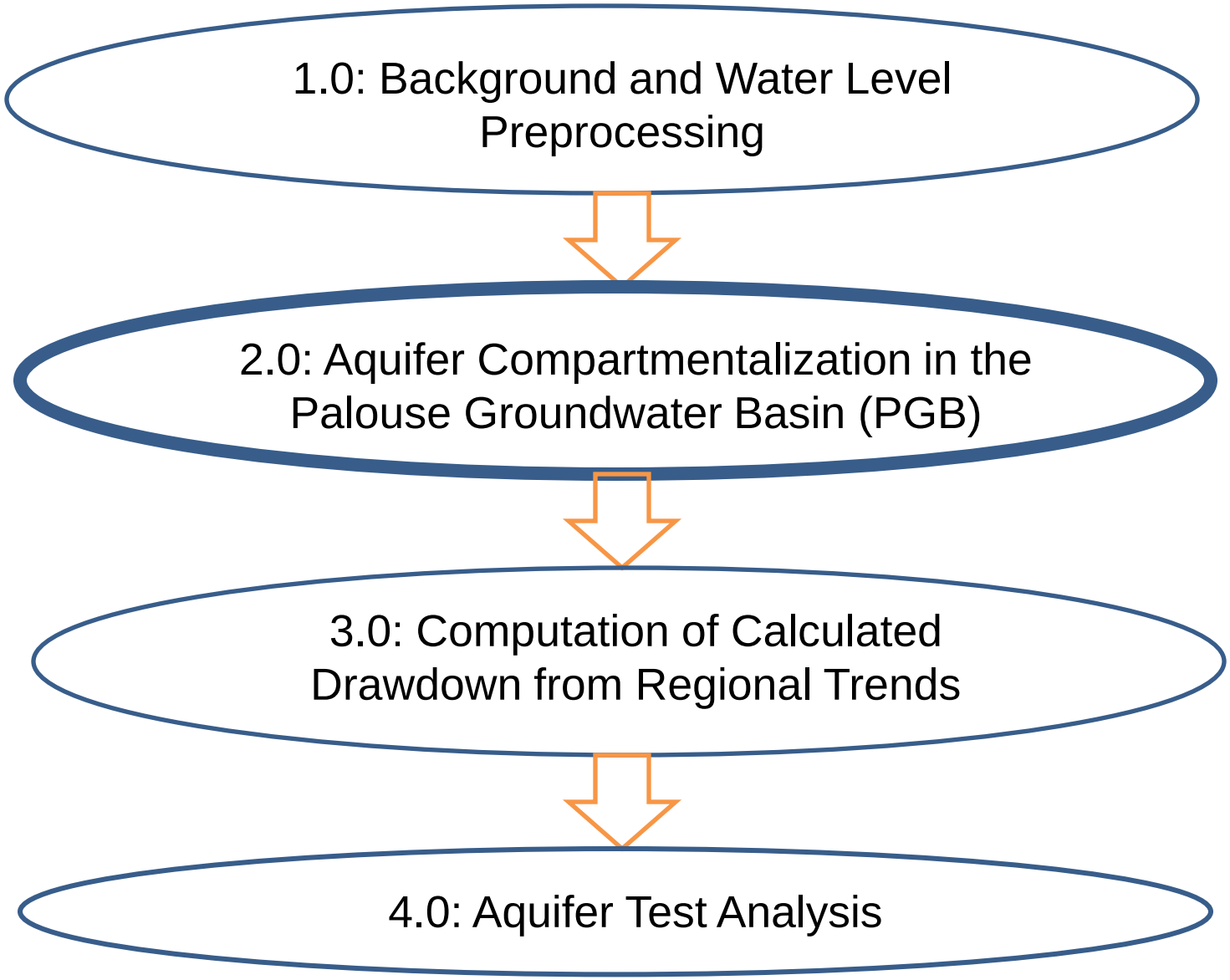
Reevaluating Palouse Groundwater Basin Compartmentalization

Attila J. Folnagy
Jim Osiensky

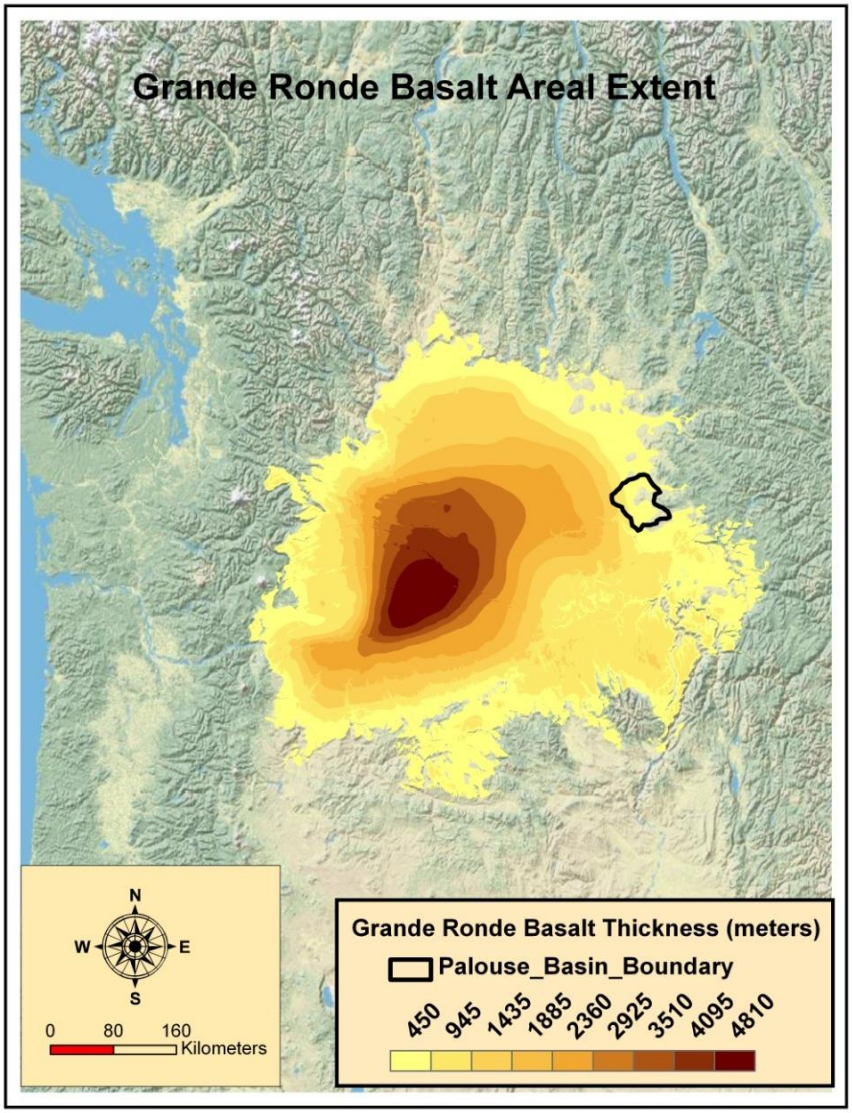
GSA-RM Meeting

May 19, 2016

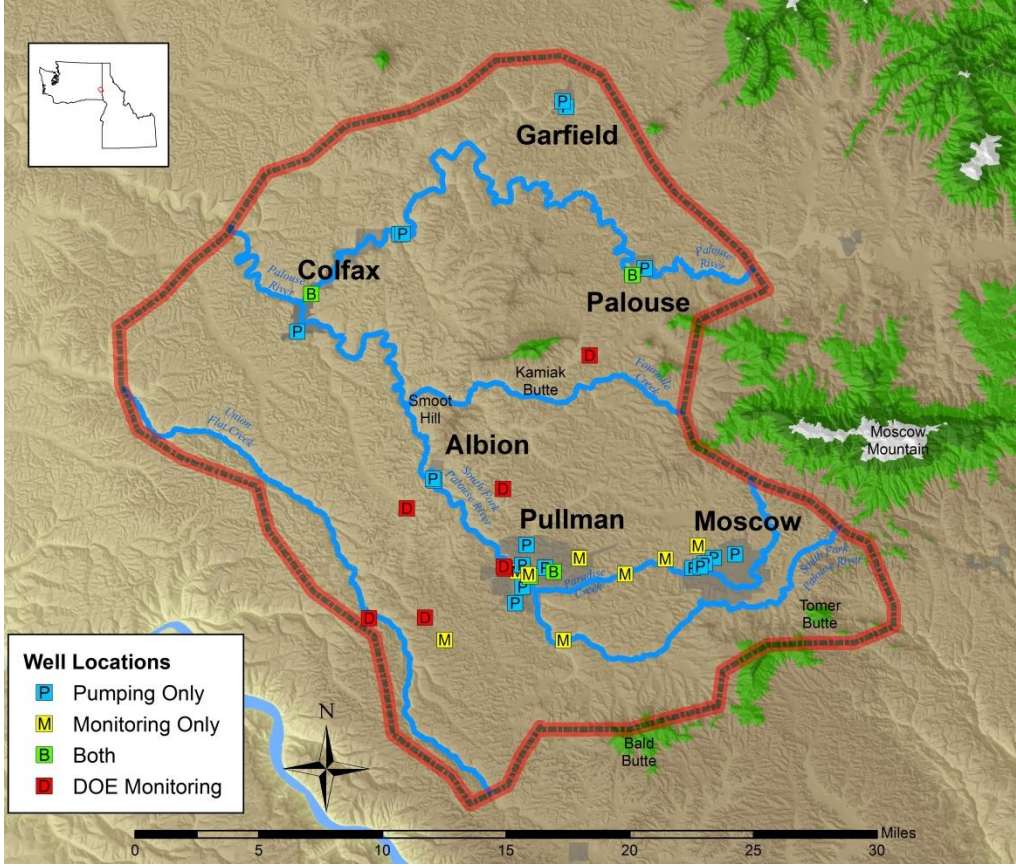
Objectives


1.0: Background and Water Level Preprocessing
2.0: Aquifer Compartmentalization in the Palouse Groundwater Basin (PGB)
3.0: Computation of Calculated Drawdown from Regional Trends
4.0: Aquifer Test Analysis

