Hydrogeological Characterization of the Palouse Basin Basalt Aquifer System

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Washington State University PBAC, May 18, 2006

OUTLINE

- Introduction
- Methodology
- Results and Discussion
- Summary and Conclusions

Map of the Palouse Basin, Washington and Idaho



INTRODUCTION

- The aquifer system in the CRBG is the sole water supply source for the Palouse Basin.
- The continuous water-level decline and the projected future development have led to serious public concerns.



Location and Orientation of the Modeled area



INTRODUCTION (cont'd)

<u>Goal</u>

 To develop a foundation for improved and informed Palouse Basin ground-water resources assessment and management.

Objectives

- To develop a hydrogeology GIS database for Palouse Basin to improve data accessibility and data processing and analysis efficiency.
- To better characterize the hydrogeology of the basalt aquifer system based on newly available spatial and temporal data.

METHODOLOGY

Data Collection, Compilation and Analysis

 Collect all available data on ground-water level, pumpage, precipitation, and well log.

Data Collection, <u>Compilation</u> and Analysis

- Digitize existing information on hard copies into ArcGIS form.
- Process existing GIS coverages (topography, township and range coordinates, stream network, land use, soil, watershed boundary).





Well 15/46-31J1

Well 39N/5W-7ad2



Data Collection, Compilation and <u>Analysis</u>

- Plot long-term hydrographs
 - Separate; composite
 - Their relations with precipitation and pumpage

Build structural contour maps

- To depict the shape of stratigraphic horizons
- Construct aquifer contour maps
 - Wanapum; Grande Ronde
- Develop hydrogeological cross-sections
 - Across the major sub-basins

RESULTS AND DISSCUSSION

GIS Database Development

Well Location Map of the Palouse Basin







11.95 4.56 Inches

Stream Network of the Palouse Basin





6.26 8.43 Inches

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RESULTS AND DISSCUSSION

Long-term Hydrographs

Composite Hydrograph of the Wells in the Palouse Basin



Water Level Elevation, a.m.s.l.,

ft



Year

RESULTS AND DISSCUSSION (cont'd)

Contour Maps

Palouse Basin Geologic Features



Anticline

Monocline



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Contour map of the top altitude of Grande Ronde Formation





Potentiometric surface contour map of the G. Ronde aquifer





RESULTS AND DISCUSSION (cont'd)

Structural Contour Maps

- The top of GR drops in elevation E towards Moscow and W and NW away from Pullman.
- Lateral changes in the occurrence of sediments and a subsurface high of the GR exist between Pullman and Moscow.

Potentiometric Surface Contour Maps

- The piezometric surface of GR shows two cones of depression as a result of heavy pumping.
- The open shape of cones of depression to the W and NW is possibly controlled by the structural feature.

RESULTS AND DISCUSSION (cont'd)

Hydrogeologic Cross-sections

Well Location Map of the Palouse Basin







RESULTS AND DISCUSSION (cont'd)

Pullman–Moscow Cross-section

Pullman side

- Less sedimentary interbedding.
- Loess is in direct contact with the basalt.
- Wanapum is unproductive.

Moscow side

- More sedimentary interbeds.
- Wanapum is productive.
- The W-GR contact slopes towards Moscow with over 300-ft change from a subsurface high between the two cities, and towards Pullman with less than 100-ft change.
- Current hydraulic gradient and thus, the flow between Pullman and Moscow is minimal.

SUMMARY AND CONCLUSIONS

- GIS database has brought together most of the scattered ground-water related data and placed it in easily accessible layers covering the basin.
- Well attributes can be easily maintained and updated by other researchers, enabling effective collaboration.

SUMMARY AND CONCLUSIONS (cont'd)

- The long-term trends of the hydrographs clearly indicate weak vertical hydraulic connection between the two basalt aquifers.
- Each aquifer exhibits a distinct pattern of waterlevel fluctuation as affected by pumping, climate and recharge.

SUMMARY AND CONCLUSIONS (cont'd)

- The potentiometric surface contour maps of the basalt aquifers display a general pattern with the ground-water level dipping from southeast to northwest.
- Existing structural futures (monoclines, anticlines and synclines) tended to create local areas with rapid changes in water levels in the approximate direction of their major axis.

SUMMARY AND CONCLUSIONS (cont'd)

- Differences in the complex stratigraphic, structural and geohydrologic characteristics help reveal distinct sub-basins that may serve as sub-units for future modeling effort.
- Generalized models that do not include all parts of the basin or do not consider the spatial variations of hydrogeological conditions are inadequate and may even produce misleading results.

RECOMMENDATIONS

- GIS database needs to be updated continually
- Continue to develop comprehensive geohydrologic conceptual model
- Continuing to build up annotated RM bibliography

ACKNOWLEDGMENTS

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THANK YOU !