APPENDIX D

Hydrological Analysis

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1.0 SUPPORTING INFORMATION

Three types of surface treatments for certain external overburden disposal areas (ODAs) and backfilled pits at the Smoky Canyon Mine are considered in conjunction with Alternatives 2, 3, and 4. These are:

- Installation of a 2-foot soil cap, compacted only by the normal travel of construction equipment, followed by revegetation (Alternative 2);
- The addition of organic amendments to existing soil followed by revegetation (Alternative 3); and
- Installation of a low-permeability cap, comprised of 1) a bottom, 6-inch cushion layer (where necessary), 2) a geosynthetic clay liner (GCL); 3) a 1-foot chert drainage layer; and 4) an uppermost, 1.5-foot revegetated soil layer (Alternative 4).

ArcView, a geographic information system (GIS) software tool, was used to determine physical parameters for each of the evaluated areas. Surface area, slope angle, reclamation type, and ground cover were all acquired from the existing GIS database layers. Source data for the GIS layers include September 2004 high-resolution (1-foot) aerial imagery, September 2004 5-foot contours, the Simplot 2004 annual operations report, and an outline of mine disturbance areas developed by NewFields and updated with September 2004 data.

Potential reductions in infiltration associated with these surface treatments are discussed below. In addition, potential reductions in water inflow to some of the ODAs and backfilled pits associated with construction of run-on control ditches are also discussed.

1.1 Potential Infiltration Reductions with 2-Foot Soil Cover

Under Alternative 2, an additional two feet of topsoil would be added to the top of the subject waste area and seeded. This would provide for the relatively rapid establishment of an improved vegetative cover which would increase evapotranspiration and therefore decrease infiltration. The additional soil would also provide additional water storage capacity which would decrease infiltration. Pilot studies conducted in an arid New Mexico environment have shown that a simple landfill cover consisting of 1.5 feet of compacted soil overlain by 6 inches of loose, revegetated soil can reduce infiltration by up to 98 percent, with increasing effectiveness as the vegetation matures (Dwyer, 2001). Other field-level studies have shown that average percolation rates for conventional (compacted earth) covers with soil barriers are on the order of 6 percent to 17 percent of precipitation (Albright, et al., 2004). Effectiveness rates this high are not expected to be achieved at the Smoky Canyon Mine because the environment is less arid than that for some of these field studies and the proposed 2-foot soil would not be aggressively compacted. Thus, for the purposes of this analysis, it is reasonable to expect that infiltration

rates would be reduced by 50 percent with a 2-foot soil cover after a mature vegetative cover has been established. As previously noted, such establishment is expected to be relatively rapid with a 2-foot soil cover over the mine waste.

1.2 Potential Infiltration Reductions With Soil Amendment

Under Alternative 3, an organic amendment such as composted manure would be mixed into the top 12 inches of the existing surface of the subject waste area and the amended surface would be seeded with the same mix as under Alternative 2. The composted manure would add organic mass to the surface layer of the waste area and, over time, should improve the vegetative cover. This would result in increased evapotranspiration and reduced infiltration. With proper care and maintenance, it is likely that the density and distribution of the vegetative cover established on the amended soil surface would eventually approach that of a vegetated, 2-foot soil cover as described in the previous subsection. Therefore, for the purposes of this analysis, the amended, revegetated surface is expected to have a similar level of effectiveness (i.e., a 50 percent reduction in infiltration) as the vegetated, 2-foot soil cover except that a longer period of time and possibly a higher level of operations and maintenance would be needed to achieve that level of effectiveness.

1.3 Potential Infiltration Reductions with a Low-Permeability Cap

The Hydrologic Evaluation of Landfill Performance (HELP) model was developed for EPA by the U.S. Army Corps of Engineers to evaluate landfills, cover systems, and solid waste disposal systems based upon water balances. “The model accepts weather, soil and design data and uses solution techniques that account for the effects of surface storage, snowmelt, runoff, infiltration, evapotranspiration, vegetative growth, soil moisture storage, lateral subsurface drainage, leachate recirculation, unsaturated vertical drainage, and leakage through soil, geomembrane or composite liners” (Schroeder et al., 1994).

