Appendix A. Development of a Three-Dimensional Hydrogeologic Framework Model

A three-dimensional hydrogeologic framework model was constructed using all available information. The foundation of the hydrogeologic framework model is a geologic framework model constructed from available surficial and structural geologic maps and geologic interpretations from 318 well logs (fig. 2) (Newcomb, 1969; Grady, 1983; Kienle, 1995; and Jervey, 1996). The following summarizes the technical aspects of the geologic modeling process and conversion of geologic model units to groundwater-flow model units (see Hydrogeologic Framework, figs. 3–5).

A.1—Motivation and Methods

The geologic framework modeling process was iterative (fig. A1), consisting of three interpretive steps: (1) creation of trend surfaces from compiled data, (2) building a 3-dimensional geologic model using the trend surfaces, and (3) analysis of the resulting model to evaluate how well the resulting geologic model matches the data. At the end of step 3, if the results are deemed inadequate, then the process is repeated with appropriate alterations to steps 1 and 2. Step 2 uses geologic and other physical principles, such as the geologic laws of superposition and original horizontality, to construct the distribution of geologic units from surfaces representing geologic unit tops and bottoms. More details of the motivation and methods used here are provided by Burns and others (2011).

Geologic unit tops were modeled as trend surfaces (fig. A1*B*), and it is assumed that the bottom of any unit is the top of the underlying unit. Trend surfaces were used for five reasons:

1. Well logs from which geologic picks were selected are of variable quality, with inherent inaccuracy in the estimates of ground-surface elevation and depth to contact;
2. Geologic picks from well logs from the previous studies were occasionally in conflict with each other, indicating that some picks are erroneous;
3. Geologic tops encountered in boreholes represent point samples of an undulating paleotopographic surface;
4. Mapped geologic contacts are smooth lines drawn across the current topography, providing artificial variability in estimated geologic unit top elevation; and
5. An understanding of the trend of the surface and local mismatch between data and the trend is deemed to be more informative about aquifer-system geometry than locally noisy fits acquired using exact interpolation of possibly erroneous data.

An example of using a trend to model a geologic surface is shown in the workflow of figure A1*B*, where mismatch between the trend surface and the data provides information about location and offset of a fault.

A.2—Geologic Model Assumptions and Implementation

Trend surface modeling was accomplished iteratively (fig. A1*B*); the first step was data compilation and confidence weighting. Because no data were obviously of lower quality, either initially or during the interpolation, all data received an equal weight. In addition to well data, the surficial geologic map compilation was also used. Where a geologic contact line represents the top of a unit at land surface, the line was sampled at a high frequency using points along the line. The elevation of the contact at each point was assigned the value from a digital elevation map of the land surface topography. Because the geologic map was constructed by drawing a smooth line across undulating terrain, the sampled geology also displayed this undulation. It was assumed that this elevation was correct on average, so points representing the local median were subsampled from the surficial geology points, providing a data reduction and estimates of the typical elevation of the contact.

The geologic map sample points were merged with the well data to provide sets of points representing each geologic model layer. Smooth trend surfaces were fit to data representing the top of each geologic unit (step 2 of fig. A1*B*). This was accomplished with a 2-dimensional local estimation regression method, LOESS, which was written in *S* for implementation in *S-Plus* (Cleveland and others, 1992). As implemented, LOESS performs a local linear fit to the data with an intended goal being a symmetrical distribution of the residuals around zero, where the residuals are defined as the difference between the measured value and the modeled surface. The LOESS algorithm has a variety of options, but all options were set to the default except for span and degree.

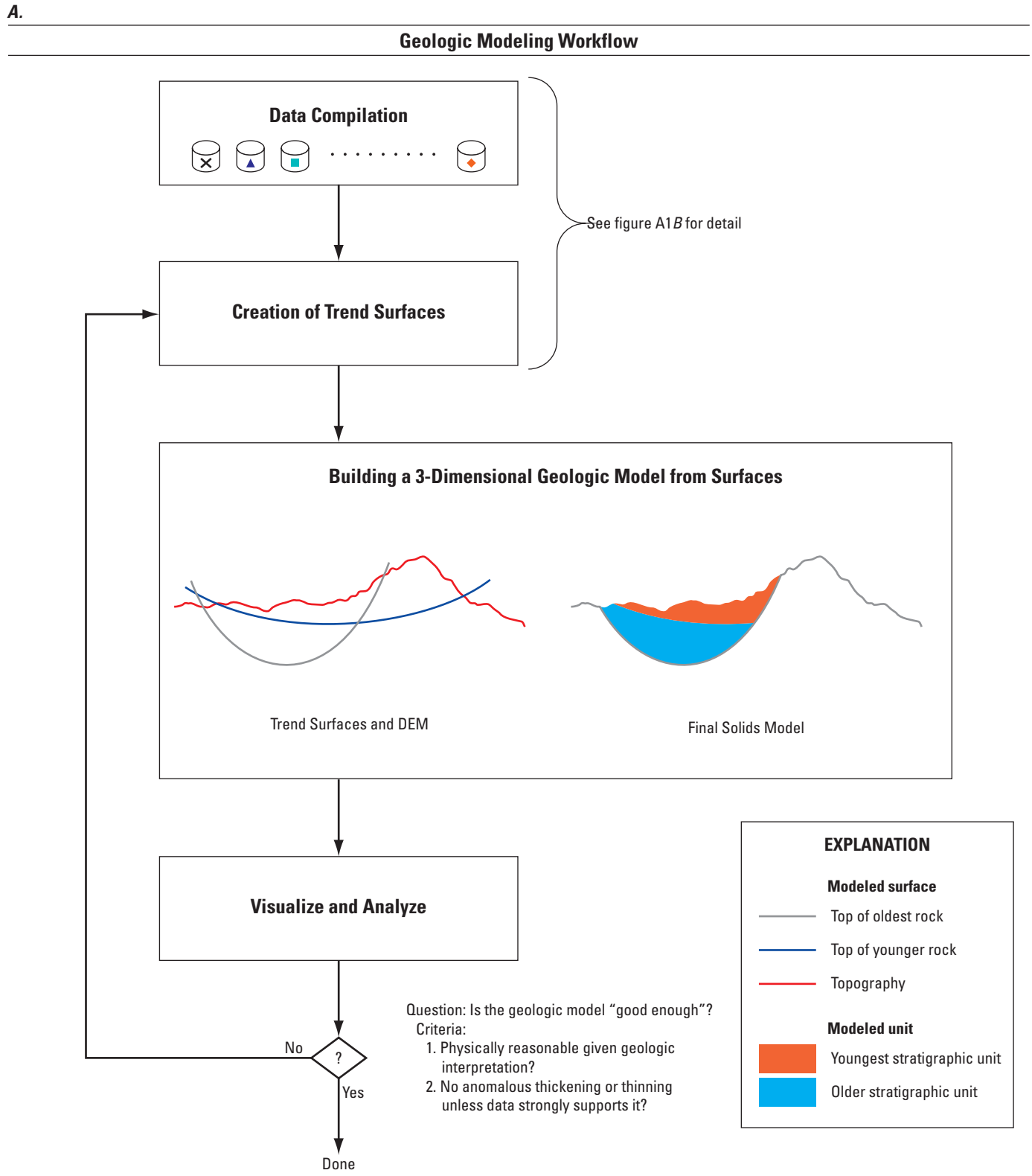


Figure A1. The geologic modeling process. (*A*) Geologic modeling workflow, (*B*) details of trend surface modeling.

B.

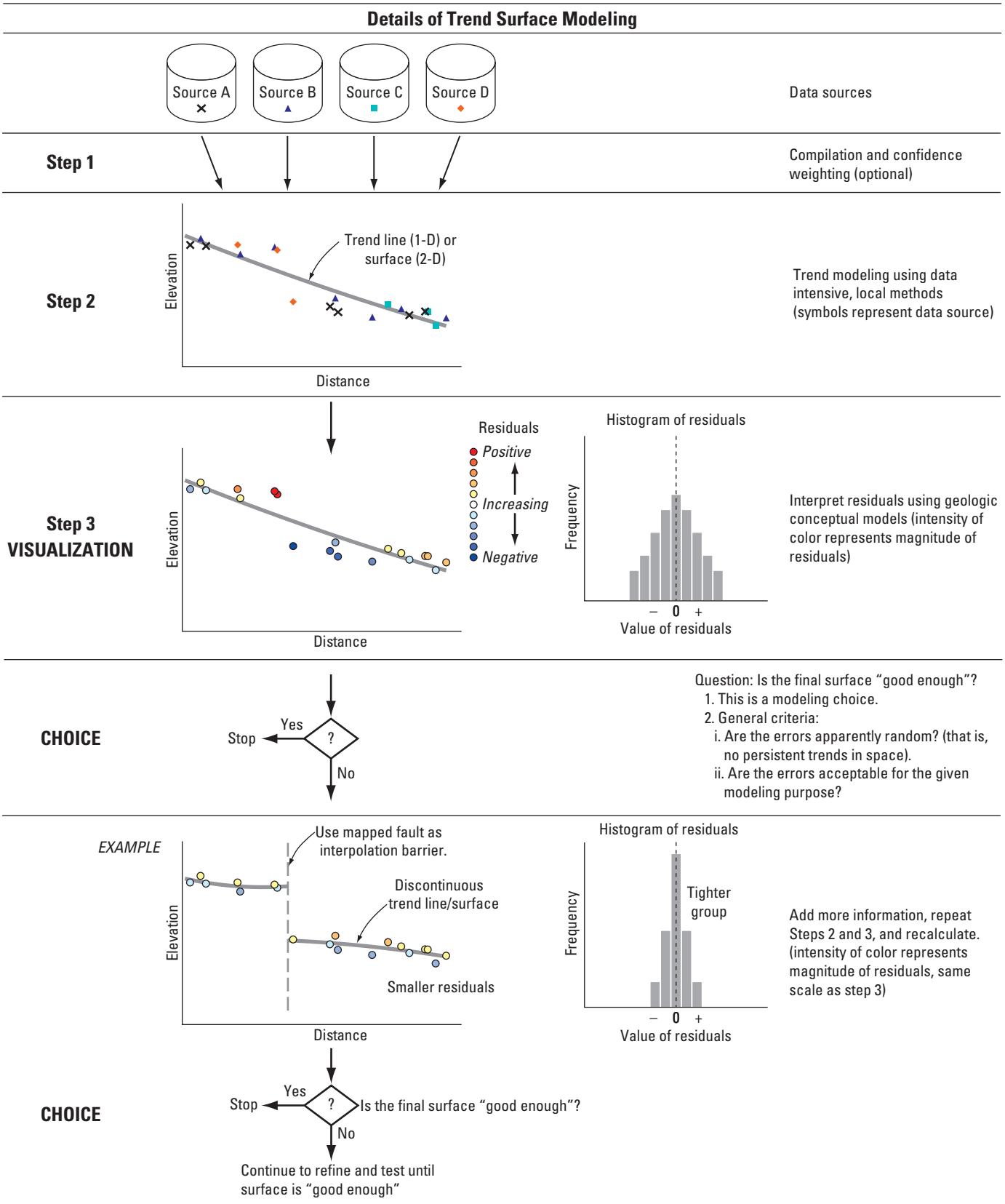


Figure A1.—Continued

Degree controls whether the local fitting function is linear or quadratic, and in all cases, linear was selected here. Span controls the percentage of data that goes into the interpolation at any given data point, and data are locally weighted during interpolation using a tri-cube weighting function with heavier weight nearer the interpolation point. As a result, increasing the span uses more data for the local estimation, resulting in a smoother trend surface. If the span is small, only data close to the interpolation point are used, and the surface becomes irregular and numerical edge effects can occur. An edge effect is where an incorrect trend supported by only a few measurement points is continued past the data, resulting in substantially incorrect estimates of the surface in that direction. The "best" span is defined here as the largest span for which the residuals appear to be randomly distributed in space (the smoothest surface with no strong trend in the residuals when they are plotted on a map).

Iterative trend surface modeling revealed three distinct fault-bounded geologic modeling blocks (fig. A2). The associated faults had significant offsets (greater than 200 ft) across known faults or fault groups (fig. 2). The boundaries of the geologic modeling blocks represent the approximate location of the large offsets of the Rocky Prairie thrust fault and the Maupin wrench fault(s). The Maupin wrench fault has high offset to the south, with little or no offset to the north. The geometry of this fault to the north is uncertain because of low data density on the west side of the fault. The well data were insufficient to resolve offset on other mapped faults, so only these two faults are represented in the geologic model.

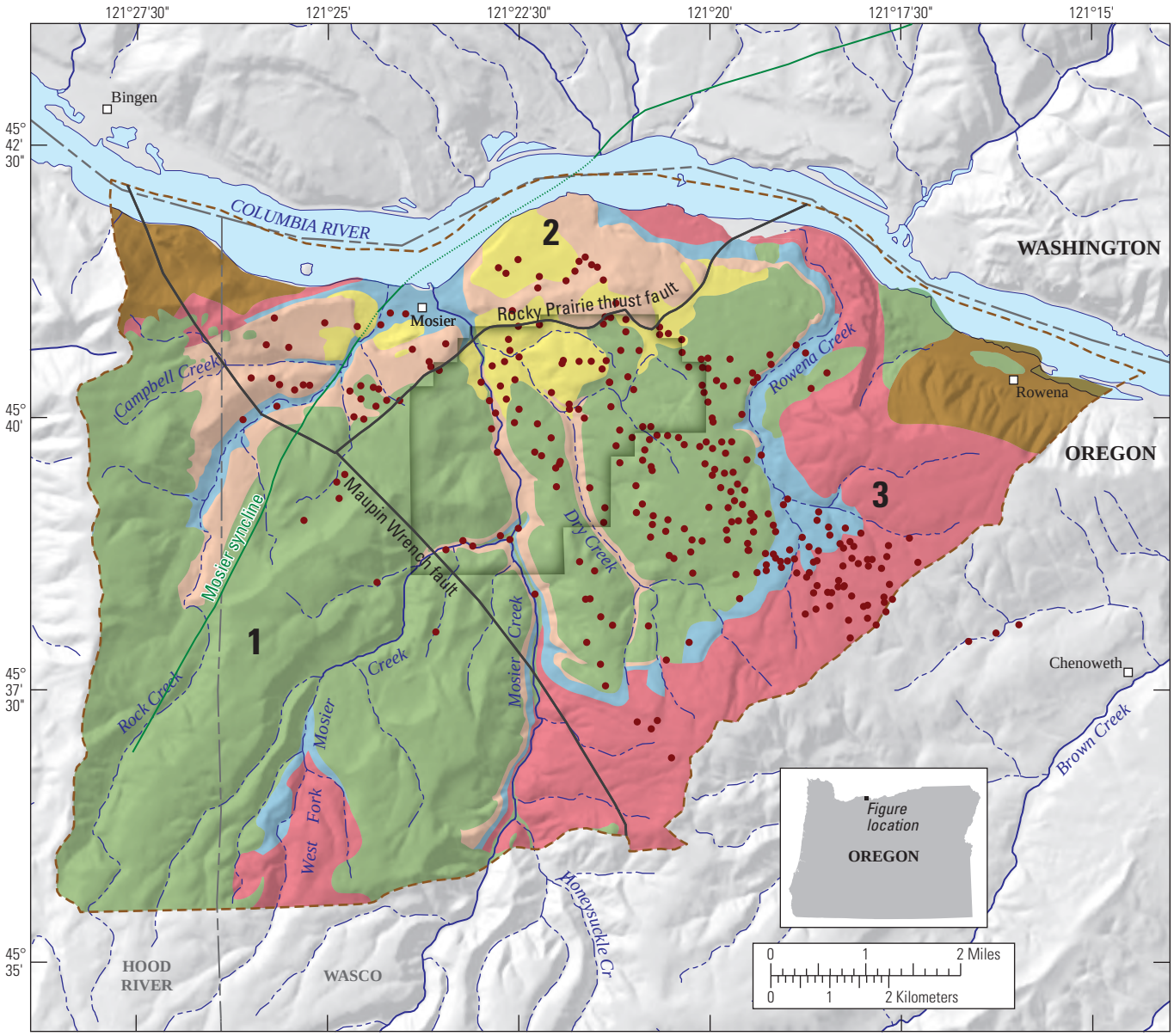
Because the angle of plunge of the Mosier syncline through geologic modeling block 1 is not known and there are little data available to constrain the geologic model, inferred control points were added to the interpolation for this block to represent the syncline as a gently plunging feature. The resulting geologic model has high uncertainty in this block, so calculations and estimates for this side of the model implicitly have higher uncertainty. However, the modeled geometry retains the necessary hydraulic character to route recharge in a manner consistent with the best available geologic understanding of the watershed.

Sufficient data existed to generate surfaces representing the tops of the overburden, the Pomona Basalt, the Priest Rapids Basalt, the Frenchman Springs Basalt, and the Grand Ronde Basalt (figs. 2, 3, and A2, and appendix A.5). The Selah and Quincy-Squaw Creek interbeds were less frequently identified in well logs, indicating that they possibly were not present or missed during drilling. Well log interpretation of the Priest Rapids Basalt was inconsistent, with some studies identifying the Lolo and Rosalia sub-units, whereas others only used the more generic Priest Rapids designation. Because insufficient data were available for the interbeds and the top of the lower Priest Rapids Basalt, the tops of these units were modeled as proportions of the distance between the overlying and underlying tops.

The distance between the top of the Pomona Basalt and the top of the Priest Rapids Basalt is partially filled by the Selah Interbed, which is overlain by the Pomona Basalt. The interbed represents the soil and alluvium that was accumulating on top of the Priest Rapids flows until the Pomona was deposited over it. Because the Pomona basalt flowed in through the valley bottoms and over the lower ridges of the paleo-Mosier valley, the thickest parts of the Selah correspond to the valley bottom deposits with thinner or non-existent deposits preserved in the topographically higher areas. Data coverage of the Selah Interbed is sparse with the thickest deposits estimated to be approximately 170 ft, but more commonly between 30 and 50 ft in the OWRD groundwater administrative area (Lite and Grondin, 1988). To generate a physically reasonable layer to represent the hydraulic character of the Selah Interbed, the interbed was modeled as a fraction of the distance between the underlying Priest Rapids and overlying Pomona basalt tops. The fraction was scaled to zero feet of thickness in the uplands where the Pomona basalt pinches out and to 40 ft of thickness in the administrative area to provide a simple linear relation that matches the data reasonably well (fig. A3). In plan view (not shown) measured thickness is highly variable over short distances, with relatively thin deposits of this confining unit occurring not far from thick deposits. So even though a better fit might be achieved using more complicated relations, the simplified relation is likely adequate for use in the flow model. This is because there is much more uncertainty in hydraulic conductivity of the interbeds than in interbed thickness through which groundwater flows.

The thickness between the tops of the Frenchman Springs Basalts and the Priest Rapids Basalts is filled with two individual Priest Rapids Basalt flows and the Quincy-Squaw Creek interbed directly overlying the Frenchman Springs unit. Twenty-one wells had data on interbed thickness, and the sedimentary interbed had no strong or persistent spatial trend in thickness (fig. A4). Reported thicknesses ranged from 10 to 53 ft with an average value of 24.7 ft and a median value of 20 ft. It is assumed that presence of the Priest Rapids Basalt will preserve interbed deposits, so the interbed was modeled wherever Priest Rapids Basalt was present. If total distance between top of Frenchman Springs and Top of Priest rapids was greater than or equal to 30 ft, a constant thickness of 20 ft was modeled as interbed. Below 30 ft, interbed thickness is modeled as two-thirds of the total thickness (fig. A4).

Many wells contained picks for either or both of the upper and lower Priest Rapids flows, but when modeling the top of the upper Priest Rapids flow, it became apparent that a pick for top of the Priest Rapids unit occasionally was in fact a pick for the top of the lower Priest Rapids flow.



Base modified from USGS and other digital data. Coordinate system: State Plane, Oregon North, FIPS 3601, North American Datum of 1927.

EXPLANATION

Geologic model unit

- Glaciofluvial Deposits
- Undifferentiated Overburden
- Pomona Basalt
- Priest Rapids Basalt
- Frenchman Springs Basalt
- Grande Ronde Basalt

- **OWRD Groundwater Administrative Area**
- **Modeled fault**
- **Groundwater-flow model boundary**
- **Syncline**
- Syncline
- **Syncline concealed**
- **Perennial stream**
- **Ephemeral stream**
- **Stratigraphic control well**
- **1** **Geologic-modeling panel number**

Figure A2. Simplified geology, wells with interpreted geology, and simulated faults corresponding to major structural features in the Mosier study area. Simulated faults were used to define separate geologic modeling blocks.