Study Area

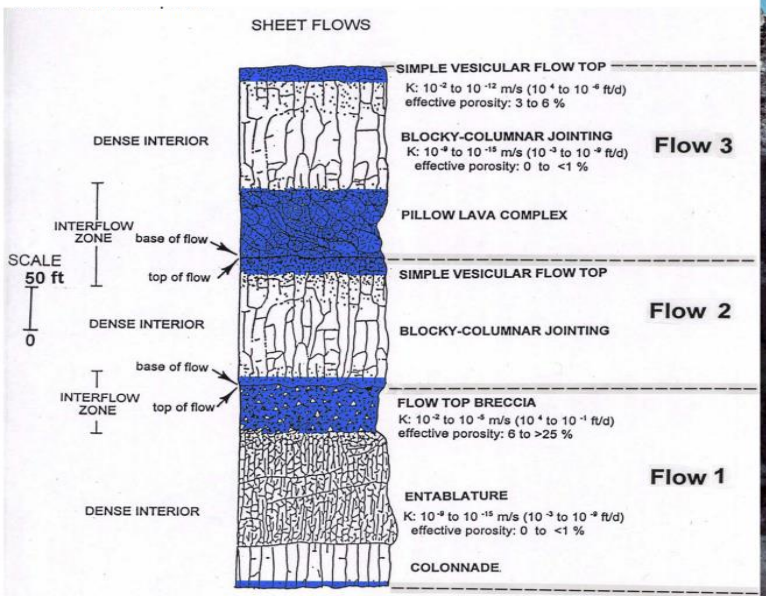


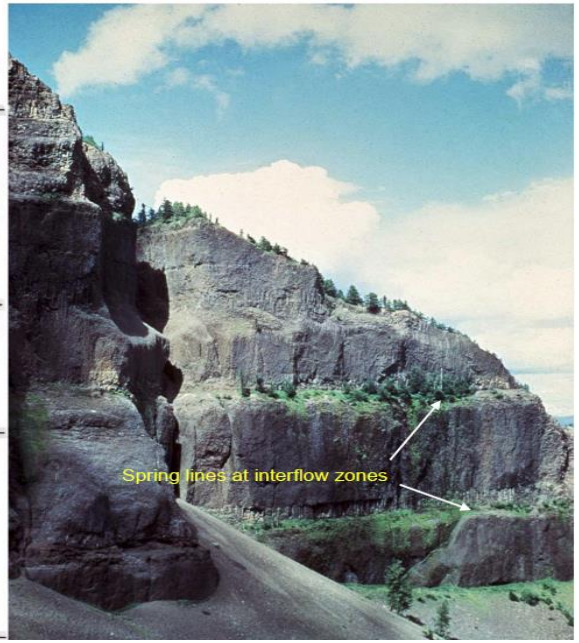
Burns (2011)



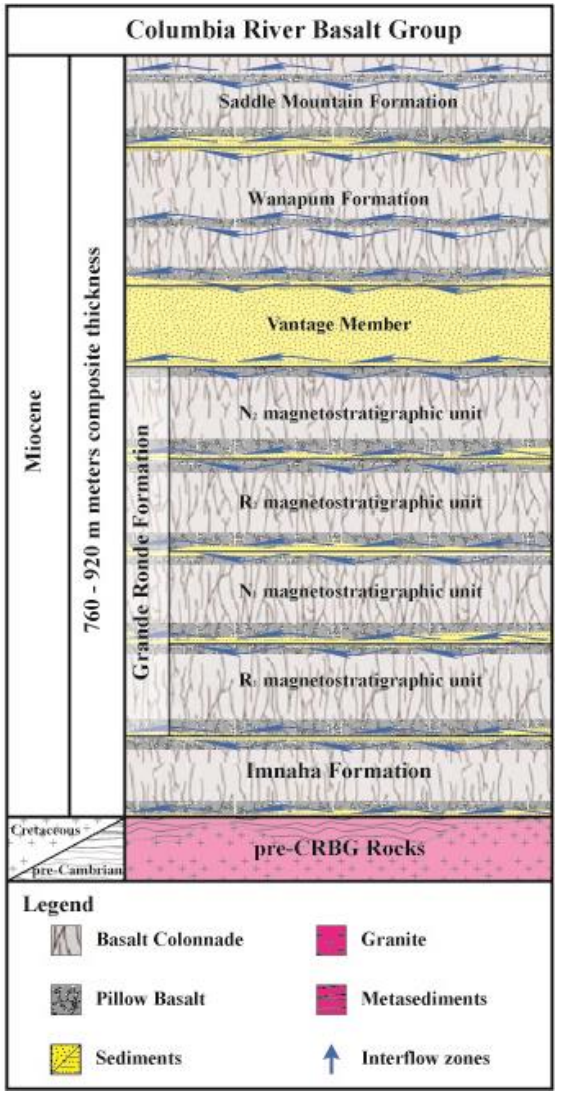
Bush (2005)

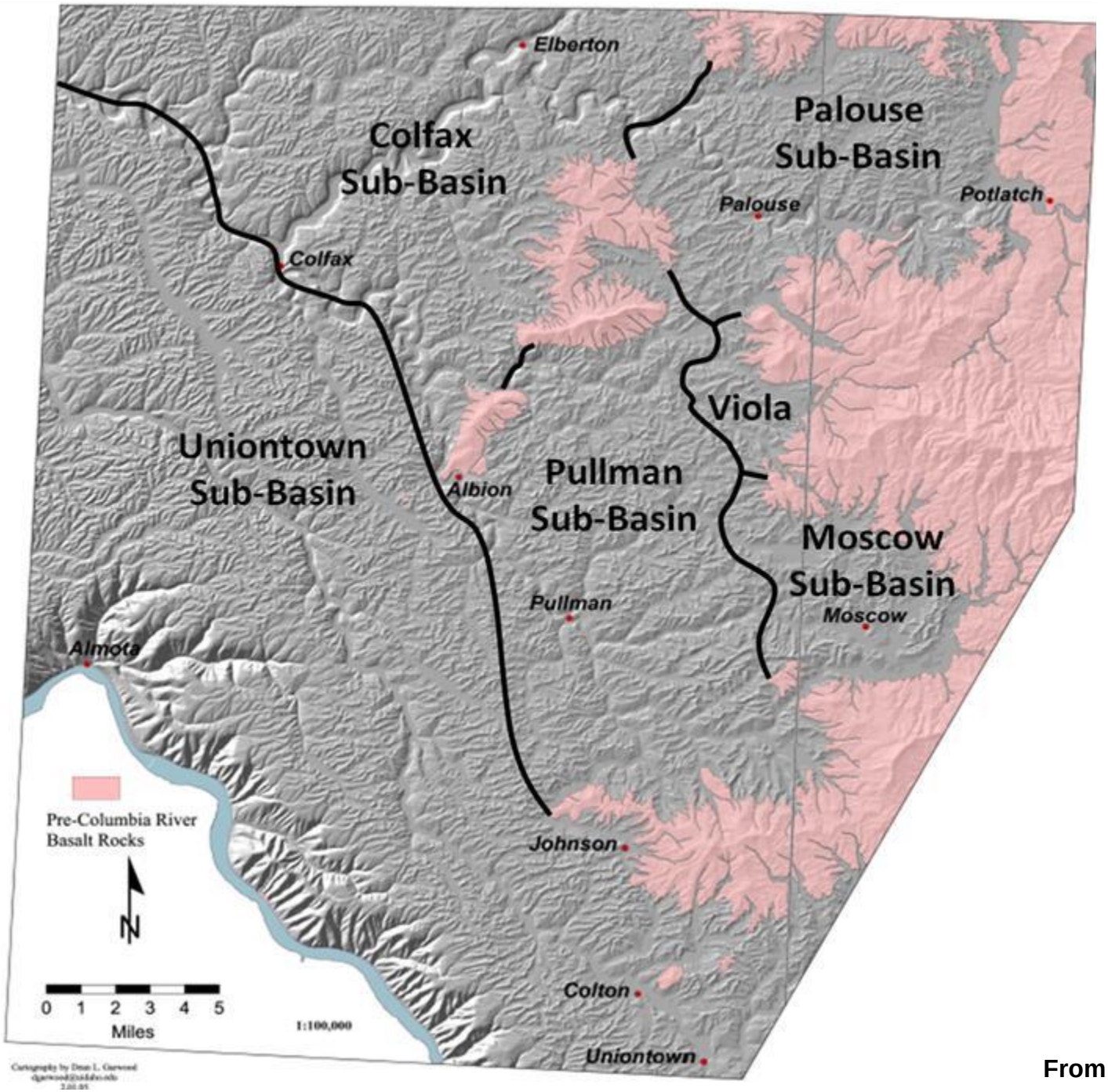
Columbia River Basalt Group (CRBG)





