CV-SALTS Technical Approaches for Salt and Nitrate Characterization of Central Valley Groundwater

Vicki Kretsinger Grabert

January 18, 2019
Presentation at State Water Resources Control Board Drinking Water Needs Assessment Workshop
CV-SALTS Stakeholder Led Initiative

- State and Federal Agencies
- Local Agencies
- Discharger Community
  - Agriculture
  - Industry
  - Wastewater treatment
- Environmental Justice and Disadvantaged Community Representatives

12+ year effort
Policies/technical work covering 40% of the State

Central Valley Salinity Alternatives for Long-Term Sustainability
Groundwater Quality

- Groundwater technical support to CV-SALTS since 2009; many reports
- Today: Focus on “High Resolution” report (2016; 3,168 pages mostly figures along with many tables)
- Analyses and mapping for Region 5 including Central Valley Floor
- Constituents: Nitrate and Salt (TDS)
- Mapping
  - Ambient Concentrations
  - Predicted Concentrations (based on actual/historical observations)
  - Trends

**CV-SALTS:** All Wells with Publicly Available Salt & Nitrate Data; 46,228 Wells
- Many without construction info
• Organize GW Quality data (nitrate and TDS) relative to GW system

• Delineated with numerous datasets; focus on domestic well depths
## Upper Zone Calculation Datasets

<table>
<thead>
<tr>
<th>Data Layer</th>
<th>Weights for Establishing Bottom of Upper Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Wells Bottom Perforation</td>
<td>40%</td>
</tr>
<tr>
<td>Farm Virtual Wells Top Perforation</td>
<td>10%</td>
</tr>
<tr>
<td>Urban PWS Top Perforation</td>
<td>20%</td>
</tr>
<tr>
<td>Rural PWS Top Perforation</td>
<td>20%</td>
</tr>
<tr>
<td>DDW Systems Top Perforation</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

*Wells Used in Calculating Upper and Lower Zones*

- DDW Wells
- Urban PWS (CVHM2)
- Rural PWS (CVHM2)
- Domestic Wells (CVHM2 Texture Database)
- Ag Wells** (CVHM2)

**Central Valley Extent**

Defined Every 1 sq mile.
Upper Zone Conceptual Cartoon

Interpolation for Each 1-Mile Sq. Cell

- Domestic Well
- Farm Virtual Well (from USGS)
- Urban PWS
- Rural PWS
- Rural PWS
- DDW Public Supply

Interpolated Virtual Farm Top Perf Depth
Interpolated DDW Public Supply Top Perf Depth
Interpolated Domestic Bottom of Perf Depth
Interpolated Rural PWS Top Perf
Interpolated Urban PWS Top Perf Depth
EXAMPLE CALCULATION: FOR EACH 1 MILE x 1 MILE CELL

- **Domestic Top Perf + 100ft (40%)**
  - 289ft

- **Farm Virtual Top Perf (10%)**
  - 66ft

- **Urban PWS Top Perf (20%)**
  - 178ft

- **Rural PWS Top Perf (20%)**
  - 149ft

- **Public Supply Top Perf (10%)**
  - 146ft

Resultant Bottom of Upper Zone 208ft

\[(0.4 \times 289ft) + (0.1 \times 66ft) + (0.2 \times 178ft) + (0.2 \times 149ft) + (0.1 \times 146ft) = 208ft\]
Depth to Bottom of Upper Groundwater Zone

- Results of data interpretation
- Depth variable across Central Valley; 1 sq. mile interpretation

**Map:**
- Depth to Bottom of Upper Zone (Feet)
  - 161-320 ft

**Diagram:**
- Vadose Zone
- Domestic Well
- Ag and Industrial Wells
- Large Municipal DW Wells
- Oil and Gas Well

**Legend:**
- Upper Zone
- Lower Zone
- Production Zone
- Corcoran Clay
- Below Production Zone
- Lower Aquifer System
Characterization of Ambient Nitrate and Salt in Central Valley Groundwater
Wells with Data Used in CV Analyses

Avg. Well NO3-N Conc. Upper Zone

Average Well Concentration (Data: 2000-2016)

