SECTION 41

PROBABLE HYDROLOGIC CONSEQUENCES

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LIST OF REVISIONS DURING PERMIT TERM

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SECTION 41 PROBABLE HYDROLOGIC CONSEQUENCES

This section provides an assessment of the potential for adverse hydrologic impacts from proposed mining and reclamation in the No Name Permit Area (NNP). The primary focus of the probable hydrologic consequences (PHC) is to predict the effects of proposed mining and reclamation activities on the prevailing hydrologic balance with respect to the quality and quantity of water in surface water and groundwater systems both during mining and after reclamation. The PHC assessment builds on the baseline hydrologic and geologic information contained in the permit application package (PAP) and observations of hydrologic impacts of mining at the adjacent Navajo Mine. The PHC also couples those data with detailed SEDCAD™ 4 (SEDCAD) modeling of surface flows and sediment yields, spoil leaching test results, and groundwater flow and chemical transport modeling in order to develop projections about potential hydrologic impacts at NNP. Extensive groundwater modeling was conducted in 2009 for Area 4S and 5, which considered Coal Combustion Byproducts (CCBs) in mine backfill. This report can be found in Appendix 41.B. A new model was created in 2025 by BARR Engineering that did not consider CCBs in mine backfill and the results of this model are discussed herein. The full report can be found Appendix 41.E.

Disruption of the surface and geologic conditions and associated surface and groundwater flow systems is necessary in order to extract the coal resource by surface mining. Surface coal mining and reclamation operations may impact the hydrologic balance in a several ways, including:

- changing groundwater levels, recharge rates, and flow directions by removal of overburden and interburden materials and mining of the coal and by backfilling mine pits;
- exposing unweathered mineral surfaces in overburden and interburden to weathering processes during mining and backfilling operations;
- changing the quantity and quality of surface runoff and stream flows by construction of diversions, surface disturbance, sediment control structures, and construction and operation of best management practices (BMPs);
- altering surface topography and stream channels during mining and in reclamation; and
- modifying stream channel characteristics due to changes in the flows and sediment relationships downstream of mining.

The PHC is a process for identifying these potential changes in the hydrologic balance that may result from proposed mining and reclamation. The PHC also identifies the appropriate preventive and remedial measures to minimize the impacts to water resources and water uses. Any unavoidable impacts on existing water uses and water rights must be replaced subject to existing state, federal, and Navajo Nation water rights laws. The PHC lays the groundwork for the monitoring plans described in Section 35 Hydrologic Reclamation Plan.

41.1 Acid-Forming and Toxic-Forming Materials

The PHC requires the identification of acid-forming or toxic-forming materials that could contaminate surface water or groundwater. This assessment draws on the detailed characterization of overburden and interburden materials provided in Section 17 Geologic Information. This section summarizes the results of overburden and interburden sampling and analyses performed within Area 4 South and Area 5. Statistical analysis of overburden and interburden quality data is provided in Appendix 17.E.

In summary, these data show that there is no widespread occurrence of potentially acid- and toxic- forming (PATFM) overburden or interburden materials within Area 4 South or Area 5. Characterization of the in-situ interburden above each coal seam suggests that, in some locations, the rock strata associated with the interburden above the No. 7 coal seam (I7) and interburden above the No. 6 coal seam (I6) in Area 4 South have total selenium concentrations that exceed the Office of Surface Mining Reclamation and Enforcement (OSM) criteria limits, but are below Navajo Mine criteria limits. Also, characterization of the in-situ interburden above each coal seam suggests that, in general, the rock strata present in I6, I4, I3, and I2 across Area 4 South and Area 5 possess saturation percent, sodium adsorption ratio (SAR), and pH values that are outside criteria limits established by OSM and Navajo Mine for root zone suitability.

Section 20 Mining Operations describes the methods that will be applied to exclude potentially unsuitable or PATFM materials from the root zone. This section also describes the plans for handling PATFM and combustible materials encountered or exposed during mining. Section 34 Post-Reclamation Topography describes how exposed combustible materials and PATFM will be adequately covered with nontoxic, noncombustible material suitable for plant growth.

Acid-base potential characterization of the overburden and interburden materials that will be removed during mining and used to backfill the mine pit indicates an overall net alkaline environment for overburden and interburden layers within Area 4 South and Area 5. The characterization has identified some limited locations within Area 4 South, where the acid-base potential values within interburden intervals I6 and I3 are outside the root-zone criteria limits. These locations are limited and the intervals are thin compared to the total thickness of interburden to be excavated during mining such that the mine backfill will remain net alkaline (Section 17 Geologic Information). Section 20 Mining Operations describes the plan for removal and backfilling of interburden materials that ensures adequate blending and mixing of these thin strata so that zones of PATFM will not occur within mine backfill.

The assessment of PATFM also draws on the detailed testing of mine spoils that are planned to be placed in the mine backfill to help achieve approximate original contour requirements for mine reclamation. At one time, the placement of CCBs were considered in mine spoils, however at this time no CCBs are planned to

be placed in mine spoils. Leaching tests of both CCBs and mine spoils were performed and are provided in Appendix 41.A and only mine spoils data are summarized in Table 41.1-1.

The leaching test results indicate that the pH of leachate using the expected field site materials and waters remains neutral to alkaline. This finding is supported by data collected and conclusions reported for site wide geologic and hydrologic conditions in Section 17 and Section 18, respectively. The synthetic precipitation leaching solution started with an initial pH of 5.0 and increased to pH values of 7.4 and 7.5 for spoil 18-hour batch samples, respectively, indicating the buffering influence of these materials to slightly alkaline conditions. An initial flush of salts, principally calcium and sulfate, will occur with leaching of these spoil materials along with detectable concentrations of some metals and trace constituents as indicated in Table 41.1-1.

Fluoride, sulfate, and TDS concentrations were above the relevant livestock and wildlife watering criteria in background Pictured Cliffs Sandstone (PCS), alluvial, and Fruitland Formation coal groundwaters, as described in Section 18 Water Resources. Fluoride was at a concentration of 2.4 mg/L in the background composite coal groundwater sample used in the leaching test, however fluoride concentrations are attenuated in mine spoils as demonstrated by the leaching test results of mine spoil, which showed fluoride concentrations dropping from the concentration of 2.4 mg/L to concentrations of 1.6 and 1.5 mg/L in the in 18-hour and 45-day spoil leachates, respectively.

41.2 Probable Hydrologic Consequences During Mining and Reclamation Operations

The PHC relies heavily on baseline hydrologic information and focuses particularly on the water resources that need be preserved to support intended post-mining land uses. The detailed baseline groundwater and surface water information is presented in Section 18 Water Resources and is briefly summarized in this assessment.

41.2.1 Groundwater Changes During Mining and Reclamation Operations

The groundwater resource within and adjacent to the permit area supports marginal stock water use. The alluvial groundwater in both Pinabete Arroyo and Cottonwood Arroyo is used for stock watering, although the TDS and sulfate concentrations in the Pinabete alluvial groundwater exceed guidelines for livestock use based on the Navajo Nation Surface Water Quality Standards (Section 18 Water Resources). The baseline fluoride concentrations fluctuate in the alluvial groundwater and are often above the relevant water quality criteria for livestock, wildlife and drinking water use (NNEPA WQP 2015). Baseline selenium concentrations in the Pinabete alluvial groundwater, presented in Section 18 Water Resources, meet the livestock use criterion. However, selenium concentrations fluctuate in the alluvial groundwater, and in all samples the values exceed the relevant water quality criteria for wildlife use. Two stock water wells are completed in alluvium of Pinabete Arroyo within the permit area (Section 18 Water Resources). Another stock water well

(13-15-2) is completed in the alluvium of a tributary to Pinabete Arroyo adjacent to the Burnham Road (Section 18 Water Resources).

Several livestock water wells are also completed in alluvium of Cottonwood Arroyo north of the permit area and within the alluvium of the Chaco River west of the permit area (Section 18 Water Resources). The Navajo Mine has also performed baseline monitoring of the groundwater quality of the alluvium near the mouth of Cottonwood Arroyo. These results indicate poor water quality similar to the Pinabete alluvium with TDS concentrations ranging from 2,020 to over 15,000 mg/L (Table 18.2-11 of the Pinabete PAP, OSM Permit No. NM-0042B) (NTEC 2021). Limited groundwater quality baseline data are also provided by Thorn (1993) for the Chaco River alluvium near the mouth of Cottonwood Arroyo. The results from two alluvial wells indicate that the groundwater quality of the Chaco River in the vicinity of the Cottonwood Arroyo confluence meets livestock use criteria with TDS concentrations ranging from 740 to 1,070 mg/L, sulfate concentrations from 350 to 610 mg/L, and fluoride concentrations ranging from 0.4 to 1.0 mg/L.

There are no water wells completed in the Fruitland Formation within or adjacent to the permit area and there is one stock water well (13-15-1), located adjacent to the Burnham Road in Area 5 that may be completed in the PCS (Section 18 Water Resources). However, the completion zone for this well is uncertain and the well has been capped and welded shut. The groundwater yields from wells completed in the Fruitland Formation and in the PCS, which underlies the Fruitland Formation at the NNP site, are quite low and wells are typically pumped dry during testing and well purging for sampling. However, there are a few locations within and adjacent to the permit area where the yields from the PCS or the No. 8 coal may be sufficient to supply a livestock tank. Nevertheless, the water quality in the PCS and Fruitland Formation is poor. The groundwater in the PCS within and adjacent to the NNP site is unsuitable for domestic use as concentrations of TDS, sulfate, chloride, and boron all exceed domestic use criteria. The PCS is also a poor source for livestock watering, with TDS concentrations typically above 5,000 mg/L and sulfate concentrations above 2,000 mg/L, both well above the relevant water quality criteria for livestock and wildlife use (Section 18 Water Resources). The TDS concentrations at most monitoring locations within the Fruitland Formation within and adjacent to the permit area also exceed the relevant water quality criteria for livestock and wildlife use (Section 18 Water Resources). At times, sulfate and fluoride also exceed the relevant water quality criteria for livestock and wildlife use. Nevertheless, the water quality in some locations is similar to the groundwater quality in the Pinabete alluvium, which is used for stock watering even though TDS, sulfate, and fluoride concentrations in the groundwater exceeds the relevant water quality criteria for livestock use (Section 18 Water Resources).

The potential impacts to the groundwater balance that are addressed in this section include:

- disruption of the shallow alluvial aquifer within Pinabete Arroyo by mining,
- pit inflows from the coal seams and the PCS,

- drawdown of water levels in the adjacent alluvial aquifers, the Fruitland coals, and PCS due to mining within the NNP, and
- changes in groundwater quality resulting from mining and reclamation operations.

41.2.1.1 Groundwater Quantity Changes During Mining and Reclamation Operations

41.2.1.1.1 Alluvial Impacts

The primary groundwater quantity impact from proposed mining operations is the drainage of groundwater from the alluvium in Pinabete Arroyo within the permit area by establishment of the Pinabete Diversion and the removal of the alluvial material during mining. The alluvium of Pinabete Arroyo upstream of the permit area will not be affected. Baseline information indicates that saturated conditions occur over much of the base of the alluvium of Pinabete Arroyo. However, groundwater levels in the alluvium are too low to support base flow in the Pinabete channel at any time. The Pinabete alluvium is recharged from direct precipitation and from ephemeral surface water flows in Pinabete Arroyo. There may also be a minor component of groundwater flow to the alluvium from outcropped coal seams and the PCS. However, there was only one location within the permit area where groundwater discharge to the alluvium was indicated by dense vegetation cover and salt deposits on the channel bed and banks. This site, located along Pinabete Arroyo, appeared to be associated with groundwater in the No. 8 coal seam (Section 18 Water Resources). At other locations along Pinabete Arroyo, a thin interval of saturation in the alluvium was observed to be perched above unsaturated bedrock.

The groundwater occurring within the alluvium is sufficient to support limited stock water use. Two dug alluvial livestock watering wells, 13-R-37 and 13-R-38, are located within the portions of the alluvium of Pinabete Arroyo proposed to be mined out (Section 18 Water Resources and Exhibit 18.2-1). Another stock water well (13-5-1) and its associated alluvial aquifer will be removed during mining. This well is completed in the alluvium of a tributary to Pinabete Arroyo adjacent to the Burnham Road (Section 18 Water Resources and Exhibit 18.2-1). This well is recharged by an adjacent manmade pond and is equipped with a hand pump. The saturated thickness and yield of these alluvial wells is quite low but sufficient to provide stock water via windmill driven pumps at dug wells. The water level in these wells varies with precipitation patterns and levels are generally too low to supply water to the dug wells during very dry years. Section 41.4 provides further description of potential short-term and long-term impacts to the groundwater sources for the water supply wells that will be removed by mining.

One Pinabete alluvial water well, 13-8-1, is located approximately 1,500 ft east of the permit area, while another Pinabete alluvial water well, 13-R-38, is located approximately 9,800 ft east of the permit area (Section 18 Water Resources). However, neither of these is hydrologically adjacent to the permit area because these wells are topographically up gradient of the mine and the groundwater source is the perched water in the alluvium, which will not be affected by mining.

Groundwater flow in the Pinabete alluvium downstream of mining is expected to diminish as a result of mining through Pinabete Arroyo. The possible effects on the Chaco River alluvium during mining and reclamation operations are addressed in Section 41.2.3.

Recharge of the alluvium of No Name Arroyo may increase downstream of the Pinabete Diversion due to an increase in frequency and duration of ephemeral flows due to the temporary diversion. Enhanced recharge of the alluvium may result in more frequent or more extensive saturation of the alluvium in this area where baseline monitoring indicates it is normally dry.

41.2.1.1.2 Pit Inflows and Water Level Drawdown

Model simulations of the advance of open pit mining have been performed to provide estimates of drawdown in the Fruitland coals and in the PCS during mining and estimates of rates of pit water inflow (Appendix 41.E). These simulations were performed for 5-year mining blocks as depicted in Figure 41.2-1. For the purposes of the model, mining began in 2026 and progressed from Area 4 South to Area 5. Area 4 North mining is also included in the model as it sits adjacent to the NNP area and its effects should be included. The open pits act as a drain for drawdown of any groundwater in the overburden/interburden and coal seams.

Model estimates of lateral pit inflows from the alluvium/overburden, Fruitland Formation coals and the PCS are provided in Table 41.2-1. Inflow rates of the magnitude predicted in Table 41.2-1 would be removed by evaporation along the face of the highwall, in the pit floor, or in pit sumps. Occasional pit pumping may be required after large precipitation events and, perhaps, due to a surge in pit inflows from an isolated saturated sand or localized zone of high permeability coal. However, the lack of significant water production encountered at most exploration holes at the NNP and observations at the Navajo Mine indicate that inflow surges from the coals and overburden are expected to be rare. Pit inflows from the coals and overburden have been too low at the adjacent Navajo Mine to either be observed or require pit pumping except at locations where the overburden was saturated with water from adjacent Navajo Agriculture Products Industry (NAPI) irrigation. NAPI irrigation activities do not extend into the drainages associated with the NNP site.

The estimated drawdown in the No. 8 coal seam in Year 2030, 2080, 2165 and 3165 is provided in Figure 41.2-2 for both Area 4 South and Area 5. The corresponding drawdown in the No. 3 coal in Year 2030, 2080, 2165 and 3165 are provided in Figure 41.2-3 for the entire permit area. The No. 8 coal is representative of the upper coal while the No. 3 coal is representative of lower coal unit. No water supply wells are located in the Fruitland Formation within the study area. Thus, the expected drawdown in the Fruitland Formation during mining will not affect any existing use. Furthermore, any drawdown in the No. 8 coal unit is not expected to affect water levels in the alluvium of Pinabete Arroyo east of the permit area because groundwater in Pinabete Arroyo in this area is perched above the water in the No. 8 coal seam and primarily unsaturated

as indicated by pre-mine conditions. The highest inflows are exhibited just north of the permit area due to timing and the orientation of regional groundwater flow. The inflows in Area 4 South are limited due to its proximity to previously mined areas to the north. Area 5 shows little to no inflow in the early periods of mining as this area is located in a drier geologic setting, however inflows increase as mining progresses to the final pits.

There will also be some depressurization of the PCS below the mine pit, although the layer of shale separating the bottom of the lowest coal seam and the PCS should serve to restrict groundwater inflow from the PCS during mining. No noticeable upward seepage from the PCS through the shale has been observed in the mine pits at the Navajo Mine even though the potentiometric levels in the PCS have often been above the pit floor.

The numerical groundwater model has also been applied to simulate drawdown that can be expected to occur within the PCS during mining. The estimated drawdown in the PCS during, at the completion of mining, and 1,000 yrs after mining in Area 4 South and Area 5 is provided in Figure 41.2-4. Estimated drawdown of potentiometric levels in the PCS during mining indicate impacts to the central and eastern portions of the permit area with the greatest decline in Area 4 North and far eastern portions of Area 5.

Water well 13-15-1 will be removed as a result of mining within Area 5. The completion zone for this well is not known but is believed to be a PCS well, based on the depth reported by Metric Corporation (1991). The well has not been used for quite some time and has been capped and welded shut. Section 32 Temporary Structures and Facilities Removal and Reclamation describes the plans for abandonment of wells prior to mining.

41.2.1.2 Groundwater Quality Changes During Mining and Reclamation Operations

Groundwater quality changes beyond the active mine area at the NNP will be minimal during mining and reclamation operations. During active mining, hydraulic gradients and groundwater flow directions in the alluvium, the adjacent Fruitland Formation, and in the underlying PCS will be toward the mine pits and backfill areas. Thus, it is expected that there will be little change in the quality of groundwater beyond the limits of the mine pit and mine backfill during mining and reclamation operations. Along lower No Name Arroyo more extensive saturation of the alluvium may occur due to flows from the Pinabete Diversion. The Pinabete Diversion design is presented in Section 26 Drainage Control. The water quality of any groundwater in the alluvium of No Name Arroyo is expected to have high TDS comparable to the average TDS of 13,000 mg/L at No Name alluvial well #1 (NNA-1). The high TDS is due to dissolution of soluble salts that have formed as a result of high evaporation rates. It is possible, however, that TDS levels in the alluvium of No Name may decline due to dilution with higher levels of recharge and saturation of the alluvium.

The water quality in the mine backfill materials will also evolve as these materials begin to resaturate with recharge from groundwater inflows from the adjacent Fruitland Formation coal seams and from the underlying PCS. Dissolved solids present in the pore water of mine overburden and interburden materials (spoil) that are removed and backfilled may be concentrated by evaporation during mining. Also, there may be some enhanced weathering of the minerals within the newly fractured and broken interburden strata that are removed during mining of the coals and placed within the mine backfill.

The characteristics of the overburden and interburden strata at the NNP were determined from an extensive drilling, coring, and testing program described in Section 17 Geologic Information. Test results include analyses of saturated paste extracts of overburden and interburden samples. McWhorter and Landers (1985) have found that the results of saturation extracts from overburden samples correlate well with the antecedent pore water that is displaced in the first flush from backfill material in column leach tests. Electrical conductivity (EC) in saturated paste extracts of overburden and interburden materials indicates considerable variability. Nevertheless, there will be substantial blending of these materials as a result of mining.

The average values from the various interburden layers indicate a general decline in EC with depth from the overburden layer above the No. 8 coal seam (I8) to the lowest interburden layer above the No. 2 coal seam (I2) as summarized in Table 41.2-2. Higher EC is observed in the overburden above the S8 coal as a result of increased weathering. The influence of weathering and associated EC values decreases with depth. The average EC for all spoil material within Area 4 South is estimated to be 2.7 mmhos/cm while the average EC for all spoil material within Area 5 is estimated to be 3.3 mmhos/cm. These results might be considered representative of the EC expected in the initial spoil water as long as additional weathering does not occur as a result of mining. On the other hand, higher EC values of 4.2 to 4.9 mmhos/cm for the weathered overburden (I8) from Area 4 South and Area 5 may provide a better approximate estimate for the EC that might occur in the first flush of pore water from weathered mine spoils placed in the backfill materials. Assuming a TDS/EC ratio of about 700 based on coal and alluvial groundwater at the NNP and the EC in saturated paste extracts from weathered overburden, the TDS concentrations in initial mine backfill waters would be expected to be on the order of 3,000 mg/L within Area 4 South and 3,500 mg/L within Area 5.

Resaturated mine backfill will develop from recharge from precipitation, lateral inflow from the coals and interburden of the Fruitland Formation, and potentially upward flow from the PCS although observations at the mine have not shown this to occur. The groundwater model predictions indicate that the largest source of groundwater entering the mine backfill under steady-state conditions will be from direct precipitation recharge. Lateral inflows from the coal will be much less and there will be essentially no upward flow into the mine backfill from the PCS once steady-state conditions have been reached. Recovery rates are low due to low permeability of the surrounding formations and low groundwater recharge of the region. Concentrations of TDS in mine spoils from leaching by precipitation recharge and by lateral inflow from the

coals can be estimated from the synthetic precipitation leaching protocol (SPLP) spoil leaching tests and the coal groundwater leaching tests presented in Appendix 41.A. It may be expected that groundwater quality in the backfill will be a blend of these leaching concentrations.

Based on the leaching test results, the relative amounts of precipitation recharge, and lateral inflow from the coals into the mine backfill, the resulting TDS for Area 4 South is estimated to be 1,907 mg/L while the TDS for Area 5 is estimated to be only 1,543 mg/L as indicated in Table 41.2-3. These TDS estimates of post-reclamation backfill water are thought to be too low for the initial mine spoils for the following reasons. First, the saturated paste test results from sampling of weathered overburden, as presented in Table 41.2-2, indicate TDS concentrations in initial mine backfill waters around 3,000 mg/L within Area 4 South and 3,500 mg/L within Area 5. Also, the initial water source for the mine backfill will include much larger fractions of coal water and PCS water when water levels recover in the backfill. The TDS concentrations in these water sources will be considerably higher than the TDS concentrations leached from precipitation or in the SPLP leaching tests.

At the Navajo Mine, the TDS concentration in the representative coal water used for the leaching tests was 9,800 mg/L while the spoil leaching test results using this coal groundwater were 11,000 and 12,000 mg/L. These results are also reasonably consistent with the TDS concentrations of 12,000 and 14,600 mg/L observed in spoil-water monitoring wells in the Bitsui Pit, as indicated in Table 1 of Attachment 41.A.A of Appendix 41.A. The consistency between the leaching test and field monitoring results supports the use of the leaching test results using coal water from Appendix 41.A to predict initial backfill water TDS concentrations at the NNP.

Although the TDS concentration observed at the wells completed in the spoils at the Bitsui Pit at Navajo Mine were considerably higher than the TDS observed in spoil leaching tests using coal water from the NNP site, the mine backfill water source at the Bitsui Pit at Navajo Mine is from water sources with higher initial TDS concentrations. These sources include the No. 8 coal water with TDS levels of 5,000 to 10,000 mg/L near the Bitsui mine pit and groundwater seepage from adjacent NAPI irrigation plots, which is also expected to have high TDS concentrations due to leaching of soluble salts from weathered soils and overburden. In contrast, the TDS concentration in the coal water at the NNP is lower and on the order of 3,000 mg/L.

41.2.2 Surface Water Changes During Mining and Reclamation Operations

During mining and reclamation operations in No Name, ephemeral stream flow from the 43.9-sq-mi drainage area of Pinabete Arroyo located east of the NNP will be diverted around active mining operations. The only viable option for diverting Pinabete Arroyo is through the construction of a diversion channel along the southern side of Area 4 South. This diversion, herein referred to as the Pinabete Diversion, will tie into Pinabete Arroyo approximately 200 ft west of the eastern Navajo Transitional Energy Company (NTEC)

lease boundary in Area 4 South and tie into No Name Arroyo approximately 2,500 ft downstream of the existing No Name Impoundment. There will also be a smaller diversion (East Diversion) located along the eastern boundary of Area 4 South, which will divert precipitation runoff south and into the Pinabete Diversion from the 2.74-sq-mi drainage area located up gradient and east of Area 4 South that would otherwise flow into the proposed mining area. The Pinabete Diversion and the East Diversion have been designed to safely accommodate the expected flows from a 100yr-6hr storm event consistent with the OSM design requirements for permanent diversions. Detailed designs for the Pinabete Diversion and the East Diversion are provided in Appendix 26.A.

Precipitation runoff from the drainages that normally flowed into the Pinabete Arroyo from within Area 4 South will not make it to the Chaco River during mining and reclamation within No Name, but will either be intercepted by the mine pit or captured in temporary pit protection ponds located up gradient of mining. Precipitation runoff collected in the pit or in the pit protection ponds may be utilized for dust suppression, other mine needs, or will naturally diminish from evaporation and seepage. Once reclamation is completed within No Name, precipitation runoff from these reclaimed areas will flow to the reconstructed Pinabete Arroyo channel and then to the Chaco River. Precipitation runoff from reclaimed areas might be reduced somewhat from pre-mine levels due to lower slopes, enhanced vegetative growth from the use of quality soils, engineered geomorphic drainage designs, and the use of other sediment-control BMPs that operate to retain water in the reclaimed areas, reducing storm-water runoff to the channels.

41.2.2.1 Surface Water Quantity Changes During Mining and Reclamation Operations

Although No Name Arroyo will not be mined under the mine plan described in Section 20 Mining Operations, the lower segment of the No Name channel will be influenced by construction of the Pinabete Diversion presented in Section 26 Drainage Control Plan. The Pinabete Diversion will operate until mining and reclamation are completed within Area 4 South. The Pinabete Diversion and the East Diversion will serve to transfer precipitation runoff from a 47.6-sq-mi area into No Name Arroyo, which has a drainage area of about 7.5 sq mi above the end point of the Pinabete Diversion at the No Name channel. The portion of Pinabete Arroyo contributing to the Chaco River along the Pinabete channel will initially decline from 59.1 sq mi to 11.6 sq mi after construction of the Pinabete and East diversions, and then to 3.6 sq mi once mining begins within the Pinabete drainage.

SEDCAD modeling was performed to evaluate peak flows and storm volumes under pre-mine, operational, and post-reclamation conditions on Pinabete Arroyo, No Name Arroyo, the unnamed tributary to Cottonwood Arroyo, two unnamed tributaries to the Chaco River west of Area 5, and Brimhall Wash. SEDCAD is a commercially available software package with routines derived from the Natural Resources Conservation Service Technical Release No. 55 (NRCS 1986). Application of the SEDCAD program involves subdivision of the drainage area into subwatersheds and establishment of a linked network of routing between the

watersheds. Designation of subwatersheds with relatively uniform surface characteristics enhances the application of model assumptions and improves the estimation of results. SEDCAD calculates the runoff response to a given precipitation event for specific surface topography, soil, and vegetative cover conditions. Curve numbers were assigned to subwatersheds based on their soil and cover characteristics. Information is designated for physical characteristics of channel segments that may affect flow-routing within channels. A medium hydrologic response class was utilized on all model runs. The 10yr-24hr storm event and the 2-year, 10-year, 25-year, 50-year, and 100-year 6-hour events were modeled with SEDCAD. Pre-mine modeling may be reviewed in Appendix 18.B. Operational and post-reclamation modeling may be reviewed in Appendix 41.C and Appendix 41.D, respectively.

Peak flows from Pinabete Arroyo to the Chaco River from storm events of various return periods will initially be reduced by 40% to 55% following construction of the Pinabete Diversion and East Diversion, and by 70% to 73% once mining begins in the Pinabete drainage within Area 4 South (Section 41.2.4). Once mining begins, the flow from the 13.5 sq mi of watershed within the permit area that is either intercepted by the mine pit or captured in temporary pit protection ponds may be utilized for mine operations such as dust suppression (Section 25 Sediment Control Plan). Although a flood attenuation feature is incorporated into the design of the Pinabete Diversion to attenuate peak flows diverted into No Name Arroyo, peak flows in No Name are projected to increase. The estimated peak flows on No Name Arroyo downstream of the Pinabete Diversion are projected to increase by only 18% for the 2yr-6hr storm event and by 37% for the 10yr-6hr storm event (Table 41.2-4). Peak flows are projected to increase by a greater percentage for the larger storm events (25yr-6hr, 50yr-6hr, and 100yr-6hr storms), as the flow attenuation features of the Pinabete Diversion are at capacity in attenuating the peak flows from the Pinabete Diversion during extreme events (Table 41.2-4 and Appendix 26.A). However, the attenuation structure is effective at attenuating the peak flows. For example, for the 100yr-6hr storm event the estimated peak flow in No Name Arroyo at the confluence with the Chaco River is approximately twice the peak flow for the pre-mine conditions on No Name, even though the contributing watershed is 4.8 times larger than for pre-mine conditions (Table 41.2-4 and Appendix 26.A). The SEDCAD modeling also projected storm volumes, which are directly dependent on contributing watershed area and curve numbers. The effect of this increase in flow within the lower segment of No Name Arroyo on erosion and sediment yield and channel changes is addressed in Section 41.2.2.2.

Table 41.2-4 also identifies the changes in flows in No Name Arroyo during operations in Area 4 South, while Table 41.2-5 identifies changes in flows in No Name Arroyo during operations in Area 5. During mining within Area 5, when the Pinabete Diversion is still in place, some of the drainages that normally flowed into No Name Arroyo from the southwest will be mined out. This will decrease flows in No Name Arroyo during mining of Area 5 compared with flows in No Name Arroyo during the mining of Area 4 South. The anticipated change in precipitation runoff within No Name Arroyo at the western permit boundary during proposed Area 5 mining is summarized in Table 41.2-5.

Four other watersheds will be affected during the mining of Area 5. There are two unnamed tributaries that drain into the Chaco River from the western side of the permit area. A 2.81-sq-mi portion within the Area 5 mine drains to Brimhall Wash. Flow from the disturbed areas will be retained on-site by berms and/or ponds and will result in less runoff reaching Brimhall Wash. SEDCAD flow projections show very slight changes during operations, with flows ranging from a decrease of 8% to 12% as summarized in Table 41.2-5.

It is anticipated that Stevenson's Well Pond will be mined through in Area 4 South, and that seven ponds (C#1, C#2, C#3, NN#1, NN#2, NN#3, NN#4), will be mined through in Area 5 (Exhibit 18-2). The B#1 pond, immediately southeast of Area 5, will not be disturbed by mining but flows could be affected. No Name Impoundment will not be mined through but in the absence of maintenance, storage capacity in No Name Impoundment will decrease over the lifetime of the mine due to sedimentation from natural flows. Therefore, a maintenance plan is proposed for No Name Impoundment during mining operations in Area 4 South and in Area 5 to maintain pond capacity and to contribute to the reduction in storm-water runoff flowing to the segment of No Name Arroyo downstream of the Pinabete Diversion.

There are no surface water filings within the NNP area, although there may be occasional use of water stored in ponds for livestock when water is available. Section 41.4 provides further discussion of the potential short-term and long-term impacts to surface water sources that may be used for livestock and wildlife at the NNP.

41.2.2.2 Erosion and Sediment Yields During Mining and Reclamation Operations

Under baseline conditions, sediment in the Chaco River, Pinabete Arroyo, and No Name Arroyo is derived from a variety of natural sources, including:

- erosion of soils on the hillsides, particularly from badland areas;
- erosion from roads and disturbed areas; and
- erosion of bed or banks of the stream channels.

The erosion, sedimentation, and landscape evolution in semiarid drainage basin systems is unique in comparison with that of humid fluvial systems. Several studies of basin sediment yield in the Southwest have found that channel incision and stream-bank erosion of alluvial channels contribute the majority of the total sediment yield from the drainage basin (Rosgen 2001). Ultimately, however, the primary source of the sediments in channel erosion is surface erosion from the contributing watershed. Sediments delivered to the valleys from the hill slopes and first-order drainage swales are typically carried only short distances within ephemeral streams during storm flow events. Sediments stored within the ephemeral stream valley result in progressive steepening of the valley slope. Also, ephemeral streams often deposit fans of material upon entering a larger valley with lower valley slopes. These fans of material can extend across the valley from

the mouth of tributary drainages, resulting in convex valley segments. This deposition of sediments continues until flushing of the sediment takes place by gullying (Schumm et al. 1980).

Thus, gullying and channel instabilities are common natural features in arid and semiarid landscapes. The cycle of incision and filling is called arroyo evolution (Schumm et al. 1984; Gellis et al. 1991). Arroyos are incised channel systems that carry large volumes of sediment during ephemeral flow events. Following channel incision, an arroyo evolves through time from a narrow, V-shaped gully with low width-to-depth ratios to a wide U-shaped channel. Sediment deposition and channel aggradation increase with the increase in channel width. With channel aggradation, a floodplain and small channel system develop within the wide U-shaped channel. Channel aggradation within the ephemeral stream valley results in steepening of the valley slope that continues until channel incision occurs with a repeat of the cycle of arroyo evolution. The stage within the arroyo evolution cycle varies spatially along an ephemeral stream valley, with channel incision occurring within some segments and channel aggradation occurring in other segments. This process of arroyo evolution with segments of channel incision and head cutting and segments of channel aggradation is a common phenomenon throughout the southwest and is particularly evident in the reach of No Name Arroyo between the Burnham Road crossing and its confluence with the Chaco River.

Section 25 Sediment Control Plan provides a description of the plans and measures to be taken to control sediment and erosion during surface coal mining and reclamation operations, through final bond release. Thus, while these measures prevent additional contributions of suspended solids to stream flow outside of the permit area, these activities will not function to prevent the natural off-site erosion and stream channel evolution processes that currently exist downstream of the permit area.

NTEC will route all disturbed area runoff to sediment ponds or BMP sediment controls, as described in the sediment control plan in Section 25. Sediment ponds and sediment control BMPs will stay in use through bond release or until demonstrations that runoff from the disturbed areas will not contribute quantities of suspended solids greater than those generated pre-mining. Water management techniques, as described below, will reduce the impact of mine disturbance on off-site sediment transport to surface waters down gradient of the permit area. A National Pollutant Discharge Elimination System (NPDES), Multi-Sector General Permit (MSGP) Sector H, Stormwater Pollution Prevention Plan (SWPPP) is in place for the construction phase of mining operations and for the post construction phase of mining and reclamation operations. This SWPPP will be maintained and available at the mine site.

Mine development will be initiated with the establishment of transportation features. Maximum road disturbances will be surveyed and storm-water BMPs will be employed. These may include but are not limited to the use of silt fences, rock check dams, straw wattles or fiber logs, straw bales, and soil berms between the disturbed area and down gradient channels or adjacent undisturbed areas. Topdressing materials

will be salvaged and placed in protected stockpiles aligned and shaped to minimize wind and water erosion. Protection will consist of a drainage berm around the base of the pile. Refer to Section 22 Support Facilities for additional control measures and the operation of stockpiles.

Road construction will include the establishment of road fill embankments and associated road drainage structures, such as culverts across drainage swales and road ditching adjacent to primary roads. Diversion ditches may be established above road cuts to minimize flow across the cut. Berms, ditches, or downdrain pipes will be installed along the groin of road fills to safely pass water from the crest of the embankment to the toe. Energy dissipating BMPs will be utilized to control velocity at outlets of culverts, along steep slopes associated with embankments, and in areas exhibiting visual evidence of downcutting. Further discussion on road design and sediment and drainage control plans is found in Section 23 Roads, Section 25 Sediment Control Plan, and Section 26 Drainage Control Plan.

Temporary sediment control will also be utilized during the construction of sediment ponds, most often through the use of containment berms and silt fences. Suitable topdressing materials will be removed from the area disturbed for sediment pond and ditch construction and placed in topdressing stockpiles that have been established in protected areas with a perimeter drainage berm established around the base of the pile (Sections 20 Mining Operations, 22 Support Facilities, 25 Sediment Control Plan, and 36 Post-Reclamation Soil). The topdressing storage area will be clearly marked with signs identifying them as such and the stockpile surface will be stabilized (Section 40 Environmental Protection and 22 Support Facilities).

Sediment ponds are engineered to retain either a 10yr-24hr or 100yr-6hr storm event and sufficient sediment storage (Section 26 Drainage Control Plan). Spillway outlets will be armored with riprap, if necessary, to reduce erosive velocities during discharge. Sediment ponds are used within the permit area to capture and/or treat surface water runoff from disturbed areas, including mine spoils, areas undergoing topdressing stripping, coal handling facilities, ancillary support facilities, and other disturbed areas within the permit area. Coal will be hauled by truck to a stockpile. Runoff from some of these disturbed areas may be intercepted by the active mine pit. Excess water in the mine pit during large storm events will be collected in pit sumps and pumped to one or more of the sediment ponds or managed as described in Section 25 Sediment Control Plan.

Subsequent disturbances for ancillary facilities and coal handling areas will be developed using the principles described above. The outside disturbance perimeter will be marked and down gradient areas will be protected from disturbed area runoff initially with earthen berms, silt fences, straw wattles/fiber logs or brush dams, and then sediment ponds capable of containing either the 10yr-24hr or 100yr-6hr storm event will be constructed. Water from these disturbed areas may alternatively be directed toward a mine pit, which will eliminate all potential for off-site discharge (Section 25 Sediment Control Plan and Section 26 Drainage Control Plan).

In summary, erosion and sediment control for mine disturbance will employ industry BMPs to minimize erosion and the migration of sediment. Sediment yields from the mine area will be substantially lower during mining and reclamation as disturbed area runoff and associated sediments are retained in sediment ponds, within berms, and within the mine pit. Excess water in the pit resulting from extreme precipitation events may be pumped to one or more of the sediment ponds. However, little-to-no discharge from sediment ponds is expected based on large design capacities and the operational experience at the nearby Navajo Mine. Consequently, there will be little-to-no contribution of sediment to surface waters outside the permit area, as the sediment and runoff from all but the occasional extreme event (much larger than the 10yr-24hr event) are retained within the mine pit and sediment ponds. No NPDES outfalls are anticipated in the NNP at this time however, should outfalls be added at a later date, discharges will be further managed under applicable provisions of NPDES regulations.

The Pinabete Diversion and the East Diversion are designed to minimize the quantity of surface water runoff that is impacted by mining and needs to be retained and/or treated to meet the applicable discharge criteria for coal mine discharges. Nevertheless, the construction and use of diversion channels can contribute to erosion and sediment transport or to disruption of the dynamic relationship among stream flow, sediment, and channel characteristics within the stream channels below diversion points.

The construction of the Pinabete Diversion and the East Diversion will proceed in an orderly sequence that will help minimize any off-site sediment release, as described in Appendix 26.A. NTEC currently utilizes a MSGP SWPPP that will be followed for the construction phase of the Pinabete and East diversions. This SWPPP will be maintained and available at the mine site. The Pinabete Diversion and the Eastern Diversion have been designed to safely pass the estimated peak flow from a 100yr-6hr storm event consistent with the Surface Mining Control and Reclamation Act (SMCRA) design requirements for permanent diversions. The diversions have also been designed to minimize adverse impacts to the hydrologic balance within the permit and adjacent areas and to prevent material damage outside the permit area. The diversion designs are well below erosive velocities for the 10yr-6hr event. The design velocities for the 100yr-6hr event for the Eastern Diversion are below erosion thresholds, while the design velocity for the 100yr-6hr event for the main Pinabete Diversion slightly exceeds erosion thresholds. However, little erosion is likely to occur within the channel during this extreme event because the natural sediment concentrations in the flows from Pinabete Arroyo entering the diversion are estimated to peak at 27,063 mg/L for the 100yr-6hr event as indicated in the SEDCAD modeling results described below.

This PHC also includes an assessment of the effects of the diversion of ephemeral stream flows from the Pinabete drainage into No Name watershed on the channel characteristics and channel erosion within lower No Name Arroyo. As described in Section 4.3.1 of Appendix 26.A, the Pinabete Diversion has been designed

to attenuate the peak flows from design storm runoff events within the Pinabete watershed upstream of the NNP permit area that would be conveyed through the Pinabete Diversion to the No Name Arroyo. The diversion design includes a gabion control structure and an increase in diversion widths at the "horseshoe excavation" near the beginning of the diversion. These design features provide very significant attenuation of peak flows for the 10yr-6hr event and very good results in comparison with alternatives for the 100yr-6hr design storm event. These design features also maintain sediment concentrations in the diverted flow within a range that reduces impacts to the geomorphology of the No Name Arroyo channel and prevents any material impact on the water quality in the Chaco River.

The baseline surface water studies show that both No Name Arroyo and Pinabete Arroyo carry high concentrations of sediment during storm runoff events. Also, the No Name channel is unstable, with active channel incision and bank sloughing. Releasing clear water to the No Name channel would accelerate channel erosion downstream of the release point. Thus, the selected design for the diversion, as presented in Appendix 26.A, functions to attenuate flood flows without significant reductions in sediment concentrations.

SEDCAD modeling was performed to evaluate sediment generation under pre-mine, operational, and post-reclamation conditions for drainages traversing or intersecting the permit area. Projections on sediment yield are developed based on storm-specific flows and six parameters associated with sediment loss: soil texture, soil erodibility constants, representative slopes of overland flow within the watershed, representative lengths, cover, and management practices. Soil samples were acquired from selected representative soil types around the site and sent to the University of Kentucky for assessment of the erodible particle size textural distribution (Appendix 18.B). These data were applied to mapped soil types within the permit area and adjacent watersheds and utilized to develop representative particle size distributions for use within the model. The results, coupled with applicable county soil survey textural information or texture data from soil mapping at the adjacent Navajo Mine were also employed to assign soil erodibility constants. Slope and length information were acquired from ArcView slope analyses of the watersheds. Cover information was applied to the subwatersheds from vegetation mapping and the management factor was assigned a value of 1 for all subwatersheds. Copies of pre-mine SEDCAD runs may be reviewed in Appendix 18.B and copies of operational and post-reclamation SEDCAD runs may be reviewed in Appendix 41.C and Appendix 41.D, respectively. Exhibit 41.2-1 displays the subwatersheds associated with the operational SEDCAD models and Exhibit 41.2-2 shows the subwatersheds used in the post-reclamation models.

Table 41.2-6 and Table 41.2-7 summarize sediment yield projections developed by SEDCAD modeling comparing operational and pre-mine conditions for Area 4 South and Area 5, respectively. Results are quantified by sediment yield in tons/event, and by sediment loss in tons/acre. The Area 4 South effects are addressed with the modeling of Pinabete Arroyo at the confluence with the Chaco River, and No Name Arroyo at the confluence with the Chaco River. Area 5 effects are evaluated on No Name Arroyo at the

confluence with the Chaco River, on three separate unnamed tributaries to Chaco at their confluence with the Chaco River, and on Brimhall Wash at the confluence with the Chaco River.

Two operational scenarios for Pinabete were modeled (Appendix 41.C). In the first case, sediment yield was projected from the 11.57-sq-mi Pinabete watershed following construction of the Pinabete Diversion and East Diversion but prior to mining within Area 4 South. The contributing watershed drops by 80% and the sediment yields drop by 68% to 75%, depending upon the storm event (Table 41.2-6). The second scenario will occur when mining has started within the Pinabete drainage within Area 4 South and most of the runoff from the Pinabete drainage down gradient of the Pinabete Diversion and the East Diversion is contained within the mine pit, sediment ponds, and pit protection ponds preventing it from reaching the mouth of Pinabete Arroyo. In this situation, Pinabete Arroyo at the confluence with Chaco will see drainage from a watershed of only 3.59 sq mi, rather than the 59.08 sq mi prior to mining (Table 41.2-6). Sediment yields under this scenario drop by 83% to 87% depending on the storm event (Table 41.2-6). Conversely, when the diversions are in place, the total sediment yield from No Name Arroyo increases at the confluence with Chaco by 180% to 320%, depending upon the storm event because the watershed increased by 415% (Table 41.2-6). However, the combined sediment yield reaching the Chaco River from Pinabete Arroyo and No Name Arroyo is lower under both operational scenarios in comparison with the pre-mine baseline yields as shown in Table 41.2-6. Sediment yields increase with the amount of precipitation.

Table 41.2-6 shows that the sediment loss, normalized to tons/acre, declines for No Name Arroyo, but increases for Pinabete Arroyo under the operational scenarios relative to baseline conditions. The declines in the normalized sediment loss for No Name Arroyo are biased by the substantially larger watershed, 53.5 square miles compared with 11.5 square miles. The increases in the normalized sediment loss for Pinabete and Cottonwood between the pre-mine and operational cases while sometimes twice as high, are very small absolute values, and reflect substantial reductions in contributing watershed size, an inverse situation to that occurring in the modeling of the No Name watershed.

Table 41.2-7 summarizes the sediment yield and the normalized yield of sediment loss in tons/acre in drainages associated with mining in Area 5. Two operational scenarios for No Name Arroyo were also modeled and presented in the table. The first case is for the mining within Area 5 prior to final reclamation within Area 4 South and reclamation of the Pinabete Diversion and East Diversion. Sediment yields (tons) increase by 137% to 280% depending on the storm event, for an area that has increased 366% due to the diversion of the upper reaches of the Pinabete watershed. The normalized yield (tons/acre) dropped between the operational and pre-mine case for all storm events also shows that sediment yields from Brimhall Wash at the confluence exhibit a 11% to 18% decrease for the operational case relative to pre-mine conditions (Table 41.2-7). These declines in sediment are attributable to the fact that 3.3% of the watershed is either intercepted by the mine pit or controlled by sediment ponds upstream of the permit boundary (Table 41.2-7).

The two unnamed tributaries to the Chaco River influenced by Area 5 operations also show decreases in sediment yield of 20% to 27%, depending on the storm event (Table 41.2-7).

Although the total sediment yields from No Name Arroyo increase during the mine operational period, the SEDCAD modeling results show that the combined sediment yield from both No Name Arroyo and Pinabete Arroyo is lower during mine operations. Consequently, there is no adverse impact predicted on sediment yield or water quality in the Chaco River from overland flow and surface water runoff. The SEDCAD model represents surface erosion and sediment transport during storm events and provides predictions of the expected sediment yields for watersheds and disturbed areas. Conventional surface water sediment modeling does not provide estimates of sediment yield resulting from channel incision and stream-bank erosion. Thus, any increase in sediment yields resulting from possible increases in the rate of channel erosion along lower No Name Arroyo following construction of the Pinabete Diversion and East Diversion are not included in these estimates.

However as indicated previously, the proposed design for the Pinabete Diversion and East Diversion provides substantial attenuation in the peak flows, particularly for the lower magnitude storm events (Appendix 26.A). The estimated peak flows on No Name downstream of the Pinabete Diversion were estimated to increase by only 8.0% for the 2yr-6hr storm event and by 25.6% for the 10yr-6hr storm event while the peak flows increased by a greater percentage for the larger storm events and were more than twice the baseline flow for the 100yr-6hr storm event (Table 41.2-4). Thus, while the Pinabete Diversion design includes features to mitigate the impact of the diversion on the flows within No Name Arroyo, the diversion still functions to increase the magnitude and frequency of ephemeral flow within the No Name Arroyo channel downstream of the diversion, due to the increased contributing watershed. The expected effect of the increased flow is addressed in this section of the PHC.

As discussed in Appendix 18.A, the No Name Arroyo channel downstream or west of the Burnham Road crossing is an unstable channel. The detailed 2-ft topographic survey and channel profile provided in Appendix 18.A show a major head cut along the No Name channel below the confluence with the Pinabete Diversion and just upstream of the western permit boundary. This head cut involves a near vertical drop of about 10 to 12 ft. The head cut is approximately 30 ft wide, the channel is incised about 8 to 12 ft downstream of the head cut, and channel width varies from approximately 10 to 30 ft with near vertical channel banks. Channel bends are fairly minor and the channel bed is braided in places. Channel vegetation consists primarily of grasses with some salt cedar and low brush. Upstream of the head cut No Name Arroyo consists of a wide shallow channel heavily braided in places and vegetated with grasses, annual forbs, brush, and some salt cedar as described in Appendix 18.A.

The rate of migration of this head cut could increase with an increase in the magnitude and frequency of ephemeral flow within No Name Arroyo following construction of the Pinabete Diversion. Head-cut migration is thought to occur as a series of discrete mass failures of the surface layer caused by undercutting in a plunge pool formed immediately downstream. The timescale for each failure episode is controlled by the soil strength, soil unit weight, erodibility and critical shear stress, overall head-cut height, backwater depth, and approach flow depth (Hanson et al. 2001). The rate of head-cut advance was found to increase with both the upstream flow depth and with the backwater depth below the head-cut height. Based on these results, it is expected that an increase in flows in the channel could result in an increase in the rate of head-cut migration with a corresponding increase in sediment production.

The additional contribution of sediment resulting from head-cut migration can be minimized by the construction of a stabilization structure at this head-cut location. Mitigation designs to stabilize this head cut are provided in Section 35 Hydrologic Reclamation Plan. Post-reclamation erosion and sediment yields are addressed in Section 41.3.2.2.

41.2.2.3 Surface Water Quality Changes During Mining and Reclamation Operations

Potential surface water quality changes that could occur during mining and reclamation operations include the generation of additional sediment, as described above, and possible increases in salinity in water that might be flushed from sediment ponds and containment berms during large storm events that produce spillway overflows. However, any increased salinity in water from ponds or berms is unlikely to produce a measurable change in the salinity in flows in No Name Arroyo and Pinabete Arroyo due to the high flows in the drainages under the storm events that could discharge water from containment structures.

NTEC has designed the mine plan to minimize impacts to the hydrologic balance and surface water quality by routing upland flows from Pinabete Arroyo around Area 4 South and by not mining through No Name Arroyo in the Area 5 mine plan. When runoff does occur, the newly exposed overburden, interburden, and coals and mine spoils may result in increases in TDS, sulfate, iron, and manganese in surface runoff from these disturbed areas. The analyses of overburden and interburden materials presented in Section 17 Geologic Information, Section 41.1, and Section 41.2.1.1 show that these materials are not acid forming. The water quality of newly exposed strata and mine spoils is best characterized by the SPLP leaching test results for mine spoils. The results in Table 41.1-1 indicate TDS and sulfate concentrations of 1,200mg/L and 670 mg/L, respectively. These concentrations are above the median concentrations observed in surface water baseline samples at the NNP but are well below the highest concentrations observed in the baseline surface water quality samples. Also, surface runoff from disturbed areas will be retained by BMPs and is unlikely to reach Pinabete Arroyo or No Name Arroyo except during extreme precipitation events that exceed the design requirements of the structures. Also, trace constituents in SPLP spoil leachate are below detection

limits except for fluoride, boron, and barium, which are well below their corresponding livestock and wildlife use criteria, and manganese, which has no livestock and wildlife use criterion (Table 41.1-1).

The water and sediment control measures, as outlined in Section 41.2.2.2, not only prevent additional contributions of sediment but also serve to contain mine water that may have higher concentrations of TDS and sulfate than in the baseline flow in Pinabete Arroyo and No Name Arroyo. Thus, these measures also serve to minimize potential changes in water quality of receiving streams outside the permit area. Any future truck dump and coal sizing facilities will be partially enclosed and surrounded by containment berms to minimize migration of coal fines, and any off-site discharge from the area will be through a sediment pond. Berms will be able to contain the runoff from a 10yr-6hr storm of 1.6 in. Motor fuel storage and equipment maintenance will be provided at the Area 3 industrial facilities area within the Navajo Mine permit area. Nevertheless, equipment repair may on occasion, need to be within the active mining or reclamation areas. NTEC maintains and implements a Spill Prevention, Control and Countermeasure (SPCC) plan that identifies areas of risk, specifies appropriate controls for bulk storage areas, identifies control strategies for managing a spill, should it occur, and lists procedures for safely disposing of any contaminated materials.

Federal and state or tribal water quality standards will be met during surface coal mining and reclamation operations at the permit boundary, due to the use of perimeter berms and sediment ponds to contain runoff within the permit area. The Navajo Nation Environmental Protection Agency (NNEPA) has identified three uses of drainages within the permit area, including livestock and wildlife watering, aquatic habitat, and secondary human contact (NNEPA WQP, 2015). Baseline water quality exceeds the chronic aquatic standards for aluminum and copper in Pinabete Arroyo and exceeds the chronic aquatic standard for dissolved aluminum in No Name Arroyo (Section 18 Water Resources). When flow occurs, sediment loss results in significant concentrations of total suspended solids (TSS). Section 41.4 discusses the short-term and long-term impacts to surface water resources.

41.2.3 Changes to the Hydrologic Balance During Mining and Reclamation Operations

The NNP will be developed in a planned, orderly progression to facilitate development of the operation while protecting the hydrologic balance. Mine planning incorporates the use of BMPs into all development activities potentially impacting water. BMPs may include but are not limited to minimizing inflow into the project area, eliminating traffic through flowing channels, and routing disturbed area runoff generated by storm events into either the mining pit or into sediment ponds.

The primary changes in the hydrologic balance during the surface mining and reclamation operations are the changes in ephemeral stream flows in Pinabete Arroyo and No Name Arroyo that occur as a result of the Pinabete Diversion, the East Diversion, and the containment of surface runoff within the mine area. The flows from No Name Arroyo are expected to increase while the flows from Pinabete will decrease. These

changes in flow are not expected to measurably affect the Chaco River due to the ephemeral nature of tributary flows to Chaco and the fact that the confluence points with Pinabete Arroyo and with No Name Arroyo are relatively close, separated by a distance of less than 1 mi. Section 35 Hydrologic Reclamation Plan describes the mitigation measures that will be implemented to minimize the potential impact of the Pinabete Diversion and East Diversion on the No Name channel downstream of the diversion. The mitigation also serves to prevent the additional contribution of sediment outside the permit area.

Groundwater within the mine areas will also be affected with the removal of the Pinabete alluvium during mining and the drawdown of potentiometric levels in the coal seams and the PCS adjacent to the permit area. The groundwater in the Chaco River alluvium is beyond the influence of drawdown in the PCS due to mining and will not be directly affected by mining. Downstream of mining, alluvial groundwater flow along Pinabete Arroyo might also diminish during mining. As noted in Section 18, there are no indications of groundwater discharge along the Chaco River in the vicinity of the Pinabete Arroyo. The only springs and seeps noted along the Chaco River are further north. Based on the valley gradient for Pinabete channel of about 0.8%, an average hydraulic conductivity of 51 ft/day for the alluvium, the average saturated thickness of 3 ft and a valley width of 200 ft, the steady-state groundwater flow in the alluvium is only about 1.27 gallons per minute (gpm). Reduction in flow in the Pinabete alluvium would reduce this potential source of groundwater flow to the alluvium along the Chaco River.

Baseline groundwater flows in the Chaco River alluvium are believed to be on the order of about 18 gpm. This estimate was derived by assuming that the hydraulic conductivity of the Chaco River alluvium is the same as the 51 ft/day estimate for the Pinabete alluvium. The slope of the potentiometric surface in the Chaco River alluvium was assumed to be the same as the valley gradient of 0.25% measured from the topographic map of the Chaco River valley segment east of the NNP. The average width of the alluvium was estimated at 3,998 ft based on the average width of the mapped alluvium in the Geologic Map of New Mexico (Anderson and Jones 1994) for the segment of the Chaco River valley west of the NNP. The average saturated thickness within the alluvium along the Chaco River west of the NNP was determined from a measurement of 6.7 ft of saturated thickness observed by Metric Corporation (1991) at "Unknown Well # 2" completed in the alluvium of the Chaco River east of the NNP. The groundwater flow rate of approximately 18 gpm was estimated based on these assumptions, although given the uncertainty in the estimate of the average saturated thickness and the average hydraulic conductivity, the actual value could be half or ten times this estimate.

It is also expected that the groundwater flow rates in both the Pinabete Arroyo and Chaco River alluvium vary seasonally and from year to year. However, based on these estimates it is expected that the alluvial groundwater flow from the Pinabete watershed represents about 7% of the alluvial groundwater flow in the Chaco River near the confluence with Pinabete Arroyo. Most of this alluvial flow in Pinabete Arroyo will be interrupted by mining, resulting in up to a 7% reduction in groundwater flows in the Chaco alluvium.

Existing water use of the Chaco alluvium is limited. The inventory of water wells in Exhibit 18.2-1 shows one livestock water well (13-15-4) completed in the alluvium of the Chaco River down valley from the Pinabete confluence. A reduction in alluvial groundwater flow on the order of 7% is not expected to materially affect the water supply for this well.

41.3 Post-reclamation Probable Hydrologic Consequences

41.3.1 Post-reclamation Groundwater Changes

The mine pits will be backfilled following the extraction of the coal resources and the groundwater regime will start to move towards a final equilibrium in recharge-discharge relationships within the reconstructed alluvium of Pinabete Arroyo, the mine backfill, the underlying PCS, the adjacent coal units of the Fruitland Formation and the alluvium of Cottonwood Arroyo and No Name Arroyo. The groundwater chemistry will also evolve over time as resaturation of the mine backfill occurs through recharge from precipitation, lateral inflow from the coal seams and interburden of the Fruitland Formation, and upward flow from the PCS. The potential impacts to the groundwater balance that are addressed in this section include:

- The placement of alluvial material within the reclaimed portion of Pinabete Arroyo and the partial resaturation of a portion of the alluvium;
- The rate and extent of saturation of the mine backfill;
- The rate and magnitude of recovery of water levels in the Fruitland Formation coal seams, and the underlying PCS;
- Groundwater recharge rates, flow directions, and flow rates; and
- Possible changes in groundwater quality resulting from flow through mine spoils.

41.3.1.1 Post-reclamation Groundwater Quantity Changes

41.3.1.1.1 Post-reclamation Changes in Pinabete Alluvium

NTEC plans to reconstruct the Pinabete channel with coarse-textured soil materials similar to the pre-mine alluvial materials and placed over the spoil backfill within the reconstructed valley of Pinabete Arroyo as presented in Section 34 Post-Reclamation Topography and described in Section 35 Hydrologic Reclamation Plan. To the extent practicable, NTEC will utilize topdressing materials salvaged from the Pinabete channel for replacement. The primary objective of selective placement of similarly textured alluvial materials is to restore an alluvial channel for Pinabete Arroyo that is in dynamic equilibrium with the flows and sediment composition occurring immediately upstream. Selective placement will not replicate the depth, shape, and extent of the pre-mine alluvial deposits but will provide sufficient material for reconstruction of the meandering channel and floodplain. Nevertheless, placement of these sandy materials will also provide a potential aquifer that can convey alluvial groundwater flows from upstream of the reclaimed segment along with any groundwater flow from saturated backfill. The sandy alluvial materials will also permit higher recharge rates similar to the recharge of the alluvium prior to mining. The reconstructed alluvium will be

recharged predominantly by flows from periodic storms and by groundwater flow from the up-gradient alluvium as discussed in Section 35 Hydrologic Reclamation Plan.

In post-mine conditions, alluvial groundwater flows may increase slightly due to reclamation practices mentioned previously, producing higher porosity and hydraulic conductivity, however it is anticipated that future recharge and flows remain similar to pre-mine conditions.

There may be slightly more groundwater flow in the Pinabete alluvium within the permit area briefly following reclamation to support the limited use for livestock water that exists under baseline conditions. For the interim period prior to recovery of water levels in the alluvium, livestock water supplies can be obtained from the Pinabete alluvium or the No. 8 coal seam immediately east of the Area 4 South mine area. Also, livestock water supplies would continue to be available in the Chaco River alluvium.

41.3.1.1.2 Long-term Changes in Groundwater Flow from Mine Backfilling and Reclamation

The mining and reclamation of the Fruitland Formation will result in the removal of the individual coal units and the backfilling of the mine pit with overburden and interburden materials (spoil) removed during mining. Under baseline conditions the coal beds have higher hydraulic conductivities than the interbedded shales, resulting in large downward vertical potentiometric gradients through the Fruitland Formation (Section 18 Water Resources). Lateral flow within the Fruitland Formation occurs primarily in the coal seams (Section 18 Water Resources). One of the primary hydrogeologic changes to occur as a result of mining is the removal of the coal, the interbedded shales, and the sandstone strata, resulting in more homogeneous and isotropic conditions within the mine backfill. When broken up during mining, the overburden and interburden material placed in the mine pit as backfill have higher porosity and hydraulic conductivity than the pre-mine in-situ interbedded sedimentary deposits of the Fruitland Formation. Laboratory measurements of pre-mine overburden core indicate porosity values of about 0.35 while porosity of mine spoils is on the order of 0.4. These laboratory porosity measurements are consistent with the long-term swell factor of 12% estimated based on experience in mining the same formation at the Navajo Mine. The higher porosity will result in higher hydraulic conductivity in comparison with the pre-mine interburden and overburden material.

Horizontal hydraulic conductivity values of pre-mine overburden and interburden strata are expected to be in the range from 8.63×10^{-3} ft/day to 2.8×10^{-5} ft/day based on regional information from Kaiser et al. (1994) and Frenzel (1983). The hydraulic conductivity estimates from laboratory measurements of two pre-mine overburden samples from the Navajo Mine are within this range. The horizontal hydraulic conductivity, measuring 1.53×10^{-5} m/day to 1.53×10^{-3} m/day, was used in the calibrated model at the NNP for unweathered interburden materials.

Hydraulic properties of mine backfill were kept fixed, set at 0.02m/day, with a vertical anisotropy of 0.1. Porosity and specific yield were both assigned a value of 0.2 while specific storage was set at 1.0E-04 m^{-1}. These parameters were based on previous models and values used in Appendix B and other hydraulic conductivity data from mine spoils obtained by Rehm et al. (1980). Although there was only slight variation among the laboratory estimates of hydraulic conductivities for the five Navajo Mine spoil samples, Rehm et al. (1980) note a wide variation in the hydraulic conductivity of mine spoils at mines within the Northern Great Plains region. The variation appeared to be related to the lithology of the original overburden materials and the method of mining and recontouring. Hydraulic conductivity ranges and calibrated values used in the groundwater model can be found in Table 41.3-1.

Also consistent with previous models, dispersivity data and longitudinal and transvers dispersivity values were assumed 100 m and 10 m. A molecular diffusion coefficient of 8 x 10^{-6} m^2/day was uniformly applied across all model layers.

Recharge rates overall are slow due to low permeability of surrounding formations and low groundwater recharge of the region. Potentiometric levels were simulated to 1,000 years post-mining as shown in Figure 41.3-2 and Figure 41.3-3. Overall, full recovery of potentiometric levels to pre-mine conditions is estimated to take at least 1,000 years. Stone reported recharge rates ranging from 0.005 to 0.2 cm/year. The lowest rates were observed in badlands (0.005 cm/year), which dominates the drainage basins of the arroyos in the permit area. Recharge from precipitation was implemented in the groundwater model by the MODFLOW Recharge Package.

The drawdown and pit inflow estimates obtained from simulation of proposed mining using the transient model were presented in Section 41.2.1.1. The same model simulation of the mine plan and backfill sequence was applied to simulate the rate of recovery of water levels in mine backfill and the drawdown and recovery of potentiometric levels at the various monitoring well locations in study area, as presented below.

Wells KF98-02 and KF98-03 in Area 4 South and vibrating wire piezometer VWP2007-05 in Area 5 are located within areas of proposed mining and backfilling. Although these wells and piezometers will be destroyed by mining, they have been used as prediction points for presentation of model results of the rate of groundwater recovery in the mine backfill as shown in Figure 41.3-2. These results show that it could take over 1,000 years for groundwater levels to recover in the backfill to a steady-state condition. It is possible that actual recovery rates may be slightly faster than the estimates shown in these figures if the recharge rates are higher than the estimates used for modeling. However, it is more likely that recovery rates will be slower as recharge rates and the steady-state groundwater levels lower than estimated herein as the post-reclamation recharge rates may be closer to the pre-mine rates. As discussed previously, the recharge rates used to

represent conditions during mining and reclamation and for long-term reclamation were equivalent to the average recharge rate for the mine area prior to mining.

Model simulations of drawdown and recovery in the Fruitland Formation are depicted in Figure 41.3-2 and the Pictured Cliffs Sandstone in Figure 41.3-3. As stated in the 2025 Navajo Mine Groundwater Report produced by BARR, predictive simulations show a localized decline in hydraulic head within the permit area during mining, where the most pronounced drawdown occurring in Area 4 North (just north of the permit area), where heads are simulated at over 30 m lower than during pre-mine/early mining stages. The lowering of groundwater levels may actually cause the flow to change direction, southward into the active mining area. As mining expands, declines of at least 20 m are simulated in Area 4 South and Area 5. As the mining area has been exhausted, drawdown simulations show effects east of the permit area although limited.
After backfill of both Area 4 South and Area 5 has occurred, the hydraulic gradient and flow directions nearly return to pre-mine conditions.

Model simulations of drawdown and recovery in the No. 8 Coal Seam, located immediately east of mining within Area 4 South, are depicted in Figure 41.2-2 and Figure 41.3-2. These results show a large decline in the potentiometric level or head in the No. 8 coal seam as mining advances to the east. Heads continue to decline to a maximum drawdown of about 30m approximately after the mining commences in Area 4 South. There is a slow recovery in heads, which approach steady-state approximately 1,000 years after the start of mining.

Model simulations of drawdown and recovery in the No. 3 coal seam are depicted in Figure 41.3-2. This figure shows the results for vibrating wire piezometers VWP2007-01, located immediately north of mining within Area 4 South, and VWP2007-02, located immediately east of mining within Area 4 South. Results for monitoring wells KF98-02, located between Area 5 and Area 4 South mining, and KF98-03 are also shown in this figure. The locations for these wells and piezometers are shown on Figure 41.3-1.

Figure 41.3-2 shows a large decline in the head in the No. 3 coal seam at the commencement of mining for VWP2007-01, VWP2007-02 and VWP2007-03 as mining advances to the east. The drawdown is greater at VWP2007-02 and reaches a maximum drawdown of about 15m after the start of mining. The drawdown and recovery of heads at this VWP in the No. 3 coal seam occurs quickly as indicated in the results for well KF2007-01, VWP2007-02, KF98-02 and VWP2007-03 in Figure 41.3-2. The final steady-state head at these sites is slightly below the pre-mine head. These model results show the long-term hydrogeologic effects of mining, particularly the effects of removal of the interbedded coal, shales, mudstones, and sandstone strata and replacement with a relatively homogeneous and isotropic mine backfill.

The baseline hydrogeologic conditions within the mine area indicated large declines in heads through the Fruitland Formation with perched groundwater conditions in the alluvium and upper coal seams. The groundwater model simulates this large decline in heads through the Fruitland Formation. Hydraulic heads in the mine spoil are much more uniform with depth, although there is still a slight downward head gradient and downward flow. Locally, groundwater flows from west and south toward the southern portion of the permit area and then north toward Area 4 North. There is a brief period of groundwater flow reversal as heads are lowered in Area 4 North due to mining and flow is directed toward the mining area instead of north.

Under steady-state post-reclamation conditions there will also be a vertical downward potentiometric gradient and flow from the mine backfill to the PCS. The model simulated potentiometric surface in the PCS in Figure 41.3-3 is similar to but slightly lower than the simulated potentiometric surface in the mine backfill and No. 3 coal seam presented in Figure 41.3-2. The downward gradients and flows are also shown in the drawdown maps in Figure 41.2-4. At well KPC2007-02, within Area 4 South, the baseline gradient is downward and is the greatest displacement of around 10 m. This well recovers slowly, ultimately reaching a near steady state just below pre-mine conditions by year 3165. VWP2007-02 shows much less of an impact initially as mining commences and a gradual recovery back to pre-mine conditions. VWP2007-05 indicates a gradual decrease in head as mining commences in Area 5 and a much more gradual recovery to below pre-mine conditions.

These results together with the simulation of drawdown and recovery in the PCS at wells and at vibrating wire piezometer locations adjacent to mining show that post-reclamation steady-state conditions in the PCS have relatively recovered within 1,000 years following the start of mining. The heads in the PCS after reaching the long-term steady-state conditions at the monitoring locations within and adjacent to the mine area are similar to the pre-mine heads.

Water levels in the Pinabete alluvium downstream of mining are expected to recover following mining. Groundwater flow in the Pinabete alluvium may actually be higher than in pre-mine conditions due to enhanced recharge rates within reclaimed areas. However, the potential well yield from the reconstructed alluvium along Pinabete Arroyo may be less than for pre-mine conditions throughout most of the reconstructed alluvium due to lower saturated thickness in the alluvium as a result of reduced alluvial thickness.

The potential for water supply from other units within and adjacent to the mine areas under baseline conditions is quite limited due to poor yield and poor water quality. Well yield from spoil backfill will be low although it may be similar to if not higher than that of the baseline coal units of the Fruitland Formation. Section 41.4 provides further discussion of the potential long-term impacts to groundwater sources and supplies.

41.3.1.2 Post-reclamation Groundwater Quality Changes

Resaturated mine backfill will develop from recharge from precipitation, lateral inflow from the coals and interburden of the Fruitland Formation, and upward flow from the PCS. Once water levels rise sufficiently in the backfill, groundwater will flow at a very slow rate from the backfill into the lower coal seams of the Fruitland Formation, into the PCS, and toward the topographic lows along the alluvial channels of No Name and Pinabete arroyos. Section 41.3.1.1 and Appendix 41.E indicate that the rate of groundwater recovery in the mine backfill is very slow and conclude that it may take up to 1,000 years before the final steady-state potentiometric levels and groundwater flow systems become established.

Groundwater modeling in Area 4 South and Area 5 previously considered CCBs in mine backfill. The model is found as Appendix 41.B. This chemical transport model was applied to the steady-state post-reclamation groundwater flow conditions to assist in the predictions of long-term post-reclamation groundwater quality. The FEFLOW™ software used for previous groundwater flow modeling includes features that simulate both conservative and reactive transport. The FEFLOW™ transport routines were applied to simulate the transport of both conservative and sorbed constituents from the mine spoil and CCB minefill areas in the backfill.

In 2025, a groundwater model was developed using MODFLOW 6 software that only considered mine spoils in backfill. The full report of the 2025 groundwater model provided by BARR Engineering can be found in Appendix 41.E.

Table 41.2-3 includes the corresponding concentrations of constituents in the mine spoils leached with synthetic precipitation and with composite coal water. Estimates of spoil-water concentrations for Area 4 South and Area 5 are provided based on the relative contributions of precipitation and coal water to the mine spoils in each area as determined from the steady-state post-reclamation groundwater model. Although direct precipitation recharge is a larger source for the groundwater in the mine backfill than is lateral flow from the Fruitland Formation coals under long-term post-reclamation steady-state conditions, the spoil leaching test results using the local composited coal groundwater as the leaching source were selected to represent the source concentrations for mine spoils in the transport modeling scenarios for the following reasons:

- The coal water spoil leaching test provided higher concentrations of major ions and trace constituents as compared to the results of leaching of mine spoils using synthetic precipitation and is therefore more environmentally conservative.
- The source TDS concentrations obtained for mine spoils using synthetic precipitation were thought to be too low in comparison with the expected TDS concentrations obtained from saturated paste extracts of overburden and interburden materials that constitute the mine spoil material. In addition, the TDS for coal water spoil leaching test was similar to the TDS concentrations inferred from the weathered spoil saturated paste extracts.

- The coal water and PCS water are a larger component of groundwater in the spoil prior to reaching steady-state conditions.

Table 41.2-3 also provides adsorption coefficients for arsenic, boron, fluoride, selenium, and vanadium as estimated in the interpretations of the leaching tests in Appendix 41.A. The previous groundwater model considering CCBs selected TDS, fluoride, selenium, and boron for transport modeling. TDS was only considered in the 2025 model. TDS was assumed to behave conservatively, that is with no attenuation due do adsorption or chemical transformation. Sulfate was not modeled separately but was assumed to vary with TDS based on the sulfate-TDS ratio in the source. This assumption is environmentally conservative, as both TDS and sulfate can decline under reducing conditions in the coals down gradient of the mine area. Sulfate reduction can be expected to result in measurable attenuation of elevated sulfate from spoil water in the coals within 100 ft down gradient of the mine spoils. The process of sulfate reduction in coals down gradient of mine spoils has been described and confirmed by field data in a study by Clark (1995) for the Big Sky and West Decker surface coal mines in Montana.

Solute transport simulations indicate that the primary TDS migration from mine backfill is vertical, moving into the PCS. Figure 41.3-6 shows model simulated TDS concentrations within the PCS in 2035, 2085, 2165 and 3165. No significant lateral migration of TDS is simulated within the alluvium and upper coal seams. Figure 41.3-4 and Figure 41.3-5 show model simulated TDS concentrations in upper and lower coal seams. A limited lateral migration is simulated within the lower seams, particularly toward the north. Post mining, the extent of lateral migration in the coal seam layers increases slightly but remains confined within ~500 m north and east of mine backfill.

Vertical migration of TDS into the PCS begins in a relatively short period of time after mining commences due to the proximity of the TDS source to this unit and the limited thickness of the interburden. Generally, migration follows topographic gradients along Pinabete and No Name Arroyos. TDS concentrations in the PCS exceeding 2,000 mg/L are predominantly restricted to areas directly beneath the mine backfill.

In summary, the mine spoils are expected to have higher concentrations of TDS than the pre-mine Fruitland Formation coals. TDS migration remains predominantly vertical and spatially confined, with no significant off-site transport. Within the PCS, elevated TDS concentrations remain mostly restricted to areas directly beneath the permit area. Consequently, the expected changes in post-reclamation water quality are not expected to adversely impact groundwater use-potential as discussed with impacts to surface water and groundwater availability in Section 41.4.

41.3.2 Post-reclamation Surface Water Changes

41.3.2.1 Post-reclamation Surface Water Quantity Changes

NTEC's objective in establishing the post-reclamation topography is to generally replicate the relief at the site, to replace or improve the drainage density, and to enhance vegetation production to support the post mining land use, which will reduce surface erosion and sediment yield (Section 34 Post-Reclamation Topography, Section 35 Hydrologic Reclamation Plan, and Section 38 Post-Reclamation Surface Stabilization and Sediment Control). NTEC has designed the post-reclamation topography and drainages to conform with existing drainages along the perimeter of the mine in order to safely convey water from upstream, off-lease watersheds to either Pinabete Arroyo or No Name Arroyo. NTEC will use appropriate channel types, slopes, and drainage densities to construct landforms appropriate to the area and based on reference watersheds, as described in Section 38 Post-Reclamation Surface Stabilization and Sediment Control. Additional details on the post-reclamation topography may be reviewed in Section 34 Post-Reclamation Topography.

NTEC modeled surface water flows in Pinabete Arroyo, No Name Arroyo, Brimhall Wash, and unnamed tributaries to the Chaco River using SEDCAD. Pre-mine surface water flow predictions are provided in Section 18 Water Resources. SEDCAD was also applied to the post-reclamation drainage configuration and watershed conditions to predict post-reclamation flows. These SEDCAD event-based flow results for Area 4 South and Area 5 post-reclamation conditions are provided in Appendix 41.D. Comparisons of pre-mine and post-reclamation event-based peak flow results for Area 4 South are provided in Table 41.3-6. Table 41.3-7 provides a comparison of the pre-mine and post-reclamation event-based peak flow results for Area 5. These results show little difference between pre-mine conditions and post-reclamation conditions, except in No Name Arroyo, where the replacement of loamy-textured topdressing materials reduced flows 18% to 50% (Table 41.3-7).

The Hydrologic Reclamation Plan presented in Section 35 Hydrologic Reclamation Plan is predicated on the use of geomorphic principles that have been employed to create the reconstructed landforms, drainage density, and channels (Section 38 Post-Reclamation Surface Stabilization and Sediment Control). Although many of the pre-mine channels are incised with little or no active floodplain, reclaimed channels for higher-order drainages are designed for long-term stability with a low-flow or pilot channel capable of accommodating average annual peak flows or flows from a 2yr-6hr event and a floodplain to contain more extreme flows, as appropriate, based on slope (Section 38 Post-Reclamation Surface Stabilization and Sediment Control). Post-reclamation channels for first-order drainages are typically designed as vegetated swales.

The reclaimed and reconstructed channel and floodplain system for Pinabete Arroyo has been shaped and sized to pass the 100yr-6hr design storm. Pinabete channel reclamation will include the use of sandy

materials laid down within and/or above the valley spoil regrade. The meandering, low-flow pilot channel for Pinabete reconstruction will be constructed within this replaced alluvium. The replacement alluvial materials will help maintain the dynamic equilibrium between flow and sediment transport that exists within the undisturbed channel upstream of the reclaimed channel. Channel meander migration during flood flows will continue to rework the alluvial material as in baseline conditions. The use of replacement alluvial materials for the reconstructed channel helps to ensure the reconstruction of a stable channel that is in dynamic equilibrium with the post-reclamation flow regime and sediment yields.

The Pinabete Arroyo SEDCAD models had 52 pre-mine subwatersheds identified and 51 post-reclamation subwatersheds identified. While the pre-mine and post-reclamation watersheds were basically the same area, the average slope increased 0.1% to 4% in seven of the subwatersheds. Average post-reclamation slopes in the Pinabete watersheds ranged from 1.8% to 15.1% (Section 34 Post-Reclamation Topography, Appendix 41.D, and Exhibit 41.2-2).

Only 1 of the 19 modeled subwatersheds of No Name Arroyo will have a higher post-reclamation average slope. The 181-ac pre-mine Subwatershed 4 within Structure 6 (S6 SWS4) will see the average slope increase from 12.1% to 12.5 % in the corresponding 171-ac post-reclamation subwatershed. The average subwatershed slopes ranged from 1.3% to 20.1% for the subwatersheds contributing to No Name Arroyo. The balance of the No Name subwatersheds will maintain the same average slope or decrease slightly. Maximum post-reclamation slopes were generally higher in localized areas within each subwatershed in both the Pinabete watershed and the No Name watershed.

NTEC is planning to reclaim all of the sediment and drainage control ponds utilized during the operation. At some future date, the Navajo Nation may request that some or all of the ponds remain. Future discussions may result in the retention or construction of ponds replacing the original livestock ponds (Section 18 Water Resources and Section 35 Hydrologic Reclamation Plan). Should pond retention occur, ponds located on-channel will modify the hydrograph associated with the storm event by lowering the peak flows, extending the runoff over a longer period of time, and reducing storm runoff volumes. For small runoff events, the ponds may retain all of the storm runoff from upstream. Pond reconstruction will be performed to generally reproduce the storage capacity and surface area of the original pre-mine impoundment. The spoil material at each pond location will be compacted under appropriate moisture conditions in order to reduce permeability and, thereby, prevent excess pond infiltration. Specific discussions of temporary and permanent sediment ponds and the replacement of surface water sources are presented in Section 35 Hydrologic Reclamation Plan.

41.3.2.2 Post-reclamation Erosion and Sediment Yields

It is difficult to obtain reliable measurements of baseline erosion and sediment yield, due to the infrequency of the transport events in ephemeral stream systems like those in Area 4 South and Area 5. Consequently, event-based sediment yields have been estimated using the SEDCAD model. SEDCAD model estimates of sediment yields for pre-mine and post-reclamation conditions are summarized in Table 41.3-6 for Area 4 South and in Table 41.3-7 for Area 5. The results suggest that the replacement of poor quality sodic soils with suitable topdressing materials will reduce sediment generation from pre-mine to post-reclamation levels. The exception to this appears in the Pinabete drainage, where reduced slopes coupled with longer subwatershed length factors resulted in slightly larger sediment yields. The additional storm sediment yields are low and range from 0.00004 tons/ac to 0.001 tons/ac, depending on the storm.

The Surface Stabilization and Sediment Control Plan in Section 38 includes a description of the sediment control measures that will be used on the reclaimed lands to prevent additional contributions of suspended solids to stream flow to meet applicable federal, state, and tribal water quality laws, regulations, and standards.

41.3.2.3 Post-reclamation Surface Water Quality Changes

Reclamation of disturbed areas and replacement of poor quality sodic soils with suitable topdressing materials is expected to result in improvement in surface water quality under post-reclamation conditions. SEDCAD modeling results presented in the previous section indicate reductions in post-reclamation sediment yields relative to baseline conditions. TDS, sulfate, iron, and manganese concentrations in surface runoff from reclaimed areas are expected to decline with time to concentrations well below the SPLP leaching test results for mine spoils in Table 41.1-1. Also, trace constituents in surface runoff are expected to be well below the SPLP spoil leachate results, which are less than detection limits or livestock and wildlife use criteria as shown in Table 41.1-1. Groundwater flow and transport modeling presented in Section 41.3.2.1 project the transport of dissolved solids and several trace constituents toward the topographic lows along Pinabete Arroyo and No Name Arroyo. The rates of groundwater flow are very slow relative to storm water runoff volumes, and groundwater flows are expected to be retained within the alluvium and not contribute to surface water.

Following reclamation, surface water quality in Pinabete Arroyo and No Name Arroyo will probably be improved from pre-mine water quality for the following reasons:

- Sediment contribution from reclaimed areas is likely to decrease relative to baseline due to the overall reduction in slopes and improvement in the permanent vegetation cover.
- Sediment contribution from channel erosion is likely to decrease as incised unstable channels are replaced by stable channel and floodplain configurations.

- Poor quality and sodic soils will be buried within the backfill, and overland flow from the reclaimed areas is expected to exhibit lower concentrations of sodium and TDS.
- Dissolved aluminum concentrations should decline with the reduction in suspended solids associated with reduced surface and channel erosion.

Section 41.4 addresses the potential short-term and long-term impacts to surface water sources that are used for legitimate purposes.

41.3.3 Post-reclamation Changes to the Hydrologic Balance

The groundwater within the alluvium of Pinabete Arroyo is the only groundwater source within the permit area and adjacent area that is adequate to support limited use for livestock water. The alluvium in Pinabete Arroyo within Area 4 South will be removed by mining and then reestablished during reclamation. It is expected that under long-term post-reclamation conditions resaturation will occur within the replaced alluvium.

The mine spoils are expected to have higher concentrations of TDS than the pre-mine Fruitland Formation coals. Any changes in the post-reclamation concentrations of TDS in the Pinabete alluvium are estimated to be minor and well within the natural variation in baseline concentrations of these constituents in alluvial monitoring wells (Section 41.3.1.2).

Any increase in groundwater flow from the mine area toward the topographic lows along Pinabete Arroyo and No Name Arroyo would contribute to the groundwater flow in the Chaco River alluvium. Baseline groundwater flows in the Chaco River alluvium are believed to be on the order of about 18 gpm or higher, depending upon the saturated thickness within the alluvium (Section 41.2.3). The estimates of post-reclamation TDS concentrations remain vertically and spatially confined with no significant off-site transport. Consequently, mining is likely to have little, if any, effect on the long-term post-reclamation groundwater quality of the Chaco River alluvium down gradient of the mine area.

The SEDCAD modeling presented in Section 41.3.2 shows little change in surface flows and sediment yields following reclamation relative to baseline conditions. Minor changes in ephemeral flow may occur if some of the sediment and drainage control ponds are converted to permanent replacement livestock water use at the request of the Navajo Nation or the water user (Section 35 Hydrologic Reclamation Plan).

41.3.4 Post-reclamation Hydrologic Model

As previously discussed, a groundwater model of the post-reclamation hydrologic regime has been developed to support the PHC evaluations. The multilayer, numerical groundwater flow was developed and calibrated to baseline conditions as described in Appendix 41.E. This appendix includes a description of the conceptual

model of both the baseline and post-reclamation groundwater flow system. The conceptual groundwater model provides a narrative description of the physical processes within the groundwater system and identifies all relevant components that can be translated not a numerical model. A previous model for the same area was developed in 2009 and can be found in Appendix 41.B.

41.4 Impacts to Surface Water and Groundwater Availability

During surface coal mining operations there will be a temporary reduction in surface water and alluvial groundwater flows in Pinabete Arroyo, and a portion of the alluvium that contains two livestock water supply wells (Section 18 Water Resources) will be removed during mining. A third stock water well (13-15-2) completed in the alluvium of a tributary to Pinabete Arroyo within Area 4 South (Section 18 Water Resources) will also be removed by mining operations. Livestock grazing will not occur within Area 4 South during active mining. Thus, alternate water supply will be provided for any off-lease livestock grazing that have used these stock water supply wells located within Area 4 South. Groundwater flows in the Pinabete alluvium down gradient of the mine are also expected to diminish during active mining within Area 4 South. However, there are no livestock water supply wells within this segment of alluvium.

Following reclamation, the water supplies for existing livestock use will be replaced (Section 35 Hydrologic Reclamation Plan). As discussed in Section 41.2.1, water levels in the Pinabete alluvium downstream of mining are expected to recover following mining and flows may actually be higher than in pre-mine conditions due to enhanced recharge rates within reclaimed areas. Potential well yield from the reconstructed alluvium along Pinabete Arroyo will depend upon the saturated thickness in the restored alluvium. Saturated thickness within the alluvium of Pinabete Arroyo may be slightly less than for pre-mine conditions within portions of the reconstructed alluvium due to the reduced alluvial thickness but greater width specified for the reconstructed alluvial channel and floodplain (Section 41.3.1.1.2). Plans to replace water supplies for existing wells that will be impacted by mining have been included in Section 35 Hydrologic Reclamation Plan.

Potential future use of groundwater within the reclaimed mine is negligible, due to the low permeability of the spoil and poor water quality. In addition, the potential use of groundwater from the PCS and Fruitland Formation near the site is limited, due to the baseline pre-mine low permeability and poor water quality (Section 18 Water Resources). As indicated in Section 18 Water Resources, there are no known water supply wells completed in either the Fruitland or PCS Formation within the PHC study area. Although well 13.15-1 located in Area 5 may have some screened interval in the lower PCS, this well has been abandoned and no longer supports use. The baseline groundwater in the PCS within and adjacent to the NNP site is a poor source for livestock watering, as TDS concentrations are typically above 5,000 mg/L and sulfate concentrations are above 2,000 mg/L; both exceeding the relevant water quality criteria for livestock and wildlife use (Section 18 Water Resources).

The ponds found in the permit areas during the baseline surveys do not appear to have water-right filings (Section 18 Water Resources); however, the small basins are periodically utilized by livestock and wildlife when water collects in them following a storm. Pond reconstruction, if executed, will be performed to generally reproduce the storage capacity and surface area of the original impoundment (Section 35 Hydrologic Reclamation Plan). The water availability at the reconstructed ponds should be comparable to pre-mine conditions, as SEDCAD modeling presented in Section 41.3.2 shows little change in surface flows and sediment yields following reclamation relative to baseline conditions. Additional water supplies may be available if new ponds are constructed or some of the sediment and/or drainage control ponds are converted to permanent stock water use at the request of the Navajo Nation (Section 35 Hydrologic Reclamation Plan).

41.5 Probable Hydrologic Consequences Analysis

The probable hydrologic consequences analysis was developed with the support of site-specific data and modeling. Surface water and sediment modeling was performed using SEDCAD. Key assumptions on soil and cover were derived from soil and vegetation mapping at the site with contributions from erodible particle size data collected from depositional zones around the site. This work, coupled with a literature review, provided the supporting evidence needed to assess fate and transport of potential contaminants from materials planned as backfill at the NNP site. Laboratory tests of geologic strata and mine spoils, well response tests, information from the literature, and model calibration provided the basis for the MODFLOW 6 modeling, which was utilized to characterize groundwater flow and potentiometric conditions during and following mining. Solute transport simulations in MODFLOW 6 was also utilized to assess the long-term transport of TDS associated with the mine spoils.

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Table 41.1-1 Summary of Spoil Leaching Test Results

Analyte[1] (mg/L except pH)	Navajo Nation livestock and wildlife watering criteria	Initial composite coal water sample	Spoil leached with coal water (18 hr)	Spoil leached with coal water (45 days)	Spoil composite Synthetic Precipitation Leaching Procedure (SPLP)
Aluminum	0.5	0.13	0.29	0.38	< 0.05
Arsenic	0.02	<< 0.015	<< 0.015	<< 0.015	<< 0.015
Barium	10	0.093	0.25	0.079	0.07
Bicarbonate		1300	1000	960	33
Boron	5	0.31	0.44	0.36	0.084
Calcium		3.4	64	56	150
Carbonate		260	< 7	< 7	14
Chloride	600	710	610	600	1.5
Chromium	1	< 0.01	< 0.01	< 0.01	< 0.01
Copper	0.5	< 0.005	< 0.005	0.053	< 0.005
Fluoride	2	2.4	1.6	1.5	0.54
Iron		0.067	0.17	< 0.05	< 0.05
Lithium		< 0.1	0.1	0.11	< 0.1
Magnesium		1.3	13	12	15
Manganese		< 0.01	0.11	0.098	0.19
Mercury	0.01[2]	<< 0.00005	< 0.00024, 0.0001*	<< 0.00005	<< 0.00005
Molybdenum		0.012	0.014	0.015	< 0.01
pH		9	8	8	7.5
Potassium		11	14	14	7
Selenium	0.05[3]	<< 0.026	<< 0.026	<< 0.026	<< 0.026
Sodium		1200	1200	1200	150
Sulfate	1000	300	970	930	670
TDS	2212	3100	3500	3500	1200
Vanadium	0.1	< 0.01	< 0.01	< 0.01	< 0.01
Zinc	25	< 0.005	< 0.005	< 0.005	< 0.005

[1] Analysis results for antimony, beryllium, cadmium, cobalt, lead, nickel, silver, and thallium were

[2] Wildlife standard for mercury is 0.000012 mg/L, which is below detection limits of the analytical

[3] Wildlife standard for total selenium is 0.002 mg/L

<< Reported value is less than the Method Detection Limit (MDL)

*Above MDL, but below PQL

Table 41.2-1 Mine-Pit Inflows

Mine Plan Year	Area 4 North					Area 4 South					Area 5				
	Inflow From Unit (gpm)				Pit inflow (gpm)	Inflow From Unit (gpm)				Pit inflow (gpm)	Inflow From Unit (gpm)				Pit inflow (gpm)
	Alluvium Overburden	Fruitland	PCS	Backfill		Alluvium Overburden	Fruitland	PCS	Backfill		Alluvium Overburden	Fruitland	PCS	Backfill	
2026-30	0	2.8	1.5	0	4.4	0	0.1	0	0	0.1					
2031-35	0	0	0	0	0	0	0.1	0	0	0.1					
2036-40	0	0	0	0	0	0	0.4	0	0	0.4					
2041-45	0	0	0	0	0	0	0.5	0	0.1	0.6					
2046-50	0	0.3	0	0	0.3	0	0.6	0	0.1	0.7					
2051-55	0.5	2.5	1.4	0	4.4	0	0.7	0	0.3	1					
2056-60	0.3	2.0	1.5	0	3.8	0	1.1	0.0	0.4	1.4					
2061-65	0.3	3.8	2.2	0	6.3	0	0.7	0	0.7	1.4					
2066-70	0	1.1	0.9	1.2	3.2	0	1	0.2	0.5	1.7					
2071-75	0	0.9	0.2	0.1	1.2	0	0.5	0	0.6	1.1					
2076-80	0.1	1	0.2	0	1.4						0	0.1	0	0	0.1
2081-85	0	0.9	0.3	0	1.3						0	0.2	0	0	0.2
2086-90	0	1	0.4	0	1.4						0	0.1	0	0	0.1
2091-95	0	0.6	0.2	0.4	1.2						0	0.4	0	0.1	0.5
2096-100	0	0.9	0	0.3	1.2						0	0.1	0	0.2	0.4
2101-105	0	0.5	0	0.1	0.6						0	0.2	0.1	0.1	0.4
2106-110	0	0.1	0	0.3	0.4	0.5	0	0	0.1	0.6	0	0.2	0	0.2	0.5
2111-115						1.7	0	0.6	0.5	2.8	0.1	0.6	0	0.4	1.1
2116-120						1	0	0	0.5	1.5	0.1	0.6	0	0.5	1.2
2121-125						1.1	0.1	0	0.4	1.6	0	1.5	0.7	0.3	2.5
2126-130						0.4	0.1	0	0.3	0.7	0	0.8	0	0.5	1.3
2131-135						0.5	0	0	0.2	0.7	0	1.2	0.6	1.0	2.9
2136-140						0.6	0	0	0.1	0.7	0.2	0.6	0.1	1.4	2.3
2141-145						0.2	0	0	0.2	0.4	0.3	0.2	0	1.3	1.8
2146-150						0	0	0	0	0	0.3	1	0	0.7	2.0
2151-155						0	0	0	0	0	0.1	1	0	1.2	2.3
2156-160						0	0	0	0	0	0.2	0.5	0	0.5	1.2
2161-165						0	0	0	0	0	0.1	1.2	0	1.1	2.4

Table 41.2-2 Saturated Paste Estimates of Spoil TDS Concentrations

Interburden name	Electrical conductivity (mmhos/cm)	
	Area 4 South	Area 5
I8	4.2	4.9
I7	3.6	3.2
I6	3.0	3.2
I4	1.3	2.2
I3	1.4	1.4
I2	1.1	1.7
Spoil composite EC (mmhos/cm)	2.7	3.3
TDS equivalent (mg/L)	1,896	2,284
I8 TDS equivalent (mg/L)	2,921	3,440

Table 41.2-3 Constituent Adsorption Coefficients (Kds) and Estimated Source Concentrations in Mine Spoils

Analysis	Kd (l/mg)	KF GW	Estimated Source Concentrations in Mine Spoils (mg/L)			
			Spoil SPLP	Spoil leached with coal water	Area 4S spoil-precip. and GW mix (69.9% SPLP)	Area 5 spoil-precip. and GW mix (85.4% SPLP)
Arsenic	1.3E-04	0	0	0	0	0
Boron	6.8E-06	0.3	0.084	0.45	0.19	0.14
Calcium		3.4	150	67	125	138
Chloride		704	1.5	610	185	90
Fluoride	8.6E-06	2.5	0.54	1.6	0.86	0.69
Sodium		1150	150	1200	466	303
Selenium	5.0E-05	0	0.0	0.0	0.0	0.0
Sulfate		274	670	980	763	715
TDS		3027	1200	3550	1907	1543
Vanadium	2.2E-04	0	0	0	0	0
				Use for spoils		

KF= Fruitland Formation
SPLP= Synthetic Precipitation Leaching Procedure

Table 41.2-4 Comparison of Pre-mine and Operational Flows for Pinabete Arroyo, and No Name Arroyo, in No Name Permit

Watershed location	Area (sq mi)	2-yr, 6-hr event (0.85 inches) Flow (cfs)	10-yr, 6-hr event (1.28 inches) Flow (cfs)	25-yr, 6-hr event (1.56 inches) Flow (cfs)	50-yr, 6-hr event (1.79 inches) Flow (cfs)	100-yr, 6-hr event (2.04 inches) Flow (cfs)
Pinabete at confluence with Chaco, pre-mine	59.08	359.89	1,015.49	1,577.69	2,092.93	2703.51
Pinabete at confluence with Chaco, operational	3.59	110.23	298.71	448.41	581.74	736.7
Pinabete at Confluence with Chaco, post pin div, pre-mine	11.57	216.41	519.89	759.85	974.58	1222.11
No Name at Chaco, pre-mine	11.48	159.08	420.90	632.06	819.70	1036.53
No Name at Chaco, during 4S operations w SWMP	59.11	187.80	577.39	1,105.95	1,763.67	2433.05

post pin div= post Pinabete Diversion
SWMP= Stormwater Management Plan

Table 41.2-5 Comparison of Pre-mine and Operational Flows for No Name Arroyo, Brimhall Wash, and Unnamed Tributaries to Chaco River

Watershed location	Area (sq mi)	2-yr, 6-hr event (0.85 inches) Flow (cfs)	10-yr, 6-hr event (1.28 inches) Flow (cfs)	25-yr, 6-hr event (1.56 inches) Flow (cfs)	50-yr, 6-hr event (1.79 inches) Flow (cfs)	100-yr, 6-hr event (2.04 inches) Flow (cfs)
No Name at Chaco, pre-mine	11.48	159.08	420.90	632.06	819.70	1,036.53
No Name at Chaco, during 4S and 5 operations	53.48	184.47	572.07	1,098.28	1,752.63	2,417.58
No Name at Chaco, during 5 operations	7.91	171.82	455.84	679.28	878.83	1,107.64
Brimhall at the confluence, pre-mine	85.21	424.62	1,197.76	1,824.37	2,390.53	3,047.08
Brimhall at the confluence, operations	85.21	378.98	1,080.53	1,665.07	2,191.63	2,806.50
ChacoTrib 1, pre-mine	3.40	74.91	216.06	330.44	433.26	553.70
Chaco Trib 1, operations	3.40	58.46	175.42	273.73	363.00	468.17
Chaco Trib 2, pre-mine	2.78	131.44	355.90	537.85	701.94	891.87
Chaco Trib 2, operations	2.78	113.91	293.64	438.38	567.71	717.28

Table 41.2-6 Comparison of Pre-mine and Operational Sediment Yield for Pinabete Arroyo, No Name Arroyo, and Unnamed Tributaries to Cottonwood Arroyo in Area 4 South During Mining Operations

SEDCAD designation	Watershed location	Area (sq mi)	2-yr, 6-hr event (0.85 inches)		10-yr, 6-hr event (1.28 inches)		25-yr, 6-hr event (1.56 inches)		50-yr, 6 (1.79
			Sediment yield (tons)	Sediment loss (tons/acre)	Sediment yield (tons)	Sediment loss (tons/acre)	Sediment yield (tons)	Sediment loss (tons/acre)	Sediment yield (tons)
Structure 9	Pinabete at confluence with Chaco, pre-mine	59.08	2,019	0.05	7,247	0.19	12,257	0.32	17127
Structure 9	Pinabete at confluence with Chaco, prior to mining Pinabete	11.57	642	0.09	2,035	0.27	3,267	0.44	4424
	Pinabete at confluence with Chaco, during mining	3.59	338	0.15	1,050	0.46	1,663	0.72	2234
Structure 7	No Name at Chaco, pre-mine	11.48	665	0.09	2,020	0.27	3,161	0.43	4251
AKA Structure 25	No Name at Chaco, during Area 4 South operations w/ SWMP	59.11	1,863	0.05	6,799	0.18	12,087	0.32	16624

Table 41.2-6 Comparison of Pre-mine and Operational Sediment Yield for Pinabete Arroyo, No Name Arroyo, and Unnamed Tributaries to Cottonwood Arroyo in Area 4 South During Mining Operations

SEDCAD designation	Watershed location	-hr event inches)	100-yr, 6-hr event (2.04 inches)	
		Sediment loss (tons/acre)	Sediment yield (tons)	Sediment loss (tons/acre)
Structure 9	Pinabete at confluence with Chaco, pre-mine	0.45	23171	0.61
Structure 9	Pinabete at confluence with Chaco, prior to mining Pinabete	0.60	5810	0.78
	Pinabete at confluence with Chaco, during mining	0.97	2916	1.27
Structure 7	No Name at Chaco, pre-mine	0.58	5564	0.76
AKA Structure 25	No Name at Chaco, during Area 4 South operations w/ SWMP	0.44	23408	0.62

Table 41.2-7 Comparison of Pre-mine and Operational Sediment Yield for No Name Arroyo, Brimhall Wash, and Unnamed Tributaries to Chaco River in No Name During Mining Operations

SEDCAD designation	Watershed location	Area (sq mi)	2-yr, 6-hr event		10-yr, 6-hr event		25-yr, 6-hr event		50-yr, 6-hr event		100-yr, 6-hr event	
			Sediment yield (tons)	Sediment loss (tons/acre)	Sediment yield (tons)	Sediment loss (tons/acre)	Sediment yield (tons)	Sediment loss (tons/acre)	Sediment yield (tons)	Sediment loss (tons/acre)	Sediment yield (tons)	Sedimentl oss (tons/acre)
Structure 7	No Name at Chaco, pre-mine	11.48	665	0.09	2,020	0.27	3,161	0.43	4,251	0.58	5,564	0.76
AKA Structure 25	No Name at Chaco, during 4S and 5 operations	53.48	1,576	0.05	5,627	0.16	11,366	0.33	15,306	0.45	21,128	0.62
		3.66	1.37	-0.49	1.79	-0.40	2.60	-0.23	2.60	-0.23	2.80	-0.19
AKA Structure 25	No Name at Chaco, during 5 operations	7.91	569	0.11	1,788	0.35	2,840	0.56	3,807	0.75	4,955	0.98
			-0.14	0.24	-0.11	0.28	-0.10	0.30	-0.10	0.30	-0.11	0.29
Structure 12	Brimhall at the confluence, pre-mine	85.21	4,305	0.08	14,286	0.26	23,161	0.42	31,497	0.58	41,272	0.76
	Brimhall at the confluence, operations	85.21	3,549	0.07	12,198	0.22	20,203	0.37	27,802	0.51	36,761	0.67
			-0.18	-0.18	-0.15	-0.15	-0.13	-0.13	-0.12	-0.12	-0.11	-0.11
Structure 3	Chaco Trib 1, pre-mine	3.40	290	0.13	988	0.45	1,609	0.74	2,195	1.01	2,903	1.33
	Chaco Trib 1, operations	3.40	205	0.09	760	0.35	1,285	0.59	1,787	0.82	2,401	1.10
			-0.29	-0.29	-0.23	-0.23	-0.20	-0.20	-0.19	-0.19	-0.17	-0.17
Structure 3	Chaco Trib 2, pre-mine	2.78	426	0.24	1,272	0.72	1,999	1.12	2,661	1.50	3,365	1.89
	Chaco Trib 2, operations	2.78	354	0.20	1,061	0.60	1,684	0.95	2,262	1.27	2,857	1.61
			-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.08	-0.08	-0.08	-0.08

AKA Structure 25 - Node on SEDCAD run at the confluence of No Name with Chaco

Table 41.3-1 Hydraulic Conductivity Ranges and Calibrated Values for Groundwater Model

Parameter name	Horizontal hydraulic conductivity (m/day)			Vertical hydraulic conductivity (m/day)
	Lower limit	Upper limit	Calibrated value	Calibrated value
Alluvium	1.00	5.0×10^{1}	1.22 - 50.0	1.03×10^{-2} - 8.65×10^{-1}
Overburden	3.05×10^{-5} - 1×10^{-4} (2)	3.05×10^{-3} - 1.00 (2)	1.05×10^{-4} - 7.23×10^{-3}	7.36×10^{-2} - 9.52×10^{-1}
Coal Seam #8	1.22×10^{-3} (1)	1.83×10^{-2} (1)	1.07×10^{-2}	1.10×10^{-2}
Coal Seam #7	3.96×10^{-5} (1)	2.44×10^{-3} (1)	6.29×10^{-5}	2.01×10^{-3}
Coal Seam #6	3.96×10^{-5} (1)	2.44×10^{-3} (1)	4.17×10^{-5}	1.01×10^{-3}
Coal Seam #4	3.96×10^{-5} (1)	2.44×10^{-3} (1)	3.96×10^{-5}	1.19×10^{-3}
Coal Seam #3	3.96×10^{-5} (1)	2.44×10^{-3} (1)	2.18×10^{-3}	1.64×10^{-2}
Coal Seam #2	3.96×10^{-5} (1)	2.44×10^{-3} (1)	2.44×10^{-3}	8.01×10^{-2}
Interburden	1.53×10^{-5} (3)	1.53×10^{-3} (3)	1.53×10^{-5} - 1.53×10^{-3}	1.52×10^{-3} - 9.27×10^{-1}
Pictured Cliffs Sandstone	3.05×10^{-5} (1)	1.34×10^{-1} (1)	9.57×10^{-3}	1.30×10^{-1}
Lewis Shale	1.53×10^{-5}	1.53×10^{-1}	1.53×10^{-5}	9.58×10^{-1}

1) NTEC Well Tests
2) Norwest Applied Hydrology, 2009
3) Kaiser et al 1994 & Frenzel, 1983

Table 41.3-2 Porosity and Storage Values

Parameter Name	Porosity	Specific Yield	Specific Storage (m^{-1})
Alluvium	0.35	0.12 (1)	8.20×10^{-5} (1)
Overburden	0.35	0.12 - 0.2 (1)	1.18×10^{-5} - 8.20×10^{-5} (1)
Coal Seam #8	0.35	0.005 (1)	1.38×10^{-4} (1)
Coal Seam #7	0.35	0.005 (1)	1.38×10^{-4} (1)
Coal Seam #6	0.35	0.005 (1)	1.38×10^{-4} (1)
Coal Seam #4	0.35	0.005 (1)	1.38×10^{-4} (1)
Coal Seam #3	0.35	0.005 (1)	1.38×10^{-4} (1)
Coal Seam #2	0.35	0.005 (1)	1.38×10^{-4} (1)
Interburden	0.35	0.12 (1)	8.20×10^{-5} (1)
Pictured Cliffs Sandstone	0.35	0.20	1.18×10^{-5} (1)
Lewis Shale	0.35	0.005	1.38×10^{-4}

Source: 1) Norwest Applied Hydrology, 2009

Table 41.3-3 Baseline and Post-reclamation Estimates of Chaco River Alluvium Mixing Calculations

	Baseline Estimates		Post-Mine Estimates	
	Chaco alluvium (up gradient)	Chaco alluvium below Pinabete	Chaco below Pinabete (maximum)	Chaco below Pinabete (mixed)
Flow ft^3/day	3,407.0	4,598.6	5,081.8	5,081.8
Fluoride (g/day)	74.8	141.5	165.6	125.4
Selenium (g/day)	0.1	0.3	0.5	0.4
Boron (g/day)	6.3	20.7	29.0	22.6
TDS (g/day)	91,555	202,180	255,493	215,364
Fluoride (mg/L)	0.775	1.086	1.151	0.871
Selenium (mg/L)	0.001	0.002	0.003	0.003
Boron (mg/L)	0.065	0.159	0.202	0.157
TDS (mg/L)	949	1,552	1,775	1,496

Table 41.3-4 Comparison of Pre-mine and Post-reclamation Flows for Pinabete Arroyo, No Name Arroyo, Tributaries to Cottonwood Arroyo, and Tributaries to Brimhall Wash to Chaco River in No Name

SEDCAD designation	Watershed location	Area (sq mi)	2-yr, 6-hr event (0.85 inches) Flow (cfs)	10-yr, 6-hr event (1.28 inches) Flow (cfs)	25-yr, 6-hr event (1.56 inches) Flow (cfs)	50-yr, 6-hr event (1.79 inches) Flow (cfs)	100-yr, 6-hr event (2.04 inches) Flow (cfs)
Structure 6	Pinabete upstream, pre-mine	43.88	406.03	1,124.25	1,714.72	2,252.50	2,879.25
Structure 8	Pinabete downstream, pre-mine	55.49	395.68	1,099.20	1,677.53	2,203.65	2,816.87
Structure 8	Pinabete downstream, post-reclamation	55.50	363.91	1,023.30	1,586.20	2,102.09	2,716.03
Structure 2	No Name upstream, pre-mine	2.90	54.18	231.18	297.02	400.79	522.95
Structure 5	No Name downstream, pre-mine	8.64	113.85	563.64	660.92	870.11	1,021.67
Structure 5	No Name downstream, post-reclamation	8.63	54.28	226.50	388.52	542.12	727.27
Structure 7	Brimhall tributaries directly down gradient of Area 5, pre-mine	2.58	113.92	293.41	434.98	560.86	705.27
Structure 9	Brimhall tributaries draining Area 5, pre-mine	4.82	132.12	350.41	525.00	681.42	862.62
Structure 12	Brimhall at the confluence, pre-mine	85.21	424.62	1,197.76	1,824.37	2,390.53	3,047.08
Structure 12	Brimhall at the confluence, post-reclamation	85.21	378.98	1,080.53	1,665.07	2,191.63	2,806.50
Structure 3	Chaco Trib 1, pre-mine	3.40	74.91	216.06	330.44	433.26	553.70
Structure 3	Chaco Trib 1, post-reclamation	3.40	58.46	175.42	273.73	363.00	468.17
Structure 3	Chaco Trib 2, pre-mine	2.78	131.44	355.90	537.85	701.94	891.87
Structure 3	Chaco Trib 2, post-reclamation	2.78	113.91	293.64	438.38	567.71	717.28

Table 41.3-5 Comparison of Pre-mine and Post-reclamation Flows for Pinabete Arroyo, No Name Arroyo, Tributaries to Brimhall Wash, & Tributaries to Chaco River in Area 5

SEDCAD designation	Watershed location	Area (sq mi)	2-yr, 6-hr event (0.85 inches) Flow (cfs)	10-yr, 6-hr event (1.28 inches) Flow (cfs)	25-yr, 6-hr event (1.56 inches) Flow (cfs)	50-yr, 6-hr event (1.79 inches) Flow (cfs)	100-yr, 6-hr event (2.04 inches) Flow (cfs)
Structure 6	Pinabete upstream, pre-mine	43.88	406.03	1,124.25	1,714.72	2,252.50	2,879.25
Structure 8	Pinabete downstream, pre-mine	55.49	395.68	1,099.20	1,677.53	2,203.65	2,816.87
Structure 8	Pinabete downstream, post-reclamtion	55.50	395.26	1,098.33	1,676.20	2,202.00	2,815.30
Structure 2	No Name upstream, pre-mine	2.90	54.18	231.18	297.02	400.79	522.95
Structure 5	No Name downstream, pre-mine	8.64	113.85	563.64	660.92	870.11	1,021.67
Structure 5	No Name downstream, post-reclamtion	8.63	76.45	282.38	464.16	634.13	836.16
Structure 7	Brimhall tributaries directly down gradient of Area 5, pre-mine	2.58	113.92	293.41	434.98	560.86	705.27
Structure 9	Brimhall tributaries draining Area 5, pre-mine	4.82	132.12	350.41	525.00	681.42	862.62
Structure 12	Brimhall at the confluence, pre-mine	85.21	424.62	1,197.76	1,824.37	2,390.53	3,047.08
Structure 12	Brimhall at the confluence, post-reclamtion	85.21	378.98	1,080.53	1,665.07	2,191.63	2,806.50
Structure 3	Chaco Trib 1, pre-mine	3.40	74.91	216.06	330.44	433.26	553.70
Structure 3	Chaco Trib 1, post-reclamtion	3.40	67.20	200.03	312.84	421.81	549.77
Structure 3	Chaco Trib 2, pre-mine	2.78	131.44	355.90	537.85	701.94	891.87
Structure 3	Chaco Trib 2, post-reclamtion	2.78	123.73	340.47	520.26	682.98	871.74

Table 41.3-6 Comparison of Sediment Yield Pre-mining and Post-mining for Pinabete Arroyo, and No Name Arroyo in Area 4 South

SEDCAD designation	Watershed location	Area (sq mi)	2-yr, 6-hr event (0.85 inches) Sediment yield (tons)	10-yr, 6-hr event (1.28 inches) Sediment yield (tons)	25-yr, 6-hr event (1.56 inches) Sediment yield (tons)	50-yr, 6-hr event (1.79 inches) Sediment yield (tons)	100-yr, 6-hr event (2.04 inches) Sediment yield (tons)
Structure 8	Pinabete downstream, pre-mine	55.49	2,146.9	7,808.1	13,103.4	18,151.3	24,239.3
	Pinabete downstream, post-mine	55.50	2,107.3	7,426.6	12,462.9	17,342.3	23,379.2
			-0.001	-0.00028	-0.01803	-0.00010	-0.00008
Structure 5	No Name downstream, pre-mine	8.64	290	1543.5	1781.2	2427.5	3091.3
	No Name downstream, post-mine	8.63	109.3	515.5	931.5	1343.4	1857.3

Table 41.3-7 Comparison of Sediment Yield Pre-mining and Post-mining for No Name Arroyo, Tributaries to Brimhall Wash, and Tributaries to Chaco River in Area 5

SEDCAD designation	Watershed location	Area (sq mi)	2-yr, 6-hr event (0.85 inches) Sediment yield (tons)	10-yr, 6-hr Event (1.28 inches) Sediment yield (tons)	10-yr, 24-hr event (1.7 inches) Sediment yield (tons)	25-yr, 6-hr event (1.56 inches) Sediment yield (tons)	50-yr, 6-hr event (1.79 inches) Sediment yield (tons)	100-yr, 6-hr event (2.04 inches) Sediment yield (tons)
Structure 5	No Name downstream, pre-mine	8.64	290.00	1,543.50	1,875.50	1,781.20	2,427.50	3,091.30
	No Name downstream, post-mine	8.63	126.50	544.10	1,018.00	941.70	1,334.00	1,816.50
Structure 12	Brimhall at the confluence, pre-mine	85.21	4,305.00	14,286.10	24,877.70	23,161.20	31,496.60	41,272.40
	Brimhall at the confluence, post-mine	85.21	4,223.50	14,055.20	24,488.50	22,795.10	30,972.20	40,591.50
Structure 3	Chaco Trib 1, pre-mine	3.40	289.60	988.40	1,723.80	1,609.30	2,195.40	2,902.50
	Chaco Trib 1, post-mine	3.40	251.50	899.60	1,607.50	1,491.90	2,066.20	2,761.80
Structure 3	Chaco Trib 2, pre-mine	2.78	425.70	1,271.90	2,063.40	1,999.00	2,660.80	3,364.80
	Chaco Trib 2, post-mine	2.78	360.60	1,100.60	1,859.20	1,753.40	2,365.50	3,094.30

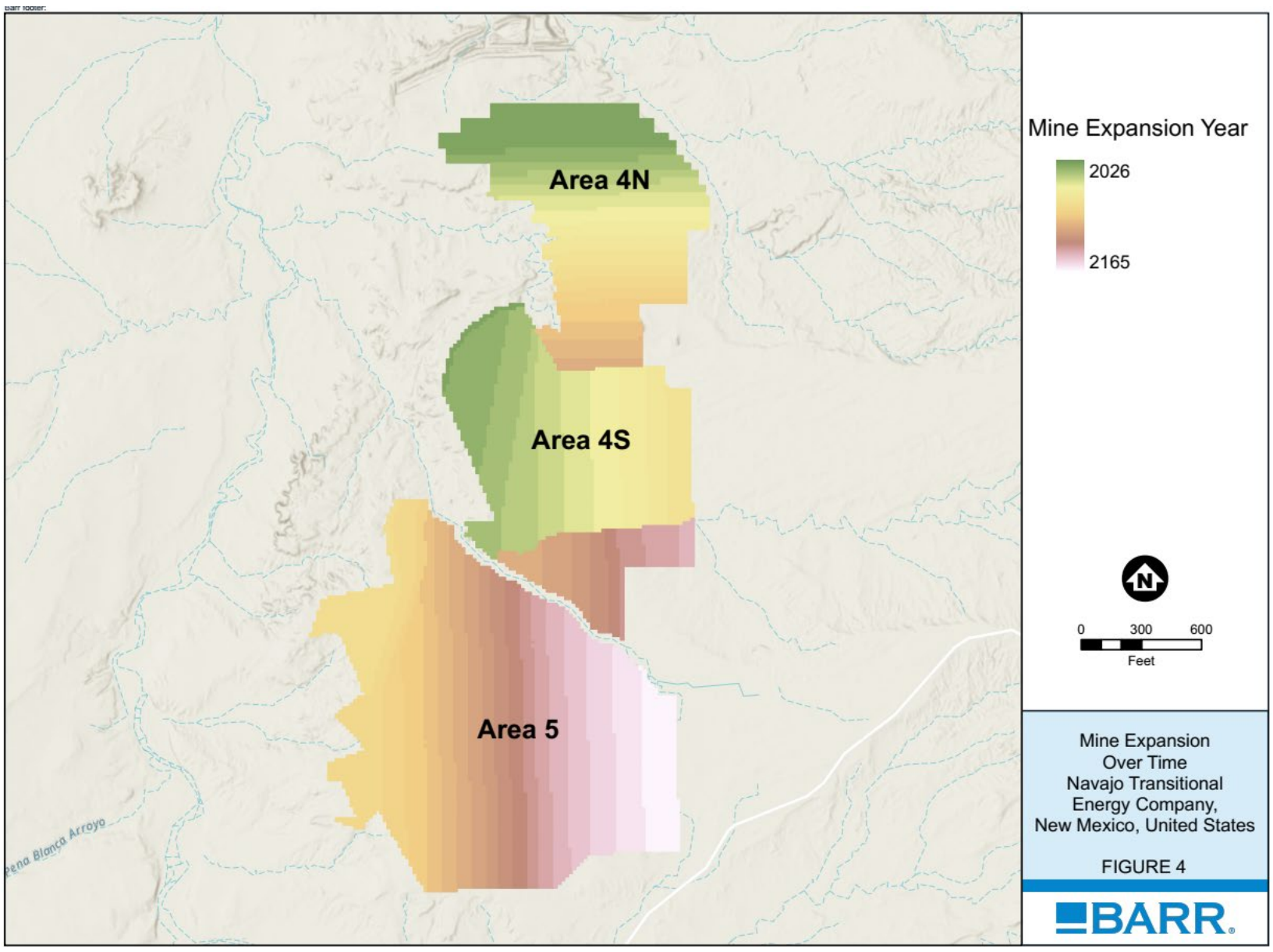


Figure 41.2-1. Mining Block Sequences used for Model Simulations

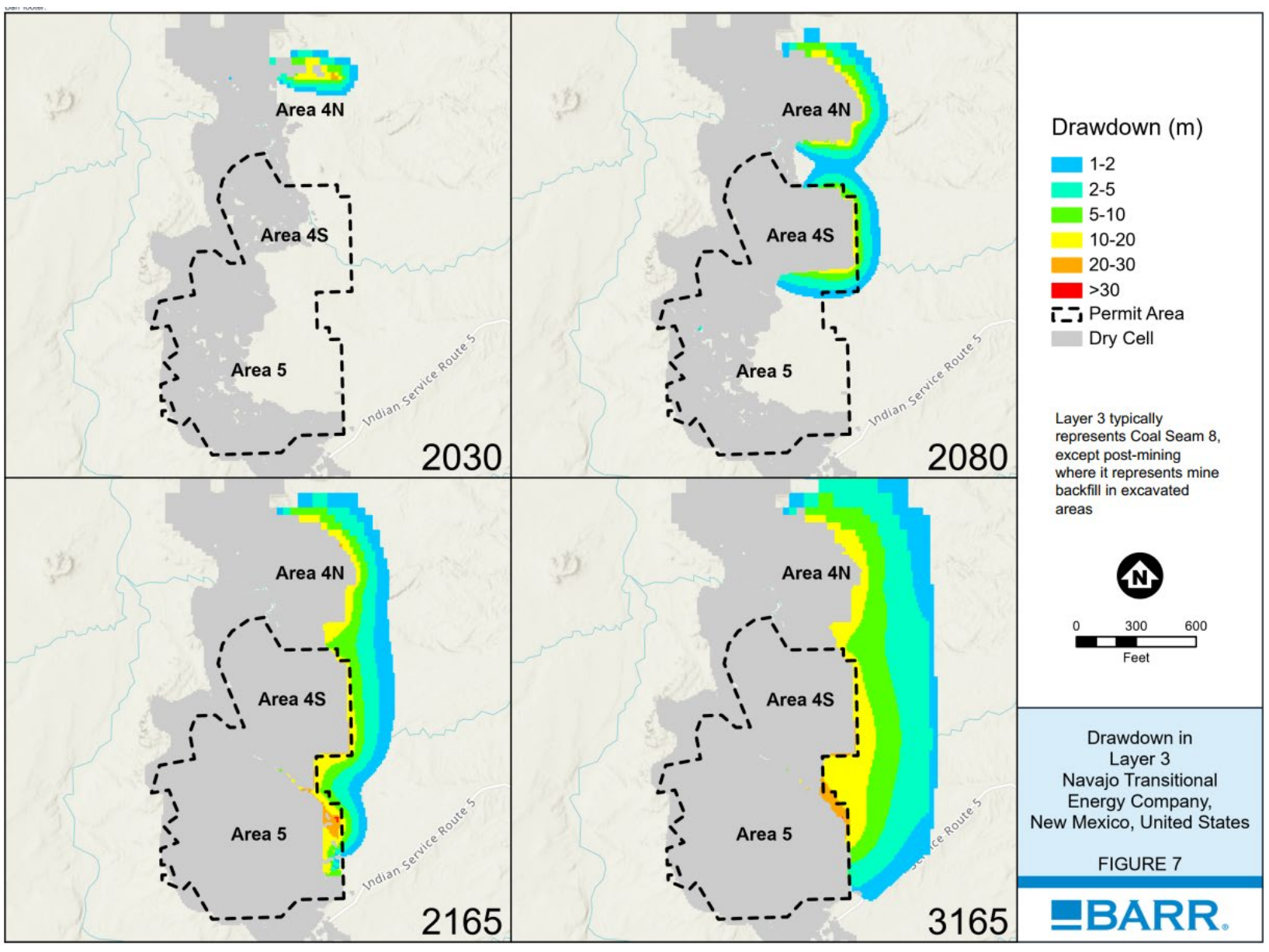


Figure 41.2-2. Modeled Drawdown in the No. 8 Coal Seam (Layer 3) to 3165

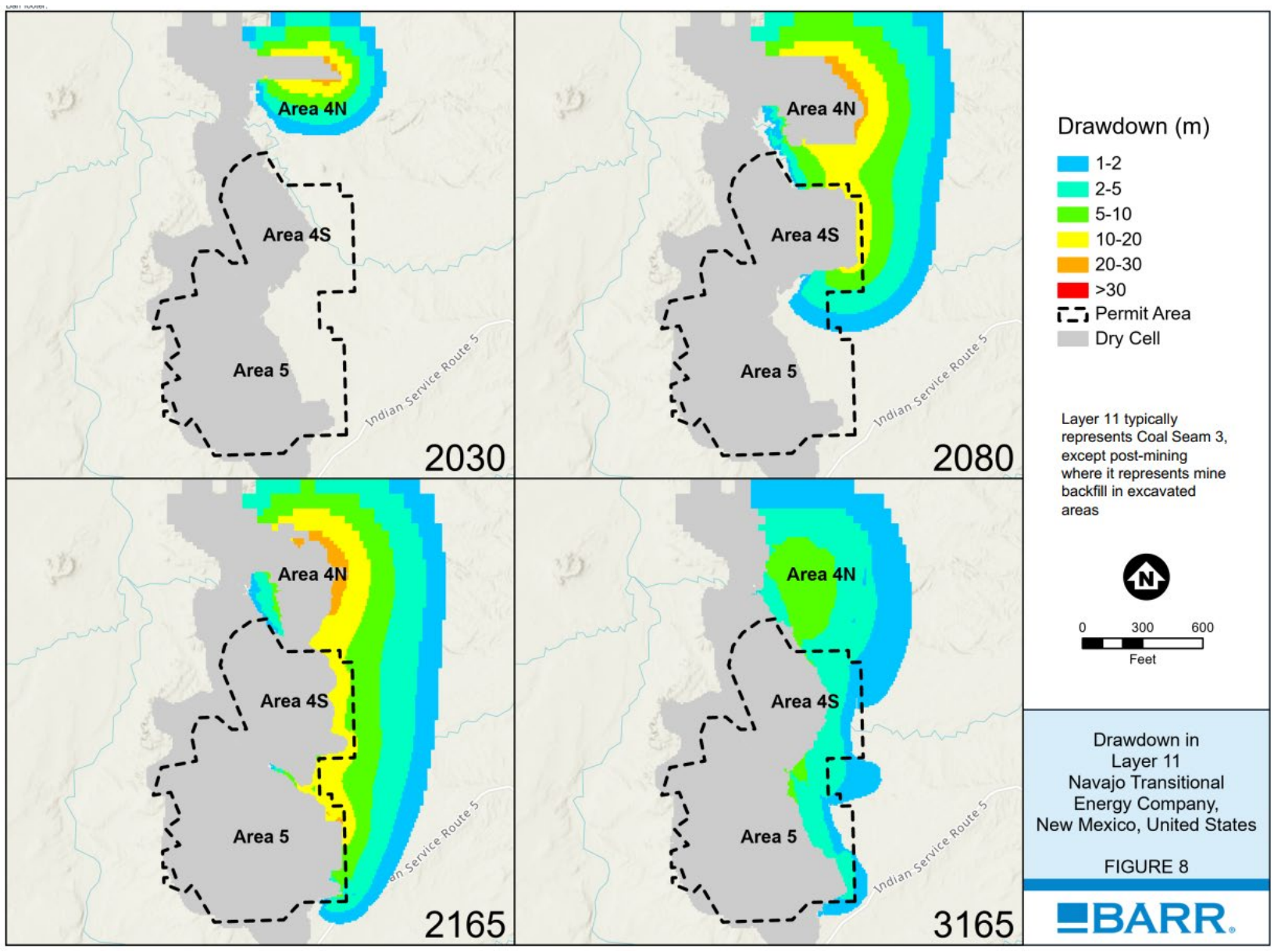


Figure 41.2-3. Modeled Drawdown in the No. 3 Coal Seam (Layer 11) to 3165

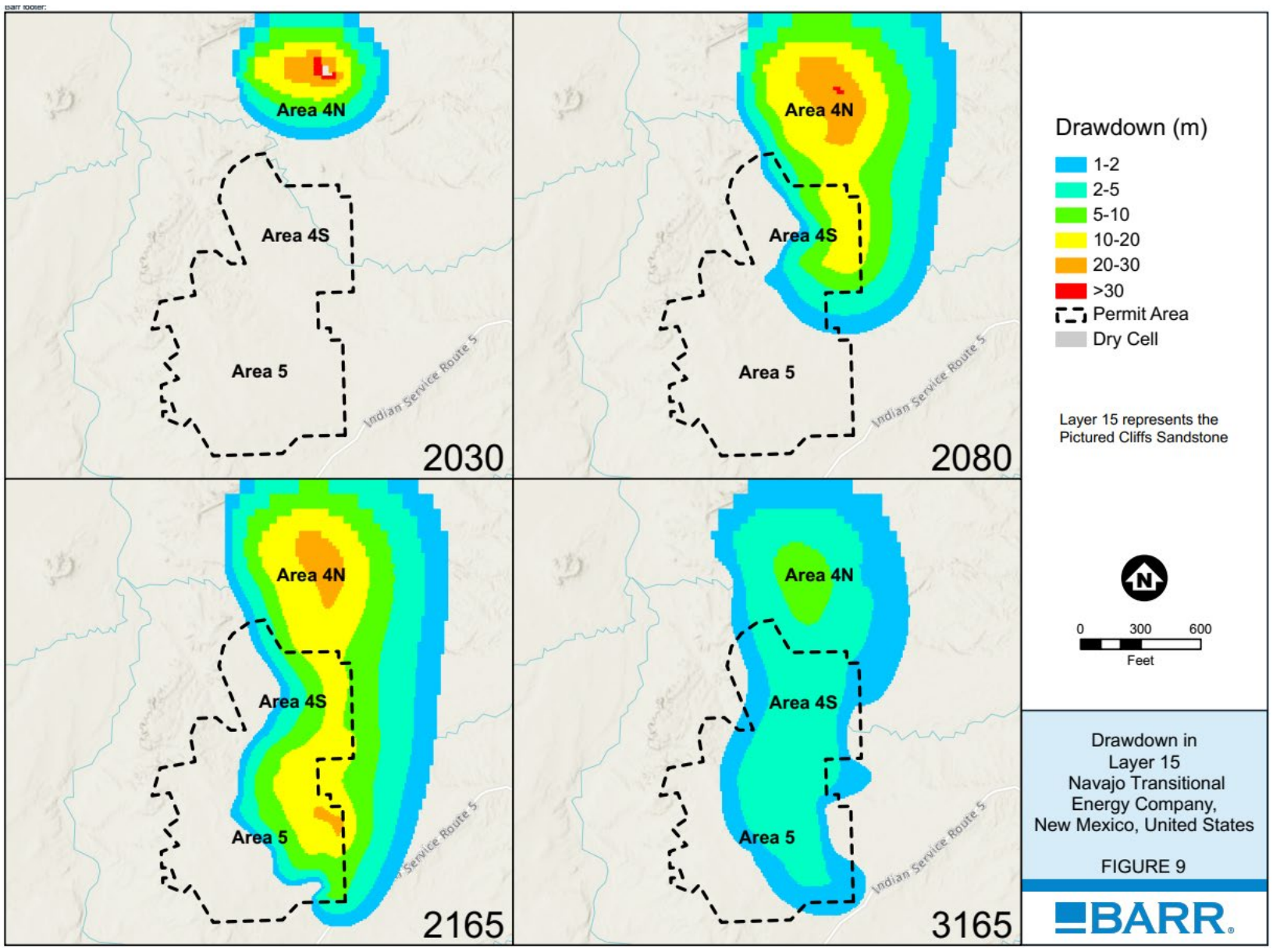


Figure 41.2-4. Modeled Drawdown in the PCS (Layer 15) to 3165

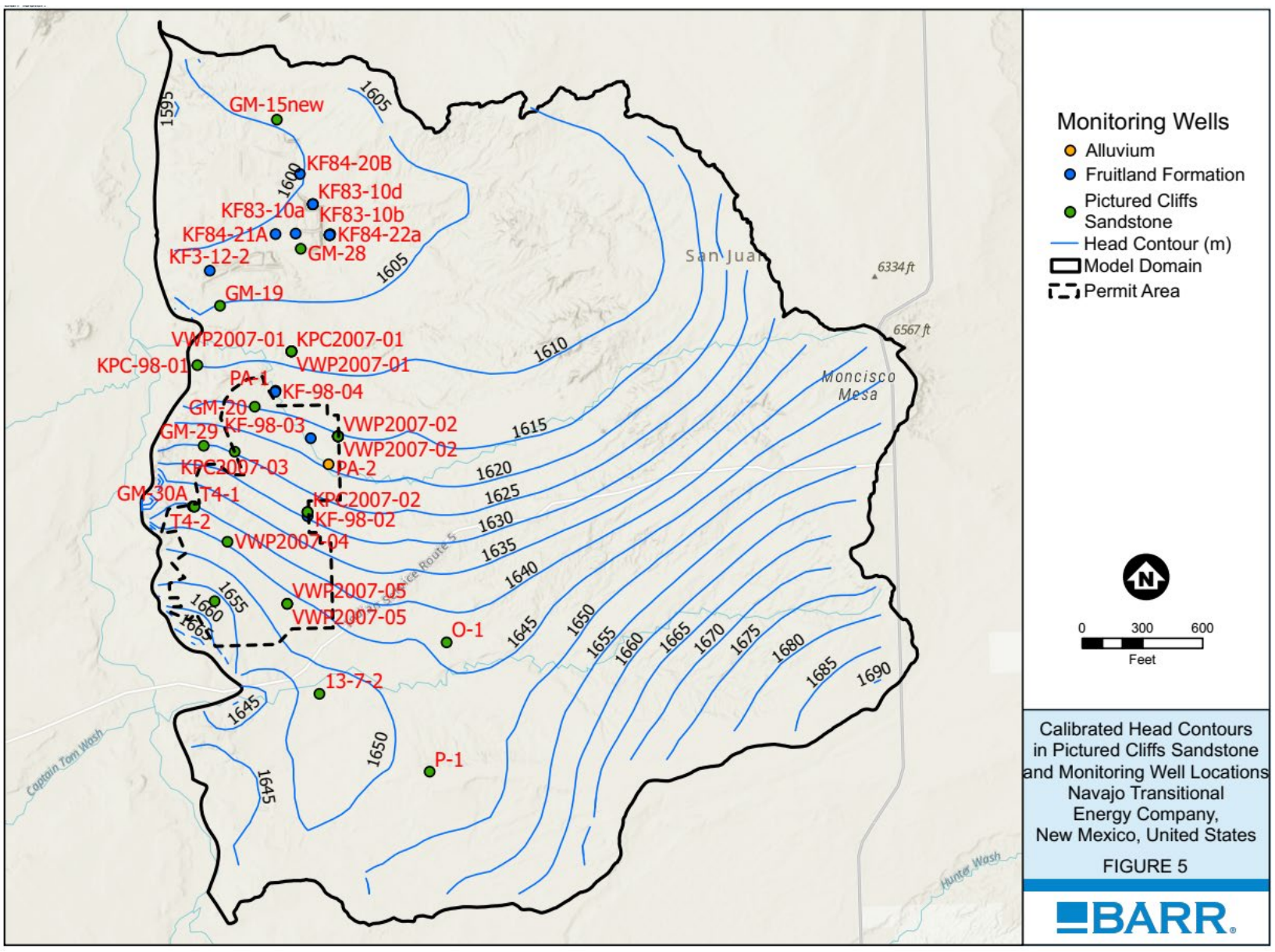


Figure 41.3-1 Location of Permit Area, Head Contours and Wells and Piezometers Used for Calibration

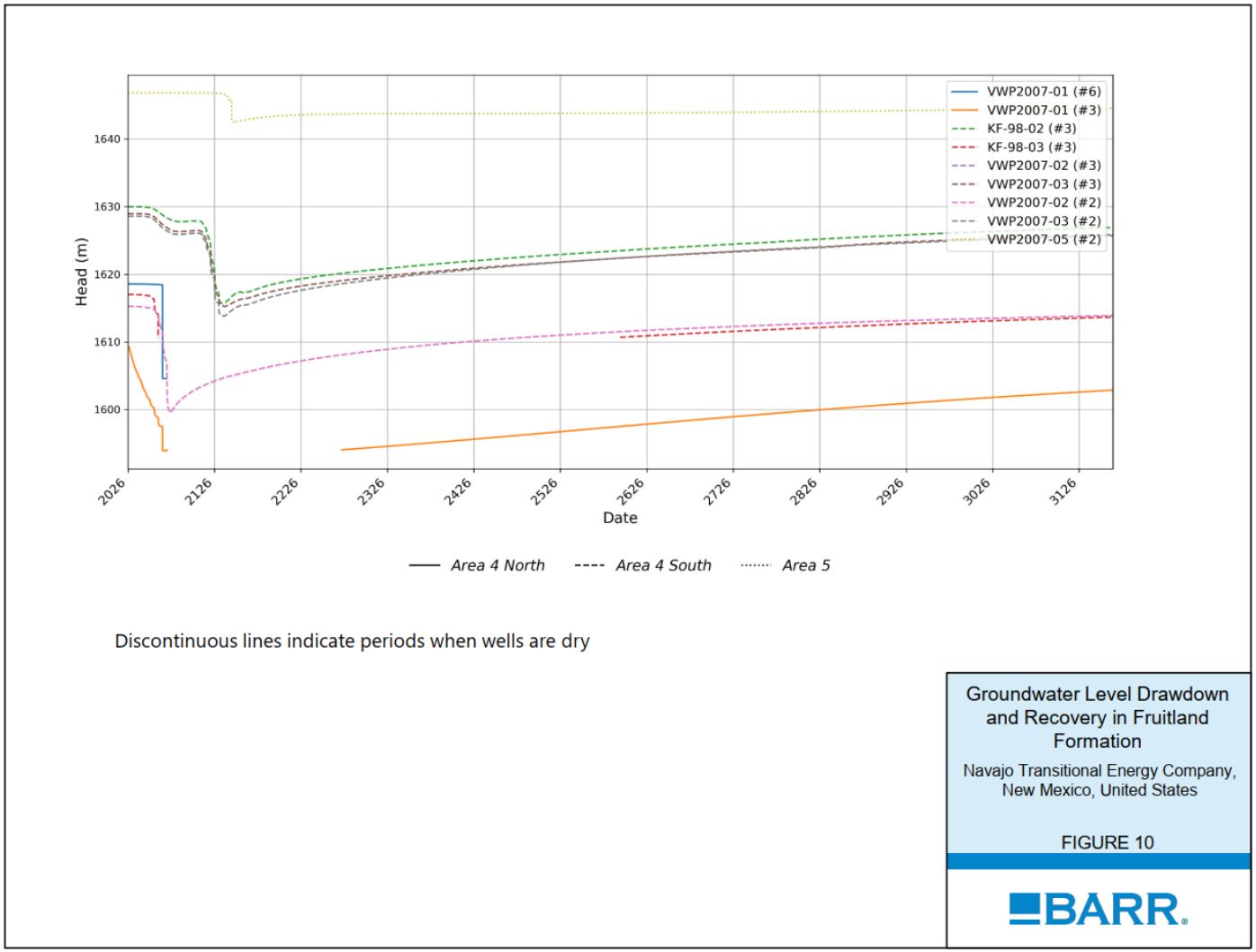


Figure 41.3-2 Model Simulated Groundwater Drawdown and Recovery in Fruitland Formation

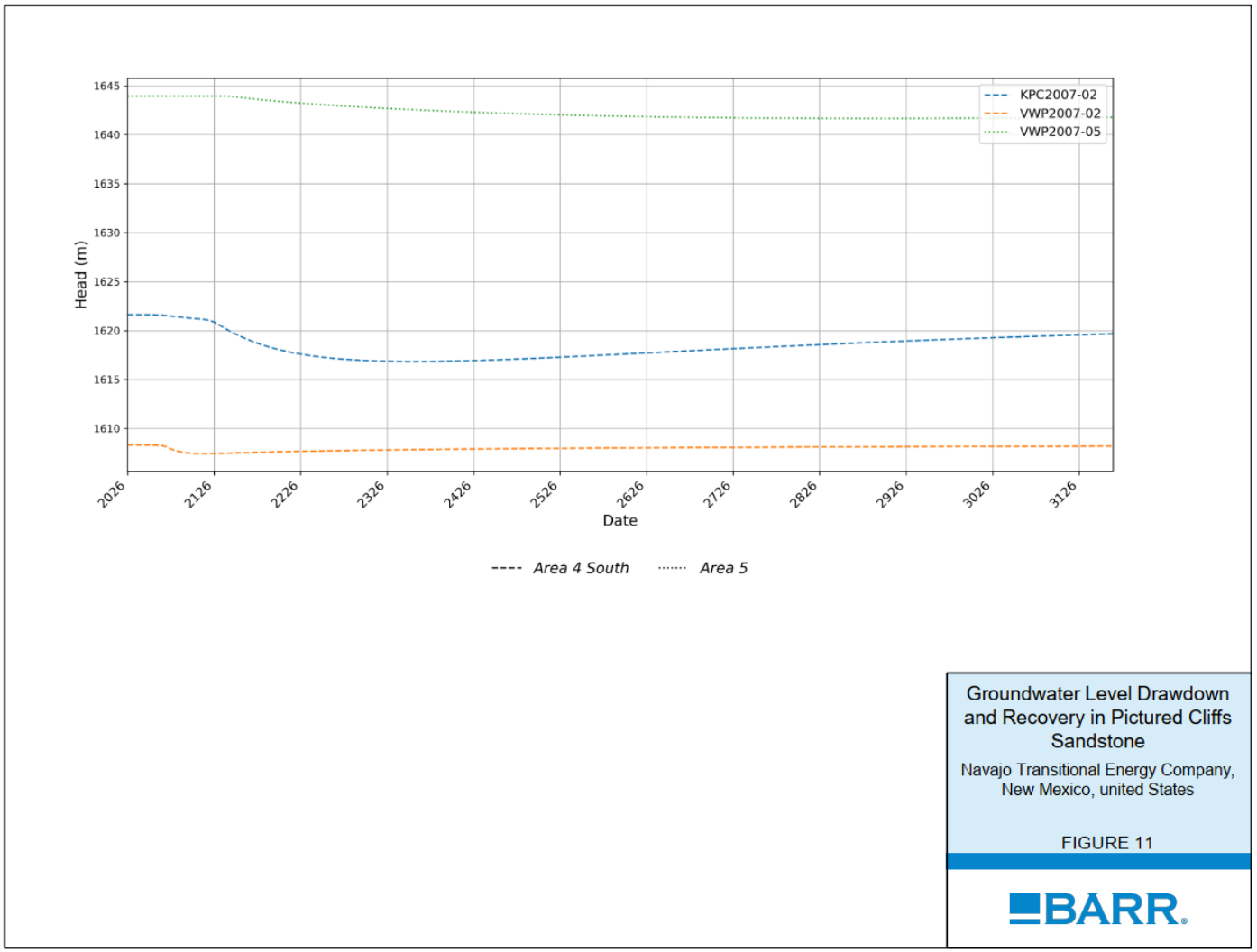


Figure 41.3-3 Model Simulated Groundwater Drawdown and Recovery in Pictured Cliffs Sandstone

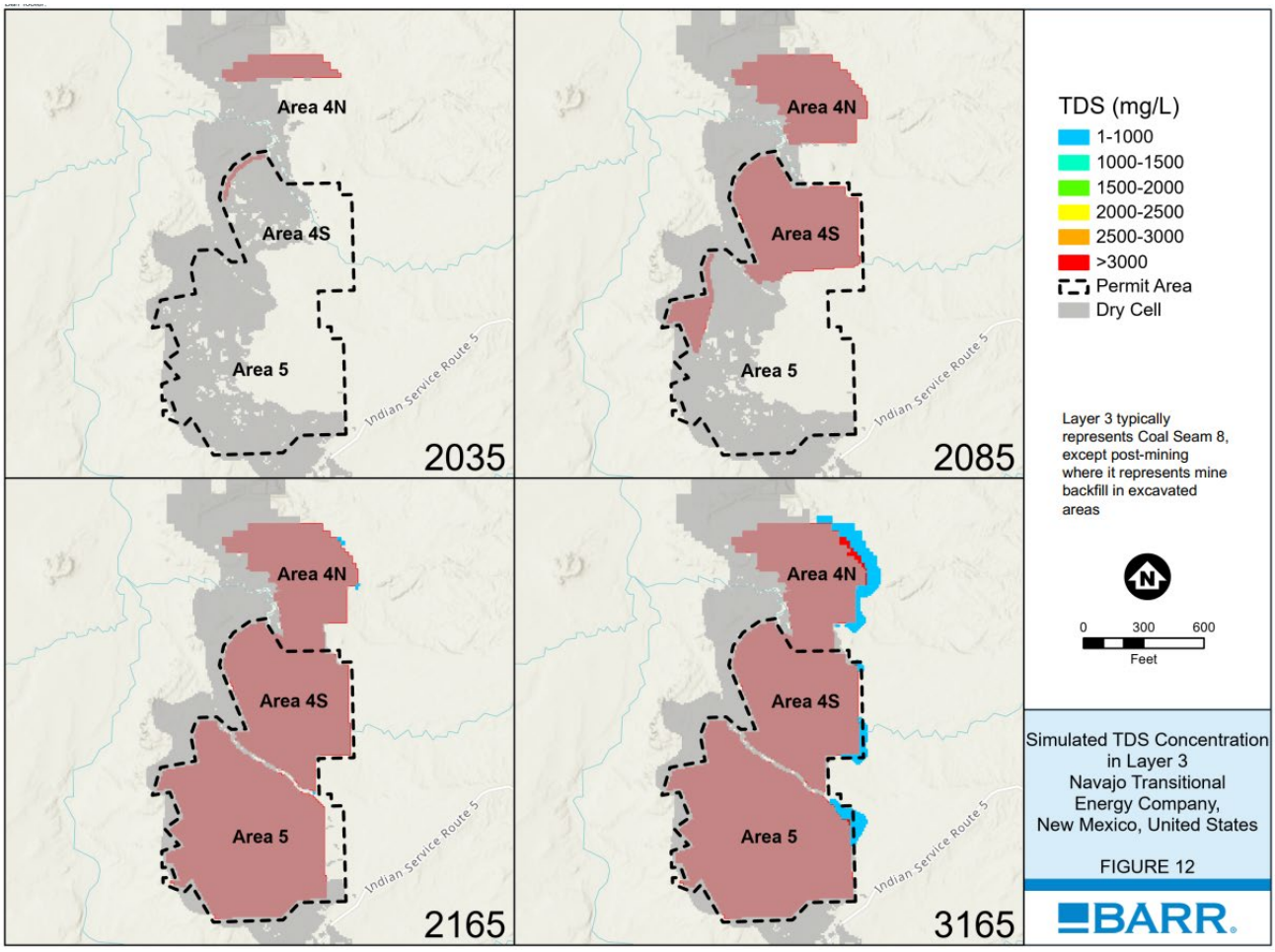


Figure 41.3-4 Model Simulated TDS Concentration in No. 8 Coal Seam (Layer 3) to 3165

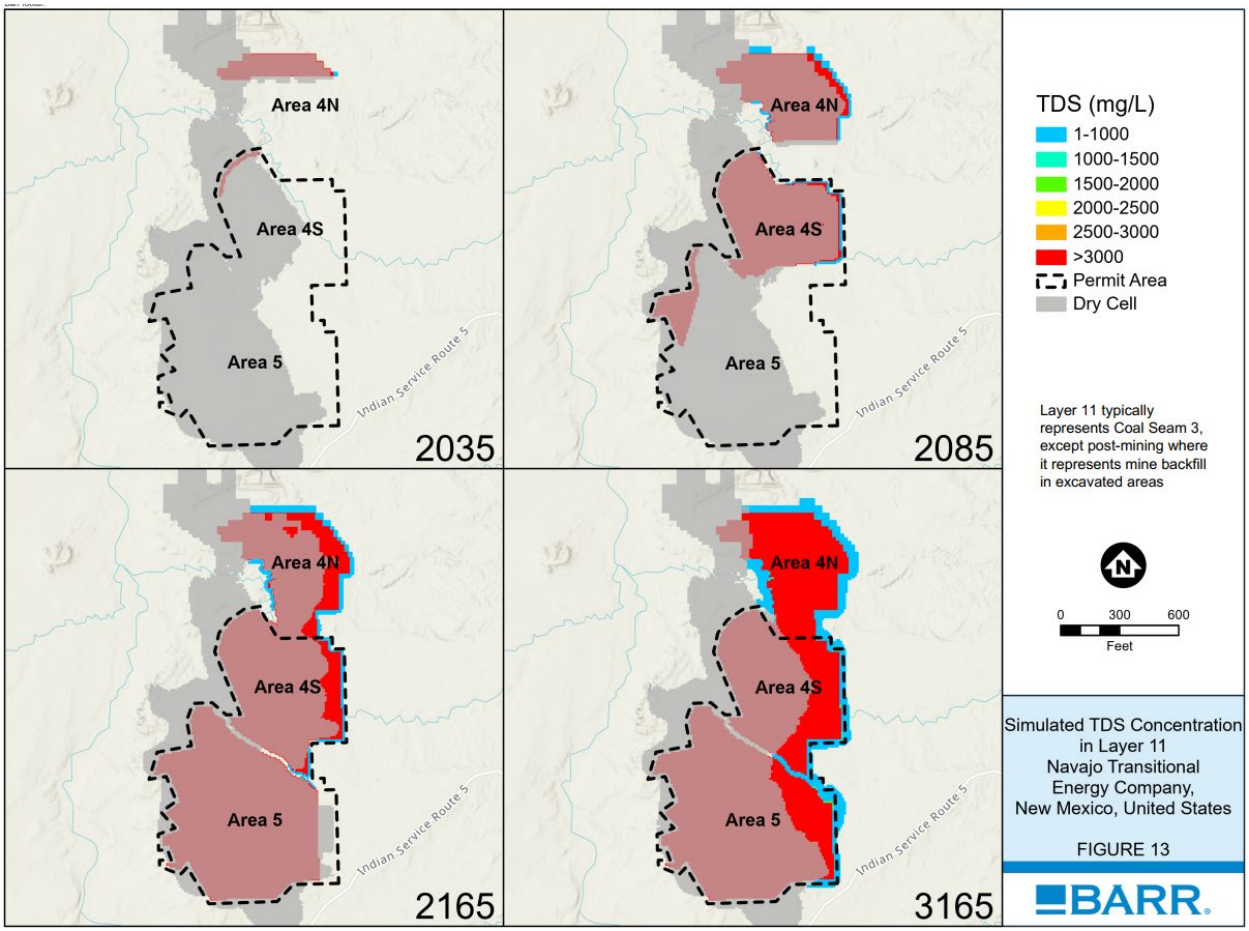
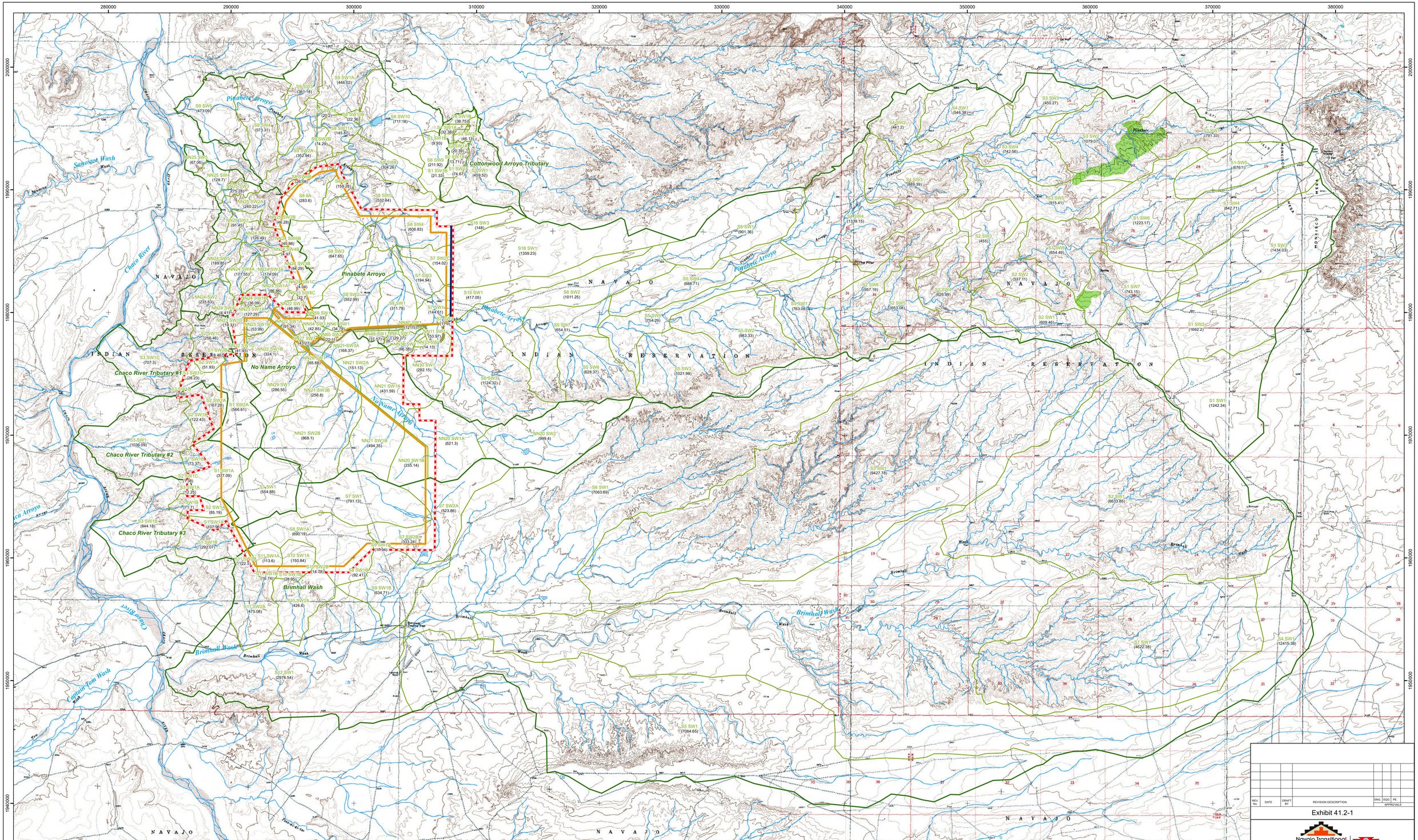


Figure 41.3-5 Model Simulated TDS Concentration in No. 3 Coal Seam (Layer 11) to 3165



Units US Feet

0 1,500 3,000 6,000 9,000 Feet

1:40,000

Legend

- Pinabete Diversion
- Eastern Diversion
- **Mining Disturbance**
- Disturbance-Mining
- Permit Area
- Major Watersheds
- Subwatersheds
- Ponds
- Streams

NOTE: Detailed Subwatershed Delineation along Pinabete Diversion on Exhibit 26.A-1

REV No.	DATE	DRAFT BY	REVISION DESCRIPTION	ENG.	EGD.	PE.
				APPROVALS		

Exhibit 41.2-1

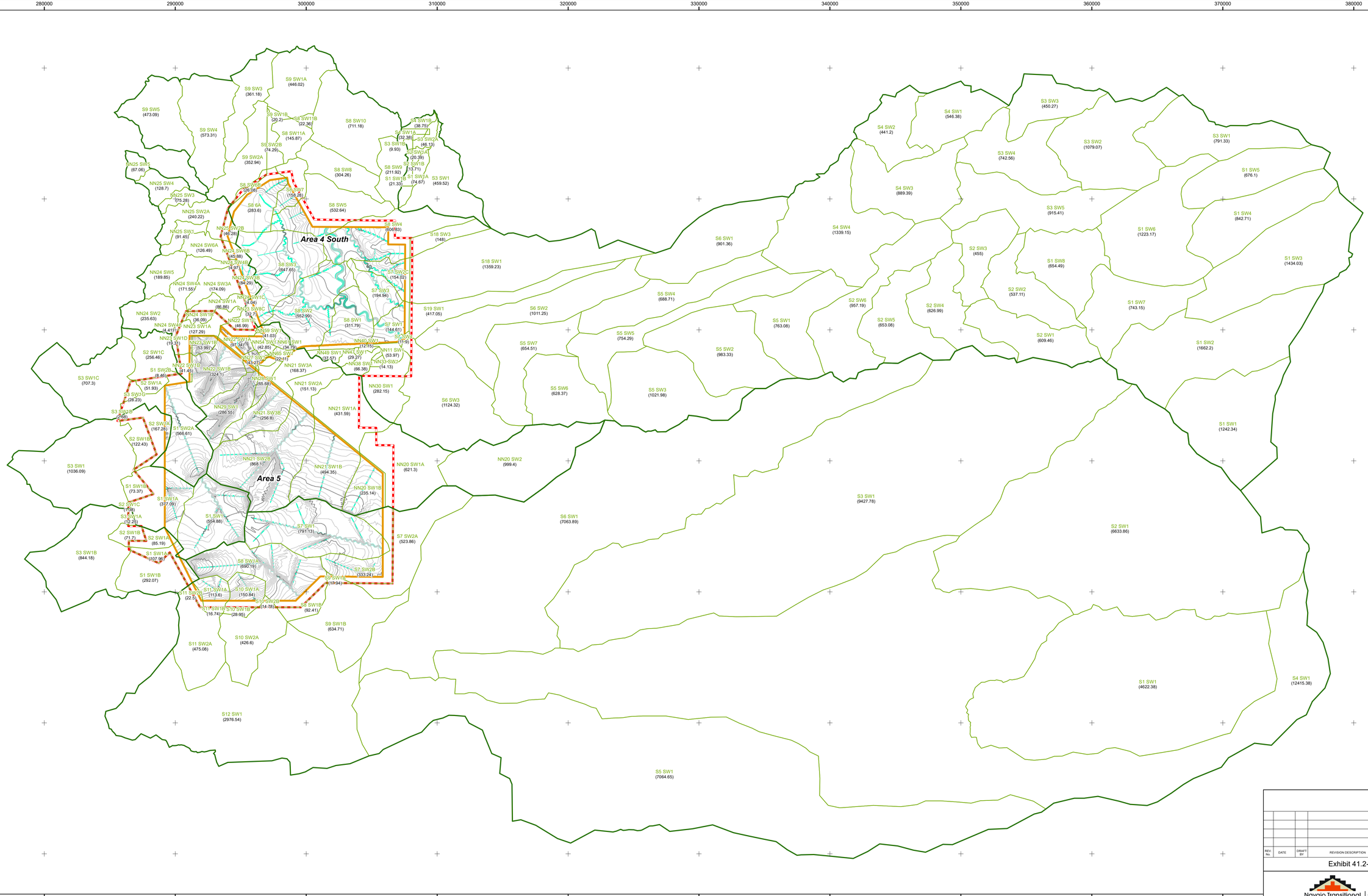
Navajo Transitional Energy Company

P.O.BOX 1717 FRUITLAND,NEW MEXICO 87416/PHONE 505-598-4200/FAX 505-598-4229

No Name Permit

Operational Watersheds
with SEDCAD4 Subwatersheds

PREPARED BY: SS	DRAWN BY: SS	PAPER SIZE: ARCH D
APPROVED BY: SS	DATE: 9/30/25	



N

Units US Feet

0 1,500 3,000 6,000 9,000 Feet

1:40,000

Legend

Major Watersheds

Subwatersheds

Mining Disturbance

Disturbance-Mining

Permit Area

Final Surface Configuration

Channels

Index Contours

Intermediate Contours

REV No.	DATE	DRAFT BY	REVISION DESCRIPTION	ENG.	EGO.	PE
				APPROVALS		

Exhibit 41.2-2

Navajo Transitional Energy Company

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No Name Permit

Post-reclamation Watersheds with SEDCAD4 Subwatersheds

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APPROVED BY: SS	DATE: 09/30/25	

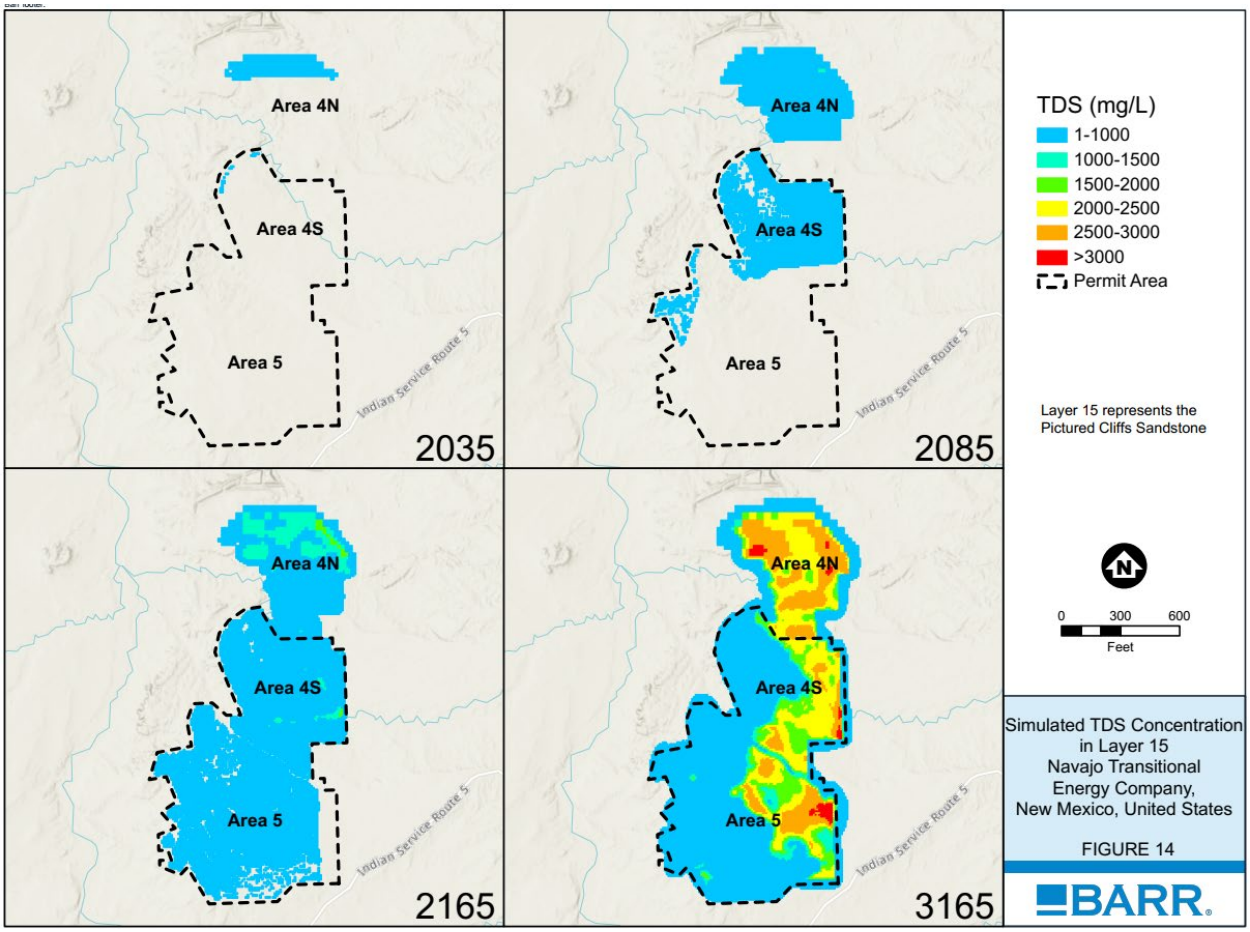


Figure 41.3-6 Model Simulated TDS Concentration in the Pictured Cliffs Sandstone (Layer 15) to 3165

Appendix 41.A

Navajo Mine Extension Project: Mine Spoil and Coal Combustion By-products Leachate Test Analyses and Geochemical Modeling

NAVAJO MINE EXTENSION PROJECT: MINE SPOIL AND COAL COMBUSTION BY-PRODUCTS LEACHATE TEST ANALYSES AND GEOCHEMICAL MODELING

Submitted to:
BHP NAVAJO COAL COMPANY

November 26, 2008

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NORWEST
Applied Hydrology

APPENDIX 41.A

MINE SPOIL AND COAL COMBUSTION BY-PRODUCTS LEACHATE TEST ANALYSES AND GEOCHEMICAL MODELING

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MINE SPOIL AND COAL COMBUSTION BY-PRODUCTS LEACHATE TEST ANALYSES AND GEOCHEMICAL MODELING

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MINE SPOIL AND COAL COMBUSTION BY-PRODUCTS LEACHATE TEST ANALYSES AND GEOCHEMICAL MODELING

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APPENDIX 41.B

MINE SPOIL AND COAL COMBUSTION BY-PRODUCTS LEACHATE TEST ANALYSES AND GEOCHEMICAL MODELING

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41.A.A	Leachate Analysis Work Plan
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EXECUTIVE SUMMARY

In order to determine probable hydrologic consequences (PHC) of planned placement of coal combustion by-products (CCBs) from the Desert Rock Power Plant within the mine backfill of the Navajo Mine Extension Project (NMEP), Norwest conducted a study of available information in literature and available information from past studies at the Navajo and San Juan Mines. In addition, representative samples were collected for use in batch leaching tests with the results incorporated into geochemical modeling and chemical transport modeling in support of the PHC.

