

WebH₂O: A Web-Based Environmental Information Management and Data Analysis System

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Outline

- Background and motivation: The Central Valley Salinity Study
- What is WebH₂O and how does it work?
- WebH₂O as a community-based application tool – Sonoma Valley
- Our vision for WebH₂O

Salinity

- Globally, 7% of the land area is salinity-impacted (soil or groundwater)
- Regions: Eastern Europe, Mediterranean, Australia, Arizona...
- Sources: natural, municipal, industrial, agricultural



Salinity in Central Valley

older estimate:



Figure 1. Salt accumulation in the San Joaquin Valley totals about 11 semi-trailers an hour at 25 tons per truck. From Salt balance in the San Joaquin Valley, 2001. Water Facts, Department of Water Resources.

Regional Water Quality Control Board,
2006: Salinity in Central Valley-An
Overview.

Input

Tulare Lake & San Joaquin
River Basins
>2 million tn/yr = 228 tn/h = 9
trucks
+ Sacramento River Basin 0.8
million tn/yr?

Output

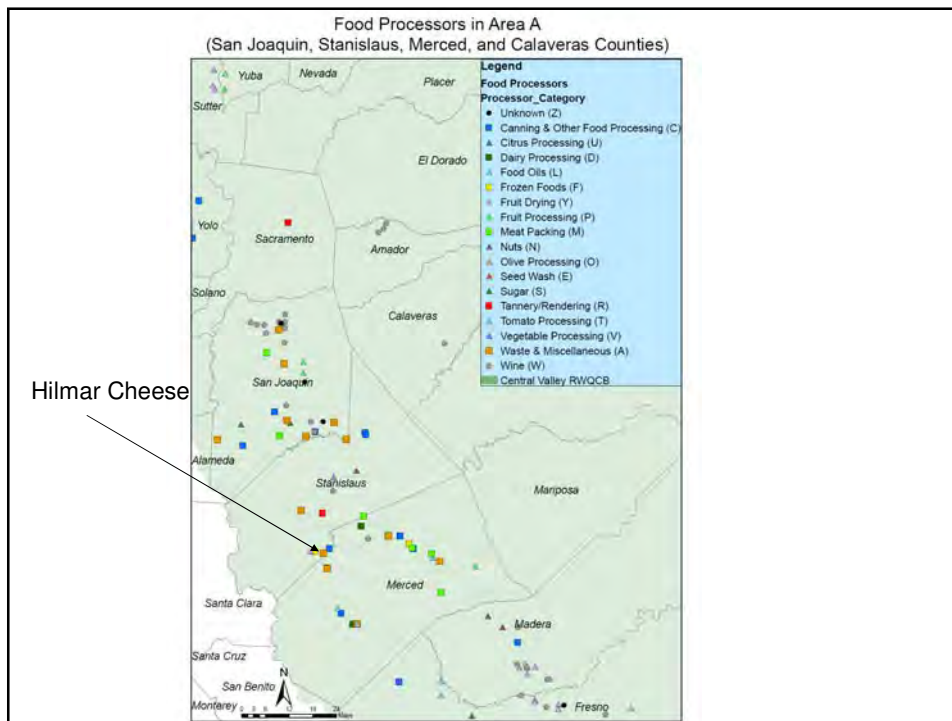
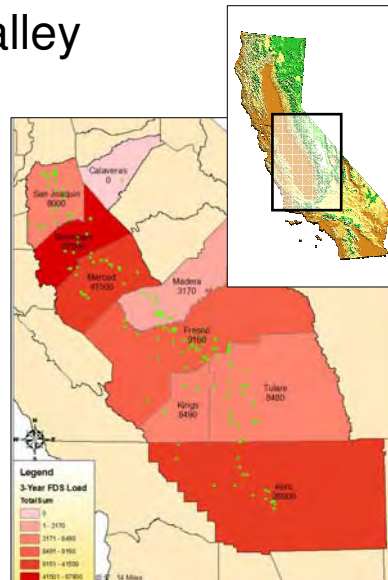
Sacramento & San Joaquin
Delta
700,000 tn/yr = 3 trucks

Groundwater

San Joaquin Basin
400,000 tn/yr

Food Processing Wastewater in the Central Valley

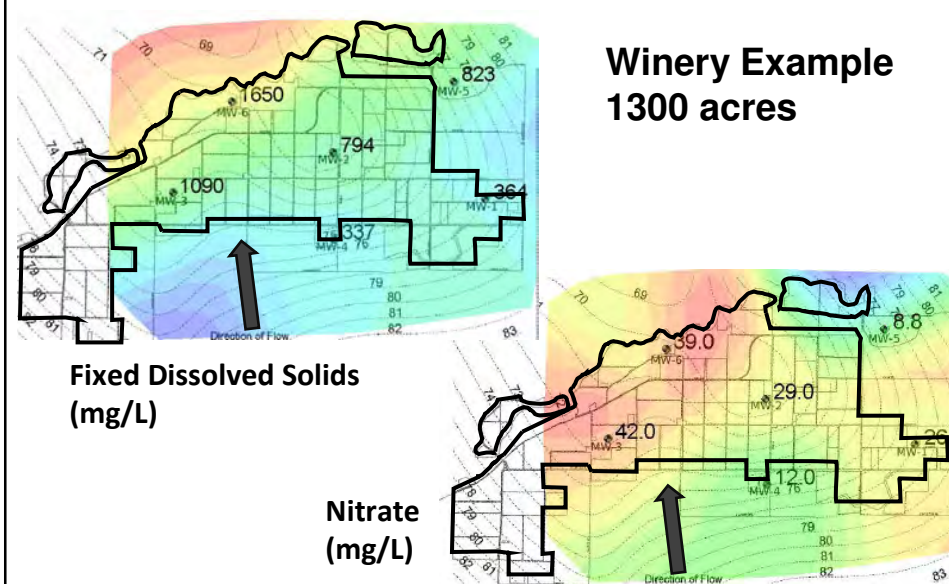
- Over 600 facilities
- >\$62 billion in revenue
- Water use: 80 million m³ yr⁻¹
- High in salinity (FDS), organic carbon, and nitrogen
- Typical disposal method: land application for irrigation
- Discharged to alluvial fan and floodplain deposits



An Environmental Threat?

