

Investigation Conclusions

General Technical Conclusions

1. Ground water occurs in both basalt and basin fill in the eastern Lost River sub-basin. However, wells with higher yields are generally located within the valleys and produce from basalt. Therefore, this investigation focused primarily upon the various influences affecting the behavior of ground water in basalt including pumping and climatic events.
2. The geology in the sub-basin is complex. However, sufficient hydraulic connection exists between water bearing zones in predominantly basalt units to allow lumping them as undifferentiated basalt. Additionally, sufficient hydraulic connection exists between water bearing zones in predominantly basin fill sedimentary rock and sediment units to allow lumping them as undifferentiated sediments.
3. Ground water in basalt and the overlying basin fill is generally hydraulically interconnected, especially in Langell, Poe, and Yonna Valleys. Evidence includes similar ground water elevations and ground water level trends.
4. In Swan Lake Valley and Pine Flat, ground water in the deeper portion of the basin fill has an efficient (direct) hydraulic connection to ground water in the basalt below. Ground water in the upper portion of the basin fill is either perched above deeper ground water or has a high vertical gradient to deeper ground water. Evidence includes anomalously high ground water elevations at a few wells surrounded by wells showing much lower ground water elevations and different ground water trends.
5. Ground water in basalt generally flows toward the valleys from the surrounding uplands and then flows down valley toward or parallel to the Lost River. Recharge appears to occur locally in both the uplands and valleys. Most discharge occurs at fault-related valley springs within or near the Lost River. Limited discharge occurs through the basin fill and stratigraphically controlled springs above the valley floors.
6. Ground water in basalt is hydraulically connected to the Lost River via springs and diffuse seepage through overlying basin fill.
7. The most efficient interconnection between ground water in sub-basin basalt and the Lost River occurs at fault controlled valley floor springs where basalt is at or near land surface. The greatest ground water discharge from basalt to the Lost River occurs at Bonanza Big Springs and west Poe Valley springs located in or adjacent to the river. Additional discharge occurs at south Langell Valley springs located away from the river.

8. The least efficient interconnection between ground water in sub-basin basalt and the Lost River is through basin fill that overlies the basalt. Ground water discharge to the river occurs as diffuse, low flow, seepage.
9. Both fault and stratigraphically controlled springs exist in the sub-basin. The fault controlled springs generally occur on the valley floors, facilitate ground water discharge from the sub-basin basalt, and have larger and relatively continuous flow. Stratigraphically controlled springs generally occur above the valley floor and have smaller, often intermittent, flow.
10. The occasional hot springs in the sub-basin are fault controlled with water absorbing heat during deep circulation along faults.
11. The sub-basin can be divided into four sub-areas (south Langell Valley, Lorella, Bonanza, and Swan Lake Valley to Poe Valley) based primarily on the behavior of ground water in basalt and in part on geology. At different locations within each sub-area, the ground water response to natural and anthropogenic stress is similar.
12. The Lorella and the Swan Lake Valley to Poe Valley sub-areas can be further divided into compartments based on the behavior of ground water affected by geologic structure.
13. Ground water levels in sub-basin basalt are generally controlled by climate in the long-term and ground water use in the short-term. A distinguishable canal leakage influence occurs in the Lorella sub-area.
14. Pumping ground water from basalt affects ground water levels in both basalt and overlying basin fill.
15. Water level data from 1999 through 2002 indicate the impacts of summer ground water pumping from basalt did not propagate beyond sub-area or compartment boundaries during those years. This does not imply the sub-areas and compartments are hydraulically isolated or that any long-term effects, such as year-to-year declines, from future ground water uses will not propagate to neighboring areas in the long-term.
16. Investigation data indicate springs showing an acute response to seasonal ground water pumping from basalt were located in the same sub-area or compartment as the seasonal ground water use. For example, Bonanza Big Springs responded to summer ground water use in the Bonanza sub-area only. This does not imply that long-term effects from any future ground water uses will not propagate in the long-term to affect springs in neighboring sub-areas or compartments.