The literature review focused on available information on potential leaching of CCB materials. Of particular interest was the available information on leaching of spent carbon from activated carbon injection systems used to control mercury emission, as it is planned to dispose of spent carbon from the Desert Rock Power Plant with the CCB material. Currently, activated carbon injection is not utilized at local power generation facilities and that material was not available for testing as part of this study. The available literature suggests that activated carbon is relatively safe for inclusion in minefill and that trace metals are strongly bound within the activated carbon.

Although the Desert Rock Power Plant and the Navajo Mine Extension Project are not operational, materials representative of the expected mine spoil and CCBs, minus the spent carbon, were used for testing. Representative samples of spoil materials were collected from the adjacent Navajo Mine. The Navajo Mine extracts coal from the Fruitland Formation, the same formation planed for mining in the NMEP and rock characteristics are expected to be essentially the same between the two mines. CCB materials to be used in mine placement at the NMEP are estimated to be composed of approximately 70 percent (%) fly ash, 15% bottom ash, and 15% flue gas desulfurization product (FGD). Representative samples of fly ash and bottom ash were obtained from the Four Corners Power Plant that burns coal from the Navajo Mine. The wet limestone scrubber technology for flue gas desulfurization utilized at the San Juan Generating Station is comparable to the technology proposed for the Desert Rock Power Plant and this material was used to prepare the 15% FGD in the composite CCB samples used for this testing program. Both the coal and CCB materials were composited in the laboratory under specific instructions to ensure representative samples.

Batch leaching tests included various combinations of spoil and CCB materials leached with groundwater collected from coal seams at the NMEP or synthetic precipitation.

Results indicate that the pH of leachate using the expected field site materials remains neutral to alkaline indicating that low pH values that are typically responsible for enhanced trace metals transport will not exist with the CCB materials generated from the Desert Rock Power Plant and mine spoil. The synthetic precipitation leaching solution started with an initial pH of 5.0 and increased to pH values of 7.4 and 7.5 for CCB and spoil 18-hour batch samples, respectively, indicating the buffering capacity of the materials allows the pH of the water to increase to slightly alkaline conditions.

Batch leachate testing of CCB materials resulted in some trace elements leaching into solution. However, attenuation of the trace metals leached from CCBs was observed when CCB leachate was used as the source water for leaching of spoil materials. Some trace metals and anions, including aluminum, arsenic, boron, copper, fluoride, manganese, selenium, sulfate, and

vanadium were detected above domestic use and/or livestock and wildlife watering criteria. Fluoride, sulfate, and total dissolved solids are above relevant regulatory criteria in background coal groundwater. Background groundwater fluoride levels are at 2.5 milligrams per Liter (mg/L) and fluoride increases in all CCB leachates to between 3.2 and 5.0 mg/L. However, fluoride values in 18-hour and 45-day spoil leachates are attenuated below regulatory criteria with values of 1.6 and 1.5 mg/L, respectively. Bottom ash leachate also indicates some fluoride attenuation with a lower fluoride concentration of 2.2 mg/L compared to the initial groundwater concentration of 2.5 mg/L.

Arsenic was only detected in the second successive CCB composite leachate at a value of 0.11 mg/L just above the practical quantification limit and the Navajo Nation domestic use and livestock and wildlife watering criteria. Aluminum, boron, copper, and vanadium were detected above regulatory criteria only in some CCB leachates but were not consistently in all CCB leachates. For example copper was only detected above regulatory criteria in the 45-day CCB leachate and not the 18-hour or other leachates involving CCBs. Additionally, attenuation of arsenic, boron, barium, fluoride molybdenum, selenium, and vanadium was achieved when these elements were generated in CCB leachate that was then leached through mine spoil solids.

41.A.1 INTRODUCTION

This report has been prepared to support the Probable Hydrologic Consequences (PHC) assessment of the planned placement of coal combustion by-products (CCBs) generated from the Desert Rock Power Plant (DRPP) in the mine backfill at the Navajo Mine Extension Project (NMEP). Placement of CCBs within the mine backfill is accepted practice for handling of the CCBs and this practice is currently in use at the adjacent Navajo Mine and nearby San Juan Mine. This minefill method for CCBs provides an appropriate placement location which serves to isolate these materials to prevent adverse impacts on surface water or groundwater and avoids disposal of this materials in landfills, surface impoundments, or other locations. The placement of CCBs within the mine backfill also helps to achieve approximate original contour requirements for mine reclamation.

The use of these materials as mine backfill is dependent on their inorganic chemistry and the potential for leaching of constituents of concern, including trace metals, to surrounding groundwater and surface water. The CCB materials used in this testing program were prepared to best represent the CCB material that would be generated from the combustion of NMEP coals at the proposed DRPP and placed at the NMEP as backfill along with spoil generated during the Navajo Mine coal mining operations. The testing and evaluation was performed in accordance with the "*Work Plan for CCB Testing and Evaluation for the Navajo Mine Extension Project"* (Work Plan). This Work Plan was submitted to the Office of Surface Mining Reclamation and Enforcement (OSM) prior to start of the work and is included as Attachment 41.A of this report. The Work Plan presents a detailed description of the work to be completed to generate the information on CCB properties and mine backfill characteristics. The resulting information as described in this report will be used to prepare the PHC assessment for proposed CCB placement in mine backfill at the NMEP.

41.A.1.1 ORIGIN OF COAL COMBUSTION BY-PRODUCT MATERIALS

DRPP will be a supercritical pulverized-coal power plant facility. Coal for the DRPP will be from the NMEP. CCBs generated by the plant include bottom ash, fly ash, flue gas desulfurization (FGD) products, and spent activated carbon. The DRPP will make use of clean air technologies to minimize emissions of potential air pollutants in the flue gas which likely includes the use of activated carbon injection (ACI) to reduce mercury (Hg) emissions. The air pollution controls planned for use at DRPP consist of the following as outlined in the Desert Rock Energy Project (DREP) Draft Environmental Impact Statement (EIS).

- Low nitrogen oxide burners and selective catalytic reduction to control nitrogen oxide emissions
- Low sulfur coal and wet flue gas desulfurization to control sulfur dioxide emissions
- Wet flue gas desulfurization and a wet stack to control acid gas emissions
- Wet flue gas desulfurization to control Hg emissions
- Activated carbon and hydrated quicklime injection to be installed before the fabric filter baghouse, with secondary reductions in sulfur dioxide emissions and sulfuric acid mist
- A fabric filter to control particulate emissions

- High efficiency combustion to control carbon monoxide and volatile organic compound emissions

The clean air technologies employed will result in enhanced reductions in air pollution. However, the clean air technologies also result in the concentration of trace metals and potential pollutants within the generated waste streams including pollutants captured or residing in bottom ash, fly ash, and FGD product. In addition spent carbon from the activated carbon injection system will likely be included in the CCBs.

Fly ash and bottom ash are generated during the combustion of coal and retain trace elements, including trace metals that are considered pollutants, found in the coal from which they originate. The fly ash is the noncombustible portion of the coal that is small enough to be carried with the fuel gas stream. The fly ash is collected from the flue gas stream in emission control baghouses. Particles that are too large to be carried by the flue gas fall to the bottom of the boiler during the combustion process and are removed as bottom ash. A 1987 Electric Power Research Institute (EPRI) report found concentrations of trace metals, including aluminum (Al), calcium (Ca), iron (Fe), magnesium (Mg) and silicon (Si), in fly ash and bottom ash.

As pulverized coal is burned in the power plant it will produce sulfur dioxide gas emissions. The sulfur dioxide will be removed through an FGD system. The FGD system will introduce an alkaline sorbent consisting of lime in spray form into the flue gas exhaust stream. The lime will react with the sulfur dioxide creating a slurry of calcium sulfite and calcium sulfate. The slurry is typically allowed to settle as a sludge product and the water is recycled. Because FGD systems are usually accompanied by or combined with a fly ash removal system, fly ash is often incorporated into the FGD product. Additionally, FGD can be used to attenuate Al in ash leachate.

ACI is used in fly ash bag houses to reduce trace metals, primarily Hg, in air emissions through adsorption of the Hg onto the activated carbon. Activated carbon is typically produced using oxygenation, high temperatures ranging between 800-900^{o}C and or a chemical or physical activation process (Bandosz 2006, Marsh and Rodriguez-Reino 2006). The activated product is extremely porous, resulting in a very large surface area. The large surface area created during activation results in significantly increased sorption potential for inorganic trace metals, such as arsenic (As), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), tin (Sn), Hg, and silver (Ag) (CSMWG 2003, Bandosz 2006, Marsh and Rodriguez-Reino 2006, Sellers 1998). As a result of the very high adsorption capacity for activated carbon that limits the potential for metals leaching, spent activated carbon from treatment facilities is often sent to landfills when it is not regenerated (Sellers 1998). In addition to its use in the treatment of coal combustion emissions, activated carbon is also commonly used in water purification of organic and inorganics. Activated carbon is injected into the flue gas stream and trace metals are sorbed onto the carbon. Hg is the targeted trace metal for removal using activated carbon injection, but other metals may be sorbed onto the carbon as well.

41.A.1.2 ORIGIN AND MAKE-UP OF MINE SPOIL MATERIAL

CCBs generated at the DRPP will be placed within the backfill of the NMEP along with spoil generated during mining to achieve approximate original contour of the surface. The mine spoil

is non coal overburden and interburden materials removed to allow access to the coals of the Fruitland Formation. The spoil is generally rock of varying sizes

Since the NMEP is not operational, spoils used for testing in this study were collected from the adjacent Navajo Mine in accordance with the Work Plan. The adjacent Navajo Mine mines coals from the Fruitland Formation, the same formation planed for mining in the NMEP and rock characteristics are expected to be essentially the same between the two mines.

41.A.1.3 COAL COMBUSTION BY-PRODUCT AND MINE SPOIL LITERATURE REVIEW AND TESTING PROGRAM

This report includes an evaluation of information available in the literature and in past studies conducted on similar materials; an analysis of representative samples of the composited CCB and spoil materials; an analysis of laboratory testing on leachate from a series of leaching tests performed on the spoil, CCB and a composite of both; and numerical model simulations.

Relevant literature was reviewed to identify the trace metals that may be present in leachate generated from saturated CCBs. The literature review also provided supporting evidence for empirical values used in numerical model simulations. The literature review included the review of published literature and investigations presented at technical conferences. In addition, previous assessments directly related to CCB placement in mine backfill at the Navajo and San Juan Mines were reviewed. Section 41.A.2 of this report discusses the literature review.

The leaching of trace metals contained in CCBs can be detrimental to the environment if the CCBs are not disposed of properly to mitigate any potential impacts of leaching on water quality Appropriate testing can help to predict if the trace metals will be released above relevant regulatory criteria. The test program for the CCB and spoil was presented in the Work Plan and is summarized in Section 41.A.3 of this document.

The materials were analyzed for mineralogy and content. Results of the CCB and spoil solids analysis are discussed in Section 41.A.4. The CCB and spoil materials were then subjected to varying leaching tests and numerical model simulations with the results discussed in Sections 41.A.5 and 41.A.6, respectively.

The results of CCB and mine spoil solids testing are provided in this report and are related to the current literature and previous site assessments. Laboratory analyses results were validated prior to analysis and interpretation. Leaching tests were performed under different saturation scenarios to understand how concentrations of constituents influence water quality (Section 41.A.5). Additionally, geochemical modeling was performed and is discussed in this report providing an understanding of the processes affecting the leaching of trace metals and major ions from CCB and mine spoil materials and is used to support interpretation of leachate testing results (Section 41.A.6). Solids analyses and x-ray diffraction (XRD) used to characterize the mine spoils and composite CCB materials in conjunction with water quality analyses from leachate tests and geochemical modeling provide the supporting evidence needed to assess fate and transport of potential contaminants from materials planned as backfill at the NMEP site.

41.A.2 LITERATURE REVIEW OF COAL COMBUSTION BY-PRODUCT MATERIALS AND PUBLISHED RESULTS OF PAST TESTING

41.A.2.1 OVERVIEW

The literature was reviewed for information pertaining to environmental stability of CCBs associated with ash and clean air technologies (i.e. ACI and FGD product). This review includes literature pertaining to the mineralogy of the Fruitland Formation, the chemical and mineral composition of CCBs from various emissions control technologies, and geochemical and leaching studies of CCBs. The literature review also provides information on the minerals that are expected to be found in the composite CCB samples after hydrolysis. Finally, the literature review was performed to assess the potential differences in leachate water quality that might occur due to the incorporation of activated carbon that will be used in clean air technologies at the DRPP but are not yet available for testing.

41.A.2.2 FLY ASH

As previously discussed, fly ash is very fine particles of ash generated from the combustion of coal. Fly ash retains trace elements found in the coal from which they originate. The fly ash is collected from the flue gas stream in emission control baghouses. The original composition of the feed coal, the combustion conditions, the size of the fly ash particles, and the fly ash mineralogy influence the distribution and mobility of trace metals from fly ash into the environment including groundwater and surface water (Brownfield et al. 1999). Reactions between the fly ash and water solutions, including recharge through precipitation or groundwater inflow, change the overall resulting solution composition through precipitation, dissolution, oxidation, reduction, and ion exchange reactions. These reactions then affect the pH and the mobility of trace elements (Rice et al., 1999). The pH dependency of trace metal mobility emphasizes the importance of solution-solid phase interaction in controlling trace element mobility.

Ash and ash leachate geochemical characteristics, including pH and trace metal form and composition, are determined by coal characteristics including coal rank and coal mineralogy (Evangelou, 1996). In some cases fly ashes formed from combustion of high rank coals (e.g., bituminous) have been found to be acidic with no liming value or acid neutralizing capacity. Fly ashes from the combustion of lower rank coals tend to have a considerable liming value that is related to their higher content of alkali oxides and anhydrous Ca- or Mg-sulfates. The ash formed from sub-bituminous coals from the Fruitland Formation would then be expected to have some liming value compared to ash generated from bituminous coals. The implications of liming are related to sorption and trace metal transport and pH control. Nevertheless, data from Evangelou (1996) showed that both acid and alkaline fly ash samples exhibit greater potential to adsorb heavy metals at higher pH levels within the range of pH tested. Evangelou (1996) concludes that ash disposal sites should always have the pH maintained at above 6 in order to keep most heavy metals immobile.

Evangelou (1996) describes fly ash being comprised of three groups of solid components. The first group is non-water reactive oxides of Si, Al, Fe, and titanium (Ti) (Terman, 1978; Adriano et

al., 1980). However, these oxides are associated with electrically charged surface sites that can adsorb metal cations, such as Cd, Ni, and Pb, or oxyanions including arsenate, borate, and sulfate. The second group of components includes the metal cations and oxyanions that can be adsorbed onto the oxide surfaces. The chemical behavior and release of heavy metals and oxyanions to water is highly interrelated to the surface electric properties of oxides. The third solids group is extremely reactive with water and includes oxides of Ca, sodium (Na), Mg, potassium (K), and barium (Ba), as well as gypsum and sulfite. Fly ash from lignite and sub-bituminous coals can also contain significant quantities of anhydrous Ca and Mg sulfates.

Previous mineralogical and trace metal analyses have been conducted on ash produced from combustion of Fruitland Formation coals from the Navajo Mine. These analyses were performed using the ASTM International (ASTM) standard method for characterization of coal fly ash. The ash was produced from the Fruitland Formation coals, but at the Four Corners Power Plant (FCPP) and may not necessarily represent the composition of fly ash that will be produced at the proposed DRPP. Nevertheless, the principal components of fly ash should be represented by these results and serve as a background for the major composition found in typical fly ash from the Fruitland Formation coals. The fly ash is comprised largely of oxides of Si and alkali earth metals (Table 41.A-1). The fly ash also contains secondary components of carbon and trace elements (e.g., As, Ba, Cd, Cu, zinc (Zn), and others) (Table 41.A-2). The types of metals and their concentrations will vary depending on the characteristics of the combustion processes of the plant with these results serving as a starting point for comparison to results from this study.

The concentration of many fly ash leachate elements, including trace metals, B, and fluoride (F), are a function of pH and ionic strength. Bonetti et al. (1996) found that trace elements in fly ash leachates were at the lowest levels over the pH range of 6.00 to 8.06. Bonetti et al. (1996) also noted that As, B, and Cr are related to surficial sorption processes of fly ash that are more easily leached and or involved in ion exchange. In contrast, Pb and other trace elements are held within the interior matrix of fly ash particles and thus are more stable and unlikely to leach from the fly ash material. These results show that concentrations of many trace elements in leachate are not directly related to total concentrations of these constituents in CCB materials.

Scheetz et al. (2005) and Schlorholtz et al. (1987) describe and model the behaviour of fly ash as it is hydrated in a mine backfill scenario. The hydration of ash results in meta-clay pozzolanic reactions forming the mineral ettringite and amorphous hydrous Ca silicate. The formation of ettringite is an important process because it can be involved in As attenuation (Scheetz et al. 2005). Scheetz et al. (2005) used Portland cement as an analog for ettringite formation in geochemical modeling of the batch leachate tests (Eq. 2.3-1).

Eq. 2.3-1: Alumino-silicate + $CaSO_4 \cdot 2H_2O \rightarrow Ca_6Al_2(SO_4)_3(OH)_{12} \cdot 24H_2O$ (Scheetz et al. 2005)
clay + gypsum → ettringite

Initially, ash leachate reactions typically result in the dissolution of alkali oxides such as lime, resulting in pH values in excess of 10.0 (Donahoe 2004). However, over time, the incorporation of carbon dioxide gas, mineral dissolution, and precipitation reactions can significantly lower pH values to near neutral (Donahoe 2004). Donahoe (2004) describes a four-step process presented by Janssen-Jurkovicovfi et al. (1994) of alkaline fly ash weathering including ash hydrolysis, secondary mineral precipitation, and dissolution reactions that typically occur with the introduction of water. The first step involves a rapid initial increase in pH to approximately 11.0

as oxides and salts dissolve. The second step involves the release of metals as the high pH solution dissolves the more soluble glass at the outer surfaces of ash particles followed by precipitation of alumino-silicates and Fe hydroxides on the surfaces of ash particles. During the second step, dissolution and precipitation reactions along with the carbonation provided by carbon dioxide in the air or from organic decay results in a buffering of the pH to a value of ~8.0. The third and fourth steps involve continued dissolution of ash, and formation and aging of secondary amorphous mineral phases including Fe oxides, clay minerals, and zeolites (Donahoe 2004). These secondary amorphous mineral phases have very high adsorption capacities and exert a major control on trace element mobility (Donahoe 2004).

41.A.2.3 FLUE GAS DESULFURIZATION PRODUCT

As previously discussed, FGD product is produced by clean air scrubbers that remove sulfur dioxide pollution from the flue gas emissions using lime and results in the formation of calcium sulfite and calcium sulfate. The planned DRPP wet limestone scrubber technology is comparable to the technology used at the San Juan Generating Station (SJGS). The primary constituents associated with FGD product for potential release are Ca and sulfate with very minor contributions of trace metals. Ziemkiewicz (2005) found that trace metals were significantly lowered and reduced to levels below groundwater regulatory standards in column leachate tests of FGD solids. This was in part attributed to pH control and the precipitation of Fe oxyhydroxides that co-precipitated other metals. The precipitation of Fe oxyhydroxides would also increase the available surface area for sorption of trace metals. However, Ziemkiewicz (2005) did note that boron (B) was elevated above groundwater regulatory standards.

Additionally, the use of FGD product can be used to attenuate Al in ash leachates. Gypsum, the primary mineral in FGD product, results in the formation of relatively insoluble Al-hydroxy-sulfates (Evangelou 1996) and the sulfate and Ca from gypsum dissolution can limit bioavailability of Al (Ziemkiewicz 2005).

41.A.2.4 ACTIVATED CARBON INJECTION

As previously discussed, ACI is used in fly ash bag houses to reduce trace metals, primarily Hg, in air emissions through adsorption of the Hg onto the activated carbon. Concerns have been expressed in public comments on the DREP EIS and proposed plan for incorporation of CCBs into the mine backfill for the NMEP about possible leaching of Hg, Selenium (Se), and As from CCB residues generated using ACI technologies. Currently, ACI for Hg emissions controls is not utilized at local power generation facilities. Thus, samples that are entirely representative of the CCBs that would be generated from combustion of Fruitland Formation coals using ACI for emissions control were not available for evaluation, testing, and comparison as part of this study. Consequently, the possible effect of ACI on CCB leachate chemistry is assessed through literature studies until CCB samples containing ACI from the DRPP are available for testing.

Hg is generally expected to be of greatest concern with respect to ACI as it is the target element for removal from the flue gas stream using ACI technology. While Hg is concentrated in the activated carbon captured in the fly ash, all of the studies in the literature indicate that leaching of Hg from ACI fly ash is minimal. Studies performed by the Environmental Protection Agency's (EPA's) National Risk Management Research indicate that leaching of Hg from ACI materials does not occur at levels of concern (NAC 2006). Likewise, a Department of Energy (DOE) National Energy Technology Laboratory (NETL) sponsored study found that, although Hg and sometimes

Se are present at higher concentrations in CCBs generated using ACI, Hg is not readily leached from CCBs (Hassett et al., 2007). Hassett et al., 2007 shows Hg was below the analytical detection limit in most of the leachate sample results and found that Se concentrations were higher in the short-term leachates from CCBs with ACI materials in comparison with CCBs without ACI. The study also found that concentrations of As, Se, and B were reduced in long-term leachates as these elements that are most likely to be incorporated into the ettringite mineral structure that develops over time in CCBs exposed to water.

An EPA sponsored study by Sanchez et al. (2006) performed extensive laboratory leaching tests on CCB samples from four coal combustion facilities using powdered activated carbon injection and from two facilities using brominated powdered activated carbon injection to control Hg emissions. For each facility, the evaluation included assessments of CCBs generated both with and without use of the activated carbon injection. Laboratory leaching tests were performed over a large range of pH conditions to assess the behavior of CCBs in the context of a wide range of disposal conditions associated with surface impoundments and landfills. The study concluded that leaching of Hg from CCBs generated from activated carbon injection emission control technologies did not appear to be of concern, but that As and Se may be leached at levels of potential concern from CCBs generated at some facilities both with and without enhanced Hg control technology. Leachate concentrations of As and Se did not correlate with total content of these elements in the CCB test samples. Instead, leachate concentrations were observed to vary with final pH conditions, suggesting that geochemistry and solubility control the observed leachate concentrations.

Other studies of fly ash leachate using fly ash generated from traditional processes and advanced technologies including ACI found that fly ash generated by ACI, compared to fly ash without ACI, results in a finer grain size and higher total concentrations of Hg and Se but no increase in the concentrations of As, Cd, Cr, Cu, Pb, and Ni. While the analysis of the solid fly ash material showed higher total concentrations of Hg and Se the results of leachate studies exhibited no significant increase in Hg and Se leachability versus fly ash generated without ACI (Kazonich et al. 2005, Hassett et al. 2005, Kim and Schroeder 2005, Pflughoeft-Hassett et al. 2007, Starns et al. 2003, and Xin et al. 2006).

Aljoe et al. (2005) provides a summary of DOE NETL's extensive research on the environmental characterization and fate of Hg in CCBs. The results show minimal Hg release to the environment from CCBs generated using both ACI and wet FGD control technologies. The 2005 study found the amount of Hg leached from CCB materials is significantly lower than the federal drinking water standards and water quality criteria for the protection of aquatic life. In many cases, Hg concentrations in the leachate were below the detection limits of the analytical methods.

Starns et al. (2003) and Senior (2004) report significantly higher total concentrations of Hg in fly ash with ACI, while Hg concentrations in leachate from toxicity characteristic leaching procedure (TCLP) and synthetic groundwater leaching procedure (SGLP) tests of ACI-generated fly ash were approximately two orders of magnitude lower than the primary drinking water standard and not significantly different than leachate from fly ash without ACI. Pflughoeft-Hassett et al. (2007) also report higher total concentrations of Hg in fly ash with ACI, although the Hg is not released in leachate and remains stable when exposed to water. Pflughoeft-Hassett et al. (2007), Starns et al. (2003), and Senior et al. (2004) reported no significant release of Hg using both

TCLP and SGLP leachate tests on fly ash and ACI generated from different coal types including sub-bituminous ranks similar to those that will be used at the DRPP. Pflughoeft-Hassett et al. (2007) demonstrated using a long-term leaching procedure that Hg sorbed with ACI is stable over time.

41.A.2.5 ARSENIC, SELENIUM, BORON, AND FLUORIDE LEACHING

As, Se, B, and F are often associated with CCB leachates and could pose a potential groundwater and surface water quality concern if released at high concentrations. Studies indicate that their release is typically attenuated and first flush concentrations from leachate studies typically over predict the concentrations that might be observed under field conditions (Paul and Chen, 2001). A brief literature review of studies describing the potential behaviour of these elements has been completed to allow comparison of the information found in literature to the observed presence of these elements in the leachate batch testing performed for this study.

An EPRI (1987) study concluded that B, F, and Se were concentrated in fly ash and FGD product. The EPRI (1987) study also concluded that the composition of leachates from the CCB materials was extremely variable and related to pH, the degree of aqueous complexation of elements, and the types of solubility-controlling solids formed. The aqueous concentrations of trace elements As, Cu, Ni, and Zn show pH-dependent solubility and were at or near the detection limits in most leachates from fly ash at pH values greater than 5.0. Se also shows pH-dependent solubility with higher leaching potential under alkaline conditions (i.e., when pH is greater than 10.0). Se also attenuates moderately well through adsorption onto mine spoils and aquifer materials (Murarka 2003).

Murarka and Erickson (2006) report case studies of trace metals monitoring near CCB placement as fill for backfilling of mines and to mitigate acid mine drainage. Their results indicated that little to no impacts were observed from constituents of concern such as trace metals including As, Se, B, and F. Murarka and Erickson (2006) also indicated that concentrations of trace elements from leachate studies can far exceed observed values in the field. These differences can be associated with the high liquids to solids ratios and pulverization of samples creating greater reactive surface area. The first flush of salts is not sustainable in longer-term leachate tests. Lastly, the reduced permeability and flow associated with ash in field scale scenarios also resulted in low concentrations of trace elements in field testing.

There is an extensive body of studies on As sorption onto Fe and Al oxides, aluminosilicates, and clays (Lombi et al. 1999, Manning and Goldberg 1997, Livesey and Huang 1981, Matisoff et al. 1982, Dzombak and Morel 1990, Boland et al. 1999, Kinniburgh and Smedley 2001, Murarka and Erickson 2006). The speciation of As plays an important role in transport. For the arsenite ion, the reduced form As(III), sorption is greatest between pH values 7 to 9 while for arsenate, the oxidized form As(V), sorption is greatest at lower or acidic pH values (Boland et al. 1999, Kinniburgh and Smedley 2001).

B is an important constituent often identified with CCBs because it can be elevated in ash leachates as compared to groundwater background concentrations. Nearly all CCBs contain soluble salts, which if exposed to groundwater, will dissolve or release constituents such as B, chloride, and Na carbonates through desorption reactions (Ziemkiewicz, 2005). B has been identified in literature as sorbing to Al, Fe, and manganese oxides, silicates, and clays (Spivack et

al. 1987, Schwarcz et al. 1969, Goldberg and Glaubig 1985, Boland et al. 1999). B naturally occurs in the minerals tourmaline (Garrett 1998, Boyd 2002), illite (Garrett 1998), reedmergnerite (B albite) (Clark and Appleman 1960 Milton et al. 1960, Fleet 1992, Garrett 1998), as boralsilite which is a "Boron-Mullite" (Grew et al. 2008) or other boro-silicates (Garrett 1998), and in feldspars (Garrett 1998). B could potentially be associated with these minerals and or as evaporite type minerals (i.e. Na borates) in the spoil and CCB composites.

Increased leaching of B is observed in leachates in which the pH is initially high and decreases over time (Terman 1978, Adriano et al. 1980, Boland et al. 1999). This observation indicates a pH controlled sorption that is most likely associated with the speciation of B between the boric acid and the borate anion. At higher pH values (> 9.2), B is speciated primarily into the anion form, which is more likely to sorb due to the negative charge as compared to the neutral boric acid species (Stumm and Morgan 1996). As the pH is lowered, the B shifts from the anion to the neutral species and B is released from positively charged sorption sites increasing its dissolved concentration.

Hollis et al. (1988) determined that soluble B in fly ash was primarily associated with the small particles of ash and that dissolution was independent of the dissolution of Ca from fly ash, indicating that it was not associated with gypsum, Ca oxyhydroxides, or calcite. Rather, Hollis et al. (1988) determined that B was strongly affected by pH and that a decrease in pH from 12.5 to 6.0 increased the release of B into solution indicating a sorption process. Moreover, Hollis et al. (1988) also noted that some B was still adsorbed by fly ash at pH 7.0 and indicated that this was due to ligand exchange. Hollis et al. (1988) also stated that sorption of B increased with increasing pH, up to 12.0, and that this could not be explained by ligand exchange and therefore was the result of coprecipitation with calcite (Hollis et al. 1988). Furthermore, the speciation of B could be the process associated with sorption of the negatively charged borate anion, which is the dominant form of B above a pH of 9.2. Research by Paul and Chen (2001) supports the concept that sorption controls B concentrations derived from fly ash leachate, stating that high B releases observed in standard shake tests are usually due to soluble B located in surface coatings on the particles and that this is common with fly ash. Paul and Chen (2001) also concluded that the release of B from surface B coatings provide an initial release of B that is not sustainable. They stressed that that reliance on initial leachate test values for B concentrations can lead to errors resulting in "drastic overestimation of the extent and concentration of B plumes."

Another study by Boyd (2002) found that leachate studies showed no relationship between the B content found in fly ash and concentration of B leached from ash samples using reagent water. Boyd (2002) concluded that B is not leached from fly ash and that fly ash disposal does not pose a concern for B release into the environment. While the conclusions differed between Hollis et al. (1988) and Boyd (2002), the implications are that B may be present in fly ash at concentrations of potential concern, but release and attenuation is controlled to varying degrees depending on the disposal environment and the characteristics of the fly ash.

Laboratory studies and literature for F indicate the potential for attenuation in ash and native coal aquifer materials (Stumm and Morgan 1996, Piekos and Paslawska 1998, Boland et al. 1999, Agarwal et al. 2002, Harrington et al. 2003, Pekař 2006). Sorption of F on fly ash is shown by Piekos and Paslawska (1998) as being effectively sorbed even at higher concentrations. Pekař (2006) shows that F is strongly bound to lignite coals and that coal aquifers may provide attenuation of any F leached from CCBs. Boland et al. (1999), Agarwal et al. (2002), and

Harrington et al. (2003) also indicate the potential for native materials to attenuate F through pH controlled sorption processes associated with clays and oxides with the greatest sorption occurring at pH values above 7.0 for clays. Harrington et al. (2003) determined that F sorption was strongly related to surficial ligand exchange with hydroxyl groups and water on Al and Fe amorphous and crystalline oxide surfaces. Boland et al. (1999) also noted that F mobility is low in calcareous soils because it is limited by incorporation into insoluble Ca minerals (i.e. hydroxyapatite).

The Fruitland formation lithology was described by Lucas et al. (2006) as being comprised of interbedded sandstone, mudstone and coal, and minor volumes of clinker, siltstone and sideritic concretions. The observation of siderite provides a means for the presence of Fe in the spoil samples. The presence of Fe in both the spoil and CCBs is an important component in the retention of trace metals that are of potential concern. Trace metals are known to sorb to Fe oxide surfaces. As CCB materials become saturated in the environment, geochemical reactions result in the additional precipitation of Fe oxide and hydroxide minerals that are present in the spoil.

41.A.2.6 Previous Coal Combustion By-product Studies Completed at the Navajo Mine and San Juan Mine

41.A.2.6.1 Previous Testing at Navajo Mine

In support of the plan for CCB placement in mine backfill and the determination of the PHC at the Navajo Mine, BHP Navajo Coal Company (BNCC) completed detailed studies of the constituents leached from CCBs and the hydrogeology of the mine with respect to CCB placement locations. These studies included results of a 1984 study and report by IT Corporation entitled "Laboratory Assessment of Ground Water Quality Impacts from Ash Disposal at the Navajo Mine," which is included in Appendix 11-K of the Navajo Mine Permit Application Package (PAP). Note that the CCBs being disposed include only fly ash and bottom ash so the report uses the term ash instead of CCB materials to describe the waste products from the FCPP being disposed with the mine spoil at the Navajo Mine.

A "Supplemental Ground Water Study, November 1996 through March 1998" (SGS) was also completed and submitted to the OSM as Appendix 11-MM of the PAP. The purpose of the SGS was to investigate possible impacts to groundwater from previous CCB placement at the Navajo Mine. This investigation was accomplished by installing six groundwater-monitoring wells within mine backfill and CCB placement areas in the Watson and Bitsui Pits. The Bitsui Pit was largely saturated due to seepage from the adjacent center pivot irrigation conducted by Navajo Agricultural Products Industry. The results of the leaching and attenuation studies are summarized in Table 41.A-3 along with the groundwater sampling results from spoil and CCB wells installed at the Bitsui and Watson Pits.

Leaching test methods and results are described in the IT Corporation Report, Appendix 11-K, Tables 27-B13 through 27-B29 (Navajo Mine PAP). These tests were conducted using samples of CCB materials from the FCPP and mine rock spoils, which were used as pit backfill material at the Navajo Mine. Tests were performed using a batch leaching procedure, where the solids to water ratio was maintained at 1:4. Surface water samples from Chinde Arroyo and composite coal water samples from the Number 4 and 6-seam coals were selected as leaching fluids. The batch leaching test jars were placed in a tumbler agitator and the samples were tumbled

periodically for a total period of 48 hours over a 7-day period. Chemical analyses were performed on the leachate extracted following the 7-day period.

Table 41.A-3 includes the leaching test results that were summarized in Appendix 11-K Table 11-14 of the PAP. The table shows selected constituent analysis results for the surface water and groundwater samples used in the leaching test and the concentrations of pH, salinity, major ions, and trace metals in these fluids after leaching through different mixtures of spoil and ash. In general, the total dissolved solids (TDS) concentrations increase with leaching, primarily due to increases in Ca concentrations. Sulfate and manganese (Mn) concentrations increase in the leachate from spoils and in the leachate from spoils with CCB but remain unchanged or decrease in leachate from bottom ash and fly ash. Concentrations of Fe, As, and Cd remain unchanged or decrease, relative to source water, in the leachates from all samples while Se concentrations appear to increase slightly, relative to source water, in almost all of the leachates. B concentrations increase in fly ash leachate but not in leachate from bottom ash or spoil. The leaching test results reported show similar concentrations in leachates from spoils and CCB for most constituents (Table 41.A-3). However, based on these leaching test results for Navajo Mine spoils and CCB from the FCPP, water leaching through CCB would have higher B but lower sulfate than water leaching through spoils.

The same conclusions are reached when comparing constituent concentrations observed in a monitoring well completed in the CCB backfill (Watson 4) with constituent concentrations in wells completed in the spoil, Bitsui 4 and Bitsui 5 (Table 41.A-3). Concentrations of As, Cd and Se were at less than detection levels in the samples taken from the wells completed in both the spoil and the CCB backfill.

41.A.2.6.2 Previous Testing at San Juan Mine

CCB materials are also placed in the backfill at the San Juan Mine (SJM). These CCBs are composed of approximately 70% fly ash, 15% bottom ash, and 15% FGD (Luther et al., 2005). Tests were completed by conducting batch leaching tests on mine backfill samples and backfill-plus-CCB samples using a composite of groundwater from four wells completed in the 8-seam coal at the SJM. Laboratory leachates generated from the batch tests were analyzed for groundwater quality parameters. The laboratory leachates generated from mine backfill samples and backfill-plus-CCB samples were used as leaching fluids in batch tests performed on samples of the 8-seam coal to assess the attenuation characteristics of the coal.

Table 41.A-4 shows dissolved metal concentrations for the composite No. 8coal seam groundwater sample and the leaching test results for SJM batch leachate testing. The laboratory results show that the concentrations of Al, As, B, and F are higher in the backfill-plus-CCB leachate, while Fe and Mn are higher in the backfill only sample. Generally, the concentrations of most constituents decreased as a result of mixing with coal, although As increased in the coal attenuated backfill/CCB leachate and B increased in the coal attenuated backfill.

The SJM also conducted 18-hour leaching tests of CCB materials placed in mine pits using ASTM Method D-3987-85 (ASTM 1990). Composite CCB samples were obtained for testing from weekly sample aliquots. Deionized water was used as the leaching fluid in the tests in accordance with the testing requirements specified by the State of New Mexico. Mean concentrations from the leachate analysis results from 18-hour leachate quarterly monitoring data from 2001 through 2004 are presented in Table 41.A-5.

Analysis results that were below the practical quantification level (PQL), or the lowest level achievable by good laboratories within specified limits during routine laboratory operating conditions, were assumed to be at concentrations of one half the PQL for calculating the mean concentrations in Table 41.A-5. The results in the summary show that the mean Al levels in CCB leachate from the 18-hour leachate procedure were all below levels measured in the backfill only leachate test, with the exception of the backfill/CCB leachate result of 2.2 mg/L (Table 41.A-4). As and Ni concentrations were frequently not detected at the PQL in many of the leaching tests of CCB materials. Levels of B in leachates of CCB materials were higher than the B concentrations in the water from the No. 8 coal seam or in the backfill only leachate (Table 41.A-4). Concentrations of F in fly ash and bottom ash leachate are below the concentrations in the water from the No. 8 coal seam or in the backfill only leachate, while the F concentrations in the FGD leachate exceed the No. 8 coal seam background groundwater concentrations (Table 41.A-4).

41.A.2.7 CONCLUSIONS FROM LITERATURE REVIEW AND PAST TESTING RESULTS

The literature review provides insight into the controlling mechanisms associated with the environmental stability of CCBs from the various coal sources and coal combustion facilities that are placed in a wide range of environments. The original composition of the feed coal, the combustion conditions, the size of the fly ash particles, and the fly ash mineralogy all influence the distribution and mobility of trace metals from fly ash and FGD product. Reactions between the CCBs and water in the solution change the solution composition, which in turn affects the pH and the mobility of trace elements. Nevertheless, multiple laboratory and field investigations of CCB materials in a range of emplacement environments have indicated minimal migration of trace metals due to pH-controlled precipitation reactions, adsorption and ion exchange with the least amount of impact generated under neutral to alkaline conditions that are expected with the DRPP CCBs. Additionally, it is found that batch leachate tests can over predict the concentrations of pollutants found at field sites and that there may exist a potential first flushing effect which is not sustained in subsequent flushes.

The leaching test and groundwater monitoring results conducted at the Navajo Mine and SJM provide a good indication of the pH, salinity, major ions, and trace metals leached from mine spoils that are considered representative of mine spoils at the NMEP and from CCBs that are from the same coal source that will be used at the DRPP. However, the CCBs from the DRPP, which are planned for placement in mine backfill at the NMEP, will differ from the CCBs placed at Navajo Mine in two major respects.

- First, the fly ash at the DRPP will be generated from clean air technologies designed to minimize emissions of potential air pollutants in the flue gas including the use of ACI to reduce Hg emissions. The possible effect of clean air technologies on CCB leachate chemistry from the DRPP has been addressed from literature studies, which generally show that leaching of activated carbon does not increase metal concentrations despite the higher concentration of metals within the activated carbon material. An EPA sponsored study by Sanchez et al. (2006) found that, depending upon the chemistry of the water used for leaching and the pH in the leaching environment, As and Se may be leached at levels of potential concern from CCBs generated at some facilities both with and without enhanced emissions control technology. This suggests that As and Se leaching is not directly linked to the use of activated carbon.

- Second, the composite CCBs planned for placement at the NMEP will include approximately 15% FGD product. To date FGD product has not been included in CCB material placed at the Navajo Mine. The primary constituents associated with FGD product for potential release are Ca and sulfate with minor contributions of trace metals. Thus, the observations from leaching tests and groundwater monitoring at the Navajo Mine that water leaching through CCBs would have lower sulfate than water leaching through mine spoils may not apply to CCBs containing FGD product. Dissolution of gypsum from FGD can change the chemistry of the composite CCB material placed at the NMEP. For instance, the gypsum in the FGD product contributes significant amounts of Ca and sulfate that can result in the formation of relatively insoluble Al-hydroxy-sulfates that attenuates Al in solution.

Consequently, as described in Section 3 of this report, leaching tests for this study have been performed using a composite CCB sample that has been prepared to best represent the CCB material that would be generated from the combustion of NMEP coals at the proposed DRPP. This includes the use of FGD product in the composited CCBs tested, but does not include the use of ACI. These leaching test results combined with geochemical modeling provided in Section 6 of this report provide a basis for assessing the leaching of trace metals and major ions from CCBs and mine spoil materials placed as mine backfill at the NMEP site and the fate and transport of the leached constituents in groundwater. ACI as part of the NMEP CCBs are evaluated through a literature review and will be confirmed through additional test work to be completed once a sample is available.

41.A.3 COAL COMBUSTION BY-PRODUCT AND MINE SPOIL TESTING PROGRAM

The proposed Work Plan for testing and evaluation of CCB and CCB mixed with mine spoil was developed by Norwest Applied Hydrology in 2007 and provided to OSM for review. The plan detailed the major tasks to be undertaken to develop information on CCB properties and mine backfill characteristics to complete the PHC assessment for the proposed CCB placement in mine backfill at the NMEP. The Work Plan is included as Attachment 41.A.A. The following discussion summarizes the testing procedures to provide a background and understanding for interpreting the results presented in Sections 4 through 6.

41.A.3.1 REPRESENTATIVE SAMPLE COLLECTION

The geochemical testing was conducted using available materials that are representative of expected CCB and mine spoil. Since the DRPP from which the actual CCBs will be obtained is not yet operational and the NMEP has not commenced mining operations, representative samples from existing facilities were obtained and used for the testing. Once the DRPP and NMEP are operational, representative samples will be obtained and tested using the same protocols to confirm the conclusions reached in this study.

41.A.3.1.1 Coal Combustion By-product Samples

CCB materials to be used in mine placement at the NMEP are estimated to be composed of approximately 70% fly ash, 15% bottom ash, and 15% FGD. Representative samples of fly ash and bottom ash were obtained from the FCPP that burns coal from the Navajo Mine. The coal seams mined at Navajo Mine are the same coals that will be mined at the NMEP.

Currently, ACI for Hg emissions controls is not utilized at the FCPP or other local power generation facilities. Thus, the possible effect of ACI on CCB chemistry has been addressed through literature studies. Once ACI CCB samples are available from the DRPP, these will be tested to confirm the conclusions of the literature review that Hg leaching from ACI fly ash is expected to be minimal (see Section 2).

The wet limestone scrubber technology for FGD utilized at the SJGS is comparable to the technology proposed for the DRPP. The FGD product from the SJGS is placed as backfill at the SJM and this material was used to prepare the 15% FGD in the composite CCB samples used for this testing program.

Composite samples of fly ash, bottom ash, and FGD product were obtained from three random sample aliquots of equal volume collected from these facilities over a period of one week. Composite samples consisted of a minimum of 3 kilograms (kg) of fly ash and 0.5 kg each of bottom ash and FGD. These samples were sent to the laboratory where a composite CCB sample was be prepared consisting of 70% fly ash, 15% bottom ash, and 15% FGD by weight.

The composite CCB sample was mixed and reduced in particle size as required by EPA Method 1312. Then three subsamples of the composite sample were used for chemical and mineralogical analysis.

41.A.3.1.2 Mine Spoil Samples

Composite spoil samples were obtained from the adjacent Navajo Mine in accordance with the current regraded spoil sampling plan. Samples were collected on a 2.5-acre (ac) square grid. The 2.5-acplot was divided into four equal subplots (0.625 ac each). A four-foot deep sample pit was then excavated in the center of each subplot. In order to obtain a representative sample of composite spoil material, sub-samples were collected over the interval from zero to four feet at each of the four subplot locations and one composite sample was prepared from the four sub-samples. The composite sample was be comprised of a minimum of 2 kg of spoil material and was split in the field using a corner to corner sampling technique (USDA-NRCS 1996).

Composite samples were collected, following the same procedure, at three additional 2.5-ac plot locations. Solids analysis was conducted on sample splits from each of the four 2.5-acre grid locations. The other split samples from the four 2.5-ac plots were combined and mixed to form a single composite sample of approximately 4 kg. This composite sample and the four splits were sent to the laboratory for geochemical testing.

The four individual sample splits were analyzed for trace metals and major ions in order to characterize the broad spatial variability in spoil material. The composite sample was mixed again in the lab and reduced in particle size as required by EPA Method 1312. Three subsamples of the composite sample were obtained for chemical and mineralogical analysis.

41.A.3.1.3 Ground Water Samples

A composite sample of coal water was be obtained from equal proportions of water extracted from the No. 8 coal seam well KF-2007-01 and from the No. 3 coal seam well KF-98-02 at the NMEP. The two wells are representative of groundwater from the upper and lower coal units at the NMEP project site. Two 5-gallon containers of coal water sample were obtained from each well. The 5-gallon containers were sent to the laboratory where composite coal water was prepared for use in the batch tests. Two duplicate samples were obtained from the composite coal water and submitted for chemical analysis.

41.A.3.2 LABORATORY LEACHING TEST PROCEDURES

The leaching tests were conducted using the EPA Synthetic Precipitation Leaching Procedure (SPLP, SW-846 Method 1312), the Synthetic Groundwater Leaching Procedure (SGLP), and modifications of these tests. Modifications to the standard test were performed to address site specific conditions. The modifications were as follows:

1. Use of leaching fluids that are appropriate to the site through collection of groundwater samples in addition to the synthetic rainwater that is specified in the SPLP method (Section 3.1.2.1).
2. Inclusion of a 45-day leach test in addition to the method specified 18-hour leaching procedure, in order to assess the impacts of longer exposure to the leachant.
3. For the 45-day leach test, it was not practical for the laboratory to tumble the sample for the entire period. Thus the procedure was modified to include periodic 18-hour tumble of the sample: at the start of the test, after 15-days, after 30 days and with a final 18-hour tumble at the end of the 45-day period. The periodic tumbling was followed by an extended period of

time during which the solids remain in contact with the fluid without tumbling intended to provide an indication of any leachability changes due to mineral aging, hydrolysis (e.g., ettringite formation), and diffusion.

4. The test was also modified in one set of experiments to use sequential leaching as described in EPA's multiple extraction procedure (MEP, SW-846 Method 1320). The purpose of this was to simulate solids exposure to fresh rainwater.

Proposed leaching procedures are provided as flow charts in Figures 41.A-1 through 41.A-4 and consist of the following components. The leachate name as used in the discussions in Section 4 through 6 is included in bold in the discussion below and also highlighted on the flow charts.

1. Use of coal well water and the synthetic leaching fluid described in Method 1312; CCB-exposed coal well water; and spoil-exposed coal well water.
2. A sequence in which CCB was leached in duplicate (18-hr tests) with coal well water (**CCB Leachate 1 and CCB Leachate 1 DUP**). The fluid remaining from that step was then used to conduct an 18-hour leach of spoil (**Spoil in CCB Water**). This sequence was intended to emulate the possibility of coal water passing through a layer of CCB, then a layer of spoil. Analyses of all leachates were performed, providing a duplicate analysis of the CCB leaching and a single analysis of the final leach with CCB-exposed coal water.
3. A sequence in which spoil was leached in duplicate (18-hr tests) with coal well water (**Spoil Leachate 1 and Spoil Leachate 1 DUP**). The fluid from that step is then used to conduct an 18-hour leach of CCB (**CCB in Spoil Water**). This step is intended to emulate the possibility of coal water passing through a layer of spoil, then a layer of CCB. Analyses of all leachates will be performed, providing a duplicate analysis of the spoil leaching and a single analysis of the final leach with spoil-exposed coal water.
4. A test in which CCB is exposed to coal water for 45 days according to the long-term leaching procedure described above (**CCB 45-Day**).
5. A test in which spoil is exposed to coal water for 45 days according to the long-term leaching procedure described above (**Spoil 45-Day**).
6. 18-hour leaching tests of CCB and spoil using the synthetic leaching fluid described in the SPLP (**CCB SPLP, CCB SPLP DUP; Spoil SPLP**)
7. A multiple extraction procedure on the CCB sample remaining after the 45-day leaching test (**CCB Successive #1, CCB Successive #2, CCB Successive #3**). In the procedure, the EPA multiple extraction procedure (MEP) will be modified so that the solid after the 45-day leaching test is isolated and exposed to fresh leachate (coal well water) a minimum of 3 times (18-hour extractions). In this procedure, additional 18-hour extractions will take place if the concentrations of contaminants of concern are observed to increase in the third 18-hour extraction compared to the first and second extractions. The test as described in the MEP is designed to simulate an active flow system in which groundwater is continuously moving through and flushing the system. It is proposed to provide additional information concerning the leaching characteristics of CCBs under different environmental conditions that may be useful for interpretation of future monitoring data.
8. Finally, an 18-hr leach test will be conducted on a bottom ash only sample (**Bottom Ash Leachate)**. Bottom ash consists of coarse grained materials that are quite inert and very permeable. Given these characteristics, bottom ash could be selectively used for various mine reclamation applications provided that any constituents leached from bottom ash materials meets relevant water quality criteria. For instance, one use could be the selective placement of bottom ash pit to ensure that any groundwater from an active flow system can

be directed away from placement of other CCB materials. Although active groundwater flow systems are not expected at the NMEP, it is proposed that bottom ash will be separately subjected to an 18-hour leaching with the coal water. This should provide an indication of the suitability of bottom ash as a permeable substrate for mine reclamation use.

41.A.4 SOLIDS ANALYSES

The solids, both spoil and CCB composites, were analyzed using Rietveld XRD for mineral identification, total metals analysis for major element identification, and cation exchange capacity (CEC) for determining the amount of exchange of cations between solution and solids. Data validation is a systematic process for reviewing, screening, checking, auditing, and verifying laboratory data to provide assurance that the data are adequate for their intended use. The Data Validation Summary report prepared by Gateway Enterprises (2008) is included in this report as Attachment 41.A.B. Gateway Enterprises is an independent contractor who performs data evaluations.

As discussed in Section 3, the spoil composites used in the leachate testing are comprised of samples collected from spoil backfill from the adjacent Navajo Mine, collected in accordance with the Work Plan.

Solids analysis was performed on sample splits from each of the four composite samples from the 2.5-ac grid locations. The individual sample splits (four samples) were analyzed for total trace metals and major ions in order to characterize the broad spatial variability in spoil material. The other split samples from the four 2.5-ac plots were combined and mixed to form a single composite sample of spoil material that was used for the leaching tests. Three splits of this composite spoil sample were taken for replicate for chemical and mineralogical analysis in order to assess homogeneity of the composite spoil sample. The four individual sample split results are contained in Attachment 41.A.C and Attachment 41.A.D. The following discussions focus on the three splits analyzed for the mixed composite sample discussed above.

The expected CCB materials mixture used as mine backfill from DRPP at the NMEP site are based on backfill operations at SJM as discussed by Luther et al. (2005) where the CCB mixture contains approximately 70% fly ash, 15% bottom ash, and 15% FGD product by weight. Representative samples of fly ash and bottom ash were obtained from the FCPP that utilizes coal from the Navajo Mine. The coal seams mined at Navajo Mine are the same coals that will be mined for use at DRPP. The FGD material used to prepare the composite CCB sample for leachate analyses in this study was obtained from SJM because the wet limestone scrubber technology that generates the FGD product at SJM is comparable to the technology planned for the DRPP. The CCB composite was prepared for batch leachate testing such that it would represent a mixture of the CCBs that are planned for placement in the mine backfill at the NMEP site. The composite CCB samples were prepared following the procedures outlined in the Attachment 41.A.B with each of the solid samples homogenized prior to compositing or analysis.

While the naming convention used in laboratory testing and sample reporting refers to CCB composites as “ash”, this report refers to the CCB composites as CCB to prevent confusion with ash only testing and to emphasize the fact that the solids tested were composites of fly ash, bottom ash, and FGD product. The inclusion of FGD product with the fly ash and bottom ash results in a significantly different chemistry than with ash alone.

41.A.4.1 RIETVELD X-RAY DIFFRACTION RESULTS

Rietveld XRD analysis was carried out in triplicate for both the spoil and CCB composite samples at the Department of Earth and Ocean Sciences, The University of British Columbia,

Vancouver, British Columbia under the direction of Professor Mati Raudsepp. The laboratory results are provided in Attachment 41.A.C.

41.A.4.1.1 Composite Mine Spoil Samples

A summary of composite spoil Rietveld XRD data is presented in Table 41.A-6. The spoil and CCB composite samples were analyzed in triplicate and the results indicate good reproducibility (Attachment 41.A.B). The spoil samples were also modeled by the XRD laboratory to fit a smectite model. However, the smectite model may not be highly accurate due to the large amount of amorphous material with no definite crystalline structure in the samples. The initial spoil model without a smectite fit indicates that the spoil is primarily comprised of quartz, kaolinite, and K-feldspar with lesser amounts (<5%) of gypsum, anhydrite, and calcite. Fitting the smectite model to the XRD data resulted in additional minerals montmorillonite, albite, and orthoclase. Although gypsum, anhydrite, and calcite were found in smaller relative amounts (<5%) in both interpretative results, their role in reactive chemistry is very important (Table 41.A-6 and Table 41.A-7). This is due to their high solubility and relatively quick dissolution and precipitation rates as well as the buffering capacity of calcite on pH where pH controls the sorption of trace metals and other potentially important constituents.

41.A.4.1.2 Composite Coal Combustion By-product Samples

A summary of Rietveld XRD CCB composite samples are provided in Table 41.A-8. Samples were analyzed in triplicate and resulted in good reproducibility. The CCB composite was found to be primarily comprised of gypsum, quartz, and mullite with lesser amounts (<5%) of calcite, dolomite, and magnetite. These samples were also associated with a large component of amorphous or very fine grained unidentified material lacking crystalline structure. The large contribution of gypsum is a result of the FGD processing. The large amount of amorphous material is comprised of oxides that are typically found in fly ash as seen in analysis of fly ash presented in Section 2. Additionally, as with the spoil samples, the lesser relative amounts (<5%) of calcite, dolomite, and magnetite do not preclude their role in reactive chemistry. As discussed above, the role of these minerals is important in geochemical reactions because of the high solubility and the relatively quick dissolution and precipitation rate of calcite and its buffering capacity on pH, where pH controls the sorption of trace metals and other potentially important constituents. The presence of magnetite is also important as magnetite is an Fe oxide and is important in the sorption of trace metals and other important constituents including B and F.

41.A.4.2 TOTAL METALS RESULTS

Total metals analysis was carried out in triplicate for both the spoil and CCB composite samples using method 6010B at Analytica Environmental Laboratories, 12189 Pennsylvania Street, Thornton, Colorado. A detailed description of sampling and testing is provided in the Attachment 41.A.B and laboratory results are provided in Attachment 41.A.D. The results are described in the following sections and correspond closely with previous findings for fly ash samples in the literature review in Section 2.

41.A.4.2.1 Composite Mine Spoil Samples

The composite spoil samples were analyzed for metals (Table 41.A-9). The composite spoils are primarily comprised of Ca, Fe, Al, Na, Mg, and K. There are trace amounts (<1%) of several other trace metals. However, the results for all three analyses indicate Ag, As, and thallium (Tl)

are not present. The major cations also correlate with the primary minerals identified in the Rietveld XRD analyses:

- Ca with gypsum, calcite, and montmorillonite;
- Al with plagioclase, K-feldspar, kaolinite, albite, orthoclase, and montmorillonite;
- Na with plagioclase, albite, and montmorillonite;
- K with K-feldspar and orthoclase; and
- Mg with montmorillonite.

Although relatively high Fe concentrations are observed in the total Fe (Table 41.A-9), no Fe containing minerals were identified in the XRD analyses. The Fe is associated with the non-identifiable amorphous material in the XRD analyses, most likely as amorphous Fe hydroxide. Additionally, siderite has been identified in the literature by Lucas et al. (2006) in the form of sideritic concretions.

41.A.4.2.2 Composite Coal Combustion By-product Samples

The CCB composite samples were analyzed for metals (Table 41.A-10). The CCB composite results are similar to the spoils and are primarily comprised of Ca, Al, Fe, Mg, Na, and K. Tl was the only trace metal that was not detected in any of the three analyses. Quantities of the other trace metals analyzed were much less than 0.01% of the total. The major cations can be related back to the XRD analyses:

- Ca can be associated with gypsum, calcite, and dolomite;
- Fe can be associated with magnetite; and
- Al can be associated with mullite.

However, no minerals were identified in the CCB composites using Rietveld XRD that contained Na or K. The large percentage of Na and K indicate that the material found in the amorphous phase during Rietveld XRD analysis contains oxides containing Na and K.

41.A.4.3 Cation Exchange Capacity

The CEC was measured for both spoil and CCB composites by Colorado Analytical Laboratories, Inc. using EPA method 9081 (US EPA 2007). The laboratory results are provided in Attachment 41.A.E and Table 41.A-11 provides a summary of the results. The analyses were carried out for the seven collected spoil samples; including the four individual samples from each plot and the three composited samples, and on the CCB composite which was analyzed in two duplicate samples.

The CEC value for the spoil samples ranged between 8.7 and 9.9 milli-equivalents per 100 grams (meq/100g) with an average of 9.3 meq/100g. The CEC value for the CCB composite samples ranged between 0.2 and 0.4 with an average of 0.3 meq/100g. These results indicate the relative ability of both CCB and spoil materials to sorb and exchange different cations. The CEC for spoil composite is more than an order of magnitude greater than for that of the CCB composite. In terms of trace metals and cations of concern the spoil may provide a greater attenuation than the CCB.

41.A.5 LEACHATE TEST RESULTS OVERVIEW

41.A.5.1 LEACHATE SOLUTIONS

The solutions used as the beginning leachant solutions included groundwater collected and composited from two coal monitoring wells at the NMEP and synthetic precipitation prepared in the laboratory, as described in Section 3 and in the Work Plan in Attachment 41.A.A. The water quality leachate data laboratory reports are provide in Attachment 41.A.F and quality assurance quality control documentation and review is provided in Attachment 41.A.B. Initial solution chemistry is summarized in Table 41.A-12. The Navajo Nation domestic use and EPA drinking water standards and health advisories and the Navajo Nation livestock and wildlife watering criteria are also included in Table 41.A-12 for comparison.

Table 41.A-12 presents all reported values above the PQL from the laboratory with the exception of quality assurance quality control analyses. The data below the PQL are listed with a "<" sign followed by the PQL value and data below the method detection limit (MDL) are presented with "<<" followed by the MDL. The Navajo Nation wildlife watering criteria for Hg and the Navajo Nation domestic use criteria for antimony (Sb), As, and Tl are below the laboratory method MDL. Additionally, the reported PQL values for Cd, Pb, and Se are above the Navajo Nation domestic use or EPA drinking water criteria. Detected values below the PQL that exceed Navajo Nation and EPA water quality regulatory limits are included in Table 41.A-12, with the reported value listed in the table after the PQL value. However, the PQL is the lowest level of quantification that a laboratory can reliably achieve based on specified limits of precision and accuracy relating to instrumentation and sample interferences. Thus, the values below the PQL reported in Table 41.A-12 are not considered reliable and should be considered non-detect.

41.A.5.1.1 Synthetic Precipitation Leachate Solution Chemistry

Synthetic precipitation was prepared in the laboratory and used as a surrogate for field site precipitation that could percolate through the backfill and provide recharge to groundwater and potentially surface water discharge. The prepared solution is highly purified water with strong solvating properties. The water quality is presented in Table 41.A-12 under the heading "Initial Synthetic Precipitation".

41.A.5.1.2 Coal Groundwater Leachate Solution Chemistry

In order to simulate the effects of natural background groundwater interaction and flow through the backfill, batch leachate tests were performed using groundwater collected from the site. The composite groundwater sample was obtained from samples collected from well KF2007-01, completed in the No. 8 coal seamof the Fruitland Formation, and from well KF-98-02, completed in the No. 3 coal seamof the Fruitland Formation. Each sample was combined to form a composite sample for use as the leachant in leachate batch testing. The two wells are representative of groundwater from the upper and lower coal units at the NMEP project site. The groundwater from the coal zones and precipitation recharge represent the water sources that are expected to resaturate the backfill materials after mining. The groundwater quality data for the composite coal water sample is presented in Table 41.A-12 under the field heading "Initial Coal Water".

The composite coal groundwater sample results indicate that the water would be suitable for marginal livestock use, although TDS, chloride, and F concentrations are above the Navajo

Nation Criteria for livestock and wildlife watering (Table 41.A-12). The groundwater would not be suitable for drinking water due to elevated TDS, chloride, F, and sulfate concentrations above the regulatory standards for drinking water. The composite coal water sampling results are consistent with the sampling results reported in Section 18 of the PAP for individual coal monitoring wells at the NMEP.

41.A.5.2 LEACHATE MAJOR ION CHANGES AND TRACE ELEMENT DETECTIONS

The data was plotted and reviewed for overall general geochemical changes between initial groundwater and the final leachates. Bar plot figures of leachate water quality data are presented in Attachment 41.A.G. These charts compare the major ion chemistry and trace metals in initial leaching solutions, coal water, and synthetic precipitation to the leachate water quality after geochemical reactions have taken place. Major ion compositions are also plotted in a Piper-trilinear plot in Figure 41.A-5.

41.A.5.2.1 Leachate Major Ion Changes

Major ion changes can be observed in the Piper-trilinear diagram provided in Figure 41.A-5 and as major ion water types (Table 41.A-13). The TDS in the leachate from CCB and spoil increase significantly while the TDS in the leachate from the bottom ash does not. This indicates that major constituents in groundwater leached through bottom ash are not significantly affected. Both the CCB and spoil leachates resulted in significant TDS increases that are primarily a function of leaching of Ca and sulfate. For those tests performed using coal water, the water changes from a Na bicarbonate water-type to a Na sulfate water-type with the exception of CCB Successive #2, CCB Successive #3, and Bottom Ash 18-hour leachates. For these three tests, the water stays as a Na bicarbonate water type. For the leaching tests performed using synthetic precipitation, the water changes from a Na bicarbonate water type to a Ca sulfate water type. These results indicate a significant source of sulfate in both the spoil and CCB. The first leachate for the successive CCB leaching, CCB Successive #1, resulted in major ion changes similar to the CCB leachate indicating a source of sulfate. However, the successive leaching of CCB (CCB Successive #2, CCB Successive #3) and the Bottom Ash 18-hour leachates all retain a similar relative major ion contribution to the original coal water used for the leaching. These results indicate substantial removal of leachable material in the first flush of the CCB material such that subsequent leachate more closely represent the original coal groundwater leaching water source. Additionally, the bottom ash contributes little in terms of major ion chemistry resulting in a major ion composition similar to the original coal groundwater.

As the sulfate is increased both bicarbonate and carbonate in the initial coal groundwater are reduced in both CCB and spoil leachates, but not in the bottom ash sample. Reduction in carbonate concentrations is reflected by a pH drop from approximately 9.0 in the coal groundwater to 7.7 and 8.0 in the CCB and spoil leachates, respectively. The sulfate and TDS in all the leachates exceed criteria for the Navajo Nation domestic use and or the Navajo Nation livestock and wildlife watering criteria.

The EPA secondary drinking water limits for chloride are exceeded in all samples except for all SPLP leachates. Additionally, chloride does not increase in value in groundwater leachates and increases from non-detect to 1.5 mg/L and 5.6 mg/L in spoil and CCB SPLP leachates, respectively. Chloride is removed in all final leachates compared to background groundwater when groundwater is used as the initial solution. The loss of chloride is significant (as much as

134 mg/L) and not attributed to sampling or analytical error. Typically chloride is considered conservative meaning that it is not involved in sorption, oxidation, reduction, or degradation reactions. However, sorption of chloride on soils has been documented in the literature (Yu and Li 1997, Wang et al. 1987, Borggaard 1984). Sorption is a possible mechanism for the removal of chloride in these leachate tests. The results indicate CCBs and spoil are not a source of chloride and that chloride is elevated in the natural groundwater at the NMEP site.

41.A.5.2.2 Leachate Trace Element Detections

Concentrations of Sb, beryllium (Be), Cd, cobalt (Co), Hg, Ni, Pb, Ag, and Tl are non-detect at levels reported below the PQL in all samples, while the Pb results for all samples were below the MDL (Table 41.A-12). Trace elements detected at concentrations above the PQL and above one or more of the relevant water quality criteria are as follows:

- As was detected in the CCB Successive #2 leachate at a value of 0.11 mg/L just above the PQL and the Navajo Nation domestic use and livestock and wildlife watering criteria.
- B was detected at values above the PQL and above the EPA drinking water health advisory for B in the CCB 45-day, the Spoil in CCB Water, the CCB in Spoil Water, and the CCB Leachate.
- Al was detected at values above the PQL and above the Navajo Nation livestock and wildlife watering criterion in the CCB Successive #2, the CCB Successive #3, and the CCB 45-day.
- F was detected at values above the PQL and above the Navajo Nation domestic use and livestock and wildlife watering criteria in the Initial Coal Water and in all CCB leachates and in the Spoil in CCB Water. F was below the Navajo Nation domestic use and livestock and wildlife watering criteria in all spoil leachates except for the Spoil in CCB Water. These results show that F is adsorbed and attenuated in mine spoils.
- Mn was detected at values above the PQL and above the EPA secondary drinking water criteria in all leachates except for the CCB Successive #1, #2 and #3; the Bottom Ash Leachate, and CCB SPLP leachate.
- Cu was detected at a value above the PQL and above Navajo Nation livestock and wildlife watering criterion in the CCB 45-day result.
- V was just above the Navajo Nation livestock and wildlife watering limit of 0.1 mg/L only in the CCB 45-day (0.1 mg/L), CCB in Spoil Water (0.13 mg/L), and CCB Leachate (0.12 mg/L).
- Se was detected at values above the PQL and above Navajo Nation domestic use and livestock and wildlife watering criteria in the CCB 45-Day, the CCB in Spoil Water, and the CCB Leachate.
- Zn was found in a duplicate split Spoil Leachate sample and in the CCB 45-Day and CCB Successive #2 samples for both the normal samples and the laboratory duplicate analyses. The results for Zn indicate that it is potentially present in trace amounts in both spoil and CCB samples and is spatially variable but significantly below relevant Navajo Nation and EPA water quality criteria.
- Cr was found at levels approximately an order of magnitude below the regulatory limit only in CCB Leachate and was not identified in the Initial Coal Water or Spoil Leachate samples.

The reported values for Sb, As, Cd, Hg, Se, and Tl that are above the MDL but below the PQL are included in Table 41.A-12 for comparison with the Navajo Nation and EPA water quality criteria. Since the PQL is the lowest level of quantification that a laboratory can reliably achieve based on specified limits of precision and accuracy relating to instrumentation and sample interferences, the values below the PQL reported in Table 41.A-12 are not considered reliable and should be considered non-detect below the PQL. The non-detect analytes in leachate are not considered for further investigation.

41.A.5.2.3 Distribution Ratios

Distribution ratios (K_r) were calculated for cations and oxyanions that are typically associated with sorption processes and that are associated with a regulatory standard. The distribution ratio is similar to a sorption isotherm where the concentration in solution is related to the concentration associated with the mass in or on the solid phase. The distribution ratio is defined in equation 4.2.

eq. 4.2 $$K_r = \frac{\text{mass of solute on solid phase per unit mass of solute}}{\text{concentration of solute in solution}}$$

The calculated K_r values (Table 41.A-14) reflect overall geochemical reactions of sorption and precipitation that result in attenuation of the solutes. As discussed in detail within the literature review section, the pH, redox conditions, temperature, solids characteristics, and the constituents in solution will affect the distribution of solutes on the solid phase. The precipitation of oxides and oxyhydroxides, such as Fe and Mn oxides, can significantly increase sorption capacity. Thus, as precipitation reactions occur the number of sorption sites also increases providing greater attenuation. The results indicate that the majority of constituents show either no attenuation or are below detection limits such that a value could not be calculated (Table 41.A-14). However, spoil showed the greatest overall ability to attenuate constituents with reduced values for As, Ba, B, F, molybdenum (Mo), Se, and vanadium (V). The spoil attenuation was observed for leachate from coal groundwater and CCB that resulted in elevated trace elements that were then reduced to significantly lower or to non-detectable values after leaching with spoil. F and Fe were also attenuated in coal groundwater and bottom ash leachates.

41.A.6 PHREEQC GEOCEHMICAL MODELING

41.A.6.1 KEY MINERAL IDENTIFICATION

The chemistry data for leachates, for the initial coal groundwater and for the synthetic precipitation were imported into PHREEQC for geochemical equilibrium modeling to support hypotheses as to the reactions taking place in spoil and CCB materials leached with various solutions. Geochemical equilibrium modeling performed by PHREEQC is a quantitative analysis requiring reliable data. Consequently, non-detect values, those values below the PQL were not used in the analysis. Results from duplicates were averaged unless one of the duplicate values was above the PQL and the other was not. In this case the value above the PQL was used. The first step in modeling was the generation of equilibrium and speciation output for each individual solution (i.e., coal groundwater, spoil leachate, CCB leachate, etc.). This also provides saturation index (SI) values for major minerals (eq. 6.1).

eq. 6.1
$$SI = \log\left(\frac{IAP}{K_{sp}}\right)$$

where:

SI > 0 indicates precipitation, SI = 0 the system is in equilibrium, or SI < 0 indicates dissolution,

IAP is the ion activity product calculated from field samples and analyzed by a laboratory, and

K_{sp} is the equilibrium constant as defined from experiments and thermodynamics.

The SI values were used in conjunction with the total concentrations of the solids and the Rietveld XRD analyses to determine the most suitable and plausible minerals reacting with the initial solutions to produce the resulting leachate. SI values for each solution and selected minerals are provided in Table 41.A-15. The values listed as -1000.00 are the result of one or more constituents needed to form that mineral not being accounted for in the database. The minerals listed in Table 41.A-15 include those from the XRD analyses and the minerals inferred from the literature and the solids total concentration analyses results. The results for the SI values indicate that several of the minerals found in the Rietveld XRD analysis are at equilibrium, just below equilibrium, or just above equilibrium indicating their potential reactions accounting for the solution changes.

Minerals selected using the solids data and SI values for each leachate test were then input into PHREEQC along with the chemistry for the initial and final leachate solutions and run as an inverse model. The inverse model is not based on thermodynamics. Rather it is used to identify plausible reactions that could explain the water quality changes observed between the initial source water and final leachate solutions in the leaching test experiments. The inverse model provides a mole balance associated with reactions of precipitation, dissolution, ion exchange, and redox processes that can account for the observed changes in water quality.

41.A.6.1.1 Mine Spoil Leachate Saturation Index Values

The leachate generated from the Spoil Leachate 18-hour tests resulted in major ion and trace element chemistry changes. The major ion changes can be linked to three major dissolution precipitation reactions. The trace element changes are linked to ion exchange and sorption. Ca concentrations increase while the carbonate species decrease but not in a one-to-one relationship. Rather, Ca is generated from the dissolution of anhydrite and or gypsum. This increased the SI value for calcite past equilibrium resulting in precipitation. The overall result is a significant increase in sulfate, a much smaller increase in Ca, and a large decrease in carbonates. The precipitation of calcite is also reflected in the pH drop from 8.95 to 7.95. This is supported by the change in concentrations as well as the SI values for calcite, gypsum, and anhydrite (Table 41.A-15). The calcite SI rises from an already supersaturated condition of 0.69 to a value of 0.93, indicating that carbonate and or Ca were added to the system increasing the potential for calcite precipitation. The gypsum and anhydrite SI values are under saturated for both the Initial Coal Water and Spoil Leachate. The under saturated condition for gypsum and anhydrite indicates that they will dissolve in both the groundwater and the spoil leachate but as they dissolve from the spoil into the groundwater the values rise toward the equilibrium value of zero as indicated by the rise in SI from -3.0 to -1.1 for gypsum and from -3.2 to -1.4 for anhydrite. This changes the water from sodium bicarbonate type to sodium sulfate type (Table 41.A-13).

The lower Ba observed in the 45-day leachate relative to the 18-hour leachate can be attributed to a slow kinetic incorporation of Ba into carbonates or a slow kinetic precipitation of Ba sulfate (barite). The SI value for barite is above zero for all samples except the Synthetic Precipitation Water indicating its potential for precipitation. As the sulfate is dissolved into the leachate, the SI value for barite increases from 0.4 in Initial Coal Water to 1.2 in the 18-hour Spoil Leachate and then declines to 0.7 in the Spoil 45-Day leachate. The lower SI for barite and the lower Ba concentration for the 45-day leachate compared to the 18-hour leachate indicate that there is a kinetic control on the precipitation and attenuation of Ba as barite.

There is also an increase in K from the Initial Coal Water to the Spoil Leachate (Table 41.A-12) which is attributable to ion exchange processes. The large percentage of K-feldspar with high surface area due to pulverization for leachate testing could result in the release of K as the material is broken down. However, K-feldspars are typically associated with slow dissolution rates, as indicated by the positive SI values (Table 41.A-15). Consequently, both the ion exchange of K as well as dissolution of K-feldspar could account for the observed changes.

The most significant change observed for this leachate test was the decrease in F concentrations. Concentrations of F decrease from 2.45 mg/L in the Initial Coal Water to 1.60 mg/L (Table 41.A-12) in the 18-hour Spoil Leachate indicating a significant removal of F. The removal of F is most likely due to sorption and not precipitation. The SI values for fluorite, the most likely mineral to precipitate F, is under saturated in the initial groundwater and in the resulting leachate indicating a potential for dissolution and not precipitation. These results indicate that F is removed through sorption processes onto positive surface sites associated with the Fe or Al oxides and or the clays. The sorption of F is well known as described previously in Section 2.5 of this report. The removal of F was also observed in the Spoil 45-Day leachate test results with a final leachate F value of 1.5 mg/L. The similarity between the 45-day and the 18-hour leachate test results indicate that the F sorption is a relatively quick process (Table 41.A-12)

B concentrations in the 18-hour Spoil Leachate increases from 0.30 mg/L in the Initial Coal Water to 0.45 mg/L. However, the B value in the 45-day leachate is similar to initial groundwater. Searlesite, reedmergnerite, and borax are some of the more common B containing minerals and all are under saturated indicating potential for dissolution. However, as discussed in Section 2.5 of this report, B sorption processes are pH dependent. Relatively little B is released from the spoil during leaching, indicating that B solubility is controlled by sorption processes.

41.A.6.1.2 Coal Combustion By-product Leachate Saturation Index Values

The SI values were calculated for a suite of minerals that were identified by Rietveld XRD, the results of the CCB composite solids analyses, or from literature describing common hydrolysis products of ash, including ettringite, portlandite, and the oxides of Ca, Mg, K, and Na. The calculated SI values indicate under saturation of the commonly reported hydrolysis products of ettringite and portlandite as well as under saturation of oxide minerals (Table 41.A-15). This result is in a large part due to the pH of the final leachate solution. The 18-hour CCB Leachate has a slightly alkaline pH of 7.7. The hydrolysis products of fly ash alone are typically stable at higher pH values. Ettringite, for example, is stable at pH values 10.7 to 12.5 (Scheetz 2003).

The leachate results for this study appear to fit the second step of the four step process described by Donahoe (2004) of alkaline fly ash weathering. As discussed in Section 2.3, in the second step the oxides and salts have been dissolved and secondary precipitation and dissolution reactions along with the incorporation of carbon dioxide into solution results in a near neutral to slightly alkaline solution. The third and fourth steps include continued dissolution of CCB and formation of secondary amorphous mineral phases with very high adsorption capacities. The third and fourth steps may have begun during batch testing but that is not certain. However, the presence of secondary amorphous mineral phases is suggested by the removal of Fe from the initial groundwater at 0.07 mg/L to non-detect (<0.05 mg/L) in the leachate and would represent a part of the third and fourth steps. The groundwater and leachates are also under saturated with respect to carbon dioxide indicating potential for dissolution (Table 41.A-15). The differences in the composite leaching test results from the processes described by Donahoe (2004) could be partially explained by the incorporation of FGD product in CCB composites.

The gypsum in the FGD product, which comprises 15% of the composite CCB sample, contributes significant amounts of Ca that results in super saturation of calcite with the available carbonate. However, there is a disproportionate increase in the concentration of sulfate compared to Ca indicating precipitation of calcite that results in a reduction in bicarbonate. While the gypsum dissolves, the resulting leachate approaches equilibrium but remains slightly under saturated with respect to gypsum. The dissolution of gypsum and the precipitation of calcite are supported by Ca, sulfate, and bicarbonate concentrations as observed in the Spoil Leachate. The overall TDS concentration increases from 3,050 mg/L to 5,400 mg/L (Table 41.A-12) largely due to Ca and sulfate increasing.

Barite is supersaturated as indicated by its SI value and would be expected to precipitate out of solution. Thus, precipitation of barite could attenuate any Ba released from weathering of Ba oxides or from ion exchange. The 18-hour leaching test results show increases in Ba concentrations as Ba is leached from the CCB material. In the CCB Leachate Ba increases from the initial value of 0.0905 mg/L in groundwater to 0.0995 mg/L in the leachate (Table 41.A-12). On the other hand, the CCB 45-Day test shows that Ba is reduced in the leachate from the initial

groundwater value of 0.0905 mg/L to 0.033 mg/L. The reduction on the longer term 45-day test compared to the slight increase observed in the 18-hour test suggests a kinetic removal of Ba and that over time Ba will be attenuated as it precipitates to form highly insoluble barite.

The results for the CCB 45-Day leachate indicate that the kinetics for these precipitation and dissolution reactions are relatively quick and that the 18-hour leachate is representative of equilibrium. However, the concentrations of Ba, Cu, and Zn were found to be notably different between the two tests. The Ba concentration of 0.033 mg/l observed in the CCB 45-Day test was about one third lower than the 0.1 mg/l observed in the 18-hour test while the concentrations of Cu and Zn were below detection limits in the 18-hour test samples but at concentrations of 0.72 and 0.098 mg/l, respectively, in the 45-day test sample.

The higher Cu and Zn observed in the 45-day test sample relative to the 18-hour test is thought to be the result of weathering of Zn and Cu oxides from the CCB materials. Both Zn and Cu are found as oxides within CCB materials and their release can be related to weathering. Abbott et al. (2001) found that Zn and Cu are sequentially leached out with the highest concentrations at the initial weathering stages and with concentrations decreasing with continued weathering. The Zn and Cu found in the CCB 45-Day leachate test are likely due to weathering reactions that are slow such that they are not apparent in the 18-hour leachate test results. However, the concentrations are expected to decline with time as suggested by Abbott ea al (2001) and by the results of sequential leaching tests performed on the 45-day leached sample of composite CCB material.

F concentration in CCB Leachate doubles from 2.5 mg/L in the initial groundwater to 5.0 mg/L in the CCB Leachate (Table 41.A-12). This is the opposite effect observed in the Spoil Leachate. The fluorite SI value for the CCB Leachate indicates that fluorite is supersaturated and has the potential to remove F from solution through precipitation. However, the CCB 45-Day leachate indicates a greater increase in F, 8.2 mg/L, than the 18-hour test, 5.0 mg/L and fluorite remains supersaturated with a larger SI value for the 45-day test compared to the 18-hour CCB Leachate test. Thus, while fluorite is supersaturated, precipitation and removal of F does not appear to occur, indicating that fluorite precipitation is kinetically controlled and may require longer time periods to precipitate. This lends further support to the hypothesis that F removal observed in the Spoil Leachate tests, at the observed time frames of 18 hours and 45 days, is controlled by sorption processes and not by precipitation of fluorite.

B concentrations also increased from an Initial Coal Water value of 0.3 mg/L to a value of 2.6 mg/L in both the 18-hour and 45-day CCB composite leachates. The B is most likely in the form of highly soluble salts, similar to borax, or adsorbed on sorption sites. The SI values for borax in CCB leachates are negative, indicating that it is under saturated and that borax and other B salts would dissolve thereby releasing B into solution. Furthermore, the release of B appears to be a relatively quick process as the similar results are observed in both the 18-hour and 45-day leachate tests.

In the CCB Successive tests, the CCB composite material was initially leached with coal groundwater for 45-days and subsequently leached by three successive 18-hour tests using fresh coal groundwater for each test. The SI values associated with the successive test results showed a change toward equilibrium with respect to several minerals: calcite, barite, witherite, quartz, Ca-montmorillonite, kaolinite, gibbsite, and brucite. However, the dolomite SI value changed toward equilibrium in the first two tests and then returned to a value close to that observed in the initial

coal groundwater sample in the final leachate. The initial deviation away from Initial Coal Water concentrations followed by concentrations approaching Initial Coal Water values is also observed in the pH values, where the value is initially lowered from the alkaline coal groundwater value of 8.95 to values closer to neutral (7.4) and then back to an alkaline value of 9.0 in the last of the successive leachates (Table 41.A-12). The first successive leaching resulted in a flushing of the more soluble salts (i.e. B salts, and soluble minerals, i.e. gypsum combined with the removal of Ca and carbonate, through precipitation of calcite). B, Ca, sulfate, and TDS concentrations are initially high in the 45-day leachate but return to concentrations comparable with the initial groundwater after the second successive leaching. However, Al and F remain above background at the end of the third successive leaching. The F is most likely controlled by the fluctuations in pH and competitive sorption with other analytes (i.e. OH, B, Na, Mg, Ca). F sorption has been identified as being strongly correlated with amorphous and crystalline oxides of Al and Fe through ligand exchange with hydroxyl groups and water molecules (Harrington et al. 2003). The sorption of F would be in competition with hydroxyl ions and an increase in pH (i.e., increase in hydroxide concentration), would reduce F sorption. The changes in F are similar to the changes observed in Al and pH. The combined effect of changing pH and dissolution of Al oxides could result in the observed changes in F concentrations.

41.A.6.1.3 Mine Spoil Composite SPLP Saturation Index Values

The Initial Synthetic Precipitation was used in batch testing to simulate precipitation leaching through backfill. The synthetic precipitation is slightly acidic (pH = 5.0) with trace concentrations of Al, Ca, and Cu. Major ion chemistry comprised of carbonate, Na, and sulfate makes the Initial Synthetic Precipitation water a sodium carbonate water type. The Spoil SPLP 18-hour leachate resulted in significant mineral dissolution and or ion desorption of several elements from the spoil, causing an increase in TDS from 28 mg/L in the Initial Synthetic Precipitation to 1,200 mg/L (Table 41.A-12). Similar geochemical processes as seen in the Spoil Leachate using groundwater are observed for the Spoil SPLP leachate. The water type changes from the Na carbonate type in the Initial Synthetic Precipitation to a Ca sulfate type. The geochemical processes identified from the SI values include the dissolution of gypsum and or anhydrite (Table 41.A-15). One main difference between the Spoil Leachate using groundwater and the Spoil SPLP leachate is that the SI value of -0.3 for calcite in the Spoil SPLP suggests no precipitation of calcite (Table 41.A-15). However, the calcite SI value increases from -5.8 in the Initial Synthetic Precipitation to near equilibrium in the Spoil SPLP leachate at -0.3. This indicates the dissolution of carbonates and Ca, from both calcite and gypsum or anhydrite. The pH is buffered by the minerals in the spoil and incorporation of atmospheric carbon dioxide to a near neutral value of 7.5 (Table 41.A-12).

Ba, B, chloride, F, K, and Na increase in the Spoil SPLP leachate; however the final concentrations are below those observed in Initial Coal Water samples. Conversely, concentrations of Mg, sulfate, and Mn increase to levels above those observed in the Initial Coal Water. Al and Cu are found in the Initial Synthetic Precipitation water but are non-detect in the Spoil SPLP leachate, indicating removal by precipitation, ion exchange, or sorption.

41.A.6.1.4 Coal Combustion By-product Composite SPLP Saturation Index Values

Similar to the CCB Leachate with groundwater, the SI values for the CCB SPLP were calculated for a suite of minerals that were either identified by Rietveld XRD, based on total analyses of the

composite CCB solids, or from the literature results describing common hydrolysis products of ash including ettringite and Portland cement (Table 41.A-15). The use of Initial Synthetic Precipitation as the leachant resulted in lower and more negative SI values for those minerals chosen when compared to the CCB Leachate with groundwater. This result is attributable to the lower initial pH and dissolved solids in the Initial Synthetic Precipitation and its greater solvating properties. It is also noted that the formation of a stable ettrignite mineral is most likely not feasible in this batch study as it is under saturated with respect to its equilibrium value and the leachate sample is potentially at the second step of the ash weathering process as described in Section 41.A.2.5.

In the CCB SPLP test, Ba increases from non-detect in the Initial Synthetic Precipitation to 0.110 mg/L. The release of Ba either from Ba oxide or ion exchange and the increased sulfate concentrations results in an increased SI index for barite. Although barite has a high potential to precipitate, the high SI value with respect to barite does not show signs of removal on a short term basis. It is possible that barite may precipitate out over longer time frames.

41.A.6.1.5 Bottom Ash Leachate Saturation Index Values

The Bottom Ash Leachate test resulted in some of the lowest contributions of trace metals and geochemical changes compared to other leachate tests (Table 41.A-12). Although bottom ash is considered relatively inert compared to CCB and spoil, the leachate is associated with slightly increased Al and Ba concentrations that are most likely due to the dissolution of oxides (Table 41.A-12). The SI values for oxides all indicate the potential to dissolve as shown by the negative values indicating under saturated conditions (Table 41.A-15).

41.A.6.2 INVERSE MODELING

Inverse modeling was performed for a select set of leachate batch studies. The object of inverse modeling was to find sets of minerals that, when reacted in appropriate amounts, quantitatively account for the differences in composition between the initial leaching solution and the final leachate. The equations involved in inverse modeling are mole balance for each element or valence state of each element in the system, charge balance for each solution, alkalinity balance for the system, and electron balance for the system. The unknowns include the mole transfers of phases, the mole transfers of redox reactions, and the uncertainty unknowns for each element in each solution

The primary reactions and minerals determined from SI values are supported by the generation of inverse models results. Sets of minerals based on the XRD data and literature were input into PHREEQC to generate the inverse models. Inverse modeling was not applied to the CCB Successive leaching tests due to the complex nature of the multiple extractions. Additionally, 18-hour leachate tests were selected for inverse models because the overall major geochemical processes are similar for the 45-day tests and results would not be expected to change.

41.A.6.2.1 Bottom Ash Leachate Inverse Modeling

Inverse model solutions were generated using only oxides that are typically associated with bottom ash (Table 41.A-16). The results were calculated using an error of 5% for each solution composition. Only four models were found with each comprised of only four components to account for the geochemical changes. However, F and B were not accounted for and instead were

added as balances. The changes in F and B are small and are most likely associate with sorption and or analytical error. Amorphous silica was included in the models as the only source of Si. Quartz was not used because it is relatively stable and the SI value (0.53) indicates that it is supersaturated and unlikely to dissolve (Table 41.A-15). Thus, amorphous silica was used as a representation of Si oxide in the bottom ash. Amorphous silica is under saturated with an SI value of -1.15 and its dissolution is hypothesized as the increase Si concentration and is used in the inverse model to account for the Si increase.

41.A.6.2.2 Mine Spoil Leachate Inverse Modeling

Based on the SI values described above and the Rietveld XRD data, the minerals listed in Table 41.A-17 were used to determine mole balances that could account for the water quality changes observed in the Spoil Leachate using coal groundwater tests. Table 41.A-17 also includes exchange species for lithium, Na, Ca, K, and Zn.

B and F are constituents of concern that are not associated with any of the minerals identified from the Rietveld XRD analyses. However, B and F are known to adsorb to oxide surfaces, including Fe and Mn, and B is associated with shale and marine deposits such as searlesite (Larsen and Hicks, 1914; Fahey and Axelrod, 1950; Ghose and Wan, 1976; Yang and Rosenberg, 1992). Searlesite has also been documented at the Points of Rock Quarry in northern New Mexico (DeMark, 1984). Adsorption of B and F, as well as Zn, Mg, and Ca, to Fe oxide surfaces are found in the PHREEQC database and can be incorporated into forward models. The Fe available for sorption can be supported through analogies to siderite as found in literature and or to the amorphous material found during Rietveld XRD analysis as an amorphous Fe hydroxide. The existence of Fe oxides is supported by the total metals analyses where Fe makes up more than 30% of the cations in the spoil sample with an average value of 20,000 mg/Kg. Searlesite was incorporated into the geochemical model in order to balance the changes observed in B concentrations.

The SI values calculated for the Spoil Leachate using groundwater were used to set whether or not each mineral listed in Table 41.A-17 is available to dissolve, precipitate, or both in the inverse model calculations. Cation exchange and error balances were used to account for changes in constituents not directly associated with the pure minerals listed in Table 41.A-17. The species defined as exchangers are lithium, Na, Zn, Mg, and K. While Na is a component of the minerals albite, plagioclase, and montmorillonite, it was also included as a cation exchanger because it is often associated with ion exchange in groundwater systems. Chloride (Cl) and F were defined as balances. The use of balances results in the model making adjustments to fit the data for those constituents listed without incorporating them into the mineral and exchange phases. An uncertainty limit of 2.5 percent was assigned to all chemical data, except Cl and F, for both the initial water and final water. The 2.5-percent uncertainty limit is often applied in inverse model as a reasonable level of uncertainty in analytical results. Cl and F, which are included as balances, have their own specific uncertainty associated with minimum uncertainty limit necessary to obtain mole balance.

The result of using the minerals defined in Table 41.A-17 and the Spoil Leachate using coal groundwater water quality data resulted in several possible models. All of these models included significant dissolution of gypsum, amorphous Al hydroxide, manganite, searlesite, siderite, and witherite. Several models also show the precipitation of calcite and all show the precipitation of

kaolinite and amorphous Fe hydroxide. The inclusion of minerals in all models indicates that those minerals are necessary in order to balance the mole changes. All models contain nearly identical mole transfers for amorphous Fe hydroxide, siderite, manganite, lithium exchange, and Zn exchange. These do not change from one model to another because they are sinks or sources for those elements that otherwise are not defined by another process but change from the initial groundwater to the final leachate value and must be accounted for in the model. As an example, searlesite serves as the source for the increase in B but may not be the true source of B. B may also be found in albite or carbonates. The other option is placing them as balances. Either way, the use of minerals as a balance for each element that changes is necessary for the model to find a solution. The precipitation of Al and Fe hydroxides is important in that as they are precipitated they provide additional sorption sites for trace constituents and can result in increased attenuation.

41.A.6.2.3 Mine Spoil SPLP Inverse Modeling

Spoil SPLP 18-hour leaching inverse modeling was performed using similar solids and exchange input as was used for the Spoil Leachate using coal groundwater model because the minerals identified in the spoil control the geochemical reactions for both leaching solutions. Similar inverse models also fit the observed changes from leaching in both tests (Table 41.A-18). The primary geochemical reactions identified by the inverse models are dissolution of gypsum, carbon dioxide off gassing, and the potential break down of montmorillionite clay and/or feldspar to kaolinite and/or gibbsite. The latter is typically very slow due to kinetics but may have been enhanced in the leaching tests by the pulverizing of the sample. Alkalinity increases may also indicate the dissolution of calcite, although only half of the inverse models indicated that calcite dissolution was needed to balance the geochemical changes. For those models without calcite dissolution, the solution chemistry is balanced with magnesite dissolution and the ion exchange of Ca in place of calcite dissolution. However, the calcite dissolution models are more likely for the Spoil SPLP because calcite was identified to be present in the spoil at approximately three percent by weight in the XRD analysis and calcite is a very soluble mineral. Additionally, calcite is under saturated based on its SI value for the Spoil SPLP leachate.

Ion exchange is also identified as an important process as all models require some ion exchange in order to converge on a solution. This is supported by the findings for the Spoil Leachate using coal groundwater as well as the exchange capacity identified by laboratory testing. The precipitation of amorphous Al hydroxide is also found in several model solutions and can provide additional sorption and attenuation of trace constituents.

41.A.6.2.4 Coal Combustion By-product Leachate Inverse Modeling

Based on the SI values described above, the Rietveld XRD data, and literature review, the minerals listed in Table 41.A-19 were used to determine mole balances that could account for the water quality changes observed in the 18-hour leaching of CCB with coal groundwater. While the CCB composite provides a significantly different starting mineralogy when compared to the spoils, some of the major ion processes are similar because of the overlap in mineralogy (e.g., gypsum) among the materials. However, due to the large number of possible minerals involved, the complex geochemical nature of CCB, and the inclusion of 15% FGD product, many models were found that could balance out the observed changes. Given this complexity, there are still several minerals identified in all of the inverse models including gypsum, calcite, amorphous silica, Al hydroxide, magnetite, manganite, borax, and lithium exchange. In all cases gypsum, amorphous silica, magnetite, manganite, and borax dissolve, while calcite and Al hydroxide

precipitate. Carbon dioxide was included as a possible reactant but was not available in any of the solutions because the models indicated it was generated or lost from solution. Carbon dioxide is under saturated in all samples indicating that it is more likely to dissolve. However, carbon dioxide is less under saturated in the leachate than the initial groundwater indicating that some carbon dioxide was either generated potentially from calcite dissolution or was dissolved into solution. While the exact form and nature of each mineral is not known, they serve as surrogates for contributions of elements. For example borax may not be available in the actual mineral form in the CCB composite. However, to provide a source of B it was incorporated into the model. B is typically available as a borate salt in fly ash. The other option is to have B included as a large error and not have it involved in the mole balance. B was included as a mineral to try and account for observed solution changes rather than use it as an error correction such that a mole balance for B could be achieved.

41.A.6.2.5 Coal Combustion By-product SPLP Inverse Modeling

The primary geochemical reactions for CCB SPLP 18-hour leachate can be modeled using the dissolution of gypsum and the oxides of silica and Al. However, the dissolution of Al hydroxide could also be the source of Al in the leachate and provides additional model solutions. The inverse models use either Al hydroxide or Al oxide as a source of Al. Both the Al oxide and hydroxide are under saturated and could be contributing to the solution chemistry (Table 41.A-20). The CCB SPLP leachate also indicates that there is dissolution of calcite. CCB SPLP inverse modeling also shows that carbon dioxide is removed from solution as indicated by negative values and not dissolved as is indicated by some studies in the literature review (Table 41.A-20). The carbon dioxide is removed in the dissolution of calcite. Thus, the carbonates in the CCB solids buffer the system to a neutral to alkaline pH and the model predictions of the removal of carbon dioxide in calcite dissolution appear to represent the conditions associated with the leaching test as well as the conditions associated with CCB material placed in the mine backfill, where it is surrounded by mine spoils and largely isolated from atmospheric carbon dioxide.

41.A.6.2.6 Oxide Sorption Site and Cation Exchange Capacity Calculations

In support of sorption processes that can attenuate trace constituents, the number of sorption sites were calculated for oxide surfaces and cation exchange sites. As previously discussed, B and F are constituents of potential concern that are not directly associated with any of the identified minerals in the Rietveld XRD analyses. However, B and F are known to adsorb to oxide surfaces, including Fe and Mn oxides. Adsorption of other metals, including As, Zn, V, Mg, and Ca to oxide surfaces also occurs. The Fe available for sorption as an amorphous Fe hydroxide is indicated by the large amount of Fe found in solids analyses and the large fraction of amorphous material found in the Rietveld XRD analysis. The prevalence of Fe oxides in spoil is demonstrated by the total metals analyses, where Fe makes up more than 30% of the cations (Table 41.A-9). Likewise, the presence of Fe oxides in CCB composite is demonstrated by the total metals analyses, which show an average Fe content of 3,967 mg/Kg (Table 41.A-10).

Parkhurst and Appelo (1999) provide data from which it is possible to estimate the number of sorption sites per liter of water in the solids. The sorption onto oxide surfaces was calculated using the total metals analysis for Fe assuming that Fe is the primary oxide surface available for sorption. Several assumptions had to be made in order to calculate the number of surface sites. The assumptions were based on the method of calculations provided by Parkhurst and Appelo

(1999) and came from published literature as discussed below. A rock density of 2.65 g/cm^3 was assumed and a porosity of 0.2 was also assumed (Maidment, 1993). The specific surface area was also assumed as 600 m^2 /g (Parkhurst and Appelo 1999, Stumm and Morgan 1996). The three total metals analyses for Fe in the spoil averaged 20,000 mg/Kg or 2 percent by weight. Using these assumptions and a content of 2 percent by weight Fe for the spoils corresponds to 3.8 mol/L of Fe. However, the form of the Fe is not known. A significant amount of Fe could be in the form of amorphous hydroxide and or magnetite, which have far fewer surface sites than hydrous ferric oxide (Parkhurst and Appelo 1999). Parkhurst and Appelo (1999) used a low fraction, 0.1, of Fe as hydrous ferric oxide to account for the different forms of Fe present in sediments that have different sorption properties. Thus, a total of 0.38 mol/L of Fe was assumed to be available as hydrous ferric oxide in mine spoil at the NMEP site. The number of sorption sites was assumed to be 0.2 per mole of Fe (Parkhurst and Appelo 1999, Stumm and Morgan 1996, Dzombak and Morel 1990), resulting in a total of 0.076 mol of sites per liter of water for spoil composite materials. The mass of hydrous ferric oxide was calculated as 34 g/L using a gram formula weight of 89 g/mol (Parkhurst and Appelo 1999, Dzombak and Morel 1990).

Similarly, the sorption onto oxide surfaces in CCB composite was modeled using the same method as for spoil using the total metals analysis for Fe assuming that Fe is the primary oxide surface available for sorption. Several assumptions had to be made in order to calculate the number of surface sites using the method by Parkhurst and Appelo (1999) and these assumptions came from published literature or existing data on similar CCBs as discussed below. A fly ash density of 1.42 g/cm^3 was assumed from fly ash characteristics generated from Navajo Mine coals. A porosity of 0.2 was also assumed. The three total metals analyses for Fe in the CCB composite averaged 3,967 mg/Kg (Table 41.A-9) or 0.4 percent by weight. Using these assumptions and a content of 0.4 weight percent Fe for the CCBs corresponds to 0.4 mol/L of Fe. However, again the form of the Fe is not known and a significant amount could be in the form of amorphous hydroxide and or magnetite, which have far fewer surface sites than hydrous ferric oxide (Parkhurst and Appelo, 1999). Using the same 0.1 fraction of Fe as hydrous ferric oxide to account for the different forms of Fe present, a total of 0.04 mol of Fe was assumed to be available as hydrous ferric oxide. The number of sorption sites per mole of Fe was assumed to be 0.2, resulting in a total of 0.008 mol of sites per liter of water. The mass of hydrous ferric oxide was calculated as 3.6 g/L using a gram formula weight of 89. The specific surface area was also assumed as 600 m^2 /g (Parkhurst and Appelo 1999, Dzombak and Morel 1990).

The spoil and CCB samples were also analyzed for CEC. The results of seven spoil analyses ranged between 8.7 and 9.9 meq/100 g with an average of 9.3 meq/100 g (Table 41.A-11). The average of three CCB composite CEC analyses was 0.27 meq/100 g. The total number of equivalents of CEC was calculated using the some of the same assumptions for the Fe oxide surface calculations. For spoil, a rock density of 2.65 g/cm^3 was used and for the CCB composite a density of 1.42 g/cm^3 was used. A porosity of 0.2 was used for both spoil and CCB composite. The calculations result in a total of 986 meq/L, or 0.986 moles of exchange sites per liter of water, for spoil material, and 28 meq/L, or 0.028 moles per liter of water, for composite CCB material.

The inverse models previously presented reflect geochemical changes due to ion exchange in addition to mineral precipitation and dissolution reactions. The individual exchange species (i.e. MgX2, LiX, KX, CaX2, NaX) from the inverse models were reviewed. The total number of moles of exchange from the inverse models (≈10^{-3} moles/L) is much lower, by approximately an

order of magnitude, than the range calculated from laboratory analyses (≈ 1 to 10^{-2} moles/L). While there is a total capacity of exchange sites of 0.986 moles/L for spoil and 0.028 moles/L for CCB composite, the total amount of exchange for any one ion is determined by the equilibrium values and solution chemistry and analytes that are in competition for these sites. The inverse model results including ion exchange are consistent with sorption and ion exchange characteristics of the spoil and composite CCB samples. These results demonstrate the potential for trace metal attenuation through sorption and ion exchange processes and support the observed attenuation in leachate data.

41.A.7 CONCLUSIONS

Review of literature on CCB leaching and the results of the leaching tests on composite CCB material indicate that the major minerals and trace metals identified in the CCB leachates in this study are similar to those observed in other studies. An initial flush of salts and metals may occur and the concentrations of constituents of concern generated from the CCB composites, such as As, F, and B, are expected to be relatively low and potentially be attenuated in spoil and coals. The leaching test results for mine spoil material were used to generate data for transport modeling including distribution coefficients. These results show that As, F, and B in leachate from CCB materials are attenuated in mine spoil materials. The leaching test results also indicate increases in the concentrations of sulfate and Ca, with higher concentrations observed in the CCB leachate in comparison with the spoil leachate. The increased sulfate concentrations appear in the initial leach results and decline to the background levels present in the groundwater in the successive leaching tests performed on the CCB material.

The batch leaching tests in this study were performed using various leaching fluids, including standard synthetic precipitation, composite groundwater from coal seams at the NMEP site, and samples collected from leaching tests on mine spoil and on the composite CCB sample. Analyses results of the water source used in leaching and leachate samples after batch leaching provided information on the potential water quality effects of placement of mine spoil and CCB materials in mine backfill. Water quality results from leaching tests and from background coal groundwater samples were compared to Navajo Nation domestic use and livestock and wildlife watering criteria and to EPA drinking water standards and health advisories.

Several constituents of primary concern were identified based on the leaching results from the CCB material assessed in this study. These are the constituents in the leachates that exceed the livestock and wildlife use criteria, as these uses are the closest potential receptors for any groundwater originating from the NMEP site. The constituents of potential concern include As, F, Se, V, sulfate, and TDS. B may also be included as an indicator because it is commonly observed in ash leachate and was observed in CCB leachates in this study at concentrations above the U.S. EPA health advisory for drinking water. However, the B generated from CCB leaching is attenuated in spoil material to a slight extent and concentrations based on leachate studies are expected to represent an initial flush of higher concentrations that are not sustainable over time and will be diluted through dispersion as it migrates off site before reaching a receptor. Additionally, groundwater in the near vicinity of the NEMP site already exceeds EPA drinking water standards for several other parameters: sulfate, total dissolved solids, chloride, and fluoride.

Spoil showed an overall capability to attenuate a number of trace constituents, including As, B, F, Se, and V. Distribution coefficients were calculated for As, B, F, Se, and V based on removal in spoil leached with a source solution derived from the leaching tests of groundwater with CCB composite materials. The concentrations of As, Se, and V in this source solution of CCB leachate were reduced to below relevant use criteria or to non-detectable values after leaching with mine spoil. F concentrations in both background groundwater and in CCB leachate are reduced by leaching through spoil material, indicating the potential for spoil attenuation of F concentrations in background coal water and in any CCB leachate.

The hypothesized major ion geochemical processes were supported using the geochemical modeling software PHREEQC. Trace element changes (i.e. F and B) can be accounted for by

sorption processes that are supported by calculated sorption surface sites based on total analyses, Fe content, and CEC data for both spoils and CCB composites. The primary constituents in the leachates from both spoil and CCB composites are sulfate and Ca. These constituents are derived from the dissolution of the gypsum in the native interburden and overburden materials that comprise the mine spoil and the synthetic gypsum in FGD product. Spoil was able to effectively attenuate trace metals (e.g., B and F) that were initially leached from the CCB composites; however, the spoil did not attenuate sulfate or TDS from CCB composites. The mine spoils, that are the native overburden material at the site, are a source for sulfate and TDS in precipitation recharge and groundwater flow. Nevertheless, TDS and sulfate concentrations in spoil and CCB leachates occurs within the range of concentrations observed in baseline groundwater at or near the NMEP site. Consequently, TDS has been modeled as a conservative constituent to assess potential long-term changes in concentrations of TDS at potential points of use within and adjacent to the NMEP site resulting from partial saturation of CCB and mine spoils. Sulfate concentrations are assessed based on the sulfate/TDS ratios in spoil water, composite CCB water, and baseline groundwater.

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41.A.9 TABLES

TABLE 41.A-1 ASH MINERALOGY FROM AREA 4 SOUTH OF THE BNCC LEASE AREA

Mineral	Formula	Average (wt%)	Minimum (wt%)	Maximum (wt%)
Phosphorous Pentoxide	P_2O_5	0.21	0.03	0.66
Silica	SiO_2	57.61	43.5	64.07
Ferric Oxide	Fe_2O_3	6.08	4.31	11
Alumina	Al_2O_3	24.78	22.48	31.43
Titania	TiO_2	0.94	0.71	1.15
Calcium Oxide	CaO	3.85	1.47	9.68
Magnesium Oxide	MgO	0.83	0.53	1.03
Sulfur Trioxide	SO_3	2.21	0.78	7.59
Potassium Oxide	K_2O	0.99	0.36	1.49
Sodium Oxide	Na_2O	1.69	1.44	2.03

TABLE 41.A-2 ASH TRACE METALS CONTENT FROM AREA 4 SOUTH OF THE BNCC LEASE AREA
(ALL VALUES ARE IN PARTS PER MILLION)

	Pb	Se	As	Tl	Zn	Cu	Ni	Co	Cd	Ag	Cr	Mn	Ba	Sb	Be	Hg
Average	15.4	1.1	5.9	<2.0	21.2	21.5	4.3	2.2	<2.0	4.1	9.5	32	136	1.6	1.4	0.1
Maximum	40	2	17	2	43	34	8	6	11	10	16	81	339	3	7.8	0.4
Minimum	5	ND	ND	ND	6	9	2	1	ND	2	5	9	46	ND	0.2	ND

TABLE 41.A-3 SELECTIVE RESULTS OF BATCH LEACH TESTS & MONITORING OF SPOIL AND COALCOMBUSTION BY-PRODUCT BACKFILL WELLS (CONCENTRATIONS IN MG/L)

Water Source	pH	TDS	Ca	Na	Cl	SO_4	Fe	Mn	B	Se	As	Cd
Surface Water from Chinde Wash	7.8	1,900	230	280	15	1,200	0.45	0.08	0.31	<0.001	<0.001	<0.001
SW Leachate:												
Spoil Sample S-4	7.8	4,600	640	850	43	2,700	0.06	0.7	<0.5	0.20	0.002	<0.001
Spoil Sample S-5	8.2	3,500	320	750	27	2,300	0.02	0.26	<0.5	0.018	0.002	<0.001
Fly Ash	12.2	2,000	290	380	16	590	0.02	0.02	1.0	0.09	0.009	<0.001
Bottom Ash	8.5	2,000	260	330	22	940	0.03	0.07	<0.5	0.046	<0.001	<0.001
Ash Mixed with Spoil Sample S-4	7.7	5,300	670	850	37	3,200	0.02	1.4	<0.5	0.018	<0.003	<0.001
Ash Mixed with Spoil Sample S-5	8.1	4,500	550	800	29	3,000	0.08	0.39	<0.5	0.010	<0.003	<0.001
Groundwater - coals 4 & 6 (Composite #4)	8.2	9,800	140	3,500	5,200	120	0.15	0.03	0.53	0.011	0.015	0.001
GW Leachate:												
Spoils S-4	7.8	12,000	730	3,200	5,500	2,700	0.06	0.7	<0.5	0.20	0.002	<0.001
Spoils S-5	8.2	11,000	530	3,200	5,600	2,300	0.02	0.26	<0.5	0.018	0.002	<0.001
Fly Ash	12	10,000	520	3,000	5,600	320	0.02	0.02	6.2	0.22	0.017	<0.001
Bottom Ash	8.5	8,700	170	3,500	5,500	170	0.03	0.07	0.6	0.020	<0.001	<0.001
Ash w/ S-4	7.9	12,000	790	3,100	5,700	2,000	0.04	1.3	<0.5	0.016	0.009	<0.001
Ash w/ S-5	7.9	12,000	740	3,700	5,600	2,000	0.09	0.64	0.9	0.009	0.008	<0.001
Groundwater from ash & spoil monitoring wells	**pH**	**TDS**	**Ca**	**Na**	**Cl**	**SO_4**	**Fe**	**Mn**	**B**	**Se**	**As**	**Cd**
Bitsui-5 Well (completed in mine-spoil)	7.61	12,000	56.9	3,870	990	6,200	0.1	0.123	1.1	<0.001	<0.001	<0.001
Bitsui-4-Well (completed in mine spoil)	6.78	14,600	310	3,970	530	9,000	<0.05	4.84	1.3	<0.001	<0.001	<0.001
Watson-4-Well completed in ash)	9.06	4,860	820	890	890	2,200	<0.05	0.025	26.0	<0.005	<0.005	<0.001

TABLE 41.A-4 SAN JUAN MINE ATTENUATED BATCH LEACHING TEST RESULTS

Element	Groundwater Composite mg/L	Backfill Leachate mg/L	Attenuated Backfill/Leachate mg/L	Backfill/ CCB Leachate mg/L	Attenuated Backfill/CCB Leachate mg/L
Al	<0.05	2.2	<0.05	14.0	0.11
As	<0.003	<0.003	<0.003	0.026	0.37
Ba	0.21	0.28	0.17	0.39	0.078
B	<0.009	0.44	0.89	7.0	6.2
Cd	<0.002	<0.002	<0.002	<0.002	<0.002
Cr	<0.001	<0.001	<0.001	0.006	<0.001
Co	<0.006	<0.006	<0.006	<0.006	<0.006
Cu	<0.001	<0.001	<0.001	<0.001	<0.001
CN	0.53	<0.02	<0.02	<0.02	<0.02
F	2.1	2.4	2.2	7.8	7.1
Fe	0.37	2	0.021	0.27	<0.008
Pb	0.02	0.01	<0.002	<0.002	<0.002
Mn	0.18	0.16	<0.001	<0.001	<0.001
Hg	<0.002	<0.002	<0.002	<0.002	<0.002
Ni	0.004	0.006	0.006	0.008	0.01
Se	<0.003	<0.003	<0.003	<0.003	<0.003
Ag	<0.002	0.006	<0.002	<0.002	<0.002
Zn	0.087	0.01	0.003	0.021	0.025

TABLE 41.A-5 SAN JUAN MINE 18-HOUR BATCH LEACHING TEST RESULTS

Element	Mean Fly Ash (mg/L)	Mean Bottom Ash (mg/L)	Mean FGD (mg/L)
Al	1.9	1.19	0.134
As	0.006	0.007	< PQL
B	4.06	0.773	4.3
F	0.59	0.19	19.6
Ni	<PQL	<PQL	0.01

TABLE 41.A-6 RESULTS OF COMPOSITE MINE SPOIL SAMPLES QUANTITATIVE PHASE ANALYSIS (WT. %)

First Model without Fit to Amorphous Material					
Mineral	**Ideal Formula**	**Spoil A**	**Spoil B**	**Spoil C**	**Average (wt %)**
Quartz	SiO_2	36.5	35.4	35.4	36
Plagioclase	$NaAlSi_3O_8$ - $CaAl_2Si_2O_8$	10.3	10.1	10.1	10
K-feldspar	$KAlSi_3O_8$	6	6.5	7	7
Kaolinite	$Al_2Si_2O_5(OH)_4$	40.8	40.8	40.6	41
Gypsum	$CaSO_4 \cdot 2H_2O$	2.6	3.1	2.8	3
Anhydrite	$CaSO_4$	0.9	1	1.1	1
Calcite	$CaCO_3$	2.9	3.1	2.9	3

TABLE 41.A-7 RESULTS OF COMPOSITE MINE SPOIL SAMPLES SMECTITE MODEL QUANTITATIVE PHASE ANALYSIS (WT. %)

Smectite Model Fit to Amorphous Material					
Mineral	**Ideal formula**	**Spoil A**	**Spoil B**	**Spoil C**	**Average (wt %)**
Quartz	SiO_2	29.68	27.56	28.28	29
Calcite	$CaCO_3$	0.9	2.03	2.14	2
Gypsum	$CaSO_4 \cdot 2H_2O$	2.9	3.12	2.69	3
Albite low, calcium	$Na_{0.95}Ca_{0.05}Al_{1.05}Si_{2.95}O_8$, $NaAlSi_3O_8$	6.41	5.92	6.05	6
Anhydrite	$CaSO_4$	0.83	0.67	0.88	1
Orthoclase	$KAlSi_3O_8$	3.87	2.39	3.32	3
Kaolinite	$Al_2Si_2O_5(OH)_4$	11.68	12.08	10.46	11
Montmorillonite	$(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2 \cdot n(H2O)$	43.74	46.24	46.18	45

TABLE 41.A-8 RESULTS OF COAL COMBUSTION BY-PRODUCT COMPOSITE SAMPLES QUANTITATIVE PHASE ANALYSIS (WT. %)

Mineral	**Ideal formula**	**CCB 70% FA**	**CCB DUP 1 70%FA**	**CCB DUP 2 70%FA**	**CCB Average (wt %)**
Quartz	SiO_2	21.3	26.3	24.8	24
Gypsum	$CaSO_4 \cdot 2H_2O$	50.1	38.5	45.2	45
Calcite	$CaCO_3$	1.8	1.4	0	2
Dolomite	$CaMg(CO_3)_2$	3.4	1.8	0	3
Mullite	$Al_6Si_2O_{13}$	23.4	29.5	30	28
Magnetite	$Fe3O_4$	0	2.4	0	2

TABLE 41.A-9 TOTAL METALS ANALYSIS RESULTS FOR COMPOSITE SPOIL SAMPLES

	Spoil A			Spoil B			Spoil C					
Analyte (mg/Kg)	**Result**	**PQL**	**MDL**	**Result**	**PQL**	**MDL**	**Result**	**PQL**	**MDL**	**RPD 1**	**RPD 2**	**RPD3**
Al	10000	7.4	1.8	9500	6.8	1.7	9400	7.7	1.9	5%	6%	3%
Sb	0	10	0.58	0.052	9.3	0.52	0.9	11	0.59	-200%	-284%	159%
As	0	12	1.6	0	11	1.5	0	12	1.7			
Ba	170	0.37	0.029	180	0.34	0.026	170	0.38	0.03	-6%	0%	3%
Be	1	0.19	0.0082	1	0.17	0.0075	1	0.19	0.0085	0%	0%	0%
B	13	4.7	0.63	12	4.2	0.57	12	4.8	0.64	8%	8%	5%
Cd	0.64	0.74	0.054	0.63	0.68	0.049	0.59	0.77	0.055	2%	8%	4%
Ca	20000	13	5	22000	12	4.5	20000	13	5.1	-10%	0%	6%
Cr	6.7	1.9	0.28	6	1.7	0.25	6.1	1.9	0.28	11%	10%	6%
Co	11	2.8	0.24	11	2.5	0.22	11	2.9	0.25	0%	0%	0%
Cu	26	0.56	0.15	23	0.51	0.13	24	0.57	0.15	12%	8%	6%
Fe	20000	5.6	0.41	20000	5.1	0.37	20000	5.7	0.42	0%	0%	0%
Pb	16	5.6	0.98	17	5.1	0.89	18	5.7	1	-6%	-12%	6%
Mg	3100	9.3	0.89	2900	8.5	0.81	3000	9.6	0.92	7%	3%	3%
Mn	440	0.93	0.1	430	0.85	0.094	390	0.96	0.11	2%	12%	6%
Mo	0	1.9	0.22	0.0034	1.7	0.2	0	1.9	0.23	-200%	0%	173%
Ni	13	3.7	0.4	13	3.4	0.36	14	3.8	0.41	0%	-8%	4%
K	1900	93	29	1700	85	27	1800	96	30	11%	6%	6%
Se	2.9	9.3	2.3	2.7	8.5	2.1	2.9	9.6	2.4	7%	0%	4%
Ag	0	1.4	0.14	0	1.3	0.13	0	1.4	0.15			
Na	4000	280	0.95	3900	250	0.86	4100	290	0.98	3%	-3%	3%
Tl	0	19	1.1	0	17	1	0	19	1.1			
V	23	0.93	0.18	22	0.85	0.16	22	0.96	0.19	4%	4%	3%
Zn	62	0.56	0.21	65	0.51	0.19	62	0.57	0.21	-5%	0%	3%
Li	8.6	4.7	0.045	8.2	4.2	0.041	8.1	4.8	0.047	5%	6%	3%
Hg	0.087	0.044	0.0061	0.073	0.044	0.006	0.068	0.044	0.006	18%	25%	13%
Moisture %	7.98	0.0465	0.0093	8.13	0.0465	0.0093	7.87	0.0466	0.00933	-2%	1%	2%

TABLE 41.A-10 TOTAL METALS ANALYSIS RESULTS FOR COAL COMBUSTION BY-PRODUCT COMPOSITE SAMPLES (70% FCPP FLY ASH, 15% FCPP BOTTOM ASH, AND 15% SJM FGD PRODUCT BY WEIGHT) WITH CALCULATED RELATIVE PERCENT DIFFERENCES

Analyte (mg/Kg)	CCB 70% Fly Ash	CCB DUP 1 70% Fly Ash	CCB DUP 2 70% Fly Ash	PQL	RPD 1	RPD 2	RPD 3
Ag	0.21	0.13	0.026	1.4	47%	151%	76%
Al	7200	6800	7100	7.5	6%	1%	3%
As	6.9	7.2	7.9	12	-4%	-14%	7%
B	91	88	93	4.7	3%	-2%	3%
Ba	240	240	240	0.38	0%	0%	0%
Be	0.77	0.75	0.8	0.19	3%	-4%	3%
Ca	62000	41000	38000	13	41%	51%	28%
Cd	0.16	0.19	0.21	0.75	-17%	-27%	13%
Co	2	1.9	1.8	2.8	5%	11%	5%
Cr	9.8	9.1	9.5	1.9	7%	3%	4%
Cu	7.5	6.5	7.1	0.56	14%	6%	7%
Fe	4000	3900	4000	5.6	3%	0%	1%
Hg	0.17	0.21	0.16	0.043	-21%	6%	15%
K	480	410	420	94	16%	14%	9%
Li	5.2	5.2	5.4	4.7	0%	-4%	2%
Mg	2100	1500	1400	9.4	33%	42%	23%
Mn	81	79	83	0.94	3%	-2%	2%
Mo	4.6	4.6	5	1.9	0%	-8%	5%
Na	730	670	680	280	9%	7%	5%
Ni	3.4	2.9	2.9	3.8	16%	16%	9%
Lead	7.3	7.7	7.4	5.6	-5%	-1%	3%
Sb	1.4	0.66	1.2	10	72%	18%	35%
Se	8.4	6.2	8.5	9.4	30%	-1%	17%
Tl	0.011	0.011	0.011	19	0%	0%	0%
V	24	22	24	0.94	9%	0%	5%
Zn	13	11	13	0.56	17%	0%	9%

TABLE 41.A-11 CATION EXCHANGE CAPACITY LABORATORY RESULTS SUMMARIZED

Sample ID	Sample Name	CEC (meq/100g)
B0711172-2B	123 S 87W 0-4' Spoil	9.7
B0711172-3B	123 S 89W 0-4' Spoil	8.7
B0711172-4B	125 S 88W 0-4' Spoil	9.4
B0711172-5B	120 S 89W 0-4' Spoil	9.0
B0711172-6B	Spoil A	9.0
B0711172-7B	Spoil B	9.6
B0711172-8B	Spoil C	9.9
B0711172-9B	CCB 70% Fly Ash	0.4
B0711172-10B	CCB DUP 1 70% Fly Ash	0.2
B0711172-11B	CCB DUP 2 70% Fly Ash	0.2

TABLE 41.A-12 WATER QUALITY ANALYSES AND REGULATORY STANDARDS

Analyte (mg/L)	Navajo Nation Domestic Use and EPA Drinking Water Criteria	Navajo Nation Livestock & Wildlife Watering Criteria	Initial Coal Water Sample	Initial Coal Water DUP	Initial Synthetic Precipitation	CCB Successive #1	CCB Successive #2	CCB Successive #3	Spoil SPLP	CCB SPLP	CCB SPLP DUP	Spoil 45-Day
Al		0.5	0.13	0.14	0.056	0.065	0.98	0.67	< 0.05	0.36	0.346	0.38
Sb	0.0056		<< 0.0067	<< 0.0067	<< 0.0067	< 0.05, 0.011*	< 0.05, 0.0072*	< 0.05, 0.0067*	<< 0.0067	<< 0.0067	<< 0.0067	<< 0.0067
As	0.01	0.02	<< 0.015	<< 0.015	<< 0.015	< 0.1, 0.028*	0.11	< 0.1, 0.036*	<< 0.015	<< 0.015	<< 0.015	<< 0.015
Ba	1	10	0.093	0.088		0.033	0.053	0.07	0.07	0.11	0.11	0.079
Be	0.004		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
HCO_3			1300	1200		790	1200	1100	33	< 5		960
B	0.63	5	0.31	0.29		0.37	0.34	0.34	0.084	0.28	0.278	0.36
Cd	0.005	0.05	<< 0.00051	<< 0.00051	<< 0.00051	<< 0.00051	<< 0.00051	<< 0.00051	<< 0.00051	< 0.006, 0.00079*	<< 0.00051	<< 0.00051
Ca			3.4	3.3	0.27	470	3.6	3.3	150	560	549	56
CO_3			260	300	< 7	< 7	160	340	14	18		< 7
Cl	250[3]	600	710	700		610	610	620	1.5	5.6		600
Cr	0.1	1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Co		1	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cu	1.3	0.5	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.053
F	2[3]	2	2.4	2.5	0.0067	2.6	10	4.7	0.54	3.2		1.5
Fe	0.3[3]		0.067	0.073	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PB	0.015	0.1	<< 0.011	<< 0.011	<< 0.011	<< 0.011	<< 0.011	<< 0.011	<< 0.011	<< 0.011	<< 0.011	<< 0.011
Li			< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.11
Mg			1.3	1.2		2	1.5	1.9	15	0.88	0.856	12
Mn	0.05[3]		< 0.01	< 0.01	< 0.01	0.021	< 0.01	< 0.01	0.19	< 0.01	< 0.01	0.098
Hg[1]	0.002	0.01[1]	<< 0.00005	<< 0.00005	<< 0.00005	<< 0.00005	<< 0.00005	<< 0.00005	<< 0.00005	<< 0.00005		<< 0.00005
Mo			0.012	< 0.01	< 0.01	0.019	0.016	0.013	< 0.01	0.089	0.0859	0.015
Ni	0.61		< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
pH (standard units)	6.5 - 9.0		9	8.9	5	7.4	8.8	9	7.5	7.4		8
K			11	10	< 1	12	11	12	7	< 1	1.1	14
Se	0.05	0.05[2]	<< 0.026	<< 0.026	<< 0.026	< 0.1, 0.09*	< 0.1, 0.034*	<< 0.026	<< 0.026	<< 0.026	<< 0.026	<< 0.026
Ag	0.035		< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015
Na			1200	1100	5.7	1100	1200	1300	150	8.8	8.45	1200
SO_4	250[3]	1000	300	260	3.4	2100	350	290	670	1300		930
Tl	0.0017		<< 0.011	<< 0.011	<< 0.011	<< 0.011	< 0.4, 0.013*	<< 0.011	<< 0.011	<< 0.011	<< 0.011	< 0.4, 0.014*
TDS	500[3]	2212	3100	3000	28	4900	3100	3100	1200	2200		3500
V		0.1	< 0.01	< 0.01	< 0.01	0.034	0.063	0.031	< 0.01	0.088	0.0868	< 0.01
Zn	5[3]	25	< 0.005	< 0.005	< 0.005	< 0.005	0.0081	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005

[1] Wildlife standard for mercury is 0.000012 mg/l, which is below detection limits of the analytical procedure

[2] Wildlife standard for total selenium is 0.002 mg/l

[3]Secondary Standard

<< Reported value is less than the MDL

*Above MDL, but below PQL

TABLE 41.A-12 (CONTINUED)

Analyte (mg/L)	Navajo Nation Domestic Use and EPA Drinking Water Criteria	Navajo Nation Livestock & Wildlife Watering Criteria	CCB 45-Day	Bottom Ash Leachate	Spoil in CCB Water	CCB in Spoil Water	Spoil Leachate 1	Spoil Leachate 1 Dup	CCB Leachate 1	CCB Leachate 1 Dup
Al		0.5	4.6	0.2	< 0.05	< 0.05	0.29	0.3	0.053	< 0.05
Sb	0.0056		< 0.05, 0.019*	<< 0.0067	< 0.05, 0.021*	< 0.05, 0.022*	<< 0.0067	<< 0.0067	< 0.05, 0.016*	< 0.05, 0.023*
As	0.01	0.02	< 0.1, 0.043*	<< 0.015	<< 0.015	< 0.1, 0.099*	<< 0.015	<< 0.015	< 0.1, 0.081*	< 0.1, 0.075*
Ba	1	10	0.033	0.13	0.029	0.074	0.25	0.2	0.099	0.1
Be	0.004		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
HCO_3			1100	1300	640	710	1000	1000	810	820
B	0.63	5	2.6	0.39	1.9	2.8	0.44	0.45	2.6	2.5
Cd	0.005	0.05	< 0.006, 0.00092*	<< 0.00051	< 0.006, 0.0025*	<< 0.00051	< 0.006, 0.00087*	<< 0.00051	< 0.006, 0.0016*	< 0.006, 0.0014*
Ca			530	3.1	420	590	64	69	570	560
CO_3			< 7	230	< 7	< 7	< 7	< 7	< 7	< 7
Cl	250[3]	600	610	630	620	570	610	610	620	610
Cr	0.1	1	0.031	< 0.01	0.012	0.013	< 0.01	< 0.01	0.011	0.011
Co		1	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cu	1.3	0.5	0.72	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
F	2[3]	2	8.2	2.2	3.5	5	1.6	1.6	5	5
Fe	0.3[3]		0.071	0.054	< 0.05	< 0.05	0.17	0.18	< 0.05	< 0.05
Pb	0.015	0.1	<< 0.011	<< 0.011	<< 0.011	<< 0.011	<< 0.011	<< 0.011	<< 0.011	<< 0.011
Li			0.14	< 0.01	0.13	0.16	0.1	0.1	0.13	0.13
Mg			12	1.3	24	19	13	13	7.7	7.6
Mn	0.05[3]		0.12	< 0.01	0.34	0.091	0.11	0.1	0.095	0.095
Hg[1]	0.002	0.01[1]	<< 0.00005	< 0.0002, 0.0001*	<< 0.00005	<< 0.00005	< 0.00024, 0.0001*	< 0.0002, 0.00008*	<< 0.00005	<< 0.00005
Mo			0.15	< 0.01	0.11	0.16	0.014	0.014	0.15	0.14
Ni	0.61		< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
pH (standard units)	6.5 - 9.0		7.8	9	7.5	7.7	8	7.9	7.7	7.6
K			12	11	16	15	14	14	12	12
Se	0.05	0.05[2]	0.15	<< 0.026	< 0.1, 0.043*	0.14	<< 0.026	<< 0.026	0.14	0.13
Ag	0.035		< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015	< 0.015
Na			1200	1100	1200	1300	1200	1200	1200	1200
SO_4	250[3]	1000	2500	280	2700	2600	970	990	2400	2500
Tl	0.0017		<< 0.011	<< 0.011	<< 0.011	<< 0.011	<< 0.011	<< 0.011	<< 0.011	<< 0.011
TDS	500[3]	2212	5300	3100	5800	5500	3500	3600	5400	5400
V		0.1	0.1	< 0.01	< 0.01	0.13	< 0.01	< 0.01	0.12	0.12
Zn	5[3]	25	0.098	< 0.005	< 0.005	< 0.005	< 0.005	0.0095	< 0.005	< 0.005

[1] Wildlife standard for mercury is 0.000012 mg/l, which is below detection limits of the analytical procedure

[2] Wildlife standard for total selenium is 0.002 mg/l

[3]Secondary Standard

<< Reported value is less than the MDL

*Above MDL, but below PQL

TABLE 41.A-13 MAJOR ION WATER TYPES

Sample ID	Water Type	Simple Water Type
Initial Synthetic Precipitation	Na-CO3-HCO3	Sodium Bicarbonate
Initial Coal Water	Na-HCO3-Cl	Sodium Bicarbonate
Spoil Leachate 1	Na-SO4-HC03-Cl	Sodium Sulfate
CCB Leachate 1	Na-Ca-SO4-Cl	Sodium Sulfate
Bottom Ash Leachate	Na-HCO3-Cl	Sodium Bicarbonate
Spoil 45-Day	Na-SO4-HCO3-Cl	Sodium Sulfate
CCB in Spoil Water	Na-Ca-SO4	Sodium Sulfate
Spoil in CCB Water	Na-Ca-SO4-Cl	Sodium Sulfate
CCB 45-Day	Na-Ca-SO4-HCO3	Sodium Sulfate
CCB Successive #1	Na-Ca-SO4-Cl-HCO3	Sodium Sulfate
CCB Successive #2	Na-HCO3-Cl	Sodium Bicarbonate
CCB Successive #3	Na-HCO3-Cl	Sodium Bicarbonate
Spoil SPLP	Ca-Na-SO4	Calcium Sulfate
CCB SPLP	Ca-SO4	Calcium Sulfate

TABLE 41.A-14 CALCULATED DISTRIBUTION RATIOS FOR SELECTED TRACE METALS

Analyte	Bottom Ash Leachate	CCB Leachate	CCB 45-Day	CCB SPLP	Spoil Leachate	Spoil 45-Day	Spoil SPLP	CCB in Spoil Water	Spoil in CCB Water
Al	--	30.9	--	--	--	--	BD	BD	BD
As	BD	BD	BD	BD	BD	BD	BD	BD	127*
B	--	--	--	--	--	--	--	--	6.84
Ba	--	--	34.8	--	--	2.91	--	40.8	48.6
Cr	BD	--	--	BD	BD	BD	BD	--	--
Cu	BD	BD	--	BD	BD	--	BD	BD	BD
Fe	3.79	BD	--	BD	--	BD	BD	BD	BD
F	2.27	--	--	--	10.63	12.67	--	--	8.57
Mn	BD	--	--	BD	--	--	--	--	--
Mo	BD	--	--	--	--	--	BD	--	6.36
Se	BD	--	--	BD	BD	BD	BD	--	49.8
SO4	--	--	--	--	--	--	--	--	--
V	BD	--	--	--	BD	BD	BD	--	220**
Zn	BD	BD	--	BD	--	BD	BD	BD	BD

* Value estimated from single detection value of 0.11 mg/L in CCB Successive #2 and PQL value of 0.015 mg/L
** Value calculated using the PQL of 0.01 as a conservative estimate with a reported value between the PQL and MDL at 0.0065 mg/L
-- No observed attenuation
BD is below detection limit (PQL)

TABLE 41.A-15 SATURATION INDEX VALUES FOR INITIAL LEACHING SOLUTIONS AND RESULTANT LEACHATES GENERATED USING PHREEQC

Solution	Initial Synthetic Precipitation	Initial Coal Water	Bottom Ash Leachate	CCB SPLP	CCB Leachate	Spoil in CCB Water	CCB 45-Day	CCB Successive #1	CCB Successive #2	CCB Successive #3	Spoil SPLP	Spoil Leachate	CCB in Spoil Water	Spoil 45-Day
pH	5.00	8.95	8.99	7.40	7.65	7.50	7.80	7.40	8.80	9.00	7.50	7.95	7.70	8.00
Calcite	-5.83	0.69	0.67	-0.44	1.35	0.95	1.57	1.03	0.57	0.67	-0.32	0.93	1.34	0.89
Aragonite	-5.98	0.54	0.52	-0.59	1.20	0.81	1.42	0.88	0.42	0.52	-0.47	0.78	1.20	0.74
Dolomite	-1000.00	1.30	1.32	-3.42	1.10	0.94	1.77	-0.04	1.07	1.44	-1.37	1.43	1.48	1.40
Siderite	-1000.00	-3.24	-3.41	-1000.00	-1000.00	-1000.00	-0.98	-1000.00	-1000.00	-1000.00	-1000.00	-0.83	-1000.00	-1000.00
Witherite	-1000.00	-1.23	-1.06	-4.74	-3.01	-3.83	-3.23	-3.72	-1.67	-1.36	-4.23	-2.08	-3.16	-2.50
Gypsum	-5.12	-3.01	-3.05	-0.06	-0.02	-0.11	-0.06	-0.13	-2.85	-3.03	-0.70	-1.14	0.01	-1.22
Anhydrite	-5.35	-3.25	-3.28	-0.30	-0.26	-0.34	-0.29	-0.36	-3.08	-3.26	-0.94	-1.37	-0.23	-1.46
Barite	-1000.00	0.42	0.58	0.99	0.97	0.47	0.49	0.48	0.27	0.29	0.75	1.21	0.85	0.74
Fluorite	-1000.00	-1.98	-2.12	0.60	0.77	0.32	1.15	0.15	-0.69	-1.45	-1.38	-1.01	0.78	-1.13
Chalcedony	-2.17	-0.36	-0.29	-0.09	0.11	-0.04	0.04	-0.21	-0.37	-0.32	-0.68	-0.18	0.13	-0.24
Quartz	-1.74	0.06	0.14	0.33	0.53	0.39	0.47	0.21	0.06	0.11	-0.25	0.25	0.55	0.19
Albite	-11.89	-0.38	0.01	-1.30	0.59	-1000.00	2.34	-0.33	0.42	0.44	-1000.00	0.52	-1000.00	0.46
Mullite	29.33	32.52	33.51	44.65	38.64	-1000.00	49.25	39.97	38.41	36.35	-1000.00	40.88	-1000.00	41.13
Hematite	-1000.00	17.05	16.87	-1000.00	-1000.00	-1000.00	17.22	-1000.00	-1000.00	-1000.00	-1000.00	18.14	-1000.00	-1000.00
Pyrite	-1000.00	-128.63	-129.37	-1000.00	-1000.00	-1000.00	-105.10	-1000.00	-1000.00	-1000.00	-1000.00	-108.06	-1000.00	-1000.00
Ettrignite	-56.14	-24.65	-24.38	-14.17	-15.14	-1000.00	-10.88	-16.50	-22.90	-23.25	-1000.00	-18.25	-1000.00	-18.29
Halite	-1000.00	-4.90	-4.82	-8.96	-4.85	-4.84	-4.86	-4.88	-4.84	-4.81	-8.26	-4.82	-4.85	-4.82
Willemite	-1000.00	-1000.00	-1000.00	-1000.00	-1000.00	-1000.00	-2.84	-1000.00	-5.21	-1000.00	-1000.00	-4.83	-1000.00	-1000.00
Al(OH)3(a)	-2.20	-2.27	-2.13	-0.34	-1.41	-1000.00	0.38	-1.08	-1.29	-1.65	-1000.00	-0.94	-1000.00	-0.88
CO2(g)	-0.91	-2.84	-2.88	-3.22	-1.78	-1.73	-1.82	-1.54	-2.72	-2.92	-2.81	-1.97	-1.90	-2.04
Fe(OH)3(a)	-1000.00	1.82	1.73	-1000.00	-1000.00	-1000.00	1.91	-1000.00	-1000.00	-1000.00	-1000.00	2.37	-1000.00	-1000.00
K-feldspar	-1000.00	-0.01	0.41	0.20	0.98	-1000.00	2.73	0.10	0.81	0.82	-1000.00	0.99	-1000.00	0.92
Magnetite	-1000.00	16.31	16.00	-1000.00	-1000.00	-1000.00	17.72	-1000.00	-1000.00	-1000.00	-1000.00	18.94	-1000.00	-1000.00
Kaolinite	-1.57	1.89	2.32	6.30	4.56	-1000.00	8.01	4.58	3.85	3.23	-1000.00	4.93	-1000.00	4.94
Magnesite	-1000.00	0.04	0.08	-3.54	-0.81	-0.58	-0.36	-1.63	-0.06	0.20	-1.61	-0.06	-0.43	-0.06
SiO2(a)	-3.03	-1.22	-1.15	-0.95	-0.75	-0.89	-0.81	-1.07	-1.22	-1.18	-1.53	-1.03	-0.73	-1.09
Manganite	-1000.00	-1000.00	-1000.00	-1000.00	-4.98	-4.82	-4.54	-6.33	-1000.00	-1000.00	-4.68	-4.17	-4.84	-4.06
Ca-Montmorillonite	-7.90	-0.04	0.56	5.32	3.63	-1000.00	7.61	3.12	2.19	1.58	-1000.00	3.64	-1000.00	3.57
Reedmergnerite	-1000.00	-0.07	0.27	-2.77	1.16	0.45	1.12	-0.93	-0.17	0.14	-3.68	-0.15	1.34	-0.37
Gibbsite	0.53	0.46	0.60	2.40	1.33	-1000.00	3.12	1.65	1.45	1.09	-1000.00	1.80	-1000.00	1.86
Searlesite	-1000.00	-6.17	-5.90	-9.14	-5.41	-5.98	-5.39	-7.18	-6.26	-6.01	-9.47	-6.44	-5.25	-6.60
Portlandite	-19.37	-10.93	-10.90	-11.68	-11.33	-11.77	-11.07	-11.89	-11.17	-10.86	-11.96	-11.56	-11.21	-11.53
Ba Oxide	-1000.00	-36.87	-36.66	-40.00	-39.71	-40.58	-39.89	-40.66	-37.44	-36.92	-39.89	-38.59	-39.74	-38.94
Lime	-27.91	-19.46	-19.43	-20.21	-19.86	-20.31	-19.60	-20.43	-19.71	-19.40	-20.50	-20.09	-19.75	-20.06
Potassium Oxide	-1000.00	-74.75	-74.63	-79.80	-77.31	-77.36	-77.01	-77.80	-75.04	-74.59	-77.95	-76.52	-77.02	-76.42
Ba Hydroxide	-1000.00	-13.30	-13.08	-16.42	-16.14	-17.00	-16.32	-17.09	-13.86	-13.35	-16.31	-15.02	-16.17	-15.37
Brucite	-1000.00	-3.54	-3.45	-6.74	-5.44	-5.27	-4.96	-6.52	-3.76	-3.29	-5.22	-4.51	-4.95	-4.44
Periclase	-1000.00	-8.69	-8.61	-11.89	-10.60	-10.42	-10.11	-11.67	-8.91	-8.45	-10.37	-9.66	-10.11	-9.59
Borax	-1000.00	-15.93	-15.49	-22.62	-14.06	-14.86	-13.75	-18.00	-15.93	-15.75	-22.01	-16.52	-13.74	-16.80
Al Oxide	-2.57	-2.70	-2.42	1.16	-0.98	-1000.00	2.60	-0.32	-0.74	-1.46	-1000.00	-0.04	-1000.00	0.08

TABLE 41.A-16 INVERSE MODEL RESULTS FOR THE 18-HOUR GROUNDWATER AND BOTTOM ASH BATCH LEACHATE TEST. (+) INDICATES DISSOLUTION AND (-) INDICATES PRECIPITATION. RESULTS ARE REPORTED IN MOLES PER LITER

Model	SiO_2(a)	Fe(OH)3(a)	Al(OH)3(a)	Al Oxide	Ba Oxide	Ba Hydroxide
1	2.34E-05	-2.01E-07	0	1.26E-06	0	2.81E-07
2	2.34E-05	-2.01E-07	0	1.26E-06	2.81E-07	0
3	2.34E-05	-2.01E-07	2.51E-06	0	0	2.81E-07
4	2.34E-05	-2.01E-07	2.51E-06	0	2.81E-07	0

TABLE 41.A-17 INVERSE MODEL RESULTS FOR MINE SPOIL LEACHATE USING COAL GROUNDWATER. (+) INDICATES DISSOLUTION AND (-) INDICATES PRECIPITATION. RESULTS ARE REPORTED IN MOLES PER LITER

Model	Gypsum	Albite	Ca-Montmorillonite	Calcite	K-feldspar	Kaolinite	Plagioclase	Fe(OH)3(a)	Siderite	Magnesite	Al(OH)3(a)	Witherite	Manganite	Searlesite	LiX	NaX	ZnX2	MgX2	KX	CaX2
1	7.38E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-5.38E-03	4.11E-03	-2.49E-07	2.14E-06	-8.14E-03	5.09E-03	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-2.63E-03	1.46E-07	8.62E-03	8.99E-05	-7.36E-03
2	7.71E-03	0.00E+00	0.00E+00	-7.41E-03	0.00E+00	-4.28E-03	3.27E-03	-2.49E-07	2.14E-06	4.85E-04	4.05E-03	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-1.05E-04	1.46E-07	0.00E+00	8.99E-05	0.00E+00
3	7.38E-03	0.00E+00	0.00E+00	0.00E+00	8.99E-05	-5.43E-03	4.05E-03	-2.49E-07	2.14E-06	-8.14E-03	5.19E-03	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-2.59E-03	1.46E-07	8.62E-03	0.00E+00	-7.34E-03
4	7.42E-03	0.00E+00	0.00E+00	0.00E+00	5.68E-03	-8.51E-03	0.00E+00	-2.49E-07	2.14E-06	-8.14E-03	1.13E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	8.62E-03	-5.59E-03	-5.84E-03
5	7.64E-03	0.00E+00	0.00E+00	-7.44E-03	0.00E+00	-4.77E-03	3.65E-03	-2.49E-07	2.14E-06	0.00E+00	4.51E-03	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-1.08E-03	1.46E-07	4.85E-04	8.99E-05	0.00E+00
6	7.64E-03	0.00E+00	0.00E+00	-7.41E-03	8.99E-05	-4.79E-03	3.56E-03	-2.49E-07	2.14E-06	0.00E+00	4.58E-03	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-9.85E-04	1.46E-07	4.85E-04	0.00E+00	0.00E+00
7	7.38E-03	0.00E+00	0.00E+00	-8.62E-03	8.99E-05	-5.43E-03	4.05E-03	-2.49E-07	2.14E-06	4.85E-04	5.19E-03	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-2.59E-03	1.46E-07	0.00E+00	0.00E+00	1.29E-03
8	7.42E-03	0.00E+00	0.00E+00	-5.84E-03	5.68E-03	-8.51E-03	0.00E+00	-2.49E-07	2.14E-06	-2.30E-03	1.13E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	2.79E-03	-5.59E-03	0.00E+00
9	7.42E-03	0.00E+00	0.00E+00	-8.62E-03	5.68E-03	-8.51E-03	0.00E+00	-2.49E-07	2.14E-06	4.85E-04	1.13E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	0.00E+00	-5.59E-03	2.79E-03
10	7.42E-03	0.00E+00	0.00E+00	-8.14E-03	5.68E-03	-8.51E-03	0.00E+00	-2.49E-07	2.14E-06	0.00E+00	1.13E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	4.85E-04	-5.59E-03	2.30E-03
11	7.38E-03	5.59E-03	0.00E+00	-8.62E-03	8.99E-05	-8.51E-03	0.00E+00	-2.49E-07	2.14E-06	4.85E-04	1.13E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-5.67E-03	1.46E-07	0.00E+00	0.00E+00	2.83E-03
12	7.38E-03	5.68E-03	0.00E+00	-8.14E-03	0.00E+00	-8.51E-03	0.00E+00	-2.49E-07	2.14E-06	0.00E+00	1.13E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-5.76E-03	1.46E-07	4.85E-04	8.99E-05	2.34E-03
13	7.64E-03	0.00E+00	0.00E+00	-7.03E-03	1.08E-03	-4.97E-03	2.57E-03	-2.49E-07	2.14E-06	0.00E+00	5.33E-03	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	4.85E-04	-9.85E-04	0.00E+00
14	7.38E-03	5.59E-03	0.00E+00	-5.80E-03	8.99E-05	-8.51E-03	0.00E+00	-2.49E-07	2.14E-06	-2.34E-03	1.13E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-5.67E-03	1.46E-07	2.83E-03	0.00E+00	0.00E+00
15	7.38E-03	5.59E-03	0.00E+00	-8.14E-03	8.99E-05	-8.51E-03	0.00E+00	-2.49E-07	2.14E-06	0.00E+00	1.13E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-5.67E-03	1.46E-07	4.85E-04	0.00E+00	2.34E-03
16	7.38E-03	5.68E-03	0.00E+00	-5.80E-03	0.00E+00	-8.51E-03	0.00E+00	-2.49E-07	2.14E-06	-2.34E-03	1.13E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-5.76E-03	1.46E-07	2.83E-03	8.99E-05	0.00E+00
17	7.38E-03	5.68E-03	0.00E+00	-8.62E-03	0.00E+00	-8.51E-03	0.00E+00	-2.49E-07	2.14E-06	4.85E-04	1.13E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-5.76E-03	1.46E-07	0.00E+00	8.99E-05	2.83E-03
18	7.38E-03	5.59E-03	0.00E+00	0.00E+00	8.99E-05	-8.51E-03	0.00E+00	-2.49E-07	2.14E-06	-8.14E-03	1.13E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-5.67E-03	1.46E-07	8.62E-03	0.00E+00	-5.80E-03
19	7.38E-03	5.68E-03	0.00E+00	0.00E+00	0.00E+00	-8.51E-03	0.00E+00	-2.49E-07	2.14E-06	-8.14E-03	1.13E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-5.76E-03	1.46E-07	8.62E-03	8.99E-05	-5.80E-03
20	7.42E-03	0.00E+00	1.39E-02	-8.14E-03	1.08E-03	-2.72E-02	0.00E+00	-2.49E-07	2.14E-06	0.00E+00	2.08E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	4.85E-04	-9.85E-04	0.00E+00
21	7.38E-03	9.05E-04	1.42E-02	-8.14E-03	8.99E-05	-2.75E-02	0.00E+00	-2.49E-07	2.14E-06	0.00E+00	2.10E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-9.85E-04	1.46E-07	4.85E-04	0.00E+00	0.00E+00
22	7.38E-03	9.95E-04	1.42E-02	-8.14E-03	0.00E+00	-2.75E-02	0.00E+00	-2.49E-07	2.14E-06	0.00E+00	2.10E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-1.08E-03	1.46E-07	4.85E-04	8.99E-05	0.00E+00
23	7.42E-03	0.00E+00	1.69E-02	-8.62E-03	1.05E-04	-3.11E-02	0.00E+00	-2.49E-07	2.14E-06	4.85E-04	2.28E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	0.00E+00	-1.48E-05	0.00E+00
24	7.42E-03	0.00E+00	1.69E-02	0.00E+00	8.99E-05	-3.12E-02	0.00E+00	-2.49E-07	2.14E-06	-8.14E-03	2.29E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	8.62E-03	0.00E+00	-8.63E-03
25	7.41E-03	0.00E+00	1.69E-02	-8.62E-03	8.99E-05	-3.12E-02	0.00E+00	-2.49E-07	2.14E-06	4.85E-04	2.29E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-1.48E-05	1.46E-07	0.00E+00	0.00E+00	0.00E+00
26	7.42E-03	0.00E+00	1.69E-02	-8.63E-03	8.99E-05	-3.12E-02	0.00E+00	-2.49E-07	2.14E-06	4.93E-04	2.29E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	-7.38E-06	0.00E+00	0.00E+00
27	7.42E-03	0.00E+00	1.69E-02	-8.62E-03	8.99E-05	-3.12E-02	0.00E+00	-2.49E-07	2.14E-06	4.85E-04	2.29E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	0.00E+00	0.00E+00	-7.38E-06
28	7.42E-03	0.00E+00	1.69E-02	-8.14E-03	8.99E-05	-3.12E-02	0.00E+00	-2.49E-07	2.14E-06	0.00E+00	2.29E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	4.85E-04	0.00E+00	-4.93E-04
29	7.42E-03	0.00E+00	1.72E-02	0.00E+00	0.00E+00	-3.16E-02	0.00E+00	-2.49E-07	2.14E-06	-8.14E-03	2.30E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	8.62E-03	8.99E-05	-8.68E-03
30	7.42E-03	0.00E+00	1.72E-02	-8.68E-03	0.00E+00	-3.16E-02	0.00E+00	-2.49E-07	2.14E-06	5.38E-04	2.30E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	-5.23E-05	8.99E-05	0.00E+00
31	7.42E-03	0.00E+00	1.72E-02	-8.62E-03	0.00E+00	-3.16E-02	0.00E+00	-2.49E-07	2.14E-06	4.85E-04	2.30E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	0.00E+00	8.99E-05	-5.23E-05
32	7.42E-03	0.00E+00	1.72E-02	-8.14E-03	0.00E+00	-3.16E-02	0.00E+00	-2.49E-07	2.14E-06	0.00E+00	2.30E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	0.00E+00	1.46E-07	4.85E-04	8.99E-05	-5.38E-04
33	7.37E-03	0.00E+00	1.72E-02	-8.62E-03	0.00E+00	-3.16E-02	0.00E+00	-2.49E-07	2.14E-06	4.85E-04	2.30E-02	9.83E-07	1.92E-06	1.35E-05	1.45E-05	-1.05E-04	1.46E-07	0.00E+00	8.99E-05	0.00E+00