Metric	Municipal Waste	Tomato Canner
BOD (mg-O ₂ L ⁻¹)	450	820
FDS(mg L ⁻¹)	720	1680
pH	6.7	5.4
Nitrogen (mg-N L ⁻¹)	25	51
Flow Rate (gal d ⁻¹)	2.6 x 10 ⁷	1.5 x 10 ⁶
Pathogens present?	Virtually certain	Very unlikely
Sources: food, disinfectants, processing chemicals		

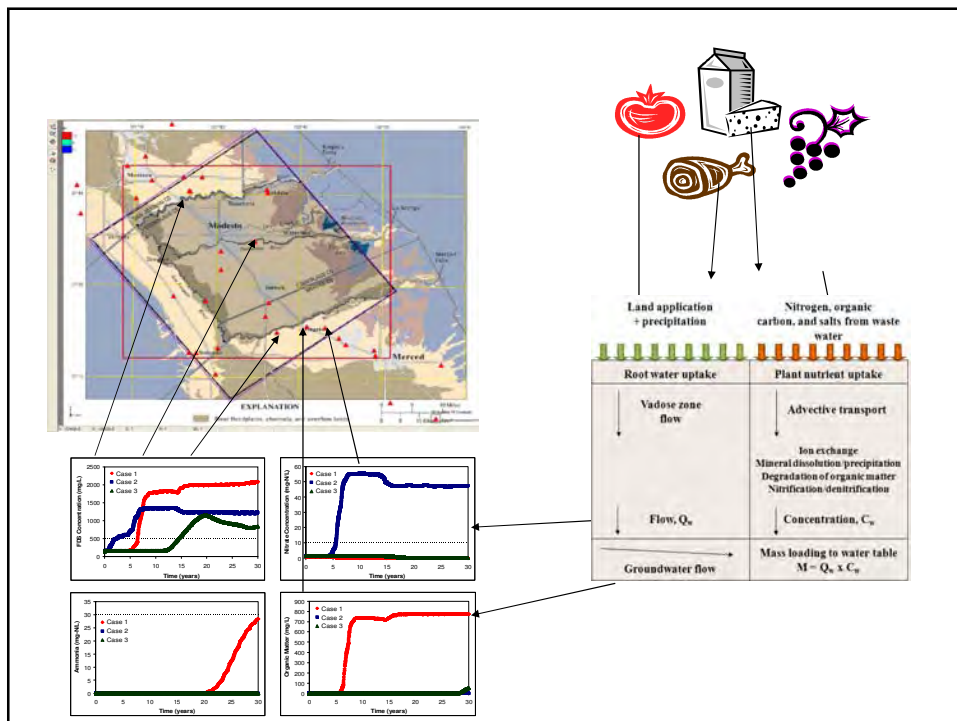
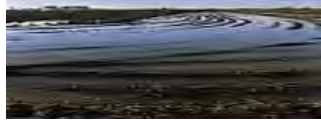
Groundwater Degradation?





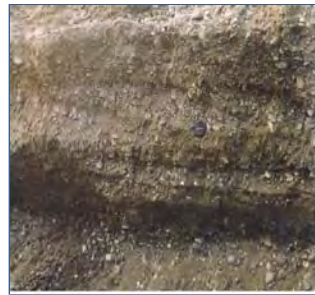
	Volume (kgal)
Industry Average Daily Flow	68665
Industry Yearly Flow	25062854
Hilmar Daily Flow	1525
Hilmar Yearly Flow	556714

Land discharge area: 600 acres



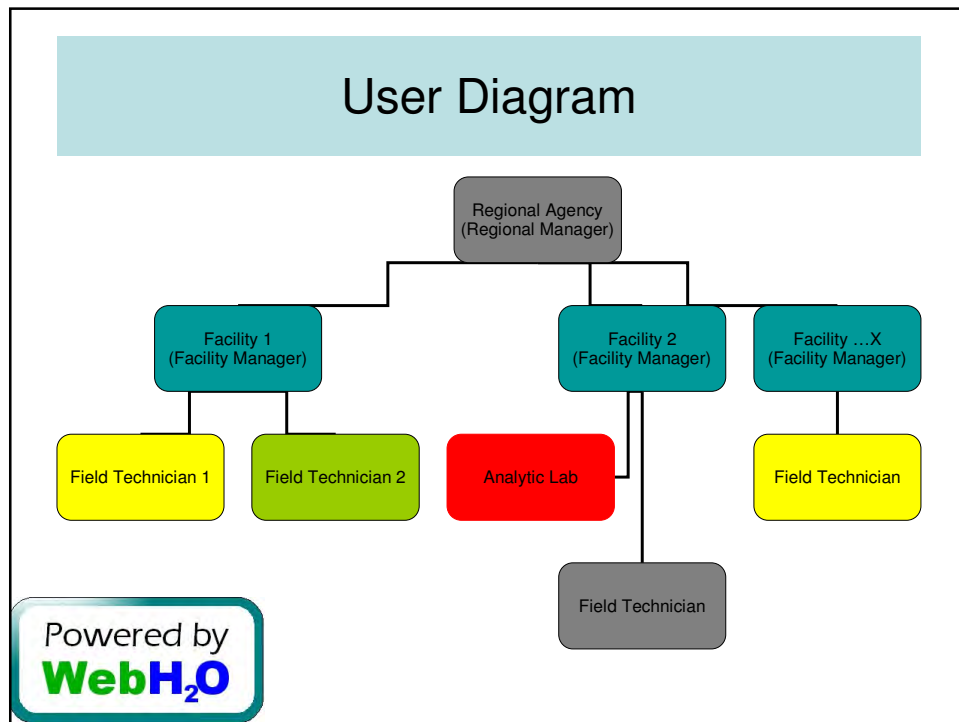
Modeling Challenges

- Modeling scale
 - 600+ producers with a large diversity in wastewater characteristics and in land application site hydrogeology
- Data Deficiency
 - Few measurements in vadose zone, none long-term
 - Regional scale hydrogeology



How to address these challenges?

- A system is needed for collecting, storing, sharing, displaying and analyzing of information
- Data sources
 - Multiple agencies and multiple facilities
 - Ontology
 - Format
 - Quality of data
- Community-based tool: Trust, Value
 - Data security and privacy: who can see what and when?
 - Encourage participation through added value

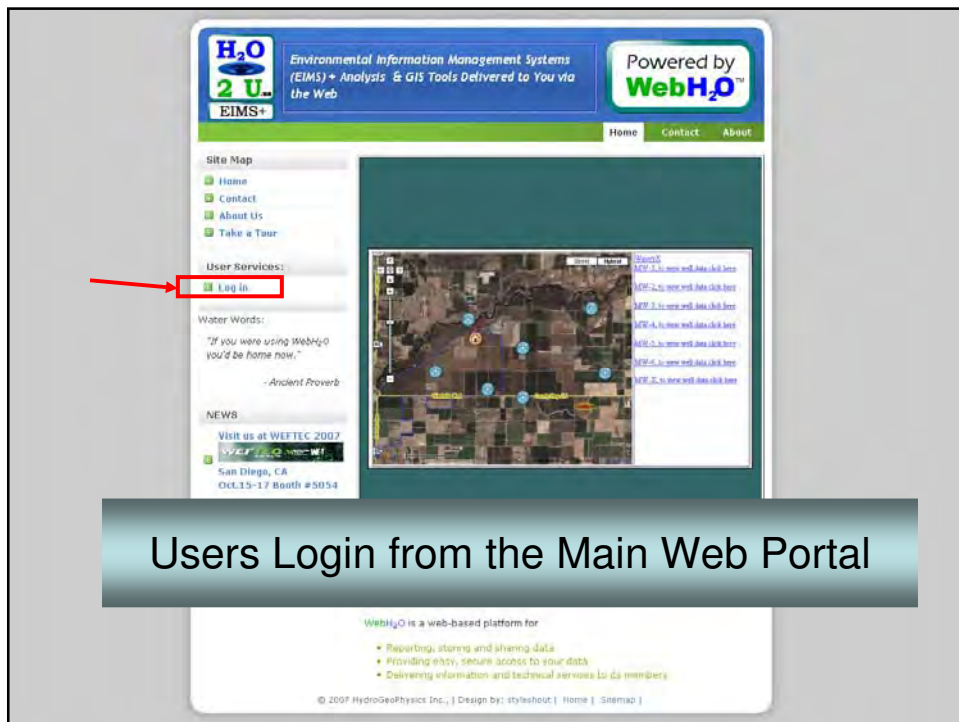


Privacy and Security

Complete Control over Data Management and Accessibility

- Two complimentary aspects:
 - Labeling of data (when?)
 - Unreported / Reported / Authorized
 - Hierarchy of user roles / permissions (who?)
 - coordinator / facility manager / technician

