Outline

• Preliminary Transient Calibration Run
• This is Preliminary
• NO we are NOT there yet!!!
Review

• Recharge program
  – Tributary underflow
    • Adjusted by multiplying starting values by a factor
    • Adjust seasonal amplitude
    • Adjust averaging period
  – Surface water irrigation efficiency
  – Canal seepage fixed percentage of diversion

• Physical properties adjusted by changing values in MODFLOW input files
  – Aquifer hydraulic conductivity and storage
  – Riverbed conductance
  – Drain conductance
Changes since last meeting

- Added more Nature Conservancy wells
- Transient Calibration Run
  - Analysis of a recent calibration run revealed that heads were above land surface in Cove Cr
    - We have no observation wells in Cove Cr
    - Added two drains with elevations set to land surface target discharge set to 0.0
  - Heads are now below land surface in Cove Cr except in late summer 1998 and 1999.
- Started work on the time varying transmissivity model
  - MODFLOW run takes several hours
  - MODFLOW frequently fails to converge and stops
Cove Drains

- Elevation of drains were set to land surface.
- Target discharge = 0.0
- Purpose is NOT to remove water but to alert PEST when head was above land surface.
- Water level now only above land surface in late summer of 1998 and 1999.
- Not retained in final model.
Cove Drains
Cove Drains
Cove Drains
Observation Wells

- Wells with GPS or surveyed location
- Measured by a trained technician
Observation Wells

- Wells with GPS or surveyed location
- Measured by a trained technician
- If fit was perfect
  - Intercept = 0
  - Slope = 1
  - $R^2 = 1$
  - All points on the red line
Observation Wells

01N 18E 01DAA1

ft abv mean sea level

- Observed
- Warm-up
- Modeled
Observation Wells

01S 18E 14AAB1

ft abv mean sea level

Jan-95 Jan-96 Dec-96 Dec-97 Jan-98 Dec-98 Jan-99 Dec-99 Jan-00 Dec-00 Jan-01 Dec-01 Jan-02 Dec-02 Jan-03 Dec-03 Jan-04 Dec-04 Jan-05 Dec-05 Jan-06 Dec-06 Jan-07 Dec-07 Jan-08 Dec-08 Jan-09 Dec-09 Jan-10 Dec-10 Jan-11

Observed  Warm-up  Modeled
Observation Wells

01S 19E 03CCB2

Observed Warm-up Modeled
Observation Wells

04N 17E 14BBC1

ft abv mean sea level

Observed
Warm-up
Modeled
Geo-located Wells

- Wells located by address
- Measured by driller
Geo-located Wells

- Wells located by address
- Measured by driller
- If fit was perfect
  - Intercept = 0
  - Slope = 1
  - \( R^2 = 1 \)
  - All points on the red line
Driller Wells

- Wells located by PLS
- Measured by driller
Driller Wells

- Wells located by PLS
- Measured by driller
- If fit was perfect
  - Intercept = 0
  - Slope = 1
  - $R^2 = 1$
  - All points on the red line

\[ y = 0.9759x + 123.94 \]
\[ R^2 = 0.9946 \]
Sun Valley Wells

- Municipal production wells
- 2 well fields
- Measured by municipal employee
Sun Valley Wells

Sun Valley-Well 02

Observed

Warm-up

Modeled

ft abv mean sea level

Jan-95 Jan-96 Dec-96 Dec-97 Jan-99 Jan-00 Dec-00 Dec-01 Jan-03 Jan-04 Dec-04 Dec-05 Jan-07 Jan-08 Dec-08 Dec-09 Jan-11
### Sun Valley Wells

#### Sun Valley-Well 11

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**Legend:**
- **Observed**
- **Warm-up**
- **Modeled**
- Graduate student installed transducers
- 12 wells
- 2 are wells we already use
- Not all wells useful for us
- Measurements every 15 min
- Mid 2010 to mid 2011
- Reduced 15 min frequency to one per day
- 5 domestic wells
  - Filtered out pumping events
The Nature Conservancy Wells

Graduate student installed transducers
12 wells
Not all wells useful for us
Measurements every 15 min
Mid 2010 to mid 2011
This well 10 ft gradations on Y axis, all others are 5 ft

Observed Warm-up Modeled
The Nature Conservancy Wells

Graduate student installed transducers – 12 wells – Not all wells useful for us – Measurements every 15 min – Mid 2010 to mid 2011 – 5 domestic wells

Jan-95 Jan-96 Dec-96 Dec-97 Jan-99 Jan-00 Dec-00 Dec-01 Jan-03 Jan-04 Dec-04 Dec-05 Jan-07 Jan-08 Dec-08 Dec-09 Jan-11