The HELP model was used to estimate direct infiltration and run-on volumes from adjacent native areas as well as the effectiveness of the Alternative 4 low-permeability cap. The HELP model was not used to model post-remediation conditions for Alternatives 2 and 3, which do not include low-permeability caps. This is because the HELP model was developed to model complex engineered caps and does not effectively model simple soil covers. Model input parameters were acquired from the B and C Panel’s Draft SEIS (U.S Bureau of Land Management and U.S. Forest Service, 2002), the Draft F and G Panel HELP modeling (Knight Piesold, 2004), and the HELP model internal database.

As previously described, the low-permeability cap would be comprised of 1) a bottom, 6-inch cushion layer (where necessary), 2) a geosynthetic clay liner (GCL); 3) a 1-foot chert drainage layer; and 4) an uppermost, 1.5-foot revegetated soil layer. HELP model results for a low-

permeability cap in the Smoky Canyon Mine area indicate infiltration rates of 0.003 inches per year, or greater than a 99 percent reduction in infiltration. It should be noted, however, that pilot studies suggest that low-permeability caps including GCL may deteriorate over time, resulting in rising infiltration rates. Such deterioration can be attributed to dessication of the GCL which does not completely repair itself after rewetting, ion exchange between the GCL and the soil which increases the GCL's permeability, damage to the GCL by root intrusion, and possible damage to the GCL during installation (Dwyer, 2001).

1.4 Potential Infiltration Reductions Using Run-On Controls

Some of the removal action alternatives included in this EECA include the installation of run-on control ditches to route water away from the waste areas. These ditches would not be lined and, therefore, some water would infiltrate through the bottom of the ditch. For the purposes of this analysis, it is assumed that the ditches would be 80 percent effective in reducing run-on to the various waste areas.

2.0 RESULTS

All estimates of current infiltration listed below were taken from the Site Investigation Report (NewFields, 2005). Estimates of potential infiltration reductions are based on the analyses described in the previous subsections.

2.1 A Panel External ODA

The majority of the A Panel external ODA is located on the eastern side of the ridge that separates the Site from Sage Valley. The ODA is approximately 3,000 feet long (north to south), between 1,300 and 1,700 feet wide (east to west) and covers approximately 80 acres. Most of the area on top of the ODA has no topsoil cover, and the soil thickness on covered areas is typically less than 6 inches. The top area was seeded in 1986. Topsoil has been placed on some areas of the east-facing slope, but the thickness in those areas is also typically less than 6 inches. The east slope was originally seeded in 1989 and additional revegetation efforts were implemented in 1996.

2.1.1 Existing Conditions

Direct infiltration is currently the only significant source of water to the A Panel external ODA. Currently, based on HELP modeling results, approximately 0.7 million cubic feet of water infiltrates through the A Panel external ODA each year. This equates to an average annual flow rate of 0.022 cfs.

A limited volume of water may run-on to the north edge of the A Panel external ODA. The area contributing this limited run-on is small (i.e., less than 15 acres) and the majority of the water would flow down a drainage created by the intersection of the A Panel external ODA and the native hillside. Therefore, compared to the volume of water that directly infiltrates into the ODA, the amount of run-on is considered to be negligible.

2.1.2 Conditions after Implementation of Alternative 1

Under Alternative 1, no further action would be taken on the A Panel external ODA and there would be no change in inflows to the ODA.

2.1.3 Conditions after Implementation of Alternative 2

Under Alternative 2, an additional two feet of topsoil would be added to the top of the A Panel external ODA and seeded. As discussed in Section 1.1, a 50 percent reduction in infiltration is a

reasonable expectation for this cover, after the vegetation matures. This would result in a continued average infiltration of 350,000 cubic feet per year (0.011 cfs).

2.1.4 Conditions after Implementation of Alternative 3

Under Alternative 3, an organic amendment such as composted manure would be mixed into the top 12 inches of the A Panel external ODA and the amended surface would be seeded with the same mix as under Alternative 2. As discussed in Section 1.2, the organic amendment is expected to result in a vegetative cover similar to that of Alternative 2 except a longer period of time and an increased level of operations and maintenance would be required to achieve the same level of vegetation. Thus, a 50 percent reduction in infiltration is a reasonable expectation for this cover, after the vegetation matures. This would result in a continued average infiltration of 350,000 cubic feet per year (0.011 cfs).