CBGM (2011)



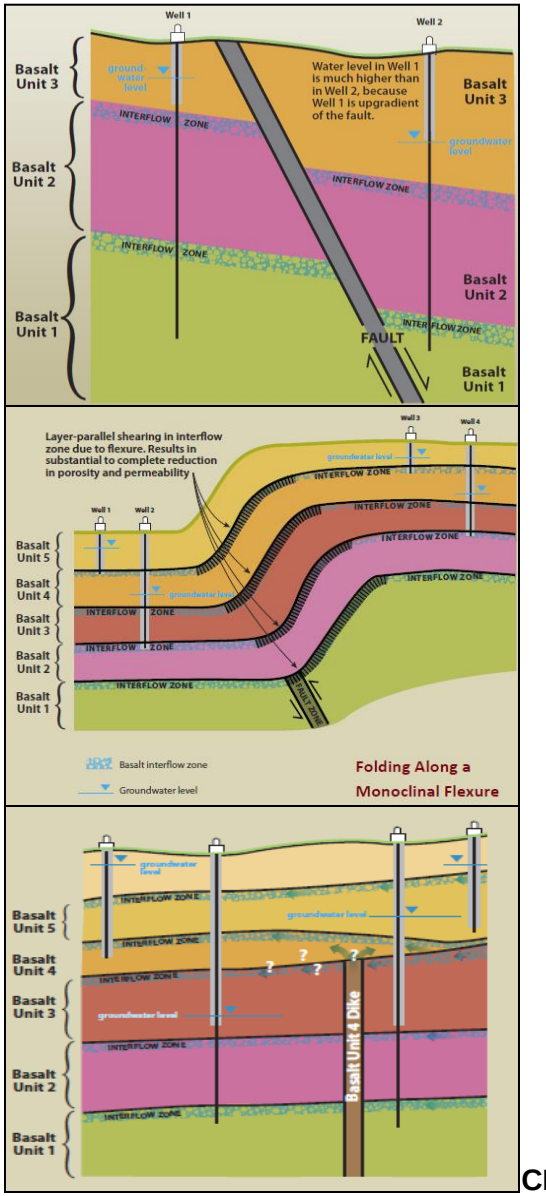


From Bush (2005)

2.0: Aquifer Compartmentalization in the Palouse Groundwater Basin

Compartment Forming Features

- **Faults:** offsets tabular, permeable interflow zones and create linear features of low horizontal and high vertical permeability
- **Folds:** disrupts the principal directions of anisotropy
- **Dikes:** result in significant contrasts in well yields and water levels



CBGM (2011)

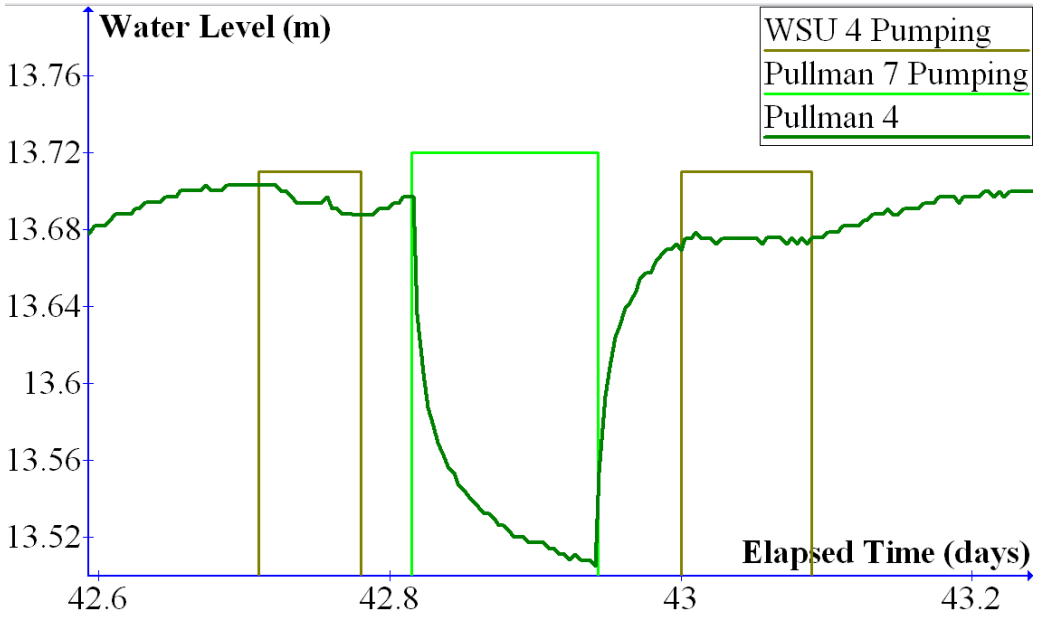
Lateral Compartmentalization

- Defined as the division of the Grande Ronde Formation into irregularly shaped blocks (i.e., compartments) that are hydraulically separated laterally by sub-vertical, low hydraulic conductivity zones.

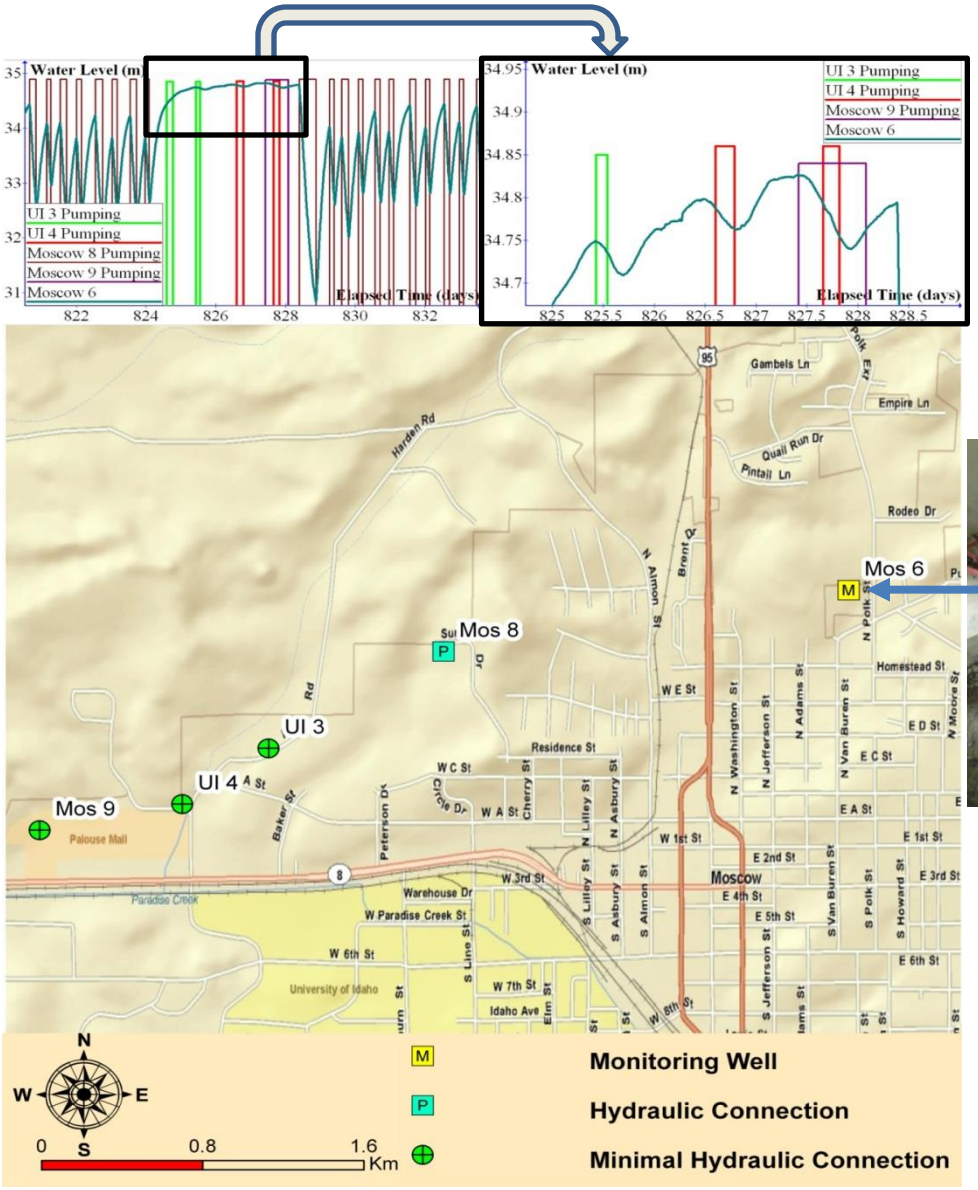
- Wells within an individual compartment respond predictably to short-term pumping stresses.