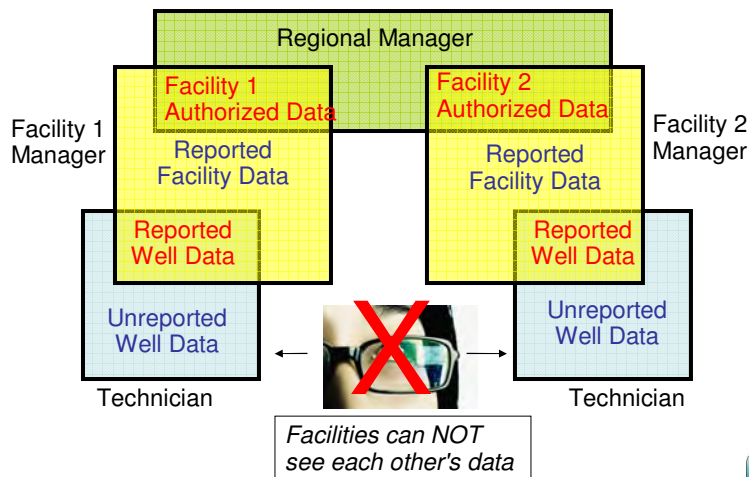
WebH₂O



Users Login from the Main Web Portal

Different Levels of User Access

Regional Manager can NOT see Facility data unless it is "Reported"



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Management Tools

- Access Data from Overview Maps
- Quick-View Status Dashboards
- Rapid Report Pull-down Menu for common Reporting tasks
- Automated Alerts can sent by email/text message when preset trigger events are reported
- Powerful Querying Tools

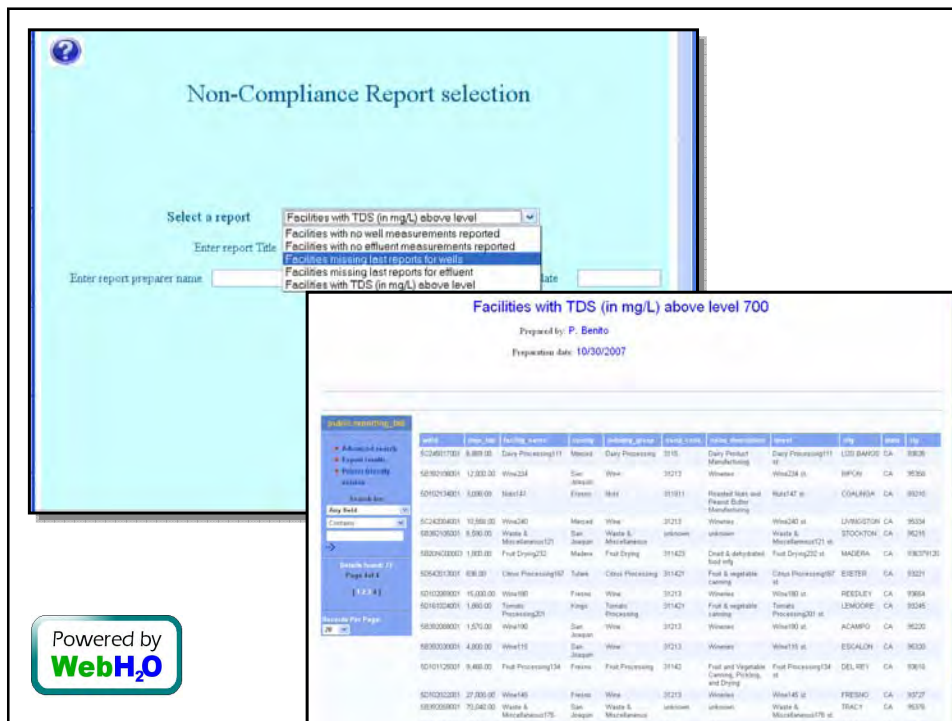
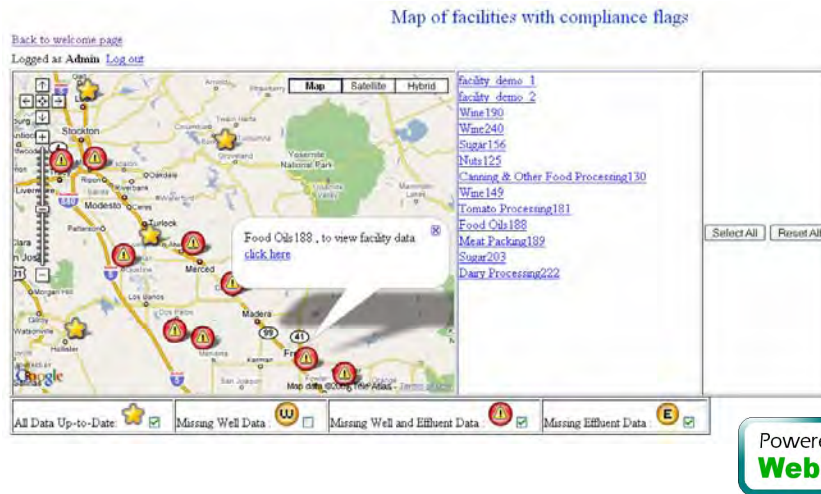
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Access Data from Overview Maps



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Quick-View Dashboards show Status of all monitored locations



WellsTab		MapView	
effluenttabextended		Advanced search	
Search for: <input checked="" type="radio"/> All conditions condition <input type="radio"/> Any condition			
	NOT		
Universal_Identifier_WDID	<input type="checkbox"/>	Contains	<input type="text"/>
DateReported	<input type="checkbox"/>	Contains	<input type="text"/>
MonthReported	<input type="checkbox"/>	More than ...	5
YearReported	<input type="checkbox"/>	Equals	2004
Volume	<input type="checkbox"/>	Contains	<input type="text"/>
Flow	<input type="checkbox"/>	Contains	<input type="text"/>
Application_Area	<input type="checkbox"/>	Contains	<input type="text"/>
pH	<input type="checkbox"/>	Contains	<input type="text"/>
Conductivity	<input type="checkbox"/>	Equal or more than ...	10000
Fixed_Dissolved_Solids_FDS	<input type="checkbox"/>	Equal or more than ...	9000
Volatile_Dissolved_Solids_VDS	<input type="checkbox"/>	Contains	<input type="text"/>
Total_Dissolved_Solids_TDS	<input type="checkbox"/>	Contains	<input type="text"/>

Advanced Queries can be made on the data



GIS Map Server

- **WebH₂O™** is compatible with existing GIS files and data (shape files, DEM, ortho-photos, etc...).
- GIS Layers can be added and accessed from internet browser.