2.1.5 Conditions after Implementation of Alternative 4

Under Alternative 4, a low-permeability cap would be placed on the A Panel external ODA. As discussed in Section 1.3, HELP modeling results indicate that yearly water infiltration would be approximately 0.003 inches per year over the 80-acre ODA. This would result in a yearly infiltration volume of approximately 1,000 cubic feet per year (<0.001 cfs) into the A Panel external ODA after implementation of Alternative 4. This would be a reduction of approximately 99.8 percent relative to current conditions.

2.2 Pole Canyon ODA

The Pole Canyon ODA is located to the south of A Panel and north of D Panel. The footprint of the disposal area covers approximately 120 acres. The Pole Canyon ODA fills the lower portion of lower Pole Canyon, and Pole Canyon Creek flows in its original channel directly through the base of the overburden materials. Reclamation of the east side of the ODA began in 1992 when the slope was reshaped and seeded. Revegetation efforts continued on the east side during 1995 when top soil was placed on the slope and the area was reseeded. In most areas, 3 to 12 inches of topsoil are present on the overburden, but there are areas where the shale overburden is currently exposed on the steeper east-facing slope.

2.2.1 Existing Conditions

Currently there are three major sources of water to the Pole Canyon ODA. The largest inflow of water comes from Pole Canyon Creek flowing directly into the upstream toe of the ODA. Pole Canyon Creek currently contributes, on average, approximately 44.2 million cubic feet of water per year to the ODA. The next largest inflow of water to the Pole Canyon ODA is surface water

run-on. Surface water run-on was estimated to contribute approximately 2.2 million cubic feet of water to the Pole Canyon ODA per year. The final major source of water to the Pole Canyon ODA is direct infiltration. Direct infiltration was estimated to contribute approximately 1.2 million cubic feet of water per year. The total estimated water inflow, on average, to the Pole Canyon ODA is 47.6 million cubic feet per year (1.51 cfs) under current conditions. Approximately 93 percent of this inflow consists of waters in Pole Canyon Creek.

2.2.2 Conditions after Implementation of Alternative 1

Under Alternative 1, no further action would be taken on the Pole Canyon ODA and there would be no change in inflows to the ODA.

2.2.3 Conditions after Implementation of Alternative 2

Under Alternative 2, a surface treatment comprised of a layer of zero-valent iron, overlain by three feet of run-of-mine (ROM) chert and a 2-foot layer of vegetated topsoil would be applied to the Pole Canyon ODA. The infiltration rate would likely not be significantly affected by the iron or chert layers, but as described in Section 1.1, it is assumed for the purposes of this evaluation that the 2-foot layer of vegetated topsoil would reduce direct infiltration by approximately 50 percent. This would result in a direct infiltration volume of 600,000 cubic feet per year into the Pole Canyon ODA. The presence of zero-valent iron should provide improvements in the quality of water infiltrating through the Pole Canyon ODA.

Also under Alternative 2, a run-on control ditch would be constructed along the northern portion of the eastern half of the ODA. As described in Section 1.4, the run-on control ditch would not be lined and the expected effectiveness of the ditch is assumed to be 80 percent. This would result in continued inflows of water from surface water run-on of approximately 440,000 cubic feet per year into the Pole Canyon ODA.

Pole Canyon Creek would continue to flow into the ODA under this alternative. This would result in no reduction of water from the creek and a continued average estimated flow of 44.2 million cubic feet of water per year.

Based on the above, the total inflows to the Pole Canyon ODA after implementation of Alternative 2 would be approximately 45.2 million cubic feet of water per year (1.44 cfs). This would be a reduction of water inflow of approximately 5 percent relative to current conditions.

