



BMO Threshold Development and Recharge Mapping

Sacramento Central Groundwater Authority

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Presenter:
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Complex Challenges | Innovative Solutions

rmcwater.com

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Local Groundwater Assistance Fund grant
from the
California Department of Water Resources



Agenda

- Background and Need
- Project Summary
- Public Involvement

Project Team

- SCGA – Project manager
- SCGA Member Agencies – Sampling assistance
- California Department of Water Resources – Funding entity
- RMC Water and Environment – Technical consultant
- HydroFocus – Technical consultant

Project Background

- Two Major Components
 - **Groundwater Elevation BMO Threshold Development**
 - Recharge Mapping

Background: Thresholds

CENTRAL SACRAMENTO COUNTY

GROUNDWATER MANAGEMENT PLAN

FEBRUARY 2006



Background - BMOs

1. Maintain a long-term average groundwater extraction rate of 273,000 AF/year.
2. Establish specific minimum groundwater elevations within all areas of the basin consistent with the Water Forum “Solution.”
3. Protect against any potential inelastic land surface subsidence.
4. Protect against any adverse impacts to surface water flows.
5. Develop specific water quality objectives for several constituents of concern.

Need – BMO No. 2

1. Actions defined
2. Triggers defined
3. Approach to implementation defined
4. Need to implement approach

Table 4-1. Monitoring Actions and Trigger Points (continued)

Monitoring Action	Trigger Points	Recommended Action
BMO No. 2. Maintain specific groundwater elevations within all areas of the basin consistent with the Water Forum "solution."		
A monitoring methodology to meet specific objectives in managing groundwater levels requires a systematic, repeatable, and scientific approach. The objective of this monitoring program is to take measurements from selected monitoring wells that have sufficient construction and hydrogeologic data. Wells will be assigned to represent the polygon areas defined in Appendix B , and may be grouped within the basin in areas that are sufficiently distinct in the makeup of hydrogeology and land use. Monitored groundwater levels for a well will be compared with the designated upper and lower groundwater level threshold for each polygon that is assigned to the well. The upper and lower thresholds are termed the "bandwidth" of the polygon.	Trigger Point 1. A 25 to 50 percent encroachment into the designated bandwidth of a polygon.	Alert stage that informs the basin governance body and the overlying groundwater extractor(s) that a specific polygon area is being compromised. Activation of this trigger will take place only after the cause of the condition is thoroughly investigated.
	Trigger Point 2. A 50 to 75 percent encroachment into the designated bandwidth of a polygon.	In the event groundwater level measurements hit Trigger Point 2 without first initiating Trigger Point 1, the recommended actions of Trigger Point 1 still apply. Additionally, this stage initiates a requirement to collect a fee to secure supplemental water supplies or to reduce pumping in a predefined area(s).
	Trigger Point 3. A 75 to 100 percent encroachment into the designated bandwidth of a polygon. This indicates continuously declining groundwater levels in an area even during wet and normal hydrologic cycles, indicating that excessive pumping is the probable cause.	Well owners with operating wells in the affected area(s) will be identified and notified of the basin's condition in their area. An assessment will be levied against those owners who continue to pump at the higher level. Every attempt will be made by the governance body to ameliorate the impact assessments to private domestic groundwater pumps.
	Trigger Point 4. Over 100 percent encroachment into the designated bandwidth of a polygon.	If the recommended actions from the first three trigger points do not result in an improvement to the affected area(s), the basin governance body will need to consider which of two actions it will take. The first is to consider whether a lower groundwater level in the area is acceptable. If so, the basin governance body has the ability to adapt to the actual monitoring data and change the model-based thresholds for management in the area. If lower groundwater levels are deemed unacceptable, the second action would require finding supplemental water supplies and construct infrastructure for the area(s) and reduce pumping to allow groundwater levels to recover to acceptable levels. Fees in addition to Trigger Point 3 fees will be assessed to cover costs associated with this action.

