Read Me

- These slides were presented to the Hood River Basin Water Planning Group on Dec 4, 2013 by Jon Rocha and Jennifer Johnson.
- Slides contain animations that rely on mouse clicks for proper display and presentation timing.
- Slides are also heavy on graphics which may not make sense without the presenters talking through the evolution of the presentation.
- Direct questions to

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Managing Water in the West

Hood River Basin Study

Groundwater Modeling

4DEC2013

U.S. Department of the Interior

Bureau of Reclamation

Outline

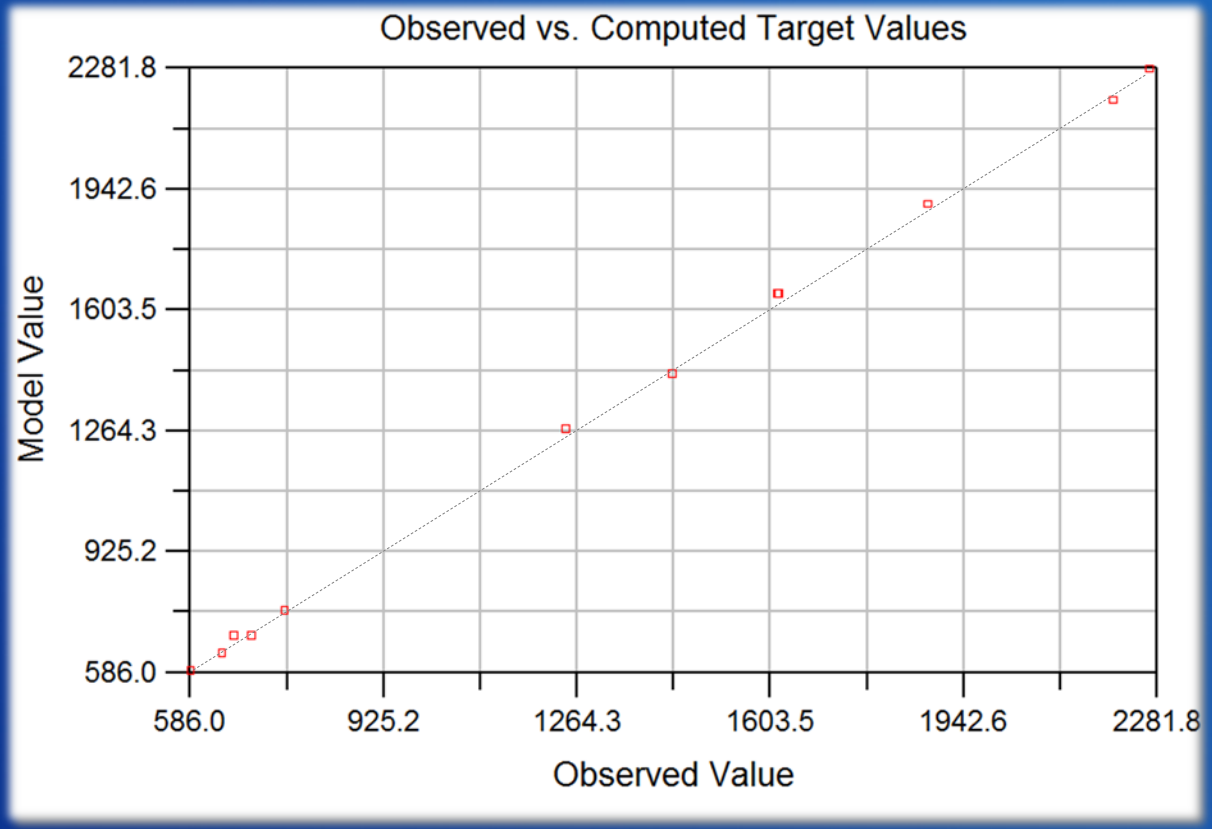
- Model calibration and results
- Modeling scenario definitions and results

Model Purpose

- Modeling was used to address the following questions:
  1. How will hydrologic changes due to climate change impact groundwater conditions?
  2. How will new development impact groundwater conditions in the basin including discharge to streams?
  3. Is managed recharge a viable option for improving stream flow?
  4. Can the basin aquifer be used for aquifer storage and recovery?

Model Calibration: Steady State

Residual Mean	= -12.60
Residual Standard Dev.	= 14.56
Absolute Residual Mean	= 15.58
Residual Sum of Squares	=4.45e+003
RMS Error	=19.25
Minimum Residual	= -33.34
Maximum Residual	= 10.41
Range of Observations	= 1682.00
Scaled Res. Std. Dev.	= 0.009
Scaled Abs. Mean	= 0.009
Scaled RMS	= 0.011
Number of Observations	= 12



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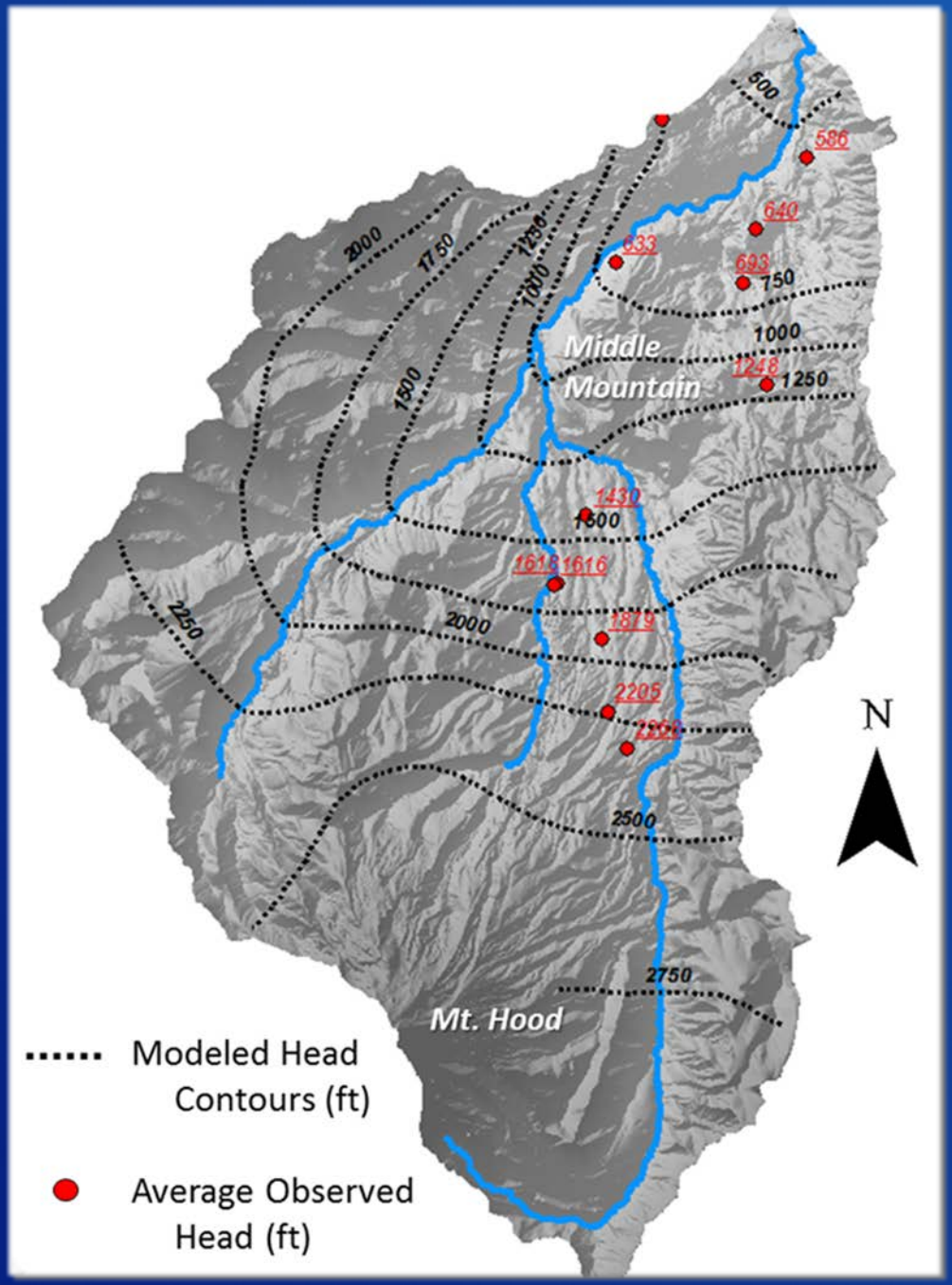
Head Comparison: Steady State