7001

Observed Warm-up Modeled
The Nature Conservancy Wells

- Graduate student installed transducers
- 12 wells
- Not all wells useful for us
- Measurements every 15 minutes
- Mid 2010 to mid 2011
- 5 domestic wells

Observed Warm-up Modeled

ft abv mean sea level

Jan-95 Jan-96 Dec-96 Jan-97 Dec-97 Jan-98 Dec-98 Jan-99 Dec-99 Jan-00 Dec-00 Jan-01 Dec-01 Jan-02 Dec-02 Jan-03 Dec-03 Jan-04 Dec-04 Jan-05 Dec-05 Jan-06 Dec-06 Jan-07 Dec-07 Jan-08 Dec-08 Jan-09 Dec-09 Jan-10 Dec-10 Jan-11
The Nature Conservancy Wells

Graduate student installed transducers – 12 wells – Not all wells useful for us – Measurements every 15 min – Mid 2010 to mid 2011 – 5 domestic wells

ft abv mean sea level

7004

Jan-95 Jan-96 Dec-96 Dec-97 Jan-98 Jan-99 Dec-99 Jan-00 Dec-00 Jan-01 Dec-01 Jan-02 Dec-02 Jan-03 Dec-03 Jan-04 Dec-04 Jan-05 Dec-05 Jan-06 Dec-06 Jan-07 Dec-07 Jan-08 Dec-08 Jan-09 Dec-09 Jan-10 Dec-10 Jan-11

Observed Warm-up Modeled

5290 5295 5300 5305 5310
The Nature Conservancy Wells

Graduate student installed transducers – 12 wells – Not all wells useful for us – Measurements every 15 min – Mid 2010 to mid 2011 – 5 domestic wells

Observed Warm-up Modeled

ft abv mean sea level

Jan-95 Jan-96 Dec-96 Dec-97 Jan-98 Jan-99 Dec-99 Jan-00 Dec-00 Jan-01 Dec-01 Jan-02 Dec-02 Jan-03 Dec-03 Jan-04 Dec-04 Jan-05 Dec-05 Jan-06 Dec-06 Jan-07 Dec-07 Jan-08 Dec-08 Jan-09 Dec-09 Jan-10 Dec-10 Jan-11
The Nature Conservancy Wells

Graduate student installed transducers on 12 wells. Not all wells were useful for the research. Measurements were taken every 15 minutes from mid-2010 to mid-2011.

Graph showing changes in feet above mean sea level (ft abv mean sea level) from January 1995 to January 2011.
The Nature Conservancy Wells

Graduate student installed transducers
- 12 wells
- Not all wells useful for us
- Measurements every 15 min
- Mid 2010 to mid 2011
- 5 domestic wells

ft abv mean sea level

<table>
<thead>
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<th>Jan-95</th>
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Observed
Warm-up
Modeled
The Nature Conservancy Wells

- Graduate student installed 12 wells
- Not all wells useful for us
- Measurements every 15 min
- Mid 2010 to mid 2011
- Since added 5 domestic wells by filtering out pumping events

Observed
Warm-up
Modeled

ft abv mean sea level

Jan-95   Jan-96   Dec-96   Dec-97   Jan-99   Jan-00   Dec-00   Dec-01   Jan-03   Jan-04   Dec-04   Dec-05   Jan-07   Jan-08   Dec-08   Dec-09   Jan-11
The Nature Conservancy Wells

Graduate student installed transducers

- 12 wells

- Not all wells useful for us

- Measurements every 15 minutes

- Mid 2010 to mid 2011

- Since added 5 domestic wells by filtering out pumping events

5125
5130
5135
5140
5145
5150
5155
5160
5165
5170
5175
Jan-95 Jan-96 Dec-96 Dec-97 Jan-99 Jan-00 Dec-00 Dec-01 Jan-03 Jan-04 Dec-04 Dec-05 Jan-07 Jan-08 Dec-08 Dec-09 Jan-11

ft abv mean sea level

7010

Observed Warm-up Modeled
The Nature Conservancy Wells

- Graduate student installed transducers
- 12 wells
- Not all wells useful for us
- Measurements every 15 min
- Mid 2010 to mid 2011
- Since added 5 domestic wells by filtering out pumping events

---

**Graph:**

**Title:** The Nature Conservancy Wells

**Graph Details:**
- 7009
- Observed, Warm-up, Modeled
- Ft abv mean sea level
- Time span: Jan-95 to Jan-11
River Gains and Losses

• Transient Gains
  – Nr Ketchum – Hailey

nr Ketchum-Hailey

- Observed
- Warm-up
- Modeled
River Gains and Losses

- Transient Gains
  - Nr Ketchum – Hailey

Hailey-Stanton Crossing

- Observed
- Warm-up
- Modeled
River Gains and Losses

- Transient Gains
  - Nr Ketchum – Hailey

![Map of Willow Creek](image_url)