2.2.4 Conditions after Implementation of Alternative 3

Under Alternative 3, an organic amendment would be mixed into the surface of the Pole Canyon ODA (zero-valent iron, as described for Alternative 2, would not be included in the amendment

under Alternative 3). As discussed in Section 1.2, the organic amendment is expected to result in a vegetative cover similar to that of Alternative 2 except a longer period of time and an increased level of operations and maintenance would be required to achieve the same level of vegetation. Thus, a 50 percent reduction in infiltration is a reasonable expectation for this cover after the vegetation matures. This would result in a continued average infiltration of 600,000 cubic feet per year into the ODA.

As described for Alternative 2, a surface water run-on control ditch would be placed along the eastern portion of the northern edge of the ODA resulting in an estimated 80 percent reduction in surface water run-on. This would result in continued inflows of 440,000 cubic feet per year.

Under Alternative 3, a portion of the Pole Canyon Creek flows would be diverted upstream of the Pole Canyon ODA and the remaining flows would be infiltrated to the Wells Formation aquifer immediately upstream of the ODA. An analysis of this approach that demonstrates the feasibility of diverting and infiltrating normal flows in Pole Canyon Creek upstream of the ODA is presented in Appendix C of this EECA. Thus, under normal conditions, Pole Canyon Creek flows would cease to enter the ODA under Alternative 3. Major storm events (e.g., the 100-year storm) occurring during times of high flow or during periods where infiltration or diversion capacity is reduced, such as spring flows or after a long period without maintenance, may exceed the capacity of the diversion and infiltration system. Under such short-term conditions, limited amounts of water could overflow the diversion/infiltration system and enter the ODA.

Based on the above, the total average estimated water inflow to the Pole Canyon ODA after implementation of Alternative 3 would be 1.04 million cubic feet per year (0.033 cfs). This would be a 98 percent reduction in water inflow to the ODA. The majority of this reduction is associated with diversion/infiltration of Pole Canyon Creek.

2.2.5 Conditions after Implementation of Alternative 4

A low-permeability cap, as described in Section 1.3, would be placed over the Pole Canyon ODA under Alternative 4. HELP modeling indicates that infiltration through such a cap would be 0.003 inches per year. This would result in a total infiltration of approximately 1,300 cubic feet per year over the 120-acre footprint of the Pole Canyon ODA.

As described for Alternative 2, a surface water run-on control ditch would be placed along the eastern portion of the northern edge of the ODA resulting in an estimated 80 percent reduction in surface water run-on. This would result in continued inflows of 440,000 cubic feet per year.

As described for Alternative 3, a diversion/infiltration system would be installed upstream of the Pole Canyon ODA. This would preclude normal flows of Pole Canyon Creek from entering the ODA.

Based on the above, the total average estimated water inflow to the Pole Canyon ODA, after implementation of Alternative 4, would be 441,000 cubic feet per year (0.014 cfs). This would be a 99 percent reduction in water inflow to the ODA.

2.3 D Panel Backfilled Pits and D Panel ODA

D Panel is located south of the Pole Canyon external ODA and north of Sage Creek. D Panel covers approximately 330 acres. Reclamation activities have been completed at the backfilled mine pits. In 1998 and 1999, the backfilled areas of the D-1 pit were reshaped, covered with top soil from E Panel mining activities, and seeded. On the southern 100 acres of the D Panel backfill, 10-foot-thick layer of chert overburden was placed on the waste-shale overburden before the backfill was covered with 12 inches of topsoil. This 100-acre area will not be subject to further capping or amendment. All of the topsoiled area has been seeded/planted for revegetation. The most recent revegetation effort was completed on the south end of the D Panel pit backfill in 2002.

The D Panel external ODA is located east of D Panel, between the Pole Canyon Creek external ODA and Sage Creek on a hillside facing Sage Valley. The D Panel external ODA covers approximately 26 acres. More than 12 inches of topsoil was placed over the ODA in 1998 and 1999 and seeded.

2.3.1 Existing Conditions

Currently there are two major sources of water inflows to the D Panel backfilled pits: direct infiltration and surface water run-on. Direct infiltration contributes approximately 5.1 million cubic feet of water per year. Surface water run-on contributes approximately 4.5 million cubic feet of water per year.[1] The total average yearly inflow of water to the D Panel backfilled pits is approximately 9.6 million cubic feet (0.304 cfs).