TABLE 41.A-18 INVERSE MODEL RESULTS FOR MINE SPOIL SPLP. (+) INDICATES DISSOLUTION AND (-) INDICATES PRECIPITATION. RESULTS ARE REPORTED IN MOLES PER LITER

Model	Gypsum	Albite	Ca-Montmorillonite	Calcite	K-feldspar	Kaolinite	Plagioclase	Al(OH)3(a)	Magnesite	NaX	MgX2	KX	CaX2	CO2(g)
1	7.22E-03	2.60E-05	0.00E+00	0.00E+00	0.00E+00	-1.41E-05	0.00E+00	0.00E+00	3.59E-04	6.26E-03	2.58E-04	1.79E-04	-3.48E-03	-4.43E-03
2	7.22E-03	0.00E+00	0.00E+00	3.59E-04	2.60E-05	-1.41E-05	0.00E+00	0.00E+00	0.00E+00	6.28E-03	6.18E-04	1.53E-04	-3.84E-03	-4.43E-03
3	7.22E-03	1.67E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.87E-05	3.64E-04	6.27E-03	2.54E-04	1.79E-04	-3.48E-03	-4.43E-03
4	7.22E-03	0.00E+00	1.36E-05	3.70E-04	0.00E+00	0.00E+00	0.00E+00	-3.38E-05	0.00E+00	6.28E-03	6.18E-04	1.79E-04	-3.85E-03	-4.44E-03
5	7.22E-03	0.00E+00	0.00E+00	0.00E+00	2.60E-05	-1.41E-05	0.00E+00	0.00E+00	3.59E-04	6.28E-03	2.58E-04	1.53E-04	-3.48E-03	-4.43E-03
6	7.22E-03	2.60E-05	0.00E+00	3.59E-04	0.00E+00	-1.41E-05	0.00E+00	0.00E+00	0.00E+00	6.26E-03	6.18E-04	1.79E-04	-3.84E-03	-4.43E-03
7	7.22E-03	0.00E+00	0.00E+00	3.64E-04	1.67E-05	0.00E+00	0.00E+00	-1.87E-05	0.00E+00	6.28E-03	6.18E-04	1.63E-04	-3.84E-03	-4.43E-03
8	7.22E-03	0.00E+00	3.89E-05	0.00E+00	0.00E+00	-4.63E-05	0.00E+00	0.00E+00	3.66E-04	6.28E-03	2.52E-04	1.79E-04	-3.48E-03	-4.44E-03
9	7.22E-03	0.00E+00	0.00E+00	0.00E+00	1.67E-05	0.00E+00	0.00E+00	-1.87E-05	3.64E-04	6.28E-03	2.54E-04	1.63E-04	-3.48E-03	-4.43E-03
10	7.22E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E-05	-2.84E-05	3.59E-04	6.27E-03	2.58E-04	1.79E-04	-3.48E-03	-4.43E-03
11	7.22E-03	0.00E+00	0.00E+00	3.59E-04	0.00E+00	0.00E+00	1.91E-05	-2.84E-05	0.00E+00	6.27E-03	6.18E-04	1.79E-04	-3.84E-03	-4.43E-03
12	7.22E-03	0.00E+00	3.89E-05	3.66E-04	0.00E+00	-4.63E-05	0.00E+00	0.00E+00	0.00E+00	6.28E-03	6.18E-04	1.79E-04	-3.85E-03	-4.44E-03
13	7.22E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-3.00E-05	4.20E-05	0.00E+00	3.43E-04	6.26E-03	2.74E-04	1.79E-04	-3.49E-03	-4.41E-03
14	7.22E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.50E-05	0.00E+00	-5.21E-05	3.72E-04	6.28E-03	2.45E-04	1.79E-04	-3.48E-03	-4.44E-03
15	7.22E-03	1.67E-05	0.00E+00	3.64E-04	0.00E+00	0.00E+00	0.00E+00	-1.87E-05	0.00E+00	6.27E-03	6.18E-04	1.79E-04	-3.84E-03	-4.43E-03
16	7.22E-03	0.00E+00	1.36E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-3.38E-05	3.70E-04	6.28E-03	2.48E-04	1.79E-04	-3.48E-03	-4.44E-03
17	7.22E-03	0.00E+00	0.00E+00	3.43E-04	0.00E+00	-3.00E-05	4.20E-05	0.00E+00	0.00E+00	6.26E-03	6.18E-04	1.79E-04	-3.84E-03	-4.41E-03
18	7.22E-03	0.00E+00	0.00E+00	3.72E-04	0.00E+00	2.50E-05	0.00E+00	-5.21E-05	0.00E+00	6.28E-03	6.18E-04	1.79E-04	-3.85E-03	-4.44E-03

TABLE 41.A-19 INVERSE MODEL RESULTS FOR CCB LEACHATE USING COAL GROUNDWATER. (+) INDICATES DISSOLUTION AND (-) INDICATES PRECIPITATION. RESULTS ARE REPORTED IN MOLES PER LITER

Model	Gypsum	Calcite	SiO2(a)	Fe(OH)3(a)	Gibbsite	Lime	Ba Oxide	Na Oxide	K Oxide	Ba Hydroxide	Brucite	Periclase	Manganite	Borax	O2(g)	MgX2	KX	CaX2	LiX	NaX
1	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	0.00E+00	0.00E+00	1.95E-05	6.72E-08	4.66E-03	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	-4.40E-03	0.00E+00	4.39E-03	1.88E-05	0.00E+00
2	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.40E-03	0.00E+00	0.00E+00	1.95E-05	6.72E-08	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	0.00E+00	0.00E+00	1.88E-05	-1.88E-05
3	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	0.00E+00	0.00E+00	1.95E-05	6.72E-08	0.00E+00	4.66E-03	1.74E-06	5.24E-05	-4.35E-07	-4.40E-03	0.00E+00	4.39E-03	1.88E-05	0.00E+00
4	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	6.72E-08	0.00E+00	1.95E-05	0.00E+00	4.66E-03	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	-4.40E-03	0.00E+00	4.39E-03	1.88E-05	0.00E+00
5	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.72E-08	0.00E+00	4.68E-03	1.74E-06	5.24E-05	-4.35E-07	-4.41E-03	3.91E-05	4.39E-03	1.88E-05	0.00E+00
6	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.39E-03	0.00E+00	0.00E+00	1.95E-05	6.72E-08	2.74E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	-9.42E-06	0.00E+00	0.00E+00	1.88E-05	0.00E+00
7	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.40E-03	6.72E-08	0.00E+00	1.95E-05	0.00E+00	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	0.00E+00	-9.42E-06	1.88E-05	0.00E+00
8	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.40E-03	0.00E+00	0.00E+00	1.95E-05	6.72E-08	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	0.00E+00	0.00E+00	1.88E-05	-1.88E-05
9	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	6.72E-08	4.33E-03	1.95E-05	0.00E+00	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	0.00E+00	2.83E-03	1.88E-05	-6.20E-03
10	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.40E-03	6.72E-08	0.00E+00	1.95E-05	0.00E+00	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	0.00E+00	0.00E+00	1.88E-05	-1.88E-05
11	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.41E-03	0.00E+00	0.00E+00	0.00E+00	6.72E-08	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	3.91E-05	0.00E+00	1.88E-05	-5.79E-05
12	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	6.72E-08	0.00E+00	0.00E+00	0.00E+00	4.68E-03	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	-4.41E-03	3.91E-05	4.39E-03	1.88E-05	0.00E+00
13	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	6.72E-08	4.07E-03	1.95E-05	0.00E+00	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	0.00E+00	2.83E-03	1.88E-05	-5.67E-03
14	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.39E-03	0.00E+00	0.00E+00	2.90E-05	6.72E-08	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	-1.88E-05	0.00E+00	1.88E-05	0.00E+00
15	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.39E-03	6.72E-08	0.00E+00	1.95E-05	0.00E+00	0.00E+00	2.74E-04	1.74E-06	5.24E-05	-4.35E-07	-9.42E-06	0.00E+00	0.00E+00	1.88E-05	0.00E+00
16	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.40E-03	0.00E+00	0.00E+00	1.95E-05	6.72E-08	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	0.00E+00	-9.42E-06	1.88E-05	0.00E+00
17	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.66E-03	6.72E-08	0.00E+00	1.95E-05	0.00E+00	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	0.00E+00	-2.74E-04	1.88E-05	0.00E+00
18	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	2.83E-03	6.72E-08	1.51E-03	1.95E-05	0.00E+00	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	0.00E+00	0.00E+00	1.88E-05	-5.49E-04
19	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	6.72E-08	4.07E-03	1.95E-05	0.00E+00	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	0.00E+00	2.83E-03	1.88E-05	-5.67E-03
20	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.39E-03	0.00E+00	0.00E+00	0.00E+00	6.72E-08	2.94E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	-2.90E-05	3.91E-05	0.00E+00	1.88E-05	0.00E+00
21	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.41E-03	0.00E+00	0.00E+00	0.00E+00	6.72E-08	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	3.91E-05	-2.90E-05	1.88E-05	0.00E+00
22	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.41E-03	0.00E+00	0.00E+00	0.00E+00	6.72E-08	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	3.91E-05	0.00E+00	1.88E-05	-5.79E-05
23	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.68E-03	0.00E+00	0.00E+00	0.00E+00	6.72E-08	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	3.91E-05	-2.94E-04	1.88E-05	0.00E+00
24	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.41E-03	6.72E-08	0.00E+00	0.00E+00	0.00E+00	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	3.91E-05	0.00E+00	1.88E-05	-5.79E-05
25	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	6.72E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.68E-03	1.74E-06	5.24E-05	-4.35E-07	-4.41E-03	3.91E-05	4.39E-03	1.88E-05	0.00E+00
26	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	6.72E-08	0.00E+00	4.41E-03	0.00E+00	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	-8.79E-03	4.39E-03	1.88E-05	0.00E+00
27	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	0.00E+00	4.09E-03	0.00E+00	6.72E-08	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	3.91E-05	2.83E-03	1.88E-05	-5.71E-03
28	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.39E-03	6.72E-08	0.00E+00	2.90E-05	0.00E+00	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	-1.88E-05	0.00E+00	1.88E-05	0.00E+00
29	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.39E-03	6.72E-08	0.00E+00	2.94E-04	0.00E+00	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	-5.49E-04	0.00E+00	1.88E-05	0.00E+00
30	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.39E-03	0.00E+00	0.00E+00	0.00E+00	6.72E-08	0.00E+00	2.94E-04	1.74E-06	5.24E-05	-4.35E-07	-2.90E-05	3.91E-05	0.00E+00	1.88E-05	0.00E+00
31	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.41E-03	0.00E+00	0.00E+00	0.00E+00	6.72E-08	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	3.91E-05	-2.90E-05	1.88E-05	0.00E+00
32	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	2.83E-03	0.00E+00	1.53E-03	0.00E+00	6.72E-08	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	3.91E-05	0.00E+00	1.88E-05	-5.88E-04
33	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.39E-03	6.72E-08	0.00E+00	0.00E+00	0.00E+00	2.94E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	-2.90E-05	3.91E-05	0.00E+00	1.88E-05	0.00E+00
34	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.41E-03	6.72E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	3.91E-05	-2.90E-05	1.88E-05	0.00E+00
35	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.41E-03	6.72E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	3.91E-05	0.00E+00	1.88E-05	-5.79E-05
36	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.68E-03	6.72E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	3.91E-05	-2.94E-04	1.88E-05	0.00E+00
37	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	0.00E+00	4.33E-03	1.95E-05	6.72E-08	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	0.00E+00	2.83E-03	1.88E-05	-6.20E-03
38	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	0.00E+00	0.00E+00	4.41E-03	6.72E-08	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	-8.79E-03	4.39E-03	1.88E-05	0.00E+00
38	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	0.00E+00	0.00E+00	4.68E-03	6.72E-08	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	-9.32E-03	4.39E-03	1.88E-05	0.00E+00
40	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	0.00E+00	4.09E-03	0.00E+00	6.72E-08	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	3.91E-05	2.83E-03	1.88E-05	-5.71E-03
41	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	0.00E+00	4.35E-03	0.00E+00	6.72E-08	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	3.91E-05	2.83E-03	1.88E-05	-6.24E-03
42	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	6.72E-08	4.09E-03	0.00E+00	0.00E+00	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	3.91E-05	2.83E-03	1.88E-05	-5.71E-03
43	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	0.00E+00	4.07E-03	1.95E-05	6.72E-08	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	0.00E+00	2.83E-03	1.88E-05	-5.67E-03

TABLE 41.A-19 (CONTINUED)

Model	Gypsum	Calcite	SiO2(a)	Fe(OH)3(a)	Gibbsite	Lime	Ba Oxide	Na Oxide	K Oxide	Ba Hydroxide	Brucite	Periclase	Manganite	Borax	O2(g)	MgX2	KX	CaX2	LiX	NaX
44	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.39E-03	6.72E-08	0.00E+00	1.95E-05	0.00E+00	2.74E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	-9.42E-06	0.00E+00	0.00E+00	1.88E-05	0.00E+00
45	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.39E-03	6.72E-08	0.00E+00	2.90E-05	0.00E+00	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	-1.88E-05	0.00E+00	1.88E-05	0.00E+00
46	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.40E-03	6.72E-08	0.00E+00	1.95E-05	0.00E+00	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	0.00E+00	-9.42E-06	1.88E-05	0.00E+00
47	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.40E-03	6.72E-08	0.00E+00	1.95E-05	0.00E+00	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	0.00E+00	0.00E+00	1.88E-05	-1.88E-05
48	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.41E-03	6.72E-08	0.00E+00	0.00E+00	0.00E+00	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	3.91E-05	-2.90E-05	1.88E-05	0.00E+00
49	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.39E-03	6.72E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E-04	1.74E-06	5.24E-05	-4.35E-07	-2.90E-05	3.91E-05	0.00E+00	1.88E-05	0.00E+00
50	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	2.83E-03	6.72E-08	1.53E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	3.91E-05	0.00E+00	1.88E-05	-5.88E-04
51	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.40E-03	0.00E+00	0.00E+00	1.95E-05	6.72E-08	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	0.00E+00	-9.42E-06	1.88E-05	0.00E+00
52	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.39E-03	0.00E+00	0.00E+00	1.95E-05	6.72E-08	0.00E+00	2.74E-04	1.74E-06	5.24E-05	-4.35E-07	-9.42E-06	0.00E+00	0.00E+00	1.88E-05	0.00E+00
53	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.39E-03	0.00E+00	0.00E+00	2.90E-05	6.72E-08	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	-1.88E-05	0.00E+00	1.88E-05	0.00E+00
54	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.39E-03	0.00E+00	0.00E+00	2.94E-04	6.72E-08	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	-5.49E-04	0.00E+00	1.88E-05	0.00E+00
55	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	4.66E-03	0.00E+00	0.00E+00	1.95E-05	6.72E-08	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	0.00E+00	-2.74E-04	1.88E-05	0.00E+00
56	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	2.83E-03	0.00E+00	1.51E-03	1.95E-05	6.72E-08	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	0.00E+00	0.00E+00	1.88E-05	-5.49E-04
57	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	6.72E-08	0.00E+00	4.41E-03	0.00E+00	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	-8.79E-03	4.39E-03	1.88E-05	0.00E+00
58	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	6.72E-08	0.00E+00	1.95E-05	0.00E+00	0.00E+00	4.66E-03	1.74E-06	5.24E-05	-4.35E-07	-4.40E-03	0.00E+00	4.39E-03	1.88E-05	0.00E+00
59	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	6.72E-08	0.00E+00	4.68E-03	0.00E+00	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	-9.32E-03	4.39E-03	1.88E-05	0.00E+00
60	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	6.72E-08	4.09E-03	0.00E+00	0.00E+00	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	3.91E-05	2.83E-03	1.88E-05	-5.71E-03
61	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	6.72E-08	4.35E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	2.65E-04	3.91E-05	2.83E-03	1.88E-05	-6.24E-03
62	2.28E-02	-1.15E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	0.00E+00	4.07E-03	1.95E-05	6.72E-08	2.65E-04	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	0.00E+00	2.83E-03	1.88E-05	-5.67E-03
63	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	0.00E+00	0.00E+00	4.41E-03	6.72E-08	0.00E+00	2.65E-04	1.74E-06	5.24E-05	-4.35E-07	0.00E+00	-8.79E-03	4.39E-03	1.88E-05	0.00E+00
64	2.21E-02	-1.22E-02	1.89E-04	-1.26E-06	-3.05E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.72E-08	4.68E-03	0.00E+00	1.74E-06	5.24E-05	-4.35E-07	-4.41E-03	3.91E-05	4.39E-03	1.88E-05	0.00E+00

TABLE 41.A-20 INVERSE MODEL RESULTS FOR COAL COMBUSTION BY-PRODUCT SPLP. (+) INDICATES DISSOLUTION AND (-) INDICATES PRECIPITATION. RESULTS ARE REPORTED IN MOLES PER LITER

Model	Gypsum	Dolomite	Calcite	SiO2(a)	Al(OH)3(a)	Magnesite	Portlandite	Lime	Ba Oxide	Na Oxide	Barite	Ba Hydroxide	Brucite	Periclase	MgX2	KX	CaX2	NaX
1	1.83E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	4.73E-03	6.41E-05	-4.73E-03	0.00E+00	0.00E+00	0.00E+00	4.77E-03	2.82E-05	-4.78E-03	0.00E+00
2	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	8.02E-07	2.92E-05	0.00E+00	0.00E+00	0.00E+00	4.77E-03	0.00E+00	2.82E-05	-4.90E-05	6.98E-05
3	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	4.79E-03	0.00E+00	0.00E+00	0.00E+00	8.02E-07	0.00E+00	0.00E+00	4.77E-03	2.82E-05	-4.84E-03	1.28E-04
4	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	8.02E-07	2.92E-05	0.00E+00	0.00E+00	4.77E-03	0.00E+00	0.00E+00	2.82E-05	-4.90E-05	6.98E-05
5	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	4.73E-03	0.00E+00	6.41E-05	0.00E+00	8.02E-07	0.00E+00	0.00E+00	4.77E-03	2.82E-05	-4.78E-03	0.00E+00
6	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.92E-05	3.00E-05	4.77E-03	0.00E+00	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
7	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	4.79E-03	8.02E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.77E-03	2.82E-05	-4.84E-03	1.28E-04
8	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	4.73E-03	8.02E-07	6.41E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.77E-03	2.82E-05	-4.78E-03	0.00E+00
9	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.92E-05	3.00E-05	0.00E+00	4.77E-03	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
10	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	2.92E-05	8.02E-07	0.00E+00	0.00E+00	0.00E+00	4.77E-03	0.00E+00	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
11	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	0.00E+00	2.92E-05	0.00E+00	8.02E-07	4.77E-03	0.00E+00	0.00E+00	2.82E-05	-4.90E-05	6.98E-05
12	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	8.02E-07	6.41E-05	0.00E+00	0.00E+00	4.73E-03	0.00E+00	3.49E-05	2.82E-05	-4.90E-05	0.00E+00
13	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	4.79E-03	0.00E+00	8.02E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.77E-03	2.82E-05	-4.84E-03	1.28E-04
14	1.83E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	0.00E+00	6.41E-05	-4.73E-03	4.73E-03	0.00E+00	0.00E+00	4.77E-03	2.82E-05	-4.78E-03	0.00E+00
15	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	2.92E-05	0.00E+00	8.02E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.77E-03	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
16	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	0.00E+00	2.92E-05	0.00E+00	8.02E-07	0.00E+00	4.77E-03	0.00E+00	2.82E-05	-4.90E-05	6.98E-05
17	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	2.92E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.02E-07	4.77E-03	0.00E+00	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
18	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	8.02E-07	6.41E-05	0.00E+00	0.00E+00	0.00E+00	4.73E-03	3.49E-05	2.82E-05	-4.90E-05	0.00E+00
19	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	0.00E+00	6.41E-05	0.00E+00	8.02E-07	0.00E+00	4.73E-03	3.49E-05	2.82E-05	-4.90E-05	0.00E+00
20	1.84E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	4.80E-03	0.00E+00	-4.79E-03	0.00E+00	0.00E+00	0.00E+00	4.77E-03	2.82E-05	-4.84E-03	1.28E-04
21	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.02E-07	4.79E-03	0.00E+00	-2.92E-05	2.82E-05	-4.90E-05	1.28E-04
22	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	2.92E-05	0.00E+00	0.00E+00	0.00E+00	8.02E-07	0.00E+00	4.77E-03	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
23	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	4.73E-03	0.00E+00	8.02E-07	6.41E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.77E-03	2.82E-05	-4.78E-03	0.00E+00
24	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	3.00E-05	0.00E+00	-2.92E-05	0.00E+00	4.77E-03	0.00E+00	0.00E+00	2.82E-05	-7.82E-05	1.28E-04

TABLE 41.A-20 (CONTINUED)

Model	Gypsum	Dolomite	Calcite	SiO2(a)	Al(OH)3(a)	Magnesite	Portlandite	Lime	Ba Oxide	Na Oxide	Barite	Ba Hydroxide	Brucite	Periclase	MgX2	KX	CaX2	NaX
25	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	4.73E-03	0.00E+00	0.00E+00	6.41E-05	0.00E+00	8.02E-07	0.00E+00	0.00E+00	4.77E-03	2.82E-05	-4.78E-03	0.00E+00
26	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	4.79E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.02E-07	0.00E+00	0.00E+00	4.77E-03	2.82E-05	-4.84E-03	1.28E-04
27	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	3.00E-05	0.00E+00	-2.92E-05	0.00E+00	0.00E+00	4.77E-03	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
28	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	8.02E-07	4.79E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.77E-03	2.82E-05	-4.90E-05	-9.46E-03
29	1.36E-02	2.92E-05	0.00E+00	1.95E-04	1.10E-05	-4.79E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.02E-07	4.79E-03	0.00E+00	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
30	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.02E-07	0.00E+00	4.79E-03	-2.92E-05	2.82E-05	-4.90E-05	1.28E-04
31	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	8.02E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.79E-03	-2.92E-05	2.82E-05	-4.90E-05	1.28E-04
32	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	2.92E-05	0.00E+00	8.02E-07	0.00E+00	0.00E+00	0.00E+00	4.77E-03	0.00E+00	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
33	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	2.92E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.02E-07	0.00E+00	4.77E-03	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
34	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	2.92E-05	8.02E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.77E-03	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
35	1.36E-02	2.92E-05	0.00E+00	1.95E-04	1.10E-05	-4.79E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.02E-07	0.00E+00	4.79E-03	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
36	1.36E-02	2.92E-05	0.00E+00	1.95E-04	1.10E-05	-4.79E-03	0.00E+00	0.00E+00	8.02E-07	0.00E+00	0.00E+00	0.00E+00	4.79E-03	0.00E+00	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
37	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	0.00E+00	6.41E-05	0.00E+00	8.02E-07	4.73E-03	0.00E+00	3.49E-05	2.82E-05	-4.90E-05	0.00E+00
38	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	0.00E+00	4.79E-03	0.00E+00	8.02E-07	0.00E+00	0.00E+00	4.77E-03	2.82E-05	-4.90E-05	-9.46E-03
39	1.84E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-4.79E-03	4.80E-03	0.00E+00	0.00E+00	4.77E-03	2.82E-05	-4.84E-03	1.28E-04
40	1.36E-02	0.00E+00	2.92E-05	1.95E-04	1.10E-05	-4.76E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.02E-07	4.79E-03	0.00E+00	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
41	1.36E-02	2.92E-05	0.00E+00	1.95E-04	1.10E-05	-4.79E-03	0.00E+00	0.00E+00	8.02E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.79E-03	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
42	1.36E-02	0.00E+00	2.92E-05	1.95E-04	1.10E-05	-4.76E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.02E-07	0.00E+00	4.79E-03	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
43	1.36E-02	0.00E+00	2.92E-05	1.95E-04	1.10E-05	-4.76E-03	0.00E+00	0.00E+00	8.02E-07	0.00E+00	0.00E+00	0.00E+00	4.79E-03	0.00E+00	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
44	1.36E-02	0.00E+00	2.92E-05	1.95E-04	1.10E-05	-4.76E-03	0.00E+00	0.00E+00	8.02E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.79E-03	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
45	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	2.92E-05	0.00E+00	0.00E+00	0.00E+00	8.02E-07	4.77E-03	0.00E+00	0.00E+00	2.82E-05	-7.82E-05	1.28E-04
46	1.36E-02	0.00E+00	0.00E+00	1.95E-04	1.10E-05	-4.73E-03	0.00E+00	0.00E+00	8.02E-07	0.00E+00	0.00E+00	0.00E+00	4.79E-03	0.00E+00	-2.92E-05	2.82E-05	-4.90E-05	1.28E-04

41.A.10 FIGURES

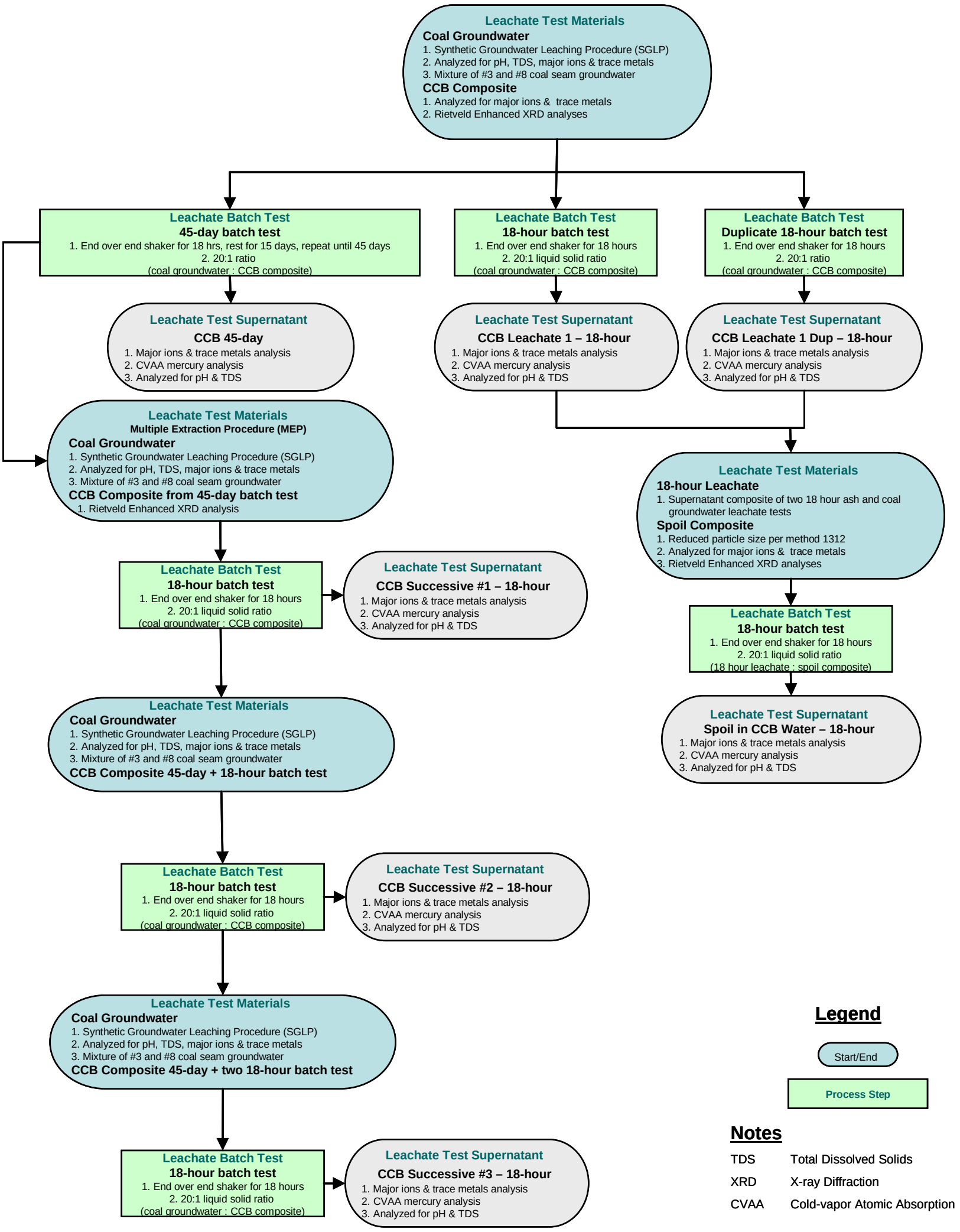
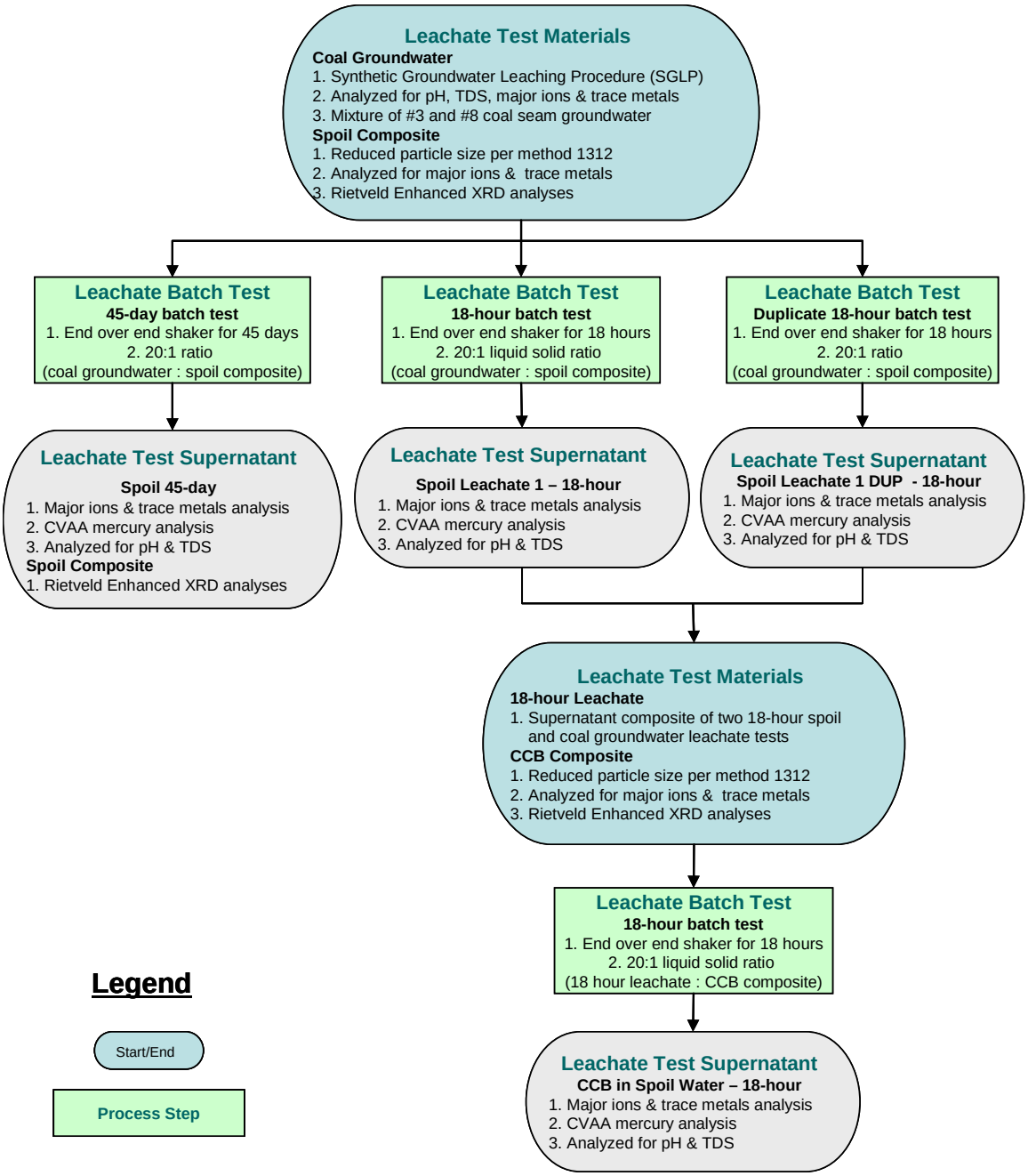


Figure 41.A-1 Flow Chart of Leachate Batch Tests Starting with Coal Groundwater and Coal Combustion By-product Composite Samples.



Notes

TDS	Total Dissolved Solids
XRD	X-ray Diffraction
CVAA	Cold-vapor Atomic Absorption

Figure 41.A-2 Flow Chart of Leachate Batch Tests Starting with Coal Groundwater and Mine Spoil Composite Samples.

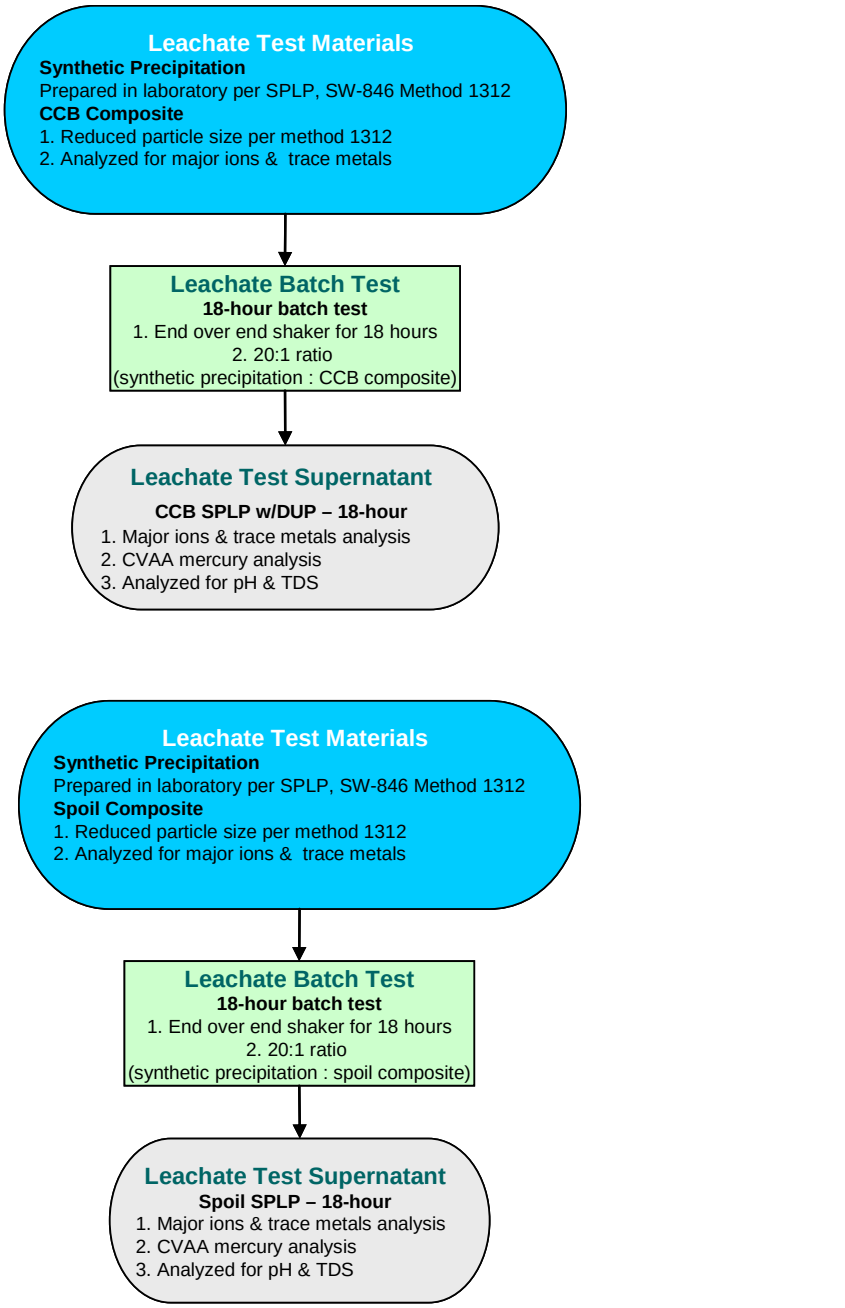
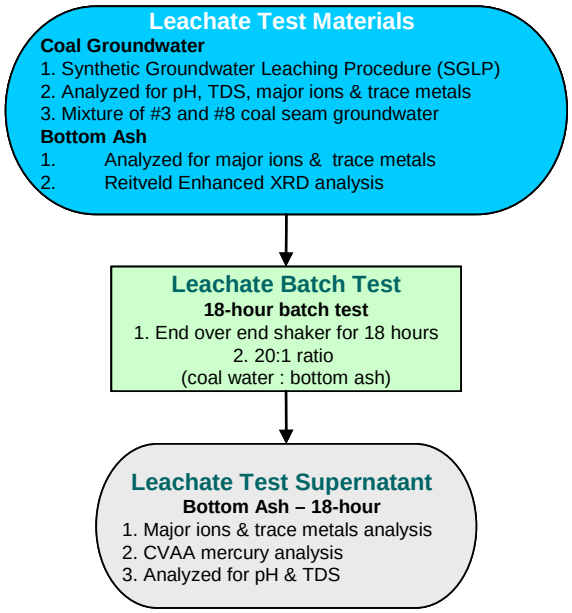


Figure 41.A-3 Flow Chart of Leachate Batch Tests Starting with Synthetic Precipitation and Both Coal Combustion By-product and Mine Spoil Composite Samples.



Notes

TDS	Total Dissolved Solids
XRD	X-ray Diffraction
CVAA	Cold-vapor Atomic Absorption

Legend

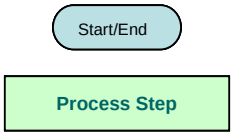


Figure 41.A-4 Flow Chart of Leachate Batch Tests Starting with Coal Groundwater and Bottom Ash Composite.

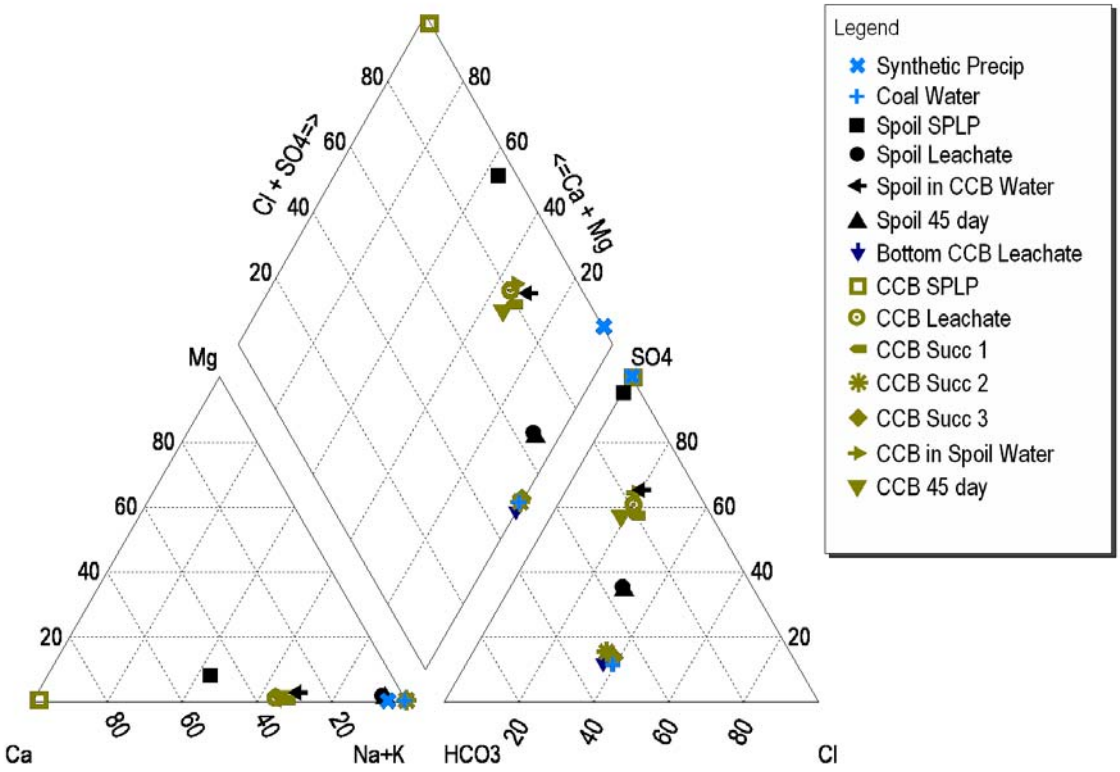


Figure 41.A-5 Piper-Trilinear Diagram of Leachate Analyses and Initial Water Compositions.

Attachment 41.A.A

Leachate Analysis Work Plan

WORK PLAN FOR CCB TESTING AND EVALUATION FOR THE NAVAJO MINE EXTENSION PROJECT

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1.0 INTRODUCTION

1.1 Background

BHP Billiton Navajo Coal Company (BNCC) proposes an expansion of its existing surface coal mining operations into Area IV South and Area V of the (BNCC) lease. This lease is located on the western flank of the San Juan Structural Basin within the Navajo Nation, southwest of Farmington, New Mexico. The proposed mine is referred to as the Navajo Mine Extension Project (NMEP). The study area for the NMEP is approximately 13,000 acres. The coal seams to be mined include seams 2, 3, 4, 6, 7, and 8 of the Cretaceous age Fruitland Formation. The project area is crossed by two arroyos, the Pinabete Arroyo through Area IV South and the No Name Arroyo in Area V. Both the Pinabete Arroyo and No Name Arroyo are ephemeral streams that drain directly into the Chaco River, a tributary of the San Juan River. The Chaco River drains an area of more than 4000 square miles and flows from south to north along the west side of the NMEP study area. Flow in the Chaco River is also ephemeral in the vicinity of the NMEP.

Based on regional and site-specific information, the potentiometric gradients in Fruitland coals is toward the north while gradients in the Pictured Cliffs Sandstone are toward the northwest. Ground water recharge from precipitation and ephemeral stream flow in the vicinity of the permit area is thought to move predominantly downward through the overburden and coal units of the Kirtland and Fruitland Formations and into the Pictured Cliffs Sandstone. Although the vertical hydraulic conductivities of the interbedded shales in the overburden and interburden of the Fruitland Formation is quite low, recharge rates are lower still, such that the Fruitland Formation within the western portion of Areas 4 and 5, is unsaturated. Stone (1984) used chloride mass balance methods to estimate recharge rate at the Navajo mine and found that recharge ranged from 0.05 to 0.51 mm/yr.

The saturated thickness of the Fruitland formation increases as the Fruitland Formation dips toward the east. In the locations, where the coals are saturated, flow is expected to be primarily laterally through the coal in the direction of the potentiometric gradient because the hydraulic conductivities of the coals is generally higher than that of the shales. Nevertheless, lateral flows in the Fruitland coals are still quite low and insufficient to sustain seeps or springs at coal subcrops and outcrops due to the low gradients and low transmissivities of these units. Given the very low recharge rates, vertical flow through interbedded shales of the Fruitland Formation is sufficient to prevent perched conditions or saturation of the shallower coals despite the low hydraulic conductivities of the interbedded shales.

There has been much speculation regarding the possible effects of coal combustion by-product (CCB) placement on water quality. The Probable Hydrologic Consequences (PHC) of the proposed surface mining operation must be determined to fulfill both operational and regulatory requirements. This work plan includes a plan for detailed testing and evaluation to assess the likely consequences of the proposed placement of CCBs in mine backfill on ground water quality in accordance with mine permit requirements (OSM 2001). The leaching test results and estimated groundwater fate and transport evaluations will be included in the PHC report. The PHC Report will also include a description of the conceptual model of the post-mining

hydrogeological conditions, including backfill characteristics, surrounding aquifers, ground water flow patterns, and surface water drainage locations.

This study plan addresses the relevant OSM guidance provided in "Guidance on Disposal of Coal Combustion Byproducts" (OSM 2001). This study plan also addresses the recommendations from the NAC (2006) report "Managing Coal Combustion Residues in Mines" but will be tailored to the specific hydrogeologic, climatic conditions, and baseline ground water conditions that occur at the NMEP.

1.2 Work Plan Overview

This work plan presents a detailed description of the work for the following major tasks that will be undertaken to develop the information on CCB properties and mine backfill characteristics needed to prepare the probable hydrologic consequences (PHC) assessment for proposed CCB placement in mine backfill.

1. Assemble and review relevant information from the literature and existing information from the Navajo and San Juan Mines related to CCB placement in mine backfill. This task is partially complete and is summarized in Section 2 of this Work Plan

2. Leachate and attenuation studies will be conducted using representative samples of CCB materials from the existing power plants and mine backfill (spoil). Detailed plans for these studies are described in Section 3 of this Work Plan.

3. Chemical fate and transport evaluations for the PHC assessment. A description of the methods and information that will be used for these evaluations is described in Section 4 of this Work Plan

2.0 REVIEW OF EXISTING INFORMATION ON CCB PROPERTIES AND MINE PLACEMENT

2.1 Characteristics and Environmental Performance of CCB Materials

A 2006 study by the National Academy of Sciences (NAC 2006) recommends characterization of CCB materials and designated mine placement areas to identify potential impacts and to protect water quality. An EPRI (1987) report provides a summary of chemical characteristics of CCB materials. This report found that fly ash and bottom ash show a marked similarity in the content of elements including aluminum (Al), calcium (Ca), iron (Fe), magnesium (Mg) and silicon (Si). Volatile elements such as boron (B), fluoride (F), and selenium (Se) were generally concentrated in fly ash and flue gas desulfurization (FGD) sludge. The study also concluded that the composition of leachates from the CCB materials was extremely variable and related to pH, the degree of aqueous complexation of elements, and the types of solubility-controlling solids formed. The aqueous concentrations of Al, barium (Ba), Ca, Fe, Si, and sulfur (S) in fly ash appeared to be controlled by precipitation/dissolution reactions, while the trace elements arsenic (As), copper (Cu), nickel (Ni), and zinc (Zn) showed pH-dependent solubilities and were at or near the detection limits in most leachates from fly ash at pH values greater than 5. Selenium also shows pH-dependent solubility with higher leaching potential under alkaline conditions (i.e., when pH is greater than 10). Selenium also attenuates moderately well through adsorption onto mine spoils and aquifer materials (Murarka, 2003)

The Desert Rock Facility will be using current emissions control technologies including the possibility of activated carbon injection (ACI) to reduce mercury (Hg) in flue gas emissions. Recent concerns have been expressed about possible leaching of Hg from residues generated from Hg control features included in coal combustion facilities. Studies performed by the Environmental Protection Agency's (EPA's) National Risk Management Research indicate that leaching of Hg from activated carbon injection materials may not be of concern (NAC 2006). Preliminary results of Heebink et al. (2004) show that leachate Hg concentrations were low, regardless of Hg concentration in the original sample. All concentrations were below the primary drinking water standard of 2 µg/L**.** Studies of fly ash leachate using fly ash generated from ACI and from traditional processes are found in literature (Aljoe et al. 2005, Kazonich et al. 2005, Hassett et al. 2005, Kim and Schroeder 2005). The fly ash generated by ACI, compared to fly ash without ACI, results in a finer grain size and higher concentrations of Hg and Se. Analysis of the trace metals arsenic, cadmium, chromium, copper, lead, and nickel did not indicate significant increases in fly ash generated with ACI. While the analysis of the solid fly ash material shows higher concentrations of Hg and Se the results of leachate studies indicate no significant increase in Hg and Se leachability versus fly ash generated without ACI (Kazonich et al. 2005, Hassett et al. 2005, Kim and Schroeder 2005).

The CCBs that are planned for placement at the NMEP are from Fruitland Formation Coals removed at the mine and used to generate power at the proposed Desert Rock Generating Station. The coals from the Fruitland Formation are characterized as sub-bituminous with 9,500 Btu/lb, 18 to 25% ash, and <1% sulfur. Fly ash, bottom ash, and FGD residuals have been produced during the combustion of the Fruitland Coals at the San Juan Generating Station (SJGS) and the APS Four

Corners Power Plant (FCPP) near Waterflow, NM and Fruitland, NM, respectively. These CCB materials are composed of approximately 70% fly ash, 15% bottom ash, and 15% FGD.

The principal components of CCB's from the SJGS and the FCPP are Si and oxides of Ca, Mg, Al, F, and S. Secondary components include carbon and various trace elements (Luther et al 2005). These materials are commonly amorphous structured minerals composed of predominately silt sized (2 to 100 um) particles and are alkaline (pH 7.4 to 12).

Mean trace element concentrations analysis provided by Luther et al (2005) show that B and Ba levels in bottom ash and fly ash materials are higher than overburden and backfill materials at San Juan Mine while Fe and Mn concentrations appear to be lower. The concentrations of other elements are similar. A similar comparison of total trace element concentrations (mg/kg) of a solid matrix of CCB and of spoil used as backfill at Navajo Mine was presented by Young (2003). The total elemental concentrations in ash and spoil were similar for most constituents. However, slightly higher concentrations of boron, barium, selenium, and chromium were observed in the ash while concentrations of sulfate, sodium, and calcium were lower in the ash as compared to the spoil.

Although an analysis of a total elemental concentrations are useful in comparing the chemical composition of CCBs, overburden and backfill materials, these results provide little information concerning the potential leaching of trace elements from CCBs and backfill materials at mining operations and the potential fate and transport of these trace elements in groundwater. There are two approaches to assess the environmental effects of placement of CCBs in mine backfill (Hassett and Pflughoeft-Hassett, 2000):

- monitor groundwater within and down gradient of CCB placement in mine backfill, or;
- predict the environmental performance through the use of models and laboratory studies, usually involving leaching tests.

The field monitoring option is not possible where predictions are needed in advance of actual CCB placement. Laboratory leaching studies have been widely used to help to determine whether specific CCBs may leach trace elements at concentrations of concern and to assess the potential ground water impacts of CCB placement in mine backfills (Dale 2005, Hassett 2005, Hassett and Pflughoeft-Hassett 2000, Kim 2003, Manghini et al 2005, and NAC 2006). Many laboratory leaching test protocols have been developed for various environments, and some agencies have mandated specific protocols in their jurisdiction. The State of New Mexico, for instance, requires leaching of combusted waste with distilled water in an 18-hour batch test in accordance with the shake extraction procedure ASTM-D3987-85 (American Society for Testing and Materials 1990), The ASTM procedure is essentially the same as the Synthetic Leaching Precipitation Procedure (SLPP) and the Synthetic Groundwater Leaching Procedure (SLGP) other than the characteristics of the water used in the extraction test (Hassett 2005). EPA has developed step tests with varying pH to mimic the progression in acid drainage. Kim (2003) documented over 100 different leaching tests in use currently or historically, most of them adaptations for site-specific conditions from agency standard protocols. Likewise, Sorini (1997) has published a summary of more than 50 different leaching tests. As would be expected, some of the tests are suitable for use with CCBs, some are clearly not suitable, and many could be debated.

In its report "Managing Coal Combustion Residues (CCRs) in Mines," the National Academy of Sciences (2006) recommends that post-placement field studies could be conducted that would allow the comparison of leaching test results against groundwater quality monitoring at sites where CCBs have been placed in mine backfills. Such studies would serve to improve and field-validate leaching tests to better predict the mobilization of constituents from CCRs in mine settings. The subsequent two subsections of this work plan provide a review of CCBs placement activities at the Navajo Mine and at the San Juan Mine. This review includes a summary of leaching test results performed on CCBs placed at these mines. Comparison of leaching test results against groundwater quality monitoring at or near where CCBs have been placed in mine backfills at these mine sites has been limited by the very limited extent of saturation that has developed in the backfill at these mines. Nevertheless, comparison of leaching results with groundwater quality monitoring has been included in this Work Plan for the Navajo Mine, where, as a result of nearby irrigation activities, saturation conditions have occurred within the mine spoil and within CCB placement locations.

2.2 CCB Placement in Mine Backfill at Navajo Mine

CCBs have been placed in mine pit backfills at the Navajo Mine since 1971 under authorizations in 1968 by the Navajo Nation and the US Department of Interior. Arizona Public Service Company, BHP, and its predecessor Utah International have also conducted a number of environmental assessments of CCBs that have been placed within backfill as part of mine reclamation operations. A study of trace elements in coal ash was included in a 1974 report by Woodward-Envicon, Inc. entitled "Trace Element Study for the Four Corners Power Plant and the Navajo Mine." This study also examined trace element concentrations in various environmental receptors in the vicinity of the mine and power plant, including, air, water, soil, plants, fish and terrestrial animals. Subsequently, a study entitled "A Laboratory Investigation of Processing and Handling Options of Fly Ash and FGD Sludge from the Four Corners Generating Station" was completed by Radian Corporation in 1981. This report studied the leachate properties of fly ash, FGD sludge and ash blends and found that the leachate quality of all CCBS were nontoxic as related to RCRA guidelines and that leachate from ash blends was better than from fly ash alone.

Approval from OSM was granted in the early 1980's to continue ash disposal at the Navajo Mine provided that the Navajo Mine conduct additional comprehensive studies of the environmental effects of CCB disposal operations. In 1984, IT Corporation completed a study and prepared a report entitled "Laboratory Assessment of Ground Water Quality Impacts from Ash Disposal at the Navajo Mine." This report and a related report by IT Corporation entitled "Ground Water Leachate Transport Studies to Assess Ground Water Quality Impacts of Ash Disposal at the Navajo Mine" were included in the Navajo Mine Permit Application Package (PAP) in response to the OSM requirement. Plans for ash placement and cover were included in the PAP. Subsequent studies were also completed under the OSM permitting process, including:

- A 1986 study of the "Effects of Fly Ash Burial on Selenium Content of Vegetation at San Juan and Navajo Mine at Farmington, New Mexico"
- A 1987 Root Depth Study were placed in the Bitsui and Watson Pits
- A 1993 "Fly Ash Disposal, Supplemental Groundwater Monitoring Plan" for Ash disposal

- A "Supplemental Groundwater Study, November 1996 through March 1998" (APPENDIX 11-MM of the PAP)

The results of leaching and attenuation studies are summarized in Table 1 along with recent ground water sampling results from spoil and ash wells installed at the Bitsui and Watson Pits. Leaching tests methods and results are described in the IT Corporation Leach Report, Appendix 11-K, Tables 27.B13 through 27B.29 (Navajo Mine PAP). These tests were conducted using samples of CCB materials and mine rock spoil (pit backfill material). Tests were performed using a batch leaching procedure, where the solids to water ratio was maintained at 1:4. Surface water samples from Chinde Arroyo and composite coal water samples from seams 4 and 6 were selected as leaching fluids. The batch leaching test jars were placed in a tumbler agitator and the samples were tumbled periodically for a total period of 48 hours over a 7-day period. Chemical analysis was performed on the leachate extracted following the 7-day period.

Table 1 includes the leaching test results that were summarized in Table 11-14C of the PAP. The table shows selected constituent analysis results for the surface and groundwater samples used in the leaching test and the concentrations in these fluids after leaching through different mixtures of spoil and ash. In general, the TDS concentrations increase with leaching, primarily due to increases in calcium concentrations. Sulfate and manganese concentrations increase in the leachate from spoils and in the leachate from spoils with ash but remain unchanged or decrease in leachate from bottom ash and fly ash. Concentrations of Fe, As, and Cd remain unchanged or decrease in leachate from all samples relative to source water while Se concentrations appear to increase slightly in almost all leachates relative to source water. Boron concentrations increase in fly ash leachate but not in leachate from bottom ash or spoil. The leaching test results reported in Table 1 indicate similar concentrations in leachates from spoils and ash for most constituents. However, based on these results water leaching through ash would have higher B but lower SO4 than water leaching through spoils.

The same conclusions are reached when comparing constituent concentrations observed in a monitoring well completed in the ash (Watson 4) with constituent concentrations in wells completed in the spoil (Bitsui 4 and Bitsui 5) as indicated in Table 1. Also, concentrations of As, Cd and Se were at less than detection levels in the samples taken from these wells completed in both the spoil and the ash at the Navajo Mine.

2.3 CCB Placement in Mine Backfill at San Juan Mine

Over the past 30-years, fly ash, bottom ash, and flue gas desulfurization (FGD) products from the adjacent SJGS have been placed in excavated portions of the mine pit, haulage ramps, and depressions at San Juan Mine (SJM) to achieve the approximate original contour (AOC) of premining topography. CCB materials placed in the backfill at the SJM are composed of approximately 70% fly ash, 15% bottom ash, and 15% FGD (Luther et al, 2005). CCB's are buried with an average of 10 ft of backfill material after final placement. The placement of CCB materials is tracked and reported annually to New Mexico Mining and Minerals Division (MMD).

Table 1. Selective Results of Batch Leach Tests & Monitoring of Spoil and Ash Wells (Concentrations in mg/L).

Water Source	**PH**	**TDS**	**Ca**	**Na**	**Cl**	**Sulfate**	**Fe[1]**	**Mn [1]**	**B**	**Se**	**As**	**Cd**
Surface Water from Chinde Wash	7.8	1,900	230	280	15	1,200	0.45	0.08	0.31	<0.001	<0.001	<0.001
SW Leachate:												
Spoils S-4	7.8	4,600	640	850	43	2,700	0.06	0.7	<0.5	0.20	0.002	<0.001
Spoils S-5	8.2	3,500	320	750	27	2,300	0.02	0.26	<0.5	0.018	0.002	<0.001
Fly Ash	12.2	2,000	290	380	16	590	0.02	0.02	1.0	0.09	0.009	<0.001
Bottom Ash	8.5	2,000	260	330	22	940	0.03	0.07	<0.5	0.046	<0.001	<0.001
Ash w/ S-4	7.7	5,300	670	850	37	3,200	0.02	1.4	<0.5	0.018	<0.003	<0.001
Ash w/ S-5	8.1	4,500	550	800	29	3,000	0.08	0.39	<0.5	0.010	<0.003	<0.001
Groundwater - coals 4 & 6 (Composite #4)	8.2	9,800	140	3,500	5,200	120	0.15	0.03	0.53	0.011	0.015	0.001
GW Leachate:												
Spoils S-4	7.8	12,000	730	3,200	5,500	2,700	0.06	0.7	<0.5	0.20	0.002	<0.001
Spoils S-5	8.2	11,000	530	3,200	5,600	2,300	0.02	0.26	<0.5	0.018	0.002	<0.001
Fly Ash	12	10,000	520	3,000	5,600	320	0.02	0.02	6.2	0.22	0.017	<0.001
Bottom Ash	8.5	8,700	170	3,500	5,500	170	0.03	0.07	0.6	0.020	<0.001	<0.001
Ash w/ S-4	7.9	12,000	790	3,100	5,700	2,000	0.04	1.3	<0.5	0.016	0.009	<0.001
Ash w/ S-5	7.9	12,000	740	3,700	5,600	2,000	0.09	0.64	0.9	0.009	0.008	<0.001
Groundwater from ash & spoil monitoring wells	**PH**	**TDS**	**Ca**	**Na**	**Cl**	**Sulfate**	**Fe[1]**	**Mn [1]**	**B**	**Se**	**As**	**Cd**
Bitsui-5-spoil	7.61	12,000	56.9	3,870	990	6,200	0.1	0.123	1.1	<0.001	<0.001	<0.001
Bitsui-4-spoil	6.78	14,600	310	3,970	530	9,000	<0.05	4.84	1.3	<0.001	<0.001	<0.001
Watson-4-ash	9.06	4,860	820	890	890	2,200	<0.05	0.025	26.0	<0.005	<0.005	<0.001

Radian Corporation conducted detailed leaching studies on the overburden and CCB materials used to backfill mine pits at SJM. These tests were performed to support predictions about potential hydrological consequence of mining and use of CCB materials as backfill. Tests were completed by conducting batch leaching tests on mine backfill samples and backfill-plus-CCB samples using a composite of groundwater from four wells completed in 8-seam coal. Laboratory leachates generated from the batch tests were analyzed for groundwater quality parameters. The laboratory leachates generated from mine backfill samples and backfill-plus-CCB samples were used as leaching fluids in batch tests performed on samples of the 8-seam coal to assess the attenuation characteristics of the coal.

Table 2 shows dissolved metal concentrations for the composite 8-seam groundwater sample and the leaching test results. The laboratory results show that the concentrations of Al, As, B, and F, are higher in the backfill-plus-CCB leachate, while Fe and Mn are higher in the backfill only sample. Generally, the concentrations of most constituents decreased as a result of mixing with coal, although As increased in the coal attenuated backfill/CCB leachate and B increased in the coal attenuated backfill.

Table 2. SJM Batch Leaching Test Results

Element	Groundwater Composite mg/L	Backfill Leachate mg/L	Attenuated Backfill/Leachate mg/L	Backfill/ CCB Leachate mg/L	Attenuated Backfill/CCB Leachate mg/L
Aluminum	<0.05	2.2	<0.05	14.0	0.11
Arsenic	<0.003	<0.003	<0.003	0.026	0.37
Barium	0.21	0.28	0.17	0.39	0.078
Boron	<0.009	0.44	0.89	7.0	6.2
Cadmium	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium	<0.001	<0.001	<0.001	0.006	<0.001
Cobalt	<0.006	<0.006	<0.006	<0.006	<0.006
Copper	<0.001	<0.001	<0.001	<0.001	<0.001
Cyanide	0.53	<0.02	<0.02	<0.02	<0.02
Fluoride	2.1	2.4	2.2	7.8	7.1
Iron	0.37	2	0.021	0.27	<0.008
Lead	0.02	0.01	<0.002	<0.002	<0.002
Manganese	0.18	0.16	<0.001	<0.001	<0.001
Mercury	<0.002	<0.002	<0.002	<0.002	<0.002
Nickel	0.004	0.006	0.006	0.008	0.01
Selenium	<0.003	<0.003	<0.003	<0.003	<0.003
Silver	<0.002	0.006	<0.002	<0.002	<0.002
Zinc	0.087	0.01	0.003	0.021	0.025

SJM has also conducted 18-hour leaching tests of CCB materials placed in mine pits using ASTM Method D-3987-85 (American Society of Testing and Materials, 1990). Composite CCB samples are obtained for quarterly testing using weekly sample aliquots. Deionized water is as the leaching fluid in the tests in accordance with the testing requirements specified

by the State of New Mexico. Mean concentrations from the leachate analysis results from 18-hour leachate quarterly monitoring data from 2001 through 2004 are presented in Table 3.

Table 3. SJM 18-hour Batch Leaching Test Results

Element	Mean Fly Ash (mg/L)	Mean Bottom Ash (mg/L)	Mean FGD (mg/L)
Aluminum	1.9	1.19	0.134
Arsenic	0.006	0.007	< PQL
Boron	4.06	0.773	4.3
Fluoride	0.59	0.19	19.6
Nickel	<PQL	<PQL	0.01

Analysis results that were below the probable quantitative limit (PQL) were assumed to be at concentrations of one half the PQL for calculating the mean concentrations in Table 3. The summary results show that the mean Al levels in CCB leachate from the 18-hour leachate procedure were below levels measured in the backfill only leachate test reported in Table 2. Arsenic and Ni concentrations were frequently not detected at the PQL in many of the tests of CCB materials. Boron levels in leachates of CCB materials are higher than the B concentrations in the water from the 8-seam coal or in the backfill only leachate reported in Table 2. Fluoride in fly ash and bottom ash leachate are below the concentrations in the water from the 8-seam coal or in the backfill only leachate reported in Table 2, while the F concentrations in the FGD leachate exceed the 8-seam background concentrations.

Monitoring wells were installed at the San Juan Mine to investigate possible impacts to groundwater from mine backfill and previous CCB disposal at the mine. Two wells, SM-1 and SM-2, were completed in the backfill to monitor the water quality of recharge to the backfill. Two other wells (L-1 and L-2) were installed to monitor recharge and water chemistry of a representative CCB placement area. To date, no samples have been collected from these SM and L monitoring wells due to lack of sufficient water for sampling.

3.0 CCB TESTING AND ANALYSIS PLAN

3.1 Introduction

It is important that new leachate testing relate closely to historic monitoring data and to the prevailing environmental conditions. Those environmental conditions include the surrounding geology and the mixing of overburden with CCBs in mining pits. OSM (2002) gives outlines for mining impact determinations but does not specify leachate testing, though the agency is expected to give input to any proposal for such testing.

There are a variety of tests available for characterizing the leaching behavior of CCB materials. Some of leaching tests include:

- *Toxicity Characteristic Leaching procedure (TCLP) (Method 1311, US EPA, 2007)* designed to simulate the leaching a waste disposed in an unlined sanitary landfill.
- *Synthetic Precipitation Leaching Procedure (SPLP) (Method 1312, US EPA, 2007)* developed for use in evaluating the leaching of a contaminated soil or waste material from acid rain in order to asses the potential impact on groundwater.
- *Multiple Extraction Procedure (MEP) (Method 1320, US EPA, 2007)* designed to simulate the leaching of a contaminated soil or waste from repeated precipitation of acid rain. The MEP is a serial batch test using synthetic acid rain as the leaching fluid.
- *ASTM Method D-3987-85, Standard Test Method for Shake Extraction of Solid Waste with Water (American Society for Testing and Materials, 1990)* is a procedure for rapidly generating a leachate from solid waste that can be used to estimate the mobility of inorganic constituents from the waste under the specified test conditions.
- *ASTM Method D-4793, Standard Test Method for Sequential Batch Extraction of Waste with Water (American Society for Testing and Materials 1999)* is a procedure for obtaining serial leachates of a waste that can be used to estimate the mobility of inorganic constituents from the waste under the specified test conditions.
- *ASTM Method D-4874, Standard Test Method for Leaching Solid Waste in a Column Apparatus (American Society for Testing and Materials 1995* is a column method using reagent water in a continuous up-flow mode to generate aqueous leachate from waste materials.
- *Synthetic Groundwater Leaching Procedure (SGLP)* developed at the University of North Dakota (UND) Energy & Environmental Research Center (EERC) to characterize leachate from alkaline CCBs. (Hassett, 2005). The protocol for the SGLP is similar to ASTM D3987 and the SGLP.
- *Long-Term Leaching Option (LTL)* developed at the University of North Dakota (UND) Energy & Environmental Research Center (EERC) developed to characterize leachate from alkaline CCBs. (Hassett, 2005). The protocol is similar to the SGLP but includes

two long-term tests of 30 and 60 (or 90) days to provide a comparison with the short-term SGLP test.

The EPA Toxicity Characteristic Leaching Procedure (TCLP) Method 1311 (USEPA, 2007) is not an appropriate test to address potential adverse effects associated with the placement of any coal wastes and CCBs in the mined out pits in the Western United States because ground water and geologic strata are alkaline and non-acid forming (Hassett and Pflughoeft-Hasset, 2003). Appropriate leachate tests should answer regulatory requirements and attempt to model or simulate the prevailing conditions of the placement environment.

The concentration of chemical constituents in CCB materials placed in mine backfill under natural leaching conditions will be a product of a number of factors that are not easily duplicated in laboratory leaching tests. These include the rate of flow through the leached material, the chemistry of the water reaching the CCB material, and the duration of time that the water is in contact with CCB materials. Since flow in many natural settings is extremely slow, it is impractical to use laboratory column leaching tests to determine potential for environmental impact of reactive alkaline CCBs (Hassett et al, 2000).

3.2 Proposed Laboratory Testing Procedures

This work plan specifies the use of batch leaching procedures. Our approach is to use the EPA Synthetic Precipitation Leaching Procedure (SPLP, SW-846 Method 1312), the Synthetic Groundwater Leaching Procedure (SGLP), and modifications of these tests. Modification of the standard test is required to address site specific conditions. The modifications proposed are as follows:

1. Use of leaching fluids that are appropriate to the site in addition to the synthetic rainwater that is specified in the SPLP method.
2. The proposed methods specify an 18-hour leaching procedure. This plan proposes to include a 45-day leach test, in addition to the 18-hour time, in order to assess the impacts of longer exposure to the leachant.
3. For the 45-day leach test, it is not practical for the laboratory to tumble the sample for the entire period. Thus the procedure will be modified to include periodic 18-hour tumble of the sample: at the start of the test, after 15-days, after 30 days and with a final 18-hour tumble at the end of the 45-day period. The periodic tumbling followed by an extended period of time during which the solids remain in contact with the fluid without tumbling should provide an indication of any leachability changes due to mineral aging, hydrolysis (e.g., ettringite formation), and diffusion.
4. The test will also be modified in one set of experiments to use sequential leaching as described in EPA's multiple extraction procedure (MEP, SW-846 Method 1320). The purpose of this is to simulate solids exposure to fresh rainwater.

There are several issues that have historically been raised concerning batch tests (Hassett and Pflughoeft-Hasset, 2003):

1. The composition of the leaching solution does not always represent a good model of waters encountered in the field.

2. Such procedures do not always monitor the final composition of the leachate.
3. There has been concern expressed about potential re-precipitation of elements in the leaching process that occurs due to compositional changes of the leachate.
4. There are mineralogical changes and hydration processes that may occur over time within coal ash that could potentially impact leaching behavior, and these are not always taken into account.

We intend to address item 1 by using appropriately-chosen leachate solutions that are reasonable based on site specific conditions. We propose the use of rainwater (or a synthetic model of rainwater), ground water from a coal site well, and a synthetic mine backfill water sample derived from the backfill leaching tests. These leachate solutions will provide representative leaching solutions.

Item 2 is to be addressed by measuring the pH of the leachate both prior to and immediately following the completion of the process, and the analytical procedures stipulated below will be employed to further characterize each leaching liquid in detail both before and after each analytical test.

Item 3 can be assessed by interpreting the changes observed with the use of sequential leaching. This involves contacting the leached solid with fresh leaching solution, which will re-dissolve such precipitates and result in a better evaluation of repeated leaching or flushing of the CCBs in an active flow system. While Hassett and Pflughoeft-Hasset (2003) caution that sequential batch and column leaching often remove potentially reactive constituents from ash-water systems, providing misleading information when applied to CCBs, sequential batch tests will be used in this study in conjunction with a long-term batch leach test. The sequential leaching tests will address the issue of secondary precipitates that may have formed due to solubility limitations in the batch tests (NAC, 2006). It will also provide additional information on the effects of more rapid flushing of the CCBs, even though rapid flushing is highly unlikely within the hydrogeologic environment at the NMEP.

Item 4 and Hassett and Pflughoeft-Hasset (2003) concerns are addressed by conducting a batch leaching test where ash-water will be allowed to equilibrate 45 days to permit the formation of important secondary hydrated phases such as ettringite.

Analyses will be conducted per SW-846 methods (USEPA, 2007) as described below. The EPA Functional Guidelines (USEPA, 2004) and laboratory control chart statistics will provide useful guidance to assess the expected reproducibility for each analytical method used. Control charts are a long-accepted method for determining appropriate control windows and for detecting problems with laboratory performance of specific methods. The laboratory conducts control charting as a matter of course and these will be reviewed as needed in order to evaluate the technical implications of any observations made, for example the relative percent differences observed between duplicate samples. Appropriate control charting practices are described in SW-846 (USEPA, 2007). The results will be evaluated in terms of homogeneity, and leaching will not proceed until it is acceptable according to these criteria.

Proposed leaching procedures are provided as flow charts in Figures 1 through 4 and consist of the following components:

1. Use of coal well water and the synthetic leaching fluid described in Method 1312; ash-exposed coal well water; and spoil-exposed coal well water.
2. A sequence in which ash is leached in duplicate (18-hr tests) with coal well water. The fluid remaining from that step is then used to conduct an 18-hour leach of spoil. This sequence is intended to emulate the possibility of coal water passing through a layer of ash, then a layer of spoil. Analyses of all leachates will be performed, providing a duplicate analysis of the ash leaching and a single analysis of the final leach with ash-exposed coal water.
3. A sequence in which spoil is leached in duplicate (18-hr tests) with coal well water. The fluid from that step is then used to conduct an 18-hour leach of ash. This step is intended to emulate the possibility of coal water passing through a layer of spoil, then a layer of ash. Analyses of all leachates will be performed, providing a duplicate analysis of the spoil leaching and a single analysis of the final leach with spoil-exposed coal water.
4. A test in which ash is exposed to coal water for 45 days according to the long-term leaching procedure described above.
5. A test in which spoil is exposed to coal water for 45 days according to the long-term leaching procedure described above.
6. 18-hour leaching tests of ash and spoil using the synthetic leaching fluid described in the SPLP.
7. A multiple extraction procedure on the ash sample remaining after the 45-day leaching test. In the procedure, the EPA multiple extraction procedure (MEP) will be modified so that the solid after the 45-day leaching test is isolated and exposed to fresh leachate (coal well water) a minimum of 3 times (18-hour extractions). In this procedure, additional 18-hour extractions will take place if the concentrations of contaminants of concern are observed to increase in the third 18-hour extraction compared to the first and second extractions The test as described in the MEP is designed to simulate an active flow system in which groundwater is continuously moving through and flushing the system. It is proposed to provide additional information concerning the leaching characteristics of CCBs under different environmental conditions that may be useful for interpretation of future monitoring data.
8. Finally, a 18-hr leach test will be conducted on a bottom ash only sample.. Bottom ash consists of coarse grained materials that are quite inert and very permeable. Given these characteristics, bottom ash could be selectively used for various mine reclamation applications provided that any constituents leached from bottom ash materials meets relevant water quality criteria. For instance, one use could be the selective placement of bottom ash pit to ensure that any groundwater from an active flow system can be directed away from placement of other CCB materials. Although active groundwater flow systems are not expected at the NMEP, it is proposed that bottom ash will be separately subjected to an 18-hour leaching with the coal water. This should provide an indication of the suitability of bottom ash as a permeable substrate for mine reclamation use.

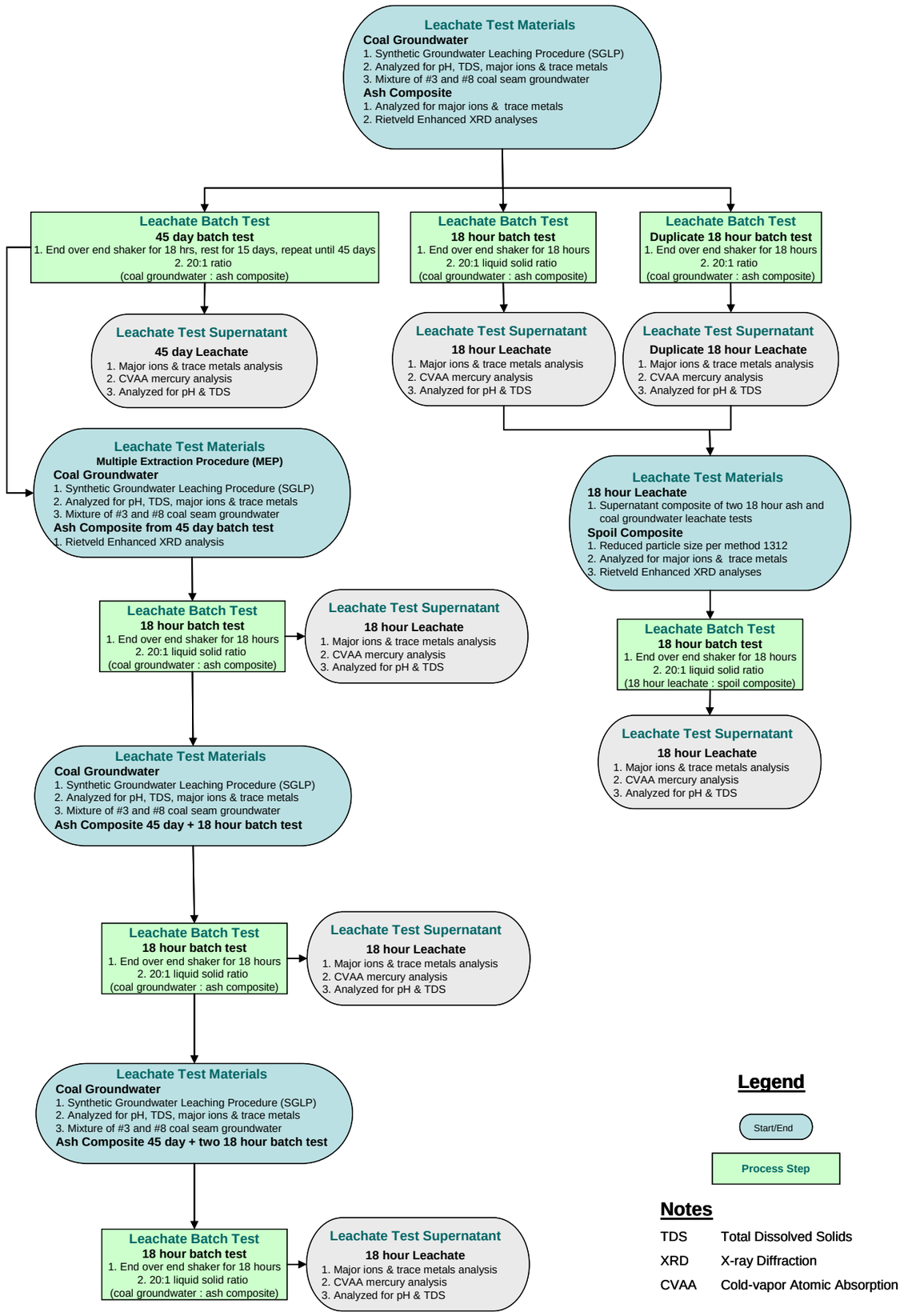
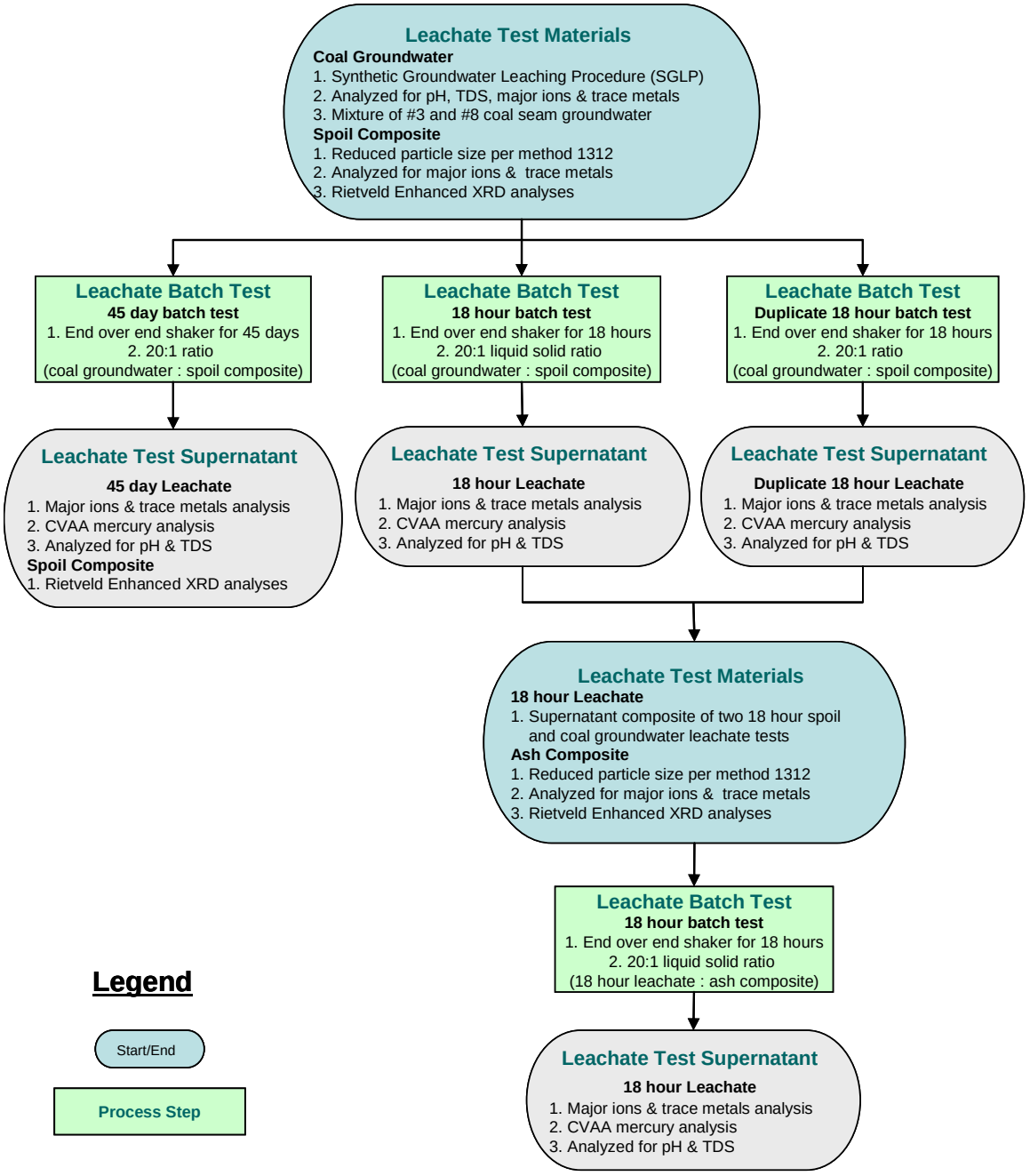


Figure 1. Flow Chart of Leachate Batch Tests Starting with Coal Groundwater and Ash Composite Samples.



Notes

TDS	Total Dissolved Solids
XRD	X-ray Diffraction
CVAA	Cold-vapor Atomic Absorption

Figure 2. Flow Chart of Leachate Batch Tests Starting with Coal Groundwater and Spoil Composite Samples.

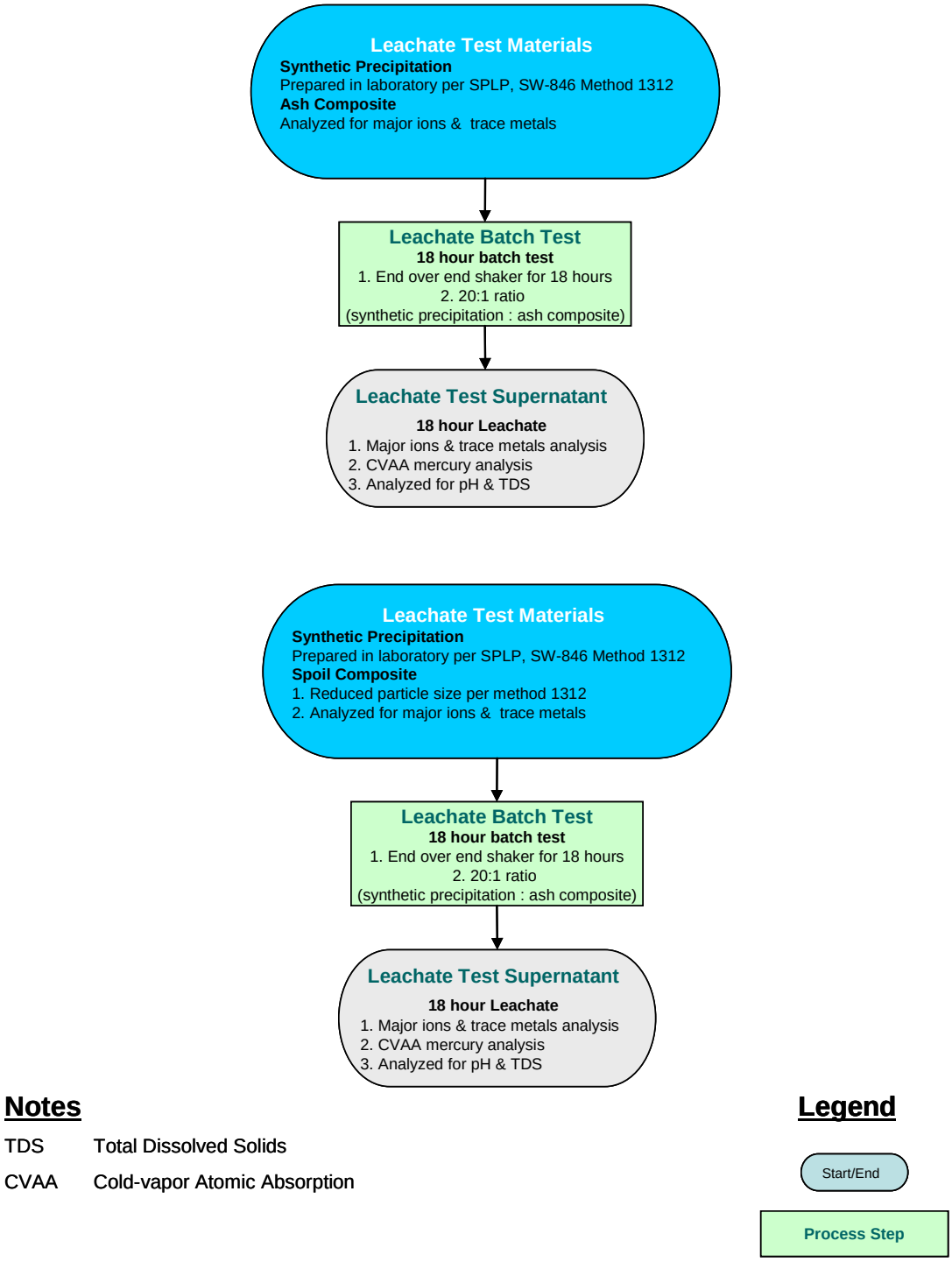
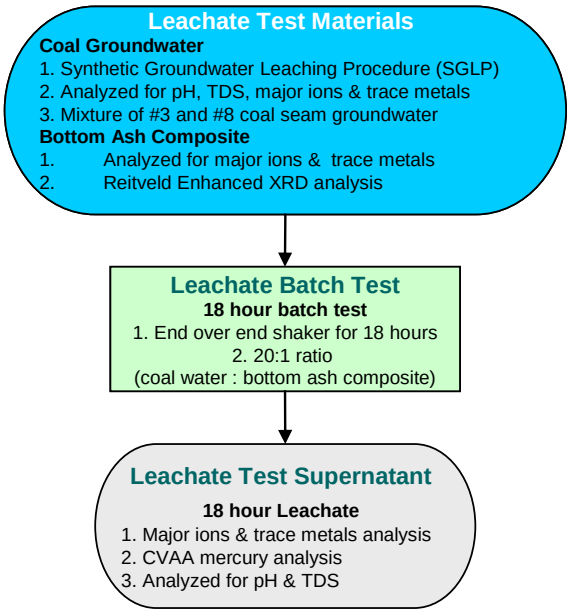


Figure 3. Flow Chart of Leachate Batch Tests Starting with Synthetic Precipitation and Both Ash and Spoil Composite Samples.



Notes

TDS	Total Dissolved Solids
XRD	X-ray Diffraction
CVAA	Cold-vapor Atomic Absorption

Legend

Start/End

Process Step

Figure 4. Flow Chart of Leachate Batch Tests Starting with Coal Water and Bottom Ash Composite Sample.

All leachates from the above set of experiments will be analyzed for the following constituents:

- Trace metals (As, Ba, Be, Sb, Cu, Co, Fe, Hg, Li, Mn, Mo, Ni, Pb, Se, Zn, B, Cr, Cd, Ag, Al, Tl, V)
- Cold Vapor Atomic Absorption (CVAA) mercury
- Major anions (carbonates, sulfate, Cl, F)
- Major cations (K, Na, Ca, Mg)
- TDS
- pH

The analytical methods proposed for the metals analysis, along with nominal detection limits and laboratory QC criteria are shown in the tables below, obtained from Analytica Environmental Laboratories of Thornton, Colorado:

Method Name		SW6010B - ICP - Total			LCS Limits		Matrix Spike Limits		
AnalyteName	CAS Number	PQL	MDL	Units	LCL	UCL	LCL	UCL	RPDCL
Aluminum	7429-90-5	0.05	0.014	mg/L	89	117	75	125	20
Antimony	7440-36-0	0.05	0.0067	mg/L	82	117	75	125	20
Arsenic	7440-38-2	0.1	0.015	mg/L	86	116	75	125	20
Barium	7440-39-3	0.01	0.00016	mg/L	86	116	75	125	20
Beryllium	7440-41-7	0.001	0.00006	mg/L	87	111	75	125	20
Boron	7440-42-8	0.05	0.0018	mg/L	76	130	75	125	20
Cadmium	7440-43-9	0.006	0.00051	mg/L	79	113	75	125	20
Calcium	7440-70-2	0.1	0.013	mg/L	79	119	75	125	20
Chromium	7440-47-3	0.01	0.0018	mg/L	86	117	75	125	20
Cobalt	7440-48-4	0.005	0.0016	mg/L	82	118	75	125	20
Copper	7440-50-8	0.005	0.0019	mg/L	86	117	75	125	20
Iron	7439-89-6	0.05	0.0027	mg/L	83	121	75	125	20
Lead	7439-92-1	0.05	0.011	mg/L	83	121	75	125	20
Lithium	7439-93-2	0.1	0.00072	mg/L	80	120	75	125	20
Magnesium	7439-96-4	0.1	0.012	mg/L	83	118	75	125	20
Manganese	7439-96-5	0.01	0.00066	mg/L	82	121	75	125	20
Molybdenum	7439-98-7	0.01	0.0018	mg/L	82	120	75	125	20
Nickel	7440-02-0	0.04	0.0027	mg/L	84	117	75	125	20
Potassium	7440-09-7	1	0.31	mg/L	74	110	75	125	20
Selenium	7784-49-2	0.1	0.026	mg/L	87	117	75	125	20
Silver	7440-22-4	0.015	0.00066	mg/L	80	127	75	125	20

Method Name		SW6010B - ICP - Total			LCS Limits		Matrix Spike Limits		
AnalyteName	CAS Number	PQL	MDL	Units	LCL	UCL	LCL	UCL	RPDCL
Sodium	7440-23-5	3	0.028	mg/L	87	113	75	125	20
Thallium	7440-28-0	0.4	0.011	mg/L	89	113	75	125	20
Zinc	7440-66-6	0.005	0.001	mg/L	81	120	75	125	20
Vanadium	7440-62-2	0.01	0.00072	mg/L	87	119	75	125	20

Method Name		SW7470A - Mercury by CVAA			LCS Limits		Matrix Spike Limits		
AnalyteName	CAS Number	PQL	MDL	Units	LCL	UCL	LCL	UCL	RPDCL
Mercury	7439-97-6	0.0002	0.00005	mg/L	80	120	70	130	20

3.3 Representative Samples

These tests will be conducted using available materials (i.e., solids) that are representative of expected CCB and mine backfill (i.e., spoil). Since the Desert Rock Facility from which the actual CCBs will be obtained is not yet operating and the NMEP has not commenced mining operations, representative samples from an existing power plant and active coal mine, respectively, will be obtained and used in this procedure. Once the Desert Rock Facility and NMEP are commercially operable, representative samples will be obtained and tested using the same protocols to confirm the conclusions reached in this study.

3.3.1 CCB Samples

CCB materials to be used in mine placement at the NMEP are estimated to be composed of approximately 70% fly ash, 15% bottom ash, and 15% FGD. Representative sample of fly ash and bottom ash will be obtained from FCPP that burns coal from the Navajo Mine. The coal seams mined at Navajo Mine are the same coals that will be mined at the NMEP.

The FCPP has five generating units. Units 4 and 5 went into service in 1969 and 1970, respectively and utilize a baghouse and scrubber configuration to control emissions. Fly ash and bottom ash from Units 4 and 5 are believed to be most representative of the fly ash and bottom ash from the proposed Desert Rock Facility, although ACI might be used for mercury control at Desert Rock Facility. Neither the FCPP nor the SJGS currently utilize ACI for Hg emissions control. Thus, the possible effect of ACI on CCB chemistry will need to be addressed through literature studies until ash samples from the Desert Rock Facility are available for testing. As discussed previously in Section 2.1 of this Work Plan, Hg leaching from ACI fly ash is expected to be minimal. Heebink et al. (2004) studied long-term Hg release from CCBs including fly ash generated from units using ACI for Hg control and found that leachate Hg concentrations were low, regardless of Hg concentration in the original sample. All concentrations were below the primary drinking water standard. Other studies in the literature include Aljoe et al (2005), Hassett et al (2005), Hassett and Heeblink (2003), Kim and Schroeder (2005) and Kazonich et al (2005).

The wet limestone scrubber technology utilized at the SJGS is comparable to the technology proposed for the Desert Rock Facility. Consequently, the FGD material used to prepare the composite ash sample will be obtained from the San Juan Generating Station rather than from the FCPP.

Composite samples of fly ash, bottom ash, and FGD sludge will be obtained from three random sample aliquots of equal volume collected from these facilities over a period of one week. Composite samples will consist of at least 3 kg of fly ash and 0.5 kg each of bottom ash and FGD. These samples will be sent to the laboratory where a composite ash sample will be prepared consisting of 70% fly ash, 15% bottom ash, and 15% FGD by weight.

Achieving an acceptable level of solid sample homogeneity and proper particle size is very important for these experiments. The composite ash sample will be mixed and reduced in particle size as necessary per Method 1312. Then three subsamples of the composite sample will be obtained for chemical and mineralogical analysis. The comparison of replicate sample

analyses will be used to ensure homogeneity. The Functional Guidelines and real-time laboratory control charts will be used to make this assessment.

3.3.2 Spoil Samples

Composite spoil samples will be obtained from the adjacent Navajo Mine. Under the current regraded spoil sampling plan, samples are collected on a 2.5-acre square grid. The 2.5-acre plot is divided into 4 equal subplots (0.625 ac each). A four-foot deep sample pit is then excavated in the center of each subplot. In order to obtain a representative sample of composite spoil material, sub-samples will be collected over the interval from 0-4 feet at each of the four subplot locations and one composite sample will be prepared from the four sub-samples. The composite sample will be comprised of at least 2 kg of spoil material and will then be split in the field using a corner to corner sampling technique (USDA-NRCS 1996).

Composite samples will be collected, following the same procedure, at three additional 2.5-acre plot locations. Solids analysis will be conducted on sample splits from each of the 4, 2.5-acre grid locations. The other split samples from the four 2.5-acre plots will be combined and mixed to form a single composite sample of approximately 4 kg. This composite sample and the 4-splits will be sent to the laboratory.

The individual sample splits (4 samples) will be analyzed for trace metals and major ions in order to characterize the broad spatial variability in spoil material. The composite sample will be mixed again in the lab and reduced in particle size as necessary per Method 1312. Then three subsamples of the composite sample will be obtained for chemical and mineralogical analysis. The comparison of replicate sample analyses will be used to ensure homogeneity.

3.3.3 Solids Analysis

The three aliquots of both the composite spoil and the composite CCB samples will be submitted for the following analysis:

- Trace metals (As, Ba, Be, Sb, Cu, Co, Fe, Hg, Li, Mn, Mo, Ni, Pb, Se, Zn, B, Cr, Cd, Ag, Al, Tl, V)
- Major cations (Na, K, Ca, Mg)
- Quantitative Minerology from Rietveld Enhanced XRD analysis (Raudsepp and Pani, 2003)
- Cation exchange capacity

SW-846 digestion method 3050B, acid digestion of sediments, sludges, and soils will be used for all the metals, including the total cations. The exception is mercury, which will be digested and analyzed according to the procedures in SW-846 Method 7471A.

3.3.4 Coal Water Sample

A composite sample of coal water will be obtained from equal proportions of water extracted from the No. 8 Coal Seam well KF-2007-01 and from the No. 3 Coal Seam well KF-98-02 at the Navajo Mine Extension Project. The two wells are representative of groundwater from the upper and lower coal units at the NMEP project site. Two, 5-gallon containers of coal water sample will be obtained from each well. The 5-gallon containers will be sent to the laboratory, where composite coal water will be prepared for use in the batch tests. Two duplicate samples will be obtained from the composite coal water and submitted for chemical analysis as described in Section 3.4.

3.4 Analysis Requirements and QA/QC Procedures

The EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, 2004 (SOP), SW-846 and other EPA methods as specified, as well as the laboratory SOPs will be employed to perform a data validation and data usability assessment. At a minimum, the following will be addressed:

1. Chain of custody and sample integrity
2. Adherence to method specifications and required procedures
3. Sample preparation procedures
4. Calibration
5. Detection limit checks
6. Calibration and preparation blanks
7. Interference checks
8. Review of laboratory method detection limit studies
9. Laboratory matrix spike and matrix duplicate analyses
10. Comparison of duplicate results as described in the leachate procedure
11. Comparison of solid duplicate results
12. Review of raw data and calculation checks of the results (on a 10% basis)
13. Ion balances
14. Review of bench sheets and standard tracking data (on a 10% basis).

Analytical results will receive qualifiers if appropriate, per the Functional Guidelines. These qualifiers, where applied, will be specifically addressed in the data usability assessment. Data completeness will be assessed, as will precision and accuracy. The completeness goals for this project are 95%. However, any rejected data that impacts contaminants of concern (e.g., metals that show significant leachability such as B) will be cause for reanalysis. Any observed matrix effects will also be addressed.

We will have secure electronic access to the laboratory data as it is generated and entered into the laboratory information management system (LIMS), by arrangement with the laboratory. Therefore, preliminary assessments of the data will be made as the project proceeds, rather than waiting for a complete set of analytical results to be obtained. These preliminary assessments will allow us to direct the laboratory activities in response to any issues that may arise, and to require corrective actions where necessary before the project has gone to

completion. We believe that this will minimize any problems associated with laboratory analysis errors or miscommunication. We will also be able to observe the leaching studies as they proceed in order to ensure that these procedures are conducted according to the methods specified. This is critical, because such studies are very dependent on proper control of conditions.

4.0 INTERPRETATION FOR PHC

The PHC Report needs to provide rationale for selection of the various techniques that are used for prediction of the potential impacts. Earlier leachate testing conducted at Navajo Mine and San Juan Mine showed that aqueous concentrations of some trace constituents are elevated in CCBs, but that these were attenuated in mixtures of CCBs and spoil. Spoil is interburden and overburden rock, predominantly montmorillonitic shale, which has significant capacity for cation exchange and adsorption. It is known that such cationic adsorption can induce charge polarization in clay matrix, so that oxyanions such as borate, selenate, and arsenate may be weakly bound and attenuated in water passing through the matrix (Leroy et al, 2007). A credible interpretation of the leachate data is reliant upon knowledge of these processes as well as dissolution and precipitation reactions. These processes can be simulated using a geochemical model and when calibrated, the model can be used as supporting evidence for fate and transport predictions. The development of a fate and transport model will allow for predictions of water quality impacts, if any, to surface water and or down gradient groundwater. Additionally, the model can be used to assess and predict potential reclamation plans if necessary.

Several geochemical models exist that are capable of modeling leachate tests (Netpath, Geochemist's Workbench, PHREEQC, WATEQ4F). PHREEQC was chosen because of its use in numerous peer reviewed publications (Parkhurst et al. online), continuing support and updates, comprehensive thermodynamic database, ability to simulate 1D reactive transport, and it is a public domain software. Neither WATEQ4F or Netpath are currently updated and WATEQ4F cannot simulate 1D transport. The Geochemist's Workbench is not a public domain software.

4.1 Leachate Geochemical Modeling

Laboratory leach tests will be modeled using the geochemical model PHREEQC (V2.14.2) (Parkhurst and Appelo, 1999). Once the PHRREQC model is calibrated to laboratory leach tests it will be used in modeling 1D reactive fate and transport. The calibrated model will also be used to produce results from other plausible scenarios (e.g., ACI in flyash and different combination of CCBs.) reducing the need for additional laboratory tests. Additionally, as new data is collected the model can be updated to fit field specific observations if different from laboratory results.

4.1.1 Water Quality Data

Analyses of the source water used for leachate tests and the resulting leachate supernatant are required to model the laboratory experiments, to determine potential geochemical changes in the field, and to provide baseline information prior to backfilling. This data will be entered into the model as an aqueous phase solution.

As discussed in Section 3.0, the source water will include coal seam groundwater and a synthetic precipitation. The analyses of major ion chemistry, trace metals, and pH will be used as input in the model as initial solutions. The initial solutions will first be equilibrated and speciated prior to reacting with the solids.

Leachate supernatant will be analyzed for the same constituents as the source water. Analytical results will be input into the geochemical model as a final solution and used in inverse modeling to provide a set of supporting minerals leading to the geochemical reactions seen in the leachate tests, and as a final solution in calibrating the outcome of forward modeling with the initial solutions and solids.

4.1.2 Solids Data

Solids data is necessary as input into the model for reaction with the initial solutions. Solids data will be entered into the model as a solid solution, exchange sites, and surface sites. The information necessary includes mineralogy and total composition such that trace metals and the specific assemblages and appropriate relative contributions of each assemblage can be entered into the model for dissolution/precipitation and sorption reaction calculations. The solids analysis will be used in the geochemical model to narrow the number of possibilities leading to the observed effects and provide a sound model. The use of Rietveld X-ray Diffraction (XRD) will provide mineral information for CCB and mine spoil including proportions of reactive oxides (Fe, Al, and Si) and silicate minerals (Montmorillonite). Mineralogy of CCBs is dependent on the type of coal and can vary based on coal characteristics (Ward and French, 2005). A totals analysis will provide the total amount of specific cations that are found in the solids including trace metals. The results include concentrations that can be compared to leachate supernatant and provides a list of all possible constituents bound in solids.

4.1.3 Leachate Batch Modeling

The purpose of the leachate batch modeling is to calibrate the PHREEQC model using the laboratory data. As mentioned above, in separate simulations, the coal groundwater and synthetic precipitation analytical results will be entered into PHREEQC as initial condition solutions using the keyword "SOLUTION". The leachate supernatant analytical data will also be entered in using the keyword "SOLUTION" and will be used as a final solution after reactions. An inverse model will be run using the solids Rietveld X-ray Diffraction data to input probabilistic phases using the keywords "INVERSE MODELING" with the identifier "phases" and keyword "PHASES" for those minerals not already supported by the PHREEQC database. The "phases" identifier also allows for the incorporation of ion-exchange processes. The differences in composition between the initial and final solutions are assumed to be due to reactions between the initial solution and the minerals it contacts. The inverse model will find sets of minerals that, when reacted in appropriate amounts, quantitatively account for the differences in composition between the solutions. The solids analysis allows input of all possible minerals from the site specific data and the inverse model finds the most appropriate quantitative processes (e.g., dissolution or precipitation), that are responsible for the changes from the initial to final solutions using the set of possible minerals. The set of reactions and reactive minerals as determined by the inverse model can then be applied to a forward model using keyword "PHASES". The forward model is used to

accommodate different hypothetical situations such as the addition of carbon from ACI or a different combination of materials other than tested for in the laboratory analyses, or the use of a different initial solution.

4.2 1D Reactive Fate and Transport Groundwater Modeling

Results from the leachate testing and calibrated PHREEQC forward batch model will be applied to a 1D reactive fate and transport groundwater model using PHREEQC. The 1D transport model will be used to predict fate and transport along predicted groundwater flow paths and down gradient from the CCB and spoil backfill. It will also be used to assess potential impacts on areas of potential discharge such as surface water. The results generated from a groundwater flow model using FEFLOW will also be used in addition to the calibrated batch model as input into the 1D reactive fate and transport model in PHREEQC. PHREEQC input will utilize the velocity and predicted flow paths from the flow model for the advection calculations and to calculate cell lengths of different simulated matrix characteristics. Transport calculations are started in PHREEQC using the keyword "TRANSPORT". The individual reactions modeled in the batch mode from spoil and from ash will be incorporated within different cells along the 1D flow path using the keywords "PHASES", "EXCHANGE", "SOLUTION", and or "SURFACE" depending on batch model results. The initial solutions will be reacted with the different compositions based on the calibrated batch models. Additionally, the initial solution from coal groundwater will be used in 1D transport and allowed to react followed by the incorporation of precipitation along the flow path introduced in different cells such that the impacts of infiltration with already present groundwater can be evaluated. The model can also be used to simulate a dual porosity system if found necessary. The complex nature of backfill may lead to preferential flow paths as well as diffusive flow through low permeability zones. The results will be used to support probable hydrological consequences of the backfill and selective placement of CCB materials in mine backfill.

5.0 REFERENCES

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Attachment 41.A.B

Leachate Water Quality QA/QC Report (Gateway Enterprises 2008)

Description of Process and Data Validation Summary
CCB Testing and Evaluation for the Navajo Mine Extension Project
Feb. 15, 2008

Summary

This report summarizes the laboratory activities and the data validation and usability assessment conducted on the data produced in support of the above-referenced project. The object of the project is to develop information on CCB (coal combustion byproducts, or ash) and mine backfill (spoil) characteristics. This information is then to be used in order to prepare an assessment of the probable hydrologic consequences for proposed CCB placement in mine backfill.

A major aspect of the task was to conduct leaching studies in the laboratory using samples of groundwater from the site, CCB from the existing power plants, and spoil. Representative samples of spoil, CCB, and groundwater were taken at the site and provided to the laboratory. At the laboratory, the samples were homogenized and analyzed to determine their chemical composition and to ensure that the subsamples used by the laboratory for leaching were representative. Once this was done, a series of leaching studies as described in the original proposal were conducted and the leachates were analyzed.

The purpose of this data validation study is to determine if the data so generated are sufficient to meet project purposes, and to provide guidance on the proper use of the data in light of any data quality issues or analytical/sampling biases that may be indicated to be present.

The EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, 2004 (SOP) and the requested CLP ILM05.4 Methods and the client list of QC items for review have been referenced by the reviewer to perform this data validation review. The EPA qualifiers have been expanded to include a descriptor code to more clearly define QC violations and their values. This descriptor code is explained in the body of this document.

Representative Samples

The samples summarized in Table 1 were taken at the site, and received at the laboratory on 11/16/2007 under chain of custody. The samples were delivered by Edmund J. Schneider, P.G. who was in possession of them from the time of sample collection to delivery. Chain of custody documents are attached.

Table 1. Samples Delivered to the Laboratory

Client Sample Identification	Sample Date	Sample Time	Matrix	No. Containers	Container type	Preservative
KF2007-01 (58)	11/15/2007	14:10	GW	3	5 gal poly	None
KF2007-01 (58) DUP	11/15/2007	14:10	GW	3	5 gal poly	None
KF-98-02 (53)	11/15/2007	16:30	GW	3	5 gal poly	None
KF-98-02 (53) DUP	11/15/2007	16:30	GW	3	5 gal poly	None

Client Sample Identification	Sample Date	Sample Time	Matrix	No. Containers	Container type	Preservative
BB - QC	11/15/2007	17:18	None	1	5 gal poly	None
123 S 87W 0-4' Spoil	11/15/2007	18:30	Solid	1	poly bucket, sealed	None
123 S 89W 0-4' Spoil	11/15/2007	18:30	Solid	1	poly bucket, sealed	None
125 S 88W 0-4' Spoil	11/15/2007	18:30	Solid	1	poly bucket, sealed	None
120 S 89W 0-4' Spoil	11/15/2007	18:30	Solid	1	poly bucket, sealed	None
Barber Ramp 3 0-4' Spoil	11/15/2007	18:30	Solid	1	poly bucket, sealed	None
4-Corners Powerplant fly ash	11/15/2007	18:30	Solid	1	poly bucket, sealed	None
4-Corners Powerplant bottom ash	11/15/2007	18:30	Solid	1	poly bucket, sealed	None
San Juan Mine FGD 1/5,1/7, 1/9 2007	11/15/2007	18:30	Solid	1	poly bucket, sealed	None
Barber Ramp 3 Spoil Megacomposite 0-4'	11/15/2007	18:30	Solid	1	poly bucket, sealed	None

From the samples provided to the laboratory, the composite samples shown in Table 2 were prepared.

Table 2. Composite Samples Prepared at the Laboratory.

Laboratory Composites	Composite Date	Time	Matrix	No. Containers	Container type	Preservative
KF2007-01 (58) + KF-98-02 (53)	11/21/2007	11:17	GW	2	500 ml poly	1 HNO3 pH < 2, 1 unpreserved
KF2007-01 (58) DUP + KF-98-02 (53) DUP	11/21/2007	11:17	GW	2	500 ml poly	1 HNO3 pH < 2, 1 unpreserved
KF2007-01 (58) + KF-98-02 (53)	12/4/2007		GW	1	10 gal each in carboy	None
70% 4-Corners Powerplant fly ash, 15% 4 Corners Powerplant bottom ash, 15% San Juan Mine FGD - composite by weight	11/26/2007		Solid	1	4 Liter Poly	None

The large composite samples were used for the leaching experiments. The smaller aqueous composite samples were used for initial analysis of the water composites. In the case of water, additional analyses are conducted of the large composite sample through the leaching process to ensure that no significant water chemistry changes have occurred. Analytical samples for the 70% fly ash composite were taken as subsamples from the large composite. This is discussed under the Analyses section of this report.

Each of the solid samples was homogenized prior to compositing or analysis. The compositing process was conducted as follows, and was conducted at the laboratory facility by John Huntington, not by laboratory personnel:

1. A polymeric sheet was placed on the laboratory floor, or in the case of the fly ash sample, the laboratory hood (the fly ash tends to produce a fine dust when handled).
2. The entire sample was deposited on the sheet.
3. The sample was split into 8 piles using a large spatula.
4. By tilting the sheet, the piles were recombined into one large pile. The sheet was then moved to mix the large pile in a manner similar to kneading a loaf of bread.
5. This entire process was repeated 3 times.

In the case of the fly ash, the fines in the ash tended to distribute themselves in the air and coat surfaces. In order to avoid loss of this fraction the agitation of the sample had to be less vigorous than for the other solids. This may have impacted the effectiveness of the homogenization. When the process was complete, however the material appeared to be at least as uniform as the other samples.

Analyses of Materials

The solids and waters were analyzed for chemical composition at Analtyica Environmental Laboratories, 12189 Pennsylvania Street, Thornton Colorado. The solids were analyzed by for mineral composition by X-ray diffraction at the Dept. of Earth & Ocean Sciences, 6339 Stores Road, The University of British Columbia, Vancouver, BC.

The solid samples submitted for analysis are summarized in Table 3, and the aqueous samples are summarized in Table 4.

Table 3. Solid Samples Submitted for Analysis

Submitted Date	Sample	Lab ID	Method
11/21/07 11:17	123 S 87W 0-4' SPOIL	B0711172-02	6010B,7471A (metals)
11/21/07 11:17	123 S 89W 0-4' SPOIL	B0711172-03	6010B,7471A (metals)
11/21/07 11:17	125 S 88W 0-4' SPOIL	B0711172-04	6010B,7471A (metals)
11/21/07 11:17	120 S 89W 0-4' SPOIL	B0711172-05	6010B,7471A (metals)
11/21/07 11:17	Barber Ramp 3 Composite Spoil A	B0711172-06	6010B,7471A (metals)
11/21/07 11:17	Barber Ramp 3 Composite Spoil B	B0711172-07	6010B,7471A (metals)
11/21/07 11:17	Barber Ramp 3 Composite Spoil C	B0711172-08	6010B,7471A (metals)
11/21/07 11:17	Ash Composite 70% FA	B0711172-09	6010B,7471A (metals)
11/21/07 11:17	Ash Composite Dup 1 70% FA	B0711172-10	6010B,7471A (metals)
11/21/07 11:17	Ash Composite Dup2 70% FA	B0711172-11	6010B,7471A (metals)
	Barber Ramp 3 Composite Spoil A	NA	XRD
	Barber Ramp 3 Composite Spoil B	NA	XRD
	Barber Ramp 3 Composite Spoil C	NA	XRD
	Ash Composite 70% FA	NA	XRD
	Ash Composite Dup 1 70% FA	NA	XRD
	Ash Composite Dup2 70% FA	NA	XRD

Table 4. Aqueous Samples Submitted for Analysis

Submitted Date	Sample	Lab ID	Method
11/21/07 11:17	KF2007-01(58) and KF-98-02(53)	B0711172-01	150.1 (pH),160.1 (TDS), 300.0 (anions), 6010B (metals), 7470A (mercury)
11/21/07 11:17	KF2007-01(58) DUP and KF-98-02(53)DUP	B0711172-12	150.1 (pH),160.1 (TDS), 300.0 (anions), 6010B (metals), 7470A (mercury)

Results for the chemical analyses were reported by Analytica under SDG B0711172, on 12/18/2007. The results for the XRD analyses were reported on 1/18/2008.

The composite solid samples were analyzed in triplicate, and the compsite waters in duplicate in order to assess the representativeness of the samples. Laboratory analyses of these samples also included laboratory-generated duplicates as well as matrix spikes to allow the assessment of the analytical precision and accuracy.

Leaching Studies and Analyses of Leachates

Once the analytical results were available for the solids and the groundwater, leaching studies were conducted by the laboratory following instructions provided by John Huntington. The original proposal provides the work plan for this, and this plan was followed as written. The laboratory assigned a senior analyst to conduct the leaching work, and he maintained a detailed logbook of all activities. This logbook is attached to this report.

Table 5 summarizes the samples submitted associated with the leaching experiments. Analytical parameters are identical to those used for the original groundwater analyses (Table 4).

Table 5. Leachates and Leachate Blanks Submitted for Analysis.

SDG	Submitted Date	Sample	Lab ID
B0712127	12/17/07 15:10	MB Leachate 1	B0712127-01A
B0712127	12/17/07 15:10	MB Leachate 1	B0712127-01B
B0712127	12/17/07 15:10	Ash Leachate 1	B0712127-02A
B0712127	12/17/07 15:10	Ash Leachate 1	B0712127-02B
B0712127	12/17/07 15:10	Ash Leachate 1 Dup	B0712127-03A
B0712127	12/17/07 15:10	Ash Leachate 1 Dup	B0712127-03B
B0712127	12/17/07 15:10	Spoil Leachate 1	B0712127-04A
B0712127	12/17/07 15:10	Spoil Leachate 1	B0712127-04B
B0712127	12/17/07 15:10	Spoil Leachate 1 Dup	B0712127-05A
B0712127	12/17/07 15:10	Spoil Leachate 1 Dup	B0712127-05B

SDG	Submitted Date	Sample	Lab ID
B0712148	12/19/07 12:00	626854 MB	B0712148-01A
B0712148	12/19/07 12:00	626854 MB	B0712148-01B
B0712148	12/19/07 12:00	626854 Ash in Spoil Water	B0712148-02A
B0712148	12/19/07 12:00	626854 Ash in Spoil Water	B0712148-02B
B0712148	12/19/07 12:00	626854 Spoil in Ash Water	B0712148-03A
B0712148	12/19/07 12:00	626854 Spoil in Ash Water	B0712148-03B
B0801027	1/7/08 13:55	MB	B0801027-01A
B0801027	1/7/08 13:55	MB	B0801027-01B
B0801027	1/7/08 13:55	4 Corners PP Bottom Ash Leachate	B0801027-02A
B0801027	1/7/08 13:55	4 Corners PP Bottom Ash Leachate	B0801027-02B
B0801191	1/28/08 12:35	MB 45 day	B0801191-01A
B0801191	1/28/08 12:35	MB 45 day	B0801191-01B
B0801191	1/28/08 12:35	Ash Composite 45 day	B0801191-02A
B0801191	1/28/08 12:35	Ash Composite 45 day	B0801191-02B
B0801191	1/28/08 12:35	Spoil Composite 45 day	B0801191-03A
B0801191	1/28/08 12:35	Spoil Composite 45 day	B0801191-03B
B0801191	1/28/08 12:35	MB SPLP	B0801191-04A
B0801191	1/28/08 12:35	MB SPLP	B0801191-04B
B0801191	1/28/08 12:35	Ash Composite SPLP	B0801191-05A
B0801191	1/28/08 12:35	Ash Composite SPLP	B0801191-05B
B0801191	1/28/08 12:35	Spoil Composite SPLP	B0801191-06A
B0801191	1/28/08 12:35	Spoil Composite SPLP	B0801191-06B
B0801197	1/29/08 13:40	MB Successive #1	B0801197-01A
B0801197	1/29/08 13:40	MB Successive #1	B0801197-01B
B0801197	1/29/08 13:40	Ash Successive #1	B0801197-02A
B0801197	1/29/08 13:40	Ash Successive #1	B0801197-02B
B0801210	1/31/08 15:05	MB Successive #2	B0801210-01A
B0801210	1/31/08 15:05	MB Successive #2	B0801210-01B
B0801210	1/31/08 15:05	Ash Successive #2	B0801210-02A
B0801210	1/31/08 15:05	Ash Successive #2	B0801210-02B
B0801210	1/31/08 15:05	MB Successive #3	B0801210-03A
B0801210	1/31/08 15:05	MB Successive #3	B0801210-03B
B0801210	1/31/08 15:05	Ash Successive #3	B0801210-04A
B0801210	1/31/08 15:05	Ash Successive #3	B0801210-04B

Some explanation of the sample identifications is needed. The samples that include "MB" in the names are the "leachate blanks" that are generated during the leaching process. These are not the same as laboratory method blanks, which are conducted separately for each analysis. Rather, these consist of the leaching fluid used, carried through the entire process but without the presence of the solid being leached. These are intended to determine the stability of the water chemistry under the conditions of leaching, so that any changes that occur without the presence of leaching solid may be assessed. When site groundwater is used for leaching, these samples are expected to produce results

very similar to the original groundwater analytical results, and when the leaching fluid is the synthetic SPLP mix, should be near non-detect for the analytes.

The laboratory sample number is a unique number which is assigned to each container submitted for analysis. The "A" and "B" at the end of the number designate different sample containers used for a single sample. This is done because the metals methods require a laboratory preservative (nitric acid to pH < 2) added at the time the sample is taken, and the other analyses require unpreserved samples.

Data Validation
The work plan specifies the following data validation process:

The EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, 2004 (SOP), SW-846 and other EPA methods as specified, as well as the laboratory SOPs will be employed to perform a data validation and data usability assessment. At a minimum, the following will be addressed:

1. Chain of custody and sample integrity
2. Adherence to method specifications and required procedures
3. Sample preparation procedures
4. Calibration
5. Detection limit checks
6. Calibration and preparation blanks
7. Interference checks
8. Review of laboratory method detection limit studies
9. Laboratory matrix spike and matrix duplicate analyses
10. Comparison of duplicate results as described in the leachate procedure
11. Comparison of solid duplicate results
12. Review of raw data and calculation checks of the results (on a 10% basis)
13. Ion balances
14. Review of bench sheets and standard tracking data (on a 10% basis).

The laboratory has provided access to their LIMS (laboratory information management system) and access to the analysts, bench sheets, and other required documentation in order to facilitate this validation. In order to ensure integrity, we have generated the required documentation ourselves using these tools, rather than depending on the laboratory itself to do so. The laboratory independently generated the detailed reports and quality control summaries also used in the validation. This procedure allows us to compare our independent findings with those reported by the laboratory.

1. Chain of Custody and Sample Integrity Reviews
Field Samples:

The solid samples were documented on chain of custody # 62629. Samples were too large to be contined in a cooler but were provided in sealed polymeric buckets. These samples were provided to Edmund Schneider of Norwest Applied Hydrology and hand-delivered the same day by him to Analytica Environmental Laboratories. Chain of custody includes a letter provided by Mr. Schneider describing his receipt of these samples from Buchanan Consultants. Documentation is accurate and complete since that sample transfer time. All samples were intact and in good condition.

The water samples that were collected for analysis were contained in their respective containers in a cooler (2 containers for each sample, one preserved in nitric acid, the other unpreserved). The temperature was recorded by the laboratory at the time of receipt and was 4.5^{o}C. The chain of

custody which accompanied the samples is # 62600. In addition to these containers, there was one 5-gal poly container of each set of waters (4 in all), which were received at ambient temperature. These containers were provided to use for generating the leaching fluids. The laboratory also generated a sample receipt checklist which documents in detail all of the samples and their condition. All were received intact and at the proper pH.

All samples were stored in the laboratory secured area in the walk-in cooler, which is maintained at a temperature of 4^{o} C +/- 2^{o}C, and is monitored on a daily basis.

Internally-Generated Samples:

The composites of water and solids, and the leachates, were internally generated from the field samples discussed above. The analyst conducting the leaching experiments prepared samples for submittal and filled out chain of custody documents associated with each SDG (sample delivery group). These are provided as an attachment to this document, and are in order with proper signatures and sample descriptions. All of these internally-generated samples were retained in a secure area at all times and were under the observation of the analyst who prepared them.

2. Adherance to Method Specifications and Required Procedures

The following methods were employed in the analyses conducted for this project:

1. SW-846 6010B, with acid digestion (3010A) for aqueous samples, including leachates.
2. SW-846 6010B, with acid digestion for solids (3050B) for all solid samples.
3. SW-846 7470A, mercury by CVAA for aqueous samples including leachates.
4. SW-846 7471A, mercury by CVAA for solid samples.
5. EPA Method 300.0, anions by ion chromatography, for aqueous samples including leachates.
6. EPA Method 310.1 (alkalinity – SM 2320B) for aqueous samples including leachates.
7. EPA Method 160.1 (total dissolved solids – SM 2540C) for aqueous samples including leachates.
8. EPA Method 150.1 (pH – SM 4500-H+B) for aqueous samples including leachates.

There are three of these methods (310.1, 160.1, and 150.1) which were withdrawn during 2007 by EPA for NPDES and SDW use. The Standard Methods citations shown in parentheses are acceptable for use instead. The laboratory has cited the requested EPA method numbers, but is following the protocol and quality control requirements in the Standard Methods citations for these analyses. We did confirm this by review of the laboratory standard operating procedures for these methods.

A review of the standard operating procedures for all the above methods shows that the laboratory prescribed practices do conform to the methods as written. The following sections will address how closely method specifications have been followed and how successfully the method criteria have been met for each method on this project.

3. Sample Preparation Procedures

Sample preparation is documented in bench sheets and within LIMS. All analytical sample preparations are performed per method.

4. Calibrations, Calibration Blanks, Interference Checks, and Reporting Limit Checks

6010B:

This method requires that an initial calibration be conducted on the instrument per manufacturer's specifications (usually one standard and a blank). Each run starts with this initial calibration, followed by an initial calibration verification (ICV) and an initial calibration blank (ICB). A check of the quantitation limit (PQL for practical quantitation limit, also called RL for reporting limit) is conduced using reporting limit check standards set at that level. Since the method is subject to intereference from high levels of certain common cations, interference check standards are analyzed to confirm that interferences have been properly compensated for and are within acceptance limits. These are standards containing the typical interferent ions at high levels.

All calibrations were reviewed.
Initial calibration – In control per method.
Initial calibration verification – per method, all ICVs are within the 90-110% recovery limits.
Interference check standards – per method interference check standards were analyzed each day as required and met criteria.
Reporting limit checks – not specified in method, laboratory criteria are used. Reporting limit check outliers observed as follows:
Reporting limit checks were run for all SDGs for each day of analysis, as required. The results were within the 70-130% window or were high. Thus there is no indication of a low bias that might impact non-detected targets. A few elements, notably aluminum and nickel, in some runs gave very elevated recoveries that were more than 5x the reporting limit. These same runs had CCVs and CCBs in control for these elements, and so the problem could be due to contamination of the reporting limit check standard. Associated samples either had no detections of these elements or else were near the PQL. In these cases, the non-detected results are not qualified, but results that are < 2x the RL are qualified as JRL, to indicate that they may have a high bias.

Only in the case of zinc in analytical runs conducted 1/30/2008 and 1/31/2008 is the RL check low. The samples should have been reanalyzed by the laboratory and corrective action should have been taken. Results from this analysis for detected zinc less than 2x PQL are qualified as JRL, indicating that there may be a bias resulting in false negatives or low values for this metal. Zinc non-detects associated with this analysis date are qualified as "R" (rejected), indicating that the data may be severely biased low and that false negatives may result. Two data points are so impacted, associated with the first succesive leachate zinc result and the result for the associated leachate blank.

Initial calibration blank – per method – All OK

Continuing calibration verification – per method, CCV outliers observed as follows:
CCVs are in control in all SDGs with one exception:
SDG B0801210: In the reanalysis of this project conducted due to failing ion balance calculations, the closing CCV has sodium out of the control windows at 111% (upper limit is 110). The samples contain high sodium levels and this outlier is believed to be due to carryover from the samples themselves. The laboratory indicated that they did not have sufficient sample volume for additional reanalysis (these samples were from the sequential leaching studies). After several additional sample runs, the closing CCV for this run was in control, confirming this conclusion. Thus the result is not due to a calibration bias and the results are usable with no qualification.

Continuing calibration blanks – per method, CCB outliers as follows:

SDG B0711172: Beryllium and silver are greater than 3x MDL but less than the PQL in a number of CCBs. These are associated with sample non-detects and no qualifiers are required. In addition, zinc has a negative raw value in several CCBs that is greater than 2x MDL. However, associated sample results are > 5x MDL, and no qualifiers are required.

SDG B0712127: Several targets are greater than 3x MDL but less than the PQL in CCBs associated with this SDG. This includes barium, beryllium, lithium, cadmium, and sodium. All are either associated with sample results > 5x the CCB, in which case the bias is negligible, or associated with non-detects. In such cases no qualifier is required.

SDG B0712148: Barium, boron, iron, lithium, silver, or cadmium are greater than 3x MDL but less than the PQL in one or more CCBs associated with this project. All reported data are either > 5x the blank level or are non-detects. No qualifiers are required.

SDG B0801027: Iron, beryllium, or silver are above 3x MDL in one or more CCBs associated with this project. All reported data are either > 5x the blank level or are non-detects. No qualifiers are required.

SDG B0801191: Barium, beryllium, calcium, lithium, or silver are above 3x MDL in one or more CCBs associated with this project. All reported data are either > 5x the blank level or are non-detects. No qualifiers are required.

SDG B0801197: Barium, beryllium, lithium, boron, or silver are above 3x MDL in one or more CCBs associated with this project. All reported data are either > 5x the blank level or are non-detects. No qualifiers are required.

SDG B0801210: Barium, beryllium, boron, lithium, cadmium, sodium, iron, or magnesium are above 3x MDL in one or more CCBs associated with this project. All reported data are either > 5x the blank level or are non-detects. No qualifiers are required.

7471A and 7370A:

All calibrations were reviewed.
Initial Calibration - In control per method.
Initial calibration verification – per method, all ICVs are within the 90-110% recovery limits.
Reporting limit checks –
Initial calibration blank – per method, ICB in control.
Continuing calibration verification – per method, all CCVs in control.
Continuing calibration blanks – per method, all CCBs in control.

EPA 300.0

All calibrations were reviewed.
Initial calibration – In control per method.
Initial calibration verification – per method, all ICVs are within the 90-110% recovery limits.
Reporting limit checks, per method all in control with the exception of several high recoveries. In all but one instance, these outliers result in no qualification because they are either associated with non-detected anions or they are associated with results greater than 2x PQL. One result for chloride is qualified JE in the analysis of the spoil composite SPLP leachate. This result may be biased high.
Initial calibration blank – per method, in control.
Continuing calibration verification – per method, CCVs in control.
Continuing calibration blanks – per method, CCBs in control.

EPA Method 310.1:
Acceptable QC for this method.

EPA Method 160.1 :

Acceptable QC for this method.

EPA Method 150.1:
Acceptable QC for this method.

5. Preparation Blanks:

6010B:
All in control

7471A and 7370A:
All in control

300.0:
All in control

EPA Method 310.1:
All in control

EPA Method 160.1 :
All in control

EPA Method 150.1:
All in control

6. MDL Studies:

6010B:
All in control

7471A and 7370A:
All in control

300.0:
All in control

EPA Method 310.1:
All in control

EPA Method 160.1 :
All in control

EPA Method 150.1:
All in control

7. Matrix Spikes

The matrix spikes conducted by the laboratory are shown in Table 6. There are a sufficient number of spikes to meet the method-recommended frequency of 1 per 20 samples.

Table 6. Matrix Spikes in Project

Method	SDG	Sample	Lab Sample ID
160.1	B0711172	KF2007-01(58) and KF-98-	B0711172-01B

Method	SDG	Sample	Lab Sample ID
		02(53)	
	B0712127	MB Leachate 1	B0712127-01B
	B0801027	4 Corners PP Bottom Ash Leachate	B0801027-02B
	B0801191	Ash Composite 45 day	B0801191-02B
	B0801197	Ash Successive #1	B0801197-02B
	B0801210	Ash Successive #2	B0801210-02B
		Ash Successive #3	B0801210-04B
300.0	B0711172	KF2007-01(58) DUP and KF-98-02(53)DUP	B0711172-12B
	B0801027	4 Corners PP Bottom Ash Leachate	B0801027-02B
	B0801191	Ash Composite 45 day	B0801191-02B
	B0801197	Ash Successive #1	B0801197-02B
	B0801210	Ash Successive #2	B0801210-02B
		Ash Successive #3	B0801210-04B
310.1	B0801027	4 Corners PP Bottom Ash Leachate	B0801027-02B
6010B	B0711172	120 S 89W 0-4' SPOIL	B0711172-05A
	B0712127	MB Leachate 1	B0712127-01A
	B0712148	626854 MB	B0712148-01A-MS
		626854 Ash in Spoil Water	B0712148-02A-MS
	B0801027	4 Corners PP Bottom Ash Leachate	B0801027-02A-MS
	B0801191	Ash Composite SPLP	B0801191-05A-MS
	B0801197	Ash Successive #1	B0801197-02A-MS
	B0801210	Ash Successive #2	B0801210-02A-MS
		Ash Successive #3	B0801210-04A-MS
7470A	B0801027	4 Corners PP Bottom Ash Leachate	B0801027-02A-MS
	B0801197	Ash Successive #1	B0801197-02A-MS
	B0801210	Ash Successive #2	B0801210-02A-MS
		Ash Successive #3	B0801210-04A-MS
7471A	B0711172	123 S 87W 0-4' SPOIL	B0711172-02A-MS

Table 7. Matrix spike outliers observed.

Method	SDG	Client Sample ID	Lab Sample ID	Type	Analyte	Recov	RPD	Qualifiers
310.1	B0801027	4 Corners PP Bottom Ash Leachate	B0801027-02B	MS	Bicarbonate	60		None, sample> 4x spike
310.1	B0801027			MS	Carbonate	66		JMS
6010B	B0711172	120 S 89W 0-4' SPOIL	B0711172-05A	MS	Iron	OUT		None, sample> 4x spike
				MS	Aluminum	OUT		None, sample> 4x spike
				MS	Antimony	41.1		JMS
				MS	Sodium	OUT		None, sample> 4x spike
				MSD	Aluminum	OUT		None, sample> 4x spike
				MSD	Antimony	38.9		JMS
				MSD	Iron	OUT		None, sample> 4x spike
				MSD	Magnesium	147		JMS
				MSD	Thallium	63.3		JMS

Method	SDG	Client Sample ID	Lab Sample ID	Type	Analyte	Recov	RPD	Qualifiers
6010B	B0712127	MB Leachate 1	B0712127-01A	MS	Sodium	OUT		None, sample> 4x spike
				MSD	Sodium	OUT		None, sample> 4x spike
6010B	B0712148	626854 Ash in Spoil Water	B0712148-02A	MS	Calcium	OUT		None, sample> 4x spike
				MS	Potassium	62		JMS
				MS	Sodium	OUT		None, sample> 4x spike
				MS	Boron	OUT		None, sample> 4x spike
				MSD	Potassium	62		JMS
				MSD	Sodium	OUT		None, sample> 4x spike
				MSD	Boron	OUT		None, sample> 4x spike
6010B	B0712148	626854 MB	B0712148-01A	MS	Sodium	OUT		None, sample> 4x spike
				MS	Lithium	129		JMS
				MS	Boron	162		JMS
				MSD	Boron	164		JMS
6010B	B0801027	4 Corners PP Bottom Ash Leachate	B0801027-02A-MS	MS	Sodium	OUT		None, sample> 4x spike
				MSD	Potassium	71		JMS
				MSD	Sodium	OUT		None, sample> 4x spike
6010B	B0801191	Ash Composite SPLP	B0801191-05A-MSD	MSD	Calcium	OUT		None, sample> 4x spike
6010B	B0801197	Ash Successive #1	B0801197-02A-MSD	MSD	Calcium	OUT		None, sample> 4x spike
				MS	Sodium	OUT		None, sample> 4x spike
				MSD	Sodium	OUT		None, sample> 4x spike
6010B	B0801210	Ash Successive #2	B0801210-02A-MSD	MSD	Cadmium	69		JMS
				MS	Cadmium	67.8		JMS
				MS	Sodium	OUT		None, sample> 4x spike
				MS	Sodium	OUT		None, sample> 4x spike
6010B	B0801210	Ash Successive #3	B0801210-04A-MSD	MSD	Sodium	OUT		None, sample> 4x spike
				MSD	Potassium	59		JMS
				MSD	Cadmium	72		JMS
				MS	Cadmium	72		JMS
				MS	Potassium	60		JMS
				MS	Sodium	OUT		None, sample> 4x spike
				MS	Boron	73		JMS
				MSD	Boron	72		JMS

8. Laboratory Duplicates

The following laboratory duplicates were prepared and analyzed.

Table 8. Laboratory Duplicates in Project

SDG	Method	Sample ID	Lab Dup ID	Matrix
B0711172	150.1	KF2007-01(58) and KF-98-02(53)	B0711172-01B-DUP	Aqueous
B0711172	160.1	KF2007-01(58) and KF-98-02(53)	B0711172-01B-DUP	Aqueous
B0711172	300	KF2007-01(58) DUP and KF-98-02(53)DUP	B0711172-12B-DUP	Aqueous
B0711172	310.1	KF2007-01(58) and KF-98-02(53)	B0711172-01B-DUP	Aqueous
B0711172	6010B	120 S 89W 0-4' SPOIL	B0711172-05A-DUP	Solid
B0711172	7471A	123 S 87W 0-4' SPOIL	B0711172-02A-DUP	Solid
B0711172	ASTM D2216 - Pmoist	Ash Composite Dup2 70% FA	B0711172-11A-DUP	Solid
B0712127	150.1	MB Leachate 1	B0712127-01B-DUP	Aqueous
B0712127	160.1	MB Leachate 1	B0712127-01B-DUP	Aqueous
B0712127	310.1	MB Leachate 1	B0712127-01B-DUP	Aqueous
B0712127	6010B	MB Leachate 1	B0712127-01A-DUP	Aqueous
B0712148	310.1	626854 MB	B0712148-01B-DUP	Aqueous
B0712148	6010B	626854 MB	B0712148-01A-DUP	Aqueous
B0801027	150.1	4 Corners PP Bottom Ash Leachate	B0801027-02B-DUP	Aqueous
B0801027	160.1	4 Corners PP Bottom Ash Leachate	B0801027-02B-DUP	Aqueous
B0801027	310.1	4 Corners PP Bottom Ash Leachate	B0801027-02B-DUP	Aqueous
B0801027	6010B	4 Corners PP Bottom Ash Leachate	B0801027-02A-DUP	Aqueous
B0801027	7470A	4 Corners PP Bottom Ash Leachate	B0801027-02A-DUP	Aqueous
B0801191	160.1	Ash Composite 45 day	B0801191-02B-DUP	Aqueous
B0801191	300	Ash Composite 45 day	B0801191-02B-DUP	Aqueous
B0801191	310.1	MB SPLP	B0801191-04B-DUP	Aqueous
B0801191	6010B	Ash Composite SPLP	B0801191-05A-DUP	Aqueous
B0801197	6010B	Ash Successive #1	B0801197-02A-DUP	Aqueous
B0801197	7470A	Ash Successive #1	B0801197-02A-DUP	Aqueous
B0801210	160.1	Ash Successive #2	B0801210-02B-DUP	Aqueous
B0801210	300	Ash Successive #2	B0801210-02B-DUP	Aqueous
B0801210	6010B	Ash Successive #2	B0801210-02A-DUP	Aqueous
B0801210	6010B	Ash Successive #3	B0801210-04A-DUP	Aqueous
B0801210	7470A	Ash Successive #2	B0801210-02A-DUP	Aqueous
B0801210	7470A	Ash Successive #3	B0801210-04A-DUP	Aqueous

A review of the duplicate comparisons is provided as a separate table in Excel. Duplicates are compared as follows, per validation guidance:

The matrix duplicate relative percent difference (RPD) should be within 20% for water and 35% for soil, or $\pm$ RL for water when results are less than 5 x RL ($\pm$ 2x RL for soils).

Due to the importance of establishing sample representativeness in this project, the RPD limit used for evaluation is 20% for both water and soils. The following laboratory duplicate results fell outside of these limits:

Table 9. Laboratory Duplicate Outliers

SDG	Method	Sample Id	analyte	Parent	PQL	Dup	PQL	RPD	RPD FLAG	PQL Diff	PQL Flag
B0711172	6010B	120 S 89W 0-4' SPOIL	Manganese	370	0.96	461	0.92	21.9	OUT		
B0801210	6010B	Ash Successive #3	Sodium	1300	3	1040	3	22.2	OUT		
B0712127	6010B	MB Leachate 1	Aluminum	0.056	0.05	0.211	0.05			0.155	OUT
B0712127	6010B	MB Leachate 1	Iron	0.073	0.05	0.313	0.05			0.24	OUT

Samples are qualified JD for duplicate outliers, indicating that there may be some laboratory or matrix variability for the analyte in question which is greater than normal in that sample.

9. Serial Dilutions

Serial dilutions are required by Method 6010B at a frequency of one per batch in order to assess matrix effects that may occur in digestates. This frequency of serial dilutions has been met by the laboratory. One digestate from the batch is chosen and diluted by a factor of 5, then reanalyzed. If there is no matrix effect at all, then the reproducibility of results that are roughly greater than 50x the method detection limit should be essentially the same as for standards, namely within 10% of the true value. Deviations from this range indicate that some matrix bias may apply to the particular matrix from which the digestate was produced.

In this project, most serial dilution results meet these criteria, indicating little or no matrix bias. However, for some of the matrices, there are some deviations as shown in Table 10 below. The sign of the %DIFF column in the table indicates whether the possible bias is high or low, with a negative sign indicating a possible high bias and a positive sign a possible low bias. Note that there are two serial dilutions available for the groundwater composite (run as leachate blanks, MB Leachate 1 and 626854 MB). These show a similar indication of a positive bias, although the magnitude is different. A review of the raw data shows that a second valid run for the sample 626854 MB exists, and if this run is used instead of the one chosen, the magnitude of the bias drops to a level similar to that indicated for MB Leachate 1. Note also that the apparent bias for sodium in MB Leachate 1 is not reproduced in 626854 MB.

Because there is a consistent indication of a small positive matrix bias for barium, boron, and calcium in the groundwater composite, all results for these parameters in runs of groundwater composite are qualified as JE per professional judgment. Only the parent sample associated with the sodium and magnesium outliers are qualified.

The magnitude of any such bias is of the order of 1-10% based on the observed results. This is not a significant enough deviation to require efforts to overcome it, which are not likely to improve results in a measurable manner for such small deviations.

Table 10. Serial Dilution Outliers

SAMPLE	Analyte	Result	Res/MDL	MDL	5xResult	%DIFF	Qual
120 S 89W 0-4' SPOIL	Calcium	27,500	5392	5.1	23,800	13	JE
120 S 89W 0-4' SPOIL	Copper	20.3	135	0.15	16.7	18	JE
120 S 89W 0-4' SPOIL	Iron	19,200	45714	0.42	16,500	14	JE
120 S 89W 0-4' SPOIL	Manganese	374	3400	0.11	429	-15	JE
120 S 89W 0-4' SPOIL	Sodium	4,090	4173	0.98	3,400	17	JE
MB Leachate 1 (Groundwater composite)	Barium	0.118	737.5	0.0002	0.133	-13	JE
	Boron	0.331	184	0.0018	0.365	-10	JE
	Calcium	2.89	222	0.013	3.32	-15	JE
	Sodium	1,180	42143	0.028	1,310	-11	JE
626854 MB (Groundwater composite)	Barium	0.155	969	0.0002	0.245	-58	JE
	Boron	0.27	150	0.0018	0.416	-54	JE
	Calcium	2.42	186	0.013	3.92	-62	JE
	Magnesium	0.926	77	0.012	1.51	-63	JE
4 Corners PP Bottom Ash Leachate	Barium	0.127	794	0.0002	0.111	12.6	JE

SAMPLE	Analyte	Result	Res/MDL	MDL	5xResult	%DIFF	Qual
4 Corners PP Bottom Ash Leachate	Calcium	3.11	239	0.013	5.53	-78	JE
4 Corners PP Bottom Ash Leachate	Magnesium	1.32	110	0.012	1.11	15.9	JE
Ash Composite SPLP	**All in control**						
Ash Successive #1	Magnesium	1.99	166	0.012	1.72	13.6	JE
Ash Successive #3	Sodium	1,270	45357	0.028	1,080	15	JE

10. Field Duplicates

There were a number of replicate field samples taken for various purposes, as described in the work plan. These are summarized below.

1. Four samples of spoil were taken from different locations in order to assess the degree of spacial heterogeneity.
2. Duplicate samples of the two different sources of coal groundwater were taken. The two sources were composited 1:1 to produce a composite sample and its duplicate.
3. After homogenization of the samples, a number of replicate solid samples were analyzed. These are summarized in Table 3.
4. The initial 24-hour leachings with coal groundwater that were conducted using spoil and ash were each conducted in duplicate.

Separately-Located Spoil Samples:
The detected targets (results above the laboratory reporting limit) all show a %RSD less than 20% with the exception of barium, calcium, manganese, and mercury. Those that are above 20% are all below 35% with the exception of mercury, which is 36.5%. However, mercury results are less than 5x the reporting limit in all cases. At these relatively low levels, normal analytical variability alone is enough to account for the observed differences, so it is not clear if these data reflect actual sample variability. The other results above 20% probably do reflect some variation from point to point on the site.

Table 11. Separately-Located Spoil Samples

Analyte	123 S 87W 0-4' SPOIL	FL	PQL	123 S 89W 0-4' SPOIL	FL	125 S 88W 0-4' SPOIL	FL	120 S 89W 0-4' SPOIL	FL	av	s	% RSD
Aluminum	9700		7.1	9600		10000		9200		9625.0	330.4	3.4
Antimony	0.024	ND	9.8	1.3	ND	0.51	ND	0.39	ND			
Arsenic	-31	ND	12	-37	ND	-31	ND	-25	ND			
Barium	150		0.36	170		220		140		170.0	35.6	20.9
Beryllium	1		0.18	1		1.1		0.84		1.0	0.1	10.9
Boron	13		4.5	13		13		11		12.5	1.0	8.0
Cadmium	0.74		0.71	0.85		0.67	ND	0.63	ND	0.7	0.1	13.3
Calcium	14000		12	21000		16000		27000		19500.0	5802.3	29.8
Chromium	6.7		1.8	6.6		6.8		6.1		6.6	0.3	4.7
Cobalt	12		2.7	11		11		11		11.3	0.5	4.4
Copper	28		0.54	25		28		20		25.3	3.8	15.0
Iron	22000		5.4	24000		22000		19000		21750.0	2061.6	9.5
Lead	17		5.4	17		18		17		17.3	0.5	2.9
Lithium	9.1		4.5	9		8.8		8.2		8.8	0.4	4.6
Magnesium	3100		8.9	3100		3100		3200		3125.0	50.0	1.6
Manganese	360		0.89	590		380		370		425.0	110.3	26.0
Molybdenum	-0.27	ND	1.8	-0.18	ND	-0.097	ND	-0.094	ND			
Nickel	15		3.6	15		14		14		14.5	0.6	4.0

Analyte	123 S 87W 0-4' SPOIL	FL	PQL	123 S 89W 0-4' SPOIL	FL	125 S 88W 0-4' SPOIL	FL	120 S 89W 0-4' SPOIL	FL	av	s	% RSD
Potassium	1800		89	1800		1900		1900		1850.0	57.7	3.1
Selenium	4.8	ND	8.9	1.9	ND	1.1	ND	1.2	ND			
Silver	-0.59	ND	1.3	-0.51	ND	-0.41	ND	-0.4	ND			
Sodium	3900		270	3800		4200		4100		4000.0	182.6	4.6
Thallium	-4.6	ND	18	-4.4	ND	-3.5	ND	-3.4	ND			
Vanadium	22		0.89	24		25		18		22.3	3.1	13.9
Zinc	73		0.54	69		66		59		66.8	5.9	8.9
Mercury	0.12		0.04	0.075		0.053		0.12		0.09	0.034	36.5
Moisture	7.06		0.047	8.64		7.6		6.86		7.5	0.8	10.6

Spoil Composite Replicates:
For the composite and homogenized spoil, subsample reproducibility is shown in Table 12. All results are well within the 20% RSD window, and most are well under 10%. Thus the composite used in the leaching studies is sufficiently homogeneous that no differences between subsamples are detectable.

Table 12. Spoil Composite Replicates

Analyte	Composite Spoil A	FL	PQL	Composite Spoil B	FL	Composite Spoil C	FL	av	s	% RSD
Aluminum	10000		7.4	9500		9400		**9633**	321.5	3.3
Antimony	-0.13	ND	10	0.052	ND	0.9	ND			
Arsenic	-29	ND	12	-29	ND	-30	ND			
Barium	170		0.37	180		170		**173**	5.8	3.3
Beryllium	1		0.19	1		1		**1.0**	0.00	0.0
Boron	13		4.7	12		12		**12.3**	0.58	4.7
Cadmium	0.64	ND	0.74	0.63	ND	0.59	ND			
Calcium	20000		13	22000		20000		**20667**	1154.7	5.6
Chromium	6.7		1.9	6		6.1		**6.3**	0.38	6.0
Cobalt	11		2.8	11		11		**11.0**	0.0	0.0
Copper	26		0.56	23		24		**24.3**	1.5	6.3
Iron	20000		5.6	20000		20000		**20000**	0.0	0.0
Lead	16		5.6	17		18		**17.0**	1.0	5.9
Lithium	8.6		4.7	8.2		8.1		**8.3**	0.3	3.2
Magnesium	3100		9.3	2900		3000		**3000**	100.0	3.3
Manganese	440		0.93	430		390		**420.0**	26.5	6.3
Molybdenum	-0.031	ND	1.9	0.0034	ND	-0.04	ND			
Nickel	13		3.7	13		14		**13.3**	0.58	4.3
Potassium	1900		93	1700		1800		**1800**	100.0	5.6
Selenium	2.9	ND	9.3	2.7	ND	2.9	ND			
Silver	-0.37	ND	1.4	-0.27	ND	-0.32	ND			
Sodium	4000		280	3900		4100		**4000**	100.0	2.5
Thallium	-4.8	ND	19	-3.4	ND	-2.6	ND			
Vanadium	23		0.93	22		22		**22.3**	0.58	2.6
Zinc	62		0.56	65		62		**63.0**	1.7	2.7
Mercury	0.087		0.04	0.073		0.068		**0.1**	0.01	13.0
Moisture	7.98		0.05	8.13		7.87		**8.0**	0.13	1.6

Ash Composite Replicates:
The data shown in Table 13 show that the %RSD for the homogenized ash composite replicates is well within 20% for all detected metals except calcium and magnesium. These are both less than 30%. This suggests that there may be some sample homogenity associated with the composite sample, related to the distribution of calcium and magnesium-rich minerals in the sample. A similar

variability was observed in the XRD analysis of separate subsamples for Dolomite and gypsum. Given the behavior of the material during the homogenization process, this is not too surprising. The fact that the toxic metals of concern are much more evenly distributed suggests that this variability in calcium and magnesium content should not materially impact the leaching behavior of subsamples from this composite.

Table 13. Ash Composite Replicates

Analyte	Ash Composite 70% FA	FL	PQL	Ash Composite Dup 1 70% FA	FL	PQL	Ash Composite Dup2 70% FA	FL	PQL	av	s	% RSD
Aluminum	7200		7.7	6800		7.5	7100		7.6	**7033**	208.2	3.0
Antimony	1.4	ND	11	0.66	ND	10	1.2	ND	10			
Arsenic	6.9	ND	12	7.2	ND	12	7.9	ND	12			
Barium	240		0.38	240		0.38	240		0.38	**240**	0.0	0.0
Beryllium	0.77		0.19	0.75		0.19	0.8		0.19	**1**	0.0	3.3
Boron	91		4.8	88		4.7	93		4.8	**91**	2.5	2.8
Cadmium	0.16	ND	0.77	0.19	ND	0.75	0.21	ND	0.76			
Calcium	62000		13	41000		13	38000		13	**47000**	13076.7	27.8
Chromium	9.8		1.9	9.1		1.9	9.5		1.9	**9**	0.4	3.7
Cobalt	2	ND	2.9	1.9	ND	2.8	1.8	ND	2.9			
Copper	7.5		0.58	6.5		0.56	7.1		0.57	**7**	0.5	7.2
Iron	4000		5.8	3900		5.6	4000		5.7	**3967**	57.7	1.5
Lead	7.3		5.8	7.7		5.6	7.4		5.7	**7**	0.2	2.8
Lithium	5.2		4.8	5.2		4.7	5.4		4.8	**5**	0.1	2.2
Magnesium	2100		9.6	1500		9.4	1400		9.5	**1667**	378.6	22.7
Manganese	81		0.96	79		0.94	83		0.95	**81**	2.0	2.5
Molybdenum	4.6		1.9	4.6		1.9	5		1.9	**5**	0.2	4.9
Nickel	3.4	ND	3.8	2.9	ND	3.8	2.9	ND	3.8			
Potassium	480		96	410		94	420		95	**437**	37.9	8.7
Selenium	8.4	ND	9.6	6.2	ND	9.4	8.5	ND	9.5			
Silver	0.21	ND	1.4	0.13	ND	1.4	0.026	ND	1.4			
Sodium	730		290	670		280	680		290	**693**	32.1	4.6
Thallium	-1.4	ND	19	-1	ND	19	-1.3	ND	19			
Vanadium	24		0.96	22		0.94	24		0.95	**23**	1.2	4.9
Zinc	13		0.58	11		0.56	13		0.57	**12**	1.2	9.4
Mercury	0.17		0.042	0.21		0.04	0.16		0.04	**0**	0.0	14.7
Moisture	7.03		0.047	6.87		0.05	6.98		0.05	**7**	0.1	1.2

Ground water duplicates:
RPDs and absolute differences for the groundwater field duplicates are shown in Table 14. As would be expected, the groundwater is very homogeneous, with all analytes showing an RPD less than 20% or an absolute difference less than the reporting limit (for results < 5x PQL).

Table 14. Ground Water Field Duplicates

SDG	Method	Analyte	GW Composite	FL	PQL	GW Composite FD	FL	RPD	RL Diff
B0711172	150.1	pH	9		0.1	8.9		1.1	
B0711172	160.1	Total Dissolved Solids	3100		10	3000		3.3	
B0711172	300	Chloride	710		21	700		1.4	
B0711172	300	Fluoride	2.4		0.4	2.5		4.1	
B0711172	300	Sulfate	300		1.5	260		14.3	
B0711172	310.1	Bicarbonate	1300		5	1200		8.0	
B0711172	310.1	Carbonate	260		7	300		14.3	
B0711172	6010B	Aluminum	0.13		0.05	0.14			0.01
B0711172	6010B	Antimony	0.0027	ND	0.05	-0.00089	ND		
B0711172	6010B	Arsenic	-0.00025	ND	0.1	-0.00084	ND		
B0711172	6010B	Barium	0.093		0.01	0.088		5.5	

SDG	Method	Analyte	GW Composite	FL	PQL	GW Composite FD	FL	RPD	RL Diff
B0711172	6010B	Beryllium	0.00019	ND	0.001	0.00013	ND		
B0711172	6010B	Boron	0.31		0.05	0.29		6.7	
B0711172	6010B	Cadmium	0.00024	ND	0.006	-0.00034	ND		
B0711172	6010B	Calcium	3.4		0.1	3.3		3.0	
B0711172	6010B	Chromium	0.003	ND	0.01	0.0037	ND		
B0711172	6010B	Cobalt	0.0014	ND	0.005	0.0011	ND		
B0711172	6010B	Copper	0	ND	0.005	0.0019	ND		
B0711172	6010B	Iron	0.067		0.05	0.073			0.006
B0711172	6010B	Lead	0.0077	ND	0.05	0.0058	ND		
B0711172	6010B	Lithium	0.08	ND	0.1	0.073	ND		
B0711172	6010B	Magnesium	1.3		0.1	1.2		8.0	
B0711172	6010B	Manganese	0.0095	ND	0.01	0.0076	ND		
B0711172	6010B	Molybdenum	0.012		0.01	0.0097	ND		0.0023
B0711172	6010B	Nickel	-0.00023	ND	0.04	0.0011	ND		
B0711172	6010B	Potassium	11		1	10		9.5	
B0711172	6010B	Selenium	0.012	ND	0.1	0.019	ND		
B0711172	6010B	Silver	0.0022	ND	0.015	0.0026	ND		
B0711172	6010B	Sodium	1200		3	1100		8.7	
B0711172	6010B	Thallium	0.0085	ND	0.4	0.0018	ND		
B0711172	6010B	Vanadium	0.003	ND	0.01	0.0031	ND		
B0711172	6010B	Zinc	-0.005	ND	0.005	-0.008	ND		
B0711172	7470A	Mercury	-0.00013	ND	0.0002	0.00018	ND		

Ash Leachate Duplicates:
Ash leachate duplicates (24-hour leaching conducted with groundwater) are compared in Table 15. These are also well within acceptance windows.