Project Background

- Two Major Components
 - Groundwater Elevation BMO Threshold Development
 - **Recharge Mapping**

Background/Need: Recharge Mapping

- Water Code, through AB359, requires a map of recharge areas in GWMPs
- Important to understand recharge from
 - Precipitation and applied water
 - Rivers
 - Subsurface flow at boundaries

Background/Need: Recharge Mapping

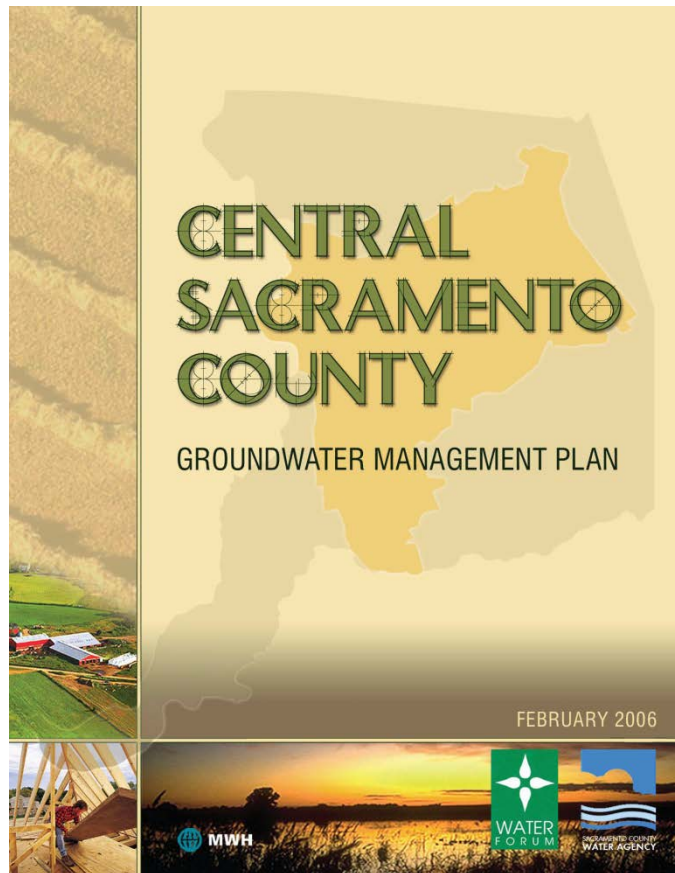
- Recharge is estimated
- Calibrated groundwater model
 - Tool for developing realistic estimates
 - Limitations due to similar recharge sources, results in non-unique solutions
- Sampling will improve the understanding of the contributions of the rivers vs. other sources
- Better understanding will improve models and assist management decisions

Project Summary

- Two Major Components
 - **Groundwater Elevation BMO Threshold Development**
 - Recharge Mapping

BMO Threshold Development - Approach

Follows approach in Appendix B of the GWMP



Appendix B

Summary of the development of Basin Management Objective #2 (Maintain specific groundwater elevations within all areas of the Central Basin consistent with the Water Forum solution).