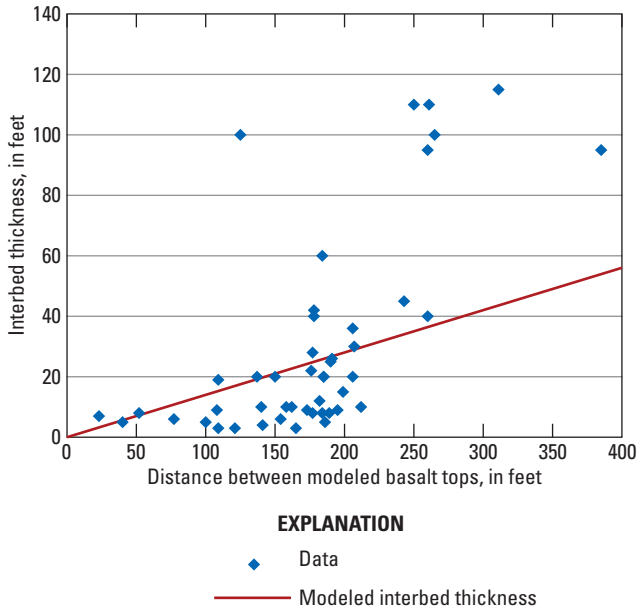


Figure A3. The relation between the thickness of the Selah interbed and separation between the top of the Pomona Basalt and the Priest Rapids Basalt. The line shows the simulated relation used in the geologic model.

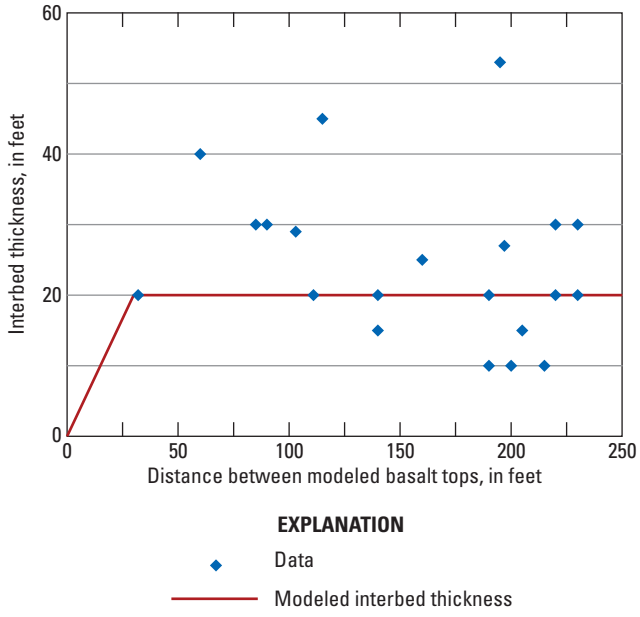


Figure A4. The relation between the thickness of the Quincy-Squaw Creek interbed and separation between the top of the Priest Rapids unit and Frenchman Springs unit. The line shows the modeled relation used in the geologic model.

To the maximum extent possible, these picks were corrected to provide a consistent set of data. To prevent inconsistencies with any erroneous points that may have been missed, the top of the Priest Rapids unit was modeled as a surface, and the demarcation between the two flows was modeled using thickness estimates from data where both flows were picked in the same wells (fig. A5). In these wells, the thicknesses of both the upper and lower units were examined, and the upper unit was approximately 70 ft thick with the lower unit exhibiting more variability. Additionally, if total thickness of the Priest Rapids flows plus interbed thickness was less than 82 ft, only one flow was typically present. For this reason, the demarcation between the units was computed by assuming that the lower unit and interbed constituted the entire thickness until the 82-ft threshold was exceeded, then the lower unit was modeled at a constant 82 ft thick until the upper unit was 70 ft thick. After the total value of 152 ft is reached, the upper unit is held at 70 ft of thickness with the balance being modeled as the lower unit. The lower unit is simulated as having a larger extent because the 82-ft threshold is larger than the 70 ft typical thickness of the upper unit and because it is convenient hydraulically to allow recharge to enter this unit directly for flow modeling. This precludes the need to rectify potential disconnects between focused recharge to the lower unit and the PRMS derived recharge, which inherently evenly distributes recharge across the PRMS hydrologic units. Contrarily, there is some preliminary geologic evidence that the upper unit can be of larger extent in some locations. The potential error introduced to the flow model is that more water is available from the lower unit at the expense of the upper unit, but because these units are separated by less than 70 vertical ft in the final flow model, and several wells draw water from multiple units, this error is likely negligible when considering the larger flow-system dynamics. The above relations are shown graphically compared to the data (fig. A5).

Only a few wells completely penetrate the Frenchman Springs Basalt and contact Grande Ronde Basalt. All of these wells are located in the upper part of the model area (generally, near the crest of the Columbia Hills anticline, fig. 2). As a result, the Frenchman Springs Basalt thickness and Grande Ronde unit top elevation are poorly defined except in this one small area. Even though the thickness is likely variable across the watershed, a typical upland value of 420 ft thickness of Frenchman Springs Basalt is used everywhere, defining the Grande Ronde unit top elevation everywhere. This simplified representation resulted in a corresponding poorer fit compared to other interpolated surfaces (table A1 and fig. A6). Further, there are no reliable estimates of uncertainty of this thickness because there are no Grande Ronde Basalt data in most parts of the watershed. However, the simplified formulation of both the Frenchman Springs and Grande Ronde Basalts is deemed adequate for groundwater-flow hypothesis testing subject to the conceptual model of the flow system.

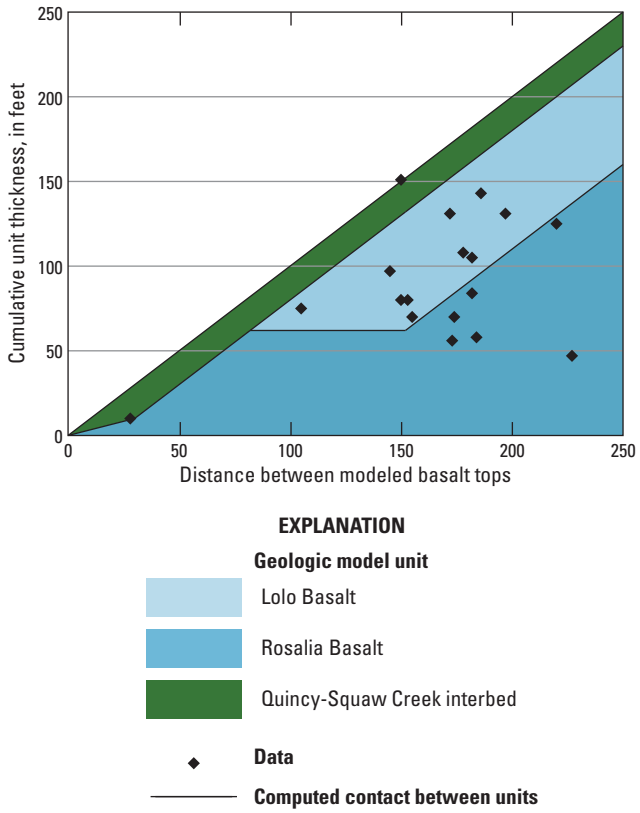


Figure A5. The relations between the thickness of the lower Priest Rapids units (Rosalia) and the total thickness of Priest Rapids Basalt and the Quincy-Squaw Creek interbed. The lines show the rules used to construct the Lolo and Rosalia geologic model units as a function of the available thickness.

This conceptual model merely requires that recharge into Frenchman Springs and Grande Ronde Basalts be transmitted toward the Columbia River through the deep flow system.

The residuals of well data for the final modeled surfaces are generally symmetrically distributed (fig. A6) and are random in map view, with typical magnitudes less than 50 ft (table A1). Generally, inclusion of surficial geology points used in trend surface estimation will result in smaller computed variances, mean values closer to zero, and a more symmetrical distribution of residuals. However, the number of geologic points used in the interpolation is arbitrary because surficial geology can be sampled at an arbitrary interval. Because the number of sample points affects the computed statistics, only well points were used when computing and displaying summary statistics that may be used to infer model error.

An illustrative example of the role of geologic map sample points on geologic model fit results are shown for the Frenchman Springs flow top in geologic model block 3 (figs. A7 and A8). Figure A8*C* is data shown in A6*D* that is for geologic model block 3. The asymmetry of the histogram for the surficial geology points (fig. A8*B*) indicates that the top of the Frenchman Springs unit in outcrop is consistently higher than the trend of the well picks, indicating there may be some bias in selection of the top of the Frenchman Springs unit using drillers' logs.

Table A1. Summary statistics for well data residuals from the interpolation of each of the modeled basalt unit tops, Mosier, Oregon study area.

[**Variance** shown in units of square feet. All other quanities in units of feet. While including the surficial geology residuals would have a tendency to reduce variance and make the mean value closer to zero, the number of surficial geology points is a function of sampling methodology, so these data are not reported]

Unit top	Variance	Standard deviation	Number of points	Mean	Median	5th percentile	10th percentile	90th percentile	95th percentile
Pomona	2,404.0	49.0	165	13.8	10.6	-49.6	-36.2	78.9	106.5
Lolo	3,845.3	62.0	214	11.6	16.5	-107.9	-59.7	73.3	103.5
Rosalia	3,469.4	58.9	20	-12.7	-2.6	-96.8	-87.6	47.7	50.8
Frenchman Springs	3,986.9	63.1	240	-12.7	-3.8	-114.3	-79.8	51.9	65.6
Grande Ronde	11,589.7	107.7	39	-29.5	-37.2	-181.2	-162.6	119.6	124.9

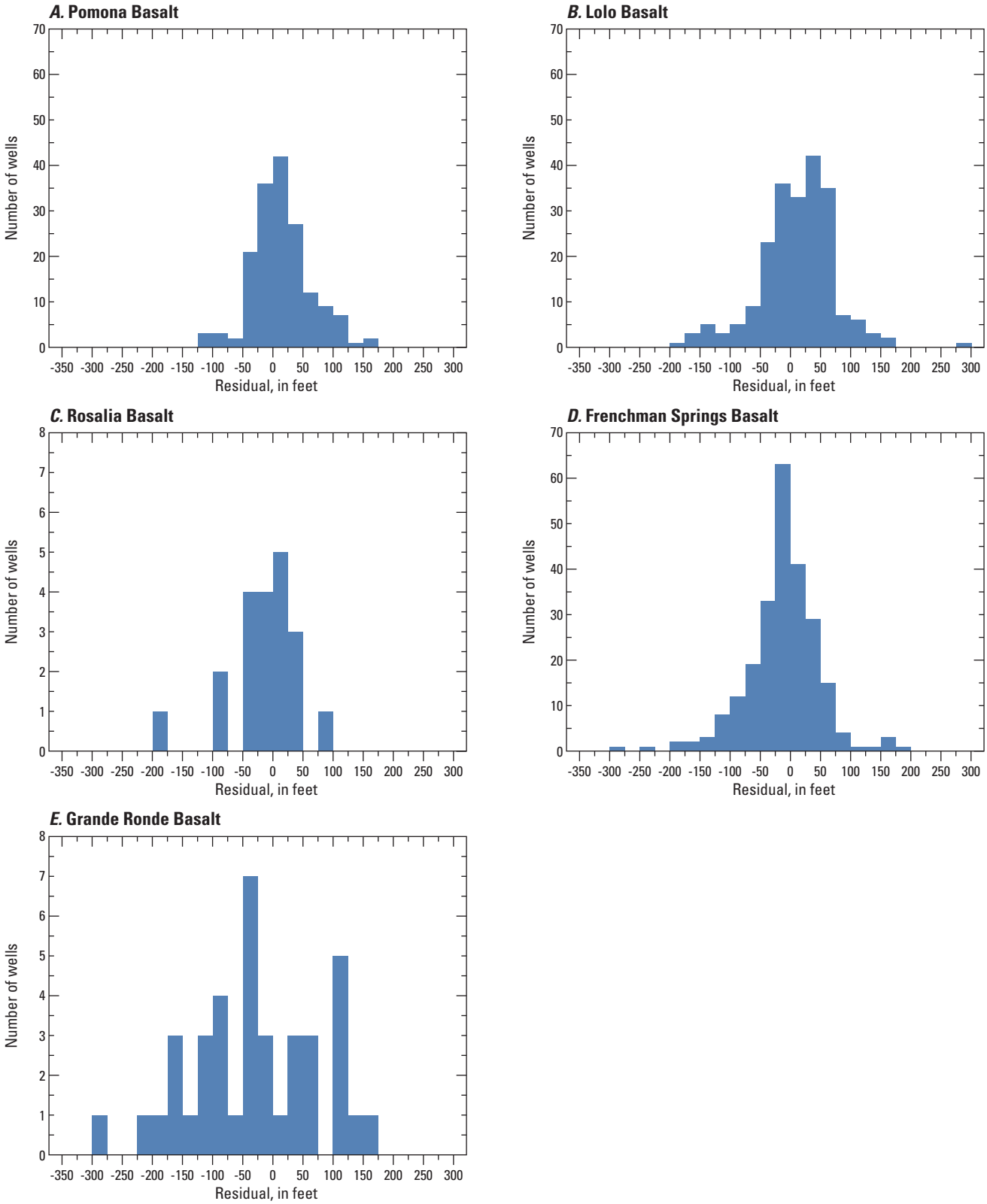
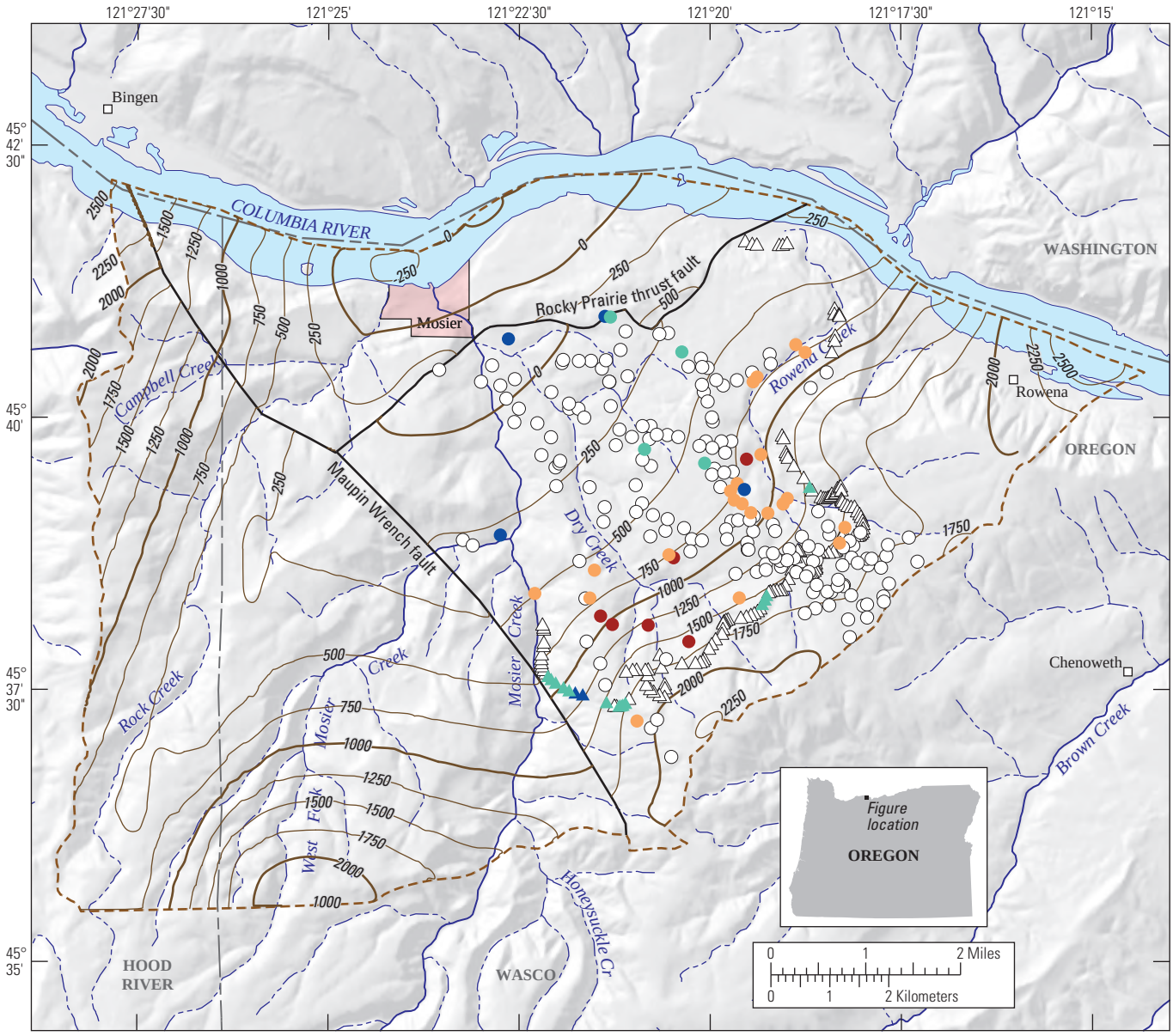


Figure A6. Residuals for the wells only from the interpolation of each of the modeled basalt unit tops (*A*) Pomona Basalt, (*B*) Lolo Basalt, (*C*) Rosalia Basalt, (*D*) Frenchman Springs Basalt, (*E*) Grande Ronde Basalt.



Base modified from U. S. Geological Survey and other agency digital data, various scales.
Coordinate system : State Plane Oregon North, FIPS 3601, North American Datum of 1927. Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD88).

EXPLANATION

Well data residual, in feet

- -309.2 to -150.0
- -149.9 to -75.0
- -74.9 to 75.0
- 75.0 to 150.0
- 150.0 to 225.0

Geology map data residual, in feet

- -4.8 to 75.0
- 75.0 to 150.0
- 150.0 to 225.0

- **Mosier City limits**
- **Simulated trend surface elevation of top of Frenchman Springs Basalt**—Contour interval 250 feet; bold line at 1,000-foot intervals
- **Groundwater-flow model boundary**
- **Perennial stream**
- **Ephemeral stream**
- **Simulated fault**

Figure A7. Distribution of residuals between both the geologic map and well data and the final trend surface for the top of the Frenchman Springs unit in geologic model block 3.

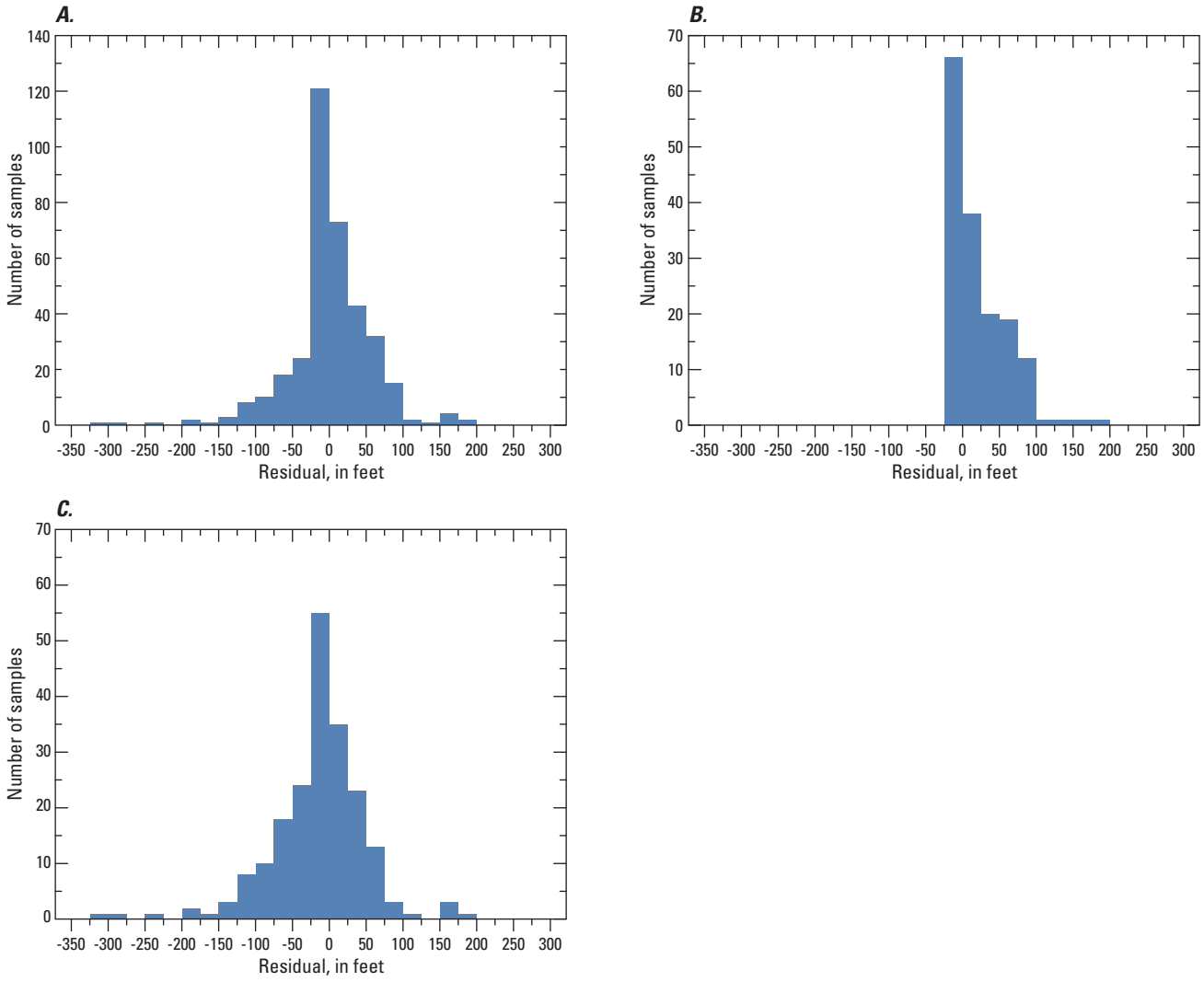


Figure A8. Residuals between both the geologic map and well data and the final trend surface for the top of the Frenchman Springs unit in geologic model block 3. Histograms are for three data groups: (*A*) surficial geology sample points and wells, (*B*) surficial geology sample points only, and (*C*) wells only. The composite histogram shows that the modeling criteria is satisfied overall, but the skew in the other histograms indicates that the other data are potentially not consistent, indicating possible error in some well data.