Spatial Query Tools: Links Database + GIS Info

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SPATIAL QUERY FORM

Selected objects will be highlighted on the map

Select
Facility
With ...

volume (kgal)	Equals	
flow (kgal/day)	Equals	
application_area (acres)	Equals	
ph	Equals	
conductivity (mc-S/cm)	Equals	
fixed_dissolved_solids_fdr (mg/L)	Equals	
volatile_dissolved_solids_vds (mg/L)	Equals	
total_dissolved_solids_tds (mg/L)	More than	700
total_suspended (mg/L)	Equals	
total_cod_or_cod (mg/L)	Equals	
total_bod5_or_bod5 (mg/L)	Equals	
total_organic_carbon_toc (mg/L)	Equals	
solids_bod (mc/L)	Equals	

Having a
Surface Water Body
Within ... 2 Kilometers
Between ... 2001-01-01 and 2007-10-15
Open Map

WebH₂O: Registered User Area - Mozilla Firefox

File Edit View History Bookmarks Tools Help

welldata, Add new record

Back to list

mw_id: MW-1
date_reported: September 10, 2007
month_reported: 9
year_reported: 2007
dept_to_groundwater_n: 77.52
ec_umhos_cm:
tds_mg_l:
no3_as_n_mg_l:
toc_mg_l:
nh3_mg_l:
le_mg_l:
mn_mg_l:
view_status: Private
reported_by: Jim Brown
supporting_docs:

Save Reset

http://206.7...

September 2007

zotero Open Notebook

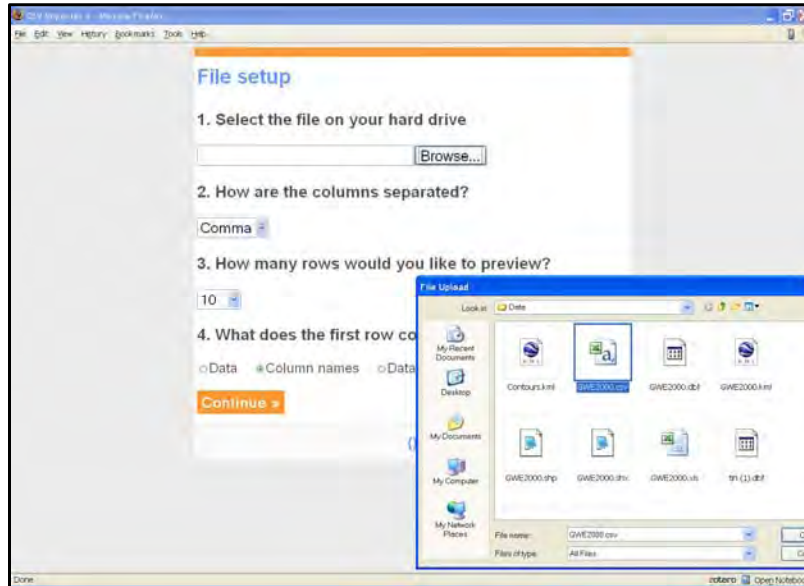
Required field

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Done zotero Open Notebook

Add new data
using interactive
online web forms

...or upload data from a file



Data Validation

Completeness, Consistency, Integrity

- **Completeness**
 - Required fields for data entry
 - Pre-populated fields
 - Error detection for well names - state plane and USGS well coordinate systems
- **QA through Consistency**
 - Alerts generated when new data inconsistent with historical records
- **Integrity**
 - Data capture and storage
 - Unique facility id's, well names, user logins



WebH2O: Home WebH2O: Registered User...

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Instant Data Validation and Alerts

public.welldata, Add new record

Back to list

mw_id	MW-1	
datereported	10/30/2007 0:55:08	
dept_to_groundwater_ft	120	Warning: > 20% from last (=78.14) Warning: > 20% difference from min or max (min=77.33,max=84.4)
ec_umhos_cm	0.2154	Critical Error: ec_umhos_cm cannot contain non numeric characters
tds_mg_l		
no3_as_n_mg_l		
toc_mg_l	02sd	Critical Error: toc_mg_l cannot contain non numeric characters
nh3_mg_l		
fe_mg_l	120	last measurement is null Warning: > 20% difference from min or max (min=0.17,max=3.8)
mn_mg_l		
view_status	Unreported	
reported_by	pascual	
supporting_docs		

Save Reset

The page at http://206.71.179.192 says:

Critical errors found, please correct and save again

OK

Supporting Documents & Chain of Custody

Supporting Documents (reports, certificates, well logs, etc...) can be associated with each measurement

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Report # _____ Field Log / Groundwater Sampling Form Date: 3/7/2005

Client _____ Well Name _____

Project Name _____ Well Type: G: Monitor G: Extraction G: Other _____

Consultant _____ Sampler _____

Proj. Manager _____

Purge Method: ☐ Bailor Type ☐ Pump Type ☐ Other _____

Total Well Depth: 52.0 mgt Multiplier: 1.0000

Depth to Water: 29.70 mgt

Water Column Length: 22.30 mgt

Water column length Multiplier: 1.0000 No. Volumes: 0

Purge Vol: 2.53 L / 0.67 gal TOTAL PURGE TIME: 6.44 min

Total Purge Time & Volumes: PURGE TIME/VOL

Time	Gal/Min	qt	Conductivity	Salinity	SPH
Start	3.28	-	-	-	-
Vol 1	2.13	2.3	6.5	4.9	1.1
Vol 2	2.24	2.0	6.6	4.7	1.1
Vol 3	2.35	1.3	6.6	4.6	1.1
Vol 4					
Vol 5					

Return type: 30 Scientific

Comments/purge: _____

Science Modules

- Can be mounted directly on top of map interface to collected data and GIS Layers
- Can be used for real-time data analysis such as risk assessment, contouring, vector plots, fate & transport models, etc...

