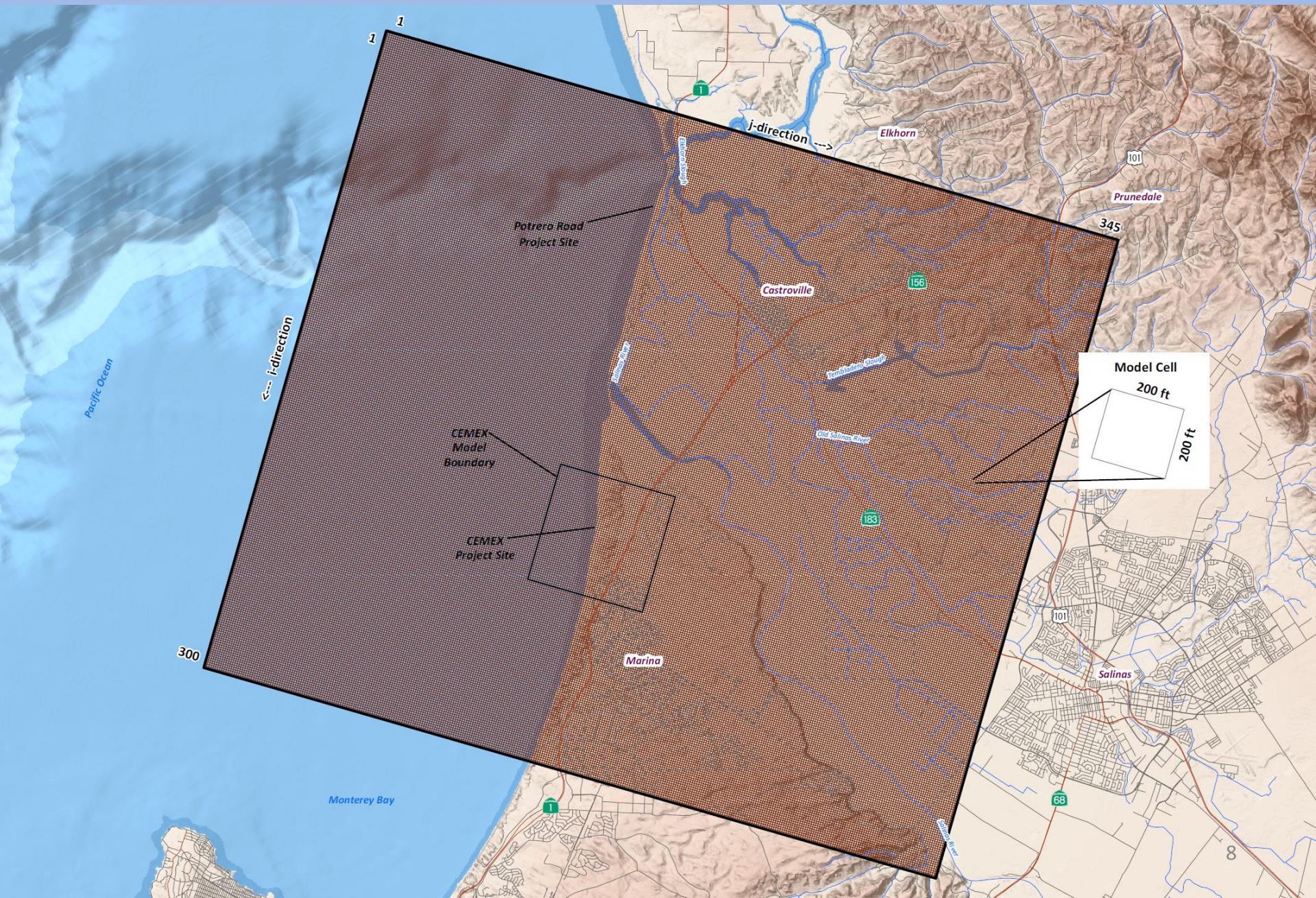
- Purpose and Scope of Hydrogeology Modeling
- **Types of Model Input**
  - **Groundwater Models**
  - Aquifer Parameters
  - Model Inflow Terms
  - Model Outflow Terms
- Major Assumptions of Predictive Model Scenarios
- Results Output

Groundwater Models

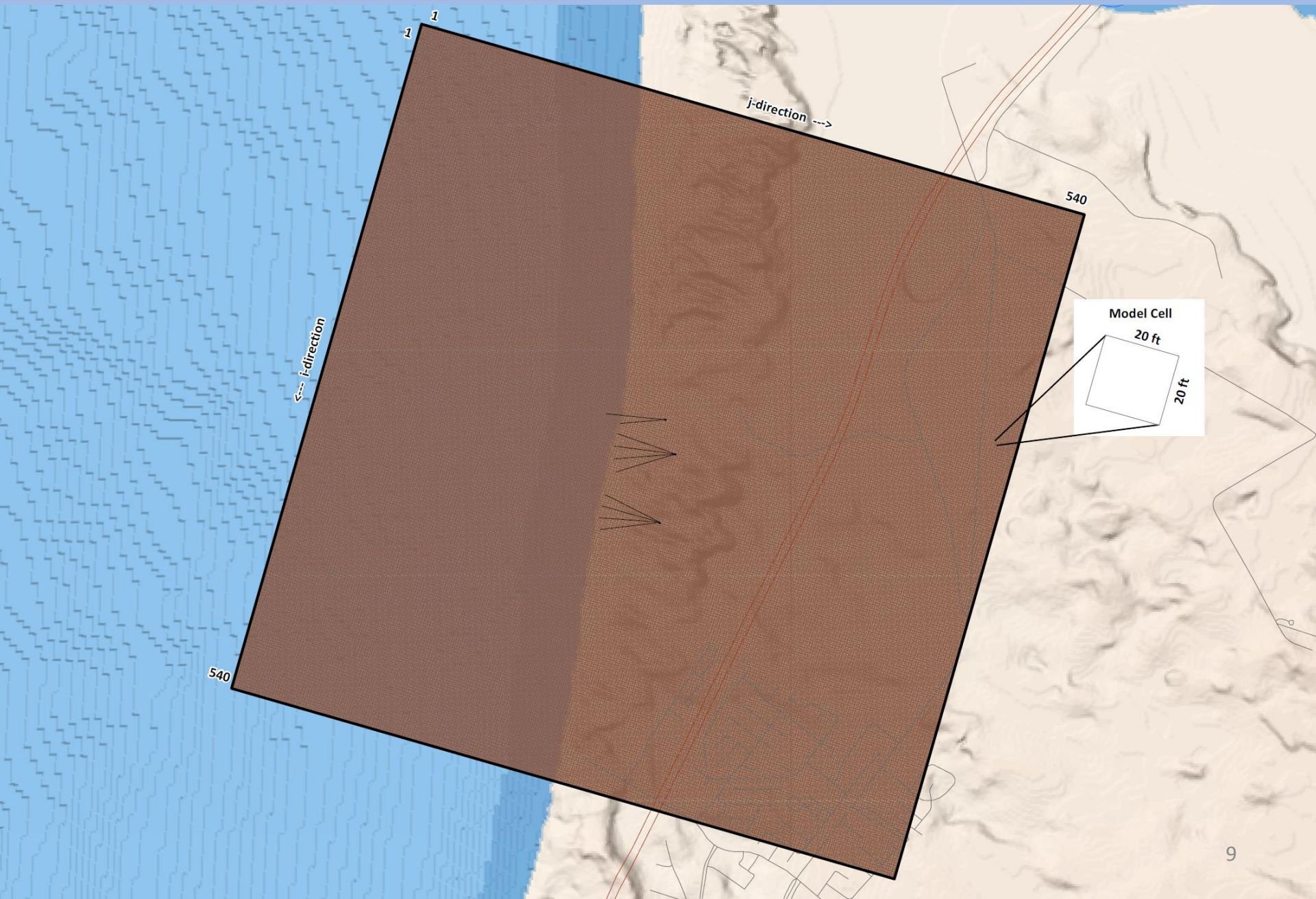


	SVIGSM	NMGWM	CEMEX Model
Computer Code	IGSM	MODFLOW & MT3DMS	SEAWAT
Cell Size	Approx. 0.4 sq. miles	200 ft X 200 ft	20 ft X 20 ft
Number of Model Layers	3	8	12

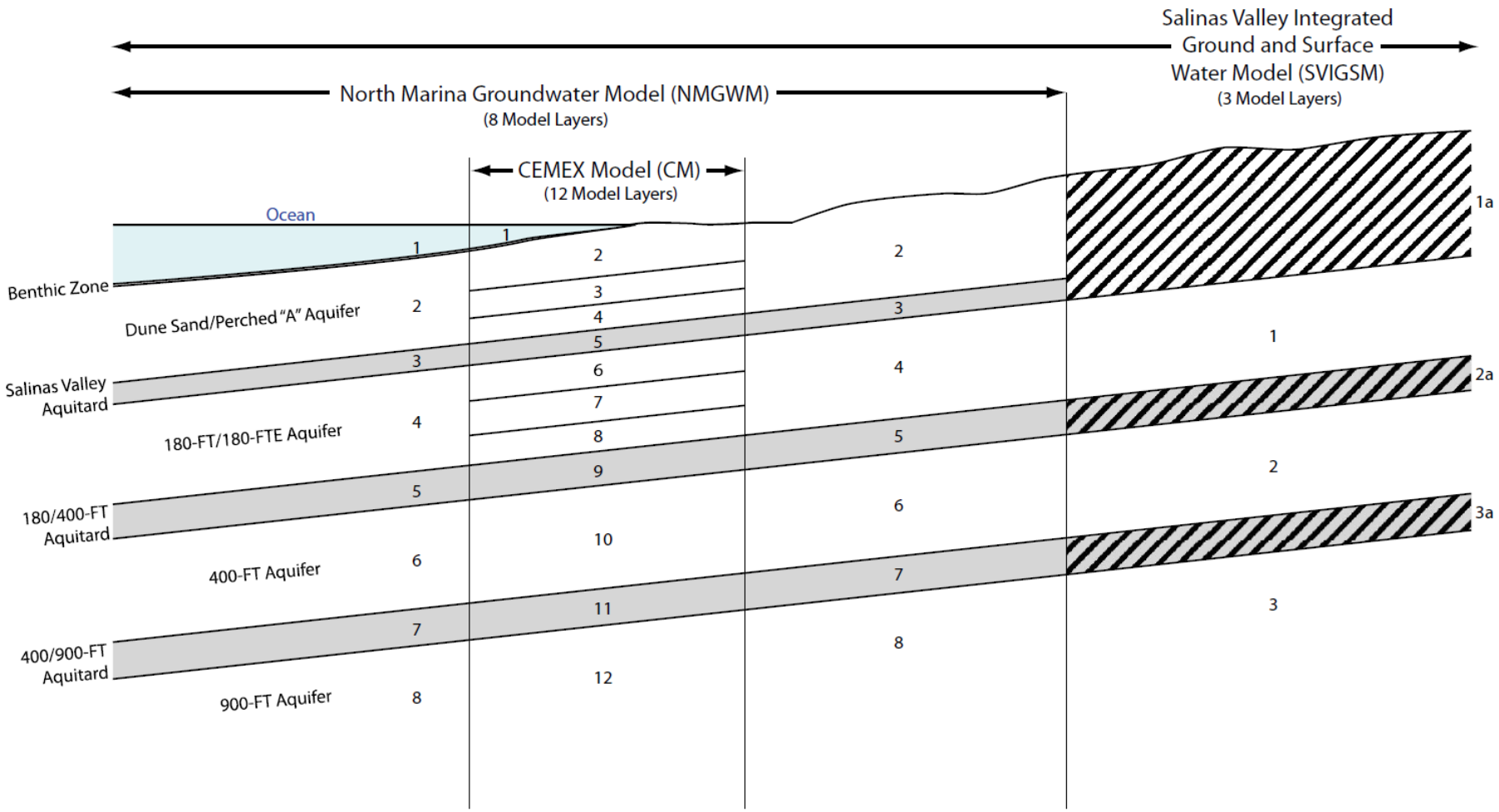
North Marina Groundwater Model Grid



CEMEX Model Grid



Model Integration

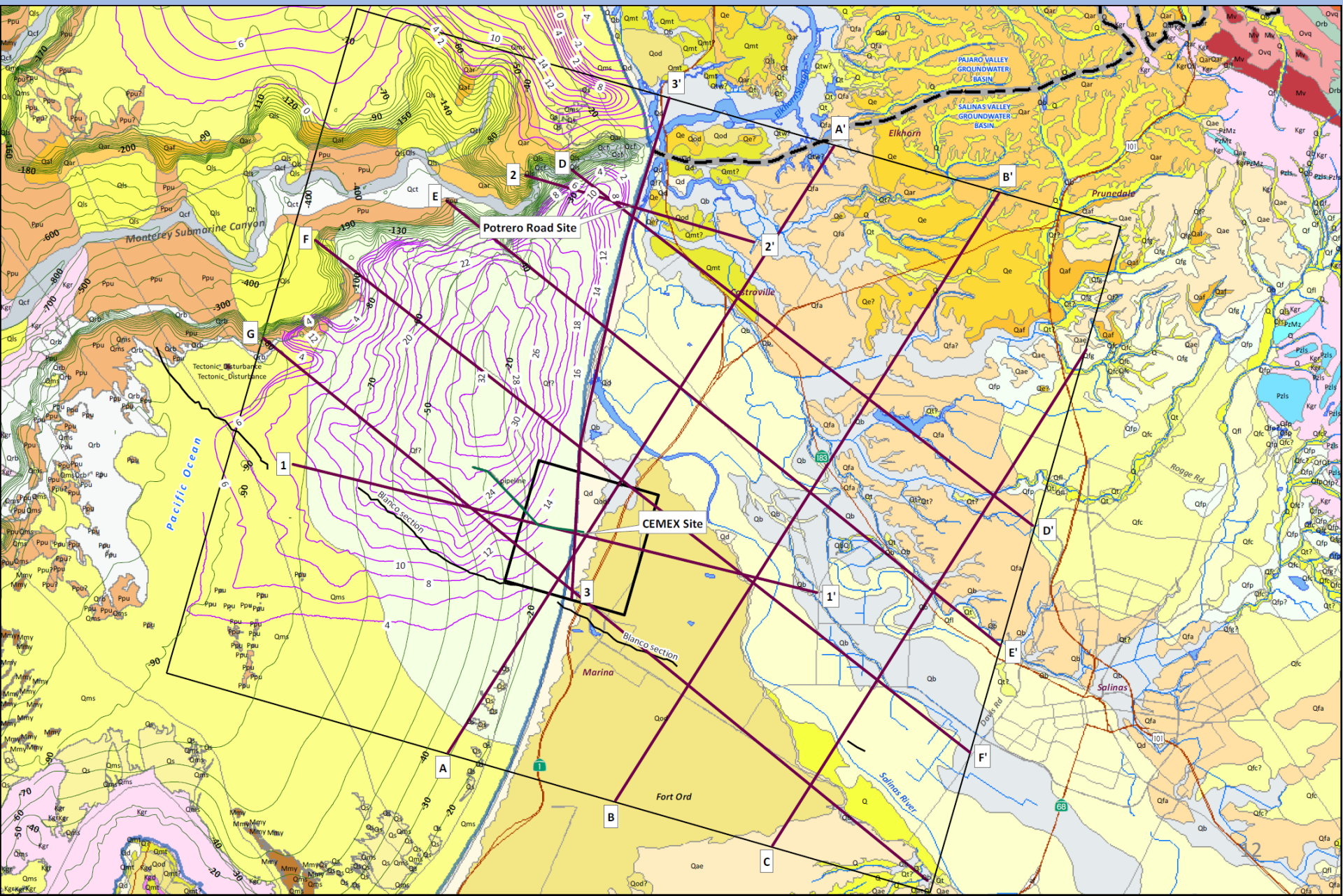


Note : Numbers indicate model layer.
SVIGSM "a" model layers have the vertical hydraulic conductivity and thickness input into the model
Not drawn to scale

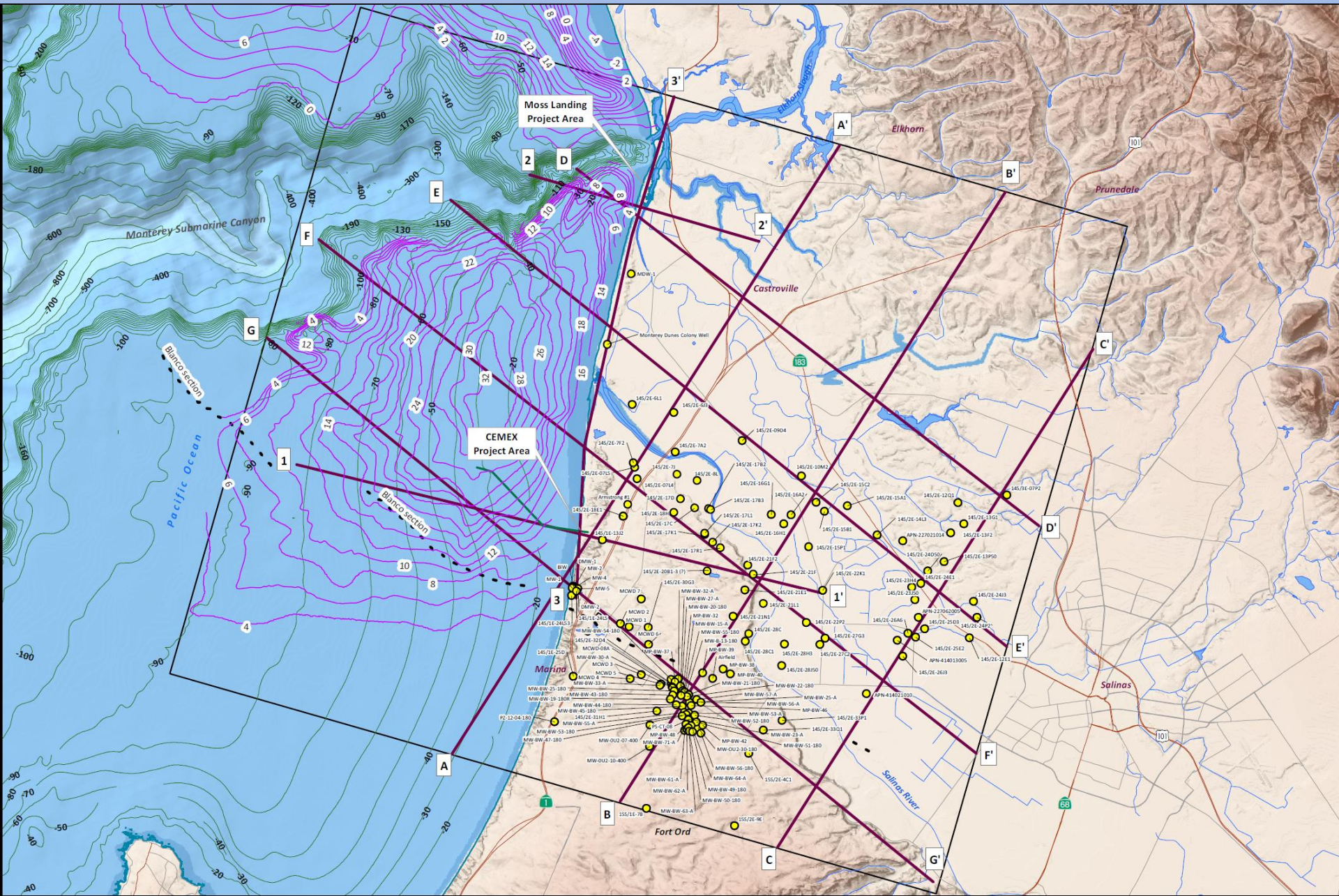
Overview

- Purpose and Scope of Hydrogeology Modeling
- Types of Model Input
  - Groundwater Models
  - **Aquifer Parameters**
  - Model Inflow Terms
  - Model Outflow Terms
- Major Assumptions of Predictive Model Scenarios
- Results Output