Recall that the best trend surface is defined as the smoothest surface that removes most spatial trends in residuals and for which the distribution of residuals is symmetric with mean value of about zero. Rather than removing possibly erroneous data from the dataset, all data are used in the analysis. A color scheme was applied to figure A7 to highlight the effect of data outliers. Generally, spatial trends in these extremes are random, but some trends are discernible. Of particular interest is the cluster of highly negative residuals to the south. These negative values indicate that the smooth trend surface is higher than the data here. Except for these outliers, a smooth trend in the area adequately explains the observations, matching well data to the north and outcrop data to the south.

There are various possible reasons for these outliers. It is possible that the data represent a flow top other than the top of the Frenchman Springs unit. Recall that the Frenchman Springs Basalt in the area likely comprises four distinct flows. It is possible that the geologist that classified the top correctly identified the top of one of the lower Frenchman Springs units. In general, geologic picks with high negative residuals tend to occur in topographically lower areas, so if depth was used to identify the top of the unit (instead of elevation) then a lower Frenchman Springs flow top may have been identified as the top. Another possibility is that there is a fault or other geologic structure between the outliers and the remaining data, but there are no continuous mapped structures in the area (fig. 2). The last possibility considered here is that the data represent a local steep-sided bowl-shaped depression in the top of the Frenchman Springs unit. This violates the assumption that the surface is a fairly simple, smoothly varying surface. Because of the likelihood of erroneous interpretation of strata at some locations, the assumption of a simple smoothly varying surface is retained in the model for parsimony given the support of the remaining data. Retention of the high residual data in the fit statistics identifies data that can require further examination in the future.

Examination of fig A8*C* shows that the picks with outlier high negative residuals wells are generally 200–300 ft lower than the trend surface (fig. A8). In fact, these few outliers contribute a significant part of the computed variance of the residuals (table A2) and skew the histogram of the surficial geology picks (fig. A8*B*). Combination of the residuals from each data source, figures A8*C* and A8*B*, into a single composite data histogram (fig. A8*A*) shows that the fit criteria of symmetrical residuals with mean zero is generally achieved for the composite dataset (table A2).

Surficial geology data points vary smoothly in space, so inclusion of these residuals with well residuals for computation of fit statistics tends to reduce measures of spread (table A2), indicating that summary statistics based only on well data provide relatively conservative estimates of model error. A typical value of standard deviation for well residuals for each layer except Grande Ronde is about 60 ft (table A1). This measure of geologic model error generally applies in areas where there is some data support to ensure the trend surface is near the true value. In areas with poor data support, such as geologic-modeling panel 1, the estimated surface has greater uncertainty, and far from supporting data, should be viewed as reflecting the conceptual geologic model. Near structurally complex areas, close to faults with significant offset and tight folds, uncertainty also is greater due to the inability of a smoothly varying trend model to capture small-scale spatial variability. This is illustrated by the larger residuals near the Rocky Prairie thrust fault (fig. A7). When considering the geometry of the geologic units to be described in Mosier, a local error of 100 ft compared to the typical about 3,000 ft of relief of the surface to be described, corresponds to about 3 percent error. Because the median and mean errors are close to zero and there are no significant trends in residuals, the model-generated surfaces are correct on average.

Table A2. Summary statistics for residuals from the Frenchman Springs Basalt top interpolation in geologic-modeling panel number 3, Mosier, Oregon, study area.

[**Variance** shown in units of square feet. All other quantities in units of square feet]

	Variance	Standard deviation	Number of points	Mean	Median	5th percentile	10th percentile	90th percentile	95th percentile
Wells	4,269.5	65.3	203	-13.7	-3.3	-115.0	-87.3	51.1	62.8
Geology	1,261.2	35.5	159	23.3	0.9	-0.8	-0.3	75.3	87.8
Both	3,280.3	57.3	362	2.5	-0.0	-97.9	-62.7	60.1	81.1

A.3—Groundwater-Flow Model Units

The digital geologic model units were converted into groundwater-flow simulation model units (fig. 3) using estimates of the fraction of each unit occupied by hydrogeologic units. Each permeable basalt unit flow top is estimated as 10 percent of total flow thickness. Because the Frenchman Springs Basalt unit consists of four or five distinct flows in the area with insufficient data to allow delineation of these individual flows, the flow tops are modeled as one unit, consisting of the upper 10 percent of the total thickness. Because few wells penetrate the upper part of the Grande Ronde Basalt in the study area, only the flow top is modeled and the flow interior is treated as a no flow boundary, precluding the need to model it explicitly in the geologic model. Flow top thicknesses of 10–20 ft are not uncommon for sheet flows, and because the Grande Ronde is assumed to be a sheet flow in the study area, the Grande Ronde flow top is assumed to be a uniform thickness of 20 ft.

In this study area, the only basalt flow with a documented laterally extensive, permeable flow bottom is the Pomona Basalt (Lite and Grondin, 1988). The permeable part of the flow bottom has a much smaller footprint than the flow itself. It is generally coincident with the thicker parts of the Selah Interbed and is postulated to have formed when the hot basalt flowed across the wet valley bottom deposits. The footprint of the permeable zone in geologic model block 3 has an estimated areal extent between 4 and 6 mi^2 immediately south of the Rocky Prairie thrust fault with a maximum thickness of about 20 ft (Lite and Grondin, 1988). Further, prior to development, this zone was hydraulically isolated from the underlying Priest Rapids flow top aquifer. Because the Pomona Basalt flow was thickest in valley bottoms, the thickness of this unit was used to estimate a reasonable distribution of permeable flow bottom. Whenever modeled Pomona thickness exceeds 155 ft, permeable flow bottom is assumed to exist, and the excess thickness is scaled linearly so that the maximum thickness of the flow bottom is 20 ft. The resulting modeled aquifer has several nice properties: (1) it is about 4 mi^2 in the area generally identified by Lite and Grondin (1988), and about 8 mi^2 over the entire area; and (2) the footprint is completely contained within the Selah Interbed footprint, ensuring the Selah can act as an confining unit as supported by early data. The modeled aquifer overly simplified, and exact geometry may be somewhat different, but supporting data indicate the geometry is a reasonable representation for use in the hydrogeologic flow simulation model.

In an idealized geologic model, flow tops would be modeled as 10 percent of the thickness before truncating the model with surficial topography. This would ensure that the flow top intersected erosional stream cuts at the appropriate elevation. This would result in the flow interior being exposed in a thin band along the stream-cut wall, much like is observed in reality. Instead, based on flow modeling considerations, this was not done here. The flow top is modeled here as 10 percent of the final computed thickness at all locations, even at stream cuts and other erosional features that may occur on topographic highs. This provides many properties that aid in stability of the numerical flow model, allowing for robust estimation of parameters during automated sensitivity and predictive runs, and that are consistent with physical and other modeling assumptions. The properties aiding stability include:

1. Because PRMS provides a recharge estimate that is uniformly distributed across a model hydrologic response unit, preferential recharge pathways into system aquifers are not represented in the recharge field. Rather than identifying focused recharge areas and redistributing PRMS estimated recharge to these zones, simulating the upper 10 percent of every basalt unit as aquifer allows the distributed recharge to enter the aquifers as distributed recharge. This prevents high model heads from occurring when flux into confining unit model cells is prescribed, preventing the need to alter the hydraulic conductivity of these cells to achieve physically reasonable simulation results.

2. Connectivity between basalts and streams and drains is highest where the flow top is present in reality, and diminishes as basalts thin erosionally, providing a physically reasonable distribution of stream connection. This is especially true for the lumped Frenchman Springs Basalts, which is commonly about 400 ft thick consisting of multiple flows, but is modeled as a single flow top over a thick low permeability interior.

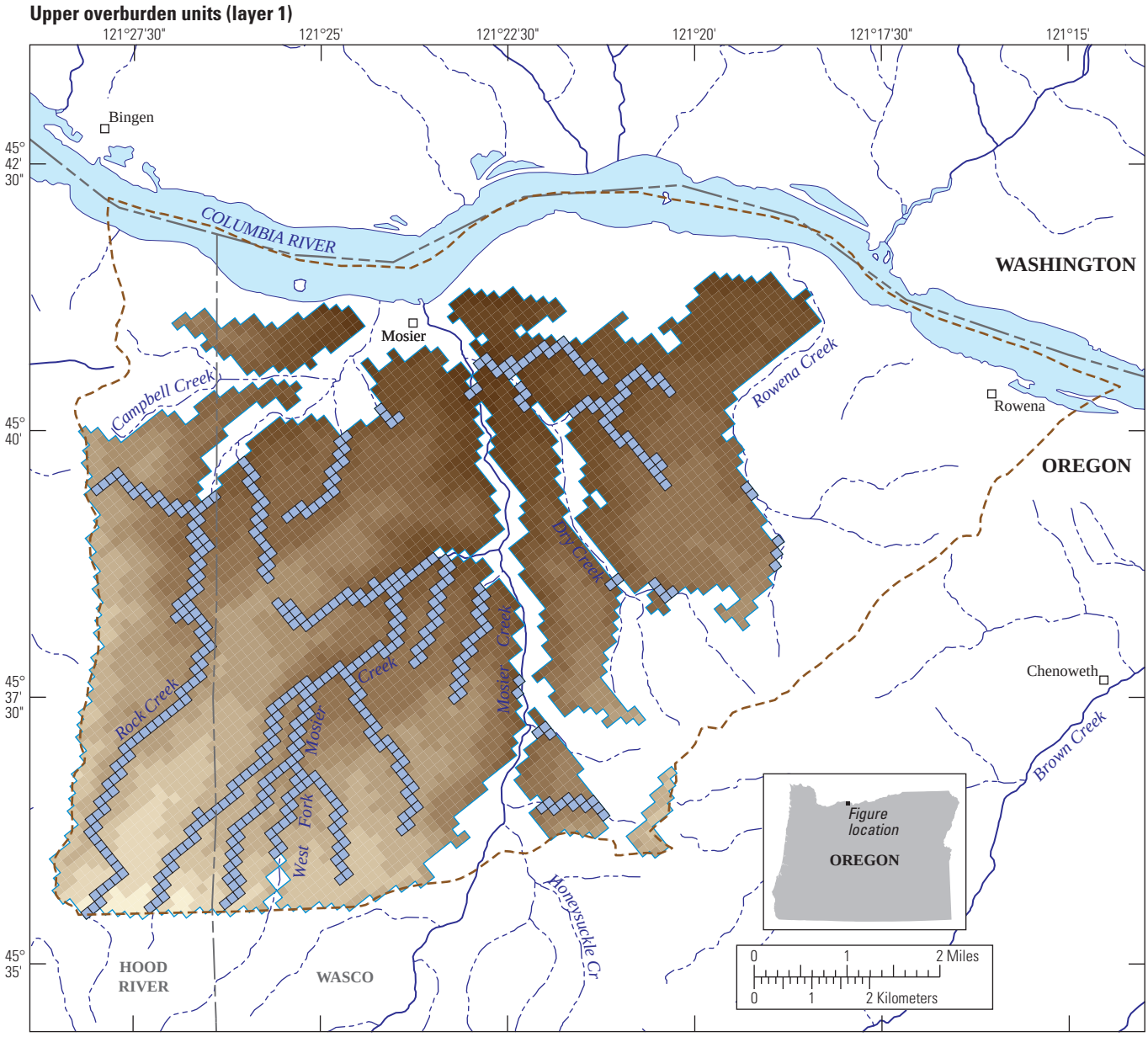
The overburden is laterally zoned into undifferentiated overburden and glaciofluvial deposits (fig. A2). Each zone is assumed to occupy the upper two groundwater-flow model layers (fig. 3). The Chenoweth Formation, which constitutes most of the undifferentiated overburden, is documented as generally having low permeability, as is expected of poorly sorted mud and ash deposits of volcanic origin. However, the base of this unit is occasionally coarse-grained and productive. Considering the morphology of debris flows, a gross oversimplification would be to conceptualize that the coarse, heavy deposits were funneled into the lowest path and to fell out much more rapidly than the finer deposits.

This gives a conceptual model of deposits that grade from fine to coarse from top down, and thicker sequences of coarse deposits in valley bottoms which also have thicker deposits overall. Accordingly, the overburden was divided into an upper 90 percent and lower 10 percent to allow for a relatively higher permeability base. Glaciofluvial deposits also retain the 90 to 10 percent split of groundwater-flow model layers, but because no data indicated that the upper and lower parts had dissimilar hydraulic properties, both groundwater-flow model layers were assigned the same hydraulic properties.

A.4—Groundwater-Flow Simulation Model Surfaces

Tops were computed for each of the groundwater-flow model units (fig. 3) at a 500 ft MODFLOW grid spacing (figs. A9–A22). The Grande Ronde aquifer unit is assumed to be 20 ft thick, defining the bottom of the flow model domain (20 ft below the surface shown in fig. A22). Each figure shows the extent of the MODFLOW model grid with cell color reflecting elevation and relevant boundary conditions displayed in appropriate cells. The set of lines from which the horizontal flow barriers are derived also is shown (figs. A11–A22).

For groundwater-flow simulation, model layers 3–11 have thin pseudo-cells that transmit water vertically between layers where hydrogeologic units have pinched out. These pseudo-cells are not shown on figures A11–A19, although they are a part of the active domain for groundwater-flow simulation. The reason for use of these cells is summarized in appendix E.3.



Base modified from USGS and other digital data. Coordinate system: State Plane, Oregon North, FIPS 3601, North American Datum of 1927. Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD88).

EXPLANATION

Groundwater-flow model cell top elevation—in feet

2,800
2,400
2,000
1,600
1,200
800
400

Note: Range is 250 (minimum) to 2,709 (maximum).

Boundary condition cell

Stream

Groundwater model boundary

Model layer boundary

Perennial stream

Ephemeral stream

Figure A9. The extent, model layer top elevation, and model boundary conditions of the upper overburden units (layer 1) in the Mosier, Oregon, groundwater-simulation model area.

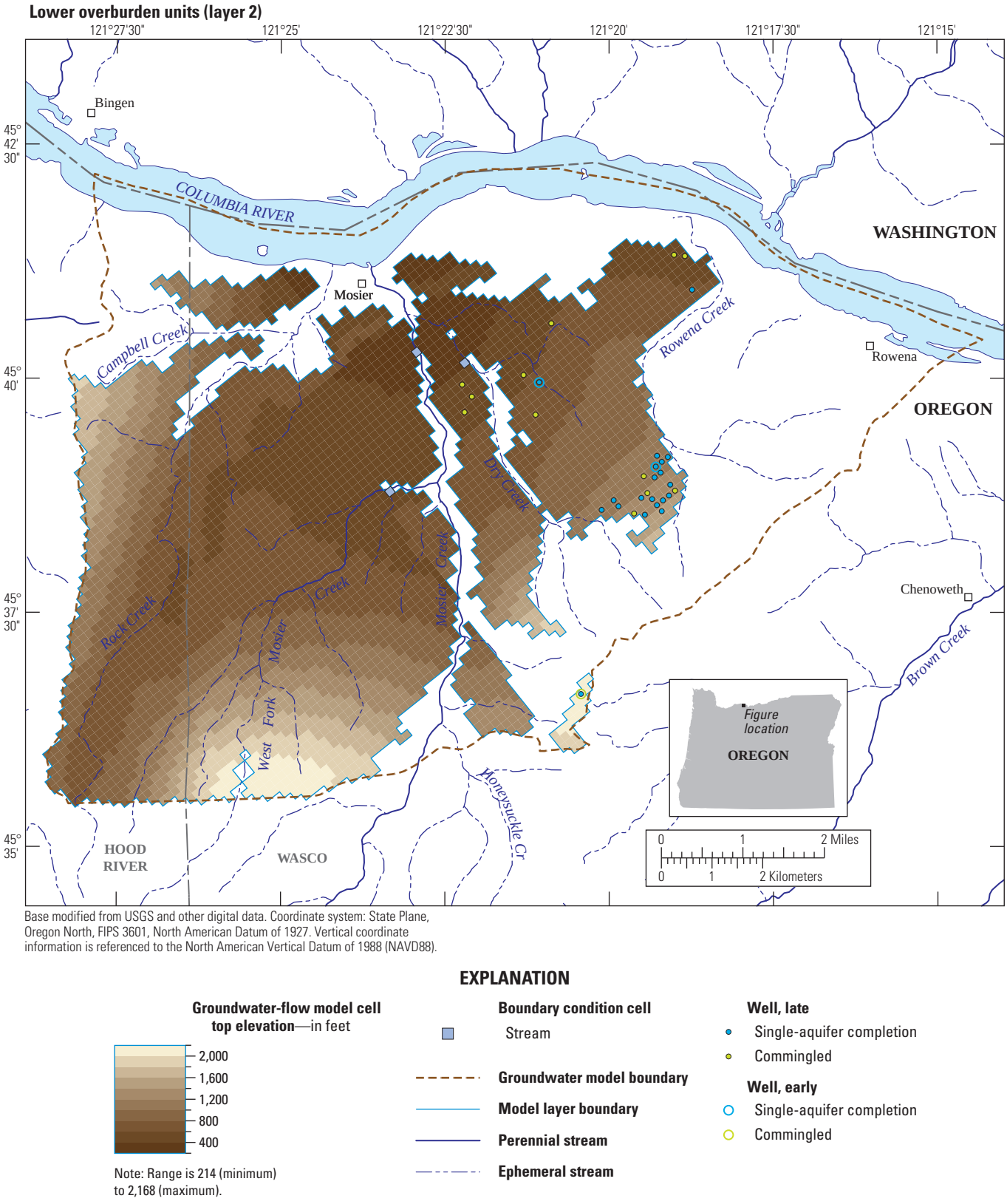
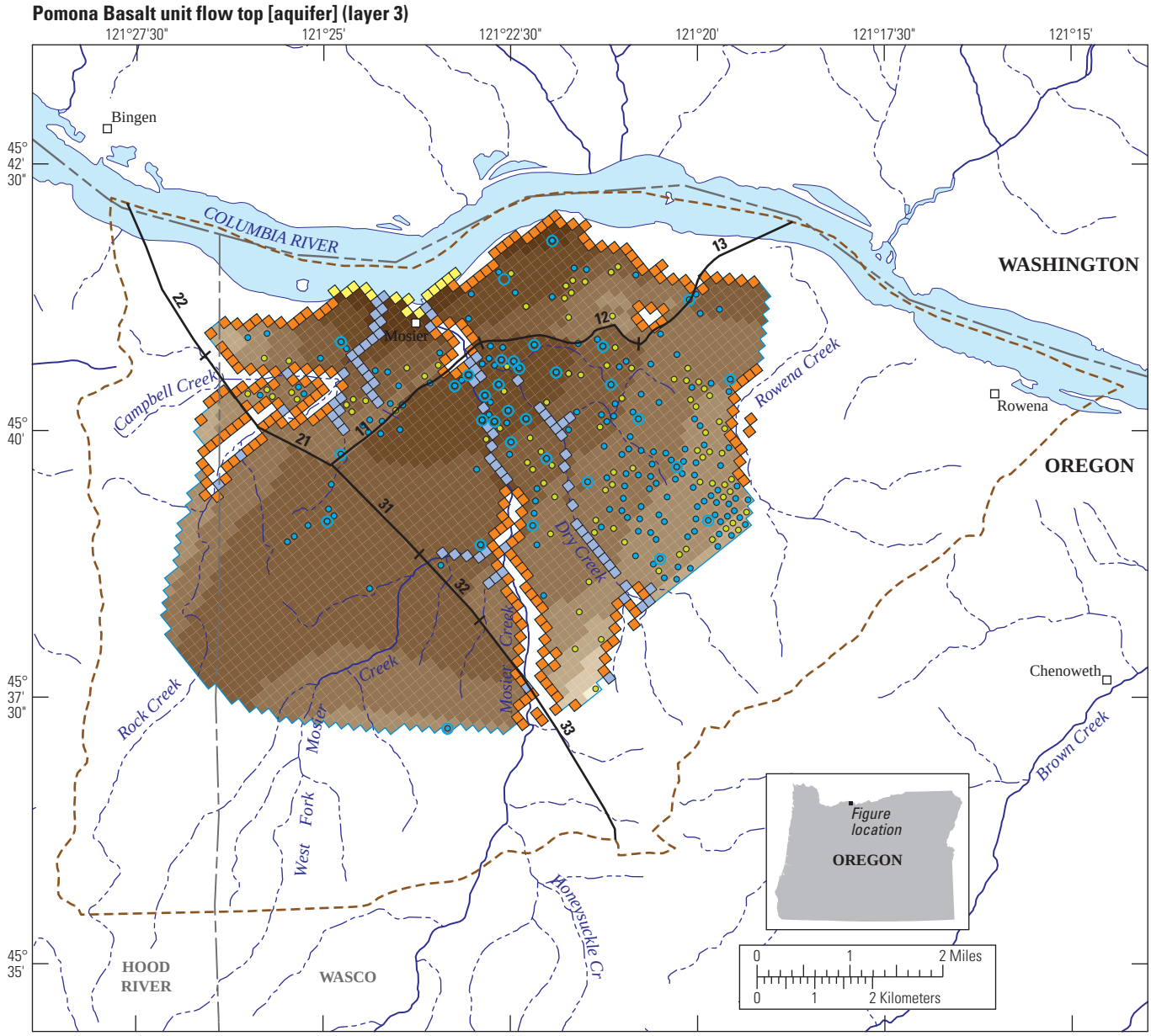


Figure A10. The extent, model layer top elevation, and model boundary conditions of the lower overburden units (layer 2) in the Mosier, Oregon, groundwater-simulation model area.