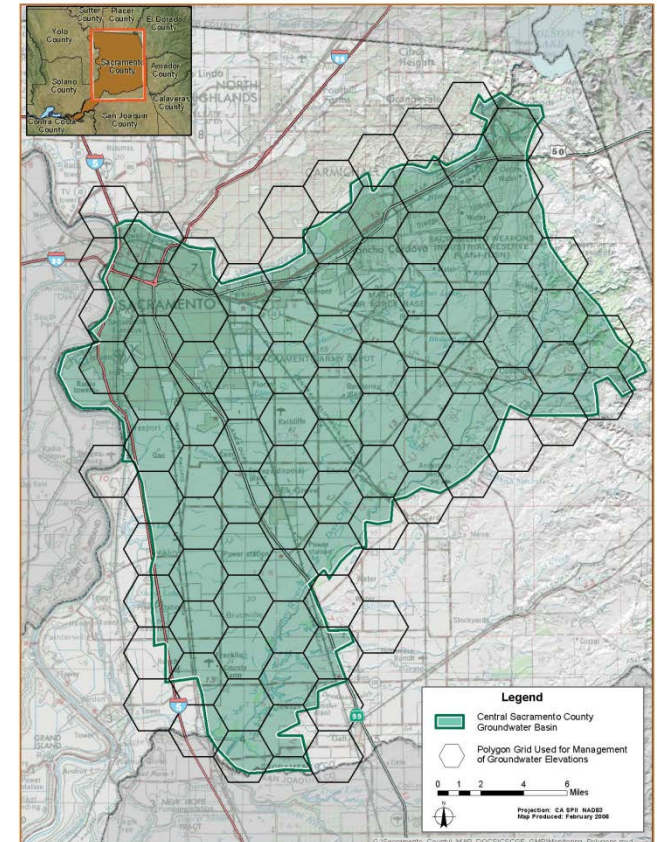
BMO Threshold Development - Approach

Follows approach in Appendix B of the GWMP

1. Define polygon grid.
 - Developed in GWMP
 - Will be used in analysis

Section 3. Management Plan Elements

Figure 3-3 Polygon Grid Used for Management of Groundwater Elevations

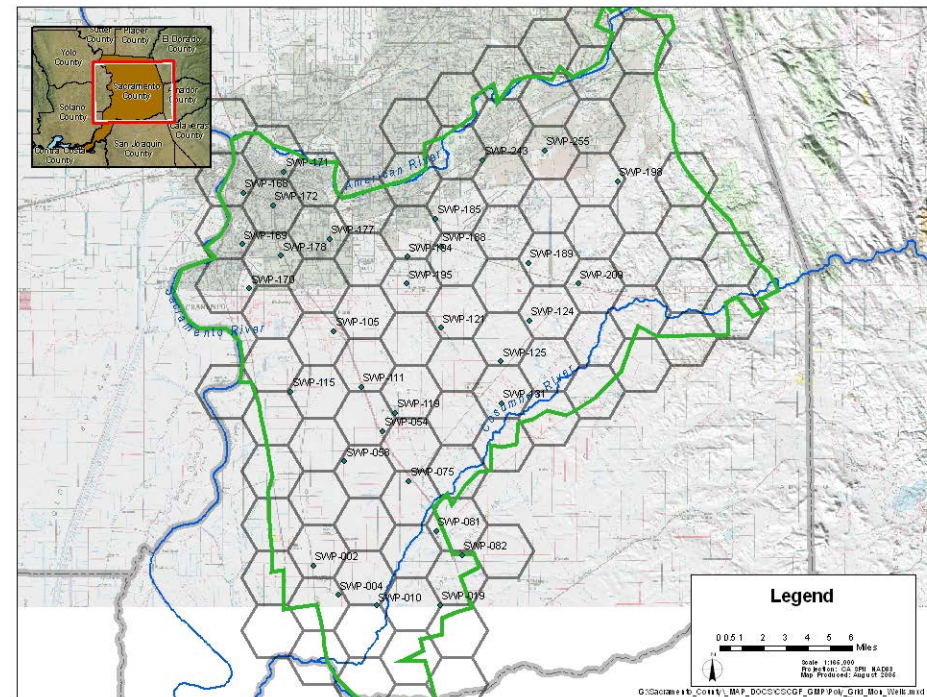


BMO Threshold Development - Approach

Follows approach in Appendix B of the GWMP

2. Locate a State Monitoring Well to represent each grid area.

- Developed in GWMP
- Requires updating

