Model Boundary Revision 2

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Eastern Snake Plain Aquifer Model Enhancement
Model Design and Calibration Document Number DDM-002-R2

DESIGN DOCUMENTS

Design documents are a series of technical papers addressing specific design topics on the eastern Snake River Plain Aquifer Model upgrade. Each design document will contain the following information: topic of the design document, how that topic fits into the whole project, which design alternatives were considered and which design alternative is proposed. In draft form, design documents are used to present proposed designs to reviewers. Reviewers are encouraged to submit suggested alternatives and comments to the design document. Reviewers include all members of the Eastern Snake Hydrologic Modeling (ESHM) Committee as well as selected experts outside of the committee. The design document author will consider all suggestions from reviewers, update the draft design document, and submit the design document to the SRPAM Model Upgrade Program Manager. The Program Manager will make a final decision regarding the technical design of the described component. The author will modify the design document and publish the document in its final form in .pdf format on the SRPAM Model Upgrade web site.

The goal of a draft design document is to allow all of the technical groups which are interested in the design of the SRPAM Model Upgrade to voice opinions on the upgrade design. The final design document serves the purpose of documenting the final design decision. Once the final design document has been published for a specific topic, that topic will no longer be open for reviewer comment. Many of the topics addressed in design documents are subjective in nature. It is acknowledged that some design decisions will be controversial. The goal of the Program Manager and the modeling team is to deliver a well-documented, defensible model which is as technically representative of the physical system as possible, given the practical constraints of time, funding and manpower. Through the mechanism of design documents, complicated design decisions will be finalized and documented.

Final model documentation will include all of the design documents, edited to ensure that the "as-built" condition is appropriately represented.

INTRODUCTION

Some of the first decisions faced when beginning work on a model center around determining extent of the modeled area. This is the topic addressed in this Design Document.

Problem Statement

This section outlines the options considered in the process of establishing model boundaries.

The purpose of this model is to assist in managing the surface water and ground water resources within the Eastern Snake Plain Aquifer and the Snake River. Therefore the model boundaries should encompass the boundaries of the Eastern Snake Plain aquifer. Decisions regarding where to place the model boundary must be made where the Eastern Snake Plain aquifer interfaces with tributary aquifers. These decisions should be based on the model purpose and data availability.

Extending model boundaries to bedrock outcrops in tributary basins allows incorporation of seasonal and long-term changes into the model simulation rather than estimating them external to the model. Extending the boundaries to Include land with similar irrigation practices is desirable, if the resulting boundary does not cross a hydrologic barrier. However, there is little value in including a tributary aquifer if there are no data available for that aquifer. If aquifer geometry or aquifer head data do not exist, modeled fluxes and responses to stress in the tributary basin will likely be in error.