Hydraulic Connection Types

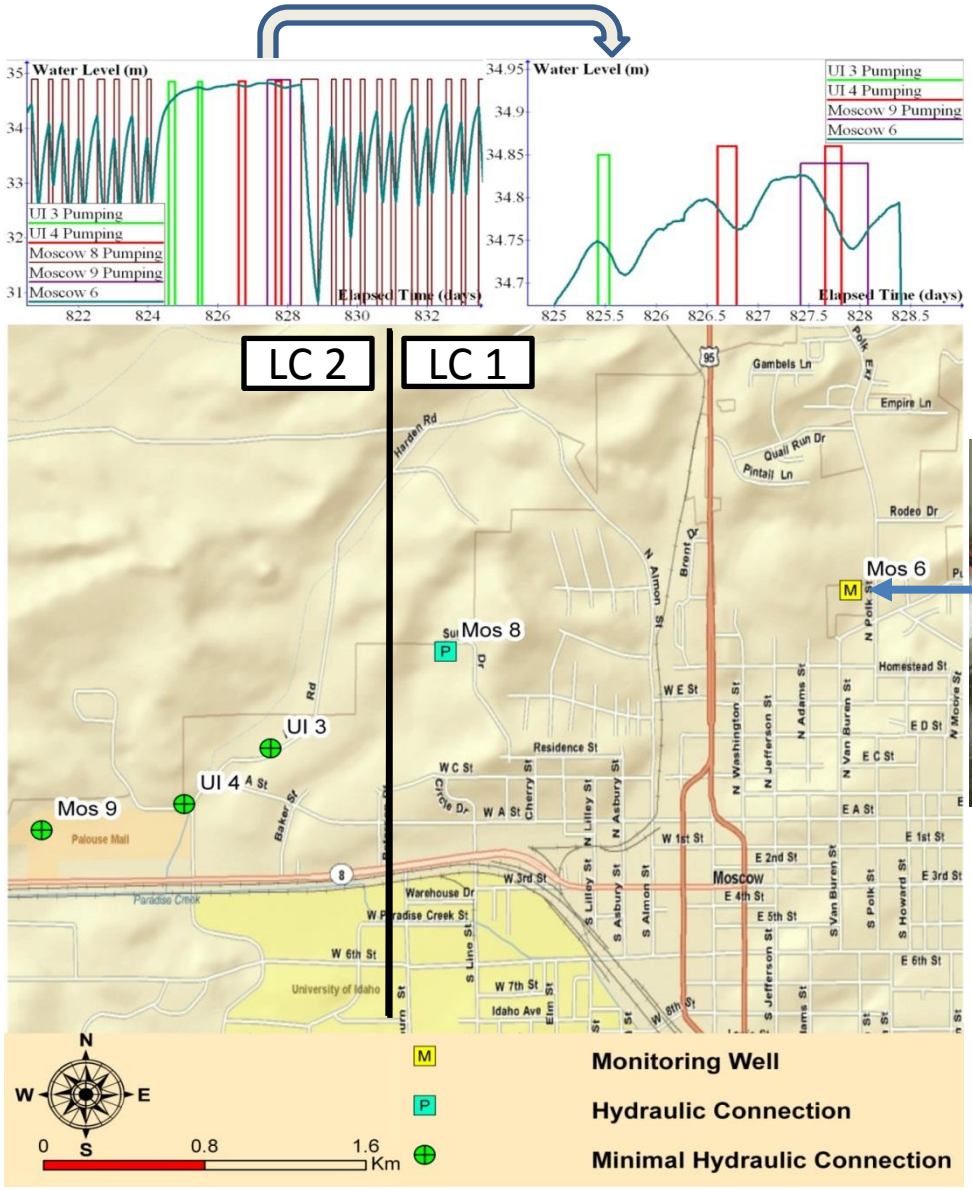
- Drawdown spikes (no compartment walls between them)
- Damped response (i.e., a non-theoretically predicted response)



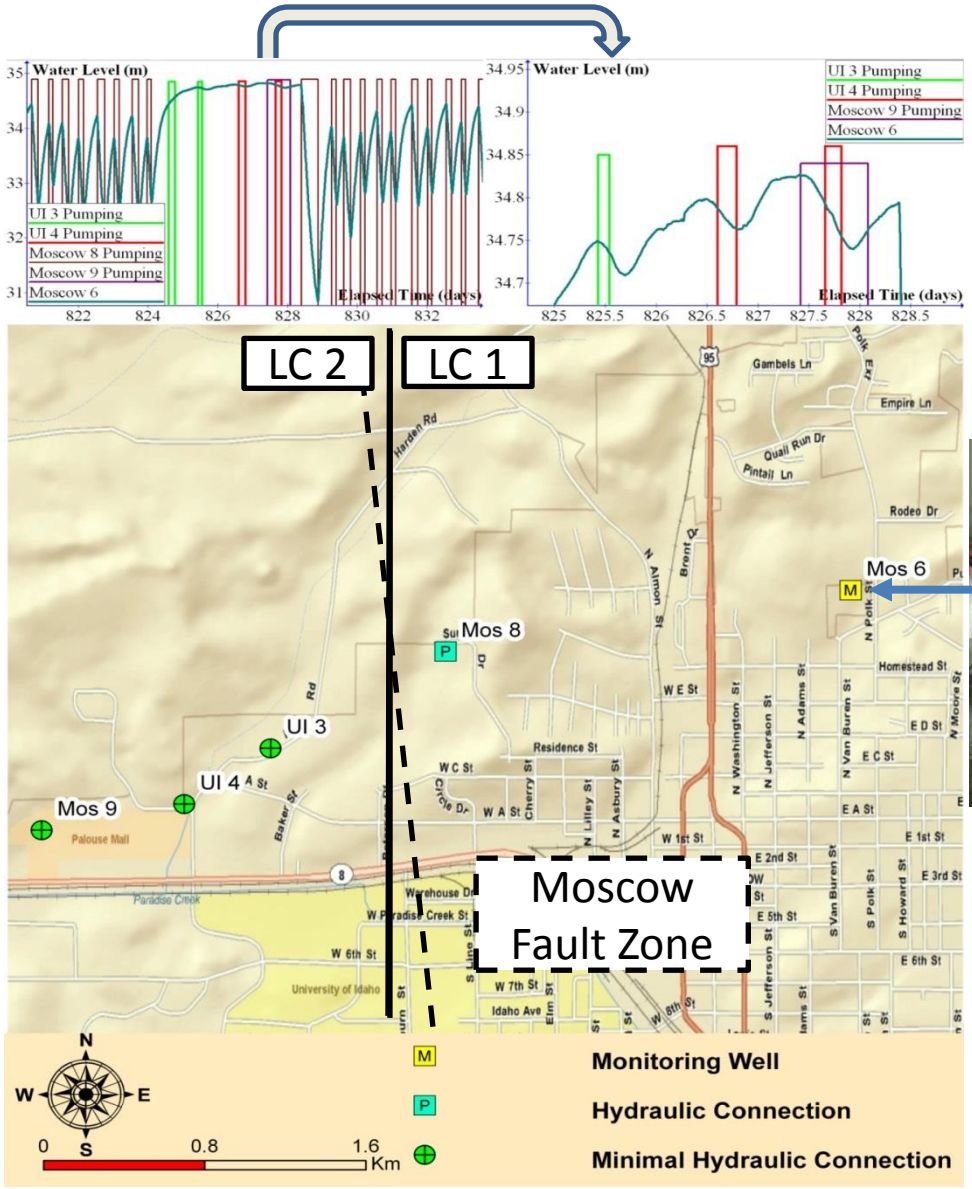
Determining Lateral Compartments



Lateral Compartment 1 (LC 1)