17. High basalt transmissivities (exceeding 100,000 ft²/day) exist in the Bonanza and south Langell Valley sub-areas and the central portion of the Swan Lake Valley to Poe Valley sub-area. These transmissivities facilitate smaller, but very rapid ground water level responses at springs and other locations within the same sub-area or compartment where pumping ground water from basalt occurs. Even though the water level response at a spring is small, the impact upon spring discharge is large given the higher transmissivities and direct connection between the basalt and springs. Most of the ADR permit wells are located in these areas, especially the Bonanza sub-area.
18. Low basalt transmissivities and compartmentalization generally exist in the Lorella sub-area and in south and eastern Poe Valley. These facilitate greater ground water level drawdown when a well pumps from basalt in these areas. Despite the greater water level response, the short-term impact upon surface water is small in these areas. This is due to the lower transmissivities, compartmentalization, and/or thicker basin fill making the interconnection between the basalt and surface water inefficient. Fewer of the ADR permits are located in these areas.

Ground Water Response to Development

19. Ground water use in the sub-basin has increased over the decades. Condition D in the ADR permits requires the Oregon Water Resources Department to determine whether “excessively declining ground water levels” have occurred due to well use. The definition exists in Oregon Administrative Rule OAR 690-08-001 (6).
20. Water level measurements at nine state observation wells (generally from the 1960s through the 1990s) indicate ground water levels in the sub-basin decline and recover seasonally and over multiple years. The seasonal fluctuations correspond to the seasonality of ground water recharge and ground water use. The fluctuation over multiple years corresponds to long-term precipitation trend variations.
21. At eight of the nine state observation wells, water levels during the late 1990s are similar to the initial levels. Over a 40-year period, a possible decline of 1 to 2 ft occurred in south Swan Lake Valley, Yonna Valley, and south Langell Valley, and a possible 3 ft decline occurred near Lorella. These declines are not considered “excessive” as defined by OAR 690-08-001 (6).

22. At the ninth state observation well located in southeast Poe Valley, a 20 ft total decline occurred as two 10 ft steps, first in the 1960s and subsequently in the 1990s. The decline resulted from local aquifer properties and compartmentalization amplifying ground water use impacts during droughts. The decline is notable, a concern, and deserves continued monitoring. However, it is geographically limited and not considered “excessive” as defined by OAR 690-08-001 (6).
23. Under the rule, an “excessive” decline includes water quality deterioration as a result of “ongoing lowering” of the ground water level. Periodic ground water quality deterioration has occurred in the vicinity of Bonanza Big Springs as a result of drought, seasonal ground water use, and management of the Lost River. This situation is not considered an “excessive” decline under OAR 690-08-001 (6) since the deterioration is not related to an “ongoing lowering” of ground water levels.

Potential Impact Upon the Lost River and Bonanza Big Springs

24. Condition A in the ADR permits requires the Oregon Water Resources Department to determine whether the Lost River stage or Bonanza Big Springs flows are not significantly diminished by use of water under each permit.
25. To address condition A, this investigation calculated the potential drawdown of ground water in basalt at the Lost River, Bonanza Big Springs, and other springs due to pumping ground water as allowed by the ADR permits. River and spring sites selected for the drawdown calculations were limited to sites within the same sub-area or compartment as the pumping well.
26. The effect of pumping ground water from basalt upon the Lost River and springs is directly proportional to the amount of ground water drawdown caused by the pumping and the efficiency of the interconnection between the ground water in basalt and surface water.
27. Drawdown from a pumping well at any location is dependent upon the pumping rate, aquifer transmissivity and storage coefficient, distance from the pumping well, and elapsed pumping time. Higher pumping rates, smaller transmissivity, and storage coefficient, shorter distance from the pumping well, and longer elapsed time lead to larger drawdown estimates. Conversely, smaller pumping rates, larger transmissivity and storage coefficient, greater distance from the pumping well, and shorter elapsed time lead to smaller drawdown estimates.