Considered Options

This section outlines the options considered when selecting the model boundary. Figure 1 shows the location of the Eastern Snake Plain. Figure 2 contains the model boundary for the previous version of the DWR/UI model (Cosgrove et al, 1999) along with the model boundary used in the Regional Aquifer-System Analysis (RASA) study (Garabedian, 1992). While great similarity exists between these boundary selections, they highlight the decisions that need to be made in this modeling effort. For example, the IDWR/UI model ignores the Twin Falls tract while it is included in the RASA model. The RASA model extends to King Hill while the IDWR/UI model terminates shortly west of Salmon Falls. Another difference is that the IDWR/UI model tends to extend up the tributary basins farther than the RASA model. Figure 2 also contains irrigated acres in 1992 and proposed options for the new model.
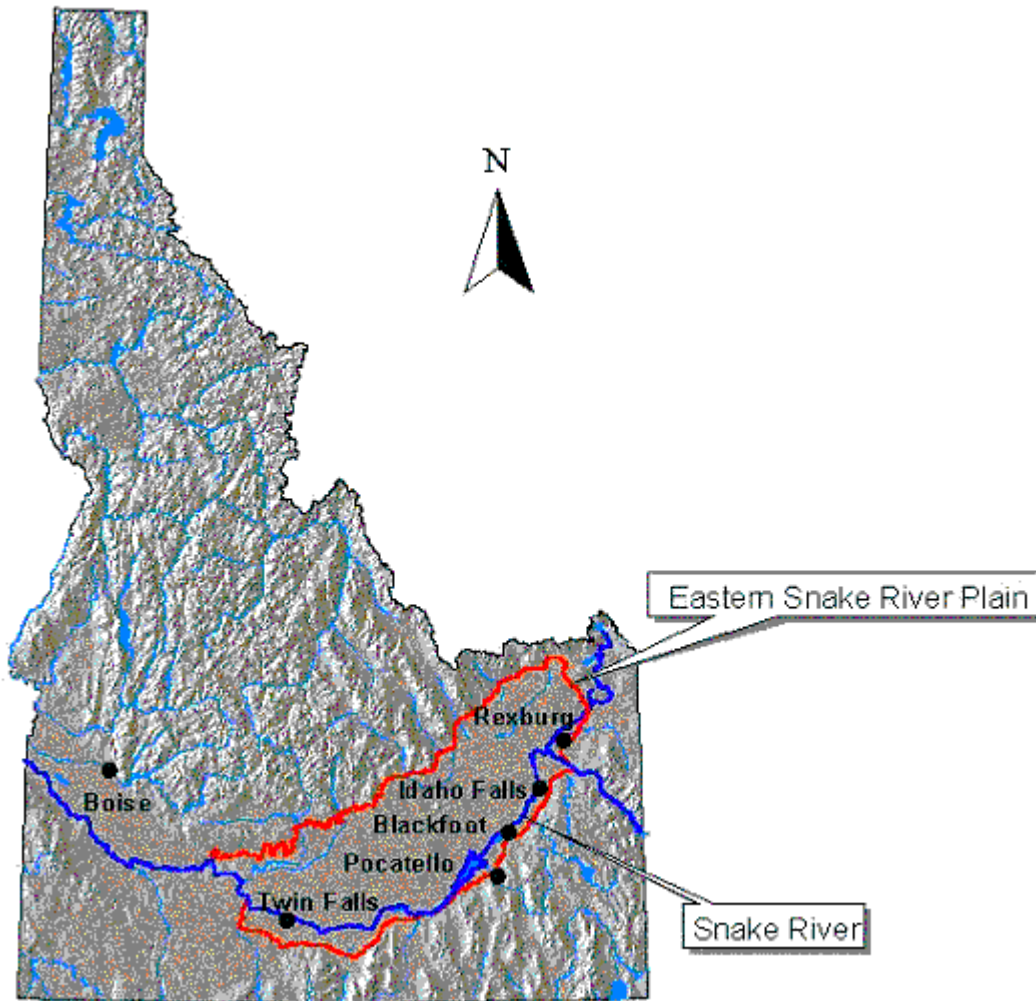
Figure 1. Location of the Eastern Snake River Plain

Ideally model boundaries are based on physical barriers to ground water flow. A model built in this manner will have all flux into the model as irrigation, surface water or as precipitation. Since surface water is much easier to measure than ground water, this limits potential water balance errors due to calculating flux from tributary aquifers. Sometimes it is not practical to extend the model to physical boundaries in every direction and artificial boundaries are imposed. In these instances the artificial boundaries must be located to minimize their impact on prediction uncertainties.

Effect

This section discusses the effect the various boundary options will have on the model. Boundary choices can affect model uncertainty, model run times and numerical stability.

The model boundary should include the portions of the aquifer germane to the

issues driving model creation. These issues principally involve interactions between the Snake River and the Snake Plain Aquifer. The model is not sensitive to water use in the Twin Falls tract because the Snake River canyon effectively disconnects the area south of the river from the regional aquifer on the north. The model is sensitive to water use in this area only insofar as use offsets reach gains between Milner and King Hill. These gains can be estimated as part of the water budget. Therefore the Twin Falls tract does not need to be explicitly modeled.