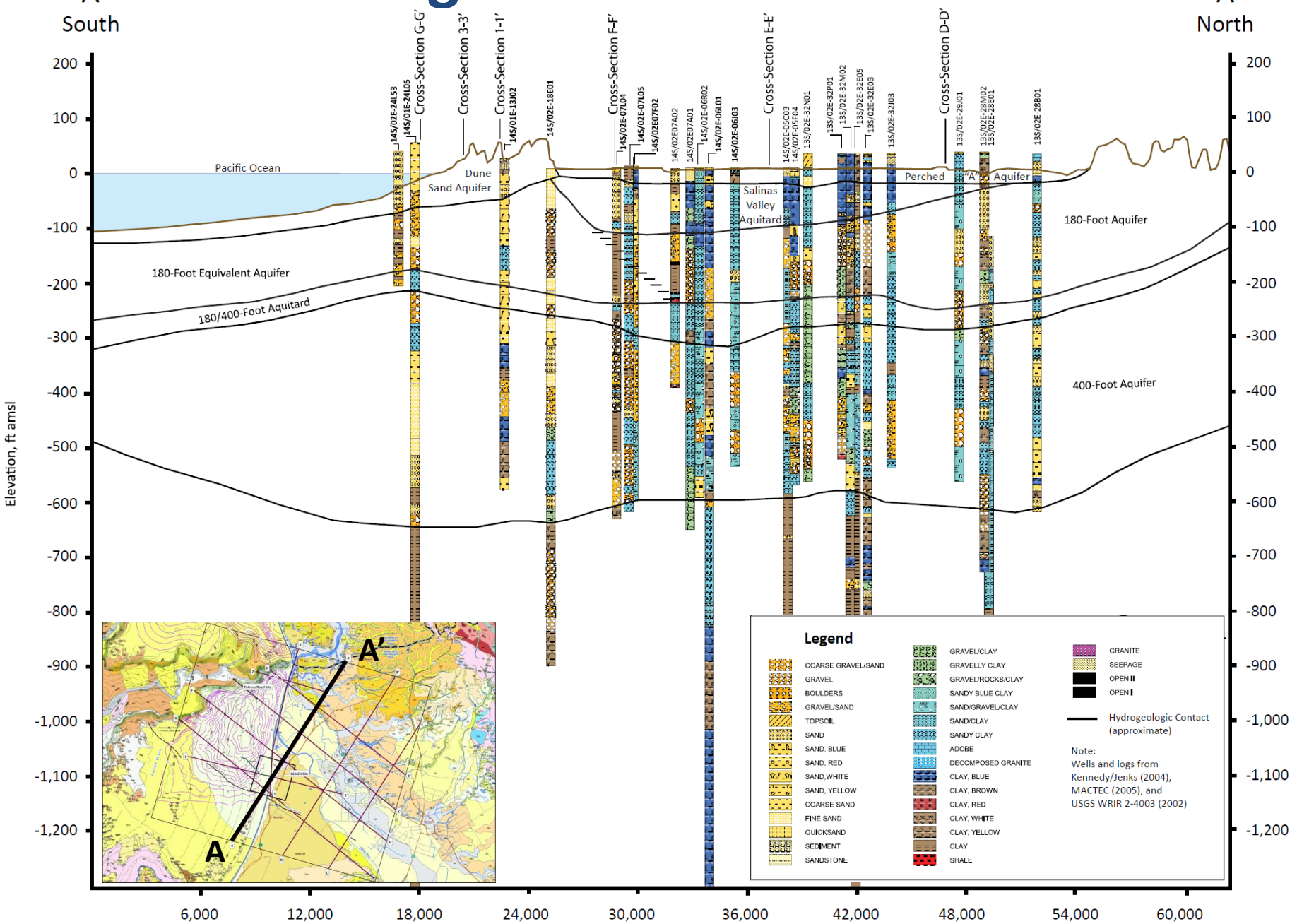
Geologic Map



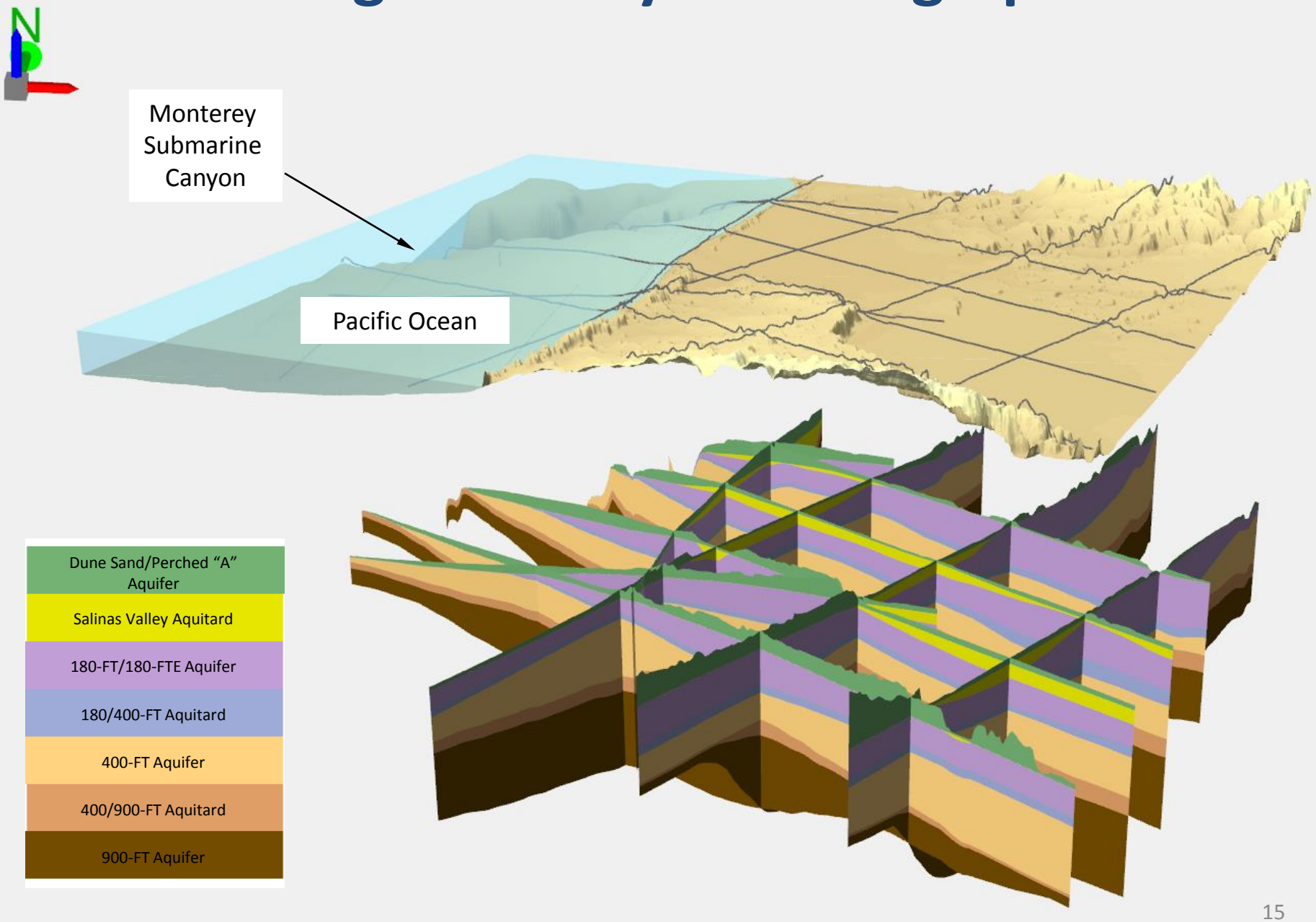
Well and Cross-Section Locations



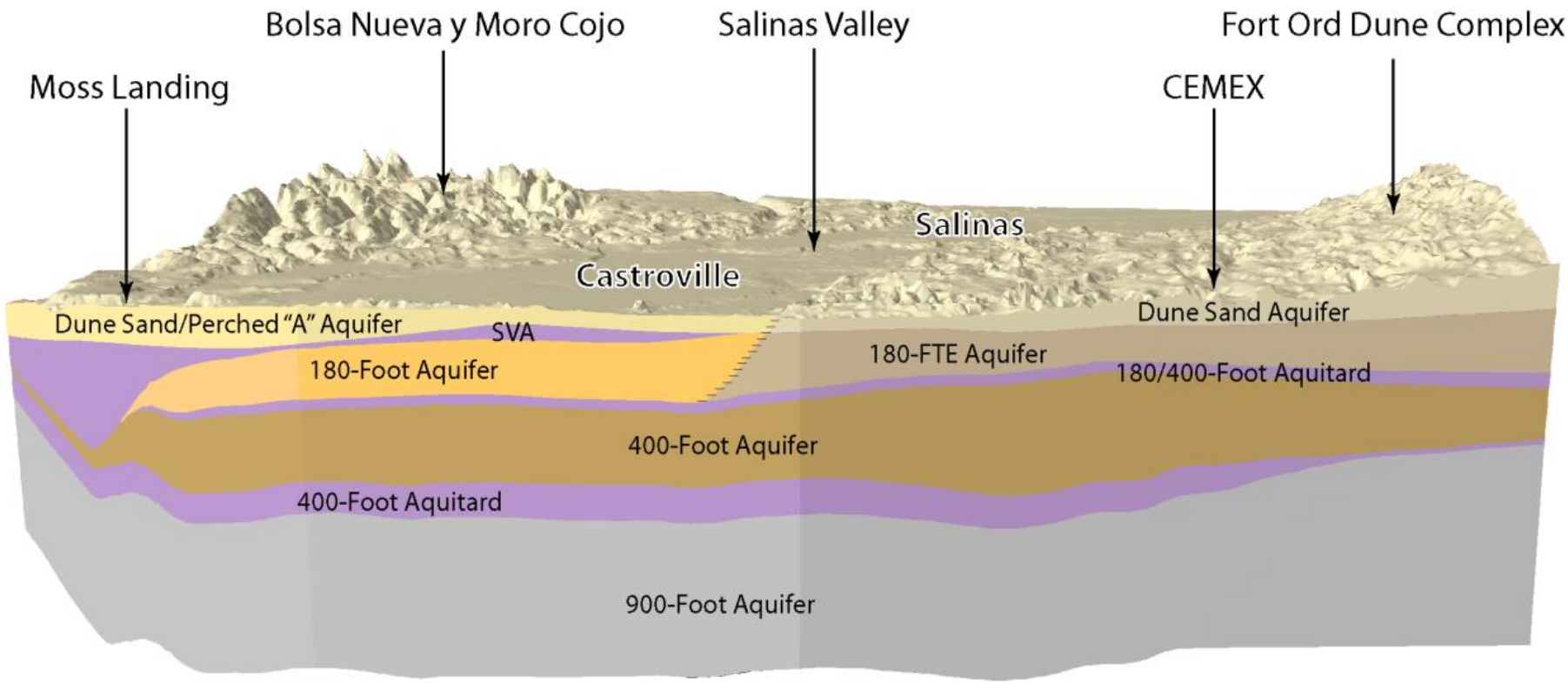
Geologic Cross-Section A-A’



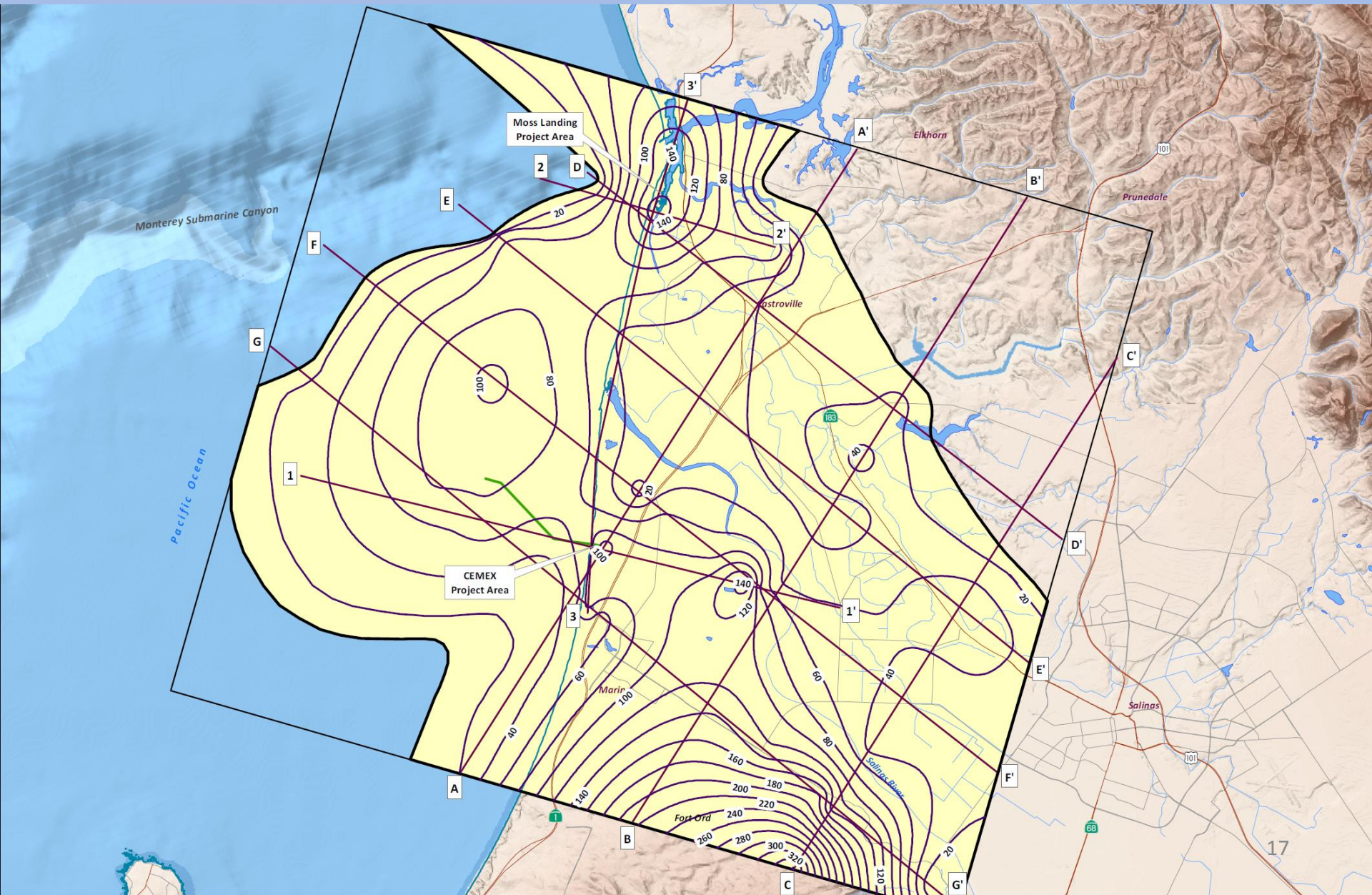
Fence Diagram of Hydrostratigraphic Units



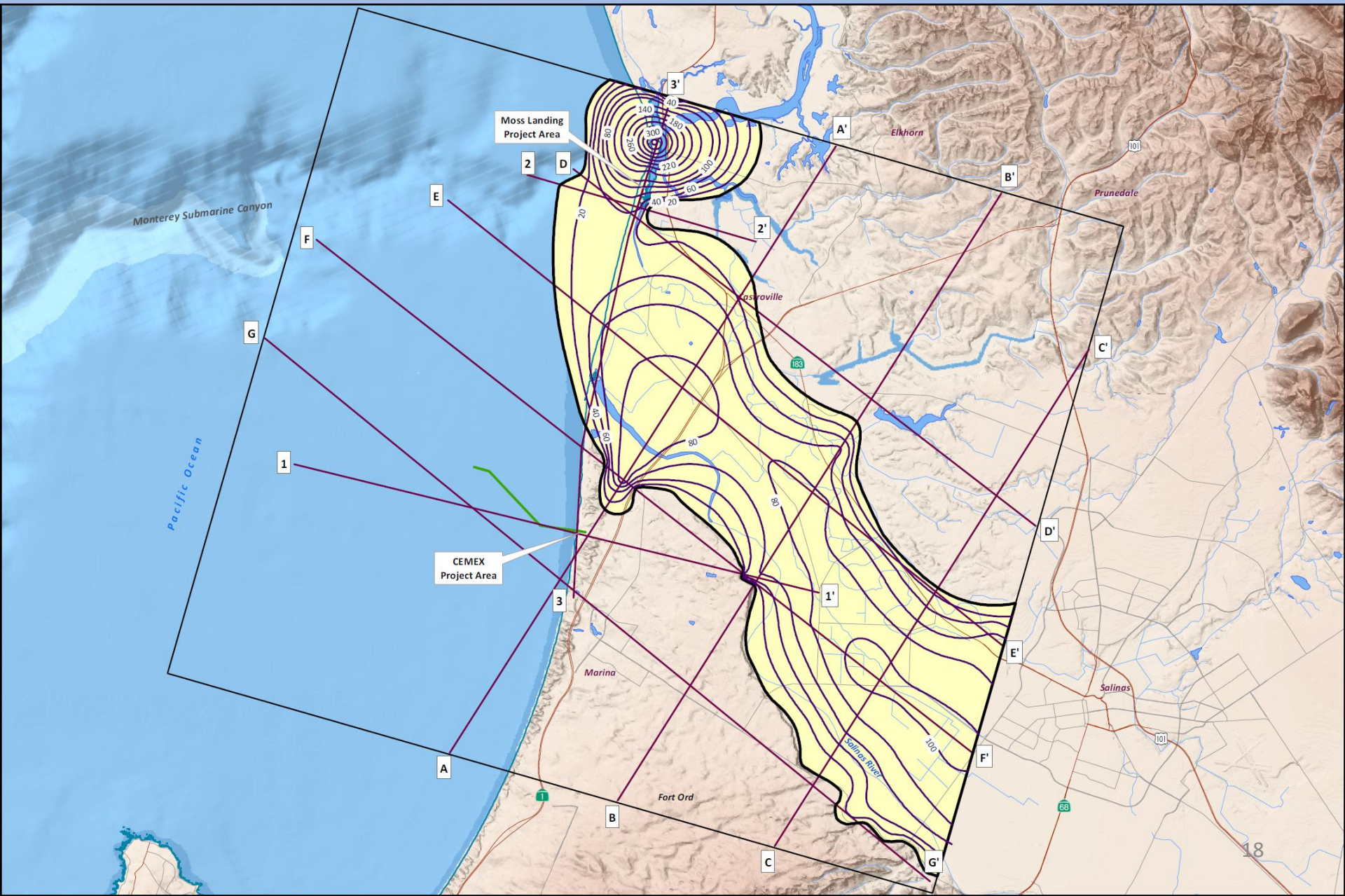
Hydrostratigraphic Units – Moss Landing to CEMEX Area



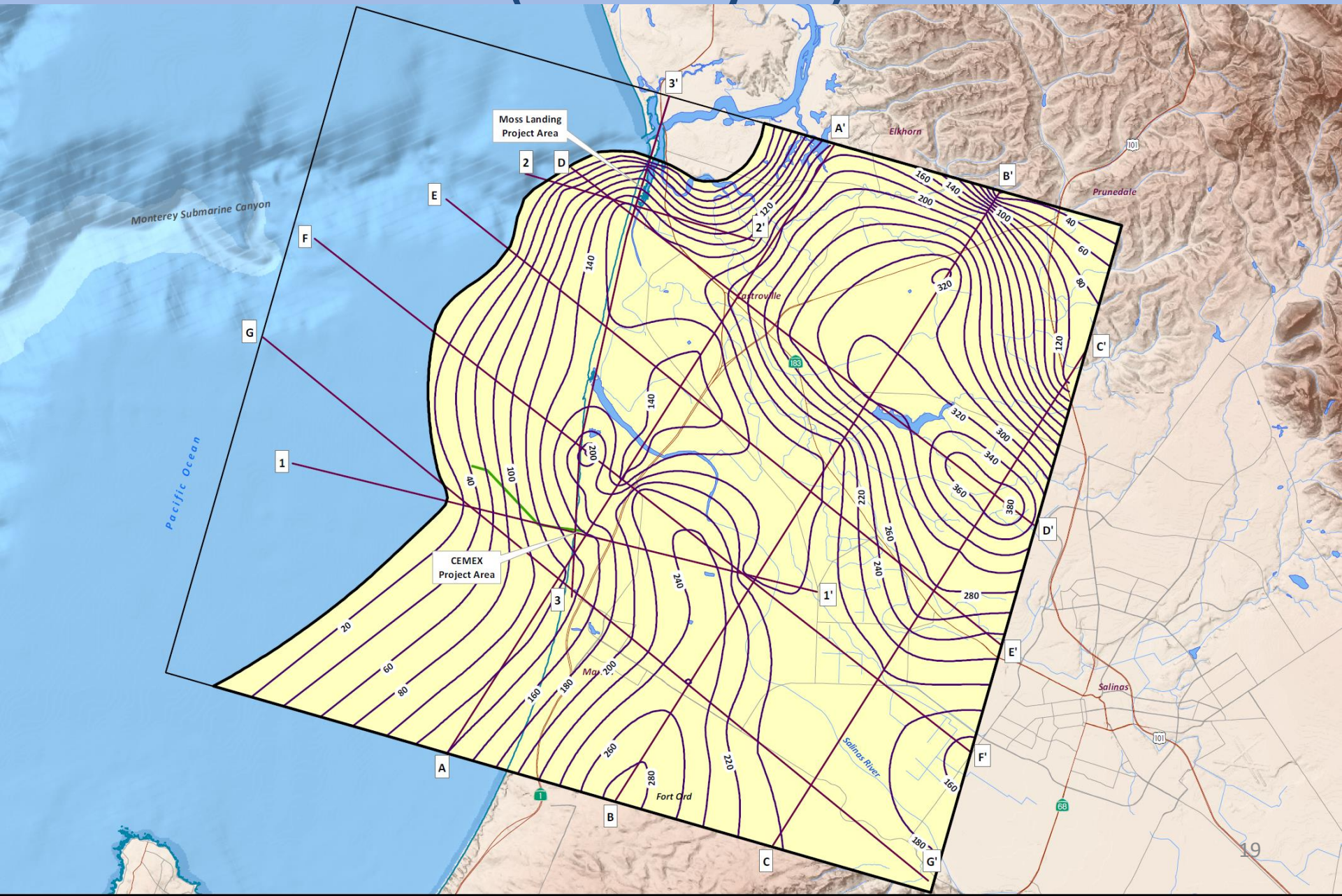
Thickness of Dune Sand, Perched "A" and Deltaic Deposit Aquifers (Model Layer 2)



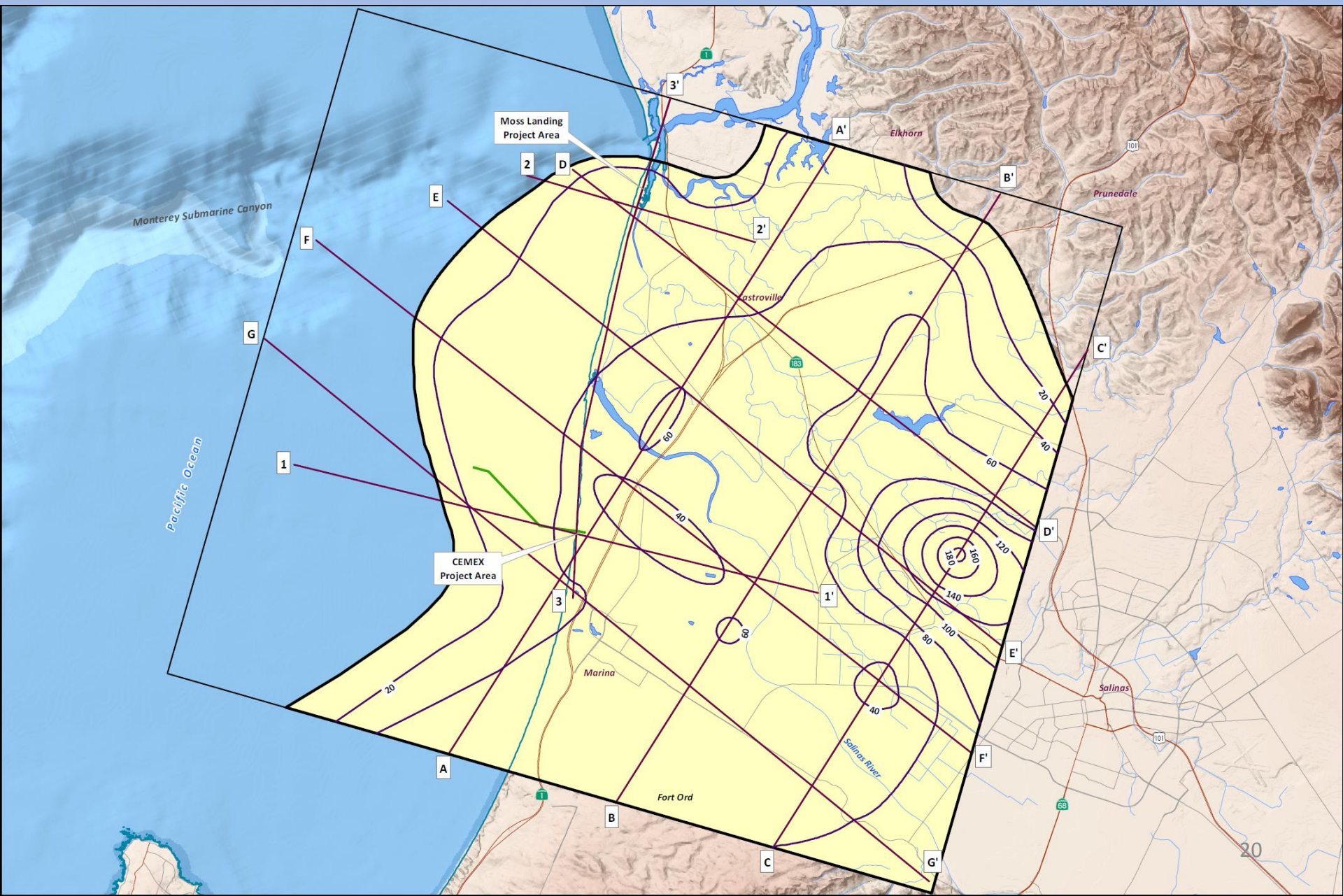
Thickness of Salinas Valley Aquitard (Model Layer 3)



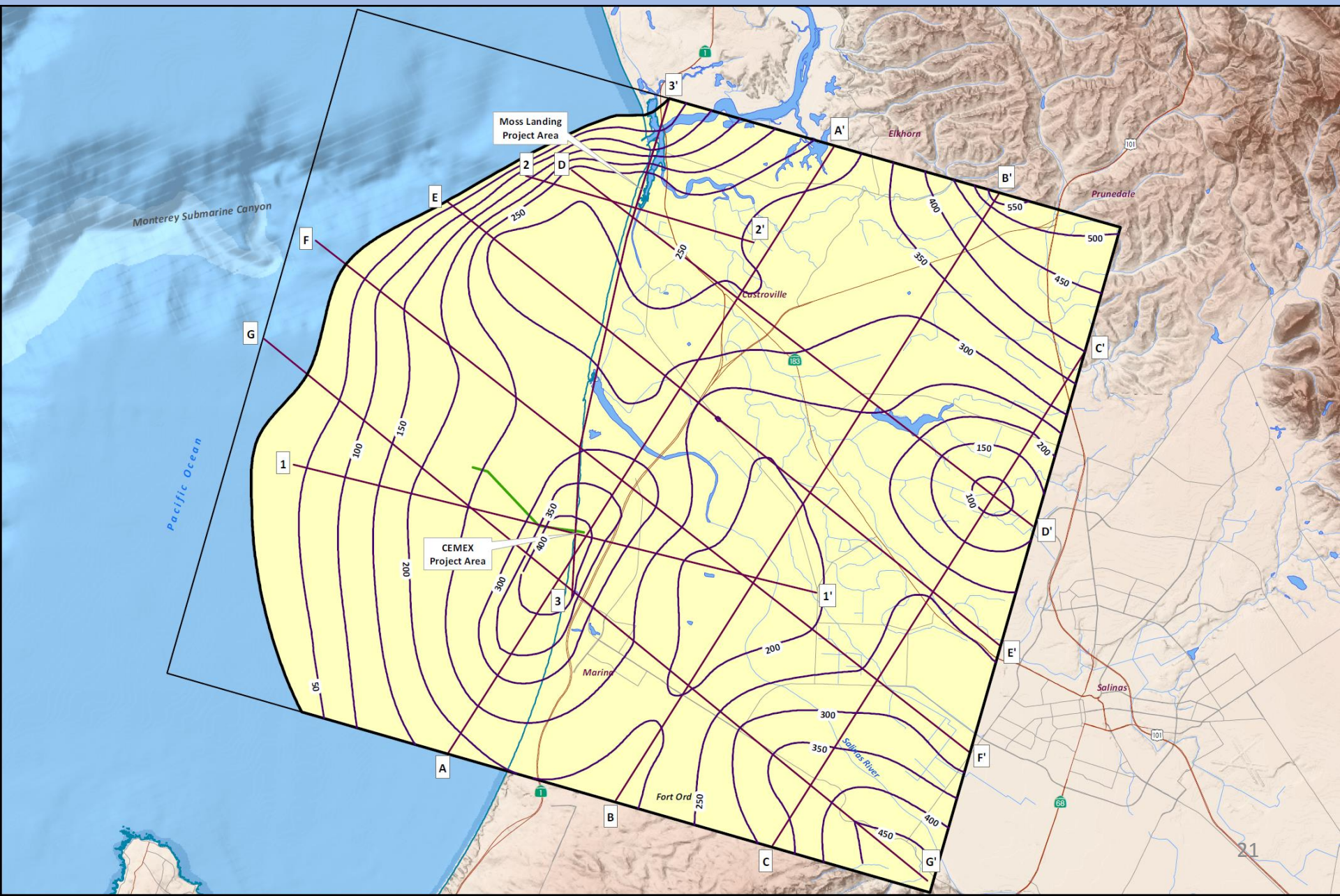
Thickness of 180-Foot and 180-Foot Equivalent Aquifers (Model Layer 4)



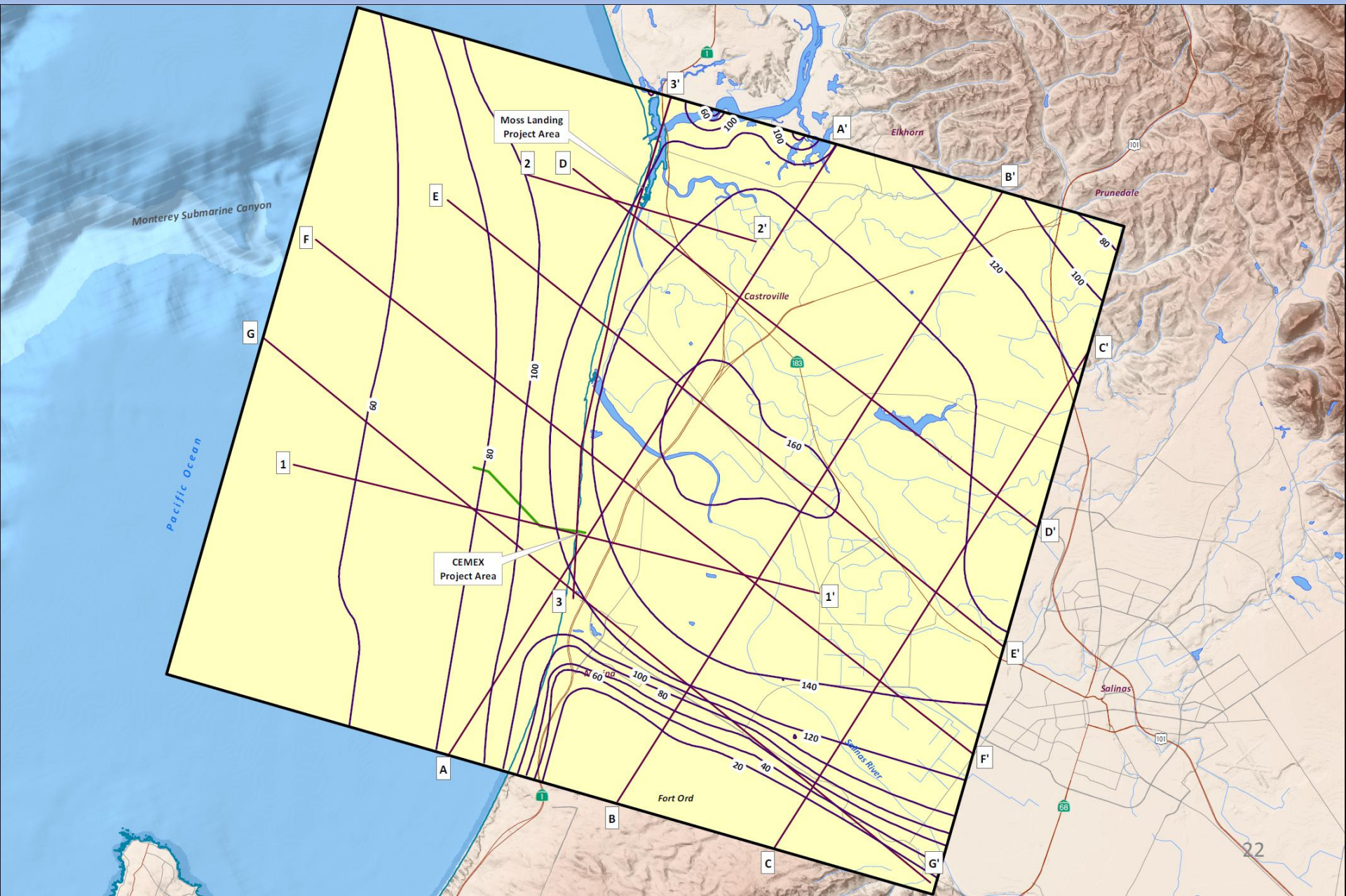
Thickness of 180/400-Foot Aquitard (Model Layer 5)