Table 15. Ash Leachate Duplicates

Method	Analyte	Ash Leachate 1	FL	PQL	Ash Leachate 1 Dup	FL	PQL	RPD	RL Diff
150.1	pH	7.7		0.1	7.6		0.1	1.31	
160.1	Total Dissolved Solids	5400		10	5400		10	0	
300	Chloride	620		16	610		21	1.63	
300	Fluoride	5		0.4	5		0.4	0	
300	Sulfate	2400		30	2500		15	4.08	
310.1	Bicarbonate	810		5	820		5	1.23	
310.1	Carbonate	0	ND	7	0	ND	7		
6010B	Aluminum	0.053		0.05	0.044	ND	0.05		0.009
6010B	Antimony	0.016	ND	0.05	0.023	ND	0.05		
6010B	Arsenic	0.081	ND	0.1	0.075	ND	0.1		
6010B	Barium	0.099		0.01	0.1		0.01	1.01	
6010B	Beryllium	0.00053	ND	0	0.00063	ND	0.001		
6010B	Boron	2.6		0.05	2.5		0.05	3.92	
6010B	Cadmium	0.0016	ND	0.01	0.0014	ND	0.006		
6010B	Calcium	570		0.1	560		0.1	1.77	
6010B	Chromium	0.011		0.01	0.011		0.01		0
6010B	Cobalt	0.0015	ND	0.01	0.0024	ND	0.005		
6010B	Copper	0.0013	ND	0.01	0.0017	ND	0.005		
6010B	Iron	0.0018	ND	0.05	-0.0076	ND	0.05		
6010B	Lead	-0.01	ND	0.05	-0.00034	ND	0.05		
6010B	Lithium	0.13		0.1	0.13		0.1		0
6010B	Magnesium	7.7		0.1	7.6		0.1	1.31	

Method	Analyte	Ash Leachate 1	FL	PQL	Ash Leachate 1 Dup	FL	PQL	RPD	RL Diff
6010B	Manganese	0.095		0.01	0.095		0.01	0	
6010B	Molybdenum	0.15		0.01	0.14		0.01	6.9	
6010B	Nickel	0.0029	ND	0.04	0.0029	ND	0.04		
6010B	Potassium	12		1	12		1	0	
6010B	Selenium	0.14		0.1	0.13		0.1		0.01
6010B	Silver	0.00081	ND	0.02	-0.00054	ND	0.015		
6010B	Sodium	1200		3	1200		3	0	
6010B	Thallium	0.01	ND	0.4	0.0056	ND	0.4		
6010B	Vanadium	0.12		0.01	0.12		0.01	0	
6010B	Zinc	-0.0071	ND	0.01	-0.0098	ND	0.005		
7470A	Mercury	-2.00E-05	ND	0	-0.00015	ND	0.0002		

Spoil Leachate Dups:
Table 16 compares the duplicate 24-hour leaching studies done with spoil and site groundwater, and these also meet criteria with the exception of barium, which has an RPD of 22%.

Table 16. Spoil Leachate Duplicates

Method	Analyte	Spoil Leachate 1	FL	PQL	Spoil Leachate 1 Dup	FL	PQL	RPD	RL Diff
150.1	pH	8		0.1	7.9		0.1	1.26	
160.1	Total Dissolved Solids	3500		10	3600		10	2.82	
300	Chloride	610		21	610		21	0	
300	Fluoride	1.6		0.4	1.6		0.4		0
300	Sulfate	970		15	990		15	2.04	
310.1	Bicarbonate	1000		5	1000		5	0	
310.1	Carbonate	0	ND	7	0	ND	7		
6010B	Aluminum	0.29		0.05	0.3		0.05	3.39	
6010B	Antimony	0.0035	ND	0.05	-0.0016	ND	0.05		
6010B	Arsenic	0.0094	ND	0.1	0.012	ND	0.1		
6010B	Barium	0.25		0.01	0.2		0.01	22.2	
6010B	Beryllium	0.0002	ND	0	0.00014	ND	0		
6010B	Boron	0.44		0.05	0.45		0.05	2.25	
6010B	Cadmium	0.00087	ND	0.01	0.00049	ND	0.01		
6010B	Calcium	64		0.1	69		0.1	7.52	
6010B	Chromium	0.001	ND	0.01	0.00036	ND	0.01		
6010B	Cobalt	0.0029	ND	0.01	0.0023	ND	0.01		
6010B	Copper	0.0022	ND	0.01	0.0026	ND	0.01		
6010B	Iron	0.17		0.05	0.18		0.05		0.01
6010B	Lead	-0.0044	ND	0.05	-0.00017	ND	0.05		
6010B	Lithium	0.1		0.1	0.1		0.1		0
6010B	Magnesium	13		0.1	13		0.1	0	
6010B	Manganese	0.11		0.01	0.1		0.01	9.52	
6010B	Molybdenum	0.014		0.01	0.014		0.01		0
6010B	Nickel	0.0029	ND	0.04	0.0015	ND	0.04		
6010B	Potassium	14		1	14		1	0	
6010B	Selenium	0.0057	ND	0.1	-0.0053	ND	0.1		
6010B	Silver	0.0019	ND	0.02	-0.00068	ND	0.02		
6010B	Sodium	1200		3	1200		3	0	

Method	Analyte	Spoil Leachate 1	FL	PQL	Spoil Leachate 1 Dup	FL	PQL	RPD	RL Diff
6010B	Thallium	0.0074	ND	0.4	0.0037	ND	0.4		
6010B	Vanadium	0.0023	ND	0.01	0.0028	ND	0.01		
6010B	Zinc	0.0042	ND	0.01	0.0095		0.01		
7470A	Mercury	1.00E-04	ND	0	8.00E-05	ND	0		

11. Ion Balance and Other Secondary Indicators.

Ion balance is a useful QC indicator for the aqueious samples. The major cations and major anions, expressed in meq/L, must in principle be equal to one another in order to maintain charge neutrality. The accuracy of the analytical methods at different concentration ranges must be considered in this calculation. Criteria are provided in Standard Methods as follows:

If ($\Sigma_{cations} + \Sigma_{anions}$) is 0 to 6.0 meq/L, ion balance may be: ± 0.2 meq/L

If ($\Sigma_{cations} + \Sigma_{anions}$) is 6.0 to 20.0 meq/L, ion balance may be: ± 2.0 percent

If ($\Sigma_{cations} + \Sigma_{anions}$) is 20 to 600 meq/L, ion balance may be: ± 5.0 percent

These criteria have been applied to all aqueous samples in this project. Detailed calculations are available in an Excel Workbook provided as support documentation. All results pass the Standard Methods criteria except for those shown in Table 16.

Table 16. Ion Balances out of Standard Methods Limits (note that values shown are meq/L)

Sample	Na	K	Ca	Mg	Cl	SO4	F	HCO3	CO3	Cations-anions	% Bal
KF2007-01(58) DUP and KF-98-02(53)DUP	47.83	0.26	0.17	0.10	19.72	5.42	0.13	25.43	4.59	-6.1	6.7%
626854 Spoil in Ash Water	52.17	0.41	21.00	2.00	17.46	56.25	0.18	12.62	0.18	-11.1	6.9%
4 Corners PP Bottom Ash Leachate	47.83	0.28	0.16	0.11	17.75	5.83	0.12	24.90	5.72	-5.9	5.8%
Ash Composite 45 day	52.17	0.31	26.50	1.00	17.18	52.08	0.43	21.63	0.37	-11.7	6.8%
MB Successive #2	43.48	0.31	0.14	0.10	16.90	5.83	0.25	22.10	6.32	-7.4	7.7%
MB Successive #3	43.48	0.28	0.14	0.09	17.46	5.83	0.25	23.60	6.82	-10	10.2%

There are no data validation criteria for ion balance, and all of the outliers except one leachate control blank (groundwater) are less than 10%. That result is within 10.2%.

The Standard Methods criteria were developed for "typical" waters, whereas these are sodic waters with higher levels of sodium than is routinely found in most natural water. The difference between the cations and anions is negative in each case shown in Table 16; this appears to be due to sodium or calcium results in most instances. A change in sodium content of 10% or less would bring these results into control. Since this is an acceptable range for sodium analytical variability, professional judgement is that these results do not impair the usability of the data.

The total dissolves solids can also be compared with the calculated total dissolved solids based on the anion and cation analysis. The results of that comparison show that these results are all within 20% of the measured TDS value, with most within less than 5% of the measured value. This is an indication that there are not significant levels of cations or anions not being considered in the analysis.

12. Laboratory Results between the PQL and MDL

The laboratory reports results to the PQL, or quantitation limit. This is defined by the laboratory on the basis of a daily standard analyzed at that level or the low point of the calibration curve. It is set such that it is at least 3x the MDL for most methods. This establishes a reporting limit which is likely to produce a result which is approximately within normal accuracy limits for the method and matrix involved. The methods nontheless do produce measurements for values falling below the PQL, but the laboratory does not report them as part of the standard report. If they were to do so, they would be flagged as estimates.

These results are available in the EDD although they are not in the hardcopy report. The laboratory includes all measured values, whether below the PQL or not, but flags the ones that are below the PQL as ND for "not detected." If needed such results may be usable, but will require additional review, particularly with respect to associated blank levels that are also less than the PQL but above the MDL.

13. Qualified Data Table

Table 17 provides a list of all data qualifiers added to the EDD. The validation qualifiers are in the DVAL field, and should be considered in all use of the data. Two data points for zinc were rejected, producing a completeness of 99.8%, which meets the goals of the work plan.

The qualified data (80 data points) represent 7.5% of the total data set. These are usable results, indicating the possibility of some bias but still usable for the purposes of this project. 35 of these qualified results are associated with leachate control blanks, which are somewhat less important than the leachate data and the solids data themselves. Eight qualified results are associated with solid sample data, and 37 are associated with leachate data.

The precision, accuracy, and completeness of the data in this set meet criteria except where otherwise noted in the qualifiers added. Results qualified with "J" are usable after consideration of the deviations involved. In most instances these deviations are minor.

Table 17. Qualified Results

SDG	Sample	Lab ID	Method	Batch	Analyte	Result	PQL	MDL	Flag	DVAL
B0711172	KF2007-01(58) and KF-98-02(53)	B0711172-01A	6010B	75434	Barium	0.093	0.01	0.00016		JE
B0711172	KF2007-01(58) and KF-98-02(53)	B0711172-01A	6010B	75434	Boron	0.31	0.05	0.0018		JE
B0711172	KF2007-01(58) and KF-98-02(53)	B0711172-01A	6010B	75434	Calcium	3.4	0.1	0.013		JE
B0711172	KF2007-01(58) and KF-98-02(53)	B0711172-01A	6010B	75434	Iron	0.067	0.05	0.0027		JRL
B0711172	120 S 89W 0-4' SPOIL	B0711172-05A	6010B	75419	Antimony	0.39	11	0.6	ND	JMS
B0711172	120 S 89W 0-4' SPOIL	B0711172-05A	6010B	75419	Calcium	27000	13	5.1		JE
B0711172	120 S 89W 0-4' SPOIL	B0711172-05A	6010B	75419	Copper	20	0.58	0.15		JE
B0711172	120 S 89W 0-4' SPOIL	B0711172-05A	6010B	75419	Iron	19000	5.8	0.42		JE
B0711172	120 S 89W 0-4' SPOIL	B0711172-05A	6010B	75419	Magnesium	3200	9.6	0.92		JMS

SDG	Sample	Lab ID	Method	Batch	Analyte	Result	PQL	MDL	Flag	DVAL
B0711172	120 S 89W 0-4' SPOIL	B0711172-05A	6010B	75419	Manganese	370	0.96	0.11		JE
B0711172	120 S 89W 0-4' SPOIL	B0711172-05A	6010B	75419	Sodium	4100	290	0.98		JE
B0711172	120 S 89W 0-4' SPOIL	B0711172-05A	6010B	75419	Thallium	-3.4	19	1.1	ND	JMS
B0711172	KF2007-01(58) DUP and KF-98-02(53)DUP	B0711172-12A	6010B	75434	Barium	0.088	0.01	0.00016		JE
B0711172	KF2007-01(58) DUP and KF-98-02(53)DUP	B0711172-12A	6010B	75434	Boron	0.29	0.05	0.0018		JE
B0711172	KF2007-01(58) DUP and KF-98-02(53)DUP	B0711172-12A	6010B	75434	Calcium	3.3	0.1	0.013		JE
B0711172	KF2007-01(58) DUP and KF-98-02(53)DUP	B0711172-12A	6010B	75434	Iron	0.073	0.05	0.0027		JRL
B0712127	MB Leachate 1	B0712127-01A	6010B	75853	Aluminum	0.056	0.05	0.014		JRL
B0712127	MB Leachate 1	B0712127-01A	6010B	75853	Barium	0.12	0.01	0.00016		JE
B0712127	MB Leachate 1	B0712127-01A	6010B	75853	Boron	0.33	0.05	0.0018		JE
B0712127	MB Leachate 1	B0712127-01A	6010B	75853	Calcium	2.9	0.1	0.013		JE
B0712127	MB Leachate 1	B0712127-01A	6010B	75853	Iron	0.073	0.05	0.0027		JRL
B0712127	MB Leachate 1	B0712127-01A	6010B	75853	Sodium	1200	3	0.028		JE
B0712127	Ash Leachate 1	B0712127-02A	6010B	75853	Chromium	0.011	0.01	0.0018		JRL
B0712127	Ash Leachate 1	B0712127-02A	6010B	75853	Aluminum	0.053	0.05	0.014		JRL
B0712127	Ash Leachate 1 Dup	B0712127-03A	6010B	75853	Chromium	0.011	0.01	0.0018		JRL
B0712127	Spoil Leachate 1	B0712127-04A	6010B	75853	Iron	0.17	0.05	0.0027		JRL
B0712127	Spoil Leachate 1 Dup	B0712127-05A	6010B	75853	Iron	0.18	0.05	0.0027		JRL
B0712127	Spoil Leachate 1 Dup	B0712127-05A	6010B	75853	Zinc	0.0095	0.005	0.001		JRL
B0712148	626854 MB	B0712148-01A	6010B	75946	Barium	0.16	0.01	0.00016		JE
B0712148	626854 MB	B0712148-01A	6010B	75946	Boron	0.27	0.05	0.0018		JMSE
B0712148	626854 MB	B0712148-01A	6010B	75946	Calcium	2.4	0.1	0.013		JE
B0712148	626854 MB	B0712148-01A	6010B	75946	Magnesium	0.93	0.1	0.012		JE

SDG	Sample	Lab ID	Method	Batch	Analyte	Result	PQL	MDL	Flag	DVAL
B0712148	626854 MB	B0712148-01A	6010B	75946	Lithium	0.087	0.1	0.00072	ND	JMS
B0712148	626854 Ash in Spoil Water	B0712148-02A	6010B	75946	Potassium	15	1	0.31		JMS
B0712148	626854 Spoil in Ash Water	B0712148-03A	6010B	75946	Chromium	0.012	0.01	0.0018		JRL
B0801027	MB	B0801027-01A	6010B	76368	Aluminum	0.058	0.05	0.014		JRL
B0801027	MB	B0801027-01A	6010B	76368	Barium	0.088	0.01	0.00016		JE
B0801027	MB	B0801027-01A	6010B	76368	Boron	0.35	0.05	0.0018		JE
B0801027	MB	B0801027-01A	6010B	76368	Calcium	2.4	0.1	0.013		JE
B0801027	4 Corners PP Bottom Ash Leachate	B0801027-02A	6010B	76368	Barium	0.13	0.01	0.00016		JE
B0801027	4 Corners PP Bottom Ash Leachate	B0801027-02A	6010B	76368	Cadmium	-0.003	0.006	0.00051	ND	JE
B0801027	4 Corners PP Bottom Ash Leachate	B0801027-02A	6010B	76368	Iron	0.054	0.05	0.0027		JRL
B0801027	4 Corners PP Bottom Ash Leachate	B0801027-02A	6010B	76368	Magnesium	1.3	0.1	0.012		JE
B0801027	4 Corners PP Bottom Ash Leachate	B0801027-02A	6010B	76368	Potassium	11	1	0.31		JMS
B0801191	MB 45 day	B0801191-01A	6010B	76966	Barium	0.081	0.01	0.00016		JE
B0801191	MB 45 day	B0801191-01A	6010B	76966	Boron	0.32	0.05	0.0018		JE
B0801191	MB 45 day	B0801191-01A	6010B	76966	Calcium	3	0.1	0.013		JE
B0801191	MB 45 day	B0801191-01A	6010B	76966	Molybdenum	0.013	0.01	0.0018		JRL
B0801191	MB 45 day	B0801191-01A	6010B	76966	Zinc	0.0053	0.005	0.001		JRL
B0801191	Ash Composite 45 day	B0801191-02A	6010B	76966	Iron	0.071	0.05	0.0027		JRL
B0801191	Spoil Composite 45 day	B0801191-03A	6010B	76966	Molybdenum	0.015	0.01	0.0018		JRL
B0801191	Spoil Composite 45 day	B0801191-03A	6010B	76966	Zinc	-0.009	0.005	0.001	ND	JRL
B0801191	MB SPLP	B0801191-04A	6010B	76966	Zinc	-0.015	0.005	0.001	ND	JRL
B0801191	Ash Composite SPLP	B0801191-05A	6010B	76966	Zinc	-0.015	0.005	0.001	ND	JRL
B0801191	Spoil Composite SPLP	B0801191-06A	6010B	76966	Zinc	-0.02	0.005	0.001	ND	JRL
B0801191	Spoil Composite SPLP	B0801191-06B	300	77039	Chloride	1.5	0.8	0.042		JE

SDG	Sample	Lab ID	Method	Batch	Analyte	Result	PQL	MDL	Flag	DVAL
B0801197	MB Successive #1	B0801197-01A	6010B	77023	Aluminum	0.063	0.05	0.014		JRL
B0801197	MB Successive #1	B0801197-01A	6010B	77023	Barium	0.085	0.01	0.00016		JE
B0801197	MB Successive #1	B0801197-01A	6010B	77023	Boron	0.31	0.05	0.0018		JE
B0801197	MB Successive #1	B0801197-01A	6010B	77023	Calcium	3.2	0.1	0.013		JE
B0801197	MB Successive #1	B0801197-01A	6010B	77023	Molybdenum	0.016	0.01	0.0018		JRL
B0801197	MB Successive #1	B0801197-01A	6010B	77023	Zinc	-0.014	0.005	0.001	ND	R
B0801197	Ash Successive #1	B0801197-02A	6010B	77023	Aluminum	0.065	0.05	0.014		JRL
B0801197	Ash Successive #1	B0801197-02A	6010B	77023	Molybdenum	0.019	0.01	0.0018		JRL
B0801197	Ash Successive #1	B0801197-02A	6010B	77023	Zinc	-0.014	0.005	0.001	ND	R
B0801210	MB Successive #2	B0801210-01A	6010B	77211	Barium	0.089	0.01	0.00016		JE
B0801210	MB Successive #2	B0801210-01A	6010B	77211	Boron	0.31	0.05	0.0018		JE
B0801210	MB Successive #2	B0801210-01A	6010B	77211	Calcium	3	0.1	0.013		JE
B0801210	MB Successive #2	B0801210-01A	6010B	77211	Aluminum	0.051	0.05	0.014		JRL
B0801210	Ash Successive #2	B0801210-02A	6010B	77211	Cadmium	-0.002	0.006	0.00051	ND	JMS
B0801210	Ash Successive #2	B0801210-02A	6010B	77211	Zinc	0.0081	0.005	0.001		JRL
B0801210	MB Successive #3	B0801210-03A	6010B	77211	Barium	0.089	0.01	0.00016		JE
B0801210	MB Successive #3	B0801210-03A	6010B	77211	Boron	0.32	0.05	0.0018		JE
B0801210	MB Successive #3	B0801210-03A	6010B	77211	Calcium	3	0.1	0.013		JE
B0801210	MB Successive #3	B0801210-03A	6010B	77211	Iron	0.051	0.05	0.0027		JRL
B0801210	Ash Successive #3	B0801210-04A	6010B	77211	Boron	0.34	0.05	0.0018		JMS
B0801210	Ash Successive	B0801210-04A	6010B	77211	Cadmium	-0.001	0.006	0.00051	ND	JMS

SDG	Sample	Lab ID	Method	Batch	Analyte	Result	PQL	MDL	Flag	DVAL
	#3									
B0801210	Ash Successive #3	B0801210-04A	6010B	77211	Magnesium	1.9	0.1	0.012		JE
B0801210	Ash Successive #3	B0801210-04A	6010B	77211	Potassium	12	1	0.31		JMS
B0801210	Ash Successive #3	B0801210-04A	6010B	77211	Sodium	1300	3	0.028		JE

References

1. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, OSWER 9240.1-45 EPA 540-R-04-004 October 2004
2. USEPA SW-846, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods"

Attachment 41.A.C

Rietveld X-ray Diffraction Laboratory Results

QUANTITATIVE PHASE ANALYSIS OF TWO POWDER SAMPLES USING THE RIETVELD METHOD AND X-RAY POWDER DIFFRACTION DATA.

Project: NavajoMine Extension Leaching Study – P.O. 62651

Art O'Hayre, Ph.D
NORWEST Applied Hydrology USA
950 S. Cherry St., Suite 810
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Mati Raudsepp, Ph.D.
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Dept. of Earth & Ocean Sciences
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January 18, 2008

EXPERIMENTAL METHODS

The six samples from Project Navajo Mine were reduced to the optimum grain-size range for quantitative X-ray analysis (<5 μm) by grinding under ethanol in a vibratory McCrone Micronising Mill for 7 minutes. Fine grain-size is an important factor in reducing micro-absorption contrast between phases.

Step-scan X-ray powder-diffraction data were collected over a range 3-80°2θ with CoKα radiation on a standard Siemens (Bruker) D5000 Bragg-Brentano diffractometer equipped with an Fe monochromator foil, 0.6 mm (0.3°) divergence slit, incident- and diffracted-beam Soller slits and a Vantec-1 strip detector. The long fine-focus Co X-ray tube was operated at 35 kV and 40 mA, using a take-off angle of 6°.

RESULTS

The X-ray diffractograms were analyzed using the International Centre for Diffraction Database PDF-4 using Search-Match software by Siemens (Bruker). X-ray powder-diffraction data were refined with Rietveld program Topas 3 (Bruker AXS). The results of quantitative phase analysis by Rietveld refinements are given in Table 1. These amounts represent the relative amounts of crystalline phases normalized to 100%. The Rietveld refinement plots are shown in Figures 1-6.

The patterns of the three “Spoil” samples show a hump between about 6 and 10º2θ that likely corresponds to either amorphous or nanoscale material (disordered clays?) we cannot identify. Therefore, the related results must be considerate approximate.

Table 1. Results of quantitative phase analysis (wt. %) – NORWEST Applied Hydrology - Project Navajo Mine

Mineral	**Ideal formula**	**BR3* Composite Spoil A**	**BR3* Composite Spoil B**	**BR3* Composite Spoil C**	**Ash Composite 70% FA**	**Ash Composite DUP 1 70%FA**	**Ash Composite DUP 2 70%FA**
Quartz	SiO_2	36.5	35.4	35.4	21.3	26.3	24.8
Plagioclase	$NaAlSi_3O_8 – CaAl_2Si_2O_8$	10.3	10.1	10.1			
K-feldspar	$KAlSi_3O_8$	6.0	6.5	7.0			
Kaolinite	$Al_2Si_2O_5(OH)_4$	40.8	40.8	40.6			
Gypsum	$CaSO_4 \cdot 2H_2O$	2.6	3.1	2.8	50.1	38.5	45.2
Anhydrite	$CaSO_4$	0.9	1.0	1.1			
Calcite	$CaCO_3$	2.9	3.1	2.9	1.8	1.4	
Dolomite	$CaMg(CO_3)_2$				3.4	1.8	
Mullite	$Al_6Si_2O_{13}$				23.4	29.5	30.0
Magnetite	Fe_3O_4					2.4	
Total		100.0	100.0	100.0	100.0	100.0	100.0

*** Semi-quantitative results**

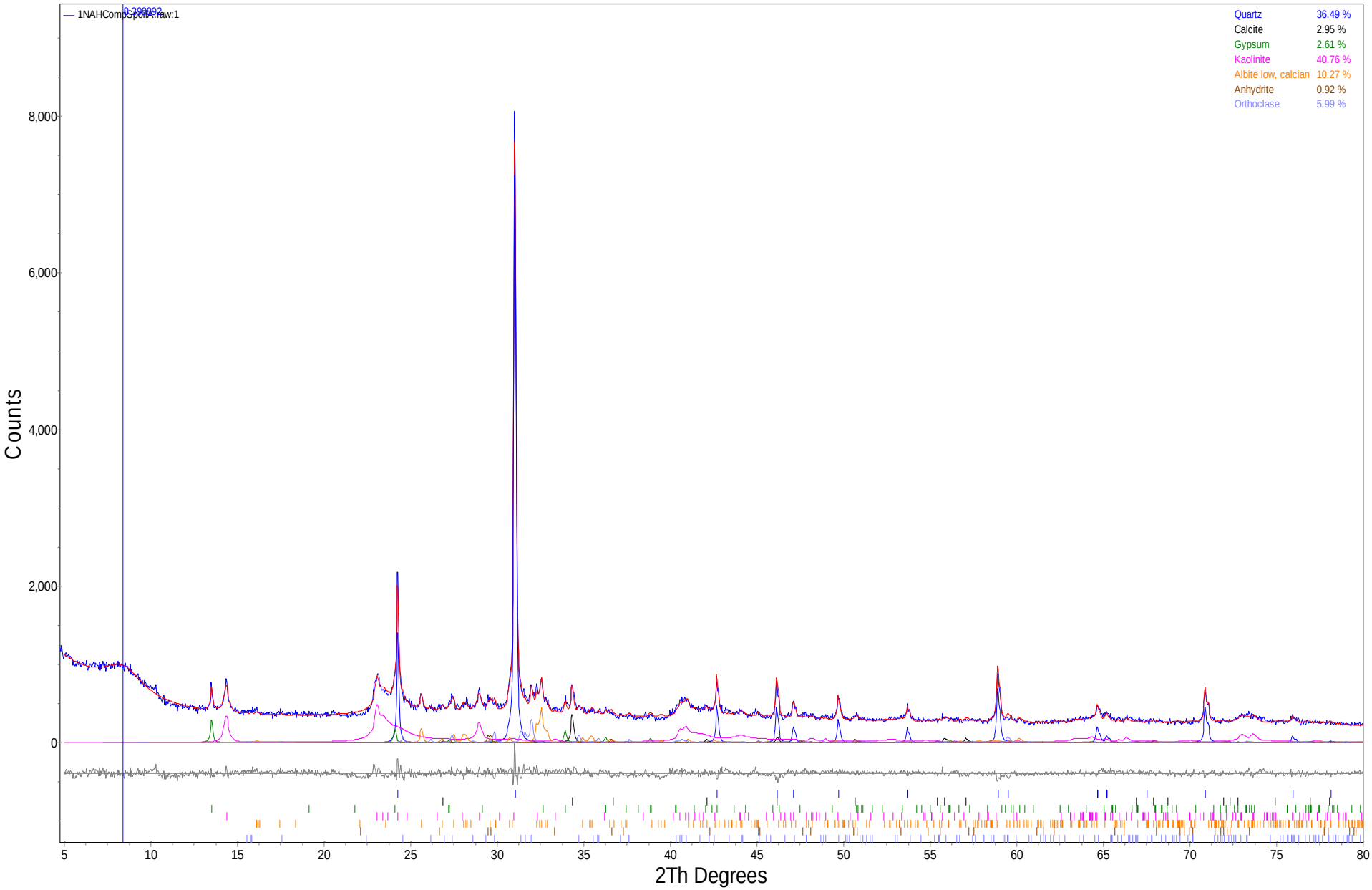


Figure 1. Rietveld refinement plot of sample **Norwest B.R.Composite Spoil A** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

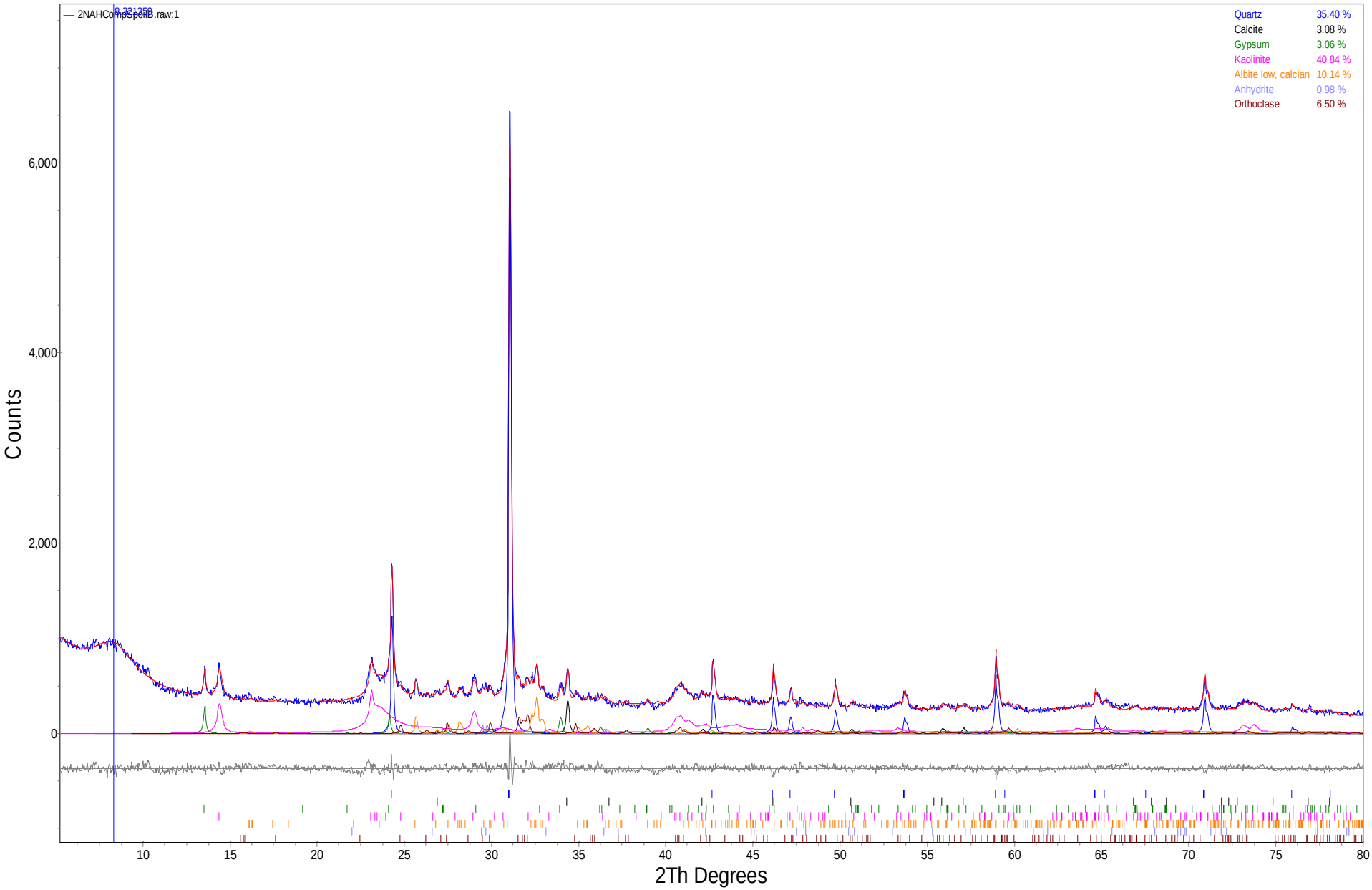


Figure 2. Rietveld refinement plot of sample **Norwest B.R. Composite Spoil B** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

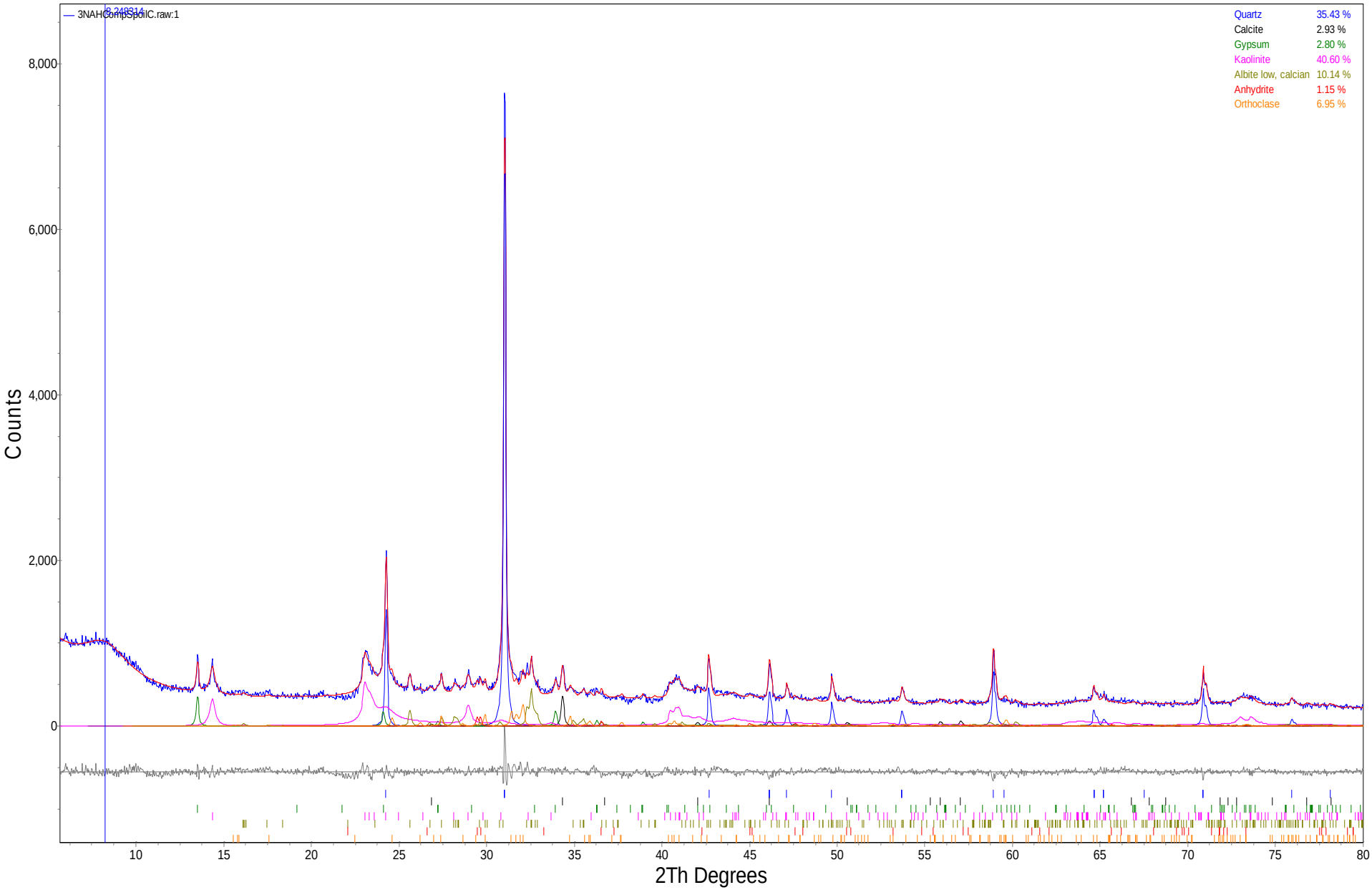


Figure 3. Rietveld refinement plot of sample **Norwest B.R. Composite Spoil C** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

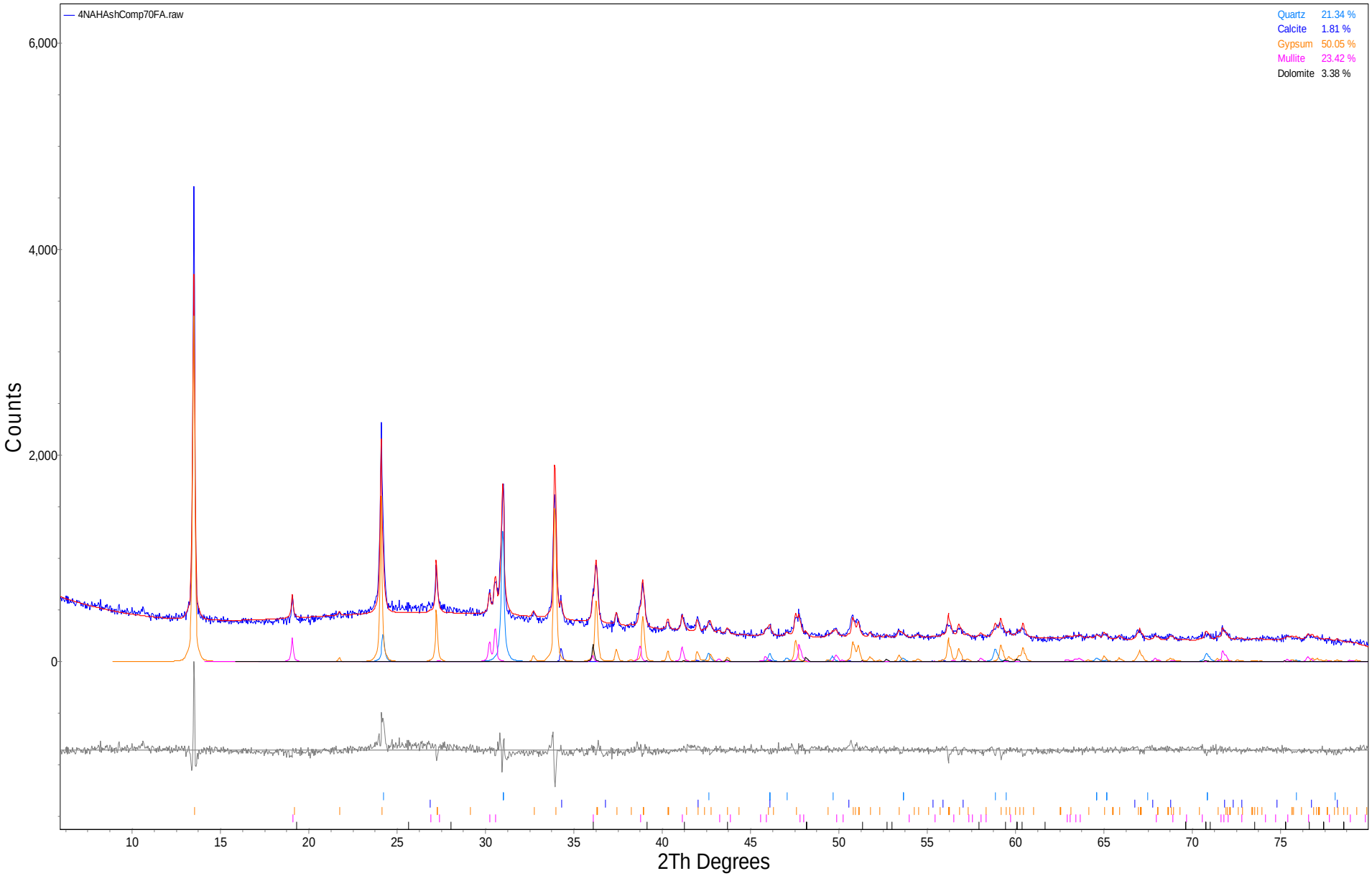


Figure 4. Rietveld refinement plot of sample **Norwest Ash Composite 70% FA** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

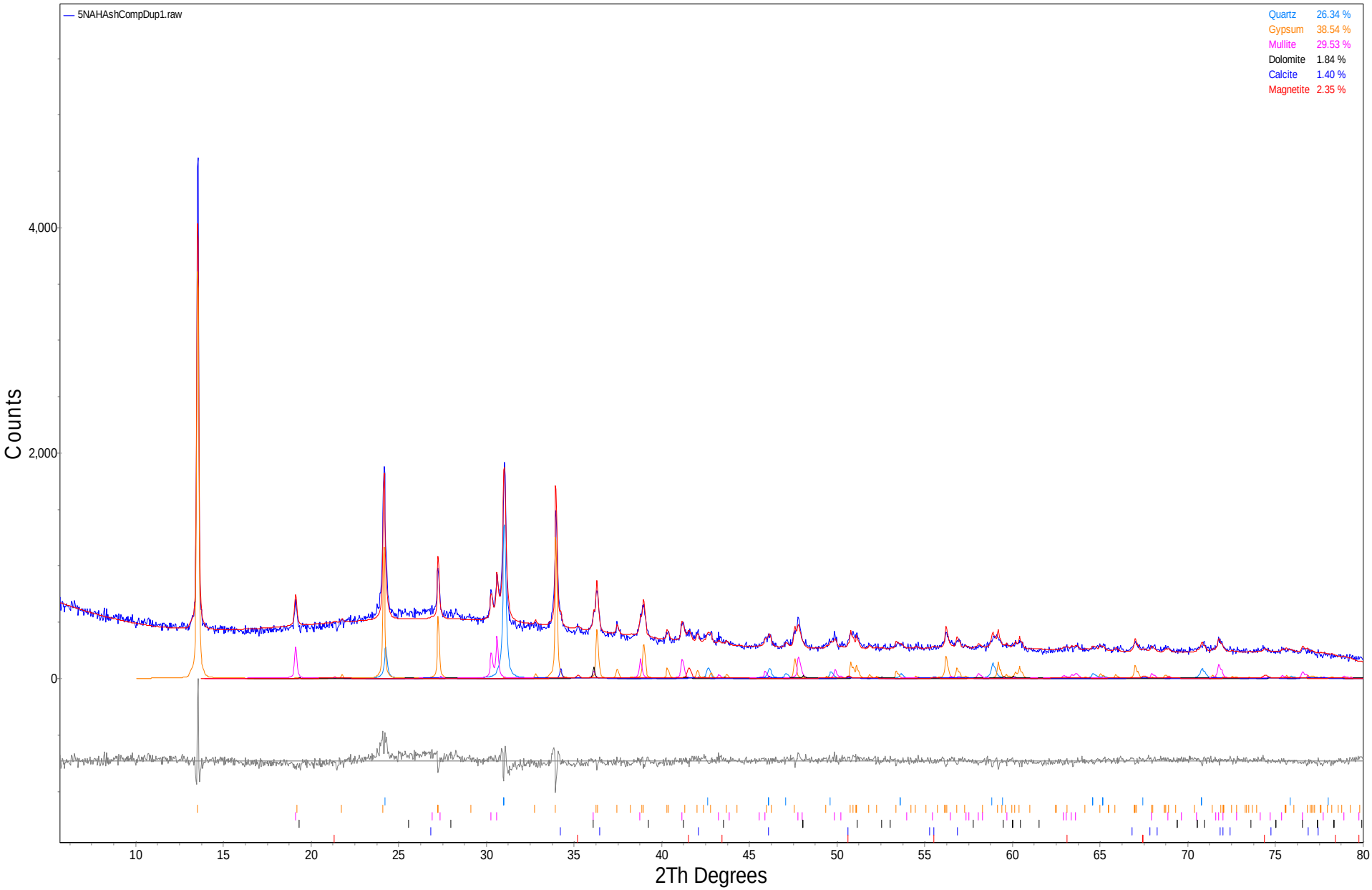


Figure 5. Rietveld refinement plot of sample **Norwest Ash Composite DUP 1 70% FA** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

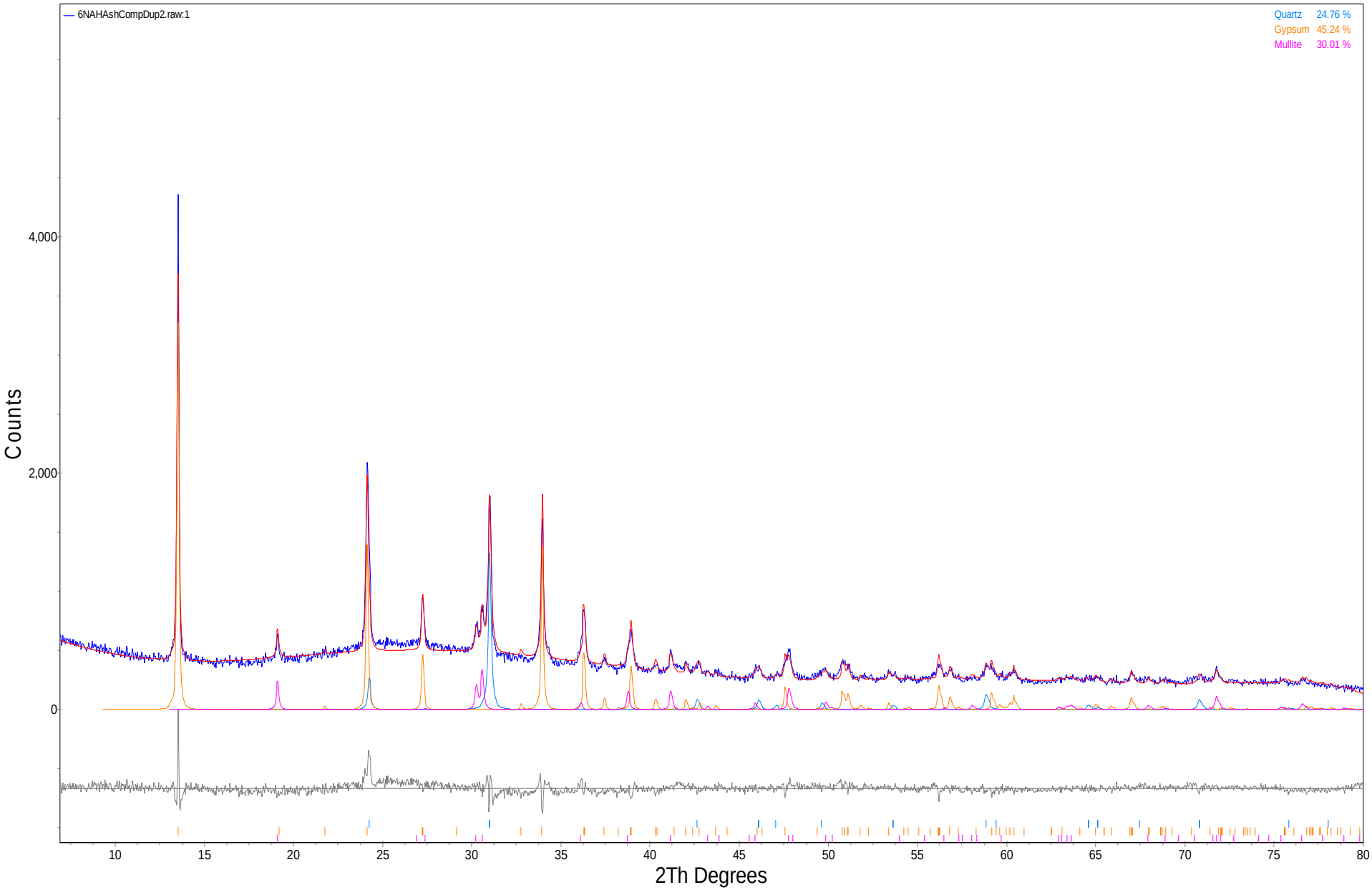


Figure 6. Rietveld refinement plot of sample **Norwest Ash Composite DUP 2 70% FA** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

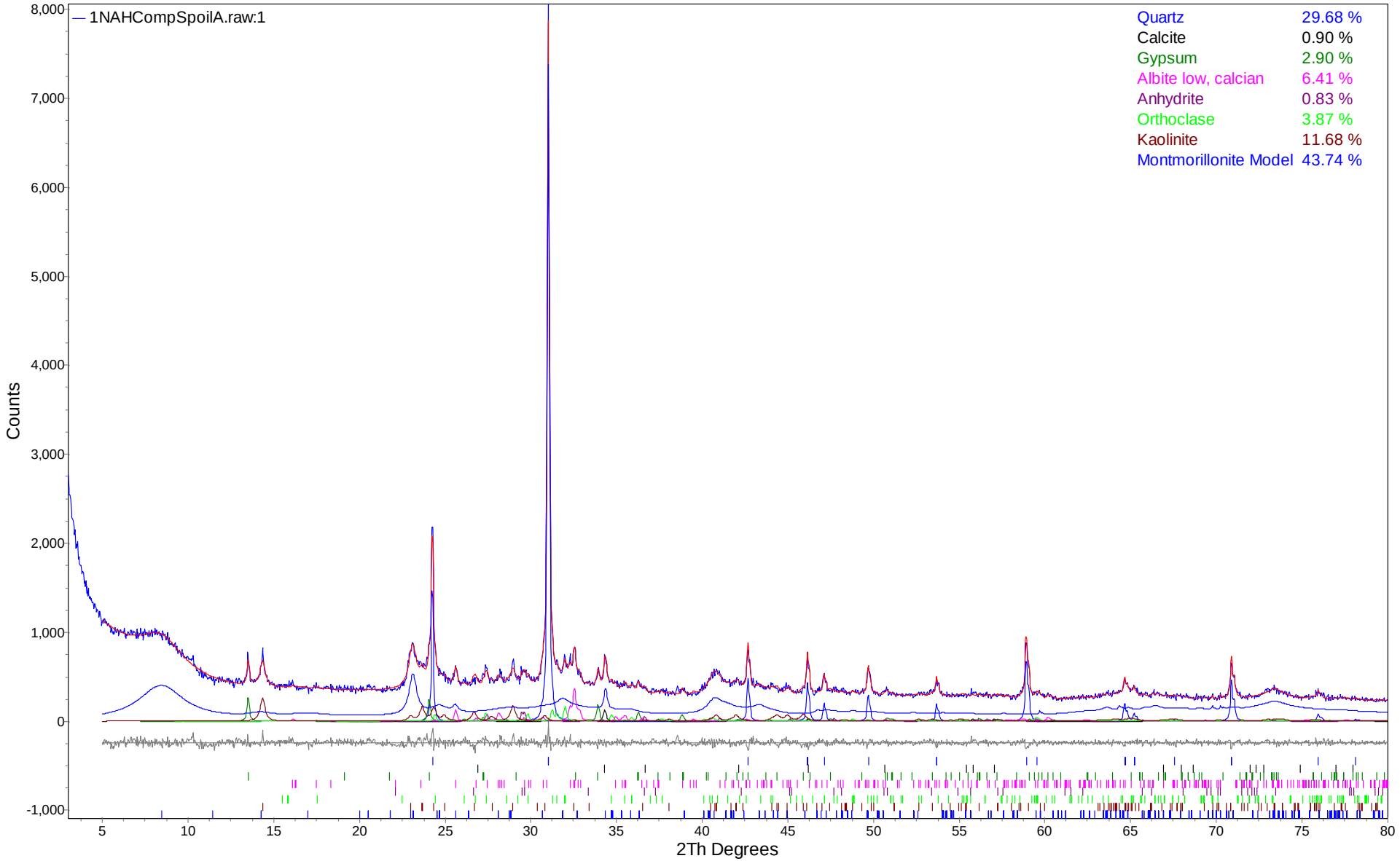


Figure 1. Rietveld refinement plot of sample **Norwest B.R.Composite Spoil A** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

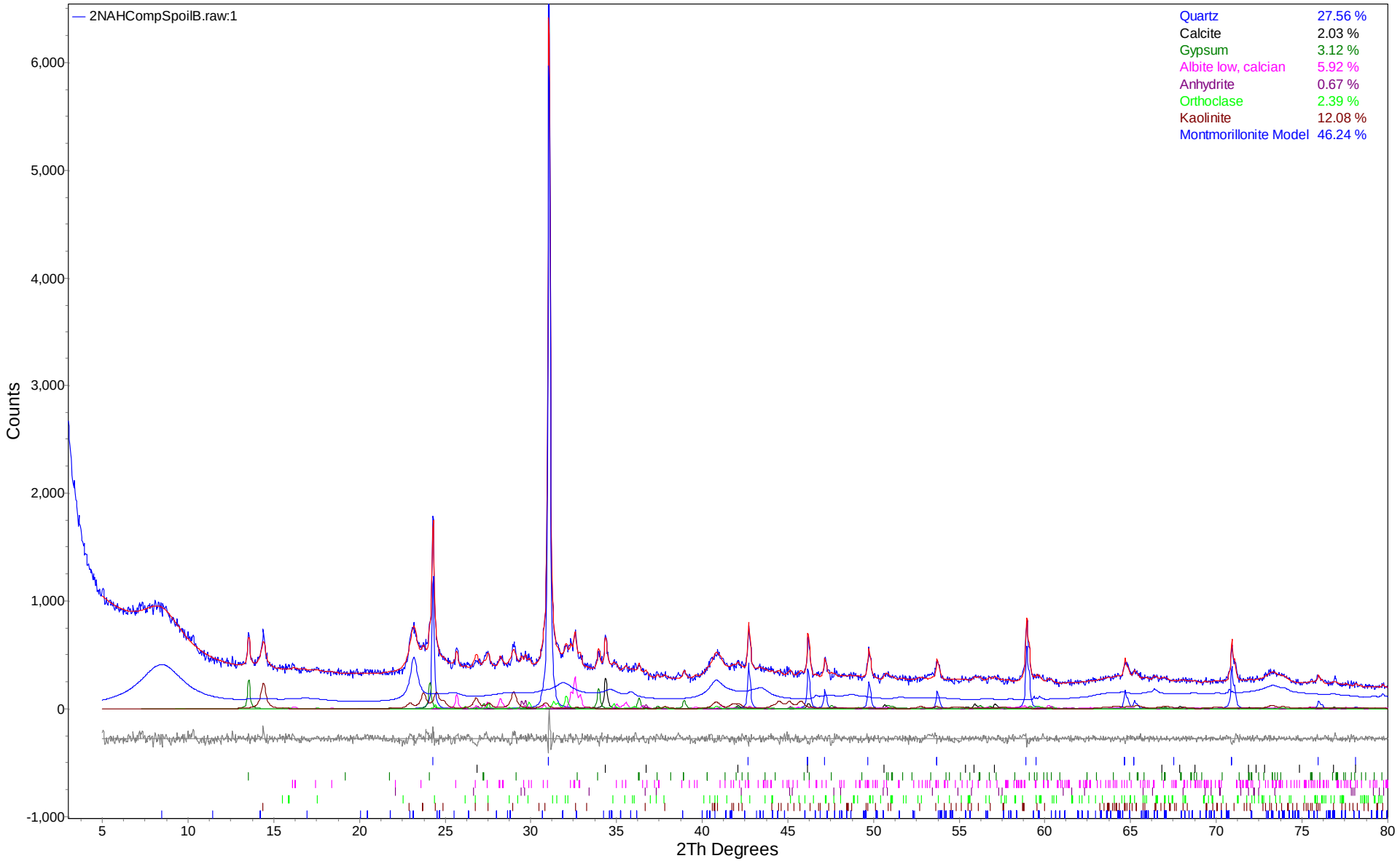


Figure 2. Rietveld refinement plot of sample **Norwest B.R. Composite Spoil B** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

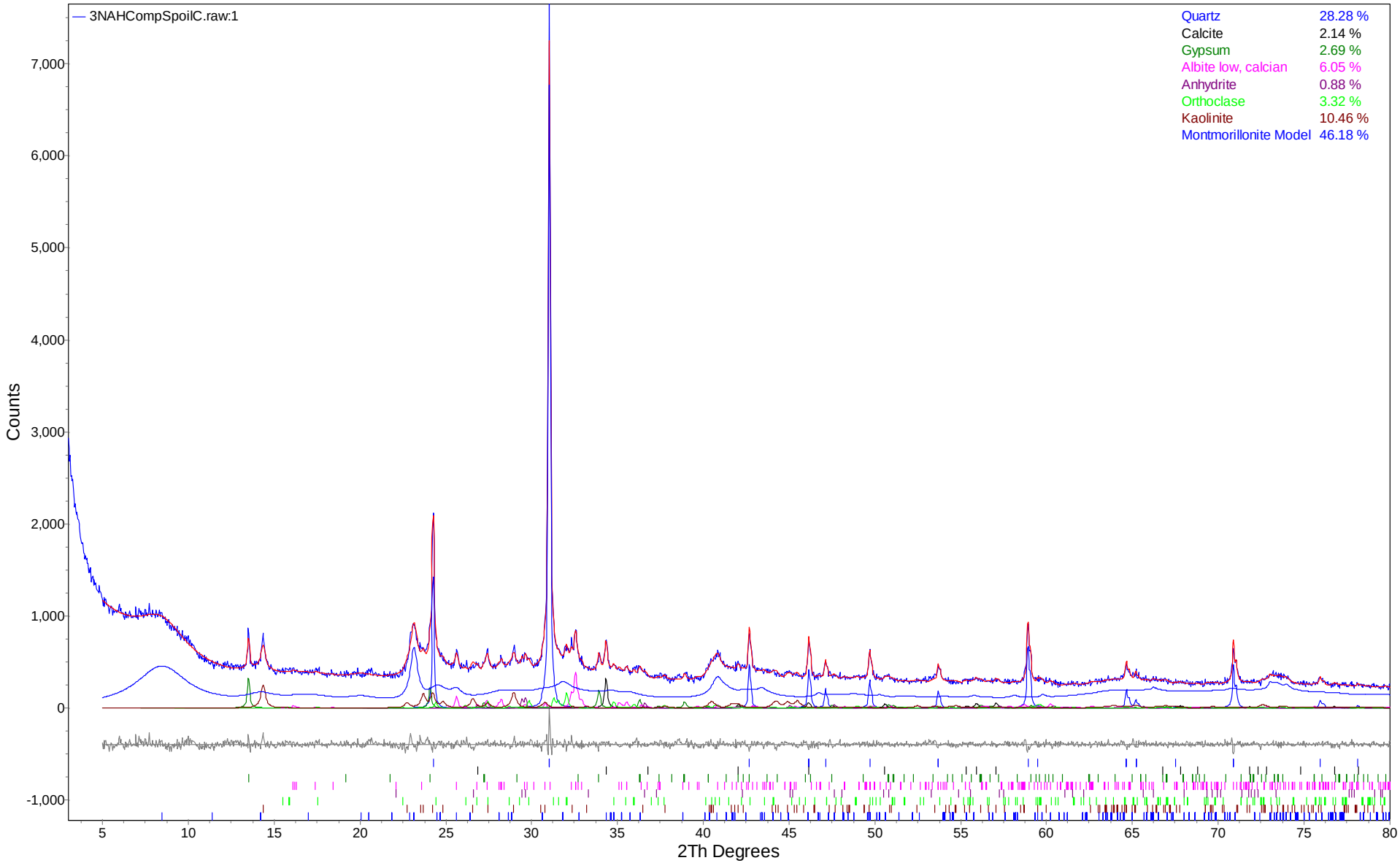


Figure 3. Rietveld refinement plot of sample **Norwest B.R. Composite Spoil C** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars, positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

Attachment 41.A.D

Total Analyses Laboratory Results

ANALYTICA
Environmental Laboratories

Analytica Environmental
Laboratories, Inc.
12189 Pennsylvania Street
Thornton, CO 80241
Phone: 303-469-8868
Fax: 303-469-5254

12/11/2007

Applied Hydrology Associates, Inc.
950 South Cherry Street
Suite 810
Denver, CO 80246
Attn: Art O'Hayre

Work Order #: B0711172
Date: 12/11/2007
Work ID: Navajo Mine Extension Leaching Study
Date Received: 11/21/2007

Sample Identification

Lab Sample Number	Client Description	Lab Sample Number	Client Description
B0711172-01	KF2007-01(58) and KF-98-02(5	B0711172-02	123 S 87W 0-4' SPOIL
B0711172-03	123 S 89W 0-4' SPOIL	B0711172-04	125 S 88W 0-4' SPOIL
B0711172-05	120 S 89W 0-4' SPOIL	B0711172-06	Barber Ramp 3 Composite Spoi
B0711172-07	Barber Ramp 3 Composite Spoi	B0711172-08	Barber Ramp 3 Composite Spoi
B0711172-09	Ash Composite 70% FA	B0711172-10	Ash Composite Dup 1 70% FA
B0711172-11	Ash Composite Dup2 70% FA	B0711172-12	KF2007-01(58) DUP and KF-98

Enclosed are the analytical results for the submitted sample(s). Please review the CASE NARRATIVE for a discussion of any data and/or quality control issues. Listings of data qualifiers, analytical codes, key dates, and QC relationships are provided at the end of the report.

Sincerely,

Claire Toon
Project Manager

"The Science of Analysis, The Art of Service"

Case Narrative

Analytica Environmental Laboratories, Inc.

Work Order: B0711172

Samples were prepared and analyzed according to EPA or equivalent methods outlined in the following references:

Methods for Chemical Analysis of Water and Wastes, USEPA 600/4-79-020, March 1983.

Standard Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D 2216-80, July 1980.

Pfaff, J. D., C. A. Brockhoff and J. W. O'Dell. 1994. The Determination of Inorganic Anions in Water by Ion Chromatography. Method 300.0A. U. S. Environmental Protection Agency. Environmental Monitoring Systems Lab.

Test Methods for Evaluating Solid Waste, USEPA SW-846, Third Edition,Revision 4,December 1996.

SAMPLE RECEIPT:
Twelve (12) samples were received on 11/21/2007 11:17:00 AM, at a temperature of 20 deg C., at Analytica-Thornton. The samples were received in good condition and in order per chain of custody.

REVIEW FOR COMPLIANCE WITH ANALYTICA QA PLAN
A summary of our review is shown below, organized by test:

Test Method: 150.1 - pH, Elecrometric - pH - Aqueous

HOLDING TIMES:
The method specified holding time was waived, per client request.

HOLD TIMES MISSED:
Sample KF2007-01(58) and KF-98-02(53),B0711172-01B
Sampled: 11/15/2007 4:30:00 PM, Prepped: 11/28/2007
Regulatory hold time: 24 Hrs
Sample KF2007-01(58) DUP and KF-98-02(53)DUP,B0711172-12B
Sampled: 11/15/2007 4:30:00 PM, Prepped: 11/28/2007
Regulatory hold time: 24 Hrs
Sample DUP,B0711172-01B-DUP
Sampled: 11/15/2007 4:30:00 PM, Prepped: 11/28/2007
Regulatory hold time: 24 Hrs

SAMPLE PREPARATION ISSUES AND OBSERVATIONS:
There were no unusual observations.

INITIAL CALIBRATIONS:
Initial calibrations were within method criteria.

OPENING CONTINUING CALIBRATIONS:
Opening continuing calibrations were within method criteria.

CLOSING CONTINUING CALIBRATIONS:
Closing continuing calibrations were within method criteria or not applicable.

METHOD BLANK OUTLIERS:
There are no method blank outliers.

Case Narrative

Analytica Environmental Laboratories, Inc.
Work Order: B0711172
(continued)

LCS OUTLIERS:
There are no LCS outliers.

MS/MSD and DUP OUTLIERS:
There are no MS/MSD or DUP outliers.

Test Method: 160.1 - Total Dissolved Solids dried at 180°C - TDS - Aqueous

HOLDING TIMES:
The method specified holding time was waived, per client request.

HOLD TIMES MISSED:
Sample KF2007-01(58) and KF-98-02(53),B0711172-01B
Sampled: 11/15/2007 4:30:00 PM, Prepped: 11/29/2007
Regulatory hold time: 7 Days
Sample KF2007-01(58) DUP and KF-98-02(53)DUP,B0711172-12B
Sampled: 11/15/2007 4:30:00 PM, Prepped: 11/29/2007
Regulatory hold time: 7 Days
Sample DUP,B0711172-01B-DUP
Sampled: 11/15/2007 4:30:00 PM, Prepped: 11/29/2007
Regulatory hold time: 7 Days
Sample MS,B0711172-01B-MS
Sampled: 11/15/2007 4:30:00 PM, Prepped: 11/29/2007
Regulatory hold time: 7 Days

SAMPLE PREPARATION ISSUES AND OBSERVATIONS:
There were no unusual observations.

METHOD BLANK OUTLIERS:
There are no method blank outliers.

LCS OUTLIERS:
There are no LCS outliers.

MS/MSD and DUP OUTLIERS:
There are no MS/MSD or DUP outliers.

Test Method: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity - Aqueous

HOLDING TIMES:
Holding times were met for this test.

SAMPLE PREPARATION ISSUES AND OBSERVATIONS:
There were no unusual observations.

METHOD BLANK OUTLIERS:
There are no method blank outliers.

LCS OUTLIERS:
There are no LCS outliers.

MS/MSD and DUP OUTLIERS:

Case Narrative

Analytica Environmental Laboratories, Inc.
Work Order: B0711172
(continued)

MS/MSD and DUP OUTLIERS:
There are no MS/MSD or DUP outliers.

Test Method: ASTM D2216 - Pmoist - Solid

All method criteria were met for this test.

Test Method: Inorganic Anions by Ion Chromatography - Anions by IC - Aqueous

HOLDING TIMES:
Holding times were met for this test.

SAMPLE PREPARATION ISSUES AND OBSERVATIONS:
There were no unusual observations.

INSTRUMENT PERFORMANCE CHECKS:
Instrument checks were within method criteria.

INITIAL CALIBRATIONS:
Initial calibrations were within method criteria.

OPENING CONTINUING CALIBRATIONS:
Opening continuing calibrations were within method criteria.

CLOSING CONTINUING CALIBRATIONS:
Closing continuing calibrations were within method criteria or not applicable.

METHOD BLANK OUTLIERS:
There are no method blank outliers.

LCS OUTLIERS:
There are no LCS outliers.

MS/MSD and DUP OUTLIERS:
There are no MS/MSD or DUP outliers.

Test Method: SW6010B - ICP - Total - Aqueous

HOLDING TIMES:
Holding times were met for this test.

SAMPLE PREPARATION ISSUES AND OBSERVATIONS:
There were no unusual observations.

INSTRUMENT PERFORMANCE CHECKS:
Instrument checks were within method criteria.

INITIAL CALIBRATIONS:
Initial calibrations were within method criteria.

OPENING CONTINUING CALIBRATIONS:
Opening continuing calibrations were within method criteria.

Case Narrative

Analytica Environmental Laboratories, Inc.
Work Order: B0711172
(continued)

CLOSING CONTINUING CALIBRATIONS:
Closing continuing calibrations were within method criteria or not applicable.

METHOD BLANK OUTLIERS:
There are no method blank outliers.

LCS OUTLIERS:
There are no LCS outliers.

MS/MSD and DUP OUTLIERS:
Copper and zinc were recovered out of limits in the batch Matrix Spike. However, the spiked sample is not associated with this project.

Test Method: SW6010B - ICP - Total - Solid

HOLDING TIMES:
Holding times were met for this test.

SAMPLE PREPARATION ISSUES AND OBSERVATIONS:
There were no unusual observations.

INSTRUMENT PERFORMANCE CHECKS:
Instrument checks were within method criteria.

INITIAL CALIBRATIONS:
Initial calibrations were within method criteria.

OPENING CONTINUING CALIBRATIONS:
Opening continuing calibrations were within method criteria.

CLOSING CONTINUING CALIBRATIONS:
Closing continuing calibrations were within method criteria or not applicable.

METHOD BLANK OUTLIERS:
There are no method blank outliers.

LCS OUTLIERS:
There are no LCS outliers.

MS/MSD and DUP OUTLIERS:
Several targets were recovered outside the acceptance limits in the MS/MSD shown below. The sample had target concentrations of Aluminum, Calcium, Iron and Sodium greater than four times the spike amounts. In these cases it is not appropriate to calculate recoveries. The results should be used as replicates. Recoveries for Antimony, Thallium and Magnesium were affected by matrix interference.

Type	Client Sample	LabSample	Analyte	Recovery	LCL	UCL	Parent	Spike
MS	120 S 89W 0-4' S	B0711172-05A	Aluminum	2200	70	130	9240	192
MS	120 S 89W 0-4' S	B0711172-05A	Calcium	-166	70	130	27500	958
MS	120 S 89W 0-4' S	B0711172-05A	Iron	-417	70	130	19200	95.8
MS	120 S 89W 0-4' S	B0711172-05A	Sodium	65.1	70	130	4090	958
MS	120 S 89W 0-4' S	B0711172-05A	Antimony	41.1	70	130	0.389	47.9

Case Narrative

Analytica Environmental Laboratories, Inc.
Work Order: B0711172
(continued)

MS 120 S 89W 0-4' S B0711172-05A	Antimony	41.1	70	130	0.389	47.9
MSD 120 S 89W 0-4' S B0711172-05A	Aluminum	2360	70	130	9240	191
MSD 120 S 89W 0-4' S B0711172-05A	Antimony	39.0	70	130	0.389	47.8
MSD 120 S 89W 0-4' S B0711172-05A	Calcium	-165	70	130	27500	955
MSD 120 S 89W 0-4' S B0711172-05A	Iron	1070	70	130	19200	95.5
MSD 120 S 89W 0-4' S B0711172-05A	Thallium	63.3	70	130	-3.40	19.1
MSD 120 S 89W 0-4' S B0711172-05A	Magnesium	151	70	130	3160	955

Test Method: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg - Aqueous

HOLDING TIMES:
Holding times were met for this test.

SAMPLE PREPARATION ISSUES AND OBSERVATIONS:
There were no unusual observations.

INSTRUMENT PERFORMANCE CHECKS:
Instrument checks were within method criteria.

INITIAL CALIBRATIONS:
Initial calibrations were within method criteria.

OPENING CONTINUING CALIBRATIONS:
Opening continuing calibrations were within method criteria.

CLOSING CONTINUING CALIBRATIONS:
Closing continuing calibrations were within method criteria or not applicable.

METHOD BLANK OUTLIERS:
There are no method blank outliers.

LCS OUTLIERS:
There are no LCS outliers.

MS/MSD and DUP OUTLIERS:
There are no MS/MSD or DUP outliers.

Test Method: SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Total Hg - Solid

HOLDING TIMES:
Holding times were met for this test.

SAMPLE PREPARATION ISSUES AND OBSERVATIONS:
There were no unusual observations.

INSTRUMENT PERFORMANCE CHECKS:
Instrument checks were within method criteria.

INITIAL CALIBRATIONS:
Initial calibrations were within method criteria.

OPENING CONTINUING CALIBRATIONS:
Opening continuing calibrations were within method criteria.

Case Narrative

Analytica Environmental Laboratories, Inc.
Work Order: B0711172
(continued)

Opening continuing calibrations were within method criteria.

CLOSING CONTINUING CALIBRATIONS:
Closing continuing calibrations were within method criteria or not applicable.

METHOD BLANK OUTLIERS:
There are no method blank outliers.

LCS OUTLIERS:
There are no LCS outliers.

MS/MSD and DUP OUTLIERS:
There are no MS/MSD or DUP outliers.

The samples were subcontracted for Cation Exchange Capacity analysis to Colorado Analytical Laboratory, 240 South Main Street, Brighton, CO, 80601. Please refer to the attached CAL report for results.

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **KF2007-01(58) and KF-98-02(53)**

Matrix: Aqueous Collection Date: 11/15/2007 4:30:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-01A
Prep Date: 11/30/2007
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T071130013
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 11/30/2007 4:07:17PM
Instrument: CVAA_1
File Name: B113007W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	ND		mg/L	0.00020	0.000050	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-01A
Prep Date: 12/3/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T071203011
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 12/3/2007 6:01:00PM
Instrument: ICP_2
File Name: E12037A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.13**		mg/L	0.050	0.014	1
Antimony	7440-36-0	ND		mg/L	0.050	0.0067	
Arsenic	7440-38-2	ND		mg/L	0.10	0.015	
Barium	7440-39-3	**0.093**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	ND		mg/L	0.0010	0.000060	
Cadmium	7440-43-9	ND		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**3.4**		mg/L	0.10	0.013	
Chromium	7440-47-3	ND		mg/L	0.010	0.0018	
Cobalt	7440-48-4	ND		mg/L	0.0050	0.0016	
Copper	7440-50-8	ND		mg/L	0.0050	0.0019	
Iron	7439-89-6	**0.067**		mg/L	0.050	0.0027	
Lead	7439-92-1	ND		mg/L	0.050	0.011	
Lithium	7439-93-2	ND		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**1.3**		mg/L	0.10	0.012	
Manganese	7439-96-5	ND		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.012**		mg/L	0.010	0.0018	
Nickel	7440-02-0	ND		mg/L	0.040	0.0027	
Potassium	7440-09-7	**11**		mg/L	1.0	0.31	
Selenium	7784-49-2	ND		mg/L	0.10	0.026	
Silver	7440-22-4	ND		mg/L	0.015	0.00066	
Sodium	7440-23-5	**1,200**		mg/L	3.0	0.028	
Thallium	7440-28-0	ND		mg/L	0.40	0.011	
Vanadium	7440-62-2	ND		mg/L	0.010	0.00072	

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **KF2007-01(58) and KF-98-02(53)**

Matrix: Aqueous Collection Date: 11/15/2007 4:30:00PM

Lab Sample Number:	B0711172-01A	Analysis Date:	12/3/2007 6:01:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3010_ICP	Dilution Factor:	1
Prep Batch Number:	T071203011		
Report Basis:	As Received	Analyst Initials:	rm
Sample prep wt./vol:	50.00 ml	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	ND		mg/L	0.0050	0.0010	1

Lab Sample Number:	B0711172-01A	Analysis Date:	12/4/2007 5:19:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12047A
Prep Method ID:	3010_ICP	Dilution Factor:	1
Prep Batch Number:	T071203011		
Report Basis:	As Received	Analyst Initials:	rm
Sample prep wt./vol:	50.00 ml	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Boron	7440-42-8	**0.31**		mg/L	0.050	0.0018	2

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **123 S 87W 0-4' SPOIL**

Matrix: Solid Collection Date: 11/15/2007 12:00:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	B0711172-02A	Analysis Date:	12/4/2007 3:25:10PM
Prep Date:	12/4/2007	Instrument:	CVAA_1
Analytical Method ID:	SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Total H	File Name:	B120407S.WK
Prep Method ID:	7471A	Dilution Factor:	1
Prep Batch Number:	T071204013	Percent Moisture	7.06
Report Basis:	Dry Weight Basis	Analyst Initials:	DL
Sample prep wt./vol:	0.67 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**0.12**		mg/Kg	0.040	0.0055	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	B0711172-02A	Analysis Date:	12/3/2007 1:27:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	7.06
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.60 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**9,700**		mg/Kg	7.1	1.8	1
Antimony	7440-36-0	ND		mg/Kg	9.8	0.55	
Arsenic	7440-38-2	ND		mg/Kg	12	1.6	
Barium	7440-39-3	**150**		mg/Kg	0.36	0.028	
Beryllium	7440-41-7	**1.0**		mg/Kg	0.18	0.0079	
Boron	7440-42-8	**13**		mg/Kg	4.5	0.60	
Cadmium	7440-43-9	**0.74**		mg/Kg	0.71	0.051	
Calcium	7440-70-2	**14,000**		mg/Kg	12	4.8	
Chromium	7440-47-3	**6.7**		mg/Kg	1.8	0.26	
Cobalt	7440-48-4	**12**		mg/Kg	2.7	0.23	
Copper	7440-50-8	**28**		mg/Kg	0.54	0.14	
Iron	7439-89-6	**22,000**		mg/Kg	5.4	0.39	
Lead	7439-92-1	**17**		mg/Kg	5.4	0.94	
Magnesium	7439-96-4	**3,100**		mg/Kg	8.9	0.85	
Manganese	7439-96-5	**360**		mg/Kg	0.89	0.099	
Molybdenum	7439-98-7	ND		mg/Kg	1.8	0.21	
Nickel	7440-02-0	**15**		mg/Kg	3.6	0.38	
Potassium	7440-09-7	**1,800**		mg/Kg	89	28	
Selenium	7784-49-2	ND		mg/Kg	8.9	2.2	
Silver	7440-22-4	ND		mg/Kg	1.3	0.14	
Sodium	7440-23-5	**3,900**		mg/Kg	270	0.91	
Thallium	7440-28-0	ND		mg/Kg	18	1.1	
Vanadium	7440-62-2	**22**		mg/Kg	0.89	0.17	

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **123 S 87W 0-4' SPOIL**

Matrix: Solid Collection Date: 11/15/2007 12:00:00PM

Lab Sample Number:	B0711172-02A	Analysis Date:	12/3/2007 1:27:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	7.06
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.60 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	**73**		mg/Kg	0.54	0.20	1

Lab Sample Number:	B0711172-02A	Analysis Date:	12/4/2007 3:03:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12047A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	7.06
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.60 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Lithium	7439-93-2	**9.1**		mg/Kg	4.5	0.043	2

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **123 S 89W 0-4' SPOIL**

Matrix: Solid Collection Date: 11/15/2007 12:00:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-03A
Prep Date: 12/4/2007
Analytical Method ID: SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Total H
Prep Method ID: 7471A
Prep Batch Number: T071204013
Report Basis: Dry Weight Basis
Sample prep wt./vol: 0.63 g

Analysis Date: 12/4/2007 4:05:31PM
Instrument: CVAA_1
File Name: B120407S.WK
Dilution Factor: 1
Percent Moisture 8.64
Analyst Initials: DL
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**0.075**		mg/Kg	0.044	0.0060	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-03A
Prep Date: 12/3/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3050B
Prep Batch Number: T071203005
Report Basis: Dry Weight Basis
Sample prep wt./vol: 0.59 g

Analysis Date: 12/3/2007 1:32:00PM
Instrument: ICP_2
File Name: E12037A
Dilution Factor: 1
Percent Moisture 8.64
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**9,600**		mg/Kg	7.5	1.8	1
Antimony	7440-36-0	ND		mg/Kg	10	0.58	
Arsenic	7440-38-2	ND		mg/Kg	12	1.6	
Barium	7440-39-3	**170**		mg/Kg	0.37	0.029	
Beryllium	7440-41-7	**1.0**		mg/Kg	0.19	0.0083	
Boron	7440-42-8	**13**		mg/Kg	4.7	0.63	
Cadmium	7440-43-9	**0.85**		mg/Kg	0.75	0.054	
Calcium	7440-70-2	**21,000**		mg/Kg	13	5.0	
Chromium	7440-47-3	**6.6**		mg/Kg	1.9	0.28	
Cobalt	7440-48-4	**11**		mg/Kg	2.8	0.24	
Copper	7440-50-8	**25**		mg/Kg	0.56	0.15	
Iron	7439-89-6	**24,000**		mg/Kg	5.6	0.41	
Lead	7439-92-1	**17**		mg/Kg	5.6	0.98	
Magnesium	7439-96-4	**3,100**		mg/Kg	9.3	0.89	
Manganese	7439-96-5	**590**		mg/Kg	0.93	0.10	
Molybdenum	7439-98-7	ND		mg/Kg	1.9	0.22	
Nickel	7440-02-0	**15**		mg/Kg	3.7	0.40	
Potassium	7440-09-7	**1,800**		mg/Kg	93	29	
Selenium	7784-49-2	ND		mg/Kg	9.3	2.3	
Silver	7440-22-4	ND		mg/Kg	1.4	0.14	
Sodium	7440-23-5	**3,800**		mg/Kg	280	0.95	
Thallium	7440-28-0	ND		mg/Kg	19	1.1	
Vanadium	7440-62-2	**24**		mg/Kg	0.93	0.18	

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **123 S 89W 0-4' SPOIL**

Matrix: Solid Collection Date: 11/15/2007 12:00:00PM

Lab Sample Number:	B0711172-03A	Analysis Date:	12/3/2007 1:32:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	8.64
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.59 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	**69**		mg/Kg	0.56	0.21	1

Lab Sample Number:	B0711172-03A	Analysis Date:	12/4/2007 3:08:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12047A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	8.64
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.59 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Lithium	7439-93-2	**9.0**		mg/Kg	4.7	0.045	2

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **125 S 88W 0-4' SPOIL**

Matrix: Solid Collection Date: 11/15/2007 12:00:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	B0711172-04A	Analysis Date:	12/4/2007 4:13:55PM
Prep Date:	12/4/2007	Instrument:	CVAA_1
Analytical Method ID:	SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Total H	File Name:	B120407S.WK
Prep Method ID:	7471A	Dilution Factor:	1
Prep Batch Number:	T071204013	Percent Moisture	7.60
Report Basis:	Dry Weight Basis	Analyst Initials:	DL
Sample prep wt./vol:	0.62 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**0.053**		mg/Kg	0.044	0.0060	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	B0711172-04A	Analysis Date:	12/3/2007 1:37:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	7.60
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.61 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**10,000**		mg/Kg	7.1	1.7	1
Antimony	7440-36-0	ND		mg/Kg	9.7	0.55	
Arsenic	7440-38-2	ND		mg/Kg	12	1.6	
Barium	7440-39-3	**220**		mg/Kg	0.35	0.027	
Beryllium	7440-41-7	**1.1**		mg/Kg	0.18	0.0078	
Boron	7440-42-8	**13**		mg/Kg	4.4	0.60	
Cadmium	7440-43-9	ND		mg/Kg	0.71	0.051	
Calcium	7440-70-2	**16,000**		mg/Kg	12	4.7	
Chromium	7440-47-3	**6.8**		mg/Kg	1.8	0.26	
Cobalt	7440-48-4	**11**		mg/Kg	2.7	0.23	
Copper	7440-50-8	**28**		mg/Kg	0.53	0.14	
Iron	7439-89-6	**22,000**		mg/Kg	5.3	0.39	
Lead	7439-92-1	**18**		mg/Kg	5.3	0.93	
Magnesium	7439-96-4	**3,100**		mg/Kg	8.9	0.85	
Manganese	7439-96-5	**380**		mg/Kg	0.89	0.098	
Molybdenum	7439-98-7	ND		mg/Kg	1.8	0.21	
Nickel	7440-02-0	**14**		mg/Kg	3.5	0.38	
Potassium	7440-09-7	**1,900**		mg/Kg	89	28	
Selenium	7784-49-2	ND		mg/Kg	8.9	2.2	
Silver	7440-22-4	ND		mg/Kg	1.3	0.14	
Sodium	7440-23-5	**4,200**		mg/Kg	270	0.90	
Thallium	7440-28-0	ND		mg/Kg	18	1.0	
Vanadium	7440-62-2	**25**		mg/Kg	0.89	0.17	

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **125 S 88W 0-4' SPOIL**

Matrix: Solid Collection Date: 11/15/2007 12:00:00PM

Lab Sample Number:	B0711172-04A	Analysis Date:	12/3/2007 1:37:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	7.60
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.61 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	**66**		mg/Kg	0.53	0.20	1

Lab Sample Number:	B0711172-04A	Analysis Date:	12/4/2007 3:13:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12047A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	7.60
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.61 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Lithium	7439-93-2	**8.8**		mg/Kg	4.4	0.043	2

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **120 S 89W 0-4' SPOIL**

Matrix: Solid Collection Date: 11/15/2007 12:00:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	B0711172-05A	Analysis Date:	12/5/2007 9:42:00AM
Prep Date:	12/4/2007	Instrument:	CVAA_1
Analytical Method ID:	SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Total H	File Name:	B120407S.WK
Prep Method ID:	7471A	Dilution Factor:	1
Prep Batch Number:	T071204013	Percent Moisture	6.86
Report Basis:	Dry Weight Basis	Analyst Initials:	DL
Sample prep wt./vol:	0.62 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**0.12**		mg/Kg	0.044	0.0060	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	B0711172-05A	Analysis Date:	12/3/2007 1:43:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	6.86
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.56 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**9,200**		mg/Kg	7.7	1.9	1
Antimony	7440-36-0	ND		mg/Kg	11	0.60	
Arsenic	7440-38-2	ND		mg/Kg	13	1.7	
Barium	7440-39-3	**140**		mg/Kg	0.39	0.030	
Beryllium	7440-41-7	**0.84**		mg/Kg	0.19	0.0085	
Boron	7440-42-8	**11**		mg/Kg	4.8	0.65	
Cadmium	7440-43-9	ND		mg/Kg	0.77	0.056	
Calcium	7440-70-2	**27,000**		mg/Kg	13	5.1	
Chromium	7440-47-3	**6.1**		mg/Kg	1.9	0.29	
Cobalt	7440-48-4	**11**		mg/Kg	2.9	0.25	
Copper	7440-50-8	**20**		mg/Kg	0.58	0.15	
Iron	7439-89-6	**19,000**		mg/Kg	5.8	0.42	
Lead	7439-92-1	**17**		mg/Kg	5.8	1.0	
Molybdenum	7439-98-7	ND		mg/Kg	1.9	0.23	
Nickel	7440-02-0	**14**		mg/Kg	3.9	0.41	
Potassium	7440-09-7	**1,900**		mg/Kg	96	30	
Selenium	7784-49-2	ND		mg/Kg	9.6	2.4	
Silver	7440-22-4	ND		mg/Kg	1.4	0.15	
Sodium	7440-23-5	**4,100**		mg/Kg	290	0.98	
Thallium	7440-28-0	ND		mg/Kg	19	1.1	
Vanadium	7440-62-2	**18**		mg/Kg	0.96	0.19	
Zinc	7440-66-6	**59**		mg/Kg	0.58	0.21	

Lab Sample Number: B0711172-05A Analysis Date: 12/4/2007 3:18:00PM

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **120 S 89W 0-4' SPOIL**

Matrix: Solid

Collection Date: 11/15/2007 12:00:00PM

Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12047A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	6.86
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.56 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Lithium	7439-93-2	**8.2**		mg/Kg	4.8	0.047	3
Magnesium	7439-96-4	**3,200**		mg/Kg	9.6	0.92	
Manganese	7439-96-5	**370**		mg/Kg	0.96	0.11	

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Barber Ramp 3 Composite Spoil A**

Matrix: Solid Collection Date: 11/15/2007 12:00:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-06A
Prep Date: 12/4/2007
Analytical Method ID: SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Total H
Prep Method ID: 7471A
Prep Batch Number: T071204013
Report Basis: Dry Weight Basis
Sample prep wt./vol: 0.61 g

Analysis Date: 12/5/2007 9:49:39AM
Instrument: CVAA_1
File Name: B120407S.WK
Dilution Factor: 1
Percent Moisture 7.98
Analyst Initials: DL
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**0.087**		mg/Kg	0.044	0.0061	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-06A
Prep Date: 12/3/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3050B
Prep Batch Number: T071203005
Report Basis: Dry Weight Basis
Sample prep wt./vol: 0.58 g

Analysis Date: 12/3/2007 2:28:00PM
Instrument: ICP_2
File Name: E12037A
Dilution Factor: 1
Percent Moisture 7.98
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**10,000**		mg/Kg	7.4	1.8	1
Antimony	7440-36-0	ND		mg/Kg	10	0.58	
Arsenic	7440-38-2	ND		mg/Kg	12	1.6	
Barium	7440-39-3	**170**		mg/Kg	0.37	0.029	
Beryllium	7440-41-7	**1.0**		mg/Kg	0.19	0.0082	
Boron	7440-42-8	**13**		mg/Kg	4.7	0.63	
Cadmium	7440-43-9	ND		mg/Kg	0.74	0.054	
Calcium	7440-70-2	**20,000**		mg/Kg	13	5.0	
Chromium	7440-47-3	**6.7**		mg/Kg	1.9	0.28	
Cobalt	7440-48-4	**11**		mg/Kg	2.8	0.24	
Copper	7440-50-8	**26**		mg/Kg	0.56	0.15	
Iron	7439-89-6	**20,000**		mg/Kg	5.6	0.41	
Lead	7439-92-1	**16**		mg/Kg	5.6	0.98	
Magnesium	7439-96-4	**3,100**		mg/Kg	9.3	0.89	
Manganese	7439-96-5	**440**		mg/Kg	0.93	0.10	
Molybdenum	7439-98-7	ND		mg/Kg	1.9	0.22	
Nickel	7440-02-0	**13**		mg/Kg	3.7	0.40	
Potassium	7440-09-7	**1,900**		mg/Kg	93	29	
Selenium	7784-49-2	ND		mg/Kg	9.3	2.3	
Silver	7440-22-4	ND		mg/Kg	1.4	0.14	
Sodium	7440-23-5	**4,000**		mg/Kg	280	0.95	
Thallium	7440-28-0	ND		mg/Kg	19	1.1	
Vanadium	7440-62-2	**23**		mg/Kg	0.93	0.18	

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Barber Ramp 3 Composite Spoil A**

Matrix: Solid Collection Date: 11/15/2007 12:00:00PM

Lab Sample Number:	B0711172-06A	Analysis Date:	12/3/2007 2:28:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	7.98
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.58 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	**62**		mg/Kg	0.56	0.21	1

Lab Sample Number:	B0711172-06A	Analysis Date:	12/4/2007 4:04:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12047A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	7.98
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.58 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Lithium	7439-93-2	**8.6**		mg/Kg	4.7	0.045	2

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Barber Ramp 3 Composite Spoil B**

Matrix: Solid Collection Date: 11/15/2007 12:00:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	B0711172-07A	Analysis Date:	12/5/2007 9:57:26AM
Prep Date:	12/4/2007	Instrument:	CVAA_1
Analytical Method ID:	SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Total H	File Name:	B120407S.WK
Prep Method ID:	7471A	Dilution Factor:	1
Prep Batch Number:	T071204013	Percent Moisture	8.13
Report Basis:	Dry Weight Basis	Analyst Initials:	DL
Sample prep wt./vol:	0.62 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**0.073**		mg/Kg	0.044	0.0060	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	B0711172-07A	Analysis Date:	12/3/2007 2:33:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	8.13
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.64 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**9,500**		mg/Kg	6.8	1.7	1
Antimony	7440-36-0	ND		mg/Kg	9.3	0.52	
Arsenic	7440-38-2	ND		mg/Kg	11	1.5	
Barium	7440-39-3	**180**		mg/Kg	0.34	0.026	
Beryllium	7440-41-7	**1.0**		mg/Kg	0.17	0.0075	
Boron	7440-42-8	**12**		mg/Kg	4.2	0.57	
Cadmium	7440-43-9	ND		mg/Kg	0.68	0.049	
Calcium	7440-70-2	**22,000**		mg/Kg	12	4.5	
Chromium	7440-47-3	**6.0**		mg/Kg	1.7	0.25	
Cobalt	7440-48-4	**11**		mg/Kg	2.5	0.22	
Copper	7440-50-8	**23**		mg/Kg	0.51	0.13	
Iron	7439-89-6	**20,000**		mg/Kg	5.1	0.37	
Lead	7439-92-1	**17**		mg/Kg	5.1	0.89	
Magnesium	7439-96-4	**2,900**		mg/Kg	8.5	0.81	
Manganese	7439-96-5	**430**		mg/Kg	0.85	0.094	
Molybdenum	7439-98-7	ND		mg/Kg	1.7	0.20	
Nickel	7440-02-0	**13**		mg/Kg	3.4	0.36	
Potassium	7440-09-7	**1,700**		mg/Kg	85	27	
Selenium	7784-49-2	ND		mg/Kg	8.5	2.1	
Silver	7440-22-4	ND		mg/Kg	1.3	0.13	
Sodium	7440-23-5	**3,900**		mg/Kg	250	0.86	
Thallium	7440-28-0	ND		mg/Kg	17	1.00	
Vanadium	7440-62-2	**22**		mg/Kg	0.85	0.16	

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Barber Ramp 3 Composite Spoil B**

Matrix: Solid Collection Date: 11/15/2007 12:00:00PM

Lab Sample Number:	B0711172-07A	Analysis Date:	12/3/2007 2:33:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	8.13
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.64 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	**65**		mg/Kg	0.51	0.19	1

Lab Sample Number:	B0711172-07A	Analysis Date:	12/4/2007 4:09:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12047A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	8.13
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.64 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Lithium	7439-93-2	**8.2**		mg/Kg	4.2	0.041	2

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Barber Ramp 3 Composite Spoil C**

Matrix: Solid Collection Date: 11/15/2007 12:00:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-08A
Prep Date: 12/4/2007
Analytical Method ID: SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Total H
Prep Method ID: 7471A
Prep Batch Number: T071204013
Report Basis: Dry Weight Basis
Sample prep wt./vol: 0.62 g

Analysis Date: 12/5/2007 10:05:12AM
Instrument: CVAA_1
File Name: B120407S.WK
Dilution Factor: 1
Percent Moisture 7.87
Analyst Initials: DL
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**0.068**		mg/Kg	0.044	0.0060	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-08A
Prep Date: 12/3/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3050B
Prep Batch Number: T071203005
Report Basis: Dry Weight Basis
Sample prep wt./vol: 0.57 g

Analysis Date: 12/3/2007 2:38:00PM
Instrument: ICP_2
File Name: E12037A
Dilution Factor: 1
Percent Moisture 7.87
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**9,400**		mg/Kg	7.7	1.9	1
Antimony	7440-36-0	ND		mg/Kg	11	0.59	
Arsenic	7440-38-2	ND		mg/Kg	12	1.7	
Barium	7440-39-3	**170**		mg/Kg	0.38	0.030	
Beryllium	7440-41-7	**1.0**		mg/Kg	0.19	0.0085	
Boron	7440-42-8	**12**		mg/Kg	4.8	0.64	
Cadmium	7440-43-9	ND		mg/Kg	0.77	0.055	
Calcium	7440-70-2	**20,000**		mg/Kg	13	5.1	
Chromium	7440-47-3	**6.1**		mg/Kg	1.9	0.28	
Cobalt	7440-48-4	**11**		mg/Kg	2.9	0.25	
Copper	7440-50-8	**24**		mg/Kg	0.57	0.15	
Iron	7439-89-6	**20,000**		mg/Kg	5.7	0.42	
Lead	7439-92-1	**18**		mg/Kg	5.7	1.0	
Magnesium	7439-96-4	**3,000**		mg/Kg	9.6	0.92	
Manganese	7439-96-5	**390**		mg/Kg	0.96	0.11	
Molybdenum	7439-98-7	ND		mg/Kg	1.9	0.23	
Nickel	7440-02-0	**14**		mg/Kg	3.8	0.41	
Potassium	7440-09-7	**1,800**		mg/Kg	96	30	
Selenium	7784-49-2	ND		mg/Kg	9.6	2.4	
Silver	7440-22-4	ND		mg/Kg	1.4	0.15	
Sodium	7440-23-5	**4,100**		mg/Kg	290	0.98	
Thallium	7440-28-0	ND		mg/Kg	19	1.1	
Vanadium	7440-62-2	**22**		mg/Kg	0.96	0.19	

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Barber Ramp 3 Composite Spoil C**

Matrix: Solid Collection Date: 11/15/2007 12:00:00PM

Lab Sample Number:	B0711172-08A	Analysis Date:	12/3/2007 2:38:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	7.87
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.57 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	**62**		mg/Kg	0.57	0.21	1

Lab Sample Number:	B0711172-08A	Analysis Date:	12/4/2007 4:14:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12047A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	7.87
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.57 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Lithium	7439-93-2	**8.1**		mg/Kg	4.8	0.047	2

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Composite 70% FA**

Matrix: Solid Collection Date: 11/26/2007 10:00:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-09A
Prep Date: 12/4/2007
Analytical Method ID: SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Total H
Prep Method ID: 7471A
Prep Batch Number: T071204013
Report Basis: Dry Weight Basis
Sample prep wt./vol: 0.63 g

Analysis Date: 12/5/2007 10:21:36AM
Instrument: CVAA_1
File Name: B120407S.WK
Dilution Factor: 1
Percent Moisture 7.03
Analyst Initials: DL
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**0.17**		mg/Kg	0.042	0.0058	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-09A
Prep Date: 12/3/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3050B
Prep Batch Number: T071203005
Report Basis: Dry Weight Basis
Sample prep wt./vol: 0.56 g

Analysis Date: 12/3/2007 2:43:00PM
Instrument: ICP_2
File Name: E12037A
Dilution Factor: 1
Percent Moisture 7.03
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**7,200**		mg/Kg	7.7	1.9	1
Antimony	7440-36-0	ND		mg/Kg	11	0.60	
Arsenic	7440-38-2	ND		mg/Kg	12	1.7	
Barium	7440-39-3	**240**		mg/Kg	0.38	0.030	
Beryllium	7440-41-7	**0.77**		mg/Kg	0.19	0.0085	
Boron	7440-42-8	**91**		mg/Kg	4.8	0.65	
Cadmium	7440-43-9	ND		mg/Kg	0.77	0.055	
Calcium	7440-70-2	**62,000**		mg/Kg	13	5.1	
Chromium	7440-47-3	**9.8**		mg/Kg	1.9	0.28	
Cobalt	7440-48-4	ND		mg/Kg	2.9	0.25	
Copper	7440-50-8	**7.5**		mg/Kg	0.58	0.15	
Iron	7439-89-6	**4,000**		mg/Kg	5.8	0.42	
Lead	7439-92-1	**7.3**		mg/Kg	5.8	1.0	
Magnesium	7439-96-4	**2,100**		mg/Kg	9.6	0.92	
Manganese	7439-96-5	**81**		mg/Kg	0.96	0.11	
Molybdenum	7439-98-7	**4.6**		mg/Kg	1.9	0.23	
Nickel	7440-02-0	ND		mg/Kg	3.8	0.41	
Potassium	7440-09-7	**480**		mg/Kg	96	30	
Selenium	7784-49-2	ND		mg/Kg	9.6	2.4	
Silver	7440-22-4	ND		mg/Kg	1.4	0.15	
Sodium	7440-23-5	**730**		mg/Kg	290	0.98	
Thallium	7440-28-0	ND		mg/Kg	19	1.1	
Vanadium	7440-62-2	**24**		mg/Kg	0.96	0.19	

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Composite 70% FA**

Matrix: Solid Collection Date: 11/26/2007 10:00:00AM

Lab Sample Number:	B0711172-09A	Analysis Date:	12/3/2007 2:43:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	7.03
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.56 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	**13**		mg/Kg	0.58	0.21	1

Lab Sample Number:	B0711172-09A	Analysis Date:	12/4/2007 4:19:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12047A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	7.03
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.56 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Lithium	7439-93-2	**5.2**		mg/Kg	4.8	0.047	2

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Composite Dup 1 70% FA**

Matrix: Solid Collection Date: 11/26/2007 10:00:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-10A
Prep Date: 12/4/2007
Analytical Method ID: SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Total H
Prep Method ID: 7471A
Prep Batch Number: T071204013
Report Basis: Dry Weight Basis
Sample prep wt./vol: 0.62 g

Analysis Date: 12/5/2007 10:31:17AM
Instrument: CVAA_1
File Name: B120407S.WK
Dilution Factor: 1
Percent Moisture 6.87
Analyst Initials: DL
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**0.21**		mg/Kg	0.043	0.0059	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-10A
Prep Date: 12/3/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3050B
Prep Batch Number: T071203005
Report Basis: Dry Weight Basis
Sample prep wt./vol: 0.57 g

Analysis Date: 12/3/2007 2:48:00PM
Instrument: ICP_2
File Name: E12037A
Dilution Factor: 1
Percent Moisture 6.87
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**6,800**		mg/Kg	7.5	1.9	1
Antimony	7440-36-0	ND		mg/Kg	10	0.58	
Arsenic	7440-38-2	ND		mg/Kg	12	1.7	
Barium	7440-39-3	**240**		mg/Kg	0.38	0.029	
Beryllium	7440-41-7	**0.75**		mg/Kg	0.19	0.0083	
Boron	7440-42-8	**88**		mg/Kg	4.7	0.63	
Cadmium	7440-43-9	ND		mg/Kg	0.75	0.054	
Calcium	7440-70-2	**41,000**		mg/Kg	13	5.0	
Chromium	7440-47-3	**9.1**		mg/Kg	1.9	0.28	
Cobalt	7440-48-4	ND		mg/Kg	2.8	0.25	
Copper	7440-50-8	**6.5**		mg/Kg	0.56	0.15	
Iron	7439-89-6	**3,900**		mg/Kg	5.6	0.41	
Lead	7439-92-1	**7.7**		mg/Kg	5.6	0.99	
Magnesium	7439-96-4	**1,500**		mg/Kg	9.4	0.90	
Manganese	7439-96-5	**79**		mg/Kg	0.94	0.10	
Molybdenum	7439-98-7	**4.6**		mg/Kg	1.9	0.22	
Nickel	7440-02-0	ND		mg/Kg	3.8	0.40	
Potassium	7440-09-7	**410**		mg/Kg	94	30	
Selenium	7784-49-2	ND		mg/Kg	9.4	2.3	
Silver	7440-22-4	ND		mg/Kg	1.4	0.14	
Sodium	7440-23-5	**670**		mg/Kg	280	0.96	
Thallium	7440-28-0	ND		mg/Kg	19	1.1	
Vanadium	7440-62-2	**22**		mg/Kg	0.94	0.18	

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Composite Dup 1 70% FA**

Matrix: Solid Collection Date: 11/26/2007 10:00:00AM

Lab Sample Number:	B0711172-10A	Analysis Date:	12/3/2007 2:48:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	6.87
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.57 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	**11**		mg/Kg	0.56	0.21	1

Lab Sample Number:	B0711172-10A	Analysis Date:	12/4/2007 4:24:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12047A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	6.87
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.57 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Lithium	7439-93-2	**5.2**		mg/Kg	4.7	0.046	2

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Composite Dup2 70% FA**

Matrix: Solid Collection Date: 11/26/2007 10:00:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	B0711172-11A	Analysis Date:	12/5/2007 10:40:18AM
Prep Date:	12/4/2007	Instrument:	CVAA_1
Analytical Method ID:	SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Total H	File Name:	B120407S.WK
Prep Method ID:	7471A	Dilution Factor:	1
Prep Batch Number:	T071204013	Percent Moisture	6.98
Report Basis:	Dry Weight Basis	Analyst Initials:	DL
Sample prep wt./vol:	0.61 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**0.16**		mg/Kg	0.044	0.0060	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number:	B0711172-11A	Analysis Date:	12/3/2007 2:53:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	6.98
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.57 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**7,100**		mg/Kg	7.6	1.9	1
Antimony	7440-36-0	ND		mg/Kg	10	0.59	
Arsenic	7440-38-2	ND		mg/Kg	12	1.7	
Barium	7440-39-3	**240**		mg/Kg	0.38	0.029	
Beryllium	7440-41-7	**0.80**		mg/Kg	0.19	0.0084	
Boron	7440-42-8	**93**		mg/Kg	4.8	0.64	
Cadmium	7440-43-9	ND		mg/Kg	0.76	0.055	
Calcium	7440-70-2	**38,000**		mg/Kg	13	5.1	
Chromium	7440-47-3	**9.5**		mg/Kg	1.9	0.28	
Cobalt	7440-48-4	ND		mg/Kg	2.9	0.25	
Copper	7440-50-8	**7.1**		mg/Kg	0.57	0.15	
Iron	7439-89-6	**4,000**		mg/Kg	5.7	0.42	
Lead	7439-92-1	**7.4**		mg/Kg	5.7	1.00	
Magnesium	7439-96-4	**1,400**		mg/Kg	9.5	0.91	
Manganese	7439-96-5	**83**		mg/Kg	0.95	0.11	
Molybdenum	7439-98-7	**5.0**		mg/Kg	1.9	0.23	
Nickel	7440-02-0	ND		mg/Kg	3.8	0.41	
Potassium	7440-09-7	**420**		mg/Kg	95	30	
Selenium	7784-49-2	ND		mg/Kg	9.5	2.3	
Silver	7440-22-4	ND		mg/Kg	1.4	0.15	
Sodium	7440-23-5	**680**		mg/Kg	290	0.97	
Thallium	7440-28-0	ND		mg/Kg	19	1.1	
Vanadium	7440-62-2	**24**		mg/Kg	0.95	0.19	

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Composite Dup2 70% FA**

Matrix: Solid Collection Date: 11/26/2007 10:00:00AM

Lab Sample Number:	B0711172-11A	Analysis Date:	12/3/2007 2:53:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	6.98
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.57 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	**13**		mg/Kg	0.57	0.21	1

Lab Sample Number:	B0711172-11A	Analysis Date:	12/4/2007 4:29:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12047A
Prep Method ID:	3050B	Dilution Factor:	1
Prep Batch Number:	T071203005	Percent Moisture	6.98
Report Basis:	Dry Weight Basis	Analyst Initials:	rm
Sample prep wt./vol:	0.57 g	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Lithium	7439-93-2	**5.4**		mg/Kg	4.8	0.046	2

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **KF2007-01(58) DUP and KF-98-02(53)DUP**

Matrix: Aqueous Collection Date: 11/15/2007 4:30:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-12A
Prep Date: 11/30/2007
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T071130013
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 11/30/2007 4:09:34PM
Instrument: CVAA_1
File Name: B113007W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	ND		mg/L	0.00020	0.000050	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-12A
Prep Date: 12/3/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T071203011
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 12/3/2007 6:06:00PM
Instrument: ICP_2
File Name: E12037A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.14**		mg/L	0.050	0.014	1
Antimony	7440-36-0	ND		mg/L	0.050	0.0067	
Arsenic	7440-38-2	ND		mg/L	0.10	0.015	
Barium	7440-39-3	**0.088**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	ND		mg/L	0.0010	0.000060	
Cadmium	7440-43-9	ND		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**3.3**		mg/L	0.10	0.013	
Chromium	7440-47-3	ND		mg/L	0.010	0.0018	
Cobalt	7440-48-4	ND		mg/L	0.0050	0.0016	
Copper	7440-50-8	ND		mg/L	0.0050	0.0019	
Iron	7439-89-6	**0.073**		mg/L	0.050	0.0027	
Lead	7439-92-1	ND		mg/L	0.050	0.011	
Lithium	7439-93-2	ND		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**1.2**		mg/L	0.10	0.012	
Manganese	7439-96-5	ND		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	ND		mg/L	0.010	0.0018	
Nickel	7440-02-0	ND		mg/L	0.040	0.0027	
Potassium	7440-09-7	**10**		mg/L	1.0	0.31	
Selenium	7784-49-2	ND		mg/L	0.10	0.026	
Silver	7440-22-4	ND		mg/L	0.015	0.00066	
Sodium	7440-23-5	**1,100**		mg/L	3.0	0.028	
Thallium	7440-28-0	ND		mg/L	0.40	0.011	
Vanadium	7440-62-2	ND		mg/L	0.010	0.00072	

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **KF2007-01(58) DUP and KF-98-02(53)DUP**

Matrix: Aqueous Collection Date: 11/15/2007 4:30:00PM

Lab Sample Number:	B0711172-12A	Analysis Date:	12/3/2007 6:06:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12037A
Prep Method ID:	3010_ICP	Dilution Factor:	1
Prep Batch Number:	T071203011		
Report Basis:	As Received	Analyst Initials:	rm
Sample prep wt./vol:	50.00 ml	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	ND		mg/L	0.0050	0.0010	1

Lab Sample Number:	B0711172-12A	Analysis Date:	12/4/2007 5:24:00PM
Prep Date:	12/3/2007	Instrument:	ICP_2
Analytical Method ID:	SW6010B - ICP - Total	File Name:	E12047A
Prep Method ID:	3010_ICP	Dilution Factor:	1
Prep Batch Number:	T071203011		
Report Basis:	As Received	Analyst Initials:	rm
Sample prep wt./vol:	50.00 ml	Prep Extract Vol:	50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Boron	7440-42-8	**0.29**		mg/L	0.050	0.0018	2

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Solid Collection Date: 12/4/2007 12:00:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T071204013-MB
Prep Date: 12/4/2007
Analytical Method ID: SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Total H
Prep Method ID: 7471A
Prep Batch Number: T071204013
Report Basis: Dry Weight Basis
Sample prep wt./vol: 0.60 g

Analysis Date: 12/4/2007 3:00:38PM
Instrument: CVAA_1
File Name: B120407S.WK
Dilution Factor: 1
Percent Moisture NA
Analyst Initials: DL
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	ND		mg/Kg	0.042	0.0057	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T071203005-MB
Prep Date: 12/3/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3050B
Prep Batch Number: T071203005
Report Basis: Dry Weight Basis
Sample prep wt./vol: 0.50 g

Analysis Date: 12/3/2007 1:12:00PM
Instrument: ICP_2
File Name: E12037A
Dilution Factor: 1
Percent Moisture NA
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	ND		mg/Kg	8.0	2.0	1
Antimony	7440-36-0	ND		mg/Kg	11	0.62	
Arsenic	7440-38-2	ND		mg/Kg	13	1.8	
Barium	7440-39-3	ND		mg/Kg	0.40	0.031	
Beryllium	7440-41-7	ND		mg/Kg	0.20	0.0089	
Boron	7440-42-8	ND		mg/Kg	5.0	0.67	
Cadmium	7440-43-9	ND		mg/Kg	0.80	0.058	
Calcium	7440-70-2	ND		mg/Kg	14	5.3	
Chromium	7440-47-3	ND		mg/Kg	2.0	0.30	
Cobalt	7440-48-4	ND		mg/Kg	3.0	0.26	
Copper	7440-50-8	ND		mg/Kg	0.60	0.16	
Iron	7439-89-6	ND		mg/Kg	6.0	0.44	
Lead	7439-92-1	ND		mg/Kg	6.0	1.1	
Magnesium	7439-96-4	ND		mg/Kg	10	0.96	
Manganese	7439-96-5	ND		mg/Kg	1.0	0.11	
Molybdenum	7439-98-7	ND		mg/Kg	2.0	0.24	
Nickel	7440-02-0	ND		mg/Kg	4.0	0.43	
Potassium	7440-09-7	ND		mg/Kg	100	31	
Selenium	7784-49-2	ND		mg/Kg	10	2.5	
Silver	7440-22-4	ND		mg/Kg	1.5	0.15	
Sodium	7440-23-5	ND		mg/Kg	300	1.0	
Thallium	7440-28-0	ND		mg/Kg	20	1.2	
Vanadium	7440-62-2	ND		mg/Kg	1.0	0.20	

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Solid Collection Date: 12/3/2007 12:00:00AM

Lab Sample Number: T071203005-MB
Prep Date: 12/3/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3050B
Prep Batch Number: T071203005
Report Basis: Dry Weight Basis
Sample prep wt./vol: 0.50 g

Analysis Date: 12/4/2007 2:48:00PM
Instrument: ICP_2
File Name: E12047A
Dilution Factor: 1
Percent Moisture NA
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Lithium	7439-93-2	ND		mg/Kg	5.0	0.049	2

Lab Sample Number: T071203005-MB
Prep Date: 12/3/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3050B
Prep Batch Number: T071203005
Report Basis: Dry Weight Basis
Sample prep wt./vol: 0.50 g

Analysis Date: 12/5/2007 1:51:00PM
Instrument: ICP_2
File Name: E12057A
Dilution Factor: 1
Percent Moisture NA
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	ND		mg/Kg	0.60	0.22	3

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T071130013-MB
Prep Date: 11/30/2007
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T071130013
Report Basis: Dry Weight Basis
Sample prep wt./vol: 30.00 ml

Analysis Date: 11/30/2007 4:00:22PM
Instrument: CVAA_1
File Name: B113007W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	ND		mg/L	0.00020	0.000050	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T071203011-MB
Prep Date: 12/3/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T071203011
Report Basis: Dry Weight Basis
Sample prep wt./vol: 50.00 ml

Analysis Date: 12/3/2007 5:46:00PM
Instrument: ICP_2
File Name: E12037A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	ND		mg/L	0.050	0.014	1
Antimony	7440-36-0	ND		mg/L	0.050	0.0067	
Arsenic	7440-38-2	ND		mg/L	0.10	0.015	

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous

Collection Date: 12/3/2007 12:00:00AM

Lab Sample Number: T071203011-MB
Prep Date: 12/3/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T071203011
Report Basis: Dry Weight Basis
Sample prep wt./vol: 50.00 ml

Analysis Date: 12/3/2007 5:46:00PM
Instrument: ICP_2
File Name: E12037A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Barium	7440-39-3	ND		mg/L	0.010	0.00016	1
Beryllium	7440-41-7	ND		mg/L	0.0010	0.000060	
Cadmium	7440-43-9	ND		mg/L	0.0060	0.00051	
Calcium	7440-70-2	ND		mg/L	0.10	0.013	
Chromium	7440-47-3	ND		mg/L	0.010	0.0018	
Cobalt	7440-48-4	ND		mg/L	0.0050	0.0016	
Copper	7440-50-8	ND		mg/L	0.0050	0.0019	
Iron	7439-89-6	ND		mg/L	0.050	0.0027	
Lead	7439-92-1	ND		mg/L	0.050	0.011	
Lithium	7439-93-2	ND		mg/L	0.10	0.00072	
Magnesium	7439-96-4	ND		mg/L	0.10	0.012	
Manganese	7439-96-5	ND		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	ND		mg/L	0.010	0.0018	
Nickel	7440-02-0	ND		mg/L	0.040	0.0027	
Potassium	7440-09-7	ND		mg/L	1.0	0.31	
Selenium	7784-49-2	ND		mg/L	0.10	0.026	
Silver	7440-22-4	ND		mg/L	0.015	0.00066	
Sodium	7440-23-5	ND		mg/L	3.0	0.028	
Thallium	7440-28-0	ND		mg/L	0.40	0.011	
Vanadium	7440-62-2	ND		mg/L	0.010	0.00072	

Lab Sample Number: T071203011-MB
Prep Date: 12/3/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T071203011
Report Basis: Dry Weight Basis
Sample prep wt./vol: 50.00 ml

Analysis Date: 12/4/2007 5:04:00PM
Instrument: ICP_2
File Name: E12047A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Boron	7440-42-8	ND		mg/L	0.050	0.0018	2

Lab Sample Number: T071203011-MB
Prep Date: 12/3/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T071203011

Analysis Date: 12/5/2007 1:41:00PM
Instrument: ICP_2
File Name: E12057A
Dilution Factor: 1

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous

Collection Date: 12/3/2007 12:00:00AM

Report Basis: Dry Weight Basis

Analyst Initials: rm

Sample prep wt./vol: 50.00 ml

Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	ND		mg/L	0.0050	0.0010	3

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **KF2007-01(58) and KF-98-02(53)**

Matrix: Aqueous Collection Date: 11/15/2007 4:30:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-01B
Prep Date: 11/29/2007
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T071203006
Report Basis: As Received
Sample prep wt./vol: 25.00 ml

Analysis Date: 11/29/2007 10:08:49AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 25.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**1,300**		mg/L	5.0	1.5	1
Carbonate		**260**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-01B
Prep Date: 11/28/2007
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Prep Method ID: 150.1
Prep Batch Number: T071203004
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 11/28/2007 10:05:27AM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**9.0**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-01B
Prep Date: 11/29/2007
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T071203008
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 12/4/2007 9:06:42AM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**3,100**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-01B
Prep Date: 11/29/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071130001
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 11/29/2007 1:54:49PM
Instrument: IC
File Name: 071129_013.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **KF2007-01(58) and KF-98-02(53)**

Matrix: Aqueous Collection Date: 11/15/2007 4:30:00PM

Lab Sample Number: B0711172-01B Analysis Date: 11/29/2007 1:54:49PM
Prep Date: 11/29/2007 Instrument: IC
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC File Name: 071129_013.D
Prep Method ID: 300.0 Dilution Factor: 1
Prep Batch Number: T071130001
Report Basis: As Received Analyst Initials: KB
Sample prep wt./vol: 20.00 ml Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**2.4**		mg/L	0.40	0.031	2
Sulfate		**300**		mg/L	1.5	0.11	

Lab Sample Number: B0711172-01B Analysis Date: 11/30/2007 12:00:01PM
Prep Date: 11/29/2007 Instrument: IC
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC File Name: 071130_007.D
Prep Method ID: 300.0 Dilution Factor: 27
Prep Batch Number: T071130001
Report Basis: As Received Analyst Initials: KB
Sample prep wt./vol: 20.00 ml Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**710**		mg/L	21	1.1	1

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **KF2007-01(58) DUP and KF-98-02(53)DUP**

Matrix: Aqueous Collection Date: 11/15/2007 4:30:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-12B
Prep Date: 11/29/2007
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T071203006
Report Basis: As Received
Sample prep wt./vol: 25.00 ml

Analysis Date: 11/29/2007 10:08:49AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 25.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**1,200**		mg/L	5.0	1.5	1
Carbonate		**300**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-12B
Prep Date: 11/28/2007
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Prep Method ID: 150.1
Prep Batch Number: T071203004
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 11/28/2007 10:05:27AM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**8.9**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-12B
Prep Date: 11/29/2007
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T071203008
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 12/4/2007 9:06:42AM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**3,000**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0711172-12B
Prep Date: 11/29/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071130001
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 11/29/2007 2:11:40PM
Instrument: IC
File Name: 071129_014.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **KF2007-01(58) DUP and KF-98-02(53)DUP**

Matrix: Aqueous Collection Date: 11/15/2007 4:30:00PM

Lab Sample Number: B0711172-12B
Prep Date: 11/29/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071130001
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 11/29/2007 2:11:40PM
Instrument: IC
File Name: 071129_014.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**2.5**		mg/L	0.40	0.031	2

Lab Sample Number: B0711172-12B
Prep Date: 11/29/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071130001
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 11/29/2007 10:36:20PM
Instrument: IC
File Name: 071129_044.D
Dilution Factor: 10
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sulfate		**260**		mg/L	15	1.1	3

Lab Sample Number: B0711172-12B
Prep Date: 11/29/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071130001
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 11/30/2007 12:16:51PM
Instrument: IC
File Name: 071130_008.D
Dilution Factor: 27
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**700**		mg/L	21	1.1	1

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 11/29/2007 12:00:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T071203006-MB
Prep Date: 11/29/2007
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T071203006
Report Basis: Dry Weight Basis
Sample prep wt./vol: 100.00 ml

Analysis Date: 11/29/2007 10:08:49AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 100.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		ND		mg/L	5.0	1.5	1
Carbonate		ND		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T071203008-MB
Prep Date: 11/29/2007
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T071203008
Report Basis: Dry Weight Basis
Sample prep wt./vol: 100.00 ml

Analysis Date: 12/4/2007 9:06:42AM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		ND		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T071130001-MB
Prep Date: 11/29/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071130001
Report Basis: Dry Weight Basis
Sample prep wt./vol: 20.00 ml

Analysis Date: 11/29/2007 1:04:19PM
Instrument: IC
File Name: 071129_010.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		ND		mg/L	0.80	0.042	1
Fluoride		ND		mg/L	0.40	0.031	
Sulfate		ND		mg/L	1.5	0.11	

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0711172
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071203011**

LCS/LCSD REPORT

Analysis: SW6010B - ICP - Total
MB: T071203011-MB
Prep Date: 12/3/2007
MB Anal. Date: 12/3/2007 5:46:00PM
Units: mg/L
LCS Anal. Date: 12/3/2007 5:51:00PM LCSD Anal. Date: 12/3/2007 5:56:00PM Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Aluminum	ND	2.09	2.05	2.00	2.00	104.5	102.5	1.9	89 - 117	20	
Antimony	ND	0.504	0.491	0.500	0.500	100.8	98.2	2.6	82 - 117	20	
Arsenic	ND	2.04	2.00	2.00	2.00	102.0	100.0	2.0	86 - 116	20	
Barium	ND	2.00	1.97	2.00	2.00	100.0	98.5	1.5	86 - 116	20	
Beryllium	ND	0.0511	0.0500	0.0500	0.0500	102.2	100.0	2.2	87 - 111	20	
Boron	ND	0.650	0.638	0.500	0.500	130.0	127.6	1.9	76 - 130	20	
Cadmium	ND	0.0500	0.0482	0.0500	0.0500	100.0	96.4	3.7	79 - 113	20	
Calcium	ND	10.0	9.85	10.0	10.0	100.0	98.5	1.5	79 - 119	20	
Chromium	ND	0.202	0.197	0.200	0.200	101.0	98.5	2.5	86 - 117	20	
Cobalt	ND	0.506	0.494	0.500	0.500	101.2	98.8	2.4	82 - 118	20	
Copper	ND	0.252	0.247	0.250	0.250	100.8	98.8	2.0	86 - 117	20	
Iron	ND	1.02	1.02	1.00	1.00	102.0	102.0	0.0	83 - 121	20	
Lead	ND	0.511	0.505	0.500	0.500	102.2	101.0	1.2	83 - 121	20	
Magnesium	ND	10.6	10.4	10.0	10.0	106.0	104.0	1.9	83 - 118	20	
Manganese	ND	0.507	0.497	0.500	0.500	101.4	99.4	2.0	82 - 121	20	
Molybdenum	ND	0.508	0.496	0.500	0.500	101.6	99.2	2.4	82 - 120	20	
Nickel	ND	0.510	0.496	0.500	0.500	102.0	99.2	2.8	84 - 117	20	
Potassium	ND	9.04	8.48	10.0	10.0	90.4	84.8	6.4	74 - 110	20	
Selenium	ND	2.01	1.96	2.00	2.00	100.5	98.0	2.5	87 - 117	20	
Silver	ND	0.266	0.259	0.250	0.250	106.4	103.6	2.7	80 - 127	20	
Sodium	ND	9.67	9.69	10.0	10.0	96.7	96.9	0.2	87 - 113	20	
Thallium	ND	0.204	0.189	0.200	0.200	102.0	94.5	7.6	89 - 113	20	
Vanadium	ND	0.514	0.503	0.500	0.500	102.8	100.6	2.2	87 - 119	20	
Zinc	ND	0.495	0.478	0.500	0.500	99.0	95.6	3.5	81 - 120	20	
Lithium	ND	0.479	0.475	0.500	0.500	95.8	95.0	0.8	80 - 120	20	

Prep Batch: **T071130013**

LCS/LCSD REPORT

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0711172
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071130013**

LCS/LCSD REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
MB: T071130013-MB
Prep Date: 11/30/2007
MB Anal. Date: 11/30/2007 4:00:22PM
Units: mg/L
LCS Anal. Date: 11/30/2007 4:02:28PM LCSD Anal. Date: 11/30/2007 4:05:02PM Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Mercury	ND	0.00233	0.00196	0.00200	0.0020	116.5	98.0	17.2	80 - 120	20	

Prep Batch: **T071203005**

SAMPLE DUPLICATE REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0711172-05A
Prep Date: 12/3/2007
Samp. Anal. Date: 12/3/2007 1:43:00PM
Units: mg/Kg
DUP Anal. Date: 12/3/2007 1:48:00PM
Matrix: Solid

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Aluminum	9,240	10,500	12.8	35	
Antimony	ND	ND	0.0	35	
Arsenic	ND	ND	0.0	35	
Barium	141	142	0.7	35	
Beryllium	0.838	0.943	11.8	35	
Boron	10.8	11.9	9.7	35	
Cadmium	ND	ND	0.0	35	
Calcium	27,500	25,500	7.5	35	
Chromium	6.15	6.34	3.0	35	
Cobalt	11.1	10.6	4.6	35	
Copper	20.3	19.2	5.6	35	
Iron	19,200	19,200	0.0	35	
Lead	17.0	16.9	0.6	35	
Magnesium	3,160	3,310	4.6	35	
Manganese	374	461	20.8	35	
Molybdenum	ND	ND	0.0	35	
Nickel	14.3	13.6	5.0	35	
Potassium	1,880	1,980	5.2	35	
Selenium	ND	ND	0.0	35	
Silver	ND	ND	0.0	35	

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0711172
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071203005**

SAMPLE DUPLICATE REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0711172-05A
Prep Date: 12/3/2007

Samp. Anal. Date: 12/3/2007 1:43:00PM
DUP Anal. Date: 12/3/2007 1:48:00PM
Units: mg/Kg
Matrix: Solid

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Sodium	4,090	3,880	5.3	35	
Thallium	ND	ND	0.0	35	
Vanadium	17.9	19.5	8.6	35	
Zinc	59.4	60.1	1.2	35	
Lithium	8.19	9.07	10.2	35	

LCS/LCSD REPORT

Analysis: SW6010B - ICP - Total
MB: T071203005-MB
Prep Date: 12/3/2007

MB Anal. Date: 12/3/2007 1:12:00PM
LCS Anal. Date: 12/3/2007 1:17:00PM LCSD Anal. Date: 12/3/2007 1:22:00PM
Units: mg/Kg
Matrix: Solid

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Aluminum	ND	204	203	200	200	102.0	101.5	0.5	70 - 130	35	
Antimony	ND	47.2	47.7	50.0	50.0	94.4	95.4	1.1	70 - 130	35	
Arsenic	ND	192	193	200	200	96.0	96.5	0.5	70 - 130	35	
Barium	ND	199	199	200	200	99.5	99.5	0.0	70 - 130	35	
Beryllium	ND	4.82	4.82	5.00	5.00	96.4	96.4	0.0	70 - 130	35	
Boron	ND	60.2	64.5	50.0	50.0	120.4	129.0	6.9	70 - 130	35	
Cadmium	ND	5.06	5.01	5.00	5.00	101.2	100.2	1.0	70 - 130	35	
Calcium	ND	954	947	1,000	1,000	95.4	94.7	0.7	70 - 130	35	
Chromium	ND	19.6	19.6	20.0	20.0	98.0	98.0	0.0	70 - 130	35	
Cobalt	ND	48.2	48.3	50.0	50.0	96.4	96.6	0.2	70 - 130	35	
Copper	ND	24.7	24.9	25.0	25.0	98.8	99.6	0.8	70 - 130	35	
Iron	ND	99.4	98.7	100	100	99.4	98.7	0.7	70 - 130	35	
Lead	ND	48.1	48.7	50.0	50.0	96.2	97.4	1.2	70 - 130	35	
Magnesium	ND	994	992	1,000	1,000	99.4	99.2	0.2	70 - 130	35	
Manganese	ND	49.0	48.8	50.0	50.0	98.0	97.6	0.4	70 - 130	35	
Molybdenum	ND	48.6	48.4	50.0	50.0	97.2	96.8	0.4	70 - 130	35	
Nickel	ND	47.9	48.1	50.0	50.0	95.8	96.2	0.4	70 - 130	35	
Potassium	ND	937	954	1,000	1,000	93.7	95.4	1.8	70 - 130	35	

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0711172

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071203005**

LCS/LCSD REPORT

Analysis: SW6010B - ICP - Total

MB: T071203005-MB

Prep Date: 12/3/2007

MB Anal. Date: 12/3/2007 1:12:00PM

Units: mg/Kg

LCS Anal. Date: 12/3/2007 1:17:00PM LCSD Anal. Date: 12/3/2007 1:22:00PM

Matrix: Solid

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Selenium	ND	189	191	200	200	94.5	95.5	1.1	70 - 130	35	
Silver	ND	24.9	25.0	25.0	25.0	99.6	100.0	0.4	70 - 130	35	
Sodium	ND	1,010	1,000	1,000	1,000	101.0	100.0	1.0	70 - 130	35	
Thallium	ND	20.4	18.6	20.0	20.0	102.0	93.0	9.2	70 - 130	35	
Vanadium	ND	49.9	49.6	50.0	50.0	99.8	99.2	0.6	70 - 130	35	
Zinc	ND	54.1	62.4	50.0	50.0	108.2	124.8	14.2	70 - 130	35	
Lithium	ND	47.3	47.0	50.0	50.0	94.6	94.0	0.6	70 - 130	35	

MS/MSD REPORT

Analysis: SW6010B - ICP - Total

Parent: B0711172-05A

Prep Date: 12/3/2007

Samp. Anal. Date: 12/3/2007 1:43:00PM

Units: mg/Kg

MS Anal. Date: 12/3/2007 1:53:00PM MSD Anal. Date: 12/3/2007 1:58:00PM

Matrix: Solid

Analyte Name	SampResult	MSRes.	MSDRes	SPLev	SPDLev	Recov.	MSD Rec.	RPD	Recov Lim	RPDLim	Flag
Aluminum	9,240	13,400	13,700	192	191	2,171.5	2,334.7	2.2	70 - 130	35	*NOTE 2 NOTE 2*
Antimony	ND	19.7	18.6	47.9	47.8	41.1	38.9	5.7	70 - 130	35	*lowMS lowMSD*
Arsenic	ND	158	157	192	191	82.5	82.2	0.6	70 - 130	35	
Barium	141	319	320	192	191	92.9	93.7	0.3	70 - 130	35	
Beryllium	0.838	5.47	5.46	4.79	4.78	96.7	96.8	0.2	70 - 130	35	
Boron	10.8	67.1	66.8	47.9	47.8	117.6	117.3	0.4	70 - 130	35	
Cadmium	ND	5.48	5.44	4.79	4.78	114.4	113.9	0.7	70 - 130	35	
Calcium	27,500	25,900	25,900	958	955	-167.0	-167.5	0.0	70 - 130	35	*NOTE 2 NOTE 2*
Chromium	6.15	25.8	26.2	19.2	19.1	102.6	105.0	1.5	70 - 130	35	
Cobalt	11.1	54.1	54.3	47.9	47.8	89.8	90.5	0.4	70 - 130	35	
Copper	20.3	42.4	43.0	23.9	23.9	92.3	95.1	1.4	70 - 130	35	
Iron	19,200	18,800	20,200	95.8	95.5	-417.6	1,046.9	7.2	70 - 130	35	*NOTE 2 NOTE 2*
Lead	17.0	60.7	61.4	47.9	47.8	91.2	93.0	1.1	70 - 130	35	
Magnesium	3,160	4,370	4,600	1,030	955	117.7	150.8	5.1	70 - 130	35	*highMSD*

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0711172
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071203005**

MS/MSD REPORT

Analysis: SW6010B - ICP - Total
Parent: B0711172-05A
Prep Date: 12/3/2007
Samp. Anal. Date: 12/4/2007 3:18:00PM
Units: mg/Kg
MS Anal. Date: 12/4/2007 3:28:00PM MSD Anal. Date: 12/4/2007 3:33:00PM
Matrix: Solid

Analyte Name	SampResult	MSRes.	MSDRes	SPLev	SPDLev	Recov.	MSD Rec.	RPD	Recov Lim	RPDLim	Flag
Manganese	374	431	419	51.4	47.8	110.9	94.2	2.8	70 - 130	35	*NOTE 2* *NOTE 2*
Molybdenum	ND	43.2	42.4	47.9	47.8	90.2	88.8	1.9	70 - 130	35	
Nickel	14.3	56.9	58.1	47.9	47.8	88.9	91.7	2.1	70 - 130	35	
Potassium	1,880	2,870	2,920	958	955	103.4	108.9	1.7	70 - 130	35	
Selenium	ND	189	187	192	191	98.7	97.9	1.1	70 - 130	35	
Silver	ND	23.6	23.3	23.9	23.9	98.6	97.6	1.3	70 - 130	35	
Sodium	4,090	4,710	5,020	958	955	64.7	97.4	6.4	70 - 130	35	*NOTE 2* *NOTE 2*
Thallium	ND	13.6	12.1	19.2	19.1	71.0	63.3	11.7	70 - 130	35	*lowMSD*
Vanadium	17.9	67.0	67.8	47.9	47.8	102.5	104.5	1.2	70 - 130	35	
Zinc	59.4	97.6	105	47.9	47.8	79.8	95.5	7.3	70 - 130	35	
Lithium	8.19	58.0	54.6	51.4	47.8	96.9	97.2	6.0	70 - 130	35	

POST DIGESTION SPIKE REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0711172-05A
Prep Date: 12/3/2007
Samp. Anal. Date: 12/3/2007 1:43:00PM
Units: mg/Kg
PDS Anal. Date: 12/3/2007 2:18:00PM
Matrix: Solid

Analyte Name	SampResult	PDSRes.	SPLev	Recov.	Recov Lim	Flag
Aluminum	9,240	14,100	206	2,369.3	70 - 130	Note 2
Antimony	ND	20.7	51.4	39.5	70 - 130	lowPDS
Arsenic	ND	168	206	93.7	70 - 130	
Barium	141	334	206	94.1	70 - 130	Note 2
Beryllium	0.838	5.72	5.14	95.0	70 - 130	
Boron	10.8	70.3	51.4	115.6	70 - 130	
Cadmium	ND	5.59	5.14	96.6	70 - 130	
Calcium	27,500	27,300	1,030	-23.3	70 - 130	Note 2
Chromium	6.15	27.1	20.6	102.0	70 - 130	Note 2

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0711172
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071203005**

POST DIGESTION SPIKE REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0711172-05A
Prep Date: 12/3/2007
Samp. Anal. Date: 12/3/2007 1:43:00PM
Units: mg/Kg
PDS Anal. Date: 12/3/2007 2:18:00PM
Matrix: Solid

Analyte Name	SampResult	PDSRes.	SPLev	Recov.	Recov Lim	Flag
Cobalt	11.1	57.0	51.4	89.3	70 - 130	
Copper	20.3	44.2	25.7	93.2	70 - 130	Note 2
Iron	19,200	19,800	103	569.3	70 - 130	Note 2
Lead	17.0	64.3	51.4	92.0	70 - 130	Note 2
Magnesium	3,160	4,600	1,030	139.6	70 - 130	Note 2
Manganese	374	446	51.4	139.5	70 - 130	Note 2
Molybdenum	ND	45.1	51.4	87.9	70 - 130	
Nickel	14.3	59.6	51.4	88.1	70 - 130	Note 2
Potassium	1,880	3,030	1,030	111.8	70 - 130	Note 2
Selenium	ND	203	206	98.3	70 - 130	
Silver	ND	24.9	25.7	98.3	70 - 130	
Sodium	4,090	4,990	1,030	87.3	70 - 130	Note 2
Thallium	ND	13.7	20.6	83.1	70 - 130	
Vanadium	17.9	70.3	51.4	102.0	70 - 130	Note 2
Zinc	59.4	103	51.4	84.3	70 - 130	Note 2
Lithium	8.19	59.1	51.4	99.0	70 - 130	

SERIAL DILUTION REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0711172-05A
Prep Date: 12/3/2007
Samp. Anal. Date: 12/3/2007 1:43:00PM
Units: mg/Kg
SER DIL. Date: 12/4/2007 3:59:00PM
Matrix: Solid

Analyte Name	SampResult	PQL.	MDL.	SerialRes.	SerPQL.	RPD	Flag
Aluminum	9,240	7.7	1.9	9,470	39	2.4	
Antimony	ND	11	0.60	ND	53		
Arsenic	ND	13	1.7	ND	63		
Barium	141	0.39	0.030	128	1.9	9.6	
Beryllium	0.838	0.19	0.0085	ND	0.96		
Boron	10.8	4.8	0.65	ND	24		

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0711172
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071203005**

SERIAL DILUTION REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0711172-05A
Prep Date: 12/3/2007
Samp. Anal. Date: 12/3/2007 1:43:00PM
Units: mg/Kg
SER DIL. Date: 12/4/2007 3:59:00PM
Matrix: Solid

Analyte Name	SampResult	PQL.	MDL.	SerialRes.	SerPQL.	RPD	Flag
Cadmium	ND	0.77	0.056	ND	3.9		
Calcium	27,500	13	5.1	23,800	67	14.4	OUT
Chromium	6.15	1.9	0.29	ND	9.6		
Cobalt	11.1	2.9	0.25	ND	14		
Copper	20.3	0.58	0.15	16.7	2.9	19.4	OUT
Iron	19,200	5.8	0.42	16,500	29	15.1	OUT
Lead	17.0	5.8	1.0	ND	29		
Magnesium	3,160	9.6	0.92	2,990	48	5.5	
Manganese	374	0.96	0.11	429	4.8	13.7	OUT
Molybdenum	ND	1.9	0.23	ND	9.6		
Nickel	14.3	3.9	0.41	ND	19		
Potassium	1,880	96	30	1,720	480	8.8	
Selenium	ND	9.6	2.4	ND	48		
Silver	ND	1.4	0.15	ND	7.2		
Sodium	4,090	290	0.98	3,400	1,400	18.4	OUT
Thallium	ND	19	1.1	ND	96		
Vanadium	17.9	0.96	0.19	19.6	4.8	9.0	
Zinc	59.4	0.58	0.21	55.1	2.9	7.5	
Lithium	8.19	4.8	0.047	ND	24		

Prep Batch: **T071204013**

SAMPLE DUPLICATE REPORT

Analysis: SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Tot
Base Sample: B0711172-02A
Prep Date: 12/4/2007
Samp. Anal. Date: 12/4/2007 3:25:10PM
Units: mg/Kg
DUP Anal. Date: 12/4/2007 3:33:00PM
Matrix: Solid

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Mercury	0.124	0.134	7.8	35	

LCS/LCSD REPORT

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0711172

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071204013**

LCS/LCSD REPORT

Analysis: SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Tot

MB: T071204013-MB

Prep Date: 12/4/2007

MB Anal. Date: 12/4/2007 3:00:38PM

Units: mg/Kg

LCS Anal. Date: 12/4/2007 3:08:17PM LCSD Anal. Date: 12/4/2007 3:16:19PM

Matrix: Solid

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Mercury	ND	0.845	0.843	0.833	0.833	101.4	101.2	0.2	70 - 130	35	

MS/MSD REPORT

Analysis: SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Tot

Parent: B0711172-02A

Prep Date: 12/4/2007

Samp. Anal. Date: 12/4/2007 3:25:10PM

Units: mg/Kg

MS Anal. Date: 12/4/2007 3:41:00PM MSD Anal. Date: 12/4/2007 3:49:21PM

Matrix: Solid

Analyte Name	SampResult	MSRes.	MSDRes	SPLev	SPDLev	Recov.	MSD Rec.	RPD	Recov Lim	RPDLim	Flag
Mercury	0.124	0.966	0.999	0.845	0.873	99.7	100.2	3.4	70 - 130	35	

POST DIGESTION SPIKE REPORT

Analysis: SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Tot

Base Sample: B0711172-02A

Prep Date: 12/4/2007

Samp. Anal. Date: 12/4/2007 3:25:10PM

Units: mg/Kg

PDS Anal. Date: 12/4/2007 3:57:39PM

Matrix: Solid

Analyte Name	SampResult	PDSRes.	SPLev	Recov.	Recov Lim	Flag
Mercury	0.124	1.01	0.876	101.3	80 - 130	

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

FOOTNOTES TO QC REPORT

Note 1: Results are shown to three significant figures to avoid rounding errors in calculations.

Note 2: If the sample concentration is greater than 4 times the spike level, a recovery is not meaningful, and the result should be used as a replicate. In such cases the spike is not as high as expected random measurement variability of the sample result itself.

Note 3: For sample duplicates, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample and duplicate results are not five times the PQL or greater, then the RPD is not expected to fall within the window shown and the comparison should be made on the basis of the absolute difference. Analytica uses the criterion that the absolute difference should be less than the PQL for water or less than 2XPQL for other matrices.

Note 4: For serial dilutions, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample result is not 50 times the MDL or greater, then the fact that the RPD does not meet the 10% criterion has little signifcance. Otherwise it indicates that a matrix bias may exist at the analytical step.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0711172
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071207005**

SAMPLE DUPLICATE REPORT

Analysis: ASTM D2216 - Pmoist
Base Sample: B0711172-11A
Prep Date: 12/6/2007

Samp. Anal. Date: 12/7/2007 9:39:41AM
DUP Anal. Date: 12/7/2007 9:39:41AM
Units: %
Matrix: Solid

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Moisture	6.98	6.39	8.8	20	

FOOTNOTES TO QC REPORT

Note 1: Results are shown to three significant figures to avoid rounding errors in calculations.

Note 2: If the sample concentration is greater than 4 times the spike level, a recovery is not meaningful, and the result should be used as a replicate. In such cases the spike is not as high as expected random measurement variability of the sample result itself.

Note 3: For sample duplicates, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample and duplicate results are not five times the PQL or greater, then the RPD is not expected to fall within the window shown and the comparison should be made on the basis of the absolute difference. Analytica uses the criterion that the absolute difference should be less than the PQL for water or less than 2XPQL for other matrices.

Note 4: For serial dilutions, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample result is not 50 times the MDL or greater, then the fact that the RPD does not meet the 10% criterion has little signifcance. Otherwise it indicates that a matrix bias may exist at the analytical step.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0711172
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071130001**

SAMPLE DUPLICATE REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
Base Sample: B0711172-12B
Prep Date: 11/29/2007

Samp. Anal. Date: 11/29/2007 2:11:40PM
DUP Anal. Date: 11/29/2007 2:28:30PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Fluoride	2.46	2.45	0.4	30	
Chloride	700	702	0.3	30	
Sulfate	263	263	0.0	30	

LCS/LCSD REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
MB: T071130001-MB
Prep Date: 11/29/2007

MB Anal. Date: 11/29/2007 1:04:19PM
LCS Anal. Date: 11/29/2007 1:21:08PM
LCSD Anal. Date: 11/29/2007 1:37:58PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Fluoride	ND	2.62	2.55	2.50	2.50	104.8	102.0	2.7	90 - 110	20	
Chloride	ND	5.13	5.12	5.00	5.00	102.6	102.4	0.2	90 - 110	20	
Sulfate	ND	39.0	39.1	37.5	37.5	104.0	104.3	0.3	90 - 110	20	

MS REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
Parent: B0711172-12B
Prep Date: 11/29/2007

Samp. Anal. Date: 11/29/2007 2:11:40PM
MS Anal. Date: 11/29/2007 2:45:21PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim	Flag
Fluoride	2.46	5.28	2.50	112.8	70 - 130	
Chloride	700	845	133	108.8	70 - 130	*NOTE 2*
Sulfate	263	693	375	114.7	70 - 130	

Prep Batch: **T071203008**

SAMPLE DUPLICATE REPORT

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0711172

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071203008**

SAMPLE DUPLICATE REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS

Base Sample: B0711172-01B
Prep Date: 11/29/2007

Samp. Anal. Date: 12/4/2007 9:06:42AM
DUP Anal. Date: 12/4/2007 9:06:42AM

Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Total Dissolved Solids	3,070	2,980	3.0	20	

LCS/LCSD REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS

MB: T071203008-MB
Prep Date: 11/29/2007

MB Anal. Date: 12/4/2007 9:06:42AM
LCS Anal. Date: 12/4/2007 9:06:42AM LCSD Anal. Date: 12/4/2007 9:06:42AM

Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Total Dissolved Solids	ND	730	735	744	744	98.1	98.8	0.7	80 - 120	20	

MS REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS

Parent: B0711172-01B
Prep Date: 11/29/2007

Samp. Anal. Date: 12/4/2007 9:06:42AM
MS Anal. Date: 12/4/2007 9:06:42AM

Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim	Flag
Total Dissolved Solids	3,070	3,790	744	96.8	70 - 130	*NOTE 2*

Prep Batch: **T071203004**

SAMPLE DUPLICATE REPORT

Analysis: 150.1 - pH, Elecrometric - pH

Base Sample: B0711172-01B
Prep Date: 11/28/2007

Samp. Anal. Date: 11/28/2007 10:05:27AM
DUP Anal. Date: 11/28/2007 10:05:27AM

Units: pH
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
pH	8.97	8.95	0.2	20	

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0711172
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071203004**

Prep Batch: **T071203006**

SAMPLE DUPLICATE REPORT

Analysis: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Base Sample: B0711172-01B
Prep Date: 11/29/2007

Samp. Anal. Date: 11/29/2007 10:08:49AM
Units: mg/L
DUP Anal. Date: 11/29/2007 10:08:49AM
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Bicarbonate	1,280	1,230	4.0	20	
Carbonate	256	288	11.8	20	

LCS/LCSD REPORT

Analysis: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
MB: T071203006-MB
Prep Date: 11/29/2007

MB Anal. Date: 11/29/2007 10:08:49AM
Units: mg/L
LCS Anal. Date: 11/29/2007 10:08:49AM LCSD Anal. Date: 11/29/2007 10:08:49AM
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Bicarbonate	ND	24.0	26.0	25.0	25.0	96.0	104.0	8.0	80 - 120	20	
Carbonate	ND	49.0	50.0	50.0	50.0	98.0	100.0	2.0	80 - 120	20	

FOOTNOTES TO QC REPORT

Note 1: Results are shown to three significant figures to avoid rounding errors in calculations.

Note 2: If the sample concentration is greater than 4 times the spike level, a recovery is not meaningful, and the result should be used as a replicate. In such cases the spike is not as high as expected random measurement variability of the sample result itself.

Note 3: For sample duplicates, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample and duplicate results are not five times the PQL or greater, then the RPD is not expected to fall within the window shown and the comparison should be made on the basis of the absolute difference. Analytica uses the criterion that the absolute difference should be less than the PQL for water or less than 2XPQL for other matrices.

Note 4: For serial dilutions, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample result is not 50 times the MDL or greater, then the fact that the RPD does not meet the 10% criterion has little signifcance. Otherwise it indicates that a matrix bias may exist at the analytical step.

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **81,530** **Lab Project Number:** **B0711172**

Prep Date: 11/29/2007

Lab Method Blank Id: T071130001-MB
Prep Batch ID: T071130001
Method: Inorganic Anions by Ion Chromatography - Anions by IC

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T071130001-LCS	LCS	071129_011.DXD	11/29/2007 1:21:08PM
T071130001-LCSD	LCSD	071129_012.DXD	11/29/2007 1:37:58PM
B0711172-01B	KF2007-01(58) and KF-98-02(53)	071129_013.DXD	11/29/2007 1:54:49PM
B0711172-12B	KF2007-01(58) DUP and KF-98-02(53)DUP	071129_014.DXD	11/29/2007 2:11:40PM
B0711172-12B-DUP	DUP	071129_015.DXD	11/29/2007 2:28:30PM
B0711172-12B-MS	MS	071129_016.DXD	11/29/2007 2:45:21PM
B0711172-12B	KF2007-01(58) DUP and KF-98-02(53)DUP	071129_044.DXD	11/29/2007 10:36:20PM
B0711172-12B-DUP	DUP	071129_045.DXD	11/29/2007 10:53:10PM
B0711172-12B-MS	MS	071129_046.DXD	11/29/2007 11:09:59PM
B0711172-01B	KF2007-01(58) and KF-98-02(53)	071130_007.DXD	11/30/2007 12:00:01PM
B0711172-12B	KF2007-01(58) DUP and KF-98-02(53)DUP	071130_008.DXD	11/30/2007 12:16:51PM
B0711172-12B-DUP	DUP	071130_009.DXD	11/30/2007 12:33:40PM
B0711172-12B-MS	MS	071130_010.DXD	11/30/2007 12:50:29PM

Prep Date: 11/30/2007

Lab Method Blank Id: T071130013-MB
Prep Batch ID: T071130013
Method: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0711172-01A	KF2007-01(58) and KF-98-02(53)	B113007W.WKS	11/30/2007 4:07:17PM
B0711172-12A	KF2007-01(58) DUP and KF-98-02(53)DUP	B113007W.WKS	11/30/2007 4:09:34PM
J0711112-01B	Batch QC	B113007W.WKS	11/30/2007 4:14:48PM
T071130013-LCS	LCS	B113007W.WKS	11/30/2007 4:02:28PM
T071130013-LCSD	LCSD	B113007W.WKS	11/30/2007 4:05:02PM
J0711112-01B-DUP	DUP	B113007W.WKS	11/30/2007 4:17:01PM
J0711112-01B-MS	MS	B113007W.WKS	11/30/2007 4:19:11PM
J0711112-01B-MSD	MSD	B113007W.WKS	11/30/2007 4:21:35PM
J0711112-01B-PDS	PDS	B113007W.WKS	11/30/2007 4:23:43PM

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **81,530** **Lab Project Number:** **B0711172**

Prep Date: 12/3/2007

Lab Method Blank Id: T071203005-MB
Prep Batch ID: T071203005
Method: SW6010B - ICP - Total

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0711172-02A	123 S 87W 0-4' SPOIL	E12037A	12/3/2007 1:27:00PM
B0711172-03A	123 S 89W 0-4' SPOIL	E12037A	12/3/2007 1:32:00PM
B0711172-04A	125 S 88W 0-4' SPOIL	E12037A	12/3/2007 1:37:00PM
B0711172-05A	120 S 89W 0-4' SPOIL	E12037A	12/3/2007 1:43:00PM
B0711172-06A	Barber Ramp 3 Composite Spoil A	E12037A	12/3/2007 2:28:00PM
B0711172-07A	Barber Ramp 3 Composite Spoil B	E12037A	12/3/2007 2:33:00PM
B0711172-08A	Barber Ramp 3 Composite Spoil C	E12037A	12/3/2007 2:38:00PM
B0711172-09A	Ash Composite 70% FA	E12037A	12/3/2007 2:43:00PM
B0711172-10A	Ash Composite Dup 1 70% FA	E12037A	12/3/2007 2:48:00PM
B0711172-11A	Ash Composite Dup2 70% FA	E12037A	12/3/2007 2:53:00PM
T071203005-LCS	LCS	E12037A	12/3/2007 1:17:00PM
T071203005-LCS	LCS	E12037A	12/3/2007 2:58:00PM
T071203005-LCSD	LCSD	E12037A	12/3/2007 1:22:00PM
B0711172-05A-DUP	DUP	E12037A	12/3/2007 1:48:00PM
B0711172-05A-MS	MS	E12037A	12/3/2007 1:53:00PM
B0711172-05A-MSD	MSD	E12037A	12/3/2007 1:58:00PM
B0711172-05A-PDS	PDS	E12037A	12/3/2007 2:18:00PM
B0711172-02A	123 S 87W 0-4' SPOIL	E12047A	12/4/2007 3:03:00PM
B0711172-03A	123 S 89W 0-4' SPOIL	E12047A	12/4/2007 3:08:00PM
B0711172-04A	125 S 88W 0-4' SPOIL	E12047A	12/4/2007 3:13:00PM
B0711172-05A	120 S 89W 0-4' SPOIL	E12047A	12/4/2007 3:18:00PM
B0711172-06A	Barber Ramp 3 Composite Spoil A	E12047A	12/4/2007 4:04:00PM
B0711172-07A	Barber Ramp 3 Composite Spoil B	E12047A	12/4/2007 4:09:00PM
B0711172-08A	Barber Ramp 3 Composite Spoil C	E12047A	12/4/2007 4:14:00PM
B0711172-09A	Ash Composite 70% FA	E12047A	12/4/2007 4:19:00PM
B0711172-10A	Ash Composite Dup 1 70% FA	E12047A	12/4/2007 4:24:00PM
B0711172-11A	Ash Composite Dup2 70% FA	E12047A	12/4/2007 4:29:00PM
T071203005-LCS	LCS	E12047A	12/4/2007 2:53:00PM
T071203005-LCSD	LCSD	E12047A	12/4/2007 2:58:00PM
B0711172-05A-DUP	DUP	E12047A	12/4/2007 3:23:00PM
B0711172-05A-MS	MS	E12047A	12/4/2007 3:28:00PM
B0711172-05A-MSD	MSD	E12047A	12/4/2007 3:33:00PM
B0711172-05A-PDS	PDS	E12047A	12/4/2007 3:54:00PM

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **81,530** **Lab Project Number:** **B0711172**

Prep Date: 11/29/2007

Lab Method Blank Id: T071203006-MB
Prep Batch ID: T071203006
Method: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0711172-01B	KF2007-01(58) and KF-98-02(53)		11/29/2007 10:08:49AM
B0711172-12B	KF2007-01(58) DUP and KF-98-02(53)DUP		11/29/2007 10:08:49AM
T071203006-LCS	LCS		11/29/2007 10:08:49AM
T071203006-LCSD	LCSD		11/29/2007 10:08:49AM
B0711172-01B-DUP	DUP		11/29/2007 10:08:49AM

Prep Date: 11/29/2007

Lab Method Blank Id: T071203008-MB
Prep Batch ID: T071203008
Method: 160.1 - Total Dissolved Solids dried at 180°C - TDS

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0711172-01B	KF2007-01(58) and KF-98-02(53)		12/4/2007 9:06:42AM
B0711172-12B	KF2007-01(58) DUP and KF-98-02(53)DUP		12/4/2007 9:06:42AM
T071203008-LCS	LCS		12/4/2007 9:06:42AM
T071203008-LCSD	LCSD		12/4/2007 9:06:42AM
B0711172-01B-DUP	DUP		12/4/2007 9:06:42AM
B0711172-01B-MS	MS		12/4/2007 9:06:42AM

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **81,530** **Lab Project Number:** **B0711172**

Prep Date: 12/3/2007

Lab Method Blank Id: T071203011-MB
Prep Batch ID: T071203011
Method: SW6010B - ICP - Total

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0711172-01A	KF2007-01(58) and KF-98-02(53)	E12037A	12/3/2007 6:01:00PM
B0711172-12A	KF2007-01(58) DUP and KF-98-02(53)DUP	E12037A	12/3/2007 6:06:00PM
F0711221-01A	Batch QC	E12037A	12/3/2007 6:11:00PM
T071203011-LCS	LCS	E12037A	12/3/2007 5:51:00PM
T071203011-LCSD	LCSD	E12037A	12/3/2007 5:56:00PM
F0711221-01A-DUP	DUP	E12037A	12/3/2007 6:16:00PM
F0711221-01A-MS	MS	E12037A	12/3/2007 6:21:00PM
F0711221-01A-MSD	MSD	E12037A	12/3/2007 6:26:00PM
F0711221-01A-PDS	PDS	E12037A	12/3/2007 6:31:00PM
B0711172-01A	KF2007-01(58) and KF-98-02(53)	E12047A	12/4/2007 5:19:00PM
B0711172-12A	KF2007-01(58) DUP and KF-98-02(53)DUP	E12047A	12/4/2007 5:24:00PM
F0711221-01A	Batch QC	E12047A	12/5/2007 9:03:00AM
T071203011-LCS	LCS	E12047A	12/4/2007 5:09:00PM
T071203011-LCSD	LCSD	E12047A	12/4/2007 5:14:00PM
F0711221-01A-DUP	DUP	E12047A	12/5/2007 9:08:00AM
F0711221-01A-MS	MS	E12047A	12/5/2007 9:13:00AM
F0711221-01A-MSD	MSD	E12047A	12/5/2007 9:18:00AM
F0711221-01A-PDS	PDS	E12047A	12/5/2007 9:23:00AM
F0711221-01A-MS	MS	E12057A	12/5/2007 6:20:00PM
F0711221-01A-MSD	MSD	E12057A	12/6/2007 10:14:00AM

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **81,530** **Lab Project Number:** **B0711172**

Prep Date: 12/4/2007

Lab Method Blank Id: T071204013-MB

Prep Batch ID: T071204013

Method: SW7471A - Mercury in Solid or Semisolid Waste by CVAA - Tot

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0711172-02A	123 S 87W 0-4' SPOIL	B120407S.WKS	12/4/2007 3:25:10PM
B0711172-03A	123 S 89W 0-4' SPOIL	B120407S.WKS	12/4/2007 4:05:31PM
B0711172-04A	125 S 88W 0-4' SPOIL	B120407S.WKS	12/4/2007 4:13:55PM
B0711172-05A	120 S 89W 0-4' SPOIL	B120407S.WKS	12/5/2007 9:42:00AM
B0711172-06A	Barber Ramp 3 Composite Spoil A	B120407S.WKS	12/5/2007 9:49:39AM
B0711172-07A	Barber Ramp 3 Composite Spoil B	B120407S.WKS	12/5/2007 9:57:26AM
B0711172-08A	Barber Ramp 3 Composite Spoil C	B120407S.WKS	12/5/2007 10:05:12AM
B0711172-09A	Ash Composite 70% FA	B120407S.WKS	12/5/2007 10:21:36AM
B0711172-10A	Ash Composite Dup 1 70% FA	B120407S.WKS	12/5/2007 10:31:17AM
B0711172-11A	Ash Composite Dup2 70% FA	B120407S.WKS	12/5/2007 10:40:18AM
T071204013-LCS	LCS	B120407S.WKS	12/4/2007 3:08:17PM
T071204013-LCSD	LCSD	B120407S.WKS	12/4/2007 3:16:19PM
B0711172-02A-DUP	DUP	B120407S.WKS	12/4/2007 3:33:00PM
B0711172-02A-MS	MS	B120407S.WKS	12/4/2007 3:41:00PM
B0711172-02A-MSD	MSD	B120407S.WKS	12/4/2007 3:49:21PM
B0711172-02A-PDS	PDS	B120407S.WKS	12/4/2007 3:57:39PM

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **81,530** **Lab Project Number:** **B0711172**

Prep Date: 12/6/2007

Lab Method Blank Id: T071207005-MB

Prep Batch ID: T071207005

Method: ASTM D2216 - Pmoist

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0711172-02A	123 S 87W 0-4' SPOIL		12/7/2007 9:39:41AM
B0711172-03A	123 S 89W 0-4' SPOIL		12/7/2007 9:39:41AM
B0711172-04A	125 S 88W 0-4' SPOIL		12/7/2007 9:39:41AM
B0711172-05A	120 S 89W 0-4' SPOIL		12/7/2007 9:39:41AM
B0711172-06A	Barber Ramp 3 Composite Spoil A		12/7/2007 9:39:41AM
B0711172-07A	Barber Ramp 3 Composite Spoil B		12/7/2007 9:39:41AM
B0711172-08A	Barber Ramp 3 Composite Spoil C		12/7/2007 9:39:41AM
B0711172-09A	Ash Composite 70% FA		12/7/2007 9:39:41AM
B0711172-10A	Ash Composite Dup 1 70% FA		12/7/2007 9:39:41AM
B0711172-11A	Ash Composite Dup2 70% FA		12/7/2007 9:39:41AM
B0711172-11A-DUP	DUP		12/7/2007 9:39:41AM

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:

ND = Not Detected at or above the Reporting Limit
NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:

LOW = Recovery is below Lower Control Limit
HIGH = Recovery , RPD, or other parameter is above Upper Control Limit
E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:

B = Analyte was detected in the laboratory method blank
J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:

J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
W = Post digestion spike did not meet criteria
S = Reported value determined by the Method of Standard Additions (MSA)

Other Flags may be applied. See Case Narrative for Description

Workorder (SDG): B0711172

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

REPORTING CONVENTIONS FOR THIS REPORT

B0711172

TestPkgName	Basis	# Sig Figs	Reporting Limit
150.1/150.1 (Aqueous) - pH	As Received		Report to PQL
160.1/160.1 (Aqueous) - TDS	As Received		Report to PQL
300.0/300.0 (Aqueous) - Anions by IC	As Received		Report to PQL
310.1/310.1 (Aqueous) - Alkalinity	As Received		Report to PQL
6010B/3010A (Aqueous) - Total	As Received		Report to PQL
6010B/3050B (Solid) - Total	Dry Weight Basis		Report to PQL
7470A/7470A (Aqueous) - Total Hg	As Received		Report to PQL
7471A/7471A (Solid) - Total Hg	Dry Weight Basis		Report to PQL
ASTMD2216/ASTMD2216 (Solid) - Pmoist	As Received		Report to MDL, J qual below PQL

Attachment 41.A.E

Cation Exchange Capacity Laboratory Results

Colorado Analytical Laboratories, Inc.