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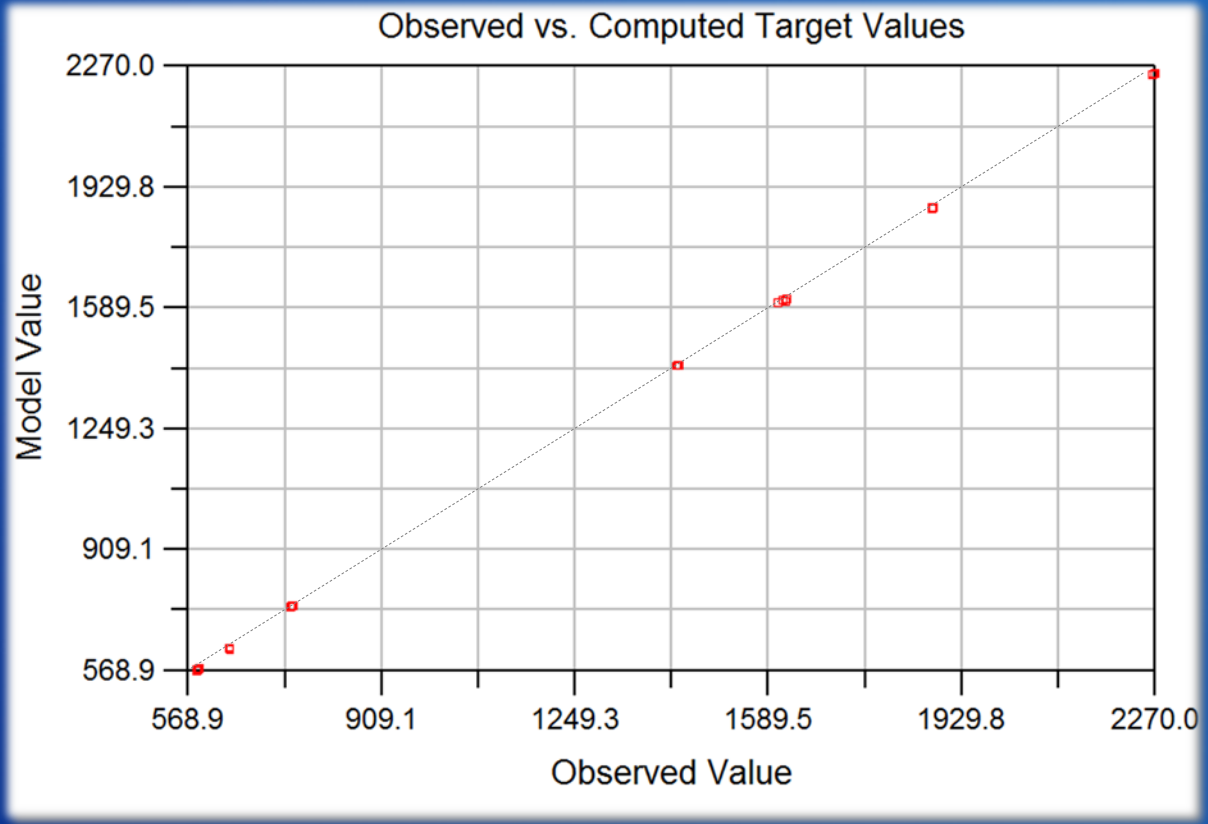
Model Calibration: Transient

Residual Mean	= 8.46
Residual Standard Dev.	= 6.42
Absolute Residual Mean	= 8.51
Residual Sum of Squares	=1.58e+004
RMS Error	=10.62
Minimum Residual	= -0.83
Maximum Residual	= 21.14
Range of Observations	= 1686.00
Scaled Res. Std. Dev.	= 0.004
Scaled Abs. Mean	= 0.005
Scaled RMS	= 0.006
Number of Observations	= 140



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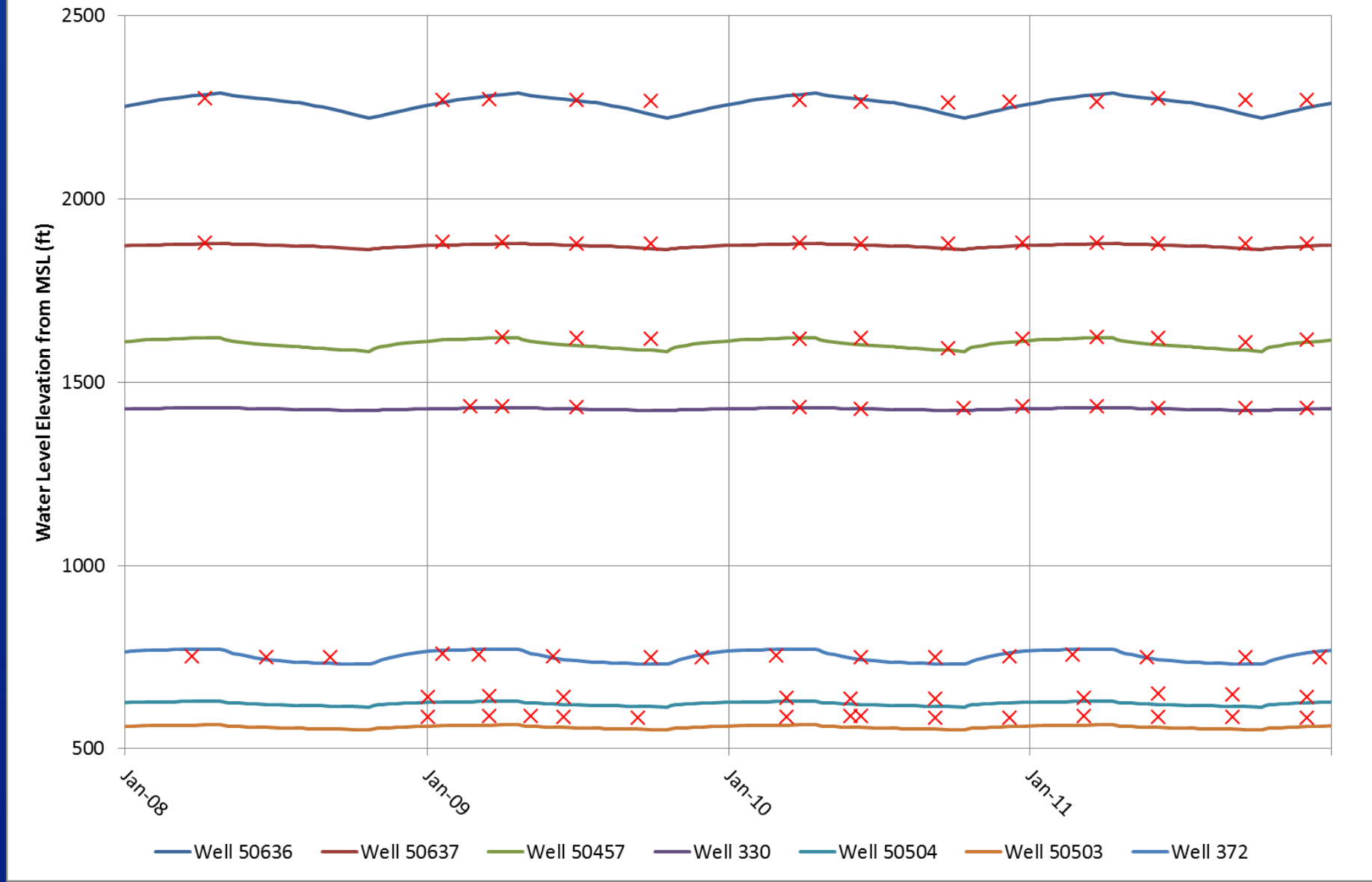
Head Comparison: Transient