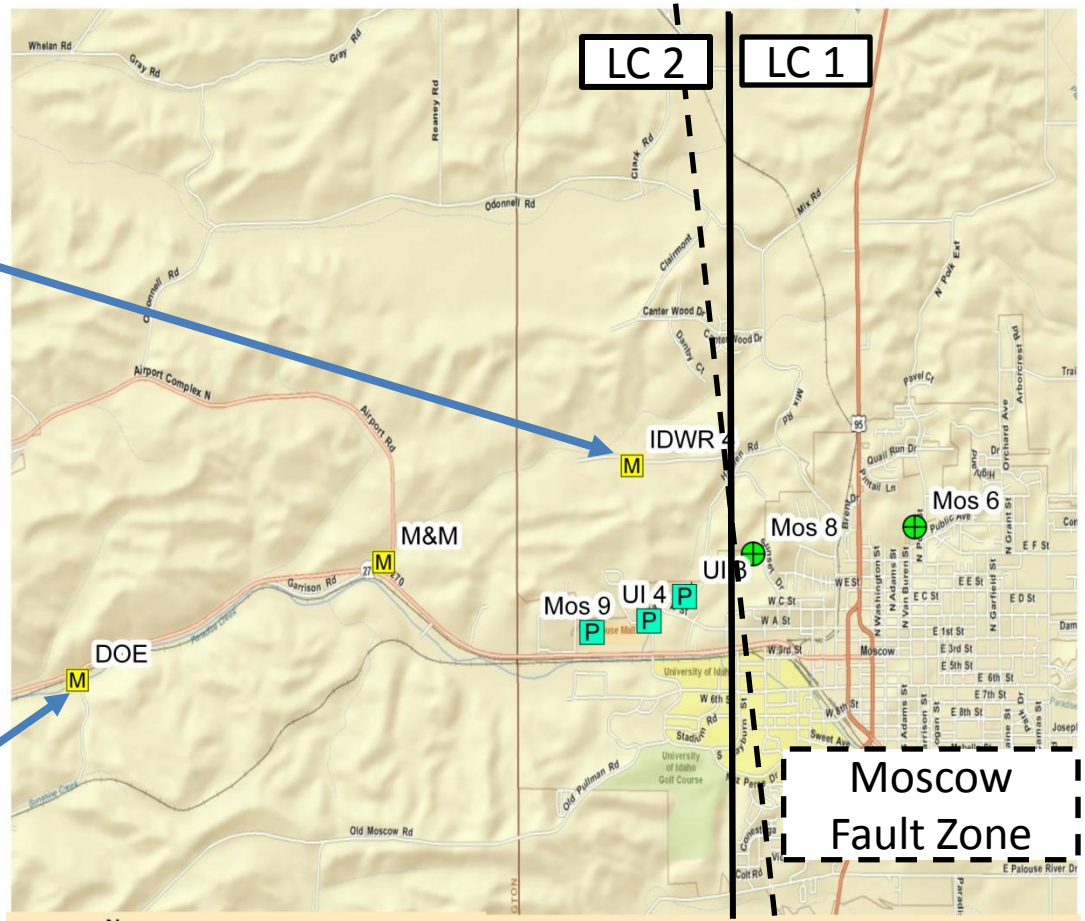


Lateral Compartment 1 (LC 1)



Moscow Fault Zone mapped by Conrey and Crow (2014)

Lateral Compartment 2 (LC 2)

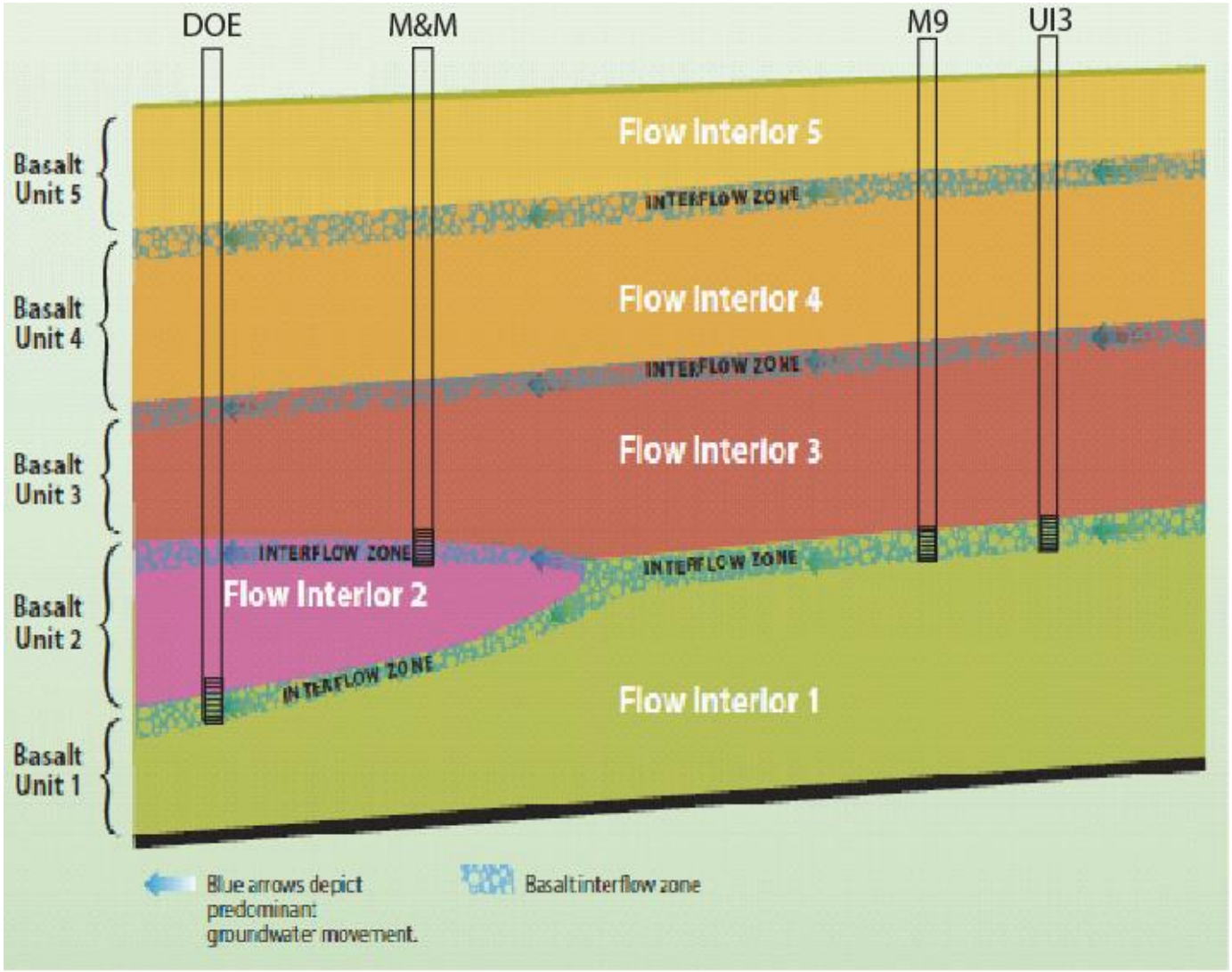


LC 2 Hydraulic Connections

- P — **Hydraulic Connection**
- M — **Monitoring Well**
- ⊕ — **Minimal Hydraulic Connection**

Moscow Fault Zone mapped by Conrey and Crow (2014)

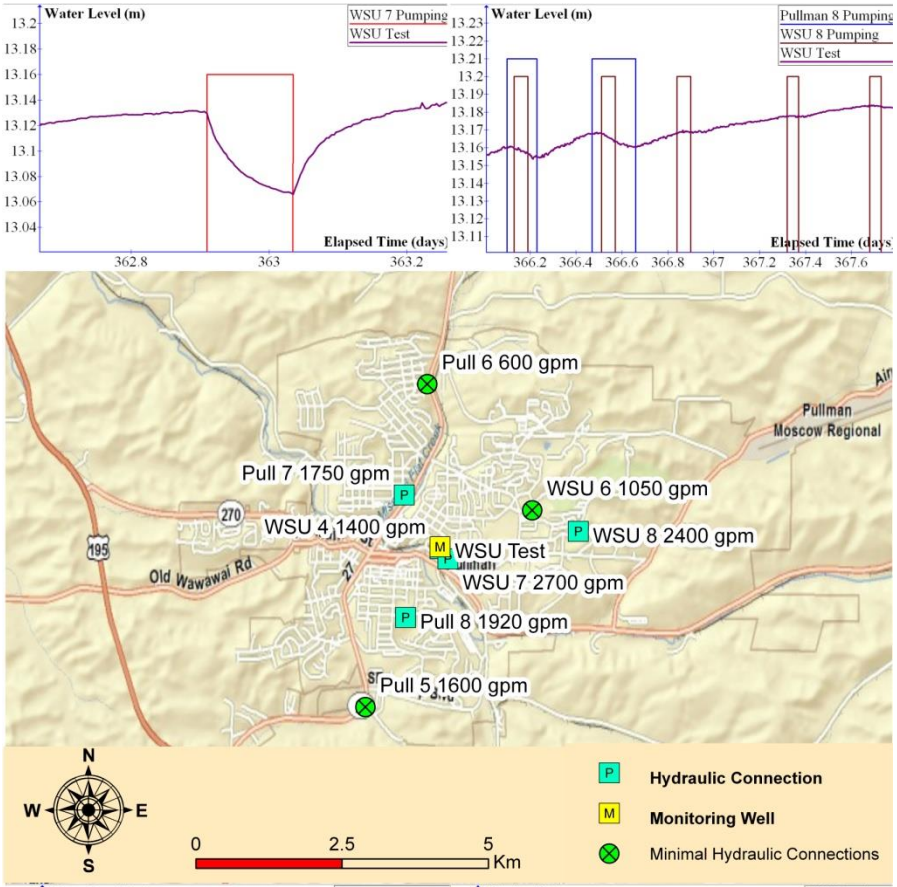
Upper Aquifer Connection to Lower Aquifer