Infiltration and run-on comprise water inflows to the D Panel external ODA as well. Direct infiltration contributes approximately 300,000 cubic feet of water per year (0.010 cfs). Infiltration of runoff from the D Panel backfilled pits also contributes a potentially significant but non-quantified volume of water to the D Panel. A limited amount of surface water run-on is possible from the undisturbed area north of the D Panel external ODA, but due to the existing topography the majority of the run-on would travel down the channel formed by the intersection of the D Panel external ODA and the undisturbed area and would not infiltrate the ODA. Therefore, a significant volume of water is not believed to be contributed from this run-on.

[1] This value differs from the value presented in the Site Investigation (SI) Report. This is because it was believed that a run-on control ditch ran the full length of the western edge of the D Panel pit when the SI Report was prepared. It was not discovered until recently that a run-on control ditch is present only along the northern half of the backfilled pit.

2.3.2 Conditions after Implementation of Alternative 1

Under Alternative 1, no further action would be taken on the D Panel backfilled pits or the D Panel external ODA and there would be no change in inflows to the northern 230 acres of the backfilled pits. The southern 100 acres of the backfilled pits, and the D panel external ODA have been covered with soil and seeded. Over time, if proper operations and maintenance are implemented, it is expected that a mature stand of vegetation will become established on these areas that will significantly reduce direct infiltration as well as infiltration of run-on. Vegetation would remain sparse on the remaining areas and would have little effect on infiltration. It is reasonable to expect that infiltration reductions of up to 50 percent could be achieved on the southern 100 acres. It is assumed that the total of direct infiltration and run-on (9.6 million cubic feet per year) is evenly distributed over the surface of the backfilled pit area and therefore the 50 percent decrease in inflow would apply to 30 percent of the annual infiltration. This would result in a total inflow of 8.16 million cubic feet of water per year (0.259 cfs) to the D Panel backfilled pits. This is a reduction of approximately 15 percent relative to current conditions. Achievement of this level of infiltration reduction would likely require a greater amount of time than for alternatives involving a soil cover or organic amendments.

The existing vegetation on the D Panel external ODA also would be expected to provide a 50 percent reduction in infiltration over time. This would result in an inflow of 150,000 cubic feet per year (0.005 cfs). Again, achievement of this level of infiltration reduction would likely require a greater amount of time than for alternatives involving a soil cover or organic amendments.

2.3.3 Conditions after Implementation of Alternative 2

Under Alternative 2, the northern portion of the D Panel backfilled pits (approximately 230 acres or 70 percent of the backfilled pit surface area) and the external ODA would receive a 2-foot vegetated soil cover. As discussed in Section 1.1, a 50 percent reduction in infiltration is a reasonable expectation for this cover, after the vegetation matures. As for the no-action alternative, eventual maturation of the vegetation on the southern 100 acres that has previously been reclaimed is also expected. This would result in total direct infiltration of 2.55 million cubic feet per year.

Under this alternative there would also be a surface water run-on control ditch installed along the southern half of the western edge of the D Panel backfilled pits. As described in Section 1.4, the run-on control ditch would be expected to reduce run-on by approximately 80 percent. The total annual run-on to this area is 4.5 million cubic feet per year. Approximately 3.4 million cubic feet of the annual run-on originates from the southern half of the western edge of the backfilled pits. An 80 percent decrease in this amount would leave 680,000 cubic feet per year of continued run-on. The remaining 1.1 million cubic feet originates from the undisturbed area within the backfilled pits and cannot be diverted. Therefore, approximately 1.8 million cubic feet of water per year would continue to enter the D Panel backfilled pits. The total annual inflow of

water from direct infiltration and run on to the D Panel backfilled pits under Alternative 2 would be approximately 4.35 million cubic feet (0.138 cfs).

Similar to the D Panel backfilled pits, the D Panel external ODA would receive a 2-foot vegetated topsoil cover under this alternative. As discussed in Section 1.1, a 50 percent reduction in infiltration is a reasonable expectation for this cover, after the vegetation matures. This would equate to an annual inflow of approximately 150,000 cubic feet of water per year (0.005 cfs). The runoff from the D Panel backfilled pits that currently enters the D Panel external ODA would be eliminated as well by regrading a limited portion of the backfilled pits to redirect the runoff.