Analytical Results

Report To: Claire Toon
Company: Analytica Environmental Labs
12189 Pennsylvania Street
Thornton CO 80241-3115

Task No: 07112932
Date Received 11/29/07
Reported: 12/13/07
Client PO: T13190
Client Project: B0711172

Customer Sample ID 123 S 87W 0-4' Spoil (B0711172-2B)
Sample Date/Time: 11/15/07 12:00 PM
Lab Number: 07112932-01
Matrix: Soil - Environmental

Test	Result	Reporting Limit	Method
Dry Weight Basis			
Cation Exchange Capacity	**9.7 meq/100g**	0.1	EPA 9081

ASA = "Methods of Soil Analysis, Parts 1 and 2", Second Edition, American Society of Agronomy and Soil Science Society of America. Madison, WI, 1982.
SW-846 = "Test Methods for Evaluating Solid Waste"; USEPA; November 1986
AB-DTPA = "Soil Testing Methods Used at Colorado State University for the Evaluation of Fertility, Salinity and Trace Element Toxicity"; Colorado State University Technical Bulletin LTR88-2; Jan 1998; SM Workman, PN Soltanpour and RH Follett.

DATA APPROVED FOR RELEASE BY

240 South Main Street / Brighton, CO 80601-0507 / 303-659-2313
Mailing Address: P.O. Box 507 / Brighton, CO 80601-0507 / Fax: 303-659-2315

Colorado Analytical Laboratories, Inc.

Analytical Results

Report To: Claire Toon
Company: Analytica Environmental Labs
12189 Pennsylvania Street
Thornton CO 80241-3115

Task No: 07112932
Date Received 11/29/07
Reported: 12/13/07
Client PO: T13190
Client Project: B0711172

Customer Sample ID **123 S 89W 0-4' Spoil (B0711172-3B)** **Lab Number:** 07112932-02
Sample Date/Time: 11/15/07 12:00 PM **Matrix:** Soil - Environmental

Test	Result	Reporting Limit	Method
Dry Weight Basis			
Cation Exchange Capacity	**8.7 meq/100g**	0.1	EPA 9081

ASA = "Methods of Soil Analysis, Parts 1 and 2", Second Edition, American Society of Agronomy and Soil Science Society of America. Madison. WI. 1982.
SW-846 = "Test Methods for Evaluating Solid Waste"; USEPA; November 1986
AB-DTPA = "Soil Testing Methods Used at Colorado State University for the Evaluation of Fertility, Salinity and Trace Element Toxicity"; Colorado State University Technical Bulletin LTB88-2; Jan 1998; SM Workman, PN Soltanpour and RH Follett.

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Colorado Analytical Laboratories, Inc.

Analytical Results

Report To: Claire Toon
Company: Analytica Environmental Labs
12189 Pennsylvania Street
Thornton CO 80241-3115

Task No: 07112932
Date Received 11/29/07
Reported: 12/13/07
Client PO: T13190
Client Project: B0711172

Customer Sample ID 125 S 88W 0-4' Spoil (B0711172-4B)
Sample Date/Time: 11/15/07 12:00 PM
Lab Number: 07112932-03
Matrix: Soil - Environmental

Test	Result	Reporting Limit	Method
Dry Weight Basis			
Cation Exchange Capacity	**9.4 meq/100g**	0.1	EPA 9081

ASA = "Methods of Soil Analysis, Parts 1 and 2", Second Edition, American Society of Agronomy and Soil Science Society of America, Madison, WI. 1982.
SW-846 = "Test Methods for Evaluating Solid Waste"; USEPA; November 1986
AB-DTPA = "Soil Testing Methods Used at Colorado State University for the Evaluation of Fertility, Salinity and Trace Element Toxicity"; Colorado State University Technical Bulletin LTB88-2; Jan 1998; SM Workman, PN Soltanpour and RH Follett.

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Colorado Analytical Laboratories, Inc.

Analytical Results

Report To: Claire Toon
Company: Analytica Environmental Labs
12189 Pennsylvania Street
Thornton CO 80241-3115

Task No: 07112932
Date Received 11/29/07
Reported: 12/13/07
Client PO: T13190
Client Project: B0711172

Customer Sample ID 120 S 89W 0-4' Spoil (B0711172-5B) **Lab Number:** 07112932-04
Sample Date/Time: 11/15/07 12:00 PM **Matrix:** Soil - Environmental

Test	Result	Reporting Limit	Method
Dry Weight Basis			
Cation Exchange Capacity	**9.0 meq/100g**	0.1	EPA 9081

ASA = "Methods of Soil Analysis, Parts 1 and 2", Second Edition, American Society of Agronomy and Soil Science Society of America. Madison, WI. 1982.
SW-846 = "Test Methods for Evaluating Solid Waste"; USEPA: November 1986
AB-DTPA = "Soil Testing Methods Used at Colorado State University for the Evaluation of Fertility, Salinity and Trace Element Toxicity"; Colorado State University Technical Bulletin LTB88-2; Jan 1998; SM Workman, PN Soltanpour and RH Follett.

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Mailing Address: P.O. Box 507 / Brighton, CO 80601-0507 / Fax: 303-659-2315

Colorado Analytical Laboratories, Inc.

Analytical Results

Report To: Claire Toon
Company: Analytica Environmental Labs
12189 Pennsylvania Street
Thornton CO 80241-3115

Task No: 07112932
Date Received 11/29/07
Reported: 12/13/07
Client PO: T13190
Client Project: B0711172

Customer Sample ID **Barber Ramp 3 Composite Soil A (B0711172** **Lab Number:** 07112932-05
Sample Date/Time: 11/15/07 12:00 PM **Matrix:** Soil - Environmental

Test	Result	Reporting Limit	Method
Dry Weight Basis			
Cation Exchange Capacity	**9.0 meq/100g**	0.1	EPA 9081

ASA = "Methods of Soil Analysis, Parts 1 and 2", Second Edition, American Society of Agronomy and Soil Science Society of America, Madison, WI, 1982.
SW-846 = "Test Methods for Evaluating Solid Waste"; USEPA; November 1986
AB-DTPA = "Soil Testing Methods Used at Colorado State University for the Evaluation of Fertility, Salinity and Trace Element Toxicity"; Colorado State University Technical Bulletin LTB88-2; Jan 1998; SM Workman, PN Soltanpour and RH Follett.

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Mailing Address: P.O. Box 507 / Brighton, CO 80601-0507 / Fax: 303-659-2315

Colorado Analytical Laboratories, Inc.

Analytical Results

Report To: Claire Toon
Company: Analytica Environmental Labs
12189 Pennsylvania Street
Thornton CO 80241-3115

Task No: 07112932
Date Received 11/29/07
Reported: 12/13/07
Client PO: T13190
Client Project: B0711172

Customer Sample ID **Barber Ramp 3 Composite Soil B (B0711172** **Lab Number:** 07112932-06
Sample Date/Time: 11/15/07 12:00 PM **Matrix:** Soil - Environmental

Test	Result	Reporting Limit	Method
Dry Weight Basis			
Cation Exchange Capacity	**9.6 meq/100g**	0.1	EPA 9081

ASA = "Methods of Soil Analysis, Parts 1 and 2", Second Edition, American Society of Agronomy and Soil Science Society of America, Madison, WI, 1982.
SW-846 = "Test Methods for Evaluating Solid Waste"; USEPA; November 1986
AB-DTPA = "Soil Testing Methods Used at Colorado State University for the Evaluation of Fertility, Salinity and Trace Element Toxicity"; Colorado State University Technical Bulletin LTB88-2; Jan 1998; SM Workman, PN Soltanpour and RH Follett.

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240 South Main Street / Brighton, CO 80601-0507 / 303-659-2313
Mailing Address: P.O. Box 507 / Brighton, CO 80601-0507 / Fax: 303-659-2315

Colorado Analytical Laboratories, Inc.

Analytical Results

Report To: Claire Toon
Company: Analytica Environmental Labs
12189 Pennsylvania Street
Thornton CO 80241-3115

Task No: 07112932
Date Received 11/29/07
Reported: 12/13/07
Client PO: T13190
Client Project: B0711172

Customer Sample ID **Barber Ramp 3 Composite Soil C (B0711172** **Lab Number:** 07112932-07
Sample Date/Time: 11/15/07 12:00 PM **Matrix:** Soil - Environmental

Test	Result	Reporting Limit	Method
Dry Weight Basis			
Cation Exchange Capacity	**9.9 meq/100g**	0.1	EPA 9081

ASA = "Methods of Soil Analysis, Parts 1 and 2", Second Edition, American Society of Agronomy and Soil Science Society of America. Madison, WI, 1982.
SW-846 = "Test Methods for Evaluating Solid Waste"; USEPA; November 1986
AB-DTPA = "Soil Testing Methods Used at Colorado State University for the Evaluation of Fertility, Salinity and Trace Element Toxicity"; Colorado State University Technical Bulletin LTB88-2; Jan 1998; SM Workman, PN Soltanpour and RH Follett.

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Colorado Analytical Laboratories, Inc.

Analytical Results

Report To: Claire Toon
Company: Analytica Environmental Labs
12189 Pennsylvania Street
Thornton CO 80241-3115

Task No: 07112932
Date Received 11/29/07
Reported: 12/13/07
Client PO: T13190
Client Project: B0711172

Customer Sample ID **Ash Composite 70% FA (B0711172-9B)** **Lab Number:** 07112932-08
Sample Date/Time: 11/26/07 10:00 AM **Matrix:** Soil - Environmental

Test	Result	Reporting Limit	Method
Dry Weight Basis			
Cation Exchange Capacity	**0.4 meq/100g**	0.1	EPA 9081

ASA = "Methods of Soil Analysis, Parts 1 and 2", Second Edition, American Society of Agronomy and Soil Science Society of America. Madison, WI, 1982.
SW-846 = "Test Methods for Evaluating Solid Waste"; USEPA; November 1986
AB-DTPA = "Soil Testing Methods Used at Colorado State University for the Evaluation of Fertility, Salinity and Trace Element Toxicity": Colorado State University Technical Bulletin LTB88-2: Jan 1998: SM Workman, PN Soltanpour and RH Follett.

DATA APPROVED FOR RELEASE BY

240 South Main Street / Brighton, CO 80601-0507 / 303-659-2313
Mailing Address: P.O. Box 507 / Brighton, CO 80601-0507 / Fax: 303-659-2315

Colorado Analytical Laboratories, Inc.

Analytical Results

Report To: Claire Toon
Company: Analytica Environmental Labs
12189 Pennsylvania Street
Thornton CO 80241-3115

Task No: 07112932
Date Received 11/29/07
Reported: 12/13/07
Client PO: T13190
Client Project: B0711172

Customer Sample ID **Ash Composite Dup 1 70% FA (B0711172-10** **Lab Number:** 07112932-09
Sample Date/Time: 11/26/07 10:00 AM **Matrix:** Soil - Environmental

Test	Result	Reporting Limit	Method
Dry Weight Basis			
Cation Exchange Capacity	**0.2 meq/100g**	0.1	EPA 9081

ASA = "Methods of Soil Analysis, Parts 1 and 2", Second Edition, American Society of Agronomy and Soil Science Society of America, Madison, WI. 1982.
SW-846 = "Test Methods for Evaluating Solid Waste"; USEPA; November 1986
AB-DTPA = "Soil Testing Methods Used at Colorado State University for the Evaluation of Fertility, Salinity and Trace Element Toxicity"; Colorado State University Technical Bulletin LTBR-2; Jan 1998; SM Workmen, PN Soltanpour and RH Follett.

DATA APPROVED FOR RELEASE BY

240 South Main Street / Brighton, CO 80601-0507 / 303-659-2313
Mailing Address: P.O. Box 507 / Brighton, CO 80601-0507 / Fax: 303-659-2315

Colorado Analytical Laboratories, Inc.

Analytical Results

Report To: Claire Toon
Company: Analytica Environmental Labs
12189 Pennsylvania Street
Thornton CO 80241-3115

Task No: 07112932
Date Received 11/29/07
Reported: 12/13/07
Client PO: T13190
Client Project: B0711172

Customer Sample ID **Ash Composite Dup 2 70% FA (B0711172-11** **Lab Number:** 07112932-10
Sample Date/Time: 11/26/07 10:00 AM **Matrix:** Soil - Environmental

Test	Result	Reporting Limit	Method
Dry Weight Basis			
Cation Exchange Capacity	**0.2 meq/100g**	0.1	EPA 9081

ASA = "Methods of Soil Analysis, Parts 1 and 2", Second Edition. American Society of Agronomy and Soil Science Society of America, Madison, WI, 1982.
SW-846 = "Test Methods for Evaluating Solid Waste"; USEPA; November 1986
AB-DTPA = "Soil Testing Methods Used at Colorado State University for the Evaluation of Fertility, Salinity and Trace Element Toxicity"; Colorado State University Technical Bulletin LTB88-2; Jan 1998; SM Workman, FN Soltanpour and RH Follett.

DATA APPROVED FOR RELEASE BY

240 South Main Street / Brighton, CO 80601-0507 / 303-659-2313
Mailing Address: P.O. Box 507 / Brighton, CO 80601-0507 / Fax: 303-659-2315

07112932

PAGE 12/12

COLORADO ANALYTICAL

3036592315

12/13/2007 15:58

07112932

Analytica Chain of Custody Form

Page _____ of _____

ANALYTICA GROUP®

12189 Pennsylvania St.
Thornton, CO 80241
(303) 469-8868
(303) 469-5254 fax

4307 Arctic Boulevard
Anchorage, AK 99503
(907) 258-2155
(907) 258-6634 fax

475 Hall St.
Fairbanks, AK 99701
(907) 456 - 3116
(907) 456-3125 Fax

5438 Shaune Drive
Juneau, AK 99801
(907) 780-6668
(907) 780-6670 fax

Chain of Custody No: 62661

Client Name & Address:

Public Water System (PWS) ID#:

Project Name: B0711172

Report to: Claire Toon
Phone No: 303-301-2237
Fax No: above
E-mail: ctoon@analyticagroup.com

Special Instructions/Comments: Sub to CAL

Turnaround Time for Results (TAT)

___ Standard ___ Expedited (< 10 days, prior authorization required)
(please specify due date below; add'l charges may apply)

Requested Due Date for Results:

Section To Be Completed by Analytica

Quote ID: | LGN:

Account #: | Cash | Credit Card

Invoice to Name & Address: Same as Client

P.O. or Contract No: T13190

Requested Analysis/Method

Kit Prep/Shipping Charge: $					9081 Cation Exchange Cap										
Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers									Field Preserved	Field Filtered	MS/MSD ?
1235 87W 0-4' Spoil (B0711172-2B)	11/15/07	12:00	Solid	1	X										
1235 89W 0-4' Spoil (3B)					X										
1255 88W 0-4' Spoil (4B)					X										
1205 89W 0-4' Spoil (5B)					X										
Barber Ramp 3 Composite Spoil AC 6B)					X										
Barber Ramp 3 Composite Spoil BC 7B)					X										
Barber Ramp 3 Composite Spoil CC 8B)	↓	↓			X										
Ash Composite 70% FA (9B)	11/26/07	10:00			X										
Ash Composite Dup1 70% FA (10B)	↓	↓			X										
Ash Composite Dup2 70% FA (11B)	↓	↓	↓	↓	X										

Relinquished by:	Date	Time	Received by:	Date	Time
[signature]	11/29/07	10:00	[signature]	11-29-07	1420
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Name of Sampler: (printed)

Section To Be Completed by Analytica

Condition of Custody Seal?:	THO	ANC	JNU	FBKS
Initialed By:				
Temp/Loc:				
Thermo ID#:				
Shipped Via:				

Version 2.0

Attachment 41.A.F

Leachate Water Quality Laboratory Results

The Analytica Group
CLIENT INVOICE

Remit to: Accounting Dpt
Analytica Environmental Laboratories, Inc.
P.O. Box 973426
Dallas,TX 75397-3426

Phone: (303) 469-8868

Attention: Mr.Art O'Hayre
Invoice to: Applied Hydrology Associates, Inc.
950 South Cherry Street
Suite 810
Denver, CO 80246

Invoice #: **81372**
Work Order#: **B0712127**
Account#: 030188
Quote ID#: 11340
Invoice Date: 1/3/2008
Work ID: Navajo Mine Extension Leaching Study
PO #: none

Received: 12/17/2007
Reported: 1/3/2008
Client Project#: Navajo Mine Extension Leach

Comments:

Item charges		**Qty**	**Price**	**Total**
SW7470A - Mercury in Liquid Waste by CVAA - Total Hg In Aqueous	M	5	35.00	175.00
160.1 - Total Dissolved Solids dried at 180°C - TDS In Liquid	Matrix	5	22.00	110.00
150.1 - pH, Elecrometric - pH In Liquid	Matrix	5	10.00	50.00
SW6010B - ICP - Total In Aqueous	Matrix	5	312.00	1,560.00
Inorganic Anions by Ion Chromatography - Anions by IC In Liquid	Matrix	5	54.00	270.00
310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity In Liquid	Matrix	5	36.00	180.00
		Total of Items Above:		**$2,345.00**

Adjustments or Special Services	**Qty**	**Price**	**Total**
Charge for Tumbling	1	95.00	95.00
	Total of Items Above:		**$95.00**
	Grand Total:		**$2,440.00**

All invoices are due and payable upon receipt. Outstanding balances over 30 days are subject to a finance charge of 1.5% per month, plus a late fee of $25.00. If Analytica engages legal counsel to enforce its rights or any other rights under an application for payment, the customer will be liable to Analytica for all costs of collection and other legal expenses, including reasonable attorney fees.

The Analytica Group
CLIENT INVOICE

REMITTANCE ADVICE
PLEASE RETURN THIS PORTION WITH YOUR PAYMENT

Mr.Art O'Hayre
Applied Hydrology Associates, Inc.
950 South Cherry Street
Suite 810
Denver, CO 80246

Account#: 030188
Invoice #: **81372**
Invoice Date: 1/3/2008

TOTAL INVOICE AMOUNT: **$2,440.00**

PAYMENT AMOUNT ENCLOSED: _____

ANALYTICA
Environmental Laboratories

Analytica Environmental
Laboratories, Inc.
12189 Pennsylvania Street
Thornton, CO 80241
Phone: 303-469-8868
Fax: 303-469-5254

1/3/2008

Applied Hydrology Associates, Inc.
950 South Cherry Street
Suite 810
Denver, CO 80246
Attn: Art O'Hayre

Work Order #: B0712127
Date: 1/3/2008
Work ID: Navajo Mine Extension Leaching Study
Date Received: 12/17/2007
Proj #: none

Sample Identification

Lab Sample Number	Client Description	Lab Sample Number	Client Description
B0712127-01	MB Leachate 1	B0712127-02	Ash Leachate 1
B0712127-03	Ash Leachate 1 Dup	B0712127-04	Spoil Leachate 1
B0712127-05	Spoil Leachate 1 Dup		

Enclosed are the analytical results for the submitted sample(s). Please review the CASE NARRATIVE for a discussion of any data and/or quality control issues. Listings of data qualifiers, analytical codes, key dates, and QC relationships are provided at the end of the report.

Sincerely,

Claire Toon
Project Manager

"The Science of Analysis, The Art of Service"

Case Narrative

Analytica Environmental Laboratories, Inc.
Work Order: B0712127

Samples were prepared and analyzed according to EPA or equivalent methods outlined in the following references:

Methods for Chemical Analysis of Water and Wastes, USEPA 600/4-79-020,March 1983.

Pfaff, J. D., C. A. Brockhoff and J. W. O'Dell. 1994. The Determination of Inorganic Anions in Water by Ion Chromatography. Method 300.0A. U. S. Environmental Protection Agency. Environmental Monitoring Systems Lab.

Methods for the Determination of Metals in Environmental Samples, EPA/600/R-94/111, May 1994.

SAMPLE RECEIPT:
Five (5) samples were received on 12/17/2007 3:10:00 PM., at a temperature of 20 deg C., at Analytica-Thornton. The samples were received in good condition and in order per chain of custody.

REVIEW FOR COMPLIANCE WITH ANALYTICA QA PLAN
A summary of our review is shown below.

All analytical results contained in this report have been reviewed under Analytica's internal quality assurance and quality control program. Any deviations in quality control parameters for specific analyses are noted in the following text. A complete quality assurance report, including laboratory control, matrix spike, and sample duplicate recoveries is kept on file in our office and is available upon request.

All method specifications were met for the following tests:

Test Method: 150.1 - pH, Elecrometric - pH - Aqueous

Test Method: 160.1 - Total Dissolved Solids dried at 180°C - TDS - Aqueous

Test Method: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity - Aqueous

Test Method: Inorganic Anions by Ion Chromatography - Anions by IC - Aqueous

Test Method: SW6010B - ICP - Total - Aqueous

MS/MSD and DUP OUTLIERS:
As shown below, the MS/MSD was outside of limits for Sodium. The sample had Sodium concentrations greater than four times the spike amount. In these cases it is not appropriate to calculate a recovery. The result should be used as a replicate.

Type	Client Sample	LabSample	Analyte	Recovery	LCL	UCL	Parent	Spike
MS	MB Leachate 1	B0712127-01A	Sodium	418	75	125	1180	10.0
MSD	MB Leachate 1	B0712127-01A	Sodium	-76.	75	125	1180	10.0

Case Narrative

Analytica Environmental Laboratories, Inc.
Work Order: B0712127
(continued)

Test Method: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg - Aqueous

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB Leachate 1**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-01A
Prep Date: 12/18/2007
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T071218023
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 12/18/2007 5:51:20PM
Instrument: CVAA_1
File Name: B121807W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.000050	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-01A
Prep Date: 12/18/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T071218012
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 12/19/2007 4:17:00PM
Instrument: ICP_2
File Name: E12197A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.056**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.12**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**0.33**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**2.9**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**0.073**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**1.2**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.014**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**11**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB Leachate 1**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

Lab Sample Number: B0712127-01A Analysis Date: 12/19/2007 4:17:00PM
Prep Date: 12/18/2007 Instrument: ICP_2
Analytical Method ID: SW6010B - ICP - Total File Name: E12197A
Prep Method ID: 3010_ICP Dilution Factor: 1
Prep Batch Number: T071218012
Report Basis: As Received Analyst Initials: rm
Sample prep wt./vol: 50.00 ml Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**1,200**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-01B Analysis Date: 12/19/2007 2:30:16PM
Prep Date: 12/19/2007 Instrument: Titrametric
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity File Name:
Prep Method ID: Alkalinity_W Dilution Factor: 1
Prep Batch Number: T071219013
Report Basis: As Received Analyst Initials: kl
Sample prep wt./vol: 100.00 ml Prep Extract Vol: 100.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**1,300**		mg/L	5.0	1.5	1
Carbonate		**260**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-01B Analysis Date: 12/18/2007 9:45:23AM
Prep Date: 12/18/2007 Instrument: Probe
Analytical Method ID: 150.1 - pH, Elecrometric - pH File Name:
Prep Method ID: 150.1 Dilution Factor: 1
Prep Batch Number: T071218019
Report Basis: As Received Analyst Initials: kl
Sample prep wt./vol: 10.00 ml Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**9.0**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB Leachate 1**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

Lab Sample Number: B0712127-01B
Prep Date: 12/21/2007
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T071221010
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 12/31/2007 10:51:30AM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**3,000**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-01B
Prep Date: 12/18/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071218016
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 12/18/2007 8:44:03PM
Instrument: IC
File Name: 071218_026.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**2.2**		mg/L	0.40	0.031	1
Sulfate		**280**		mg/L	1.5	0.11	

Lab Sample Number: B0712127-01B
Prep Date: 12/18/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071218016
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 12/20/2007 5:51:04PM
Instrument: IC
File Name: 071220_003.D
Dilution Factor: 20
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**620**		mg/L	16	0.84	3

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Leachate 1**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-02A
Prep Date: 12/18/2007
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T071218023
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 12/18/2007 5:58:45PM
Instrument: CVAA_1
File Name: B121807W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.000050	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-02A
Prep Date: 12/18/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T071218012
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 12/19/2007 4:58:00PM
Instrument: ICP_2
File Name: E12197A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.053**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.099**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**2.6**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**570**		mg/L	0.10	0.013	
Chromium	7440-47-3	**0.011**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**0.13**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**7.7**		mg/L	0.10	0.012	
Manganese	7439-96-5	**0.095**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.15**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**12**		mg/L	1.0	0.31	
Selenium	7784-49-2	**0.14**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Leachate 1**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

Lab Sample Number: B0712127-02A Analysis Date: 12/19/2007 4:58:00PM
Prep Date: 12/18/2007 Instrument: ICP_2
Analytical Method ID: SW6010B - ICP - Total File Name: E12197A
Prep Method ID: 3010_ICP Dilution Factor: 1
Prep Batch Number: T071218012
Report Basis: As Received Analyst Initials: rm
Sample prep wt./vol: 50.00 ml Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**1,200**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**0.12**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-02B Analysis Date: 12/19/2007 2:30:16PM
Prep Date: 12/19/2007 Instrument: Titrametric
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity File Name:
Prep Method ID: Alkalinity_W Dilution Factor: 1
Prep Batch Number: T071219013
Report Basis: As Received Analyst Initials: kl
Sample prep wt./vol: 100.00 ml Prep Extract Vol: 100.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**810**		mg/L	5.0	1.5	1
Carbonate		**ND**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-02B Analysis Date: 12/18/2007 9:45:23AM
Prep Date: 12/18/2007 Instrument: Probe
Analytical Method ID: 150.1 - pH, Elecrometric - pH File Name:
Prep Method ID: 150.1 Dilution Factor: 1
Prep Batch Number: T071218019
Report Basis: As Received Analyst Initials: kl
Sample prep wt./vol: 10.00 ml Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**7.7**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Leachate 1**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

Lab Sample Number: B0712127-02B
Prep Date: 12/21/2007
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T071221010
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 12/31/2007 10:51:30AM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**5,400**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-02B
Prep Date: 12/18/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071218016
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 12/19/2007 9:50:23AM
Instrument: IC
File Name: 071218_027.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**5.0**		mg/L	0.40	0.031	1

Lab Sample Number: B0712127-02B
Prep Date: 12/18/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071218016
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 12/20/2007 6:27:50PM
Instrument: IC
File Name: 071220_005.D
Dilution Factor: 20
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**620**		mg/L	16	0.84	4
Sulfate		**2,400**		mg/L	30	2.2	

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Leachate 1 Dup**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-03A
Prep Date: 12/18/2007
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T071218023
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 12/18/2007 6:00:49PM
Instrument: CVAA_1
File Name: B121807W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.000050	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-03A
Prep Date: 12/18/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T071218012
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 12/19/2007 5:03:00PM
Instrument: ICP_2
File Name: E12197A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**ND**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.10**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**2.5**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**560**		mg/L	0.10	0.013	
Chromium	7440-47-3	**0.011**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**0.13**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**7.6**		mg/L	0.10	0.012	
Manganese	7439-96-5	**0.095**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.14**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**12**		mg/L	1.0	0.31	
Selenium	7784-49-2	**0.13**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Leachate 1 Dup**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

Lab Sample Number: B0712127-03A Analysis Date: 12/19/2007 5:03:00PM
Prep Date: 12/18/2007 Instrument: ICP_2
Analytical Method ID: SW6010B - ICP - Total File Name: E12197A
Prep Method ID: 3010_ICP Dilution Factor: 1
Prep Batch Number: T071218012
Report Basis: As Received Analyst Initials: rm
Sample prep wt./vol: 50.00 ml Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**1,200**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**0.12**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-03B Analysis Date: 12/19/2007 2:30:16PM
Prep Date: 12/19/2007 Instrument: Titrametric
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity File Name:
Prep Method ID: Alkalinity_W Dilution Factor: 1
Prep Batch Number: T071219013
Report Basis: As Received Analyst Initials: kl
Sample prep wt./vol: 100.00 ml Prep Extract Vol: 100.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**820**		mg/L	5.0	1.5	1
Carbonate		**ND**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-03B Analysis Date: 12/18/2007 9:45:23AM
Prep Date: 12/18/2007 Instrument: Probe
Analytical Method ID: 150.1 - pH, Elecrometric - pH File Name:
Prep Method ID: 150.1 Dilution Factor: 1
Prep Batch Number: T071218019
Report Basis: As Received Analyst Initials: kl
Sample prep wt./vol: 10.00 ml Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**7.6**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Leachate 1 Dup**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

Lab Sample Number: B0712127-03B
Prep Date: 12/21/2007
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T071221010
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 12/31/2007 10:51:30AM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**5,400**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-03B
Prep Date: 12/18/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071218016
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 12/19/2007 10:08:47AM
Instrument: IC
File Name: 071218_028.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**5.0**		mg/L	0.40	0.031	1

Lab Sample Number: B0712127-03B
Prep Date: 12/18/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071218016
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 12/20/2007 5:57:55AM
Instrument: IC
File Name: 071219_058.D
Dilution Factor: 10
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sulfate		**2,500**		mg/L	15	1.1	2

Lab Sample Number: B0712127-03B
Prep Date: 12/18/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071218016
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 12/20/2007 7:04:36PM
Instrument: IC
File Name: 071220_007.D
Dilution Factor: 27
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**610**		mg/L	21	1.1	3

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Spoil Leachate 1**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-04A
Prep Date: 12/18/2007
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T071218023
Report Basis: As Received
Sample prep wt./vol: 25.00 ml

Analysis Date: 12/18/2007 6:03:02PM
Instrument: CVAA_1
File Name: B121807W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00024	0.000060	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-04A
Prep Date: 12/18/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T071218012
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 12/19/2007 5:08:00PM
Instrument: ICP_2
File Name: E12197A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.29**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.25**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**0.44**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**64**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**0.17**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**0.10**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**13**		mg/L	0.10	0.012	
Manganese	7439-96-5	**0.11**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.014**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**14**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Spoil Leachate 1**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

Lab Sample Number: B0712127-04A Analysis Date: 12/19/2007 5:08:00PM
Prep Date: 12/18/2007 Instrument: ICP_2
Analytical Method ID: SW6010B - ICP - Total File Name: E12197A
Prep Method ID: 3010_ICP Dilution Factor: 1
Prep Batch Number: T071218012
Report Basis: As Received Analyst Initials: rm
Sample prep wt./vol: 50.00 ml Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**1,200**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-04B Analysis Date: 12/19/2007 2:30:16PM
Prep Date: 12/19/2007 Instrument: Titrametric
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity File Name:
Prep Method ID: Alkalinity_W Dilution Factor: 1
Prep Batch Number: T071219013
Report Basis: As Received Analyst Initials: kl
Sample prep wt./vol: 100.00 ml Prep Extract Vol: 100.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**1,000**		mg/L	5.0	1.5	1
Carbonate		**ND**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-04B Analysis Date: 12/18/2007 9:45:23AM
Prep Date: 12/18/2007 Instrument: Probe
Analytical Method ID: 150.1 - pH, Elecrometric - pH File Name:
Prep Method ID: 150.1 Dilution Factor: 1
Prep Batch Number: T071218019
Report Basis: As Received Analyst Initials: kl
Sample prep wt./vol: 10.00 ml Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**8.0**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Spoil Leachate 1**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

Lab Sample Number: B0712127-04B
Prep Date: 12/21/2007
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T071221010
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 12/31/2007 10:51:30AM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**3,500**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-04B
Prep Date: 12/18/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071218016
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 12/19/2007 10:27:11AM
Instrument: IC
File Name: 071218_029.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**1.6**		mg/L	0.40	0.031	1

Lab Sample Number: B0712127-04B
Prep Date: 12/18/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071218016
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 12/20/2007 6:16:18AM
Instrument: IC
File Name: 071219_059.D
Dilution Factor: 10
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sulfate		**970**		mg/L	15	1.1	2

Lab Sample Number: B0712127-04B
Prep Date: 12/18/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071218016
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 12/20/2007 7:23:00PM
Instrument: IC
File Name: 071220_008.D
Dilution Factor: 27
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**610**		mg/L	21	1.1	3

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Spoil Leachate 1 Dup**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-05A
Prep Date: 12/18/2007
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T071218023
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 12/18/2007 6:05:14PM
Instrument: CVAA_1
File Name: B121807W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.000050	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-05A
Prep Date: 12/18/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T071218012
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 12/19/2007 5:13:00PM
Instrument: ICP_2
File Name: E12197A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.30**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.20**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**0.45**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**69**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**0.18**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**0.10**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**13**		mg/L	0.10	0.012	
Manganese	7439-96-5	**0.10**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.014**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**14**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Spoil Leachate 1 Dup**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

Lab Sample Number: B0712127-05A Analysis Date: 12/19/2007 5:13:00PM
Prep Date: 12/18/2007 Instrument: ICP_2
Analytical Method ID: SW6010B - ICP - Total File Name: E12197A
Prep Method ID: 3010_ICP Dilution Factor: 1
Prep Batch Number: T071218012
Report Basis: As Received Analyst Initials: rm
Sample prep wt./vol: 50.00 ml Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**1,200**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**0.0095**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-05B Analysis Date: 12/19/2007 2:30:16PM
Prep Date: 12/19/2007 Instrument: Titrametric
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity File Name:
Prep Method ID: Alkalinity_W Dilution Factor: 1
Prep Batch Number: T071219013
Report Basis: As Received Analyst Initials: kl
Sample prep wt./vol: 100.00 ml Prep Extract Vol: 100.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**1,000**		mg/L	5.0	1.5	1
Carbonate		**ND**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-05B Analysis Date: 12/18/2007 9:45:23AM
Prep Date: 12/18/2007 Instrument: Probe
Analytical Method ID: 150.1 - pH, Elecrometric - pH File Name:
Prep Method ID: 150.1 Dilution Factor: 1
Prep Batch Number: T071218019
Report Basis: As Received Analyst Initials: kl
Sample prep wt./vol: 10.00 ml Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**7.9**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Spoil Leachate 1 Dup**

Matrix: Aqueous Collection Date: 12/17/2007 9:40:00AM

Lab Sample Number: B0712127-05B
Prep Date: 12/21/2007
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T071221010
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 12/31/2007 10:51:30AM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**3,600**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0712127-05B
Prep Date: 12/18/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071218016
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 12/19/2007 10:45:34AM
Instrument: IC
File Name: 071218_030.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**1.6**		mg/L	0.40	0.031	1

Lab Sample Number: B0712127-05B
Prep Date: 12/18/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071218016
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 12/20/2007 6:34:42AM
Instrument: IC
File Name: 071219_060.D
Dilution Factor: 10
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sulfate		**990**		mg/L	15	1.1	2

Lab Sample Number: B0712127-05B
Prep Date: 12/18/2007
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T071218016
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 12/20/2007 7:41:22PM
Instrument: IC
File Name: 071220_009.D
Dilution Factor: 27
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**610**		mg/L	21	1.1	3

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 12/18/2007 12:00:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T071218023-MB
Prep Date: 12/18/2007
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T071218023
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 12/18/2007 5:28:28PM
Instrument: CVAA_1
File Name: B121807W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.000050	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T071218012-MB
Prep Date: 12/18/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T071218012
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 12/19/2007 3:57:00PM
Instrument: ICP_2
File Name: E12197A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**ND**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**ND**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**ND**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**ND**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**ND**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**ND**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**ND**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 12/18/2007 12:00:00AM

Lab Sample Number: T071218012-MB
Prep Date: 12/18/2007
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T071218012
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 12/19/2007 3:57:00PM
Instrument: ICP_2
File Name: E12197A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**ND**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T071219013-MB
Prep Date: 12/19/2007
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T071219013
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 12/19/2007 2:30:16PM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 100.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**ND**		mg/L	5.0	1.5	1
Carbonate		**ND**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T071221010-MB
Prep Date: 12/21/2007
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T071221010
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 12/31/2007 10:51:30AM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**ND**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous

Collection Date: 12/18/2007 12:00:00AM

Lab Sample Number: T071218016-MB

Prep Date: 12/18/2007

Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC

Prep Method ID: 300.0

Prep Batch Number: T071218016

Report Basis: As Received

Sample prep wt./vol: 20.00 ml

Analysis Date: 12/18/2007 6:17:08PM

Instrument: IC

File Name: 071218_018.D

Dilution Factor: 1

Analyst Initials: KB

Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**ND**		mg/L	0.80	0.042	1
Fluoride		**ND**		mg/L	0.40	0.031	
Sulfate		**ND**		mg/L	1.5	0.11	

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0712127
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071218012**

SAMPLE DUPLICATE REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0712127-01A
Prep Date: 12/18/2007

Samp. Anal. Date: 12/19/2007 4:17:00PM
DUP Anal. Date: 12/19/2007 4:22:00PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Aluminum	0.0556	0.211	116.6	20	OUT
Antimony	ND	ND	0.0	20	
Arsenic	ND	ND	0.0	20	
Barium	0.118	0.143	19.2	20	
Beryllium	ND	ND	0.0	20	
Boron	0.331	0.340	2.7	20	
Cadmium	ND	ND	0.0	20	
Calcium	2.89	3.28	12.6	20	
Chromium	ND	ND	0.0	20	
Cobalt	ND	0.00726	0.0	20	
Copper	ND	0.00783	0.0	20	
Iron	0.0733	0.313	124.1	20	OUT
Lead	ND	ND	0.0	20	
Magnesium	1.24	1.42	13.5	20	
Manganese	ND	0.0116	0.0	20	
Molybdenum	0.0141	0.0180	24.3	20	OUT
Nickel	ND	ND	0.0	20	
Potassium	11.0	11.6	5.3	20	
Selenium	ND	ND	0.0	20	
Silver	ND	ND	0.0	20	
Sodium	1,180	1,200	1.7	20	
Thallium	ND	ND	0.0	20	
Vanadium	ND	ND	0.0	20	
Zinc	ND	0.00930	0.0	20	
Lithium	ND	ND	0.0	20	

LCS/LCSD REPORT

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0712127
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071218012**

LCS/LCSD REPORT

Analysis: SW6010B - ICP - Total
MB: T071218012-MB
Prep Date: 12/18/2007
MB Anal. Date: 12/19/2007 3:57:00PM
Units: mg/L
LCS Anal. Date: 12/19/2007 4:02:00PM LCSD Anal. Date: 12/19/2007 4:07:00PM Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Aluminum	ND	2.06	2.08	2.00	2.00	103.0	104.0	1.0	89 - 117	20	
Antimony	ND	0.487	0.492	0.500	0.500	97.4	98.4	1.0	82 - 117	20	
Arsenic	ND	1.96	1.97	2.00	2.00	98.0	98.5	0.5	86 - 116	20	
Barium	ND	1.95	1.98	2.00	2.00	97.5	99.0	1.5	86 - 116	20	
Beryllium	ND	0.0507	0.0517	0.0500	0.0500	101.4	103.4	2.0	87 - 111	20	
Boron	ND	0.648	0.616	0.500	0.500	129.6	123.2	5.1	76 - 130	20	
Cadmium	ND	0.0434	0.0442	0.0500	0.0500	86.8	88.4	1.8	79 - 113	20	
Calcium	ND	9.92	10.2	10.0	10.0	99.2	102.0	2.8	79 - 119	20	
Chromium	ND	0.200	0.200	0.200	0.200	100.0	100.0	0.0	86 - 117	20	
Cobalt	ND	0.494	0.500	0.500	0.500	98.8	100.0	1.2	82 - 118	20	
Copper	ND	0.244	0.249	0.250	0.250	97.6	99.6	2.0	86 - 117	20	
Iron	ND	1.03	1.07	1.00	1.00	103.0	107.0	3.8	83 - 121	20	
Lead	ND	0.497	0.493	0.500	0.500	99.4	98.6	0.8	83 - 121	20	
Magnesium	ND	10.1	10.2	10.0	10.0	101.0	102.0	1.0	83 - 118	20	
Manganese	ND	0.497	0.505	0.500	0.500	99.4	101.0	1.6	82 - 121	20	
Molybdenum	ND	0.491	0.501	0.500	0.500	98.2	100.2	2.0	82 - 120	20	
Nickel	ND	0.490	0.496	0.500	0.500	98.0	99.2	1.2	84 - 117	20	
Potassium	ND	9.25	8.89	10.0	10.0	92.5	88.9	4.0	74 - 110	20	
Selenium	ND	1.93	1.97	2.00	2.00	96.5	98.5	2.1	87 - 117	20	
Silver	ND	0.256	0.259	0.250	0.250	102.4	103.6	1.2	80 - 127	20	
Sodium	ND	9.79	9.97	10.0	10.0	97.9	99.7	1.8	87 - 113	20	
Thallium	ND	0.199	0.207	0.200	0.200	99.5	103.5	3.9	89 - 113	20	
Vanadium	ND	0.504	0.512	0.500	0.500	100.8	102.4	1.6	87 - 119	20	
Zinc	ND	0.476	0.495	0.500	0.500	95.2	99.0	3.9	81 - 120	20	
Lithium	ND	0.492	0.500	0.500	0.500	98.4	100.0	1.6	80 - 120	20	

MS/MSD REPORT

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0712127
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071218012**

MS/MSD REPORT

Analysis: SW6010B - ICP - Total
Parent: B0712127-01A
Prep Date: 12/18/2007
Samp. Anal. Date: 12/19/2007 4:17:00PM
Units: mg/L
MS Anal. Date: 12/19/2007 4:27:00PM MSD Anal. Date: 12/19/2007 4:42:00PM Matrix: Aqueous

Analyte Name	SampResult	MSRes.	MSDRes	SPLev	SPDLev	Recov.	MSD Rec.	RPD	Recov Lim	RPDLim	Flag
Aluminum	0.0556	2.11	2.04	2.00	2.00	102.7	99.2	3.4	75 - 125	20	
Antimony	ND	0.497	0.482	0.500	0.500	99.4	96.4	3.1	75 - 125	20	
Arsenic	ND	2.04	1.98	2.00	2.00	102.0	99.0	3.0	75 - 125	20	
Barium	0.118	2.03	1.93	2.00	2.00	95.6	90.6	5.1	75 - 125	20	
Beryllium	ND	0.0510	0.0495	0.0500	0.0500	102.0	99.0	3.0	75 - 125	20	
Boron	0.331								75 - 125		
Cadmium	ND	0.0445	0.0459	0.0500	0.0500	89.0	91.8	3.1	75 - 125	20	
Calcium	2.89	12.9	12.7	10.0	10.0	100.1	98.1	1.6	75 - 125	20	
Chromium	ND	0.198	0.196	0.200	0.200	99.0	98.0	1.0	75 - 125	20	
Cobalt	ND	0.490	0.482	0.500	0.500	98.0	96.4	1.6	75 - 125	20	
Copper	ND	0.244	0.234	0.250	0.250	97.6	93.6	4.2	75 - 125	20	
Iron	0.0733	1.05	1.02	1.00	1.00	97.7	94.7	2.9	75 - 125	20	
Lead	ND	0.499	0.484	0.500	0.500	99.8	96.8	3.1	75 - 125	20	
Magnesium	1.24	11.4	10.9	10.0	10.0	101.6	96.6	4.5	75 - 125	20	
Manganese	ND	0.499	0.484	0.500	0.500	99.8	96.8	3.1	75 - 125	20	
Molybdenum	0.0141	0.508	0.496	0.500	0.500	98.8	96.4	2.4	75 - 125	20	
Nickel	ND	0.487	0.478	0.500	0.500	97.4	95.6	1.9	75 - 125	20	
Potassium	11.0	21.0	20.3	10.0	10.0	100.0	93.0	3.4	75 - 125	20	
Selenium	ND	2.03	1.97	2.00	2.00	101.5	98.5	3.0	75 - 125	20	
Silver	ND	0.251	0.245	0.250	0.250	100.4	98.0	2.4	75 - 125	20	
Sodium	1,180	1,230	1,180	10.0	10.0	500.0	0.0	4.1	75 - 125	20	*NOTE 2 NOTE 2*
Thallium	ND		0.167		0.200		83.5		75 - 125	20	
Vanadium	ND	0.509	0.494	0.500	0.500	101.8	98.8	3.0	75 - 125	20	
Zinc	ND	0.492	0.484	0.500	0.500	98.4	96.8	1.6	75 - 125	20	
Lithium	ND	0.578	0.548	0.500	0.500	115.6	109.6	5.3	75 - 125	20	

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0712127
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071218012**

POST DIGESTION SPIKE REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0712127-01A
Prep Date: 12/18/2007
Samp. Anal. Date: 12/19/2007 4:17:00PM
Units: mg/L
PDS Anal. Date: 12/19/2007 4:48:00PM
Matrix: Aqueous

Analyte Name	SampResult	PDSRes.	SPLev	Recov.	Recov Lim	Flag	
Aluminum	0.0556	2.04	2.00	99.3	75 - 117		
Antimony	ND	0.485	0.500	96.5	75 - 117		
Arsenic	ND	1.99	2.00	99.3	75 - 116		
Barium	0.118	1.93	2.00	90.7	75 - 116		
Beryllium	ND	0.0492	0.0500	98.0	75 - 111		
Cadmium	ND	0.0447	0.0500	89.7	75 - 113		
Calcium	2.89	12.6	10.0	97.4	75 - 119		
Chromium	ND	0.193	0.200	96.4	75 - 117		
Cobalt	ND	0.477	0.500	95.0	75 - 118		
Copper	ND	0.234	0.250	93.4	75 - 117		
Iron	0.0733	1.02	1.00	94.6	75 - 121		
Lead	ND	0.487	0.500	97.1	75 - 121		
Magnesium	1.24	11.0	10.0	97.3	75 - 118		
Manganese	ND	0.482	0.500	95.9	75 - 121		
Molybdenum	0.0141	0.494	0.500	96.1	75 - 120		
Nickel	ND	0.473	0.500	94.4	75 - 117		
Potassium	11.0	20.6	10.0	96.2	75 - 110		
Selenium	ND	1.98	2.00	99.7	75 - 117		
Silver	ND	0.245	0.250	98.4	75 - 127		
Sodium	1,180	1,180	10.0	-54.9	75 - 113	lowPDS	Note 2
Thallium	ND	0.191	0.200	90.7	75 - 113		
Vanadium	ND	0.492	0.500	98.0	75 - 119		
Zinc	ND	0.482	0.500	98.8	75 - 120		
Lithium	ND	0.553	0.500	94.5	75 - 120		

SERIAL DILUTION REPORT

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0712127
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071218012**

SERIAL DILUTION REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0712127-01A
Prep Date: 12/18/2007
Samp. Anal. Date: 12/19/2007 4:17:00PM
Units: mg/L
SER DIL. Date: 12/19/2007 4:53:00PM
Matrix: Aqueous

Analyte Name	SampResult	PQL.	MDL.	SerialRes.	SerPQL.	RPD	Flag
Aluminum	0.0556	0.050	0.014	ND	0.25		
Antimony	ND	0.050	0.0067	ND	0.25		
Arsenic	ND	0.10	0.015	ND	0.50		
Barium	0.118	0.0100	0.00016	0.133	0.050	11.9	OUT
Beryllium	ND	0.0010	0.000060	ND	0.0050		
Boron	0.331	0.050	0.0018	0.365	0.25	9.7	
Cadmium	ND	0.0060	0.00051	ND	0.030		
Calcium	2.89	0.10	0.013	3.32	0.50	13.8	OUT
Chromium	ND	0.0100	0.0018	ND	0.050		
Cobalt	ND	0.0050	0.0016	ND	0.025		
Copper	ND	0.0050	0.0019	ND	0.025		
Iron	0.0733	0.050	0.0027	ND	0.25		
Lead	ND	0.050	0.011	ND	0.25		
Magnesium	1.24	0.10	0.012	1.32	0.50	6.2	
Manganese	ND	0.0100	0.00066	ND	0.050		
Molybdenum	0.0141	0.0100	0.0018	ND	0.050		
Nickel	ND	0.040	0.0027	ND	0.20		
Potassium	11.0	1.0	0.31	12.1	5.0	9.5	
Selenium	ND	0.10	0.026	ND	0.50		
Silver	ND	0.015	0.00066	ND	0.075		
Sodium	1,180	3.0	0.028	1,310	15	10.4	OUT
Thallium	ND	0.40	0.011	ND	2.0		
Vanadium	ND	0.0100	0.00072	ND	0.050		
Zinc	ND	0.0050	0.0010	ND	0.025		
Lithium	ND	0.10	0.00072	ND	0.50		

Prep Batch: **T071218023**

LCS/LCSD REPORT

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0712127

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071218023**

LCS/LCSD REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg

MB: T071218023-MB

Prep Date: 12/18/2007

MB Anal. Date: 12/18/2007 5:28:28PM

Units: mg/L

LCS Anal. Date: 12/18/2007 5:31:45PM LCSD Anal. Date: 12/18/2007 5:33:52PM Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Mercury	ND	0.00218	0.00214	0.00200	0.0020	109.0	107.0	1.9	80 - 120	20	

FOOTNOTES TO QC REPORT

Note 1: Results are shown to three significant figures to avoid rounding errors in calculations.

Note 2: If the sample concentration is greater than 4 times the spike level, a recovery is not meaningful, and the result should be used as a replicate. In such cases the spike is not as high as expected random measurement variability of the sample result itself.

Note 3: For sample duplicates, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample and duplicate results are not five times the PQL or greater, then the RPD is not expected to fall within the window shown and the comparison should be made on the basis of the absolute difference. Analytica uses the criterion that the absolute difference should be less than the PQL for water or less than 2XPQL for other matrices.

Note 4: For serial dilutions, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample result is not 50 times the MDL or greater, then the fact that the RPD does not meet the 10% criterion has little signifcance. Otherwise it indicates that a matrix bias may exist at the analytical step.

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0712127
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071218016**

LCS/LCSD REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
MB: T071218016-MB
Prep Date: 12/18/2007
MB Anal. Date: 12/18/2007 6:17:08PM
Units: mg/L
LCS Anal. Date: 12/18/2007 6:35:30PM LCSD Anal. Date: 12/18/2007 6:53:53PM Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Fluoride	ND	2.25	2.29	2.50	2.50	90.0	91.6	1.8	90 - 110	20	
Chloride	ND	4.68	4.68	5.00	5.00	93.6	93.6	0.0	90 - 110	20	
Sulfate	ND	38.6	36.4	37.5	37.5	102.9	97.1	5.9	90 - 110	20	

Prep Batch: **T071221010**

SAMPLE DUPLICATE REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Base Sample: B0712127-01B
Prep Date: 12/21/2007
Samp. Anal. Date: 12/31/2007 10:51:30AM
Units: mg/L
DUP Anal. Date: 12/31/2007 10:51:30AM
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Total Dissolved Solids	3,030	3,030	0.0	20	

LCS/LCSD REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS
MB: T071221010-MB
Prep Date: 12/21/2007
MB Anal. Date: 12/31/2007 10:51:30AM
Units: mg/L
LCS Anal. Date: 12/31/2007 10:51:30AM LCSD Anal. Date: 12/31/2007 10:51:30AM Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Total Dissolved Solids	ND	742	753	744	744	99.7	101.2	1.5	80 - 120	20	

MS REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Parent: B0712127-01B
Prep Date: 12/21/2007
Samp. Anal. Date: 12/31/2007 10:51:30AM
Units: mg/L
MS Anal. Date: 12/31/2007 10:51:30AM
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim		Flag
Total Dissolved Solids	3,030	3,820	744	106.2	70 - 130	*NOTE 2*	

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0712127
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T071221010**

MS REPORT

Prep Batch: **T071218019**

SAMPLE DUPLICATE REPORT

Analysis: 150.1 - pH, Elecrometric - pH
Base Sample: B0712127-01B
Prep Date: 12/18/2007

Samp. Anal. Date: 12/18/2007 9:45:23AM
DUP Anal. Date: 12/18/2007 9:45:23AM
Units: pH
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
pH	9.01	8.95	0.7	20	

Prep Batch: **T071219013**

SAMPLE DUPLICATE REPORT

Analysis: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Base Sample: B0712127-01B
Prep Date: 12/19/2007

Samp. Anal. Date: 12/19/2007 2:30:16PM
DUP Anal. Date: 12/19/2007 2:30:16PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Bicarbonate	1,270	1,230	3.2	20	
Carbonate	264	284	7.3	20	

LCS/LCSD REPORT

Analysis: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
MB: T071219013-MB
Prep Date: 12/19/2007

MB Anal. Date: 12/19/2007 2:30:16PM
Units: mg/L
LCS Anal. Date: 12/19/2007 2:30:16PM LCSD Anal. Date: 12/19/2007 2:30:16PM Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Bicarbonate	ND	25.0	25.0	25.0	25.0	100.0	100.0	0.0	80 - 120	20	
Carbonate	ND	51.0	50.0	50.0	50.0	102.0	100.0	2.0	80 - 120	20	

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

FOOTNOTES TO QC REPORT

Note 1: Results are shown to three significant figures to avoid rounding errors in calculations.

Note 2: If the sample concentration is greater than 4 times the spike level, a recovery is not meaningful, and the result should be used as a replicate. In such cases the spike is not as high as expected random measurement variability of the sample result itself.

Note 3: For sample duplicates, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample and duplicate results are not five times the PQL or greater, then the RPD is not expected to fall within the window shown and the comparison should be made on the basis of the absolute difference. Analytica uses the criterion that the absolute difference should be less than the PQL for water or less than 2XPQL for other matrices.

Note 4: For serial dilutions, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample result is not 50 times the MDL or greater, then the fact that the RPD does not meet the 10% criterion has little signifcance. Otherwise it indicates that a matrix bias may exist at the analytical step.

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **82,236** **Lab Project Number:** **B0712127**

Prep Date: 12/18/2007

Lab Method Blank Id: T071218012-MB

Prep Batch ID: T071218012

Method: SW6010B - ICP - Total

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0712127-01A	MB Leachate 1	E12197A	12/19/2007 4:17:00PM
B0712127-02A	Ash Leachate 1	E12197A	12/19/2007 4:58:00PM
B0712127-03A	Ash Leachate 1 Dup	E12197A	12/19/2007 5:03:00PM
B0712127-04A	Spoil Leachate 1	E12197A	12/19/2007 5:08:00PM
B0712127-05A	Spoil Leachate 1 Dup	E12197A	12/19/2007 5:13:00PM
T071218012-LCS	LCS	E12197A	12/19/2007 4:02:00PM
T071218012-LCSD	LCSD	E12197A	12/19/2007 4:07:00PM
B0712127-01A-DUP	DUP	E12197A	12/19/2007 4:22:00PM
B0712127-01A-MS	MS	E12197A	12/19/2007 4:27:00PM
B0712127-01A-MSD	MSD	E12197A	12/19/2007 4:42:00PM
B0712127-01A-PDS	PDS	E12197A	12/19/2007 4:48:00PM
T071218012-LCSD	LCSD	E12207A	12/20/2007 12:58:00PM

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **82,236** **Lab Project Number:** **B0712127**

Prep Date: 12/18/2007

Lab Method Blank Id: T071218016-MB

Prep Batch ID: T071218016

Method: Inorganic Anions by Ion Chromatography - Anions by IC

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T071218016-LCS	LCS	071218_019.DXD	12/18/2007 6:35:30PM
T071218016-LCSD	LCSD	071218_020.DXD	12/18/2007 6:53:53PM
B0712136-01C	Batch QC	071218_022.DXD	12/18/2007 7:30:41PM
B0712136-01C-DUP	DUP	071218_023.DXD	12/18/2007 7:49:04PM
B0712136-01C-MS	MS	071218_024.DXD	12/18/2007 8:07:29PM
B0712127-01B	MB Leachate 1	071218_026.DXD	12/18/2007 8:44:03PM
B0712127-02B	Ash Leachate 1	071218_027.DXD	12/19/2007 9:50:23AM
B0712127-03B	Ash Leachate 1 Dup	071218_028.DXD	12/19/2007 10:08:47AM
B0712127-04B	Spoil Leachate 1	071218_029.DXD	12/19/2007 10:27:11AM
B0712127-05B	Spoil Leachate 1 Dup	071218_030.DXD	12/19/2007 10:45:34AM
T071218016-LCS	LCS	071219_049.DXD	12/20/2007 3:12:25AM
T071218016-LCSD	LCSD	071219_050.DXD	12/20/2007 3:30:48AM
B0712136-01C	Batch QC	071219_052.DXD	12/20/2007 4:07:34AM
B0712136-01C-DUP	DUP	071219_053.DXD	12/20/2007 4:25:58AM
B0712136-01C-MS	MS	071219_054.DXD	12/20/2007 4:44:21AM
B0712127-03B	Ash Leachate 1 Dup	071219_058.DXD	12/20/2007 5:57:55AM
B0712127-04B	Spoil Leachate 1	071219_059.DXD	12/20/2007 6:16:18AM
B0712127-05B	Spoil Leachate 1 Dup	071219_060.DXD	12/20/2007 6:34:42AM
B0712127-01B	MB Leachate 1	071220_003.DXD	12/20/2007 5:51:04PM
B0712127-02B	Ash Leachate 1	071220_005.DXD	12/20/2007 6:27:50PM
B0712127-03B	Ash Leachate 1 Dup	071220_007.DXD	12/20/2007 7:04:36PM
B0712127-04B	Spoil Leachate 1	071220_008.DXD	12/20/2007 7:23:00PM
B0712127-05B	Spoil Leachate 1 Dup	071220_009.DXD	12/20/2007 7:41:22PM

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **82,236** **Lab Project Number:** **B0712127**

Prep Date: 12/18/2007

Lab Method Blank Id: T071218023-MB
Prep Batch ID: T071218023
Method: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
J0712041-01B-MS	MS	B1218072.WKS	12/19/2007 12:58:57PM
B0712127-01A	MB Leachate 1	B121807W.WKS	12/18/2007 5:51:20PM
B0712127-02A	Ash Leachate 1	B121807W.WKS	12/18/2007 5:58:45PM
B0712127-03A	Ash Leachate 1 Dup	B121807W.WKS	12/18/2007 6:00:49PM
B0712127-04A	Spoil Leachate 1	B121807W.WKS	12/18/2007 6:03:02PM
B0712127-05A	Spoil Leachate 1 Dup	B121807W.WKS	12/18/2007 6:05:14PM
J0712041-01B	Batch QC	B121807W.WKS	12/18/2007 6:13:47PM
T071218023-LCS	LCS	B121807W.WKS	12/18/2007 5:31:45PM
T071218023-LCSD	LCSD	B121807W.WKS	12/18/2007 5:33:52PM
J0712041-01B-DUP	DUP	B121807W.WKS	12/18/2007 6:15:51PM
J0712041-01B-MSD	MSD	B121807W.WKS	12/18/2007 6:25:46PM
J0712041-01B-PDS	PDS	B121807W.WKS	12/18/2007 6:27:55PM

Prep Date: 12/19/2007

Lab Method Blank Id: T071219013-MB
Prep Batch ID: T071219013
Method: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0712127-01B	MB Leachate 1		12/19/2007 2:30:16PM
B0712127-02B	Ash Leachate 1		12/19/2007 2:30:16PM
B0712127-03B	Ash Leachate 1 Dup		12/19/2007 2:30:16PM
B0712127-04B	Spoil Leachate 1		12/19/2007 2:30:16PM
B0712127-05B	Spoil Leachate 1 Dup		12/19/2007 2:30:16PM
T071219013-LCS	LCS		12/19/2007 2:30:16PM
T071219013-LCSD	LCSD		12/19/2007 2:30:16PM
B0712127-01B-DUP	DUP		12/19/2007 2:30:16PM

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **82,236** **Lab Project Number:** **B0712127**

Prep Date: 12/21/2007

Lab Method Blank Id: T071221010-MB

Prep Batch ID: T071221010

Method: 160.1 - Total Dissolved Solids dried at 180°C - TDS

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0712127-01B	MB Leachate 1		12/31/2007 10:51:30AM
B0712127-02B	Ash Leachate 1		12/31/2007 10:51:30AM
B0712127-03B	Ash Leachate 1 Dup		12/31/2007 10:51:30AM
B0712127-04B	Spoil Leachate 1		12/31/2007 10:51:30AM
B0712127-05B	Spoil Leachate 1 Dup		12/31/2007 10:51:30AM
T071221010-LCS	LCS		12/31/2007 10:51:30AM
T071221010-LCSD	LCSD		12/31/2007 10:51:30AM
B0712127-01B-DUP	DUP		12/31/2007 10:51:30AM
B0712127-01B-MS	MS		12/31/2007 10:51:30AM

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:

ND = Not Detected at or above the Reporting Limit
NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:

LOW = Recovery is below Lower Control Limit
HIGH = Recovery , RPD, or other parameter is above Upper Control Limit
E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:

B = Analyte was detected in the laboratory method blank
J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:

J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
W = Post digestion spike did not meet criteria
S = Reported value determined by the Method of Standard Additions (MSA)

Several ways of defining the limit of detection and quantitation are prevalent in the laboratory industry and may appear in Analytica reports. These include the following:

MRL = "minimum reporting level", from the EPA Safe Drinking Water program (SDW)
PQL = "practical quantitation limit", from SW-846
EQL = "estimated quantitation limit", from SW-846
LOQ = "limit of quantitation", from a number of authoritative sources

In Analytica's work, all of these terms have the same meaning, equivalent to the EPA definition of the MRL. This reporting level is supported by a satisfactory calibration data point which is at that level or lower, and also is supported by a method detection limit (MDL) determined by the procedure in 40CFR. The MDL is lower than the MRL and represents an estimate of the level where positive detections have a 99% probability of being real, but where quantitation accuracy is unknown.

The MRL as defined by Analytica is the lowest demonstrated point of known quantitation accuracy.
The MRL should not be confused with the MCL, which is the EPA-defined "maximum contaminant level" allowed for certain regulated targets under specific regulations, such as the National Primary Drinking Water Regulations. Normally, the MRL is set at a level which is much lower than the MCL in order to ensure that levels are well below those limits. Not all target analytes have MCL levels established.

Other Flags may be applied. See Case Narrative for Description

Workorder (SDG): B0712127

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

REPORTING CONVENTIONS FOR THIS REPORT

B0712127

TestPkgName	Basis	# Sig Figs	Reporting Limit
150.1/150.1 (Aqueous) - pH	As Received	2	Report to PQL
160.1/160.1 (Aqueous) - TDS	As Received	2	Report to PQL
300.0/300.0 (Aqueous) - Anions by IC	As Received	2	Report to PQL
310.1/310.1 (Aqueous) - Alkalinity	As Received	2	Report to PQL
6010B/3010A (Aqueous) - Total	As Received	2	Report to PQL
7470A/7470A (Aqueous) - Total Hg	As Received	2	Report to PQL

Analytica Chain of Custody Form

ANALYTICA GROUP®

12189 Pennsylvania St. Thornton, CO 80241 (303) 469-8868 (303) 469-5254 fax

4307 Arctic Boulevard Anchorage, AK 99503 (907) 258-2155 (907) 258-6634 fax

475 Hall St. Fairbanks, AK 99701 (907) 456 - 3116 (907) 456-3125 Fax

5438 Shaune Drive Juneau, AK 99801 (907) 780-6668 (907) 780-6670 fax

Chain of Custody No: 62854

Client Name & Address: Applied Hydrology Associates, Inc.

Public Water System (PWS) ID#:

Project Name: Navajo Mine Extension Leaching Study

Section To be Completed by Analytica

Quote ID:

LGN: B0712127

Account #: 030185 Cash Credit Card

Report to:

Phone No:

Fax No:

E-mail:

Turnaround Time for Results (TAT)

___ Standard ___ Expedited (< 10 days, prior authorization required)

(please specify due date below; add'l charges may apply)

Requested Due Date for Results:

Invoice to Name & Address:

Special Instructions/Comments:

Tumbled in house by R.S.

Duplicate 18 hour tumble step 1

P.O. or Contract No:

Kit Prep/Shipping Charge: $

Requested Analysis/Method

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers	6010B/3010A-TTL Lot # Pres.	7470A/7470A-Hg Lot # Pres.	150.1 pH Lot # Pres.	160.1 TDS Lot # Pres.	300.0 Anions/IC Lot # Pres.	310.1 Alk Lot # Pres.		Field Preserved	Field Filtered	MS/MSD ?
MB Leachate 1	12/17/07	0940	other	2	X	X	X	X	X	X				
Ash Leachate 1	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				
Ash Leachate 1 Dup														
Spoil Leachate 1														
Spoil Leachate 1 Dup	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓				

Relinquished by:	Date	Time	Received by:	Date	Time
R. Seeman	12/17/07	1510	[signature]	12/17/07	15:10
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Name of Sampler: (printed)					

Section To Be Completed by Analytica

	THO	ANC	JNU	FBKS
Condition of Custody Seal?:				
Initialed By:				
Temp/Loc:				
Thermo ID#:				
Shipped Via:				

Version 2.0

ANALYTICA

Cooler Receipt Form

Client: Applied Hydrology Associates **Client Code:** 030188 **Order #:** B0712127
Project: Navajo Mine Extension Leaching Study

Cooler ID: 1

A. Preliminary Examination Phase:

Date cooler opened: 12/17/2007
Cooler opened by: gp **Signature:** GP

1. Was airbill Attached?	N/A	**Airbill #:**		**Carrier Name:**	Other
2. Custody Seals?	N/A	**How many?**	0	**Location:**	**Seal Name:**
3. Seals intact?	N/A				
4. COC Attached?	Yes	**Properly Completed?**	Yes	**Signed by AEL employee?**	Yes
5. Project Identification from custody paper:		Navajo Mine Extension Leaching Study			
6. Preservative:	None	**Temperature:**	20.0 deg. C		

Designated person initial here to acknowledge receipt: GP **Date:** 12/17/07

COMMENTS:

B. Log-In Phase: **Samples Log-in Date:** 12/17/2007 **Log-in By:** gp

1. Packing Type:	Other		
2. Were samples in separate bags?	N/A		
3. Were containers intact?	Yes	**Labels agree with COC?**	Yes
4. Number of bottles received:	10	**Number of samples received:**	5
5. Correct containers used?	Yes	**Correct preservatives added?**	Yes
6. Sufficient sample volume?	Yes		
7. Bubbles in VOA samples?	N/A		

8. Was Project manager called and status discussed? No

9. Was anyone called? No **Who was called?** _____ **By whom?** _____ **Date:** _____

COMMENTS:

The Analytica Group
CLIENT INVOICE

Remit to: Accounting Dpt
Analytica Environmental Laboratories, Inc.
P.O. Box 973426
Dallas,TX 75397-3426

Phone: (303) 469-8868

Attention: Mr.Art O'Hayre
Invoice to: Applied Hydrology Associates, Inc.
950 South Cherry Street
Suite 810
Denver, CO 80246

Invoice #: **81993**
Work Order#: **B0801027**
Account#: 030188
Quote ID#: 11340
Invoice Date: 1/21/2008
Work ID: Navajo Mine Extension Leaching Study
PO #: none

Received: 1/7/2008
Reported: 1/21/2008
Client Project#: Navajo Mine Extension Leach

Comments:

Item charges		**Qty**	**Price**	**Total**
SW7470A - Mercury in Liquid Waste by CVAA - Total Hg In Aqueous	M	2	35.00	70.00
160.1 - Total Dissolved Solids dried at 180°C - TDS In Liquid	Matrix	2	22.00	44.00
150.1 - pH, Elecrometric - pH In Liquid	Matrix	2	10.00	20.00
SW6010B - ICP - Total In Aqueous	Matrix	2	312.00	624.00
Inorganic Anions by Ion Chromatography - Anions by IC In Liquid	Matrix	2	54.00	108.00
310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity In Liquid	Matrix	2	36.00	72.00
		Total of Items Above:		**$938.00**

Adjustments or Special Services	**Qty**	**Price**	**Total**
One Gallon of DI water	4	24.00	96.00
Tumbling Charge	1	95.00	95.00
Total of Items Above:			**$191.00**
Grand Total:			**$1,129.00**

All invoices are due and payable upon receipt. Outstanding balances over 30 days are subject to a finance charge of 1.5% per month, plus a late fee of $25.00. If Analytica engages legal counsel to enforce its rights or any other rights under an application for payment, the customer will be liable to Analytica for all costs of collection and other legal expenses, including reasonable attorney fees.

The Analytica Group
CLIENT INVOICE

REMITTANCE ADVICE
PLEASE RETURN THIS PORTION WITH YOUR PAYMENT

Mr.Art O'Hayre
Applied Hydrology Associates, Inc.
950 South Cherry Street
Suite 810
Denver, CO 80246

Account#: 030188
Invoice #: **81993**
Invoice Date: 1/21/2008

TOTAL INVOICE AMOUNT: **$1,129.00**

PAYMENT AMOUNT ENCLOSED: _____

Analytica Environmental
Laboratories, Inc.
12189 Pennsylvania Street
Thornton, CO 80241
Phone: 303-469-8868
Fax: 303-469-5254

ANALYTICA
Environmental Laboratories

1/21/2008

Applied Hydrology Associates, Inc.
950 South Cherry Street
Suite 810
Denver, CO 80246
Attn: Art O'Hayre

Work Order #: B0801027
Date: 1/21/2008
Work ID: Navajo Mine Extension Leaching Study
Date Received: 1/7/2008
Proj #: none

Sample Identification

Lab Sample Number	Client Description	Lab Sample Number	Client Description
B0801027-01	MB	B0801027-02	4 Corners PP Bottom Ash Leac

Enclosed are the analytical results for the submitted sample(s). Please review the CASE NARRATIVE for a discussion of any data and/or quality control issues. Listings of data qualifiers, analytical codes, key dates, and QC relationships are provided at the end of the report.

Sincerely,

Kristen Stone
Project Manager

"The Science of Analysis, The Art of Service"

Case Narrative

Analytica Environmental Laboratories, Inc.
Work Order: B0801027

Samples were prepared and analyzed according to EPA or equivalent methods outlined in the following references:

Methods for Chemical Analysis of Water and Wastes, USEPA 600/4-79-020, March 1983.

Pfaff, J. D., C. A. Brockhoff and J. W. O'Dell. 1994. The Determination of Inorganic Anions in Water by Ion Chromatography. Method 300.0A. U. S. Environmental Protection Agency. Environmental Monitoring Systems Lab.

Methods for the Determination of Metals in Environmental Samples, EPA/600/R-94/111, May 1994.

SAMPLE RECEIPT:
Two (2) samples were received on 1/7/2008 1:55:00 PM., at a temperature of 3.1 deg C., at Analytica-Thornton. The samples were received in good condition and in order per chain of custody. The samples were tumbled upon arrival to the laboratory.

REVIEW FOR COMPLIANCE WITH ANALYTICA QA PLAN
A summary of our review is shown below.

All analytical results contained in this report have been reviewed under Analytica's internal quality assurance and quality control program. Any deviations in quality control parameters for specific analyses are noted in the following text. A complete quality assurance report, including laboratory control, matrix spike, and sample duplicate recoveries is kept on file in our office and is available upon request.

All method specifications were met for the following tests:

Test Method: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg - Aqueous
Test Method: 150.1 - pH, Elecrometric - pH - Aqueous
Test Method: 160.1 - Total Dissolved Solids dried at 180°C - TDS - Aqueous
Test Method: Inorganic Anions by Ion Chromatography - Anions by IC - Aqueous

Test Method: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity - Aqueous

MS/MSD and DUP OUTLIERS:
As shown below, the MS was outside of limits for Bicarbonate and Carbonate. Bicarbonate had a sample concentration that was greater than four times the spike amount. In these cases it is not appropriate to calculate a recovery. The result should be used as a replicate. The MS recovery of Carbonate was slightly low. No corrective action was taken, as the recoveries of this compounds in the LCS/LCSD were acceptable.

Type	Client Sample	LabSample	Analyte	Recovery	LCL	UCL	Parent	Spike
MS	4 Corners PP Bot	B0801027-02B	Bicarbonate	56.0	70	130	1250	50.0
MS	4 Corners PP Bot	B0801027-02B	Carbonate	68.0	70	130	228	100

Test Method: SW6010B - ICP - Total - Aqueous

Case Narrative

Analytica Environmental Laboratories, Inc.
Work Order: B0801027
(continued)

MS/MSD and DUP OUTLIERS:

As shown below, the MS/MSD were outside of the limits for Sodium. Sodium had a sample concentration that was greater than four times the spike amount. In these cases it is not appropriate to calculate a recovery. The result should be used as a replicate. The MSD recovery of Potassium is slightly low. No corrective action was taken, as the recovery of Pottasium in the LCS/LCSD/MS were acceptable.

Type	Client Sample	LabSample	Analyte	Recovery	LCL	UCL	Parent	Spike
MS	4 Corners PP Bot	B0801027-02A	Sodium	-149	75	125	1130	10.0
MSD	4 Corners PP Bot	B0801027-02A	Potassium	71.2	75	125	10.9	10.0
MSD	4 Corners PP Bot	B0801027-02A	Sodium	-607	75	125	1130	10.0

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 1/4/2008 1:20:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801027-01A
Prep Date: 1/8/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T080108012
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 1/8/2008 5:17:11PM
Instrument: CVAA_1
File Name: B010807W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.000050	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801027-01A
Prep Date: 1/8/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080108015
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/8/2008 7:53:00PM
Instrument: ICP_2
File Name: E01088A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.058**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.088**		mg/L	0.010	0.00016	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**2.4**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**0.0073**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**1.2**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**ND**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**11**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	
Sodium	7440-23-5	**1,200**		mg/L	3.0	0.028	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 1/4/2008 1:20:00PM

Lab Sample Number: B0801027-01A Analysis Date: 1/8/2008 7:53:00PM
Prep Date: 1/8/2008 Instrument: ICP_2
Analytical Method ID: SW6010B - ICP - Total File Name: E01088A
Prep Method ID: 3010_ICP Dilution Factor: 1
Prep Batch Number: T080108015
Report Basis: As Received Analyst Initials: rm
Sample prep wt./vol: 50.00 ml Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	1

Lab Sample Number: B0801027-01A Analysis Date: 1/9/2008 1:35:00PM
Prep Date: 1/8/2008 Instrument: ICP_2
Analytical Method ID: SW6010B - ICP - Total File Name: E01098A
Prep Method ID: 3010_ICP Dilution Factor: 1
Prep Batch Number: T080108015
Report Basis: As Received Analyst Initials: rm
Sample prep wt./vol: 50.00 ml Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	2
Boron	7440-42-8	**0.35**		mg/L	0.050	0.0018	
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801027-01B Analysis Date: 1/17/2008 2:31:55PM
Prep Date: 1/17/2008 Instrument: Titrametric
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity File Name:
Prep Method ID: Alkalinity_W Dilution Factor: 1
Prep Batch Number: T080117013
Report Basis: As Received Analyst Initials: kl
Sample prep wt./vol: 50.00 ml Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**1,300**		mg/L	5.0	1.5	1
Carbonate		**220**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801027-01B Analysis Date: 1/5/2008 9:29:27AM
Prep Date: 1/5/2008 Instrument: Probe
Analytical Method ID: 150.1 - pH, Elecrometric - pH File Name:
Prep Method ID: 150.1 Dilution Factor: 1
Prep Batch Number: T080117001
Report Basis: As Received Analyst Initials: rs
Sample prep wt./vol: 10.00 ml Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 1/4/2008 1:20:00PM

Lab Sample Number: B0801027-01B Analysis Date: 1/5/2008 9:29:27AM
Prep Date: 1/5/2008 Instrument: Probe
Analytical Method ID: 150.1 - pH, Elecrometric - pH File Name:
Prep Method ID: 150.1 Dilution Factor: 1
Prep Batch Number: T080117001
Report Basis: As Received Analyst Initials: rs
Sample prep wt./vol: 10.00 ml Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**9.0**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801027-01B Analysis Date: 1/16/2008 1:50:18PM
Prep Date: 1/11/2008 Instrument: SCALE
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS File Name:
Prep Method ID: 160.1 Dilution Factor: 1
Prep Batch Number: T080111013
Report Basis: As Received Analyst Initials: KLibhart
Sample prep wt./vol: 100.00 ml Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**3,100**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801027-01B Analysis Date: 1/8/2008 2:44:31AM
Prep Date: 1/7/2008 Instrument: IC
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC File Name: 080107_047.D
Prep Method ID: 300.0 Dilution Factor: 25
Prep Batch Number: T080107001
Report Basis: As Received Analyst Initials: CS
Sample prep wt./vol: 20.00 ml Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**630**		mg/L	20	1.1	1

Lab Sample Number: B0801027-01B Analysis Date: 1/8/2008 3:21:16AM
Prep Date: 1/7/2008 Instrument: IC
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC File Name: 080107_049.D
Prep Method ID: 300.0 Dilution Factor: 1
Prep Batch Number: T080107001
Report Basis: As Received Analyst Initials: CS
Sample prep wt./vol: 20.00 ml Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**2.2**		mg/L	0.40	0.031	3
Sulfate		**280**		mg/L	1.5	0.11	

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **4 Corners PP Bottom Ash Leachate**

Matrix: Aqueous Collection Date: 1/4/2008 1:20:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801027-02A
Prep Date: 1/8/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T080108012
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 1/8/2008 5:19:17PM
Instrument: CVAA_1
File Name: B010807W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.000050	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801027-02A
Prep Date: 1/8/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080108015
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/8/2008 7:58:00PM
Instrument: ICP_2
File Name: E01088A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.20**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.13**		mg/L	0.010	0.00016	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**3.1**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**0.054**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**1.3**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**ND**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**11**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	
Sodium	7440-23-5	**1,100**		mg/L	3.0	0.028	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **4 Corners PP Bottom Ash Leachate**

Matrix: Aqueous Collection Date: 1/4/2008 1:20:00PM

Lab Sample Number: B0801027-02A Analysis Date: 1/8/2008 7:58:00PM
Prep Date: 1/8/2008 Instrument: ICP_2
Analytical Method ID: SW6010B - ICP - Total File Name: E01088A
Prep Method ID: 3010_ICP Dilution Factor: 1
Prep Batch Number: T080108015
Report Basis: As Received Analyst Initials: rm
Sample prep wt./vol: 50.00 ml Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	1

Lab Sample Number: B0801027-02A Analysis Date: 1/9/2008 1:40:00PM
Prep Date: 1/8/2008 Instrument: ICP_2
Analytical Method ID: SW6010B - ICP - Total File Name: E01098A
Prep Method ID: 3010_ICP Dilution Factor: 1
Prep Batch Number: T080108015
Report Basis: As Received Analyst Initials: rm
Sample prep wt./vol: 50.00 ml Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	3
Boron	7440-42-8	**0.39**		mg/L	0.050	0.0018	
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801027-02B Analysis Date: 1/17/2008 2:31:55PM
Prep Date: 1/17/2008 Instrument: Titrametric
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity File Name:
Prep Method ID: Alkalinity_W Dilution Factor: 1
Prep Batch Number: T080117013
Report Basis: As Received Analyst Initials: kl
Sample prep wt./vol: 50.00 ml Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**1,300**		mg/L	5.0	1.5	1
Carbonate		**230**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801027-02B Analysis Date: 1/5/2008 9:29:27AM
Prep Date: 1/5/2008 Instrument: Probe
Analytical Method ID: 150.1 - pH, Elecrometric - pH File Name:
Prep Method ID: 150.1 Dilution Factor: 1
Prep Batch Number: T080117001
Report Basis: As Received Analyst Initials: rs
Sample prep wt./vol: 10.00 ml Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **4 Corners PP Bottom Ash Leachate**

Matrix: Aqueous Collection Date: 1/4/2008 1:20:00PM

Lab Sample Number: B0801027-02B
Prep Date: 1/5/2008
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Prep Method ID: 150.1
Prep Batch Number: T080117001
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 1/5/2008 9:29:27AM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: rs
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**9.0**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801027-02B
Prep Date: 1/11/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080111013
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 1/16/2008 1:50:18PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: KLibhart
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**3,100**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801027-02B
Prep Date: 1/7/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080107001
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/8/2008 3:58:04AM
Instrument: IC
File Name: 080107_051.D
Dilution Factor: 25
Analyst Initials: CS
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**630**		mg/L	20	1.1	1

Lab Sample Number: B0801027-02B
Prep Date: 1/7/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080107001
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/8/2008 4:34:49AM
Instrument: IC
File Name: 080107_053.D
Dilution Factor: 1
Analyst Initials: CS
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**2.2**		mg/L	0.40	0.031	3
Sulfate		**280**		mg/L	1.5	0.11	

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 1/8/2008 12:00:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080108012-MB
Prep Date: 1/8/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T080108012
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 1/8/2008 5:04:24PM
Instrument: CVAA_1
File Name: B010807W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.000050	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080108015-MB
Prep Date: 1/8/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080108015
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/8/2008 7:38:00PM
Instrument: ICP_2
File Name: E01088A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**ND**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**ND**		mg/L	0.010	0.00016	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**ND**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**ND**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**ND**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**ND**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	
Sodium	7440-23-5	**ND**		mg/L	3.0	0.028	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 1/8/2008 12:00:00AM

Lab Sample Number: T080108015-MB
Prep Date: 1/8/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080108015
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/8/2008 7:38:00PM
Instrument: ICP_2
File Name: E01088A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	ND		mg/L	0.0050	0.0010	1

Lab Sample Number: T080108015-MB
Prep Date: 1/8/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080108015
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/9/2008 1:05:00PM
Instrument: ICP_2
File Name: E01098A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Beryllium	7440-41-7	ND		mg/L	0.0010	0.000060	2
Boron	7440-42-8	ND		mg/L	0.050	0.0018	
Thallium	7440-28-0	ND		mg/L	0.40	0.011	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080117013-MB
Prep Date: 1/17/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T080117013
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 1/17/2008 2:31:55PM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 100.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		ND		mg/L	5.0	1.5	1
Carbonate		ND		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080111013-MB
Prep Date: 1/11/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080111013
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 1/16/2008 1:50:18PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: KLibhart
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 1/11/2008 12:00:00AM

Lab Sample Number: T080111013-MB
Prep Date: 1/11/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080111013
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 1/16/2008 1:50:18PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: KLibhart
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		ND		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080107001-MB
Prep Date: 1/7/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080107001
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/8/2008 12:12:51PM
Instrument: IC
File Name: 080108_009.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sulfate		ND		mg/L	1.5	0.11	2

Lab Sample Number: T080107001-MB
Prep Date: 1/7/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080107001
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/9/2008 3:32:33AM
Instrument: IC
File Name: 080108_059.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		ND		mg/L	0.40	0.031	3

Lab Sample Number: T080107001-MB
Prep Date: 1/7/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080107001
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/10/2008 9:49:26PM
Instrument: IC
File Name: 080110_032.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		ND		mg/L	0.80	0.042	4

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801027
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080108015**

SAMPLE DUPLICATE REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0801027-02A
Prep Date: 1/8/2008

Samp. Anal. Date: 1/8/2008 7:58:00PM
DUP Anal. Date: 1/8/2008 8:03:00PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Aluminum	0.198	0.205	3.5	20	
Antimony	ND	ND	0.0	20	
Arsenic	ND	ND	0.0	20	
Barium	0.127	0.128	0.8	20	
Beryllium	ND	ND	0.0	20	
Boron	0.390	0.386	1.0	20	
Cadmium	ND	ND	0.0	20	
Calcium	3.11	3.12	0.3	20	
Chromium	ND	ND	0.0	20	
Cobalt	ND	ND	0.0	20	
Copper	ND	ND	0.0	20	
Iron	0.0542	0.0637	16.1	20	
Lead	ND	ND	0.0	20	
Magnesium	1.32	1.33	0.8	20	
Manganese	ND	ND	0.0	20	
Molybdenum	ND	ND	0.0	20	
Nickel	ND	ND	0.0	20	
Potassium	10.9	11.2	2.7	20	
Selenium	ND	ND	0.0	20	
Silver	ND	ND	0.0	20	
Sodium	1,130	1,140	0.9	20	
Thallium	ND	ND	0.0	20	
Vanadium	ND	ND	0.0	20	
Zinc	ND	ND	0.0	20	
Lithium	ND	ND	0.0	20	

LCS/LCSD REPORT

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0801027

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080108015**

LCS/LCSD REPORT

Analysis: SW6010B - ICP - Total

MB: T080108015-MB

Prep Date: 1/8/2008

MB Anal. Date: 1/8/2008 7:38:00PM

Units: mg/L

LCS Anal. Date: 1/8/2008 7:43:00PM LCSD Anal. Date: 1/8/2008 7:48:00PM

Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Aluminum	ND	1.83	1.85	2.00	2.00	91.5	92.5	1.1	89 - 117	20	
Antimony	ND	0.433	0.446	0.500	0.500	86.6	89.2	3.0	82 - 117	20	
Arsenic	ND	1.77	1.78	2.00	2.00	88.5	89.0	0.6	86 - 116	20	
Barium	ND	1.84	1.86	2.00	2.00	92.0	93.0	1.1	86 - 116	20	
Beryllium	ND	0.0507	0.0505	0.0500	0.0500	101.4	101.0	0.4	87 - 111	20	
Boron	ND	0.509	0.507	0.500	0.500	101.8	101.4	0.4	76 - 130	20	
Cadmium	ND	0.0475	0.0471	0.0500	0.0500	95.0	94.2	0.8	79 - 113	20	
Calcium	ND	8.53	8.99	10.0	10.0	85.3	89.9	5.3	79 - 119	20	
Chromium	ND	0.178	0.184	0.200	0.200	89.0	92.0	3.3	86 - 117	20	
Cobalt	ND	0.436	0.443	0.500	0.500	87.2	88.6	1.6	82 - 118	20	
Copper	ND	0.234	0.237	0.250	0.250	93.6	94.8	1.3	86 - 117	20	
Iron	ND	0.913	0.952	1.00	1.00	91.3	95.2	4.2	83 - 121	20	
Lead	ND	0.442	0.454	0.500	0.500	88.4	90.8	2.7	83 - 121	20	
Magnesium	ND	9.31	9.42	10.0	10.0	93.1	94.2	1.2	83 - 118	20	
Manganese	ND	0.444	0.451	0.500	0.500	88.8	90.2	1.6	82 - 121	20	
Molybdenum	ND	0.431	0.435	0.500	0.500	86.2	87.0	0.9	82 - 120	20	
Nickel	ND	0.434	0.440	0.500	0.500	86.8	88.0	1.4	84 - 117	20	
Potassium	ND	9.01	8.87	10.0	10.0	90.1	88.7	1.6	74 - 110	20	
Selenium	ND	1.78	1.84	2.00	2.00	89.0	92.0	3.3	87 - 117	20	
Silver	ND	0.244	0.246	0.250	0.250	97.6	98.4	0.8	80 - 127	20	
Sodium	ND	9.55	10.6	10.0	10.0	95.5	106.0	10.4	87 - 113	20	
Thallium	ND	0.198	0.218	0.200	0.200	99.0	109.0	9.6	89 - 113	20	
Vanadium	ND	0.450	0.456	0.500	0.500	90.0	91.2	1.3	87 - 119	20	
Zinc	ND	0.436	0.473	0.500	0.500	87.2	94.6	8.1	81 - 120	20	
Lithium	ND	0.490	0.497	0.500	0.500	98.0	99.4	1.4	80 - 120	20	

MS/MSD REPORT

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0801027

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080108015**

MS/MSD REPORT

Analysis: SW6010B - ICP - Total

Parent: B0801027-02A

Prep Date: 1/8/2008

Samp. Anal. Date: 1/8/2008 7:58:00PM

Units: mg/L

MS Anal. Date: 1/8/2008 8:23:00PM MSD Anal. Date: 1/8/2008 8:28:00PM

Matrix: Aqueous

Analyte Name	SampResult	MSRes.	MSDRes	SPLev	SPDLev	Recov.	MSD Rec.	RPD	Recov Lim	RPDLim	Flag
Aluminum	0.198	1.73	1.94	2.00	2.00	76.6	87.1	11.4	75 - 125	20	
Antimony	ND	0.378	0.430	0.500	0.500	75.6	86.0	12.9	75 - 125	20	
Arsenic	ND	1.54	1.73	2.00	2.00	77.0	86.5	11.6	75 - 125	20	
Barium	0.127	2.08	1.83	2.00	2.00	97.7	85.2	12.8	75 - 125	20	
Beryllium	ND	0.0499	0.0498	0.0500	0.0500	99.8	99.6	0.2	75 - 125	20	
Boron	0.390	0.870	0.869	0.500	0.500	96.0	95.8	0.1	75 - 125	20	
Cadmium	ND	0.0410	0.0413	0.0500	0.0500	82.0	82.6	0.7	75 - 125	20	
Calcium	3.11	13.1	11.0	10.0	10.0	99.9	78.9	17.4	75 - 125	20	
Chromium	ND	0.192	0.166	0.200	0.200	96.0	83.0	14.5	75 - 125	20	
Cobalt	ND	0.475	0.410	0.500	0.500	95.0	82.0	14.7	75 - 125	20	
Copper	ND	0.196	0.221	0.250	0.250	78.4	88.4	12.0	75 - 125	20	
Iron	0.0542	0.819	0.905	1.00	1.00	76.5	85.1	10.0	75 - 125	20	
Lead	ND	0.376	0.414	0.500	0.500	75.2	82.8	9.6	75 - 125	20	
Magnesium	1.32	8.91	9.93	10.0	10.0	75.9	86.1	10.8	75 - 125	20	
Manganese	ND	0.379	0.422	0.500	0.500	75.8	84.4	10.7	75 - 125	20	
Molybdenum	ND	0.377	0.423	0.500	0.500	75.4	84.6	11.5	75 - 125	20	
Nickel	ND	0.481	0.409	0.500	0.500	96.2	81.8	16.2	75 - 125	20	
Potassium	10.9	19.0	18.0	10.0	10.0	81.0	71.0	5.4	75 - 125	20	*lowMSD*
Selenium	ND	1.56	1.75	2.00	2.00	78.0	87.5	11.5	75 - 125	20	
Silver	ND	0.207	0.229	0.250	0.250	82.8	91.6	10.1	75 - 125	20	
Sodium	1,130	984	1,070	10.0	10.0	-1,460.0	-600.0	8.4	75 - 125	20	*NOTE 2 NOTE 2*
Thallium	ND	0.187	0.174	0.200	0.200	93.5	87.0	7.2	75 - 125	20	
Vanadium	ND	0.381	0.429	0.500	0.500	76.2	85.8	11.9	75 - 125	20	
Zinc	ND	0.383	0.424	0.500	0.500	76.6	84.8	10.2	75 - 125	20	
Lithium	ND	0.465	0.524	0.500	0.500	93.0	104.8	11.9	75 - 125	20	

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801027
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080108015**

POST DIGESTION SPIKE REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0801027-02A
Prep Date: 1/8/2008
Samp. Anal. Date: 1/8/2008 7:58:00PM
Units: mg/L
PDS Anal. Date: 1/8/2008 8:33:00PM
Matrix: Aqueous

Analyte Name	SampResult	PDSRes.	SPLev	Recov.	Recov Lim	Flag	
Aluminum	0.198	1.98	2.00	88.9	75 - 117		
Antimony	ND	0.438	0.500	87.0	75 - 117		
Arsenic	ND	1.78	2.00	88.8	75 - 116		
Barium	0.127	1.88	2.00	87.5	75 - 116		
Beryllium	ND	0.0478	0.0500	95.4	75 - 111		
Boron	0.390	0.846	0.500	91.1	75 - 130		
Cadmium	ND	0.0408	0.0500	86.7	75 - 113		
Calcium	3.11	11.2	10.0	80.8	75 - 119		
Chromium	ND	0.172	0.200	85.4	75 - 117		
Cobalt	ND	0.418	0.500	83.5	75 - 118		
Copper	ND	0.228	0.250	91.1	75 - 117		
Iron	0.0542	0.925	1.00	87.1	75 - 121		
Lead	ND	0.430	0.500	86.0	75 - 121		
Magnesium	1.32	10.1	10.0	88.3	75 - 118		
Manganese	ND	0.431	0.500	84.9	75 - 121		
Molybdenum	ND	0.429	0.500	84.0	75 - 120		
Nickel	ND	0.417	0.500	83.0	75 - 117		
Potassium	10.9	17.8	10.0	69.0	75 - 110	lowPDS	
Selenium	ND	1.79	2.00	89.2	75 - 117		
Silver	ND	0.234	0.250	93.2	75 - 127		
Sodium	1,130	1,100	10.0	-349.9	75 - 113	lowPDS	Note 2
Thallium	ND	0.174	0.200	85.7	75 - 113		
Vanadium	ND	0.440	0.500	87.4	75 - 119		
Zinc	ND	0.432	0.500	86.5	75 - 120		
Lithium	ND	0.539	0.500	92.0	75 - 120		

SERIAL DILUTION REPORT

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801027
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080108015**

SERIAL DILUTION REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0801027-02A
Prep Date: 1/8/2008
Samp. Anal. Date: 1/8/2008 7:58:00PM
Units: mg/L
SER DIL. Date: 1/8/2008 8:38:00PM
Matrix: Aqueous

Analyte Name	SampResult	PQL.	MDL.	SerialRes.	SerPQL.	RPD	Flag
Aluminum	0.198	0.050	0.014	ND	0.25		
Antimony	ND	0.050	0.0067	ND	0.25		
Arsenic	ND	0.10	0.015	ND	0.50		
Barium	0.127	0.0100	0.00016	0.111	0.050	13.4	OUT
Cadmium	ND	0.0060	0.00051	ND	0.030		
Calcium	3.11	0.10	0.013	5.53	0.50	56.0	OUT
Chromium	ND	0.0100	0.0018	ND	0.050		
Cobalt	ND	0.0050	0.0016	ND	0.025		
Copper	ND	0.0050	0.0019	ND	0.025		
Iron	0.0542	0.050	0.0027	ND	0.25		
Lead	ND	0.050	0.011	ND	0.25		
Magnesium	1.32	0.10	0.012	1.11	0.50	17.2	OUT
Manganese	ND	0.0100	0.00066	ND	0.050		
Molybdenum	ND	0.0100	0.0018	ND	0.050		
Nickel	ND	0.040	0.0027	ND	0.20		
Potassium	10.9	1.0	0.31	10.3	5.0	5.6	
Selenium	ND	0.10	0.026	ND	0.50		
Silver	ND	0.015	0.00066	ND	0.075		
Sodium	1,130	3.0	0.028	1,030	15	9.2	
Vanadium	ND	0.0100	0.00072	ND	0.050		
Zinc	ND	0.0050	0.0010	0.204	0.025		
Lithium	ND	0.10	0.00072	ND	0.50		

Prep Batch: **T080108012**

SAMPLE DUPLICATE REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Base Sample: B0801027-02A
Prep Date: 1/8/2008
Samp. Anal. Date: 1/8/2008 5:19:17PM
Units: mg/L
DUP Anal. Date: 1/8/2008 5:21:31PM
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801027
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080108012**

SAMPLE DUPLICATE REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Base Sample: B0801027-02A
Prep Date: 1/8/2008

Samp. Anal. Date: 1/8/2008 5:19:17PM
DUP Anal. Date: 1/8/2008 5:21:31PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Mercury	ND	ND	0.0	20	

LCS/LCSD REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
MB: T080108012-MB
Prep Date: 1/8/2008

MB Anal. Date: 1/8/2008 5:04:24PM
LCS Anal. Date: 1/8/2008 5:10:50PM
LCSD Anal. Date: 1/8/2008 5:12:54PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Mercury	ND	0.00203	0.00208	0.00200	0.0020	101.5	104.0	2.4	80 - 120	20	

MS/MSD REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Parent: B0801027-02A
Prep Date: 1/8/2008

Samp. Anal. Date: 1/8/2008 5:19:17PM
MS Anal. Date: 1/8/2008 5:23:34PM
MSD Anal. Date: 1/8/2008 5:25:40PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	MSDRes	SPLev	SPDLev	Recov.	MSD Rec.	RPD	Recov Lim	RPDLim	Flag
Mercury	ND	0.00213	0.00210	0.00200	0.00200	106.5	105.0	1.4	70 - 130	20	

POST DIGESTION SPIKE REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Base Sample: B0801027-02A
Prep Date: 1/8/2008

Samp. Anal. Date: 1/8/2008 5:19:17PM
PDS Anal. Date: 1/8/2008 5:27:45PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	PDSRes.	SPLev	Recov.	Recov Lim	Flag
Mercury	ND	0.00216	0.00200	103.1	80 - 120	

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

FOOTNOTES TO QC REPORT

Note 1: Results are shown to three significant figures to avoid rounding errors in calculations.

Note 2: If the sample concentration is greater than 4 times the spike level, a recovery is not meaningful, and the result should be used as a replicate. In such cases the spike is not as high as expected random measurement variability of the sample result itself.

Note 3: For sample duplicates, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample and duplicate results are not five times the PQL or greater, then the RPD is not expected to fall within the window shown and the comparison should be made on the basis of the absolute difference. Analytica uses the criterion that the absolute difference should be less than the PQL for water or less than 2XPQL for other matrices.

Note 4: For serial dilutions, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample result is not 50 times the MDL or greater, then the fact that the RPD does not meet the 10% criterion has little signifcance. Otherwise it indicates that a matrix bias may exist at the analytical step.

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801027
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080107001**

LCS/LCSD REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
MB: T080107001-MB
Prep Date: 1/7/2008
MB Anal. Date: 1/9/2008 3:32:33AM
Units: mg/L
LCS Anal. Date: 1/7/2008 6:27:53PM LCSD Anal. Date: 1/7/2008 6:46:17PM
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Fluoride	ND	2.31	2.25	2.50	2.50	92.4	90.0	2.6	90 - 110	20	
Chloride	ND	4.71	4.71	5.00	5.00	94.2	94.2	0.0	90 - 110	20	
Sulfate	ND	34.1	34.0	37.5	37.5	90.9	90.7	0.3	90 - 110	20	

MS REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
Parent: B0801027-02B
Prep Date: 1/7/2008
Samp. Anal. Date: 1/8/2008 4:34:49AM
Units: mg/L
MS Anal. Date: 1/9/2008 2:37:21AM
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim		Flag
Fluoride	2.16	4.39	2.50	89.2	70 - 130		
Chloride	632	755	125	98.4	70 - 130	*NOTE 2*	
Sulfate	285	323	37.5	101.3	70 - 130	*NOTE 2*	

Prep Batch: **T080111013**

SAMPLE DUPLICATE REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Base Sample: B0801027-02B
Prep Date: 1/11/2008
Samp. Anal. Date: 1/16/2008 1:50:18PM
Units: mg/L
DUP Anal. Date: 1/16/2008 1:50:18PM
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Total Dissolved Solids	3,070	3,060	0.3	20	

LCS/LCSD REPORT

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0801027

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080111013**

LCS/LCSD REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS

MB: T080111013-MB

Prep Date: 1/11/2008

MB Anal. Date: 1/16/2008 1:50:18PM

Units: mg/L

LCS Anal. Date: 1/16/2008 1:50:18PM LCSD Anal. Date: 1/16/2008 1:50:18PM

Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Total Dissolved Solids	ND	815	826	825	825	98.8	100.1	1.3	80 - 120	20	

MS REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS

Parent: B0801027-02B

Prep Date: 1/11/2008

Samp. Anal. Date: 1/16/2008 1:50:18PM

Units: mg/L

MS Anal. Date: 1/16/2008 1:50:18PM

Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim	Flag
Total Dissolved Solids	3,070	3,850	825	94.5	70 - 130	

Prep Batch: **T080117001**

SAMPLE DUPLICATE REPORT

Analysis: 150.1 - pH, Elecrometric - pH

Base Sample: B0801027-02B

Prep Date: 1/5/2008

Samp. Anal. Date: 1/5/2008 9:29:27AM

Units: pH

DUP Anal. Date: 1/5/2008 9:29:27AM

Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
pH	8.97	8.97	0.0	20	

Prep Batch: **T080117013**

SAMPLE DUPLICATE REPORT

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801027
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080117013**

SAMPLE DUPLICATE REPORT

Analysis: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Base Sample: B0801027-02B
Prep Date: 1/17/2008

Samp. Anal. Date: 1/17/2008 2:31:55PM
DUP Anal. Date: 1/17/2008 2:31:55PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Bicarbonate	1,250	1,240	0.8	20	
Carbonate	228	248	8.4	20	

LCS/LCSD REPORT

Analysis: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
MB: T080117013-MB
Prep Date: 1/17/2008

MB Anal. Date: 1/17/2008 2:31:55PM
LCS Anal. Date: 1/17/2008 2:31:55PM LCSD Anal. Date: 1/17/2008 2:31:55PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Bicarbonate	ND	28.0	26.0	25.0	25.0	112.0	104.0	7.4	80 - 120	20	
Carbonate	ND	51.0	49.0	50.0	50.0	102.0	98.0	4.0	80 - 120	20	

MS REPORT

Analysis: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Parent: B0801027-02B
Prep Date: 1/17/2008

Samp. Anal. Date: 1/17/2008 2:31:55PM
MS Anal. Date: 1/17/2008 2:31:55PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim		Flag
Bicarbonate	1,250	1,280	50.0	60.0	70 - 130	*NOTE 2*	
Carbonate	228	296	100	68.0	70 - 130	*lowMS*	

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

FOOTNOTES TO QC REPORT

Note 1: Results are shown to three significant figures to avoid rounding errors in calculations.

Note 2: If the sample concentration is greater than 4 times the spike level, a recovery is not meaningful, and the result should be used as a replicate. In such cases the spike is not as high as expected random measurement variability of the sample result itself.

Note 3: For sample duplicates, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample and duplicate results are not five times the PQL or greater, then the RPD is not expected to fall within the window shown and the comparison should be made on the basis of the absolute difference. Analytica uses the criterion that the absolute difference should be less than the PQL for water or less than 2XPQL for other matrices.

Note 4: For serial dilutions, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample result is not 50 times the MDL or greater, then the fact that the RPD does not meet the 10% criterion has little signifcance. Otherwise it indicates that a matrix bias may exist at the analytical step.

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **82,878** **Lab Project Number:** **B0801027**

Prep Date: 1/7/2008

Lab Method Blank Id: T080107001-MB
Prep Batch ID: T080107001
Method: Inorganic Anions by Ion Chromatography - Anions by IC

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T080107001-LCS	LCS	080107_020.DXD	1/7/2008 6:27:53PM
T080107001-LCSD	LCSD	080107_021.DXD	1/7/2008 6:46:17PM
B0801018-08B	Batch QC	080107_036.DXD	1/7/2008 11:22:10PM
B0801027-01B	MB	080107_047.DXD	1/8/2008 2:44:31AM
B0801027-01B	MB	080107_049.DXD	1/8/2008 3:21:16AM
B0801027-02B	4 Corners PP Bottom Ash Leachate	080107_051.DXD	1/8/2008 3:58:04AM
B0801027-02B	4 Corners PP Bottom Ash Leachate	080107_053.DXD	1/8/2008 4:34:49AM
T080107001-LCS	LCS	080108_010.DXD	1/8/2008 12:31:14PM
T080107001-LCSD	LCSD	080108_011.DXD	1/8/2008 12:49:38PM
B0801018-08B-DUP	DUP	080108_026.DXD	1/8/2008 5:25:29PM
B0801018-08B-MS	MS	080108_027.DXD	1/8/2008 5:43:52PM
B0801027-02B-MS	MS	080108_052.DXD	1/9/2008 1:23:44AM
B0801027-02B-MS	MS	080108_056.DXD	1/9/2008 2:37:21AM
B0801018-08B	Batch QC	080111_042.DXD	1/12/2008 12:33:51AM
B0801018-08B-DUP	DUP	080111_043.DXD	1/12/2008 12:52:16AM

Prep Date: 1/8/2008

Lab Method Blank Id: T080108012-MB
Prep Batch ID: T080108012
Method: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0801027-01A	MB	B010807W.WKS	1/8/2008 5:17:11PM
B0801027-02A	4 Corners PP Bottom Ash Leachate	B010807W.WKS	1/8/2008 5:19:17PM
T080108012-LCS	LCS	B010807W.WKS	1/8/2008 5:10:50PM
T080108012-LCSD	LCSD	B010807W.WKS	1/8/2008 5:12:54PM
B0801027-02A-DUP	DUP	B010807W.WKS	1/8/2008 5:21:31PM
B0801027-02A-MS	MS	B010807W.WKS	1/8/2008 5:23:34PM
B0801027-02A-MSD	MSD	B010807W.WKS	1/8/2008 5:25:40PM
B0801027-02A-PDS	PDS	B010807W.WKS	1/8/2008 5:27:45PM

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **82,878** **Lab Project Number:** **B0801027**

Prep Date: 1/8/2008

Lab Method Blank Id: T080108015-MB
Prep Batch ID: T080108015
Method: SW6010B - ICP - Total

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0801027-01A	MB	E01088A	1/8/2008 7:53:00PM
B0801027-02A	4 Corners PP Bottom Ash Leachate	E01088A	1/8/2008 7:58:00PM
T080108015-LCS	LCS	E01088A	1/8/2008 7:43:00PM
T080108015-LCSD	LCSD	E01088A	1/8/2008 7:48:00PM
B0801027-02A-DUP	DUP	E01088A	1/8/2008 8:03:00PM
B0801027-02A-MS	MS	E01088A	1/8/2008 8:23:00PM
B0801027-02A-MSD	MSD	E01088A	1/8/2008 8:28:00PM
B0801027-02A-PDS	PDS	E01088A	1/8/2008 8:33:00PM
B0801027-01A	MB	E01098A	1/9/2008 1:35:00PM
B0801027-02A	4 Corners PP Bottom Ash Leachate	E01098A	1/9/2008 1:40:00PM
T080108015-LCS	LCS	E01098A	1/9/2008 1:10:00PM
T080108015-LCSD	LCSD	E01098A	1/9/2008 1:15:00PM
B0801027-02A-DUP	DUP	E01098A	1/9/2008 1:45:00PM
B0801027-02A-MS	MS	E01098A	1/9/2008 1:50:00PM
B0801027-02A-MSD	MSD	E01098A	1/9/2008 1:56:00PM
B0801027-02A-PDS	PDS	E01098A	1/9/2008 2:01:00PM

Prep Date: 1/11/2008

Lab Method Blank Id: T080111013-MB
Prep Batch ID: T080111013
Method: 160.1 - Total Dissolved Solids dried at 180°C - TDS

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0801027-01B	MB		1/16/2008 1:50:18PM
B0801027-02B	4 Corners PP Bottom Ash Leachate		1/16/2008 1:50:18PM
T080111013-LCS	LCS		1/16/2008 1:50:18PM
T080111013-LCSD	LCSD		1/16/2008 1:50:18PM
B0801027-02B-DUP	DUP		1/16/2008 1:50:18PM
B0801027-02B-MS	MS		1/16/2008 1:50:18PM

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **82,878** **Lab Project Number:** **B0801027**

Prep Date: 1/17/2008

Lab Method Blank Id: T080117013-MB

Prep Batch ID: T080117013

Method: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0801027-01B	MB		1/17/2008 2:31:55PM
B0801027-02B	4 Corners PP Bottom Ash Leachate		1/17/2008 2:31:55PM
T080117013-LCS	LCS		1/17/2008 2:31:55PM
T080117013-LCSD	LCSD		1/17/2008 2:31:55PM
B0801027-02B-DUP	DUP		1/17/2008 2:31:55PM
B0801027-02B-MS	MS		1/17/2008 2:31:55PM

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:

ND = Not Detected at or above the Reporting Limit
NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:

LOW = Recovery is below Lower Control Limit
HIGH = Recovery , RPD, or other parameter is above Upper Control Limit
E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:

B = Analyte was detected in the laboratory method blank
J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:

J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
W = Post digestion spike did not meet criteria
S = Reported value determined by the Method of Standard Additions (MSA)

Several ways of defining the limit of detection and quantitation are prevalent in the laboratory industry and may appear in Analytica reports. These include the following:

MRL = "minimum reporting level", from the EPA Safe Drinking Water program (SDW)
PQL = "practical quantitation limit", from SW-846
EQL = "estimated quantitation limit", from SW-846
LOQ = "limit of quantitation", from a number of authoritative sources

In Analytica's work, all of these terms have the same meaning, equivalent to the EPA definition of the MRL. This reporting level is supported by a satisfactory calibration data point which is at that level or lower, and also is supported by a method detection limit (MDL) determined by the procedure in 40CFR. The MDL is lower than the MRL and represents an estimate of the level where positive detections have a 99% probability of being real, but where quantitation accuracy is unknown.

The MRL as defined by Analytica is the lowest demonstrated point of known quantitation accuracy.
The MRL should not be confused with the MCL, which is the EPA-defined "maximum contaminant level" allowed for certain regulated targets under specific regulations, such as the National Primary Drinking Water Regulations. Normally, the MRL is set at a level which is much lower than the MCL in order to ensure that levels are well below those limits. Not all target analytes have MCL levels established.

Other Flags may be applied. See Case Narrative for Description

Workorder (SDG): B0801027

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

REPORTING CONVENTIONS FOR THIS REPORT

B0801027

TestPkgName	Basis	# Sig Figs	Reporting Limit
150.1/150.1 (Aqueous) - pH	As Received	2	Report to PQL
160.1/160.1 (Aqueous) - TDS	As Received	2	Report to PQL
300.0/300.0 (Aqueous) - Anions by IC	As Received	2	Report to PQL
310.1/310.1 (Aqueous) - Alkalinity	As Received	2	Report to PQL
6010B/3010A (Aqueous) - Total	As Received	2	Report to PQL
7470A/7470A (Aqueous) - Total Hg	As Received	2	Report to PQL

Analytica Chain of Custody Form

12189 Pennsylvania St.
Thornton, CO 80241
(303) 469-8868
(303) 469-5254 fax

4307 Arctic Boulevard
Anchorage, AK 99503
(907) 258-2155
(907) 258-6634 fax

475 Hall St.
Fairbanks, AK 99701
(907) 456 - 3116
(907) 456-3125 Fax

5438 Shaune Drive
Juneau, AK 99801
(907) 780-6668
(907) 780-6670 fax

Chain of Custody No: 62918

Client Name & Address: Applied Hydrology Associates, INC.

Public Water System (PWS) ID#:

Project Name: Navajo Mine Extension Leaching Study

Section To be Completed by Analytica

Quote ID:

LGN: B080102 7

Account #: 030188 Cash Credit Card

Report to:

Phone No:

Fax No:

E-mail:

Turnaround Time for Results (TAT)

___ Standard ___ Expedited (< 10 days, prior authorization required)

(please specify due date below; add'l charges may apply)

Requested Due Date for Results:

Invoice to Name & Address:

Special Instructions/Comments:
Tumbled in House by R.S.
Bottom Ash Leachate study

P.O. or Contract No:

Kit Prep/Shipping Charge: $

Requested Analysis/Method

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers	6010B/3010A-TL Lot # Pres.	7470A Hg Lot # Pres.	150.1 pH Lot # Pres.	160.1 TDS Lot # Pres.	300.0 Anions/fr Lot # Pres.	310.1 Alk Lot # Pres.	Lot # Pres.	Field Preserved	Field Filtered	MS/MSD ?
MB	1/4/08	13:20	AQ	8	✓	✓	✓	✓	✓	✓		1/2		
4 corners PP Bottom Ash Leachate	1/4/08	13:20	⊥	⊥	✓	✓	✓	✓	✓	✓		1/2		X

Relinquished by:	Date	Time	Received by:	Date	Time
B. Seeman	1/7/08	13:55	[signature]	1/7/08	13:55
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Name of Sampler: (printed)

Section To Be Completed by Analytica

	THO	ANC	JNU	FBKS
Condition of Custody Seal?:	—			
Initialed By:	—			
Temp/Loc:	3.1			
Thermo ID#:				
Shipped Via:	Ryan Seeman			

Version 2.0

ANALYTICA

Cooler Receipt Form

Client: Applied Hydrology Associates **Client Code:** 030188 **Order #:** B0801027
Project: Navajo Mine Extension Leaching Study

Cooler ID: 1

A. Preliminary Examination Phase: **Date cooler opened:** 1/7/2008
Cooler opened by: gp **Signature:** GP

1. Was airbill Attached?	N/A	**Airbill #:**		**Carrier Name:**	Other
2. Custody Seals?	N/A	**How many?**	0	**Location:**	**Seal Name:**
3. Seals intact?	N/A				
4. COC Attached?	Yes	**Properly Completed?**	Yes	**Signed by AEL employee?**	Yes
5. Project Identification from custody paper:		Navajo Mine Extension Leaching Study			
6. Preservative:	None	**Temperature:**	3.1 **deg. C**		

Designated person initial here to acknowledge receipt: GP **Date:** 1/7/08

COMMENTS:

B. Log-In Phase: **Samples Log-in Date:** 1/7/2008 **Log-in By:** gp

1. Packing Type:	Other		
2. Were samples in separate bags?	N/A		
3. Were containers intact?	Yes	**Labels agree with COC?**	Yes
4. Number of bottles received:	4	**Number of samples received:**	2
5. Correct containers used?	Yes	**Correct preservatives added?**	Yes
6. Sufficient sample volume?	Yes		
7. Bubbles in VOA samples?	N/A		
8. Was Project manager called and status discussed?	No		
9. Was anyone called?	No	**Who was called?** _____ **By whom?** _____ **Date:** _____	

COMMENTS:

The Analytica Group

CLIENT INVOICE

Remit to: Accounting Dpt
Analytica Environmental Laboratories, Inc.
P.O. Box 973426
Dallas,TX 75397-3426

Phone: (303) 469-8868

Attention: Mr.Art O'Hayre
Invoice to: Applied Hydrology Associates, Inc.
950 South Cherry Street
Suite 810
Denver, CO 80246

Invoice #: **82649**
Work Order#: **B0801191**
Account#: 030188
Quote ID#: 11340
Invoice Date: 2/11/2008
Work ID: Navajo Mine Extension Leaching Study
PO #: none

Received: 1/28/2008
Reported: 2/11/2008
Client Project#: Navajo Mine Extension Leach

Comments:

Item charges		**Qty**	**Price**	**Total**
SW7470A - Mercury in Liquid Waste by CVAA - Total Hg In Aqueous	M	6	35.00	210.00
160.1 - Total Dissolved Solids dried at 180°C - TDS In Liquid	Matrix	6	22.00	132.00
150.1 - pH, Elecrometric - pH In Liquid	Matrix	6	10.00	60.00
SW6010B - ICP - Total In Aqueous	Matrix	6	312.00	1,872.00
Inorganic Anions by Ion Chromatography - Anions by IC In Liquid	Matrix	6	54.00	324.00
310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity In Liquid	Matrix	6	36.00	216.00

Total of Items Above: **$2,814.00**

Adjustments or Special Services	**Qty**	**Price**	**Total**
Tumbling Charge	5	95.00	475.00

Total of Items Above: **$475.00**

Grand Total: **$3,289.00**

All invoices are due and payable upon receipt. Outstanding balances over 30 days are subject to a finance charge of 1.5% per month, plus a late fee of $25.00. If Analytica engages legal counsel to enforce its rights or any other rights under an application for payment, the customer will be liable to Analytica for all costs of collection and other legal expenses, including reasonable attorney fees.

REMITTANCE ADVICE
PLEASE RETURN THIS PORTION WITH YOUR PAYMENT

Mr.Art O'Hayre
Applied Hydrology Associates, Inc.
950 South Cherry Street
Suite 810
Denver, CO 80246

Account#: 030188
Invoice #: **82649**
Invoice Date: 2/11/2008

TOTAL INVOICE AMOUNT: **$3,289.00**

PAYMENT AMOUNT ENCLOSED: _____

ANALYTICA
Environmental Laboratories

Analytica Environmental
Laboratories, Inc.
12189 Pennsylvania Street
Thornton, CO 80241
Phone: 303-469-8868
Fax: 303-469-5254

2/11/2008

Applied Hydrology Associates, Inc.
950 South Cherry Street
Suite 810
Denver, CO 80246
Attn: Art O'Hayre

Work Order #: B0801191
Date: 2/11/2008
Work ID: Navajo Mine Extension Leaching Study
Date Received: 1/28/2008
Proj #: none

Sample Identification

Lab Sample Number	Client Description	Lab Sample Number	Client Description
B0801191-01	MB 45 day	B0801191-02	Ash Composite 45 day
B0801191-03	Spoil Composite 45 day	B0801191-04	MB SPLP
B0801191-05	Ash Composite SPLP	B0801191-06	Spoil Composite SPLP

Enclosed are the analytical results for the submitted sample(s). Please review the CASE NARRATIVE for a discussion of any data and/or quality control issues. Listings of data qualifiers, analytical codes, key dates, and QC relationships are provided at the end of the report.

Sincerely,

Kristen Stone
Project Manager

"The Science of Analysis, The Art of Service"

Case Narrative

Analytica Environmental Laboratories, Inc.

Work Order: B0801191

Samples were prepared and analyzed according to EPA or equivalent methods outlined in the following references:

Methods for Chemical Analysis of Water and Wastes, USEPA 600/4-79-020, March 1983.

Pfaff, J. D., C. A. Brockhoff and J. W. O'Dell. 1994. The Determination of Inorganic Anions in Water by Ion Chromatography. Method 300.0A. U. S. Environmental Protection Agency. Environmental Monitoring Systems Lab.

Methods for the Determination of Metals in Environmental Samples, EPA/600/R-94/111, May 1994.

SAMPLE RECEIPT:
Six (6) samples were received on 1/28/2008 12:35:00 PM., at a temperature of 6 deg C., at Analytica-Thornton. The samples were received in good condition and in order per chain of custody. The samples were tumbled at the laboratory.

REVIEW FOR COMPLIANCE WITH ANALYTICA QA PLAN
A summary of our review is shown below.

All analytical results contained in this report have been reviewed under Analytica's internal quality assurance and quality control program. Any deviations in quality contro parameters for specific analyses are noted in the following text. A complete quality assurance report, including laboratory control, matrix spike, and sample duplicate recoveries is kept on file in our office and is available upon request.

All method specifications were met for the following tests:

Test Method: 150.1 - pH, Elecrometric - pH - Aqueous
Test Method: 160.1 - Total Dissolved Solids dried at 180°C - TDS - Aqueous
Test Method: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity - Aqueous
Test Method: Inorganic Anions by Ion Chromatography - Anions by IC - Aqueous
Test Method: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg - Aqueous

Test Method: SW6010B - ICP - Total - Aqueous
MS/MSD and DUP OUTLIERS:
As shown below, the MSD was outside of limits for Calcium. The sample had Calcium concentrations greater than four times the spike amount. In these cases it is not appropriate to calculate a recovery. The result should be used as a replicate.

Type	Client Sample	LabSample	Analyte	Recovery	LCL	UCL	Parent	Spike
MSD	Ash Composite SP	B0801191-05A	Calcium	-11.	75	125	562	10.0

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB 45 day**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-01A
Prep Date: 1/29/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T080131004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 1/31/2008 1:50:33PM
Instrument: CVAA_1
File Name: B013108W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.00005	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-01A
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/30/2008 12:59:00PM
Instrument: ICP_2
File Name: E01308A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.85**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.081**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**0.32**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**3.0**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**0.14**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**1.2**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.013**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**12**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB 45 day**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

Lab Sample Number: B0801191-01A
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/30/2008 12:59:00PM
Instrument: ICP_2
File Name: E01308A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**1,200**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**0.0053**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-01B
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**1,200**		mg/L	5.0	1.5	1
Carbonate		**260**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-01B
Prep Date: 1/25/2008
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Prep Method ID: 150.1
Prep Batch Number: T080201005
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 1/25/2008 2:10:00PM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: R. Seeman
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**8.7**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB 45 day**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

Lab Sample Number: B0801191-01B
Prep Date: 1/31/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080131008
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 12:47:24PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**3,000**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-01B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/30/2008 4:18:17PM
Instrument: IC
File Name: 080130_011.D
Dilution Factor: 25
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**600**		mg/L	20	1.1	1

Lab Sample Number: B0801191-01B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/30/2008 9:12:31PM
Instrument: IC
File Name: 080130_027.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**2.2**		mg/L	0.40	0.031	2
Sulfate		**280**		mg/L	1.5	0.11	

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Composite 45 day**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-02A
Prep Date: 1/29/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T080131004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 1/31/2008 2:39:43PM
Instrument: CVAA_1
File Name: B013108W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.00050	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-02A
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/30/2008 1:04:00PM
Instrument: ICP_2
File Name: E01308A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**4.6**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.033**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**2.6**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**530**		mg/L	0.10	0.013	
Chromium	7440-47-3	**0.031**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**0.72**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**0.071**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**0.14**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**12**		mg/L	0.10	0.012	
Manganese	7439-96-5	**0.12**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.15**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**12**		mg/L	1.0	0.31	
Selenium	7784-49-2	**0.15**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Composite 45 day**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

Lab Sample Number: B0801191-02A
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/30/2008 1:04:00PM
Instrument: ICP_2
File Name: E01308A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**1,200**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**0.10**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**0.098**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-02B
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**1,100**		mg/L	5.0	1.5	1
Carbonate		**ND**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-02B
Prep Date: 1/25/2008
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Prep Method ID: 150.1
Prep Batch Number: T080201005
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 1/25/2008 2:10:00PM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: R. Seeman
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**7.8**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Composite 45 day**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

Lab Sample Number: B0801191-02B
Prep Date: 1/31/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080131008
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 12:47:24PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**5,300**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-02B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/30/2008 4:36:41PM
Instrument: IC
File Name: 080130_012.D
Dilution Factor: 25
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**610**		mg/L	20	1.1	1
Sulfate		**2,500**		mg/L	38	2.8	

Lab Sample Number: B0801191-02B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/30/2008 9:49:17PM
Instrument: IC
File Name: 080130_029.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**8.2**		mg/L	0.40	0.031	2

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Spoil Composite 45 day**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-03A
Prep Date: 1/29/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T080131004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 1/31/2008 2:41:52PM
Instrument: CVAA_1
File Name: B013108W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.00005	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-03A
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/30/2008 1:09:00PM
Instrument: ICP_2
File Name: E01308A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.38**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.079**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**0.36**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**56**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**0.053**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**0.11**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**12**		mg/L	0.10	0.012	
Manganese	7439-96-5	**0.098**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.015**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**14**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Spoil Composite 45 day**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

Lab Sample Number: B0801191-03A
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/30/2008 1:09:00PM
Instrument: ICP_2
File Name: E01308A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**1,200**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-03B
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**960**		mg/L	5.0	1.5	1
Carbonate		**ND**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-03B
Prep Date: 1/25/2008
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Prep Method ID: 150.1
Prep Batch Number: T080201005
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 1/25/2008 2:10:00PM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: R. Seeman
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**8.0**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Spoil Composite 45 day**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

Lab Sample Number: B0801191-03B
Prep Date: 1/31/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080131008
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 12:47:24PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**3,500**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-03B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/30/2008 5:50:15PM
Instrument: IC
File Name: 080130_016.D
Dilution Factor: 25
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**600**		mg/L	20	1.1	1
Sulfate		**930**		mg/L	38	2.8	

Lab Sample Number: B0801191-03B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/30/2008 11:02:52PM
Instrument: IC
File Name: 080130_033.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**1.5**		mg/L	0.40	0.031	2

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB SPLP**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-04A
Prep Date: 1/29/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T080131004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 1/31/2008 2:44:26PM
Instrument: CVAA_1
File Name: B013108W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.00005	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-04A
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/30/2008 1:14:00PM
Instrument: ICP_2
File Name: E01308A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.056**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**ND**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**ND**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**0.27**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**0.0067**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**ND**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**ND**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**ND**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB SPLP**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

Lab Sample Number: B0801191-04A
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/30/2008 1:14:00PM
Instrument: ICP_2
File Name: E01308A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**5.7**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-04B
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 100.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**ND**		mg/L	5.0	1.5	1
Carbonate		**10**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-04B
Prep Date: 1/25/2008
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Prep Method ID: 150.1
Prep Batch Number: T080201005
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 1/25/2008 2:10:00PM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: R. Seeman
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**5.0**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB SPLP**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

Lab Sample Number: B0801191-04B
Prep Date: 1/31/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080131008
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 12:47:24PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**ND**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-04B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/31/2008 12:16:31AM
Instrument: IC
File Name: 080130_037.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**ND**		mg/L	0.80	0.042	2
Fluoride		**ND**		mg/L	0.40	0.031	
Sulfate		**3.4**		mg/L	1.5	0.11	

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Composite SPLP**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-05A
Prep Date: 1/29/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T080131004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 1/31/2008 2:46:54PM
Instrument: CVAA_1
File Name: B013108W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.00005	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-05A
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/30/2008 1:19:00PM
Instrument: ICP_2
File Name: E01308A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.36**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.11**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**0.28**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**560**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**0.88**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.089**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**ND**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Composite SPLP**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

Lab Sample Number: B0801191-05A
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/30/2008 1:19:00PM
Instrument: ICP_2
File Name: E01308A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**8.8**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**0.088**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-05B
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 100.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**ND**		mg/L	5.0	1.5	1
Carbonate		**18**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-05B
Prep Date: 1/25/2008
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Prep Method ID: 150.1
Prep Batch Number: T080201005
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 1/25/2008 2:10:00PM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: R. Seeman
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**7.4**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Composite SPLP**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

Lab Sample Number: B0801191-05B
Prep Date: 1/31/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080131008
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 12:47:24PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**2,200**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-05B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/30/2008 6:27:01PM
Instrument: IC
File Name: 080130_018.D
Dilution Factor: 25
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sulfate		**1,300**		mg/L	38	2.8	1

Lab Sample Number: B0801191-05B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/31/2008 12:34:55AM
Instrument: IC
File Name: 080130_038.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**5.6**		mg/L	0.80	0.042	2
Fluoride		**3.2**		mg/L	0.40	0.031	

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Spoil Composite SPLP**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-06A
Prep Date: 1/29/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T080131004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 1/31/2008 2:48:59PM
Instrument: CVAA_1
File Name: B013108W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	ND		mg/L	0.00020	0.00005	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-06A
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/30/2008 2:29:00PM
Instrument: ICP_2
File Name: E01308A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	ND		mg/L	0.050	0.014	1
Antimony	7440-36-0	ND		mg/L	0.050	0.0067	
Arsenic	7440-38-2	ND		mg/L	0.10	0.015	
Barium	7440-39-3	**0.070**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	ND		mg/L	0.0010	0.000060	
Boron	7440-42-8	**0.084**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	ND		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**150**		mg/L	0.10	0.013	
Chromium	7440-47-3	ND		mg/L	0.010	0.0018	
Cobalt	7440-48-4	ND		mg/L	0.0050	0.0016	
Copper	7440-50-8	ND		mg/L	0.0050	0.0019	
Iron	7439-89-6	ND		mg/L	0.050	0.0027	
Lead	7439-92-1	ND		mg/L	0.050	0.011	
Lithium	7439-93-2	ND		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**15**		mg/L	0.10	0.012	
Manganese	7439-96-5	**0.19**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	ND		mg/L	0.010	0.0018	
Nickel	7440-02-0	ND		mg/L	0.040	0.0027	
Potassium	7440-09-7	**7.0**		mg/L	1.0	0.31	
Selenium	7784-49-2	ND		mg/L	0.10	0.026	
Silver	7440-22-4	ND		mg/L	0.015	0.00066	

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Spoil Composite SPLP**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

Lab Sample Number: B0801191-06A
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/30/2008 2:29:00PM
Instrument: ICP_2
File Name: E01308A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**150**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-06B
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 100.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**33**		mg/L	5.0	1.5	1
Carbonate		**14**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-06B
Prep Date: 1/25/2008
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Prep Method ID: 150.1
Prep Batch Number: T080201005
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 1/25/2008 2:10:00PM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: R. Seeman
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**7.5**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Spoil Composite SPLP**

Matrix: Aqueous Collection Date: 1/25/2008 2:00:00PM

Lab Sample Number: B0801191-06B
Prep Date: 1/31/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080131008
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 12:47:24PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**1,200**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801191-06B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/30/2008 7:40:34PM
Instrument: IC
File Name: 080130_022.D
Dilution Factor: 25
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sulfate		**670**		mg/L	38	2.8	1

Lab Sample Number: B0801191-06B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/31/2008 12:53:17AM
Instrument: IC
File Name: 080130_039.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**1.5**		mg/L	0.80	0.042	2
Fluoride		**0.54**		mg/L	0.40	0.031	

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 1/29/2008 12:00:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080131004-MB
Prep Date: 1/29/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T080131004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 1/31/2008 1:01:23PM
Instrument: CVAA_1
File Name: B013108W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.00050	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080129008-MB
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/30/2008 12:34:00PM
Instrument: ICP_2
File Name: E01308A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**ND**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**ND**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**ND**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**ND**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**ND**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**ND**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**ND**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 1/29/2008 12:00:00AM

Lab Sample Number: T080129008-MB
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/30/2008 12:34:00PM
Instrument: ICP_2
File Name: E01308A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**ND**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	

Lab Sample Number: T080129008-MB
Prep Date: 1/29/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080129008
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/31/2008 11:13:00AM
Instrument: ICP_2
File Name: E01318A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	2

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080205001-MB
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 100.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**ND**		mg/L	5.0	1.5	1
Carbonate		**ND**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080131008-MB
Prep Date: 1/31/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080131008
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 12:47:24PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 1/31/2008 12:00:00AM

Lab Sample Number: T080131008-MB
Prep Date: 1/31/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080131008
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 12:47:24PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		ND		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080130013-MB
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/30/2008 3:04:45PM
Instrument: IC
File Name: 080130_007.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		ND		mg/L	0.80	0.042	1
Fluoride		ND		mg/L	0.40	0.031	
Sulfate		ND		mg/L	1.5	0.11	

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801191
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080129008**

SAMPLE DUPLICATE REPORT

Analysis: SW6010B - ICP - Total

Base Sample: B0801191-05A
Prep Date: 1/29/2008

Samp. Anal. Date: 1/30/2008 1:19:00PM
DUP Anal. Date: 1/30/2008 1:40:00PM

Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Aluminum	0.359	0.346	3.7	20	
Antimony	ND	ND	0.0	20	
Arsenic	ND	ND	0.0	20	
Barium	0.113	0.110	2.7	20	
Beryllium	ND	ND	0.0	20	
Boron	0.282	0.278	1.4	20	
Cadmium	ND	ND	0.0	20	
Calcium	562	549	2.3	20	
Chromium	ND	ND	0.0	20	
Cobalt	ND	ND	0.0	20	
Copper	ND	ND	0.0	20	
Iron	ND	ND	0.0	20	
Lead	ND	ND	0.0	20	
Magnesium	0.883	0.856	3.1	20	
Manganese	ND	ND	0.0	20	
Molybdenum	0.0886	0.0859	3.1	20	
Nickel	ND	ND	0.0	20	
Potassium	ND	1.10	0.0	20	
Selenium	ND	ND	0.0	20	
Silver	ND	ND	0.0	20	
Sodium	8.85	8.45	4.6	20	
Thallium	ND	ND	0.0	20	
Vanadium	0.0883	0.0868	1.7	20	
Zinc	ND	ND	0.0	20	
Lithium	ND	ND	0.0	20	

LCS/LCSD REPORT

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0801191

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080129008**

LCS/LCSD REPORT

Analysis: SW6010B - ICP - Total

MB: T080129008-MB

Prep Date: 1/29/2008

MB Anal. Date: 1/30/2008 12:34:00PM

Units: mg/L

LCS Anal. Date: 1/30/2008 12:39:00PM LCSD Anal. Date: 1/30/2008 12:44:00PM Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Aluminum	ND	1.91	1.88	2.00	2.00	95.5	94.0	1.6	89 - 117	20	
Antimony	ND	0.474	0.458	0.500	0.500	94.8	91.6	3.4	82 - 117	20	
Arsenic	ND	1.81	1.82	2.00	2.00	90.5	91.0	0.6	86 - 116	20	
Barium	ND	1.87	1.85	2.00	2.00	93.5	92.5	1.1	86 - 116	20	
Beryllium	ND	0.0481	0.0477	0.0500	0.0500	96.2	95.4	0.8	87 - 111	20	
Boron	ND	0.463	0.459	0.500	0.500	92.6	91.8	0.9	76 - 130	20	
Cadmium	ND	0.0448	0.0430	0.0500	0.0500	89.6	86.0	4.1	79 - 113	20	
Calcium	ND	9.59	9.28	10.0	10.0	95.9	92.8	3.3	79 - 119	20	
Chromium	ND	0.189	0.185	0.200	0.200	94.5	92.5	2.1	86 - 117	20	
Cobalt	ND	0.468	0.464	0.500	0.500	93.6	92.8	0.9	82 - 118	20	
Copper	ND	0.231	0.231	0.250	0.250	92.4	92.4	0.0	86 - 117	20	
Iron	ND	0.981	0.972	1.00	1.00	98.1	97.2	0.9	83 - 121	20	
Lead	ND	0.472	0.453	0.500	0.500	94.4	90.6	4.1	83 - 121	20	
Magnesium	ND	9.61	9.54	10.0	10.0	96.1	95.4	0.7	83 - 118	20	
Manganese	ND	0.475	0.471	0.500	0.500	95.0	94.2	0.8	82 - 121	20	
Molybdenum	ND	0.468	0.463	0.500	0.500	93.6	92.6	1.1	82 - 120	20	
Nickel	ND	0.472	0.468	0.500	0.500	94.4	93.6	0.9	84 - 117	20	
Potassium	ND	7.84	7.75	10.0	10.0	78.4	77.5	1.2	74 - 110	20	
Selenium	ND	1.86	1.86	2.00	2.00	93.0	93.0	0.0	87 - 117	20	
Silver	ND	0.248	0.247	0.250	0.250	99.2	98.8	0.4	80 - 127	20	
Sodium	ND	9.34	10.1	10.0	10.0	93.4	101.0	7.8	87 - 113	20	
Thallium	ND	0.190	0.198	0.200	0.200	95.0	99.0	4.1	89 - 113	20	
Vanadium	ND	0.481	0.476	0.500	0.500	96.2	95.2	1.0	87 - 119	20	
Zinc	ND	0.476	0.543	0.500	0.500	95.2	108.6	13.2	81 - 120	20	
Lithium	ND	0.463	0.459	0.500	0.500	92.6	91.8	0.9	80 - 120	20	

MS/MSD REPORT

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0801191

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080129008**

MS/MSD REPORT

Analysis: SW6010B - ICP - Total

Parent: B0801191-05A

Prep Date: 1/29/2008

Samp. Anal. Date: 1/30/2008 1:19:00PM

Units: mg/L

MS Anal. Date: 1/30/2008 1:45:00PM MSD Anal. Date: 1/30/2008 1:50:00PM Matrix: Aqueous

Analyte Name	SampResult	MSRes.	MSDRes	SPLev	SPDLev	Recov.	MSD Rec.	RPD	Recov Lim	RPDLim	Flag
Aluminum	0.359	2.23	2.20	2.00	2.00	93.6	92.1	1.4	75 - 125	20	
Antimony	ND	0.449	0.440	0.500	0.500	89.8	88.0	2.0	75 - 125	20	
Arsenic	ND	1.80	1.73	2.00	2.00	90.0	86.5	4.0	75 - 125	20	
Barium	0.113	1.89	1.82	2.00	2.00	88.9	85.4	3.8	75 - 125	20	
Beryllium	ND	0.0466	0.0452	0.0500	0.0500	93.2	90.4	3.1	75 - 125	20	
Boron	0.282	0.733	0.715	0.500	0.500	90.2	86.6	2.5	75 - 125	20	
Cadmium	ND	0.0408	0.0411	0.0500	0.0500	81.6	82.2	0.7	75 - 125	20	
Calcium	562	572	560	10.0	10.0	100.0	-20.0	2.1	75 - 125	20	*NOTE 2 NOTE 2*
Chromium	ND	0.184	0.180	0.200	0.200	92.0	90.0	2.2	75 - 125	20	
Cobalt	ND	0.437	0.427	0.500	0.500	87.4	85.4	2.3	75 - 125	20	
Copper	ND	0.229	0.221	0.250	0.250	91.6	88.4	3.6	75 - 125	20	
Iron	ND	0.935	0.925	1.00	1.00	93.5	92.5	1.1	75 - 125	20	
Lead	ND	0.434	0.429	0.500	0.500	86.8	85.8	1.2	75 - 125	20	
Magnesium	0.883	10.5	10.2	10.0	10.0	96.2	93.2	2.9	75 - 125	20	
Manganese	ND	0.445	0.431	0.500	0.500	89.0	86.2	3.2	75 - 125	20	
Molybdenum	0.0886	0.525	0.513	0.500	0.500	87.3	84.9	2.3	75 - 125	20	
Nickel	ND	0.445	0.433	0.500	0.500	89.0	86.6	2.7	75 - 125	20	
Potassium	ND	9.32	9.45	10.0	10.0	93.2	94.5	1.4	75 - 125	20	
Selenium	ND	1.94	1.87	2.00	2.00	97.0	93.5	3.7	75 - 125	20	
Silver	ND	0.241	0.234	0.250	0.250	96.4	93.6	2.9	75 - 125	20	
Sodium	8.85	18.0	17.5	10.0	10.0	91.5	86.5	2.8	75 - 125	20	
Thallium	ND	0.179	0.176	0.200	0.200	89.5	88.0	1.7	75 - 125	20	
Vanadium	0.0883	0.546	0.532	0.500	0.500	91.5	88.7	2.6	75 - 125	20	
Zinc	ND	0.428	0.419	0.500	0.500	85.6	83.8	2.1	75 - 125	20	
Lithium	ND	0.523	0.505	0.500	0.500	104.6	101.0	3.5	75 - 125	20	

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0801191

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080129008**

POST DIGESTION SPIKE REPORT

Analysis: SW6010B - ICP - Total

Base Sample: B0801191-05A

Prep Date: 1/29/2008

Samp. Anal. Date: 1/30/2008 1:19:00PM

Units: mg/L

PDS Anal. Date: 1/30/2008 1:55:00PM

Matrix: Aqueous

Analyte Name	SampResult	PDSRes.	SPLev	Recov.	Recov Lim	Flag	
Aluminum	0.359	2.27	2.00	95.7	75 - 117		
Antimony	ND	0.444	0.500	87.5	75 - 117		
Arsenic	ND	1.76	2.00	88.3	75 - 116		
Barium	0.113	1.89	2.00	89.0	75 - 116		
Beryllium	ND	0.0467	0.0500	92.5	75 - 111		
Boron	0.282	0.736	0.500	90.7	75 - 130		
Cadmium	ND	0.0404	0.0500	79.3	75 - 113		
Calcium	562	580	10.0	186.5	75 - 119	highPDS	Note 2
Chromium	ND	0.185	0.200	88.3	75 - 117		
Cobalt	ND	0.438	0.500	87.3	75 - 118		
Copper	ND	0.227	0.250	89.9	75 - 117		
Iron	ND	0.957	1.00	95.5	75 - 121		
Lead	ND	0.438	0.500	88.0	75 - 121		
Magnesium	0.883	10.6	10.0	96.7	75 - 118		
Manganese	ND	0.443	0.500	88.4	75 - 121		
Molybdenum	0.0886	0.525	0.500	87.3	75 - 120		
Nickel	ND	0.443	0.500	88.9	75 - 117		
Potassium	ND	9.68	10.0	87.5	75 - 110		
Selenium	ND	1.94	2.00	95.6	75 - 117		
Silver	ND	0.240	0.250	96.5	75 - 127		
Sodium	8.85	18.4	10.0	95.2	75 - 113		
Thallium	ND	0.169	0.200	80.3	75 - 113		
Vanadium	0.0883	0.547	0.500	91.7	75 - 119		
Zinc	ND	0.428	0.500	88.6	75 - 120		
Lithium	ND	0.531	0.500	96.7	75 - 120		

SERIAL DILUTION REPORT

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0801191

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080129008**

SERIAL DILUTION REPORT

Analysis: SW6010B - ICP - Total

Base Sample: B0801191-05A

Prep Date: 1/29/2008

Samp. Anal. Date: 1/30/2008 1:19:00PM

Units: mg/L

SER DIL. Date: 1/30/2008 2:24:00PM

Matrix: Aqueous

Analyte Name	SampResult	PQL.	MDL.	SerialRes.	SerPQL.	RPD	Flag
Aluminum	0.359	0.050	0.014	0.526	0.25	37.7	Note 4
Antimony	ND	0.050	0.0067	ND	0.25		
Arsenic	ND	0.10	0.015	ND	0.50		
Barium	0.113	0.0100	0.00016	0.122	0.050	7.6	
Beryllium	ND	0.0010	0.000060	ND	0.0050		
Boron	0.282	0.050	0.0018	0.301	0.25	6.5	
Cadmium	ND	0.0060	0.00051	ND	0.030		
Calcium	562	0.10	0.013	585	0.50	4.0	
Chromium	ND	0.0100	0.0018	ND	0.050		
Cobalt	ND	0.0050	0.0016	ND	0.025		
Copper	ND	0.0050	0.0019	ND	0.025		
Iron	ND	0.050	0.0027	ND	0.25		
Lead	ND	0.050	0.011	ND	0.25		
Magnesium	0.883	0.10	0.012	0.965	0.50	8.8	
Manganese	ND	0.0100	0.00066	ND	0.050		
Molybdenum	0.0886	0.0100	0.0018	0.0920	0.050	3.7	
Nickel	ND	0.040	0.0027	ND	0.20		
Potassium	ND	1.0	0.31	ND	5.0		
Selenium	ND	0.10	0.026	ND	0.50		
Silver	ND	0.015	0.00066	ND	0.075		
Sodium	8.85	3.0	0.028	ND	15		
Thallium	ND	0.40	0.011	ND	2.0		
Vanadium	0.0883	0.0100	0.00072	0.0903	0.050	2.2	
Zinc	ND	0.0050	0.0010	ND	0.025		
Lithium	ND	0.10	0.00072	ND	0.50		

Prep Batch: **T080131004**

LCS/LCSD REPORT

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0801191

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080131004**

LCS/LCSD REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg

MB: T080131004-MB

Prep Date: 1/29/2008

MB Anal. Date: 1/31/2008 1:01:23PM

Units: mg/L

LCS Anal. Date: 1/31/2008 1:03:28PM LCSD Anal. Date: 1/31/2008 1:06:14PM

Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Mercury	ND	0.00204	0.00209	0.00200	0.0020	102.0	104.5	2.4	80 - 120	20	

FOOTNOTES TO QC REPORT

Note 1: Results are shown to three significant figures to avoid rounding errors in calculations.

Note 2: If the sample concentration is greater than 4 times the spike level, a recovery is not meaningful, and the result should be used as a replicate. In such cases the spike is not as high as expected random measurement variability of the sample result itself.

Note 3: For sample duplicates, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample and duplicate results are not five times the PQL or greater, then the RPD is not expected to fall within the window shown and the comparison should be made on the basis of the absolute difference. Analytica uses the criterion that the absolute difference should be less than the PQL for water or less than 2XPQL for other matrices.

Note 4: For serial dilutions, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample result is not 50 times the MDL or greater, then the fact that the RPD does not meet the 10% criterion has little signifcance. Otherwise it indicates that a matrix bias may exist at the analytical step.

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801191
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080130013**

SAMPLE DUPLICATE REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
Base Sample: B0801191-02B
Prep Date: 1/30/2008

Samp. Anal. Date: 1/30/2008 9:49:17PM
DUP Anal. Date: 1/30/2008 10:07:41PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Fluoride	8.19	8.30	1.3	30	
Chloride	611	599	2.0	30	
Sulfate	2,480	2,440	1.6	30	

LCS/LCSD REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
MB: T080130013-MB
Prep Date: 1/30/2008

MB Anal. Date: 1/30/2008 3:04:45PM
LCS Anal. Date: 1/31/2008 2:12:57PM LCSD Anal. Date: 1/31/2008 2:31:20PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Fluoride	ND	2.37	2.36	2.50	2.50	94.8	94.4	0.4	90 - 110	20	
Chloride	ND	4.75	4.75	5.00	5.00	95.0	95.0	0.0	90 - 110	20	
Sulfate	ND	34.1	34.1	37.5	37.5	90.9	90.9	0.0	90 - 110	20	

MS REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
Parent: B0801191-02B
Prep Date: 1/30/2008

Samp. Anal. Date: 1/30/2008 9:49:17PM
MS Anal. Date: 1/30/2008 10:26:05PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim	Flag
Fluoride	8.19	10.6	2.50	96.4	70 - 130	
Chloride	611	727	125	92.8	70 - 130	*NOTE 2*
Sulfate	2,480	3,420	938	100.3	70 - 130	

Prep Batch: **T080131008**

SAMPLE DUPLICATE REPORT

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801191
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080131008**

SAMPLE DUPLICATE REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Base Sample: B0801191-02B
Prep Date: 1/31/2008

Samp. Anal. Date: 2/4/2008 12:47:24PM
DUP Anal. Date: 2/4/2008 12:47:24PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Total Dissolved Solids	5,320	5,430	2.0	20	

LCS/LCSD REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS
MB: T080131008-MB
Prep Date: 1/31/2008

MB Anal. Date: 2/4/2008 12:47:24PM
LCS Anal. Date: 2/4/2008 12:47:24PM LCSD Anal. Date: 2/4/2008 12:47:24PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Total Dissolved Solids	ND	802	765	821	821	97.6	93.1	4.7	80 - 120	20	

MS REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Parent: B0801191-02B
Prep Date: 1/31/2008

Samp. Anal. Date: 2/4/2008 12:47:24PM
MS Anal. Date: 2/4/2008 12:47:24PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim		Flag
Total Dissolved Solids	5,320	6,190	821	105.9	70 - 130	*NOTE 2*	

Prep Batch: **T080205001**

SAMPLE DUPLICATE REPORT

Analysis: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Base Sample: B0801191-04B
Prep Date: 2/4/2008

Samp. Anal. Date: 2/4/2008 9:52:02AM
DUP Anal. Date: 2/4/2008 9:52:02AM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Bicarbonate	ND	ND	0.0	20	
Carbonate	10.0	8.00	22.2	20	OUT

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0801191

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080205001**

LCS/LCSD REPORT

Analysis: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity

MB: T080205001-MB

Prep Date: 2/4/2008

MB Anal. Date: 2/4/2008 9:52:02AM

Units: mg/L

LCS Anal. Date: 2/4/2008 9:52:02AM LCSD Anal. Date: 2/4/2008 9:52:02AM

Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Bicarbonate	ND	24.0	27.0	25.0	25.0	96.0	108.0	11.8	80 - 120	20	
Carbonate	ND	50.0	51.0	50.0	50.0	100.0	102.0	2.0	80 - 120	20	

FOOTNOTES TO QC REPORT

Note 1: Results are shown to three significant figures to avoid rounding errors in calculations.

Note 2: If the sample concentration is greater than 4 times the spike level, a recovery is not meaningful, and the result should be used as a replicate. In such cases the spike is not as high as expected random measurement variability of the sample result itself.

Note 3: For sample duplicates, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample and duplicate results are not five times the PQL or greater, then the RPD is not expected to fall within the window shown and the comparison should be made on the basis of the absolute difference. Analytica uses the criterion that the absolute difference should be less than the PQL for water or less than 2XPQL for other matrices.

Note 4: For serial dilutions, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample result is not 50 times the MDL or greater, then the fact that the RPD does not meet the 10% criterion has little signifcance. Otherwise it indicates that a matrix bias may exist at the analytical step.