Garabedian (1992) determined that tributary basin underflow represents about 20% of the water balance so the model will be sensitive to this flux. Water use in the tributary basins will directly affect water supply in the Eastern Snake Plain Aquifer, thus, questions arise concerning how far up the tributary basins to extend the boundary. Figure 2 shows irrigated acres along with the RASA, IDWR/UI and proposed new model boundaries. The gray areas represent irrigated agriculture.
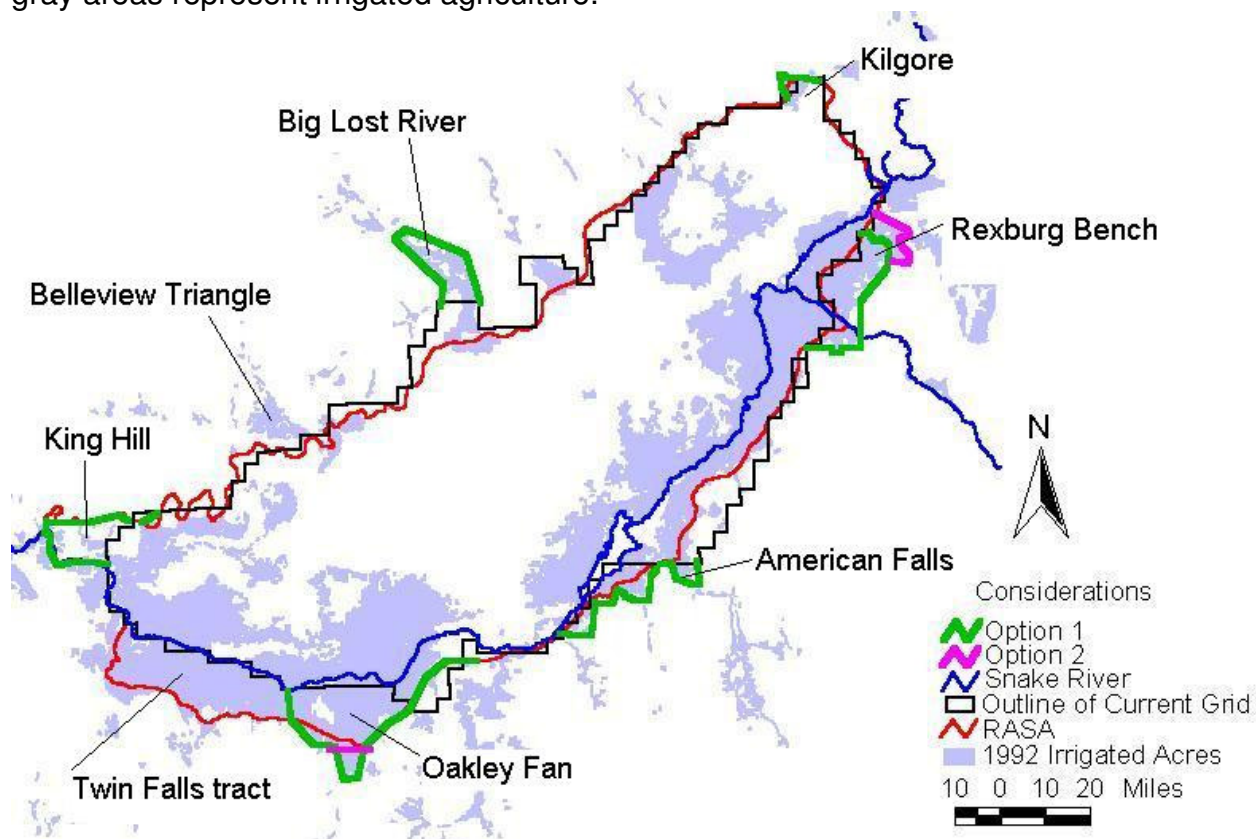

Figure 2. Proposed aquifer boundaries

The decisions made regarding the model boundary will affect the ability of the model to support later administrative decisions. For example, it will be impossible to administer areas outside the model using modeling results yet activities outside the model boundary can affect activities within the model boundary. Therefore, from a water management perspective, a goal should be to minimize the amount of irrigated agriculture dissected by the model boundary. This results in an expansion of the model domain into areas not included in previous models. The Rexburg Bench, Oakley Fan, and American

Falls areas all have irrigated acreage not previously included in the IDWR/UI model, and these areas appear to be hydraulically connected. The added advantage would be that these hydrologically connected areas can be administered similarly if necessary.