2.3.4 Conditions after Implementation of Alternative 3

Under Alternative 3, an organic amendment would be mixed into the surface of the northern 230 acres of the D Panel backfilled pits. As discussed in Section 1.2, the organic amendment is expected to result in a vegetative cover similar to that of Alternative 2 except a longer period of time and an increased level of operations and maintenance would be required to achieve the same level of vegetation. The southern 100 acres would be expected to achieve a similar level of vegetative cover. Thus, a 50 percent reduction in infiltration is a reasonable expectation for this cover, after the vegetation matures. As for Alternative 2, this would result in a total direct infiltration of 2.55 million cubic feet of water per year in the D Panel backfilled pits.

A surface water run-on control ditch would be placed along the southern portion of the western edge of the backfilled pits, resulting in an approximate 80 percent reduction in surface water run-on. As described under Alternative 2, this would leave approximately 1.8 million cubic feet of water per year as continued run-on to the D Panel backfilled pits. The total annual inflow of water from net infiltration and run-on to the D Panel backfilled pits under Alternative 3 would be approximately 4.35 million cubic feet (0.138 cfs).

Similar to the D Panel backfilled pits, the D Panel external ODA would also receive an organic surface amendment. As discussed in Section 1.2, the organic amendment is expected to result in a vegetative cover similar to that of Alternative 2 except a longer period of time and an increased level of operations and maintenance would be required to achieve the same level of vegetation. Thus, a 50 percent reduction in infiltration is a reasonable expectation for this cover, after the vegetation matures. This would equate to an annual inflow of approximately 150,000 cubic feet of water per year (0.005 cfs). As discussed under Alternative 2, the runoff from the D Panel backfilled pits that currently enters the D Panel external ODA would be eliminated as well by regrading a limited portion of the backfilled pits to redirect the runoff.

2.3.5 Conditions after Implementation of Alternative 4

A low-permeability cap, as described in Section 1.3, would be placed over the northern 230 acres of the D Panel backfilled pits under Alternative 4. HELP modeling indicates that infiltration through such a cap would be 0.003 inches per year. This would result in a total inflow of 2,500 cubic feet per year in the northern 230 acres. A 50-percent reduction in infiltration of rainfall and runoff would occur, over time, in the southern 100 acres of the backfilled pits area due to the maturation of the existing vegetation. It is assumed that the direct infiltration and run-on (5.1 million and 4.5 million cubic feet per year, respectively) to the entire backfilled pits area are evenly distributed over its surface. Therefore, the 50 percent decrease in inflow would apply to 30 percent of the annual infiltration and run-on, resulting in estimates of 765,000 cubic feet and 675,000 cubic feet per year, respectively (total of 1.44 million cubic feet per year). Inclusion of the small amount of infiltration through the northern 230 acres does not significantly change this total. Therefore, the total for the 330-acre backfilled pits area would be slightly more than 1.44 million cubic feet per year (0.046 cfs).

The D Panel external ODA would also be covered with a low-permeability cap under Alternative 4. Using the HELP model results for the low-permeability cover (0.003 inches per year) and the surface area of the ODA (26 acres), the annual infiltration under Alternative 4 is estimated to be 300 cubic feet per year (<0.001 cfs). As for the other alternatives, the D Panel backfilled pits would also be regraded to prevent runoff from entering the external ODA.

2.4 E Panel External ODA

The E Panel external ODA is located east of the E Panel mined area between the Sage Creek and South Fork Sage Creek on a hillside that faces Sage Valley. The external ODA covers approximately 100 acres and overlies moderately steep slopes and covers several minor drainages. Material management has been performed consistent with recent BMPs. Chert was disposed in the northern half of this area and seleniferous waste shale in the southern half. A chert cap is present and covered with topsoil over the entire ODA. However, vegetation has not yet become established on the ODA.

The northern half of the ODA is comprised of chert and seepage from this area contains very low selenium levels. Therefore, removal actions associated with this EECA focus on the southern 50 acres of the of the E Panel external ODA.