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **83,542** **Lab Project Number:** **B0801191**

Prep Date: 1/29/2008

Lab Method Blank Id: T080129008-MB
Prep Batch ID: T080129008
Method: SW6010B - ICP - Total

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0801191-01A	MB 45 day	E01308A	1/30/2008 12:59:00PM
B0801191-02A	Ash Composite 45 day	E01308A	1/30/2008 1:04:00PM
B0801191-03A	Spoil Composite 45 day	E01308A	1/30/2008 1:09:00PM
B0801191-04A	MB SPLP	E01308A	1/30/2008 1:14:00PM
B0801191-05A	Ash Composite SPLP	E01308A	1/30/2008 1:19:00PM
B0801191-06A	Spoil Composite SPLP	E01308A	1/30/2008 2:29:00PM
T080129008-LCS	LCS	E01308A	1/30/2008 12:39:00PM
T080129008-LCSD	LCSD	E01308A	1/30/2008 12:44:00PM
B0801191-05A-DUP	DUP	E01308A	1/30/2008 1:40:00PM
B0801191-05A-MS	MS	E01308A	1/30/2008 1:45:00PM
B0801191-05A-MSD	MSD	E01308A	1/30/2008 1:50:00PM
B0801191-05A-PDS	PDS	E01308A	1/30/2008 1:55:00PM
T080129008-LCS	LCS	E01318A	1/31/2008 11:18:00AM
T080129008-LCSD	LCSD	E01318A	1/31/2008 11:23:00AM
B0801191-05A-MS	MS	E01318A	1/31/2008 11:28:00AM
B0801191-05A-MSD	MSD	E01318A	1/31/2008 11:33:00AM
B0801191-05A-PDS	PDS	E01318A	1/31/2008 11:38:00AM

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **83,542** **Lab Project Number:** **B0801191**

Prep Date: 1/30/2008

Lab Method Blank Id: T080130013-MB

Prep Batch ID: T080130013

Method: Inorganic Anions by Ion Chromatography - Anions by IC

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T080130013-LCS	LCS	080130_008.DXD	1/30/2008 3:23:07PM
T080130013-LCSD	LCSD	080130_009.DXD	1/30/2008 3:41:32PM
B0801191-01B	MB 45 day	080130_011.DXD	1/30/2008 4:18:17PM
B0801191-02B	Ash Composite 45 day	080130_012.DXD	1/30/2008 4:36:41PM
B0801191-02B-DUP	DUP	080130_013.DXD	1/30/2008 4:55:04PM
B0801191-02B-MS	MS	080130_014.DXD	1/30/2008 5:13:28PM
B0801191-03B	Spoil Composite 45 day	080130_016.DXD	1/30/2008 5:50:15PM
B0801191-05B	Ash Composite SPLP	080130_018.DXD	1/30/2008 6:27:01PM
B0801191-06B	Spoil Composite SPLP	080130_022.DXD	1/30/2008 7:40:34PM
B0801197-02B	Batch QC	080130_024.DXD	1/30/2008 8:17:21PM
B0801197-02B-MS	MS	080130_025.DXD	1/30/2008 8:35:45PM
B0801191-01B	MB 45 day	080130_027.DXD	1/30/2008 9:12:31PM
B0801191-02B	Ash Composite 45 day	080130_029.DXD	1/30/2008 9:49:17PM
B0801191-02B-DUP	DUP	080130_030.DXD	1/30/2008 10:07:41PM
B0801191-02B-MS	MS	080130_031.DXD	1/30/2008 10:26:05PM
B0801191-03B	Spoil Composite 45 day	080130_033.DXD	1/30/2008 11:02:52PM
B0801191-04B	MB SPLP	080130_037.DXD	1/31/2008 12:16:31AM
B0801191-05B	Ash Composite SPLP	080130_038.DXD	1/31/2008 12:34:55AM
B0801191-06B	Spoil Composite SPLP	080130_039.DXD	1/31/2008 12:53:17AM
B0801197-02B	Batch QC	080130_043.DXD	1/31/2008 2:06:51AM
B0801197-02B-MS	MS	080130_044.DXD	1/31/2008 2:25:15AM
T080130013-LCS	LCS	080131_010.DXD	1/31/2008 2:12:57PM
T080130013-LCSD	LCSD	080131_011.DXD	1/31/2008 2:31:20PM

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **83,542** **Lab Project Number:** **B0801191**

Prep Date: 1/29/2008

Lab Method Blank Id: T080131004-MB
Prep Batch ID: T080131004
Method: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
A0801184-01D	Batch QC	B013108W.WKS	1/31/2008 1:13:50PM
B0801191-01A	MB 45 day	B013108W.WKS	1/31/2008 1:50:33PM
B0801191-02A	Ash Composite 45 day	B013108W.WKS	1/31/2008 2:39:43PM
B0801191-03A	Spoil Composite 45 day	B013108W.WKS	1/31/2008 2:41:52PM
B0801191-04A	MB SPLP	B013108W.WKS	1/31/2008 2:44:26PM
B0801191-05A	Ash Composite SPLP	B013108W.WKS	1/31/2008 2:46:54PM
B0801191-06A	Spoil Composite SPLP	B013108W.WKS	1/31/2008 2:48:59PM
T080131004-LCS	LCS	B013108W.WKS	1/31/2008 1:03:28PM
T080131004-LCSD	LCSD	B013108W.WKS	1/31/2008 1:06:14PM
A0801184-01D-DUP	DUP	B013108W.WKS	1/31/2008 1:16:26PM
A0801184-01D-MS	MS	B013108W.WKS	1/31/2008 1:18:43PM
A0801184-01D-MSD	MSD	B013108W.WKS	1/31/2008 1:20:47PM
A0801184-01D-PDS	PDS	B013108W.WKS	1/31/2008 1:23:11PM

Prep Date: 1/31/2008

Lab Method Blank Id: T080131008-MB
Prep Batch ID: T080131008
Method: 160.1 - Total Dissolved Solids dried at 180°C - TDS

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0801191-01B	MB 45 day		2/4/2008 12:47:24PM
B0801191-02B	Ash Composite 45 day		2/4/2008 12:47:24PM
B0801191-03B	Spoil Composite 45 day		2/4/2008 12:47:24PM
B0801191-04B	MB SPLP		2/4/2008 12:47:24PM
B0801191-05B	Ash Composite SPLP		2/4/2008 12:47:24PM
B0801191-06B	Spoil Composite SPLP		2/4/2008 12:47:24PM
B0801197-02B	Batch QC		2/4/2008 12:47:24PM
T080131008-LCS	LCS		2/4/2008 12:47:24PM
T080131008-LCSD	LCSD		2/4/2008 12:47:24PM
B0801191-02B-DUP	DUP		2/4/2008 12:47:24PM
B0801191-02B-MS	MS		2/4/2008 12:47:24PM
B0801197-02B-MS	MS		2/4/2008 12:47:24PM

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **83,542** **Lab Project Number:** **B0801191**

Prep Date: 2/4/2008

Lab Method Blank Id: T080205001-MB

Prep Batch ID: T080205001

Method: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0801191-01B	MB 45 day		2/4/2008 9:52:02AM
B0801191-02B	Ash Composite 45 day		2/4/2008 9:52:02AM
B0801191-03B	Spoil Composite 45 day		2/4/2008 9:52:02AM
B0801191-04B	MB SPLP		2/4/2008 9:52:02AM
B0801191-05B	Ash Composite SPLP		2/4/2008 9:52:02AM
B0801191-06B	Spoil Composite SPLP		2/4/2008 9:52:02AM
T080205001-LCS	LCS		2/4/2008 9:52:02AM
T080205001-LCSD	LCSD		2/4/2008 9:52:02AM
B0801191-04B-DUP	DUP		2/4/2008 9:52:02AM

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:

ND = Not Detected at or above the Reporting Limit
NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:

LOW = Recovery is below Lower Control Limit
HIGH = Recovery , RPD, or other parameter is above Upper Control Limit
E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:

B = Analyte was detected in the laboratory method blank
J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:

J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
W = Post digestion spike did not meet criteria
S = Reported value determined by the Method of Standard Additions (MSA)

Several ways of defining the limit of detection and quantitation are prevalent in the laboratory industry and may appear in Analytica reports. These include the following:

MRL = "minimum reporting level", from the EPA Safe Drinking Water program (SDW)
PQL = "practical quantitation limit", from SW-846
EQL = "estimated quantitation limit", from SW-846
LOQ = "limit of quantitation", from a number of authoritative sources

In Analytica's work, all of these terms have the same meaning, equivalent to the EPA definition of the MRL. This reporting level is supported by a satisfactory calibration data point which is at that level or lower, and also is supported by a method detection limit (MDL) determined by the procedure in 40CFR. The MDL is lower than the MRL and represents an estimate of the level where positive detections have a 99% probability of being real, but where quantitation accuracy is unknown.

The MRL as defined by Analytica is the lowest demonstrated point of known quantitation accuracy.
The MRL should not be confused with the MCL, which is the EPA-defined "maximum contaminant level" allowed for certain regulated targets under specific regulations, such as the National Primary Drinking Water Regulations. Normally, the MRL is set at a level which is much lower than the MCL in order to ensure that levels are well below those limits. Not all target analytes have MCL levels established.

Other Flags may be applied. See Case Narrative for Description

Workorder (SDG): B0801191

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

REPORTING CONVENTIONS FOR THIS REPORT

B0801191

TestPkgName	Basis	# Sig Figs	Reporting Limit
150.1/150.1 (Aqueous) - pH	As Received	2	Report to PQL
160.1/160.1 (Aqueous) - TDS	As Received	2	Report to PQL
300.0/300.0 (Aqueous) - Anions by IC	As Received	2	Report to PQL
310.1/310.1 (Aqueous) - Alkalinity	As Received	2	Report to PQL
6010B/3010A (Aqueous) - Total	As Received	2	Report to PQL
7470A/7470A (Aqueous) - Total Hg	As Received	2	Report to PQL

Analytica Chain of Custody Form

ANALYTICA GROUP®

12189 Pennsylvania St.
Thornton, CO 80241
(303) 469-8868
(303) 469-5254 fax

4307 Arctic Boulevard
Anchorage, AK 99503
(907) 258-2155
(907) 258-6634 fax

475 Hall St.
Fairbanks, AK 99701
(907) 456 - 3116
(907) 456-3125 Fax

5438 Shaune Drive
Juneau, AK 99801
(907) 780-6668
(907) 780-6670 fax

Chain of Custody No: 63226

Client Name & Address: Applied Hydrology Associates, Inc.

Public Water System (PWS) ID#:

Project Name: Navajo Mine Extension Leaching Study

Section To be Completed by Analytica

Quote ID:

LGN: 60801191

Account #:

Cash

Credit Card

Report to:

Phone No:

Fax No:

E-mail:

Turnaround Time for Results (TAT)

X Standard ___ Expedited (< 10 days, prior authorization required)

(please specify due date below; add'tl charges may apply)

Requested Due Date for Results:

Invoice to Name & Address:

Special Instructions/Comments:
Tumbled in house by R. Seeman

45 day Coal Water and SPLP Leach

P.O. or Contract No:

Kit Prep/Shipping Charge: $

Requested Analysis/Method

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers	6010B/3010A-TTL Lot# 1070790 Pres: HNO3	7470A/7470A-Hg Lot# 1070896 Pres: HNO3	150.1 pH Lot# Pres:	160.1 TDS Lot# Pres:	3500 Anions/IC Lot# Pres:	310.1 Alk Lot# Pres:	Lot# Pres:	Field Preserved	Field Filtered	MS/MSD ?
MB 45 day	1/25/08	14:00	Aq	2	X	X	X	X	X	X		1/2	Yes	
Ash Composite 45day				3	X	X	X	X	X	X		1/3		X
Spoil Composite 45day				2	X	X	X	X	X	X		1/2		
MB SPLP				2	X	X	X	X	X	X				
ASH Composite SPLP				2	X	X	X	X	X	X				
Spoil Composite SPLP				2	X	X	X	X	X	X				

Relinquished by:	Date	Time	Received by:	Date	Time
R. Seeman	1/28/08	12:35		1/28/08	12:35
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Name of Sampler: (printed)

Section To Be Completed by Analytica

	THO	ANC	JNU	FBKS
Condition of Custody Seal?:	—			
Initialed By:	—			
Temp/Loc:	6.0			
Thermo ID#:				
Shipped Via:	Ryan Seaman			

Version 2.0

ANALYTICA

Cooler Receipt Form

Client: Applied Hydrology Associates **Client Code:** 030188 **Order #:** B0801191
Project: Navajo Mine Extension Leaching Study

Cooler ID: 1

A. Preliminary Examination Phase: **Date cooler opened:** 1/28/2008
Cooler opened by: gp **Signature:** GP

1. Was airbill Attached?	N/A	Airbill #:		Carrier Name:	Other
2. Custody Seals?	N/A	How many? 0	Location:	Seal Name:	
3. Seals intact?	N/A				
4. COC Attached?	Yes	Properly Completed?	Yes	Signed by AEL employee?	Yes

5. Project Identification from custody paper: Navajo Mine Extension Leaching Study
6. Preservative: None **Temperature:** 6.0 **deg. C**

Designated person initial here to acknowledge receipt: GP **Date:** 1/28/08

COMMENTS: Tumbled in house by R. Seeman. 45 day coal water and SPLP Leach.

B. Log-In Phase: **Samples Log-in Date:** 1/28/2008 **Log-in By:** gp

1. Packing Type:	Other		
2. Were samples in separate bags?	N/A		
3. Were containers intact?	Yes	Labels agree with COC?	Yes
4. Number of bottles received:	13	Number of samples received:	6
5. Correct containers used?	Yes	Correct preservatives added?	Yes
6. Sufficient sample volume?	Yes		
7. Bubbles in VOA samples?	N/A		

8. Was Project manager called and status discussed? No
9. Was anyone called? No **Who was called?** _____ **By whom?** _____ **Date:** _____

COMMENTS:

The Analytica Group
CLIENT INVOICE

Remit to: Accounting Dpt
Analytica Environmental Laboratories, Inc.
P.O. Box 973426
Dallas,TX 75397-3426

Phone: (303) 469-8868

Attention: Mr.Art O'Hayre
Invoice to: Applied Hydrology Associates, Inc.
950 South Cherry Street
Suite 810
Denver, CO 80246

Invoice #: **82691**
Work Order#: **B0801197**
Account#: 030188
Quote ID#: 11340
Invoice Date: 2/11/2008
Work ID: Navajo Mine Extension Leaching Study
PO #: none

Received: 1/29/2008
Reported: 2/11/2008
Client Project#: Navajo Mine Extension Leach

Comments:

Item charges		**Qty**	**Price**	**Total**
SW7470A - Mercury in Liquid Waste by CVAA - Total Hg In Aqueous	M	2	35.00	70.00
160.1 - Total Dissolved Solids dried at 180°C - TDS In Liquid	Matrix	2	22.00	44.00
150.1 - pH, Elecrometric - pH In Liquid	Matrix	2	10.00	20.00
SW6010B - ICP - Total In Aqueous	Matrix	2	312.00	624.00
Inorganic Anions by Ion Chromatography - Anions by IC In Liquid	Matrix	2	54.00	108.00
310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity In Liquid	Matrix	2	36.00	72.00

Total of Items Above: **$938.00**

Adjustments or Special Services	**Qty**	**Price**	**Total**
Tumbling Charge	1	95.00	95.00

Total of Items Above: **$95.00**

Grand Total: **$1,033.00**

All invoices are due and payable upon receipt. Outstanding balances over 30 days are subject to a finance charge of 1.5% per month, plus a late fee of $25.00. If Analytica engages legal counsel to enforce its rights or any other rights under an application for payment, the customer will be liable to Analytica for all costs of collection and other legal expenses, including reasonable attorney fees.

REMITTANCE ADVICE
PLEASE RETURN THIS PORTION WITH YOUR PAYMENT

Mr.Art O'Hayre
Applied Hydrology Associates, Inc.
950 South Cherry Street
Suite 810
Denver, CO 80246

Account#: 030188
Invoice #: **82691**
Invoice Date: 2/11/2008

TOTAL INVOICE AMOUNT: **$1,033.00**

PAYMENT AMOUNT ENCLOSED: _____

ANALYTICA
Environmental Laboratories

Analytica Environmental
Laboratories, Inc.
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2/11/2008

Applied Hydrology Associates, Inc.
950 South Cherry Street
Suite 810
Denver, CO 80246
Attn: Art O'Hayre

Work Order #: B0801197
Date: 2/11/2008
Work ID: Navajo Mine Extension Leaching Study
Date Received: 1/29/2008
Proj #: none

Sample Identification

Lab Sample Number	Client Description	Lab Sample Number	Client Description
B0801197-01	MB Successive #1	B0801197-02	Ash Successive #1

Enclosed are the analytical results for the submitted sample(s). Please review the CASE NARRATIVE for a discussion of any data and/or quality control issues. Listings of data qualifiers, analytical codes, key dates, and QC relationships are provided at the end of the report.

Sincerely,

Kristen Stone
Project Manager

"The Science of Analysis, The Art of Service"

Case Narrative

Analytica Environmental Laboratories, Inc.

Work Order: B0801197

Samples were prepared and analyzed according to EPA or equivalent methods outlined in the following references:

Methods for Chemical Analysis of Water and Wastes, USEPA 600/4-79-020, March 1983.

Pfaff, J. D., C. A. Brockhoff and J. W. O'Dell. 1994. The Determination of Inorganic Anions in Water by Ion Chromatography. Method 300.0A. U. S. Environmental Protection Agency. Environmental Monitoring Systems Lab.

Methods for the Determination of Metals in Environmental Samples, EPA/600/R-94/111, May 1994.

SAMPLE RECEIPT:
Two (2) samples were received on 1/29/2008 1:40:00 PM., at a temperature of 20 deg C., at Analytica-Thornton. The samples were received in good condition and in order per chain of custody. The samples were tumbled at the laboratory.

REVIEW FOR COMPLIANCE WITH ANALYTICA QA PLAN
A summary of our review is shown below.

All analytical results contained in this report have been reviewed under Analytica's internal quality assurance and quality control program. Any deviations in quality contro parameters for specific analyses are noted in the following text. A complete quality assurance report, including laboratory control, matrix spike, and sample duplicate recoveries is kept on file in our office and is available upon request.

All method specifications were met for the following tests:

Test Method: 150.1 - pH, Elecrometric - pH - Aqueous
Test Method: 160.1 - Total Dissolved Solids dried at 180°C - TDS - Aqueous
Test Method: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity - Aqueous
Test Method: Inorganic Anions by Ion Chromatography - Anions by IC - Aqueous
Test Method: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg - Aqueous

Test Method: SW6010B - ICP - Total - Aqueous

MS/MSD and DUP OUTLIERS:
As shown below, the MS/MSD was outside of limits for Sodium and Calcium. The sample had Sodium and Calcium concentrations greater than four times the spike amount. In these case it is not appropriate to calculate a recovery. The result should be used as a replicate.

Type	Client Sample	LabSample	Analyte	Recovery	LCL	UCL	Parent	Spike
MS	Ash Successive #	B0801197-02A	Sodium	52.8	75	125	1130	10.0
MSD	Ash Successive #	B0801197-02A	Calcium	217	75	125	472	10.0
MSD	Ash Successive #	B0801197-02A	Sodium	352	75	125	1130	10.0

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB Successive #1**

Matrix: Aqueous Collection Date: 1/29/2008 11:10:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801197-01A
Prep Date: 2/5/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T080205004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 2/5/2008 4:36:31PM
Instrument: CVAA_1
File Name: B020508W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.00005	2

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801197-01A
Prep Date: 1/30/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080130010
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/31/2008 1:35:00PM
Instrument: ICP_2
File Name: E01318A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.063**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.085**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**0.31**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**3.2**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**1.3**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.016**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**12**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB Successive #1**

Matrix: Aqueous Collection Date: 1/29/2008 11:10:00AM

Lab Sample Number: B0801197-01A
Prep Date: 1/30/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080130010
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/31/2008 1:35:00PM
Instrument: ICP_2
File Name: E01318A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**1,200**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801197-01B
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**1,100**		mg/L	5.0	1.5	1
Carbonate		**280**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801197-01B
Prep Date: 1/29/2008
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Prep Method ID: 150.1
Prep Batch Number: T080201006
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 1/29/2008 11:20:00AM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: R. Seeman
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**9.1**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB Successive #1**

Matrix: Aqueous Collection Date: 1/29/2008 11:10:00AM

Lab Sample Number: B0801197-01B
Prep Date: 1/31/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080131008
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 12:47:24PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**3,000**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801197-01B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/30/2008 7:58:57PM
Instrument: IC
File Name: 080130_023.D
Dilution Factor: 25
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**600**		mg/L	20	1.1	1

Lab Sample Number: B0801197-01B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/31/2008 1:30:04AM
Instrument: IC
File Name: 080130_041.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**2.2**		mg/L	0.40	0.031	2
Sulfate		**280**		mg/L	1.5	0.11	

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Successive #1**

Matrix: Aqueous Collection Date: 1/29/2008 11:10:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801197-02A
Prep Date: 2/5/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T080205004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 2/5/2008 4:38:47PM
Instrument: CVAA_1
File Name: B020508W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.00005	2

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801197-02A
Prep Date: 1/30/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080130010
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/31/2008 1:40:00PM
Instrument: ICP_2
File Name: E01318A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.065**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.033**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**0.37**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**470**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**2.0**		mg/L	0.10	0.012	
Manganese	7439-96-5	**0.021**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.019**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**12**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Successive #1**

Matrix: Aqueous Collection Date: 1/29/2008 11:10:00AM

Lab Sample Number: B0801197-02A
Prep Date: 1/30/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080130010
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/31/2008 1:40:00PM
Instrument: ICP_2
File Name: E01318A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**1,100**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**0.034**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801197-02B
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**790**		mg/L	5.0	1.5	1
Carbonate		**ND**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801197-02B
Prep Date: 1/29/2008
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Prep Method ID: 150.1
Prep Batch Number: T080201006
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 1/29/2008 11:20:00AM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: R. Seeman
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**7.4**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Successive #1**

Matrix: Aqueous Collection Date: 1/29/2008 11:10:00AM

Lab Sample Number: B0801197-02B
Prep Date: 1/31/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080131008
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 12:47:24PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**4,900**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801197-02B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/30/2008 8:17:21PM
Instrument: IC
File Name: 080130_024.D
Dilution Factor: 25
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**610**		mg/L	20	1.1	1
Sulfate		**2,100**		mg/L	38	2.8	

Lab Sample Number: B0801197-02B
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/31/2008 2:06:51AM
Instrument: IC
File Name: 080130_043.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**2.6**		mg/L	0.40	0.031	2

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 2/5/2008 12:00:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080205004-MB
Prep Date: 2/5/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Prep Method ID: 7470A
Prep Batch Number: T080205004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 2/5/2008 4:23:51PM
Instrument: CVAA_1
File Name: B020508W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.00005	2

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080130010-MB
Prep Date: 1/30/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080130010
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/31/2008 1:04:00PM
Instrument: ICP_2
File Name: E01318A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**ND**		mg/L	0.050	0.014	1
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**ND**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**ND**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**ND**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**ND**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**ND**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**ND**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	
Sodium	7440-23-5	**ND**		mg/L	3.0	0.028	

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 1/30/2008 12:00:00AM

Lab Sample Number: T080130010-MB
Prep Date: 1/30/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080130010
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 1/31/2008 1:04:00PM
Instrument: ICP_2
File Name: E01318A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Thallium	7440-28-0	ND		mg/L	0.40	0.011	1
Vanadium	7440-62-2	ND		mg/L	0.010	0.00072	

Lab Sample Number: T080130010-MB
Prep Date: 1/30/2008
Analytical Method ID: SW6010B - ICP - Total
Prep Method ID: 3010_ICP
Prep Batch Number: T080130010
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/1/2008 12:48:00PM
Instrument: ICP_2
File Name: E02018A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Lead	7439-92-1	ND		mg/L	0.050	0.011	2
Zinc	7440-66-6	ND		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080205001-MB
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Prep Method ID: Alkalinity_W
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 100.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		ND		mg/L	5.0	1.5	1
Carbonate		ND		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080131008-MB
Prep Date: 1/31/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080131008
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 12:47:24PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 1/31/2008 12:00:00AM

Lab Sample Number: T080131008-MB
Prep Date: 1/31/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Prep Method ID: 160.1
Prep Batch Number: T080131008
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 12:47:24PM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		ND		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080130013-MB
Prep Date: 1/30/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Prep Method ID: 300.0
Prep Batch Number: T080130013
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 1/30/2008 3:04:45PM
Instrument: IC
File Name: 080130_007.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		ND		mg/L	0.80	0.042	1
Fluoride		ND		mg/L	0.40	0.031	
Sulfate		ND		mg/L	1.5	0.11	

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801197
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080130010**

SAMPLE DUPLICATE REPORT

Analysis: SW6010B - ICP - Total

Base Sample: B0801197-02A
Prep Date: 1/30/2008

Samp. Anal. Date: 1/31/2008 1:40:00PM
DUP Anal. Date: 1/31/2008 1:45:00PM

Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Aluminum	0.0655	ND	0.0	20	
Antimony	ND	ND	0.0	20	
Arsenic	ND	ND	0.0	20	
Barium	0.0334	0.0320	4.3	20	
Beryllium	ND	ND	0.0	20	
Boron	0.369	0.359	2.7	20	
Cadmium	ND	ND	0.0	20	
Calcium	472	452	4.3	20	
Chromium	ND	ND	0.0	20	
Cobalt	ND	ND	0.0	20	
Copper	ND	ND	0.0	20	
Iron	ND	ND	0.0	20	
Lead	ND	ND	0.0	20	
Magnesium	1.99	1.89	5.2	20	
Manganese	0.0213	0.0202	5.3	20	
Molybdenum	0.0188	0.0181	3.8	20	
Nickel	ND	ND	0.0	20	
Potassium	11.8	11.9	0.8	20	
Selenium	ND	ND	0.0	20	
Silver	ND	ND	0.0	20	
Sodium	1,130	1,080	4.5	20	
Thallium	ND	ND	0.0	20	
Vanadium	0.0339	0.0313	8.0	20	
Zinc	ND	ND	0.0	20	
Lithium	ND	ND	0.0	20	

LCS/LCSD REPORT

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0801197

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080130010**

LCS/LCSD REPORT

Analysis: SW6010B - ICP - Total

MB: T080130010-MB

Prep Date: 1/30/2008

MB Anal. Date: 1/31/2008 1:04:00PM

Units: mg/L

LCS Anal. Date: 1/31/2008 1:25:00PM LCSD Anal. Date: 1/31/2008 1:30:00PM Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Aluminum	ND	1.89	1.94	2.00	2.00	94.5	97.0	2.6	89 - 117	20	
Antimony	ND	0.451	0.464	0.500	0.500	90.2	92.8	2.8	82 - 117	20	
Arsenic	ND	1.84	1.88	2.00	2.00	92.0	94.0	2.2	86 - 116	20	
Barium	ND	1.84	1.89	2.00	2.00	92.0	94.5	2.7	86 - 116	20	
Beryllium	ND	0.0499	0.0512	0.0500	0.0500	99.8	102.4	2.6	87 - 111	20	
Boron	ND	0.440	0.452	0.500	0.500	88.0	90.4	2.7	76 - 130	20	
Cadmium	ND	0.0438	0.0439	0.0500	0.0500	87.6	87.8	0.2	79 - 113	20	
Calcium	ND	9.54	9.93	10.0	10.0	95.4	99.3	4.0	79 - 119	20	
Chromium	ND	0.192	0.197	0.200	0.200	96.0	98.5	2.6	86 - 117	20	
Cobalt	ND	0.474	0.488	0.500	0.500	94.8	97.6	2.9	82 - 118	20	
Copper	ND	0.229	0.234	0.250	0.250	91.6	93.6	2.2	86 - 117	20	
Iron	ND	0.998	1.04	1.00	1.00	99.8	104.0	4.1	83 - 121	20	
Lead	ND	0.465	0.479	0.500	0.500	93.0	95.8	3.0	83 - 121	20	
Magnesium	ND	9.89	10.2	10.0	10.0	98.9	102.0	3.1	83 - 118	20	
Manganese	ND	0.480	0.493	0.500	0.500	96.0	98.6	2.7	82 - 121	20	
Molybdenum	ND	0.468	0.483	0.500	0.500	93.6	96.6	3.2	82 - 120	20	
Nickel	ND	0.478	0.490	0.500	0.500	95.6	98.0	2.5	84 - 117	20	
Potassium	ND	8.36	8.35	10.0	10.0	83.6	83.5	0.1	74 - 110	20	
Selenium	ND	1.89	1.93	2.00	2.00	94.5	96.5	2.1	87 - 117	20	
Silver	ND	0.248	0.253	0.250	0.250	99.2	101.2	2.0	80 - 127	20	
Sodium	ND	9.23	9.80	10.0	10.0	92.3	98.0	6.0	87 - 113	20	
Thallium	ND	0.199	0.178	0.200	0.200	99.5	89.0	11.1	89 - 113	20	lowdup
Vanadium	ND	0.484	0.497	0.500	0.500	96.8	99.4	2.7	87 - 119	20	
Zinc	ND	0.450	0.459	0.500	0.500	90.0	91.8	2.0	81 - 120	20	
Lithium	ND	0.457	0.471	0.500	0.500	91.4	94.2	3.0	80 - 120	20	

MS/MSD REPORT

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801197
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080130010**

MS/MSD REPORT

Analysis: SW6010B - ICP - Total
Parent: B0801197-02A
Prep Date: 1/30/2008
Samp. Anal. Date: 1/31/2008 1:40:00PM
Units: mg/L
MS Anal. Date: 1/31/2008 1:50:00PM MSD Anal. Date: 1/31/2008 1:55:00PM Matrix: Aqueous

Analyte Name	SampResult	MSRes.	MSDRes	SPLev	SPDLev	Recov.	MSD Rec.	RPD	Recov Lim	RPDLim	Flag
Aluminum	0.0655	1.96	1.96	2.00	2.00	94.7	94.7	0.0	75 - 125	20	
Antimony	ND	0.449	0.459	0.500	0.500	89.8	91.8	2.2	75 - 125	20	
Arsenic	ND	1.85	1.92	2.00	2.00	92.5	96.0	3.7	75 - 125	20	
Barium	0.0334	1.77	1.82	2.00	2.00	86.8	89.3	2.8	75 - 125	20	
Beryllium	ND	0.0469	0.0492	0.0500	0.0500	93.8	98.4	4.8	75 - 125	20	
Boron	0.369	0.789	0.815	0.500	0.500	84.0	89.2	3.2	75 - 125	20	
Cadmium	ND	0.0392	0.0387	0.0500	0.0500	78.4	77.4	1.3	75 - 125	20	
Calcium	472	480	493	10.0	10.0	80.0	210.0	2.7	75 - 125	20	*NOTE 2 NOTE 2*
Chromium	ND	0.177	0.184	0.200	0.200	88.5	92.0	3.9	75 - 125	20	
Cobalt	ND	0.430	0.450	0.500	0.500	86.0	90.0	4.5	75 - 125	20	
Copper	ND	0.223	0.232	0.250	0.250	89.2	92.8	4.0	75 - 125	20	
Iron	ND	0.925	0.956	1.00	1.00	92.5	95.6	3.3	75 - 125	20	
Lead	ND	0.432	0.448	0.500	0.500	86.4	89.6	3.6	75 - 125	20	
Magnesium	1.99	11.6	12.0	10.0	10.0	96.1	100.1	3.4	75 - 125	20	
Manganese	0.0213	0.463	0.479	0.500	0.500	88.3	91.5	3.4	75 - 125	20	
Molybdenum	0.0188	0.455	0.469	0.500	0.500	87.2	90.0	3.0	75 - 125	20	
Nickel	ND	0.439	0.455	0.500	0.500	87.8	91.0	3.6	75 - 125	20	
Potassium	11.8	20.4	21.4	10.0	10.0	86.0	96.0	4.8	75 - 125	20	
Selenium	ND	2.00	2.07	2.00	2.00	100.0	103.5	3.4	75 - 125	20	
Silver	ND	0.237	0.244	0.250	0.250	94.8	97.6	2.9	75 - 125	20	
Sodium	1,130	1,130	1,160	10.0	10.0	0.0	300.0	2.6	75 - 125	20	*NOTE 2 NOTE 2*
Thallium	ND	0.166	0.165	0.200	0.200	83.0	82.5	0.6	75 - 125	20	
Vanadium	0.0339	0.494	0.509	0.500	0.500	92.0	95.0	3.0	75 - 125	20	
Zinc	ND	0.434	0.445	0.500	0.500	86.8	89.0	2.5	75 - 125	20	
Lithium	ND	0.562	0.579	0.500	0.500	112.4	115.8	3.0	75 - 125	20	

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801197
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080130010**

POST DIGESTION SPIKE REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0801197-02A
Prep Date: 1/30/2008
Samp. Anal. Date: 1/31/2008 1:40:00PM
Units: mg/L
PDS Anal. Date: 1/31/2008 2:00:00PM
Matrix: Aqueous

Analyte Name	SampResult	PDSRes.	SPLev	Recov.	Recov Lim	Flag	
Aluminum	0.0655	1.91	2.00	92.0	75 - 117		
Antimony	ND	0.447	0.500	87.2	75 - 117		
Arsenic	ND	1.85	2.00	91.2	75 - 116		
Barium	0.0334	1.76	2.00	86.3	75 - 116		
Beryllium	ND	0.0477	0.0500	94.4	75 - 111		
Boron	0.369	0.791	0.500	84.4	75 - 130		
Cadmium	ND	0.0391	0.0500	77.3	75 - 113		
Calcium	472	480	10.0	78.6	75 - 119		Note 2
Chromium	ND	0.178	0.200	88.8	75 - 117		
Cobalt	ND	0.435	0.500	86.7	75 - 118		
Copper	ND	0.225	0.250	89.0	75 - 117		
Iron	ND	0.931	1.00	93.2	75 - 121		
Lead	ND	0.442	0.500	87.1	75 - 121		
Magnesium	1.99	11.7	10.0	97.3	75 - 118		
Manganese	0.0213	0.466	0.500	89.0	75 - 121		
Molybdenum	0.0188	0.457	0.500	87.6	75 - 120		
Nickel	ND	0.444	0.500	88.3	75 - 117		
Potassium	11.8	21.1	10.0	93.1	75 - 110		
Selenium	ND	1.98	2.00	97.3	75 - 117		
Silver	ND	0.239	0.250	93.8	75 - 127		
Sodium	1,130	1,130	10.0	22.3	75 - 113	lowPDS	Note 2
Thallium	ND	0.165	0.200	79.3	75 - 113		
Vanadium	0.0339	0.496	0.500	92.4	75 - 119		
Zinc	ND	0.439	0.500	90.6	75 - 120		
Lithium	ND	0.559	0.500	94.3	75 - 120		

SERIAL DILUTION REPORT

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801197
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080130010**

SERIAL DILUTION REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0801197-02A
Prep Date: 1/30/2008
Samp. Anal. Date: 1/31/2008 1:40:00PM
Units: mg/L
SER DIL. Date: 1/31/2008 2:05:00PM
Matrix: Aqueous

Analyte Name	SampResult	PQL.	MDL.	SerialRes.	SerPQL.	RPD	Flag
Aluminum	0.0655	0.050	0.014	ND	0.25		
Antimony	ND	0.050	0.0067	ND	0.25		
Arsenic	ND	0.10	0.015	ND	0.50		
Barium	0.0334	0.0100	0.00016	ND	0.050		
Beryllium	ND	0.0010	0.000060	ND	0.0050		
Boron	0.369	0.050	0.0018	0.353	0.25	4.4	
Cadmium	ND	0.0060	0.00051	ND	0.030		
Calcium	472	0.10	0.013	435	0.50	8.1	
Chromium	ND	0.0100	0.0018	ND	0.050		
Cobalt	ND	0.0050	0.0016	ND	0.025		
Copper	ND	0.0050	0.0019	ND	0.025		
Iron	ND	0.050	0.0027	ND	0.25		
Lead	ND	0.050	0.011	ND	0.25		
Magnesium	1.99	0.10	0.012	1.72	0.50	14.5	OUT
Manganese	0.0213	0.0100	0.00066	ND	0.050		
Molybdenum	0.0188	0.0100	0.0018	ND	0.050		
Nickel	ND	0.040	0.0027	ND	0.20		
Potassium	11.8	1.0	0.31	11.7	5.0	0.8	
Selenium	ND	0.10	0.026	ND	0.50		
Silver	ND	0.015	0.00066	ND	0.075		
Sodium	1,130	3.0	0.028	1,030	15	9.2	
Thallium	ND	0.40	0.011	ND	2.0		
Vanadium	0.0339	0.0100	0.00072	ND	0.050		
Zinc	ND	0.0050	0.0010	ND	0.025		
Lithium	ND	0.10	0.00072	ND	0.50		

Prep Batch: **T080205004**

SAMPLE DUPLICATE REPORT

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801197
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080205004**

SAMPLE DUPLICATE REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Base Sample: B0801197-02A
Prep Date: 2/5/2008

Samp. Anal. Date: 2/5/2008 4:38:47PM
DUP Anal. Date: 2/5/2008 4:41:14PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Mercury	ND	ND	0.0	20	

LCS/LCSD REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
MB: T080205004-MB
Prep Date: 2/5/2008

MB Anal. Date: 2/5/2008 4:23:51PM
LCS Anal. Date: 2/5/2008 4:26:44PM
LCSD Anal. Date: 2/5/2008 4:29:07PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Mercury	ND	0.00223	0.00227	0.00200	0.0020	111.5	113.5	1.8	80 - 120	20	

MS/MSD REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Parent: B0801197-02A
Prep Date: 2/5/2008

Samp. Anal. Date: 2/5/2008 4:38:47PM
MS Anal. Date: 2/5/2008 4:43:28PM
MSD Anal. Date: 2/5/2008 4:46:03PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	MSDRes	SPLev	SPDLev	Recov.	MSD Rec.	RPD	Recov Lim	RPDLim	Flag
Mercury	ND	0.00209	0.00203	0.00200	0.00200	104.5	101.5	2.9	70 - 130	20	

POST DIGESTION SPIKE REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Base Sample: B0801197-02A
Prep Date: 2/5/2008

Samp. Anal. Date: 2/5/2008 4:38:47PM
PDS Anal. Date: 2/5/2008 4:52:53PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	PDSRes.	SPLev	Recov.	Recov Lim	Flag
Mercury	ND	0.00211	0.00200	110.2	80 - 120	

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

FOOTNOTES TO QC REPORT

Note 1: Results are shown to three significant figures to avoid rounding errors in calculations.

Note 2: If the sample concentration is greater than 4 times the spike level, a recovery is not meaningful, and the result should be used as a replicate. In such cases the spike is not as high as expected random measurement variability of the sample result itself.

Note 3: For sample duplicates, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample and duplicate results are not five times the PQL or greater, then the RPD is not expected to fall within the window shown and the comparison should be made on the basis of the absolute difference. Analytica uses the criterion that the absolute difference should be less than the PQL for water or less than 2XPQL for other matrices.

Note 4: For serial dilutions, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample result is not 50 times the MDL or greater, then the fact that the RPD does not meet the 10% criterion has little signifcance. Otherwise it indicates that a matrix bias may exist at the analytical step.

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801197
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080130013**

LCS/LCSD REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
MB: T080130013-MB
Prep Date: 1/30/2008
MB Anal. Date: 1/30/2008 3:04:45PM
Units: mg/L
LCS Anal. Date: 1/31/2008 2:12:57PM LCSD Anal. Date: 1/31/2008 2:31:20PM
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Fluoride	ND	2.37	2.36	2.50	2.50	94.8	94.4	0.4	90 - 110	20	
Chloride	ND	4.75	4.75	5.00	5.00	95.0	95.0	0.0	90 - 110	20	
Sulfate	ND	34.1	34.1	37.5	37.5	90.9	90.9	0.0	90 - 110	20	

MS REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
Parent: B0801197-02B
Prep Date: 1/30/2008
Samp. Anal. Date: 1/31/2008 2:06:51AM
Units: mg/L
MS Anal. Date: 1/31/2008 2:25:15AM
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim	Flag
Fluoride	2.55	4.83	2.50	91.2	70 - 130	
Chloride	605	743	125	110.4	70 - 130	*NOTE 2*
Sulfate	2,100	3,120	938	108.8	70 - 130	

Prep Batch: **T080131008**

LCS/LCSD REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS
MB: T080131008-MB
Prep Date: 1/31/2008
MB Anal. Date: 2/4/2008 12:47:24PM
Units: mg/L
LCS Anal. Date: 2/4/2008 12:47:24PM LCSD Anal. Date: 2/4/2008 12:47:24PM
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Total Dissolved Solids	ND	802	765	821	821	97.6	93.1	4.7	80 - 120	20	

MS REPORT

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801197
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080131008**

MS REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Parent: B0801197-02B
Prep Date: 1/31/2008
Samp. Anal. Date: 2/4/2008 12:47:24PM
Units: mg/L
MS Anal. Date: 2/4/2008 12:47:24PM
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim		Flag
Total Dissolved Solids	4,880	5,940	821	129.0	70 - 130	*NOTE 2*	

Prep Batch: **T080205001**

LCS/LCSD REPORT

Analysis: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
MB: T080205001-MB
Prep Date: 2/4/2008
MB Anal. Date: 2/4/2008 9:52:02AM
Units: mg/L
LCS Anal. Date: 2/4/2008 9:52:02AM LCSD Anal. Date: 2/4/2008 9:52:02AM
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Bicarbonate	ND	24.0	27.0	25.0	25.0	96.0	108.0	11.8	80 - 120	20	
Carbonate	ND	50.0	51.0	50.0	50.0	100.0	102.0	2.0	80 - 120	20	

FOOTNOTES TO QC REPORT

Note 1: Results are shown to three significant figures to avoid rounding errors in calculations.

Note 2: If the sample concentration is greater than 4 times the spike level, a recovery is not meaningful, and the result should be used as a replicate. In such cases the spike is not as high as expected random measurement variability of the sample result itself.

Note 3: For sample duplicates, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample and duplicate results are not five times the PQL or greater, then the RPD is not expected to fall within the window shown and the comparison should be made on the basis of the absolute difference. Analytica uses the criterion that the absolute difference should be less than the PQL for water or less than 2XPQL for other matrices.

Note 4: For serial dilutions, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample result is not 50 times the MDL or greater, then the fact that the RPD does not meet the 10% criterion has little signifcance. Otherwise it indicates that a matrix bias may exist at the analytical step.

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **83,582** **Lab Project Number:** **B0801197**

Prep Date: 1/30/2008

Lab Method Blank Id: T080130010-MB
Prep Batch ID: T080130010
Method: SW6010B - ICP - Total

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0801197-02A-PDS	PDS	E02018A	2/1/2008 1:13:00PM
T080130010-LCSD	LCSD	E02018A	2/1/2008 12:58:00PM
B0801197-02A-MS	MS	E02018A	2/1/2008 1:03:00PM
B0801197-02A-MSD	MSD	E02018A	2/1/2008 1:08:00PM
B0801197-02A-MSD	MSD	E01318A	1/31/2008 1:55:00PM
B0801197-02A-PDS	PDS	E01318A	1/31/2008 2:00:00PM
T080130010-LCS	LCS	E02018A	2/1/2008 12:53:00PM
T080130010-LCSD	LCSD	E01318A	1/31/2008 1:30:00PM
B0801197-02A-DUP	DUP	E01318A	1/31/2008 1:45:00PM
B0801197-02A-MS	MS	E01318A	1/31/2008 1:50:00PM
B0801197-01A	MB Successive #1	E01318A	1/31/2008 1:35:00PM
B0801197-02A	Ash Successive #1	E01318A	1/31/2008 1:40:00PM
T080130010-LCS	LCS	E01318A	1/31/2008 1:25:00PM

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **83,582** **Lab Project Number:** **B0801197**

Prep Date: 1/30/2008

Lab Method Blank Id: T080130013-MB
Prep Batch ID: T080130013
Method: Inorganic Anions by Ion Chromatography - Anions by IC

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T080130013-LCSD	LCSD	080131_011.DXD	1/31/2008 2:31:20PM
B0801197-02B	Ash Successive #1	080130_043.DXD	1/31/2008 2:06:51AM
B0801197-02B-MS	MS	080130_044.DXD	1/31/2008 2:25:15AM
T080130013-LCS	LCS	080131_010.DXD	1/31/2008 2:12:57PM
B0801191-02B-DUP	DUP	080130_030.DXD	1/30/2008 10:07:41PM
B0801191-02B-MS	MS	080130_031.DXD	1/30/2008 10:26:05PM
B0801197-01B	MB Successive #1	080130_041.DXD	1/31/2008 1:30:04AM
B0801197-02B	Ash Successive #1	080130_024.DXD	1/30/2008 8:17:21PM
B0801197-02B-MS	MS	080130_025.DXD	1/30/2008 8:35:45PM
B0801191-02B	Batch QC	080130_029.DXD	1/30/2008 9:49:17PM
B0801191-02B-DUP	DUP	080130_013.DXD	1/30/2008 4:55:04PM
B0801191-02B-MS	MS	080130_014.DXD	1/30/2008 5:13:28PM
B0801197-01B	MB Successive #1	080130_023.DXD	1/30/2008 7:58:57PM
T080130013-LCS	LCS	080130_008.DXD	1/30/2008 3:23:07PM
T080130013-LCSD	LCSD	080130_009.DXD	1/30/2008 3:41:32PM
B0801191-02B	Batch QC	080130_012.DXD	1/30/2008 4:36:41PM

Prep Date: 1/31/2008

Lab Method Blank Id: T080131008-MB
Prep Batch ID: T080131008
Method: 160.1 - Total Dissolved Solids dried at 180°C - TDS

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0801191-02B-MS	MS		2/4/2008 12:47:24PM
B0801197-02B-MS	MS		2/4/2008 12:47:24PM
T080131008-LCS	LCS		2/4/2008 12:47:24PM
T080131008-LCSD	LCSD		2/4/2008 12:47:24PM
B0801191-02B-DUP	DUP		2/4/2008 12:47:24PM
B0801191-02B	Batch QC		2/4/2008 12:47:24PM
B0801197-01B	MB Successive #1		2/4/2008 12:47:24PM
B0801197-02B	Ash Successive #1		2/4/2008 12:47:24PM

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **83,582** **Lab Project Number:** **B0801197**

Prep Date: 2/4/2008

Lab Method Blank Id: T080205001-MB
Prep Batch ID: T080205001
Method: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T080205001-LCS	LCS		2/4/2008 9:52:02AM
T080205001-LCSD	LCSD		2/4/2008 9:52:02AM
B0801191-04B-DUP	DUP		2/4/2008 9:52:02AM
B0801191-04B	Batch QC		2/4/2008 9:52:02AM
B0801197-01B	MB Successive #1		2/4/2008 9:52:02AM
B0801197-02B	Ash Successive #1		2/4/2008 9:52:02AM

Prep Date: 2/5/2008

Lab Method Blank Id: T080205004-MB
Prep Batch ID: T080205004
Method: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0801197-02A-PDS	PDS	B020508W.WKS	2/5/2008 4:52:53PM
B0801210-02A-PDS	PDS	B020508W.WKS	2/5/2008 5:08:38PM
B0801210-04A-PDS	PDS	B020508W.WKS	2/5/2008 5:27:21PM
B0801197-02A-MSD	MSD	B020508W.WKS	2/5/2008 4:46:03PM
B0801210-02A-MSD	MSD	B020508W.WKS	2/5/2008 5:06:23PM
B0801210-04A-MSD	MSD	B020508W.WKS	2/5/2008 5:25:08PM
B0801197-02A-MS	MS	B020508W.WKS	2/5/2008 4:43:28PM
B0801210-02A-MS	MS	B020508W.WKS	2/5/2008 5:04:18PM
B0801210-04A-MS	MS	B020508W.WKS	2/5/2008 5:22:59PM
B0801197-02A-DUP	DUP	B020508W.WKS	2/5/2008 4:41:14PM
B0801210-02A-DUP	DUP	B020508W.WKS	2/5/2008 5:02:05PM
B0801210-04A-DUP	DUP	B020508W.WKS	2/5/2008 5:20:14PM
B0801210-04A	Batch QC	B020508W.WKS	2/5/2008 5:13:23PM
T080205004-LCS	LCS	B020508W.WKS	2/5/2008 4:26:44PM
T080205004-LCSD	LCSD	B020508W.WKS	2/5/2008 4:29:07PM
B0801197-01A	MB Successive #1	B020508W.WKS	2/5/2008 4:36:31PM
B0801197-02A	Ash Successive #1	B020508W.WKS	2/5/2008 4:38:47PM
B0801210-02A	Batch QC	B020508W.WKS	2/5/2008 4:59:48PM

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:

ND = Not Detected at or above the Reporting Limit
NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:

LOW = Recovery is below Lower Control Limit
HIGH = Recovery , RPD, or other parameter is above Upper Control Limit
E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:

B = Analyte was detected in the laboratory method blank
J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:

J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
W = Post digestion spike did not meet criteria
S = Reported value determined by the Method of Standard Additions (MSA)

Several ways of defining the limit of detection and quantitation are prevalent in the laboratory industry and may appear in Analytica reports. These include the following:

MRL = "minimum reporting level", from the EPA Safe Drinking Water program (SDW)
PQL = "practical quantitation limit", from SW-846
EQL = "estimated quantitation limit", from SW-846
LOQ = "limit of quantitation", from a number of authoritative sources

In Analytica's work, all of these terms have the same meaning, equivalent to the EPA definition of the MRL. This reporting level is supported by a satisfactory calibration data point which is at that level or lower, and also is supported by a method detection limit (MDL) determined by the procedure in 40CFR. The MDL is lower than the MRL and represents an estimate of the level where positive detections have a 99% probability of being real, but where quantitation accuracy is unknown.

The MRL as defined by Analytica is the lowest demonstrated point of known quantitation accuracy.
The MRL should not be confused with the MCL, which is the EPA-defined "maximum contaminant level" allowed for certain regulated targets under specific regulations, such as the National Primary Drinking Water Regulations. Normally, the MRL is set at a level which is much lower than the MCL in order to ensure that levels are well below those limits. Not all target analytes have MCL levels established.

Other Flags may be applied. See Case Narrative for Description

Workorder (SDG): B0801197

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

REPORTING CONVENTIONS FOR THIS REPORT

B0801197

TestPkgName	Basis	# Sig Figs	Reporting Limit
150.1/150.1 (Aqueous) - pH	As Received	2	Report to PQL
160.1/160.1 (Aqueous) - TDS	As Received	2	Report to PQL
300.0/300.0 (Aqueous) - Anions by IC	As Received	2	Report to PQL
310.1/310.1 (Aqueous) - Alkalinity	As Received	2	Report to PQL
6010B/3010A (Aqueous) - Total	As Received	2	Report to PQL
7470A/7470A (Aqueous) - Total Hg	As Received	2	Report to PQL

Analytica Chain of Custody Form

ANALYTICA GROUP ®

12189 Pennsylvania St.
Thornton, CO 80241
(303) 469-8868
(303) 469-5254 fax

4307 Arctic Boulevard
Anchorage, AK 99503
(907) 258-2155
(907) 258-6634 fax

475 Hall St.
Fairbanks, AK 99701
(907) 456 - 3116
(907) 456-3125 Fax

5438 Shaune Drive
Juneau, AK 99801
(907) 780-6668
(907) 780-6670 fax

Chain of Custody No: 63243

Client Name & Address: Applied Hydrology Associates, INC.

Public Water System (PWS) ID#:

Project Name: Navajo Mine extension Leaching Study

Section To be Completed by Analytica

Quote ID:

LGN: B080197

Account #: Cash Credit Card

Report to:

Phone No:

Fax No:

E-mail:

Turnaround Time for Results (TAT)

X Standard ___ Expedited (< 10 days, prior authorization required)

(please specify due date below; add'l charges may apply)

Requested Due Date for Results:

Invoice to Name & Address:

Special Instructions/Comments:

Tumbled in house by R. Seeman

Successive Ash leaching Study

P.O. or Contract No:

Kit Prep/Shipping Charge: $

Requested Analysis/Method

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers	6010B/3010A TTL Lot #: 1107090 Pres: HNO3	7470A/7470A Hg Lot #: 1107090 Pres: HNO3	150.1 pH Lot #: Pres:	160.1 TDS Lot #: Pres:	300.0 Anions IC Lot #: Pres:	310.1 Alk. Lot #: Pres:	Lot #: Pres:	Field Preserved	Field Filtered	MS/MSD ?
MB Successive #1	1/29/08	11:10	Aq	2	X	X	X	X	X	X		Y2	✓	
Ash Successive # 1	1/29/08	11:10	Aq	2	X	X	X	X	X	X		Y2	✓	X

Relinquished by:	Date	Time	Received by:	Date	Time
R. Seeman	1/29/08	13:40		1/29/08	13:40
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Name of Sampler: (printed)

Section To Be Completed by Analytica

	THQ	ANC	JNU	FBKS
Condition of Custody Seal?:	—			
Initialed By:	—			
Temp/Loc:	20			
Thermo ID#:				
Shipped Via:	Ryan Seeman			

Version 2.0

ANALYTICA

Cooler Receipt Form

Client: Applied Hydrology Associates **Client Code:** 030188 **Order #:** B0801197
Project: Navajo Mine Extension Leaching Study

Cooler ID: 1

A. Preliminary Examination Phase: **Date cooler opened:** 1/29/2008
Cooler opened by: gp **Signature:** GP

1. **Was airbill Attached?** N/A **Airbill #:** **Carrier Name:** Other
2. **Custody Seals?** N/A **How many?** 0 **Location:** **Seal Name:**
3. **Seals intact?** N/A
4. **COC Attached?** Yes **Properly Completed?** Yes **Signed by AEL employee?** Yes
5. **Project Identification from custody paper:** Navajo Mine Extension Leaching Study
6. **Preservative:** None **Temperature:** 20.0 **deg. C**

Designated person initial here to acknowledge receipt: GP **Date:** 1/29/08

COMMENTS: Tumbled in house by R. Seeman. Successive Ash leaching study.

B. Log-In Phase: **Samples Log-in Date:** 1/29/2008 **Log-in By:** gp

1. **Packing Type:** Other
2. **Were samples in separate bags?** N/A
3. **Were containers intact?** Yes **Labels agree with COC?** Yes
4. **Number of bottles received:** 4 **Number of samples received:** 2
5. **Correct containers used?** Yes **Correct preservatives added?** Yes
6. **Sufficient sample volume?** Yes
7. **Bubbles in VOA samples?** N/A
8. **Was Project manager called and status discussed?** No
9. **Was anyone called?** No **Who was called?** _____ **By whom?** _____ **Date:** _____

COMMENTS:

ANALYTICA
Environmental Laboratories

Analytica Environmental
Laboratories, Inc.
12189 Pennsylvania Street
Thornton, CO 80241
Phone: 303-469-8868
Fax: 303-469-5254

2/21/2008

Applied Hydrology Associates, Inc.
950 South Cherry Street
Suite 810
Denver, CO 80246
Attn: Art O'Hayre

Work Order #: B0801210
Date: 2/21/2008
Work ID: Navajo Mine Extension Leaching Study
Date Received: 1/31/2008
Proj #: none

Sample Identification

Lab Sample Number	Client Description	Lab Sample Number	Client Description
B0801210-01	MB Successive #2	B0801210-02	Ash Successive #2
B0801210-03	MB Successive #3	B0801210-04	Ash Successive #3

Enclosed are the analytical results for the submitted sample(s). Please review the CASE NARRATIVE for a discussion of any data and/or quality control issues. Listings of data qualifiers, analytical codes, key dates, and QC relationships are provided at the end of the report.

Sincerely,

Kristen Stone
Project Manager

"The Science of Analysis, The Art of Service"

Case Narrative

Analytica Environmental Laboratories, Inc.

Work Order: B0801210

Samples were prepared and analyzed according to EPA or equivalent methods outlined in the following references:

Methods for Chemical Analysis of Water and Wastes, USEPA 600/4-79-020, March 1983.

Pfaff, J. D., C. A. Brockhoff and J. W. O'Dell. 1994. The Determination of Inorganic Anions in Water by Ion Chromatography. Method 300.0 A. U. S. Environmental Protection Agency. Environmental Monitoring Systems Lab.

Test Methods for Evaluating Solid Waste, USEPA SW-846, Third Edition, Revision 4, Decembe 1996.

PLEASE NOTE: THIS (2/21/08) IS A RE-ISSUE OF THE REPORT. ALL RESULTS ARE UNCHANGED EXCEPT FOR THE ICP METALS RESULTS. THE DATA VALIDATOR CONTACTED THE LABORATORY NOTING THAT THE ION BALANCE WAS OUT OF CONTROL FOR ALL SAMPLES ON THIS SDG, AND REQUESTED REANALYSIS FOR METALS. THE METALS WERE REANALYZED WITH THE EXCEPTION OF THE MATRIX SPIKES, FOR WHICH THERE WAS NOT SUFFICIENT SAMPLE. RESULTS WERE HIGHER, AND THE DATA VALIDATOR INDICATED THAT THE ION BALANCE WAS NOW IN CONTROL. THEREFORE THESE RESULTS ARE PREFERRED AND ARE SUBMITTED WITH THIS REPORT.

SAMPLE RECEIPT:
Four (4) samples were received on 1/31/2008 3:05:00 PM., at a temperature of 3 deg C., at Analytica-Thornton. The samples were received in good condition and in order per chain of custody.

REVIEW FOR COMPLIANCE WITH ANALYTICA QA PLAN
A summary of our review is shown below.

All analytical results contained in this report have been reviewed under Analytica's internal quality assurance and quality control program. Any deviations in quality contro parameters for specific analyses are noted in the following text. A complete quality assurance report, including laboratory control, matrix spike, and sample duplicate recoveries is kept on file in our office and is available upon request.

All method specifications were met for the following tests:

Test Method: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg - Aqueous
Test Method: 150.1 - pH, Elecrometric - pH - Aqueous
Test Method: 160.1 - Total Dissolved Solids dried at 180°C - TDS - Aqueous
Test Method: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity - Aqueous
Test Method: Inorganic Anions by Ion Chromatography - Anions by IC - Aqueous

Test Method: SW6010B - ICP - Total - Aqueous

CLOSING CONTINUING CALIBRATIONS:
The closing CCV immediately following these samples was slightly elevated for Sodium. Th samples are high in Sodium and this is due to small amounts of carryover. A subsequent CCV was analyzed and is in control. The results are not expected to be significantly impacted and are submitted as they are. There is not sufficient sample remaining for reanalysis.

Case Narrative

Analytica Environmental Laboratories, Inc.
Work Order: B0801210
(continued)

RunDate	Data File	Analyte	Recovery	LCL	UCL
2/19/2008 3:01:00 PM	E02198A	Sodium	111.	90	110

MS/MSD and DUP OUTLIERS:
As shown below, the MS/MSD were outside of limits for a number of targets. With the exception of Cadmium, Aluminum, Potassium, and Boron, these samples had target concentrations greater than four times the spike amount. In these cases it is not appropriate to calculate recoveries. The results should be used as replicates. Although reanalyses were conducted, there was not sufficient sample remaining to re-spike for the targets that are out of limits. These should be reviewed for potential low bias.

MS/MSD and DUP OUTLIERS:

Type	Client Sample	LabSample	Analyte	Recovery	LCL	UCL	Parent	Spike
MS	Ash Successive #2	B0801210-02A	Aluminum	71.9	75	125	0.984	2.00
MS	Ash Successive #3	B0801210-04A	Boron	72.9	75	125	0.341	0.500
MS	Ash Successive #3	B0801210-04A	Cadmium	71.9	75	125	-0.00124	0.0500
MS	Ash Successive #3	B0801210-04A	Potassium	59.6	75	125	12.4	10.0
MS	Ash Successive #3	B0801210-04A	Sodium	-291	75	125	1270	10.0
MS	Ash Successive #2	B0801210-02A	Cadmium	67.8	75	125	-0.00148	0.0500
MS	Ash Successive #2	B0801210-02A	Sodium	-272	75	125	1220	10.0
MSD	Ash Successive #2	B0801210-02A	Potassium	70.4	75	125	11.5	10.0
MSD	Ash Successive #2	B0801210-02A	Sodium	-247	75	125	1220	10.0
MSD	Ash Successive #3	B0801210-04A	Boron	72.4	75	125	0.341	0.500
MSD	Ash Successive #3	B0801210-04A	Cadmium	72.1	75	125	-0.00124	0.0500
MSD	Ash Successive #3	B0801210-04A	Potassium	60.6	75	125	12.4	10.0
MSD	Ash Successive #3	B0801210-04A	Sodium	-290	75	125	1270	10.0
MSD	Ash Successive #2	B0801210-02A	Aluminum	73.8	75	125	0.984	2.00
MSD	Ash Successive #2	B0801210-02A	Boron	69.9	75	125	0.345	0.500
MSD	Ash Successive #2	B0801210-02A	Cadmium	69.0	75	125	-0.00148	0.0500

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB Successive #2**

Matrix: Aqueous Collection Date: 1/30/2008 11:20:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-01A
Prep Date: 2/5/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Reg. Method ID: 7470A
Prep Batch Number: T080205004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 2/5/2008 4:57:34PM
Instrument: CVAA_1
File Name: B020508W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.00005	2

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-01A
Prep Date: 2/5/2008
Analytical Method ID: SW6010B - ICP - Total
Reg. Method ID: 6010B
Prep Batch Number: T080205002
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/19/2008 2:36:00PM
Instrument: ICP_2
File Name: E02198A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.051**		mg/L	0.050	0.014	2
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.089**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**0.31**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**3.0**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**1.3**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.010**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**12**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB Successive #2**

Matrix: Aqueous Collection Date: 1/30/2008 11:20:00AM

Lab Sample Number: B0801210-01A
Prep Date: 2/5/2008
Analytical Method ID: SW6010B - ICP - Total
Reg. Method ID: 6010B
Prep Batch Number: T080205002
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/19/2008 2:36:00PM
Instrument: ICP_2
File Name: E02198A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**1,200**		mg/L	3.0	0.028	2
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-01B
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Reg. Method ID: 310.1
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**1,100**		mg/L	5.0	1.5	1
Carbonate		**320**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-01B
Prep Date: 1/31/2008
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Reg. Method ID: 150.1
Prep Batch Number: T080201007
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 1/31/2008 11:25:00AM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: R. Seeman
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**9.1**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB Successive #2**

Matrix: Aqueous Collection Date: 1/30/2008 11:20:00AM

Lab Sample Number: B0801210-01B
Prep Date: 2/6/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Reg. Method ID: 160.1
Prep Batch Number: T080207003
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/12/2008 10:07:15AM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**3,000**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-01B
Prep Date: 2/4/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Reg. Method ID: 300.0
Prep Batch Number: T080204004
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 2/4/2008 4:07:47PM
Instrument: IC
File Name: 080204_017.D
Dilution Factor: 25
Analyst Initials: CS
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**600**		mg/L	20	1.1	1

Lab Sample Number: B0801210-01B
Prep Date: 2/4/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Reg. Method ID: 300.0
Prep Batch Number: T080204004
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 2/4/2008 7:30:06PM
Instrument: IC
File Name: 080204_028.D
Dilution Factor: 1
Analyst Initials: CS
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**2.2**		mg/L	0.40	0.031	2
Sulfate		**280**		mg/L	1.5	0.11	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Successive #2**

Matrix: Aqueous Collection Date: 1/30/2008 11:20:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-02A
Prep Date: 2/5/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Reg. Method ID: 7470A
Prep Batch Number: T080205004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 2/5/2008 4:59:48PM
Instrument: CVAA_1
File Name: B020508W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.00005	2

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-02A
Prep Date: 2/5/2008
Analytical Method ID: SW6010B - ICP - Total
Reg. Method ID: 6010B
Prep Batch Number: T080205002
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/19/2008 2:41:00PM
Instrument: ICP_2
File Name: E02198A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.98**		mg/L	0.050	0.014	3
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**0.11**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.053**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**0.34**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**3.6**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**1.5**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.016**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**11**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Successive #2**

Matrix: Aqueous Collection Date: 1/30/2008 11:20:00AM

Lab Sample Number: B0801210-02A
Prep Date: 2/5/2008
Analytical Method ID: SW6010B - ICP - Total
Reg. Method ID: 6010B
Prep Batch Number: T080205002
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/19/2008 2:41:00PM
Instrument: ICP_2
File Name: E02198A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**1,200**		mg/L	3.0	0.028	3
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**0.063**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**0.0081**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-02B
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Reg. Method ID: 310.1
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**1,200**		mg/L	5.0	1.5	1
Carbonate		**160**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-02B
Prep Date: 1/31/2008
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Reg. Method ID: 150.1
Prep Batch Number: T080201007
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 1/31/2008 11:25:00AM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: R. Seeman
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**8.8**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Successive #2**

Matrix: Aqueous Collection Date: 1/30/2008 11:20:00AM

Lab Sample Number: B0801210-02B
Prep Date: 2/6/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Reg. Method ID: 160.1
Prep Batch Number: T080207003
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/12/2008 10:07:15AM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**3,100**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-02B
Prep Date: 2/4/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Reg. Method ID: 300.0
Prep Batch Number: T080204004
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 2/4/2008 4:26:11PM
Instrument: IC
File Name: 080204_018.D
Dilution Factor: 25
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**610**		mg/L	20	1.1	1
Sulfate		**350**		mg/L	38	2.8	

Lab Sample Number: B0801210-02B
Prep Date: 2/4/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Reg. Method ID: 300.0
Prep Batch Number: T080204004
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 2/4/2008 7:48:30PM
Instrument: IC
File Name: 080204_029.D
Dilution Factor: 1
Analyst Initials: CS
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**10**		mg/L	0.40	0.031	2

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB Successive #3**

Matrix: Aqueous Collection Date: 1/31/2008 11:00:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-03A
Prep Date: 2/5/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Reg. Method ID: 7470A
Prep Batch Number: T080205004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 2/5/2008 5:11:03PM
Instrument: CVAA_1
File Name: B020508W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.00050	2

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-03A
Prep Date: 2/5/2008
Analytical Method ID: SW6010B - ICP - Total
Reg. Method ID: 6010B
Prep Batch Number: T080205002
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/19/2008 2:46:00PM
Instrument: ICP_2
File Name: E02198A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**ND**		mg/L	0.050	0.014	2
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.089**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**0.32**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**3.0**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**0.051**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**1.3**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.011**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**12**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB Successive #3**

Matrix: Aqueous Collection Date: 1/31/2008 11:00:00AM

Lab Sample Number: B0801210-03A
Prep Date: 2/5/2008
Analytical Method ID: SW6010B - ICP - Total
Reg. Method ID: 6010B
Prep Batch Number: T080205002
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/19/2008 2:46:00PM
Instrument: ICP_2
File Name: E02198A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**1,300**		mg/L	3.0	0.028	2
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-03B
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Reg. Method ID: 310.1
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**1,200**		mg/L	5.0	1.5	1
Carbonate		**320**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-03B
Prep Date: 1/31/2008
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Reg. Method ID: 150.1
Prep Batch Number: T080201007
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 1/31/2008 11:25:00AM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: R. Seeman
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**9.1**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **MB Successive #3**

Matrix: Aqueous Collection Date: 1/31/2008 11:00:00AM

Lab Sample Number: B0801210-03B
Prep Date: 2/6/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Reg. Method ID: 160.1
Prep Batch Number: T080207003
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/12/2008 10:07:15AM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**3,100**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-03B
Prep Date: 2/4/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Reg. Method ID: 300.0
Prep Batch Number: T080204004
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 2/4/2008 5:39:45PM
Instrument: IC
File Name: 080204_022.D
Dilution Factor: 25
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**620**		mg/L	20	1.1	1

Lab Sample Number: B0801210-03B
Prep Date: 2/4/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Reg. Method ID: 300.0
Prep Batch Number: T080204004
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 2/4/2008 9:02:06PM
Instrument: IC
File Name: 080204_033.D
Dilution Factor: 1
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**2.2**		mg/L	0.40	0.031	2
Sulfate		**280**		mg/L	1.5	0.11	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Successive #3**

Matrix: Aqueous Collection Date: 1/31/2008 11:00:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-04A
Prep Date: 2/5/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Reg. Method ID: 7470A
Prep Batch Number: T080205004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 2/5/2008 5:13:23PM
Instrument: CVAA_1
File Name: B020508W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	**ND**		mg/L	0.00020	0.00005	2

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-04A
Prep Date: 2/5/2008
Analytical Method ID: SW6010B - ICP - Total
Reg. Method ID: 6010B
Prep Batch Number: T080205002
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/19/2008 2:51:00PM
Instrument: ICP_2
File Name: E02198A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	**0.67**		mg/L	0.050	0.014	3
Antimony	7440-36-0	**ND**		mg/L	0.050	0.0067	
Arsenic	7440-38-2	**ND**		mg/L	0.10	0.015	
Barium	7440-39-3	**0.070**		mg/L	0.010	0.00016	
Beryllium	7440-41-7	**ND**		mg/L	0.0010	0.000060	
Boron	7440-42-8	**0.34**		mg/L	0.050	0.0018	
Cadmium	7440-43-9	**ND**		mg/L	0.0060	0.00051	
Calcium	7440-70-2	**3.3**		mg/L	0.10	0.013	
Chromium	7440-47-3	**ND**		mg/L	0.010	0.0018	
Cobalt	7440-48-4	**ND**		mg/L	0.0050	0.0016	
Copper	7440-50-8	**ND**		mg/L	0.0050	0.0019	
Iron	7439-89-6	**ND**		mg/L	0.050	0.0027	
Lead	7439-92-1	**ND**		mg/L	0.050	0.011	
Lithium	7439-93-2	**ND**		mg/L	0.10	0.00072	
Magnesium	7439-96-4	**1.9**		mg/L	0.10	0.012	
Manganese	7439-96-5	**ND**		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	**0.013**		mg/L	0.010	0.0018	
Nickel	7440-02-0	**ND**		mg/L	0.040	0.0027	
Potassium	7440-09-7	**12**		mg/L	1.0	0.31	
Selenium	7784-49-2	**ND**		mg/L	0.10	0.026	
Silver	7440-22-4	**ND**		mg/L	0.015	0.00066	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Successive #3**

Matrix: Aqueous Collection Date: 1/31/2008 11:00:00AM

Lab Sample Number: B0801210-04A
Prep Date: 2/5/2008
Analytical Method ID: SW6010B - ICP - Total
Reg. Method ID: 6010B
Prep Batch Number: T080205002
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/19/2008 2:51:00PM
Instrument: ICP_2
File Name: E02198A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**1,300**		mg/L	3.0	0.028	3
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**0.031**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-04B
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Reg. Method ID: 310.1
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**1,100**		mg/L	5.0	1.5	1
Carbonate		**340**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-04B
Prep Date: 1/31/2008
Analytical Method ID: 150.1 - pH, Elecrometric - pH
Reg. Method ID: 150.1
Prep Batch Number: T080201007
Report Basis: As Received
Sample prep wt./vol: 10.00 ml

Analysis Date: 1/31/2008 11:25:00AM
Instrument: Probe
File Name:
Dilution Factor: 1
Analyst Initials: R. Seeman
Prep Extract Vol: 10.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
pH		**9.0**		pH	0.10	0.10	1

The following test was conducted by: Analytica - Thornton

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Client Sample Report

Client Sample Name: **Ash Successive #3**

Matrix: Aqueous Collection Date: 1/31/2008 11:00:00AM

Lab Sample Number: B0801210-04B
Prep Date: 2/6/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Reg. Method ID: 160.1
Prep Batch Number: T080207003
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/12/2008 10:07:15AM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**3,100**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Lab Sample Number: B0801210-04B
Prep Date: 2/4/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Reg. Method ID: 300.0
Prep Batch Number: T080204004
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 2/4/2008 5:58:09PM
Instrument: IC
File Name: 080204_023.D
Dilution Factor: 25
Analyst Initials: KB
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**620**		mg/L	20	1.1	1

Lab Sample Number: B0801210-04B
Prep Date: 2/4/2008
Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC
Reg. Method ID: 300.0
Prep Batch Number: T080204004
Report Basis: As Received
Sample prep wt./vol: 20.00 ml

Analysis Date: 2/4/2008 9:20:30PM
Instrument: IC
File Name: 080204_034.D
Dilution Factor: 1
Analyst Initials: CS
Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Fluoride		**4.7**		mg/L	0.40	0.031	2
Sulfate		**290**		mg/L	1.5	0.11	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 2/5/2008 12:00:00AM

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080205004-MB
Prep Date: 2/5/2008
Analytical Method ID: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Reg. Method ID: 7470A
Prep Batch Number: T080205004
Report Basis: As Received
Sample prep wt./vol: 30.00 ml

Analysis Date: 2/5/2008 4:23:51PM
Instrument: CVAA_1
File Name: B020508W.W
Dilution Factor: 1
Analyst Initials: DL
Prep Extract Vol: 30.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Mercury	7439-97-6	ND		mg/L	0.00020	0.000050	2

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080205002-MB
Prep Date: 2/5/2008
Analytical Method ID: SW6010B - ICP - Total
Reg. Method ID: 6010B
Prep Batch Number: T080205002
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/5/2008 4:27:00PM
Instrument: ICP_2
File Name: E02058A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Aluminum	7429-90-5	ND		mg/L	0.050	0.014	1
Antimony	7440-36-0	ND		mg/L	0.050	0.0067	
Arsenic	7440-38-2	ND		mg/L	0.10	0.015	
Barium	7440-39-3	ND		mg/L	0.010	0.00016	
Beryllium	7440-41-7	ND		mg/L	0.0010	0.000060	
Boron	7440-42-8	ND		mg/L	0.050	0.0018	
Cadmium	7440-43-9	ND		mg/L	0.0060	0.00051	
Calcium	7440-70-2	ND		mg/L	0.10	0.013	
Chromium	7440-47-3	ND		mg/L	0.010	0.0018	
Cobalt	7440-48-4	ND		mg/L	0.0050	0.0016	
Copper	7440-50-8	ND		mg/L	0.0050	0.0019	
Iron	7439-89-6	ND		mg/L	0.050	0.0027	
Lead	7439-92-1	ND		mg/L	0.050	0.011	
Lithium	7439-93-2	ND		mg/L	0.10	0.00072	
Magnesium	7439-96-4	ND		mg/L	0.10	0.012	
Manganese	7439-96-5	ND		mg/L	0.010	0.00066	
Molybdenum	7439-98-7	ND		mg/L	0.010	0.0018	
Nickel	7440-02-0	ND		mg/L	0.040	0.0027	
Potassium	7440-09-7	ND		mg/L	1.0	0.31	
Selenium	7784-49-2	ND		mg/L	0.10	0.026	
Silver	7440-22-4	ND		mg/L	0.015	0.00066	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous Collection Date: 2/5/2008 12:00:00AM

Lab Sample Number: T080205002-MB
Prep Date: 2/5/2008
Analytical Method ID: SW6010B - ICP - Total
Reg. Method ID: 6010B
Prep Batch Number: T080205002
Report Basis: As Received
Sample prep wt./vol: 50.00 ml

Analysis Date: 2/5/2008 4:27:00PM
Instrument: ICP_2
File Name: E02058A
Dilution Factor: 1
Analyst Initials: rm
Prep Extract Vol: 50.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Sodium	7440-23-5	**ND**		mg/L	3.0	0.028	1
Thallium	7440-28-0	**ND**		mg/L	0.40	0.011	
Vanadium	7440-62-2	**ND**		mg/L	0.010	0.00072	
Zinc	7440-66-6	**ND**		mg/L	0.0050	0.0010	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080205001-MB
Prep Date: 2/4/2008
Analytical Method ID: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
Reg. Method ID: 310.1
Prep Batch Number: T080205001
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/4/2008 9:52:02AM
Instrument: Titrametric
File Name:
Dilution Factor: 1
Analyst Initials: cs
Prep Extract Vol: 100.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Bicarbonate		**ND**		mg/L	5.0	1.5	1
Carbonate		**ND**		mg/L	7.0	1.2	

The following test was conducted by: Analytica - Thornton

Lab Sample Number: T080207003-MB
Prep Date: 2/6/2008
Analytical Method ID: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Reg. Method ID: 160.1
Prep Batch Number: T080207003
Report Basis: As Received
Sample prep wt./vol: 100.00 ml

Analysis Date: 2/12/2008 10:07:15AM
Instrument: SCALE
File Name:
Dilution Factor: 1
Analyst Initials: kl
Prep Extract Vol: 1.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Total Dissolved Solids		**ND**		mg/L	10	8.2	1

The following test was conducted by: Analytica - Thornton

Detailed Analytical Report

Analytica Environmental Laboratories, Inc.

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Report Section: Method Blank Report

Client Sample Name: **MB**

Matrix: Aqueous

Collection Date: 2/4/2008 12:00:00AM

Lab Sample Number: T080204004-MB

Prep Date: 2/4/2008

Analytical Method ID: Inorganic Anions by Ion Chromatography - Anions by IC

Reg. Method ID: 300.0

Prep Batch Number: T080204004

Report Basis: As Received

Sample prep wt./vol: 20.00 ml

Analysis Date: 2/4/2008 2:54:13PM

Instrument: IC

File Name: 080204_013.D

Dilution Factor: 1

Analyst Initials: CS

Prep Extract Vol: 20.00 ml

Analyte	CASNo	Result	Flags	Units	PQL	MDL	run #:
Chloride		**ND**		mg/L	0.80	0.042	1
Fluoride		**ND**		mg/L	0.40	0.031	
Sulfate		**ND**		mg/L	1.5	0.11	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801210
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080205002**

SAMPLE DUPLICATE REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0801210-02A
Prep Date: 2/5/2008

Samp. Anal. Date: 2/19/2008 2:41:00PM
DUP Anal. Date: 2/5/2008 4:52:00PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Aluminum	0.984	0.855	14.0	20	
Antimony	ND	ND	0.0	20	
Arsenic	0.108	ND	0.0	20	
Barium	0.0533	0.0470	12.6	20	
Beryllium	ND	ND	0.0	20	
Boron	0.345	0.309	11.0	20	
Cadmium	ND	ND	0.0	20	
Calcium	3.61	3.34	7.8	20	
Chromium	ND	ND	0.0	20	
Cobalt	ND	ND	0.0	20	
Copper	ND	ND	0.0	20	
Iron	ND	ND	0.0	20	
Lead	ND	ND	0.0	20	
Magnesium	1.50	1.36	9.8	20	
Manganese	ND	ND	0.0	20	
Molybdenum	0.0160	0.0193	18.7	20	
Nickel	ND	ND	0.0	20	
Potassium	11.5	10.2	12.0	20	
Selenium	ND	ND	0.0	20	
Silver	ND	ND	0.0	20	
Sodium	1,220	994	20.4	20	OUT
Thallium	ND	ND	0.0	20	
Vanadium	0.0630	0.0540	15.4	20	
Zinc	0.00809	0.00785	3.0	20	
Lithium	ND	ND	0.0	20	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801210
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080205002**

SAMPLE DUPLICATE REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0801210-04A
Prep Date: 2/5/2008

Samp. Anal. Date: 2/19/2008 2:51:00PM
DUP Anal. Date: 2/5/2008 6:06:00PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Aluminum	0.674	0.601	11.5	20	
Antimony	ND	ND	0.0	20	
Arsenic	ND	ND	0.0	20	
Barium	0.0701	0.0615	13.1	20	
Beryllium	ND	ND	0.0	20	
Boron	0.341	0.311	9.2	20	
Cadmium	ND	ND	0.0	20	
Calcium	3.27	2.96	10.0	20	
Chromium	ND	ND	0.0	20	
Cobalt	ND	ND	0.0	20	
Copper	ND	ND	0.0	20	
Iron	ND	ND	0.0	20	
Lead	ND	ND	0.0	20	
Magnesium	1.88	1.65	13.0	20	
Manganese	ND	ND	0.0	20	
Molybdenum	0.0127	0.0147	14.6	20	
Nickel	ND	ND	0.0	20	
Potassium	12.4	10.4	17.5	20	
Selenium	ND	ND	0.0	20	
Silver	ND	ND	0.0	20	
Sodium	1,270	1,040	19.9	20	
Thallium	ND	ND	0.0	20	
Vanadium	0.0313	0.0268	15.5	20	
Zinc	ND	ND	0.0	20	
Lithium	ND	ND	0.0	20	

LCS/LCSD REPORT

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0801210

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080205002**

LCS/LCSD REPORT

Analysis: SW6010B - ICP - Total

MB: T080205002-MB

Prep Date: 2/5/2008

MB Anal. Date: 2/5/2008 4:27:00PM

Units: mg/L

LCS Anal. Date: 2/5/2008 4:32:00PM LCSD Anal. Date: 2/5/2008 4:37:00PM

Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Aluminum	ND	1.91	1.92	2.00	2.00	95.5	96.0	0.5	89 - 117	20	
Antimony	ND	0.445	0.442	0.500	0.500	89.0	88.4	0.7	82 - 117	20	
Arsenic	ND	1.81	1.82	2.00	2.00	90.5	91.0	0.6	86 - 116	20	
Barium	ND	1.89	1.91	2.00	2.00	94.5	95.5	1.1	86 - 116	20	
Beryllium	ND	0.0497	0.0500	0.0500	0.0500	99.4	100.0	0.6	87 - 111	20	
Boron	ND	0.458	0.461	0.500	0.500	91.6	92.2	0.7	76 - 130	20	
Cadmium	ND	0.0425	0.0428	0.0500	0.0500	85.0	85.6	0.7	79 - 113	20	
Calcium	ND	9.41	9.45	10.0	10.0	94.1	94.5	0.4	79 - 119	20	
Chromium	ND	0.191	0.191	0.200	0.200	95.5	95.5	0.0	86 - 117	20	
Cobalt	ND	0.468	0.471	0.500	0.500	93.6	94.2	0.6	82 - 118	20	
Copper	ND	0.233	0.235	0.250	0.250	93.2	94.0	0.9	86 - 117	20	
Iron	ND	1.01	1.02	1.00	1.00	101.0	102.0	1.0	83 - 121	20	
Lead	ND	0.456	0.465	0.500	0.500	91.2	93.0	2.0	83 - 121	20	
Magnesium	ND	9.99	10.0	10.0	10.0	99.9	100.0	0.1	83 - 118	20	
Manganese	ND	0.472	0.474	0.500	0.500	94.4	94.8	0.4	82 - 121	20	
Molybdenum	ND	0.464	0.467	0.500	0.500	92.8	93.4	0.6	82 - 120	20	
Nickel	ND	0.483	0.484	0.500	0.500	96.6	96.8	0.2	84 - 117	20	
Potassium	ND	8.29	8.02	10.0	10.0	82.9	80.2	3.3	74 - 110	20	
Selenium	ND	1.87	1.87	2.00	2.00	93.5	93.5	0.0	87 - 117	20	
Silver	ND	0.248	0.250	0.250	0.250	99.2	100.0	0.8	80 - 127	20	
Sodium	ND	9.48	9.59	10.0	10.0	94.8	95.9	1.2	87 - 113	20	
Thallium	ND	0.212	0.206	0.200	0.200	106.0	103.0	2.9	89 - 113	20	
Vanadium	ND	0.483	0.485	0.500	0.500	96.6	97.0	0.4	87 - 119	20	
Zinc	ND	0.455	0.457	0.500	0.500	91.0	91.4	0.4	81 - 120	20	
Lithium	ND	0.477	0.482	0.500	0.500	95.4	96.4	1.0	80 - 120	20	

MS/MSD REPORT

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801210
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080205002**

MS/MSD REPORT

Analysis: SW6010B - ICP - Total
Parent: B0801210-02A
Prep Date: 2/5/2008
Samp. Anal. Date: 2/19/2008 2:41:00PM
Units: mg/L
MS Anal. Date: 2/5/2008 4:57:00PM MSD Anal. Date: 2/5/2008 5:02:00PM
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	MSDRes	SPLev	SPDLev	Recov.	MSD Rec.	RPD	Recov Lim	RPDLim	Flag
Aluminum	0.984	2.42	2.46	2.00	2.00	71.8	73.8	1.6	75 - 125	20	*lowMS lowMSD*
Antimony	ND	0.395	0.403	0.500	0.500	79.0	80.6	2.0	75 - 125	20	
Arsenic	0.108	1.69	1.74	2.00	2.00	79.1	81.6	2.9	75 - 125	20	
Barium	0.0533	1.57	1.61	2.00	2.00	75.8	77.8	2.5	75 - 125	20	
Beryllium	ND	0.0421	0.0432	0.0500	0.0500	84.2	86.4	2.6	75 - 125	20	
Boron	0.345	0.737	0.694	0.500	0.500	78.4	69.8	6.0	75 - 125	20	*lowMSD*
Cadmium	ND	0.0339	0.0345	0.0500	0.0500	67.8	69.0	1.8	75 - 125	20	*lowMS lowMSD*
Calcium	3.61	11.4	11.6	10.0	10.0	77.9	79.9	1.7	75 - 125	20	
Chromium	ND	0.165	0.169	0.200	0.200	82.5	84.5	2.4	75 - 125	20	
Cobalt	ND	0.403	0.412	0.500	0.500	80.6	82.4	2.2	75 - 125	20	
Copper	ND	0.198	0.202	0.250	0.250	79.2	80.8	2.0	75 - 125	20	
Iron	ND	0.891	0.907	1.00	1.00	89.1	90.7	1.8	75 - 125	20	
Lead	ND	0.405	0.414	0.500	0.500	81.0	82.8	2.2	75 - 125	20	
Magnesium	1.50	9.70	9.90	10.0	10.0	82.0	84.0	2.0	75 - 125	20	
Manganese	ND	0.400	0.409	0.500	0.500	80.0	81.8	2.2	75 - 125	20	
Molybdenum	0.0160	0.414	0.424	0.500	0.500	79.6	81.6	2.4	75 - 125	20	
Nickel	ND	0.415	0.423	0.500	0.500	83.0	84.6	1.9	75 - 125	20	
Potassium	11.5	19.7	18.5	10.0	10.0	82.0	70.0	6.3	75 - 125	20	*lowMSD*
Selenium	ND	1.69	1.75	2.00	2.00	84.5	87.5	3.5	75 - 125	20	
Silver	ND	0.215	0.214	0.250	0.250	86.0	85.6	0.5	75 - 125	20	
Sodium	1,220	945	970	10.0	10.0	-2,750.0	-2,500.0	2.6	75 - 125	20	*NOTE 2 NOTE 2*
Thallium	ND	0.181	0.153	0.200	0.200	90.5	76.5	16.8	75 - 125	20	
Vanadium	0.0630	0.460	0.473	0.500	0.500	79.4	82.0	2.8	75 - 125	20	
Zinc	0.00809	0.417	0.424	0.500	0.500	81.8	83.2	1.7	75 - 125	20	
Lithium	ND	0.482	0.495	0.500	0.500	96.4	99.0	2.7	75 - 125	20	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801210
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080205002**

MS/MSD REPORT

Analysis: SW6010B - ICP - Total
Parent: B0801210-04A
Prep Date: 2/5/2008
Samp. Anal. Date: 2/19/2008 2:51:00PM
Units: mg/L
MS Anal. Date: 2/5/2008 6:11:00PM MSD Anal. Date: 2/5/2008 6:16:00PM
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	MSDRes	SPLev	SPDLev	Recov.	MSD Rec.	RPD	Recov Lim	RPDLim	Flag
Aluminum	0.674	2.32	2.29	2.00	2.00	82.3	80.8	1.3	75 - 125	20	
Antimony	ND	0.434	0.444	0.500	0.500	86.8	88.8	2.3	75 - 125	20	
Arsenic	ND	1.76	1.77	2.00	2.00	88.0	88.5	0.6	75 - 125	20	
Barium	0.0701	1.71	1.71	2.00	2.00	82.0	82.0	0.0	75 - 125	20	
Beryllium	ND	0.0424	0.0420	0.0500	0.0500	84.8	84.0	0.9	75 - 125	20	
Boron	0.341	0.705	0.703	0.500	0.500	72.8	72.4	0.3	75 - 125	20	*lowMS lowMSD*
Cadmium	ND	0.0359	0.0361	0.0500	0.0500	71.8	72.2	0.6	75 - 125	20	*lowMS lowMSD*
Calcium	3.27	12.6	12.5	10.0	10.0	93.3	92.3	0.8	75 - 125	20	
Chromium	ND	0.170	0.169	0.200	0.200	85.0	84.5	0.6	75 - 125	20	
Cobalt	ND	0.417	0.416	0.500	0.500	83.4	83.2	0.2	75 - 125	20	
Copper	ND	0.217	0.215	0.250	0.250	86.8	86.0	0.9	75 - 125	20	
Iron	ND	1.02	1.02	1.00	1.00	102.0	102.0	0.0	75 - 125	20	
Lead	ND	0.428	0.418	0.500	0.500	85.6	83.6	2.4	75 - 125	20	
Magnesium	1.88	10.3	10.3	10.0	10.0	84.2	84.2	0.0	75 - 125	20	
Manganese	ND	0.427	0.425	0.500	0.500	85.4	85.0	0.5	75 - 125	20	
Molybdenum	0.0127	0.446	0.443	0.500	0.500	86.7	86.1	0.7	75 - 125	20	
Nickel	ND	0.425	0.419	0.500	0.500	85.0	83.8	1.4	75 - 125	20	
Potassium	12.4	18.3	18.4	10.0	10.0	59.0	60.0	0.5	75 - 125	20	*lowMS lowMSD*
Selenium	ND	1.76	1.75	2.00	2.00	88.0	87.5	0.6	75 - 125	20	
Silver	ND	0.222	0.219	0.250	0.250	88.8	87.6	1.4	75 - 125	20	
Sodium	1,270	982	983	10.0	10.0	-2,880.0	-2,870.0	0.1	75 - 125	20	*NOTE 2 NOTE 2*
Thallium	ND	0.170	0.160	0.200	0.200	85.0	80.0	6.1	75 - 125	20	
Vanadium	0.0313	0.469	0.467	0.500	0.500	87.5	87.1	0.4	75 - 125	20	
Zinc	ND	0.448	0.444	0.500	0.500	89.6	88.8	0.9	75 - 125	20	
Lithium	ND	0.512	0.512	0.500	0.500	102.4	102.4	0.0	75 - 125	20	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801210
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080205002**

POST DIGESTION SPIKE REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0801210-02A
Prep Date: 2/5/2008
Samp. Anal. Date: 2/19/2008 2:41:00PM
Units: mg/L
PDS Anal. Date: 2/5/2008 5:46:00PM
Matrix: Aqueous

Analyte Name	SampResult	PDSRes.	SPLev	Recov.	Recov Lim	Flag	
Aluminum	0.984	2.79	2.00	90.2	75 - 117		
Antimony	ND	0.473	0.500	93.2	75 - 117		
Arsenic	0.108	1.97	2.00	93.1	75 - 116		
Barium	0.0533	1.85	2.00	89.7	75 - 116		
Beryllium	ND	0.0459	0.0500	92.3	75 - 111		
Boron	0.345	0.780	0.500	87.0	75 - 130		
Cadmium	ND	0.0350	0.0500	73.0	75 - 113	lowPDS	
Calcium	3.61	12.5	10.0	88.6	75 - 119		
Chromium	ND	0.185	0.200	90.6	75 - 117		
Cobalt	ND	0.452	0.500	90.2	75 - 118		
Copper	ND	0.229	0.250	89.9	75 - 117		
Iron	ND	0.971	1.00	92.9	75 - 121		
Lead	ND	0.455	0.500	90.5	75 - 121		
Magnesium	1.50	10.6	10.0	91.4	75 - 118		
Manganese	ND	0.457	0.500	91.0	75 - 121		
Molybdenum	0.0160	0.481	0.500	93.0	75 - 120		
Nickel	ND	0.455	0.500	90.8	75 - 117		
Potassium	11.5	18.8	10.0	73.6	75 - 110	lowPDS	
Selenium	ND	1.96	2.00	93.6	75 - 117		
Silver	ND	0.237	0.250	95.2	75 - 127		
Sodium	1,220	1,070	10.0	-1,516.8	75 - 113	lowPDS	Note 2
Thallium	ND	0.185	0.200	85.5	75 - 113		
Vanadium	0.0630	0.540	0.500	95.4	75 - 119		
Zinc	0.00809	0.477	0.500	93.8	75 - 120		
Lithium	ND	0.558	0.500	94.8	75 - 120		

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801210
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080205002**

POST DIGESTION SPIKE REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0801210-04A
Prep Date: 2/5/2008
Samp. Anal. Date: 2/19/2008 2:51:00PM
Units: mg/L
PDS Anal. Date: 2/5/2008 6:21:00PM
Matrix: Aqueous

Analyte Name	SampResult	PDSRes.	SPLev	Recov.	Recov Lim	Flag	
Aluminum	0.674	2.33	2.00	82.8	75 - 117		
Antimony	ND	0.433	0.500	85.3	75 - 117		
Arsenic	ND	1.77	2.00	86.4	75 - 116		
Barium	0.0701	1.74	2.00	83.7	75 - 116		
Beryllium	ND	0.0425	0.0500	85.5	75 - 111		
Boron	0.341	0.712	0.500	74.2	75 - 130	lowPDS	
Cadmium	ND	0.0330	0.0500	68.5	75 - 113	lowPDS	
Calcium	3.27	12.6	10.0	93.5	75 - 119		
Chromium	ND	0.172	0.200	84.0	75 - 117		
Cobalt	ND	0.418	0.500	82.7	75 - 118		
Copper	ND	0.219	0.250	87.1	75 - 117		
Iron	ND	1.04	1.00	100.4	75 - 121		
Lead	ND	0.422	0.500	84.6	75 - 121		
Magnesium	1.88	10.4	10.0	85.3	75 - 118		
Manganese	ND	0.429	0.500	85.4	75 - 121		
Molybdenum	0.0127	0.449	0.500	87.2	75 - 120		
Nickel	ND	0.424	0.500	84.9	75 - 117		
Potassium	12.4	18.1	10.0	57.7	75 - 110	lowPDS	
Selenium	ND	1.74	2.00	87.0	75 - 117		
Silver	ND	0.222	0.250	89.9	75 - 127		
Sodium	1,270	996	10.0	-2,766.0	75 - 113	lowPDS	Note 2
Thallium	ND	0.165	0.200	78.9	75 - 113		
Vanadium	0.0313	0.473	0.500	88.3	75 - 119		
Zinc	ND	0.449	0.500	89.5	75 - 120		
Lithium	ND	0.523	0.500	86.7	75 - 120		

SERIAL DILUTION REPORT

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado

Workorder (SDG): B0801210

Project: Navajo Mine Extension Leaching Study

Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080205002**

SERIAL DILUTION REPORT

Analysis: SW6010B - ICP - Total

Base Sample: B0801210-02A

Prep Date: 2/5/2008

Samp. Anal. Date: 2/19/2008 2:41:00PM

Units: mg/L

SER DIL. Date: 2/5/2008 5:51:00PM

Matrix: Aqueous

Analyte Name	SampResult	PQL.	MDL.	SerialRes.	SerPQL.	RPD	Flag
Aluminum	0.984	0.050	0.014	1.04	0.25	5.5	
Antimony	ND	0.050	0.0067	ND	0.25		
Arsenic	0.108	0.10	0.015	ND	0.50		
Barium	0.0533	0.0100	0.00016	0.0576	0.050	7.7	
Beryllium	ND	0.0010	0.000060	ND	0.0050		
Boron	0.345	0.050	0.0018	0.348	0.25	0.8	
Cadmium	ND	0.0060	0.00051	ND	0.030		
Calcium	3.61	0.10	0.013	3.63	0.50	0.5	
Chromium	ND	0.0100	0.0018	ND	0.050		
Cobalt	ND	0.0050	0.0016	ND	0.025		
Copper	ND	0.0050	0.0019	ND	0.025		
Iron	ND	0.050	0.0027	ND	0.25		
Lead	ND	0.050	0.011	ND	0.25		
Magnesium	1.50	0.10	0.012	1.50	0.50	0.0	
Manganese	ND	0.0100	0.00066	ND	0.050		
Molybdenum	0.0160	0.0100	0.0018	ND	0.050		
Nickel	ND	0.040	0.0027	ND	0.20		
Potassium	11.5	1.0	0.31	11.7	5.0	1.7	
Selenium	ND	0.10	0.026	ND	0.50		
Silver	ND	0.015	0.00066	ND	0.075		
Sodium	1,220	3.0	0.028	1,100	15	10.3	OUT
Thallium	ND	0.40	0.011	ND	2.0		
Vanadium	0.0630	0.0100	0.00072	0.0681	0.050	7.7	
Zinc	0.00809	0.0050	0.0010	ND	0.025		
Lithium	ND	0.10	0.00072	ND	0.50		

Analysis: SW6010B - ICP - Total

Base Sample: B0801210-04A

Prep Date: 2/5/2008

Samp. Anal. Date: 2/19/2008 2:51:00PM

Units: mg/L

SER DIL. Date: 2/5/2008 6:26:00PM

Matrix: Aqueous

Analyte Name	SampResult	PQL.	MDL.	SerialRes.	SerPQL.	RPD	Flag

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801210
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080205002**

SERIAL DILUTION REPORT

Analysis: SW6010B - ICP - Total
Base Sample: B0801210-04A
Prep Date: 2/5/2008
Samp. Anal. Date: 2/19/2008 2:51:00PM
Units: mg/L
SER DIL. Date: 2/5/2008 6:26:00PM
Matrix: Aqueous

Analyte Name	SampResult	PQL.	MDL.	SerialRes.	SerPQL.	RPD	Flag
Aluminum	0.674	0.050	0.014	0.749	0.25	10.5	Note 4
Antimony	ND	0.050	0.0067	ND	0.25		
Arsenic	ND	0.10	0.015	ND	0.50		
Barium	0.0701	0.0100	0.00016	0.0688	0.050	1.8	
Beryllium	ND	0.0010	0.000060	ND	0.0050		
Boron	0.341	0.050	0.0018	0.331	0.25	2.9	
Cadmium	ND	0.0060	0.00051	ND	0.030		
Calcium	3.27	0.10	0.013	3.24	0.50	0.9	
Chromium	ND	0.0100	0.0018	ND	0.050		
Cobalt	ND	0.0050	0.0016	ND	0.025		
Copper	ND	0.0050	0.0019	ND	0.025		
Iron	ND	0.050	0.0027	ND	0.25		
Lead	ND	0.050	0.011	ND	0.25		
Magnesium	1.88	0.10	0.012	1.81	0.50	3.7	
Manganese	ND	0.0100	0.00066	ND	0.050		
Molybdenum	0.0127	0.0100	0.0018	ND	0.050		
Nickel	ND	0.040	0.0027	ND	0.20		
Potassium	12.4	1.0	0.31	11.7	5.0	5.8	
Selenium	ND	0.10	0.026	ND	0.50		
Silver	ND	0.015	0.00066	ND	0.075		
Sodium	1,270	3.0	0.028	1,080	15	16.1	OUT
Thallium	ND	0.40	0.011	ND	2.0		
Vanadium	0.0313	0.0100	0.00072	ND	0.050		Note 4
Zinc	ND	0.0050	0.0010	ND	0.025		
Lithium	ND	0.10	0.00072	ND	0.50		

Prep Batch: **T080205004**

SAMPLE DUPLICATE REPORT

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801210
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080205004**

SAMPLE DUPLICATE REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Base Sample: B0801210-02A
Prep Date: 2/5/2008

Samp. Anal. Date: 2/5/2008 4:59:48PM
DUP Anal. Date: 2/5/2008 5:02:05PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Mercury	ND	ND	0.0	20	

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Base Sample: B0801210-04A
Prep Date: 2/5/2008

Samp. Anal. Date: 2/5/2008 5:13:23PM
DUP Anal. Date: 2/5/2008 5:20:14PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Mercury	ND	ND	0.0	20	

LCS/LCSD REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
MB: T080205004-MB
Prep Date: 2/5/2008

MB Anal. Date: 2/5/2008 4:23:51PM
LCS Anal. Date: 2/5/2008 4:26:44PM
LCSD Anal. Date: 2/5/2008 4:29:07PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Mercury	ND	0.00223	0.00227	0.00200	0.0020	111.5	113.5	1.8	80 - 120	20	

MS/MSD REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Parent: B0801210-02A
Prep Date: 2/5/2008

Samp. Anal. Date: 2/5/2008 4:59:48PM
MS Anal. Date: 2/5/2008 5:04:18PM
MSD Anal. Date: 2/5/2008 5:06:23PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	MSDRes	SPLev	SPDLev	Recov.	MSD Rec.	RPD	Recov Lim	RPDLim	Flag
Mercury	ND	0.00217	0.00209	0.00200	0.00200	108.5	104.5	3.8	70 - 130	20	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801210
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080205004**

MS/MSD REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Parent: B0801210-04A
Prep Date: 2/5/2008
Samp. Anal. Date: 2/5/2008 5:13:23PM
Units: mg/L
MS Anal. Date: 2/5/2008 5:22:59PM MSD Anal. Date: 2/5/2008 5:25:08PM
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	MSDRes	SPLev	SPDLev	Recov.	MSD Rec.	RPD	Recov Lim	RPDLim	Flag
Mercury	ND	0.00215	0.00209	0.00200	0.00200	107.5	104.5	2.8	70 - 130	20	

POST DIGESTION SPIKE REPORT

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Base Sample: B0801210-02A
Prep Date: 2/5/2008
Samp. Anal. Date: 2/5/2008 4:59:48PM
Units: mg/L
PDS Anal. Date: 2/5/2008 5:08:38PM
Matrix: Aqueous

Analyte Name	SampResult	PDSRes.	SPLev	Recov.	Recov Lim	Flag
Mercury	ND	0.00211	0.00200	109.4	80 - 120	

Analysis: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg
Base Sample: B0801210-04A
Prep Date: 2/5/2008
Samp. Anal. Date: 2/5/2008 5:13:23PM
Units: mg/L
PDS Anal. Date: 2/5/2008 5:27:21PM
Matrix: Aqueous

Analyte Name	SampResult	PDSRes.	SPLev	Recov.	Recov Lim	Flag
Mercury	ND	0.00208	0.00200	109.4	80 - 120	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

FOOTNOTES TO QC REPORT

Note 1: Results are shown to three significant figures to avoid rounding errors in calculations.

Note 2: If the sample concentration is greater than 4 times the spike level, a recovery is not meaningful, and the result should be used as a replicate. In such cases the spike is not as high as expected random measurement variability of the sample result itself.

Note 3: For sample duplicates, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample and duplicate results are not five times the PQL or greater, then the RPD is not expected to fall within the window shown and the comparison should be made on the basis of the absolute difference. Analytica uses the criterion that the absolute difference should be less than the PQL for water or less than 2XPQL for other matrices.

Note 4: For serial dilutions, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample result is not 50 times the MDL or greater, then the fact that the RPD does not meet the 10% criterion has little signifcance. Otherwise it indicates that a matrix bias may exist at the analytical step.

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801210
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080204004**

SAMPLE DUPLICATE REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
Base Sample: B0801210-02B
Prep Date: 2/4/2008

Samp. Anal. Date: 2/4/2008 7:48:30PM
DUP Anal. Date: 2/4/2008 8:06:54PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Fluoride	10.2	10.2	0.0	30	
Chloride	607	609	0.3	30	
Sulfate	349	352	0.9	30	

LCS/LCSD REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
MB: T080204004-MB
Prep Date: 2/4/2008

MB Anal. Date: 2/4/2008 2:54:13PM
LCS Anal. Date: 2/4/2008 3:12:36PM LCSD Anal. Date: 2/4/2008 3:31:00PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Fluoride	ND	2.46	2.43		2.50		97.2	1.2	90 - 110	20	
Chloride	ND	5.15	5.14		5.00		102.8	0.2	90 - 110	20	
Sulfate	ND	37.1	37.1		37.5		98.9	0.0	90 - 110	20	

MS REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
Parent: B0801210-02B
Prep Date: 2/4/2008

Samp. Anal. Date: 2/4/2008 7:48:30PM
MS Anal. Date: 2/4/2008 8:25:18PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim		Flag
Fluoride	10.2	12.8	2.50	104.0	70 - 130	*NOTE 2*	
Chloride	607	743	125	108.8	70 - 130	*NOTE 2*	
Sulfate	349	1,270	938	98.2	70 - 130		

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
Parent: B0801210-04B
Prep Date: 2/4/2008

Samp. Anal. Date: 2/4/2008 9:20:30PM
MS Anal. Date: 2/4/2008 9:38:55PM
Units: mg/L
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim	Flag

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801210
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080204004**

MS REPORT

Analysis: Inorganic Anions by Ion Chromatography - Anions by IC
Parent: B0801210-04B
Prep Date: 2/4/2008
Samp. Anal. Date: 2/4/2008 9:20:30PM
Units: mg/L
MS Anal. Date: 2/4/2008 9:38:55PM
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim		Flag
Fluoride	4.72	7.14	2.50	96.8	70 - 130		
Chloride	624	757	125	106.4	70 - 130	*NOTE 2*	
Sulfate	285	321	37.5	96.0	70 - 130	*NOTE 2*	

Prep Batch: **T080207003**

SAMPLE DUPLICATE REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Base Sample: B0801210-02B
Prep Date: 2/6/2008
Samp. Anal. Date: 2/12/2008 10:07:15AM
Units: mg/L
DUP Anal. Date: 2/12/2008 10:07:15AM
Matrix: Aqueous

Analyte Name	SampResult	DUPRes.	RPD	RPDLim	Flag
Total Dissolved Solids	3,070	3,050	0.7	20	

LCS/LCSD REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS
MB: T080207003-MB
Prep Date: 2/6/2008
MB Anal. Date: 2/12/2008 10:07:15AM
Units: mg/L
LCS Anal. Date: 2/12/2008 10:07:15AM
LCSD Anal. Date: 2/12/2008 10:07:15AM
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Total Dissolved Solids	ND	797	845	821	821	97.0	102.9	5.8	80 - 120	20	

MS REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Parent: B0801210-02B
Prep Date: 2/6/2008
Samp. Anal. Date: 2/12/2008 10:07:15AM
Units: mg/L
MS Anal. Date: 2/12/2008 10:07:15AM
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim	Flag

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

Tests Run at: Analytica Environmental Laboratories - Thornton, Colorado
Workorder (SDG): B0801210
Project: Navajo Mine Extension Leaching Study
Project Number:

QUALITY CONTROL REPORT

Prep Batch: **T080207003**

MS REPORT

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Parent: B0801210-02B
Prep Date: 2/6/2008
Samp. Anal. Date: 2/12/2008 10:07:15AM
Units: mg/L
MS Anal. Date: 2/12/2008 10:07:15AM
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim	Flag
Total Dissolved Solids	3,070	3,890	821	99.8	70 - 130	

Analysis: 160.1 - Total Dissolved Solids dried at 180°C - TDS
Parent: B0801210-04B
Prep Date: 2/6/2008
Samp. Anal. Date: 2/12/2008 10:07:15AM
Units: mg/L
MS Anal. Date: 2/12/2008 10:07:15AM
Matrix: Aqueous

Analyte Name	SampResult	MSRes.	SPLev	Recov.	Recov Lim	Flag
Total Dissolved Solids	3,060	3,930	821	105.9	70 - 130	

Prep Batch: **T080205001**

LCS/LCSD REPORT

Analysis: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity
MB: T080205001-MB
Prep Date: 2/4/2008
MB Anal. Date: 2/4/2008 9:52:02AM
Units: mg/L
LCS Anal. Date: 2/4/2008 9:52:02AM LCSD Anal. Date: 2/4/2008 9:52:02AM
Matrix: Aqueous

Analyte Name	SampResult	LCSRes.	SDRes.	SPLev	SPDLev	Recov.	SD Recov	RPD	Recov Lim	RPDLim	Flag
Bicarbonate	ND	24.0	27.0	25.0	25.0	96.0	108.0	11.8	80 - 120	20	
Carbonate	ND	50.0	51.0	50.0	50.0	100.0	102.0	2.0	80 - 120	20	

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

FOOTNOTES TO QC REPORT

Note 1: Results are shown to three significant figures to avoid rounding errors in calculations.

Note 2: If the sample concentration is greater than 4 times the spike level, a recovery is not meaningful, and the result should be used as a replicate. In such cases the spike is not as high as expected random measurement variability of the sample result itself.

Note 3: For sample duplicates, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample and duplicate results are not five times the PQL or greater, then the RPD is not expected to fall within the window shown and the comparison should be made on the basis of the absolute difference. Analytica uses the criterion that the absolute difference should be less than the PQL for water or less than 2XPQL for other matrices.

Note 4: For serial dilutions, if the result is less than the PQL, the duplicate RPD is not applicable. If the sample result is not 50 times the MDL or greater, then the fact that the RPD does not meet the 10% criterion has little signifcance. Otherwise it indicates that a matrix bias may exist at the analytical step.

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **83,686** **Lab Project Number:** **B0801210**

Prep Date: 2/4/2008

Lab Method Blank Id: T080204004-MB
Prep Batch ID: T080204004
Method: Inorganic Anions by Ion Chromatography - Anions by IC

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T080204004-LCS	LCS	080204_014.DXD	2/4/2008 3:12:36PM
T080204004-LCSD	LCSD	080204_015.DXD	2/4/2008 3:31:00PM
B0801210-01B	MB Successive #2	080204_017.DXD	2/4/2008 4:07:47PM
B0801210-02B	Ash Successive #2	080204_018.DXD	2/4/2008 4:26:11PM
B0801210-02B-DUP	DUP	080204_019.DXD	2/4/2008 4:44:34PM
B0801210-02B-MS	MS	080204_020.DXD	2/4/2008 5:02:58PM
B0801210-03B	MB Successive #3	080204_022.DXD	2/4/2008 5:39:45PM
B0801210-04B	Ash Successive #3	080204_023.DXD	2/4/2008 5:58:09PM
B0801210-04B-MS	MS	080204_024.DXD	2/4/2008 6:16:33PM
B0801210-01B	MB Successive #2	080204_028.DXD	2/4/2008 7:30:06PM
B0801210-02B	Ash Successive #2	080204_029.DXD	2/4/2008 7:48:30PM
B0801210-02B-DUP	DUP	080204_030.DXD	2/4/2008 8:06:54PM
B0801210-02B-MS	MS	080204_031.DXD	2/4/2008 8:25:18PM
B0801210-03B	MB Successive #3	080204_033.DXD	2/4/2008 9:02:06PM
B0801210-04B	Ash Successive #3	080204_034.DXD	2/4/2008 9:20:30PM
B0801210-04B-MS	MS	080204_035.DXD	2/4/2008 9:38:55PM

Prep Date: 2/4/2008

Lab Method Blank Id: T080205001-MB
Prep Batch ID: T080205001
Method: 310.1 - Alkalinity, Titrimetric (pH 4.5) - Alkalinity

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0801191-04B	Batch QC		2/4/2008 9:52:02AM
B0801210-01B	MB Successive #2		2/4/2008 9:52:02AM
B0801210-02B	Ash Successive #2		2/4/2008 9:52:02AM
B0801210-03B	MB Successive #3		2/4/2008 9:52:02AM
B0801210-04B	Ash Successive #3		2/4/2008 9:52:02AM
T080205001-LCS	LCS		2/4/2008 9:52:02AM
T080205001-LCSD	LCSD		2/4/2008 9:52:02AM
B0801191-04B-DUP	DUP		2/4/2008 9:52:02AM

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **83,686** **Lab Project Number:** **B0801210**

Prep Date: 2/5/2008

Lab Method Blank Id: T080205002-MB

Prep Batch ID: T080205002

Method: SW6010B - ICP - Total

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
T080205002-LCS	LCS	E02058A	2/5/2008 4:32:00PM
T080205002-LCSD	LCSD	E02058A	2/5/2008 4:37:00PM
B0801210-02A-DUP	DUP	E02058A	2/5/2008 4:52:00PM
B0801210-04A-DUP	DUP	E02058A	2/5/2008 6:06:00PM
B0801210-02A-MS	MS	E02058A	2/5/2008 4:57:00PM
B0801210-04A-MS	MS	E02058A	2/5/2008 6:11:00PM
B0801210-02A-MSD	MSD	E02058A	2/5/2008 5:02:00PM
B0801210-04A-MSD	MSD	E02058A	2/5/2008 6:16:00PM
B0801210-02A-PDS	PDS	E02058A	2/5/2008 5:46:00PM
B0801210-04A-PDS	PDS	E02058A	2/5/2008 6:21:00PM
T080205002-LCS	LCS	E02068A	2/6/2008 1:59:00PM
T080205002-LCSD	LCSD	E02068A	2/6/2008 2:04:00PM
B0801210-02A-MS	MS	E02068A	2/6/2008 2:09:00PM
B0801210-04A-MS	MS	E02068A	2/6/2008 2:19:00PM
B0801210-02A-MSD	MSD	E02068A	2/6/2008 2:14:00PM
B0801210-04A-MSD	MSD	E02068A	2/6/2008 2:24:00PM
B0801210-01A	MB Successive #2	E02198A	2/19/2008 2:36:00PM
B0801210-02A	Ash Successive #2	E02198A	2/19/2008 2:41:00PM
B0801210-03A	MB Successive #3	E02198A	2/19/2008 2:46:00PM
B0801210-04A	Ash Successive #3	E02198A	2/19/2008 2:51:00PM

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **83,686** **Lab Project Number:** **B0801210**

Prep Date: 2/5/2008

Lab Method Blank Id: T080205004-MB

Prep Batch ID: T080205004

Method: SW7470A - Mercury in Liquid Waste by CVAA - Total Hg

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0801197-02A	Batch QC	B020508W.WKS	2/5/2008 4:38:47PM
B0801210-01A	MB Successive #2	B020508W.WKS	2/5/2008 4:57:34PM
B0801210-02A	Ash Successive #2	B020508W.WKS	2/5/2008 4:59:48PM
B0801210-03A	MB Successive #3	B020508W.WKS	2/5/2008 5:11:03PM
B0801210-04A	Ash Successive #3	B020508W.WKS	2/5/2008 5:13:23PM
T080205004-LCS	LCS	B020508W.WKS	2/5/2008 4:26:44PM
T080205004-LCSD	LCSD	B020508W.WKS	2/5/2008 4:29:07PM
B0801197-02A-DUP	DUP	B020508W.WKS	2/5/2008 4:41:14PM
B0801210-02A-DUP	DUP	B020508W.WKS	2/5/2008 5:02:05PM
B0801210-04A-DUP	DUP	B020508W.WKS	2/5/2008 5:20:14PM
B0801197-02A-MS	MS	B020508W.WKS	2/5/2008 4:43:28PM
B0801210-02A-MS	MS	B020508W.WKS	2/5/2008 5:04:18PM
B0801210-04A-MS	MS	B020508W.WKS	2/5/2008 5:22:59PM
B0801197-02A-MSD	MSD	B020508W.WKS	2/5/2008 4:46:03PM
B0801210-02A-MSD	MSD	B020508W.WKS	2/5/2008 5:06:23PM
B0801210-04A-MSD	MSD	B020508W.WKS	2/5/2008 5:25:08PM
B0801197-02A-PDS	PDS	B020508W.WKS	2/5/2008 4:52:53PM
B0801210-02A-PDS	PDS	B020508W.WKS	2/5/2008 5:08:38PM
B0801210-04A-PDS	PDS	B020508W.WKS	2/5/2008 5:27:21PM

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

QC BATCH ASSOCIATIONS - BY METHOD BLANK

Lab Project ID: **83,686** **Lab Project Number:** **B0801210**

Prep Date: 2/6/2008

Lab Method Blank Id: T080207003-MB

Prep Batch ID: T080207003

Method: 160.1 - Total Dissolved Solids dried at 180°C - TDS

This Method blank and sample preparation batch are associated with the following samples, spikes, and duplicates:

SampleNum	ClientSampleName	DataFile	AnalysisDate
B0801210-01B	MB Successive #2		2/12/2008 10:07:15AM
B0801210-02B	Ash Successive #2		2/12/2008 10:07:15AM
B0801210-03B	MB Successive #3		2/12/2008 10:07:15AM
B0801210-04B	Ash Successive #3		2/12/2008 10:07:15AM
T080207003-LCS	LCS		2/12/2008 10:07:15AM
T080207003-LCSD	LCSD		2/12/2008 10:07:15AM
B0801210-02B-DUP	DUP		2/12/2008 10:07:15AM
B0801210-02B-MS	MS		2/12/2008 10:07:15AM
B0801210-04B-MS	MS		2/12/2008 10:07:15AM

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:

ND = Not Detected at or above the Reporting Limit
NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:

LOW = Recovery is below Lower Control Limit
HIGH = Recovery , RPD, or other parameter is above Upper Control Limit
E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:

B = Analyte was detected in the laboratory method blank
J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:

J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
W = Post digestion spike did not meet criteria
S = Reported value determined by the Method of Standard Additions (MSA)

Several ways of defining the limit of detection and quantitation are prevalent in the laboratory industry and may appear in Analytica reports. These include the following:

MRL = "minimum reporting level", from the EPA Safe Drinking Water program (SDW)
PQL = "practical quantitation limit", from SW-846
EQL = "estimated quantitation limit", from SW-846
LOQ = "limit of quantitation", from a number of authoritative sources

In Analytica's work, all of these terms have the same meaning, equivalent to the EPA definition of the MRL. This reporting level is supported by a satisfactory calibration data point which is at that level or lower, and also is supported by a method detection limit (MDL) determined by the procedure in 40CFR. The MDL is lower than the MRL and represents an estimate of the level where positive detections have a 99% probability of being real, but where quantitation accuracy is unknown.

The MRL as defined by Analytica is the lowest demonstrated point of known quantitation accuracy.
The MRL should not be confused with the MCL, which is the EPA-defined "maximum contaminant level" allowed for certain regulated targets under specific regulations, such as the National Primary Drinking Water Regulations. Normally, the MRL is set at a level which is much lower than the MCL in order to ensure that levels are well below those limits. Not all target analytes have MCL levels established.

Other Flags may be applied. See Case Narrative for Description

Workorder (SDG): B0801210

Project: **Navajo Mine Extension Leaching Study**

Client: **Applied Hydrology Associates, Inc.**

Client Project Number: **none**

REPORTING CONVENTIONS FOR THIS REPORT

B0801210

TestPkgName	Basis	# Sig Figs	Reporting Limit
150.1/150.1 (Aqueous) - pH	As Received	2	Report to PQL
160.1/160.1 (Aqueous) - TDS	As Received	2	Report to PQL
300.0/300.0 (Aqueous) - Anions by IC	As Received	2	Report to PQL
310.1/310.1 (Aqueous) - Alkalinity	As Received	2	Report to PQL
6010B/3010A (Aqueous) - Total	As Received	2	Report to PQL
7470A/7470A (Aqueous) - Total Hg	As Received	2	Report to PQL

Analytica Chain of Custody Form

ANALYTICA GROUP

12189 Pennsylvania St.
Thornton, CO 80241
(303) 469-8868
(303) 469-5254 fax

4307 Arctic Boulevard
Anchorage, AK 99503
(907) 258-2155
(907) 258-6634 fax

475 Hall St.
Fairbanks, AK 99701
(907) 456 - 3116
(907) 456-3125 Fax

5436 Shaune Drive
Juneau, AK 99801
(907) 780-6668
(907) 780-6670 fax

Chain of Custody No: 63254

Client Name & Address: Applied Hydrology Associates, INC

Public Water System (PWS) ID#:

Project Name: Navajo Mine Extension Leaching Study

Section To be Completed by Analytica

Quote ID:

LGN: B080210

Account #: | Cash | Credit Card

Report to:

Phone No:

Fax No:

E-mail:

Turnaround Time for Results (TAT)

___ Standard ___ Expedited (< 10 days, prior authorization required)

(please specify due date below; add'tl charges may apply)

Requested Due Date for Results:

Invoice to Name & Address:

Special Instructions/Comments:
Tumbled in house by R. Seeman

Ash Successive leaching Study

P.O. or Contract No:

Kit Prep/Shipping Charge: $

Requested Analysis/Method

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers	6010B/3010A TTL Lot #: 110710980 Pres: HNO3	7470A/7470A Hg Lot #: 110710980 Pres: HNO3	150.1 pH Lot #: Pres:	160.1 TDS Lot #: Pres:	300.0 Anions IC Lot #: Pres:	310.1 Alk. Lot #: Pres:		Field Preserved	Field Filtered	MS/MSD ?
MB Successive #2	1/30/08	11:20	Aq	2	X	X	X	X	X	X		Yp	Fp	
Ash Successive #2	↓	↓	|	2	X	X	X	X	X	X		|	|	X
MB Successive #3	1/31/08	11:00	|	2	X	X	X	X	X	X		|	|	
Ash Successive #3	↓	↓	↓	2	X	X	X	X	X	X		↓	↓	X

Relinquished by:	Date	Time	Received by:	Date	Time
R. Seeman	1/31/08	15:05		1/31/08	15:05
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Name of Sampler: (printed)

Section To Be Completed by Analytica

	THO	ANC	JNU	FBKS
Condition of Custody Seal?:	—			
Initialed By:	—			
Temp/Loc:	3.0			
Thermo ID#:				
Shipped Via:	R. Seeman			

Version 2.0

ANALYTICA

Cooler Receipt Form

Client: Applied Hydrology Associates **Client Code:** 030188 **Order #:** B0801210
Project: Navajo Mine Extension Leaching Study

Cooler ID: 1

A. Preliminary Examination Phase: **Date cooler opened:** 1/31/2008
Cooler opened by: gp **Signature:** GP

1. **Was airbill Attached?** N/A **Airbill #:** **Carrier Name:** Other
2. **Custody Seals?** N/A **How many?** 0 **Location:** **Seal Name:**
3. **Seals intact?** N/A
4. **COC Attached?** Yes **Properly Completed?** Yes **Signed by AEL employee?** Yes
5. **Project Identification from custody paper:** Navajo Mine Extension Leaching Study
6. **Preservative:** None **Temperature:** 3.0 **deg. C**

Designated person initial here to acknowledge receipt: GP **Date:** 1/31/08

COMMENTS: Tumbled in house by R. Seeman. Ash successive leaching study.

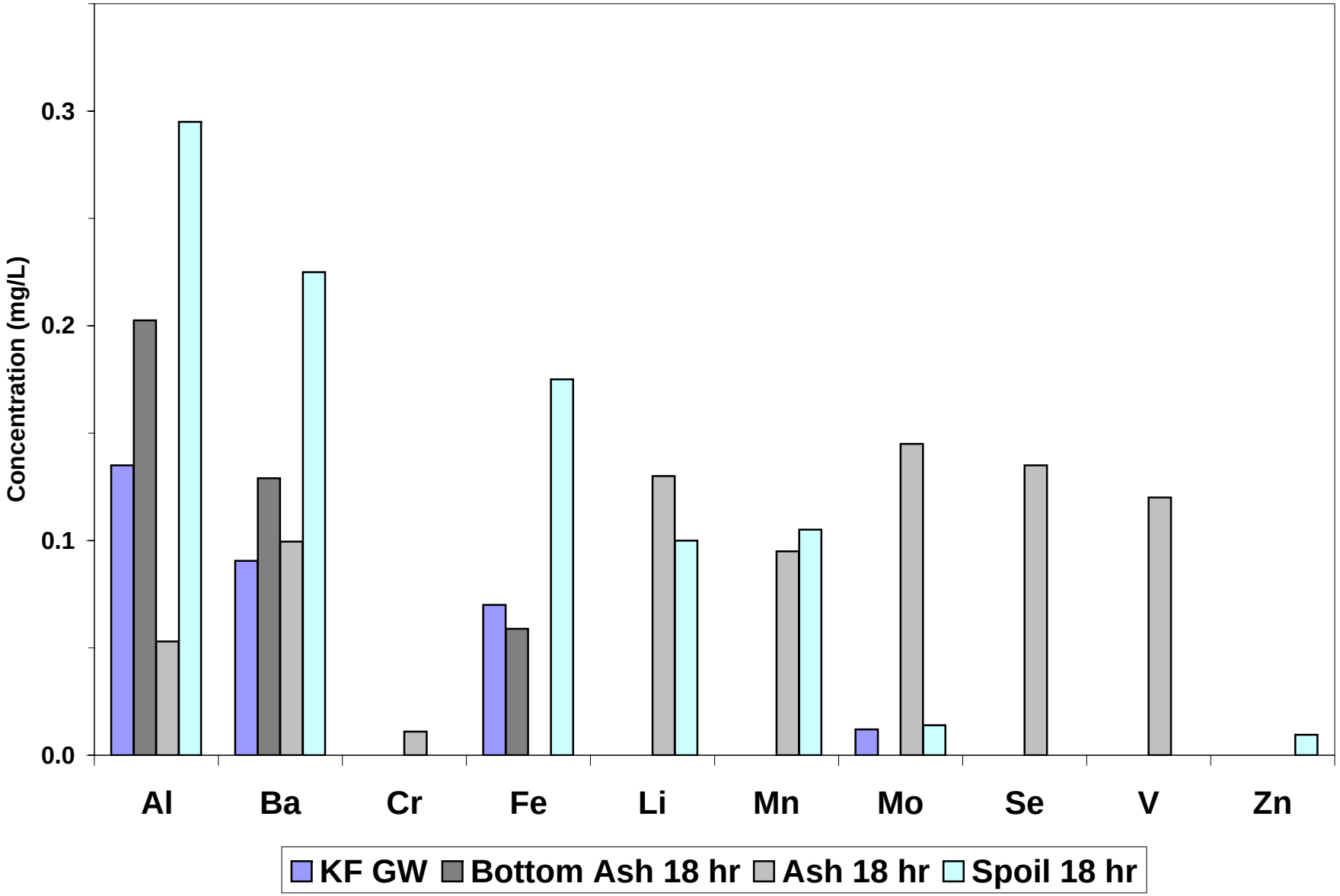
B. Log-In Phase: **Samples Log-in Date:** 1/31/2008 **Log-in By:** gp

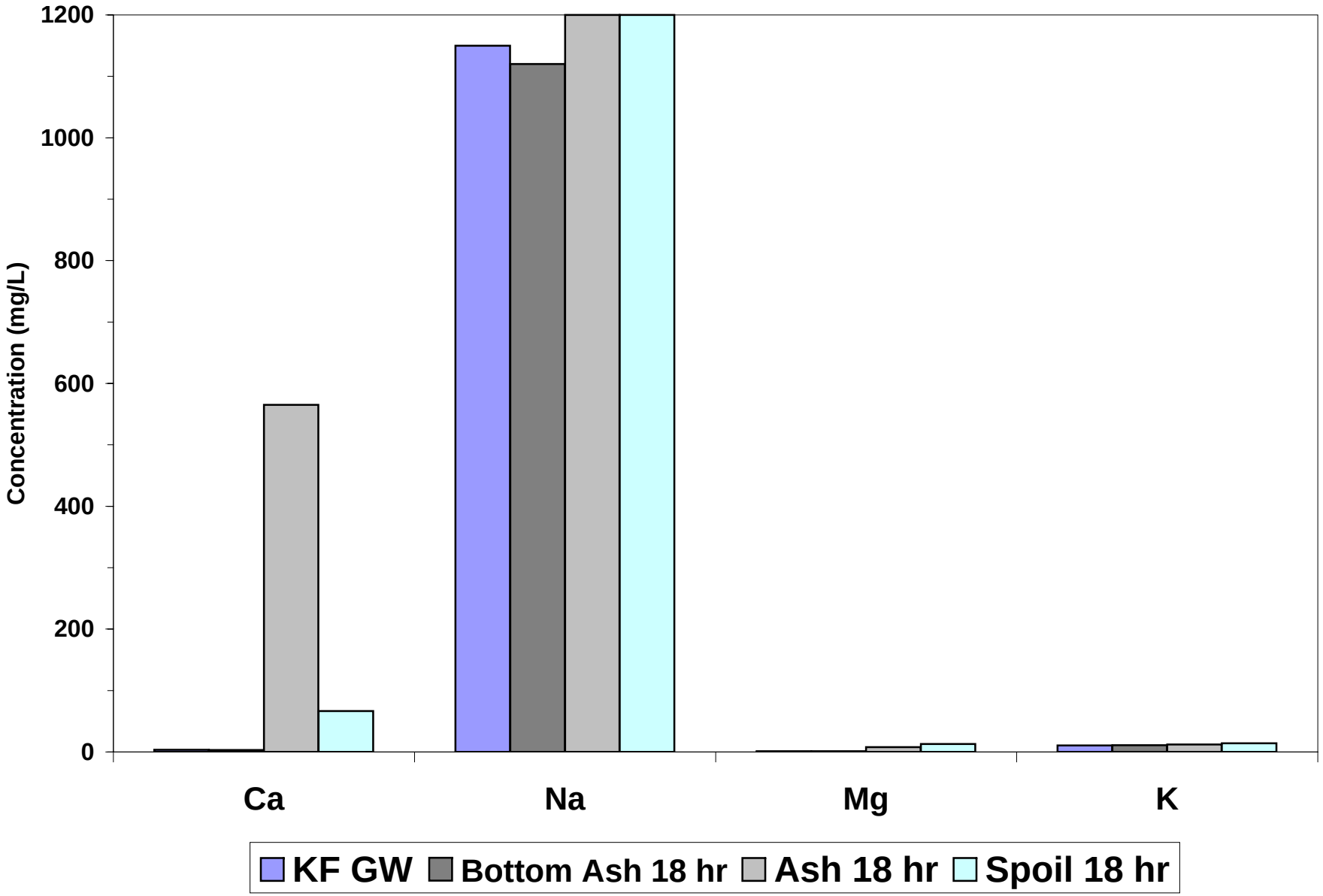
1. **Packing Type:** Other
2. **Were samples in separate bags?** N/A
3. **Were containers intact?** Yes **Labels agree with COC?** Yes
4. **Number of bottles received:** 8 **Number of samples received:** 4
5. **Correct containers used?** Yes **Correct preservatives added?** Yes
6. **Sufficient sample volume?** Yes
7. **Bubbles in VOA samples?** N/A
8. **Was Project manager called and status discussed?** No
9. **Was anyone called?** No **Who was called?** _____ **By whom?** _____ **Date:** _____

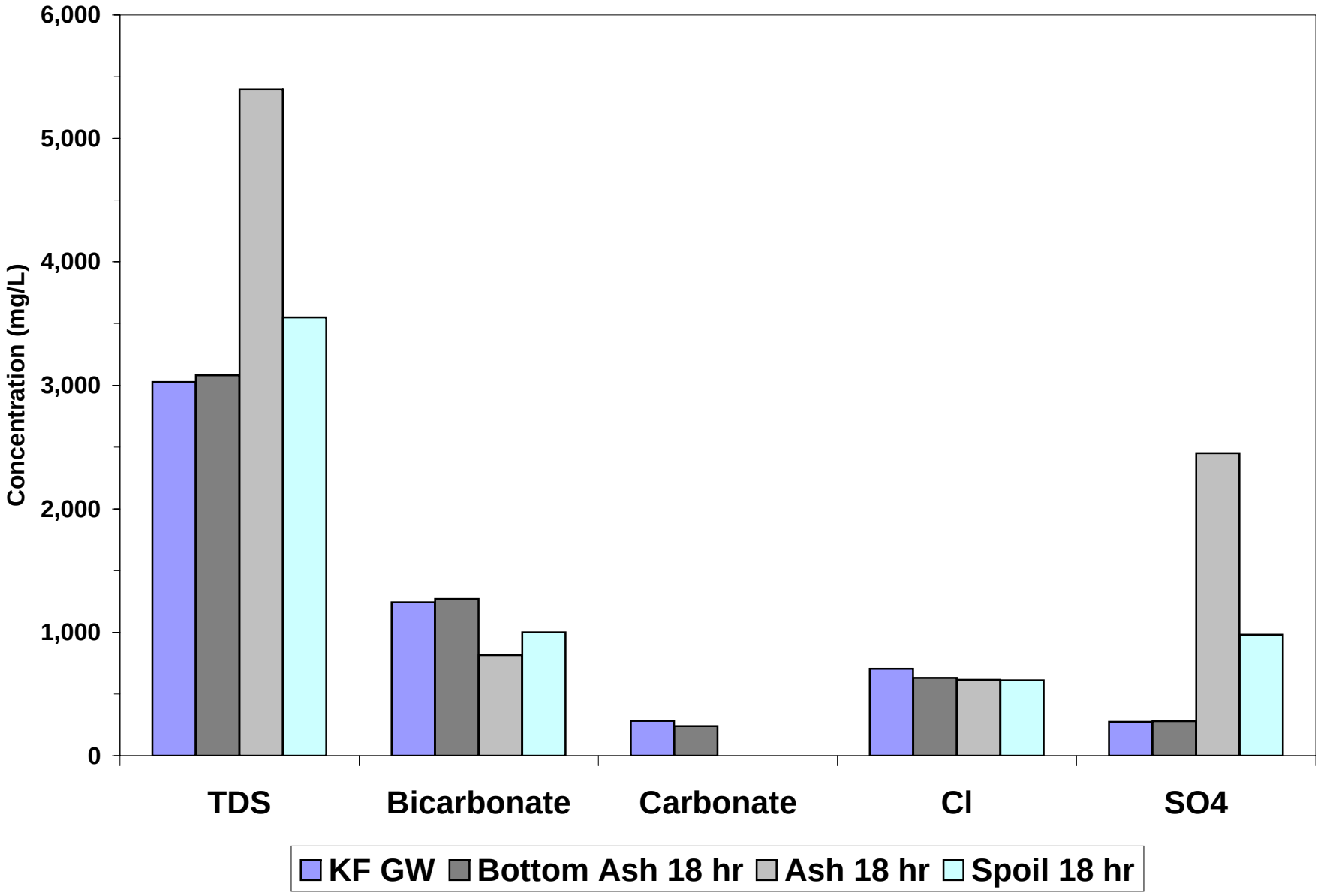
COMMENTS:

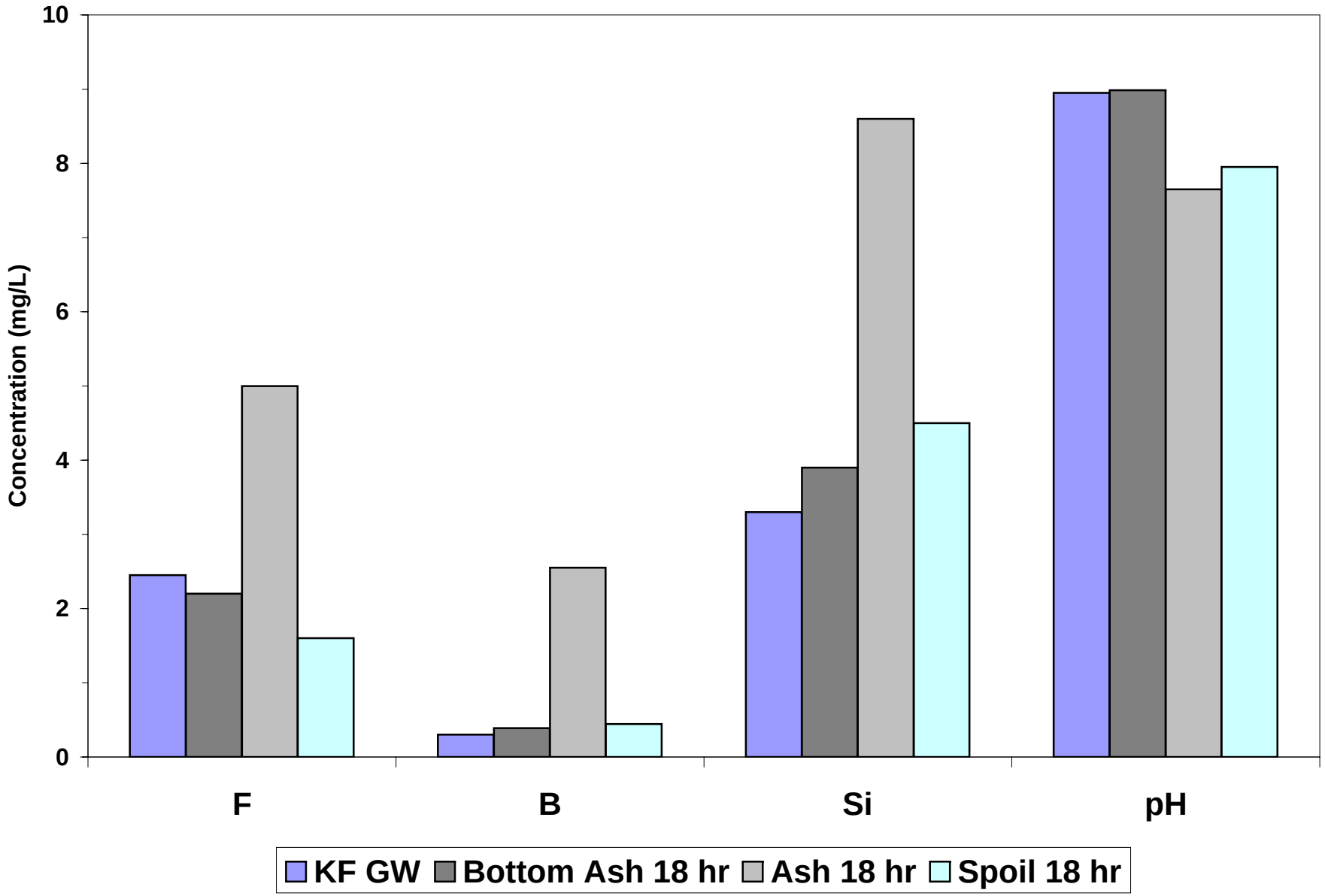
Attachment 41.A.G

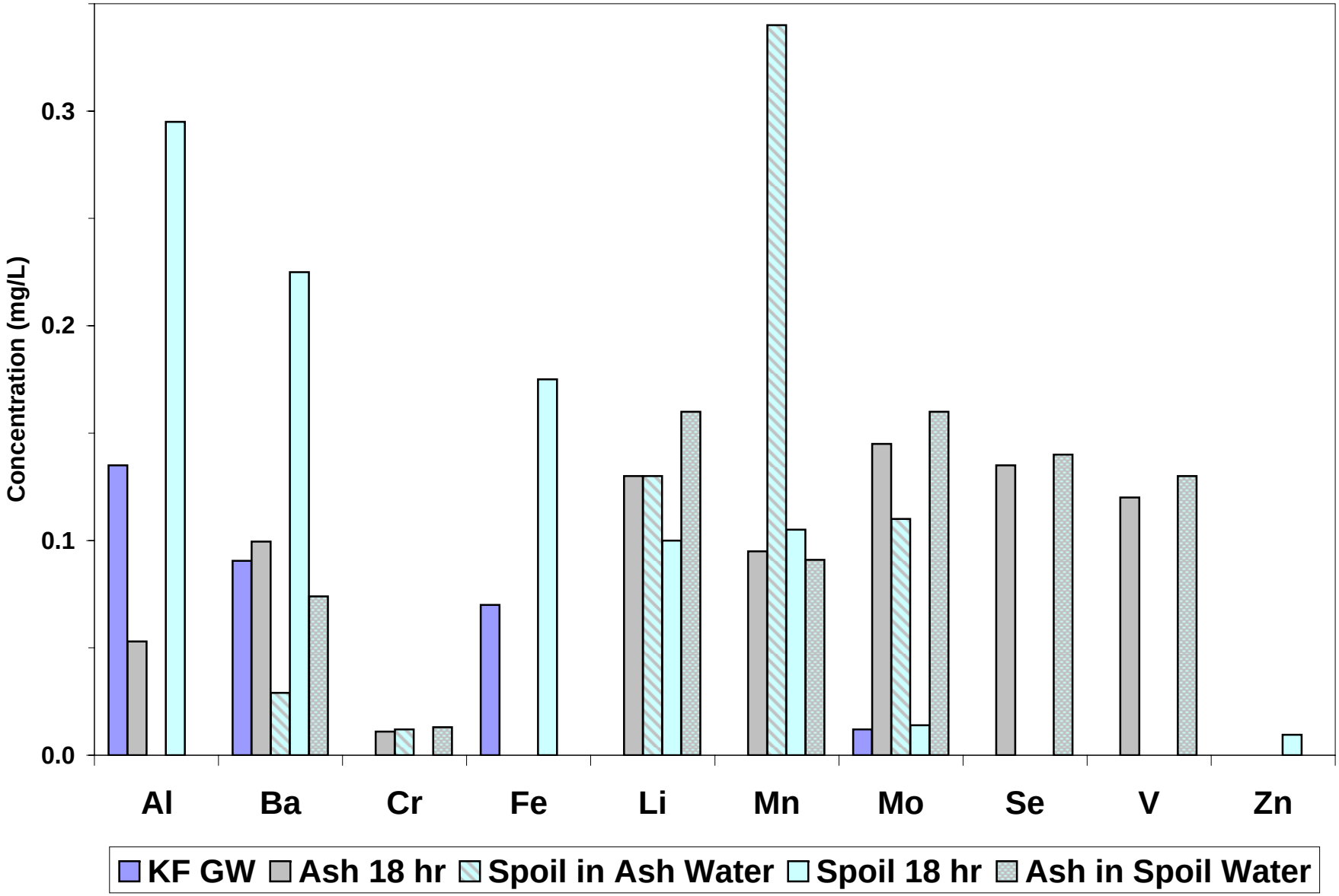
Leachate Water Quality Bar Plots

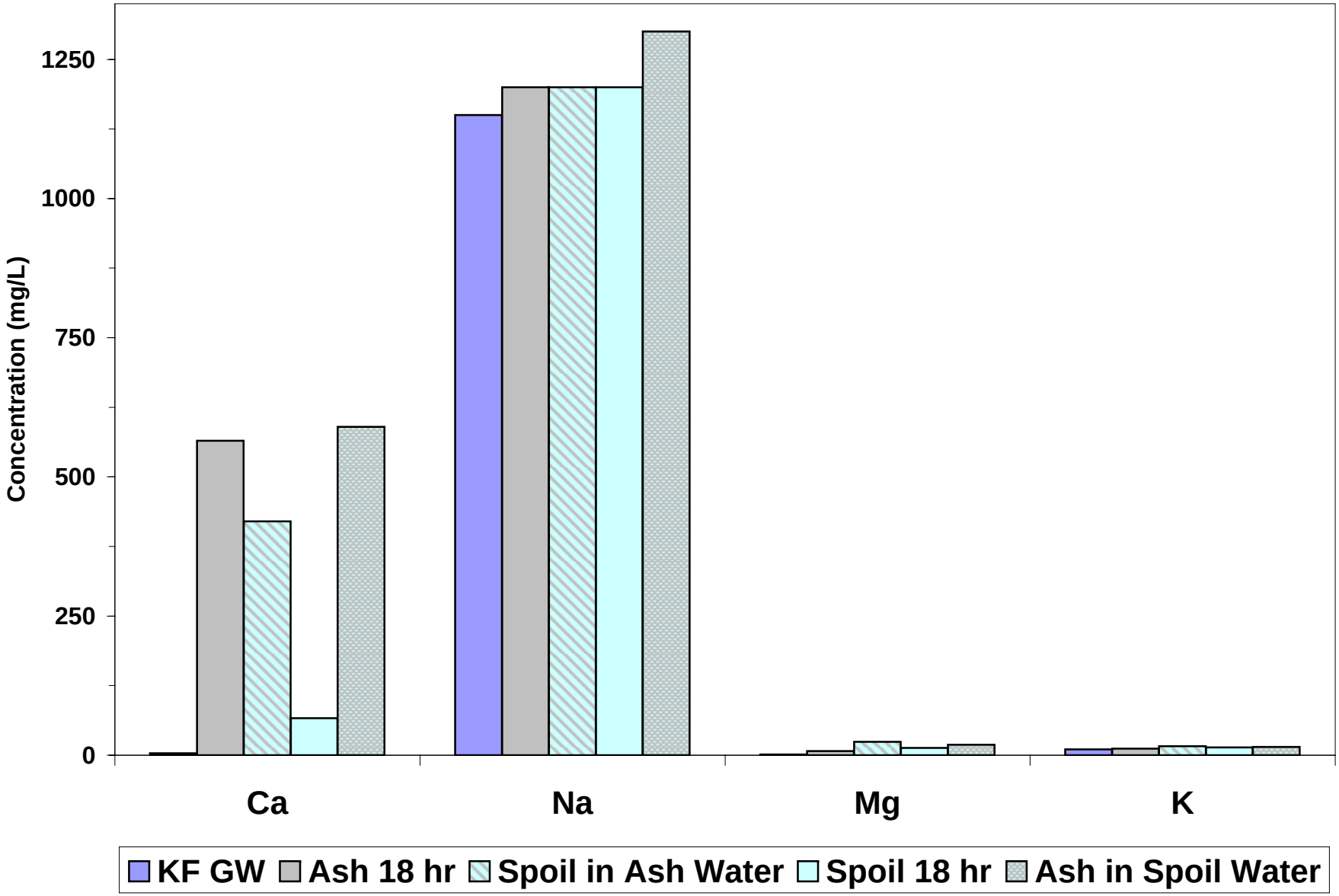

Concentration (mg/L)
0.3
0.2
0.1
0.0
Al
Ba
Cr
Fe
Li
Mn
Mo
Se
V
Zn
KF GW
Bottom Ash 18 hr
Ash 18 hr
Spoil 18 hr

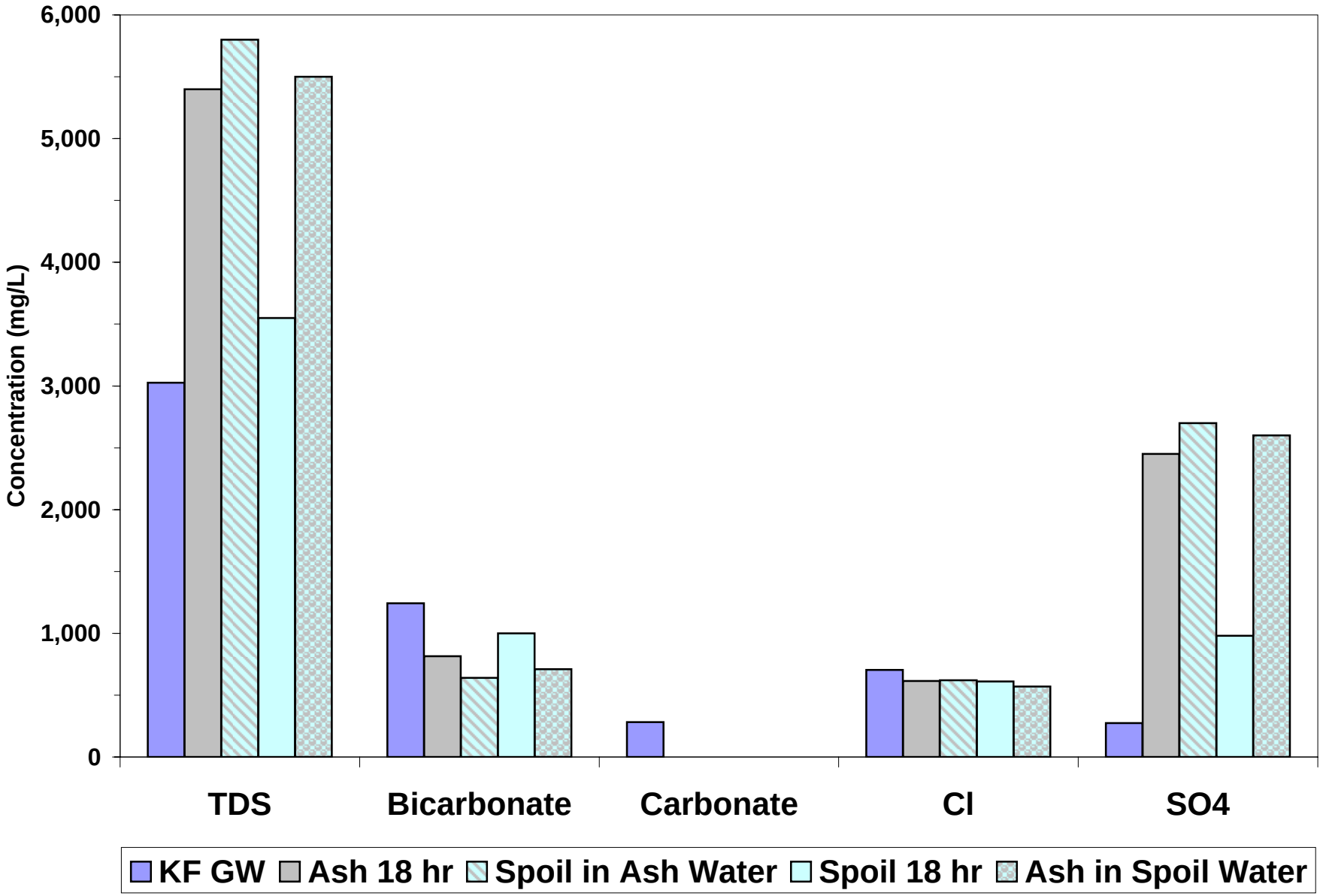

1200
1000
800
600
400
200
0
Concentration (mg/L)
Ca
Na
Mg
K
KF GW
Bottom Ash 18 hr
Ash 18 hr
Spoil 18 hr

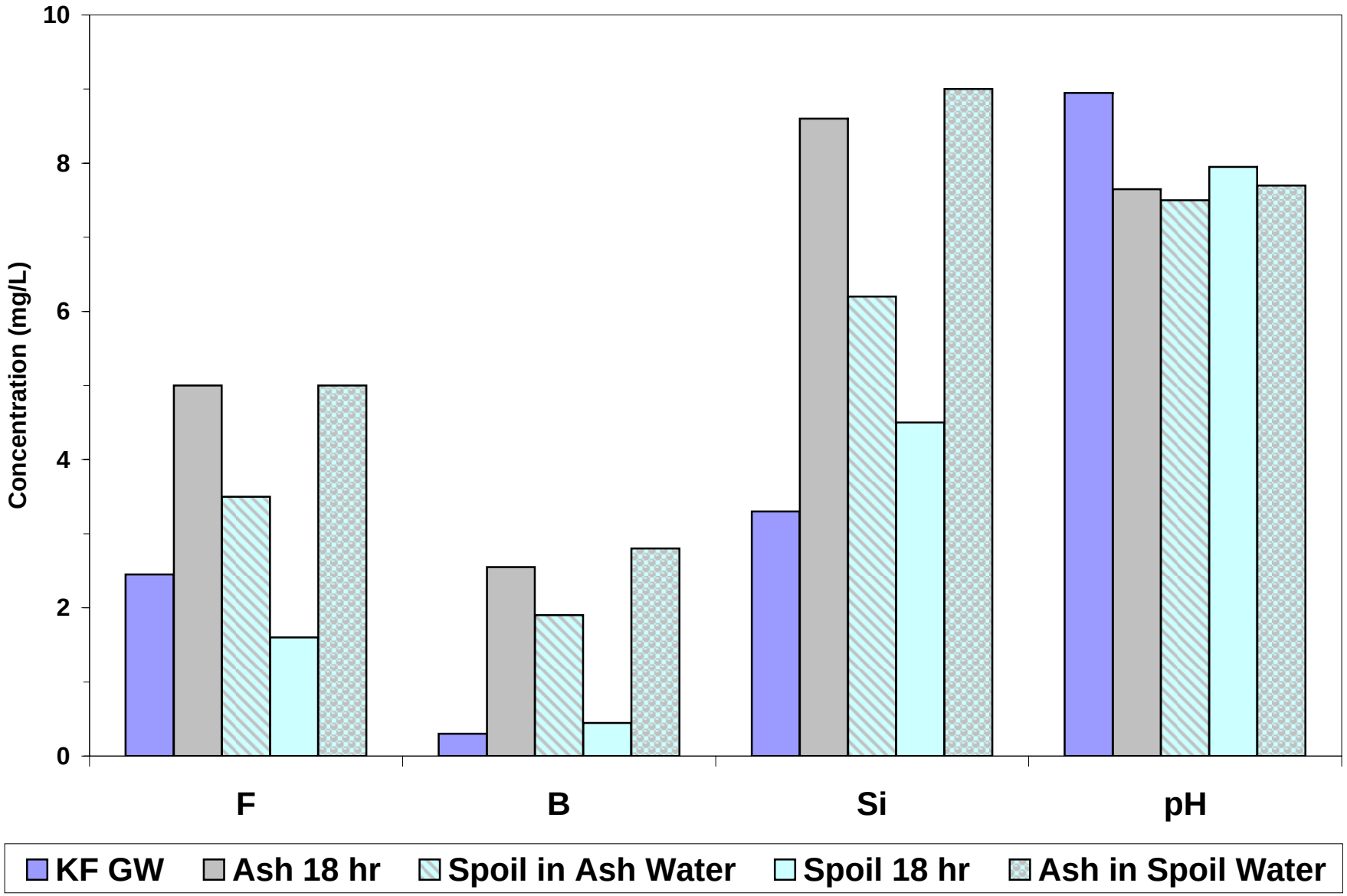

6,000
5,000
4,000
3,000
2,000
1,000
0
Concentration (mg/L)
TDS
Bicarbonate
Carbonate
Cl
SO4
KF GW
Bottom Ash 18 hr
Ash 18 hr
Spoil 18 hr

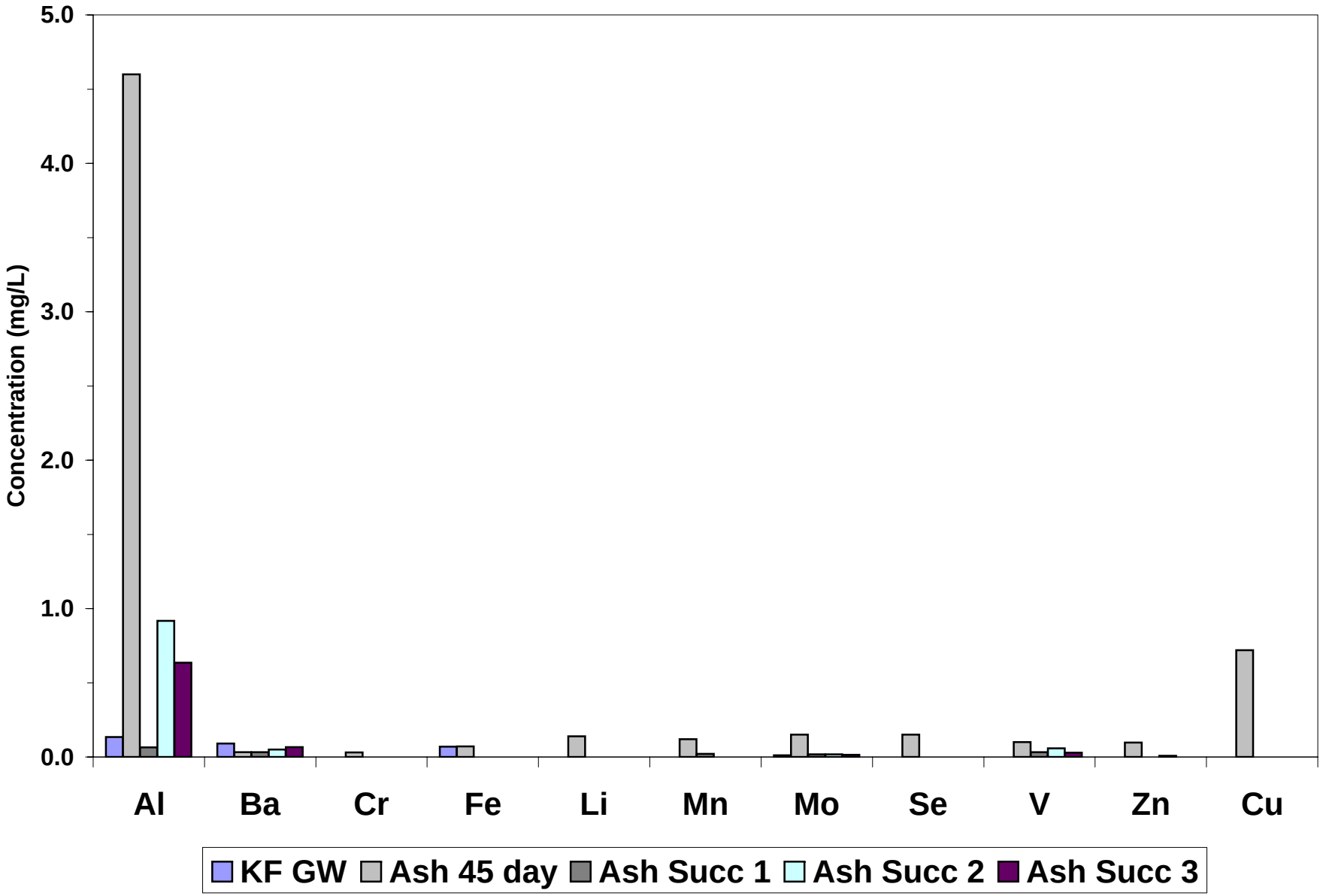

10
8
6
4
2
0
Concentration (mg/L)
F
B
Si
pH
KF GW
Bottom Ash 18 hr
Ash 18 hr
Spoil 18 hr