The model boundary should extend to bedrock outcrops in tributary valleys to reduce the number of inflow parameters that must be estimated. Examples where this concept can be employed are in the Big Lost River drainage and the Belleview Triangle (Figure 2). This results in including the Big Lost River drainage up to Mackay Reservoir and excluding all of the Belleview Triangle. The effect of this decision will be to reduce water balance errors because the fluxes into the model area are measured instead of estimated, since all the flux at the proposed boundary occurs in surface streams.

Extending the model boundary up tributary basins for administrative purposes and to contacts with bedrock to minimize water balance errors is a worthwhile effort. However, it should be recognized that model calibration errors may be more substantial in tributary basins due to a decreased density of calibration data and or an uneven temporal distribution in data.

Design Decision

The model boundary will exclude the Twin Falls tract and include more of the tributary basins as illustrated in Figure 3. This boundary includes the recognized extent of the Snake Plain aquifer, with the exception of the Twin Falls tract, most of the irrigated agriculture immediately adjacent to the plain, and, where possible, extends the boundaries to contacts with bedrock. The boundary between the included Oakley Fan and the excluded Twin Falls tract will be a no-flow boundary.
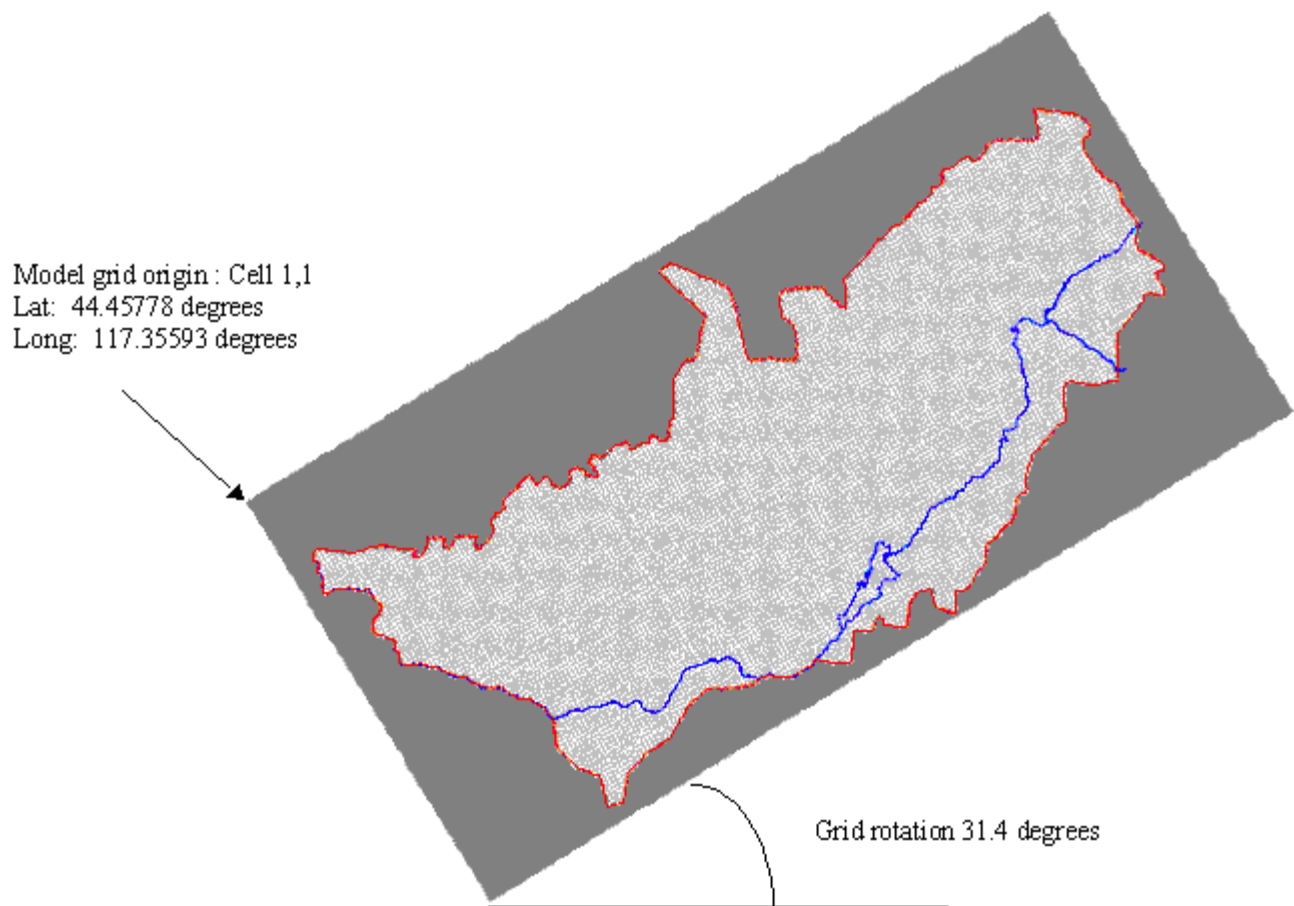
Model grid origin : Cell 1,1
Lat: 44.45778 degrees
Long: 117.35593 degrees