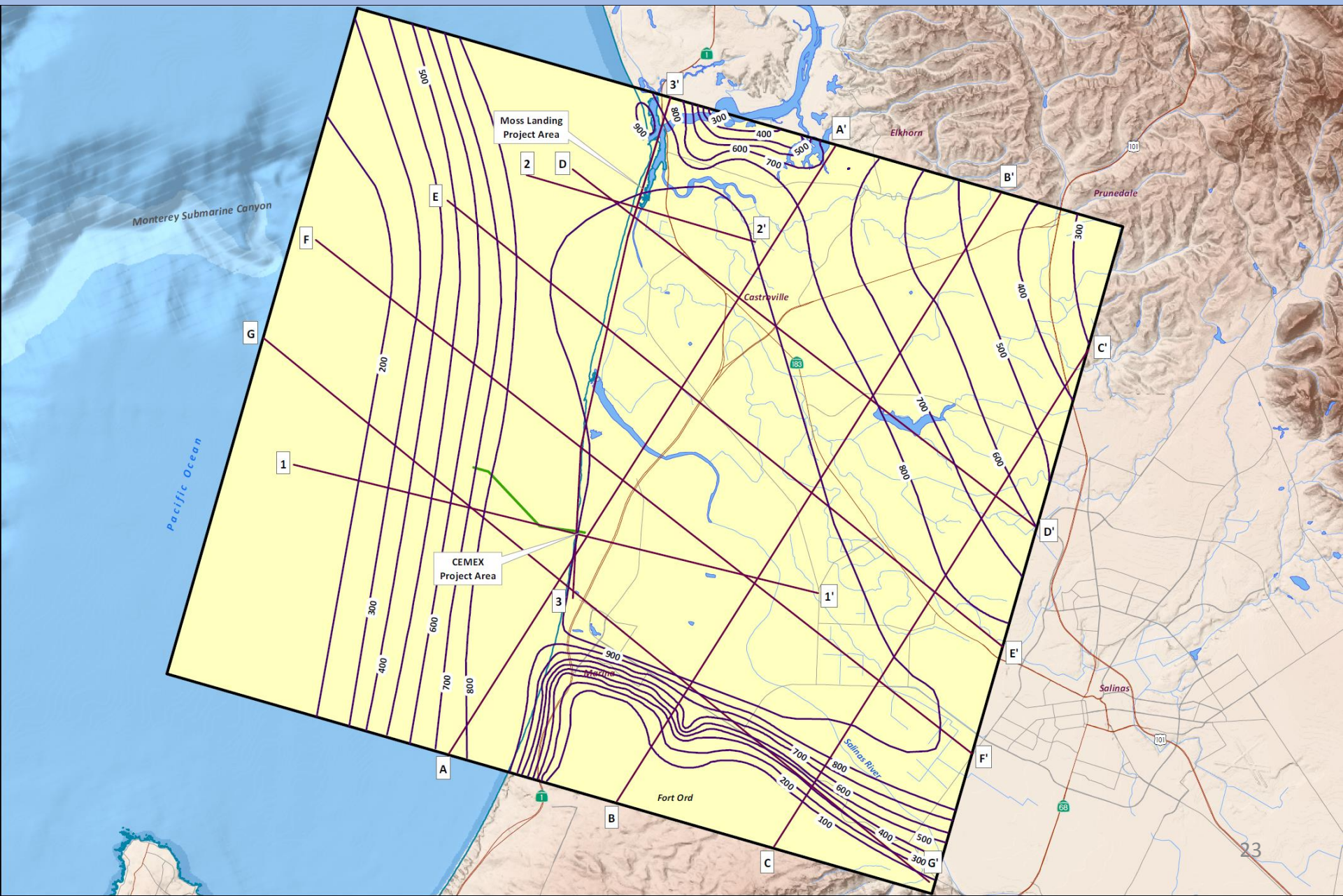
Thickness of 400-Foot Aquifer (Model Layer 6)



Thickness of 400/900-Foot Aquitard (Model Layer 7)

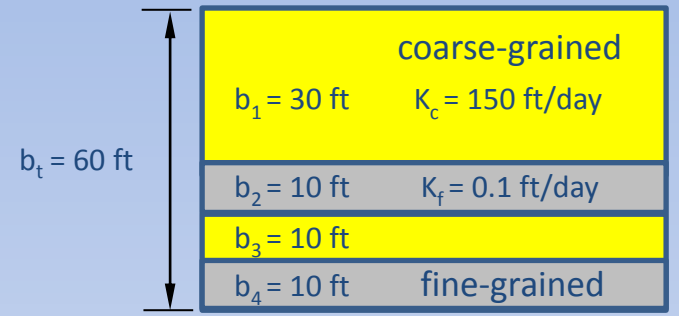


Thickness of 900-Foot Aquifer (Model Layer 8)



Hydraulic Conductivity Calculations

$$K_h \text{ or } K_v = [K_c^{\,p} F_c + K_f^{\,p} F_f]^{1/p}$$



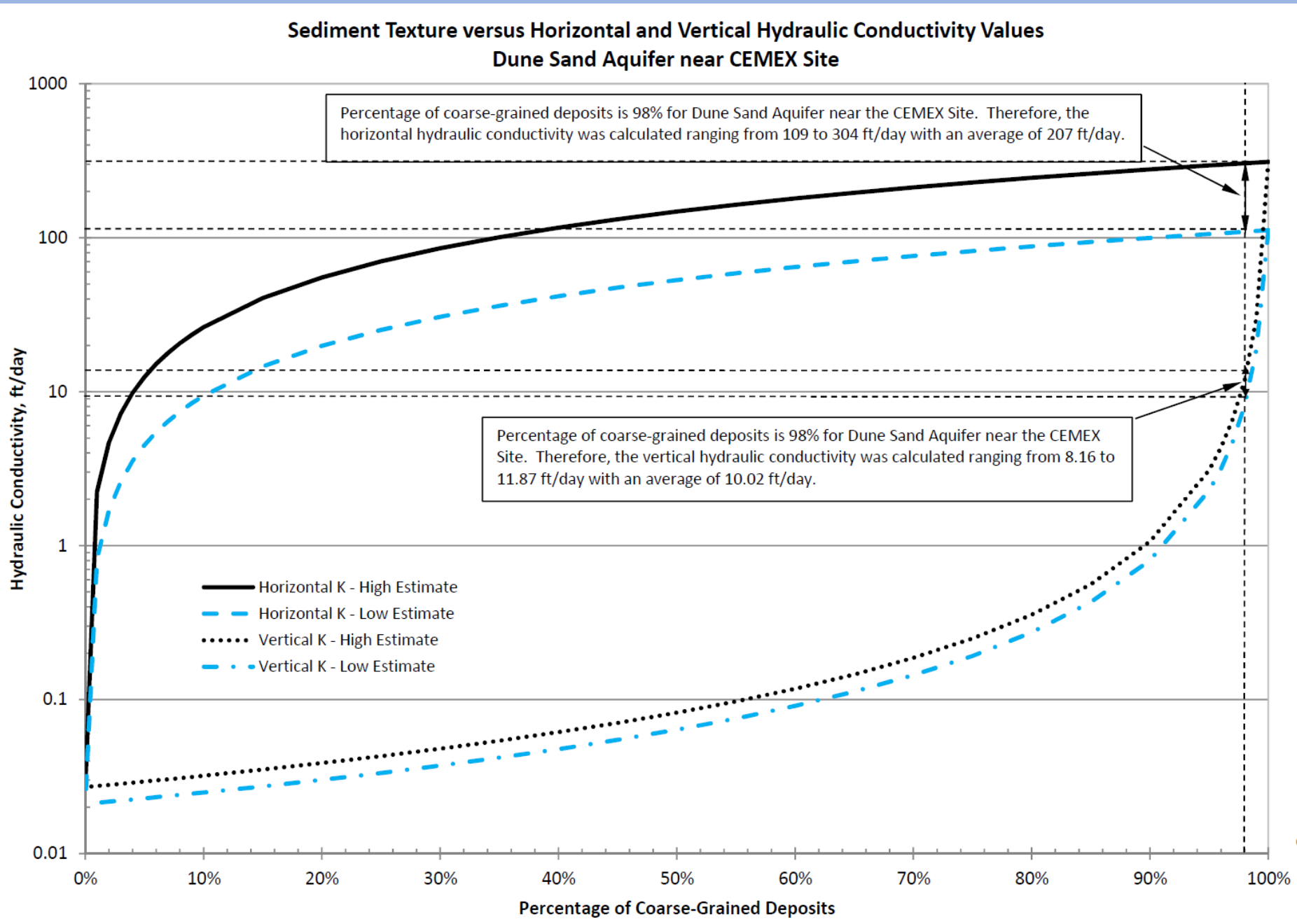
$F_c = (b_1 + b_3)/b_t = (30+10)/60 = 0.67$
$F_f = (b_2 + b_4)/b_t = (10+10)/60 = 0.33$

K_h = Horizontal hydraulic conductivity, ft/day
K_v = Vertical hydraulic conductivity, ft/day
K_c = Horizontal hydraulic conductivity for coarse-grained, ft/day
K_f = Horizontal hydraulic conductivity for fine-grained, ft/day
F_c = Fraction of coarse-grained
F_f = Fraction of fine-grained
p = Exponent of power mean for horizontal (p=0.93) or vertical (p=-0.62) hydraulic conductivity

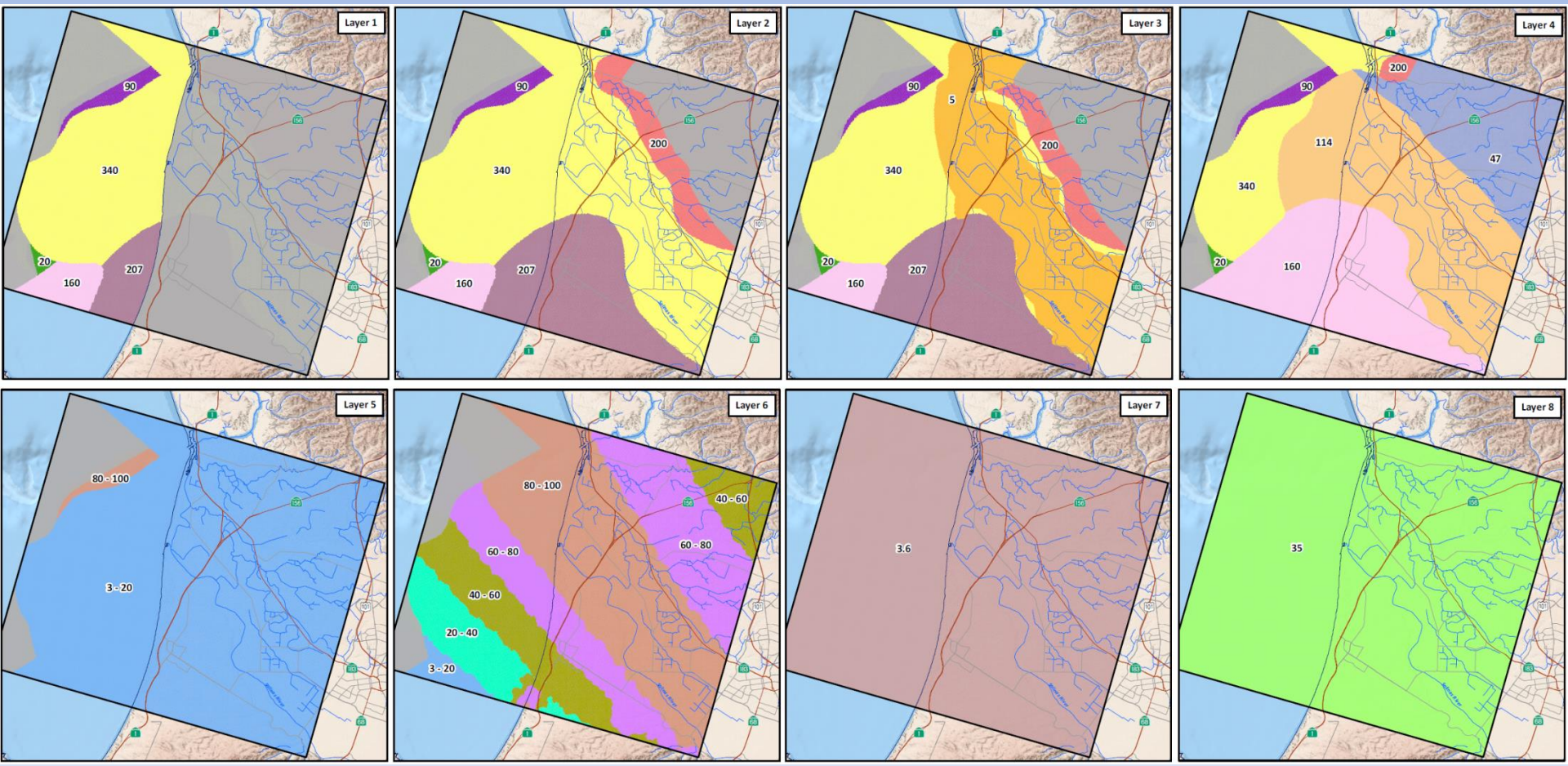
$$K_h = [K_c^{\,p} F_c + K_f^{\,p} F_f]^{1/p} = [150^{0.93} \times 0.67 + 0.1^{0.93} \times 0.33]^{1/(0.93)} = 97.57 \text{ ft/day } (p = 0.93)$$

$$K_v = [K_c^{\,p} F_c + K_f^{\,p} F_f]^{1/p} = [150^{-0.62} \times 0.67 + 0.1^{-0.62} \times 0.33]^{1/(-0.62)} = 0.58 \text{ ft/day } (p = -0.62)$$

Source: Durbin, T., 2013, Conaway Ranch Groundwater Model – Power-Law Averaging of Hydraulic Conductivity. Draft Technical Memorandum, November 2013.

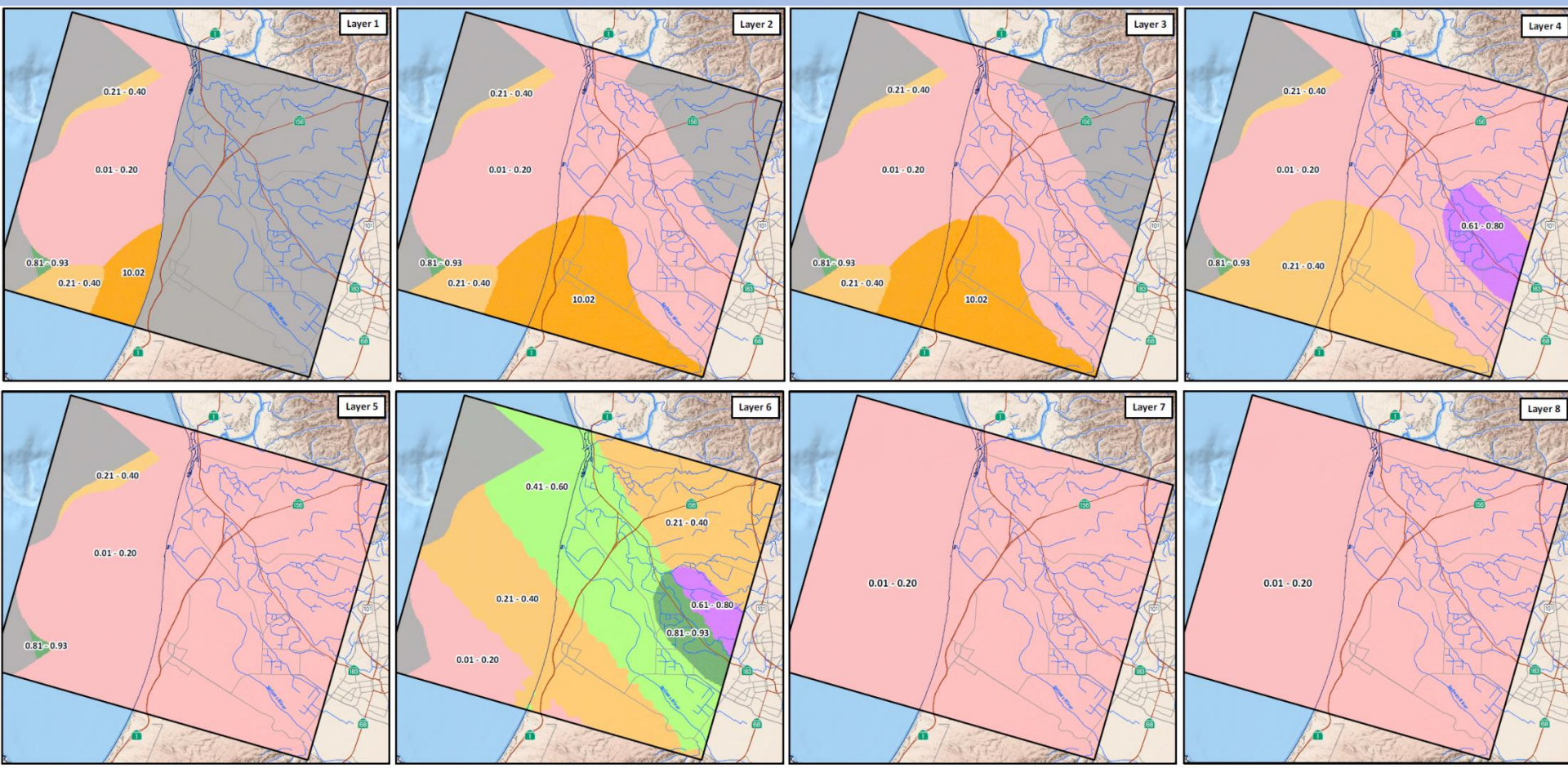

Sediment Texture versus Horizontal and Vertical Hydraulic Conductivity Values
Dune Sand Aquifer near CEMEX Site
Percentage of coarse-grained deposits is 98% for Dune Sand Aquifer near the CEMEX Site. Therefore, the horizontal hydraulic conductivity was calculated ranging from 109 to 304 ft/day with an average of 207 ft/day.
Percentage of coarse-grained deposits is 98% for Dune Sand Aquifer near the CEMEX Site. Therefore, the vertical hydraulic conductivity was calculated ranging from 8.16 to 11.87 ft/day with an average of 10.02 ft/day.
Horizontal K - High Estimate
Horizontal K - Low Estimate
Vertical K - High Estimate
Vertical K - Low Estimate
Hydraulic Conductivity, ft/day
1000
100
10
1
0.1
0.01
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percentage of Coarse-Grained Deposits