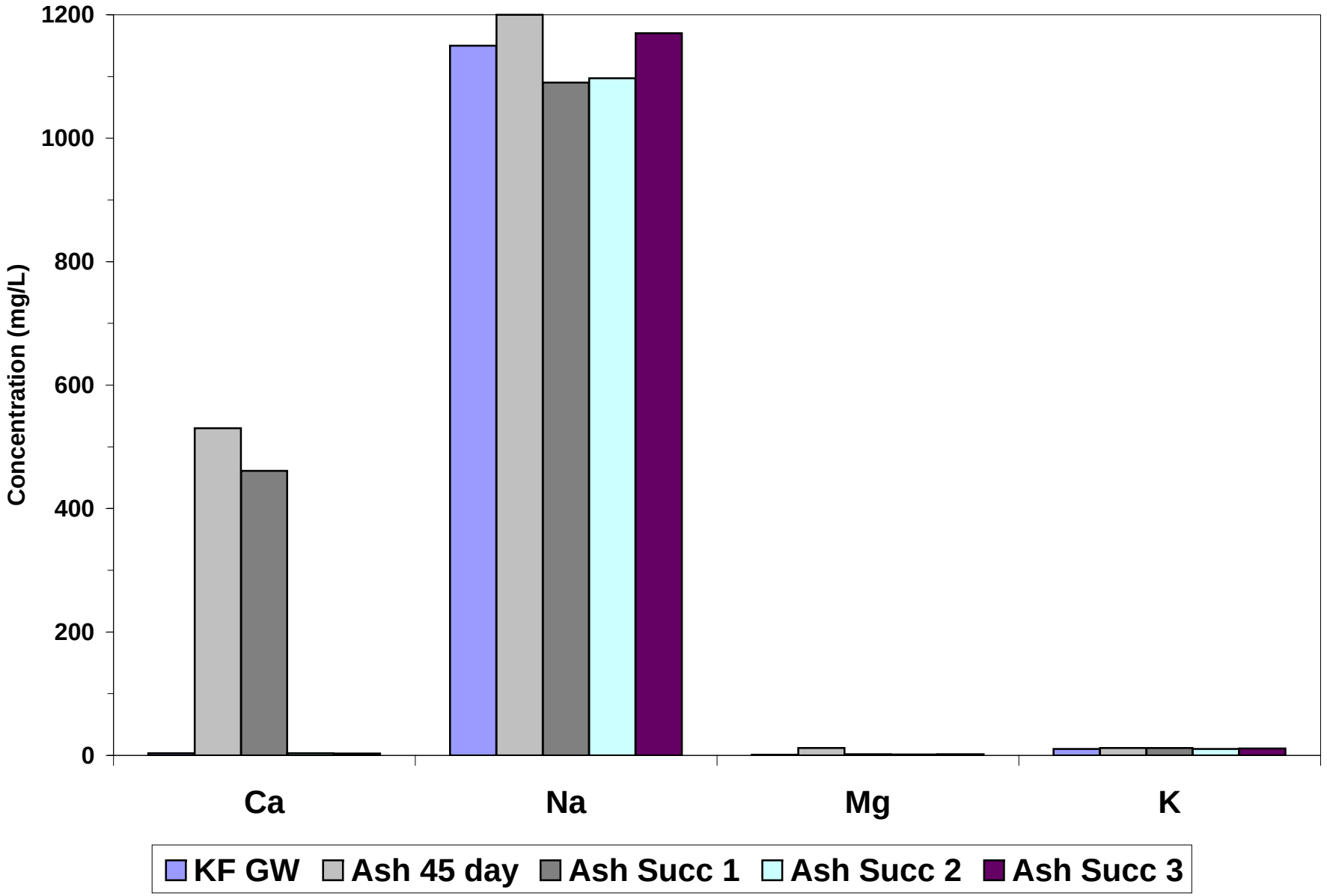

Concentration (mg/L)
0.0
0.1
0.2
0.3
Al
Ba
Cr
Fe
Li
Mn
Mo
Se
V
Zn
KF GW
Ash 18 hr
Spoil in Ash Water
Spoil 18 hr
Ash in Spoil Water

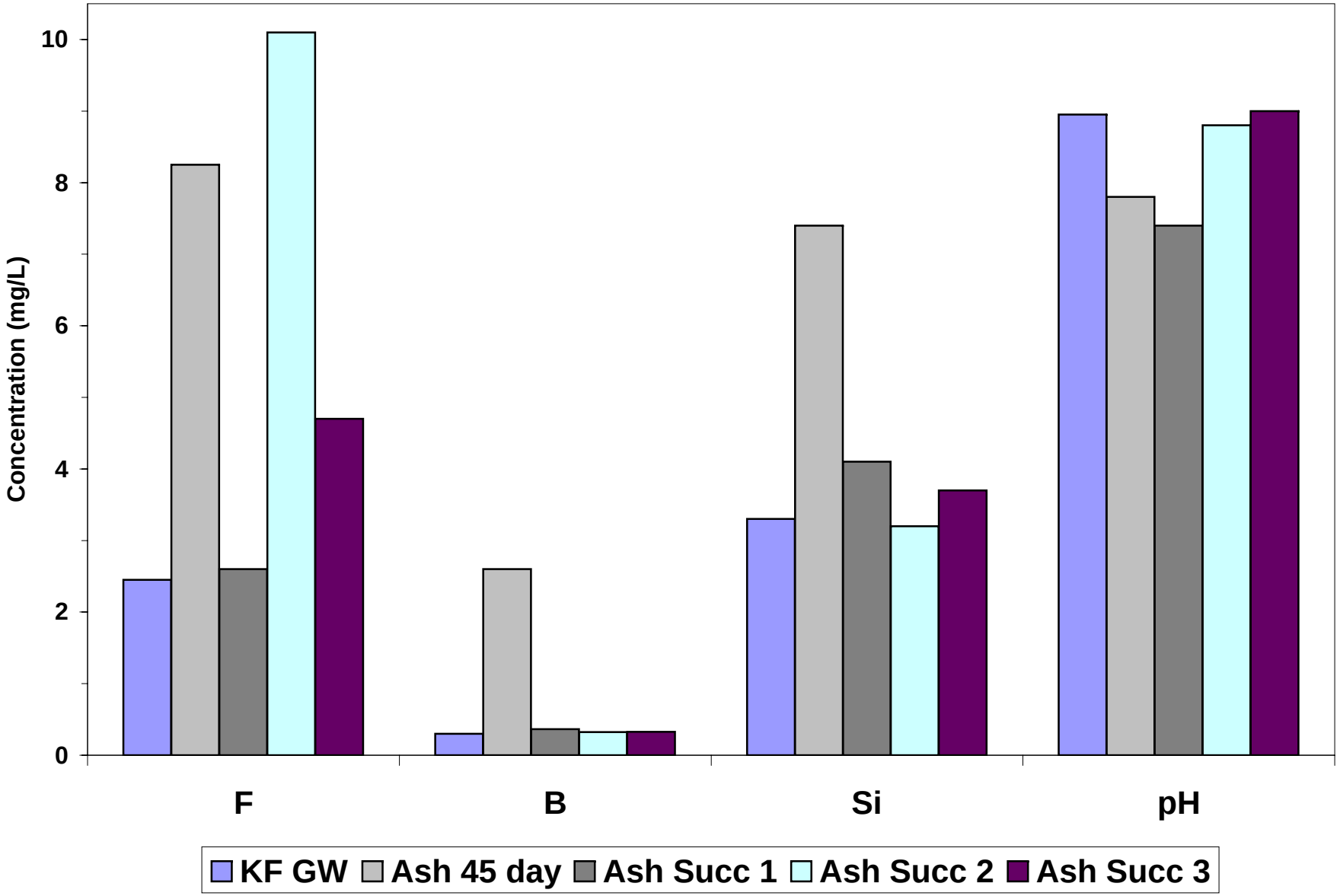

Concentration (mg/L)
1250
1000
750
500
250
0
Ca
Na
Mg
K
KF GW
Ash 18 hr
Spoil in Ash Water
Spoil 18 hr
Ash in Spoil Water

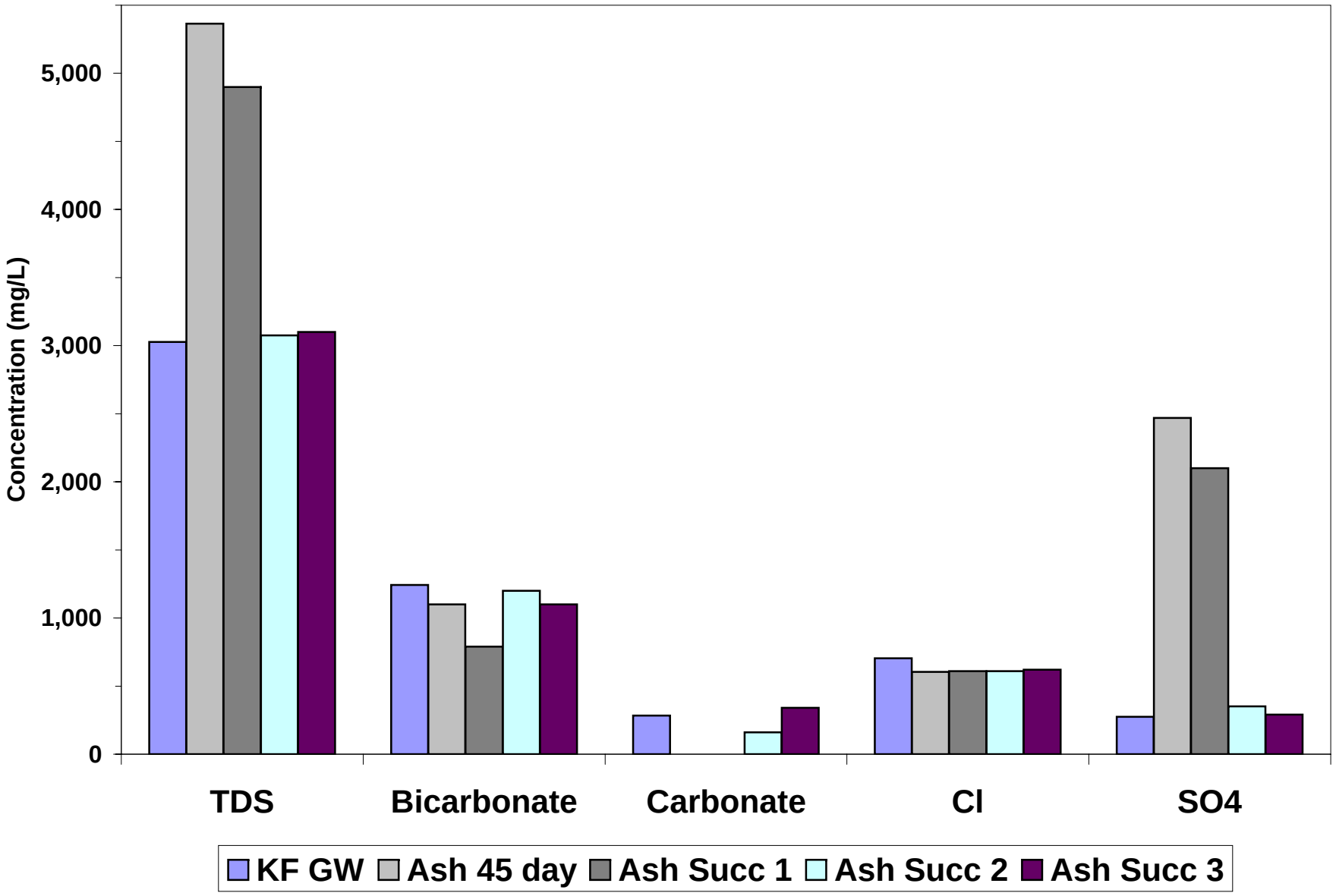

6,000
5,000
4,000
3,000
2,000
1,000
0
Concentration (mg/L)
TDS
Bicarbonate
Carbonate
Cl
SO4
KF GW
Ash 18 hr
Spoil in Ash Water
Spoil 18 hr
Ash in Spoil Water

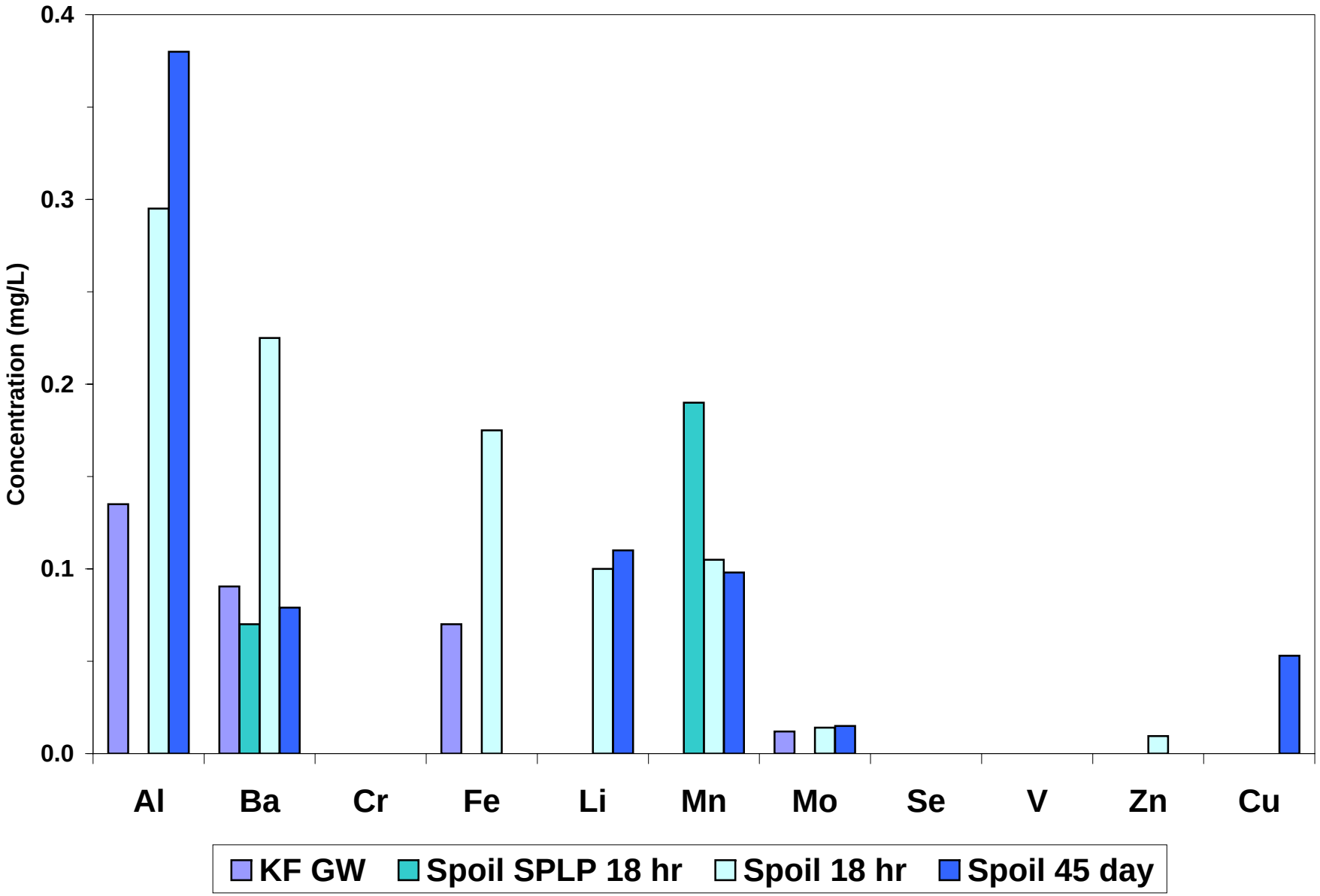

10
8
6
4
2
0
Concentration (mg/L)
F
B
Si
pH
KF GW
Ash 18 hr
Spoil in Ash Water
Spoil 18 hr
Ash in Spoil Water

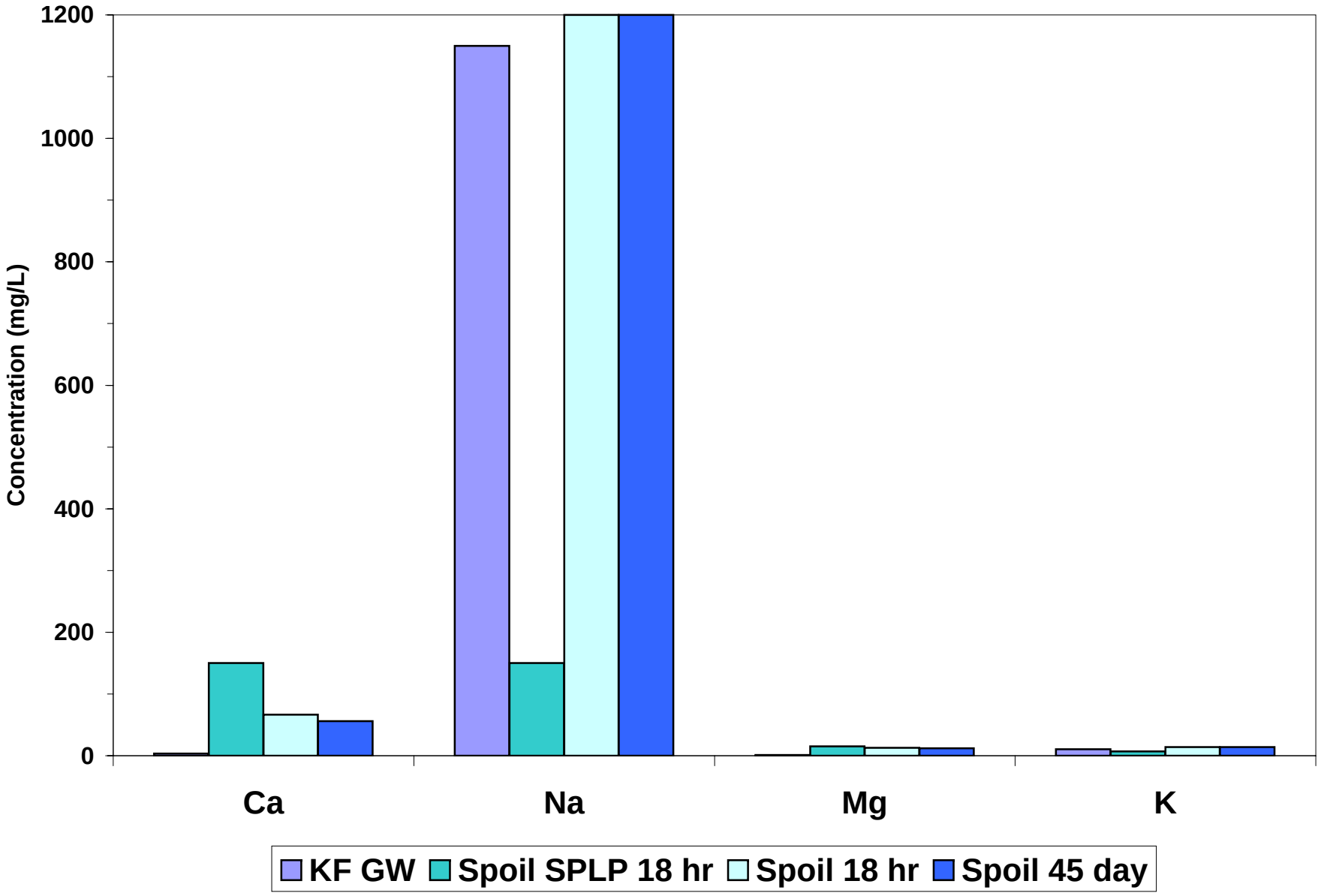

5.0
4.0
3.0
2.0
1.0
0.0
Concentration (mg/L)
Al
Ba
Cr
Fe
Li
Mn
Mo
Se
V
Zn
Cu
KF GW
Ash 45 day
Ash Succ 1
Ash Succ 2
Ash Succ 3

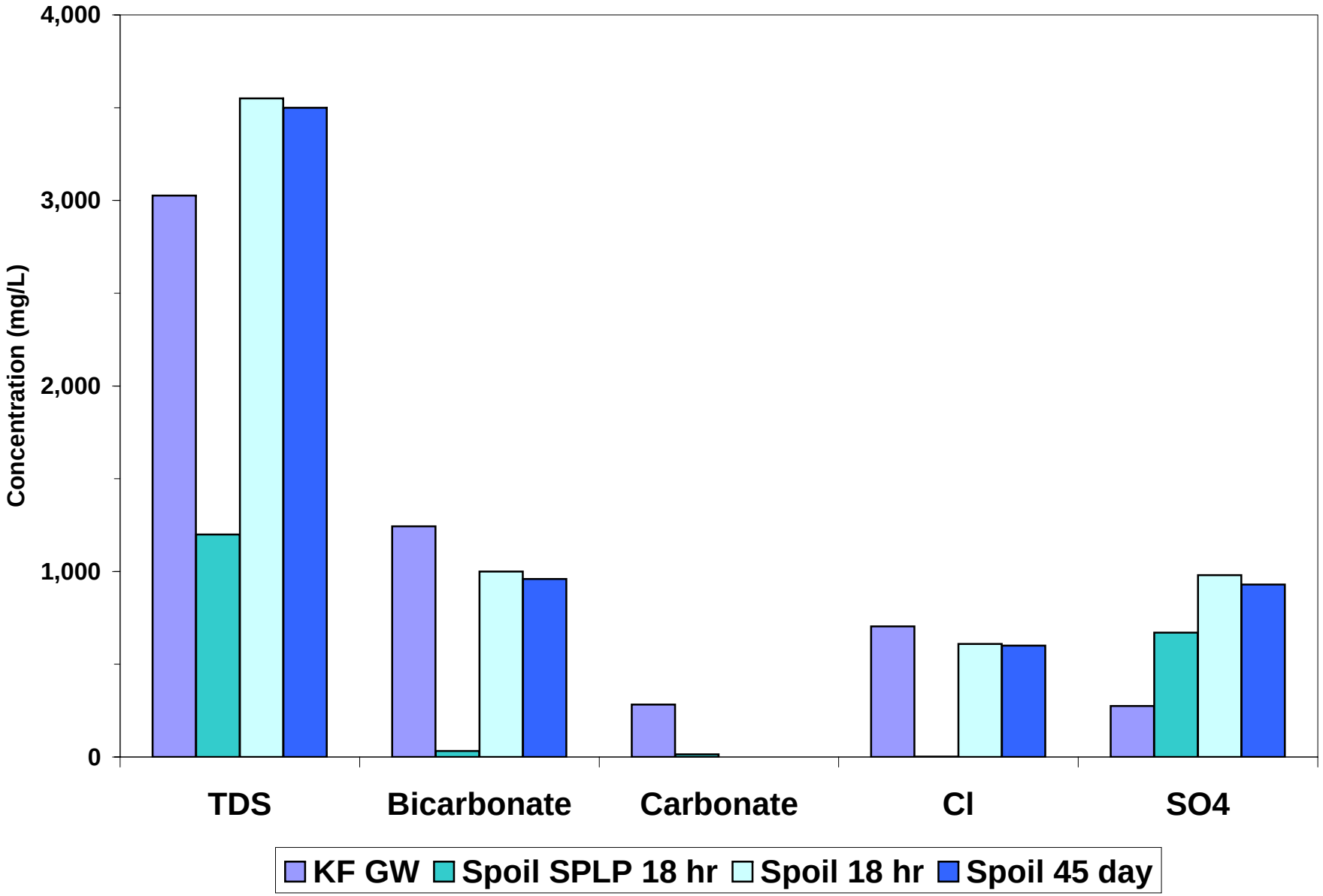

1200
1000
800
600
400
200
0
Concentration (mg/L)
Ca
Na
Mg
K
KF GW
Ash 45 day
Ash Succ 1
Ash Succ 2
Ash Succ 3

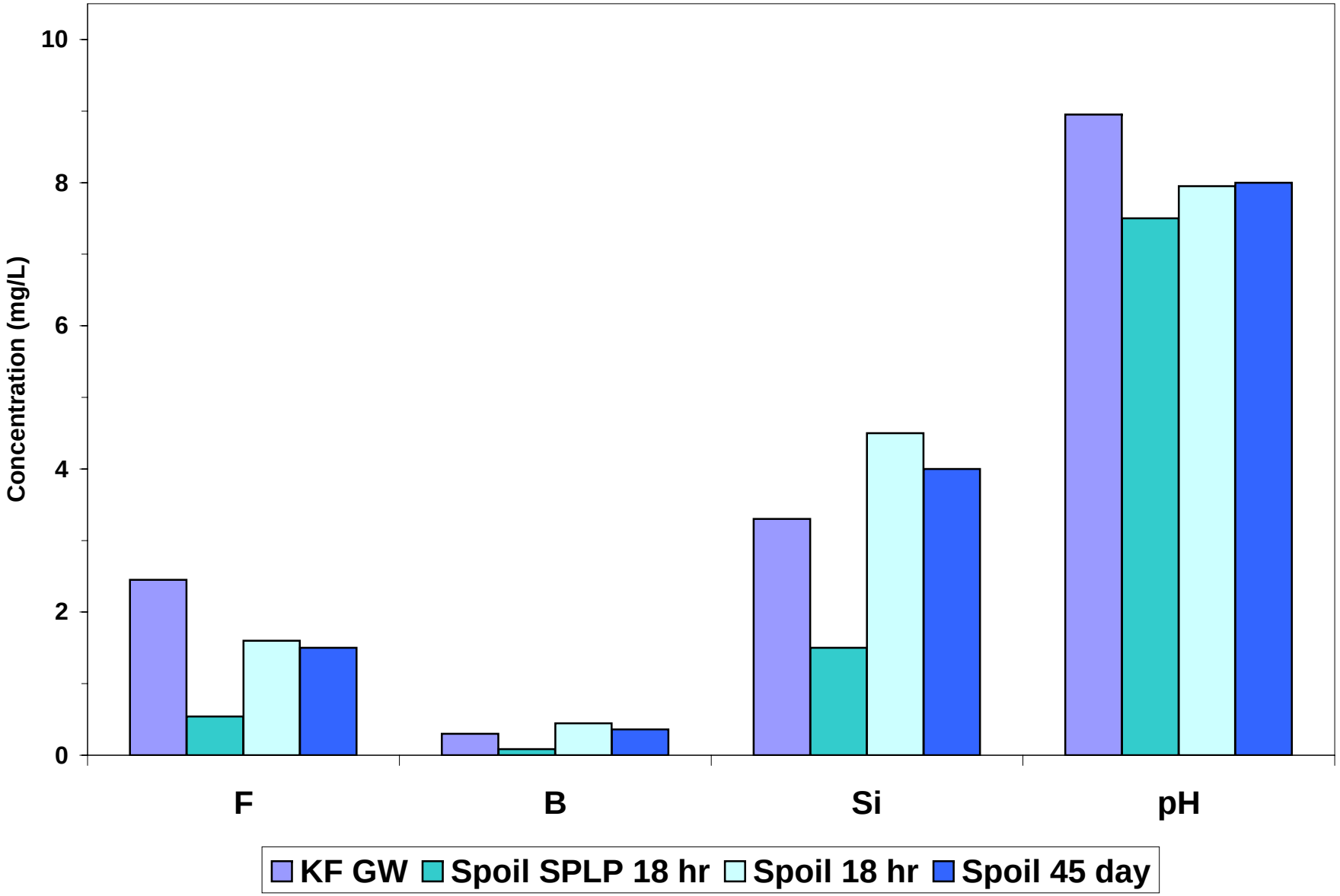

Concentration (mg/L)
10
8
6
4
2
0
F
B
Si
pH
KF GW
Ash 45 day
Ash Succ 1
Ash Succ 2
Ash Succ 3

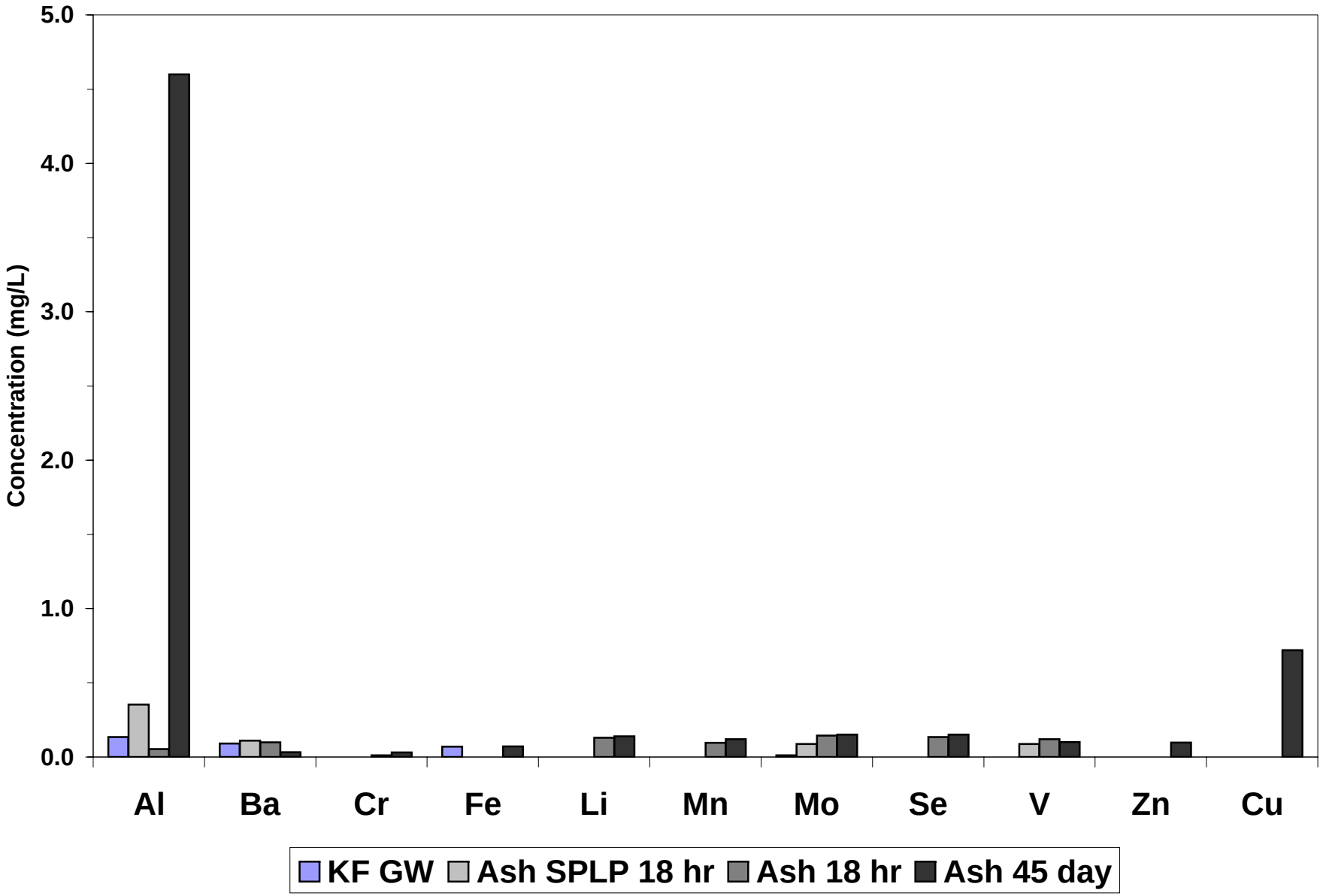

Concentration (mg/L)
5,000
4,000
3,000
2,000
1,000
0
TDS
Bicarbonate
Carbonate
Cl
SO4
KF GW
Ash 45 day
Ash Succ 1
Ash Succ 2
Ash Succ 3

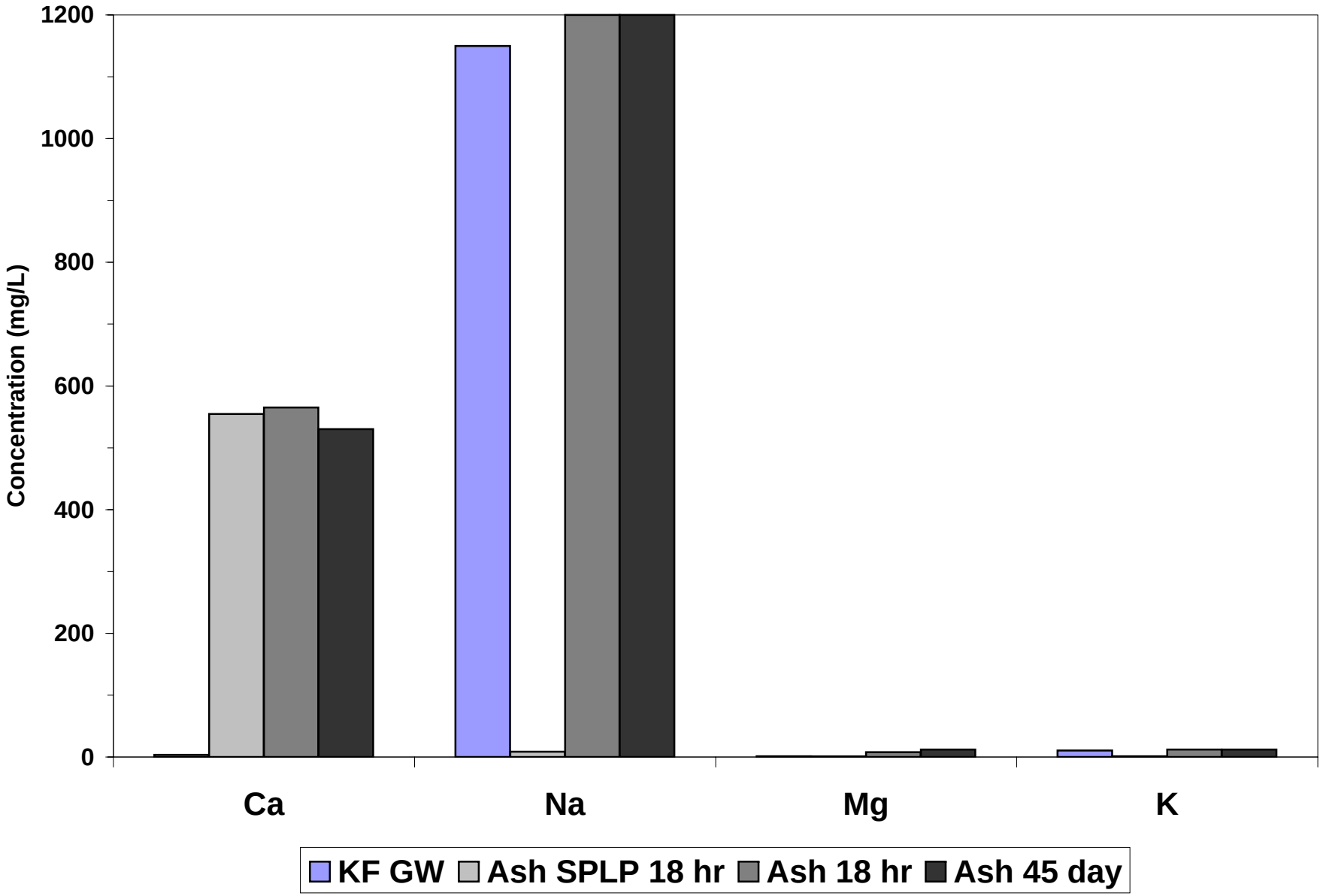

0.4
0.3
0.2
0.1
0.0
Concentration (mg/L)
Al
Ba
Cr
Fe
Li
Mn
Mo
Se
V
Zn
Cu
KF GW
Spoil SPLP 18 hr
Spoil 18 hr
Spoil 45 day

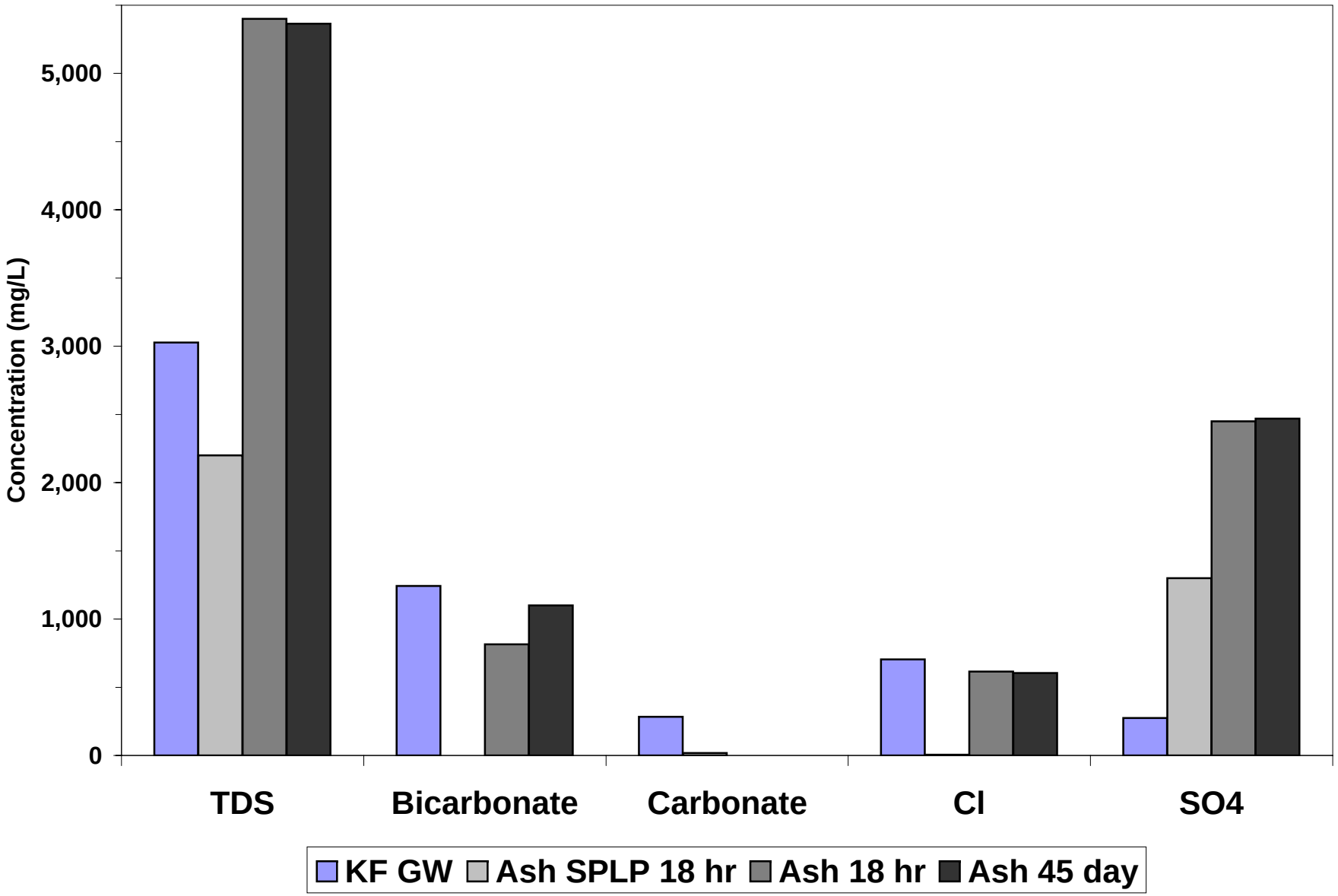

1200
1000
800
600
400
200
0
Concentration (mg/L)
Ca
Na
Mg
K
KF GW
Spoil SPLP 18 hr
Spoil 18 hr
Spoil 45 day

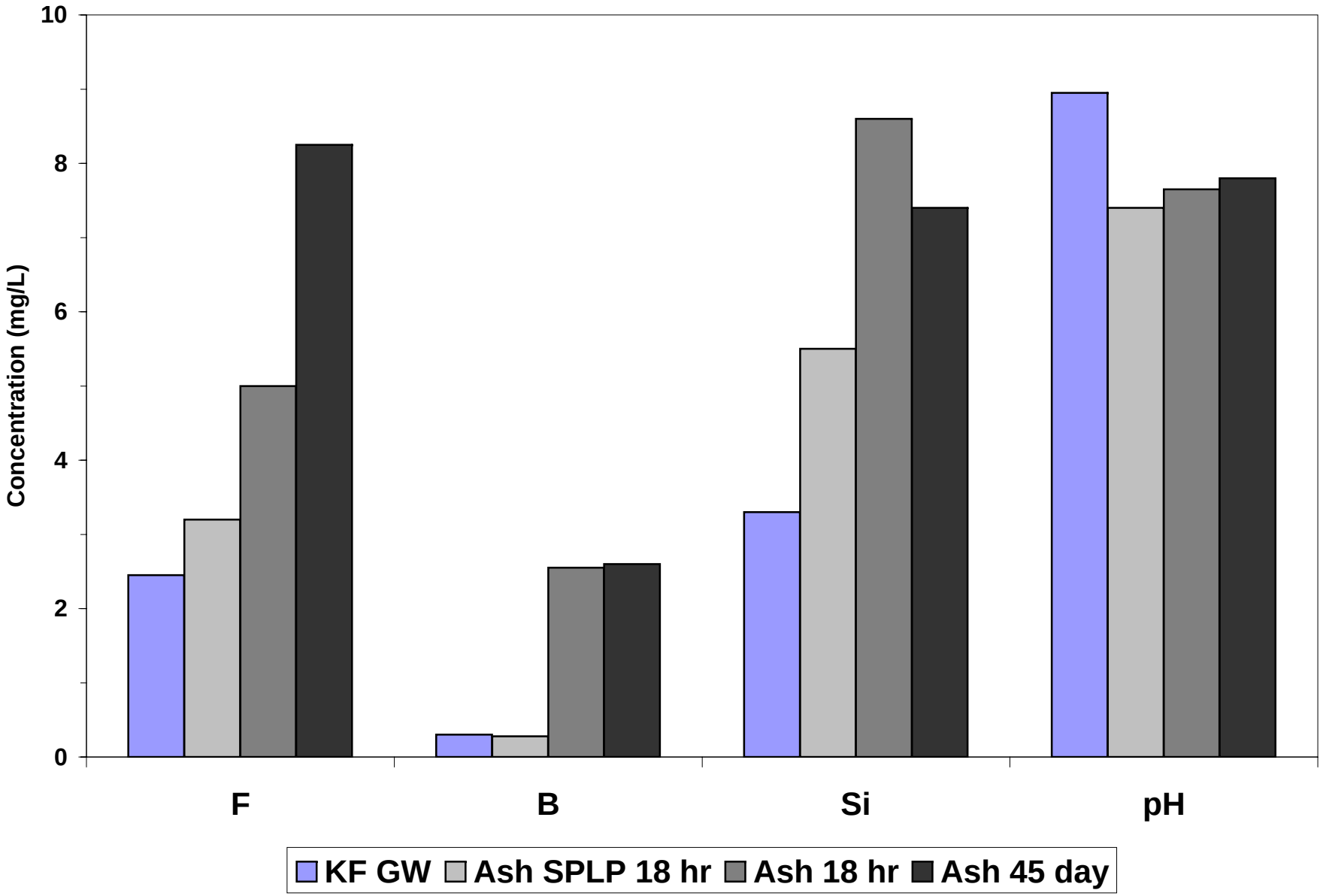

4,000
3,000
2,000
1,000
0
Concentration (mg/L)
TDS
Bicarbonate
Carbonate
Cl
SO4
KF GW
Spoil SPLP 18 hr
Spoil 18 hr
Spoil 45 day


Concentration (mg/L)
10
8
6
4
2
0
F
B
Si
pH
KF GW
Spoil SPLP 18 hr
Spoil 18 hr
Spoil 45 day


5.0
4.0
3.0
2.0
1.0
0.0
Concentration (mg/L)
Al
Ba
Cr
Fe
Li
Mn
Mo
Se
V
Zn
Cu
KF GW
Ash SPLP 18 hr
Ash 18 hr
Ash 45 day


1200
1000
800
600
400
200
0
Concentration (mg/L)
Ca
Na
Mg
K
KF GW
Ash SPLP 18 hr
Ash 18 hr
Ash 45 day


Concentration (mg/L)
5,000
4,000
3,000
2,000
1,000
0
TDS
Bicarbonate
Carbonate
Cl
SO4
KF GW
Ash SPLP 18 hr
Ash 18 hr
Ash 45 day


10
8
6
4
2
0
Concentration (mg/L)
F
B
Si
pH
KF GW
Ash SPLP 18 hr
Ash 18 hr
Ash 45 day

Appendix 41.B

Groundwater Model for Assessment of Probable Hydrologic Consequences (2009)

NAVAJO MINE EXTENSION PROJECT: APPENDIX 41.B. GROUNDWATER MODELING FOR ASSESSMENT OF PROBABLE HYDROLOGIC CONSEQUENCES

Submitted to:
BHP Navajo Coal Company,
Farmington, New Mexico
October 30, 2009

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APPENDIX 41.B

GROUNDWATER MODELING

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41.B.1 INTRODUCTION

41.B.1.1 Background

This report describes the numerical groundwater flow model developed for BHP Navajo Coal Company (BNCC) in support of the proposed expansion of its existing surface coal mining operations into Area 4 South and Area 5 of the BNCC coal lease. This lease is located on the western flank of the San Juan Structural Basin within the Navajo Nation, southwest of Farmington, New Mexico.

The proposed mine is referred to as the Navajo Mine Extension Project (NMEP) and comprises an area of approximately 13,000 acres. The coal seams to be mined include seams 2, 3, 4, 6, 7, and 8 of the Cretaceous age Fruitland Formation. Seams 7 and 8 extend over only a portion of the lease. The NMEP permit area and adjacent area is dominated by badlands and mesas with the Chaco River valley coursing from south to north approximately one mile west of the NMEP. The Chaco River flows north into the San Juan River approximately 18 miles north-north-west of the NMEP site. The regional setting of the NMEP is shown in Figure 41.B.1-1. Although the Chaco River drains an area of more than 3,640 square miles, the flow in the river and in tributary drainages is ephemeral in the vicinity of the NMEP (Section 18).

The NMEP permit area is crossed by two arroyos, the Pinabete Arroyo and the No Name Arroyo. The Pinabete Arroyo traverses in a northwest direction across the NMEP site through Area 4 South, and then flows west to the Chaco River. The drainage basin area of Pinabete Arroyo is approximately 60.3 square miles (Section 18). A smaller ephemeral stream channel, No Name Arroyo, traverses in a northwest direction across the NMEP site and separates Area 4 South from Area 5. The drainage basin area of No Name Arroyo is approximately 11.5 square miles at its confluence with the Chaco River but only about 1.8 square miles of the drainage lies to the east and upstream of the NMEP permit boundary (Section 18). The surface water drainage basin immediately south of No Name Arroyo is Brimhall Wash. Brimhall Wash has a total drainage area of about 85.2 square miles and flows in a general east to west direction to its confluence with the Chaco River southwest of the NMEP permit boundary (Section 18). A topographic and structural high area exists on the west side of Area 5, separating the No Name drainage from the Brimhall drainage. The surface water drainage immediately north of Pinabete Arroyo is Cottonwood Arroyo. The Cottonwood Arroyo has a total drainage area of about 79.8 square miles (Section 18). Only about 80 acres of the south fork of the Cottonwood Arroyo are within the Permit Area (Section 18).

Groundwater recharge is quite low due to the arid climate. Evaporation rates are high, averaging 55 inches per year, while precipitation is low, averaging less than 6 inches per year. Most precipitation occurs during several large high intensity precipitation events. Snow rarely accumulates in any significant depth over the site. Climatic conditions of the Permit Area are discussed in Section 12.

Groundwater modeling was utilized to support the baseline hydrogeologic characterization and the probable hydrologic consequences (PHC) assessment of proposed mining and reclamation activities. The hydrogeologic units within or adjacent to the NMEP permit area that could potentially be affected by proposed mining and reclamation include:

- The alluvium of Pinabete Arroyo
- The Coal Seams of the Fruitland Formation
- The Pictured Cliffs Sandstone, located below the Fruitland Formation No. 2 coal seam

Among these units, only the alluvium of Pinabete Arroyo supplies water to wells located within and adjacent to the permit area. The saturated thickness and yield of these alluvial wells is quite low but sufficient to provide stock water via windmill driven pumps at dug wells. The water level in the Pinabete alluvium varies with precipitation patterns and levels are generally too low to supply water to the dug wells during very dry years. For example, in the Fall of 2007 the saturated thickness of the Pinabete alluvium was less than 3-feet at monitoring well PA-2 located adjacent to dug well 13R-37 (Section 18). The water quality in the Pinabete alluvium is also poor with total dissolved solids (TDS) ranging from 1,610 to 3,600 mg/L and sulfate, fluoride, iron and manganese concentrations above drinking water standards. The water is suitable for its current use for livestock watering, although the fluoride and sulfate concentrations slightly exceed the Navajo Nation Water Quality Criteria for livestock use. The alluvium of Cottonwood Arroyo, located north of the NMEP and the alluvium of the Chaco River, located west of the NMEP, also contains groundwater that supplies water to dug wells.

Although, groundwater is also found in the coal units of the Fruitland Formation and in the Pictured Cliffs Sandstone (PCS), which underlies the Fruitland Formation at the NMEP site, the yields from these units are quite low and wells are typically pumped dry during testing and well purging for sampling. The water quality in these units is also poor. Although the water may be suitable for marginal livestock use, the sulfate and fluoride concentrations at most monitoring locations exceed the Navajo Nation Water Quality Criteria for livestock use. Stone and others (1983) state that the PCS cannot be considered a major aquifer, and it is important only because it is the water-bearing horizon immediately underlying the coals in the Fruitland Formation.

There are no water supply wells completed in the Fruitland Formation or the PCS within the permit area and adjacent area. One PCS water supply well, 13-7-2, is located south of the NMEP near the Burnham Chapter House. This well was originally completed as water supply for the Burnham Chapter House. The yield and water quality from this well was poor, and it was soon replaced by Tribal Well 13T-514, located approximately four miles southeast of the Chapter house and screened in the Menefee Formation, located stratigraphically below the Lewis Shale.

Groundwater models are conceptual descriptions or approximations that describe physical systems using mathematical equations. Groundwater models used for a PHC assessment can range from simple empirical equations to complex numerical computer simulations of groundwater flow and groundwater chemistry. Regardless of the level of complexity, all groundwater models are based on certain simplifying assumptions which typically involve: the direction of flow, geometry of the hydrogeologic units, the heterogeneity or anisotropy of sediments or bedrock within these aquifer units, and the location of boundaries and conditions at these boundaries.

As a result of these assumptions and the uncertainties in the values of parameters and data required by the model, all models are an approximation and not an exact representation of the physical systems being modeled. In order to select and apply an appropriate modeling code it is necessary to consider modeling objectives and have a thorough understanding of the physical system with sufficient site-specific data to apply the modeling code and to assess how well the model approximates the groundwater conditions at the Site. Extensive information on the baseline groundwater conditions at the NMEP site is provided in Section 18 of the NMEP Permit Application Package (PAP). Additional groundwater information is also available from the adjacent Navajo Mine, from U.S Geological Survey and the New Mexico Bureau of Mines and Mineral Resources Reports, and from the nearby San Juan Mine and Burnham Mine. Extrapolation of data from a nearby area to a permit area or using typical values for parameters from similar hydrogeologic environments is acceptable when the hydrogeology of the areas is similar.

41.B.1.2 Objectives and Scope

The first step in developing a groundwater model is to establish the objectives of the study. The primary groundwater resource issues or concerns related to the NMEP are as follows:

- Effects of mining and reclamation on the quantity and quality of groundwater in the alluvium of Pinabete Arroyo, No Name Arroyo, Cottonwood Arroyo, and the Chaco River that is a potential livestock water supply.
- Effects of mining and reclamation on the suitability of groundwater in the Fruitland Coals and PCS as an alternative livestock water supply for alluvial livestock water supply that may be affected by mining.
- The groundwater model for the NMEP was developed to meet the following objectives:
- The first objective is to provide a better understanding of the baseline groundwater flow systems within and adjacent to the NMEP area. Much of the model domain is under unsaturated and perched groundwater conditions, so it was determined that a full saturated/unsaturated flow model was needed to meet this objective.

- The second objective is to predict the steady-state groundwater flow system that is expected to occur long after mining and reclamation activities have been completed in the area. In particular, this evaluation will need to estimate the expected level of saturation within the mine backfill, including CCB fill locations, and the groundwater flow paths and rates through these materials.
- The third objective is to predict the transient groundwater changes that are expected during and after mining. In particular, these evaluations will assess the extent of drawdown in the Fruitland coals and the PCS and the approximate time frames for recovery to near steady-state conditions following mining.
- The forth objective is to simulate transport of chemical constituents in groundwater from mine spoils and from the CCB materials that are planned for selective placement within the mine backfill.

The modeling process involved the following steps:

- Development of a conceptual model of groundwater systems within the proposed mine area and adjacent area;
- Selection of a numerical code or modeling software capable of representing the conceptual model;
- Development of a three-dimensional groundwater flow model using the chosen software;
- Calibration of the model such that it is representative of observed conditions; and
- Application of the model to support the PHC assessment of proposed mining and reclamation.

This supporting document (Appendix 41.B) describes the model development, calibration, and sensitivity analyses, and discusses the PHC assessment results. Prior to developing the numerical groundwater flow model, it was first necessary to develop a conceptual model of the groundwater flow system. A conceptual groundwater model is a complex hypothesis of the characteristics and functions of a hydrogeologic system, including recharge and discharge relationships, groundwater flow within and between hydrogeologic units and the expected properties of these hydrogeologic units. Section 41.B.2 of this report presents the conceptual model, including the description of the model domain and basin hydrogeology. Section 41.B.3 describes the model code selection, model setup, and application of the model code to the conceptual model. Section 41.B.4 describes the model calibration, the steady-state baseline simulation results, and the sensitivity analyses. A summary of the application of the model to simulate the results to the plans for mining and reclamation is provided in Section 41.B.5. Detailed results can be found in Section 41 and in Section 18 of the NMEP PAP. References can be found in Section 41.B.6 of this report.

41.B.2 CONCEPTUAL MODEL

A conceptual model of the groundwater flow system is the foundation on which the numerical model is based. The conceptual model needs to incorporate the major processes and factors controlling the magnitude, rate, and direction of groundwater flow. The groundwater flow systems at a particular site are governed by geology, topography, and groundwater recharge. This section summarizes the conceptual model of the groundwater flow system at the NMEP Site. The nature and patterns of groundwater flow, from the locations where water enters the subsurface at a recharge area, to the locations where groundwater discharges, form a groundwater flow system. A combination of groundwater flow systems from local to regional in scale can develop in an area (Toth, 1963). Intermediate and regional systems tend to predominate in arid areas and areas with gentle topography, such as the NMEP area. Local flow systems tend to be dominant in areas with high topographic relief and wetter climates.

Groundwater flow models are used to calculate or simulate the rate and direction of movement of groundwater through geologic units. The simulation of groundwater flow requires a thorough understanding of the hydrogeologic characteristics of the site, including:

- the extent, thickness, and characteristics of hydrogeologic units included in the model domain;
- the boundary conditions for the model domain;
- the distribution and magnitude of either groundwater recharge or groundwater discharge, which is needed to characterize the overall water balance of the groundwater flow system; and
- the horizontal and vertical distribution of hydraulic heads throughout the modeled domain, which is needed for model calibration.

41.B.2.1 Hydrogeologic Units

The San Juan Basin is a typical asymmetrical, Rocky Mountain basin, with a gently dipping southern flank and a steeply dipping northern flank (Stone et al., 1983). The NMEP site is located along the western flank of the central basin with a northwest trending axis parallel to the Hogback monocline located northwest of the NMEP site. The stratigraphic section in the NMEP permit area reflects the Late Cretaceous transition of a shallow marine depositional environment to a terrestrial fluvial depositional environment. The four formations encompassing this depositional environment change are (in ascending order): the Lewis Shale, the Pictured Cliffs Sandstone, the Fruitland Formation, and the Kirtland Shale.

The Lewis Shale contains the last purely marine shales deposited in the Upper Cretaceous. It consists of gray to black shale with some interbeds of sandy limestone, brown sandstone, and bentonite. The PCS conformably overlies and intertongues with the Lewis Shale. This formation consists of both delta-front

and barrier-beach sediments and marks the change to a littoral (near-shore) depositional environment. The upper two-thirds of the PCS consists of a generally coarsening upward sequence of light gray, fine to medium grained sandstone while the lower one-third of the formation consists of interbedded shale and sandstone. The total thickness of the PCS is approximately 110 to 120 feet in the permit area.

The Fruitland Formation, which conformably overlies the PCS, contains minable coal seams that are the target of the NMEP. The coal seams are highly continuous within the NMEP permit area and are nearly flat lying, with a dip of up to 2 degrees to the east-northeast. Localized pinches, rolls, and occasional faults with minor offsets are encountered. The topography within the project area rises gently from west to east, with the overburden becoming thicker from west to east. The coal seams outcrop or subcrop close to the western limits of the permit area. The in-situ coal resource is burned or washed out beyond the western limit of the BNCC lease and within portions of the lease for some of the upper coal seams. The upper seams typically do not exist within much of the lower topographic surface in the western portions of the permit area, but come into the sequence on the eastern portion where the topography rises and as the strata dip to the east.

Surface soils are thin or nonexistent, and the near surface geology is typically comprised of a layer of weathered shale and sandstone along with unconsolidated eolian sands. Deposits of Quaternary alluvial sands also occur along the ephemeral stream channels. The unconsolidated surficial materials overlie a competent overburden comprised of shales, sandstones, and siltstones. Within the NMEP permit area, the stratigraphically highest coal seam (No. 8 coal seam) occasionally lies directly under the unconsolidated layer. Portions of No. 8 and No. 7 seams within the lease are weathered, and very little of No. 8 seam is found within Area 5. Overburden depths range from a few feet to over 80 feet. Interburdens and partings are generally composed primarily of soft gray shale, a dark gray siltstone, and carbonaceous shale. Sandstone lenses and stringers with minor thickness are found to a limited extent within the interburden, but shales and siltstones predominate.

The Kirtland Shale conformably overlies the Fruitland Formation to the east of the NMEP. This formation is divided into two units, the upper shale member, which includes the Farmington Sandstone Member, and the lower shale member. The lower shale member is composed of gray claystone shales that contain a few thin interbeds of siltstone and sandstone. No coal beds exist in the Kirtland Shale (Fasset and Hinds, 1971).

A more thorough description of the regional and local geology of the NMEP mine site is provided in Section 17 of the PAP. Based on both regional and site-specific information, the Fruitland Formation and associated coal units and the PCS are unsaturated, or partially saturated, near the outcrop of these units on the west side of the Area 4 South and Area 5, and become saturated to the east and down dip of the outcrop.

One conceptualization of the hydrogeology of the NMEP is to consider the Fruitland Formation as a single hydrogeologic unit. The single hydrogeologic unit approach was previously proposed by Billings and Associates (1987) for modeling groundwater at the Navajo Mine because of the complexity of the individual coal seams, which often split or pinch out. On the other hand, the interbedded strata and coal beds have a significant influence on the hydrogeology of the Fruitland Formation. Although the hydraulic conductivities of the coals are relatively low, they are still considerably higher than those of the interbedded shales, resulting in large vertical potentiometric gradients among the coals within the NMEP area. One of the primary hydrogeologic changes to occur as a result of mining is the removal of the coal and the interbedded shales and sandstone strata resulting in more homogeneous and isotropic conditions within the mine backfill. Furthermore, water chemistry has been found to vary among the individual coal units within the Fruitland Formation. Typically, TDS concentrations increase with depth, while sulfate concentrations decrease with depth (see Section 18.2.3.2.2).

Although the coal geology is complex with multiple coal bed splits and coal beds that pinch out, there is good correlation and spatial continuity for particular coal seam "zones" at the NMEP and adjacent Navajo Mine. These coal seams may feature one coal layer, or they may include splits with multiple coal layers. Within the BNCC lease area these coal zones are numbered sequentially from the bottom No. 2 coal zone, to the uppermost No. 8 coal zone, and correlate with the coal seams described in Section 17. The No. 1 coal zone and the No. 5 coal zone are not present, while the No. 2, No. 3, No. 4, No. 6, No. 7, and No. 8 coal zones all occur within the NMEP site. For these reasons, the conceptual hydrogeologic model and the numerical groundwater model for the NMEP site and adjacent area handles the individual coal seam zones as separate and distinct hydrogeologic units.

The PCS, the first hydrogeologic unit below the Fruitland Formation has been included in the groundwater flow model. The top of the Lewis Shale has been included as the base of the model domain. Generally, a shale zone such as the Lewis Shale would be considered as an impermeable boundary. However, given the low recharge rates at the NMEP, overall low permeability of the Fruitland Formation shales and coals, and the relatively low permeability of the PCS, the flow conditions at the boundary between the PCS and Lewis Shale were found to be significant for calibrating the groundwater flow model at the NMEP.

The delineation of the hydrogeologic units within the NMEP site was developed from the extensive geologic and groundwater information developed for the project and PAP. The extent of geologic and groundwater information that is available to support the conceptual and numerical model is more limited outside the NMEP site boundaries. Consequently, information was obtained from a variety of sources to help delineate the hydrogeologic units and define groundwater conditions for the portions of the model domain that are outside the limits of the NMEP site. Information sources included various regional geologic and hydrogeologic reports sited in the References provided in Section 41.B.6, the hydrogeologic

data in the Navajo Mine and Burnham Mine PAPs, and logs from oil and gas wells located within or near the model domain.

41.B.2.1.1 Hydraulic Conductivities of Modeled Units

Another element of the conceptual model is to define to the extent possible the properties of these hydrogeolgic units, including hydraulic conductivities and storage. The representative range for hydraulic conductivities of individual model layers is provided in Table 41.B.2-1.

Assigned hydraulic conductivities for the zones were modified during model calibration. Calibrated hydraulic conductivity values are shown in Table 41.B.2-1 along with the representative range of values from local or regional data.

41.B.2.1.2 Storage Coefficient and Specific Yield of Modeled Units

Specific storage values for the various hydrogeologic units were obtained from aquifer testing results and from literature values for similar formations in other Rocky Mountain sedimentary basins. The amount of water an aquifer can yield is described by the storage parameters of specific storage and specific yield. The specific storage of a confined aquifer is the volume of water that a unit volume of the aquifer releases from storage per unit decline in head. The specific yield is the volume of water that drains from an unconfined aquifer per unit decline in head. The specific yield is less than the porosity but much larger than specific storage.

Specific storage values were set to 3.6×10^{-6} ft^{-1} in the PCS based on observation well response during a pumping test at PCS well T4-1 (see well location on Exhibit 18.2-2). Specific storage values were set to 2.5×10^{-5} ft^{-1} in the overburden and interburden and shale formations. Specific storage for confined parts of the alluvium was set to 2.5×10^{-5} ft^{-1}, and specific storage for the coal units was set to 4.2×10^{-5} ft^{-1}.

Specific yield (under unconfined conditions) was assumed to be similar to estimated effective porosities. Specific yield will always be lower than porosity as some of the groundwater will not drain from the formation since it is held by capillary forces. A specific yield of 12 % was used for the alluvium and overburden and interburden units in the model. A lower specific yield of 0.5 % is used for the coals due to the low effective porosity of the coals.

41.B.2.1.3 Unsaturated Parameters of Modeled Units

Little hard data was available on unsaturated zone parameters in the area of the model domain. It was assumed that high capillary head wetting curves were needed given the arid site climate in the study area.

41.B.2.2 Model Domain and Boundary Conditions

An essential part of the both the conceptual and numerical models is the representation of the horizontal and vertical boundaries of the hydrogeologic system (the model domain) and the delineation of the hydrogeologic units within the model domain. It is also essential that the hydraulic head or flow conditions be defined for each of the hydrogeologic units along the boundaries of the model domain.

The horizontal extent of the hydrogeologic model is provided in Figure 41.B.1-1. The model boundaries were established where there are physical boundaries, such as the outcrop of the geologic units west of the NMEP as shown in Figure 41.B.1-1. Model boundaries were also established at sufficient distance to the north, east and south of the NMEP where the required assumptions about hydrogeologic conditions at the boundary are expected to have minimal influence on the predicted changes in the groundwater system due to drawdown associated with proposed mine pit advance and recovery following planned backfill sequences. Likewise, the vertical extent of the hydrogeologic model is from the surface to the base of the PCS. A head dependent boundary condition was also established to represent the Lewis Shale at the base of the PCS.

The boundary conditions for the horizontal model boundaries were established based on the conceptual model. The outcrop of both the PCS and the Lewis Shale is shown in Figure 41.B.1-1 along with the model boundaries. A no flow boundary condition was designated for the west boundary of the model domain along the outcrop of the PCS/Lewis Shale stratigraphic interface. A constrained constant head boundary was also established where the alluvium of Brimhall Wash, No Name Arroyo, Pinabete Arroyo, and Cottonwood Arroyo occur along this western boundary of the model domain. The constraint on the boundary was that there could be no inflow to the model domain at the constant head boundary. The constant head was determined based on average depth to alluvial groundwater near the mouth of these ephemeral streams. Constrained head dependent boundary conditions analogous to drain boundaries were defined along the portions of Pinabete Arroyo and No Name Arroyo which flow through and are downstream of the NMEP. Constrained head dependent boundary conditions were also defined along the downstream portions of Cottonwood Arroyo and Brimhall Wash.

The boundary conditions for the PCS on the south, east, and north boundaries of the model domain were established based on the conceptual model and the potentiometric surface. The potentiometric surface within the model domain is well characterized from current and historic water level monitoring data from wells completed in the PCS within the vicinity of the NMEP site along with data from Navajo Mine monitoring wells to the north and Burnham Mine monitoring wells to the south. In addition, the PCS outcrop map in the vicinity indicates a large outcrop area for potential recharge along the Hunter Wash valley south of the model domain as shown in Figure 41.B.1-1. It is expected that potentiometric elevations for the PCS along Hunter Wash are close to the elevation of the channel bottom. Down dip to the northeast and along the east side of the model domain, the potentiometric gradient is believed to be

from south to north as indicated by Kaiser et al (1994). Localized discharge is expected to occur along the topographic lows where the PCS subcrops beneath the alluvium of the ephemeral streams. The regional potentiometric surface depicted in Figure 41.B.1-1 was developed based on all these sources of information. A constant head boundary has been defined based on the potentiometric surface along the south, east, and north boundaries. A no flow boundary has been specified along the west boundary.

Boundary conditions for the model layers corresponding to the Fruitland Formation Coal Seams were established along portions of the south boundary where the PCS potentiometric surface is above the base of the coal layer. Constant head boundary conditions were defined at these locations along the south boundary based on the potentiometric surface of the PCS. Constant flux boundary conditions were established for the coal layers along the north model boundary east of the location where a portion of the south end of Dixon Pit of the Navajo Mine crosses the boundary. The fluxes for boundary conditions were determined based on the potentiometric gradient of the PCS, and the transmissivities of the coals at these locations.

41.B.2.3 Distribution and Magnitude of Groundwater Recharge

The conceptual model also includes an interpretation of spatial relationships between recharge and discharge and the approximate rates of recharge and discharge, including the groundwater inflows and outflows from the model domain. A critical aspect of hydrogeologic modeling is obtaining a reliable estimate of the magnitude of either groundwater recharge or groundwater discharge in order to constrain the overall water balance.

In hydrogeologic settings where groundwater discharge is primarily at streams, an estimate of discharge can generally be determined from measurement of the baseflow of the streams. However, this method for measuring discharge cannot be applied in arid environments such as the NMEP where groundwater discharge rates are low and insufficient to support baseflow at any time. Likewise, recharge rates are quite low due to the arid climate at the NMEP. Annual precipitation averages about six inches (150 mm) per year with most precipitation occurring during several large high intensity precipitation events during the seasonal ‘monsoon’ periods. These generally occur in March and August of each year. Snow rarely accumulates in any significant depth over the project area. Summers are hot with low relative humidity. Evaporation rates are high, averaging 55 inches per year (Section 12).

Fortunately, reliable estimates of groundwater recharge rates at the Navajo Mine were obtained by Stone (1984, 1986 and 1987) using chloride mass balance methods. Recharge estimates for undisturbed areas at the Navajo Mine ranged from 0.002 to 0.09 in/yr and are expected to be higher at surface depressions and impoundments.

"Badlands" topography comprises about half of the drainage basins of Cottonwood Arroyo, Pinabete Arroyo, and No Name Arroyo, and accounts for the high discharge and flow intensities observed in these ephemeral streams. Little groundwater recharge occurs within the badlands areas, due not only to the low rainfall rates, but also to the high proportion of rainfall that results in runoff. The low permeability of sodic clay soils nearly precludes groundwater recharge within badlands areas.

Groundwater recharge from precipitation and ephemeral stream flow within the NMEP area moves vertically downward through the interbedded shales and coal units of the Fruitland Formation and into the PCS. Where Fruitland Formation coals are saturated, groundwater will flow laterally. Based on information obtained from water levels measured in the coal seam wells and piezometers, the flow directions in the coals within the NMEP area are toward the north-north-east.

Although the vertical hydraulic conductivities of the interbedded shales in the Fruitland Formation are quite low, recharge rates are lower still. Direct recharge rates measured by chloride mass balance methods on undisturbed areas at the Navajo Mine ranged from 0.002 to 0.09 in/yr, (Stone 1987). The highest recharge rate of 0.09 in/yr was for valley terraces while the lowest recharge rate of 0.002 in/year was for badland areas. Recharge from upland flats averaged 0.03 in/year.

Based on the research by Kearns and Hendrickx (1998), aerial recharge is thought to occur during very large precipitation events and during extended wet periods with increasing soil moisture. Recharge is expected to be higher from saturated alluvium and surface impoundments. Although Stone's research (Stone, 1986 and 1987) did not include recharge estimates for the saturated alluvium and surface impoundments, he does provide an estimate of an average recharge rate of 0.16 inches per year from depressions within reclaimed mine areas at the Navajo Mine.

To incorporate Stone's recharge estimates into the NMEP groundwater model, slopes were calculated based on the USGS DEM, and Stone's geomorphologic categories were then assigned to various slope ranges. These categories, slope ranges, the associated recharge rates from Stone's research, and the associated model recharge rates are shown in Table 41.B.2-2.

41.B.2.4 Potentiometric Levels and Groundwater Flow

A potentiometric surface map for the PCS within the model domain is provided in Figure 41.B.1-1. As indicated on the potentiometric surface map, groundwater flow is from the recharge areas at the western outcrops eastward to the discharge areas in the stream reaches and outcrops to the east. Potentiometric data for the No 2, No. 3 and No. 8 coal seams indicate a general potentiometric gradient to the north northeast, although the data are limited and are not sufficient to identify possible local gradients toward topographic lows and drainages.

41.B.3 GROUNDWATER MODEL SETUP

The low rate of recharge and the interbedded strata at the site results in large vertical downward potentiometric gradients with perched groundwater zones. One of the primary hydrogeologic changes to occur as a result of mining is the removal of the coal and the interbedded shales and sandstone strata and placement of a more homogeneous post-mine backfill. Saturated groundwater flow models, such as MODFLOW, are incapable of handling three-dimensional unconfined situations with several dry model layers separating a water table from perched groundwater overlying low conductivity units. Consequently, in order to meet the modeling objectives, a multi-layer numerical groundwater flow model of the NMEP mine area and adjacent area was developed using the FEFLOW (Finite Element subsurface FLOW system) software developed and supported by DHI-WASY GmbH, a German research and consulting group specializing in groundwater and surface water hydrology. The software uses a finite element analysis technique to solve the groundwater flow equations for both saturated and unsaturated conditions.

FEFLOW can be efficiently used to describe the spatial and temporal distribution of groundwater quality constituents, to estimate the duration and travel times of these constituents in aquifers, and to assist in designing alternatives and effective monitoring schemes. It includes a sophisticated interface with GIS applications such as ArcInfo, ArcView and ArcGIS for ASCII and binary vector and grid formats. FEFLOW is used worldwide as a high-end groundwater modeling tool at universities, research institutions, government agencies, and engineering companies.

Although the objective of the groundwater modeling study is to model flow and transport in the saturated zone, given the arid climate and the perched groundwater conditions over much of the study area, a full saturated/unsaturated implementation of FEFLOW was used in the NMEP model.

41.B.3.1 Model Mesh Discretization

The model domain was discretized on a triangular mesh pattern as shown in Figure 41.B.3-1 to establish a 3D finite element mesh of 6-node triangular prisms. The groundwater flow model domain was established as described in Section 2.2 of this report. The element size was chosen to be sufficiently small to capture significant variations in topography, hydrology, and geology but large enough to minimize the model size. The pre- and post- mining steady-state model mesh includes additional detail within the mine model area and the areas of Pinabete Arroyo, No Name Arroyo, Brimhall Wash, and Cottonwood Arroyo to support simulations of the influence of mining backfilling and CCB placement in mine backfill. The post-mining transient model mesh includes added detail in the area of the proposed Pinabete Diversion (Section 26). The pre- and post-mining steady-state model mesh contains 715,568 elements and 378,363 nodes. The post-mining transient model contains 793,968 elements and 418,963 nodes.

41.B.3.2 Model Layers

The model is discretized vertically into 29 slices corresponding to 28 layers to accommodate the hydrogeologic units of interest. Layers are continuous horizontally across the model. Hydraulic parameters were assigned to each hydrostratigraphic unit through the corresponding model layer. Additional layers are needed in the finite element formulation to accommodate the transition between hydrogeologic units and for the implementation of boundary conditions in the coal layers. Thin (1.0 ft thick) buffer layers were added to reduce the conductivity contrast between the low conductivity overburden and interburden layers and the higher conductivity coals to improve model convergence. These buffer layers were assigned hydraulic properties of the corresponding overburden, or interburden, unit. Table 41.B.3-1 summarizes the correlation between model layers and slices and hydrostratigraphic units used in model design.

Implementation of the conceptual hydrogeologic model into the numerical groundwater model for the NMEP site and adjacent area includes the individual coal zones or seams as separate and distinct hydrogeologic units. Spatial grids with the elevations of the top of the PCS and the top and bottom of all coal beds within and adjacent to the NMEP site were provided by BNCC. Additional data from the Burnham Mine, the Consolidation Coal Navajo Lease, and surface topography of the PCS outcrop were used to extend the top of the PCS beyond the NMEP lease area. The individual coal beds were also identified according to coal zone. These data were used to construct the model layers. Additional data from Burnham Mine was used to extend the coal layers to the south. The top and bottom of the individual coal zones were determined from the upper and lower coal bed within the particular seam at individual grid locations. The Lewis Shale is a low conductivity unit that forms the base of the modeled groundwater flow system and was included as a head dependent boundary in the model. The top of the Lewis Shale was assumed to be 120 feet below the top of the PCS. The top surface of the model is based on topography derived from USGS Digital Elevation Models (DEMs).

41.B.3.3 Model Boundary Conditions

The conceptual boundaries discussed in Section 41.B.2.2 are implemented in FEFLOW as no flow boundaries, constant head boundaries, constant flux boundaries, and head dependent boundaries. The various boundary conditions in FEFLOW can be constrained by head or flux to represent conceptual boundaries such as drains or streams. The constraints are limitations which result from the requirement that the boundary condition is only valid as long as minimum and/or maximum head or flux bounds are satisfied. If, during a simulation run, the conditions fall below or are exceeded, the constraints are to be assigned as new intermediate boundary conditions. This section is a discussion of the implementation of boundary conditions and constraints in the NMEP model. The boundary locations for a typical model layer and for PCS are shown on Figure 41.B.3-2 and Figure 41.B.3-3.

41.B.3.3.1 No Flow Boundaries

A no flow boundary was set along the west edge of the model corresponding to the outcrop of the PCS/Lewis shale contact. A no flow boundary was also set along portions of the east edge of the model where this boundary is parallel to the regional groundwater flow direction. No flow boundary conditions are shown on Figures 41.B.3-2 and 41.B.3-3 at locations along the edge of the model domain where no other boundary conditions are present.

41.B.3.3.2 Recharge

Recharge in FEFLOW can be treated as a constant flux boundary condition with a constraint that allows flow only into the model, or as a flow into top layer of the model. Constrained boundary conditions can add significantly to the computational time to run the model, so the simplified flow into the top of the

model was chosen to represent recharge. The distribution of recharge boundaries is shown on Figure 41.B.3-4.

41.B.3.3.3 Stream Boundaries

The ephemeral streams (Cottonwood Arroyo, Pinabete Arroyo. No Name Arroyos, and Brimhall Wash) and tributaries are represented as head dependent (Cauchy) boundary conditions constrained such that the boundary removes water when the groundwater elevation is greater than a specified reference head, but that no flow in to the groundwater system is contributed by the boundary. When constrained this way the boundary acts similar to a MODFLOW drain boundary. Drain conductance is specified as a leakage coefficient and was set to a value of 10^{-4}/day. Stream boundaries are shown on Figure 41.B.3-2.

41.B.3.3.4 Head Dependent (Cauchy) Boundaries

During initial model calibration it became clear that the boundary condition to account for flow between the PCS and the Lewis Shale was an important aspect of model calibration. Head dependent, or Cauchy, boundary conditions were assigned to each finite element node at the base of model to simulate flow between the PCS and Lewis Shale. These boundary conditions were unconstrained to allow flow into or out of the base of the model.

An effort was made to examine alternate conceptual models for this boundary condition. Several configurations of reference head and leakage coefficient for the boundary conditions were examined to represent the potentiometric surface of the Lewis Shale and vertical hydraulic conductivity between the PCS and the Lewis Shale, respectively. For example, the reference head was first set as the elevation of the base of the PCS with a constant leakage coefficient. Other conceptual models examined included a reference head with a constant slope from south to north and a linear increase in leakage coefficient from west to east. The effect of these variations in reference head and leakage coefficient are discussed in Section 41.B.4.4.

In the final calibrated model, the reference head is a damped surface based on the elevation of the top of the PCS, and the leakage coefficient varies in space, generally decreasing with the depth to the top of the PCS. The damped reference head surface for the head dependent boundary conditions was determined by choosing a reference elevation contour of the top of the PCS and smoothing the highs and lows in the PCS top based on this reference contour. The final calibrated leakage coefficient is higher on the west side of the model where the PCS is shallower and decreases as the PCS dips to the east. The reference head surface and the distribution of leakage coefficient for the head dependent boundary conditions are shown on Figure 41.B.3-5 and Figure 41.B.3-6, respectively.

41.B.3.3.5 Constant Head (Dirichlet) Boundaries

Constant head, or Dirichlet, boundaries were assigned at finite element nodes where the four main streams intersect the west model boundary. These boundary conditions are constrained by setting a maximum flux constraint equal to zero. With the maximum flux constrained to zero, the boundary condition can only remove water from the model representing stream flow out of the model domain. The locations of these boundaries are shown on Figure 41.B.3-2.

Unconstrained constant head boundaries were also assigned along portions of the south, north, and east edges of the model domain in the layers corresponding to the Fruitland Formation coal seams. These boundaries were assigned the potentiometric head of the PCS and were assigned where the potentiometric head of the PCS was above the bottom of the specific model layers.

In the model layers corresponding to the PCS, constant head boundaries were assigned along the entire lengths of the south, east, and north edges of the model domain. The constant head boundaries along the north boundary are constrained such that groundwater can only flow out of the model domain. These boundaries are shown on Figure 41.B.3-2 and 41.B.3-3.

41.B.3.3.6 Flux (Neumann) Boundaries

Constant flux, or Neumann, boundaries were assigned along portions of the north model boundary in layers representing the Fruitland Formation coal seams to represent groundwater flow out of the model domain. Fluxes were determined from regional groundwater gradients and hydraulic conductivities of the individual model layers. The locations of the flux boundary conditions are shown on Figure 41.B.3-2, and the constant fluxes assigned to the boundaries in individual layers are shown in Table 41.B.3-2.

41.B.3.4 Unsaturated Zone Flow Implementation

FEFLOW utilizes a full implementation of Richard's Equation for solving saturated/unsaturated flow problems. In the NMEP model, the modified Van Genuchten parametric relationship for capillary pressure head and relative conductivity was used to model unsaturated zone flow.

41.B.4 GROUNDWATER MODEL CALIBRATION

In multilayer groundwater models, the hydraulic parameters (mainly hydraulic conductivity) of the model layers and boundary conditions (mainly recharge, potentiometric heads, and leakage coefficients) are adjusted during model calibration in order to obtain a better match with observed heads and potentiometric gradients. Model calibration is necessary because hydraulic parameters obtained from well tests, regional studies, or literature values for similar hydrogeologic units are, at best, order of magnitude estimates of the average hydraulic conductivity and storage properties of the hydrogeologic unit on the scale of the model. With reliable estimates for the expected magnitude of either groundwater recharge or groundwater

discharge and estimates for the expected upper and lower bounds for hydraulic conductivities of the hydrogeologic units, the model can be constrained during model calibration to arrive at a representative model of the hydrogeologic system.

Model calibration can also serve to revise the conceptual model of the groundwater system and provide a better assessment of the properties of hydrogeologic units on a regional scale that cannot be obtained solely from local pumping test results. Model calibration is assumed to be achieved once the model reasonably simulates the interpreted groundwater flow conditions in the area of interest using input values that are within the range of measured or estimated values. The primary measures of model calibration are the match between the measured groundwater potentiometric surface ("heads") and the model's predicted values at the same location. The data used in model calibration and the calibration results are discussed in the following text.

41.B.4.1 Calibration Targets

The calibration targets for the model were measured groundwater elevations in monitoring wells within individual coal seams, in the alluvium, and in the PCS. Surface saturation and groundwater discharges were also used as a general guide in model calibration. Table 41.B.4-1 lists the calibration wells, formation, model layer, observed potentiometric head, and the calibrated model potentiometric head. The locations of the calibration wells are shown on Figure 41.B.4-1.

41.B.4.2 Steady-state Model Calibration

Model calibration was performed by running the model repeatedly with the steady-state boundary conditions and using a range of values for model parameters. In order to better match the observed heads calibration targets, several model input parameters were varied within acceptable ranges. These parameters included hydraulic conductivity, leakage coefficient for drain and stream boundaries, recharge, and reference head and leakage coefficients for the head dependent boundary condition at the base of the model. Unsaturated zone wetting curve parameters were also varied during model calibration. The final calibrated regional PCS potentiometric surface is shown in Figure 41.B.4-2, and the calculated versus observed heads for all calibration wells is shown in Figure 41.B.4-3 and in Table 41.B.4-1.

41.B.4.3 Steady-state Model Results

Detailed discussions of the modeling results are presented in the discussion of Probable Hydrologic Consequences in Section 41 and in the discussion of baseline groundwater conditions in Section 18. Results not discussed in Section 41 and Section 18 are presented below. For model results discussed in Section 18 and Section 41, the appropriate sections in are referenced below.

41.B.4.3.1 Mass Balance and Groundwater Budget

The model mass balance was reviewed as part of the steady-state model calibration. The mass balance is the difference between the inflow into the model and the outflow (discharge) from the model. The overall model mass balance difference is 0.93 %. The low mass balance difference is indicative of a lack of numerical issues with the model and that the model is run with adequately small convergence criteria. The detailed groundwater budget of the various drainages and mine areas is discussed in Section 41.3.1.1 of the assessment of probable hydrologic consequences.

41.B.4.3.2 Potentiometric Surface Contour Maps

The model calibrated PCS potentiometric surface is shown on Figure 41.B.4-2. The modeled potentiometric surfaces for the PCS, No. 3 coal seam, and the No. 8 coal seam are shown on Figures 18.3-1, 18.3-2 and 18.3-3, respectively. The modeled pre-mining potentiometric surfaces generally follow the conceptual model. The modeled steady-state results and recharge rates are consistent with the measurements or estimates obtained from baseline monitoring as previously discussed. However, the modeled potentiometric surfaces extend beyond the limits that could be depicted from measurements at monitoring wells and piezometers. For example, the results for the No. 3 coal seam in Figure 18.3-2 show groundwater flow toward the topographic lows along the west side of the model domain in the valleys of No Name Arroyo, Pinabete Arroyo, Brimhall Wash, and Cottonwood Arroyo. These results could not be determined from potentiometric measurements alone, which indicate a general potentiometric gradient to the north northeast in the No. 3 coal seam. A detailed discussion of the steady-state model potentiometry is found in Section 18.2.3.

41.4.4 Steady-state Model Sensitivity Analyses

A sensitivity analysis was run to show the effect of individual model parameters on the model calibration. The model parameters included in the sensitivity analysis are the hydraulic conductivities of the alluvium, coals, interburden, and PCS, and the reference head and leakage coefficient of the head dependent boundary condition at the base of the PCS. The steady-state model was run varying the individual parameters over the ranges shown in Table 41.B.4-2. In addition to the formal sensitivity analysis, the effect of other model parameters was noted during model calibration. The results of both of these efforts are discussed in this section. Plots of calculated versus observed heads resulting from the sensitivity runs are shown in Figures 41.B.4-4 through 41.B.4-18. The plots show the effect that varying of individual model parameters has on the model calibration.

Figures 41.B.4-4 and 41.B.4-5 show the results of varying the hydraulic conductivity of the PCS over the range of one-half the calibrated value to twice the calibrated value. The results show that modeled potentiometric heads in the PCS are somewhat sensitive to the hydraulic conductivity of the PCS, and that the potentiometric heads in the Fruitland Coals are less sensitive to this parameter.

In the calibrated model, the horizontal to vertical hydraulic conductivity ratio (Kx/Kz) of the interburden between the upper coals (No. 6, No. 7, and No. 8 seams) was 100:1. This ratio is set at 25:1 for the interburden between the lower coals (No. 2, No. 3, and No. 4 seams) and 500:1 for the interburden between the upper and lower coals (between the No. 4 and No. 6 coal seams). Sensitivity model runs were made with Kz adjusted such that Kx/Kz = 25 and Kx/Kz = 100 for the both the upper and lower coal interburden. An additional sensitivity run was made with Kz adjusted such that Kx/Kz = 100 for the interburden between the No. 4 and No. 8 seams. Figures 41.B.4-6 through 41.B.4-8 show plots of calculated versus observed heads resulting from varying the vertical hydraulic conductivity (Kz) of the interburden layers. These plots show the model calibration to be relatively insensitive to these changes in the Kx/Kz ratios of the various interburden units over the ranges listed in Table 41.B.4-2.

The coal seams in the model are separated into zones of weathered and unweathered coal. In the calibrated model, the weathered coal has a hydraulic conductivity one order of magnitude greater than the unweathered coal. A sensitivity run was made with the weathered coal hydraulic conductivity equal to that of the unweathered coal. Figure 41.B.4-9 shows the plot of calculated verus observed heads from this model run. The plot shows that the potentiometric heads in the PCS and the alluvium are highly sensitive to the hydraulic conductivity of the weathered coals and that the heads in the coals are less sensitive to this parameter. This result is most likely due to the fact that the weathered coals are nearest to the formation outcrops to the west of the model domain. The layers above the PCS tend to thin as they approach the outcrop to the west, and hence, there is less interburden restricting flow between the coal layers and the PCS.

Figures 41.B.4-10 through 41.B.4-13 show the results of varying the hydraulic conductivity of alluvium in Cottonwood Arroyo, Pinabete Arroyo, No Name Arroyo, and Brimhall Wash. The results show that the modeled potentiometric heads in the coal layers are highly sensitive to the hydraulic conductivity of the alluvium. The heads in the PCS are also sensitive to this parameter, but less so than the heads in the coals.

During the model calibration process it became evident that the calibration was highly sensitive to the reference head and the leakage coefficient of the head dependent boundary at the base of the model which represents groundwater interaction between the PCS and the Lewis Shale. The reference head of this boundary condition represents the potentiometric head in the Lewis Shale, and the leakage coefficient is a function of the vertical hydraulic conductivities and thicknesses of the two formations. The effect of these parameters on model calibration appears to be highly coupled, therefore, only the leakage coefficient was varied in the sensitivity analysis. In the calibrated model, the leakage coefficient ranged over the model domain from $4x10^{-9}$/day to $3x10^{-8}$/day (Figure 41.B.3-6). In the sensitivity analysis, the leakage coefficient was ranged from one-half to twice the calibrated value. An additional sensitivity run was made with a

constant leakage coefficient of $3x10^{-8}$/day. Figures 41.B.4-14 through 41.B.4-16 show plots of calculated versus observed heads resulting from varying the leakage coefficient of the head dependent boundary at the base of the model. These plots show that the model calibration is highly sensitive to this parameter.

In addition to the sensitivity runs discussed above, model calibration runs revealed a high sensitivity to the recharge rates of the various surface characterizations in Table 41.B.2-2 (particularly, the upland flat recharge rate) and also to the capillary head in the unsaturated zone. Figures 41.B.4-17 and 41.B.4-18 show plots of the results of varying the recharge rates in the model from 0.8 to 1.2 times the calibrated values. These parameters, along with the hydraulic conductivity of the alluvium, are the main parameters that control flow into the groundwater system over the model domain. The head dependent boundary condition at the base on the model is the main control on groundwater flow out of the model domain. Hence, the model calibration is most sensitive to these model parameters.

41.B.5 SIMULATION OF PROPOSED MINING AND RECLAMATION

41.B.5.1 Steady-state Post-mining Conditions

The calibrated steady-state model was modified to simulate post-mining conditions. One of the primary hydrogeologic changes to occur as a result of mining is the removal of the coal and the interbedded shales and sandstone strata resulting in more homogeneous and isotropic conditions within the mine backfill. Figure 41.B.5-1 shows a plan view of the post-mine spoil and CCB placement. This figure shows mine backfill for Navajo Mine Area 4 North as well for the NMEP mine blocks in Area 4 South and Area 5. Post-mine simulations for the PHC evaluation for the NMEP were performed without backfill at the Area 4 North mine block at the Navajo Mine. Additional post-mine simulations were conducted including backfill at the Area 4 North mine block at the Navajo Mine to support the Cumulative Hydrologic Impact Assessment (CHIA), to be developed by the Office of Surface Mining Reclamation and Enforcement (OSM).

41.B.5.1.1 Steady-state Post-mine Simulations for the PHC

For the PHC modeling scenario, Area 4 South post-mining topography and the post-mining channel of Pinabete Arroyo through Area 4 South replaced the pre-mining topography from these areas in the calibrated model. Mine backfill properties were added to mined out areas in Area 4 South, Area 5, and the backfilled Pinabete Diversion. CCB properties were added to CCB placement areas in Area 4 South at the locations shown in Figure 41.B.5-1. All of the CCB placement locations are surrounded by mine spoils with at least 3.1 meters (10 feet) of spoil cover at the surface and variable depths of spoil below the base of the CCB pit at the emplacement locations.

The overburden and interburden material placed in the mine pit as backfill will have higher porosity and hydraulic conductivity than the pre-mine interbedded sedimentary deposits of the Fruitland Formation. Laboratory measurements of pre-mine overburden core indicate porosity values of about 0.35 while porosity of mine spoils is on the order of 0.4. These laboratory porosity measurements are consistent with the swell factor of 12% estimated based on experience in mining the same formation at the Navajo Mine. The higher porosity will result in higher hydraulic conductivity in comparison with the pre-mine interburden and overburden material (Van Voast, 1974).

Table 41.B.5-1 provides the hydraulic parameters used in the model for replaced alluvial materials, mine spoils and CCB materials that were used for modeling post-mine conditions. A hydraulic conductivity value of 2.0×10^{-5} cm/sec has been used in the steady-state post-mine model for the backfill mine spoils below 10 feet of the final reclaimed surface at the NMEP, layer 1 (L1) below. This estimate for hydraulic conductivity of mine spoils at the NMEP was between the average of 4.0×10^{-6} cm/sec estimated from laboratory tests on five mine spoil samples from the Navajo Mine and the estimate of 8.0×10^{-5} cm/sec

obtained by Rehm et al (1980) from the geometric mean of 40 hydraulic conductivity values measured for mine spoils in the Northern Great Plains. Given some degree of uncertainty in the ultimate hydraulic conductivity of mine spoils at the NMEP, the value selected for steady-state modeling was considered to be a reasonable upper bound for the hydraulic conductivity of the spoils over the long term. The hydraulic conductivity of 4.0×10^{-6} cm/sec estimated from laboratory tests on Navajo Mine spoils was considered to be a reasonable lower bound estimate for hydraulic conductivity of mine spoils and was used to represent mine spoils in the transient model. This lower bound estimate provides more conservative estimates of water recovery rates in mine spoils. CCB minefills will have similar hydraulic properties to the mine spoil backfill. The modeled hydraulic conductivity for the CCB minefill in the steady-state model was 7.2×10^{-6} cm/sec based on laboratory estimates obtained from CCB samples at the Navajo Mine

Recharge rate estimates used for modeling post-mine conditions are also summarized in Table 41.B.5-1. Lower slopes and placement of topdressing materials within reclaimed areas are expected to result in higher recharge than the average of 0.02 in/year over the mine area based on the estimates from Stone (1987) for the spatially variable pre-mine surfaces. For steady-state modeling, the recharge rate of 0.04 in/year measured by Stone (1987) for upland flats was assumed to be a reasonable estimate of recharge rate over the long term following reclamation. This recharge rate is twice the average pre-mine rate and reflects the improved surface and soil conditions resulting from mine reclamation. The pre-mine recharge rate of 0.09 in/year for the Pinabete alluvium was also used to represent recharge for the reclaimed Pinabete alluvium. A recharge rate of 0.10 in/year was used for mine spoils in the transient modeling until final reclamation, after which the long-term recharge rate of 0.04 in/year was used for reclaimed areas in the transient model. This recharge rate of 0.10 in/year used for mine backfill and initial reclamation in the transient simulations represents an average rate for the mine backfill in various stages of reclamation and is based on the average between Stone's estimate of 0.16 in/year for depressions during mine reclamation and the 0.04 in/year for final reclamation.

Based on pumping tests, storage coefficients of 17 and 23 percent were determined for spoil in Wyoming (Rahn, 1976, reported in Moran et al., 1979). For unconfined conditions, storage coefficient is roughly equivalent to the effective porosity. Effective porosity calculations for a reclaimed surface mine in Upshur County, West Virginia, determined by the author, ranged from 14 to 16 percent. These values were determined using slug and tracer test results, conducted more than 13 years after the site was reclaimed.

A detailed discussion of the steady-state model simulation results for post-mining conditions following mining of the Area 4 South and Area 5 is provided in Section 41.3. Comparison of the steady-state pre-mine and post-mining groundwater model results show the changes in the groundwater flow patterns and rates that are expected to occur in the long-term following mining. These results support the quantitative assessments of the potential changes in regional or local aquifers resulting from mining, particularly the

effects of removal of the interbedded coal, shales, and sandstone strata and replacement with a relatively homogeneous and isotropic spoil backfill and of the increased recharge rates for reclaimed surfaces. The steady-state pre-mine groundwater model simulates the large decline in heads through the Fruitland Formation, including the occurrence of perched groundwater zones. After mining, the simulated steady-state heads in the mine spoil are much more uniform with depth, although there is still a slight downward gradient and downward flow. Also, the perched groundwater that occurs under pre-mine conditions within the mine area is eliminated within and near the spoil backfill under long-term steady-state conditions following mining. Both the pre-mine and post-mine steady-state groundwater flow models show flow patterns in the PCS and the Fruitland Formation coals with a flow component from Area 4 South and Area 5 mine locations toward the topographic low elevations and alluvium along Pinabete and No Name Arroyos. However, the rate of groundwater flow toward these topographic lows increases for post-mining conditions due to the increase in recharge rate within the reclaimed mine areas.

41.B.5.1.2 Steady-state Post-mine Simulations for the CHIA

In addition to the post-mining results discussed in Section 41.3, a steady-state model run was made to simulate post-mining conditions with the inclusion of mine backfill properties in Area 4 North to support the CHIA. For the CHIA modeling scenario, mine backfill properties and post-mining topography for Area 4 South and Area 5 were the same as for the PHC modeling scenario described in the previous section. Spoil properties were added for the mine area within the Area 4 North mine block at the Navajo Mine as shown in Figure 41.B.5-1. Since a detailed mine plan and post-mine topography are not yet available for Area 4 North, the pre-mining topography was used to represent post-mine topography for this steady-state modeling scenario.

The post-mining steady-state potentiometric surfaces for the No. 8 coal seam, the No. 3 coal seam, and the PCS from the CHIA simulations with Area 4 North mining are shown on Figures 41.B.5-2, 41.B.5-3, and 41.B-5-4. Based on flow directions inferred from the potentiometric surfaces in these figures, the inclusion of Area 4 North has little effect on the post-mining steady-state flow conditions within Area 4 South and Area 5 as indicated by the comparison of the CHIA potentiometric surfaces with the PHC potentiometric surfaces presented and discussed in Section 41.3.

41.B.5.2 Transient Model Simulations

For the transient simulations of mining operations detailed mine progression plans for Area 4 South and Area 5 were simplified to limit computational time. The mine plans were lumped into five year increments with constant head boundaries set to the base of mining in all mined out layers over the area covered by the specific five year increment (i.e. the entire area of the five year plan was simulated as dewatered over the entire time of the five year increment). The Area 4 South mine plan runs from year zero to year 45, and the

Area 5 mine plan runs from year 30 to year 95. The transient model was run for 1000 years after the completion of mining to simulate post-mining transient behavior.

41.B.5.2.1 Transient Model Parameters

The area covering the five year increment being mined was assigned hydraulic properties to simulate "air" in the open pit. The specific yield and specific storage in these areas were set equal to 1, and hydraulic conductivity was set equal to 8,640 ft/d. As one five year increment ended and the next was started, mine backfill hydraulic parameters were added to the model over the area of the previous five year increment. As discussed in Section 41.B.5.1, swelling of mine backfill is accompanied by an increase porosity and permeability, therefore, hydraulic conductivity and storage properties were increased in the transient simulations compared with those used in the steady-state pre-mining runs. Mine backfill properties are shown in Table 41.B.5-1. The hydraulic conductivity of 4.0×10^{-6} cm/sec estimated from laboratory tests on Navajo Mine spoils was used as a lower bound estimate for mine spoils to provide more conservative estimates of water recovery rates in mine spoils. A recharge rate of 0.10 in/year was used for mine spoils in the transient modeling until final reclamation was achieved, after which the long-term recharge rate of 0.04 in/year was used for reclaimed areas in the transient model. The long-term recharge rate of 0.04 in/year for final reclamation was applied within Area 4 South after year 45 and within Area 5 after year 95 in the transient simulations.

41.B.5.2.2 Initial Conditions

The head and saturation distributions from the pre-mining steady-state simulation were used as initial conditions for the first five year transient run, years 0-5 in the mine plan. Subsequent five year transient runs used the final result of the prior five year run as initial conditions. At the conclusion of the Area 5 mine plan, the final mine area (year 90-95) was assigned backfill properties, the results from year 95 were assigned as initial conditions, and a post-mining transient simulation was run for 1000 years to simulate rebound in groundwater levels in the mine backfill.

41.B.5.2.3 Transient Model Results

The results of the transient mining simulations are discussed in the PHC Section 41.3. Transient mining simulations were not performed for the CHIA evaluations with mining in Area 4 North at the Navajo Mine because a detailed mine plan and schedule was not yet available for Area 4 North mining. The transient modeling results presented in Section 41.3 show the slow rate of spoils re-saturation as well as the rate of drawdown and recovery in adjacent aquifers.

41.B.5.3 Mass Transport Model Simulations

The FEFLOW software used for groundwater flow modeling also includes features that simulate conservative and reactive transport. The FEFLOW transport routines were applied to simulate the transport of both

conservative and reactive (sorbed) constituents from mine spoil and from the CCB minefill that are planned for selective placement within the mine backfill. Post-mine transient flow and mass transport model simulations for the NMEP were performed for the PHC evaluations with spoil backfill in Area 4 South and Area 5 and planned CCB minefill areas within Area 4 South. Additional post-mine transient flow and mass transport model with simulations were performed to support the CHIA, which included backfill at the Area 4 North mine block at the Navajo Mine along with spoil backfill in Area 4 South and Area 5 and planned CCB minefill areas within Area 4 South.

Sorption parameters and leachate concentrations for CCBs and mine spoil were derived and are described in Spoil and Coal Combustion By-product Leachate Test and Analysis and Geochemical Modeling Report included as Appendix 41.A. Transport model parameters, including sorption coefficients, are shown in Table 41.B.5-2. Leachate concentrations for mine spoil and CCB materials are provided in Table 41.B.5-3. The leaching test results for composite CCB materials leached with spoil water were selected as the best estimate of source concentrations for groundwater in CCB minefill areas in the mine backfill. These source concentrations are appropriate because all CCB materials placed within mine backfill are surrounded by and intra-layered with mine spoils and will be leached by spoil water. The TDS source concentrations obtained for CCBs leached with mine spoils water also resulted in the highest and most environmentally conservative (i.e., protective) estimate of the CCB TDS source concentrations. The constituents of potential concern in leachate from composite CCB materials are the constituents detected in the results of CCBs leached with spoil water at concentrations that exceed the relevant livestock use criteria as this is the primary water use within the NMEP area. These constituents include TDS, sulfate, fluoride, selenium, and vanadium. TDS was assumed to behave conservatively, that is with no attenuation due to adsorption or chemical transformation. Sulfate was not modeled separately but was assumed to vary with TDS based on the sulfate-TDS ratio in the source. This assumption is environmentally conservative, as both TDS and sulfate may decline under reducing conditions in the coals downgradient of the mine area. Vanadium was not modeled because it is strongly adsorbed by mine spoils as demonstrated by the reduction to below detection limits in the leachate from mine spoils, when leached with CCB leachate water. Boron has been included in Table 41.B-5.3 and in the transport modeling because it is a potential indicator of CCB leachate and it is often an order of magnitude higher than in background groundwater and spoil leachate. However, the boron concentration of 2.8 mg/L for CCBs leached with spoil water is well below the relevant livestock and wildlife watering criterion of 5.0 mg/L.

The transport model solves advection-dispersion-sorption equations of transport processes in groundwater flow. Natural background concentrations were not included in the transport modeling because the objective of the transport modeling is to simulate the direction and rate of transport of modeled constituents from the mine spoils and CCB minefill areas, including the magnitude of attenuation due to sorption and dispersion.

Separate mass transport simulations were performed for boron, fluoride, selenium, and TDS. Mass transport simulations were run for 1000 years after the completion of mining.

41.B.5.3.1 Initial Conditions

The results of the steady-state post-mining flow simulation were used as the initial flow condition for the transport simulations. Initial concentrations were assigned to areas of mine spoil and CCB minefill in the mine backfill as shown in Table 41.B.5-3.

41.B.5.3.2 Mass Transport Boundaries

Transport runs for each species were performed assuming that the source concentrations in both mine spoils and in CCB minefill remained constant throughout the 1000-year transport modeling period, an environmentally conservative approach. Constant concentration boundary conditions were assigned to mine backfill and CCB placement pits for the runs simulating constant leaching to groundwater over time. These constant concentration boundary conditions were assigned concentrations equal to the initial concentrations shown in Table 41.B.5-3.

Experience from other surface mining operations as well as the successive leaching test results indicate that the concentrations of TDS, fluoride, selenium and boron are expected to decline over time with leaching and flushing of the mine spoils and CCB minefill. Consequently, mass transport simulations were also conducted assuming an initial leachate concentration in the backfilled mine spoil and CCB minefill with no additional leaching to groundwater over time. No mass transport boundary conditions were used in these simulations.

41.B.5.4 Mass Transport Model Results

41.B.5.4.1 Transport Simulation Results for the PHC

Mass transport modeling results for the PHC with mine spoil in the backfill in Area 4 South and Area 5, and CCB minefill placement areas in the backfill in Area 4 South are presented in Section 41.3. The transport simulations based on the conservative assumption that source concentrations remain constant throughout the 1000-year simulation period show a substantial reduction in concentrations due to dispersion and mixing. Transport modeling results show that lateral migration of groundwater flow and constituents from the mine spoil and CCB minefill placement area in the backfill in Area 4 South is primarily toward the alluvium and topographic lows along Pinabete and No Name Arroyos. Transport modeling also shows that the primary direction of groundwater flow and constituents from the mine spoils and CCB minefill locations is vertically into the PCS. These results also show limited migration laterally through the PCS and then primarily toward the topographic along Pinabete and No Name Arroyos. TDS

concentrations greater than 2,000 mg/L are mostly restricted to areas directly beneath the mine backfill. There is also a vertical component of flow and constituent migration from the PCS into the Lewis Shale.

It is expected that source concentrations will decline with time as groundwater flows through the mine backfill and flushes salts that may have been concentrated in the mine spoils as a result of weathering and evaporation during mining and backfilling operations. However, the modeling scenario performed where the initial TDS source concentrations in mine spoil and CCB minefill areas were allowed to flush from the source areas over time with groundwater flow show that flushing rates are extremely slow. The flushing scenario shows lower TDS concentrations within the topographic lows along Pinabete and No Name Arroyos down gradient of the mine after 1000 years in comparison with the constant source concentration scenario. Actual results would be expected to be between the two scenarios, as higher source concentrations are expected in the initial flush with some reduction in source concentrations with groundwater flushing.

41.B.5.4.2 Transport Simulation Results for the CHIA

An additional transport simulation was performed to support the CHIA. This additional run assumed constant leaching of TDS to groundwater over time from all backfilled areas including mining backfill in Area 4 North and constant TDS concentrations in the CCB minefill areas within Area 4 South.. Simulated TDS concentrations 1000 years after mine closure are shown in Figures 41.B.5-5, 41.B.5-6, 41.B.5-7, and 41.B-5-8 for model layer 1, the No. 8 coal seam, the No. 3 coal seam, and the PCS, respectively.

These results show that the addition of Area 4 North to the TDS simulation does not significantly alter the TDS concentrations in Area 4 South and Area 5, or downstream of these areas in Pinabete Arroyo and No Name Arroyo, as compared with the results from the simulations in which Area 4 North was not included. The results also show that TDS will migrate over time from Area 4 North to the alluvium of Cottonwood Arroyo similar to Area 4 South to the alluvium of Pinabete Arroyo and Area 5 to the alluvium of No Name Arroyo. Given these results, it is assumed that the migration of leachate from Area 4 North to the alluvium of Cottonwood Arroyo will be similar to the results discussed in Section 41 for Area 4 South to the alluvium of Pinabete Arroyo, and Area 5 to the alluvium of No Name Arroyo.

41.B.6 REFERENCES

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TABLES

Table 41.B.2-1 Hydraulic Conductivity of Model Layers and Corresponding Hydrostratigraphic Units

Formation	Measured/Estimated Kx (ft/d)		Source	Calibrated Results	
	Kx (ft/d)	Kx (ft/d)		Kx (ft/d)	Kx/Kz
Alluvium	5.13E+01	1.15E+01	NMEP Well Tests	1.56E+02	
No Name Alluvium				3.11E+01	
Weathered Overburden				5.02E-03	1
Overburden	1.50E-02	1.50E-02	San Juan Mine Model Calibration	1.00E-03	10
No. 8 Coal	6.00E-02	4.00E-03	NMEP & San Juan Mine Well Tests	1.25E-02	125
Interburden	8.64E-03	2.80E-05	Kaiser et al 1994 & Frenzel 1983	5.01E-04	100
No. 7 Coal	8.00E-03	2.00E-03	Navajo Mine Well Tests	2.49E-03	2.5
Interburden	8.64E-03	2.80E-05	Kaiser et al 1994 & Frenzel 1983	5.01E-04	100
No. 6 Coal	1.40E-03	1.40E-03	Navajo Mine Well Test	1.88E-03	2.5
Interburden	8.64E-03	2.80E-05	Kaiser et al 1994 & Frenzel 1983	5.01E-04	500
No. 4 Coal	1.40E-03	1.40E-03	Navajo Mine Well Test	1.88E-03	2.5
Interburden	8.64E-03	2.80E-05	Kaiser et al 1994 & Frenzel 1983	5.01E-04	25
No. 3 Coal	1.30E-04	2.00E-03	NMEP Well Tests	4.99E-03	5
Interburden	8.64E-03	2.80E-05	Kaiser et al 1994 & Frenzel 1983	5.01E-04	25
No. 2 Coal	1.00E-03	1.00E-03	Navajo Mine Well Test	1.25E-03	2.5
Interburden	8.64E-03	2.80E-05	Kaiser et al 1994 & Frenzel 1983	5.01E-04	25
Pictured Cliffs Sandstone	4.41E-02	1.00E-04	NMEP & Burnham Mine Well Tests	1.00E-02	1

Table 41.B.2-2 Recharge Values and Surface Characterization

Surface Characterization	Recharge Range[1] (in/yr)	Mean Recharge[1] (in/yr)	Modeled Recharge (in/yr)
Badlands	0.002 to 0.01	0.006	
Slopes > 5%			0.002
Slopes: 2 to 5%			0.01
Upland Flat	.02 to 0.05	0.03	
Upland Flat (slope<1%)			0.03
Upland (Slope 1 to 2%)			0.02
Alluvial Valley	0.09	0.09	0.09
Mine Backfill			0.04

[1]From Stone, W. J. 1987. Phase-III Recharge Study at Navajo Mine

Table 41.B.3-1 Model Layers and Corresponding Hydrostratigraphic Units

Layer	Slice	Formation
1	1	Alluvium and Weathered Overburden
2,3	2,3	Overburden
4	4	No. 8 Coal
5,6,7	5,6,7	Interburden
8	8	No. 7 Coal
9,10,11	9,10,11	Interburden
12	12	No. 6 Coal
13,14,15	13,14,15	Interburden
16	16	No. 4 Coal
17,18,19	17,18,19	Interburden
20	20	No. 3 Coal
21,22,23	21,22,23	Interburden
24	24	No. 2 Coal
25,26	25,26	Interburden
27,28	27,28,29	Pictured Cliffs Sandstone

Table 41.B.3-2 Fluxes Assigned to Constant Flux Boundary Conditions

Model Layer	Coal Seam	Constant Flux (ft/d)
4	No. 8	1.704×10^{-4}
8	No. 7	8.52×10^{-6}
12	No. 6	6.375×10^{-5}
16	No. 4	6.375×10^{-5}
20	No. 3	8.52×10^{-5}
24	No. 2	4.25×10^{-6}

Table 41.B.4-1 Groundwater Model Calibration Data

Well	Formation	Model Layer	Observed Head	Calibrated Head	Residual
QACW-2B	Alluvium	1	5235.20	5223.63	-11.57
PA-1	Alluvium	1	5340.81	5304.31	-36.50
PA-2	Alluvium	1	5422.73	5399.42	-23.31
KF2007-01	No. 8 Coal	4	5392.01	5410.66	18.64
KF84-22A	No. 8 Coal	4	5270.49	5254.34	-16.15
VWP2007-02	No. 8 Coal	4	5393.67	5410.70	17.03
KF84-21C	No. 7 Coal	8	5273.98	5236.50	-37.48
KF84-22B	No. 7 Coal	8	5268.95	5252.92	-16.03
VWP2007-02	No. 7 Coal	8	5370.81	5395.60	24.78
KF84-22C	No. 6 Coal	12	5257.20	5252.09	-5.11
VWP2007-01	No. 6 Coal	12	5329.88	5345.46	15.58
KF84-22D	No. 3 Coal	20	5248.20	5248.37	0.17
KF-98-02	No. 3 Coal	20	5354.47	5366.90	12.43
KF-98-03	No. 3 Coal	20	5291.94	5328.07	36.13
VWP2007-01	No. 3 Coal	20	5278.56	5281.35	2.79
VWP2007-02	No. 3 Coal	20	5287.85	5329.30	41.46
KF-98-04	No. 3 Coal	20	5288.48	5299.21	10.73
KF84-21A	No. 2 Coal	24	5240.95	5240.55	-0.40
KF84-22E	No. 2 Coal	24	5246.90	5248.28	1.38
VWP2007-01	No. 2 Coal	24	5273.37	5281.16	7.79
VWP2007-02	No. 2 Coal	24	5291.09	5329.07	37.98
VWP2007-03	No. 2 Coal	24	5357.60	5364.45	6.85
VWP2007-5	No. 2 Coal	24	5410.61	5422.77	12.16
GM-19	PCS	28	5265.00	5271.17	6.17
GM-20	PCS	28	5333.00	5311.45	-21.55
GM-21	PCS	28	5428.00	5439.73	11.73
GM-29	PCS	28	5305.00	5310.16	5.15
GM-30A	PCS	28	5387.00	5385.61	-1.39
KPC2007-01	PCS	28	5262.00	5280.01	18.01
KPC2007-02	PCS	28	5351.90	5362.85	10.95
KPC2007-03	PCS	28	5336.52	5327.02	-9.50
KPC-98-01	PCS	28	5288.31	5271.35	-16.96
T4-1	PCS	28	5385.85	5385.68	-0.17
T4-2	PCS	28	5385.20	5385.71	0.51
O-1	PCS	28	5422.00	5430.26	8.26
13-7-2	PCS	28	5402.00	5410.01	8.01
P-1	PCS	28	5430.00	5440.20	10.20
VWP2007-01	PCS	28	5268.30	5279.99	11.69
VWP2007-02	PCS	28	5296.81	5328.77	31.96
VWP2007-4	PCS	28	5397.48	5405.10	7.61
VWP2007-5	PCS	28	5411.26	5419.84	8.58
GM-28	PCS	28	5265.00	5250.01	-14.99

Table 41.B.4-2 Model Parameters Varied in Sensitivity Analysis

Model Parameter	Calibrated Value	Sensitivity Analysis Range
Alluvium Kx	155 ft/d	31 – 187 ft/d
Upper Coal Interburden Kx/Kz Ratio	100	25
Lower Coal Interburden Kx/Kz Ratio	25	100
Interburden between Upper and Lower Coals Kx/Kz Ratio	500	100
PCS Kx	0.01 ft/d	0.005 – 0.02 ft/d
Leakage Coefficient of Head Dependent Boundary at Base of Model	Variable	$3x10^{-4}$/day, Calibrated Value x 2, Calibrated Value / 2
Recharge	Variable	Calibrated Values x 0.8 Calibrated Values x 1.2

Table 41.B.5-1 Recharge Rates and Hydraulic Properties of Coal Combustion By-products and Mine Spoils for Post-Mine Groundwater Model

Surface Characterization	Recharge Range[1] (in/yr)	Mean Recharge[1] (in/yr)	Modeled Recharge (in/yr)
Reclaimed Areas	0.01 to 0.23	0.04	
Reclaimed Depression Areas		0.16	
Reclaimed Areas-Transient			0.1
Reclaimed Areas-Steady-state			0.04
Alluvium- Pre-Mine and Reclaimed	0.09		0.09
Pre-Mine Surfaces	0.002 to 0.04		0.02

Reclamation Materials	Porosity (%)	Ksat (cm/sec)	Ksat (ft/day)
Surface Mine Spoils (L1)	40.6	2.0E-04	0.563
Mine Spoils <L1	40.6	2.0E-05	0.0563
CCBs	48.5	7.2E-06	0.0203
Geometric Mean of Mine Spoils in Northern Great Plains (Rehm et al, 1980)		8.0E-05	0.2268
Lab Tests of Navajo Mine Spoil Samples	40.6	4.0E-06	0.0113

[1] Estimates from Stone (1987)

Table 41.B.5-2 Mass Transport Model Parameters

Chemical Species	Dispersion Parameters			Sorption Parameters			
	Longitudinal Dispersivity (ft)	Transverse Dispersivity (ft)	Diffusion (ft^2/s)	Kd (l/mg)	Spoil Bulk Density (mg/l)	Overburden Bulk Density (mg/l)	Coal Bulk Density (mg/l)
B	1000	50	1.E-09	6.842E-06	1500	1700	1500
F	1000	50	1.E-09	8.571E-06	1500	1700	1500
Se	1000	50	1.E-09	4.980E-05	1500	1700	1500
TDS	1000	50	1.E-09	-	-	-	-

Note: TDS is assumed to be conservative, so no sorption parameters were used

Table 41.B.5-3 Mass Transport Model - Initial Mass and Constant Source Concetrations

Chemical Species	Backfill Concentration (mg/l)	CCB Concentration (mg/l)
Boron	0.45	2.8
Fluoride	1.6	5
Selenium	0	0.14
TDS	3550	5500

FIGURES

Figure 41.B.1-1 Pictured Cliffs Sandstone conceptual groundwater model

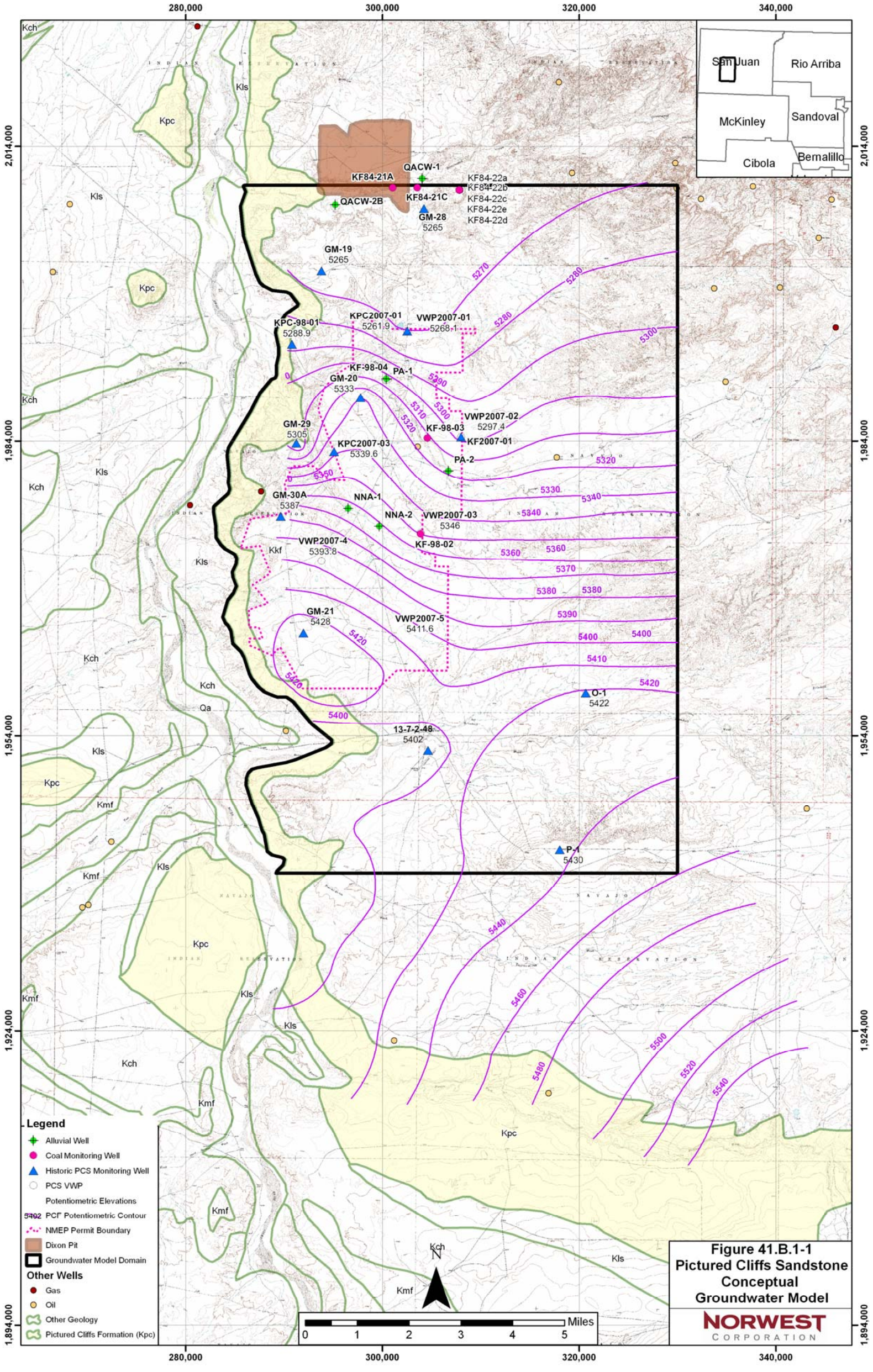


Figure 41.B.3-1 Model Domain and Mesh Discretization

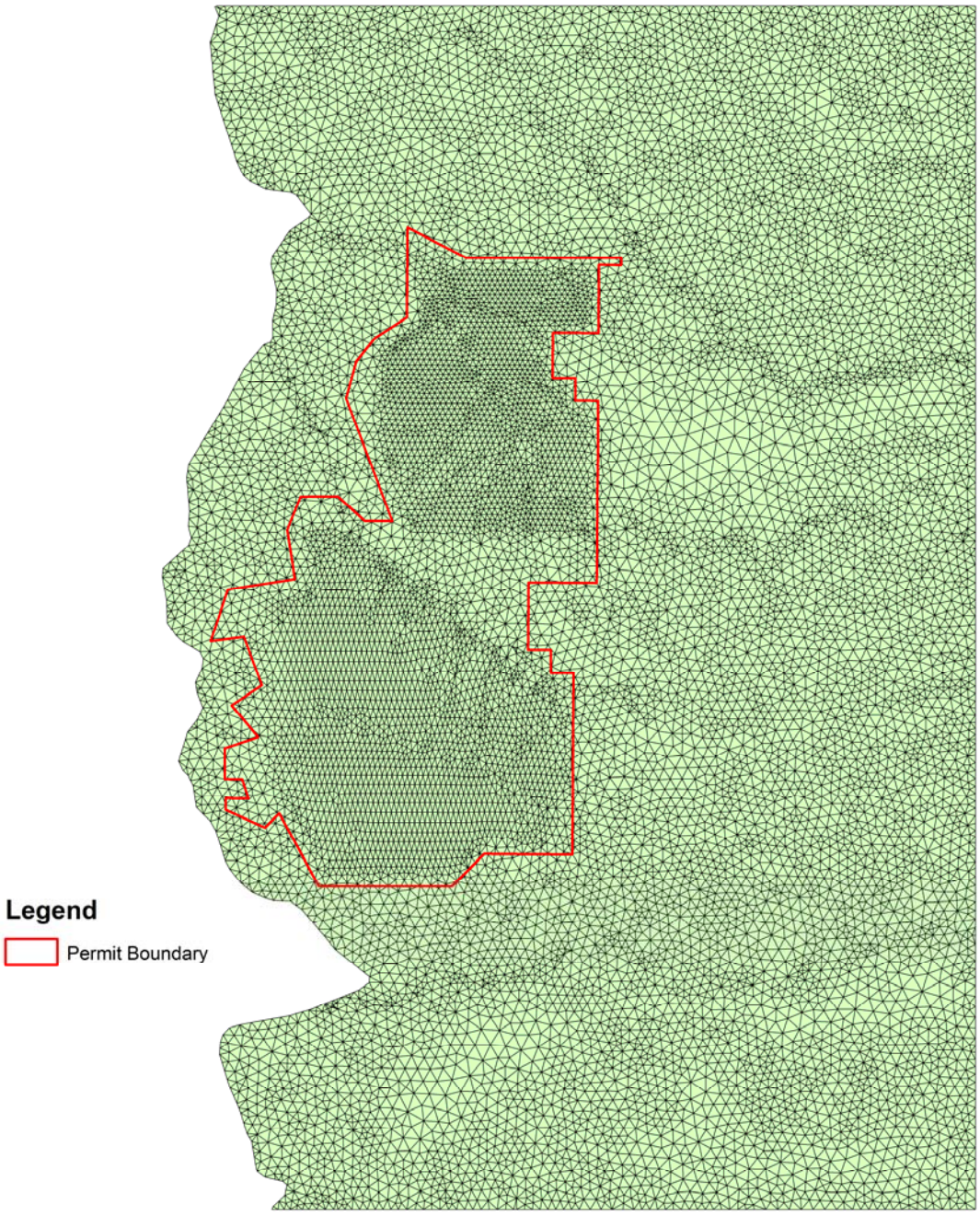


Figure 41.B.3-2 Locations of Boundary Conditions - Typical Model Layer

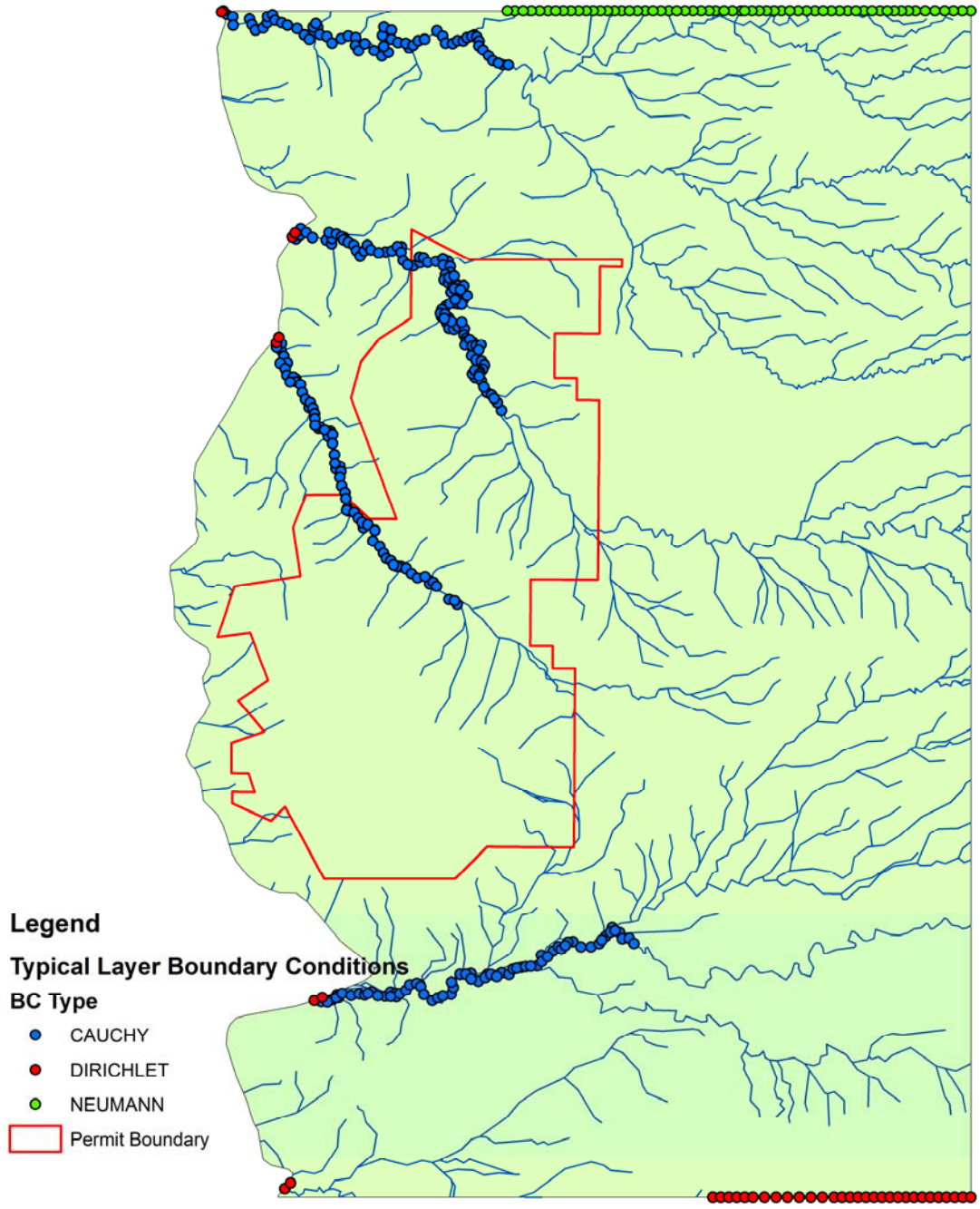


Figure 41.B.3-3 Locations of Boundary Conditions - PCS

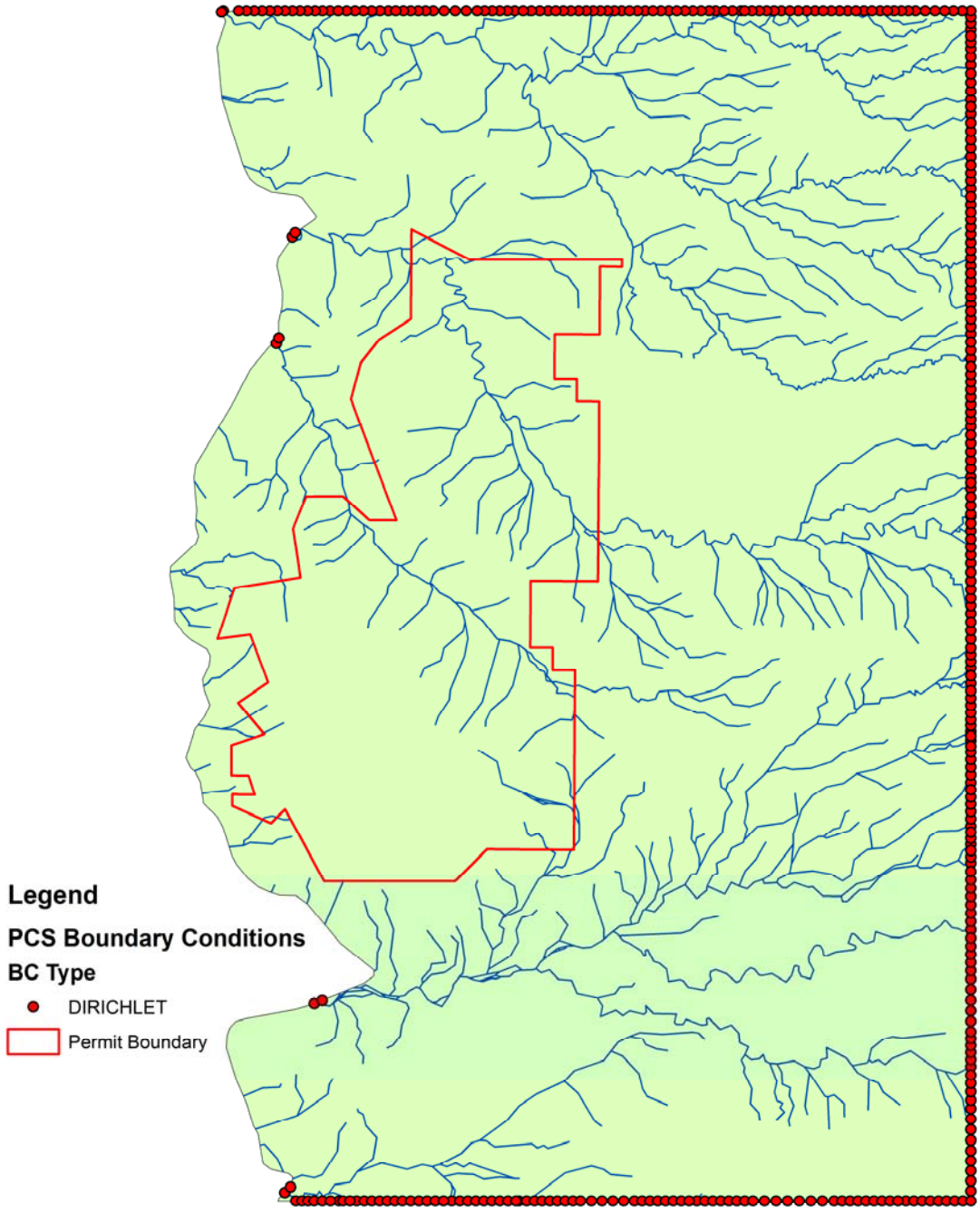


Figure 41.B.3-4 Recharge Distribution

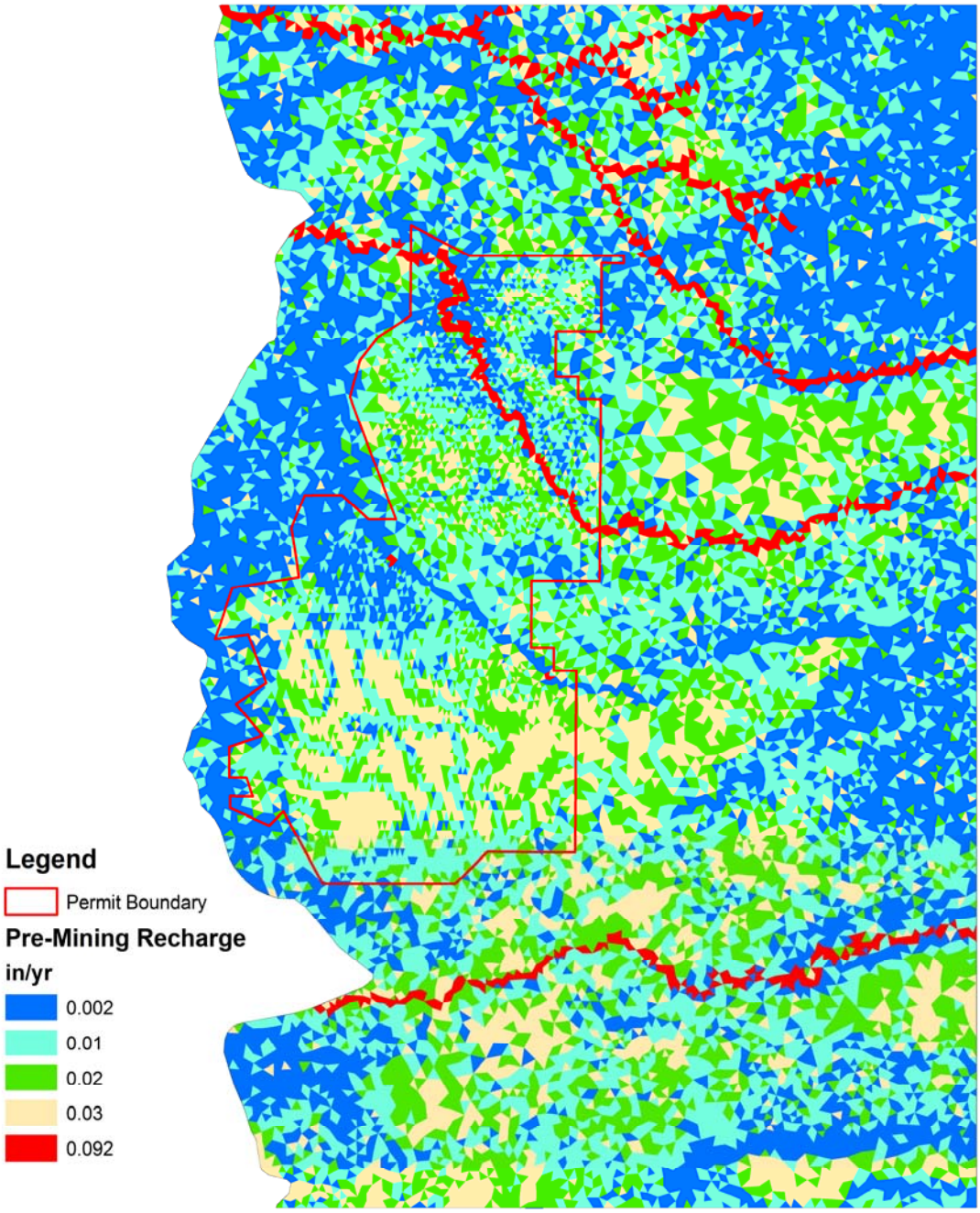


Figure 41.B.3-5 Head Dependent Boundary Conditions - Reference Head

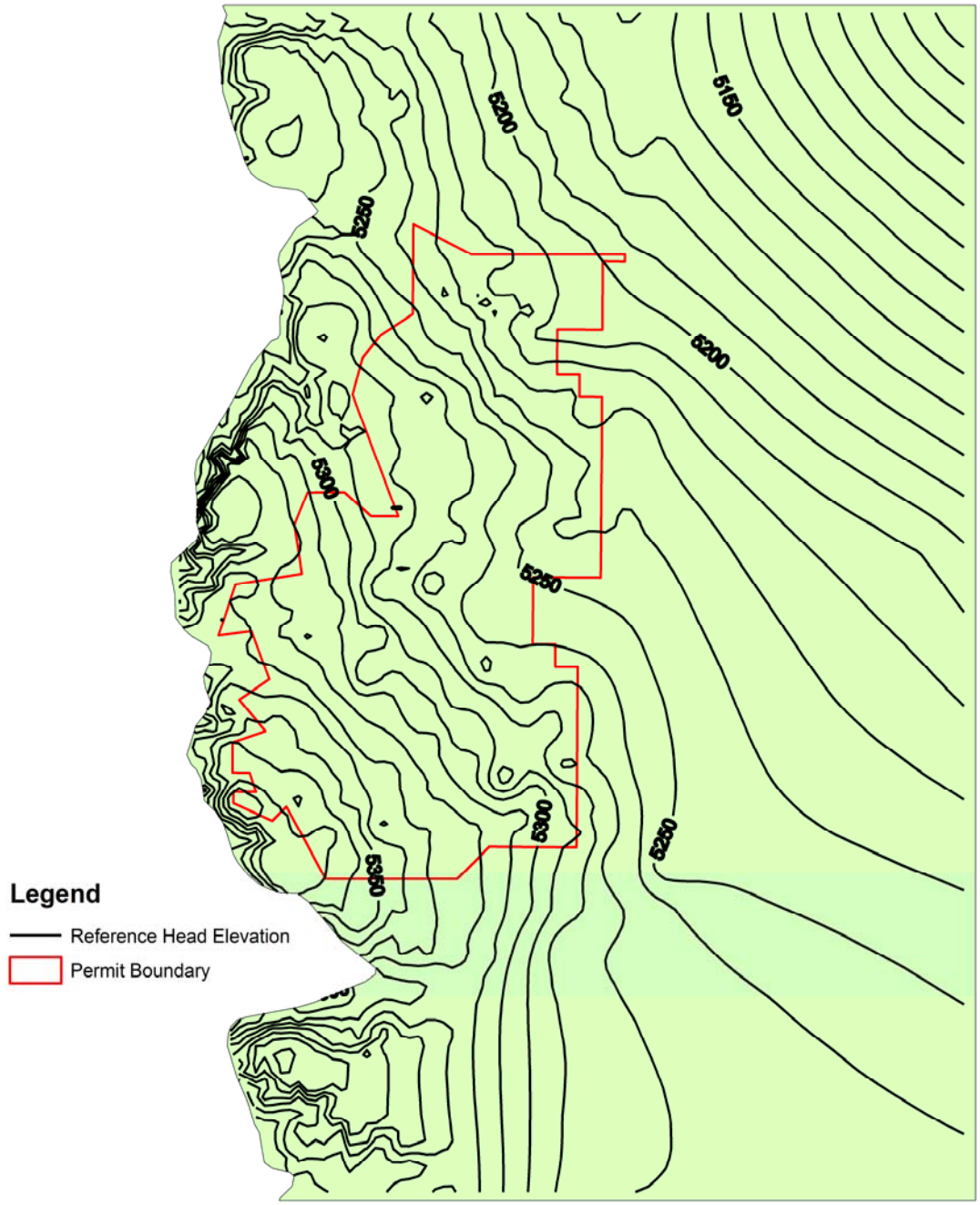


Figure 41.B.3-6 Head Dependent Boundary Condtions - Leakage Coefficient

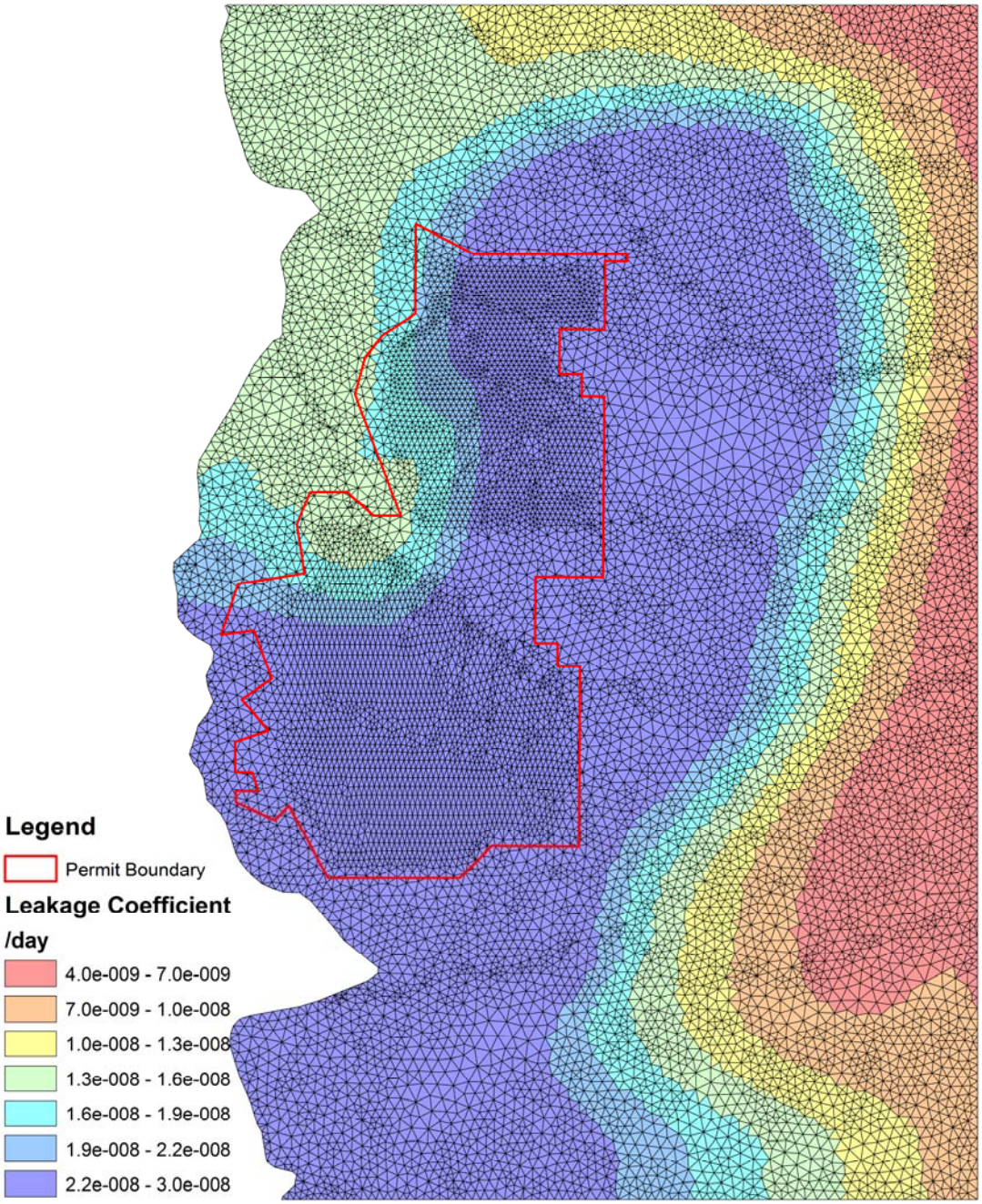


Figure 41.B.4-1 Calibration Well Locations

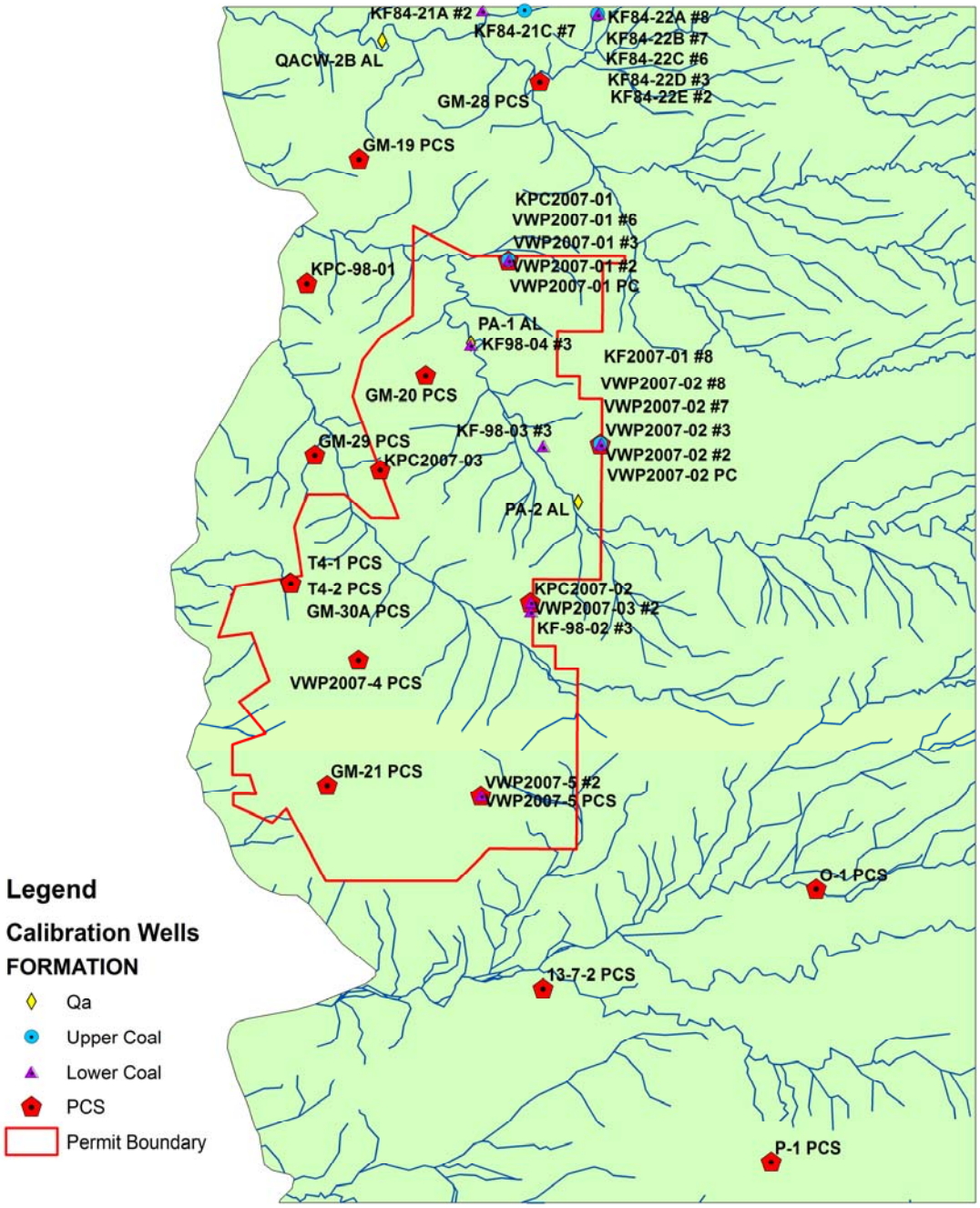


Figure 41.B.4-2 Calibrated PCS Potentiometric Surface

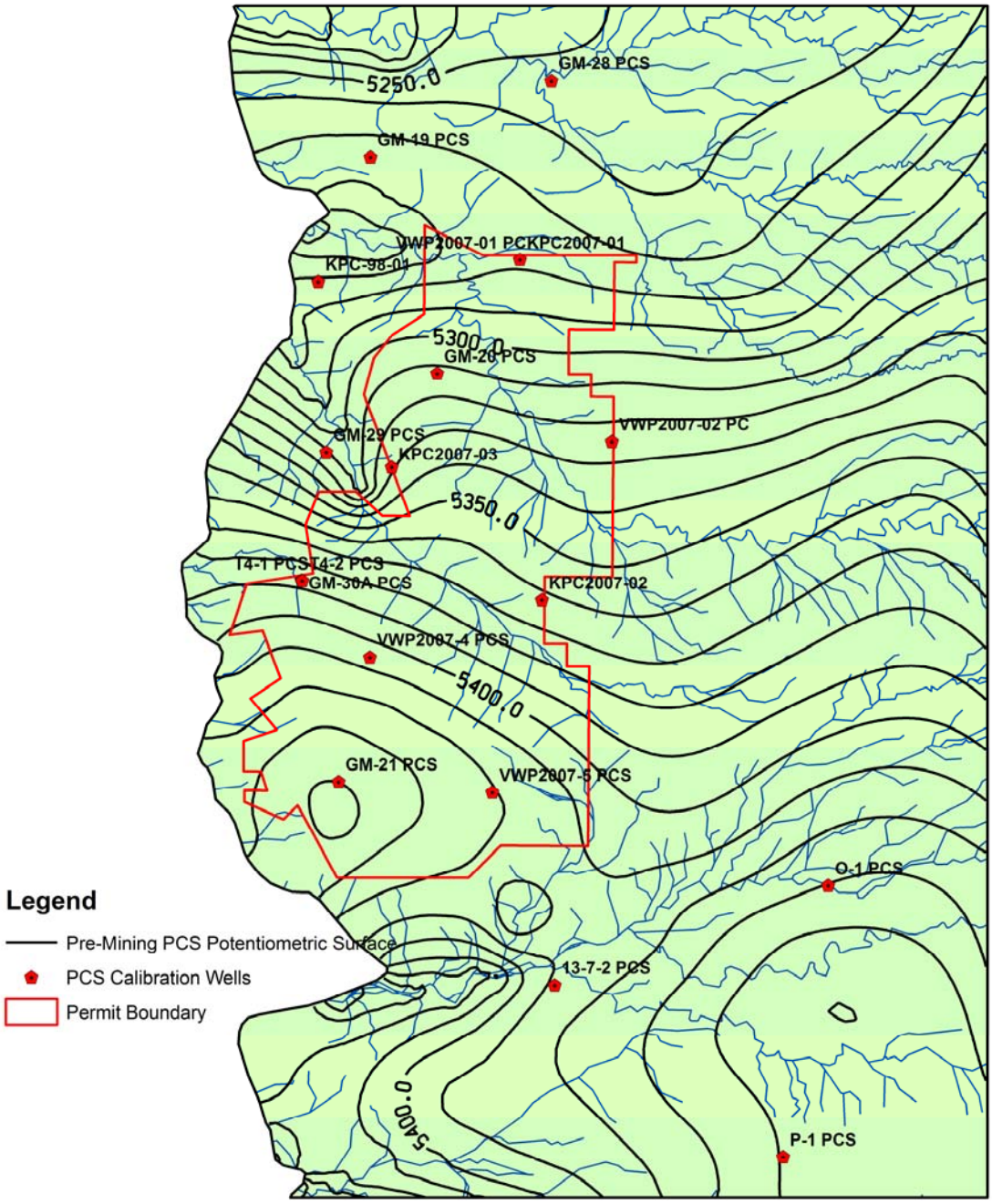


Figure 41.B.4-3 Model Calibration - Calculated versus Observed Heads

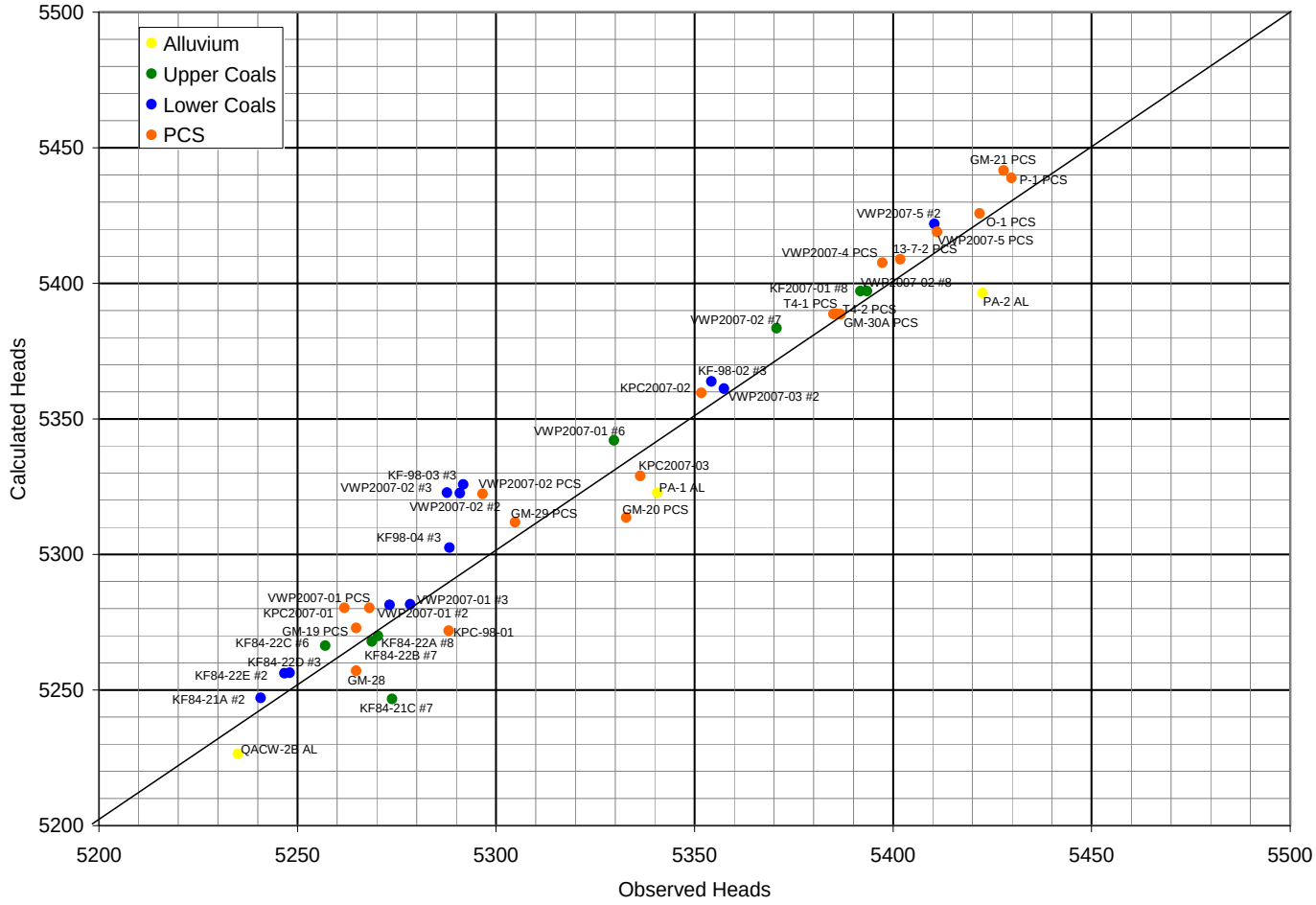


Figure 41.B.4-4 Sensitivity Analysis - Calculated versus Observed Heads - K_{PCS}=0.005 ft/d

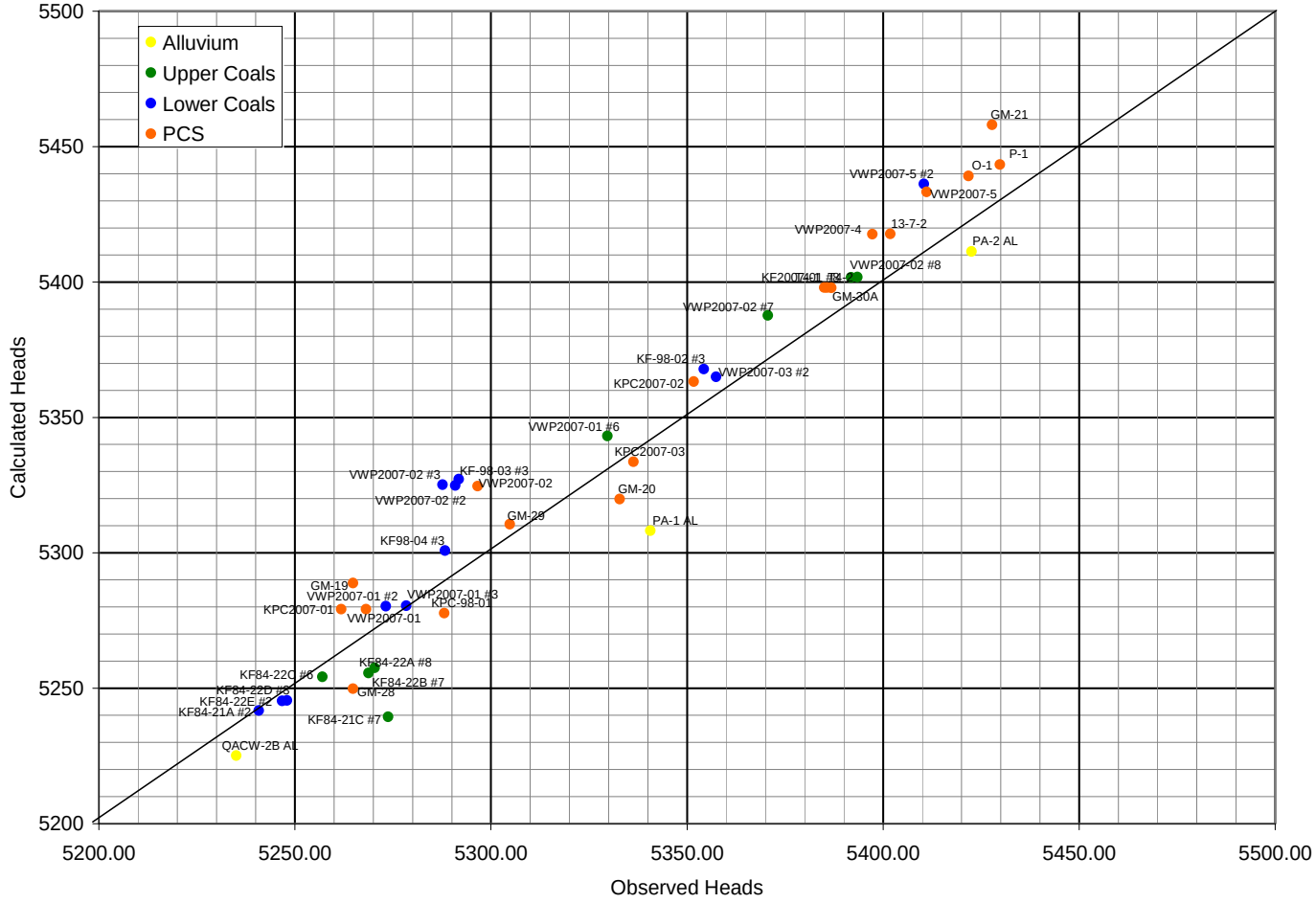


Figure 41.B.4-5 Sensitivity Analysis - Calculated versus Observed Heads - K_{PCS}=0.02 ft/d