2.4.1 Existing Conditions

Direct infiltration is the only major source of water inflows to the E Panel external ODA. Current estimates of inflow due to infiltration are 1.3 million cubic feet of water per year. If it is assumed that this infiltration is evenly distributed on the ODA, then infiltration through the southern half of

the ODA, which would be subject to potential removal actions, would be 650,000 cubic feet per year.

2.4.2 Conditions after Implementation of Alternative 1

Under Alternative 1, no further action would be taken on the E Panel external ODA other than operations and maintenance. With proper operations and maintenance, and corresponding development of a good vegetative cover, it is likely that the vegetated soil cap will significantly reduce infiltration. For the purposes of this evaluation, a 50 percent reduction is assumed. Therefore, long-term inflows due to infiltration to the southern half of the E Panel ODA are estimated to be 325,000 cubic feet per year (0.010 cfs). Achievement of this level of infiltration reduction will likely require a greater amount of time than for alternatives involving a soil cover or organic amendment.

2.4.3 Conditions after Implementation of Alternative 2

Under Alternative 2, no further action would be taken on the southern half of the E Panel external ODA and therefore there would be no change in inflow to the ODA. With proper operations and maintenance, and corresponding development of a good vegetative cover, it is likely that the vegetated soil cap will significantly reduce infiltration. For the purposes of this evaluation, a 50 percent reduction is assumed. Therefore, long-term inflows due to infiltration to the southern half of the E Panel ODA are estimated to be 325,000 cubic feet per year (0.010 cfs). Again, achievement of this level of infiltration reduction will likely require a significant period of time.

2.4.4 Conditions after Implementation of Alternative 3

Under Alternative 3 an organic amendment would be mixed into the surface of the southern half of the E Panel external ODA and the amended surface would be re-seeded to increase vegetation density. As discussed in Section 1.2, this is expected to result in a vegetative cover similar to that of a vegetated, 2-foot soil cover except a longer period of time and an increased level of operations and maintenance would be required to achieve the same level of vegetation, though the amount of time would be less than for the current conditions (see Alternatives 1 and 2, above). Thus, a 50 percent reduction in infiltration is a reasonable expectation for this amended surface, after the vegetation matures. This would result in a continued average infiltration of 325,000 cubic feet per year (0.010 cfs).

2.4.5 Conditions after Implementation of Alternative 4

The southern half of the E Panel external ODA would be covered with a low-permeability cap, as described in Section 1.3, under Alternative 4. Using the HELP model results for the low-permeability cap (0.003 inches per year) and the surface area of the southern half of the ODA (50 acres), the annual infiltration under Alternative 4 is estimated to be 550 cubic feet per year (<0.001 cfs).