Horizontal Hydraulic Conductivity



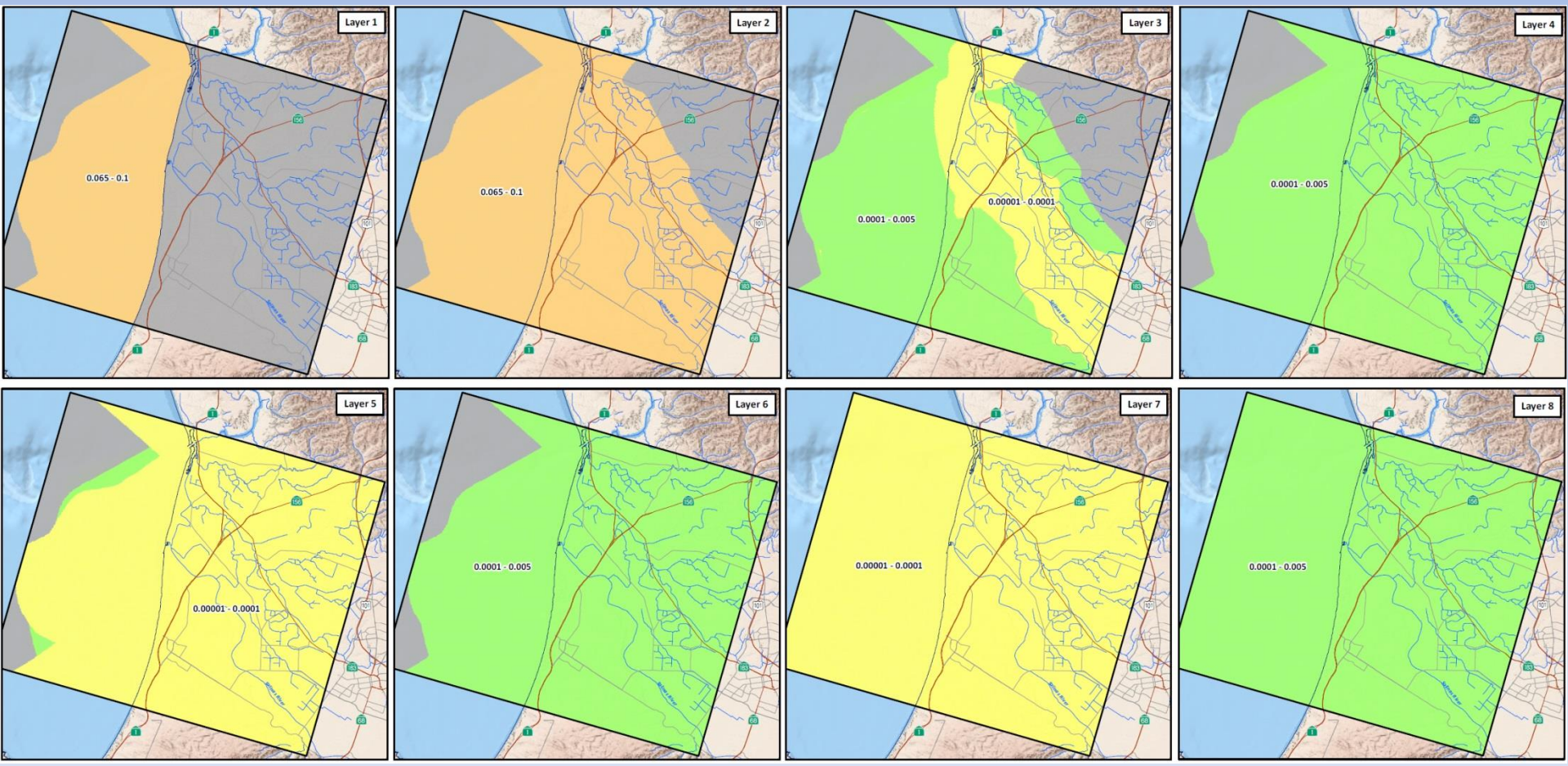
Units in ft/day

Vertical Hydraulic Conductivity



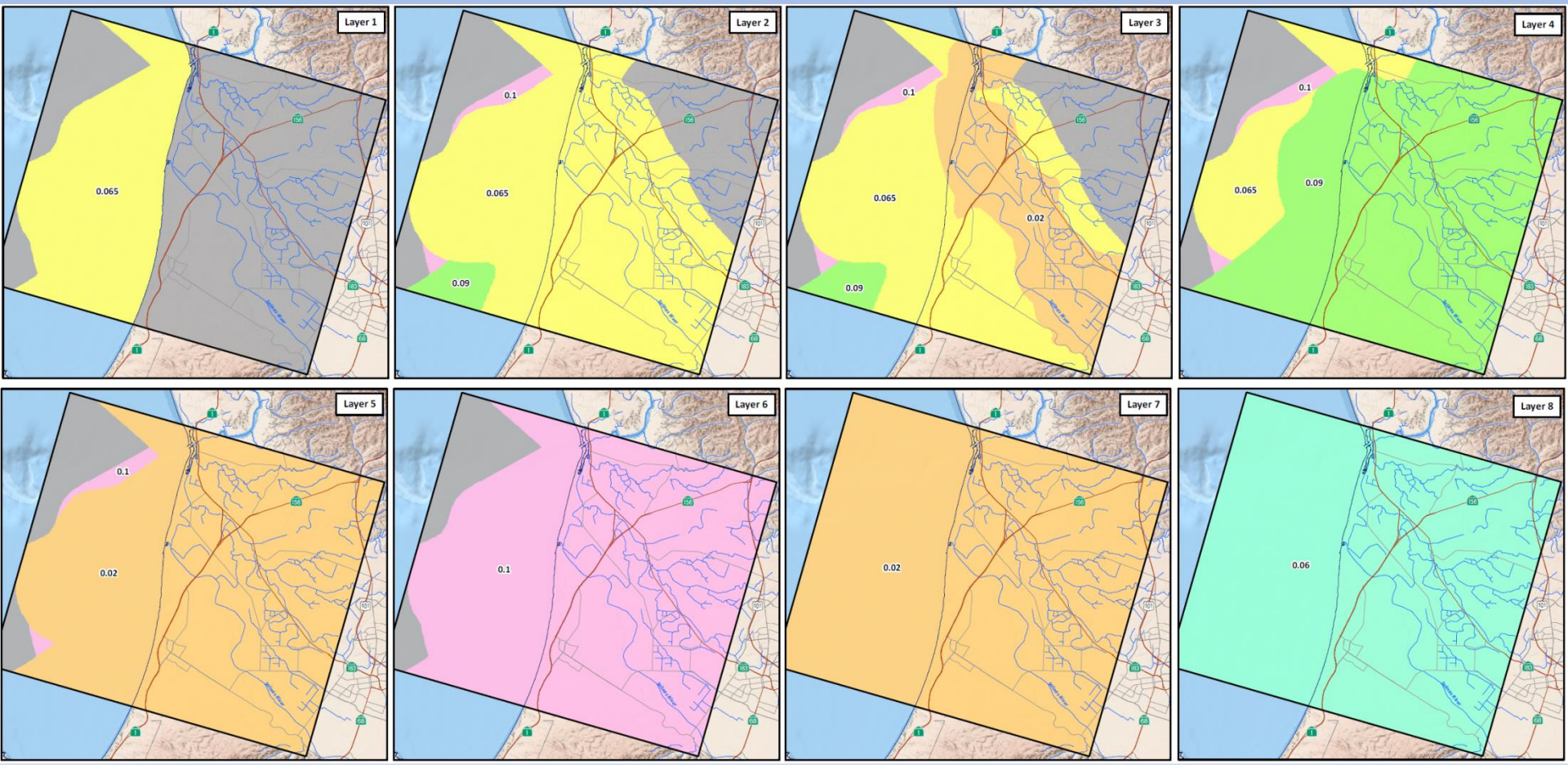
Units in ft/day

Storativity



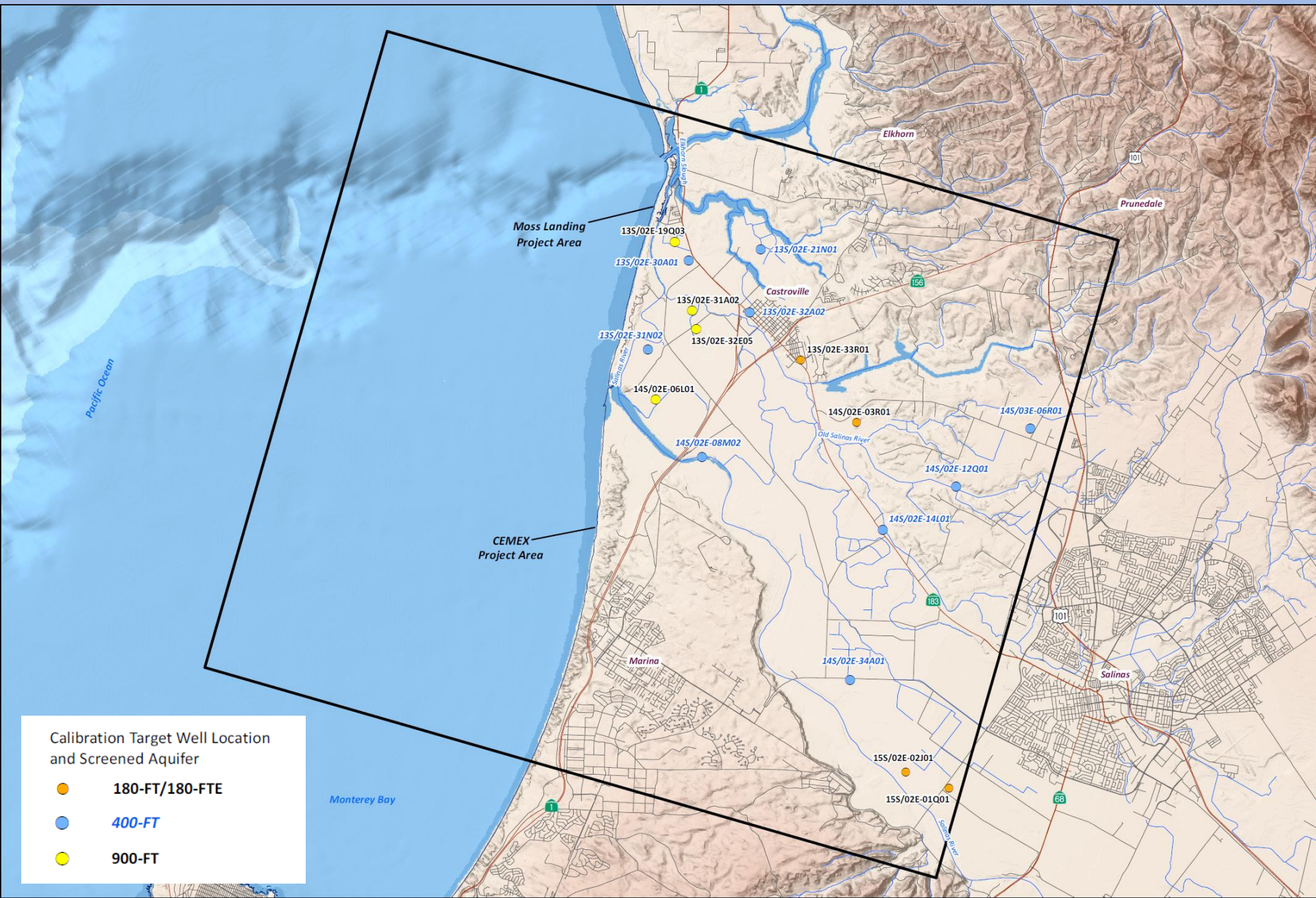
fraction

Effective Porosity

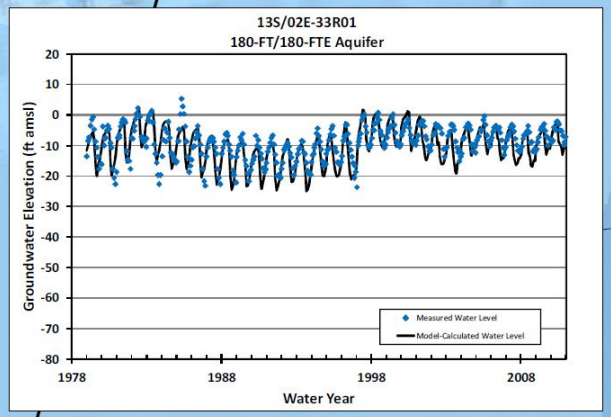


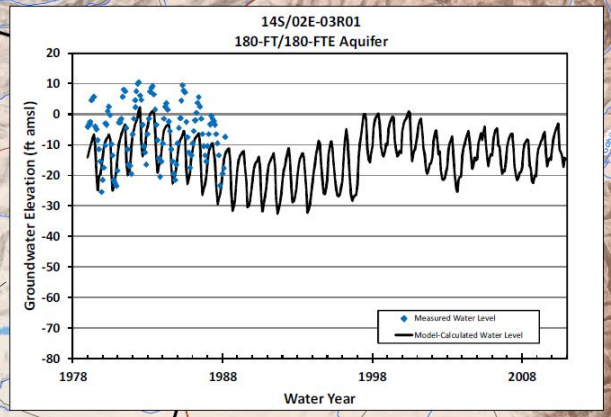
fraction

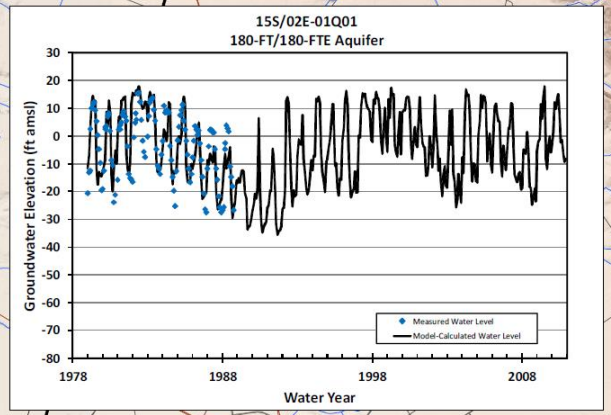
Flow Model Calibration Target Wells

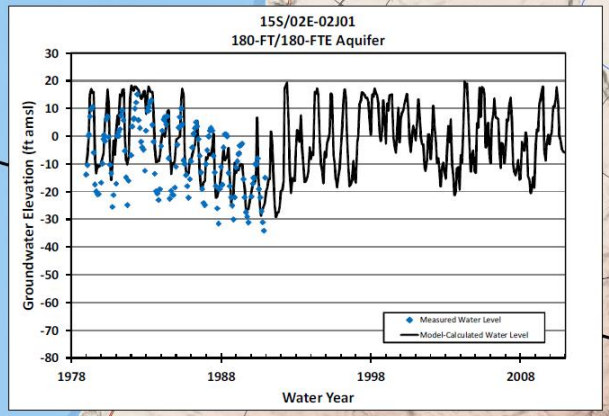


Hydrographs for 180-FT/180-FTE Aquifer (Layer 4)

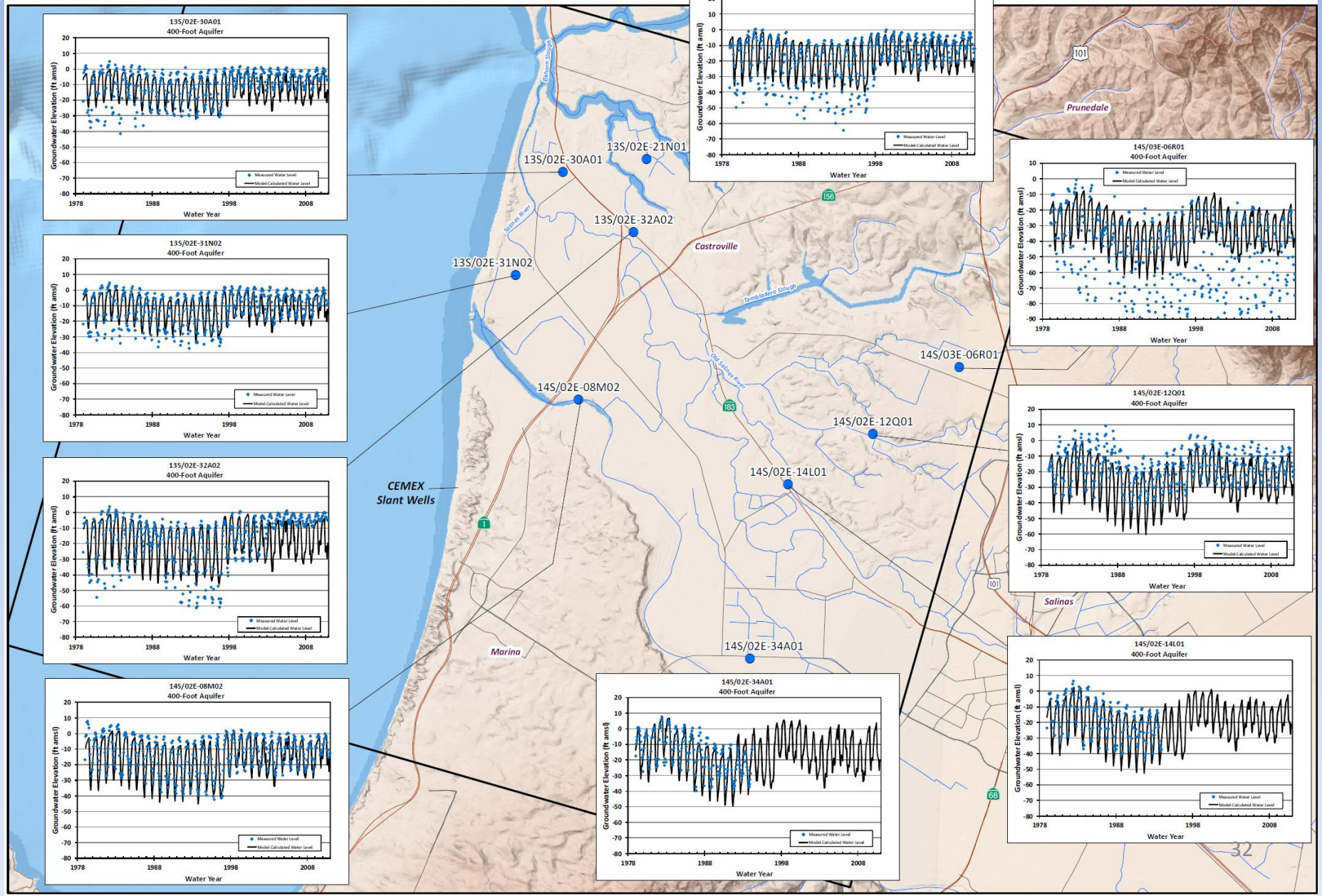




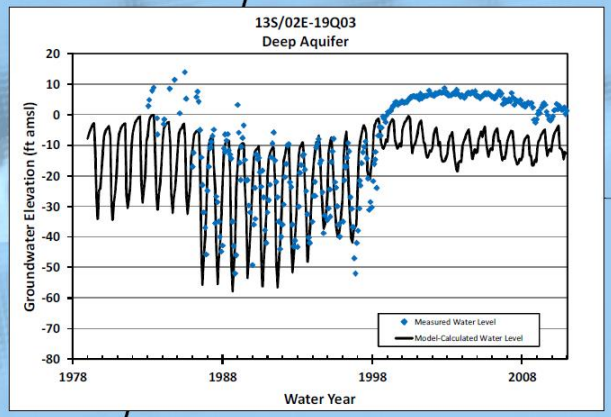


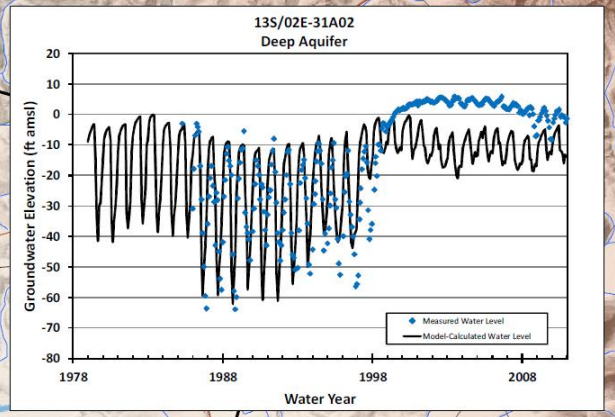


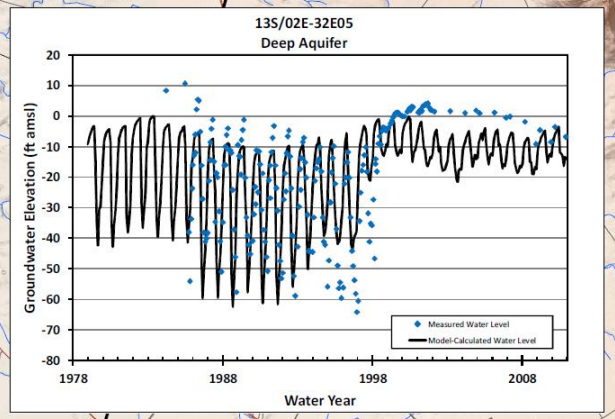
Hydrographs for 400-FT Aquifer (Layer 6)

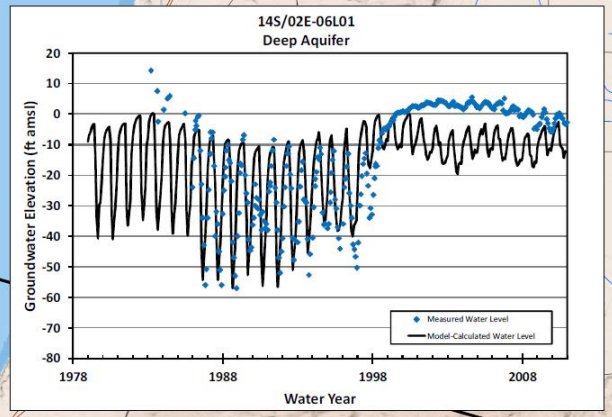


Hydrographs for 900-FT Aquifer (Layer 8)

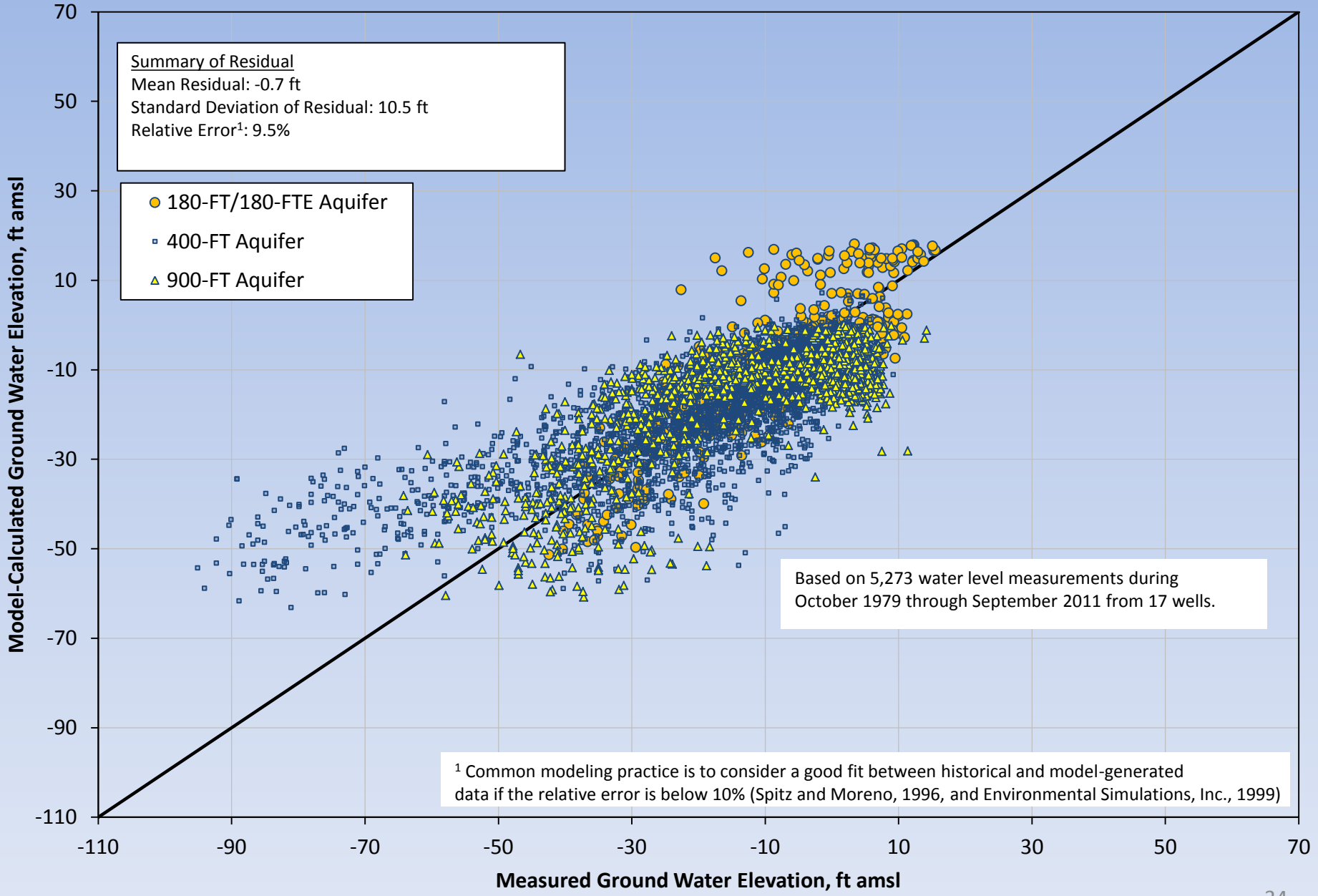


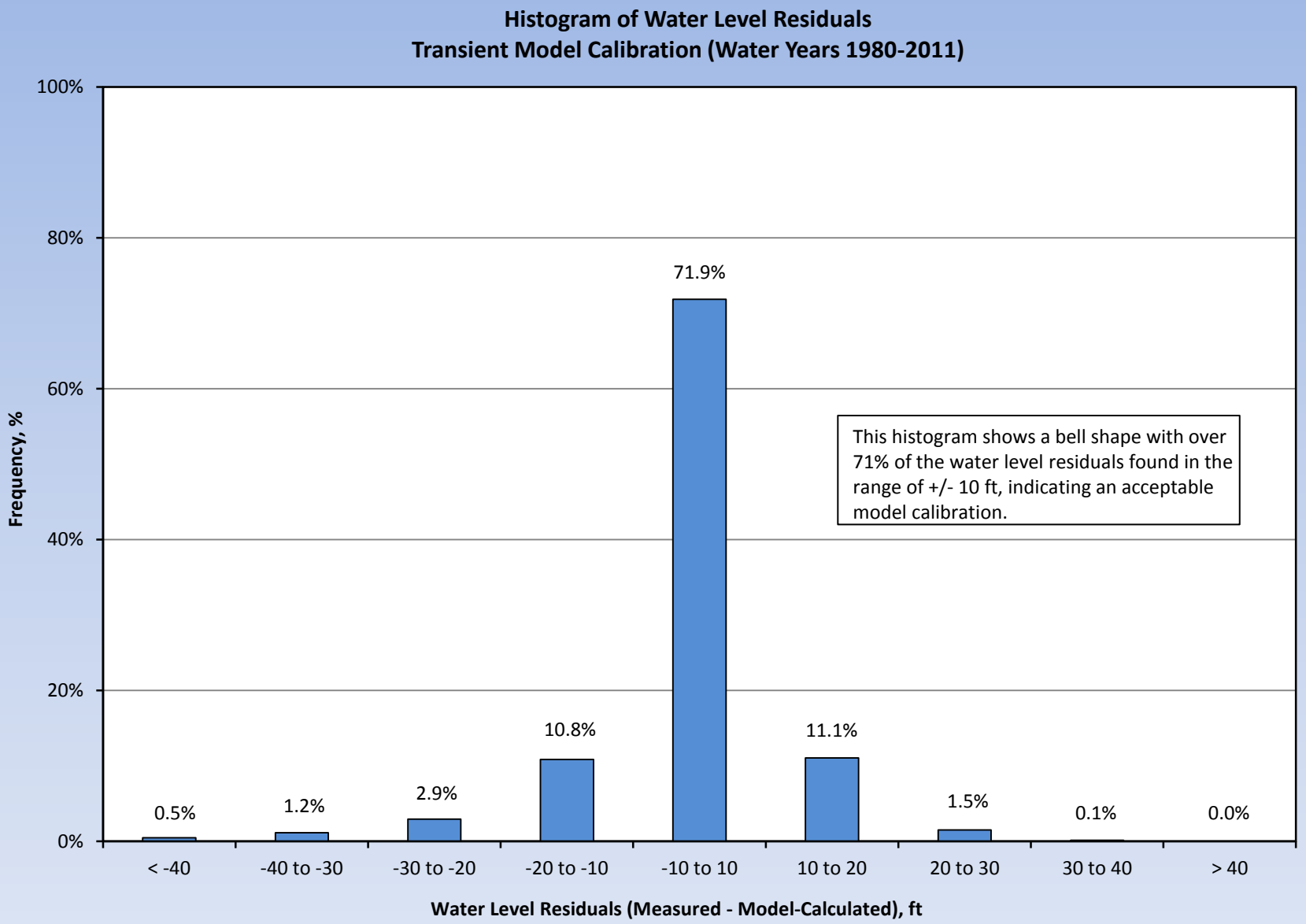




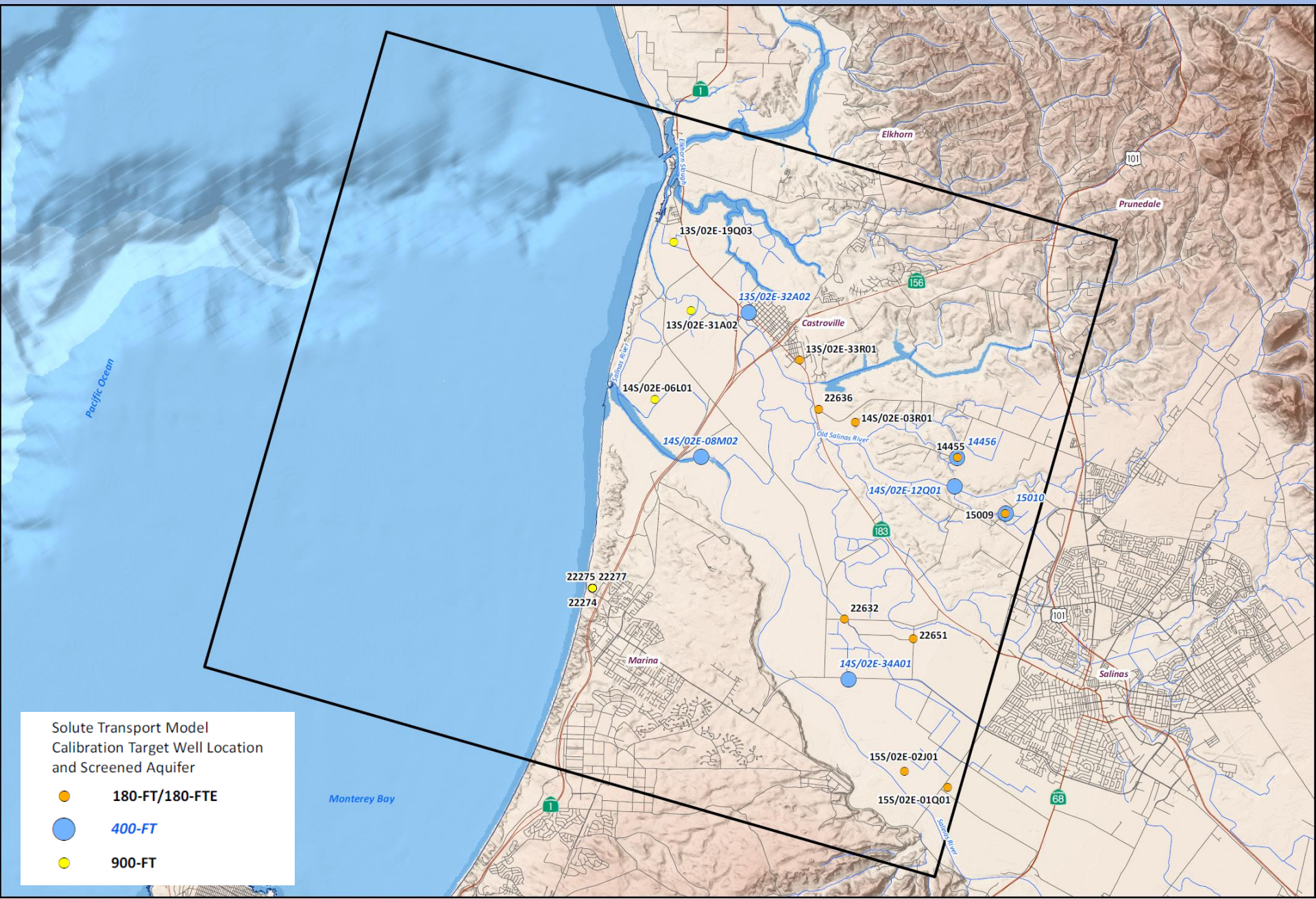


Comparison of Measured Versus Model-Calculated Groundwater Elevations
Transient Model Calibration (Water Years 1980-2011)