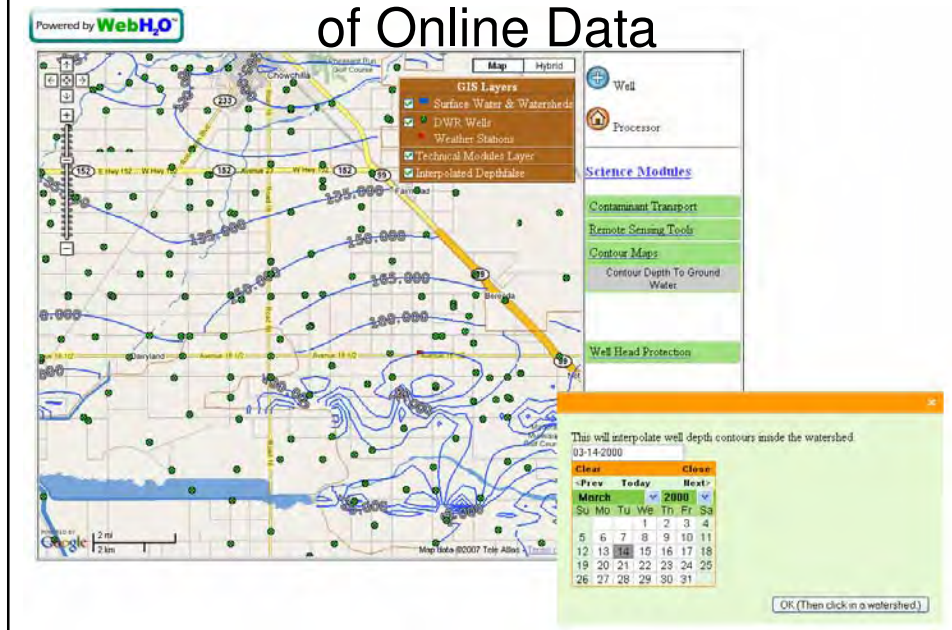
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WebH₂O™ Science Modules

- WebH₂O™ combines Engineering and Science Expertise with enterprise quality IT.
- Integrated Science Modules can be applied to your data to make preliminary assessments of field conditions and risks.

Science Modules:	
[-] Contaminant Transport	In Progress
Instantaneous Point Source	
Continuous Point Source	
Multiple Point Sources	
[+] Well Test Analysis	
[-] Remote Sensing Tools	
Airborne	
Satellite	
[+] Contour Maps	
[+] Well Head Protection	
[+] Statistical Analysis	

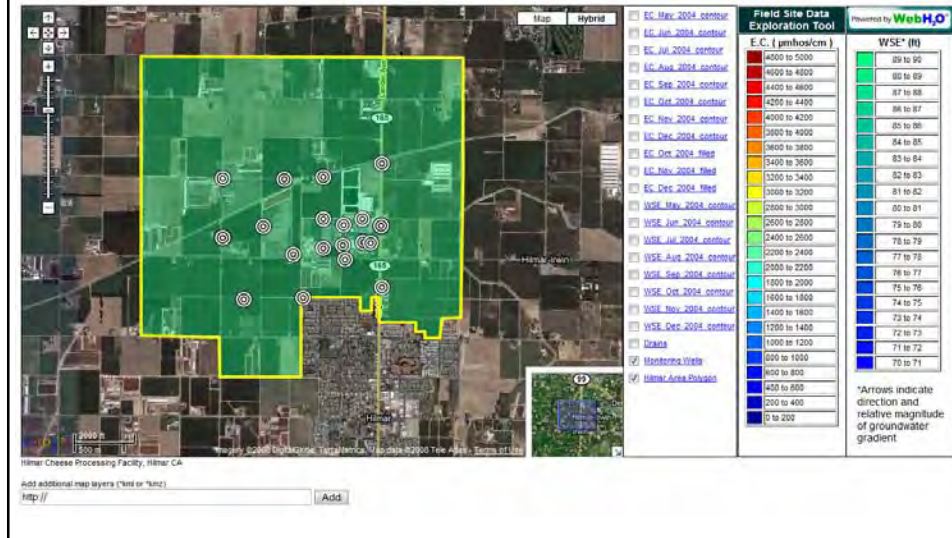
Create Contour Maps of Online Data



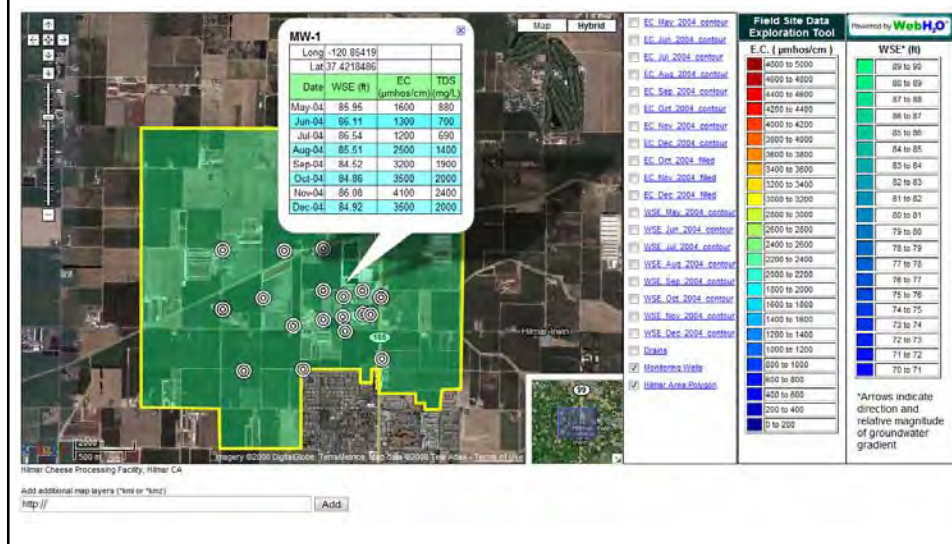
Example: Instantaneous Point Source Release