Grid rotation 31.4 degrees

Figure 3. Grid orientation and rotation point.

References

Cosgrove, D.M., G.S. Johnson, S. Laney, and J. Lindgren, 1999. Description of the IDWR/UI Snake River Plain Aquifer Model (SRPAM). Idaho Water Resources Research Institute

Garabedian, S.P., 1992. Hydrology and Digital Simulation of the Regional Aquifer System, Eastern Snake River Plain, Idaho. U.S. Geological Survey Professional Paper 1408-F

Revision 2

Introduction
In preparation for ESPAM V2 the ESHMC updated the grid projection to IDTM 83 and modified the model boundary to remove model cells below the rim in the Hagerman Valley and eliminate cells in the foothills north of Pocatello and in the foothills in the Big and Little Lost River valleys.

IDTM 83 Projection
The model grid was redrawn in IDTM83 with the origin at 8089081.6, 3904653.1 feet with a 31.4 degree counter-clockwise rotation as shown in Figure 1 below.
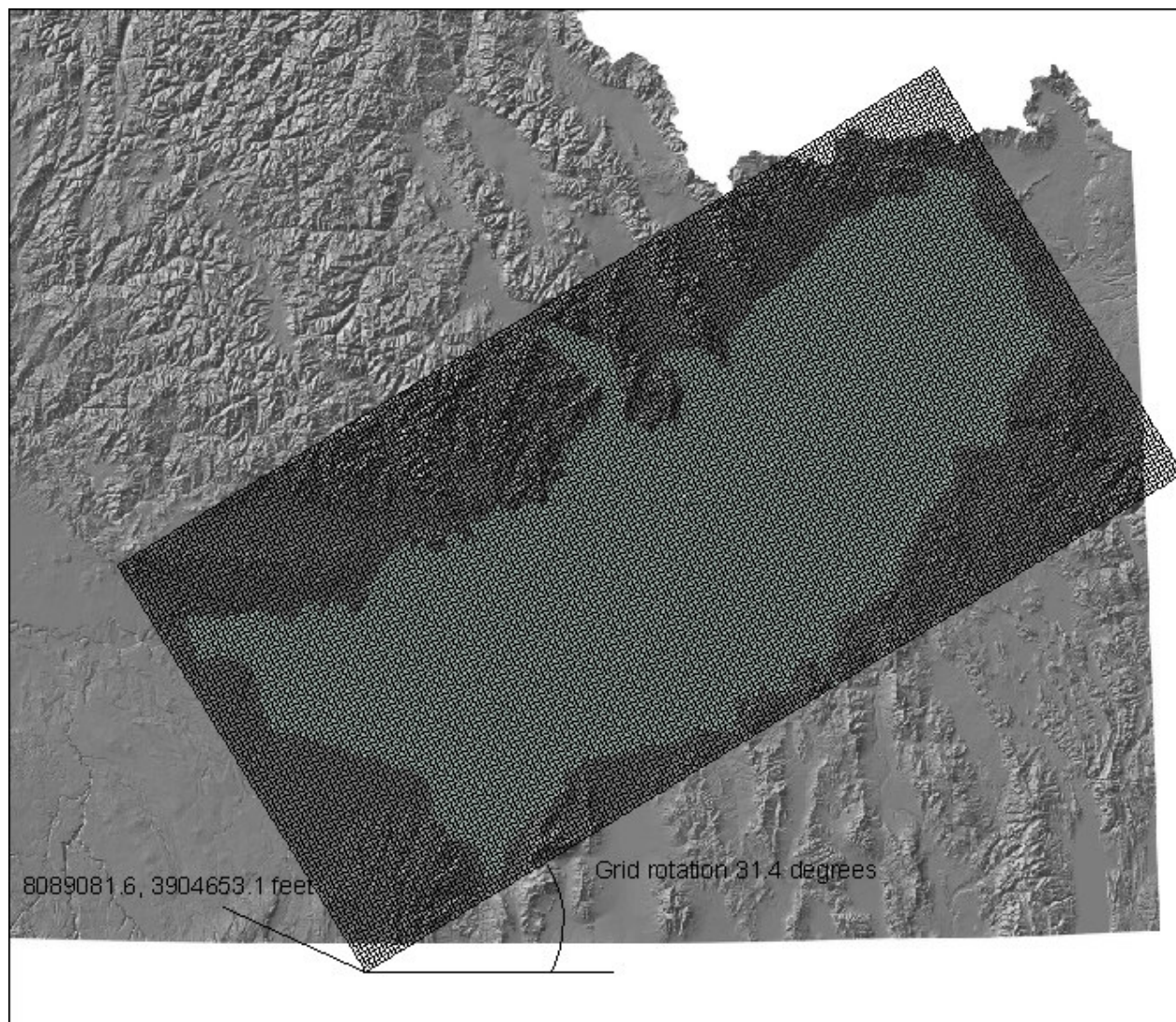
Figure 1. Grid orientation and rotation.