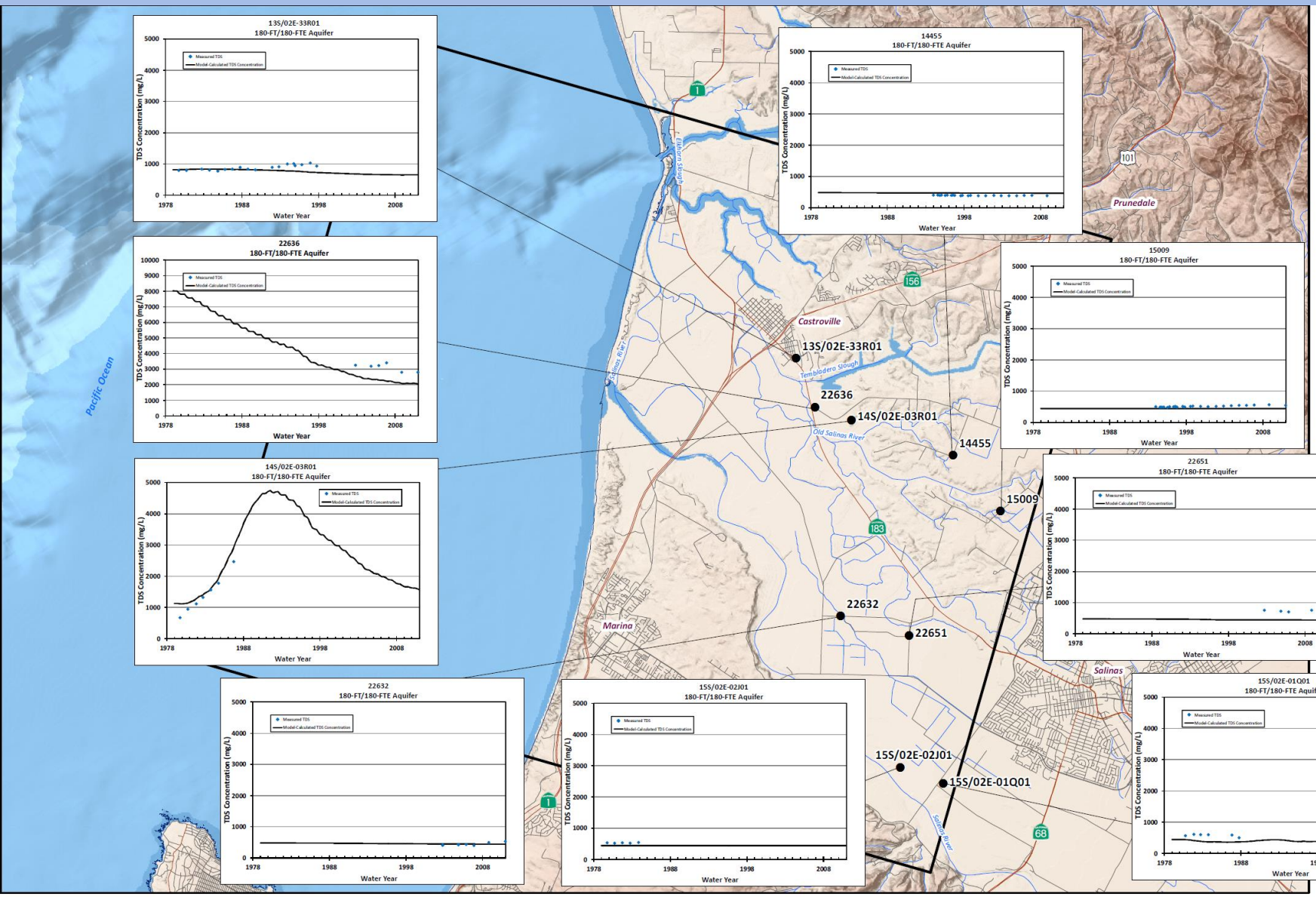



Histogram of Water Level Residuals
Transient Model Calibration (Water Years 1980-2011)
100%
80%
60%
40%
20%
0%
Frequency, %
0.5%
1.2%
2.9%
10.8%
71.9%
11.1%
1.5%
0.1%
0.0%
< -40
-40 to -30
-30 to -20
-20 to -10
-10 to 10
10 to 20
20 to 30
30 to 40
> 40
Water Level Residuals (Measured - Model-Calculated), ft
This histogram shows a bell shape with over 71% of the water level residuals found in the range of +/- 10 ft, indicating an acceptable model calibration.

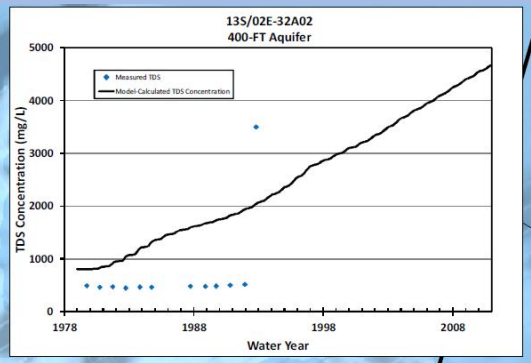
Solute Transport Model Calibration Target Wells

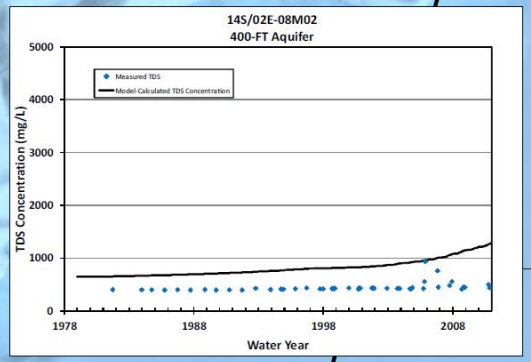


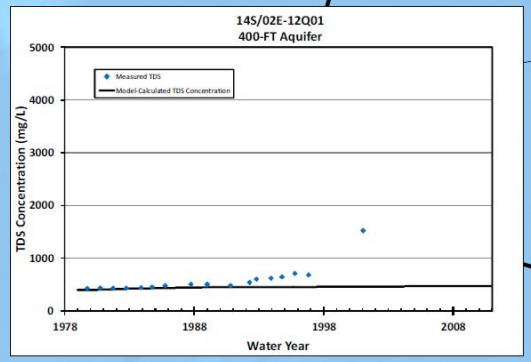
TDS Concentrations of Target Wells 180-FT/180-FTE Aquifer (Model Layer 4)

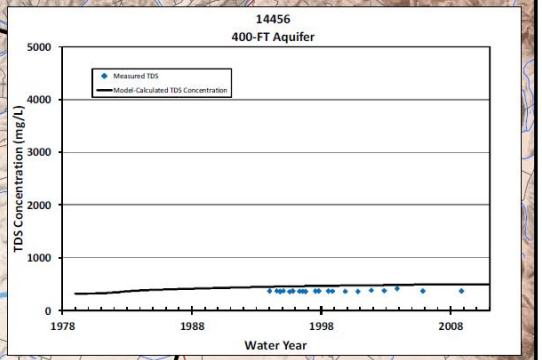


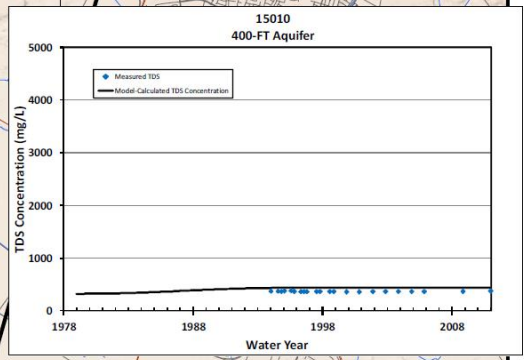
TDS Concentrations of Target Wells
400-FT Aquifer (Model Layer 6)

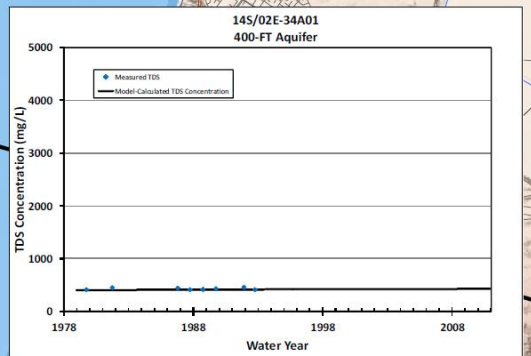












13S/02E-32A02

14S/02E-08M02

14456

14S/02E-12Q01

15010

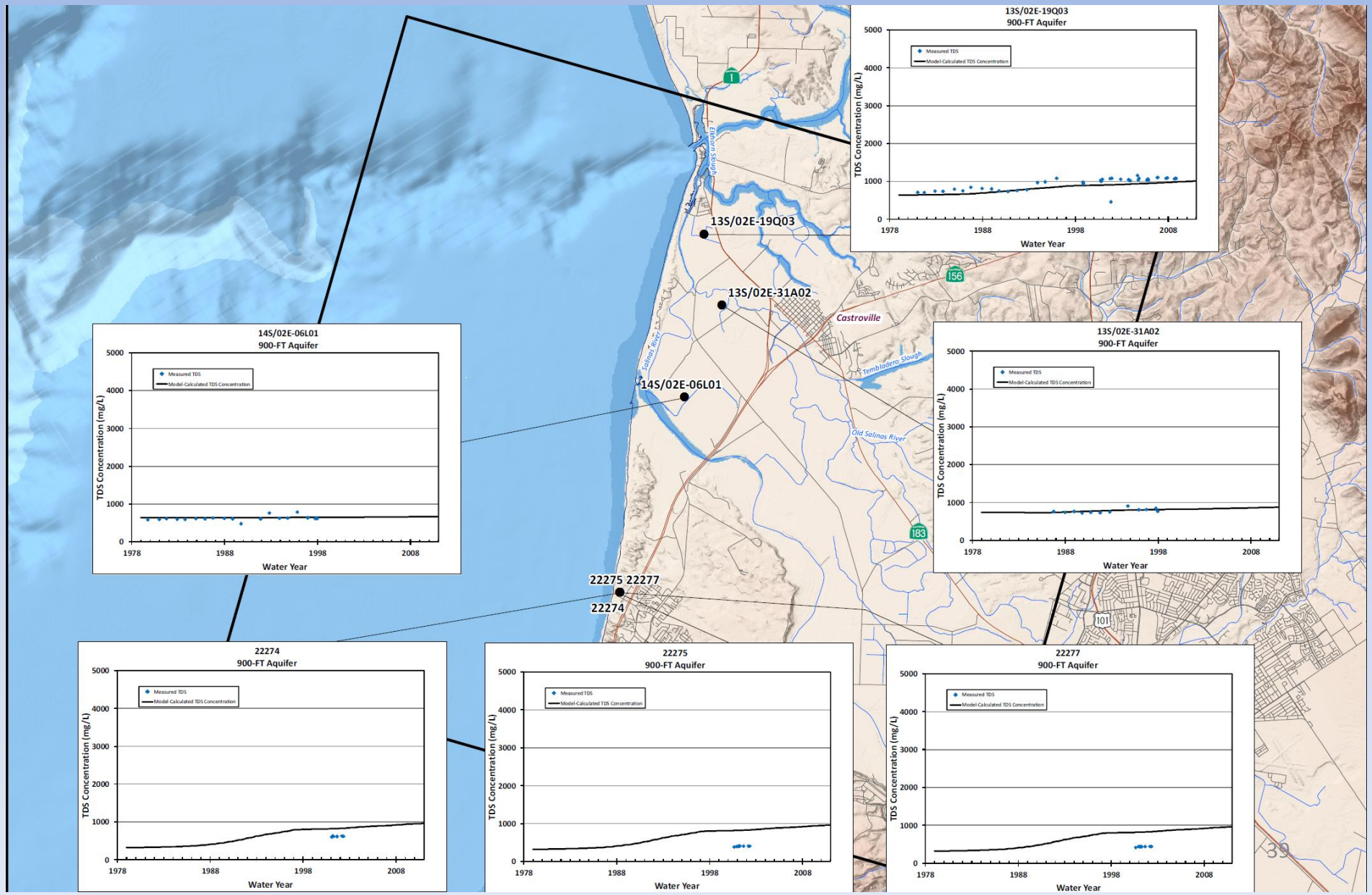
14S/02E-34A01

Elkhorn

Castroville

Monterey Bay

TDS Concentrations of Target Wells 900-FT Aquifer (Model Layer 8)



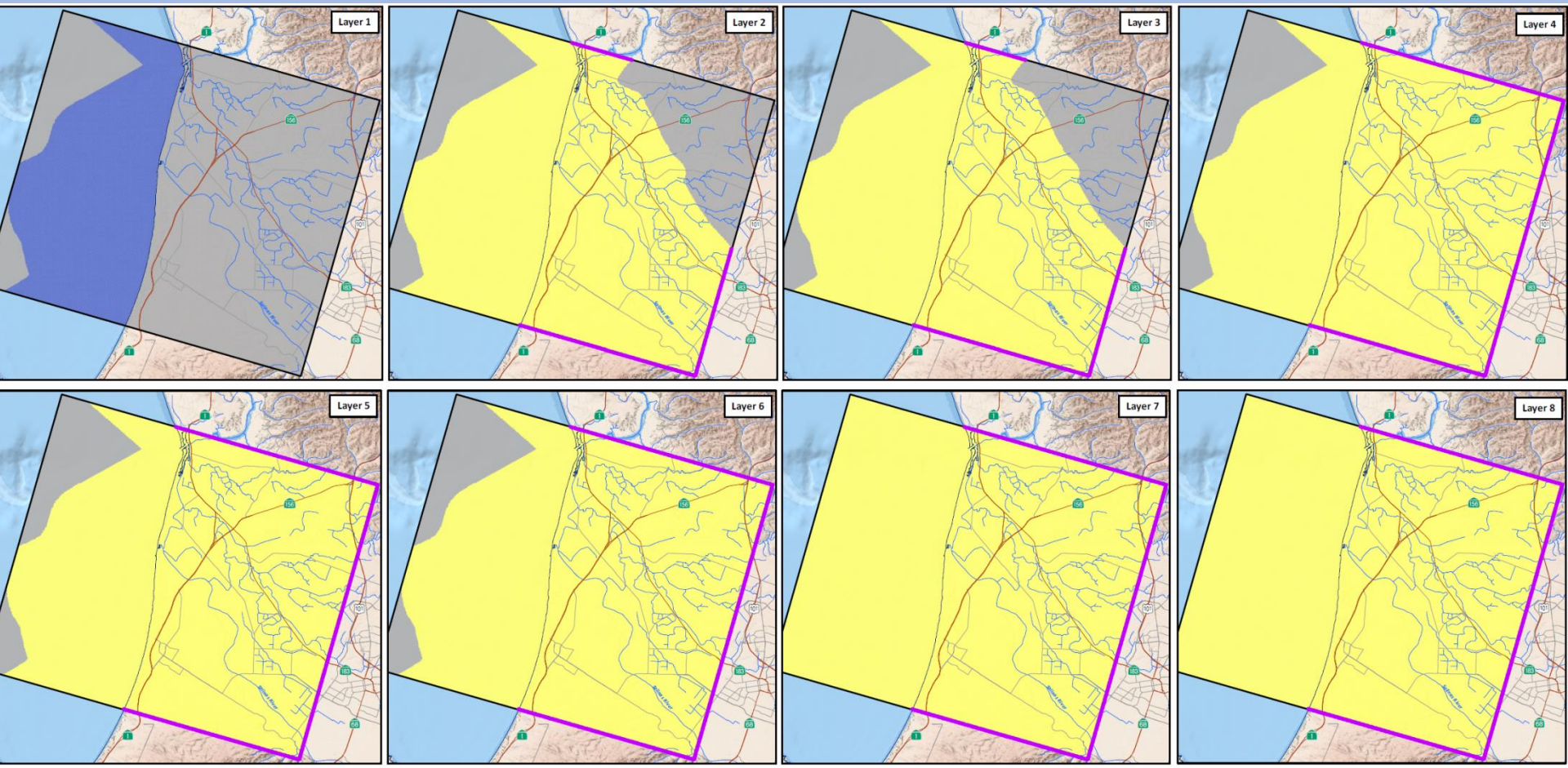
Overview

- Purpose and Scope of Hydrogeology Modeling
- **Types of Model Input**
  - Groundwater Models
  - Aquifer Parameters
  - **Model Inflow Terms**
  - Model Outflow Terms
- Major Assumptions of Predictive Model Scenarios
- Results Output

Model Inflow Terms

Flux Terms		MODFLOW Package
Inflow Terms	Deep Percolation from Precipitation and Applied Water	Recharge Package
	Underflow from Northern, Southern and Eastern Model Boundaries	General Head Boundary Package
	Streambed Percolation	Recharge Package
	Vertical Leakage from Ocean	Constant Head

Model Boundary Conditions



Boundary Conditions

- Active Model Cell
- Constant Head
- General Head Boundary
- No Flow Cell

Overview

- Purpose and Scope of Hydrogeology Modeling
- **Types of Model Input**
  - Groundwater Models
  - Aquifer Parameters
  - Model Inflow Terms
  - **Model Outflow Terms**
- Major Assumptions of Predictive Model Scenarios
- Results Output

Model Outflow Terms

Flux Terms		MODFLOW Package
Outflow Terms	Groundwater Pumping	Well Package
	Groundwater Discharge to Rivers	Recharge Package
	Underflow to Northern, Southern and Eastern Model Boundaries	General Head Boundary Package
	Underflow Outflow to Ocean	Constant Head

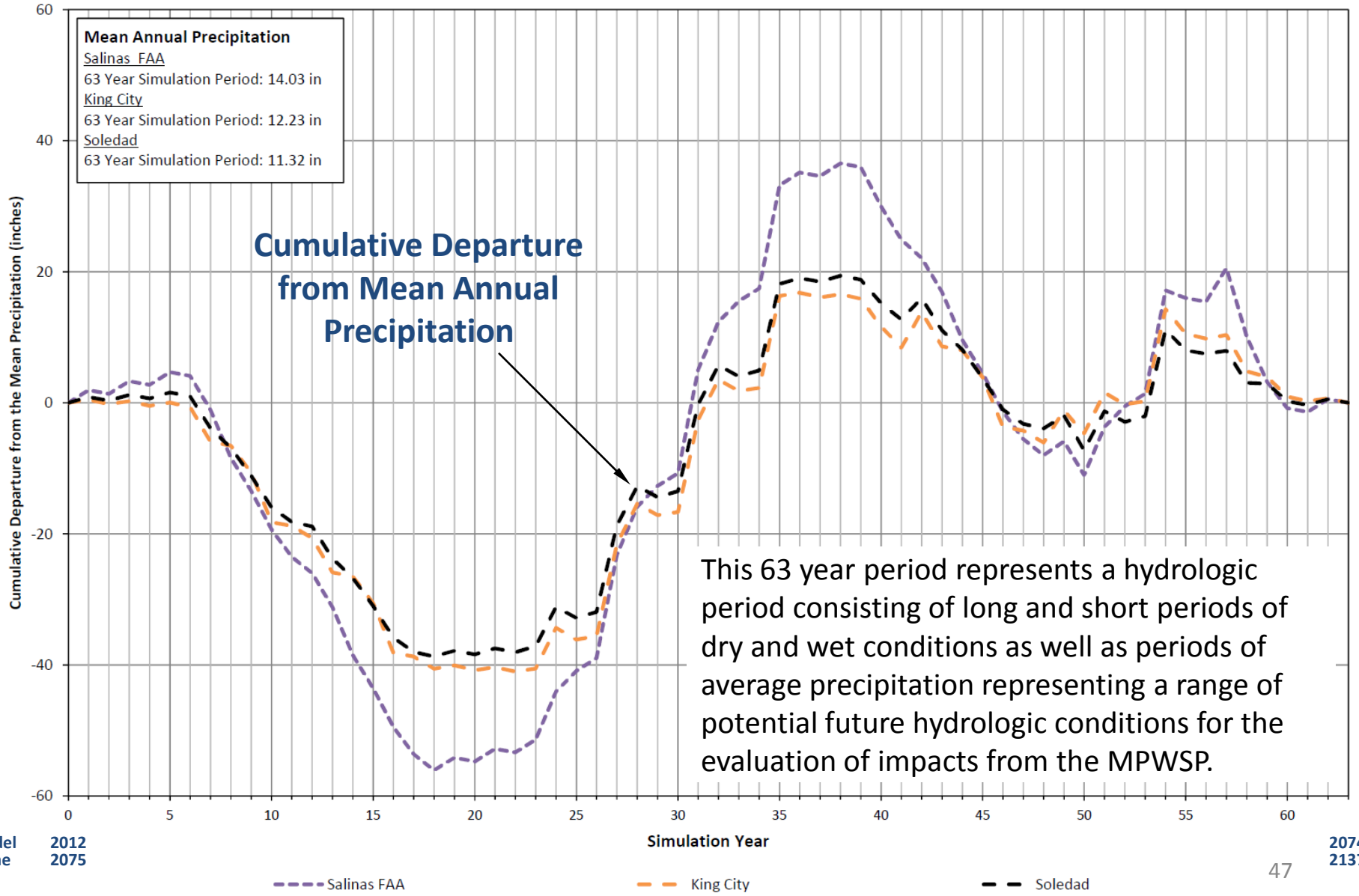
Overview

- Purpose and Scope of Hydrogeology Modeling
- Types of Model Input
  - Groundwater Models
  - Aquifer Parameters
  - Model Inflow Terms
  - Model Outflow Terms
- **Major Assumptions of Predictive Model Scenarios**
- Results Output

Major Assumptions for Predicted Model Scenarios

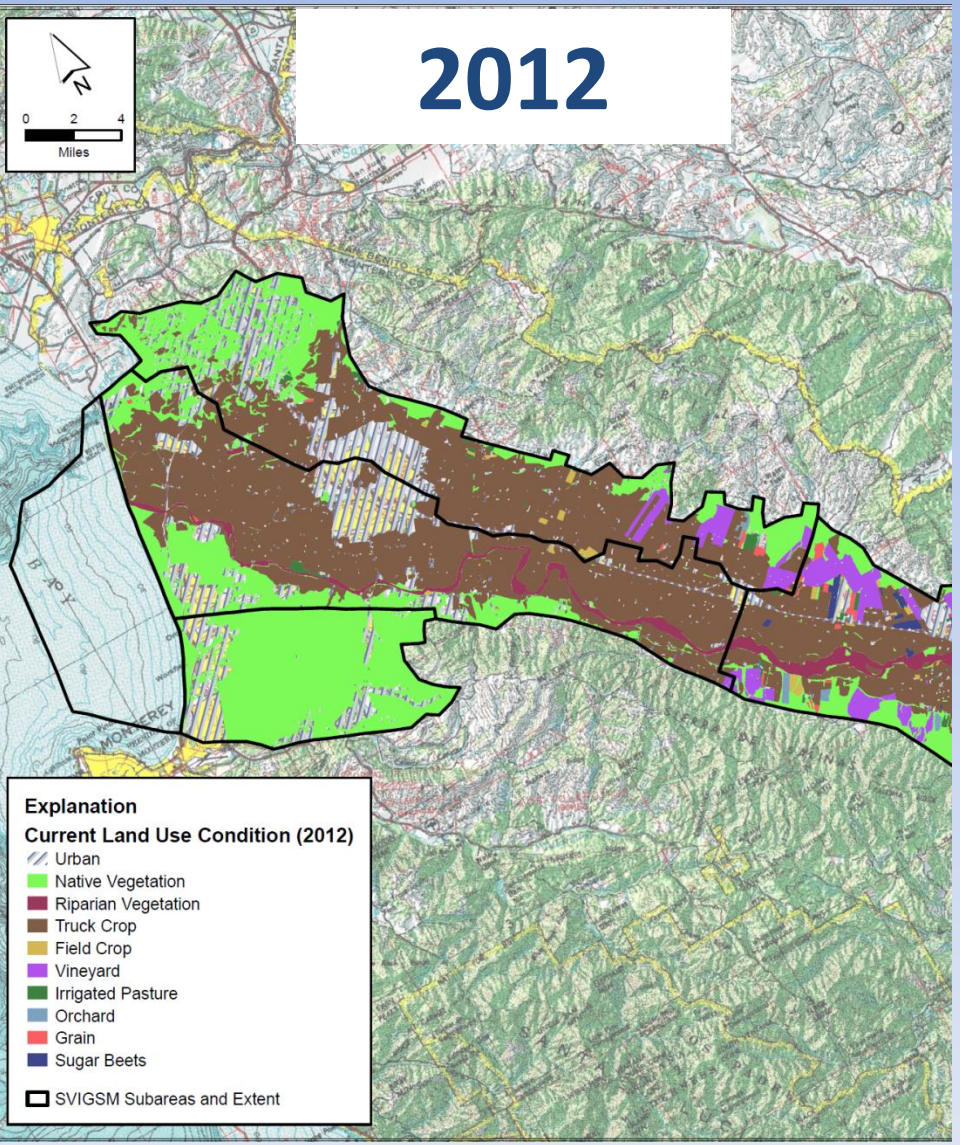
- Hydrologic Base Period
- Land Use Conditions
- SVWP Phase I and Phase II
- MCWD Desalination Project
- MPWSP Project Pumping and Slant Wells
- MPWSP Returning Basin Water
- GWR Project with Additional CSIP Water Delivery
- Sea Level Rise