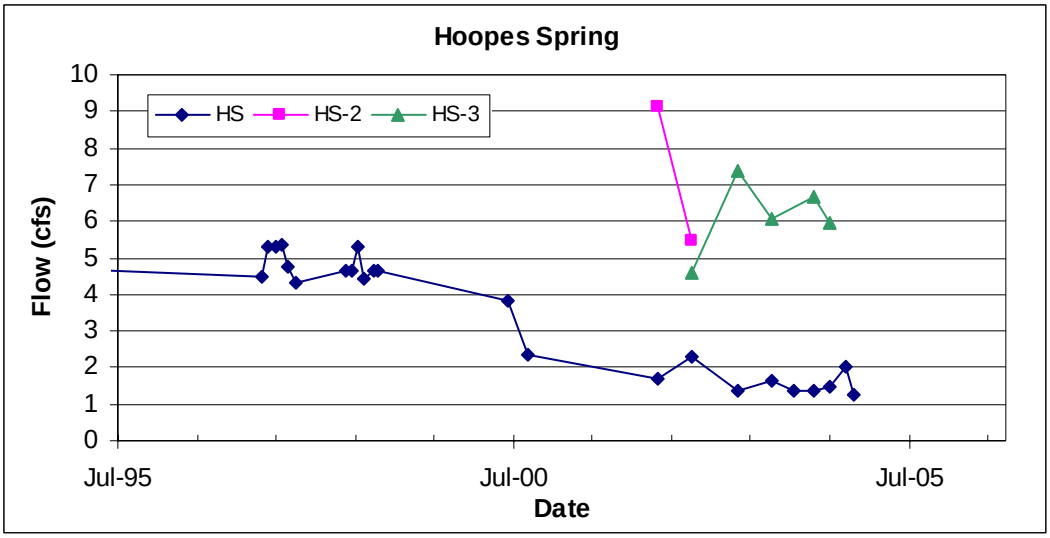
2.5 Hoopes Spring

Hoopes Spring is located along the west side of Sage Valley on the West Sage Valley Fault. The source of the spring is likely groundwater in the Wells Formation.

2.5.1 Flow

The majority of flow measurements within the Hoopes Spring drainage have been made at HS, which is just below a large diffuse spring. Flow was measured at two other sampling locations along the Hoopes Spring drainage (HS-2 and HS-3) between 2002 and 2004. Figure D-1 illustrates the flow rates measured at HS, HS-2, and HS-3 from 1997 through 2004. The flow rate at HS before 2000 was typically 4-6 cfs, after 2000 the flow rate has decreased to 1-2 cfs. However, the Hoopes Spring drainage is a gaining stream between HS and HS-3. The flow rates measured at HS-3 ranged from 4.5 to 7.5 in 2003 and 2004.

Figure D-1 – Hoopes Springs Hydrographs



3.0 SUMMARY

Implementation of Alternatives 1 through 4 would result in varying reductions in water inflows to the ODAs and backfilled pits addressed by this EECA. These reductions are summarized in Table D-1.

4.0 REFERENCES

Albright, W.H, C.H. Benson, G.W. Gee, A.C. Roesler, T. Abichou, P. Apiwnatragoon, B.F. Lyles, and S.A. Rock, 2004. Field Water Balance of Landfill Final Covers. Journal of Environmental Quality 33:2317 – 2332. November 2004.

Dwyer. 2001. Finding a Better Cover. American Society of Civil Engineers, Civil Engineering Magazine. January.

Knight Piesold. 2004. Definitive HELP Model Analyses, Smoky Canyon Mine Panels F and G, Caribou County, Idaho. Prepared for JBR Environmental Consultants. November.

NewFields. 2005. Site Investigation Report for the Smoky Canyon Mine, Caribou County, Idaho. Prepared for J.R. Simplot Company. July.

Schroeder, P.R., T.S. Dozier, P.A. Zappi, B.M. McEnroe, J.W. Sjostrom, and R.L. Peyton. 1994. The Hydrologic Evaluation of Landfill Performance (HELP) Model: Engineering Documentation for Version 3. EPA/600/R-94/168b. U.S. Environmental Protection Agency Office of Research and Development, Washington, D.C. September.

United States Department of Interior, Bureau of Land Management (BLM) and Forest Service (BLM/USFS). 2002. Final Supplemental Environmental Impact Statement, Smoky Canyon Mine, Panels B & C. Pocatello Field Office, Pocatello, Idaho.

TABLES

Table D-1
Summary of Hydrologic Information

Area	Current Inflow[2]	Alternative 1[1]		Alternative 2		Alternative 3		Alternative 4	
		Total Inflow	Percent Reduction[3]	Total Inflow	Percent Reduction	Total Inflow	Percent Reduction	Total Inflow	Percent Reduction
A Panel ODA	700,000	700,000	0%	350,000	50%	350,000	50%	1,000	>99%
Pole Canyon ODA	47,600,000	47,600,000	0%	45,200,000	5%	1,040,000	98%	441,000	99%
D Panel Pits	9,600,000	8,160,000	15%	4,350,000	55%	4,350,000	55%	1,440,000	85%
D Panel ODA	300,000	150,000	50%	150,000	50%	150,000	50%	300	>99%
E Panel ODA[4]	650,000	325,000	50%	325,000	50%	325,000	50%	550	>99%

[1] Alternative 1 is the no-action alternative.

[2] All total inflows presented in cubic feet per year.

[3] All percent reductions are relative to current conditions.

[4] Southern 50 acres of ODA only.