2.0 Black Rock Groundwater Model Purpose and Scope

The following discussion of the development and application of the Black Rock groundwater model focuses mainly on answering five basic questions related to the hydrologic impacts of the reservoir. It also addresses the considerable uncertainty that exists in the answers to these questions.

2.1 Purpose of Modeling

The Black Rock model was developed in order to answer the following five questions regarding potential Black Rock reservoir hydrologic impacts and seepage conditions. A sixth question relates to the acquisition of additional aquifer test data in areas that are critical for reducing model uncertainty. The answer to this question is based largely on hydrologic insights and understanding gained from the current modeling effort.

1. How long would it take to fill Black Rock reservoir given the expected water availability and expected reservoir seepage rates?

2. What is the expected seepage rate from the Black Rock reservoir during initial filling?

3. What is the expected seepage rate from the reservoir over time, once filled to capacity?

4. What impact would the full reservoir have on groundwater discharge to creeks, drains and springs, aquifer storage, and aquifer head conditions?

5. What impact would the reservoir have on groundwater flow and head conditions at the boundary of the Hanford Reservation?

6. What additional field testing would be most valuable in reducing uncertainty in model predictions of reservoir hydrologic impacts?

2.2 Scope of Model Development and Application

The scope of the Black Rock model development and application is necessarily limited. However, the following modeling elements are considered essential to providing the most reliable answers possible to the six questions cited previously, in the time-frame and with the resources available.

- Application of a widely used and accepted groundwater modeling software package such as U.S. Geological Survey (USGS) MODFLOW.

- Representation of a heterogeneous, multi-layer aquifer system consistent with the generally understood hydrogeologic framework of the Columbia Plateau and the Yakima Fold Belt, and with previously developed groundwater models of the area.

- Development of a steady-state model of the aquifer system without the reservoir for calibration purposes, and a transient model with the reservoir, to represent reservoir/aquifer interactions through time.

- Specification of reservoir boundary conditions using either a time-dependent reservoir inflow rate or a time-dependent reservoir head condition.

- Introduction of model boundary conditions to represent potential increases in groundwater discharge to creeks, drains, and springs in the vicinity of the reservoir.

- Introduction of model boundary conditions in the vicinity of the reservoir where groundwater discharge to creeks, drains, and springs may potentially re-infiltrate the aquifer.

- A model calibration process that combines previous Columbia Plateau regional-scale model calibration work with model sensitivity analysis in the area of the reservoir site.

- Development of model versions that reflect early-time and late-time reservoir interactions with the aquifer system.

- Development of different model parameterizations that produce a range of estimates for reservoir seepage and other hydrologic impacts, reflecting uncertainty in estimates of aquifer hydrologic properties.

The elements of the Black Rock model development are discussed in greater detail in the following chapters of this report, beginning with a discussion of the hydrogeologic framework in Chapter 3. Chapters 4 through 6 describe model development, including modeling software, data sources, the model domain, model layering, model and reservoir boundary conditions, steady-state and transient versions of the model, and model calibration.

Chapters 7 and 8 describe model application and discuss model results. Applications of the Black Rock model are intended to show the full range of possible hydrologic impacts of the reservoir, given the current level of uncertainty that exists with respect to aquifer parameterization. As such, the model applications are presented in the form of a

sensitivity analysis, conducted mainly with respect to aquifer hydraulic conductivity and aquifer specific-storage parameters.

Model results are depicted in hydrographs showing early-time and late-time reservoir interactions with the aquifer system. Hydrographs show expected reservoir seepage rates; increases in discharge to creeks, drains and springs; and increases in aquifer storage. Model results also include contour maps showing expected increases in aquifer head conditions around the reservoir, over time. Data tables show changes in groundwater flux conditions along the western boundary of the Hanford Reservation.

Chapter 9 provides detailed model-based answers to the six questions affecting reservoir hydrologic feasibility.

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