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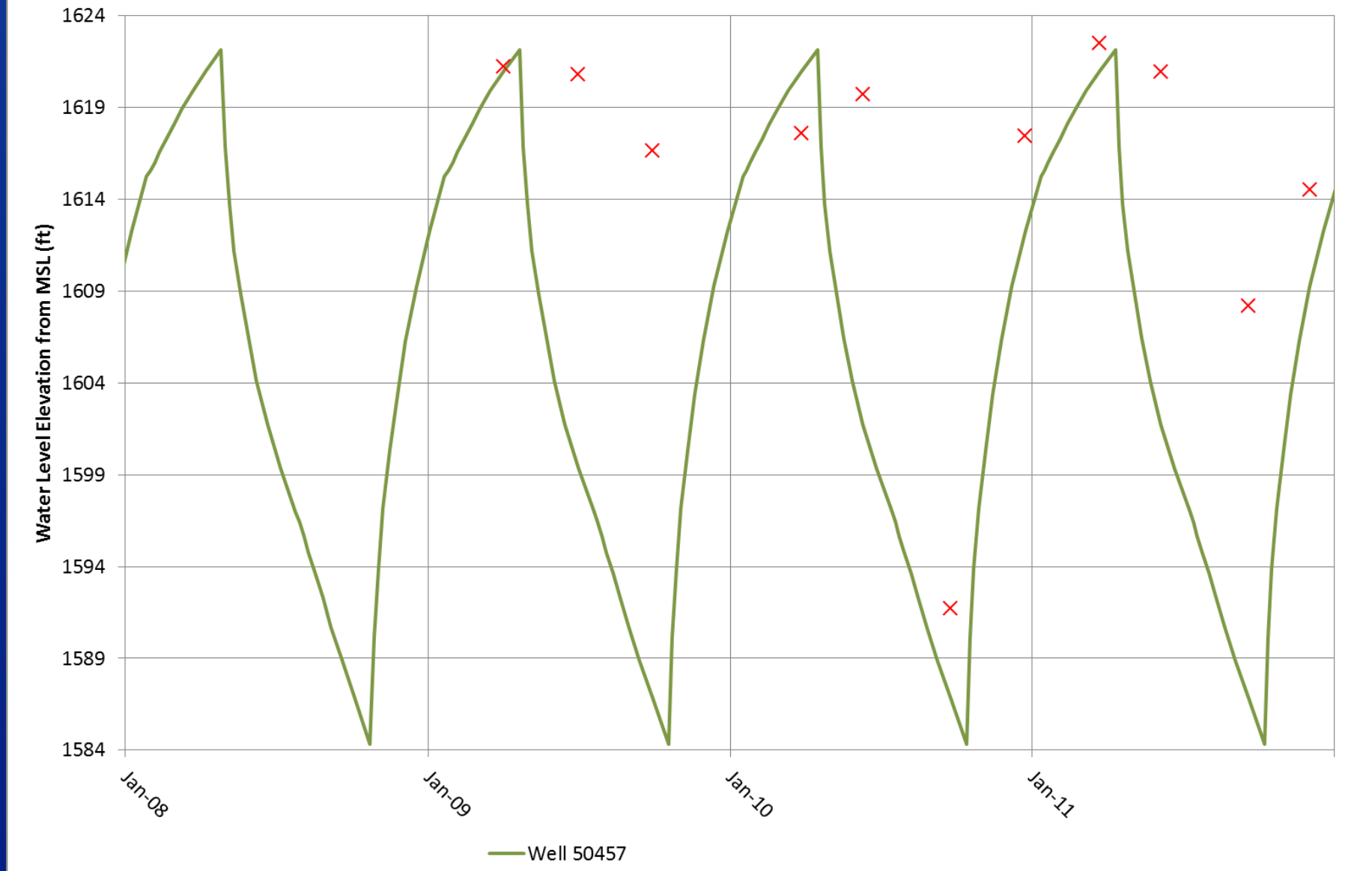
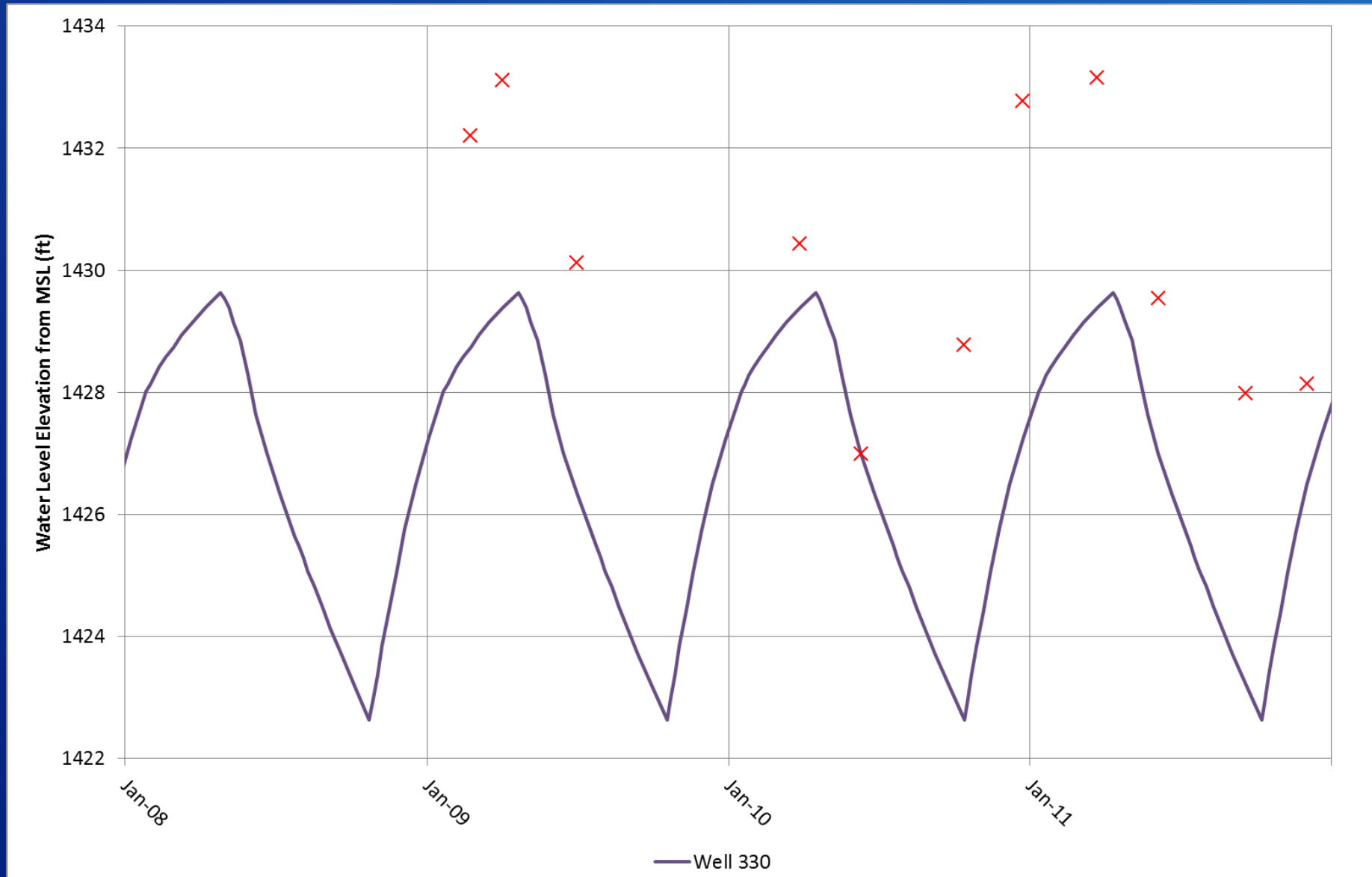


Head Comparison: Transient



Modeling Scenarios

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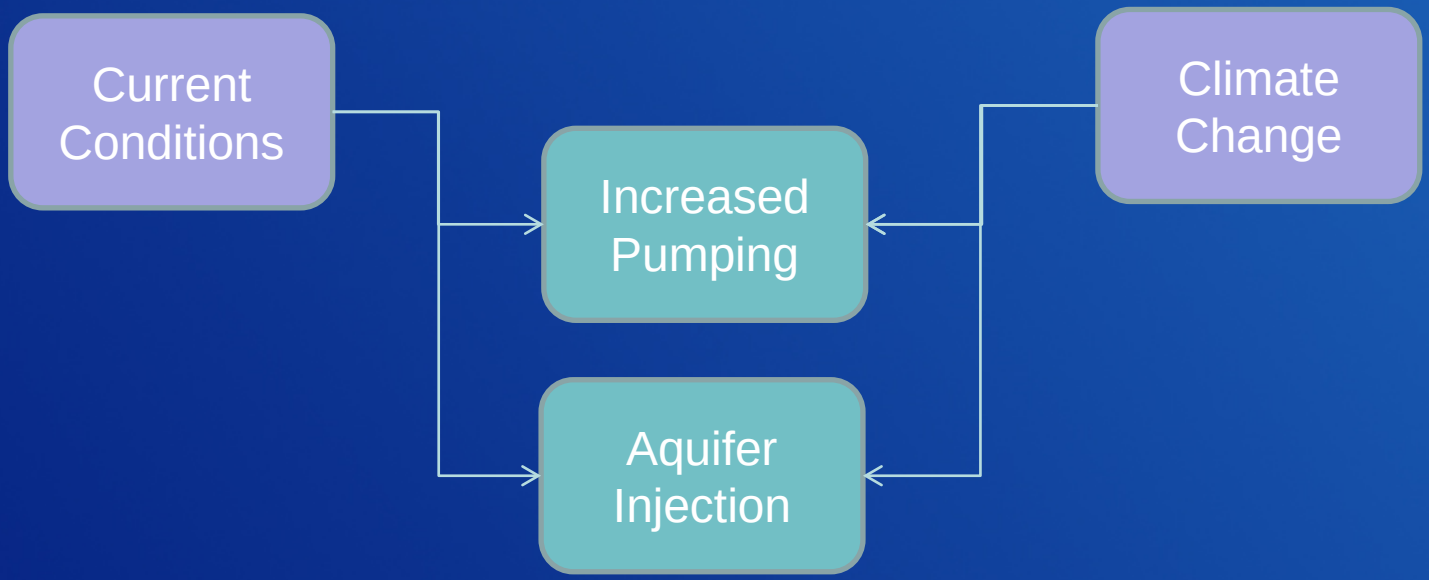
Model Scenarios

- Scenarios were formulated to answer the following questions:
  1. How will hydrologic changes due to climate change impact groundwater conditions?
  2. How will new development impact groundwater conditions in the basin including discharge to streams?
  3. Is managed recharge a viable option for improving stream flow?
  4. Can the basin aquifer be used for aquifer storage and recovery?