Base modified from USGS and other digital data. Coordinate system: State Plane, Oregon North, FIPS 3601, North American Datum of 1927. Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD88).

EXPLANATION

Groundwater-flow model cell top elevation—in feet

1,600
1,200
800
400
0

Note: Range is 74 (minimum) to 1,522 (maximum).

Boundary condition cell

- Drain
- General head
- Stream

11 **Horizontal flow barrier and segment identification No.**

Groundwater model boundary

Model layer boundary

Perennial stream

Ephemeral stream

Well, late

- Single-aquifer completion
- Commingled

Well, early

- Single-aquifer completion
- Commingled

Figure A11. The extent, model layer top elevation, and model boundary conditions of the Pomona Basalt unit flow top [aquifer] (layer 3) in the Mosier, Oregon, groundwater-simulation model area.

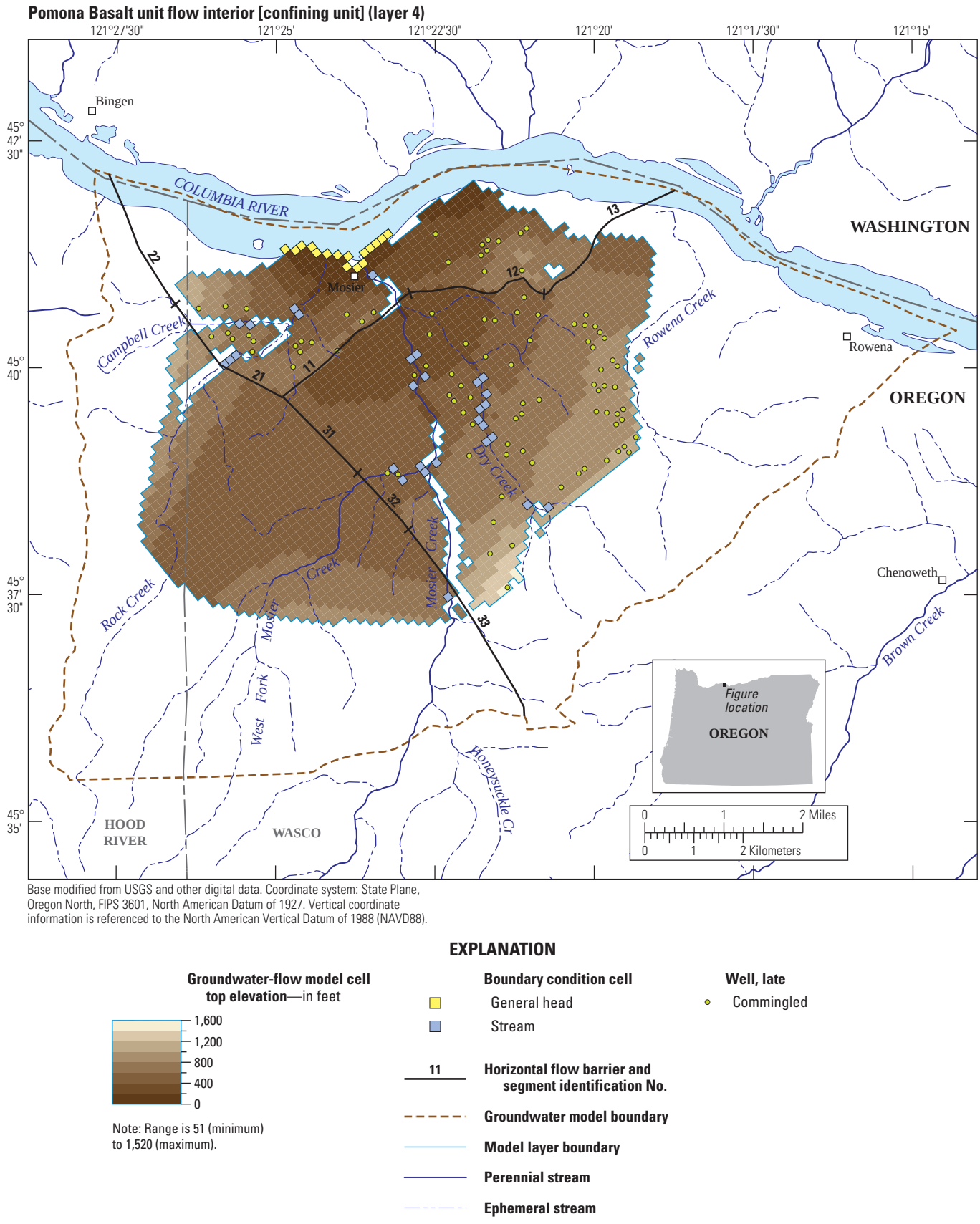
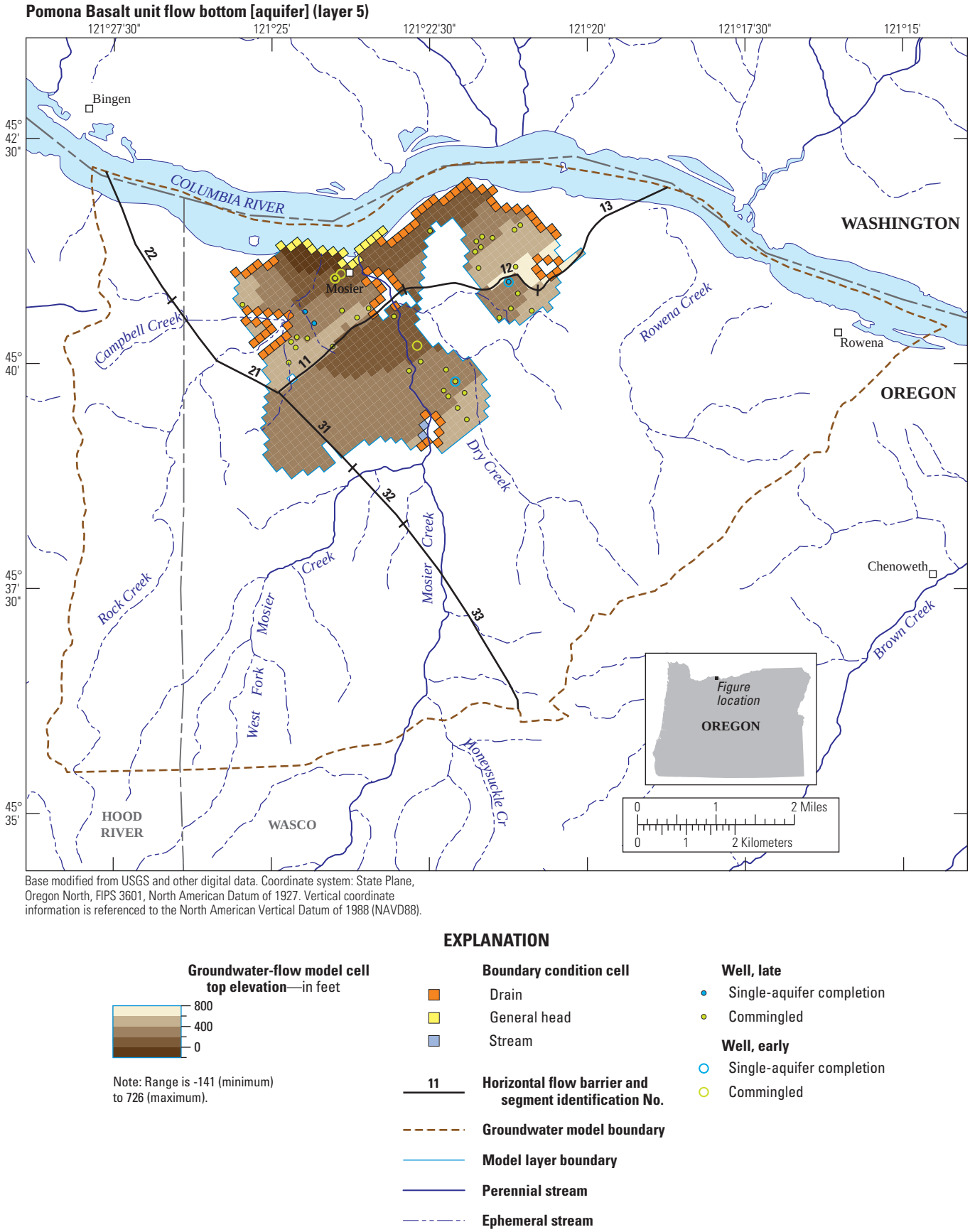


Figure A12. The extent, model layer top elevation, and model boundary conditions of the Pomona Basalt unit flow interior [confining unit] (layer 4) in the Mosier, Oregon, groundwater-simulation model area.



Base modified from USGS and other digital data. Coordinate system: State Plane, Oregon North, FIPS 3601, North American Datum of 1927. Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD88).

EXPLANATION

Groundwater-flow model cell top elevation—in feet

800
400
0

Note: Range is -141 (minimum) to 726 (maximum).

Boundary condition cell

- Drain
- General head
- Stream

11 **Horizontal flow barrier and segment identification No.**

Groundwater model boundary

Model layer boundary

Perennial stream

Ephemeral stream

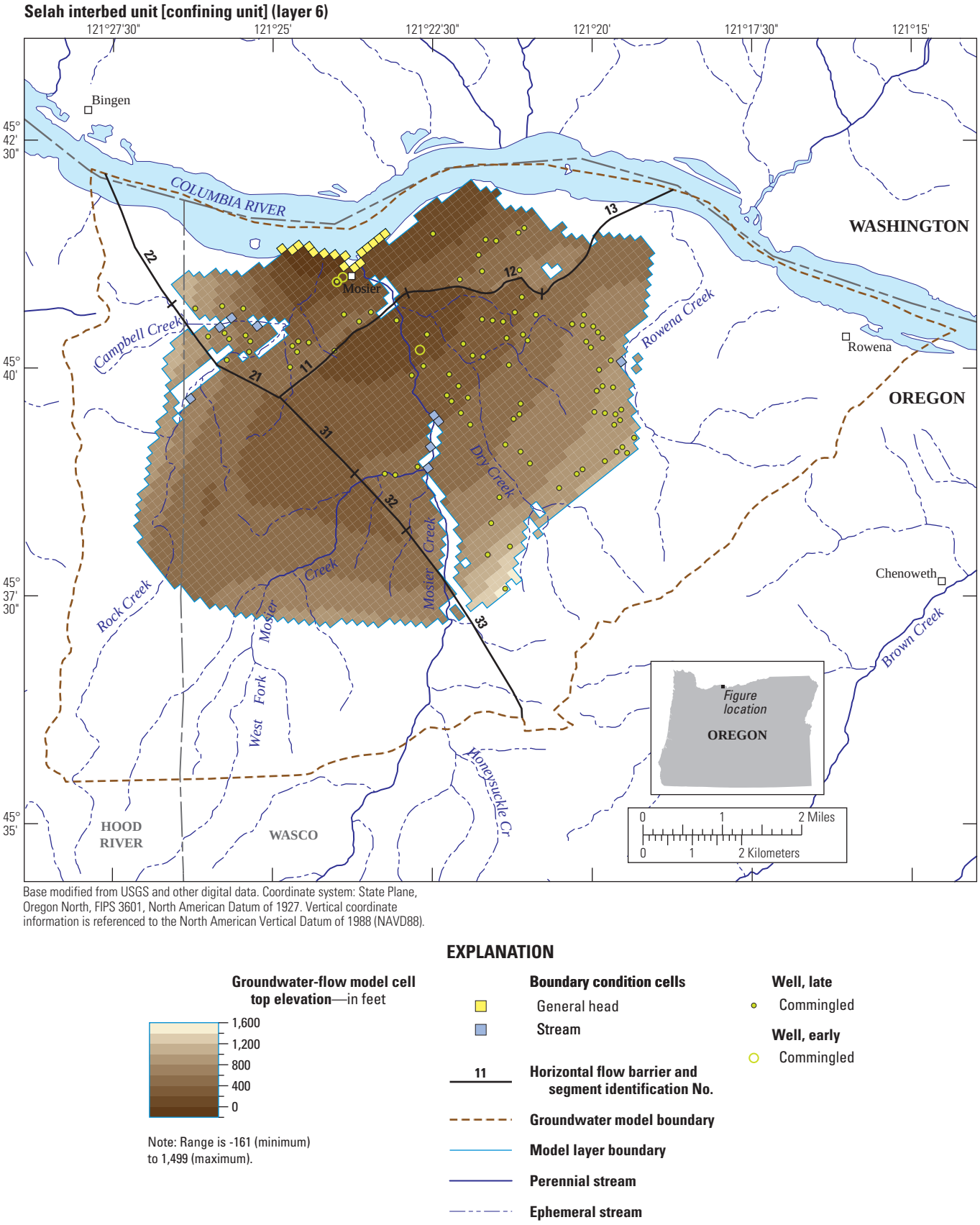
Well, late

- Single-aquifer completion
- Commingled

Well, early

- Single-aquifer completion
- Commingled

Figure A13. The extent, model layer top elevation, and model boundary conditions of the Pomona Basalt unit flow bottom [aquifer] (layer 5) in the Mosier, Oregon, groundwater-simulation model area.



Base modified from USGS and other digital data. Coordinate system: State Plane, Oregon North, FIPS 3601, North American Datum of 1927. Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD88).

EXPLANATION

Groundwater-flow model cell top elevation—in feet

1,600
1,200
800
400
0

Note: Range is -161 (minimum) to 1,499 (maximum).

Boundary condition cells
- General head
- Stream

11 **Horizontal flow barrier and segment identification No.**

Groundwater model boundary

Model layer boundary

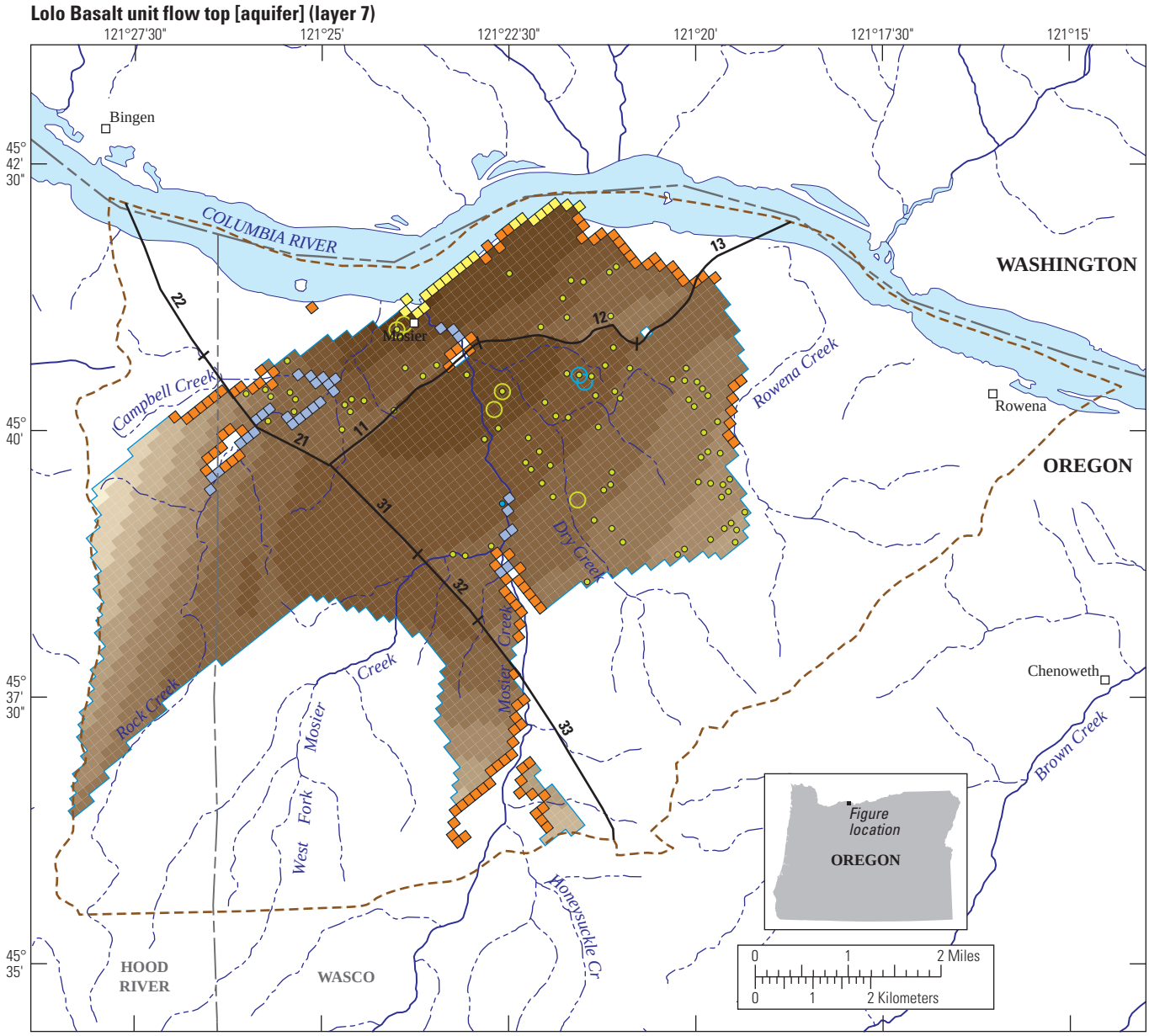
Perennial stream

Ephemeral stream

Well, late
- Commingled

Well, early
- Commingled

Figure A14. The extent, model layer top elevation, and model boundary conditions of the Selah interbed unit [confining unit] (layer 6) in the Mosier, Oregon, groundwater-simulation model area.



Base modified from USGS and other digital data. Coordinate system: State Plane, Oregon North, FIPS 3601, North American Datum of 1927. Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD88).

EXPLANATION

Groundwater-flow model cell top elevation—in feet

1,600
1,200
800
400
0

Note: Range is -119 (minimum) to 1,672 (maximum).

Boundary condition cell

- Drain
- General head
- Stream

11 **Horizontal flow barrier and segment identification No.**

Groundwater model boundary

Model layer boundary

Perennial stream

Ephemeral stream

Well, late

- Single-aquifer completion
- Commingled

Well, early

- Single-aquifer completion
- Commingled

Figure A15. The extent, model layer top elevation, and model boundary conditions of the Lolo Basalt unit flow top [aquifer] (layer 7) in the Mosier, Oregon, groundwater-simulation model area.