Hagerman Valley Changes

The ESHMC decided to remove cells below the Snake River Canyon rim as recommended by Ralston (2008). These model cells will be converted from active to inactive for version 2 of the ESPAM. Figure 2 shows the location of the removed cells.
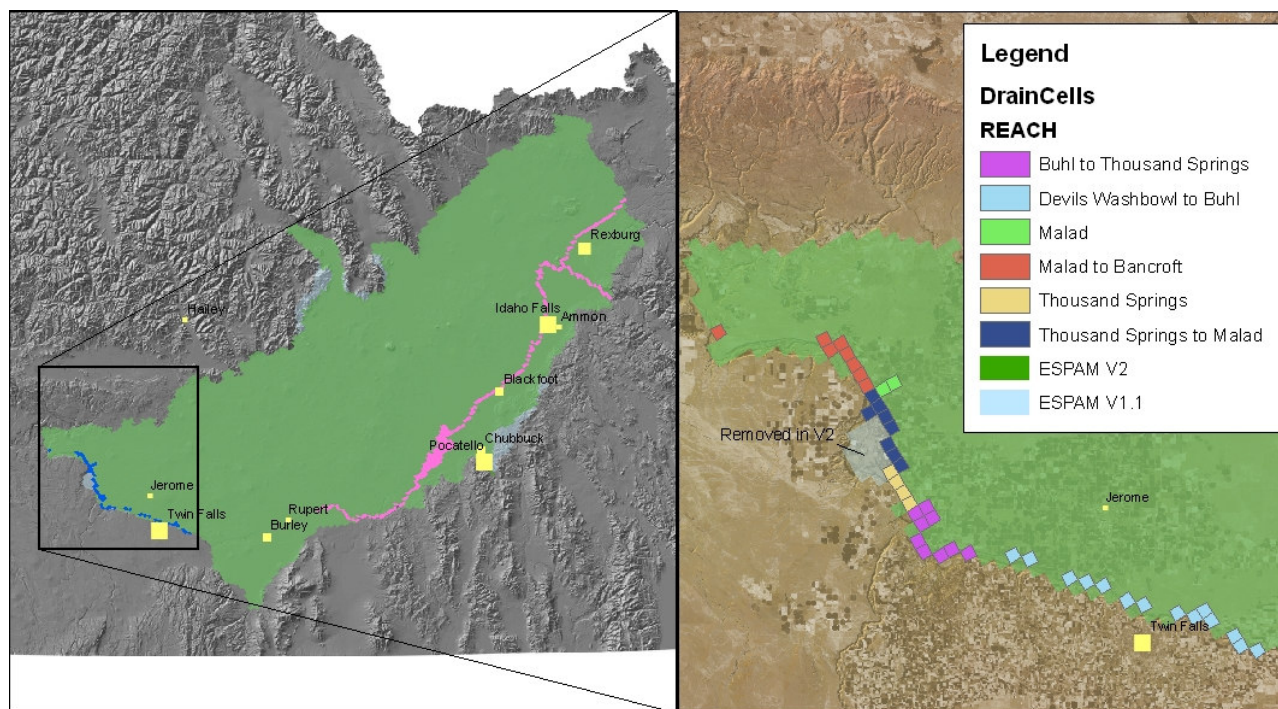
Figure 2. Model cells in the Hagerman Valley converted to inactive for version 2 of the ESPAM.