Monitoring Wells



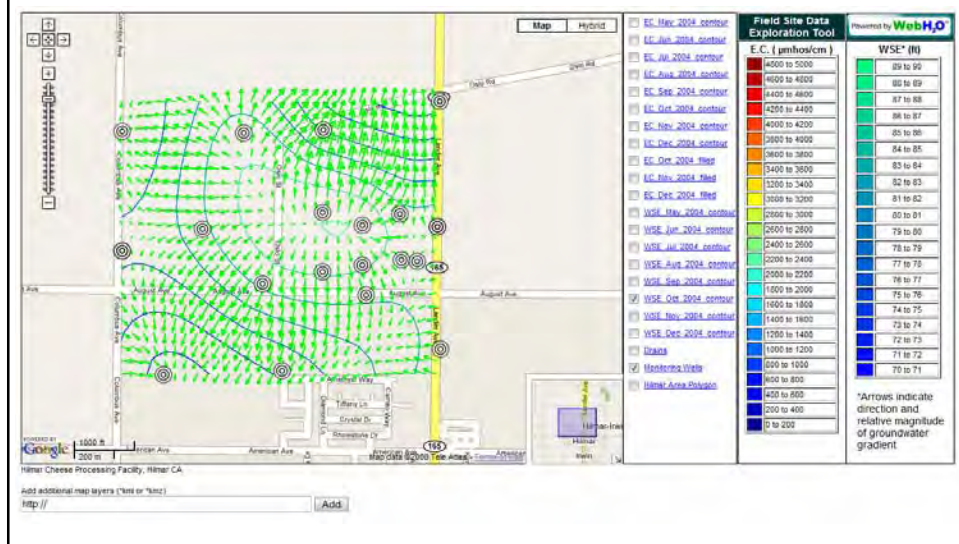
Monitoring Wells: Data View



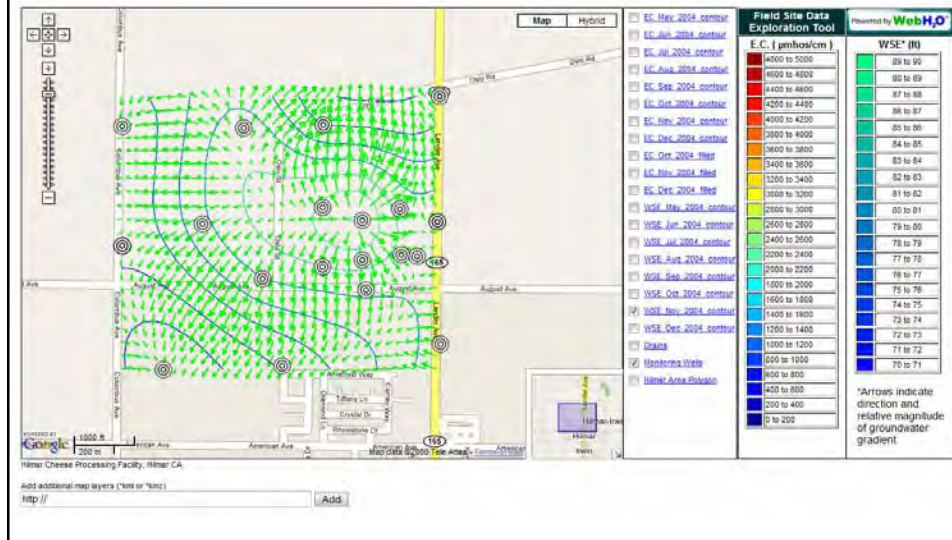
Monitoring Wells: MW-1 Chart View



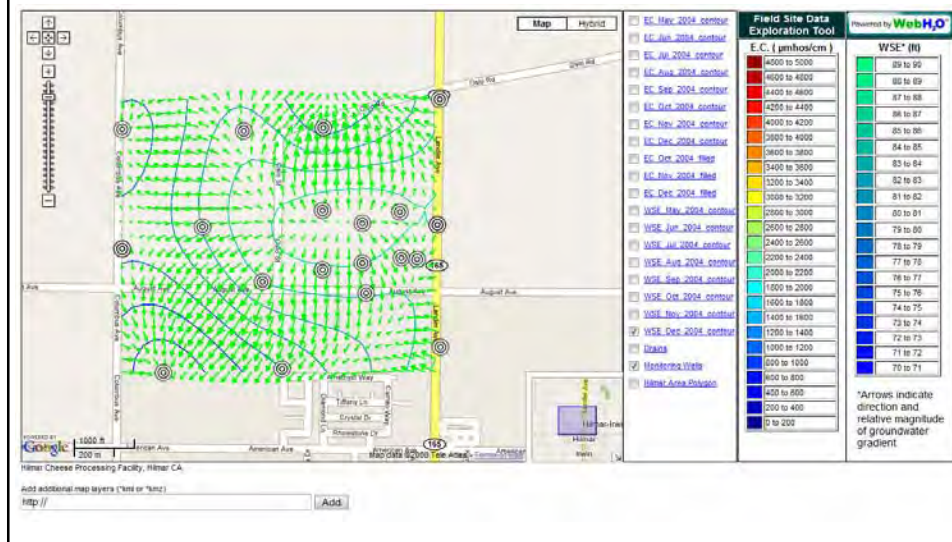
WSE: Oct 2004



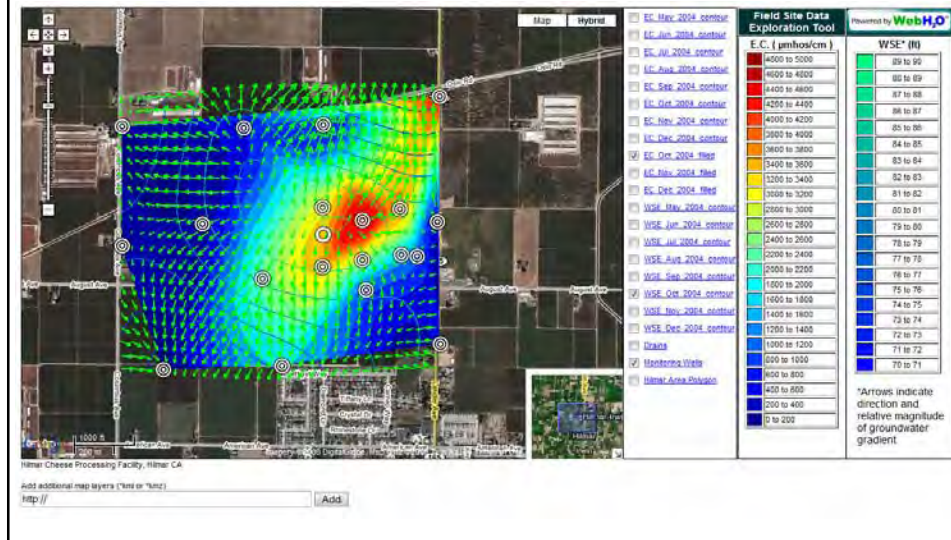
WSE: Nov 2004



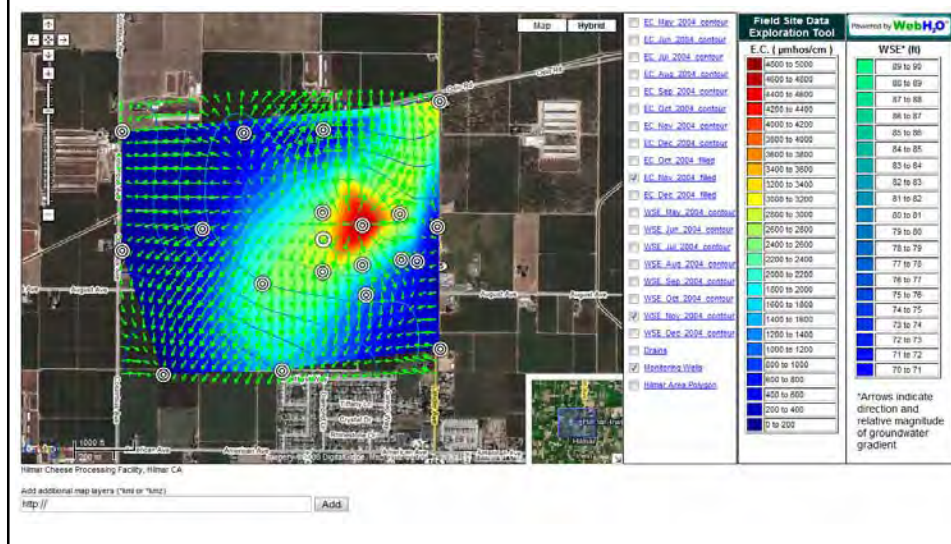
WSE: Dec 2004



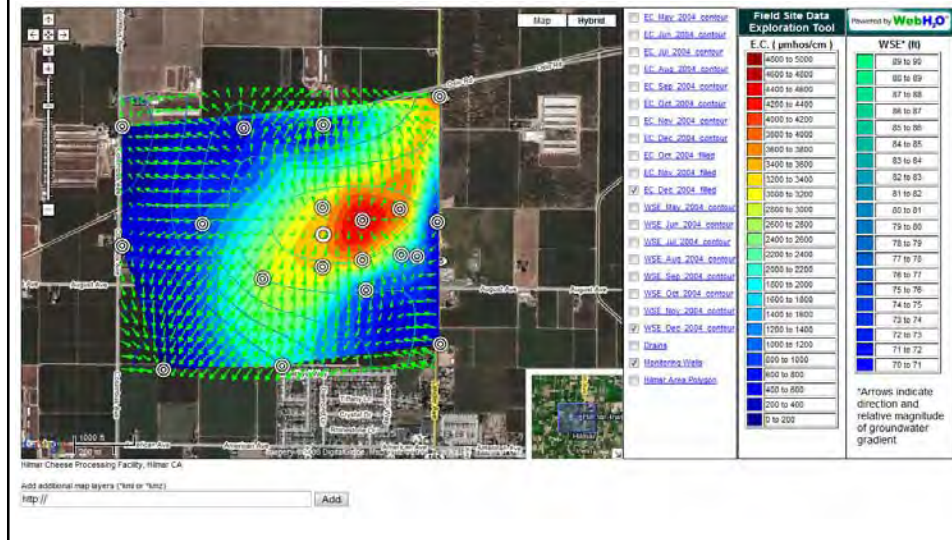
EC + WSE: Oct 2004



EC + WSE : Nov 2004



EC + WSE: Dec 2004



Sonoma Hydrological Information Portal

SHIP 1.0 Beta 1 Release



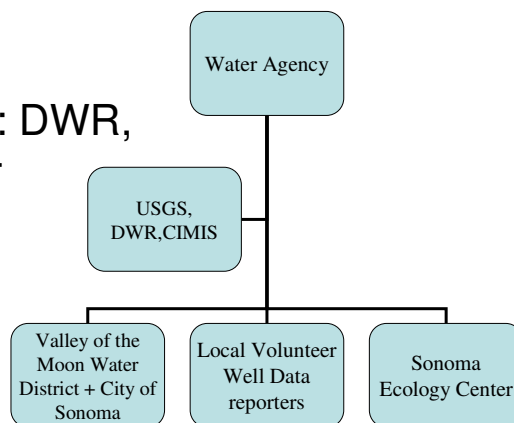
SHIP Goals