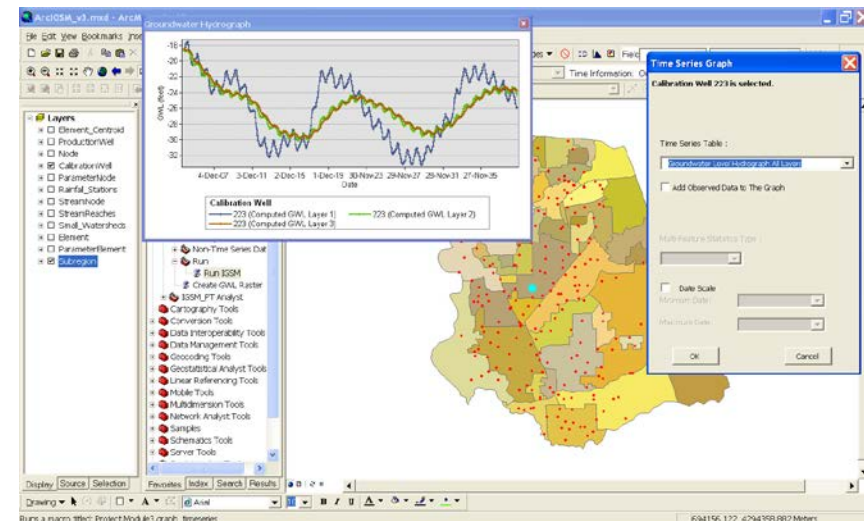


BMO Threshold Development - Approach

Follows approach in Appendix B of the GWMP

3. Extract hydrographs for each grid area from IGSM model, 2030 Conditions.

- Model is available
- Requires updating

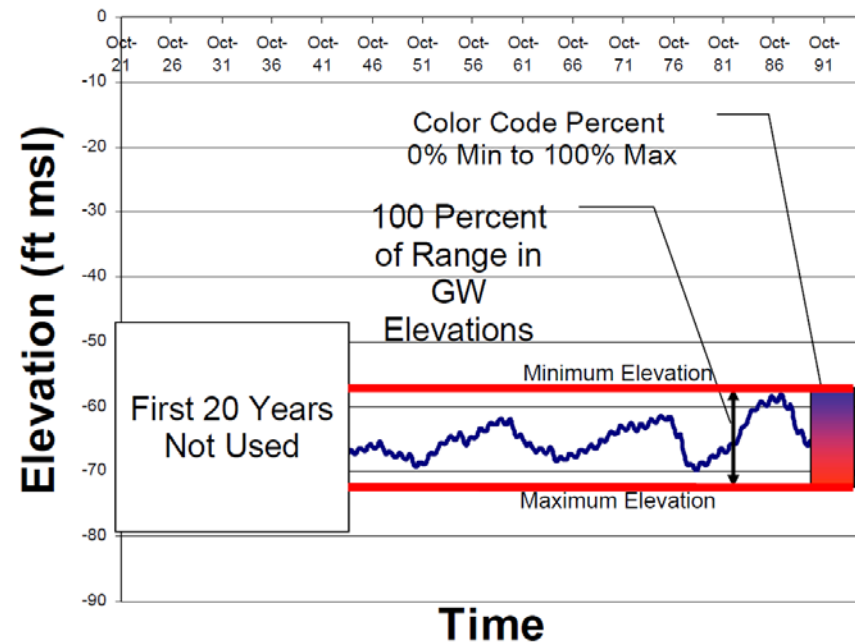


BMO Threshold Development - Approach

Follows approach in Appendix B of the GWMP

4. Identify maximum and minimum modeled groundwater elevations.

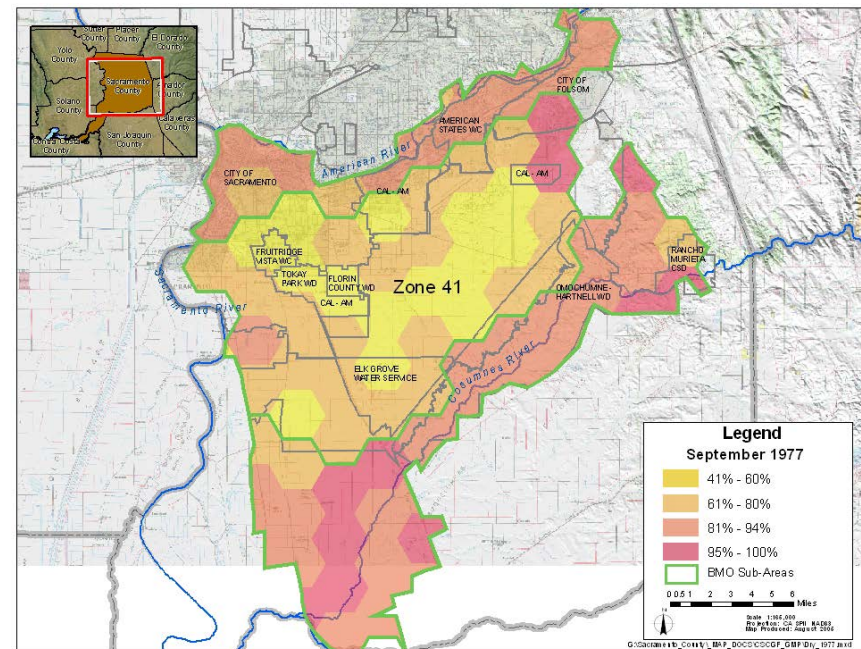
Values with 5% buffer define the bandwidth.