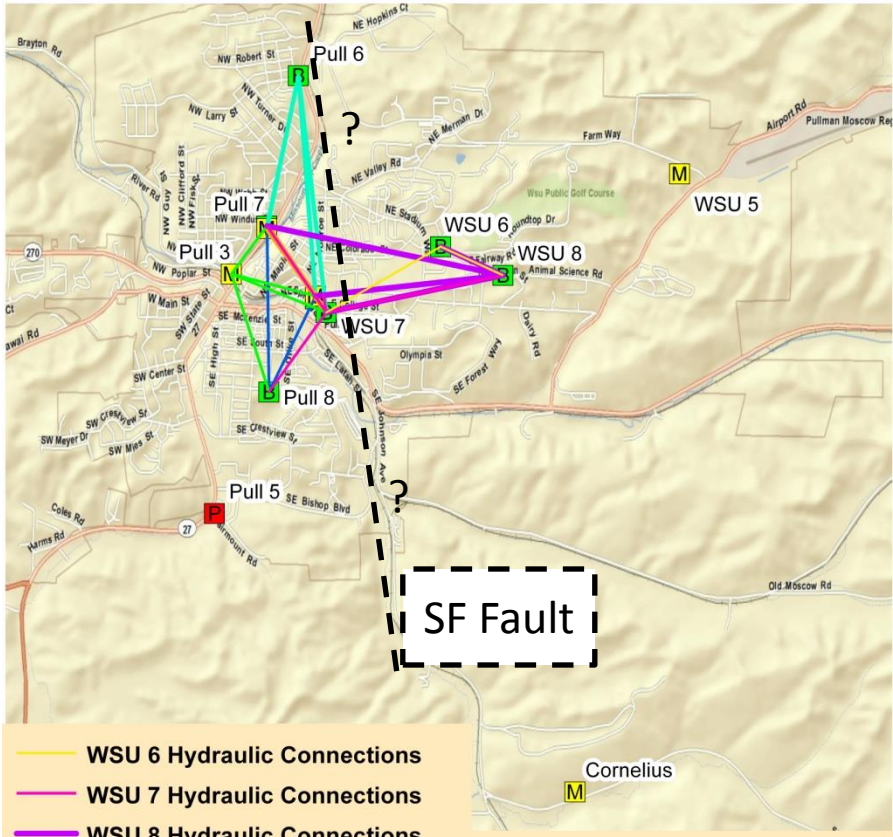


Modified from CBGM, 2011

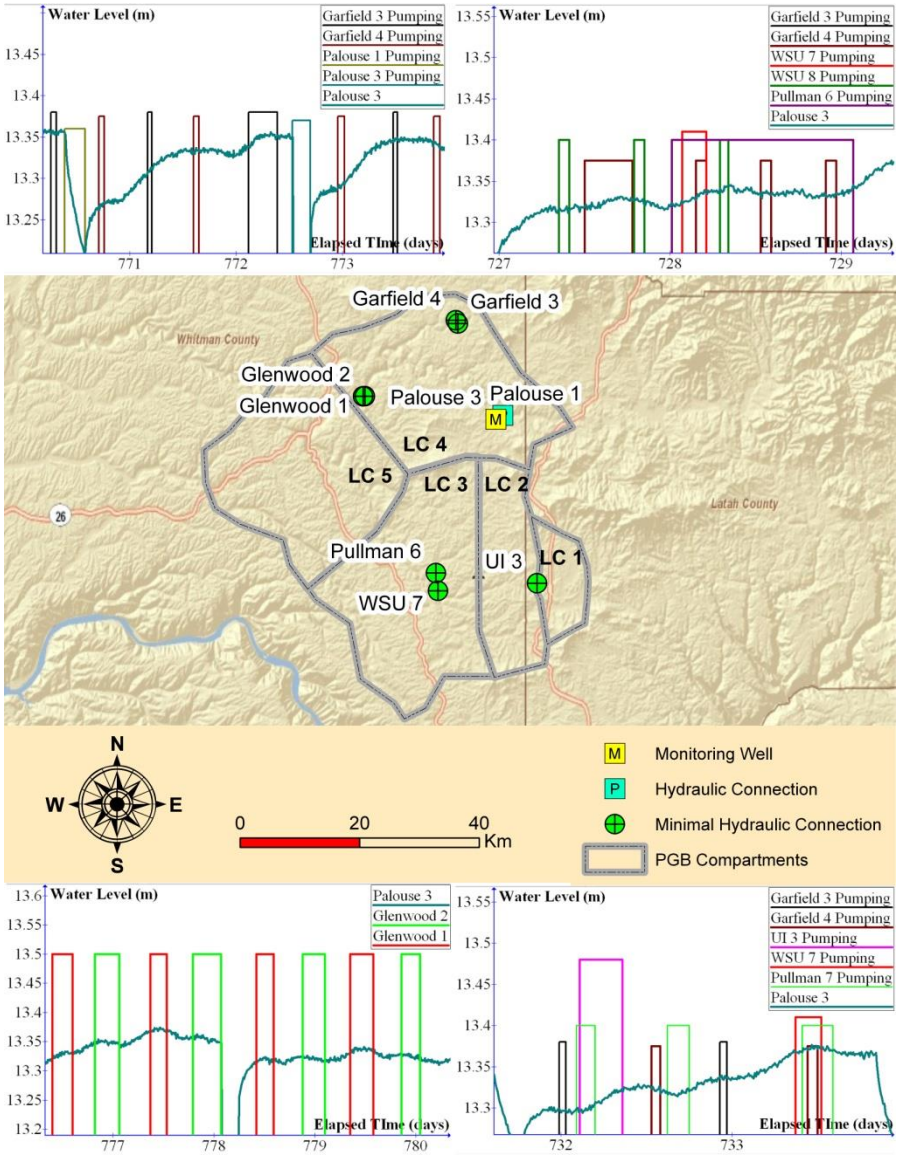
Lateral Compartment 3 (LC 3)

SF Fault mapped by Conrey and Wolff (2010)

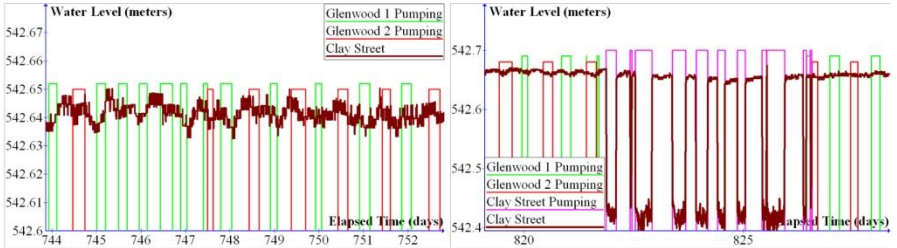


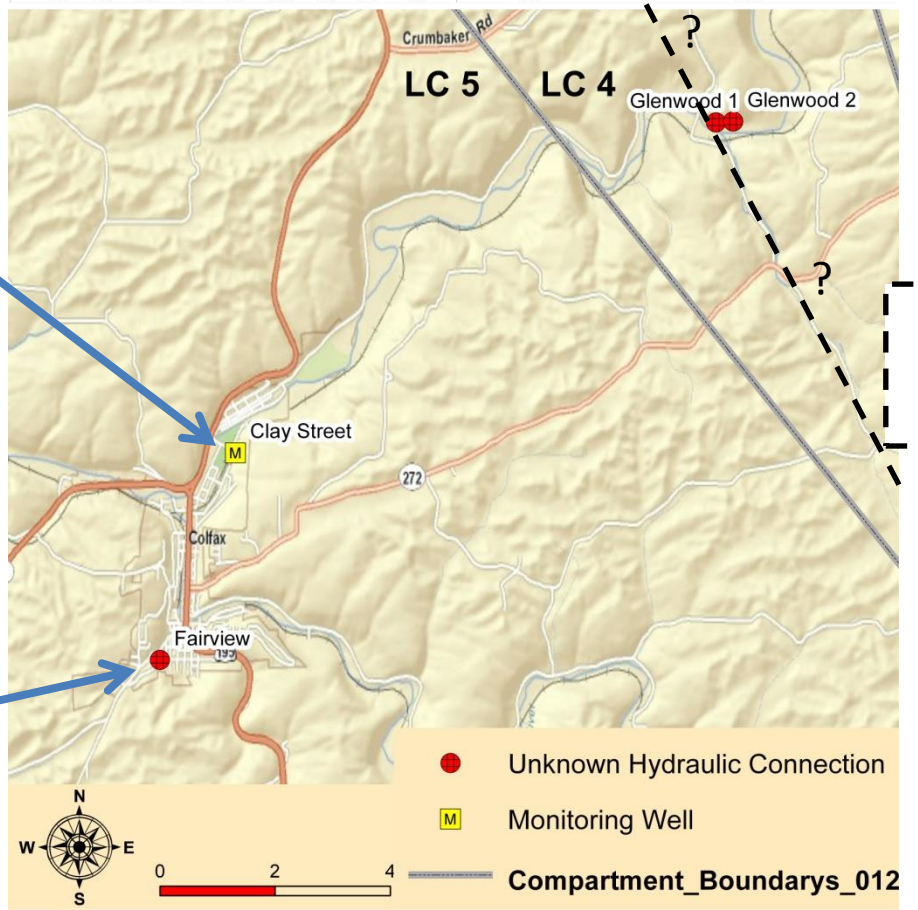


Lateral Compartment 4 (LC 4)