Model Scenarios

- Two underlying conditions each with two different scenarios
  - Conditions:
    - Current conditions
    - Climate change conditions
  - Scenarios:
    - Increased pumping
    - Aquifer injection



Current Conditions

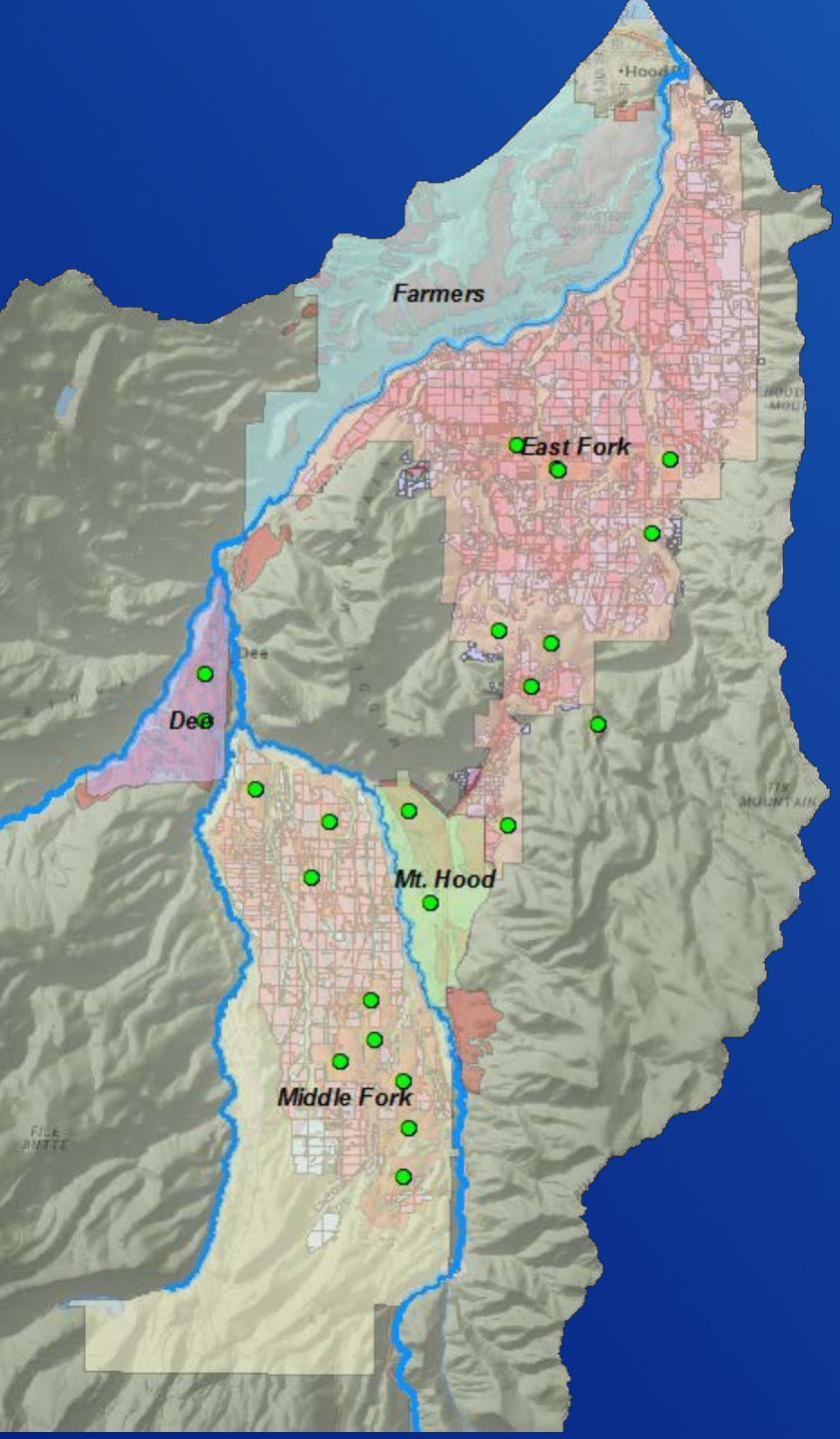
Scenario: Increased Pumping

- Maintain DMCI use
  - ~ 1% Domestic & Municipal, ~29% Commercial & Industrial, 70% Irrigation
- Increase irrigation use based on available irrigable acreage

ACREAGE IN HOOD RIVER COUNTY IRRIGATION DISTRICTS

District	Irrigable (acres)	Irrigated (acres)	Available (acres)	Qreqd (af/acre)	Wells Now	Needed Wells
DID	1297	951	346	2	0	2
EFID	10400	8525	1875	2	8	10
FID	7033	7033	0	2	6	
MFID	8000	6373	1627	2	2	9
MHID	1331	1090	241	2	0	2
SUM	28061	23972	4089			acres per well
Source: Hood River Soil & Water Conservation District, 1978.						200

Source: http://www.co.hood-river.or.us/vertical/Sites/%7B4BB5BFDA-3709-449E-9B16-B62A0A0DD6E4%7D/uploads/%7B1A759675-F44C-4224-A1E2-311BC2003587%7D.PDF



Scenario: Increased Pumping

- Pumps added to irrigate prime farmlands within ID boundaries that are currently not irrigated

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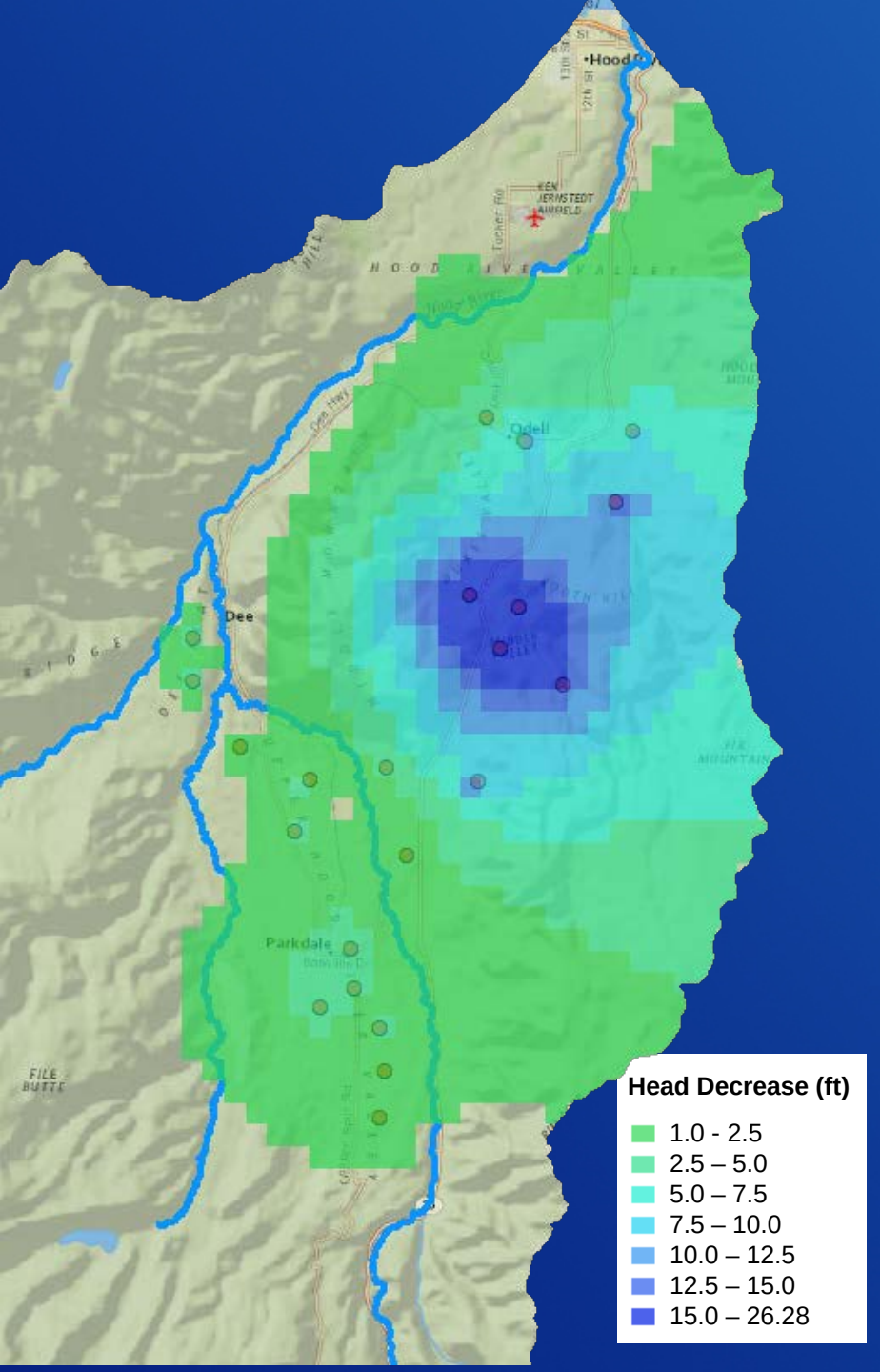

Scenario: Increased Pumping

- Greatest head difference between Baseline and the scenario shown here
  - End of summer Year 5 for the given well configuration

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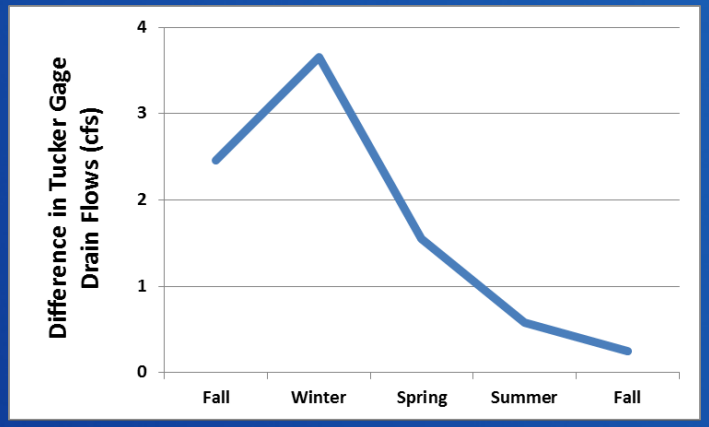
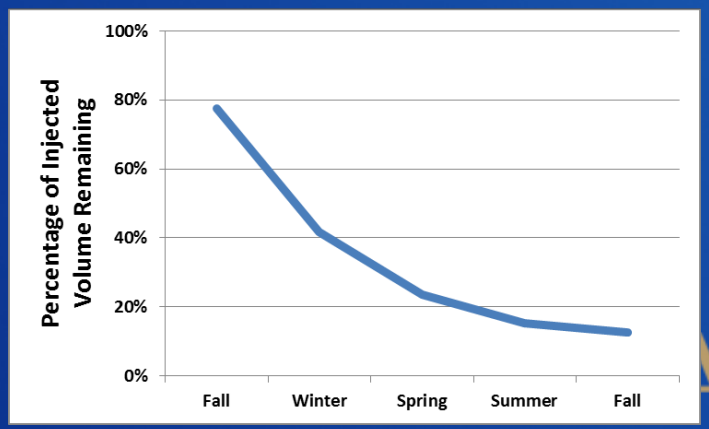
Scenario: Aquifer Injection

- Injection wells were iteratively added to each model cell and response for the entire model domain was evaluated and compared to the Baseline.