BMO Threshold Development - Approach

Follows approach in Appendix B of the GWMP

- Aggregate polygons based on similar hydrologic responses

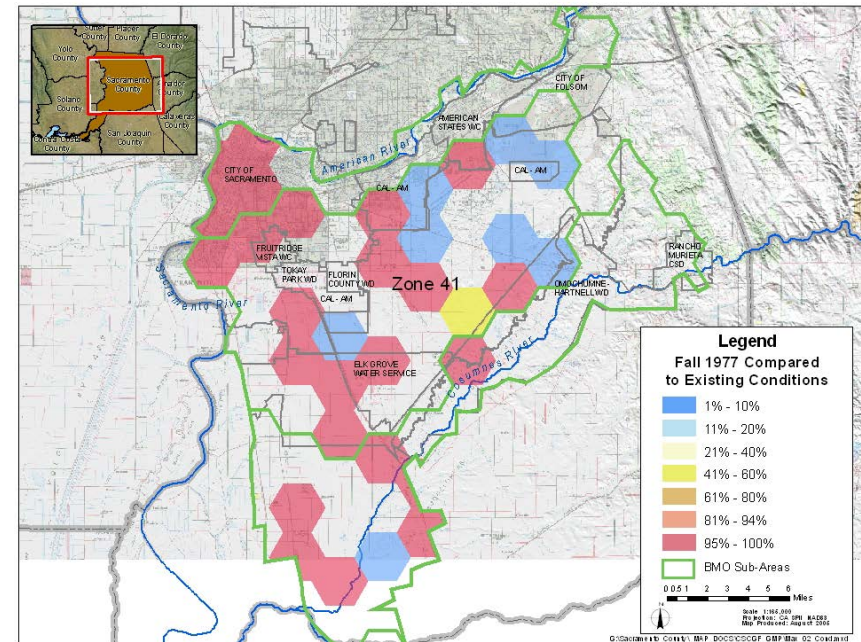


BMO Threshold Development - Approach

Follows approach in Appendix B of the GWMP

6. Ground truth the results

- 1977 measured conditions



BMO Threshold Development - Approach

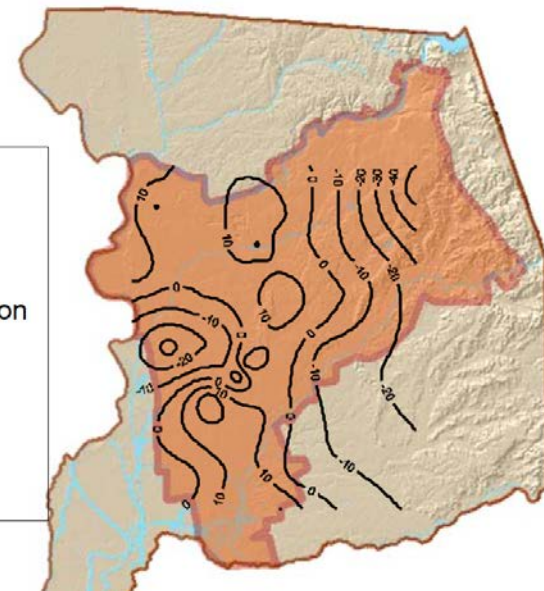
Follows approach in Appendix B of the GWMP

6. Ground truth the results

- 1977 measured conditions
- Compare modeled to measured elevations for 1977

Groundwater Elevation Contours (ft msl)

Difference Between
1977 Real Data
and
Water Forum Solution
1977 Model Data
(Negative Value
Implies Model Data
Shows Deeper
Elevation)



BMO Threshold Development - Approach

Follows approach in Appendix B of the GWMP

7. Develop framework for monitoring and management

- Contained in Section 4 of the GWMP

BMO Threshold Development - Approach

Monitoring Action	Trigger Points	Recommended Action
BMO No. 2. Maintain specific groundwater elevations within all areas of the basin consistent with the Water Forum "solution."		
<p>A monitoring methodology to meet specific objectives in managing groundwater levels requires a systematic, repeatable, and scientific approach. The objective of this monitoring program is to take measurements from selected monitoring wells that have sufficient construction and hydrogeologic data. Wells will be assigned to represent the polygon areas defined in Appendix B, and may be grouped within the basin in areas that are sufficiently distinct in the makeup of hydrogeology and land use. Monitored groundwater levels for a well will be compared with the designated upper and lower groundwater level threshold for each polygon that is assigned to the well. The upper and lower thresholds are termed the "bandwidth" of the polygon.</p>	<p>Trigger Point 1. A 25 to 50 percent encroachment into the designated bandwidth of a polygon.</p>	<p>Alert stage that informs the basin governance body and the overlying groundwater extractor(s) that a specific polygon area is being compromised. Activation of this trigger will take place only after the cause of the condition is thoroughly investigated.</p>
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Project Summary

- Two Major Components
 - Groundwater Elevation BMO Threshold Development
 - **Recharge Mapping**

Recharge Mapping

- Recharge map development
 - AB359 Compliant
 - Identify recharge areas in the basin
 - Map of areal recharge
 - Arrows for other major sources
 - Pie charts

Groundwater Quality Data

- Goal - provide information on source of recharge
- Focus on
 - Stable isotopes to help identify source water
 - Major anions and cations to distinguish between different waters