Lateral Compartment 5 (LC 5)

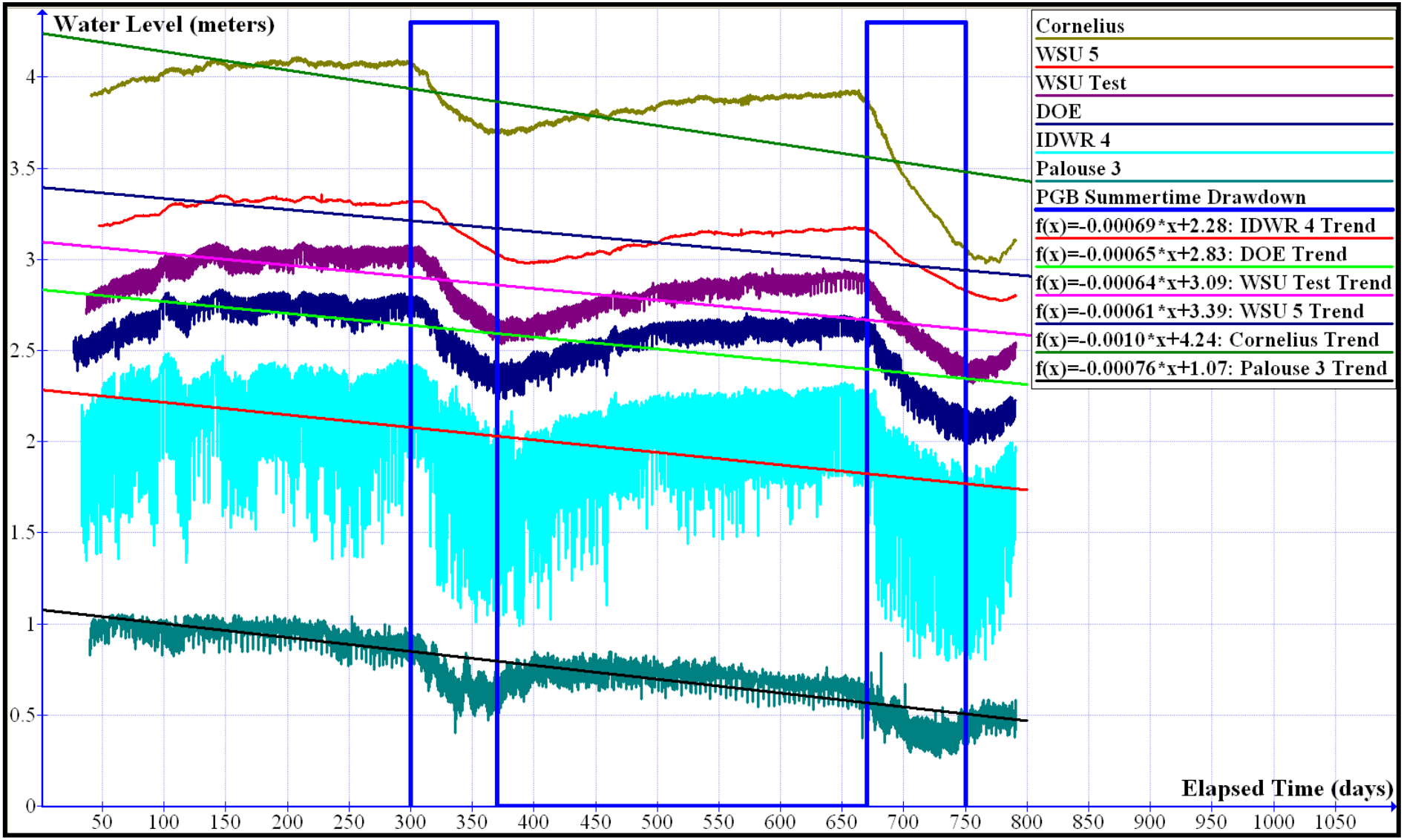




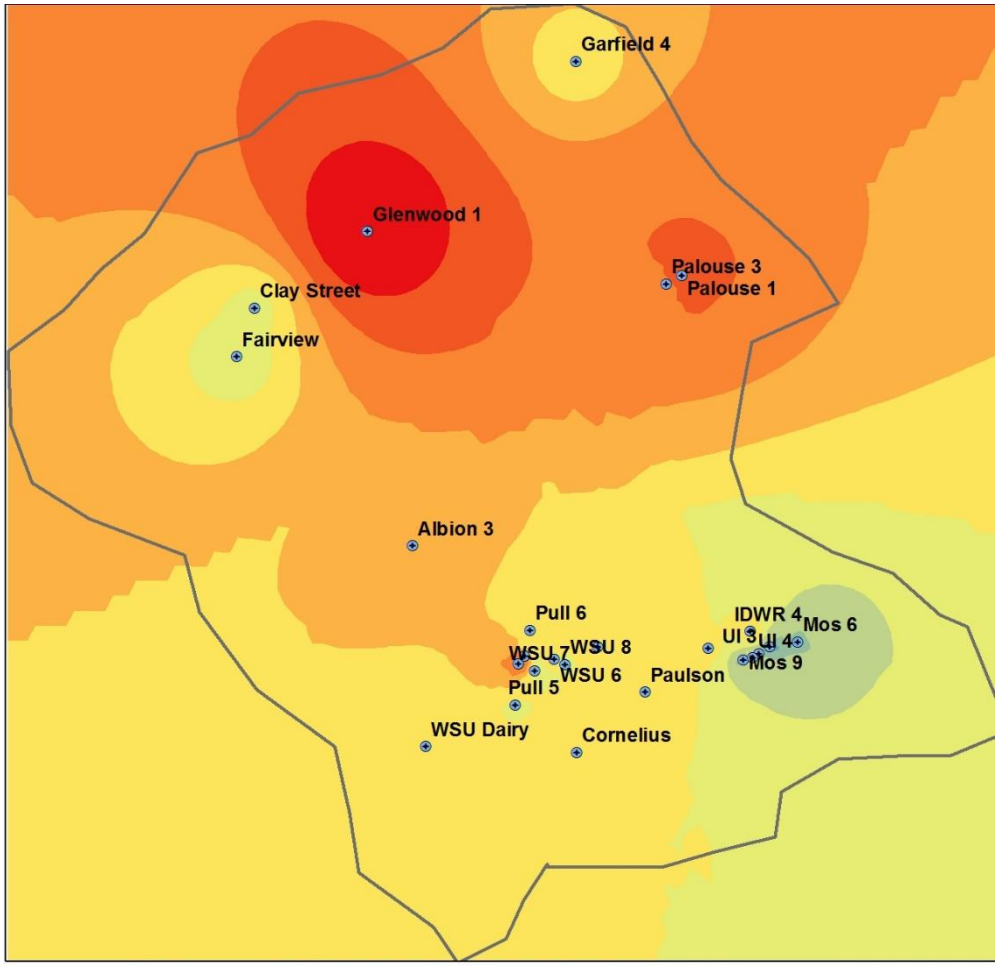
Clear Creek Fault

Clear Cr. Fault mapped by Crow and Conrey (2014)

