Sacramento Valley Simulation Model (SVSim) and C2VSim

Linda Bond
California Department of Water Resources
Division of Integrated Regional Water Management

GRA and DWR Workshop
Stream Depletion Through the SGMA Lens: Practical Solutions for a Complex Problem
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Purpose of SVSim Model

- Water Transfer Program - project-specific impacts of groundwater substitution transfers on stream depletion in the Sacramento Valley
- SGM Program – stream depletion, water budgets, land subsidence, and water management scenarios
SVSim and C2VSim
Integrated Groundwater-Surface Water Models Using DWR’s IWFM Code

SVSim and C2VSim Differences:
- Sacramento Valley vs. Central Valley
- SVSim Explicitly simulates Water Transfer Wells
- SVSim Grid and Layering

Updated Hydrogeology (new approach is being adopted for new versions of C2VSim)
SVSim Model Location

Sacramento Valley

- Physical boundaries on east, west, and north and at the base
- Southern boundary flows specified with C2VSim
SVSim
Water Transfer Wells

- Explicitly Simulates Groundwater Substitution Pumping
- Extended southern boundary ensures effect of project pumping is not distorted
SVSim Grid and Layering

- Finer grid adjacent to rivers
- Multiple thin layers beneath streams improves accuracy of calculation of stream depletion
Updated Hydrogeology

Primary Controlling Factor for Rate of Stream Depletion Caused by Pumping

Alluvial basins do not have layer-cake hydrogeology

“TEXTBOOK” EXAMPLE OF LAYER-CAKE GROUNDWATER SYSTEM

SACRAMENTO VALLEY ALLUVIAL GROUNDWATER SYSTEM
Hydrogeologic Conceptual Model

Each Time-Correlated Unit Contains Matrix of Hydrogeologic Units

Geology ≠ Hydrogeology

Tuscan Formation
Translating Conceptual Model into Numerical Model Input

Characteristics of Alluvial System
● Distribution of Coarse and Fine Sediments
● Hydraulic Properties of Sediments
● Depositional Structure of the Alluvial Basin

Characteristic Combined
To Calculate Aquifer Parameters For Model With Power-law Averaging Equation

\[ X_B = \left[ P_C X_C^p + (1 - P_C) X_F^p \right]^{\frac{1}{p}} \]
Distribution of Sediments: Texture Analysis

Legend
Texture Analysis Locations
- USGS CVHM Wells (2193)
- DWR Levee Borings Logs (1505)
- DWR IRWM Compiled Wells (760)
- Yuba County Water Agency Wells (233)

Streams
Model Boundary

4,700 LOGS ANALYZED
# Hydraulic Properties of Coarse-grained and Fine-grained Sediments

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Material</th>
<th>Coarse-Grained</th>
<th>Fine-Grained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal hydraulic conductivity $K_h$</td>
<td></td>
<td>22 to 75 ft/d</td>
<td>3.3 to 11 ft/d</td>
</tr>
<tr>
<td>Vertical Anisotropy ($K_h/K_v$)</td>
<td></td>
<td>10:1</td>
<td>10:1</td>
</tr>
<tr>
<td>Specific yield $S_y$</td>
<td></td>
<td>0.15</td>
<td>0.05</td>
</tr>
<tr>
<td>Specific storage $S_s$</td>
<td></td>
<td>$2.0 \times 10^{-6}$ 1/ft</td>
<td>$2.2 \times 10^{-4}$ 1/ft</td>
</tr>
</tbody>
</table>

Values Based on Depth-Correlation Analysis of 1500 Specific Capacity Tests
Values Based on Published Reports And Papers Applicable to Sacramento Valley
Example of Depth-Correlation Analysis
Hydraulic Conductivity Coarse-grained Sediments

Relation Between Hydraulic Conductivity of Coarse-Grained Texture and Depth

Based on 1500 Specific Capacity Tests
Depositional Structure of the Alluvial Basin

$p$ = empirical parameter that relates to connectivity of flow paths within groundwater system

NUMERICAL EXPERIMENTS:
LENSES  MATRIX

RESULTS:
$p = 0.93$ for $K_H$
$p = -0.62$ for $K_V$

$$X_B = \left[ P_C X_C^p + (1 - P_C) X_F^p \right]^{\frac{1}{p}}$$
Improved Accuracy of Stream Depletion Calculations
Using SVSim for GSPs

DATA

Creek Monitoring Well: HC-1

Drilling Method: Mud Rotary Coordinates: North American Datum 1983

Drill Date: 02/10/2010 Surface Elevation: 07-27

Geophysical Logging Contractor: Kelmanco Inc.

Lithologic Descriptions

USCS Field Classification

METHODS

\[ X_B = \left[ P_C X_C^P + (1-P_C) X_F^P \right]^{1/p} \]