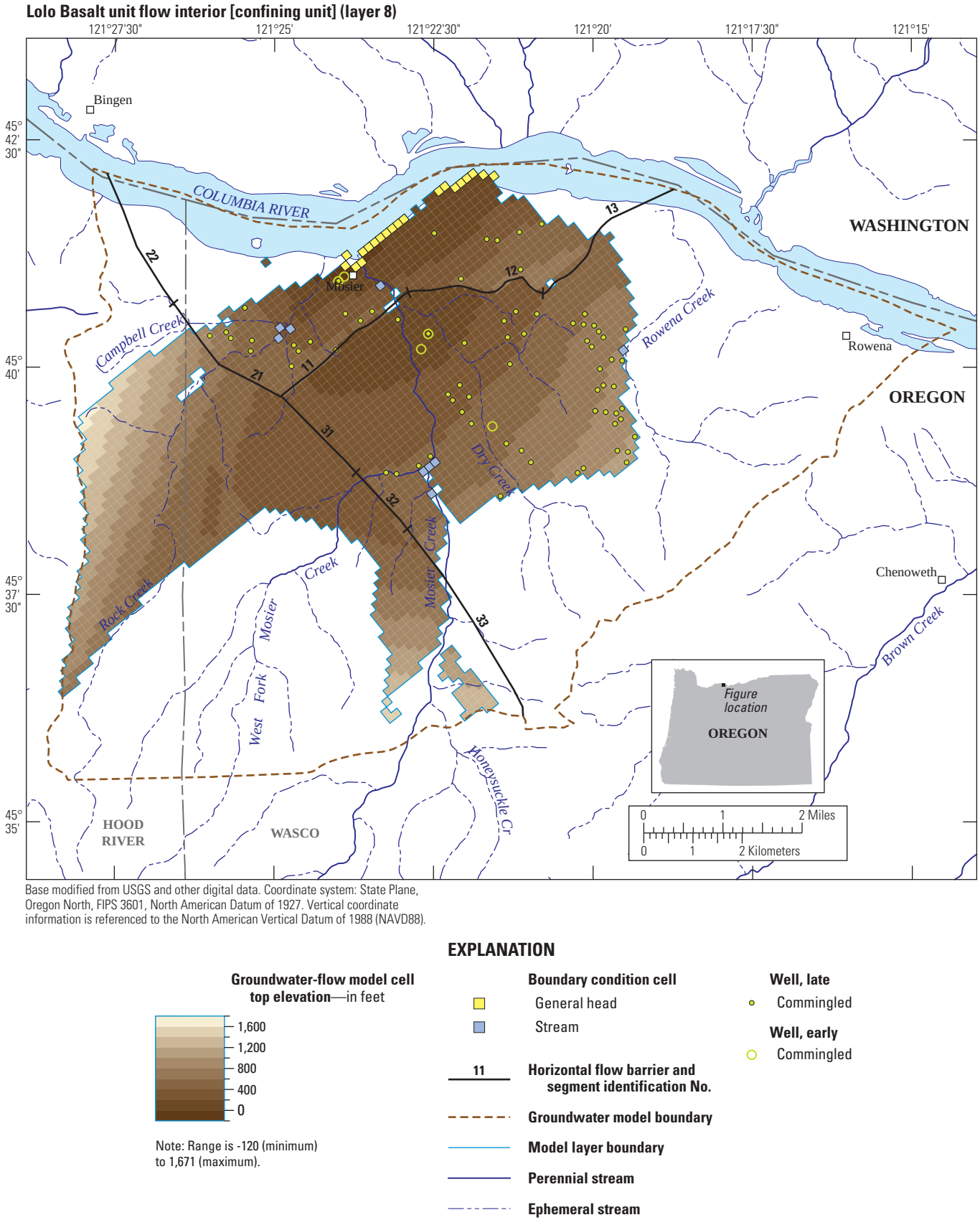
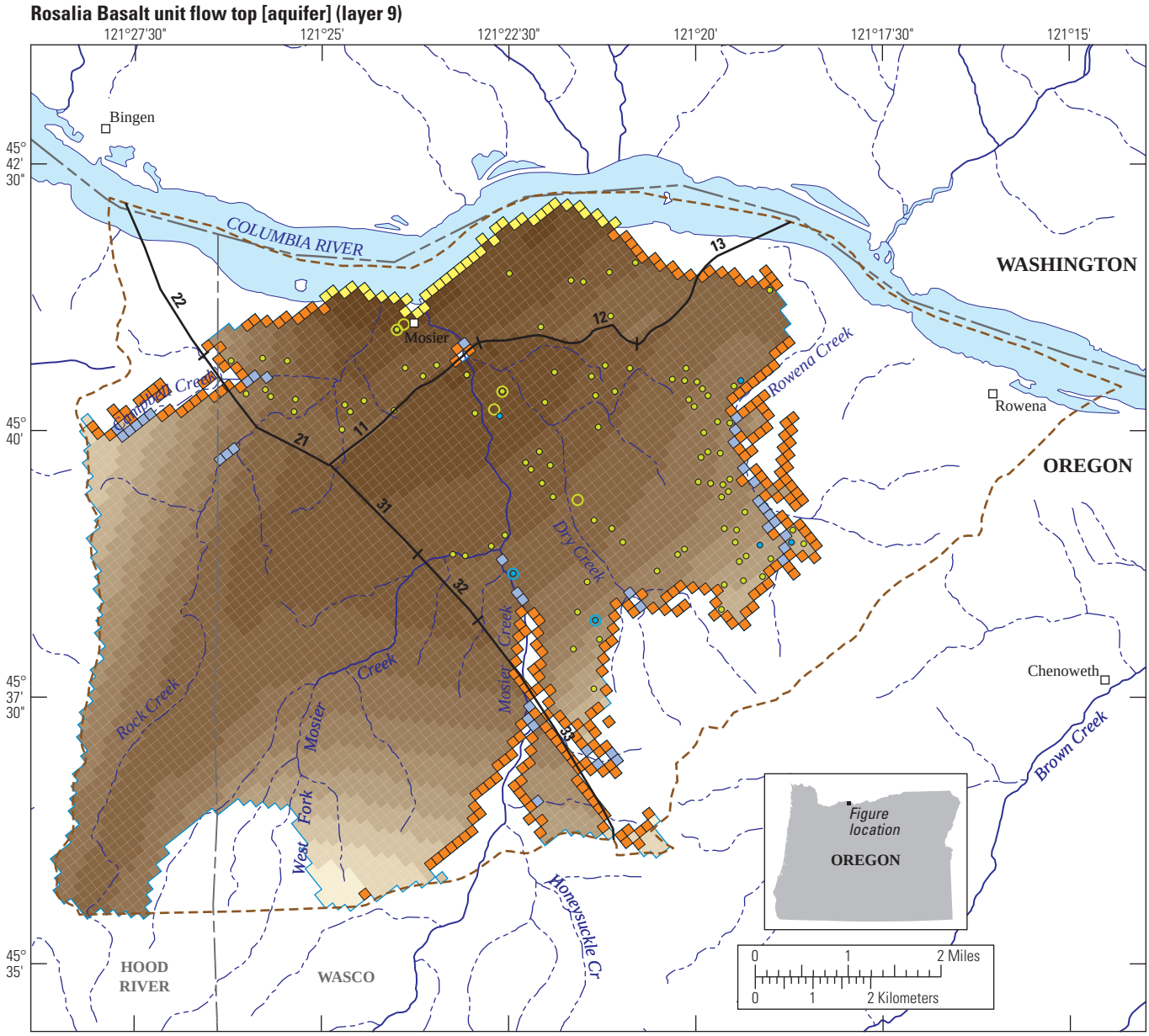


Figure A16. The extent, model layer top elevation, and model boundary conditions of the Lolo Basalt unit flow interior [confining unit] (layer 8) in the Mosier, Oregon, groundwater-simulation model area.



Base modified from USGS and other digital data. Coordinate system: State Plane, Oregon North, FIPS 3601, North American Datum of 1927. Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD88).

EXPLANATION

Groundwater flow model cell top elevation—in feet

- 2,000
- 1,600
- 1,200
- 800
- 400
- 0
- -400

Note: Range is -211 (minimum) to 2120 (maximum).

Boundary condition cells

- Drain
- General head
- Stream

11 **Horizontal flow barrier and segment identification No.**

Groundwater model boundary

Model layer boundary

Perennial streams

Ephemeral streams

Wells, late

- Single-aquifer completion
- Commingled

Wells, early

- Single-aquifer completion
- Commingled

Figure A17. The extent, model layer top elevation, and model boundary conditions of the Rosalia Basalt unit flow top [aquifer] (layer 9) in the Mosier, Oregon, groundwater-simulation model area.

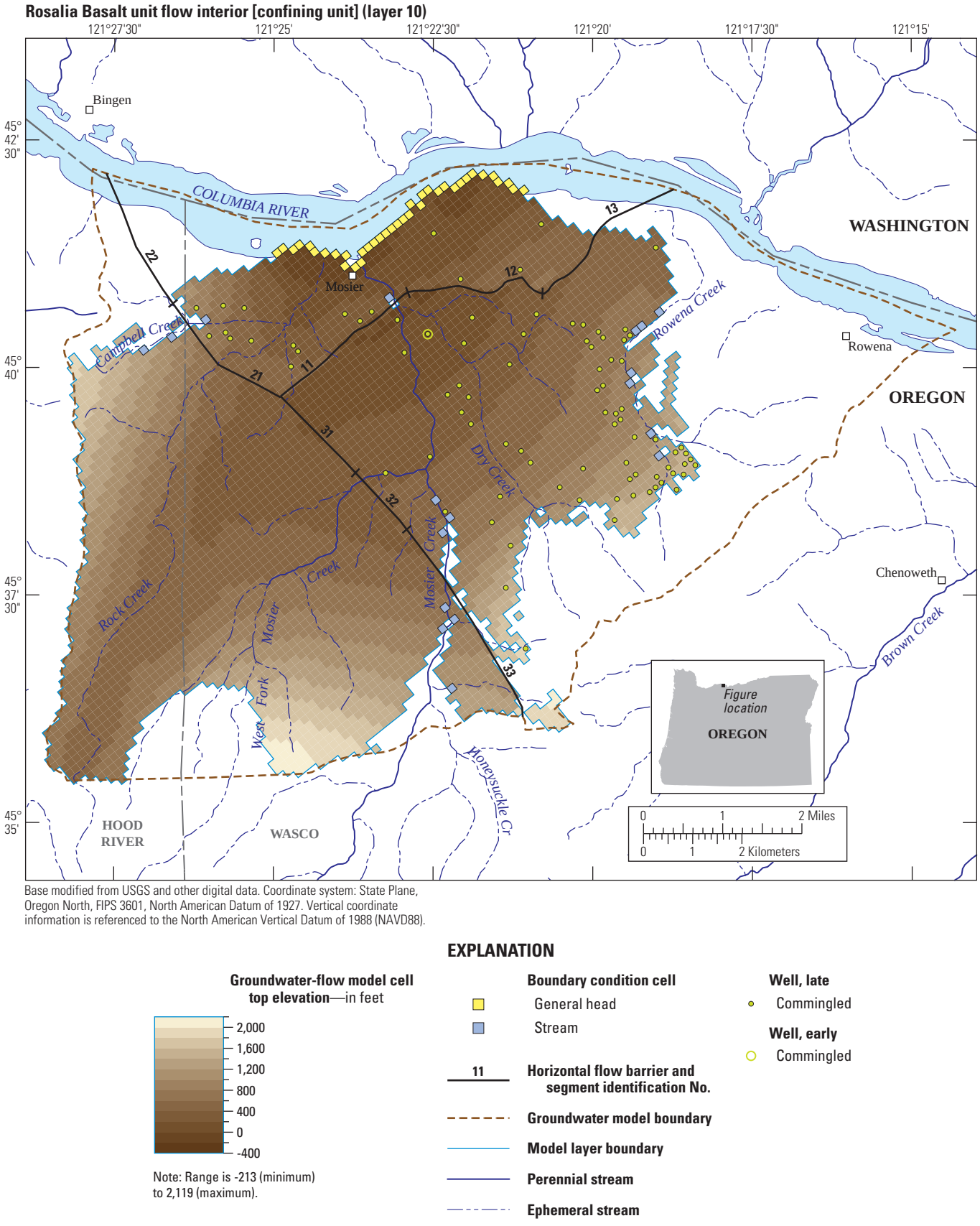
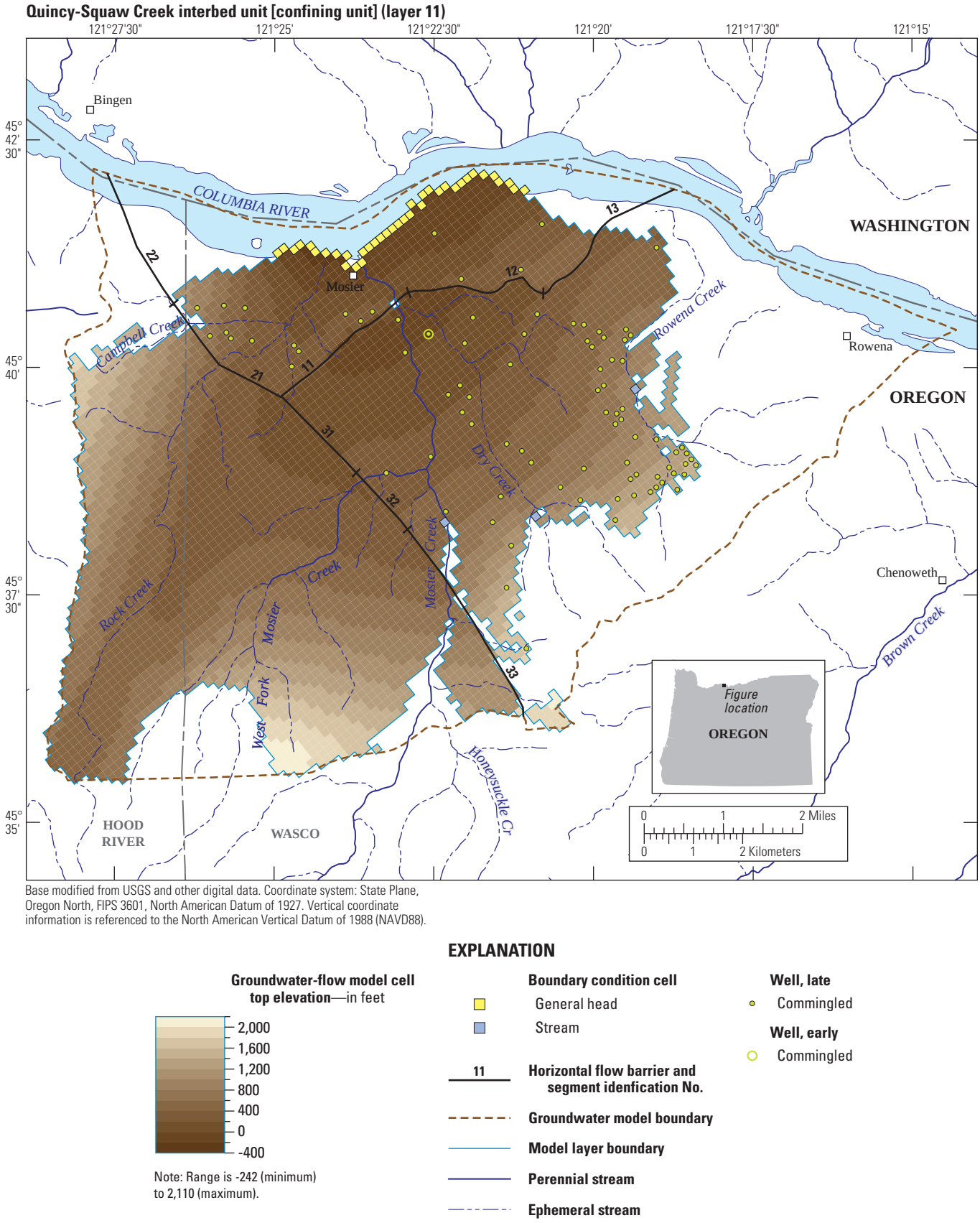


Figure A18. The extent, model layer top elevation, and model boundary conditions of the Rosalia Basalt unit flow interior [confining unit] (layer 10) in the Mosier, Oregon, groundwater-simulation model area.



Base modified from USGS and other digital data. Coordinate system: State Plane, Oregon North, FIPS 3601, North American Datum of 1927. Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD88).

EXPLANATION

Groundwater-flow model cell top elevation—in feet

- 2,000
- 1,600
- 1,200
- 800
- 400
- 0
- -400

Note: Range is -242 (minimum) to 2,110 (maximum).

Boundary condition cell

- General head
- Stream

11 Horizontal flow barrier and segment idenfication No.

- Groundwater model boundary
- Model layer boundary
- Perennial stream
- Ephemeral stream

Well, late

- Commingled

Well, early

- Commingled

Figure A19. The extent, model layer top elevation, and model boundary conditions of the Quincy-Squaw Creek interbed unit [confining unit] (layer 11) in the Mosier, Oregon, groundwater-simulation model area.

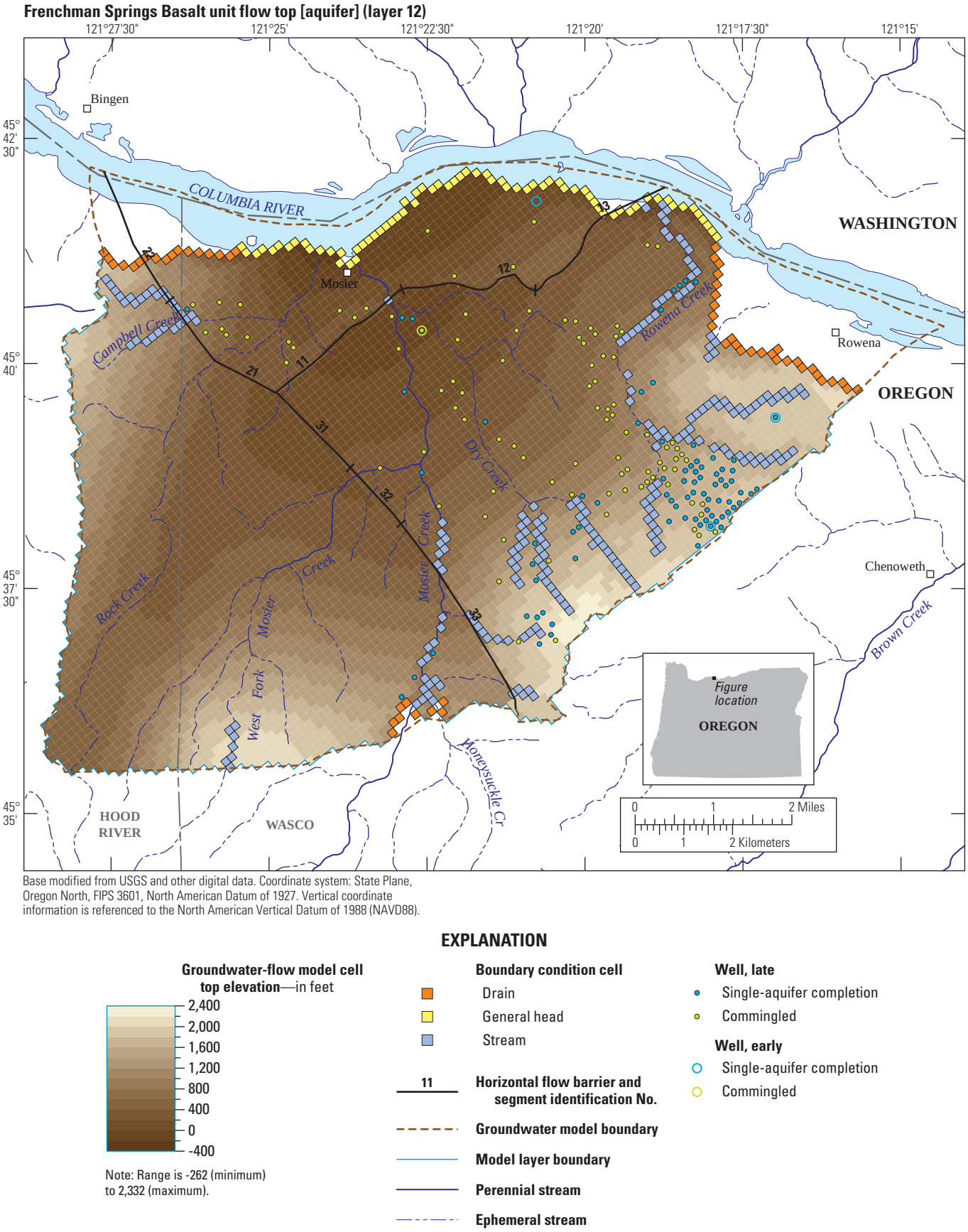
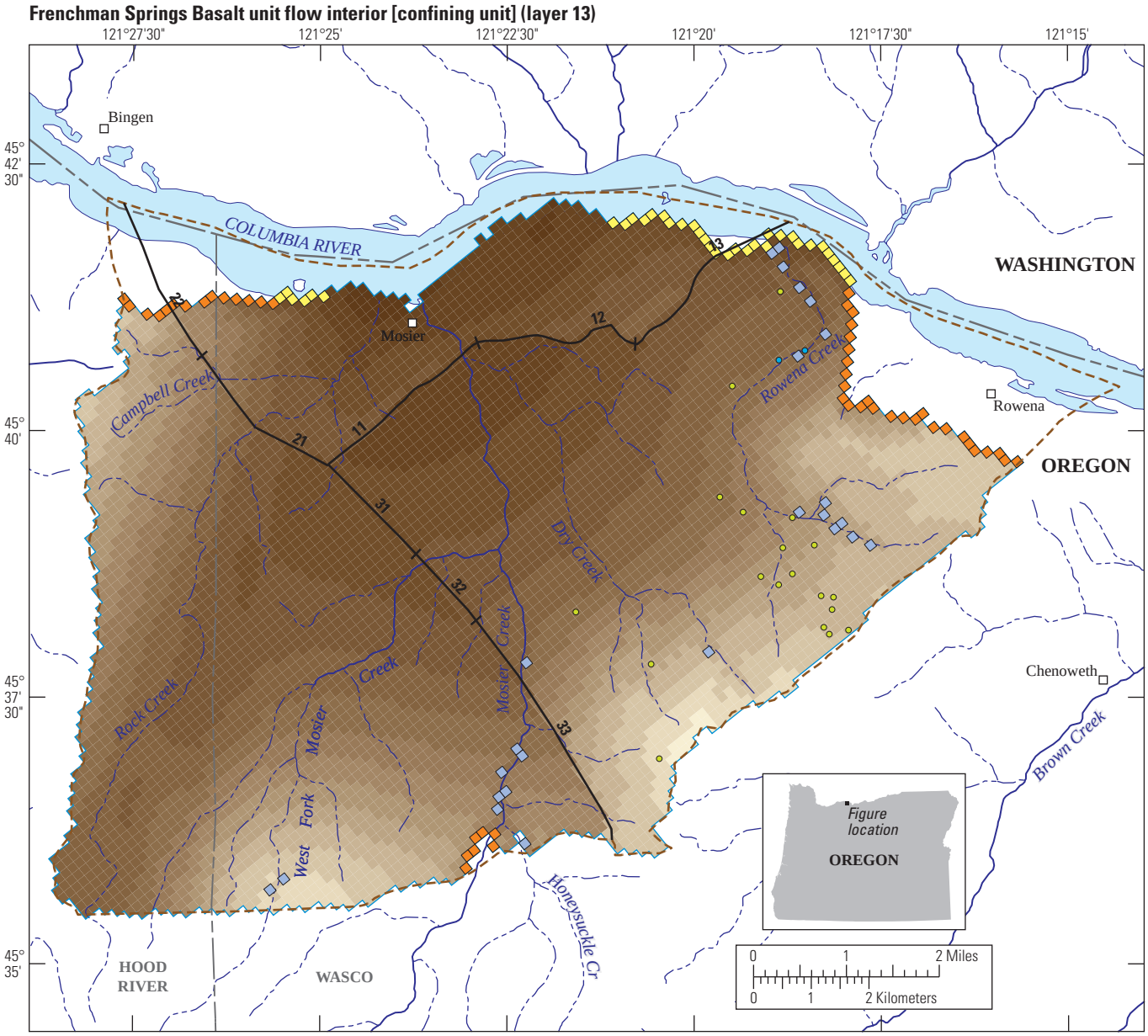


