POST-PUMPING DEPLETIONS

CAUSES & QUANTIFICATION

Presented by:
Catherine Kraeger-Rovey, Ph.D., P.E.
DIRECT CAUSES OF POST-PUMPING DEPLETIONS

- Finite Aquifer Hydraulic Conductivity - Horizontal and Vertical
- Well-to-River Distances - Horizontal and Vertical

INDIRECT CAUSES OF POST-PUMPING DEPLETIONS

- Reduced Stream Bed Hydraulic Conductivity Induced by Pumping
- Reduced Stream Bed K caused by Falling Hydrograph
PUMPING & STREAM DEPLETION PATTERNS

PUMPING

STREAM DEPLETION
Location of Study Area
Mass Balance Diagram for Arkansas Valley Study

- **Precipitation**: 75,000 acre-feet per year
- **Net River Flow**: 85,000 acre-feet per year
- **Tributary Inflow**: 14,000 acre-feet per year
- **Groundwater Underflow**: 50,000 to 55,000 acre-feet per year
- **Aquifer Storage**: 5,000 to 10,000 acre-feet per year increase
- **Evapotranspiration**: 160,000 acre-feet per year
- **Pumping**: 35,000 to 45,000 acre-feet per year
- **Canal Diversions**: acre-feet per year
- **60,000 acre-feet per year Distributed Outside Study Area**

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Pressure Head Distribution for Seepage from River to Underlying Water Table
Decision Process for Selecting the Appropriate Boundary Condition at the Stream-Aquifer Interface

- **YES**
  - $H_{i,j,k} > H_{i,j,k+1}$
    - Compute $Q$ by Equation 3-38
    - Known Head Boundary Condition

- **NO**
  - $(H_{i,j,k+1}-H_{i,j,k}) > (d+t-h_{pb})$
    - **YES**
      - Compute $Q$ by Equation 3-39
      - Known Head Boundary Condition
    - **NO**
      - Compute $Q$ by Equation 3-40
      - Known Head Boundary Condition
Comparison of Computed Observed Discharge Values below John Martin Dam for Sensitivity Results to Variation of Discharge of Lamar
Calibrated Stream-Aquifer Models (a partial list)

<table>
<thead>
<tr>
<th>Name</th>
<th>Date</th>
<th>River and Location</th>
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</thead>
<tbody>
<tr>
<td>Arkansas Valley</td>
<td>1972-1974</td>
<td>Arkansas, Southeastern Colorado</td>
</tr>
<tr>
<td>Sonnenburg (Dinsdale)</td>
<td>1979</td>
<td>South Platte, Northeastern Colorado</td>
</tr>
<tr>
<td>Rio Blanco Oil Shale</td>
<td>1982</td>
<td>Piceance and Yellow Creeks, Northwestern Colorado</td>
</tr>
<tr>
<td>San Pedro</td>
<td>1988-1998</td>
<td>San Pedro, Southeastern Arizona</td>
</tr>
<tr>
<td>Safford Valley</td>
<td>1992-1998</td>
<td>Gila, Southeastern Arizona</td>
</tr>
<tr>
<td>Tres Rios Habitat</td>
<td>1998-2000</td>
<td>Salt, Southern Arizona</td>
</tr>
<tr>
<td>Eastbank</td>
<td>1990-1998</td>
<td>Columbia, Central Washington State</td>
</tr>
<tr>
<td>Virgin River</td>
<td>1992</td>
<td>Virgin, Arizona-Utah Border</td>
</tr>
</tbody>
</table>
Modeled Heads

Lower Gravel Aquifer

Eastbank Hatchery Well Field
Modeled Temperatures

Upper Part of Lower Gravel Aquifer

Eastbank Hatchery Well Field
Stieb Pumping Test Photos
Pit by S. Platte Riv. MW-3 and S-6
Dinsdale Pumping Test (2005)

Figure 13.
QUANTIFYING STREAM DEPLETIONS DUE TO WELL PUMPING

- Correct Conceptual Model of All System Components
- Calibration

QUANTIFYING STREAM BED UNIT CONDUCTANCE

- Credible Previous Studies
- Additional Laboratory and Field Studies
- Calibration of Fully Populated Models
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