Pocatello Area Changes

The ESHMC decided to extend the active cells southeast along the Portneuf River and add one cell to allow connection of the Portneuf River to American Falls Reservoir as shown in Figure 2. The committee also decided to convert cells overlying un-irrigated foothills north and east of Pocatello to inactive (Sullivan, 2009; Wylie, 2009) as shown in Figure 3.
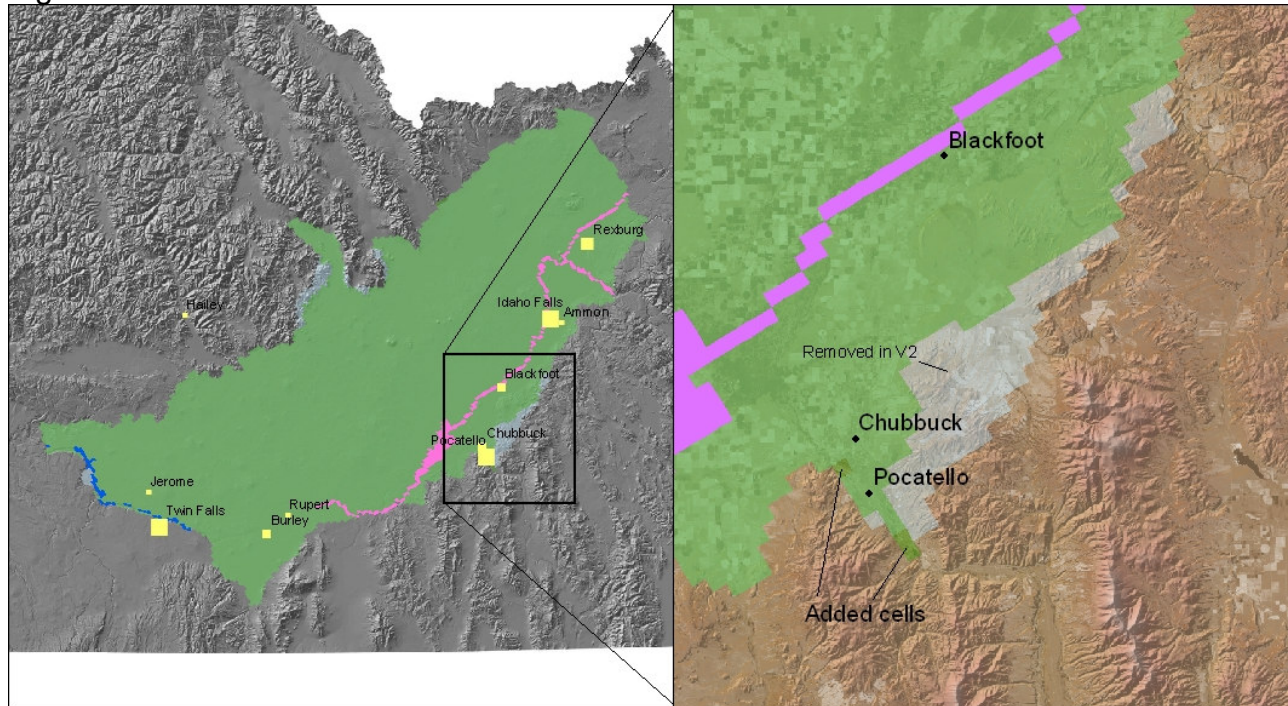

Figure 3. Pocatello area model grid changes.