28. The calculated drawdowns indicate pumping an individual well producing ground water from basalt in most Lorella sub-area compartments and in the south Poe Valley compartment yields much greater drawdown than pumping in other areas due to lower transmissivities in these compartments. Despite the greater drawdowns, compartmentalization and the presence of overlying basin fill greatly limit the short-term effect upon the Lost River.
29. Areas where calculations show smaller ground water drawdowns in basalt are also areas with higher transmissivities and better connections to the Lost River via springs. These areas include the south Langell Valley sub-area, the Bonanza sub-area, and the central portion of the Swan Lake Valley to Poe Valley sub-area. In these areas, especially the Bonanza sub-area, ground water pumping has a much greater impact upon surface water despite the smaller drawdowns.
30. The calculated cumulative ground water drawdown in basalt at Bonanza Big Springs in the Bonanza sub-area for 30 and 184 days of continuous pumping at the maximum permitted rate ranged from more than 5.40 ft to nearly 7.25 ft respectively. The total drawdown for 30 and 184 days of pro-rated pumping ranged from nearly 3.10 ft to more than 4.10 ft respectively. The calculations used aquifer test derived effective transmissivity (334,201 ft²/d) and storage coefficient (0.00096) values for the Bonanza sub-area. These values account for boundary, leakage, or delayed yield influences.
31. The calculated cumulative ground water drawdown in basalt at Kilgore Spring in the south Langell Valley sub-area for 30 and 184 days of continuous pumping at the maximum permitted rate ranged from nearly 3.00 ft to more than 3.50 ft respectively. The total drawdown for 30 and 184 days of pro-rated pumping ranged from nearly 1.75 ft to more than 2.00 ft respectively. The calculations used aquifer test derived effective transmissivity (600,000 ft²/d) and storage coefficient (0.00025) values for the south Langell Valley sub-area. These values account for boundary, leakage, or delayed yield influences. The ADR permit conditions do not address this spring.
32. The calculated cumulative ground water drawdown in basalt at High spring in the central portion of the Swan Lake Valley to Poe Valley sub-area for 30 and 184 days of continuous pumping at the maximum rate permitted ranged from nearly 3.00 ft to less than 5.00 ft respectively. The total drawdown for 30 and 184 days of pro-rated pumping ranged from over 1.50 ft to over 2.50 ft respectively. The calculations used aquifer test derived effective transmissivity (150,000 ft²/d) and storage coefficient (0.00040) values for the central portion compartment of the Swan lake Valley to Poe Valley sub-area. These values account for boundary, leakage, or delayed yield influences. The ADR permit conditions do not address this spring.

33. Most of the ADR ground water permit wells are located in the Bonanza sub-area and are directly connected to the Lost River via Bonanza Big Springs. The potential negative impact upon the Lost River flow is greatest here.
34. From 1997 through 2002, the ground water level in the basalt at Bonanza Big Springs nearly met the river stage in the summer of 1997 and 2000, and dropped below the river stage in the summer of 2001 and 2002. During those years, the spring-time basalt ground water elevations at Bonanza Big Springs changed from about 4.0 ft to 6.5 ft above the river stage immediately before impoundment occurred at Harpold Dam to about 2.0 ft to 4.5 ft above the river stage immediately after impoundment occurred. The elevation difference range corresponds to dry and wet years respectively.
35. Under current management of the Lost River, the calculated total ground water drawdown in basalt by pro-rated pumping of the Bonanza sub-area ADR permit wells is sufficient to terminate Bonanza Big Springs flow (lower the ground water level to or below river stage) in most years.
36. Fewer ADR ground water permit wells are located in the central portion of the Swan Lake Valley to Poe Valley sub-area where a direct connection with High spring exists, and the south Langell Valley sub-area where a direct connection with Kilgore Spring exists. In 2001, both springs stopped flowing due the lowering of ground water levels in the basalt caused by drought and increased pumping. The ADR permit conditions do not address these springs.