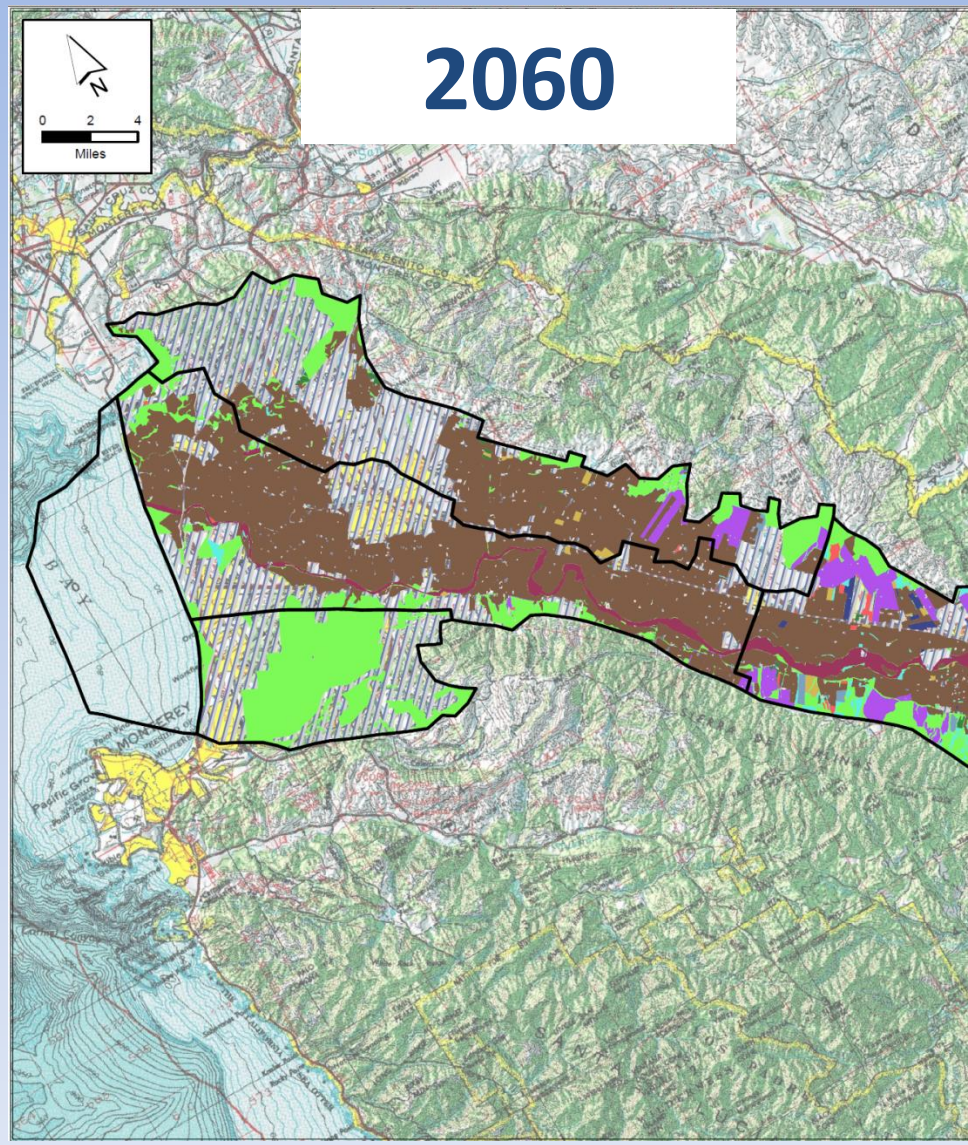
Hydrologic Base Period



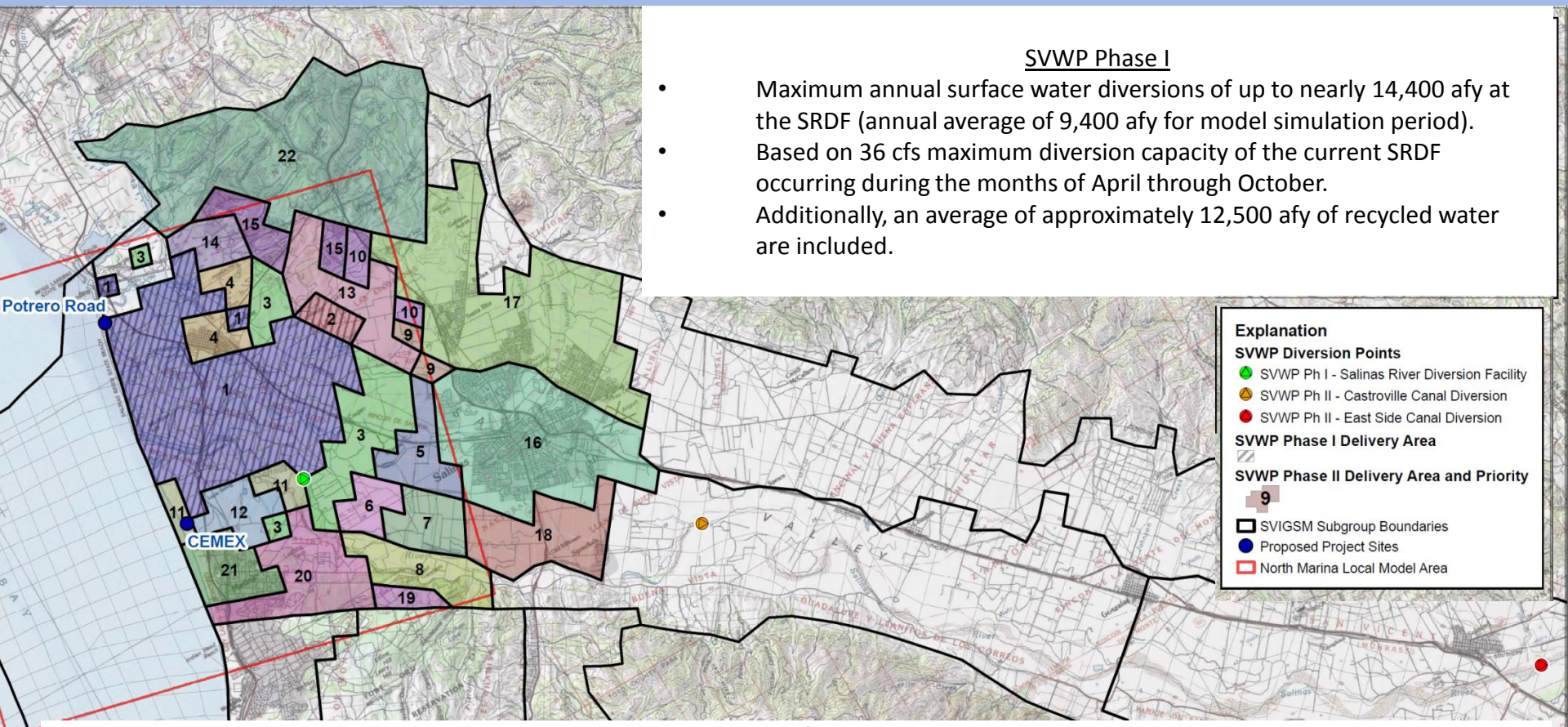
This 63 year period represents a hydrologic period consisting of long and short periods of dry and wet conditions as well as periods of average precipitation representing a range of potential future hydrologic conditions for the evaluation of impacts from the MPWSP.

2012 and 2060 Land Use Conditions





SVWP Diversion and Delivery Locations



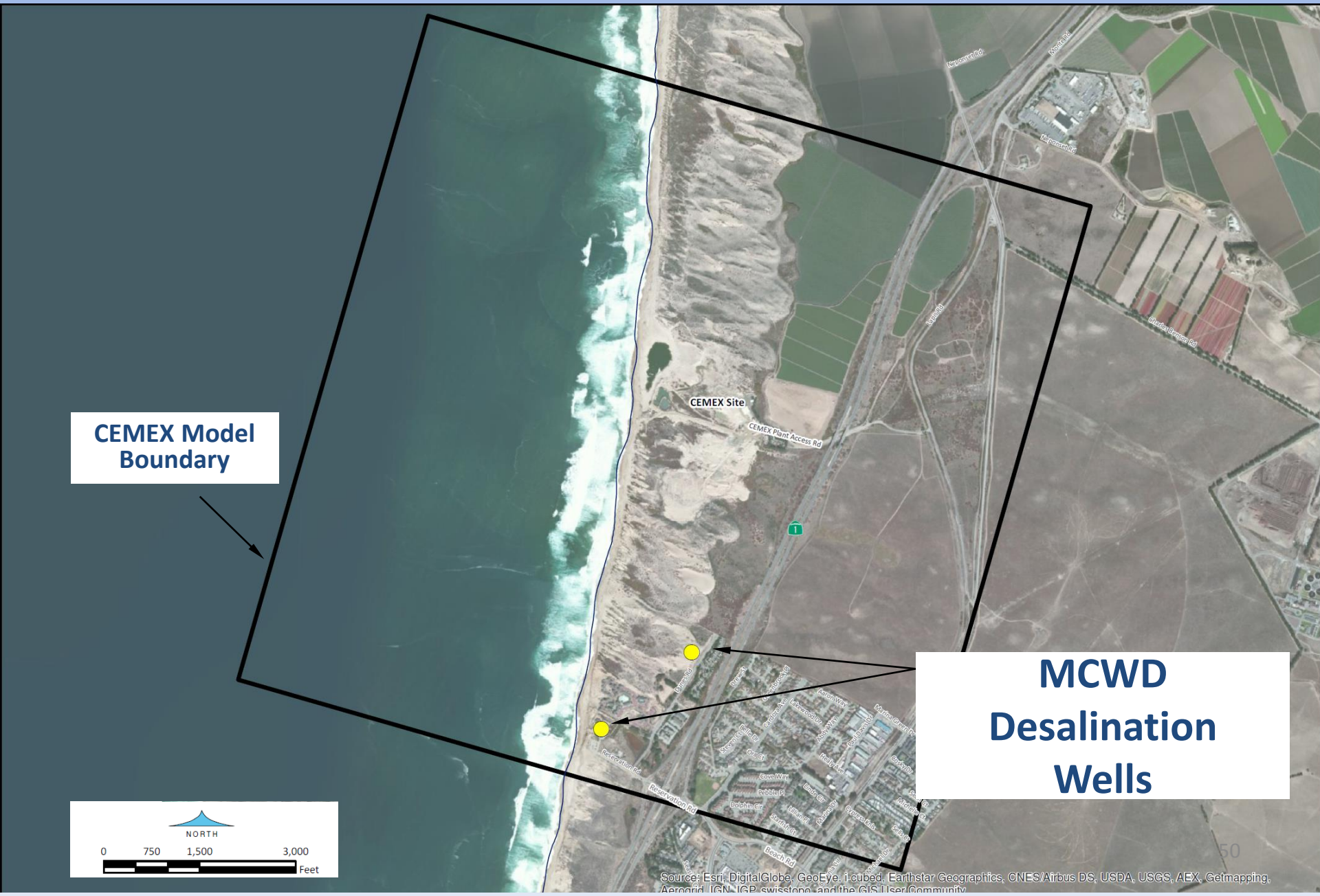
SVWP Phase I

- Maximum annual surface water diversions of up to nearly 14,400 afy at the SRDF (annual average of 9,400 afy for model simulation period).
- Based on 36 cfs maximum diversion capacity of the current SRDF occurring during the months of April through October.
- Additionally, an average of approximately 12,500 afy of recycled water are included.

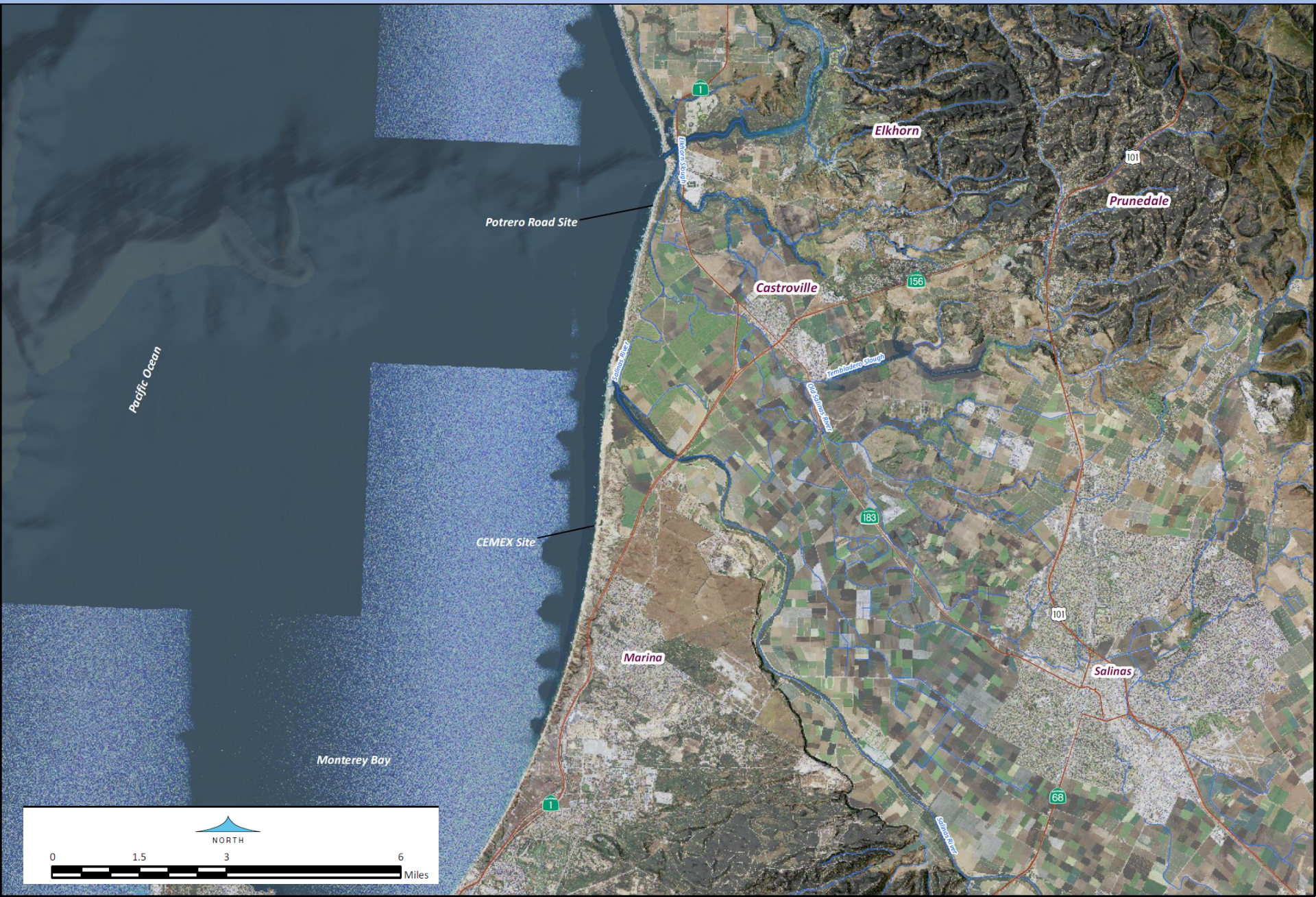
SVWP Phase II

- Based on very general information contained in the NOP of an Environmental Impact Report for a SVWP Phase II issued by MCWRA on June 25, 2014.
- The NOP suggests that Phase II would divert up to 135,000 afy of water from the Salinas River for delivery.
- The NOP indicates that two additional water diversion facilities would be constructed in the Forebay and Pressure subareas as part of this project (Castroville Canal Intake and East Side Canal Intake)
- In the Phase II scenarios, a maximum of about 135,000 afy of surface water was allowed to be diverted from the Salinas River (annual average of 72,000 afy for model simulation period).

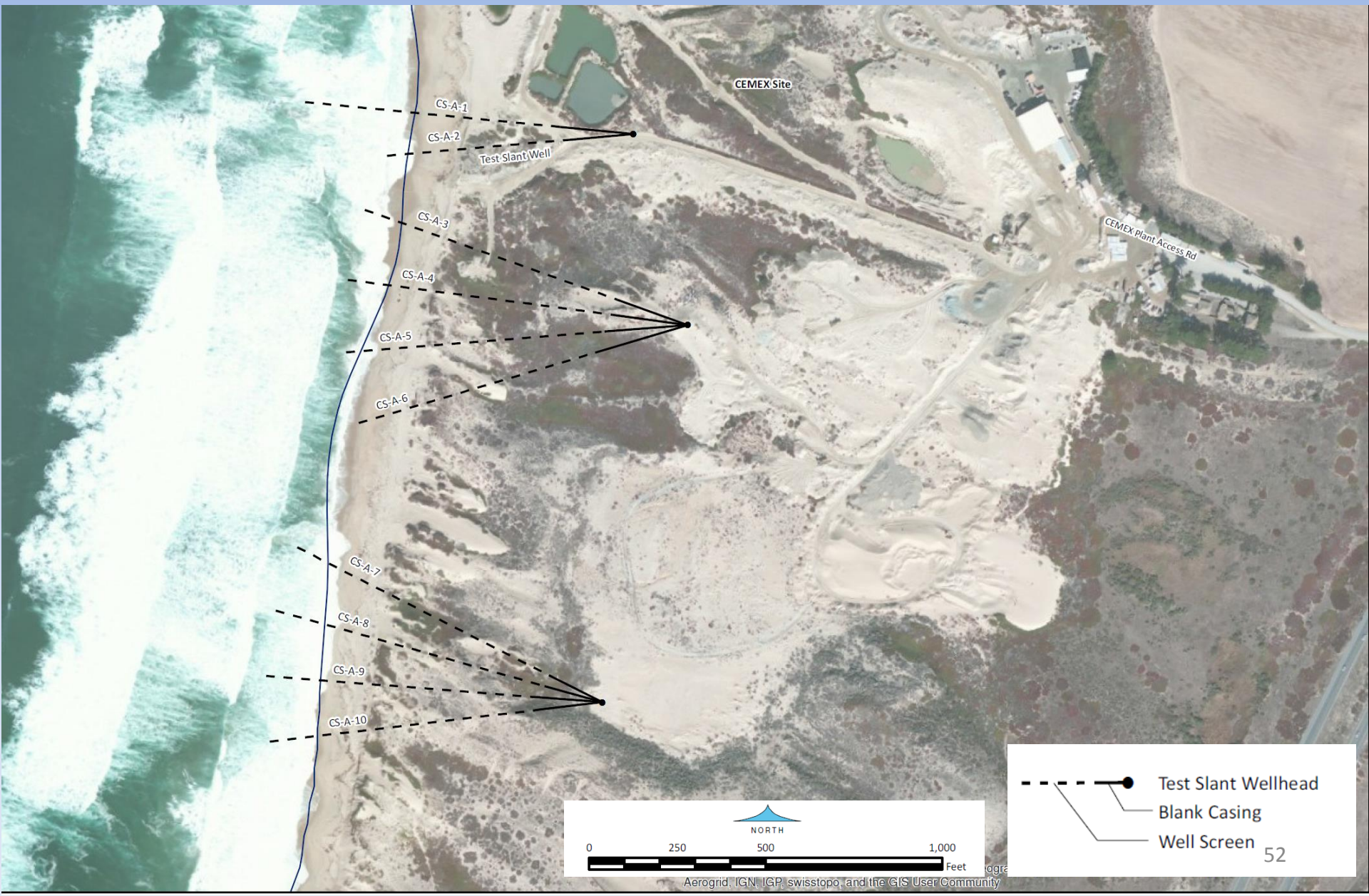
MCWD Desalination Well Location



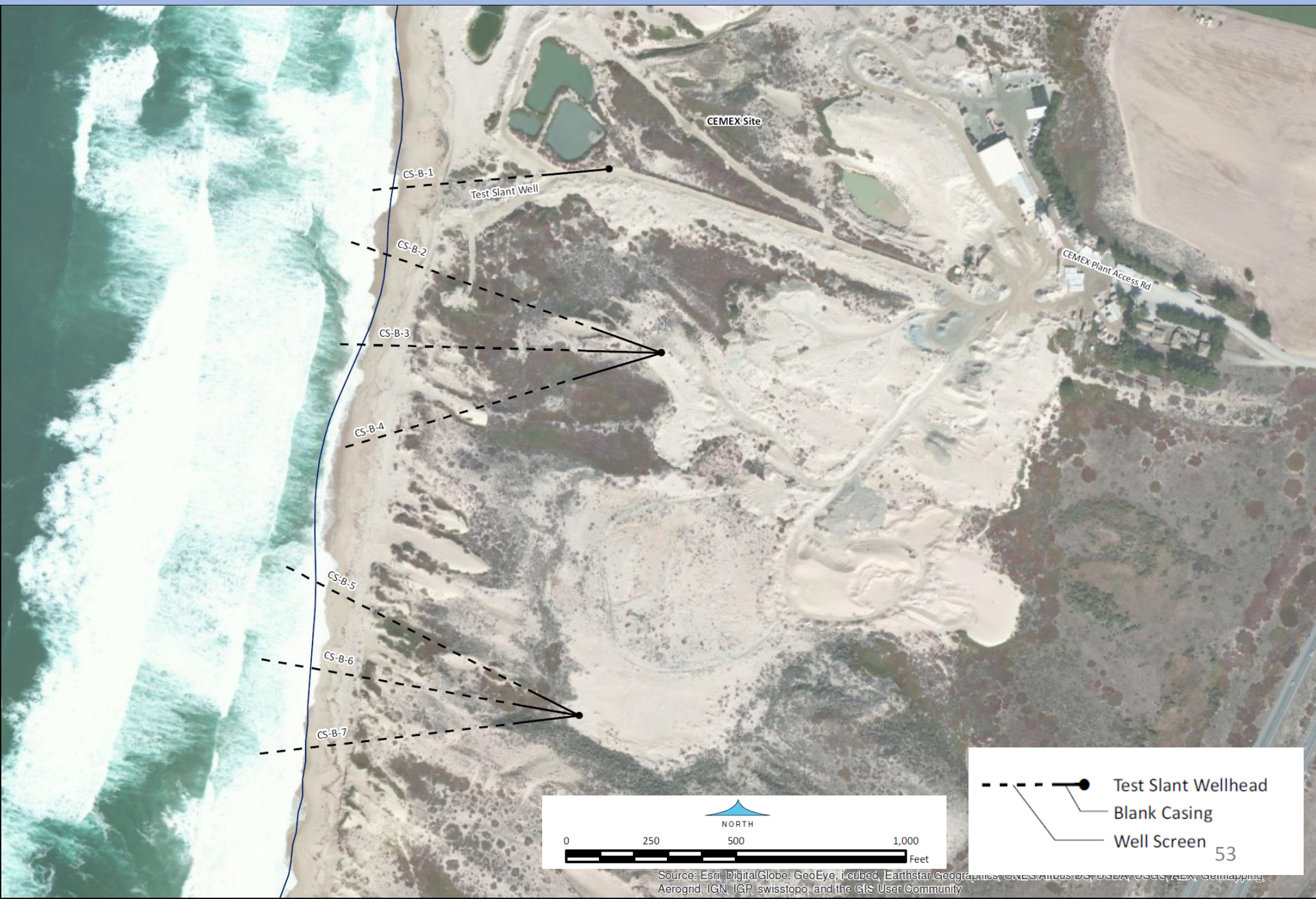
CEMEX and Potrero Rd Sites



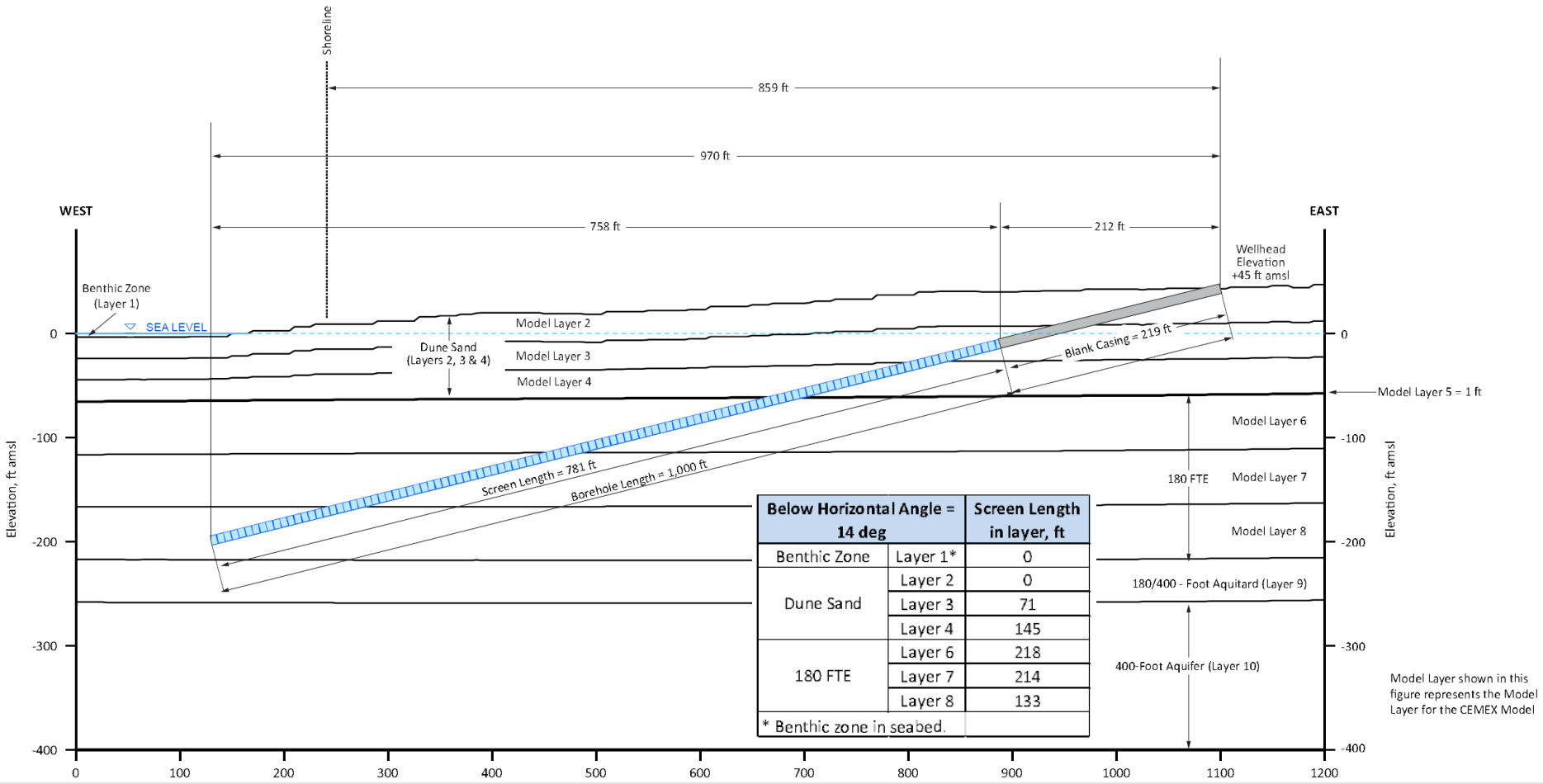
CEMEX Well Configuration A (Feedwater 24.1 MGD)