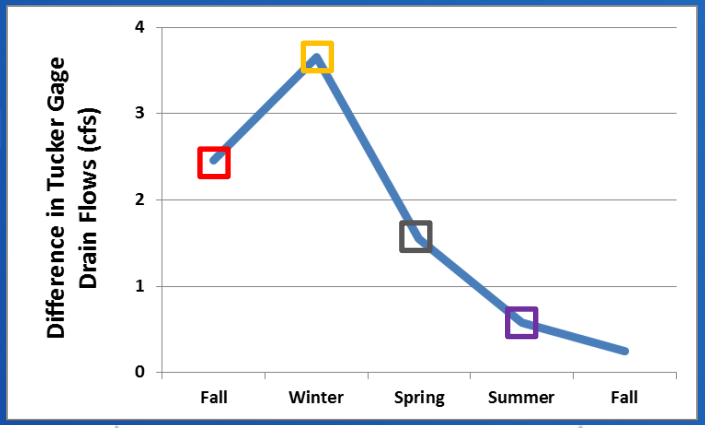
ASR for Streamflow Augmentation

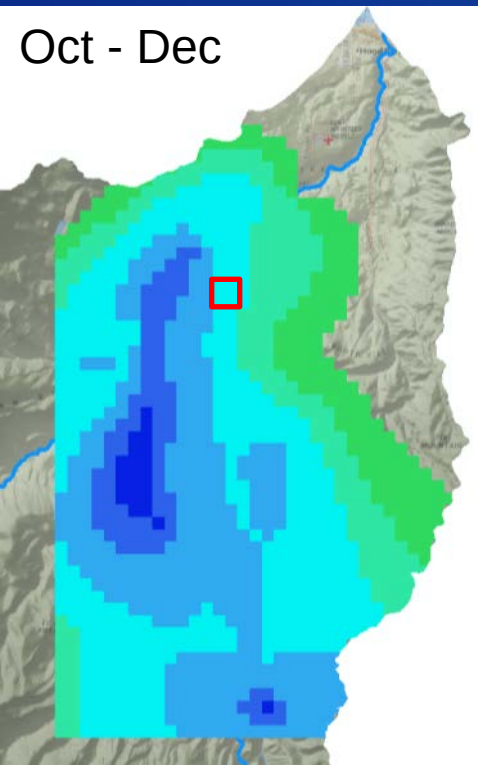


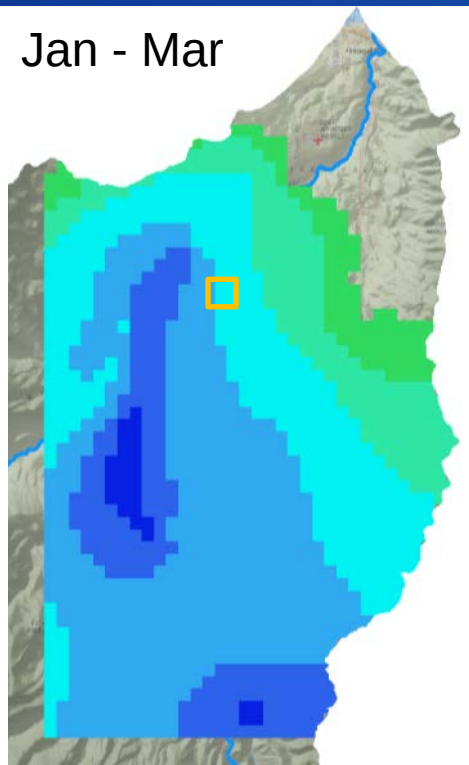
ASR for Irrigation Withdrawal

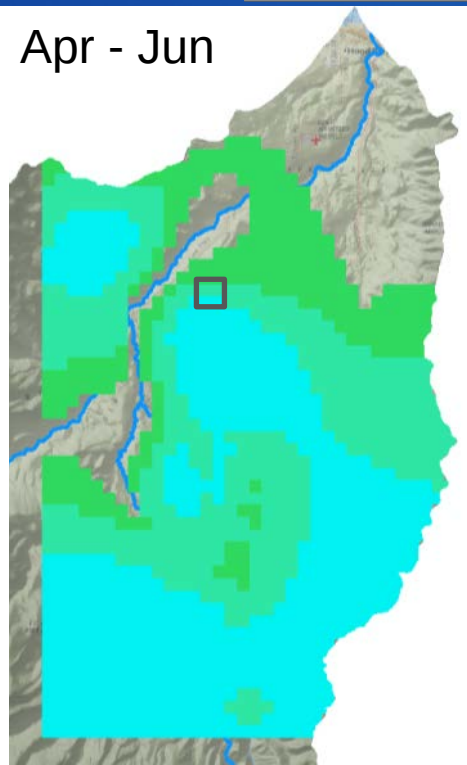
Scenario: Injection for Streamflow Augmentation

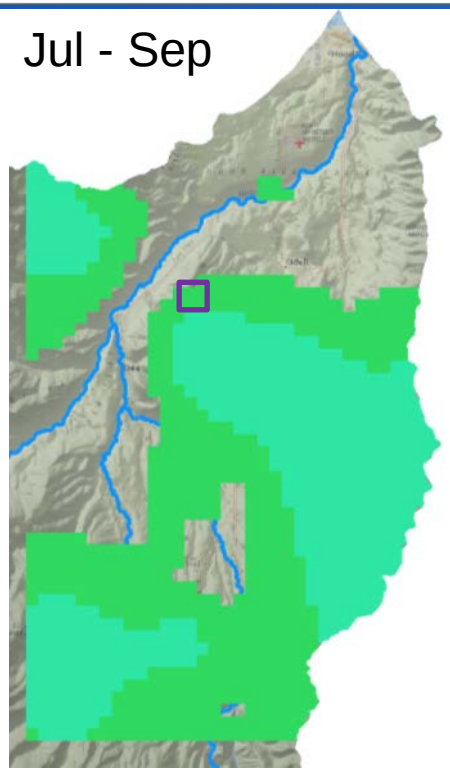
- The difference in stream gains for the H
  Tucker Bridge is mapped





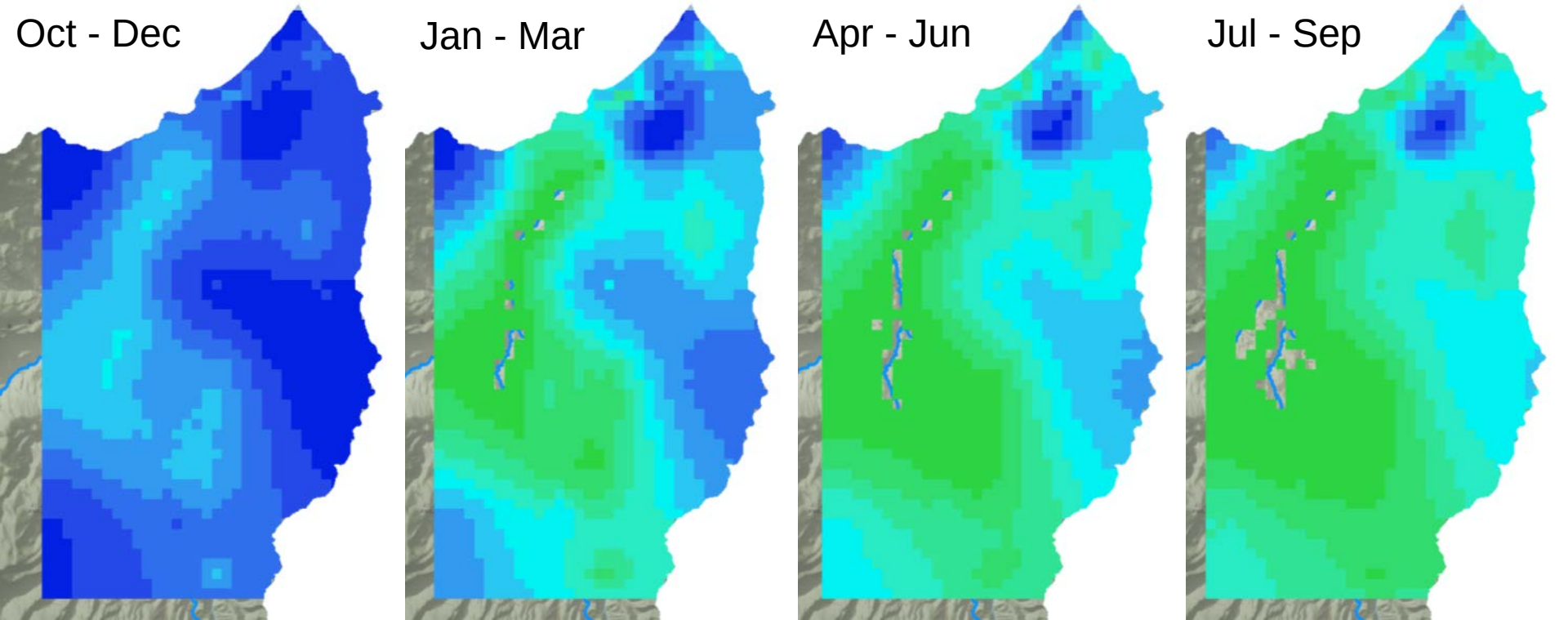






Scenario: Injection for Irrigation Withdrawal

- The volume of injected water that is retained within the model domain is mapped