Upper Zone
NO3-N (mg/L)
- 0.1 - 2.5
- 2.6 - 5.0
- 5.1 - 7.5
- 7.6 - 10.0
- >10
UPPER ZONE NITRATE

LOWER ZONE NITRATE

<2.5 mg/L

10 mg/L
251-500 mg/L

>1,000 mg/L

UPPER ZONE TDS

LOWER ZONE TDS
NITRATE-N
UPPER ZONE TRENDS

0.2-1.0 mg/L/yr
>1.0 mg/L/yr

NITRATE-N
ALL WELLS TRENDS

0.2-1.0 mg/L/yr
>1.0 mg/L/yr
Predictions Based on Historical Observations

NITRATE-N UPPER ZONE PREDICTED:
10 YEARS

NITRATE-N UPPER ZONE PREDICTED:
50 YEARS

Predicted Conditions
(Data: 2000-2016)

Upper Zone (10 years)
Nitrate (mg/L as N)
- 0.1 - 2.5
- 2.6 - 5.0
- 5.1 - 7.5
- 7.6 - 10.0
- >10

Predicted Conditions
(Data: 2000-2016)

Upper Zone (50 years)
Nitrate (mg/L as N)
- 0.1 - 2.5
- 2.6 - 5.0
- 5.1 - 7.5
- 7.6 - 10.0
- >10

SWRCB Region 5
DWR B118 Groundwater Basins
Domestic Wells Characterization (Number and Depth) with Nitrate Conditions: Central Valley and Local Example
Domestic Well Density by Section

- **<5 wells/section**
- **25-50 wells/section**

WCR data in DWR database
Section approx. 1-mile x 1-mile
Domestic Well Depths: Kings Subbasin

Summary Statistics:
# Domestic Wells: 15,028
Min: 6ft
Max: 1800ft
Median: 153ft
Average: 171ft
StDev: 84ft
Avg. Domestic Well Depth by Section

- >100-150
- >200-300

Explaination:
Average Domestic Well Depth by Section (feet)
- > 400
- > 300 - 400
- > 200 - 300
- > 100 - 200
- > 50 - 100
- > 35 - 50
- > 25 - 35
- > 10 - 25
- 0 - 10

Legend:
- Dark Purple: >400 feet
- Medium Purple: 300-400 feet
- Light Purple: 200-300 feet
- Light Yellow: 100-200 feet
- Medium Yellow: 50-100 feet
- Light Yellow: 35-50 feet
- Medium Yellow: 25-35 feet
- Light Yellow: 10-25 feet
- Light Yellow: 0-10 feet

Map shows varying well depths across different regions, with some areas highlighted for >100-150 and >200-300 feet.
Residential Water System: Community system (more than 15 connections) or State Small (5-14 connections); ~264 wells are part of water systems in Kings Subbasin
Predicted Nitrate-N Conditions
(10 yrs & 50 yrs; Based on Actual Historical Observations)

Cells with Data (1 sq. mile)
Nitrate-N Upper Zone Trends

0.2 – 1.0 mg/L/Year

Nitrate-N All Wells Trends

Groundwater Quality Trends (Data: 2000-2016)

Upper Zone
NO₃-N mg/L per year

- < -0.5
- 0.5 - 1.0
- 2.0 - 1.0
- 3.0 - 1.0

All Wells
NO₃-N mg/L per year

- > 10
- 2.0 - 1.0
- 0.0 - 0.1
- 0.2 - 1.0

DWR B118 Code: 5-22.08
Groundwater Basin: SAN JOAQUIN VALLEY
Groundwater Subbasin: KINGS
Upper Zone Ambient Nitrate-N and Domestic Well Density

Number of Domestic Wells by Section
- 1 Dot = 10 wells
- Domestic well

Ambient Nitrate Concentrations:
- 0.1 - 2.5
- 2.6 - 5.0
- 5.1 - 7.5
- 7.6 - 10.0
- 10.1 - 152.1

*Upper Zone
Conclusions

- Mapping of existing groundwater quality conditions (nitrate and TDS) for Region 5 including Central Valley Floor
- Coordinate use of existing information with datasets previously developed by others (other talks today)
- Identify needs for more comprehensive statewide database of water systems
- Explore additional details at local level for needs assessment
THANK YOU