Salinas Valley 3D Hydrogeologic Framework Model (SVHFM)

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Topics

- Data structure of the SV HFM
- Layering Estimates
- Texture and zonation estimates
- Faults
- Ongoing work
Data structure of the SVHFM

- Simplified geologic map and faults
- Study area boundary
- Active cells onshore
- Active cells offshore
Data structure of the SVHFM

- Simplified geologic map and faults
- Study area boundary
- Active cells onshore
- Active cells offshore
Data structure of the SVHFM

- 600-ft cells (XY)
- In study area, 265,000 cells
- Active cells onshore, 84,000 cells
- Active cells offshore, 11,000 cells
Data structure of the SVHFM

- Cell centroids
- Numerically easier
- XY assigned
- Multiple Z values (HSU elevation)
- Presence vs absence of unit
- Multiple attributes (thickness, percent coarse, zonation from geology)
- 600-ft cells (XY)
Data structure of the SVHFM

- Attributes at cell centroids
- Simple data structure
- Easy to export
Four Components of the SVHFM

- **Extent**  Subsurface extent of hydrogeologic units
- **Layering**  Elevation and thickness of each hydrostratigraphic unit
- **Texture**  Variation in water-transmitting properties, from 3D lithology modeling and geologic inference
- **Faults**  Location, what units are cut
Creating hydrostratigraphic unit tops

Data sources

- Cross sections from previous consultant reports
- Surfaces from existing models (3-lyr, Pajaro, Seaside)
- Geologic map + DEM (onshore and offshore)
- Existing well picks – high quality interpretations
- New picks from wells
  - DOGGR oil and gas wells (350 wells)
  - Interpretation of lithologic data (1300 wells)
Creating hydrostratigraphic unit tops

Interactive selection of stratigraphic data from wells

Well lithology (rock type)

Contacts added to database when selected on cross section

Well hydrostratigraphy (aquifer unit)

Unit contact selection window

Contacts added to database when selected on cross section

Unit contact database window

Well cross section

180-ft aquifer

400-ft aquifer

Borehole | Shallow aq. Salinas aq. 180 ft aqui 400 ft aqui Deep aqui
---|---
1233 | 37.78 | 37.78 | 66.5 | 66.5 | 127.21 | 127.21
1466 | 43.51 | 43.51 | 72.47 | 72.47 | 127.33 | 127.33
2419 | 38.6 | 38.6 | 76.34 | 76.34 | 142.8 | 142.8
2699 | 32.85 | 32.85 | 91.93 | 91.93 | 134.6 | 134.6
20641 | 26.29 | 26.29 | 68.96 | 68.96 | 142.8 | 142.8
861 | 43.44 | 43.44 | 73.39 | 73.39 | 95.21 | 95.21
2307 | 40.74 | 40.74 | 79.58 | 79.58 | 107.42 | 107.42
14544 | 35.32 | 35.32 | 54.77 | 54.77
2802 | 31.21 | 31.21
331 | 35.32 | 35.32 | 67.72 | 67.72
879 | 22746 | 22896
Interpreting hydrostratigraphic unit tops

- Shallow aquifers gradually climb upsection southward 180-ft and 400-ft aquifers very shallow or absent south of King City
- Salinas aquitard absent south of Greenfield
Interpreting hydrostratigraphic unit tops

- Elevation
- Thickness
- Onshore extent
- Offshore extent
- Account for unconformable relations

Thickness of 180-ft aquifer, in feet
Interpreting hydrostratigraphic unit tops – geologic decisions

- Geologic decision - which map to use?
- Affects interpreted extent and thickness of Purisima and Monterey and magnitude of fault offset
## Textural distributions – 3d lithologic model

<table>
<thead>
<tr>
<th>General lithology</th>
<th>Percent coarse (in %)</th>
<th>Lithologic description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>100</td>
<td>boulders, cobbles, fine gravel, gravel</td>
</tr>
<tr>
<td>Gravel and sand</td>
<td>90</td>
<td>coarse gravel/sand, cse grvl/sd, gravel/sand</td>
</tr>
<tr>
<td>Coarse sand</td>
<td>80</td>
<td>coarse sand, sand, white sand, yellow sand</td>
</tr>
<tr>
<td>Fine sand</td>
<td>75</td>
<td>blue sand, fine sand, red sand, sandstone</td>
</tr>
<tr>
<td>Gravel and clay</td>
<td>50</td>
<td>gravel/clay, gravel/rocks/clay, grvl/rocks/cl, sand/gravel/clay, snd/grvl/cl, comp grnt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>decomposed granite, gravelly clay, gravelly clay</td>
</tr>
<tr>
<td>Sand and clay</td>
<td>25</td>
<td>quicksand, adobe, sand/clay, sandy blue clay, sandy clay, sediment, sdy blu cly, top soil, topsoil</td>
</tr>
<tr>
<td>Clay</td>
<td>0</td>
<td>shale, blue clay, brown clay, clay, red clay, white clay, yellow clay, granite, bedrock</td>
</tr>
<tr>
<td>No data</td>
<td>300</td>
<td>Includes cells outside the bounds of the 3D lithology model, or downhole intervals having the following descriptors: no data, open ii, open iii, open iv, seepage, to water, water, unknown, hard hill undefined</td>
</tr>
<tr>
<td>Unit absent</td>
<td>-99999</td>
<td>Value assigned where HSU unit is absent with no overlying units present (thickness = 0)</td>
</tr>
<tr>
<td>(thickness =0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit present as &quot;phantom&quot;</td>
<td>1</td>
<td>Value assigned where HSU unit is absent but overlying units are present (thickness assigned as 1)</td>
</tr>
<tr>
<td>(thickness=1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Textural distributions – 3d lithologic model

- Downhole lithologic interval data from 1,300 wells
- Generalized lithologic classes from driller’s descriptions
- Conversion to 3D digital data for each well
Textural distributions – 3d lithologic model

- 3D volumetric lithology model showing lithologic variations
- Model built by IDW extrapolation of data outward from the wells
- Mimics top 400-ft aquifer
- Cells 1000 ft in XY and 25 ft in Z
- 4 cells in numerical model
Textural distributions – 3d lithologic model

- Series of vertical cross sections sliced through model volume
- Method works well where data density is high
Textural distributions – 3d lithologic model

- Profiles cut from 3D volumetric lithology model are similar to lithologic cross sections drawn by consultants along the same lines.
- Consistency with prior interpretation, 3D model allows sections to be cut as desired.

Orange = gravels, fluvial
Yellow = sands
Light blue = sandy clay
Green = clay
Pink = alluvial fan sand+gravel

Kennedy-Jenks section C-C’

180-ft aquifer
400-ft aquifer
Deep aquifer
Textural distributions – 3d lithologic model

- 3D volumetric lithology model is cut mid way through each HSU
- Modeled lithologies generalized into percent coarse categories
- Represents the entire aquifer thickness
- Starting point for zonation within numerical model

Texture of 180-ft aquifer, in percent coarse
Faults

- Multiple data sources
- Data integration
- GIS generalization
- Attribution of recency
Faults

- Multiple data sources
- Data integration
- GIS generalization
- Attribution of recency
- Multiple data sources
- Data integration
- GIS generalization
- Attribution of recency
• Multiple data sources
• Data integration
• GIS generalization
• Attribution of recency
Ongoing work - Next steps

- 3D volumetric model of HSU layers
- Refine layering offshore, Monterey Canyon
- Ties with Pajaro and Seaside model layering
- Correct unit assignments
- Assessment based on numerical model results
- Basin aggradation and climatic factors