CEMEX Well Configuration B (Feedwater 15.5 MGD)



Cross Section of Slant Well CS-A-3

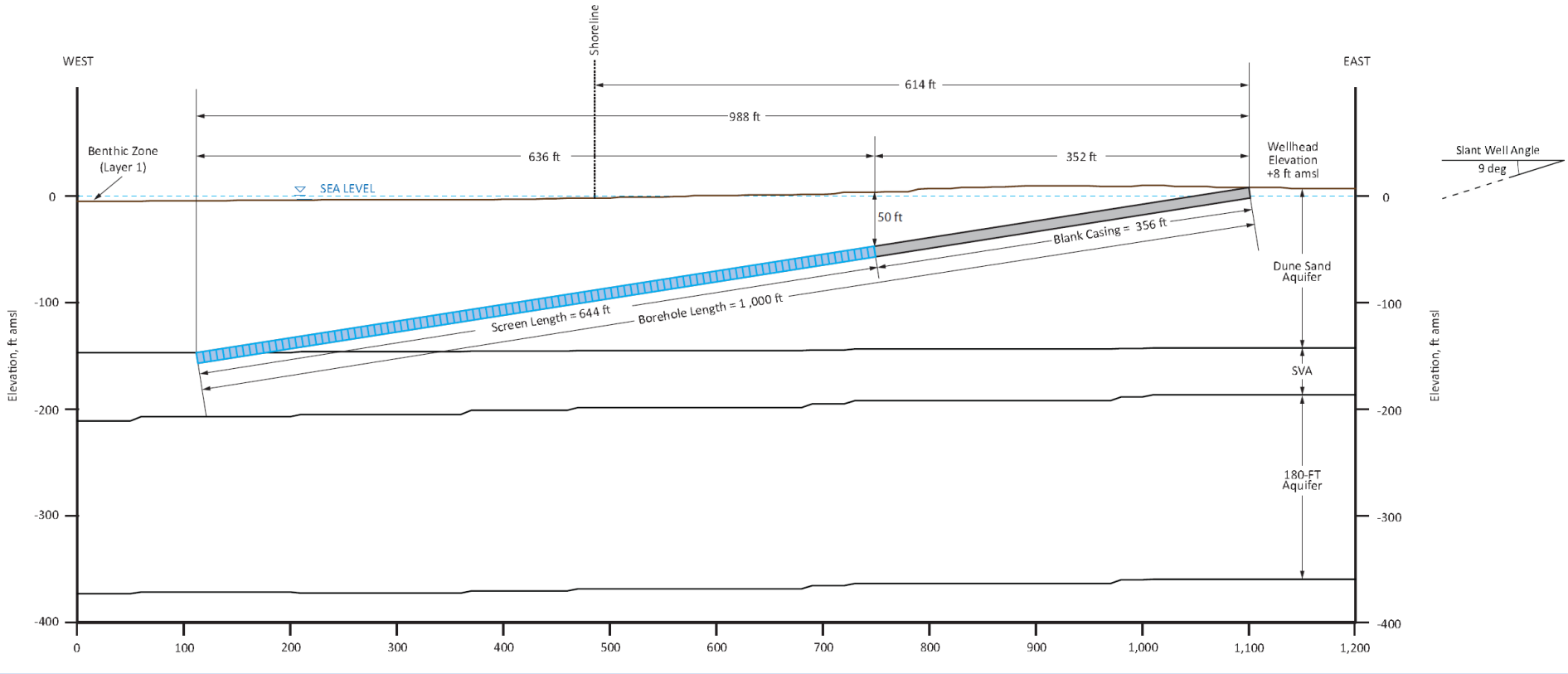


Below Horizontal Angle = 14 deg		Screen Length in layer, ft
Benthic Zone	Layer 1*	0
Dune Sand	Layer 2	0
	Layer 3	71
	Layer 4	145
180 FTE	Layer 6	218
	Layer 7	214
	Layer 8	133
* Benthic zone in seabed.		

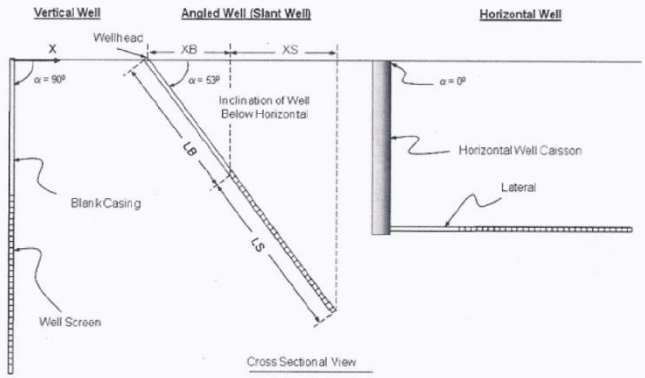
Potrero Rd. Well Configuration A (Feedwater 24.1 MGD)

Potrero Rd. Well Configuration B (Feedwater 15.5 MGD)

Cross Section of Slant Well PRS-A-2



ground water



Drawdown Distribution in the V...ity of Nonvertical Wells

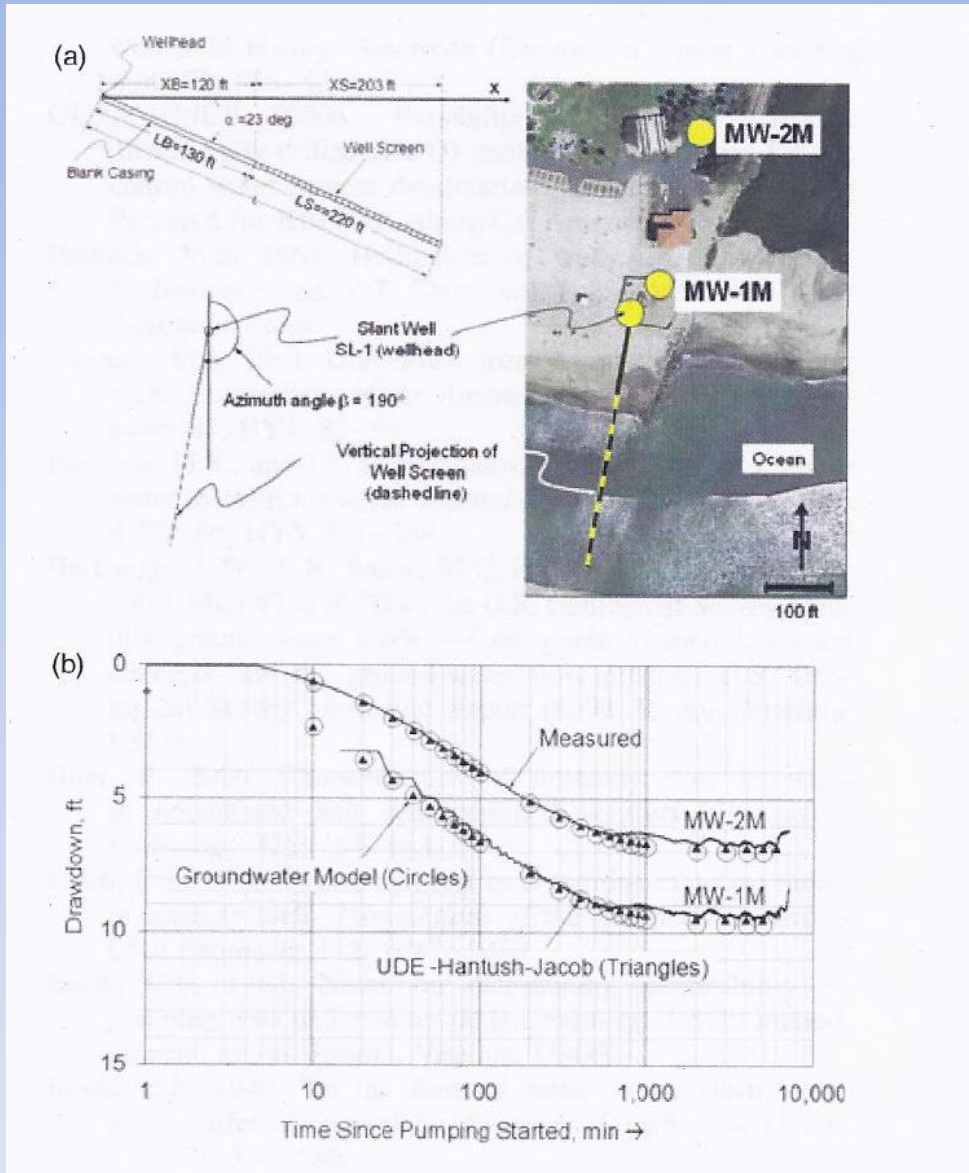
by Dennis E. Williams

Abstract

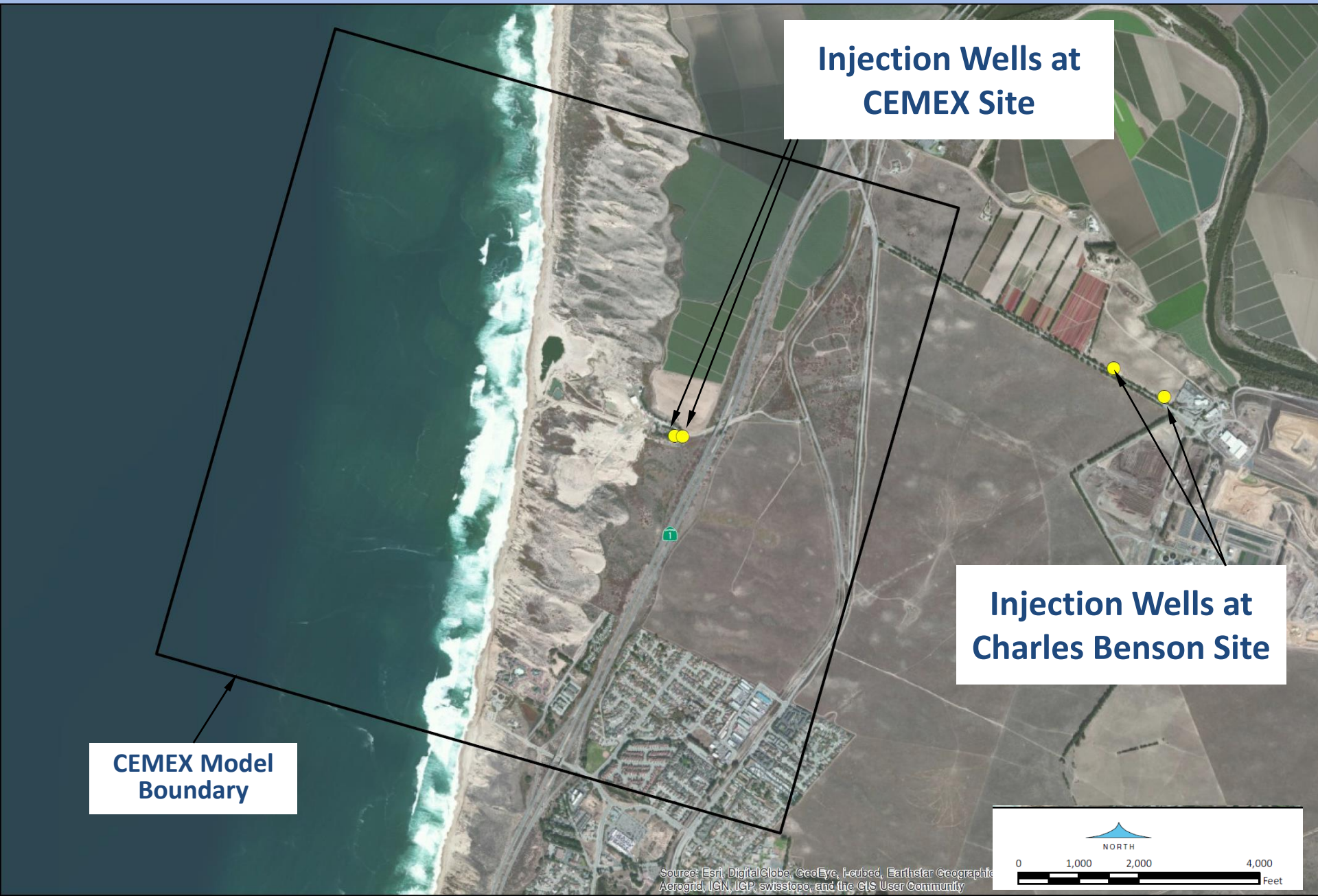
Recent developments in subsurface intake systems for ocean desalination plants are considering use of angled wells (slant wells) completed in permeable materials beneath the ocean floor. Conventional drawdown equations for vertical or horizontal wells are inadequate to properly describe the drawdown distribution in the vicinity of slant wells. Using the principle of superposition combined with standard well hydraulics, universal drawdown equations (UDE) are presented which calculate the drawdown distribution in the vicinity of production wells with inclination angles ranging from 0° (horizontal wells) to 90° (vertical wells). The method is computationally simple and other than the normal assumptions for standard well equations, it only requires that the calculated drawdown represent the drawdown which would be measured in a fully penetrating observation well. Solutions using the UDE are developed for confined, unconfined and semi-confined (leaky) aquifers and compared with analytical equations for vertical and horizontal wells, and with a numerical model for slant wells. The UDE is also applied to pumping test data from the Dana Point slant well project in Southern California.

Source: Ground Water: 2013 Sep-Oct; 51(5):745-51. doi:10.1111/gwat. 12000. Epub 2012 Dec 6.

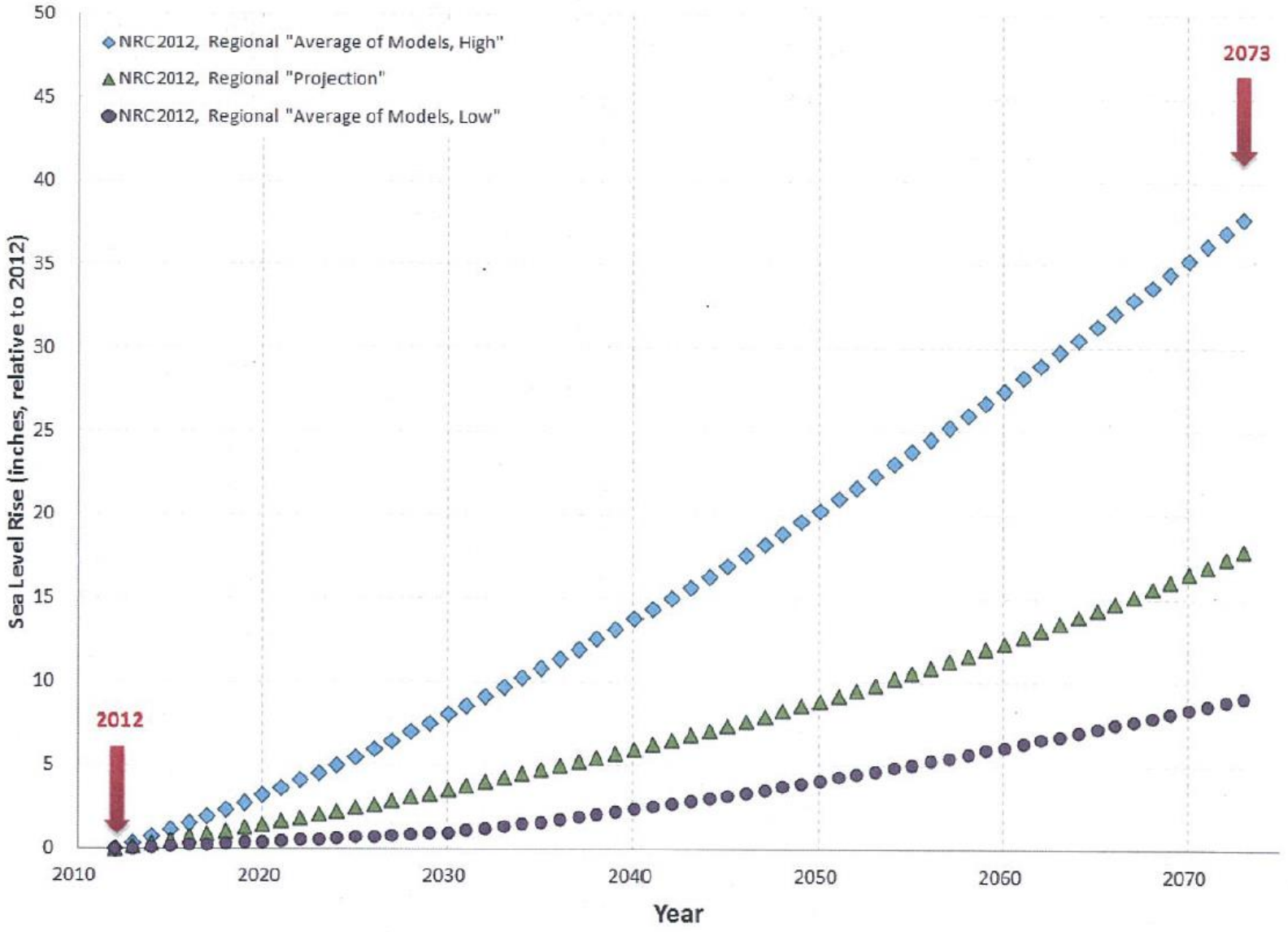
- Solutions using UDE are compared with a numerical model for slant wells.
- The UDE is also applied to pumping test data from the Dana Point slant well project.



MPWSP Returning Basin Water



Monterey Bay Sea Level Rise Curves



Source: ESA PWA, 2013. Monterey Peninsula Water Supply Project: Coastal Water Elevations and Sea Level Rise Scenarios

Equivalent Freshwater Head for Boundary Condition

$$h_f = (\rho/\rho_f)*h - [(\rho-\rho_f)/\rho_f]* Z$$

h_f = Equivalent Freshwater Head, [L]
ρ = Density of Seawater, [ML^{-3}]
ρ_f = Density of Freshwater, [ML^{-3}]
h = Sea Level, [L]
Z = Elevation, [L]

Source: 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 of Water-Resources Investigations 6-A7.

Predicted Model Scenarios
No Project Scenarios

Model Run		Model Time	Land Use	MPWSP			SVWP	MCWD	Ground Water Replenishment (GWR) Project with Additional CSIP Water Delivery
				CEMEX Site	Potrero Rd. Site	Returning Basin Water	Phase II Equivalent	1.5 MGD Desal (Product Water)	
				From Dune Sand & 180-FTE Aquifer	From Dune Sand Aquifer				
				MGD					
1n	Baseline (No Project)	2012-2074	2012						
2f	Cumulative Baseline with MCWD (No Project)	2012-2074	2060					Yes	
2af	Cumulative Baseline with SVWP II and MCWD (No Project)	2012-2074	2060				Yes	Yes	

Hydrology period spans 63 years and is synthesized using hydrologic data from the period from 1949-2011.
All model runs account for sea level rise.
* These values represent the amount of feedwater supply and product water (i.e., feedwater supply/product water).
"a" denotes SVWP Phase I and SVWP Phase II
"cb" denotes returning basin water at the Charles Benson Rd. Site
"c" denotes returning basin water at the CEMEX Site
"n" denotes no MCWD Desalination Project
"s" denotes shallow alluvium or Dune Sand Aquifer.
"r" denotes Post-Project rebound model run; the initial heads used for the Post-Project runs will be the ending heads as of 2074.
“f" denotes using 2060 land use for cumulative analysis
"180-FTE" denotes terrace deposits at the CEMEX Site that are hydrostratigraphically equivalent to the 180-FT Aquifer.

Predicted Model Scenarios
No Project Scenarios

Model Run		Model Time	Land Use	MPWSP			SVWP	MCWD	Ground Water Replenishment (GWR) Project with Additional CSIP Water Delivery
				CEMEX Site	Potrero Rd. Site	Returning Basin Water	Rubber Dam or Phase II Equivalent	1.5 MGD Desal (Product Water)	
				From Dune Sand & 180-FTE Aquifer	From Dune Sand Aquifer				
				MGD					
1n	Baseline (No Project)	2012-2074	2012				Phase I	No	No
2f	Cumulative Baseline with MCWD (No Project)	2012-2074	2060				Phase I	Yes	No
2af	Cumulative Baseline with SVWP II and MCWD (No Project)	2012-2074	2060				Phase I & II	Yes	No

Hydrology period spans 63 years and is synthesized using hydrologic data from the period from 1949-2011.
All model runs account for sea level rise.
* These values represent the amount of feedwater supply and product water (i.e., feedwater supply/product water).
"a" denotes SVWP Phase I and SVWP Phase II
"cb" denotes returning basin water at the Charles Benson Rd. Site
"c" denotes returning basin water at the CEMEX Site
"n" denotes no MCWD Desalination Project
"s" denotes shallow alluvium or Dune Sand Aquifer.
"r" denotes Post-Project rebound model run; the initial heads used for the Post-Project runs will be the ending heads as of 2074.
"180-FTE" denotes terrace deposits at the CEMEX Site that are hydrostratigraphically equivalent to the 180-FT Aquifer.
“f" denotes using 2060 land use for cumulative analysis

Predicted Model Scenarios
Project Scenarios – CEMEX Site

Model Run		Model Time	Land Use	MPWSP			SVWP	MCWD	Ground Water Replenishment (GWR) Project with Additional CSIP Water Delivery
				CEMEX Site	Potrero Rd. Site	Returning Basin Water	Phase II Equivalent	1.5 MGD Desal (Product Water)	
				From Dune Sand & 180-FTE Aquifer	From Dune Sand Aquifer				
				MGD					
3n	Project 2012 Land Use (Dune Sand & 180-FTE)	2012-2074	2012	24.1/9.5*		CSIP			
3ncb	Project 2012 Land Use with Returning Basin Water at Charles Benson Rd. Site (Dune Sand & 180-FTE)	2012-2074	2012	24.1/9.5*		1,080 AFY at Charles Benson Rd. Site			
3nc	Project 2012 Land Use with Returning Basin Water at CEMEX Site (Dune Sand & 180-FTE)	2012-2074	2012	24.1/9.5*		1,080 AFY at CEMEX Site			
4f	Project 2060 Land Use with MCWD (Dune Sand & 180-FTE)	2012-2074	2060	24.1/9.5*		CSIP		Yes	
4rf	Post –CEMEX 2060 Land Use MCWD (Dune Sand & 180-FTE)	2012-2074	2060	0/0*				Yes	
5n	Variant 2012 Land Use (Dune Sand & 180-FTE)	2012-2074	2012	15.5/6.1*		CSIP			Yes
5ncb	Variant 2012 Land Use with Returning Basin Water at Charles Benson Rd. Site (Dune Sand & 180-FTE)	2012-2074	2012	15.5/6.1*		700 AFY at Charles Benson Rd. Site			Yes
5nc	Variant 2012 Land Use with Returning Basin Water at CEMEX Site(Dune Sand & 180-FTE)	2012-2074	2012	15.5/6.1*		700 AFY at CEMEX Site			Yes
5f	Variant 2060 Land Use with MCWD (Dune Sand & 180-FTE)	2012-2074	2060	15.5/6.1*		CSIP		Yes	Yes

Predicted Model Scenarios
Project Scenarios - Potrero Rd. Site

Model Run		Model Time	Land Use	MPWSP			SVWP	MCWD	Ground Water Replenishment (GWR) Project with Additional CSIP Water Delivery
				CEMEX Site	Potrero Rd. Site	Returning Basin Water	Phase II Equivalent	1.5 MGD Desal (Product Water)	
				From Dune Sand & 180-FTE Aquifer	From Dune Sand Aquifer				
				MGD					
6sn	Project 2012 Land Use (Dune Sand)	2012-2074	2012		24.1/9.5*				
7sf	Project 2060 Land Use with MCWD (Dune Sand)	2012-2074	2060		24.1/9.5*			Yes	
7srf	Post-Potrero with MCWD (Dune Sand)	2075-2137	2060		0/0			Yes	
8sn	Variant 2012 Land Use (Dune Sand)	2012-2074	2012		15.5/6.1*				Yes
8sf	Variant 2060 Land Use with MCWD (Dune Sand)	2012-2074	2060		15.5/6.1*			Yes	Yes