- SCWA-led multi-stakeholders groups collaborating on developing the Sonoma Valley' groundwater basin plan
- Data needs include groundwater elevations, groundwater quality, well construction data and well logs
- Goals:
 - Management of groundwater resources
 - Development of groundwater numerical model
- Provide added value to stakeholders as an incentive to participate

WebH₂O

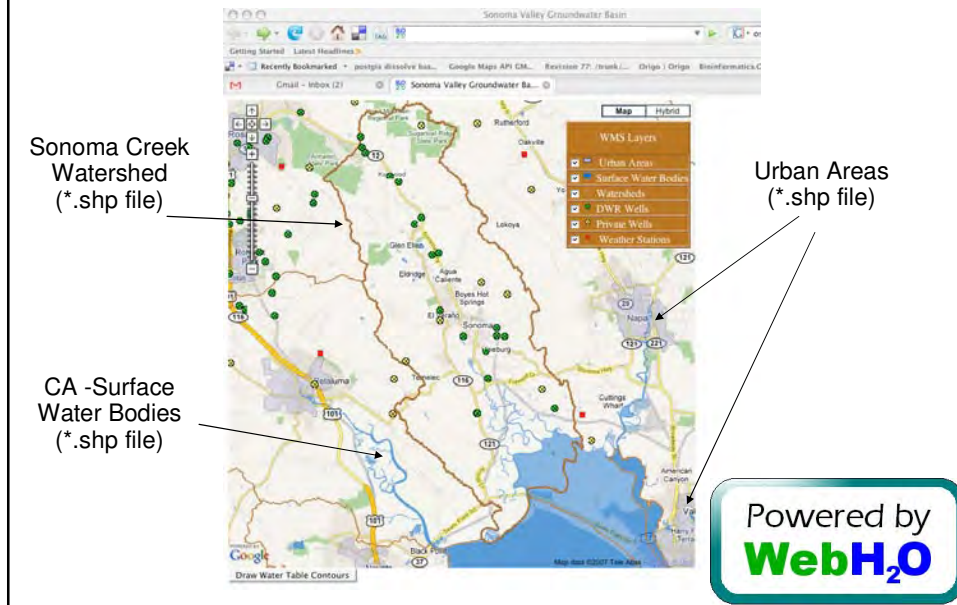
Sources of Data

- Local
- Public agencies: DWR, California Water Service, USGS

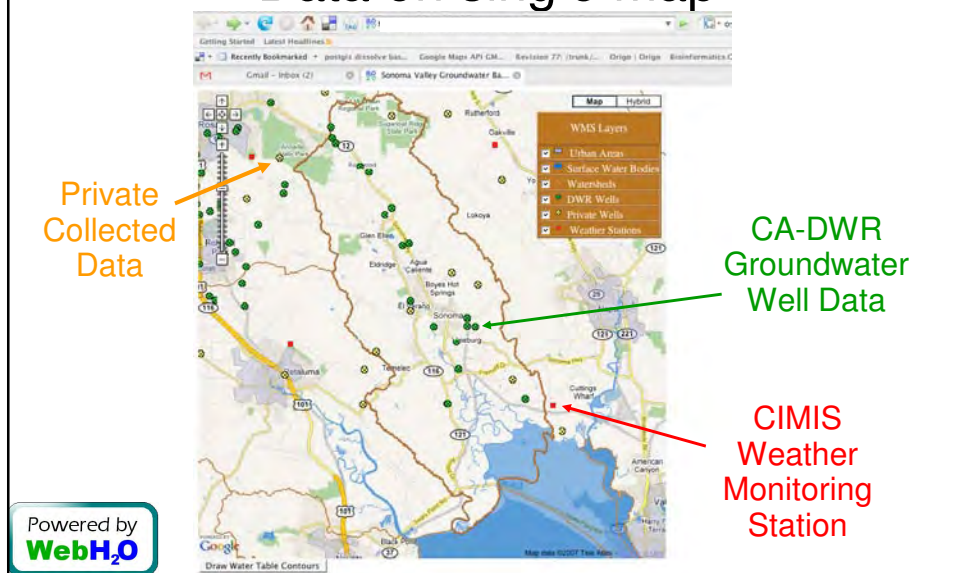


WebH₂O

View GIS Layer Overlays



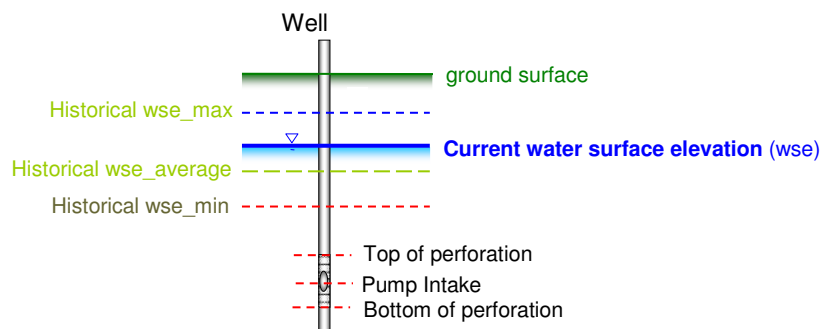
View Collected Data and Public Data on single map