Figure A20. The extent, model layer top elevation, and model boundary conditions of the Frenchman Springs Basalt unit flow top [aquifer] (layer 12) in the Mosier, Oregon, groundwater-simulation model area.



Base modified from USGS and other digital data. Coordinate system: State Plane, Oregon North, FIPS 3601, North American Datum of 1927. Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD88).

EXPLANATION

Groundwater-flow model cell top elevation—in feet

2,400
2,000
1,600
1,200
800
400
0
-400

Note: Range is -304 (minimum) to 2,282 (maximum).

Boundary condition cell
- Drain
- General head
- Stream

11 **Horizontal flow barrier and segment identification No.**

Groundwater model boundary

Model layer boundary

Perennial stream

Ephemeral stream

Well, late
- Single-aquifer completion
- Commingled

Well, early
- Single-aquifer completion
- Commingled

Figure A21. The extent, model layer top elevation, and model boundary conditions of the Frenchman Springs Basalt unit flow interior [confining unit] (layer 13) in the Mosier, Oregon, groundwater-simulation model area.

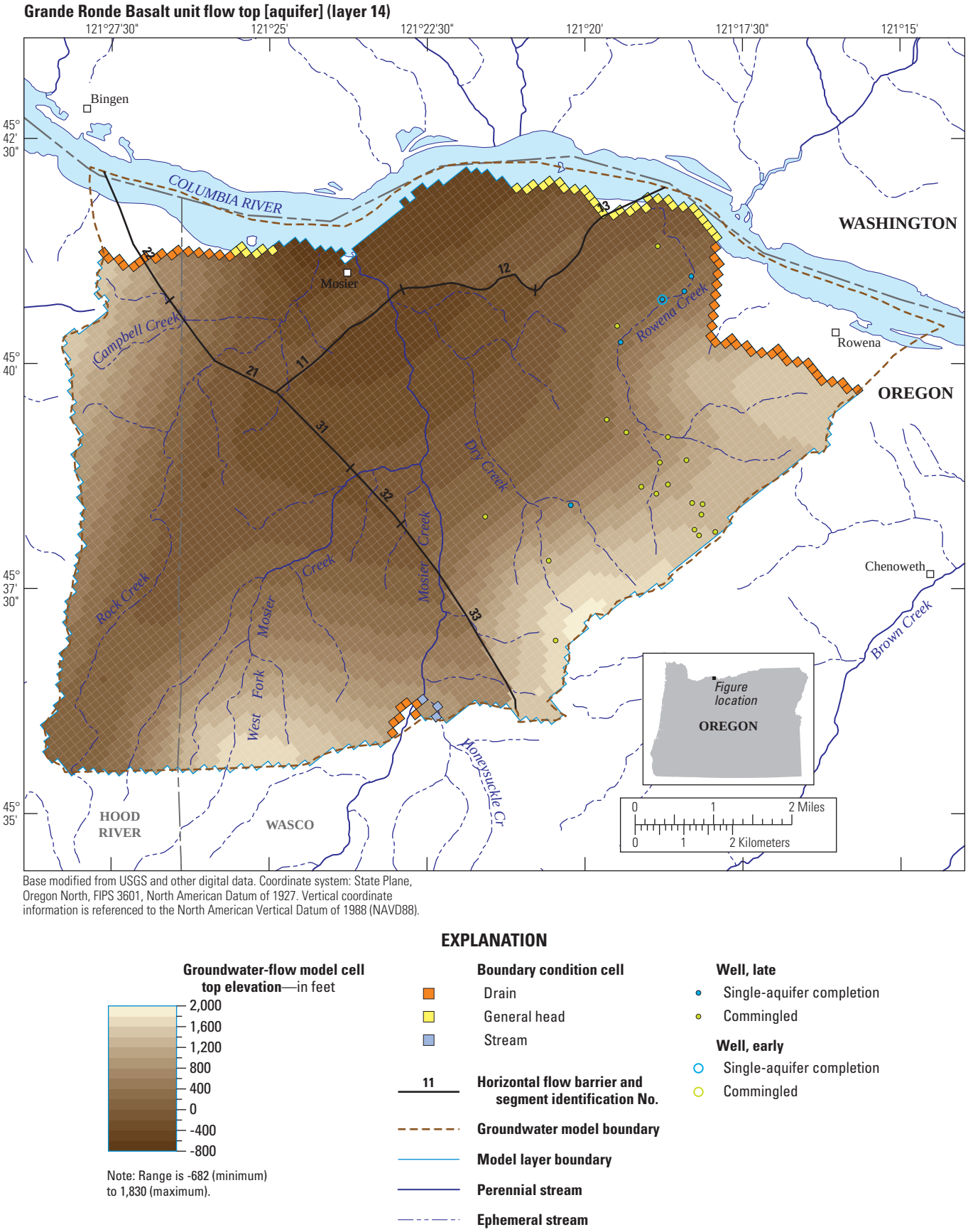


Figure A22. The extent, model layer top elevation, and model boundary conditions of the Grande Ronde Basalt unit flow top [aquifer] (layer 14) in the Mosier, Oregon, groundwater-simulation model area.

A.5—Elevation of Tops of Geologic Model Units in Wells in the Mosier, Oregon, Study Area

Table A3 contains all well log interpretations used to construct the geologic model and the source of the interpretation.

Table A3. Elevation of the tops of hydrogeologic units in wells in the Mosier, Oregon, study area.

[This table is available as a digital spreadsheet at http://pubs.usgs.gov/sir/2012/5002. **State plane:** State plane Oregon North (North American Datum of 1927) northing and easting coordinates (Kienle, 1995; Jervey, 1996). **Land-surface elevation:** Determined using state plane northing and easting coordinates (Kienle, 1995; Jervey, 1996) and USGS 10 meter digital elevation model (DEM), North American Vertical Datum of 1988 (NAVD 88). **Elevations:** Determined using well log stratigraphic intepretations (Kienle, 1995; Jervey, 1996) and land-surface elevation, NAVD 88. Grey italicized elevations have been interpreted below the drilled well hole depths using cross-sectional maps (Jervey, 1996). **Abbreviations**: USGS, U.S. Geological Survey; –, no dat

Township range and section	County well No.	State well No.	USGS well No.	Station name	State plane		Land-surface elevation (feet)	Elevation of the top of										Bottom elevation (feet)	Stratigraphic interpretation source
					Easting (feet)	Northing (feet)		Alluvium deposits (feet)	Glacio fluvial deposits (feet)	Chenoweth Formation (feet)	Pomona Member (feet)	Selah Interbed (feet)	Lolo Priest Rapids Member (feet)	Rosalia Priest Rapids Member (feet)	Quincy-Squaw Creek Interbed (feet)	Frenchman Springs Member (feet)	Grande Ronde Formation (feet)		
2N11E01	467	WASC 2730	–	–	1775250	738750	320	–	320	–	296	110	101	58	–	-85	–	-175	Keinle
2N11E02	466	WASC 2732	454053121241801	02N/11E-02DCA1	1768651	735637	152	152	–	–	–	130	120	–	–	*-70*	–	*-120*	Jervey
2N11E02	468	WASC 2733	454057121241201	02N/11E-02DDB1	1769191	736286	160	160	–	–	–	90	70	–	–	*-100*	–	*-150*	Jervey
2N11E02	469	WASC 2731	–	–	1767340	735556	359	359	–	–	314	–	154	–	–	-46	–	-71	Jervey
2N11E02	470	WASC 2734	454058121235901	02N/11E-02DAD1	1770047	736231	155	155	–	–	–	87	77	–	-93	*-120*	–	*-170*	Jervey
2N11E02	471	–	–	–	1765529	735781	576	–	–	–	576	–	419	–	–	*231*	–	*181*	Jervey
2N11E03	473	–	–	–	1762720	736080	917	–	–	–	917	–	782	–	592	562	–	422	Jervey
2N11E10	475	–	–	–	1760914	730425	686	–	–	–	–	–	686	–	–	*386*	–	*336*	Jervey
2N11E10	478	WASC 2744	454019121254101	02N/11E-10ACC1	1762973	732357	820	–	–	–	820	–	660	–	–	420	–	390	Jervey
2N11E10	479	WASC 2745	454020121252601	02N/11E-10ADC1	1763810	732054	770	–	–	–	770	640	620	–	470	–	–	450	Jervey
2N11E10	483	WASC 2738	–	–	1762809	731155	683	–	–	–	–	–	683	–	–	*358*	–	*308*	Jervey
2N11E10	513	WASC 2777	–	–	1764651	732305	660	–	–	–	660	–	530	–	–	*350*	–	*300*	Jervey
2N11E10	1204	WASC 2741	454042121252701	02N/11E-10AAB1	1763507	734433	750	–	–	–	750	–	605	–	–	435	–	325	Jervey
2N11E10	1898	WASC 1898	–	–	1764295	732331	727	–	–	–	727	–	572	–	–	370	–	177	Jervey
2N11E10	2036	WASC 2036	–	–	1762256	734591	996	–	–	996	906	–	756	–	–	526	–	446	Jervey
2N11E10	2070	WASC 2070	–	–	1762539	732717	936	–	–	936	876	–	764	–	–	464	–	424	Jervey
2N11E10	2138	WASC 2138	–	–	1761395	732749	1,058	–	–	–	1,058	–	973	–	–	818	–	613	Jervey
2N11E11	487	WASC 2752	–	–	1768940	731420	690	–	–	–	690	400	305	195	–	–	–	165	Keinle
2N11E11	488	WASC 2751	–	–	1768496	732050	621	–	–	–	621	470	360	–	–	*230*	–	*180*	Jervey
2N11E11	490	WASC 2750	–	–	1767500	732250	555	–	–	555	506	325	320	–	–	160	–	150	Keinle
2N11E11	491	WASC 2753	454016121244001	02N/11E-11CAA1	1766890	731962	531	–	–	531	500	331	323	–	–	*171*	–	*121*	Keinle
2N11E11	492	WASC 2754	454001121244001	02.00N/11.00E-11CDA01	1767100	730520	737	–	–	–	737	567	555	–	–	387	–	309	Keinle
2N11E11	493	WASC 2771	–	–	1769665	731401	749	–	–	749	*349*	–	*169*	–	–	–	–	*119*	Keinle
2N11E11	1871	–	–	–	1768334	731098	688	–	–	688	640	475	450	–	325	310	–	40	Jervey
2N11E11	1872	–	–	–	1767649	730385	780	–	–	780	590	–	*410*	–	–	*240*	–	*190*	Jervey
2N11E11	2022	WASC 2022	–	–	1767502	731512	605	–	–	605	570	–	430	–	220	200	–	175	Jervey
2N11E11	2079	WASC 2079	–	–	1768200	732150	608	–	–	608	538	400	360	–	–	*170*	–	*120*	Keinle
2N11E12	494	WASC 2765	454033121230101	02N/11E-12ABD1	1774213	732372	299	–	299	–	289	69	29	–	–	-91	–	-101	Keinle
2N11E12	496	WASC 2759	454031121224001	02N/11E-12AAD1	1775532	733511	372	–	372	369	211	15	-100	–	–	–	–	-181	Keinle
2N11E12	497	WASC 2762	454040121232801	02N/11E-12BAB1	1772261	734539	678	–	–	–	678	–	443	–	–	233	–	33	Keinle
2N11E12	499	WASC 2757	–	–	1774669	731338	318	–	–	318	311	–	–	–	–	–	–	291	Keinle
2N11E12	1793	WASC 2755	–	–	1771418	733269	678	–	–	–	678	–	523	–	–	333	–	193	Keinle

Table A3. Elevation of the tops of hydrogeologic units in wells in the Mosier, Oregon, study area.—Continued

[This table is available as a digital spreadsheet at http://pubs.usgs.gov/sir/2012/5002. **State plane:** State plane Oregon North (North American Datum of 1927) northing and easting coordinates (Kienle, 1995; Jervey, 1996). **Land-surface elevation:** Determined using state plane northing and easting coordinates (Kienle, 1995; Jervey, 1996) and USGS 10 meter digital elevation model (DEM), North American Vertical Datum of 1988 (NAVD 88). **Elevations:** Determined using well log stratigraphic intepretations (Kienle, 1995; Jervey, 1996) and land-surface elevation, NAVD 88. Grey italicized elevations have been interpreted below the drilled well hole depths using cross-sectional maps (Jervey, 1996). **Abbreviations**: USGS, U.S. Geological Survey; –, no data]

Township range and section	County well No.	State well No.	USGS well No.	Station name	State plane		Land-surface elevation (feet)	Elevation of the top of										Bottom elevation (feet)	Stratigraphic interpretation source
					Easting (feet)	Northing (feet)		Alluvium deposits (feet)	Glaciofluvial deposits (feet)	Chenoweth Formation (feet)	Pomona Member (feet)	Selah Interbed (feet)	Lolo Priest Rapids Member (feet)	Rosalia Priest Rapids Member (feet)	Quincy-Squaw Creek Interbed (feet)	Frenchman Springs Member (feet)	Grande Ronde Formation (feet)		
2N11E12	1794	WASC	2749	–	–	1771329	733553	668	–	–	–	668	–	450	–	280	260	–	95	Keinle
2N11E12	1974	WASC	1974	–	–	1774998	730645	303	–	–	–	303	–	*163*	–	–	–	–	*113*	Jervey
2N11E12	1984	WASC	1984	454024121233401	02.00N/11.00E-12BDB01	1771884	733062	645	–	–	645	*250*	–	*125*	–	–	*-50*	–	*-100*	Jervey
2N11E12	2030	WASC	2030	–	–	1775289	732153	389	–	389	–	254	*130*	*70*	–	–	*-60*	–	*-110*	Jervey
2N11E12	2092	WASC	2092	–	–	1774769	729773	382	–	–	382	372	–	*192*	–	–	–	–	*142*	Jervey
2N11E12	2112	WASC	2112	–	–	1770400	734250	607	–	–	–	607	442	422	–	280	227	–	75	Keinle
2N11E12	50012	WASC	50012	454029121225201	02.00N/11.00E-12ADB01	1774841	733278	317	–	317	–	202	37	-58	–	–	-128	–	-278	Jervey
2N11E13	506	WASC	2767	–	–	1775078	728456	374	–	–	374	364	–	*214*	–	–	–	–	*164*	Keinle
2N11E14	486	WASC	2769	453928121245001	02N/11E-14BCD1	1766555	727310	1,005	–	–	1,005	*385*	–	–	–	–	–	–	*335*	Keinle
2N11E14	508	WASC	2770	453913121245201	02N/11E-14CBD1	1766225	725976	1,026	–	–	1,026	*570*	–	–	–	–	–	–	*520*	Jervey
2N11E14	1879	WASC	1879	–	–	1766104	726889	959	–	–	959	*545*	–	–	–	–	–	–	*495*	Keinle
2N11E15	509	WASC	2772	453900121251901	02N/11E-15DDC1	1764254	724771	1,081	–	–	1,081	*616*	–	–	–	–	–	–	*566*	Jervey
2N11E23	510	WASC	2773	–	–	1768290	721270	892	–	–	892	*442*	–	–	–	–	–	–	*392*	Keinle
2N11E24	1795	WASC	2774	–	–	1775200	723800	493	–	–	–	–	–	493	–	–	433	–	343	Keinle
2N11E24	1976	WASC	2776	453853121231201	02N/11E-24ABC1	1773104	723546	516	–	–	–	516	491	391	–	–	311	–	271	Keinle
2N11E24	2029	WASC	2029	–	–	1773650	723240	505	–	–	–	505	434	428	–	–	330	–	*280*	Keinle
2N11E24	2032	WASC	2032	–	–	1772150	723050	669	–	–	–	669	–	*529*	–	–	–	–	*479*	Keinle
2N11E25	1869	WASC	1869	–	–	1771540	718470	1,123	–	1,123	–	–	–	–	–	–	–	–	645	Keinle
2N12E05	527	WASC	2820	454056121211201	02N/12E-05CCB1	1782322	735787	716	–	716	–	666	415	–	–	–	–	–	391	Keinle
2N12E05	535	WASC	2826	454103121211201	02N/12E-05CBC2	1781776	736704	807	–	–	–	807	–	650	–	–	380	–	259	Keinle
2N12E05	541	WASC	2815	454046121210501	02N/12E-05CCD1	1782313	735103	718	–	–	718	523	–	370	–	–	*170*	–	*120*	Keinle
2N12E05	543	WASC	50511	454051121203601	02.00N/12.00E-05DCB01	1784196	735343	691	–	691	–	662	–	–	–	–	–	–	566	Keinle
2N12E05	544	WASC	2805	–	–	1784684	734980	693	–	693	–	618	–	*488*	–	–	*258*	–	*208*	Jervey
2N12E05	545	WASC	2814	454055121203401	02N/12E-05DCB1	1784196	734925	698	–	698	–	603	–	*488*	–	–	*268*	–	*218*	Keinle
2N12E05	558	WASC	2843	454132121210001	02N/12E-05BBA1	1776342	739194	280	–	280	–	270	–	160	–	-40	-70	–	-350	Jervey
2N12E06	539	WASC	2823	–	–	1781091	738004	723	–	723	–	625	–	478	383	–	258	–	-107	Keinle
2N12E06	546	WASC	2838	454110121221401	02N/12E-06BCD1	1777430	737600	450	–	–	–	450	320	310	–	–	–	–	250	Keinle
2N12E06	547	WASC	2831	454129121222701	02N/12E-06BBD1	1775664	738435	312	–	312	–	279	–	–	–	–	–	–	186	Keinle
2N12E06	548	WASC	2834	–	–	1780445	738861	501	–	–	–	501	–	344	–	–	*91*	–	*41*	Jervey
2N12E06	549	WASC	2835	454052121222901	02N/12E-06CCB1	1776320	735470	435	–	435	–	–	–	–	–	–	–	–	160	Keinle