**Willow Creek**

- Observed
- Modelled
- Warm-up

<table>
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<tr>
<th>Jan-95</th>
<th>Jan-96</th>
<th>Jan-97</th>
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*Note: The diagram shows the observed, modelled, and warm-up data for Willow Creek from January 1995 to January 2010.*
River Gains and Losses

- Transient Gains
  - Nr Ketchum – Hailey

Silver Abv Sportsman's Access

- Observed
- Warm-up
- Modeled
River Gains and Losses

- Transient Gains
  - Nr Ketchum – Hailey

![Graph showing river gains and losses](image.png)

**Silver Blw Sportsman's Access**

- Observed
- Warm-up
- Modeled

<table>
<thead>
<tr>
<th>Jan-95</th>
<th>Jan-96</th>
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Legend:
- Observed
- Warm-up
- Modeled
Riverbed Conductance

- Riverbed conductance in $M^2/d$
- Wood River
Sub-reach Targets

- March 2013 seepage run
- Match ratios to larger reach
Sub-reach Targets

- August 2012 seepage run
- Match ratios to larger reach
- Flows for nr Ketchum to Hailey are unusual
- Seepage run results removed for nr Ketchum to Hailey
Sub-reach Targets

- October 2012 seepage run
- Match ratios to larger reach
Streambed Conductance

- Riverbed conductance in $M^2/d$
- Willow Cr, and Silver Cr
Layer 1 Aquifer head (famsl)
Layer 2 & 3 head (famsl)
Layer 1 head (famsl)

- Once more with contour lines
- Contour interval 10 ft
- Steady state layer 1
Layer 2 & 3 head (famsl)
Subsurface Discharge From Model

• Weight on these observations is low
• Stanton Crossing
  – Estimated ~ Negligible – 300 ac-f/yr
    • 0 - 0.41 cfs
    • Modeled = 0.41 cfs
• Silver Cr underflow
  – Estimated ~ 4,000 – 53,000 ac-f/yr
    • 5.5 – 73 cfs
    • Modeled = 7.0 cfs
Drain Conductance

- Drain conductance in $M^2/d$
- Layer 1
  - Silver Creek
  - Stanton Crossing
Drain Conductance

- Drain conductance in $M^2/d$
- Layer 2
  - Silver Creek
Drain Conductance

- Drain conductance in $M^2/d$
- Layer 3
  - Silver Creek
Layer 1 Hydraulic Conductivity

- Layer 1 temporarily modeled as non-time varying transmissivity
- Pilot points can be moved
- Number of pilot points not fixed
- Tributary valleys are in their own zones
  - Contain maximum and minimum values
  - Min = 1.50 ft/day
  - Max = 14,421 ft/day
  - Median = 233.79 ft/day
Layer 1 Hydraulic Conductivity

- Tributary valleys are in their own zones
  - Contain maximum and minimum values
- In valley and triangle
  - Min = 1.50 ft/day
  - Max = 14,421 ft/day
  - Median = 233.79 ft/day
- 437 wells in Wood River Valley alluvial sediments.
Layer 1 Hydraulic Conductivity

- Tributary valleys are in their own zones
  - Contain maximum and minimum values
- In valley and triangle
  - Min = 1.50 ft/day
  - Max = 14,421 ft/day
  - Median = 233.79 ft/day
- 437 wells in Wood River alluvial sediments.

Groundwater, Freeze & Cherry, 1979
Layer 2 Hydraulic Conductivity

- Layer 2 modeled as confined
- Includes basalt in east
- Includes confining layer
- Sand and gravel aquifer in valley and triangle
  - Min = 3.36 ft/day
  - Max = 14,775 ft/day
  - Median = 91.0 ft/day
Layer 2 Hydraulic Conductivity

- Layer 2 modeled as confined
- Includes basalt in east
- Includes confining layer
- Sand and gravel aquifer in valley and triangle
  - Min = 3.36 ft/day
  - Max = 14,775 ft/day
  - Median = 91.0 ft/day
- 14 wells completed in layer 2 sand and gravel aquifer
Layer 2 Hydraulic Conductivity

- Low hydraulic conductivity in confining layer
  - Min = 0.000985 ft/day
  - Max = 0.001002 ft/day
- Basalt intermediate value
  - Min = 38 ft/day
  - Max = 55 ft/day
- In valley and triangle
  - Min = 3.36 ft/day
  - Max = 14,775 ft/day
  - Median = 91.0 ft/day
- 14 wells in Wood River alluvial sediments.