Stable Isotopes - Recharge

- Elevation of precipitation can be seen with stable isotopes

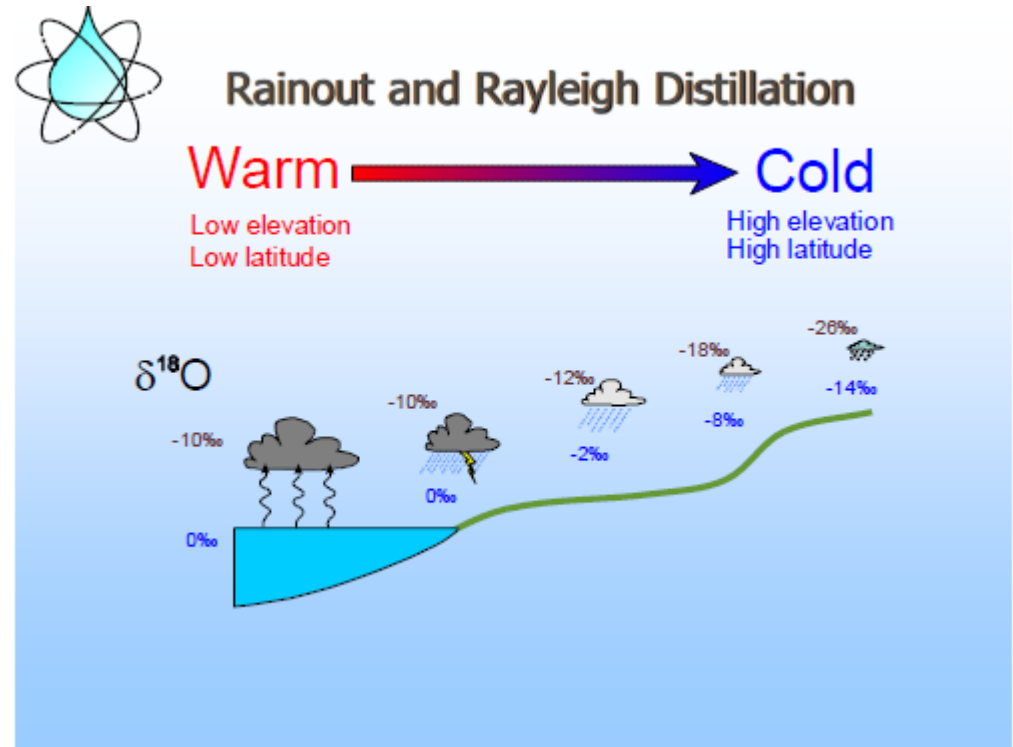
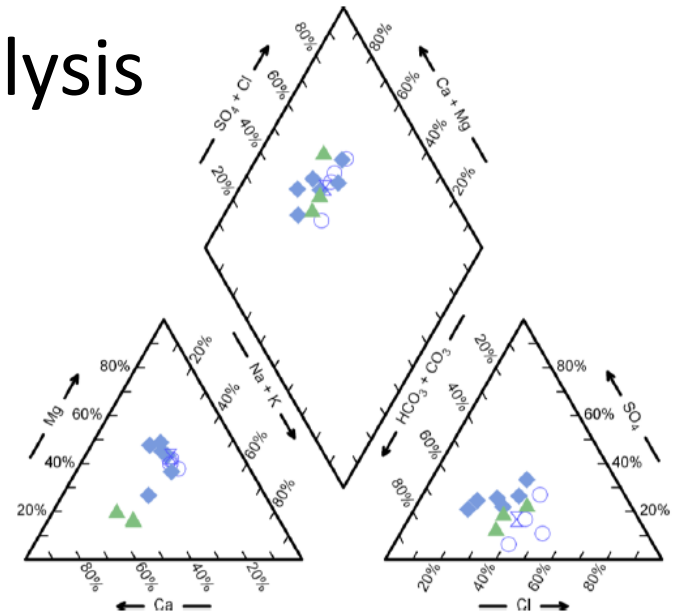


Image Source: Clark, Ian. 2013. *NGWA's Environmental Isotopes in Groundwater Studies: Introduction to Environmental Isotopes in the Hydrologic Cycle (#825)*.

Groundwater Quality Data

- Anions and Cations
 - Piper and stiff diagrams
 - Identify similar waters
- Supports stable isotope analysis



Sampling

- Sampling to occur at member agency wells
- Anticipated for late summer / fall 2014
- RMC/HydroFocus will contact member agencies with more information

Sampling Roles

- RMC/HydroFocus will:
 - Collect the water samples.
 - Conduct and record field measurements for
 - Depth to water
 - Dissolved oxygen
 - pH
 - Conductivity
 - Supply sample bottles and arrange for sample delivery to the analytical laboratories.