Table A3. Elevation of the tops of hydrogeologic units in wells in the Mosier, Oregon, study area.—Continued

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Township range and section	County well No.	State well No.	USGS well No.	Station name	State plane		Land-surface elevation (feet)	Elevation of the top of											Bottom elevation (feet)	Stratigraphic interpretation source
					Easting (feet)	Northing (feet)		Alluvium deposits (feet)	Glacio fluvial deposits (feet)	Chenoweth Formation (feet)	Pomona Member (feet)	Selah Interbed (feet)	Lolo Priest Rapids Member (feet)	Rosalia Priest Rapids Member (feet)	Quincy-Squaw Creek Interbed (feet)	Frenchman Springs Member (feet)	Grande Ronde Formation (feet)		
2N12E06	550	WASC 2847	454127121223501	02N/12E-06BBC1	1779512	738514	393	–	393	–	379	–	203	–	–	*13*	–	*-37*	Keinle
2N12E06	551	WASC 2817	454056121211901	02N/12E-06DDA1	1781169	735951	686	–	686	–	600	436	427	–	–	*230*	–	*180*	Keinle
2N12E06	553	WASC 2830	–	–	1780093	739292	422	–	–	–	422	252	216	–	–	–	–	112	Keinle
2N12E06	554	WASC 2839	454115121215101	02N/12E-06ACC1	1779007	737986	413	–	413	–	388	–	*208*	–	–	*28*	–	*-22*	Keinle
2N12E06	555	WASC 2841	–	–	1780764	738725	545	–	545	–	525	–	375	–	–	*175*	–	*125*	Jervey
2N12E06	557	–	–	–	1777522	738236	354	–	354	–	340	–	*200*	–	–	*1*	–	*-50*	Jervey
2N12E06	561	WASC 2828	454051121221501	02.00N/12.00E-06CAD02	1777500	735550	482	–	482	–	137	–	–	–	–	–	–	99	Keinle
2N12E06	564	WASC 2833	–	–	1779744	739060	396	–	–	–	396	234	231	195	–	–	–	172	Keinle
2N12E06	565	WASC 2840	–	–	1781064	735553	682	–	–	682	–	–	–	–	–	–	–	527	Keinle
2N12E06	1759	WASC 2811	–	–	1781474	735908	690	–	690	620	450	–	350	–	–	*160*	–	*110*	Jervey
2N12E06	1921	WASC 1921	–	–	1776000	736347	554	–	–	–	554	356	311	–	–	102	–	95	Keinle
2N12E07	503	WASC 2763	453959121223701	02N/12E-07CCB1	1776050	730100	459	–	–	459	441	239	229	–	–	*70*	–	*20*	Keinle
2N12E07	567	WASC 2863	454003121223101	02N/12E-07CCA1	1776311	730847	482	–	–	482	369	*192*	*162*	–	–	*22*	–	*-28*	Keinle
2N12E07	568	WASC 2862	454004121211801	02.00N/12.00E-07DDA01	1781438	730934	682	–	–	682	579	–	430	–	–	214	–	202	Keinle
2N12E07	570	WASC 2860	454032121213101	02N/12E-07AAC2	1780366	733477	683	–	683	443	403	–	275	–	–	*70*	–	*20*	Keinle
2N12E07	571	WASC 2865	454003121215101	02N/12E-07DCB1	1779123	730816	413	–	413	–	385	–	*273*	–	–	*73*	–	*23*	Keinle
2N12E07	572	WASC 2870	454006121214501	02N/12E-07DBD1	1779634	730809	517	–	517	–	494	377	*357*	–	–	*177*	–	*127*	Keinle
2N12E07	573	WASC 2869	454032121213501	02N/12E-07AAC1	1779690	733478	659	–	659	520	375	–	235	–	–	*40*	–	*-10*	Jervey
2N12E07	574	WASC 2858	454043121223801	02.00N/12.00E-07BBB02	1775767	734747	341	–	341	–	–	–	135	–	–	76	–	6	Keinle
2N12E07	575	WASC 2861	454031121215701	02N/12E-07BDA1	1778739	733369	597	–	597	417	337	–	*210*	–	–	*10*	–	*-40*	Keinle
2N12E07	576	WASC 2866	454035121223101	02N/12E-07BBD1	1776342	733762	267	–	267	–	210	*70*	*-40*	–	–	–	–	*-90*	Keinle
2N12E07	577	WASC 2864	454010121224001	02.00N/12.00E-07CBC01	1775612	731416	400	–	400	–	330	165	139	–	–	*-30*	–	*-80*	Keinle
2N12E07	578	WASC 2867	454036121224001	02N/12E-07BBC1	1775835	734132	270	–	270	–	205	*40*	*-60*	–	–	–	–	*-110*	Keinle
2N12E07	581	WASC 2852	–	–	1781380	732290	562	–	–	562	515	339	331	–	–	*125*	–	*75*	Keinle
2N12E07	583	WASC 2857	453958121221701	02.00N/12.00E-07CCD01	1777330	730020	598	–	–	598	464	316	310	269	–	*138*	–	*88*	Keinle
2N12E07	584	WASC 2855	454008121215101	02.00N/12.00E-07DBC01	1779110	731100	486	–	486	–	472	336	294	–	–	*166*	–	*116*	Keinle
2N12E07	585	WASC 2856	–	–	1778129	731755	421	–	421	–	330	–	240	–	–	70	–	60	Jervey

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Township range and section	County well No.	State well No.	USGS well No.	Station name	State plane		Land-surface elevation (feet)	Elevation of the top of										Bottom elevation (feet)	Stratigraphic interpretation source
					Easting (feet)	Northing (feet)		Alluvium deposits (feet)	Glacio fluvial deposits (feet)	Chenoweth Formation (feet)	Pomona Member (feet)	Selah Interbed (feet)	Lolo Priest Rapids Member (feet)	Rosalia Priest Rapids Member (feet)	Quincy-Squaw Creek Interbed (feet)	Frenchman Springs Member (feet)	Grande Ronde Formation (feet)		
2N12E07	587	WASC 2872	454027121212501	02N/12E-07ADA1	1780967	733039	695	–	695	629	480	–	322	–	–	*100*	–	*50*	Keinle
2N12E07	589	WASC 2871	454020121223401	02N/12E-07BCC1	1776102	732495	443	–	–	443	285	208	–	–	–	38	–	-177	Keinle
2N12E07	1164	WASC 2875	454020121211901	02.00N/12.00E-07ADD01	1781370	732300	566	–	–	566	522	341	333	–	–	*125*	–	*75*	Keinle
2N12E07	1864	–	–	–	1779951	730309	529	–	–	529	500	–	310	–	–	*130*	–	*80*	Jervey
2N12E07	2090	WASC 2090	454032121215601	02.00N/12.00E-07BAD01	1778808	733541	593	–	593	412	352	168	153	105	–	*8*	–	*-42*	Keinle
2N12E07	2091	WASC 1905	454032121212001	02.00N/12.00E-07AAD01	1781200	733500	675	–	675	570	451	297	275	–	–	*90*	–	*40*	Keinle
2N12E08	579	WASC 2859	454023121210301	02.00N/12.00E-08BCD01	1782400	732590	686	–	–	686	546	–	376	–	–	*176*	–	*126*	Jervey
2N12E08	590	WASC 2877	–	–	1786505	733528	842	–	842	–	741	635	632	452	–	405	–	280	Keinle
2N12E08	591	WASC 2885	–	–	1786640	731670	1,015	–	–	1,015	852	–	750	–	–	530	–	415	Keinle
2N12E08	593	WASC 2886	–	–	1785440	733917	806	–	–	806	728	580	570	–	–	450	–	336	Keinle
2N12E08	594	WASC 2884	–	–	1785422	734632	712	–	–	712	682	–	–	–	–	–	–	625	Keinle
2N12E08	595	WASC 2887	–	–	1782017	734066	695	–	–	695	475	–	345	–	–	*150*	–	*100*	Keinle
2N12E08	597	WASC 2879	454037121205601	02.00N/12.00E-08BAC01	1783043	734051	743	–	–	743	556	–	415	–	–	–	–	337	Keinle
2N12E08	603	WASC 2890	454017121210001	02N/12E-08CBA1	1782713	731872	692	–	–	692	567	–	*400*	–	–	–	–	*350*	Keinle
2N12E08	604	WASC 2889	453956121210401	02N/12E-08CCD1	1781912	729620	790	–	–	790	*630*	–	*470*	–	–	*250*	–	*200*	Keinle
2N12E08	620	WASC 2906	–	–	1786540	732076	963	–	–	963	806	–	628	–	–	471	–	465	Keinle
2N12E08	1801	WASC 2873	–	–	1783650	729800	877	–	–	877	676	–	*520*	–	–	*320*	–	*270*	Keinle
2N12E08	1853	WASC 2888	454024121201401	02N/12E-08ADC1	1785800	733100	892	–	–	892	689	–	569	–	–	432	–	232	Keinle
2N12E08	1884	WASC 1884	453956121205501	02.00N/12.00E-08CDC01	1783200	729800	816	–	–	816	*675*	–	*525*	–	–	*305*	–	*255*	Keinle
2N12E08	2141	–	–	–	1786569	733067	875	–	–	875	795	–	655	–	465	450	–	240	Jervey
2N12E09	606	WASC 2899	–	–	1790339	733734	830	–	–	830	–	–	770	–	–	690	–	630	Jervey
2N12E09	607	WASC 2894	–	–	1787126	730021	1,153	–	–	1,153	850	–	760	–	–	*580*	–	*530*	Jervey
2N12E09	608	WASC 2891	–	–	1787725	732021	949	–	–	949	905	–	804	727	–	622	–	283	Keinle
2N12E09	609	WASC 2900	454041121185001	02N/12E-09AAA1	1791806	734257	698	–	–	–	–	–	698	–	–	568	–	488	Keinle
2N12E09	610	WASC 2907	–	–	1787340	732330	920	–	–	920	836	–	719	–	–	580	–	250	Keinle
2N12E09	611	WASC 2892	–	–	1788103	733517	834	–	–	834	749	–	680	–	–	–	–	492	Keinle

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Township range and section	County well No.	State well No.	USGS well No.	Station name	State plane		Land-surface elevation (feet)	Elevation of the top of										Bottom elevation (feet)	Stratigraphic interpretation source
					Easting (feet)	Northing (feet)		Alluvium deposits (feet)	Glacio fluvial deposits (feet)	Chenoweth Formation (feet)	Pomona Member (feet)	Selah Interbed (feet)	Lolo Priest Rapids Member (feet)	Rosalia Priest Rapids Member (feet)	Quincy-Squaw Creek Interbed (feet)	Frenchman Springs Member (feet)	Grande Ronde Formation (feet)		
2N12E09	612	WASC 2898	454032121200001	02.00N/12.00E-09BBC001	1786874	733580	839	–	–	839	761	656	–	–	–	–	–	652	Keinle
2N12E09	614	WASC 2897	–	–	1786874	733013	873	–	–	873	830	678	668	598	–	*490*	–	*440*	Keinle
2N12E09	615	WASC 2905	454024121192701	02N/12E-09BDA1	1789350	732730	851	–	–	851	835	–	736	–	–	640	–	230	Keinle
2N12E09	619	WASC 2896	–	–	1789400	732210	786	–	–	–	–	–	–	786	–	599	–	459	Keinle
2N12E09	621	WASC 2901	–	–	1788738	730426	1,047	–	–	1,047	977	859	856	–	–	–	–	847	Keinle
2N12E09	1901	–	–	–	1787078	730240	1,144	–	–	1,144	–	–	784	–	–	*594*	–	*544*	Jervey
2N12E09	2004	–	–	–	1790393	733202	800	–	–	800	–	–	750	–	–	660	–	30	Jervey
2N12E09	2136	WASC 2136	–	–	1786849	731135	1,081	–	–	1,081	–	–	776	–	–	*560*	–	*510*	Jervey
2N12E09	2148	–	–	–	1788499	732308	892	–	–	892	847	–	787	–	–	677	–	477	Jervey
2N12E09	2214	–	–	–	1789624	732471	769	–	–	–	–	–	769	–	–	625	–	590	Jervey
2N12E10	624	–	–	–	1793504	732692	992	–	–	992	–	–	–	–	–	937	–	567	Jervey
2N12E10	625	WASC 2909	–	–	1792611	731832	970	–	–	970	–	–	–	–	–	925	–	565	Jervey
2N12E10	1838	WASC 1838	–	–	1792323	733815	702	–	–	–	–	–	702	–	–	620	–	480	Jervey
2N12E15	676	WASC 2975	–	–	1794438	724021	1,543	–	–	–	–	–	1,543	–	–	1,422	–	1,138	Keinle
2N12E15	677	WASC 2971	–	–	1792960	724940	1,374	–	–	–	–	–	1,374	–	–	1,339	–	1,066	Keinle
2N12E15	784	WASC 3134	453902121183801	02N/12E-15CCD1	1792865	724475	1,431	–	1,431	–	–	–	1,425	1,370	–	–	–	1,066	Keinle
2N12E15	1809	WASC 2970	–	–	1793500	724090	1,515	–	–	–	–	–	1,515	–	–	1,399	–	1,105	Keinle
2N12E16	679	WASC 3106	–	–	1788150	728904	1,151	–	–	1,151	929	–	821	–	–	–	–	808	Keinle
2N12E16	680	WASC 3000	453931121194701	02N/12E-16BCD1	1787189	727375	1,279	–	–	1,279	921	–	850	–	–	642	–	637	Keinle
2N12E16	681	WASC 3002	453947121200101	02N/12E-16BBB1	1786729	728908	1,207	–	–	1,207	821	–	790	–	–	*610*	–	*560*	Keinle
2N12E16	682	–	–	–	1790145	724866	1,309	–	–	1,309	–	–	1,114	–	–	924	*500*	*450*	Jervey
2N12E16	683	WASC 3001	453947121195101	02N/12E-16BBA1	1787595	728901	1,186	–	–	1,186	896	–	836	–	–	666	–	636	Keinle
2N12E16	685	WASC 3004	453943121195701	02N/12E-16BBC1	1787080	728543	1,242	–	–	1,242	844	–	790	–	–	617	–	480	Keinle
2N12E16	688	WASC 3005	453923121195501	02N/12E-16CBB1	1787513	726352	1,295	–	–	1,295	–	–	*850*	–	–	*650*	–	*600*	Keinle
2N12E16	689	WASC 2989	–	–	1787914	725233	1,322	–	–	1,322	–	–	–	–	–	–	–	1,252	Keinle
2N12E16	690	WASC 2997	–	–	1788103	724440	1,364	–	–	1,364	–	–	*960*	–	–	*820*	–	*770*	Jervey
2N12E16	692	WASC 2982	–	–	1787050	727050	1,288	–	–	1,288	–	–	853	–	–	682	–	598	Keinle
2N12E16	693	WASC 2999	453902121190901	02N/12E-16DCD1	1790420	724225	1,290	–	–	–	–	–	1,290	1,173	–	1,117	634	546	Keinle
2N12E16	694	WASC 2987	–	–	1789200	724900	1,329	–	–	1,329	1,148	–	1,063	–	–	*759*	–	*709*	Keinle
2N12E16	695	WASC 2996	–	–	1788074	726122	1,269	–	–	1,269	–	–	*820*	–	–	*620*	–	*570*	Jervey
2N12E16	697	WASC 3003	453913121194401	02N/12E-16CAC1	1788272	725616	1,272	–	–	1,272	–	–	*857*	–	–	*637*	–	*587*	Keinle
2N12E16	698	WASC 2998	453904121192301	02N/12E-16DCC1	1789348	724698	1,351	–	–	1,351	–	–	1,049	951	–	867	–	715	Keinle

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Township range and section	County well No.	State well No.	USGS well No.	Station name	State plane		Land-surface elevation (feet)	Elevation of the top of										Bottom elevation (feet)	Stratigraphic interpretation source
					Easting (feet)	Northing (feet)		Alluvium deposits (feet)	Glacio fluvial deposits (feet)	Chenoweth Formation (feet)	Pomona Member (feet)	Selah Interbed (feet)	Lolo Priest Rapids Member (feet)	Rosalia Priest Rapids Member (feet)	Quincy-Squaw Creek Interbed (feet)	Frenchman Springs Member (feet)	Grande Ronde Formation (feet)		
2N12E16	699	WASC 2988	–	–	1788481	724493	1,358	–	–	1,358	1,098	–	958	–	–	*813*	–	*763*	Keinle
2N12E16	702	WASC 3006	453930121193901	02N/12E-16BDC1	1788213	727202	1,209	–	–	1,209	–	–	1,005	–	–	700	–	604	Keinle
2N12E16	704	WASC 2981	–	–	1788452	726539	1,206	–	–	1,206	–	–	778	–	–	641	–	381	Keinle
2N12E16	1797	WASC 2977	–	–	1786840	725260	1,360	–	–	1,360	–	–	–	–	–	–	–	1,080	Keinle
2N12E16	1859	WASC 1859	–	–	1791238	725675	1,106	–	–	–	–	–	1,106	–	–	996	526	466	Jervey
2N12E16	1891	WASC 1891	–	–	1788850	726200	1,206	–	–	–	–	–	1,206	–	–	1,002	–	880	Keinle
2N12E16	1892	WASC 1892	–	–	1787800	728270	1,231	–	–	1,231	860	–	820	–	–	629	–	591	Keinle
2N12E16	1912	–	–	–	1788716	725399	1,290	–	–	1,290	–	–	985	–	–	*700*	–	*650*	Jervey
2N12E16	1978	WASC 1978	–	–	1790999	725364	1,128	–	–	–	–	–	1,128	–	–	988	*488*	*438*	Jervey
2N12E16	2020	WASC 2020	453940121191901	02.00N/12.00E-16ABC01	1789792	728141	956	–	–	–	–	–	956	–	–	836	–	756	Keinle
2N12E16	2044	WASC 2044	–	–	1789127	724495	1,352	–	–	1,352	–	–	1,087	–	–	*870*	–	*820*	Jervey
2N12E16	2144	WASC 2144	–	–	1788988	727892	1,078	–	–	1,078	–	–	780	–	–	*600*	–	*550*	Jervey
2N12E16	4108	–	–	–	1787732	727155	1,262	–	–	1,262	932	–	882	–	–	*682*	–	*632*	Jervey
2N12E17	705	WASC 3012	–	–	1785501	728771	1,166	–	–	1,166	–	–	–	–	–	–	–	1,106	Jervey
2N12E17	707	WASC 3010	453936121210901	02.00N/12.00E-17BCB01	1781900	727800	825	–	–	825	672	–	585	–	–	–	–	520	Keinle
2N12E17	708	WASC 3014	–	–	1783682	724338	1,230	–	–	1,230	850	–	772	712	–	–	–	695	Keinle
2N12E17	710	WASC 3013	–	–	1783730	724825	1,207	–	–	1,207	824	–	752	–	–	*582*	–	*532*	Keinle
2N12E17	1765	WASC 3008	–	–	1783700	727350	1,133	–	–	1,133	–	–	–	–	–	–	–	753	Keinle
2N12E17	1835	WASC 1835	–	–	1784580	729289	1,097	–	–	1,097	*700*	–	*560*	–	–	*350*	–	*300*	Jervey
2N12E17	1849	WASC 1849	–	–	1783647	727565	1,134	–	–	1,134	769	–	*649*	–	–	*479*	–	*429*	Jervey
2N12E17	1888	–	–	–	1786369	728659	1,171	–	–	1,171	750	–	700	–	–	*540*	–	*490*	Jervey
2N12E17	1997	WASC 1997	–	–	1783571	729076	940	–	–	940	*690*	–	*570*	–	–	*400*	–	*350*	Jervey
2N12E17	2010	WASC 2010	–	–	1783300	728500	1,092	–	–	1,092	715	625	606	–	–	*454*	–	*404*	Keinle
2N12E17	2015	WASC 2015	–	–	1783132	725483	1,145	–	–	1,145	805	–	*745*	–	–	*555*	–	*505*	Jervey
2N12E17	2017	WASC 2017	–	–	1782794	725012	1,072	–	–	1,072	802	–	*732*	–	–	*542*	–	*492*	Jervey
2N12E17	2019	WASC 2019	–	–	1782785	726510	895	–	–	895	*755*	–	*645*	–	–	*465*	–	*415*	Jervey
2N12E17	2037	–	–	–	1783174	727928	1,113	–	–	1,113	713	–	*613*	–	–	*433*	–	*383*	Jervey
2N12E17	2038	WASC 2038	–	–	1782600	729200	868	–	–	868	685	–	*518*	–	–	*298*	–	*248*	Keinle
2N12E17	2075	WASC 2075	453944121211301	02.00N/12.00E-17BBC01	1781700	728750	755	–	–	755	665	–	505	–	–	315	–	300	Keinle