Groundwater Freeze & Cherry, 1979
Layer 3 Hydraulic Conductivity

- Layer 3 modeled as confined
- Basalt
  - Min = 29 ft/day
  - Max = 51 ft/day
- Includes basalt in east
- Sand and gravel aquifer in valley and triangle
  - Min = 33.1 ft/day
  - Max = 43,566 ft/day
  - Median = 2,155 ft/day
Layer 3 Hydraulic Conductivity

- Sand and gravel aquifer in valley and triangle
  - Min = 33.1 ft/day
  - Max = 43,566 ft/day
  - Median = 2,155 ft/day
- 175 wells in layer 3 alluvial aquifer.
Layer 3 Hydraulic Conductivity

- Basalt
  - Min = 29 ft/day
  - Max = 51 ft/day

- Sand and gravel aquifer in valley and triangle
  - Min = 33.1 ft/day
  - Max = 43,566 ft/day
  - Median = 2,155 ft/day

Groundwater Freeze & Cherry, 1979
Layer 3 Hydraulic Conductivity

- Layer 1 sand and gravel aquifer
  - Min = 1.50 ft/day
  - Max = 14,421 ft/day
  - Median = 233.79 ft/day

- Layer 3 sand and gravel aquifer
  - Min = 33.1 ft/day
  - Max = 43,566 ft/day
  - Median = 2,155 ft/day
Layer 1 Storage

- Layer 1 temporarily modeled as non-time varying thickness
- Pilot points can be moved
- Number of pilot points not fixed
Layer 2 Storage

- Layer 2 modeled as storage
- Includes basalt in east
- Includes confining layer
- Pilot points can be moved
- Number of pilot points can be changed
Layer 3 Storage

- Layer 3 modeled as storage
- Includes basalt in east
- Pilot points can be moved
- Number of pilot points can be changed
Surface Water Irrigation Efficiency

- Inefficient fraction infiltrates into layer 1 aquifer
  - Note to the engineers
    - Low efficiency is not necessarily bad
Tributary Underflow

- Trib underflow adjusted using
  - Adjustment factors
    - Adjust average flux
  - Reduction factor
    - Adjust seasonal amplitude
  - Averaging period
    - 200 day, 300 day, 400 day, etc
### Tributary Underflow

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<thead>
<tr>
<th>Name</th>
<th>Scalar</th>
<th>OrigEst</th>
<th>Mod_AF</th>
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<td>0.4770</td>
<td>2,407</td>
<td>1,148.07</td>
<td>10,149</td>
<td>11.31%</td>
</tr>
<tr>
<td>Lake Creek</td>
<td>3.6935</td>
<td>2,406</td>
<td>8,886.63</td>
<td>17,280</td>
<td>51.43%</td>
</tr>
<tr>
<td>Lees Gulch</td>
<td>1.8509</td>
<td>134</td>
<td>248.03</td>
<td>2,240</td>
<td>11.07%</td>
</tr>
<tr>
<td>Ohio Gulch</td>
<td>0.0010</td>
<td>256</td>
<td>0.26</td>
<td>4,270</td>
<td>0.01%</td>
</tr>
<tr>
<td>Quigley Creek</td>
<td>0.0035</td>
<td>560</td>
<td>1.98</td>
<td>15,504</td>
<td>0.01%</td>
</tr>
<tr>
<td>Seamans Gulch</td>
<td>4.4530</td>
<td>1,949</td>
<td>8,678.97</td>
<td>18,768</td>
<td>46.24%</td>
</tr>
<tr>
<td>Slaughterhouse Gulch</td>
<td>0.0011</td>
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<td>0.57</td>
<td>11,509</td>
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<tr>
<td>Townshead Gulch</td>
<td>0.0010</td>
<td>58</td>
<td>0.06</td>
<td>960</td>
<td>0.01%</td>
</tr>
<tr>
<td>Trail Creek</td>
<td>3.6749</td>
<td>2,898</td>
<td>10,649.74</td>
<td>111,274</td>
<td>9.57%</td>
</tr>
<tr>
<td>Warm Springs Creek</td>
<td>1.8353</td>
<td>607</td>
<td>1,114.06</td>
<td>180,735</td>
<td>0.62%</td>
</tr>
</tbody>
</table>
## Tributary Underflow

<table>
<thead>
<tr>
<th>Name</th>
<th>Scalar</th>
<th>OrigEst</th>
<th>Mod_AF</th>
<th>BasinYld_AF</th>
<th>%BasinYield</th>
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<tbody>
<tr>
<td>Adams Gulch</td>
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<td>2.90</td>
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<tr>
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<td>704</td>
<td>1,061.09</td>
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<tr>
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<tr>
<td>Eagle Creek</td>
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<td>702.56</td>
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<tr>
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