Climate Change Conditions

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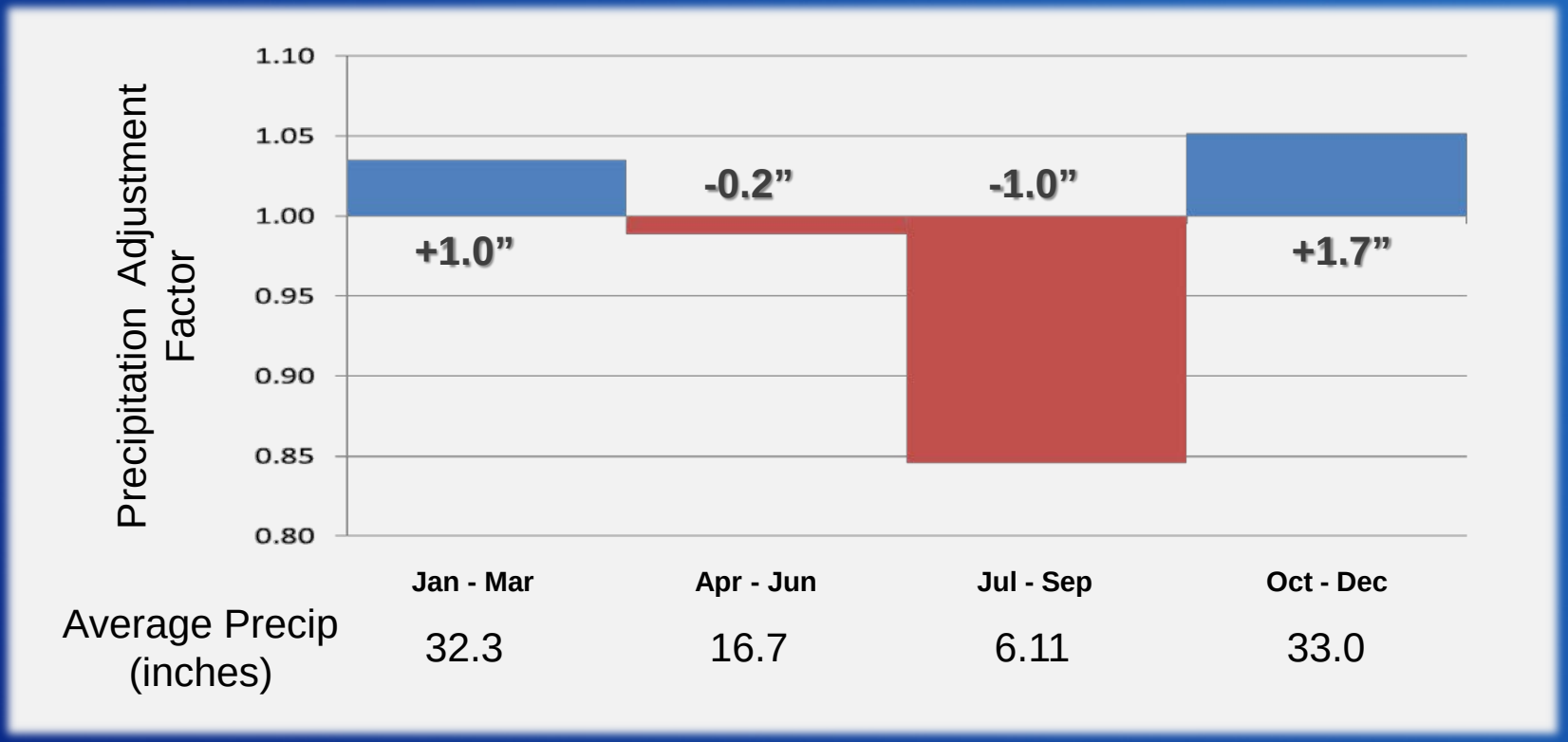
Climate Change Conditions

- Simulation of climate change conditions mimic procedures and strategies used in other Reclamation studies.
- Selected climate change conditions
  - More Warming – Drier
  - Median
  - Less Warming – Wetter

Recharge: Wet Conditions

Recharge: Median Conditions



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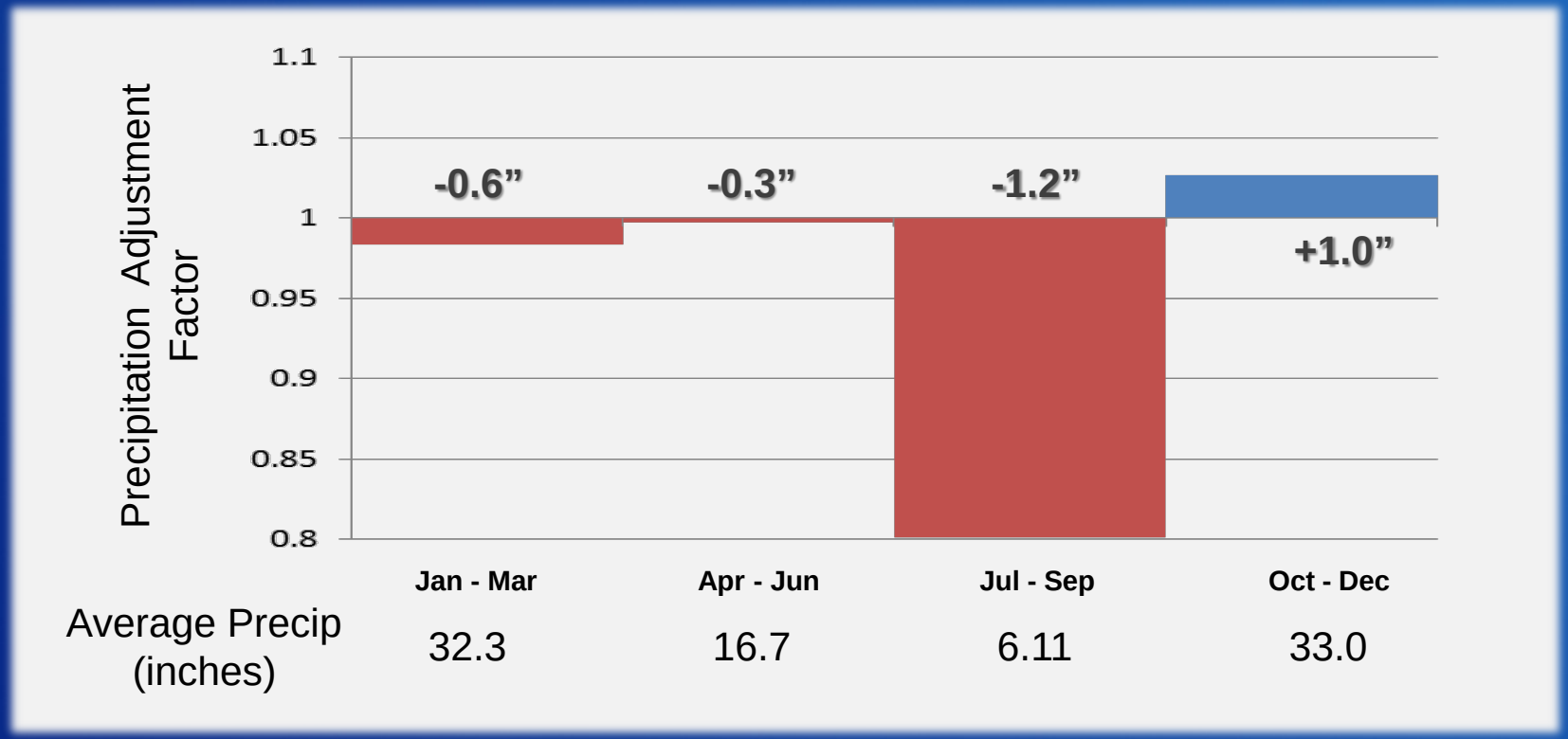
Recharge: Dry Conditions