Overview

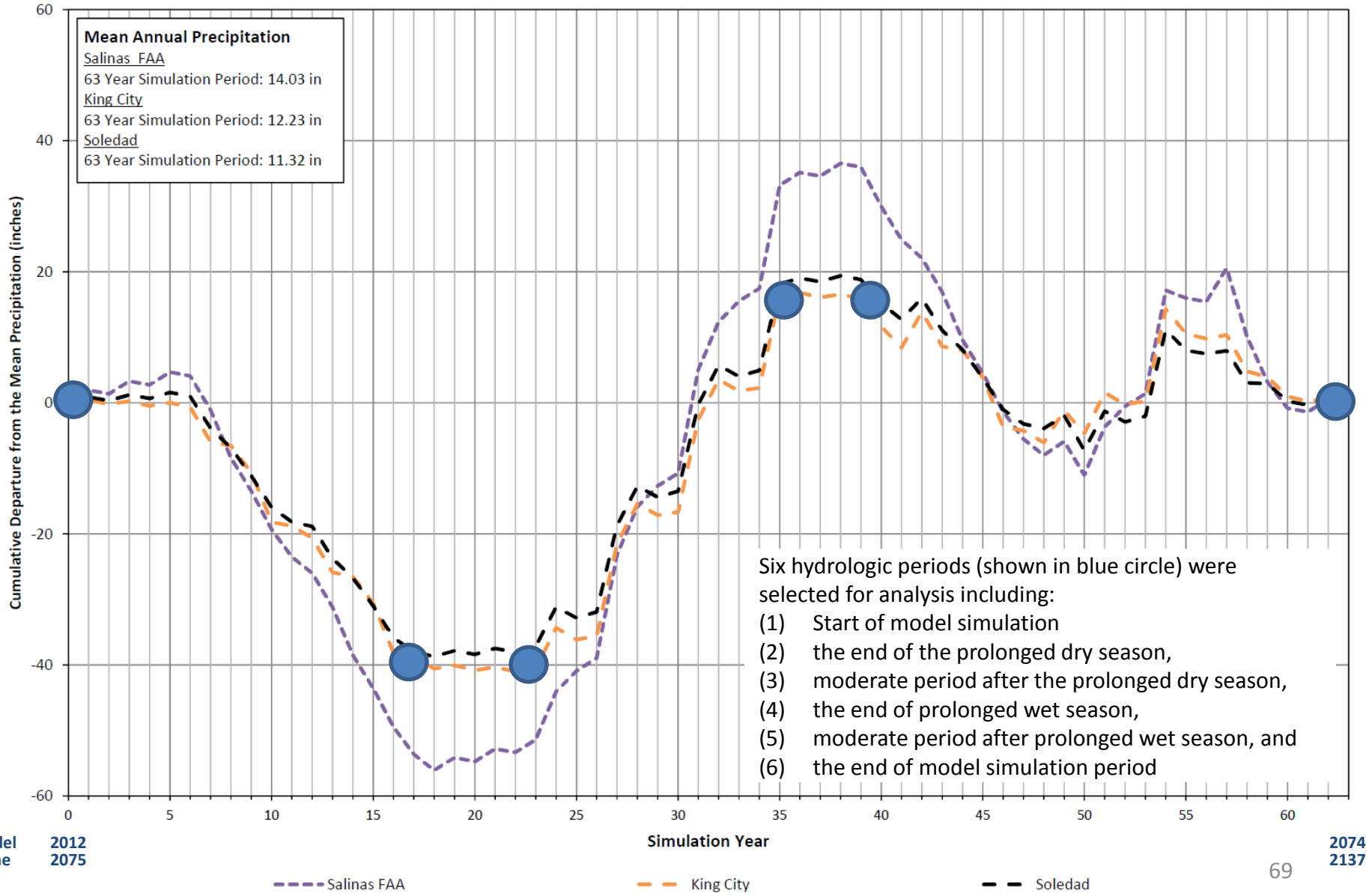
- Purpose and Scope of Hydrogeology Modeling
- Types of Model Input
  - Groundwater Models
  - Aquifer Parameters
  - Model Inflow Terms
  - Model Outflow Terms
- Major Assumptions of Predictive Model Scenarios
- **Results Output**

Model Run 3n versus Run 1n

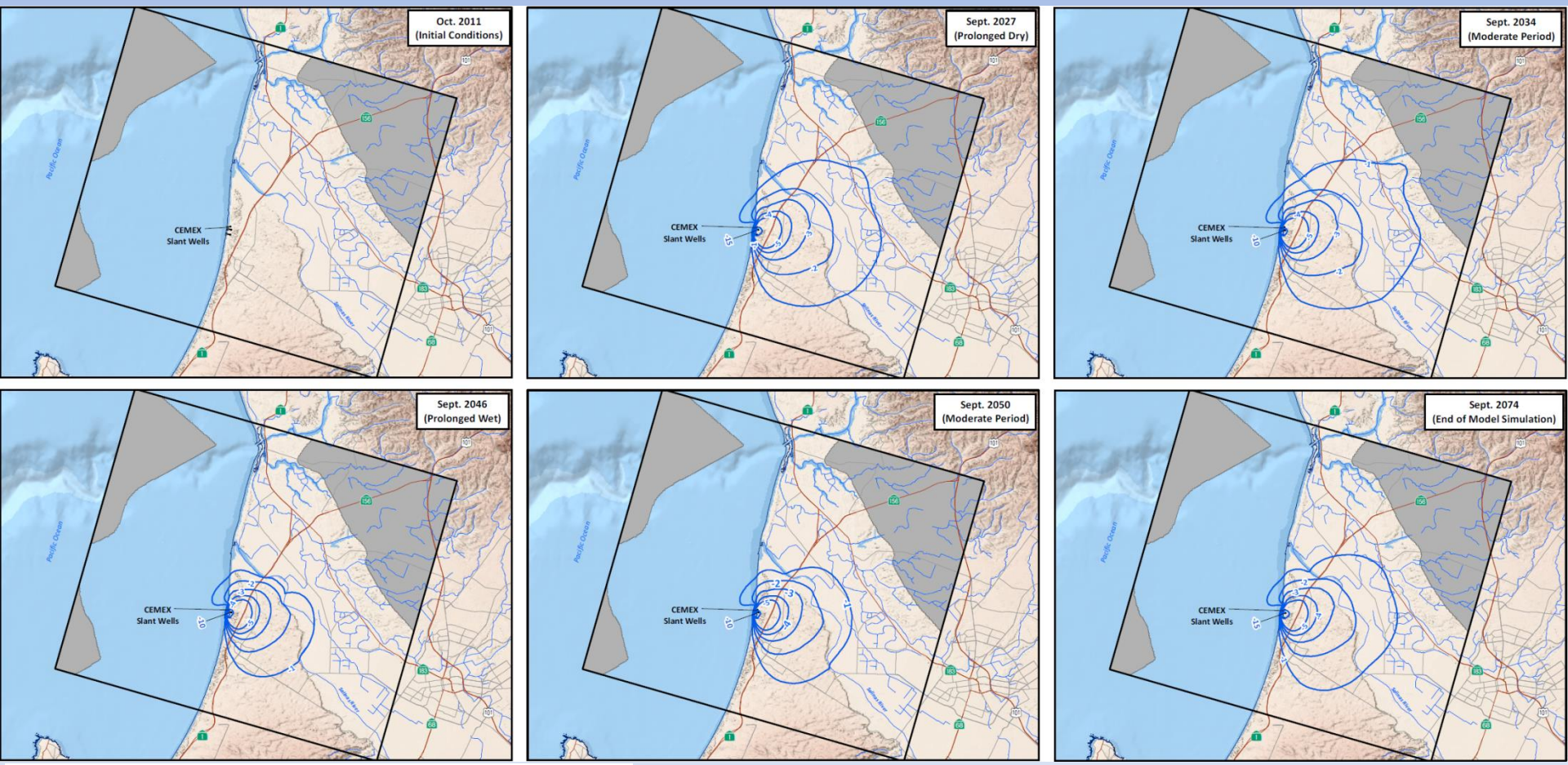
	Model Run	Model Time	Land Use	MPWSP			SVWP	MCWD	Ground Water Replenishment (GWR) Project with Additional CSIP Water Delivery
				CEMEX Site	Potrero Rd. Site	Returning Basin Water	Phase II Equivalent	1.5 MGD Desal (Product Water)	
				From Dune Sand & 180-FTE Aquifer	From Dune Sand Aquifer				
				MGD					
1n	Baseline (No Project)	2012-2074	2012						
3n	Project 2012 Land Use (Dune Sand & 180-FTE)	2012-2074	2012	24.1/9.5*		CSIP			

“n" denotes no MCWD Desalination Project

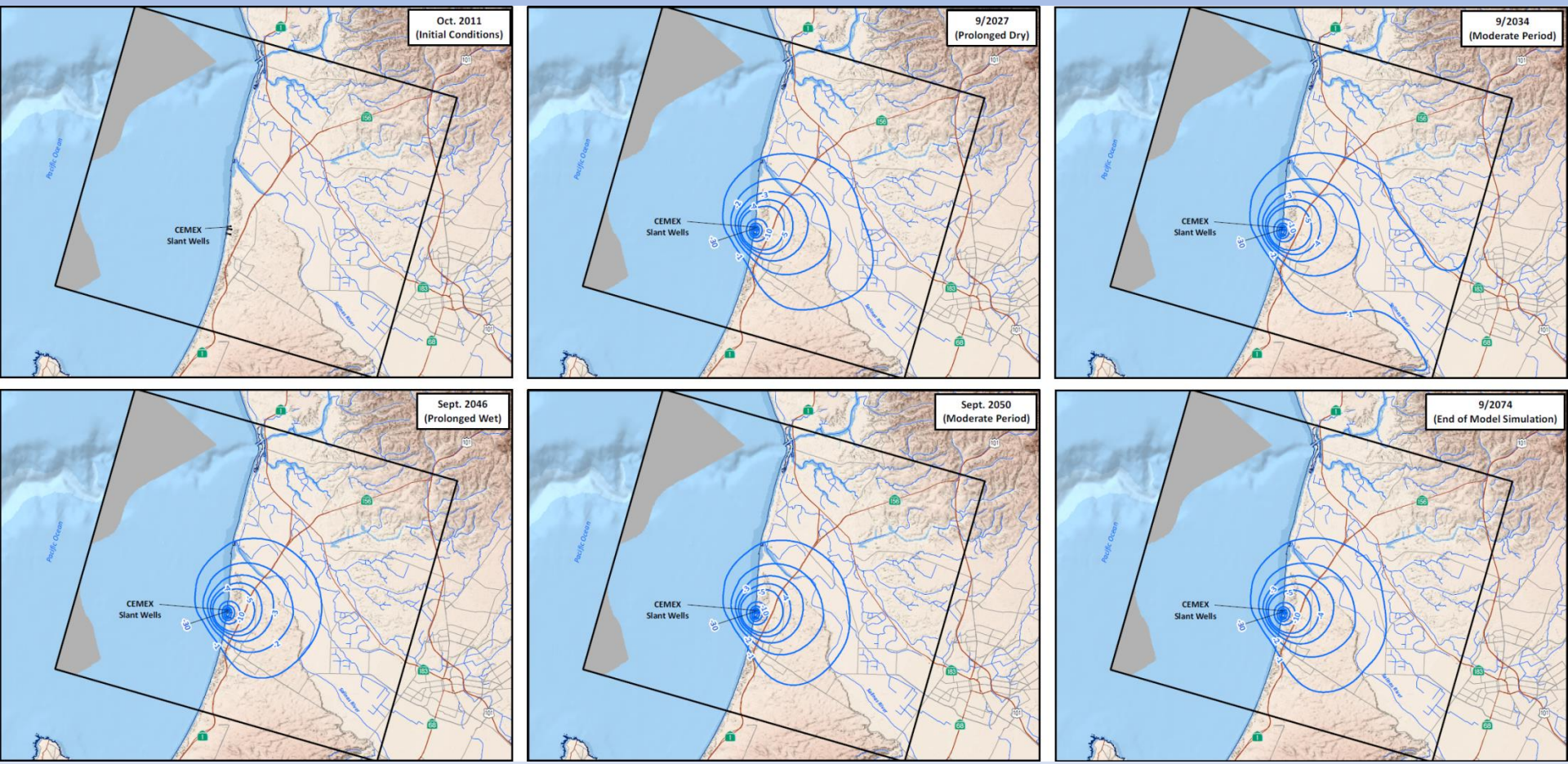
Selected Periods for Analysis



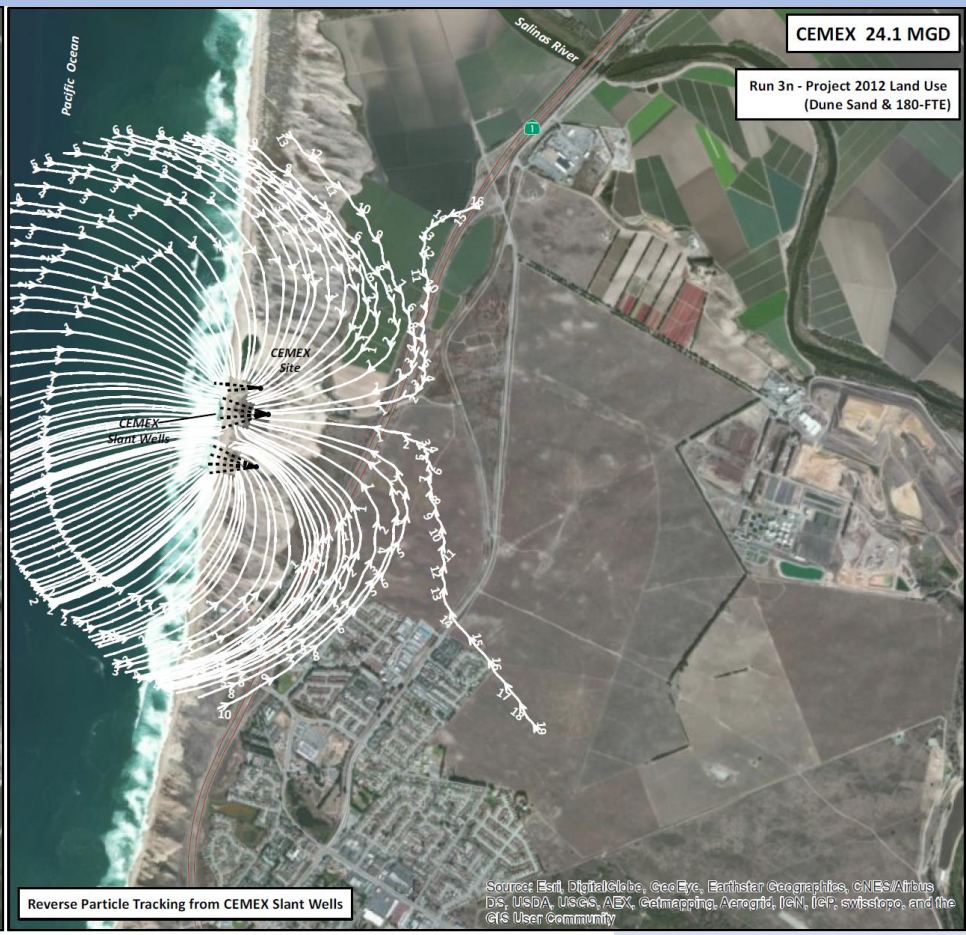
Changes in Groundwater Elevations in Selected Years Dune Sand/Perched "A" Aquifers - Run 3n minus Run 1n



Changes in Groundwater Elevations in Selected Years
180-FT/180-FTE Aquifer - Run 3n minus Run 1n



Particle Tracking near CEMEX Site – No Project (Run 1n) and CEMEX 24.1 MGD (Run 3n) 180-FT/180-FTE Aquifer

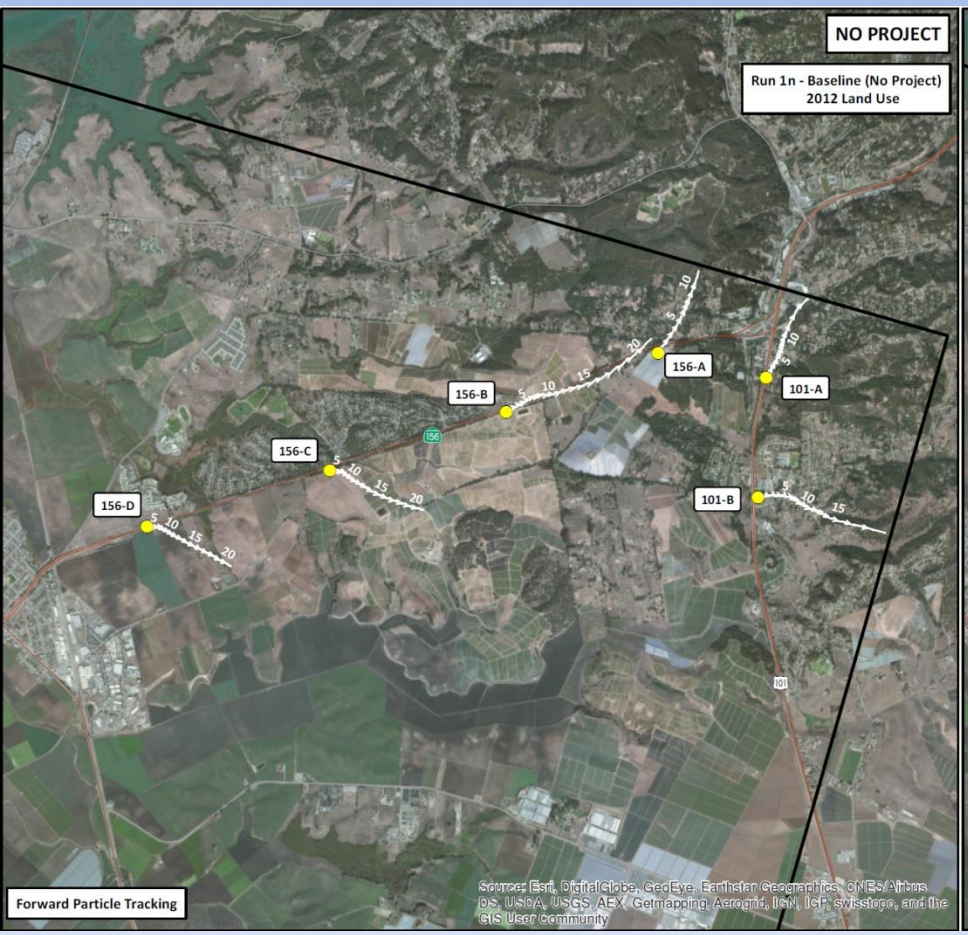


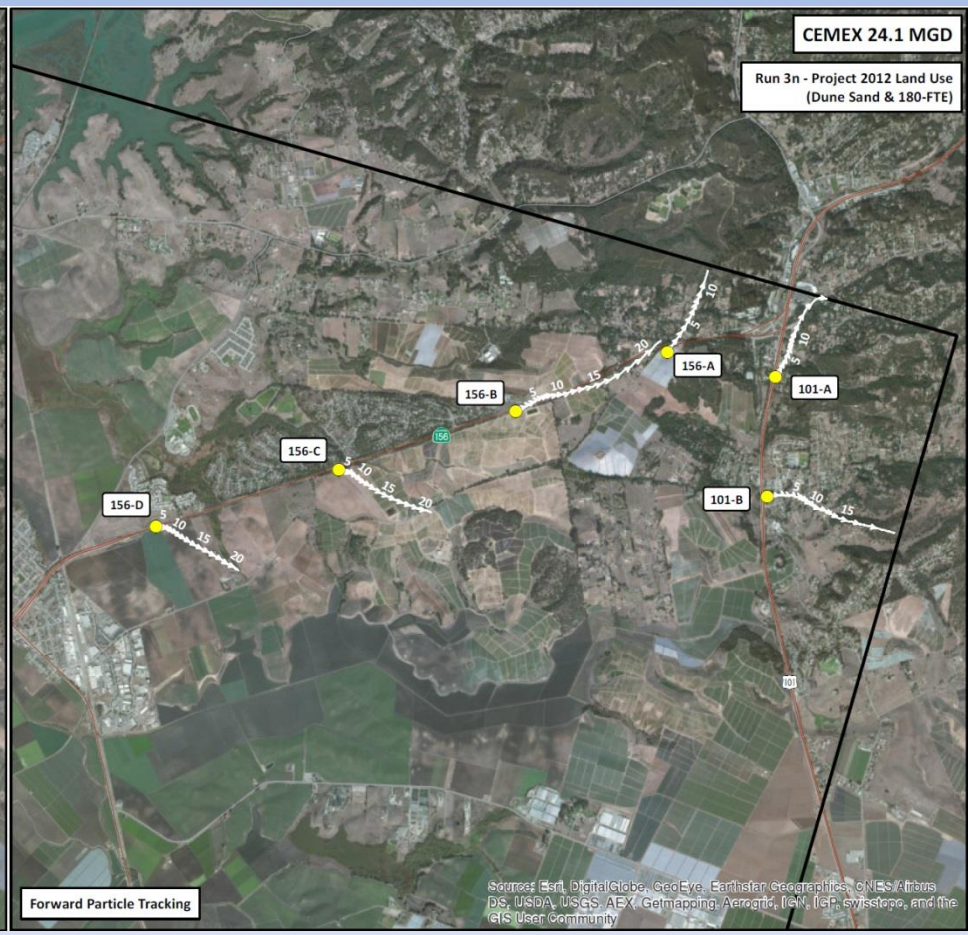
white line	Particle Travel Path
white arrow	Direction of Particle Travel and Travel Time (1 Year Increments)

Slant Wellhead
Blank Casing
Well Screen

Note: 180-FTE = 180-Foot Equivalent Aquifer

Particle Tracking near Prunedale – No Project (Run 1n) and CEMEX 24.1 MGD (Run 3n) 180-FT/180-FTE Aquifer





white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

Slant Wellhead
Blank Casing
Well Screen

Note: 180-FTE = 180-Foot Equivalent Aquifer

Percent of Ocean Water in Project Wells

FS = (OWP*OWS + (100-OWP)*IS) /100 ….(1)

100*FS =OWP*OWS + 100*IS – OWP*IS

100*FS – 100*IS = OWP*(OWS-IS)

100*(FS-IS)=OWP*(OWS-IS)

OWP = (FS-IS)/(OWS-IS)*100……..(2)

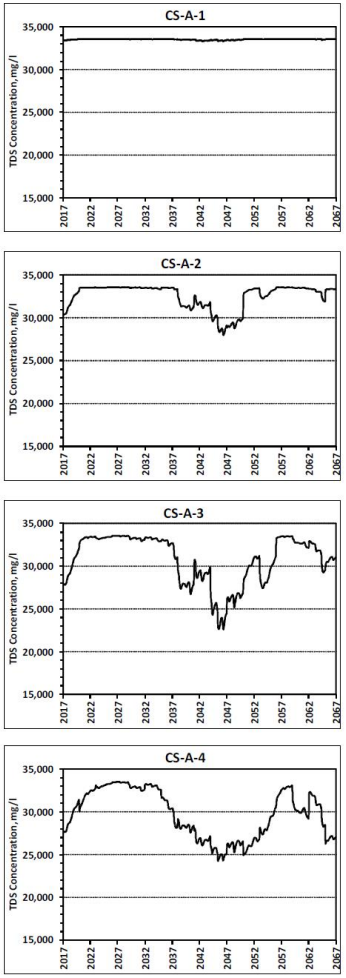
FS = Feedwater Salinity, [mg/L]
OWS = Ocean water Salinity, [mg/L]
IS = Inland Water Salinity, [mg/]
OWP = Ocean Water Percentage, %

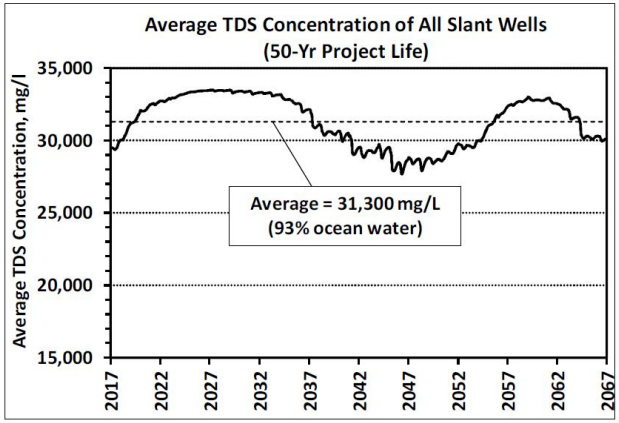
Source: Water Purchase Agreement by and among MCWD, MCWRA, Cal-AM, 2010.

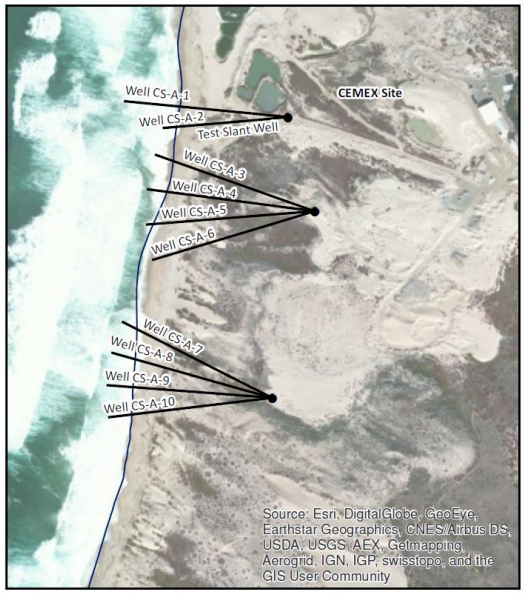
Percent of Ocean Water in Project Wells
Scenario 3n

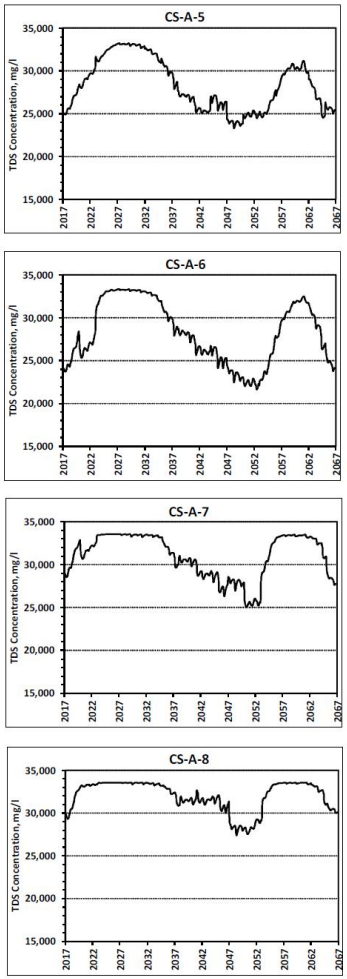
CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

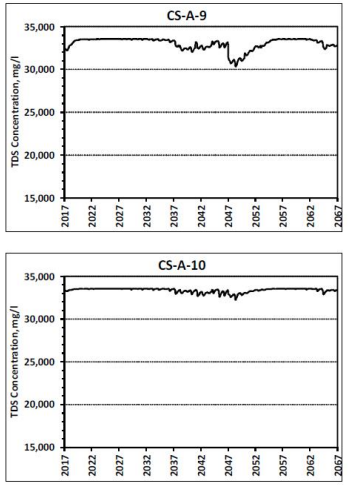
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS











PREDICTED PERCENT OF OCEAN WATER IN CEMEX SITE PROJECT SLANT WELLS - RUN 3n

EXPLANATION

Run 3n - Project 2012 Land Use
(Dune Sand & 180-FTE)

Note: 180-FTE = 180-Foot Equivalent Aquifer

17-Apr-15

Prepared by: DB. Map Projection: State Plane 1983, Zone IV.

NORTH

0 500 1,000 2,000 Feet

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

DRAFT

Figure 145