Hydrograph Characteristics

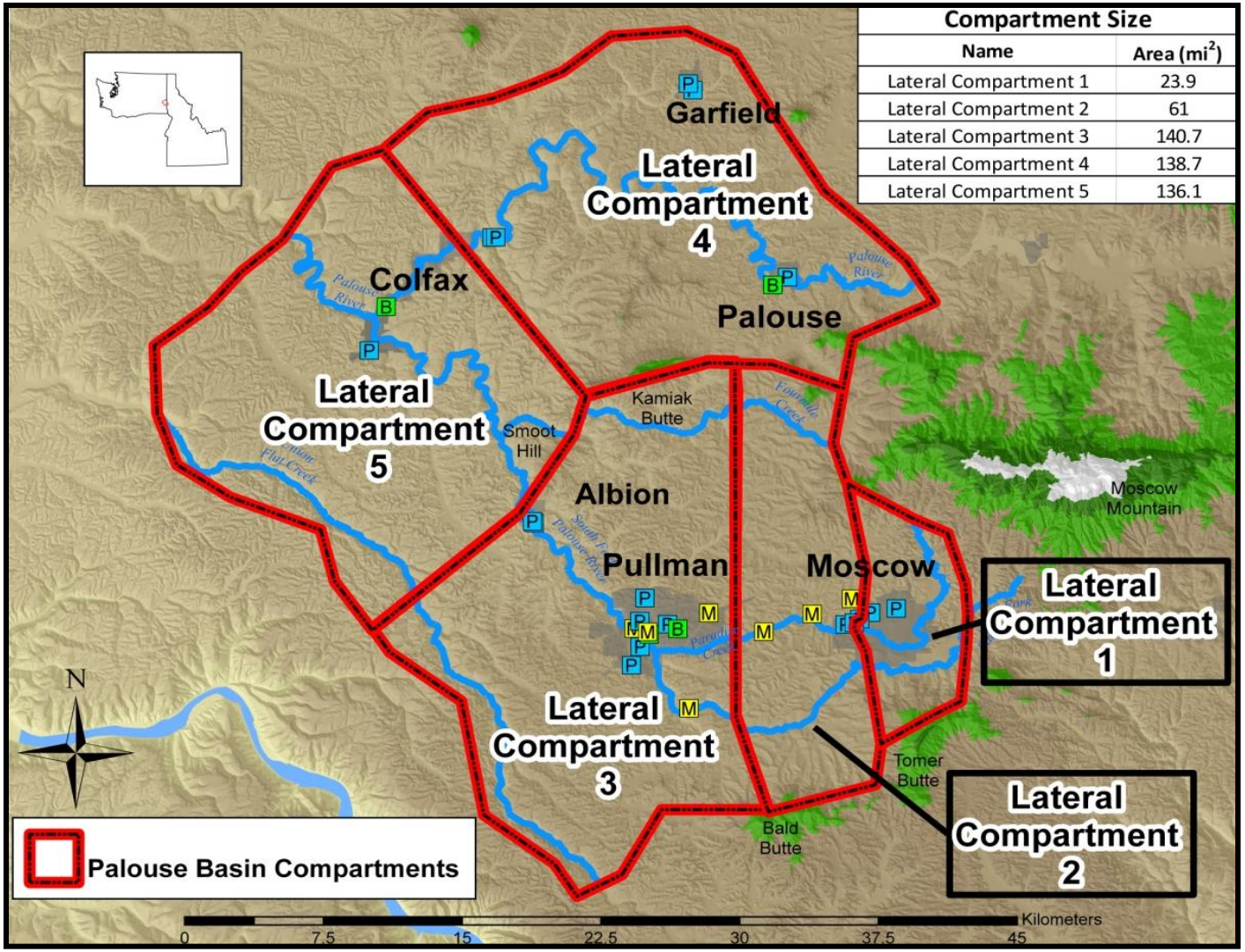


Normalized Groundwater Age



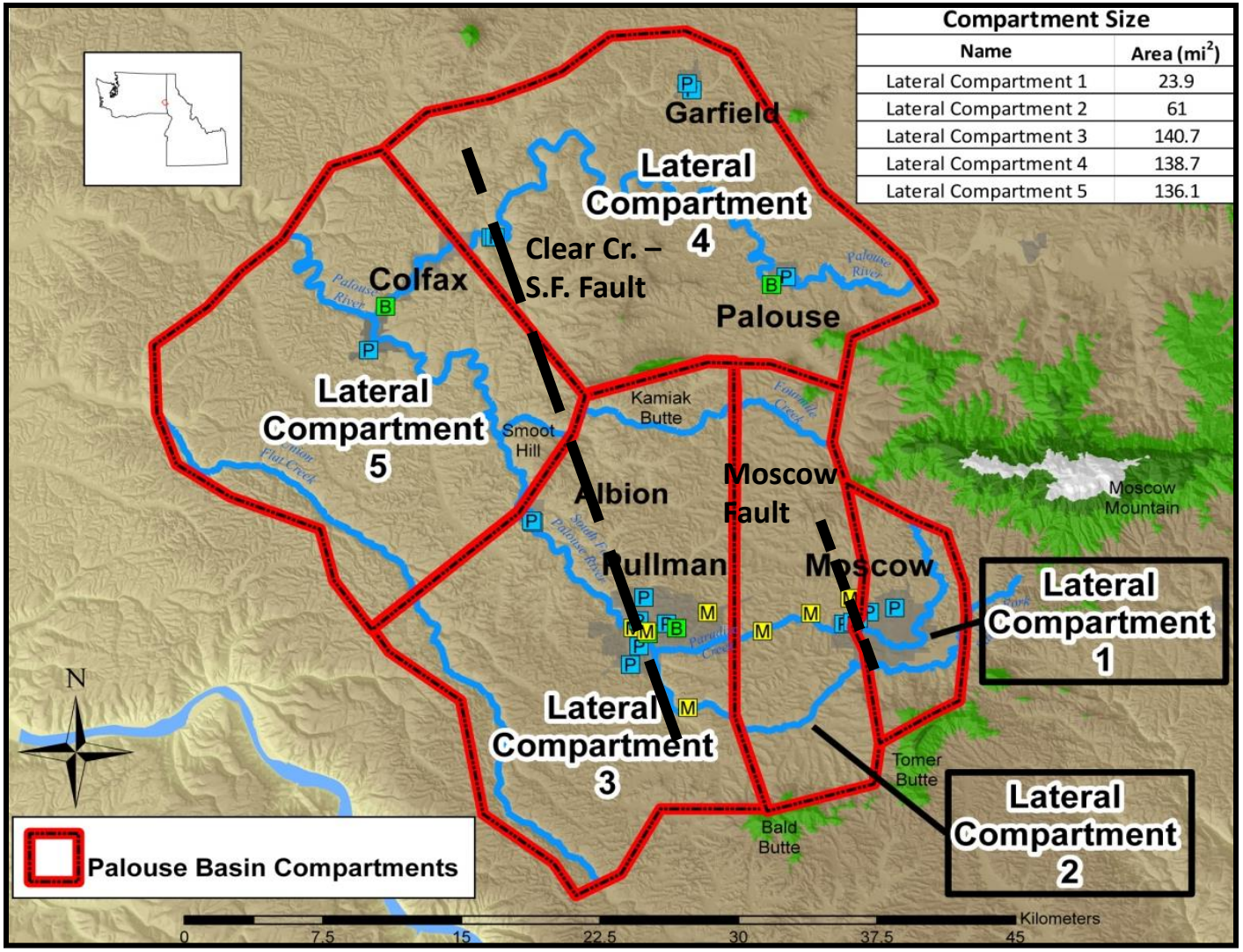
Folnagy (2012)

Compartment Boundary Estimation



Folnagy (2012)

Compartment Boundary Estimation



Conclusions

- Aquifers within the PGB Grande Ronde basalts are distinctly compartmentalized in the horizontal dimension on daily, monthly and yearly time scales.
- Conrey (2014) basalt stratigraphy and mapped faults are evidence for proposed groundwater boundaries.
- Understanding Compartment boundaries will be important for choosing a location for Aquifer Storage and Recovery Projects.

Acknowledgements

- Sincere appreciation to the Palouse Basin Aquifer Committee (PBAC) for funding this project and providing the equipment and assistance.
- All Municipal Water Managers
- Steve Robischon
- Dr. Jim Osiensky
- Dr. Ken Sprenke
- Dr. Kent Keller
- Lauren Carey
- Katie Moran

References

- Bush, J.H., 2005. The Columbia River Basalt Group of the Palouse Basin with hydrological interpretations, western Latah County, Idaho, and eastern Washington Whitman County, Washington, Palouse Basin Aquifer Committee.
- Conrey, R.M. and Wolff J.A., 2010. Basalt Lava Stratigraphy Beneath Pullman and Moscow: implications for the flow of groundwater, http://www.webpages.uidaho.edu/pbac/pubs/100331_Conrey_Wolff_Basalt_Stratigraphy_Poster.pdf.
- Conrey, R.M. and Crow K., 2014. Basalt stratigraphy of the Moscow #9 and UI #4 wells; evidence for the Moscow Fault, http://www.webpages.uidaho.edu/pbac/Presentations/2014/140619_Conrey_Moscow_Fault.pdf.
- Crow K. and Conrey, R.M., 2014. The Clear Creek Fault at Glenwood Springs, WA, http://www.webpages.uidaho.edu/pbac/Presentations/2014/140515_Conrey_Clear_Creek_Fault.pdf.
- Folnagy, A.J.B., 2012. Long-Term Grande Ronde Aquifer Stress Testing to Delineate Aquifer Compartmentalization and Water Level Responses in the Palouse Groundwater Basin, MS Thesis, University of Idaho: Moscow, ID. http://www.webpages.uidaho.edu/pbac/Theses/Folnagy_Long-term_Grande_Ronde_Aquifer_Stress_Testing_to_Delineate_Aquifer_Compartmentalization_and_Water_Level_Responses_in_the_Palouse_Groundwater_Basin.pdf.
- Folnagy, A.J.B., Osiensky, J.L., Kobayashi, D., Sprenke, K.F., 2013. Specific storage from sparse records of groundwater response to seismic waves, Journal of Hydrology 503 pgs 22–28. http://www.webpages.uidaho.edu/pbac/pubs/2013_Folnagy_etal_Specific_Storage_From_Seismic_Waves_J_Hydrology.pdf
- Porcello, J., Lindsey, K., Tonkin, M.J., Karanovic, M., 2011. Groundwater Flow Model of the Columbia Basin Groundwater Management Area Development, Calibration, and Application to Evaluate groundwater supplies in four sub-regions, The Columbia Basin Groundwater Management Area of Adams, Franklin, Grant, and Lincoln Counties http://cbgwma.org/groundwater%20modeling/Groundwater%20Flow%20Model%20Development%20Report.pdf.