Data Analysis

Statistics, Historical Trends, and Mapping Capabilities

- Automated statistics calculations
 - Well statistics for *wse* - water surface elevation



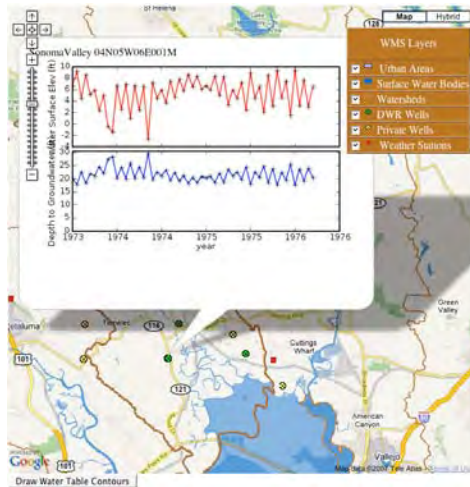
Data Analysis

Statistics, Historical Trends, and Mapping Capabilities

- Alerts for water surface elevation
 - *wse* is less than *wse_critical_lower* + 5ft
 - *wse* is less than *wse_min* (the historical minimum)
 - *wse* is less than $0.8 * wse_avg$ (the average *wse*)
 - *wse* is less than the *perforation_elevation_bottom* + 3ft
 - See SHIP user guide for additional alerts

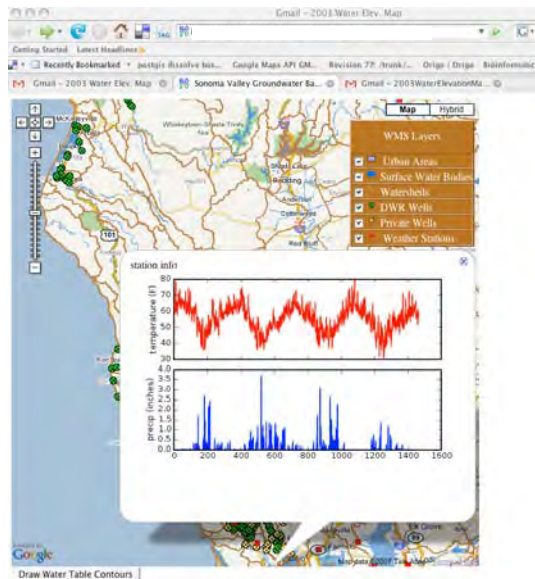


Click Wells to see Public Groundwater Data



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Weather Station Data

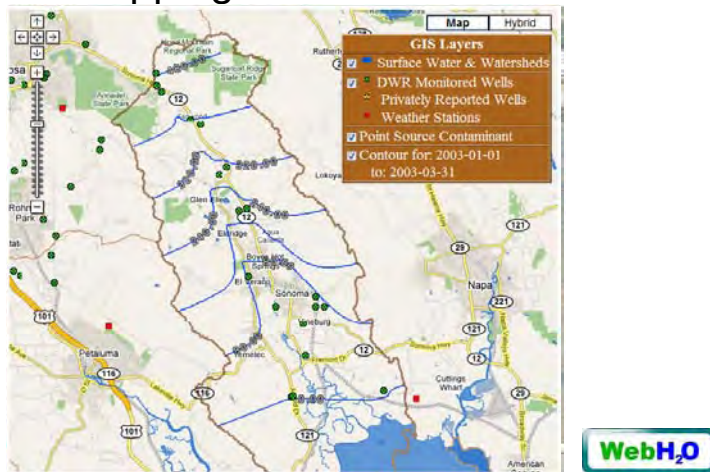


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Data Analysis

Statistics, Historical Trends, and Mapping Capabilities

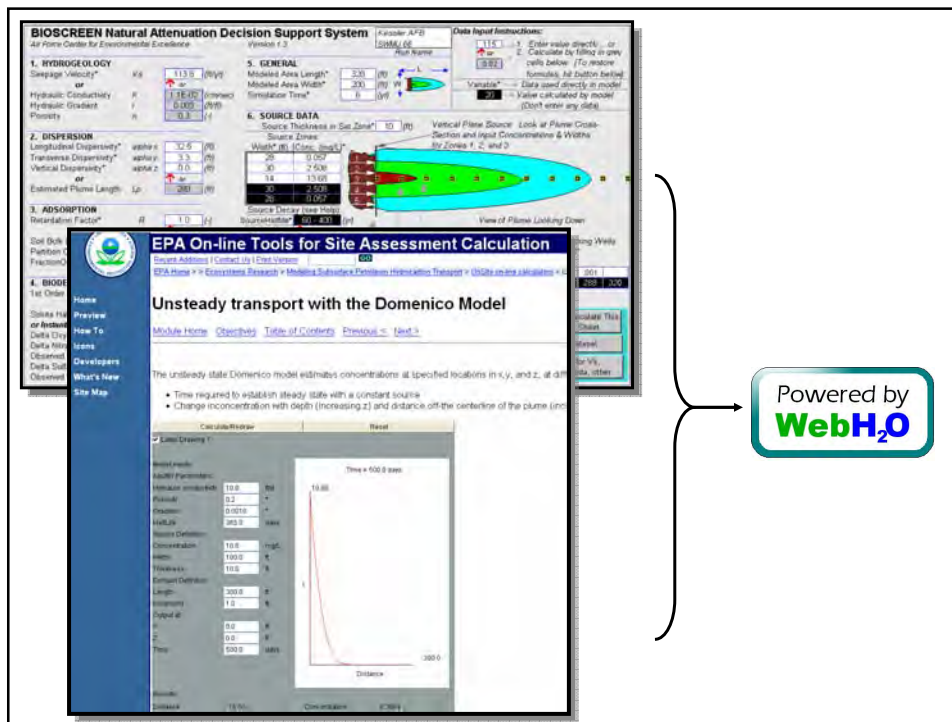
■ Contour mapping



Vision

- Expand integration with science modules
 - EPA's on-line tools such as Domenico Model, BIOSCREEN, BIOCHLOR
 - Water resources management: e.g., conjunctive use of water resources
 - Access to powerful/parallelized computing resources
- Integrate with environmental sensors
- Access on-line data bases for parameter determination (e.g., USDA's Rosetta)

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Built Using Open-Source Software Components

- PostgreSQL (database)
- PostGIS (spatial data and queries)
- MapServer (render and serve images over the web)
- Python (programming language for web, science, ...)
 - Scipy/Numpy/Matplotlib (provide Matlab+++ type functionality)
- PHP (scripting language for web development)
 - Excellent support for user administration
- Apache (fast, popular web server)
- **How is this part of our vision?**
 - Making science affordable
 - Get a broad community of developers to share and contribute

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