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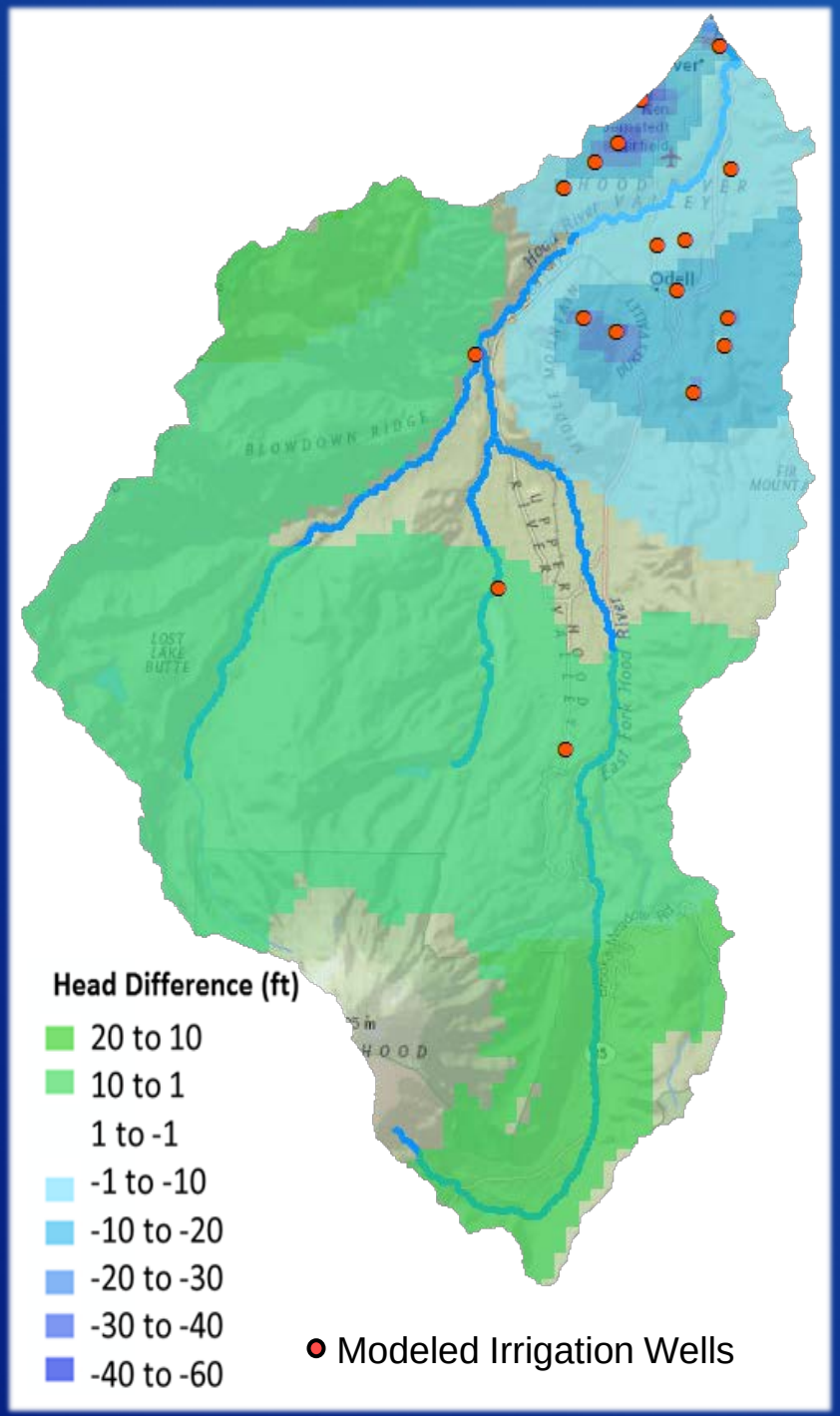
Scenario: Increased Pumping

- Additional pumping demand from 2 sources
  1. Increase in modeled Potential Evapotranspiration – direct percentage increase in GW pumping demand
  2. Decrease in modeled stream flows – assumed GW pumping increase equivalent to 50% of modeled decrease in stream flows
- Increase in pumping demand due to climate change is assessed at current irrigation wells



Scenario: Increased Pumping

- Median condition, end of summer, year 30 shown here

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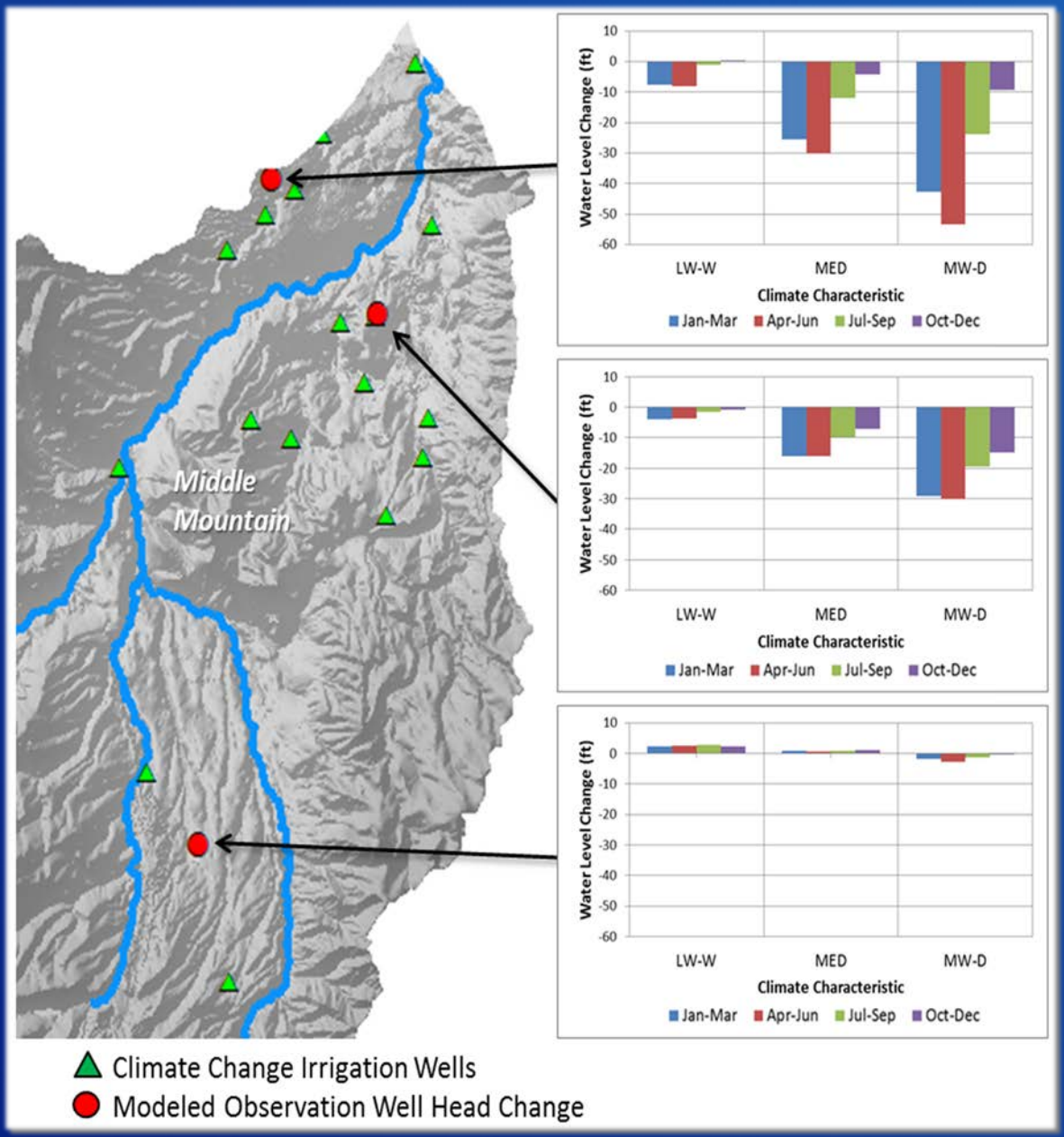
Scenario: Increased Pumping