Table A3. Elevation of the tops of hydrogeologic units in wells in the Mosier, Oregon, study area.—Continued

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Township range and section	County well No.	State well No.	USGS well No.	Station name	State plane		Land-surface elevation (feet)	Elevation of the top of										Bottom elevation (feet)	Stratigraphic interpretation source
					Easting (feet)	Northing (feet)		Alluvium deposits (feet)	Glacio fluvial deposits (feet)	Chenoweth Formation (feet)	Pomona Member (feet)	Selah Interbed (feet)	Lolo Priest Rapids Member (feet)	Rosalia Priest Rapids Member (feet)	Quincy-Squaw Creek Interbed (feet)	Frenchman Springs Member (feet)	Grande Ronde Formation (feet)		
2N12E17	2142	WASC 2142	–	–	1783991	729310	926	–	–	926	*696*	–	*540*	–	–	*330*	–	*280*	Jervey
2N12E17	2158	–	–	–	1784547	724592	1,269	–	–	1,269	870	–	830	–	–	*650*	–	*600*	Jervey
2N12E17	2159	–	–	–	1786648	727692	1,256	–	–	1,256	–	–	861	–	–	*681*	–	*631*	Jervey
2N12E17	4144	–	–	–	1785188	729172	1,130	–	–	1,130	750	–	*620*	–	–	*410*	–	*360*	Jervey
2N12E18	713	WASC 3023	453921121213101	02N/12E-18DAB1	1780210	726420	692	–	–	692	622	–	512	–	332	322	–	212	Jervey
2N12E18	714	WASC 3017	–	–	1781040	725300	820	–	–	820	725	630	625	–	420	410	–	290	Keinle
2N12E18	716	WASC 3028	453942121221501	02N/12E-18BBD1	1777164	728445	643	–	–	643	520	–	368	–	–	–	–	183	Keinle
2N12E18	717	WASC 3029	453939121221201	02N/12E-18BDB1	1777541	728238	702	–	–	702	549	400	372	–	–	*160*	–	*110*	Keinle
2N12E18	718	WASC 3025	453931121220201	02N/12E-18BDD1	1778321	727545	757	–	–	757	592	427	407	–	207	187	–	177	Keinle
2N12E18	719	WASC 3024	453922121215801	02N/12E-18CAA1	1778350	726500	791	–	–	791	621	–	450	–	260	250	–	231	Keinle
2N12E18	721	WASC 3015	–	–	1778528	727764	719	–	–	719	629	–	479	–	–	*209*	–	*159*	Jervey
2N12E18	724	WASC 3026	453937121215801	02N/12E-18BDA1	1778581	727904	678	–	–	678	603	–	431	–	–	203	–	173	Keinle
2N12E18	725	WASC 3019	–	–	1780969	724476	801	–	–	801	761	662	653	–	–	*436*	–	*386*	Keinle
2N12E18	1820	WASC 3021	453949121220301	02N/12E-18BAB1	1778085	729231	665	–	–	665	506	320	300	–	–	120	–	112	Keinle
2N12E19	727	WASC 3036	453836121213201	02.00N/12.00E-19ADC01	1780431	721785	1,248	–	–	1,248	808	–	648	–	513	488	–	258	Keinle
2N12E19	729	WASC 3032	453811121212401	02N/12E-19DDD1	1780747	719219	1,372	–	–	1,372	991	–	*870*	–	–	*730*	*270*	*220*	Keinle
2N12E19	731	WASC 3034	–	–	1779601	722302	1,201	–	–	1,201	761	–	661	–	–	481	–	201	Jervey
2N12E19	733	WASC 3031	453825121221701	02.00N/12.00E-19CBD01	1777089	720521	513	–	513	–	–	–	–	469	–	421	–	367	Keinle
2N12E19	734	WASC 3040	453847121223701	02.00N/12.00E-19BCB01	1775725	723581	433	–	433	–	–	–	386	–	–	–	–	308	Keinle
2N12E19	1964	WASC 1964	–	–	1779911	720209	1,318	–	–	1,318	900	–	800	–	–	630	–	360	Jervey
2N12E19	2081	WASC 2081	–	–	1780160	720230	1,339	–	–	1,339	934	797	793	–	–	601	*200*	*150*	Keinle
2N12E19	–	WASC 3038	453859121222901	02N/12E-19BBB1	1776200	724200	413	–	413	–	–	–	385	–	–	–	–	323	Keinle
2N12E20	735	WASC 3050	–	–	1785881	723454	1,351	–	–	1,351	956	921	916	–	–	*800*	–	*750*	Keinle
2N12E20	736	WASC 3046	–	–	1783571	723636	1,233	–	–	1,233	865	–	813	–	–	*643*	–	*593*	Keinle
2N12E20	737	WASC 3045	–	–	1785900	721600	1,251	–	–	1,251	1,027	–	906	–	–	–	–	784	Keinle
2N12E20	738	WASC 3051	–	–	1784857	722430	1,244	–	–	1,244	824	–	764	–	–	*604*	–	*554*	Keinle
2N12E20	1515	–	–	–	1785803	722781	1,324	–	–	1,324	974	–	959	–	–	*754*	–	*704*	Jervey
2N12E20	1564	WASC 3043	–	–	1785460	724080	1,323	–	–	1,323	918	874	866	–	–	750	–	540	Keinle
2N12E20	1787	WASC 3042	–	–	1786444	723382	1,375	–	–	1,375	950	–	940	–	–	840	–	780	Jervey
2N12E20	1914	WASC 1914	–	–	1784419	723948	1,273	–	–	1,273	880	–	*840*	–	–	*690*	–	*640*	Jervey

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2N12E20	2069	WASC 2069	–	–	1784600	722600	1,249	–	–	1,249	859	–	*789*	–	–	*639*	–	*589*	Keinle
2N12E21	672	WASC 2976	–	–	1791700	721550	1,480	–	–	–	–	–	–	–	–	1,480	–	1,170	Keinle
2N12E21	701	WASC 3075	453858121192201	02N/12E-21ABB1	1789316	723863	1,385	–	–	1,385	–	–	1,130	–	–	930	–	586	Keinle
2N12E21	741	WASC 741	–	–	1788979	723226	1,442	–	–	1,442	–	–	1,082	–	–	*972*	–	*922*	Jervey
2N12E21	742	WASC 3074	–	–	1787806	723981	1,397	–	–	1,397	–	–	*950*	–	–	*810*	–	*760*	Jervey
2N12E21	743	WASC 3068	–	–	1789000	722840	1,439	–	–	1,439	1,180	–	1,150	–	–	*1,020*	–	*970*	Keinle
2N12E21	744	WASC 3059	–	–	1791581	722331	1,421	–	–	–	–	–	1,421	–	–	1,401	*1,101*	*1,051*	Jervey
2N12E21	745	WASC 3062	–	–	1790546	723863	1,278	–	–	–	–	–	1,278	–	–	1,153	–	1,151	Keinle
2N12E21	746	WASC 3066	–	–	1790850	721870	1,492	–	–	–	–	–	1,492	–	–	1,402	–	1,007	Keinle
2N12E21	747	WASC 3064	453845121191401	02.00N/12.00E-21ACA01	1789968	722651	1,360	–	–	–	–	–	1,360	–	1,240	1,220	–	1,130	Jervey
2N12E21	749	WASC 3070	–	–	1791318	722840	1,441	–	–	–	–	–	1,441	1,411	–	1,336	–	1,101	Keinle
2N12E21	753	WASC 3061	–	–	1790800	722200	1,454	–	–	–	–	–	1,454	–	1,380	1,351	–	914	Keinle
2N12E21	754	WASC 3060	453842121185801	02.00N/12.00E-21ADA01	1791191	722223	1,462	–	–	–	–	–	1,462	–	1,450	1,430	–	1,322	Keinle
2N12E21	757	WASC 3072	453835121192201	02N/12E-21ACC1	1789490	721591	1,423	–	–	–	–	–	1,423	–	–	1,293	–	1,272	Keinle
2N12E21	758	WASC 3055	453857121193001	02N/12E-21BAA1	1787851	723438	1,403	–	–	1,403	1,058	–	1,023	–	–	953	–	662	Keinle
2N12E21	759	WASC 3076	–	–	1790010	722021	1,412	–	–	–	–	–	1,412	–	–	1,283	–	742	Keinle
2N12E21	762	WASC 3054	–	–	1788500	720150	1,520	–	–	1,520	–	–	–	1,500	–	1,372	–	1,273	Keinle
2N12E21	764	WASC 3057	–	–	1788308	721501	1,361	–	–	1,361	–	–	1,266	1,248	–	1,238	–	1,199	Keinle
2N12E21	2042	WASC 2042	–	–	1789040	722840	1,439	–	–	1,439	1,195	1179	1,172	–	–	1,034	–	1,019	Keinle
2N12E21	2155	WASC 2155	–	–	1790000	721700	1,435	–	–	1,435	–	–	1,425	–	–	1,292	–	1,158	Keinle
2N12E21	4102	–	–	–	1790531	722387	1,422	–	–	–	–	–	1,422	–	1,352	1,307	–	1,157	Jervey
2N12E21	4103	–	–	–	1790407	722612	1,381	–	–	–	–	–	1,381	–	1,290	1,270	–	670	Jervey
2N12E22	765	WASC 3119	453849121180801	02N/12E-22ABC1	1794896	722997	1,621	–	–	–	–	–	–	–	–	1,621	*1,200*	*1,150*	Keinle
2N12E22	766	WASC 3115	453852121181001	02N/12E-22ABB1	1794690	723262	1,587	–	–	–	–	–	–	–	–	1,587	–	1,357	Keinle
2N12E22	767	WASC 3112	–	–	1795300	723730	1,652	–	–	–	–	–	–	1,652	–	1,602	1,072	1,047	Keinle
2N12E22	768	WASC 3122	453839121175501	02N/12E-22ACD1	1795700	721890	1,764	–	–	–	–	–	–	–	–	1,764	–	1,519	Keinle
2N12E22	771	WASC 3117	453841121175701	02N/12E-22ACA1	1795655	722258	1,741	–	–	–	–	–	–	–	–	1,741	*1,261*	*1,211*	Keinle
2N12E22	772	WASC 3118	–	–	1794788	722334	1,656	–	–	–	–	–	–	–	–	1,656	*1,206*	*1,156*	Jervey
2N12E22	776	WASC 3113	453825121181001	02N/12E-22DBC2	1794344	720808	1,665	–	–	–	–	–	–	–	–	1,665	1,340	1,335	Keinle
2N12E22	777	WASC 3131	453826121183901	02N/12E-22CBD1	1792629	720429	1,607	–	–	–	–	–	–	–	–	1,607	–	1,287	Keinle
2N12E22	779	WASC 3124	453840121183601	02N/12E-22BCA1	1792840	722220	1,471	–	–	–	–	–	–	–	–	1,471	–	1,073	Keinle

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2N12E22	783	WASC 3104	–	–	1793573	723638	1,550	–	–	–	–	–	1,550	–	1,490	1,460	1,160	1,120	Jervey
2N12E22	785	WASC 3133	453849121183401	02N/12E-22BBD1	1792925	722777	1,488	–	–	–	–	–	1,488	–	–	1,439	1,150	1,143	Keinle
2N12E22	787	WASC 3101	–	–	1792027	723533	1,325	–	–	–	–	–	1,325	–	–	1,245	–	855	Keinle
2N12E22	789	WASC 3081	–	–	1792400	723000	1,427	–	–	–	–	–	1,427	–	1,407	1,367	*1,117*	*1,067*	Keinle
2N12E22	790	WASC 3126	–	–	1792752	719518	1,712	–	–	–	–	–	–	–	–	1,712	–	1,450	Jervey
2N12E22	792	WASC 3095	–	–	1793637	720428	1,692	–	–	–	–	–	–	–	–	1,692	–	1,350	Jervey
2N12E22	800	WASC 3092	–	–	1797023	720021	1,812	–	–	–	–	–	–	–	–	1,812	*1,352*	*1,302*	Keinle
2N12E22	801	WASC 3102	–	–	1795406	719641	1,788	–	–	–	–	–	–	–	–	1,788	*1,368*	*1,318*	Jervey
2N12E22	804	WASC 3103	–	–	1794564	718880	1,791	–	–	–	–	–	–	–	–	1,791	–	1,491	Keinle
2N12E22	806	WASC 3099	–	–	1792642	722147	1,498	–	–	–	–	–	–	–	–	1,498	–	1,108	Keinle
2N12E22	807	WASC 3127	453835121184201	02N/12E-22BCC1	1792400	721560	1,603	–	–	–	–	–	1,603	–	–	1,574	1,000	903	Keinle
2N12E22	808	WASC 3109	–	–	1792250	721310	1,556	–	–	–	–	–	–	–	–	1,556	1,325	1,330	Keinle
2N12E22	809	WASC 3082	–	–	1793414	720450	1,682	–	–	–	–	–	–	–	–	1,682	1,340	1,312	Keinle
2N12E22	811	WASC 3129	–	–	1794300	720750	1,654	–	–	–	–	–	–	–	–	1,654	–	1,557	Keinle
2N12E22	812	WASC 3132	453828121183601	02N/12E-22CBA1	1792829	720829	1,586	–	–	–	–	–	–	–	–	1,586	*1,330*	*1,280*	Keinle
2N12E22	813	WASC 3107	–	–	1796865	720855	1,842	–	–	–	–	–	–	–	–	1,842	*1,332*	*1,282*	Keinle
2N12E22	814	WASC 3108	453816121175701	02N/12E-22DCA1	1795630	719708	1,800	–	–	–	–	–	–	–	–	1,800	–	1,520	Keinle
2N12E22	815	WASC 3138	453822121180401	02N/12E-22DBC1	1794750	720228	1,708	–	–	–	–	–	–	–	–	1,708	–	1,497	Keinle
2N12E22	817	WASC 3139	453812121174301	02N/12E-22DDD1	1796651	719332	1,766	–	–	–	–	–	–	–	–	1,766	*1,386*	*1,336*	Keinle
2N12E22	818	WASC 3084	453808121175701	02N/12E-22DCD1	1795622	718979	1,833	–	–	–	–	–	–	–	–	1,833	1,416	1,391	Keinle
2N12E22	820	WASC 3090	–	–	1796550	720150	1,800	–	–	–	–	–	–	–	–	1,800	1,255	1,157	Keinle
2N12E22	821	WASC 3091	–	–	1796570	719856	1,793	–	–	–	–	–	–	–	–	1,793	1,380	1,300	Jervey
2N12E22	822	WASC 3120	453834121180501	02N/12E-22ACC1	1795137	722035	1,708	–	–	–	–	–	–	–	–	1,708	*1,238*	*1,188*	Keinle
2N12E22	1757	WASC 3116	–	–	1794323	722907	1,556	–	–	–	–	–	–	–	–	1,556	*1,176*	*1,126*	Jervey
2N12E22	1817	WASC 3137	453841121181301	02.00N/12.00E-22BDA01	1794280	721910	1,642	–	–	–	–	–	–	–	–	1,642	–	1,372	Keinle
2N12E22	1842	WASC 1842	–	–	1794000	720750	1,642	–	–	–	–	–	–	–	–	1,642	*1,332*	*1,282*	Keinle
2N12E22	1909	–	–	–	1792154	719251	1,753	–	–	–	–	–	–	–	–	1,753	–	1,450	Jervey
2N12E22	2006	–	–	–	1796733	722405	1,736	–	–	–	–	–	–	–	–	1,736	–	1,321	Jervey
2N12E22	2016	–	–	–	1796833	723021	1,727	–	–	–	–	–	–	–	–	1,727	–	1,472	Jervey
2N12E22	2023	WASC 2023	–	–	1795912	722257	1,742	–	–	–	–	–	–	–	–	1,742	*1,274*	*1,224*	Keinle
2N12E22	2024	WASC 3123	453838121174801	02N/12E-22ADC1	1796430	721755	1,787	–	–	–	–	–	–	–	–	1,787	1,327	1,306	Keinle
2N12E22	2080	WASC 2080	–	–	1794130	723154	1,542	–	–	–	–	–	1,542	–	1,487	1,457	1,157	947	Jervey

Table A3. Elevation of the tops of hydrogeologic units in wells in the Mosier, Oregon, study area.—Continued

[This table is available as a digital spreadsheet at http://pubs.usgs.gov/sir/2012/5002. **State plane:** State plane Oregon North (North American Datum of 1927) northing and easting coordinates (Kienle, 1995; Jervey, 1996). **Land-surface elevation:** Determined using state plane northing and easting coordinates (Kienle, 1995; Jervey, 1996) and USGS 10 meter digital elevation model (DEM), North American Vertical Datum of 1988 (NAVD 88). **Elevations:** Determined using well log stratigraphic intepretations (Kienle, 1995; Jervey, 1996) and land-surface elevation, NAVD 88. Grey italicized elevations have been interpreted below the drilled well hole depths using cross-sectional maps (Jervey, 1996). **Abbreviations**: USGS, U.S. Geological Survey; –, no data]

Township range and section	County well No.	State well No.	USGS well No.	Station name	State plane		Land-surface elevation (feet)	Elevation of the top of										Bottom elevation (feet)	Stratigraphic interpretation source
					Easting (feet)	Northing (feet)		Alluvium deposits (feet)	Glacio fluvial deposits (feet)	Chenoweth Formation (feet)	Pomona Member (feet)	Selah Interbed (feet)	Lolo Priest Rapids Member (feet)	Rosalia Priest Rapids Member (feet)	Quincy-Squaw Creek Interbed (feet)	Frenchman Springs Member (feet)	Grande Ronde Formation (feet)		
2N12E22	2108	WASC 2108	–	–	1794033	721105	1,615	–	–	–	–	–	–	–	–	1,615	–	1,390	Jervey
2N12E22	2182	–	–	–	1793518	719689	1,730	–	–	–	–	–	–	–	–	1,730	–	1,450	Jervey
2N12E23	824	–	–	–	1798003	723423	1,682	–	–	–	–	–	–	–	–	1,682	–	1,490	Jervey
2N12E23	826	WASC 3146	453838121171801	02N/12E-23BCD1	1798465	722068	1,814	–	–	–	–	–	–	–	–	1,814	–	1,414	Keinle
2N12E25	830	WASC 3153	453801121161701	02N/12E-25BBB1	1802778	718079	980	–	–	980	–	–	958	854	–	784	–	713	Keinle
2N12E25	831	WASC 3151	453805121155901	02N/12E-25BAB	1804061	718530	895	–	–	895	–	–	872	806	–	675	–	528	Keinle
2N12E26	837	WASC 3155	453800121163501	02N/12E-26AAB1	1801246	717628	1,125	–	–	1,125	–	–	1,106	1,037	–	–	–	1,025	Keinle
2N12E27	839	WASC 3159	453759121180901	02N/12E-27ABC1	1794645	717891	1,905	–	–	–	–	–	–	–	–	1,905	1,586	1,582	Keinle
2N12E27	840	WASC 3157	–	–	1796100	718600	1,841	–	–	–	–	–	–	–	–	1,841	1,461	1,451	Keinle
2N12E29	846	WASC 3161	–	–	1784378	716770	1,572	–	–	1,572	–	–	–	–	–	1,562	–	1,294	Keinle
2N12E29	1908	WASC 1908	–	–	1785660	717740	1,563	–	–	–	–	–	1,563	1,437	–	1,379	–	1,251	Keinle
2N12E29	1949	WASC 1949	–	–	1783400	718680	1,290	–	–	1,290	1,173	–	1,133	1,048	–	978	–	884	Keinle
2N12E30	728	WASC 3037	–	–	1780703	716570	1,508	–	–	1,508	–	–	1,313	1,243	–	1,163	693	438	Keinle
2N12E30	847	WASC 3164	453804121212001	02N/12E-30AAA1	1781400	718740	1,356	–	–	1,356	1,033	–	941	–	–	*780*	*340*	*290*	Keinle
2N12E30	848	WASC 3163	–	–	1780971	715366	1,653	–	–	1,653	–	–	1,560	–	–	1,380	*940*	*890*	Jervey
2N12E30	1302	WASC 3162	–	–	1779950	717800	1,386	–	–	1,386	1,091	–	1,020	–	–	*880*	*430*	*380*	Keinle
2N12E32	852	WASC 3168	–	–	1782717	713336	1,890	–	–	1,890	–	–	–	–	–	1,775	*1,295*	*1,245*	Jervey
2N12E32	853	WASC 3171	453655121203101	02N/12E-32ACC1	1784610	711310	2,151	–	–	–	–	–	–	–	–	2,151	*1,670*	*1,620*	Keinle
2N12E32	854	WASC 3169	–	–	1783497	712937	1,977	–	–	–	–	–	–	–	–	1,977	*1,472*	*1,422*	Jervey
2N12E32	855	WASC 3170	–	–	1783840	713400	2,037	–	–	–	–	–	–	–	–	2,037	1,437	1,177	Keinle