Big and Little Lost River area Changes

As an outgrowth of the decision to convert cells overlying un-irrigated foothills to inactive, modifications were made in both the Big and Little Lost River drainages. Figure 4 illustrates the changes.
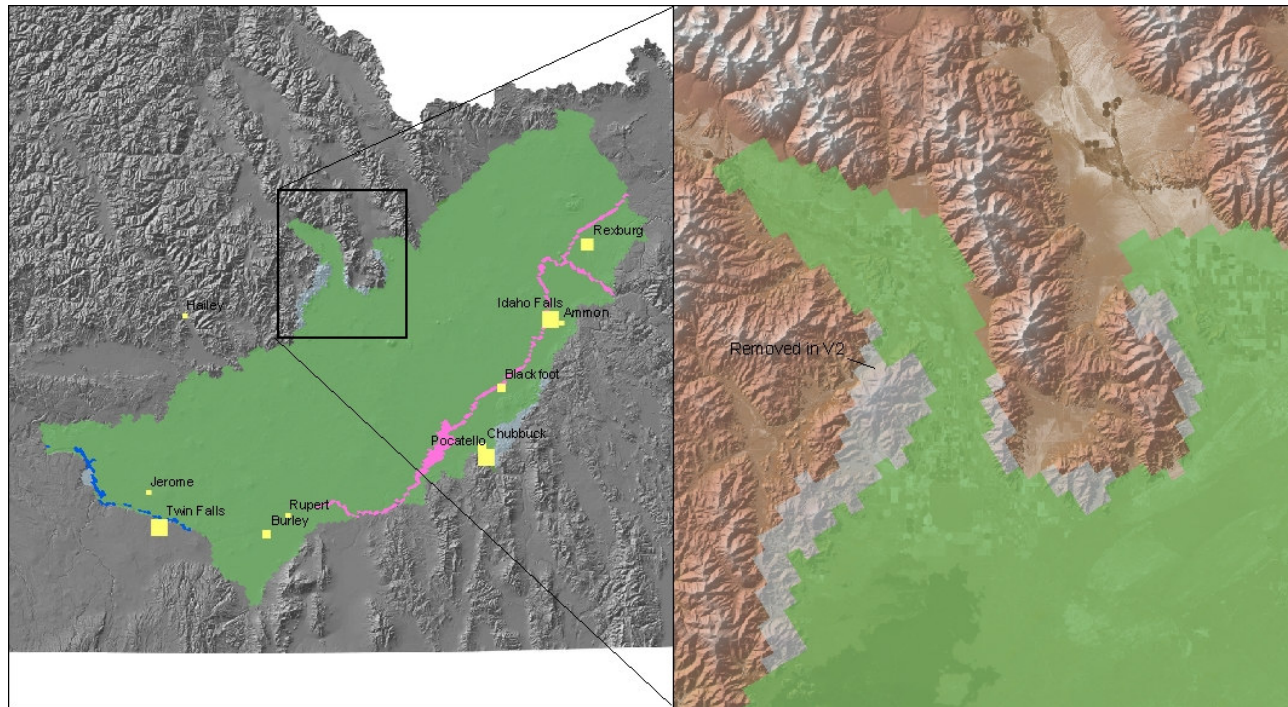
Figure 4. Changes to the model grid in the Big and Little Lost River drainages.

References

Ralston, D. 2008. Hydrology of the Thousand Springs to Malad Reach of the Enhanced Snake Plain Aquifer Model. IDWR Open File Report.

Sullivan, G. 2009. ESPAM Boundary near Pocatello. Presentation to the ESHMC at March 31-April 1, 2009 meeting.

Wylie, A. 2009. ESPAM updated Boundary. Memo to the ESHMC dated April 6, 2009.