MW-D: More Warming – Dry
MED: Median
LW-W: Less Warming – Wet

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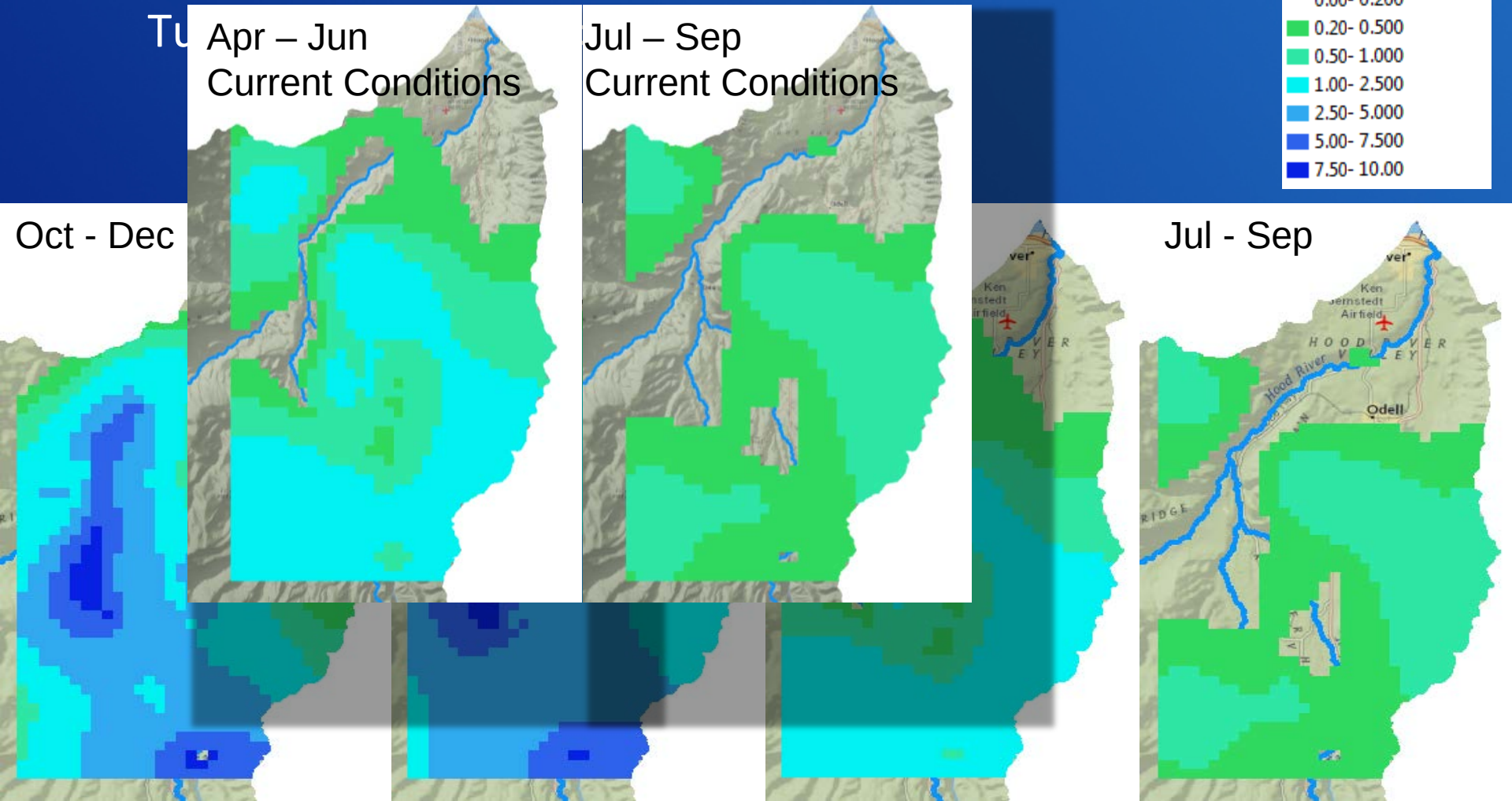
Scenario: Injection for Streamflow Augmentation

- The difference in stream gains for the Hood River at Tu



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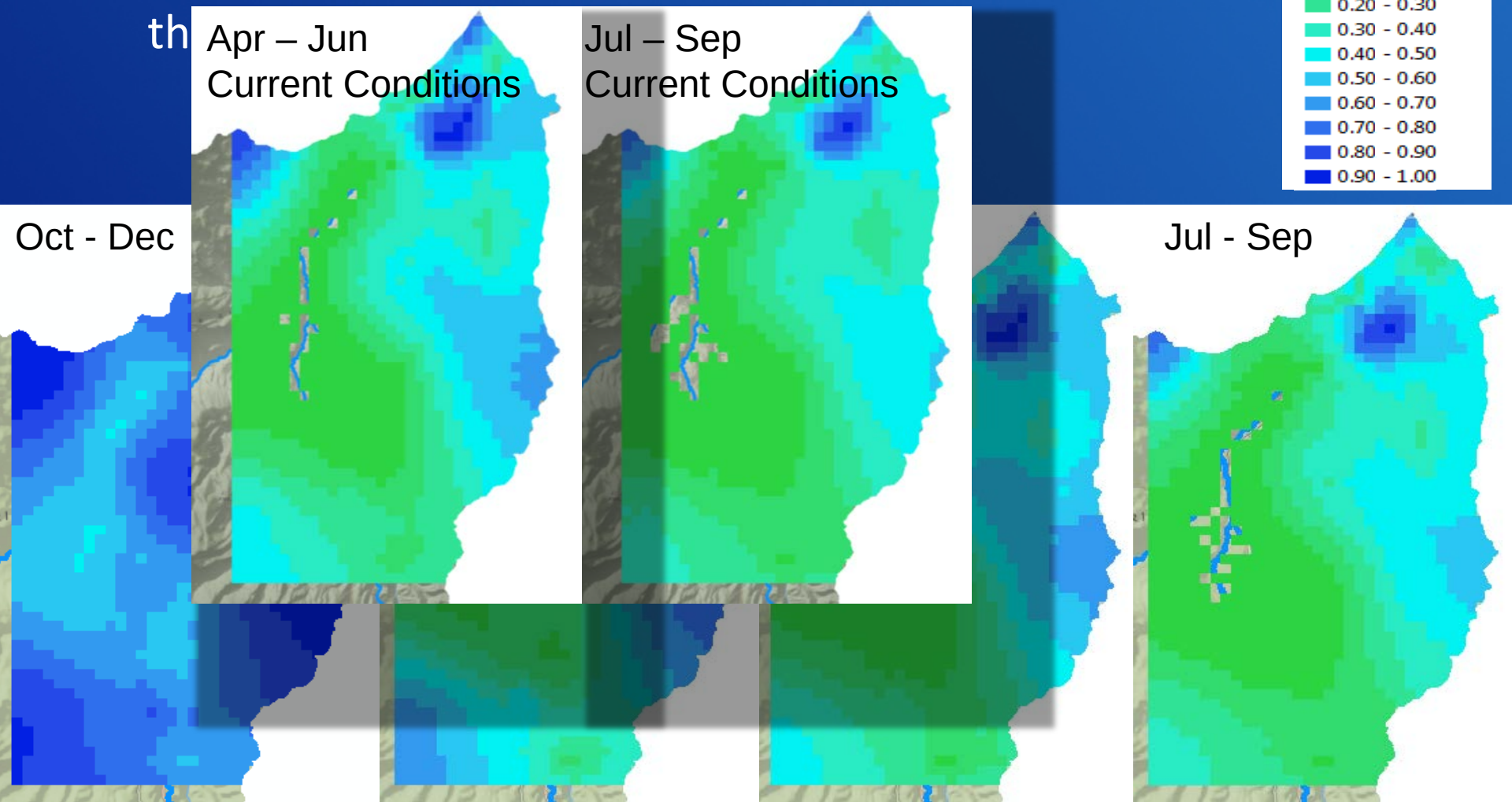

Model Answers

1. How will hydrologic changes due to climate change impact groundwater conditions?
   - Climate change conditions can be simulated by the model along with changing groundwater management considerations.
2. How will new development impact groundwater conditions in the basin?
   - Drawdowns can be simulated by the model based on the new development scenario.
3. Is managed recharge a viable option for improving stream flow?
   - Depends on the definition of viable. A return of less than 10% in the summer due to direct injection .
   - There might be some potential in using infiltration ponds.
4. Can the basin aquifer be used for aquifer storage and recovery?
   - There is some potential at select locations.

Ongoing Efforts

- Documentation
- Packaging

Acknowledgements

- Marshall Gannet, Erick Burns, & Terrence Conlon (USGS)
- Niklas Christensen
- Mattie Bossler

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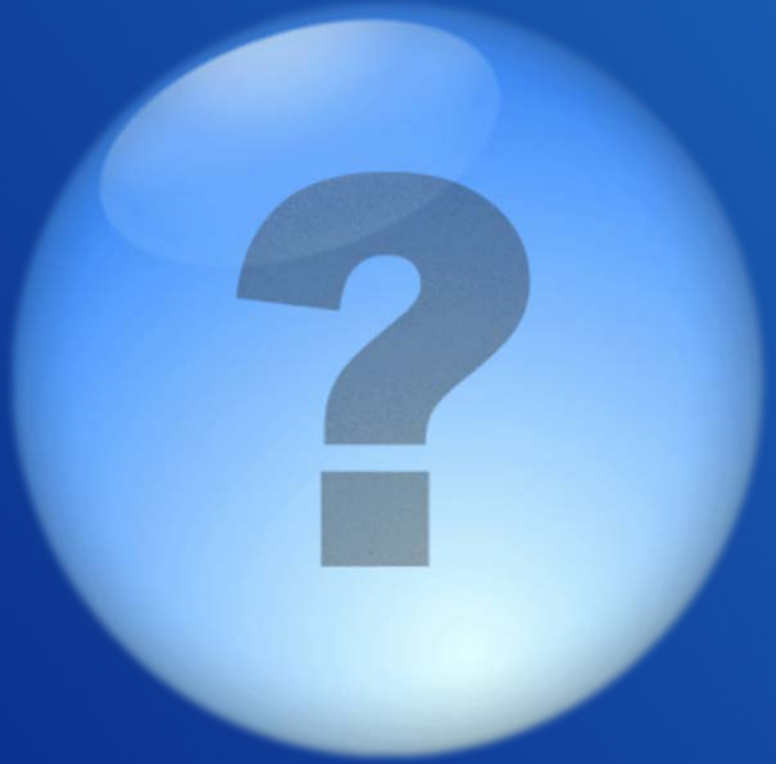
Questions



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