Cooperative Sampling – Pre Sampling Needs

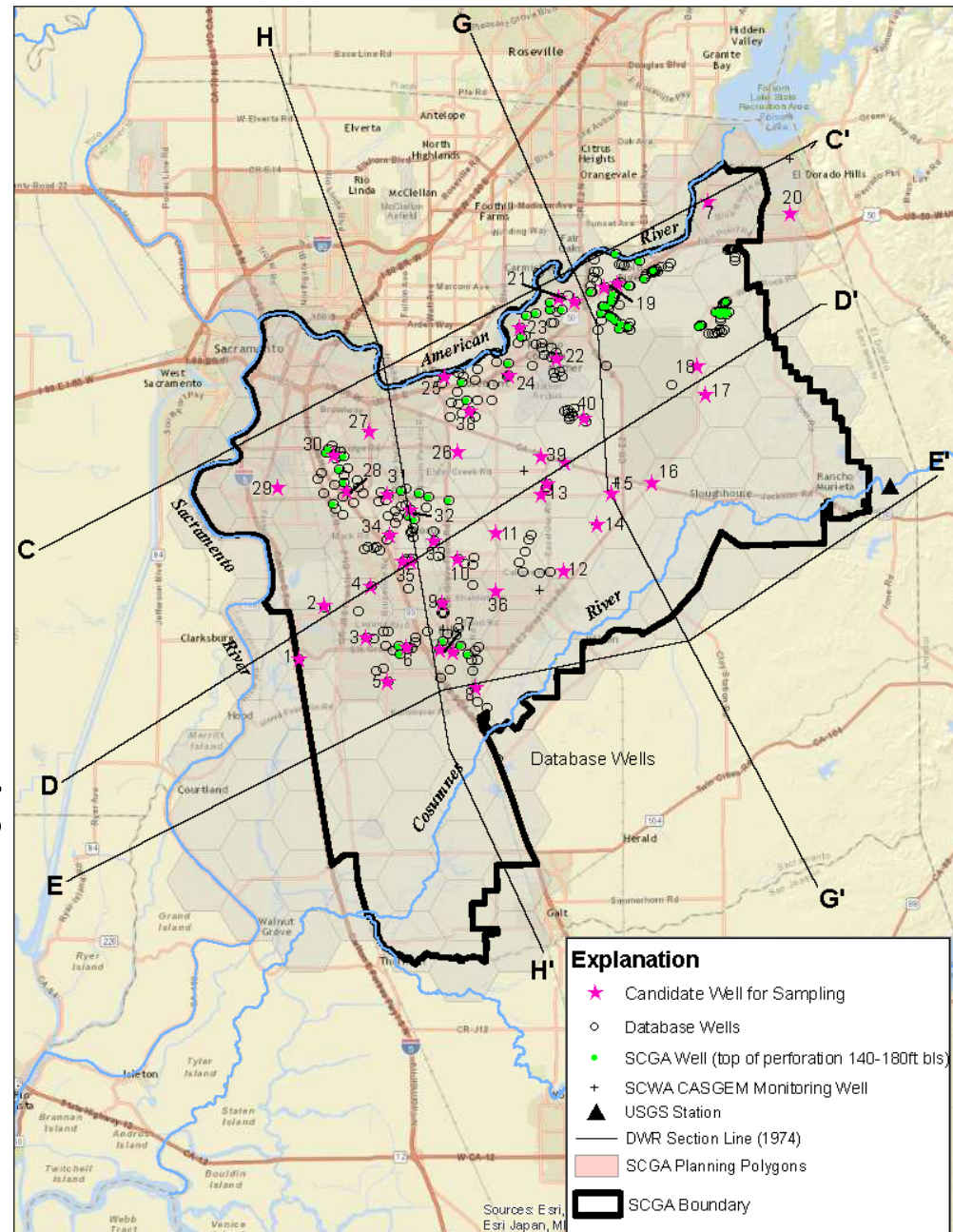
- Request for member agencies
 - Description of each sampling location
 - Location and type of sampling port
 - Picture of the well
 - Other relevant information
 - If adequate information is not available, a site visit may be conducted

Cooperative Sampling – Sampling Needs

- Request for member agencies
 - Well access
 - Operate the wells for development and sampling

Preliminary Well Map

- Wells selected based on
 - Location
 - Depth
- Selection are preliminary pending discussions with well owners



Preliminary Well List

- SCWA: 25 wells
- City of Sacramento: 2 wells
- Golden State: 4 wells
- Cal Am: 9 wells

Preliminary Well List: SCWA, CASGEM



DEPARTMENT OF WATER RESOURCES
SACRAMENTO COUNTY
WATER AGENCY

- SCGA 3
- SCGA 5
- SCGA 6
- SCGA 7
- SCGA 8
- SCGA 10
- SCGA 11
- SCGA 14 or 15
- SCGA 17
- SCGA 19*
- SCGA 20
- SCGA 21
- SCGA 23
- SCGA 25
- SCGA 27

Preliminary Well List: SCWA



DEPARTMENT OF WATER RESOURCES
SACRAMENTO COUNTY
WATER AGENCY

- Banyon LW-42
- Big Horn LW-52
- Excelsior Well #1*
- McRoberts, housing #5
- MW-1C
- Park Meadows
- Poppy Ridge WTP
- Sheldon North Lw-65
- Tillotson
- Waterman Road
- West Taron

Preliminary Well List: City of Sacramento

- Well 20
- Well 85

Preliminary Well List: Golden State Water Co.



- Anos Circle 8
- Citrus 13 or Whistler
- Folsom Blvd 15 or Pyrites Way 16
- Mather 18

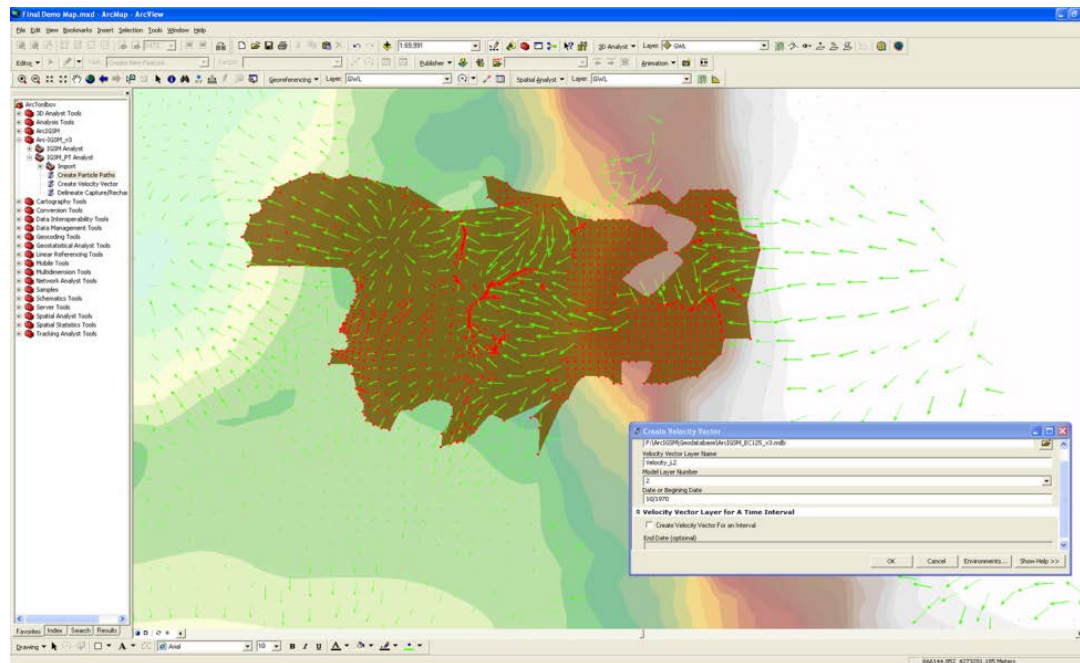
Preliminary Well List: California American Water



- Brigg Dr 6
- Elsie 23
- Explodr 24
- Larch C2-2 or Larch Co Sd #1 138-1
- Power Inn
- Sky Parkway 64
- Vntpark 76
- Woodman Way 87
- Wporter 80

Verification of Model

- Results from water quality study will be compared to simulated flowpaths to identify any need for model refinement



Major Deliverables

- Draft and Final TMs
 - Threshold Development
 - Recharge Analysis
- Draft and Final Recharge Map

Stakeholder Participation

- Four meetings are planned to keep stakeholders informed
 - Today: Initial meeting to describe the project and to receive comments
 - Winter 2014/5: Project update, including model extension and sampling.
 - Spring 2015: Project update, including proposed thresholds
 - Summer 2015: Present the final results of the study.

Contact Information

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