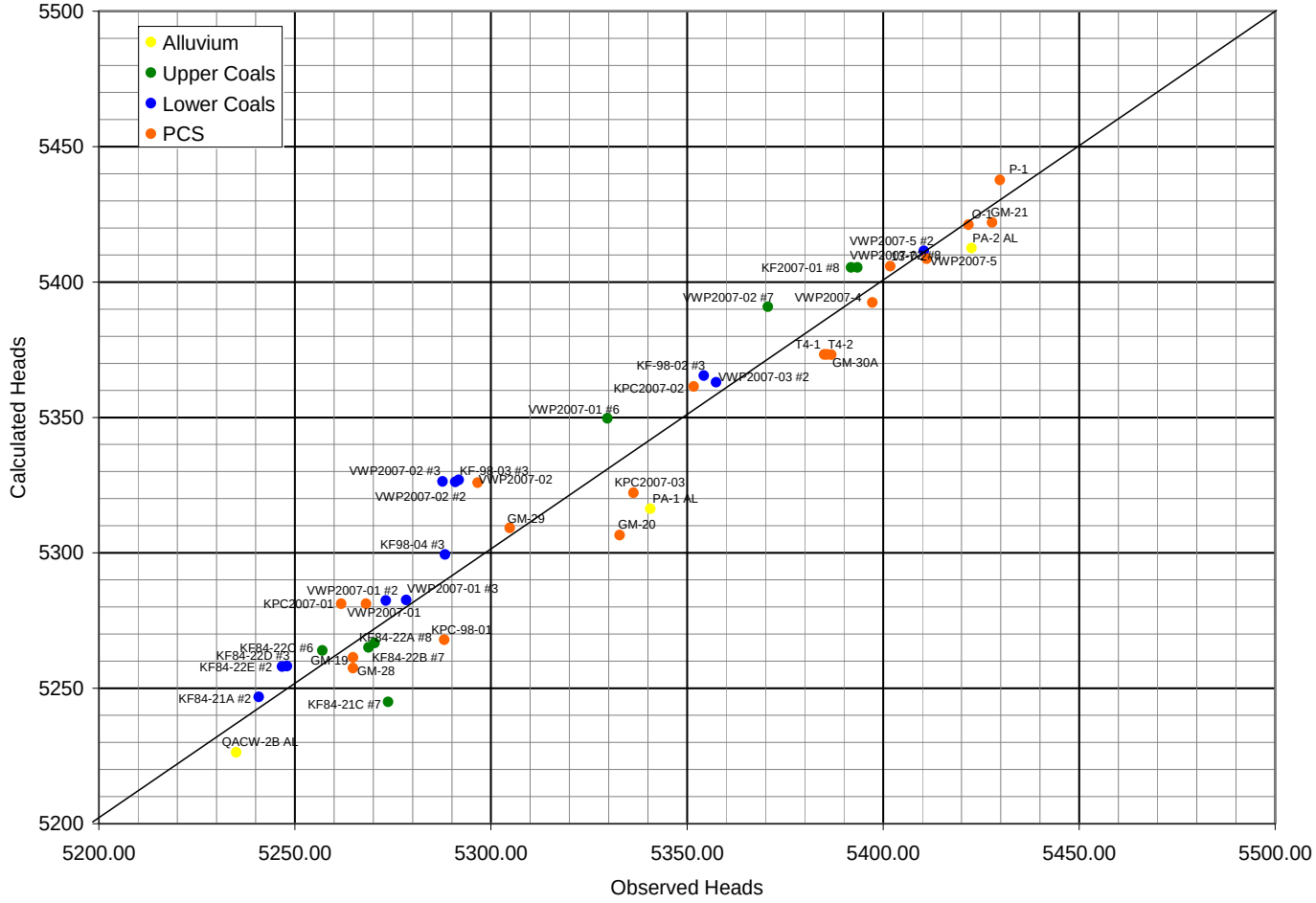


Figure 41.B.4-6 Sensitivity Analysis - Calculated versus Observed Heads - $Kz_{14}=10^{-8}$ ft/d

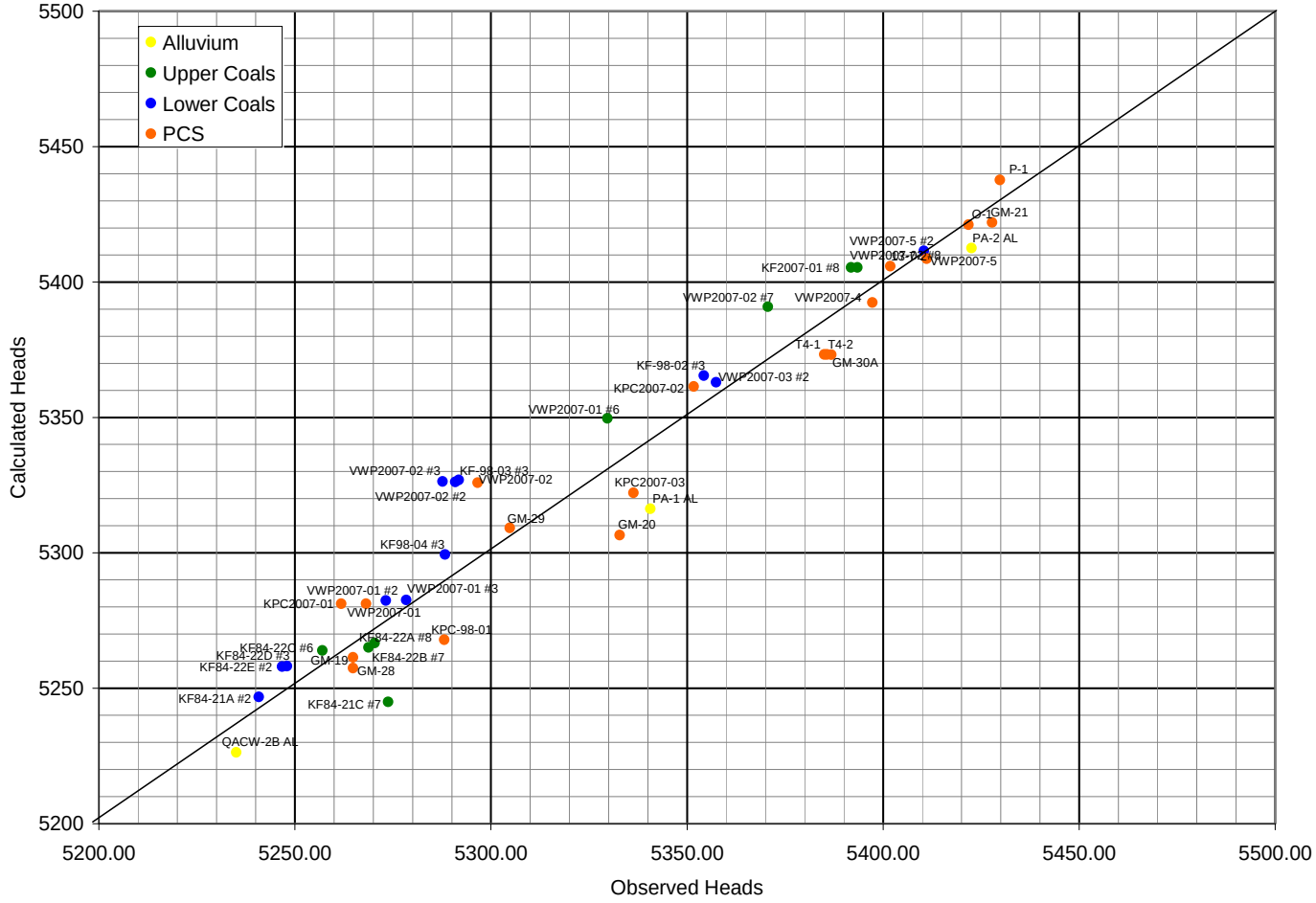


Figure 41.B.4-7 Sensitivity Analysis - Calculated versus Observed Heads - $Kz_{LowerIB}=2x10^{-7}$ ft/d

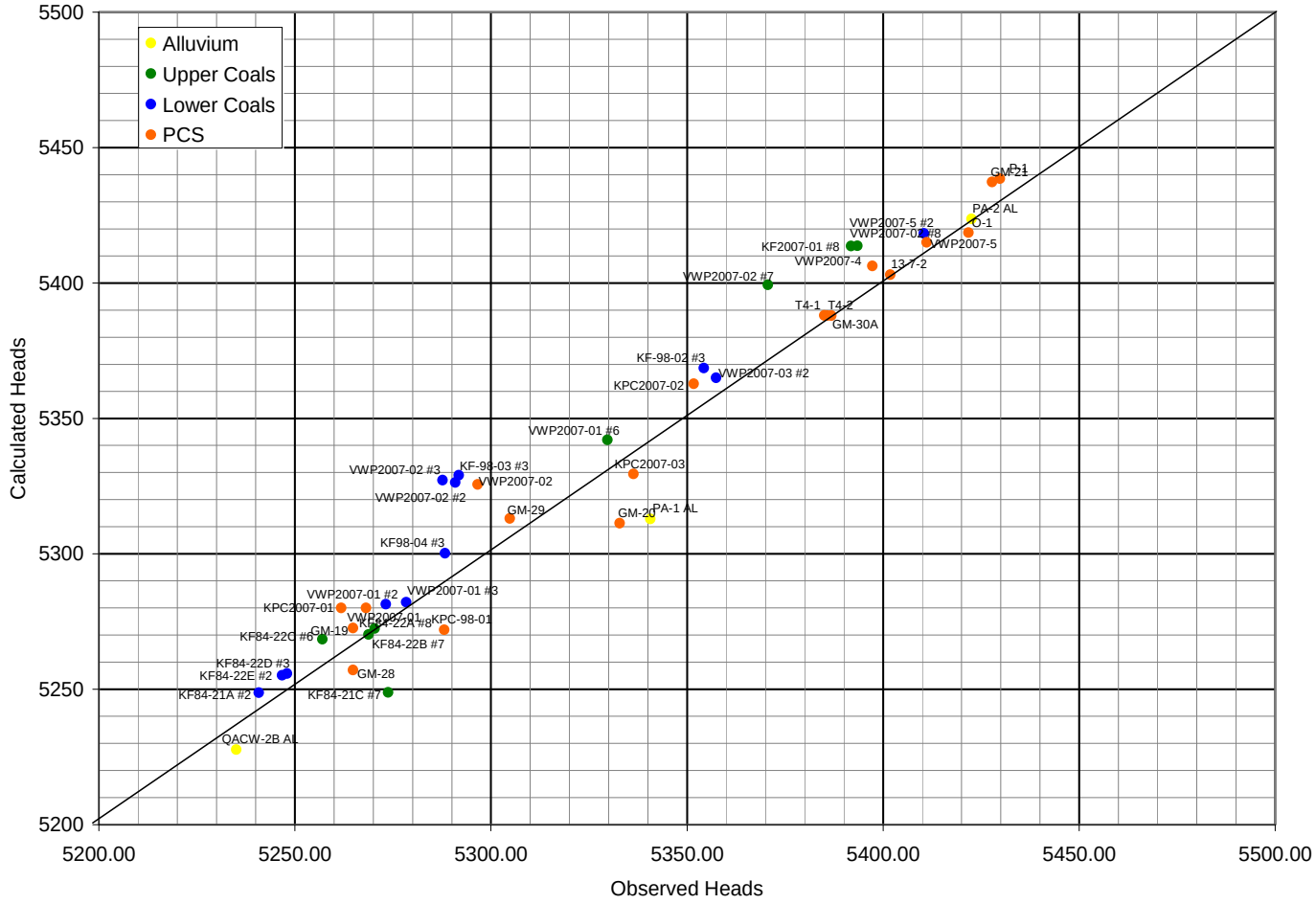


Figure 41.B.4-8 Sensitivity Analysis - Calculated versus Observed Heads - $Kz_{UpperIB}=2x10^{-7}$ ft/d

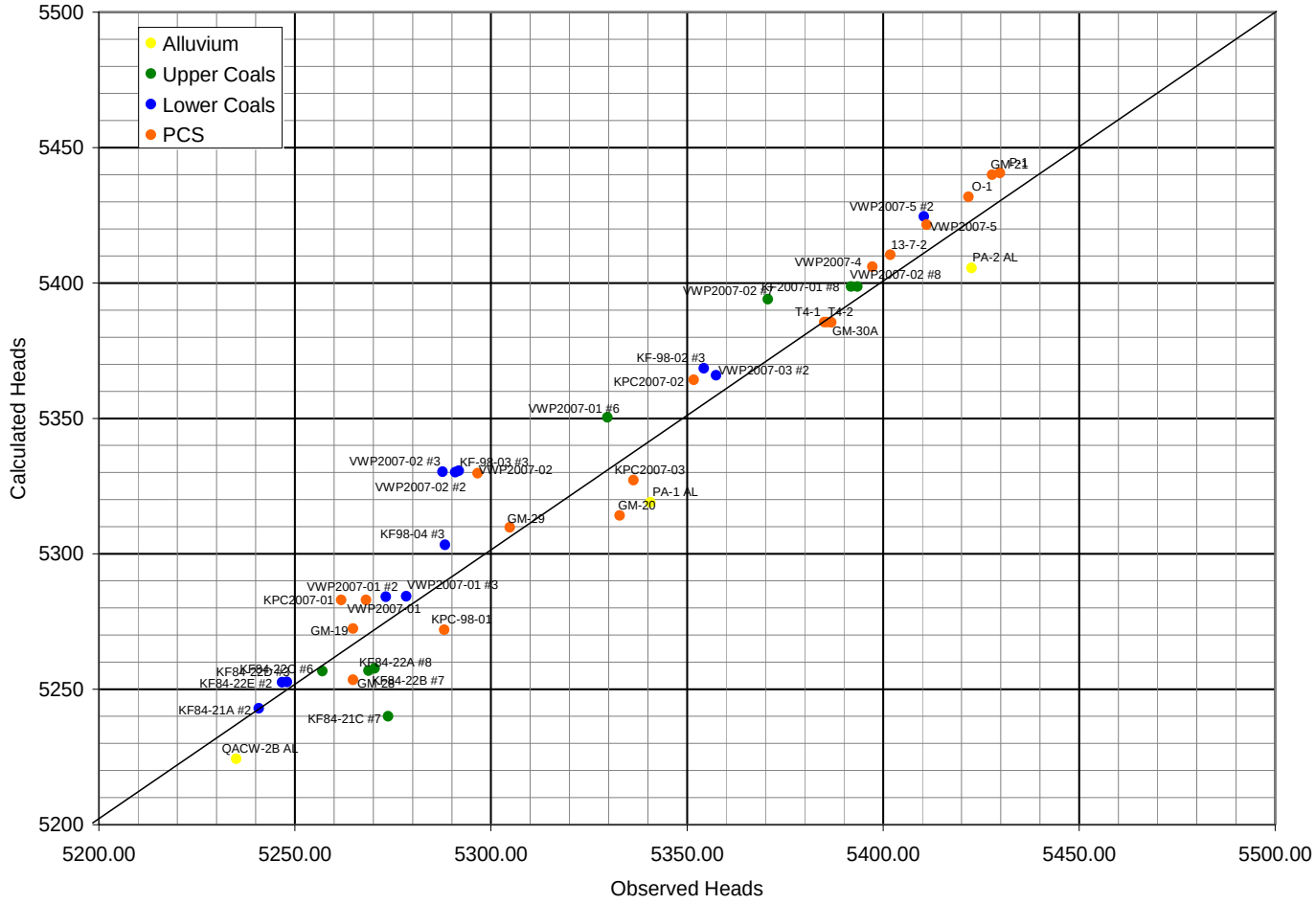


Figure 41.B.4-9 Sensitivity Analysis - Calculated versus Observed Heads - $K_{weathered\ coal}=K_{unweathered\ coal}$

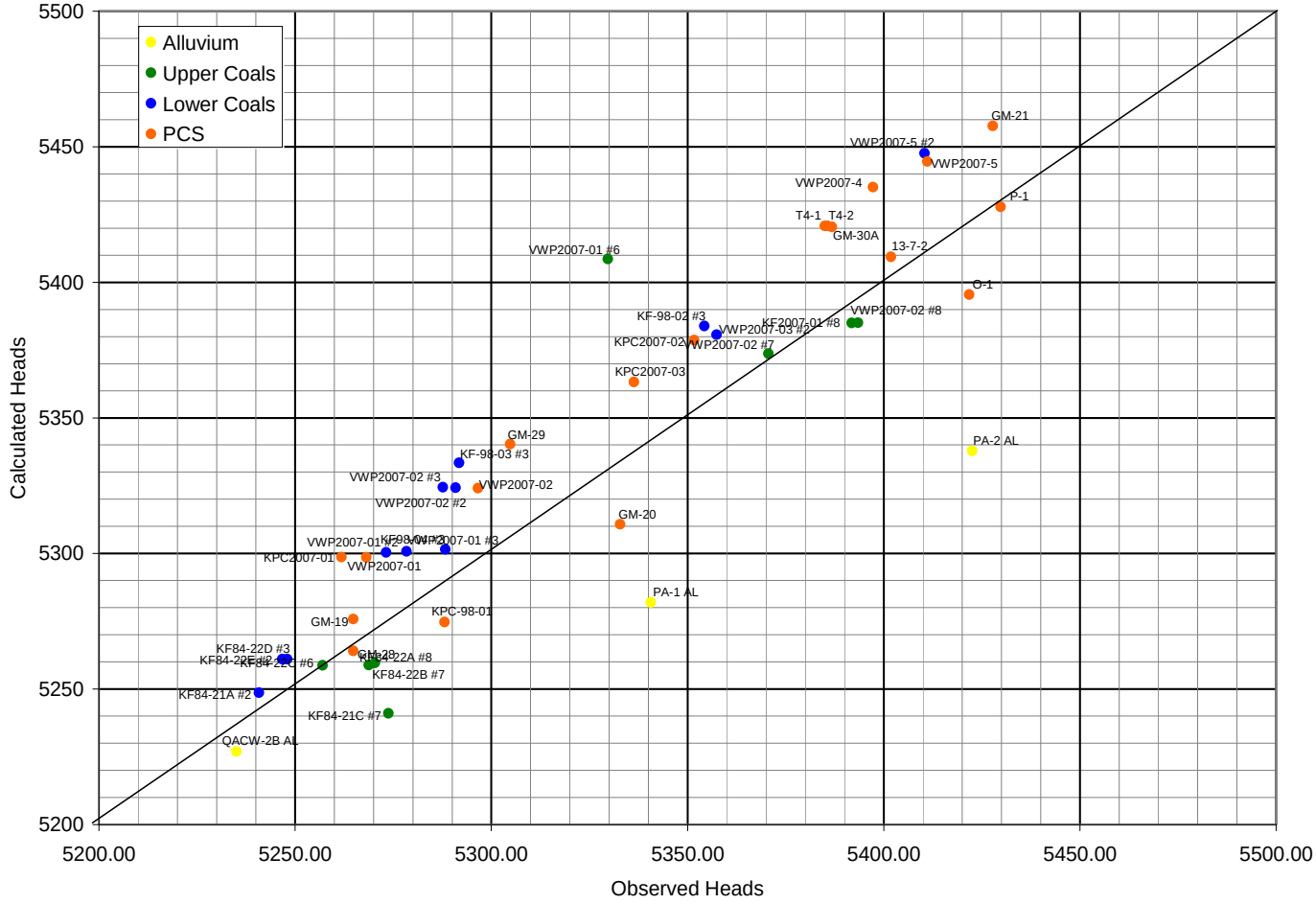


Figure 41.B.4-10 Sensitivity Analysis - Calculated versus Observed Heads - K_{al}=31 ft/d

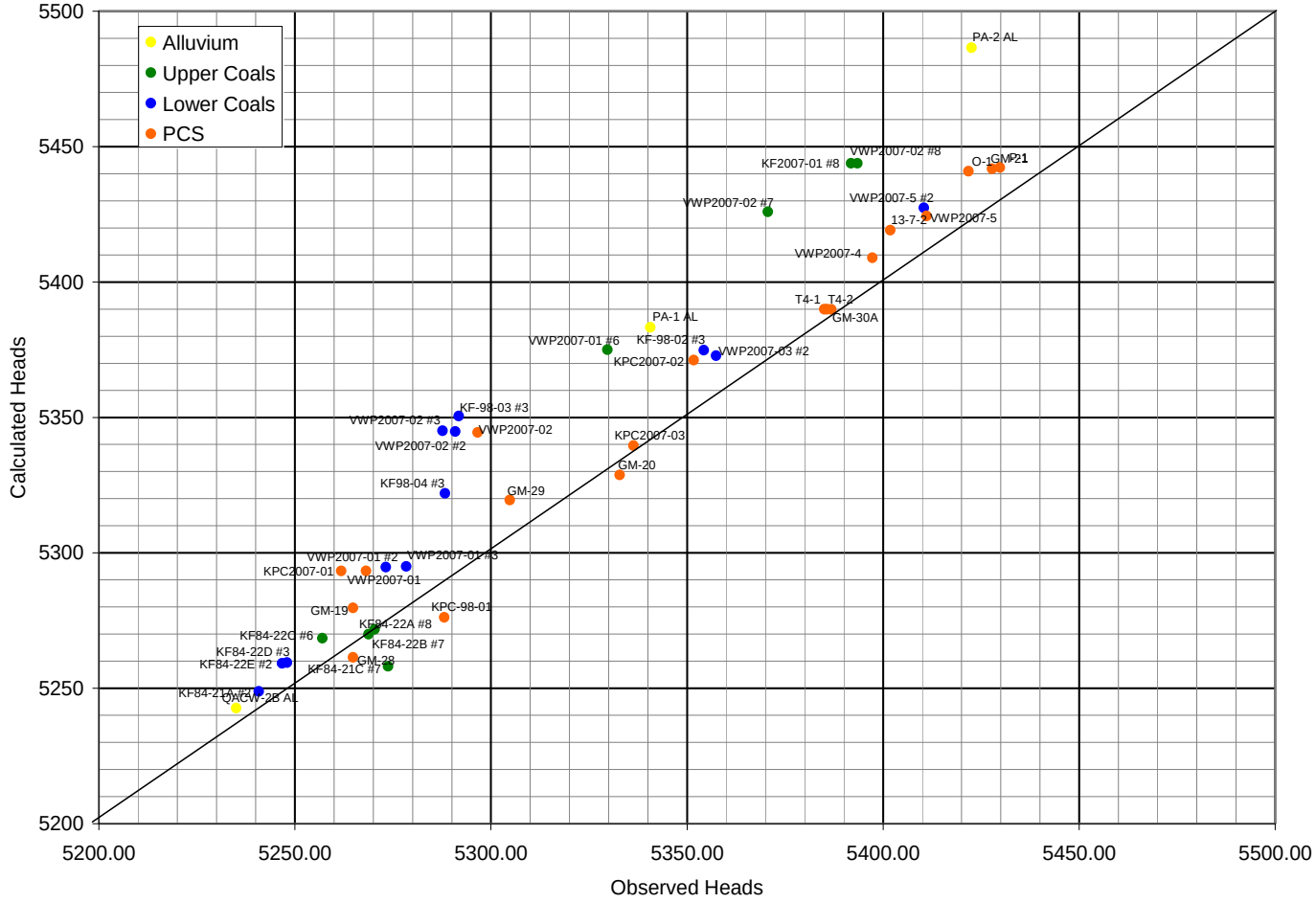


Figure 41.B.4-11 Sensitivity Analysis - Calculated versus Observed Heads - K_{al}=62 ft/d

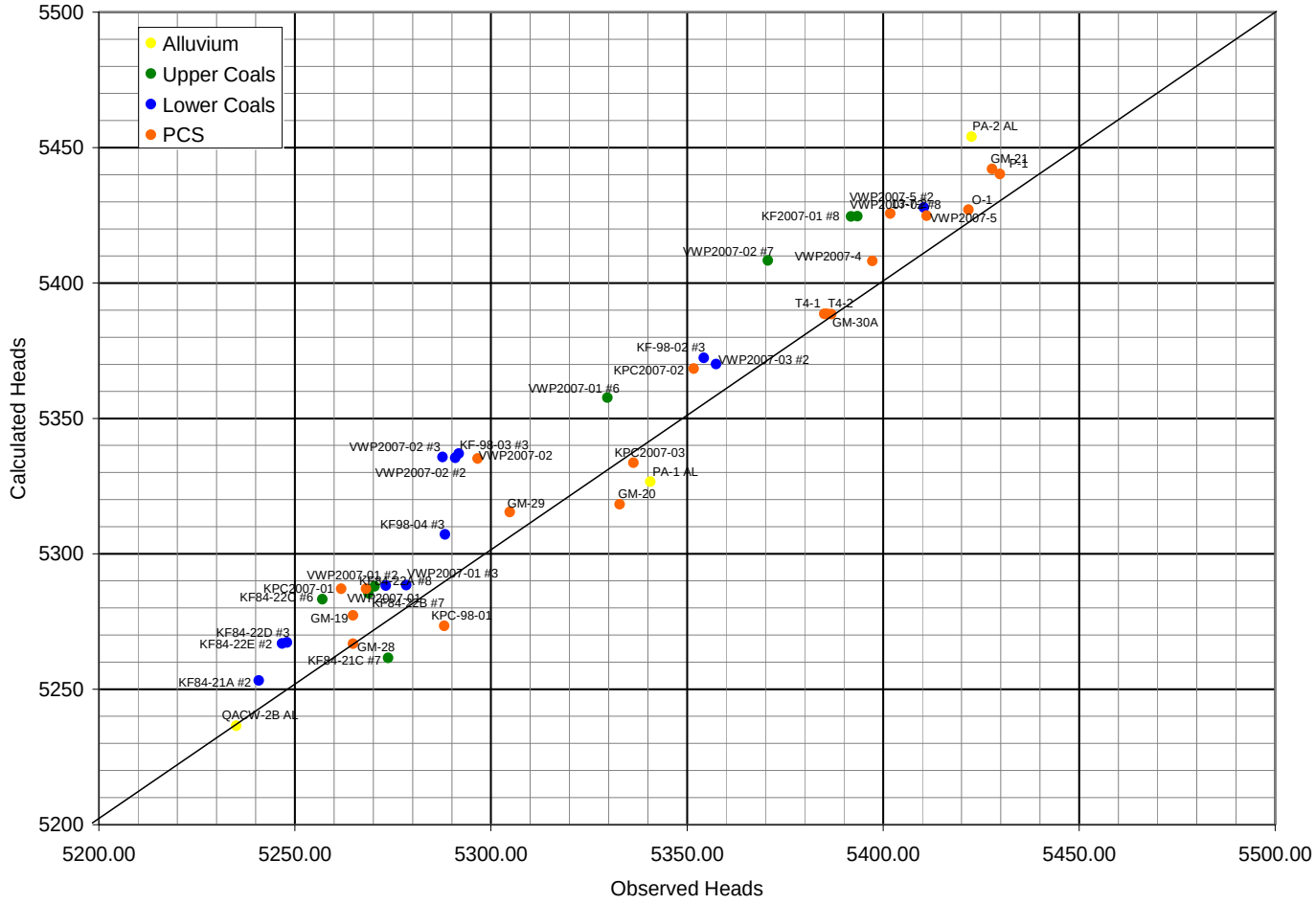


Figure 41.B.4-12 Sensitivity Analysis - Calculated versus Observed Heads - K_{al}=124 ft/d

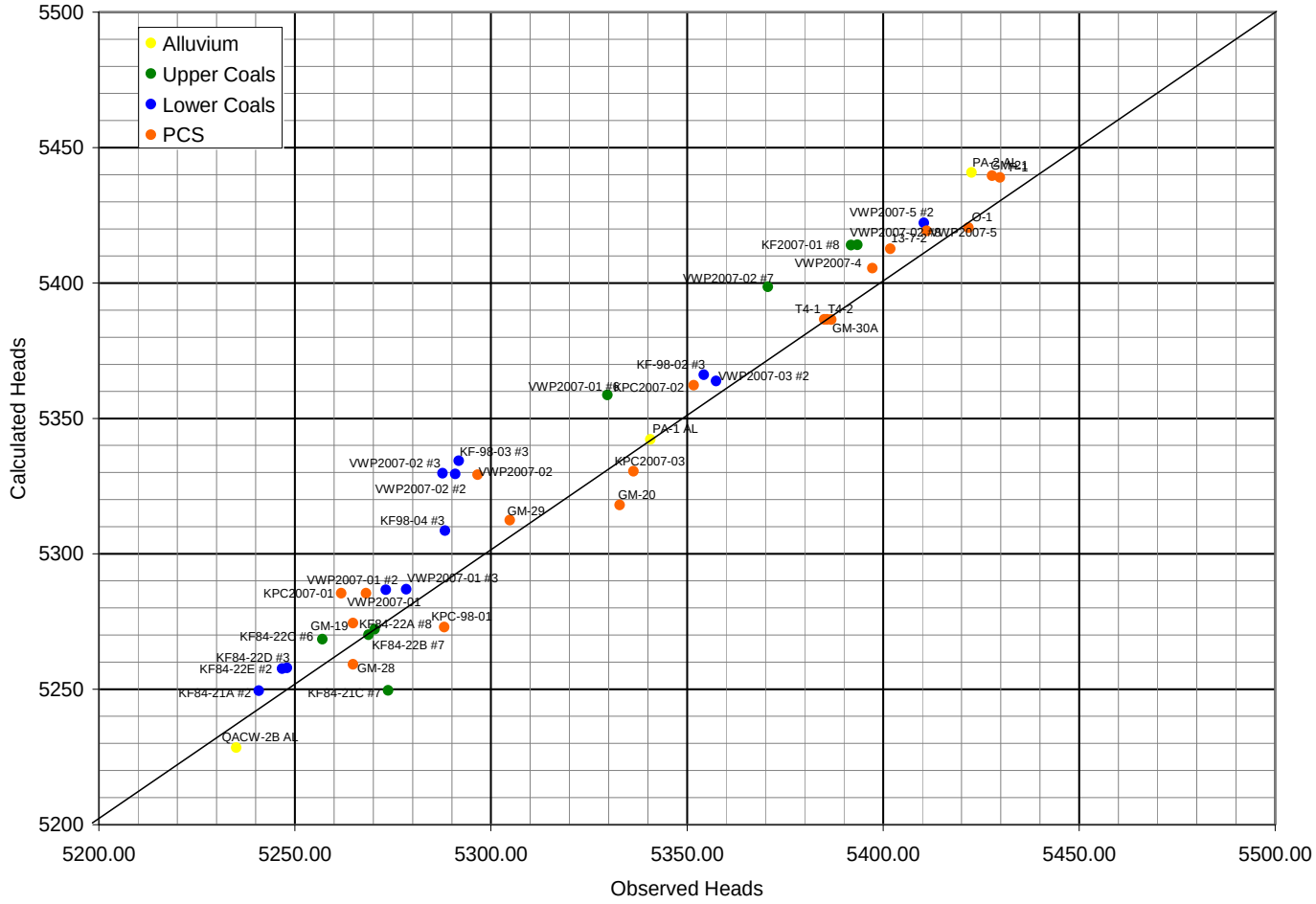


Figure 41.B.4-13 Sensitivity Analysis - Calculated versus Observed Heads - K_{al}=187 ft/d

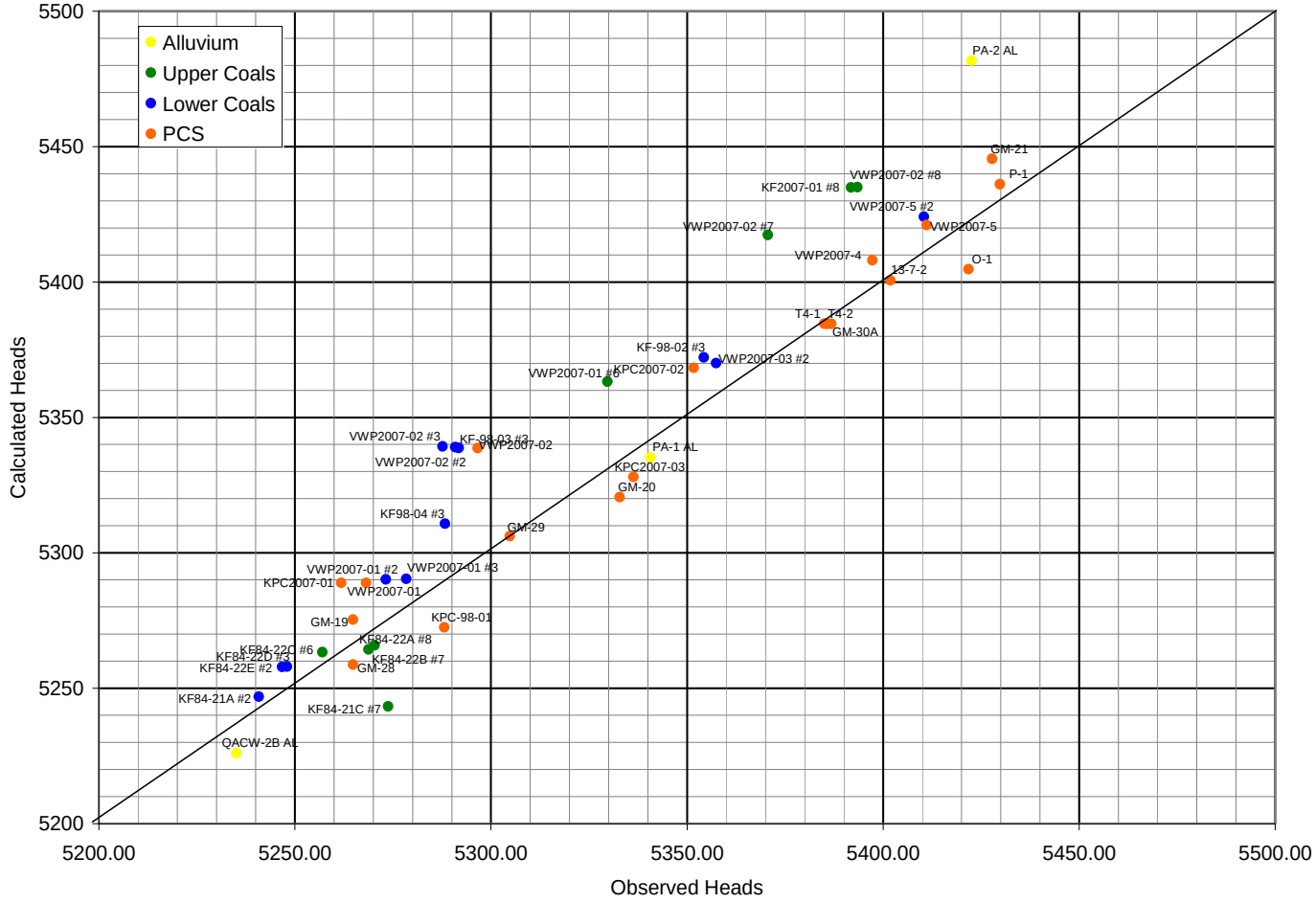


Figure 41.B.4-14 Sensitivity Analysis - Calculated versus Observed Heads - Leakage Coefficient=3x10^{-4}/d

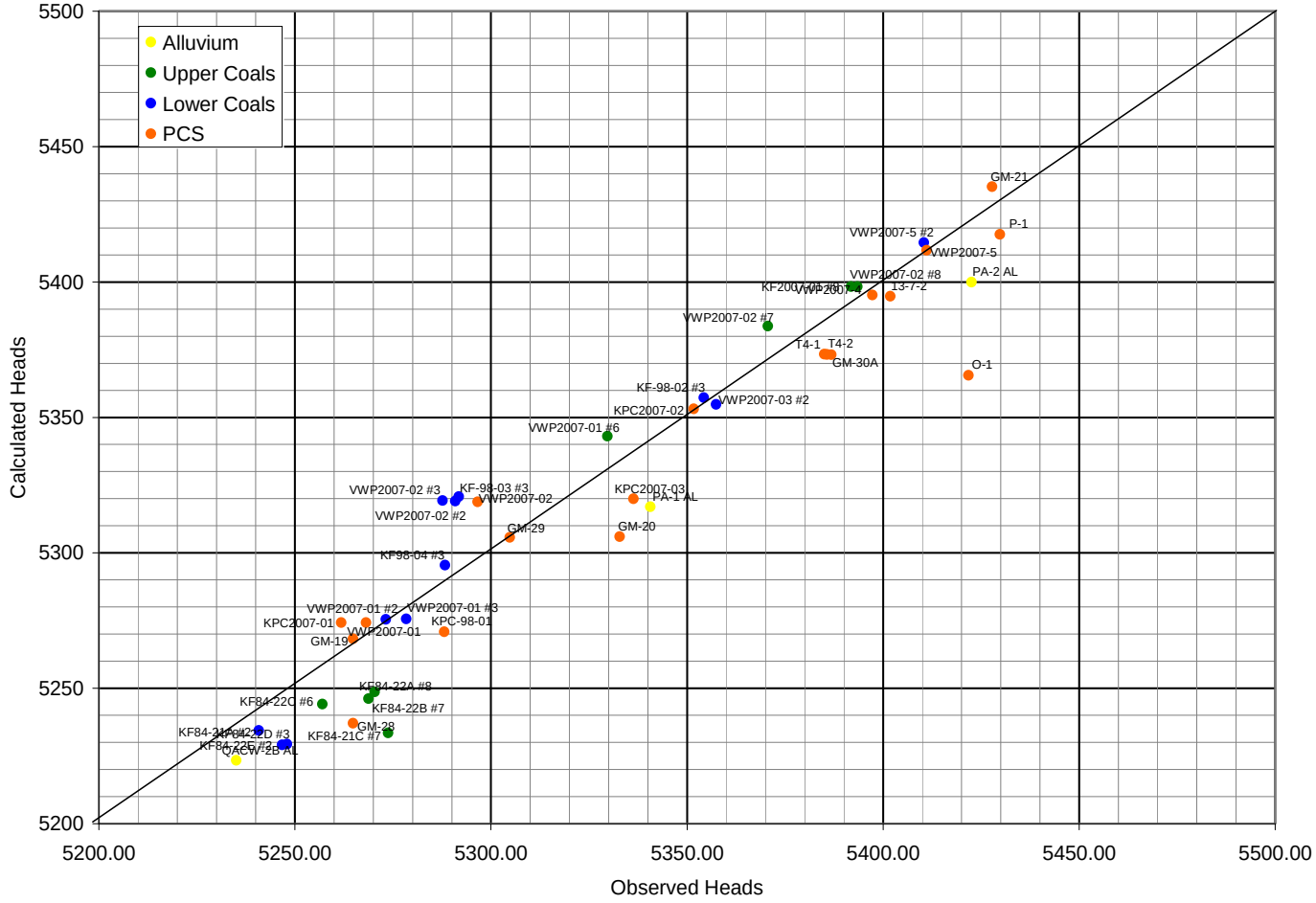


Figure 41.B.4-15 Sensitivity Analysis - Calculated versus Observed Heads - Leakage Coefficient = 1/2 Calibrated Value

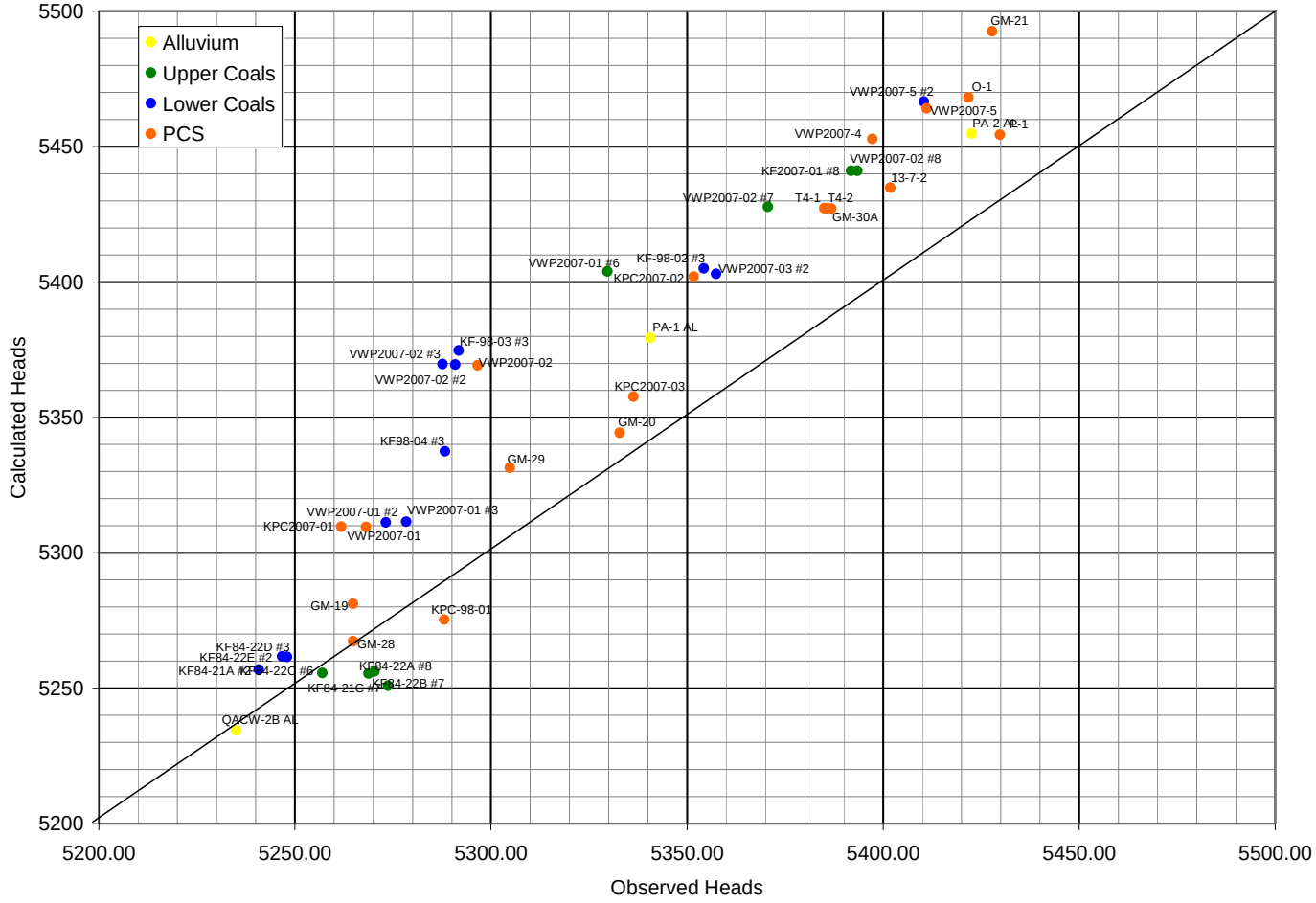


Figure 41B.4-16 Sensitivity Analysis - Calculated versus Observed Heads - Leakage Coefficient = 2x Calibrated Value

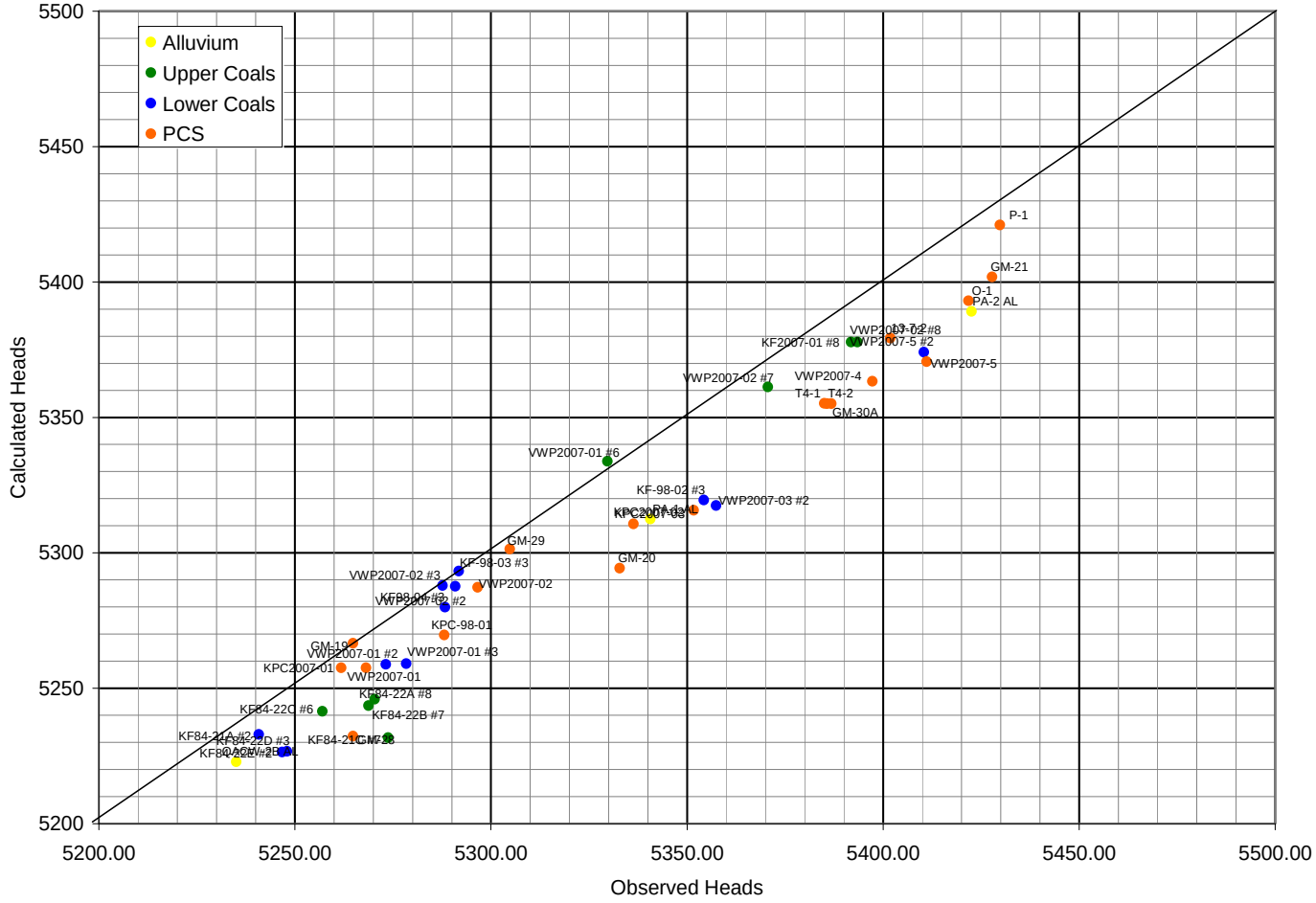


Figure 41.B.4-17 Sensitivity Analysis - Calculated versus Observed Heads - Recharge = 0.8 x Calibrated Value

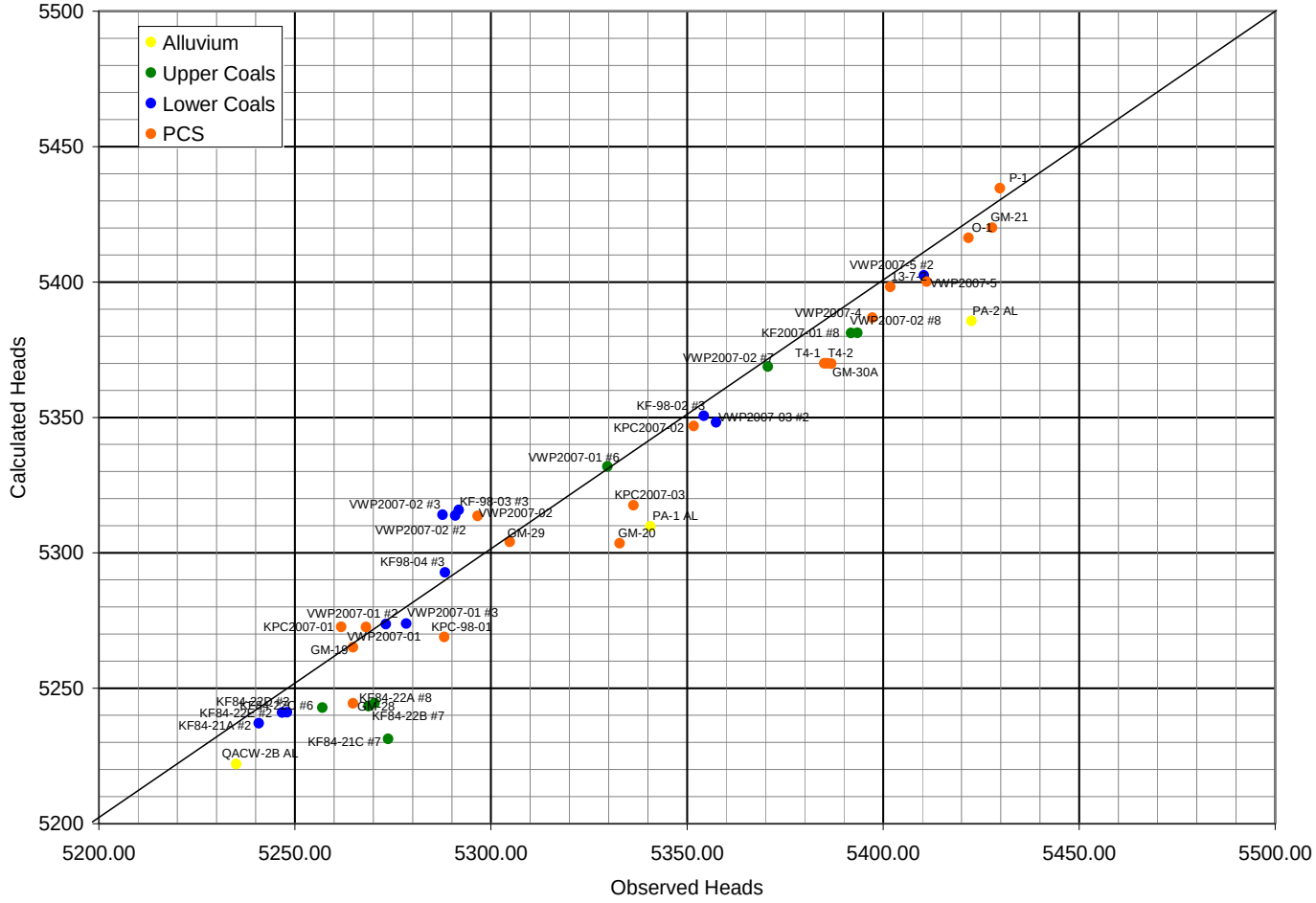


Figure 41.B.4-18 Sensitivity Analysis - Calculated versus Observed Heads - Recharge = 1.2 x Calibrated Value

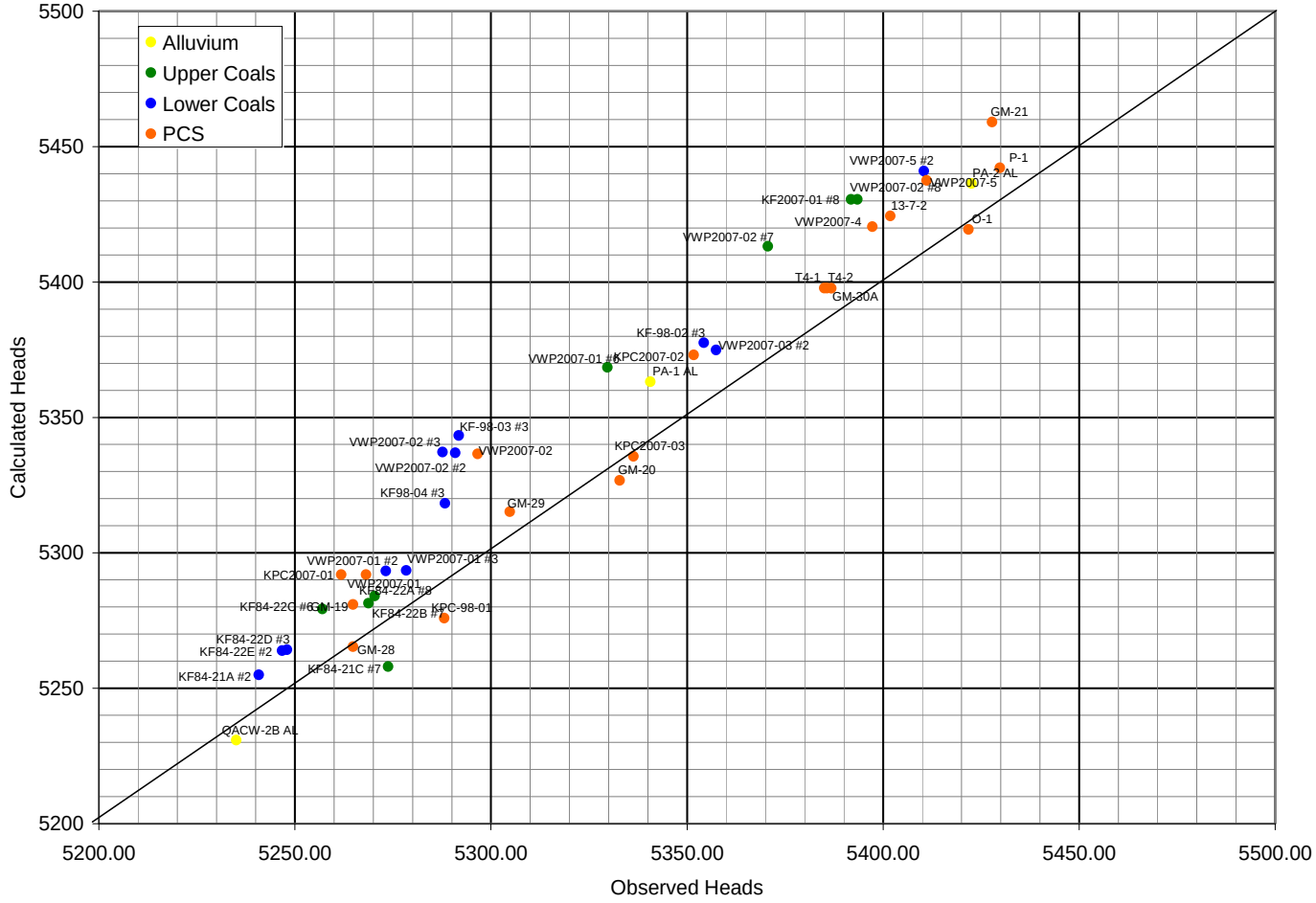


Figure 41.B.5-1 Mine Spoil and Coal Combustion By-product Minefill Locations

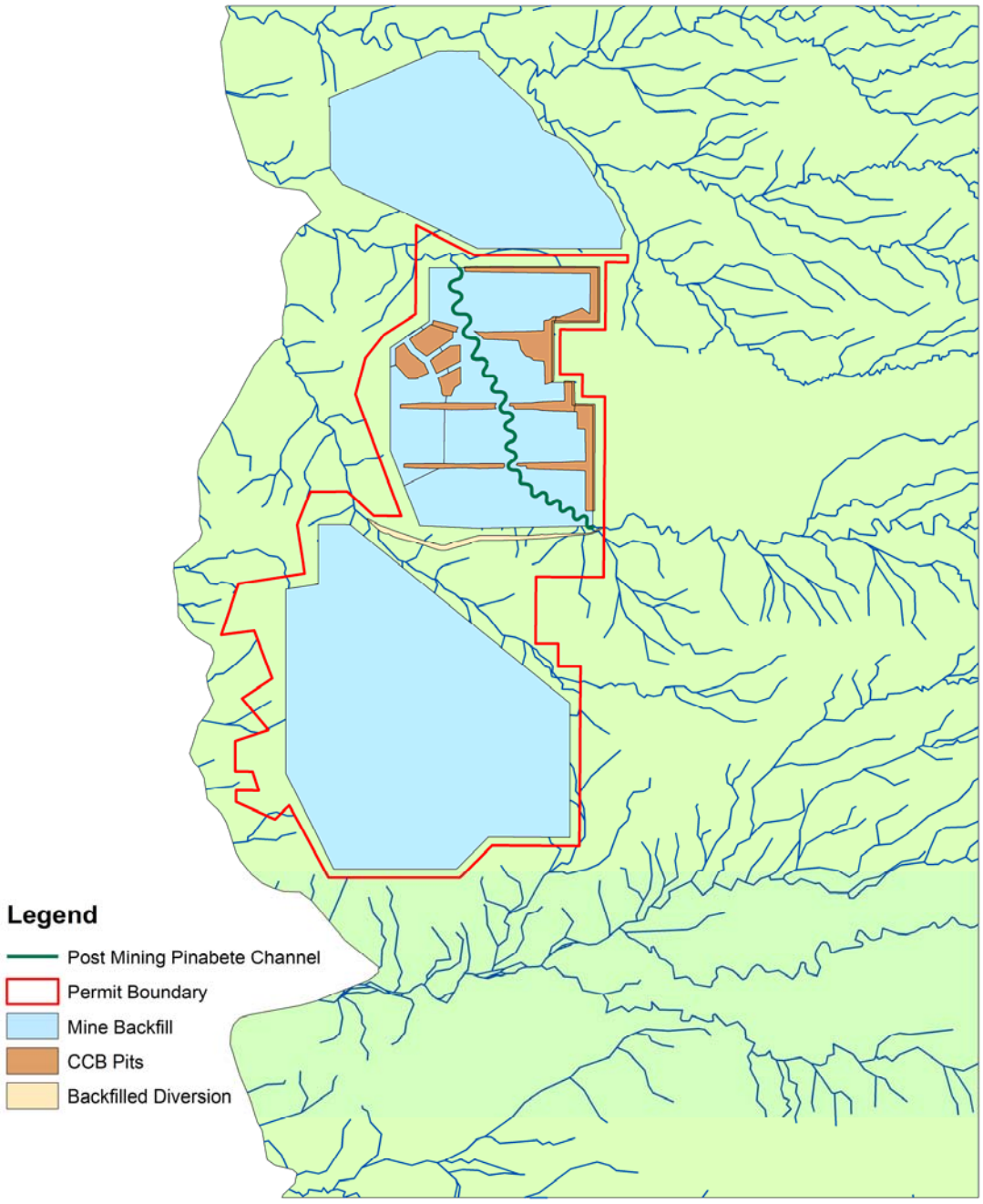


Figure 41.B.5-2 Post-mine Potentiometric Surface with Area 4 North Backfill – No. 8 Coal Seam

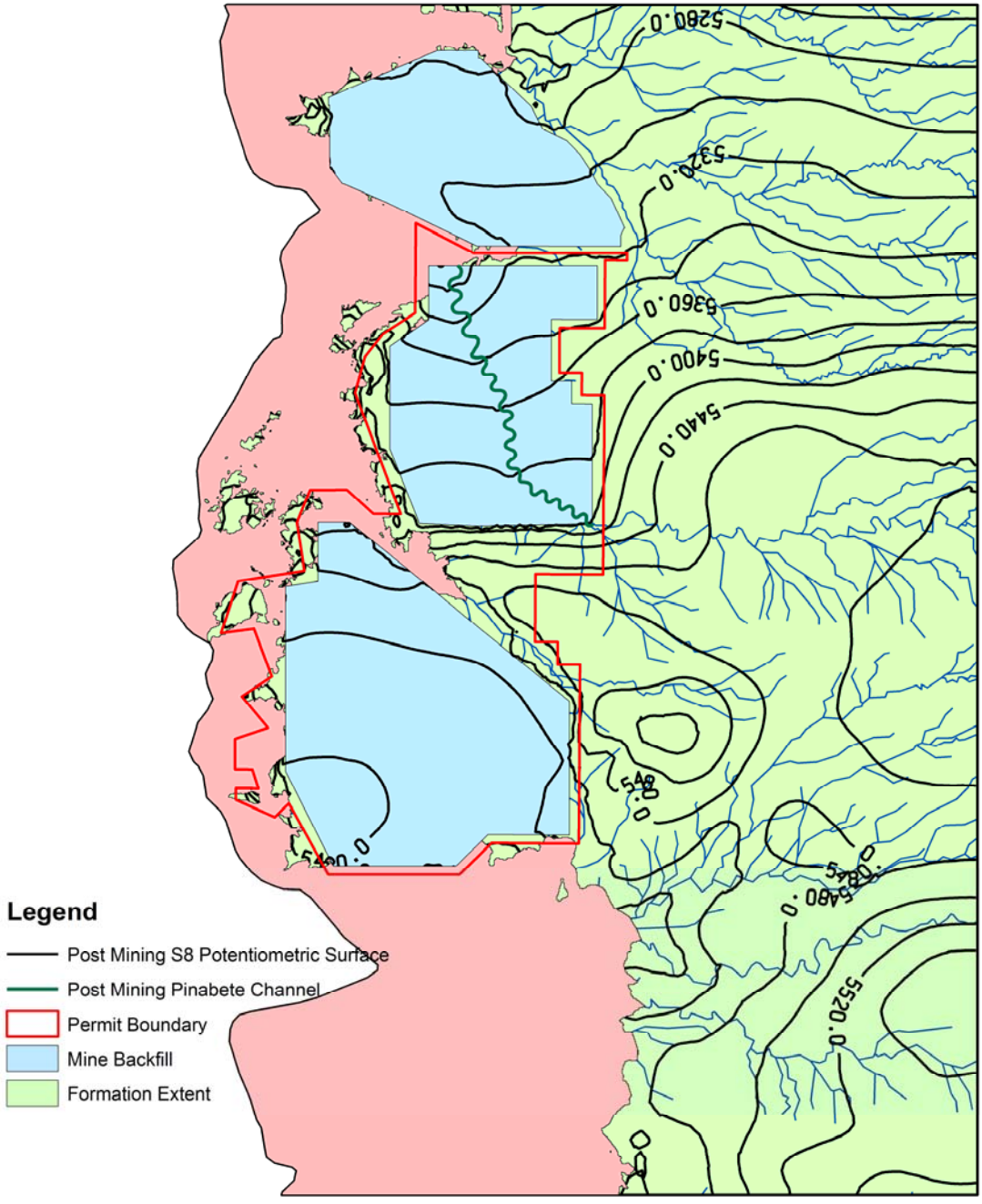


Figure 41.B.5-3 Post-mine Potentiometric Surface with Area 4 North Backfill – No. 3 Coal Seam

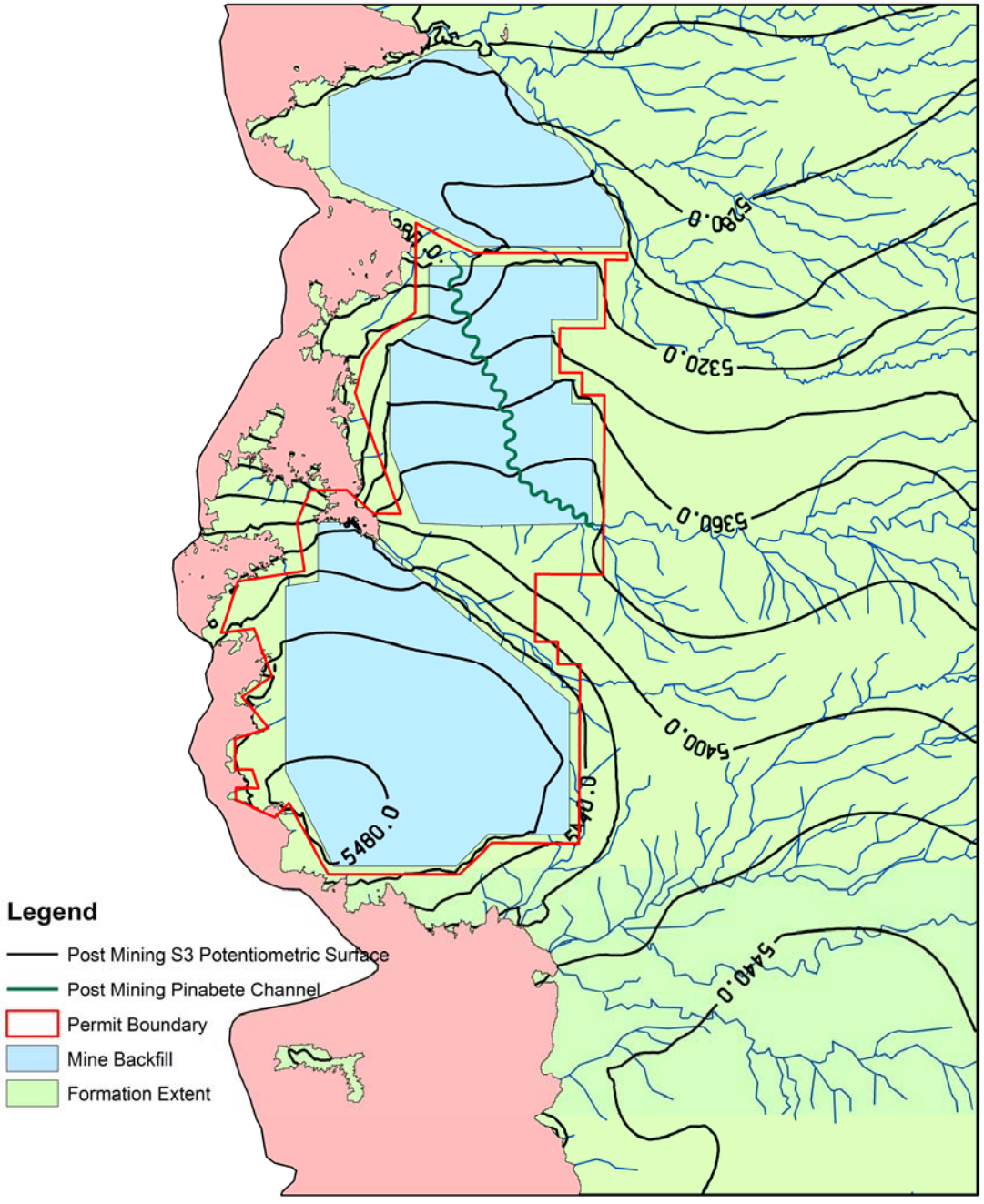


Figure 41.B.5-4 Post-mine Potentiometric Surface with Area 4 North Backfill - PCS

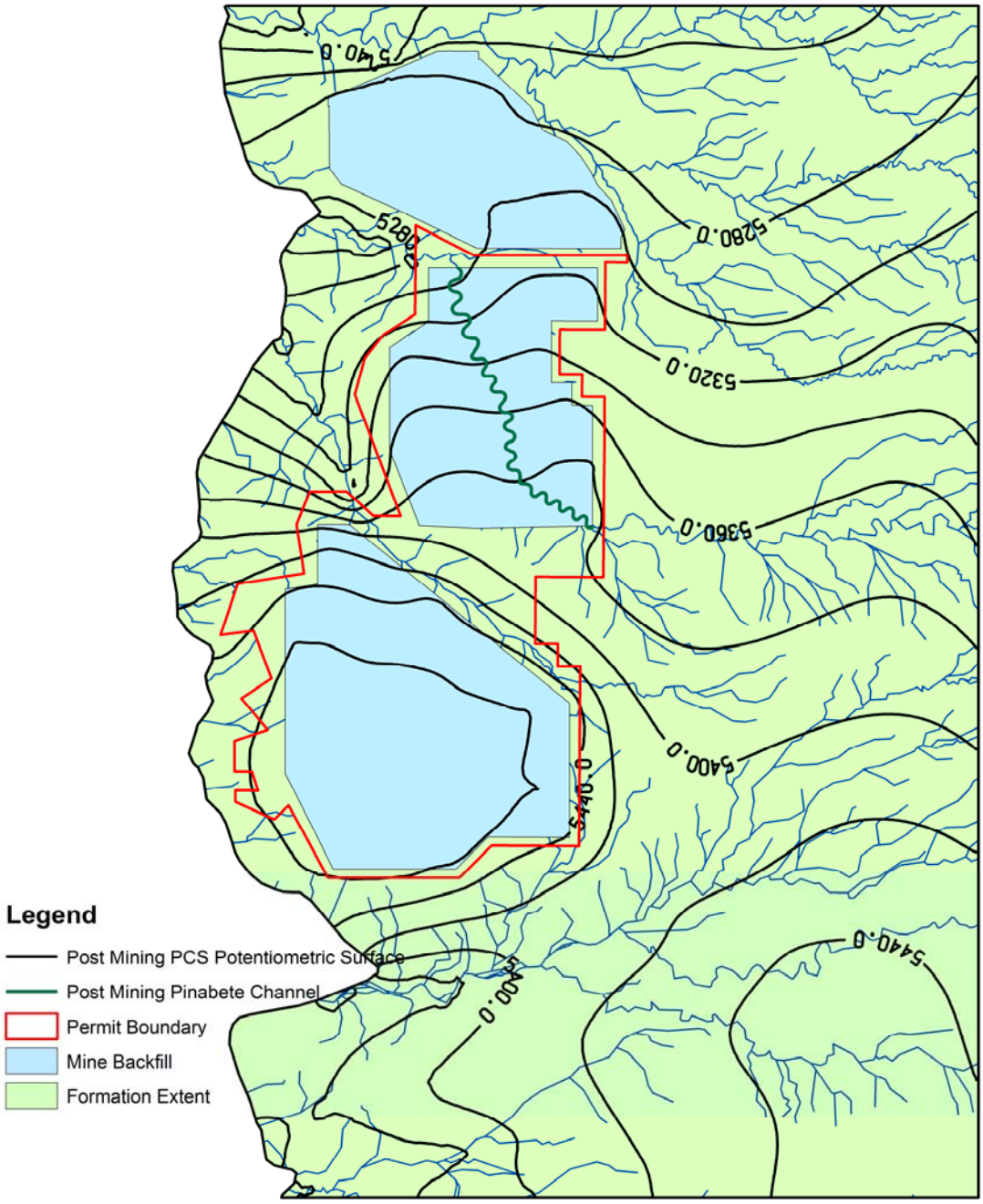


Figure 41.B.5-5 Total Dissolved Solids Transport in Model Layer 1 - Constant Source Condition with Area 4 North

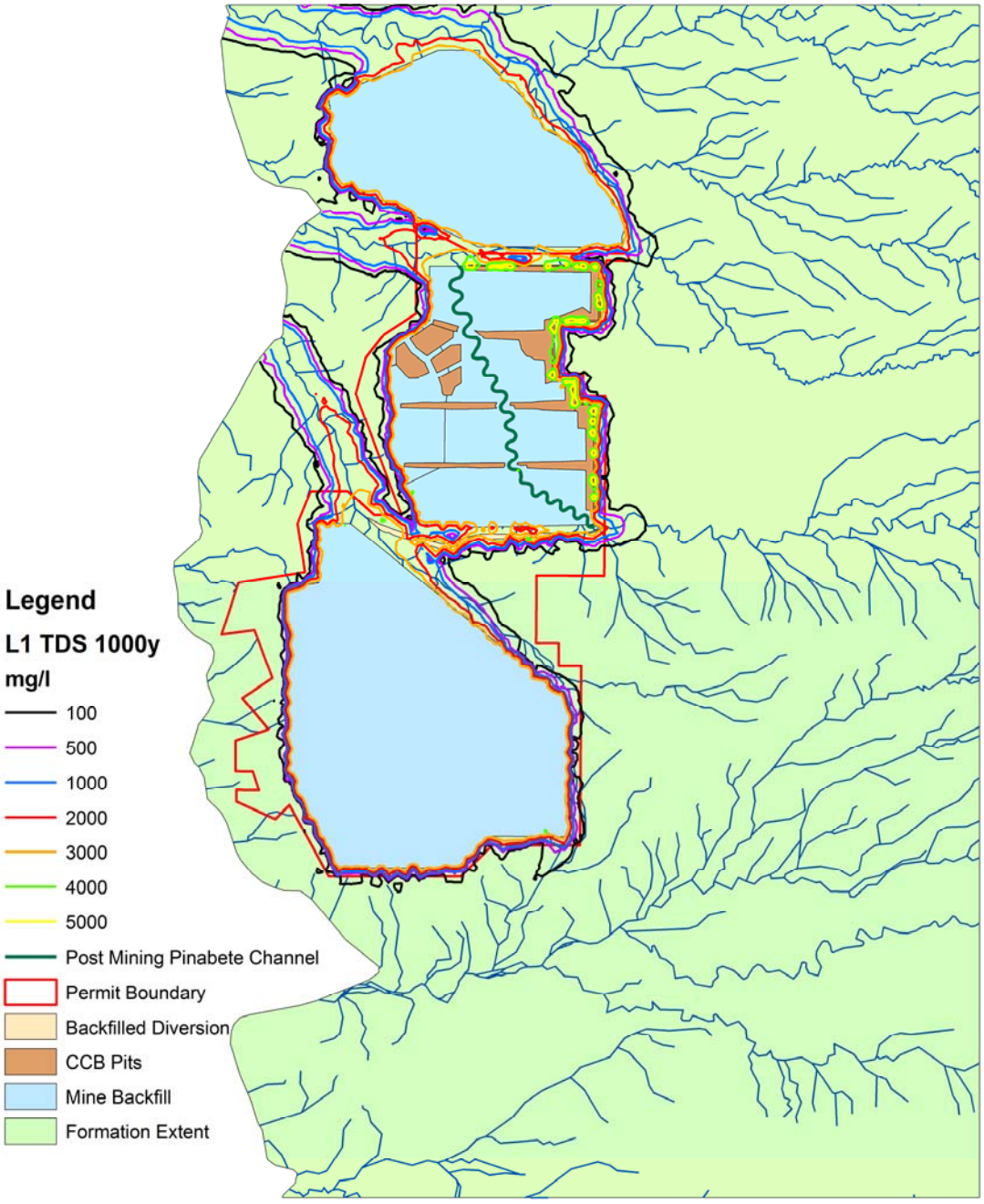


Figure 41.B.5-6 Total Dissolved Solids Transport in the No. 8 Seam - Constant Source Condition with Area 4 North

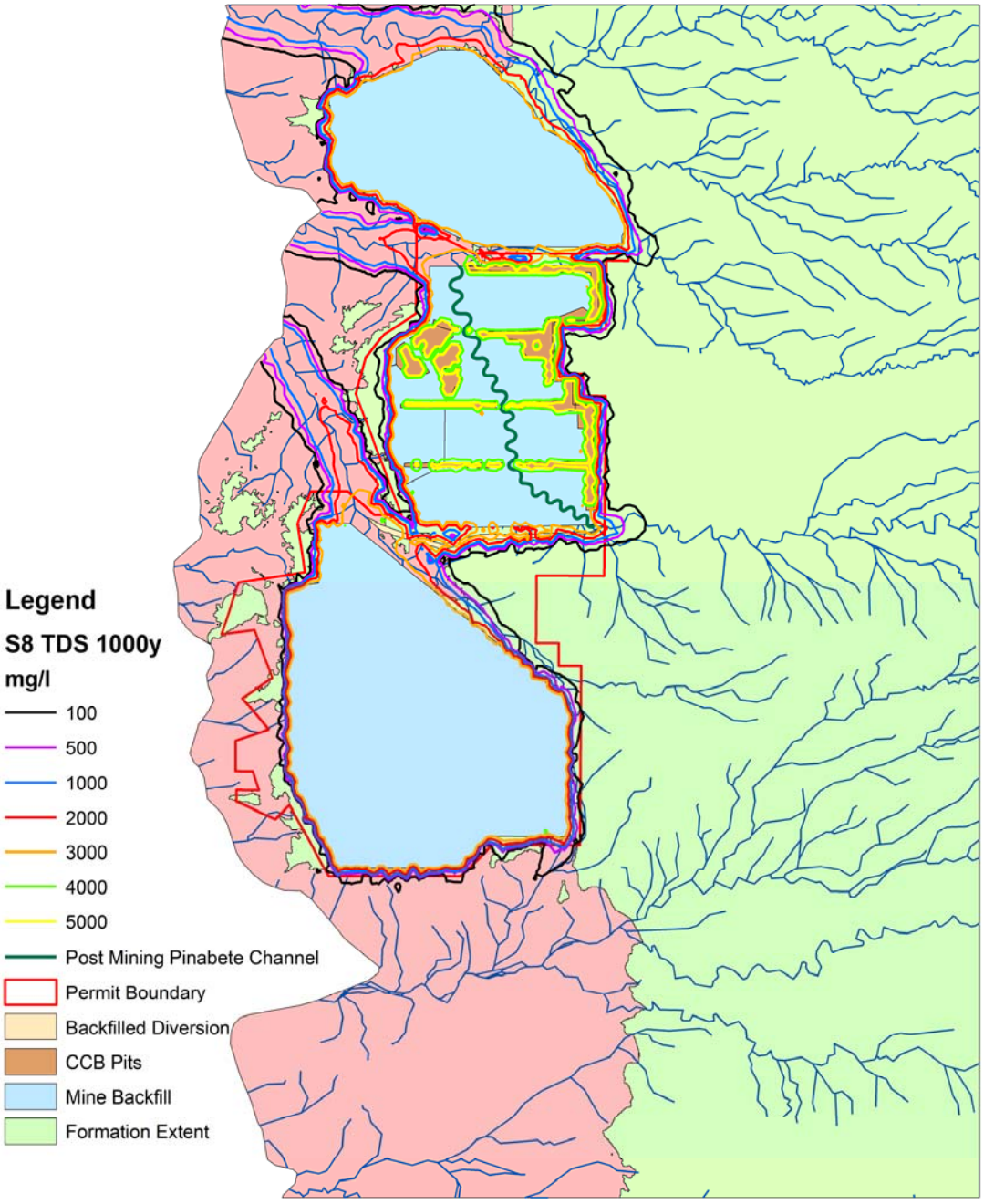


Figure 41.B-5-7. Total Dissolved Solids Transport in the No. 3 Seam - Constant Source Condition with Area 4 North

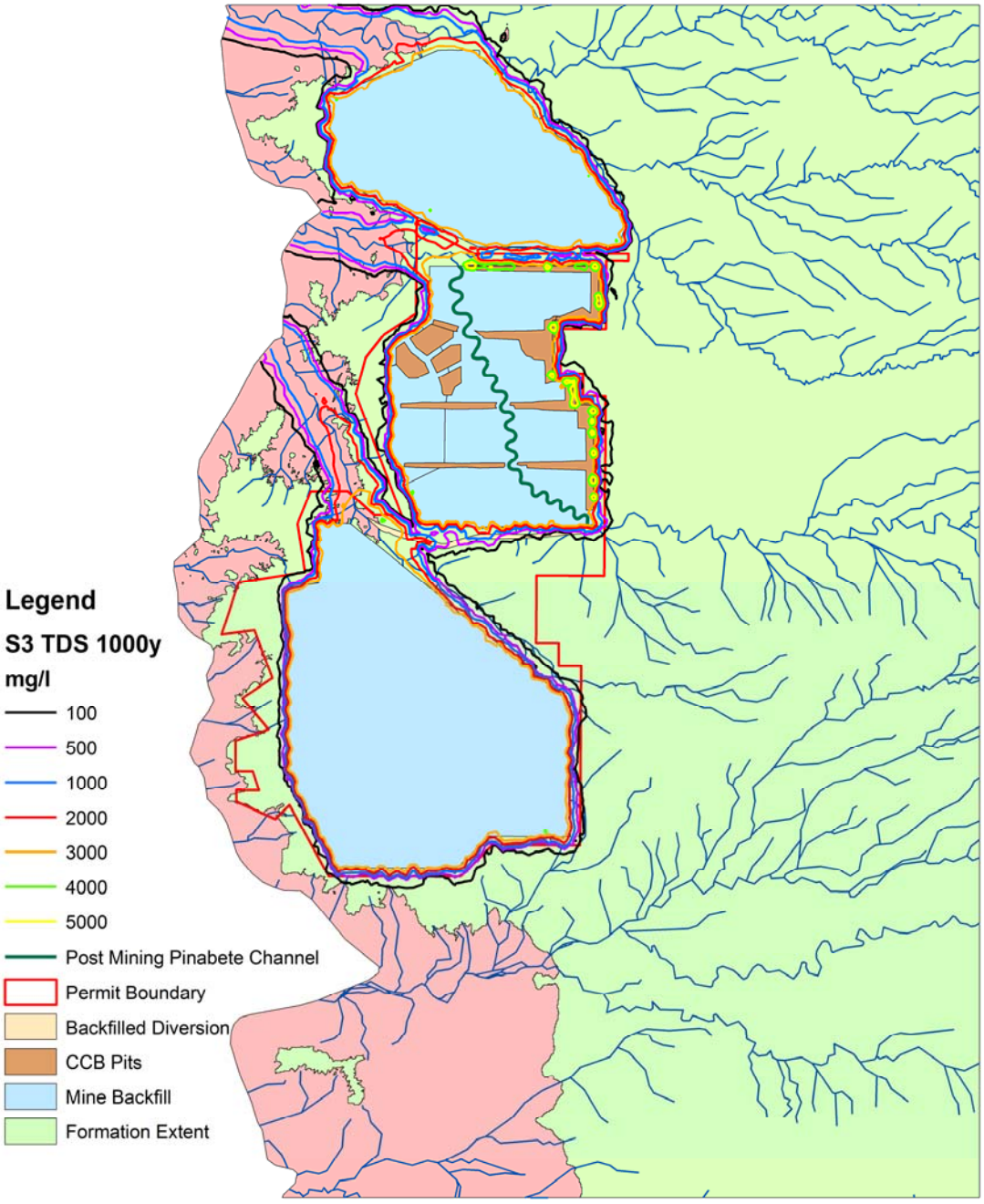
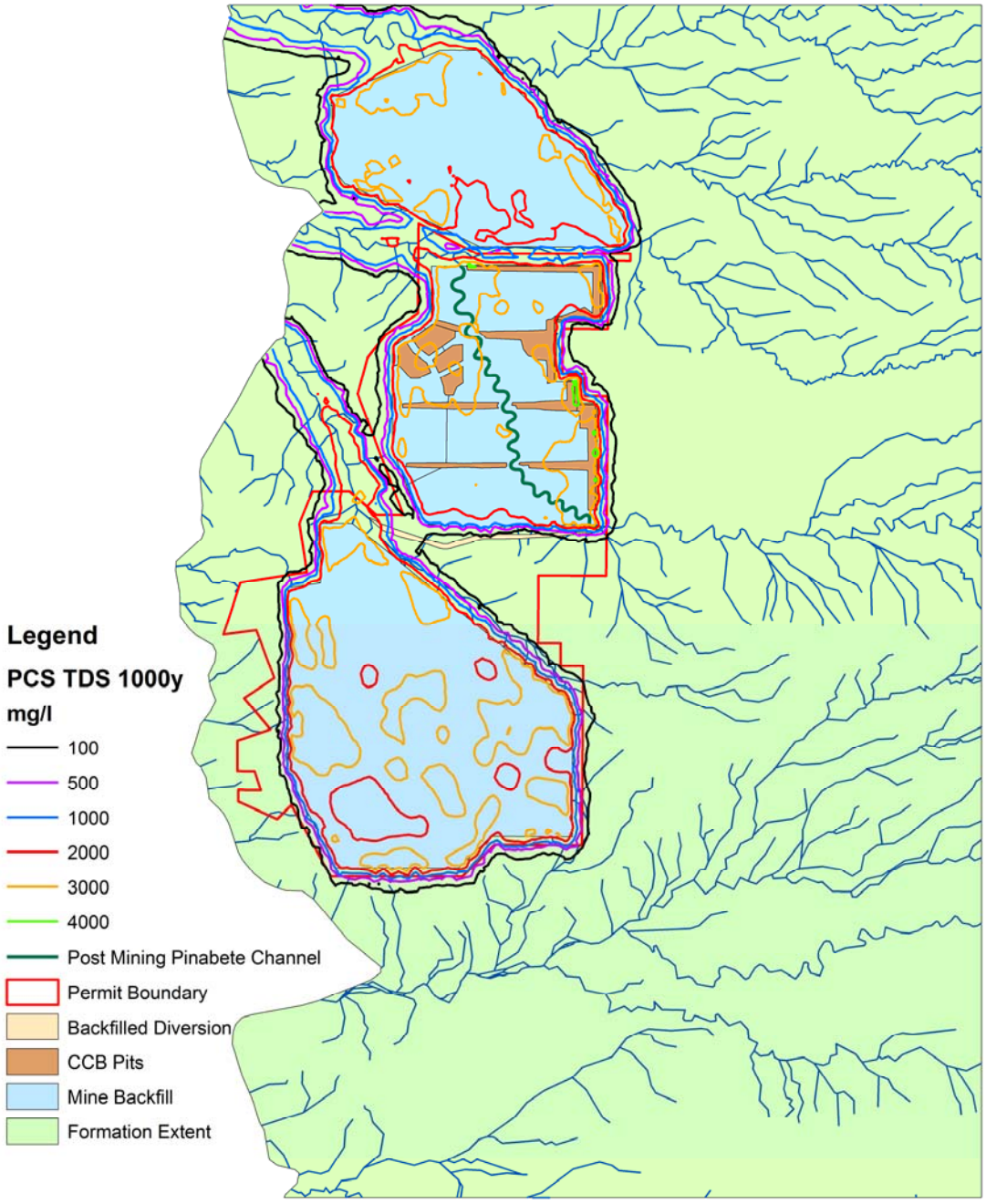


Figure 41.B-5-8. Total Dissolved Solids Transport in the PCS - Constant Source Condition with Area 4 North



Navajo Mine Groundwater Model

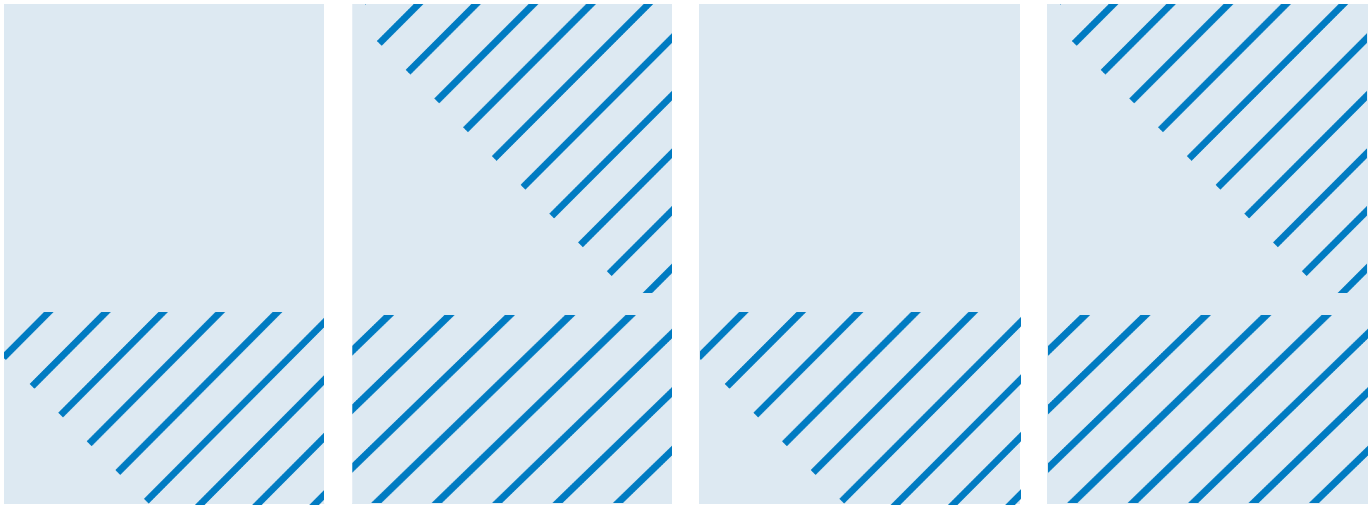
Prepared for
Navajo Transitional Energy Company

Prepared by
Barr Engineering Co.

September, 2025

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Navajo Mine Groundwater Model

September 2005

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1 Introduction

The Navajo Mine is located on the western flank of the San Juan Structural Basin within the Navajo Nation Indian Reservation, southwest of Farmington, New Mexico. It is operated by the Navajo Transitional Energy Company (NTEC), a tribally owned enterprise established in 2013. The lease associated with the Navajo Mine includes multiple areas, commonly referred to as Area 4 North, Area 4 South, and Area 5. Some of these areas are permitted for mining or are undergoing reclamation. The modeling associated with this report focused on the permit area that includes Area 4 South and Area 5. Mining in portions of Area 4 North was also included in the modeling, as it is adjacent to the permit area and planned to occur concurrently.

The coal seams targeted for mining are part of the Late Cretaceous Fruitland Formation, which is the shallowest coal-bearing unit in the region (U.S. Department of the Interior, 2015). The coal seams designated for extraction include Seams 2, 3, 4, 6, 7, and 8, with individual seam thickness reaching up to 6 meters (m) and averaging around 2m. These seams are interbedded, reflecting a transition from shallow marine to fluvial depositional environments.

At the Navajo Mine, coal is extracted using surface mining techniques, where overburden (the unconsolidated material and rock above the coal seams) is first removed to expose the coal. Once the coal seams are mined, the excavated pits are backfilled with the previously removed overburden and interburden materials. This process allows for contemporaneous reclamation to occur as mining progresses, rather than waiting until the end of operations. The backfill material may contain residual salts and trace elements, which can leach into groundwater over time. These contaminants are of concern in arid regions, where low precipitation and high evaporation rates limit groundwater recharge and increase the potential for concentration and migration of dissolved substances. To address these risks, the Surface Mining Control and Reclamation Act (SMCRA) permit for the Navajo Mine requires the operator to monitor groundwater quality and quantity within the area.

The former owner of the permit lease area had previously developed much of the information required for the permit expansion using a groundwater model but ultimately did not file the submittal. The previous groundwater model developed to support the permitting activities considered different conditions and constraints than what NTEC is planning for, and as such, NTEC retained Barr Engineering Co. (Barr) to develop a new groundwater flow and solute transport model for the site to evaluate the impact of mining and reclamation in the permit area.

1.1 Objective

This technical memorandum provides the results of the numerical groundwater flow and solute transport modeling, which was developed to evaluate potential impacts of mine activities and reclamation on groundwater balance and water quality. In particular, numerical groundwater flow and transport modeling were used to assess:

- Potential mine-pit inflows from both coal seams and the underlying Pictured Cliffs Sandstone (PCS)
- Disruption of the shallow alluvial aquifer within the Pinabete Arroyo during mining and subsequent reclamation of the alluvial material

- Drawdown and future recovery of groundwater levels in the alluvial aquifers, Fruitland coals, and PCS
- Possible changes in groundwater quality resulting from mining and reclamation
- The rate and extent of saturation of the mine backfill
- Potential changes to the overall hydrogeologic system during mining and reclamation

NTEC staff provided project information and references that Barr used to develop an understanding of the Conceptual Site Model (CSM) of current and future conditions associated with the permit area. This information was reviewed and considered for the development of the groundwater model described below.

2 Modeling Approach

A numerical groundwater flow and solute transport model was developed to support permitting of Area 4S and Area 5, currently referred to as the No Name permit area.

2.1 Model Code Selection

MODFLOW was developed by the U.S. Geological Survey (USGS) and is widely used and accepted in the industry. MODFLOW 6 (Langevin et al., 2021) is the current version supported by the USGS. MODFLOW 6 was the modeling code selected for simulation of three-dimensional, steady-state hydraulic head and groundwater flow in the project area. MODFLOW 6 contains two types of hydrologic models, the Groundwater Flow (GWF) model and the Groundwater Transport (GWT) model. The GWF model is based on a generalized control-volume finite-difference (CVFD) approach in which a model cell can be hydraulically connected to any number of surrounding model cells. The GWT model simulates three-dimensional transport of a single solute species in flowing groundwater. The GWT model solves the solute transport equation using numerical methods and a generalized CVFD approach. Both GWF and GWT models can use a Newton-Raphson formulation for calculating complex water-level problems. Model development was supported by Groundwater Vistas v.9, a graphical user interface for MODFLOW that facilitates model building, calibration, and analysis, and FloPy, a Python-based scripting interface for MODFLOW, used for assisting model setup and post-processing. Some components of model development were performed outside of these platforms to accommodate project-specific needs.

3 Conceptual Model

The conceptual site model (CSM) provides a narrative description of the physical processes within the groundwater system and identifies all relevant components that can be translated into a numerical model. The CSM serves as the foundation for numerical modeling and considers hydrogeologic, geochemical, and climatic data specific to the site.

The CSM builds upon the groundwater model initially developed by Norwest Applied Hydrology (Norwest Applied Hydrology, 2009; Norwest Corporation, 2013) and incorporates newly collected field data. Key updates include expansion of the model domain to cover several subwatersheds, revisions to the hydrostratigraphy within the mine area, updating the model excavation and backfilling plan, and adjustments to the representation of surface water bodies and climatic conditions. Detailed descriptions of these components are provided in the following subsections.

3.1 Hydrostratigraphic Framework

The Navajo Mine is situated on the western flank of the San Juan Basin, a structurally asymmetric depression at the eastern edge of the Colorado Plateau. The basin features a gently dipping southern flank and a steeply dipping northern flank, with a northwest-trending axis aligned with the Hogback Monocline.

The stratigraphy in the mine area reflects a Late Cretaceous transition from shallow marine to terrestrial fluvial depositional environments (Kelley, 1972). The primary geologic formations in ascending order (oldest/deepest to youngest/shallowest) are (Kernodle, 1996; Brister and Hoffman, 2002):

- Lewis Shale: Represents the final marine phase of the Western Interior Seaway. It consists of dark gray to black shale with interbeds of sandy limestone, sandstone, and bentonite. This unit often acts as a regional confining layer due to its low permeability.
- Pictured Cliffs Sandstone (PCS): Overlying the Lewis Shale, the PCS comprises delta-front and barrier-beach sediments. It marks a shift to nearshore environments and is characterized by a coarsening-upward sequence of fine to medium-grained sandstone and interbedded shale, with a thickness of approximately 33-35m in the permit area.
- Fruitland Formation: Overlying the PCS, this formation contains the coal seams mined at the Navajo Mine. Deposited in swampy deltaic conditions, it includes interbedded sandstone, shale, and coal. The coal seams are laterally extensive and gently dip eastward. The Fruitland Formation is subdivided into coal seams numbered from 2 to 8, with numbers 1 and 5 absent in the permit area. The Fruitland Formation is hydrologically complex due to its interbedded coal seams and shales. While coal seams exhibit relatively low hydraulic conductivity, they are more permeable than the surrounding shales, resulting in vertical potentiometric gradients.
- Kirtland Shale: Overlying the Fruitland Formation, the Kirtland Shale consists of claystone shales with minor siltstone and sandstone interbeds. It lacks coal beds and often serves as a regional confining unit.

Surface geology includes thin soils, underlain by weathered shale and sandstone, unconsolidated eolian sands, and Quaternary alluvial deposits. These alluvial materials are particularly prominent along ephemeral stream channels and arroyo systems, where they are reported to be approximately 3 to 5m thick (Ensolum, LLC., 2023). The overburden across the site ranges from just a few meters to over 25m, increasing from west to east.

3.2 Model Domain

The groundwater model domain encompasses the permit area and extends approximately 1 kilometer (km) west to the western extent of the PCS, where it outcrops, and 18km east. The eastern edge of the domain was chosen to be sufficiently far from the permit area such that boundary conditions would not affect the results, and also align with watershed divides (Figure 1). The southern and northern boundaries of the domain are located approximately 7km and 10km beyond the permit area, respectively.

3.3 Model Discretization

The model discretization uses the DISV (Discretization by Vertices) package of MODFLOW, which allows flexible polygonal cell geometry. Horizontally, the model domain was discretized on a rectangular grid with a maximum spacing of 1000m and was gradually refined to a spacing of 62.5m within and immediately around the permit area (Figure 1) to allow for detailed simulation of dewatering from excavation zones and potential seepage from mine backfill.

Vertically, the model comprises 16 numerical layers to form a 3D hydrogeologic domain. The uppermost two layers represent surface geology, with Layer 1 representing unconsolidated deposits (assumed to be no more than 5m thick) and Layer 2 representing overburden materials. The elevation of the top of Layer 1 was defined using USGS digital elevation model (DEM) data representing the surface elevation. Layers 3 through 13 include coal seams 8, 7, 6, 4, 3, and 2, along with their respective interburden layers. Layer 15 represents the PCS, which serves as the basal hydrogeologic unit. Although the Lewis Shale is recognized as hydraulically influencing flow in the PCS (Norwest Applied Hydrology, 2009), site-specific thickness data for the Lewis Shale were unavailable. To represent potential flow exchange between the PCS and the Lewis Shale, an additional layer (Layer 16) was added below the PCS with an assumed thickness of 100m. This layer was included specifically to allow the assignment of a boundary condition simulating hydraulic interaction between the two formations and is not specified to represent the actual thickness or groundwater flow within the Lewis Shale.

3.4 Simulation Period and Stress Conditions

The model simulation was designed to capture temporal changes in hydraulic head and TDS concentrations from pre-mining conditions through active mining and reclamation, continuing for 1000 years after mining ends. For the purposes of this model, mining begins in the No Name permit area in 2026, however actual commencement of mining and annual progression of pits may fluctuate due to demand.

- Stress Period 1 represents pre-mining, steady-state conditions, with groundwater storage excluded.
- Stress Periods 2 to 29 represent transient conditions during the active excavation and backfilling phases. These periods span from 2026 to 2165 and are structured in 5-year increments for model implementation.
- Stress Period 30 represents the long-term post-mining period, covering 1000 years (2165–3165), to evaluate long-term trends in groundwater head and TDS after excavation and backfilling have ceased.

3.5 Model Boundary Conditions

Boundary conditions that control how water enters or exits the model domain to reflect real-world hydrogeological conditions more effectively. The model incorporates multiple types of boundary conditions to simulate various hydrogeological conditions and mine operations and to define regional flow directions and gradients.

3.5.1 No Flow Boundary Condition

No-flow boundaries in the groundwater model were defined based on physical and geological constraints, particularly where hydrostratigraphic units outcrop west of the permit area. Regional and site-specific geologic cross-sections indicate that the stratigraphic units dip eastward. Individual coal seams and interburden layers within the Fruitland Formation and overlying alluvium thin and/or outcrop to the west of the permit area. Where the topography is lower in elevation toward the Chaco River, these units have been errored and are not present. Where this occurs, layers representing these units are set as no-flow (or inactive) boundaries. In these areas, alluvium and near-surface materials (layers 1 and 2) are either not present (as the bedrock outcrops) or are unsaturated. Therefore, the same no-flow boundary condition was applied to these upper layers.

Additionally, a no-flow boundary condition was assigned to the western edge of the model domain in layers 15 and 16, consistent with the extent of the PCS.

3.5.2 Aquifer Recharge

The model domain lies within an arid portion of the San Juan Basin, where climatic conditions limit natural groundwater recharge. Average annual precipitation is less than 15 centimeters (cm), while evaporation rates exceed 140cm per year (OneMine, 1991). Precipitation typically occurs during short-duration, high-intensity storm events between July and November, with minimal snowfall that rarely contributes meaningfully to recharge.

Recharge estimates for the groundwater model were based on the conceptual framework developed for previous groundwater modeling at the Navajo Mine (Norwest Corporation, 2013), which incorporated values reported by Stone (1984, 1986, 1987) using chloride mass balance methods. These methods are well-suited for arid environments and provide reliable estimates of recharge across different geomorphic settings. Stone reported recharge rates ranging from 0.005 to 0.2cm per year in undisturbed areas. The lowest rates were observed in badlands terrain (0.005cm/year), which dominates the drainage basins of Cottonwood Arroyo, Pinabete Arroyo, and No Name Arroyo. These areas are characterized by sodic clay soils with low permeability and high runoff, which may limit infiltration. In contrast, valley terraces exhibited the highest recharge rates (0.2cm/year), while upland flats averaged approximately 0.03 inches (in)/year.

Recharge from precipitation was implemented in the groundwater model using the MODFLOW Recharge Package (RCH Package) (Langevin et al., 2021). Following the approach used for previous modeling, Stone's recharge estimates were spatially distributed across the model domain by correlating geomorphic categories with slope ranges derived from the USGS digital elevation model (DEM) data (Figure 2). Recharge was applied to the uppermost active layer. These recharge rates were then adjusted during model calibration to better match observed water levels and flow patterns.

For the predictive model, it was assumed that the recharge rates during and after mine activities are equivalent to the calibrated recharge rate used for the pre-mining steady-state model.

3.5.3 Ephemeral Streams and Tributaries

The permit area is characterized by badlands and mesas, with the ephemeral Chaco River running approximately one mile west of the site in a south-to-north direction. The Chaco River eventually joins the San Juan River about 18 miles northwest of the No Name permit area. Several ephemeral streams and

arroyos traverse the permit area, along with their numerous tributaries (U.S. Environmental Protection Agency., 2025) (Figure 3):

- Pinabete Arroyo flows northwest through Area 4S and continues westward to the Chaco River.
- No Name Arroyo, a smaller ephemeral stream, also flows northwest and separates Area 4S from Area 5. Its drainage basin covers approximately 11.5 square miles at its confluence with the Chaco River, with 1.8 square miles lying upstream and east of the permit boundary.
- Brimhall Wash, located south of No Name Arroyo, drains an area of about 85.2 square miles and flows east to west into the Chaco River.
- Cottonwood Arroyo, north of Pinabete Arroyo, has a drainage area of approximately 79.8 square miles.

These streams are typical of arid environments and flow only during short-duration, high-intensity storm events, and groundwater-derived base flow is nonexistent (Ensolum, LLC, 2023). Although they contribute to surface runoff, their role in groundwater recharge is limited due to the region's low infiltration capacity and the presence of low-permeability soils.

In the model, these streams and their tributaries were represented using head-dependent boundary conditions with the MODFLOW Drain Package (DRN Package) (Langevin et al., 2021). Drain boundaries are designed to remove water from the aquifer when the simulated groundwater level exceeds the elevation of the drain cells. Drain cell elevations were set equal to the ground surface (top of model layer 1). A uniform drain conductance of 1,000 m^2/day was applied.

Although the conductance and stage values were not calibrated, post-calibration inflow estimates were used to validate model performance. Given the lack of base flow, the goal of validation was to achieve minimal flow through the drain cells, which should remain mostly dry under properly calibrated hydrogeologic conditions, which represented steady-state conditions (i.e. non-storm events).

3.5.4 Natural Inflows and Outflows

The eastern, northern, and southern boundaries do not intersect the outcrops of PCS and Fruitland Formation. Based on regional hydrogeologic studies, lateral groundwater inflows are expected from these directions, particularly into the PCS and Fruitland Formation. Additionally, the literature suggests vertical flow exchange occurs between the PCS and the Lewis Shale. To simulate these natural inflows and outflows, head-dependent boundary conditions were applied using the MODFLOW General Head Boundary (GHB) Package (Langevin et al., 2021). These boundaries helped to establish the regional flow gradient across the major aquifer units.

Monitoring data from previous USGS studies (Dam et al., 1990) provided head values for the PCS near the eastern and southern boundaries of the model. More recent data were available for near the northern boundary, indicating that groundwater heads in the PCS and Fruitland Formation are nearly equal in that area. Lateral GHB cells were assigned to the eastern, southern, and northern boundaries in Layer 15 (PCS), with head values interpolated from nearby monitoring points. Similar GHB conditions were applied to the Fruitland Formation layers at the same locations. To account for limited and older regional data, both the GHB heads and their conductance values were treated as calibration parameters and adjusted within an expected range based on the available data.

Outflows to the Lewis Shale (downward flow from the PCS) were simulated using GHB boundaries assigned to all model cells in Layer 16. Due to the absence of direct head measurements for the Lewis Shale, groundwater heads and their spatial distribution were estimated using pilot point parameterization during model calibration. Similarly, conductance rates for these GHB cells were also estimated through pilot point parameterization. This approach allowed for spatially variable representation of both head and conductance, improving the model's ability to simulate flow exchange between the PCS and Lewis Shale.

3.5.5 Mine Excavation

NTEC provided excavation elevations and the spatial extent of planned mine excavations at five-year intervals from 2026 to 2165 (Figure 4). These excavation stages were incorporated into the model from stress periods 2 to 29.

Mine excavation was simulated using head-dependent boundary conditions with the MODFLOW DRN Package (Langevin et al., 2021). For each five-year increment, drain cells were assigned to represent the spatial extent of excavation for that period, with the excavation elevation set to the bottom of coal seam #2, applied as the elevation of the drain cells. At the start of each new five-year increment, the drain cells from the previous excavation area were removed, and the excavation area was replaced with mine backfill materials in the model. A new set of drain cells was then assigned to represent the excavation planned for the current increment. This approach allowed the model to simulate both progressive excavation and concurrent backfilling throughout the mining period.

The drain cells were designed to remove groundwater when the simulated head exceeded the assigned excavation elevation, effectively representing dewatering during active mining. A relatively high drain conductance of 1,000 m^2/day was applied to all DRN cells to represent free-drainage or seepage into the excavation area.

3.5.6 Mine Backfill Concentration

The TDS concentration in mine backfill was simulated using a specified concentration boundary condition, implemented through the MODFLOW Constant Concentration (CNC) Package (Langevin et al., 2021). This boundary condition represents a constant source of solute, reflecting a conservative assumption that the TDS concentration in the backfill does not decrease over time. A TDS concentration of 3,500 mg/L was assigned to the backfill materials, based on values used for previous modeling (Norwest Applied Hydrology, 2009; Norwest Corporation, 2013). The concentration was applied to all mine backfill materials introduced into the model from stress periods 3 through 30.

The timing and spatial distribution of the TDS source followed the same approach as described in Section 3.5.5**.** At the beginning of each five-year mining increment, drain cells from the previous excavation area were removed, and that area was then replaced with mine backfill materials, to which the TDS concentration was also assigned. As a result, the spatial extent of the TDS source expanded progressively throughout the mining period as new areas were backfilled. In the final stress period representing post-mining conditions, the assigned TDS concentrations in the backfill materials remained constant over the entire 1,000-year simulation period. For the purpose of this model, the TDS of all other groundwater in the model domain was set at an initial TDS concentration of 0.0 mg/L.

3.6 Model Hydrogeologic Properties

Aquifer properties that control groundwater flow between model cells were defined using the Node Property Flow (NPF) Package in MODFLOW (Langevin et al., 2021). Property zones were delineated to incorporate the spatial distribution of coal seams, interburden and overburden units, surficial soil permeability as well as mine backfill materials (Table 1and Table 2). Additional hydraulic properties such as storage coefficients, porosity, and dispersion coefficients were defined in respective packages in MODFLOW (Storage Package, Dispersion Package, Mobile Storage and Transfer Package).

3.6.1 Hydrostratigraphic Units

In Layer 1, hydraulic property zones were assigned based on hydrologic soil group classifications. Subsequently, five zones were defined in layer 1 to account for the spatial distribution of hydraulic properties. Layer 2, representing the overburden, was treated as a separate hydraulic zone. Distinct hydraulic property zones were defined for each coal seam, and each interburden. Outside the extent of NTEC's geologic model, the same hydraulic property zone used for Layer 2 was applied to all the Fruitland Formation layers. Essentially, the Fruitland Formation was simulated as a single lumped hydrostratigraphic unit for areas outside of NTEC's geologic model, where individual coal seams have not been mapped. Additionally, a single zone was designated for the PCS in Layer 15. During model calibration, hydraulic conductivity values for all stratigraphic zones were adjusted to improve agreement with observed groundwater levels and flow patterns.

Storage coefficients for all hydraulic property zones were based on values from literature (Norwest Applied Hydrology, 2009). To support a conservative estimate of TDS migration, a low porosity value of 0.2 was assigned to all stratigraphic units.

3.6.2 Mine Backfill

For the predictive model, a dedicated hydraulic property zone was defined for mine backfill material. As described in Section 3.5.5, at the beginning of each five-year mining increment, drain cells from the previously excavated area were removed, and the same area was replaced with mine backfill material in the model. This process was repeated for stress period 3 through 29, during which the spatial extent of the mine backfill zone increased. In stress period 30 (representing post-mining reclamation), the mine backfill zone used in stress period 29 was retained without further modification.

Hydraulic properties of the mine backfill zone were kept fixed and based on the values used in the previous groundwater model of the site (Norwest Applied Hydrology, 2009; Norwest Corporation, 2013). The hydraulic conductivity was set at 0.02 m/day, with a vertical anisotropy of 0.1. Porosity and specific yield were both assigned a value of 0.2, while specific storage was set at 1.0E-04 m^{-1}.

To simulate void space within drain cells, their specific storage was reduced to 1.0E-20 m^{-1}, and their specific yield was increased to approximately 1.

3.6.3 Dispersion Coefficients

In the absence of site-specific dispersivity data, longitudinal and transverse dispersivity values were assumed 100 m and 10 m, respectively. A molecular diffusion coefficient of 8×10^{-6} m^2/day was uniformly applied across all model layers, consistent with previous modeling at the site (Norwest Applied Hydrology, 2009).

Table 1. Hydraulic Conductivity Ranges and Calibrated Values

Parameter name	Horizontal hydraulic conductivity (m/day)			Vertical hydraulic conductivity (m/day)
	Lower limit	Upper limit	Calibrated value	Calibrated value
Alluvium	1.00	5.0×10^{1}	1.22 - 50.0	1.03×10^{-2} - 8.65×10^{-1}
Overburden	3.05×10^{-5} - 1×10^{-4} (2)	3.05×10^{-3} - 1.00 (2)	1.05×10^{-4} - 7.23×10^{-3}	7.36×10^{-2} - 9.52×10^{-1}
Coal Seam #8	1.22×10^{-3} (1)	1.83×10^{-2} (1)	1.07×10^{-2}	1.10×10^{-2}
Coal Seam #7	3.96×10^{-5} (1)	2.44×10^{-3} (1)	6.29×10^{-5}	2.01×10^{-3}
Coal Seam #6	3.96×10^{-5} (1)	2.44×10^{-3} (1)	4.17×10^{-5}	1.01×10^{-3}
Coal Seam #4	3.96×10^{-5} (1)	2.44×10^{-3} (1)	3.96×10^{-5}	1.19×10^{-3}
Coal Seam #3	3.96×10^{-5} (1)	2.44×10^{-3} (1)	2.18×10^{-3}	1.64×10^{-2}
Coal Seam #2	3.96×10^{-5} (1)	2.44×10^{-3} (1)	2.44×10^{-3}	8.01×10^{-2}
Interburden	1.53×10^{-5} (3)	1.53×10^{-3} (3)	1.53×10^{-5} - 1.53×10^{-3}	1.52×10^{-3} - 9.27×10^{-1}
Pictured Cliffs Sandstone	3.05×10^{-5} (1)	1.34×10^{-1} (1)	9.57×10^{-3}	1.30×10^{-1}
Lewis Shale	1.53×10^{-5}	1.53×10^{-1}	1.53×10^{-5}	9.58×10^{-1}

1) NTEC Well Tests
2) Norwest Applied Hydrology, 2009
3) Kaiser et al 1994 & Frenzel, 1983

Table 2. Porosity and Storage Values

Parameter Name	Porosity	Specific Yield	Specific Storage (m^{-1})
Alluvium	0.35	0.12 (1)	8.20×10^{-5} (1)
Overburden	0.35	0.12 - 0.2 (1)	1.18×10^{-5} - 8.20×10^{-5} (1)
Coal Seam #8	0.35	0.005 (1)	1.38×10^{-4} (1)
Coal Seam #7	0.35	0.005 (1)	1.38×10^{-4} (1)
Coal Seam #6	0.35	0.005 (1)	1.38×10^{-4} (1)
Coal Seam #4	0.35	0.005 (1)	1.38×10^{-4} (1)
Coal Seam #3	0.35	0.005 (1)	1.38×10^{-4} (1)
Coal Seam #2	0.35	0.005 (1)	1.38×10^{-4} (1)
Interburden	0.35	0.12 (1)	8.20×10^{-5} (1)
Pictured Cliffs Sandstone	0.35	0.20	1.18×10^{-5} (1)
Lewis Shale	0.35	0.005	1.38×10^{-4}

Source: 1) Norwest Applied Hydrology, 2009

4 Model Calibration

The model was calibrated by systematically adjusting model parameters within defined ranges. The objective of the calibration process was to minimize the differences between observed and simulated hydraulic head values and reduce predictive uncertainty that is inherent in the simulation of all natural systems. The PEST++ software suite (White et al., 2020), which provides advanced tools for parameter estimation and uncertainty analysis in environmental models was used for the calibration. PEST++ includes several stand-alone tools for model parameter estimation, including PESTPP-IES, which was used in this study. PESTPP-IES is an iterative ensemble smoother implementation of the Gauss-Levenberg-Marquardt algorithm. This tool follows the PEST model-interface protocols (Doherty, 2010) and includes features such as a built-in parallel run manager, multiple lambda testing, and model run failure tolerance.

The calibration process included adjustment of model parameters to improve the agreement between simulated and observed data. A total of 300 model realizations were included as part of the calibration process, and the best-calibrated realization was selected for subsequent use in predictive modeling.

4.1 Calibration Datasets

Water level data from monitoring wells provided by NTEC were used to calibrate the steady-state groundwater flow model. A total of 47 observed hydraulic head measurements were included (Figure 5). These data spanned the period from 1983 to 2024 and included two head observations from the alluvium, 25 from the Fruitland Formation, and 20 from the PCS.

Although older data from as early as 1983 were included in the calibration dataset due to the limited availability of recent measurements, their influence on the calibration was reduced by assigning them lower weights compared to recent data, to account for potential uncertainty associated with older data. Among the recent data, greater weight was given to head observations in the alluvium, followed by the Kirtland Formation, and then the PCS. This weighting scheme reflects the relative reliability of the data (old vs. recent) and the importance of achieving model accuracy in the more hydraulically active zones, particularly the alluvium near the permit area.

4.2 Calibration Parameters

A total of 85 parameters were adjusted using PESTPP-IES to optimize the fit between modeled and observed heads. Adjustable parameters included horizontal and vertical hydraulic conductivity, GHB conductance and head values, and recharge rates. Parameter ranges were defined based on site-specific data, geologic interpretation, and values reported in the literature (Table 1).

4.3 Flow Model Calibration Results

A scatter plot of simulated versus observed hydraulic heads after model calibration is presented in Figure 6. Overall, the model demonstrates an acceptable fit, particularly in Layer 1 (alluvium) near the permit boundary. In this area, the calibrated model successfully reproduces field-measured hydraulic heads within a low margin of uncertainty, indicating that the model is suitable for representing shallow groundwater flow dynamics in the vicinity of the permit area. Larger residuals (> 1m) were noted in several recently installed monitoring wells completed in deeper units. These discrepancies are likely due to heterogeneity of deeper geologic layers that is not captured in the model, as they are less constrained by site-specific data. Despite these localized differences, the model reasonably replicates both regional

and local groundwater flow directions, indicating a reliable representation of lateral and vertical flow patterns in and around the permit area.

Table 1 provides a comparison between calibrated parameters and values reported in the literature. Overall, the calibrated parameters closely align with the field data, further confirming the model's ability to represent real-world hydrogeologic conditions within the permit area. Based on this alignment and the match with observed head, the calibrated model was considered suitable for project applications, including the development of the solute transport predictive model.

5 Prediction Results

The calibrated model was used for predictive simulations of groundwater flow and solute transport over a 140-year mining period followed by a 1,000-year post-mining period. These predictive simulations were conducted to assess local groundwater flow around the permit area and to evaluate the migration of groundwater originating from mine backfilling with elevated TDS during and after mining operations. To address these objectives, the model simulated hydraulic head distributions and the potential migration of high TDS groundwater from the backfill material into the surrounding groundwater system. The solute transport component was based on a conservative assumption that TDS source concentrations remained constant throughout the entire simulation period.

5.1 Groundwater Flow Direction, Drawdown, and Future Recovery of Groundwater Levels

Steady-state calibrated simulations indicate that the regional hydraulic gradient is from the southeast toward the northwest (Figure 5). Locally, groundwater flows from west and south toward the southern portion of the permit area, then northward toward Area 4S and 4N, and continues further north toward the San Juan River.

Predictive simulations showed a localized decline in hydraulic head within the permit area during mining activities post-2026 (Figure 7 to Figure 9), with the most pronounced drawdown occurring in Area 4N, where heads are simulated at over 30 m lower than during early mining stages. This lowering groundwater levels causes a reversal in local flow direction, redirecting groundwater toward the mining area instead of continuing northward. As mining expands, similar declines of at least 20 m are simulated in Areas 4S and Area 5. By 2165, drawdown effects are simulated to expand eastward, though the regional extent of these impacts remains limited to approximately 2km east of the permit area.

After mining ends, groundwater heads are simulated to recover across the permit area. By the end of the simulation, the hydraulic gradient and flow directions nearly return to the pre-mining conditions in the permit area. The rate of recovery of potentiometric levels was assessed by evaluating the predicted head at various monitoring well locations in the permit area (Figure 10 to Figure 11). Overall, recovery rates were slow due to the low permeability of the surrounding formations and low groundwater recharge of the region. In the PCS, full recovery of potentiometric levels was simulated to take at least 1,000 years. Similar recovery trends were observed in the Fruitland coal seams and alluvium. Although recovery is faster than in the PCS, it is still projected to take several hundred years for potentiometric surfaces to return to pre-mining levels. Actual recovery may vary depending on future recharge rates, which were held constant in the model.

5.2 Impacts on the Shallow Alluvial Aquifer in Pinabete Arroyo

Mining activities are expected to impact the shallow alluvial aquifer in the Pinabete Arroyo through physical excavation and removal of saturated alluvial material in the mined area. However, steady-state simulations indicate that the alluvium near the permit area is already predominantly dry, minimizing additional impacts on groundwater levels from mining activities.

Simulation results indicate drawdown in groundwater levels occurs across all mined areas during active mining phases. In the post-mining phase, water begins to re-enter excavated zones through lateral inflow from adjacent formations. As the groundwater system adjusts, model layers closer to the surface experience a localized decline in head near backfill zones, while deeper layers (e.g., PCS) show rising heads due to ongoing regional inflow. This redistribution reflects the system's adjustment to new post-mining hydrogeologic flow.

5.3 Mine Backfill Saturation

As mining progresses and excavation voids are created, backfilling is conducted as part of reclamation efforts. Simulation results indicate that the re-establishment of saturated conditions within the backfilled material was slow and spatially variable. Backfill areas located near active zones of excavation experienced delayed saturation due to both disrupted hydrologic pathways associated with adjacent mining and the relatively low permeability of the nearby soil. Saturation began during the late mining phase but remained incomplete for several hundred years post-mining. This delay resulted from the limited aquifer recharge, the disconnected nature of the post-mining hydrogeologic system, and the low hydraulic conductivity of the backfill material.

5.4 Pit Inflows

Groundwater inflows into the mine pits were simulated for Area 4N, 4S, and 5 during the excavation periods (Table 3). Estimated pit inflows included vertical contribution from the PCS and lateral inflows from the alluvium, overburden, Fruitland coal seams and interburden, as well as from mine backfill placed within areas previously excavated. Water held within aquifer storage prior to excavation, along with direct precipitation, was excluded from the pit inflow estimation.

The spatial distribution of excavation zones, and simultaneous excavation (mine scheduling) across different areas created a complex groundwater flow system. Notably, the timing overlap of excavation areas affected each other's inflow rates.

Area 4N experiences the highest inflows. This area begins excavation earlier than the others, and its alignment, perpendicular to the groundwater flow, enhances pit inflow rates. As a result, the excavation in 4N contributes to a drop in the local groundwater table, reducing subsequent inflows into neighboring areas. Total inflow in 4N exceeds ~3 gallons per minute (gpm) between 2051 and 2070 and during the initial mining phase from 2026 to 2030. Lateral contributions from the Fruitland Formation are present in nearly all active periods and is generally greater than those from the PCS, alluvium and mine backfill. PCS inflows are prominent from 2051 to 2095, while inflows from alluvium and overburden are smaller.

Excavation in Area 4S begins concurrently with Area 4N in 2026 and continues to 2075 and then resumes again from 2106 to 2145. During its early mining phase (2026-2050), inflows remain below 0.5gpm due to predominantly dry conditions in the northwest part of Area 4S. From 2051 to 2075, inflows exceed 1gpm between 2051and 2075, but there are no measurable lateral contributions from the PCS, alluvium or

overburden. In later periods, some inflow is observed, primarily from mine backfills, alluvium and overburden. The total pit inflow peaks at 2.8gpm between 2111 and 2125.

In Area 5, excavation begins as mining in Area 4N is nearing completion. By that time, the water table has already declined due to earlier dewatering, resulting in reduced groundwater availability. Furthermore, the excavation in Area 5 is planned to start in the western portion of the permit area where the upper portion of the Fruitland Formation is unsaturated. As a result, Area 5 receives minimal groundwater inflow during its early stages of mining from 2076 to 2110. Inflows begin to increase after 2110 and exceed 1gpm during the later stages of mining. Overall, the PCS, alluvium, and overburden contribute little to the inflow in Area 5, while consistent inflows were observed from the Fruitland Formation and mine backfill from adjacent areas.

In summary, Area 4N exhibited the earliest, and highest groundwater inflows, largely driven by its excavation timing and orientation to regional groundwater flow. The inflows in Area 4S were limited due to its location and the influence of prior dewatering in 4N. Area 5 showed little to no inflow during early stages of mining this area, primarily due to its late excavation schedule and location in drier geologic settings; however, inflows increase during the final stages of mining.

5.5 Groundwater Quality

Solute transport simulations indicate that the primary direction of TDS migration from the mine backfill is vertical, moving downward into the PCS (Figure 12 to Figure 14). From 2026 to 2165, during active mining operations, no significant lateral migration of TDS is simulated within the shallow layers, specifically from the alluvium (Layer 1) down to Coal Seam 6 (Layer 7). A limited lateral migration is simulated from Coal Seam 4 (Layer 9) to Coal Seam 2 (Layer 13), particularly toward the north. Post-mining, the extent of lateral migration in the coal seam layers increases slightly but remains confined within ~500 m north and east of the mine backfill areas.

Vertical migration of TDS into the PCS (layer 15) begins shortly after backfilling in Area 4N, due to the proximity of the TDS source to this layer and the limited thickness of the overlying interburden (Layer 14). This pattern aligns with findings from earlier modeling efforts (Norwest Applied Hydrology, 2013), which also shows limited lateral migration through the PCS, with migration generally following topographic gradients along Pinabete and No Name Arroyos. In the PCS, TDS concentrations exceeding 2,000 mg/L are predominantly restricted to areas directly beneath the mine backfill. Additionally, a vertical component of groundwater flow and solute migration into the Lewis Shale is observed, particularly beneath the PCS.

Table 3. Mine-Pit Inflows

Mine Plan Year	Area 4 North					Area 4 South					Area 5				
	Inflow From Unit (gpm)				Pit inflow (gpm)	Inflow From Unit (gpm)				Pit inflow (gpm)	Inflow From Unit (gpm)				Pit inflow (gpm)
	Alluvium Overburden	Fruitland	PCS	Backfill		Alluvium Overburden	Fruitland	PCS	Backfill		Alluvium Overburden	Fruitland	PCS	Backfill	
2026-30	0	2.8	1.5	0	4.4	0	0.1	0	0	0.1					
2031-35	0	0	0	0	0	0	0.1	0	0	0.1					
2036-40	0	0	0	0	0	0	0.4	0	0	0.4					
2041-45	0	0	0	0	0	0	0.5	0	0.1	0.6					
2046-50	0	0.3	0	0	0.3	0	0.6	0	0.1	0.7					
2051-55	0.5	2.5	1.4	0	4.4	0	0.7	0	0.3	1					
2056-60	0.3	2.0	1.5	0	3.8	0	1.1	0.0	0.4	1.4					
2061-65	0.3	3.8	2.2	0	6.3	0	0.7	0	0.7	1.4					
2066-70	0	1.1	0.9	1.2	3.2	0	1	0.2	0.5	1.7					
2071-75	0	0.9	0.2	0.1	1.2	0	0.5	0	0.6	1.1					
2076-80	0.1	1	0.2	0	1.4						0	0.1	0	0	0.1
2081-85	0	0.9	0.3	0	1.3						0	0.2	0	0	0.2
2086-90	0	1	0.4	0	1.4						0	0.1	0	0	0.1
2091-95	0	0.6	0.2	0.4	1.2						0	0.4	0	0.1	0.5
2096-100	0	0.9	0	0.3	1.2						0	0.1	0	0.2	0.4
2101-105	0	0.5	0	0.1	0.6						0	0.2	0.1	0.1	0.4
2106-110	0	0.1	0	0.3	0.4	0.5	0	0	0.1	0.6	0	0.2	0	0.2	0.5
2111-115						1.7	0	0.6	0.5	2.8	0.1	0.6	0	0.4	1.1
2116-120						1	0	0	0.5	1.5	0.1	0.6	0	0.5	1.2
2121-125						1.1	0.1	0	0.4	1.6	0	1.5	0.7	0.3	2.5
2126-130						0.4	0.1	0	0.3	0.7	0	0.8	0	0.5	1.3
2131-135						0.5	0	0	0.2	0.7	0	1.2	0.6	1.0	2.9
2136-140						0.6	0	0	0.1	0.7	0.2	0.6	0.1	1.4	2.3
2141-145						0.2	0	0	0.2	0.4	0.3	0.2	0	1.3	1.8
2146-150						0	0	0	0	0	0.3	1	0	0.7	2.0
2151-155						0	0	0	0	0	0.1	1	0	1.2	2.3
2156-160						0	0	0	0	0	0.2	0.5	0	0.5	1.2
2161-165						0	0	0	0	0	0.1	1.2	0	1.1	2.4

6 Model Assumptions and Limitations

The performance and predictive accuracy of the groundwater model are inherently dependent on the quality, resolution, and availability of input data. Several assumptions were made to simplify the modeling process. Despite these simplifications, the model calibration results demonstrate that it performs adequately in predicting hydraulic heads within the permit area. The key assumptions and limitations are summarized below:

- Incorporating all complexities of the real-world system into the conceptual model is not feasible. Due to limited data on small-scale variability in hydraulic conductivity, uniform values of hydraulic conductivity and porosity were assigned to each stratigraphic unit. This approach is consistent with methods used in previous models (Norwest Applied Hydrology. 2009 and 2013) where similar assumptions were made based on available site data.

- Geologic cross-sections, borehole logs, and head monitoring data from previous investigations and literature were used to define the stratigraphy in areas outside of the NTEC geologic model and to support the definition of boundary conditions. However, much of this data is older, and its representativeness of current conditions is unknown.

- Elevation data from the site-specific geologic model were used to define model layers 3 through 13 within the permit area. For Layer 15 (PCS), NTEC provided similar elevation data, approximately within the extent of the geologic model. For stratigraphic units outside the geologic model coverage, additional elevation data were obtained from historical sources and published literature. It was assumed that these datasets are consistent and reliable for model development.

- Past mining activities in Areas 1 and 2 were not included in the model. However, calibration results near the permit boundary indicate that excluding these areas does not significantly impact groundwater flow or contaminant transport predictions within the permit area.

- Field-measured dispersivity values were not available. Therefore, relatively high values were assumed to represent conservative estimates.

- All available monitoring well data were assumed to be reliable for calibration. However, greater weight was assigned to more recent observations to account for potential changes in the flow system since the collection of older datasets.

- It was assumed that the impact of elevated TDS concentrations (up to 3,500 mg/L) on groundwater density is negligible, and thus density-dependent flow was not modeled.

- Assumptions were made to define the vertical extent of future mine backfill zones due to limited site-specific information.

- Data on the bottom elevation of the alluvium (Layer 1) and differentiation between weathered and unweathered overburden materials (Layer 2) were limited. Consequently, the thickness of the alluvium was estimated based on available borehole data.

- The hydraulic properties of the mine backfill were set based on those used for previous modeling at the Navajo Mine (NTEC corporation, 2013).

- Ephemeral streams within the model domain were assumed to drain groundwater when the water table is high. The recharge distribution accounted for potentially greater recharge along the ephemeral streams, but actual stream losses were not simulated.
- Future recharge in the permit area was assumed to remain similar to the calibrated steady-state conditions.
- This groundwater model was specifically developed to evaluate the impacts of mine development within the permit area. The model does not include all historical or other planned mining areas and should not be used to assess groundwater impacts in those excluded regions.

7 Conclusion

Barr developed a groundwater flow and solute transport model for the Navajo Mine area and the surrounding groundwater system. The primary objective of this model was to assess local flow near the permit area and evaluate the long-term behavior of TDS originating from mine backfilling activities. The model was designed to simulate both the active mining phase (140 years) and an extended post-mining period (1,000 years). The model was used to predict how groundwater flow and TDS migration would respond to changes caused by mining and backfilling over time.

The predictive modeling results indicate that while mining activities alter local groundwater flow, drawdown, and quality, the impacts remain largely contained near the permit boundaries over both operational and post-mining timeframes. Findings include:

- Groundwater flow direction shifts during mining, with localized declines in hydraulic head causing flow to reverse toward the permit areas.
- Groundwater levels experience localized drawdown during mining, with gradual recovery projected during post-mining.
- The shallow alluvium is minimally impacted due to its pre-existing unsaturated condition.
- Saturation of mine backfill is slow, primarily due to low permeability and limited recharge.
- TDS migration remains predominantly vertical and spatially confined, with no significant off-site transport.
- Within the PCS, elevated TDS concentrations (>2,000 mg/L) remain mostly restricted to areas directly beneath the mine area.

Overall, the model results support the conclusion that mine-related changes to groundwater flow and quality are geographically limited and are expected to stabilize over the long term, assuming no significant deviation from current climatic and hydrogeologic conditions. However, actual outcomes will depend on future recharge rates and site-specific geologic variability, which may be better understood through groundwater monitoring during and after mining operations.

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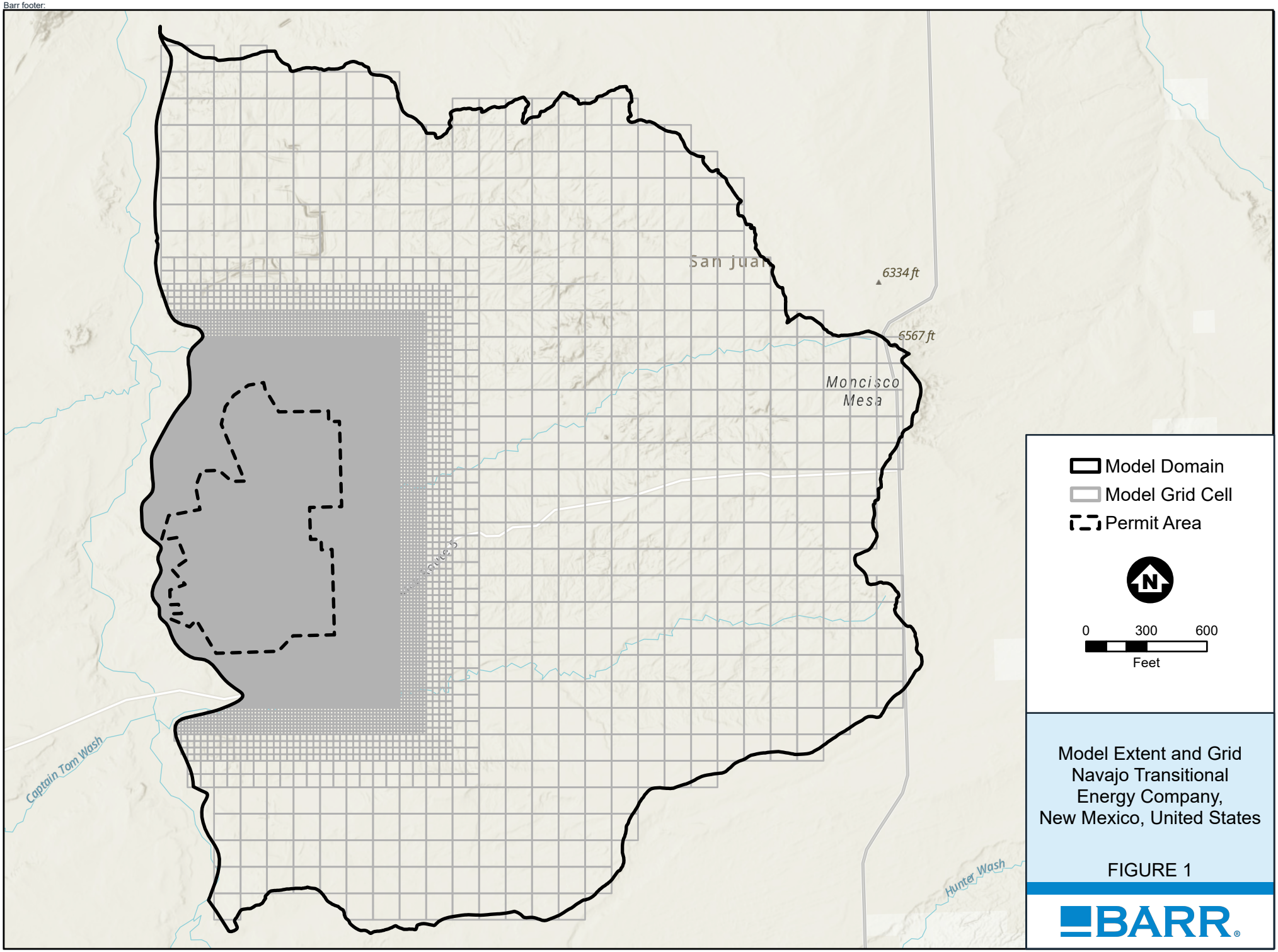
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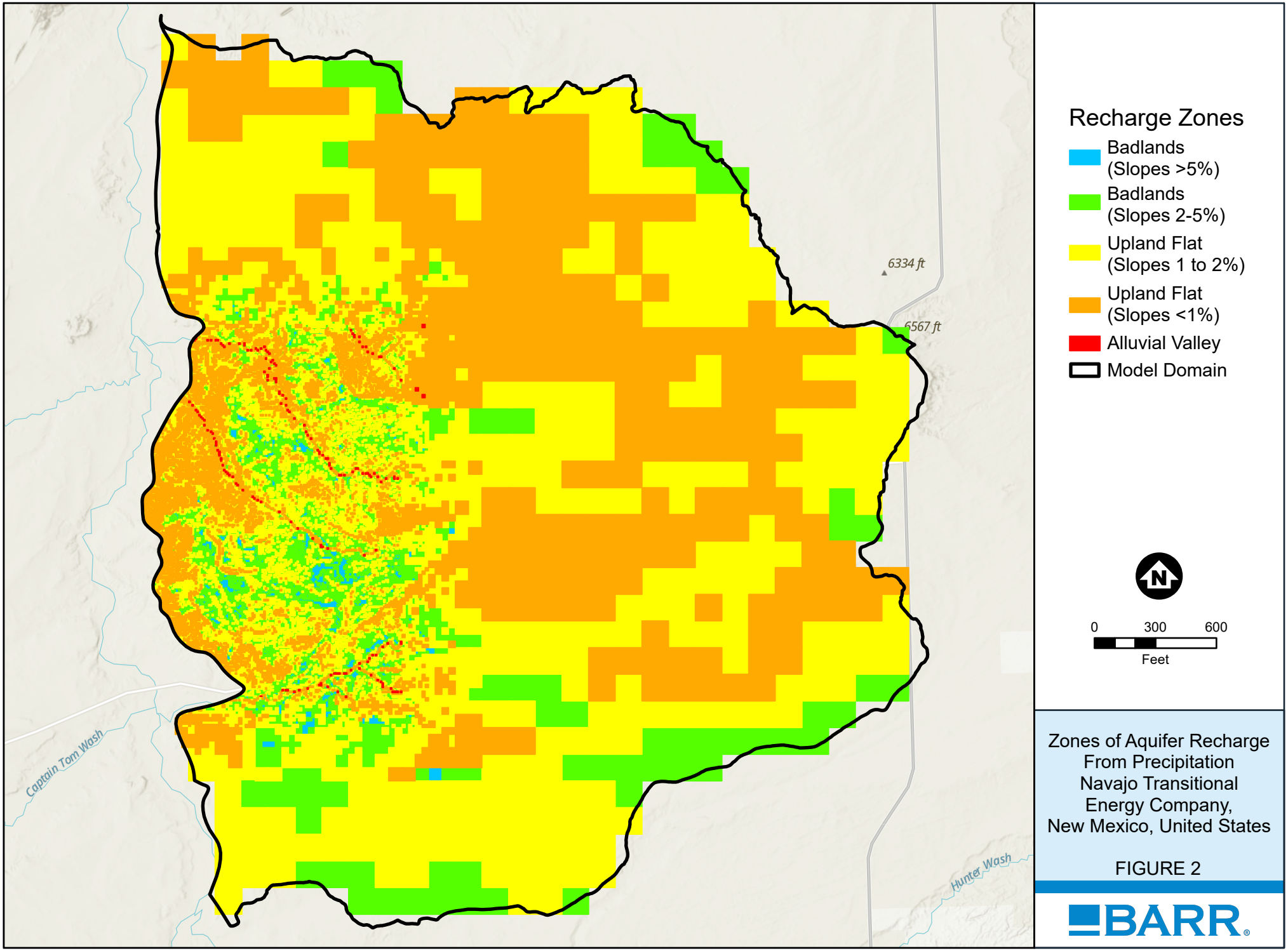


Model Extent and Grid
Navajo Transitional Energy Company,
New Mexico, United States

FIGURE 1

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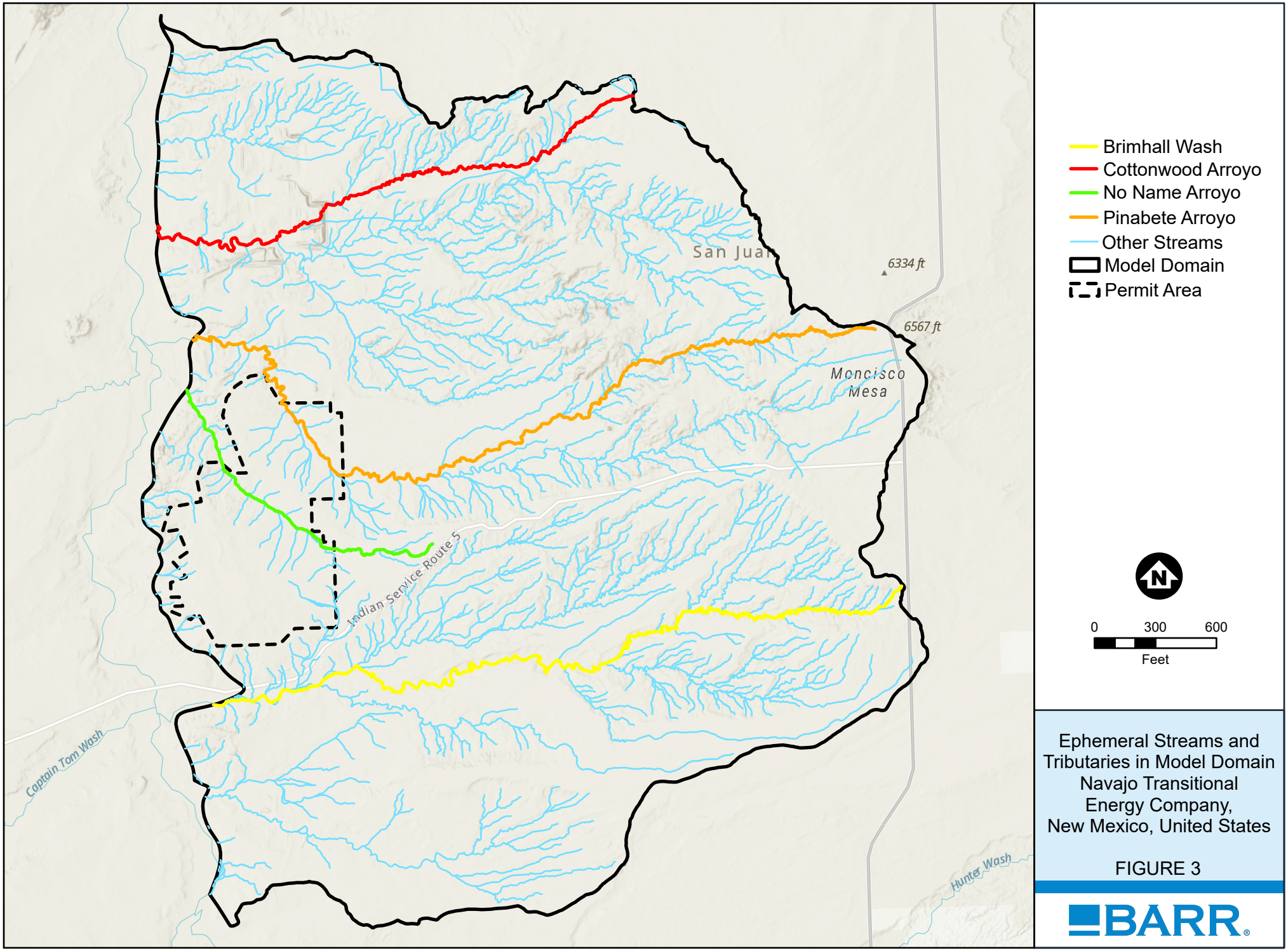


Zones of Aquifer Recharge From Precipitation Navajo Transitional Energy Company, New Mexico, United States

FIGURE 2

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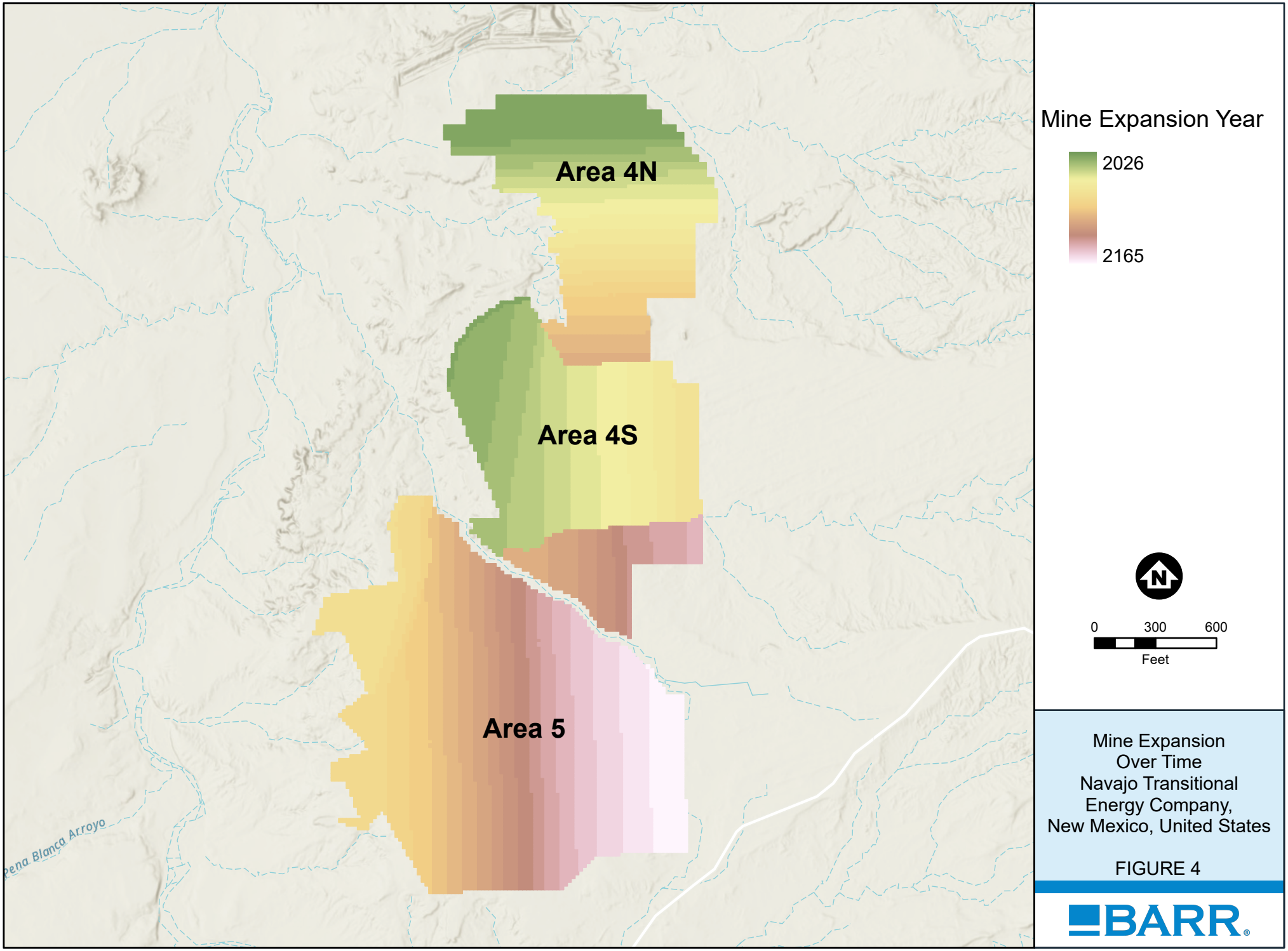


Ephemeral Streams and Tributaries in Model Domain
Navajo Transitional Energy Company,
New Mexico, United States

FIGURE 3

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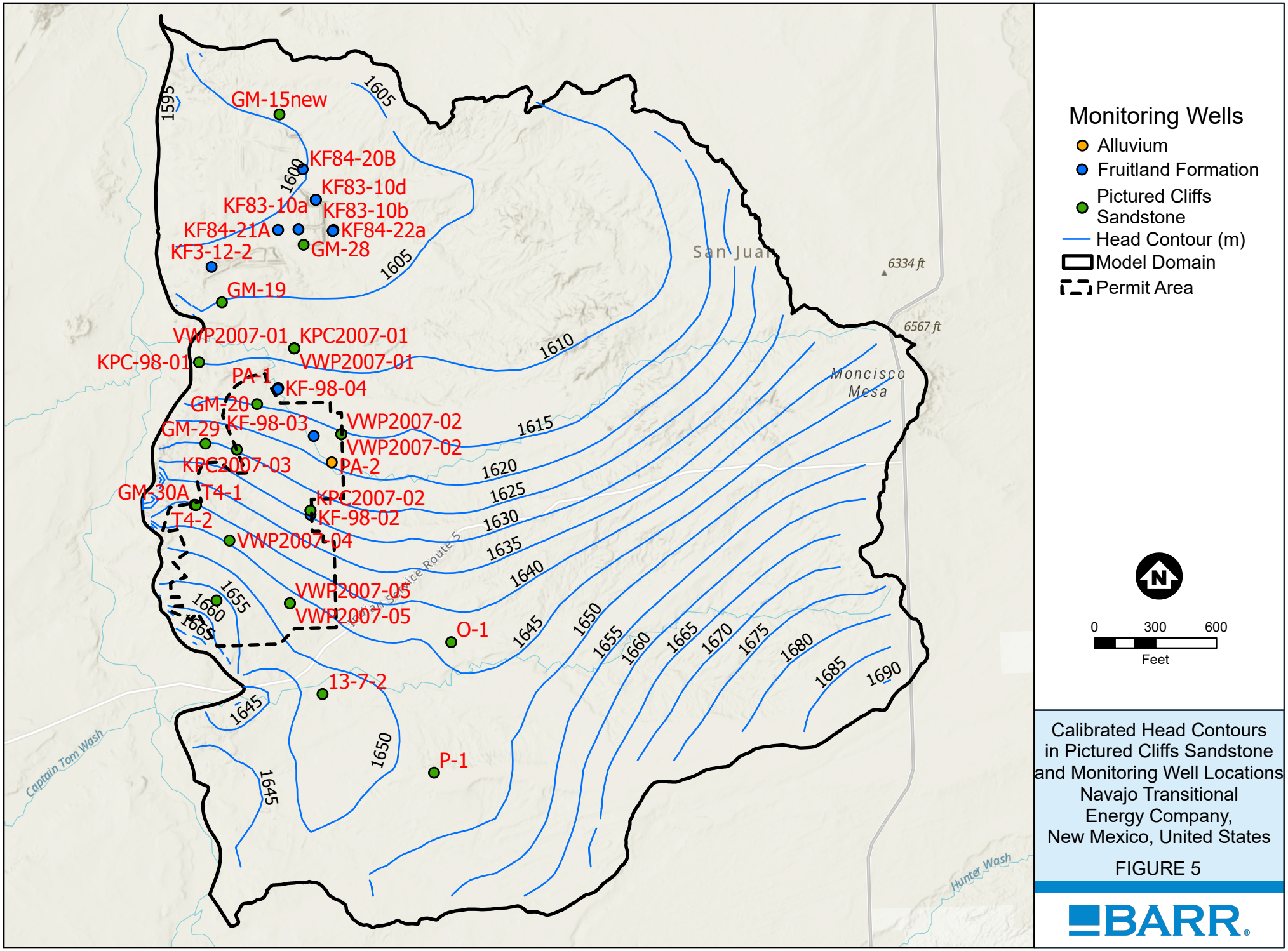


Mine Expansion
Over Time
Navajo Transitional
Energy Company,
New Mexico, United States

FIGURE 4

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Monitoring Wells

- Alluvium
- Fruitland Formation
- Pictured Cliffs Sandstone
- Head Contour (m)
- Model Domain
- Permit Area

N

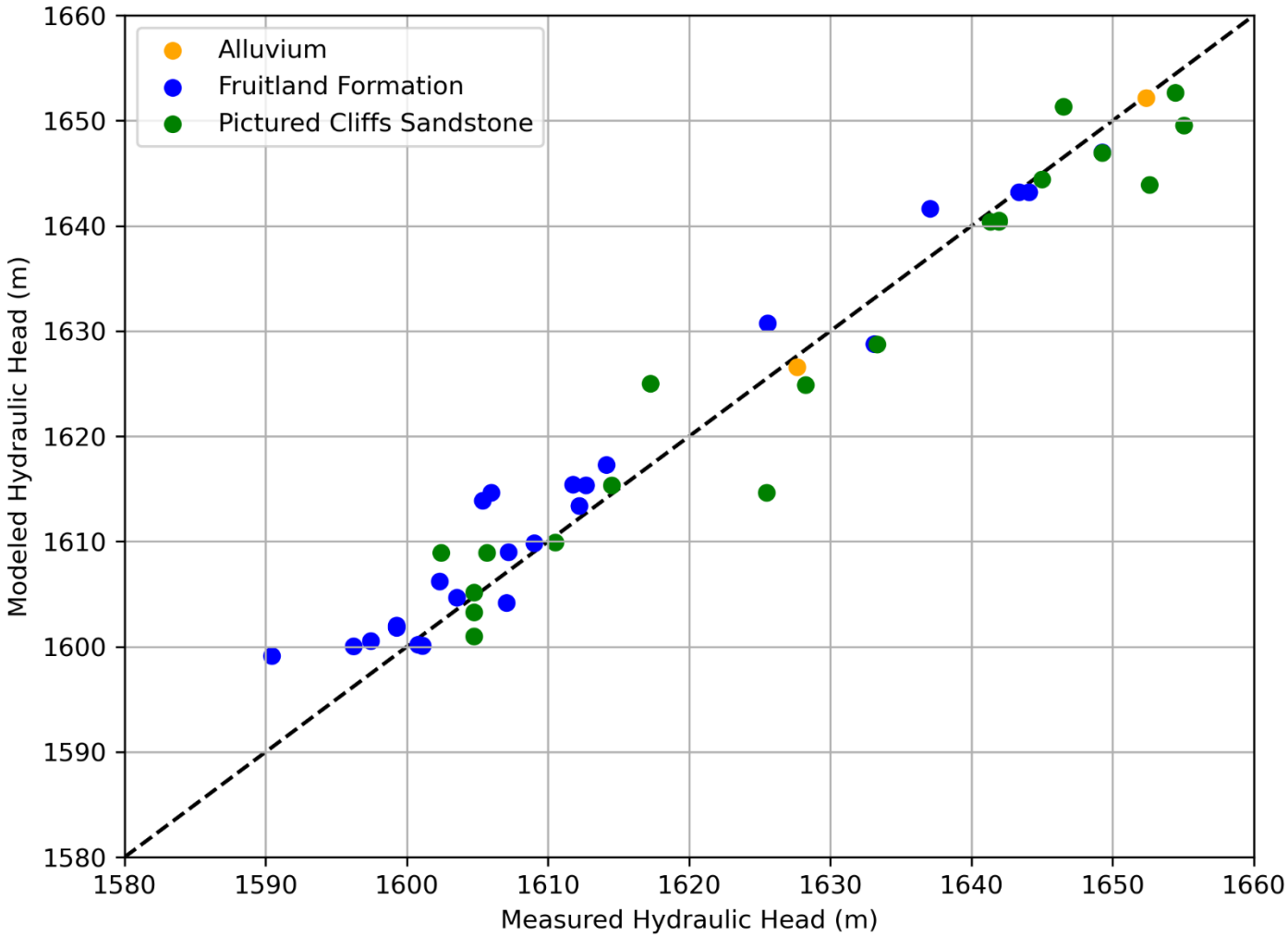
0 300 600

Feet

Calibrated Head Contours in Pictured Cliffs Sandstone and Monitoring Well Locations
Navajo Transitional Energy Company, New Mexico, United States

FIGURE 5

BARR



The black dashline represents the best fit

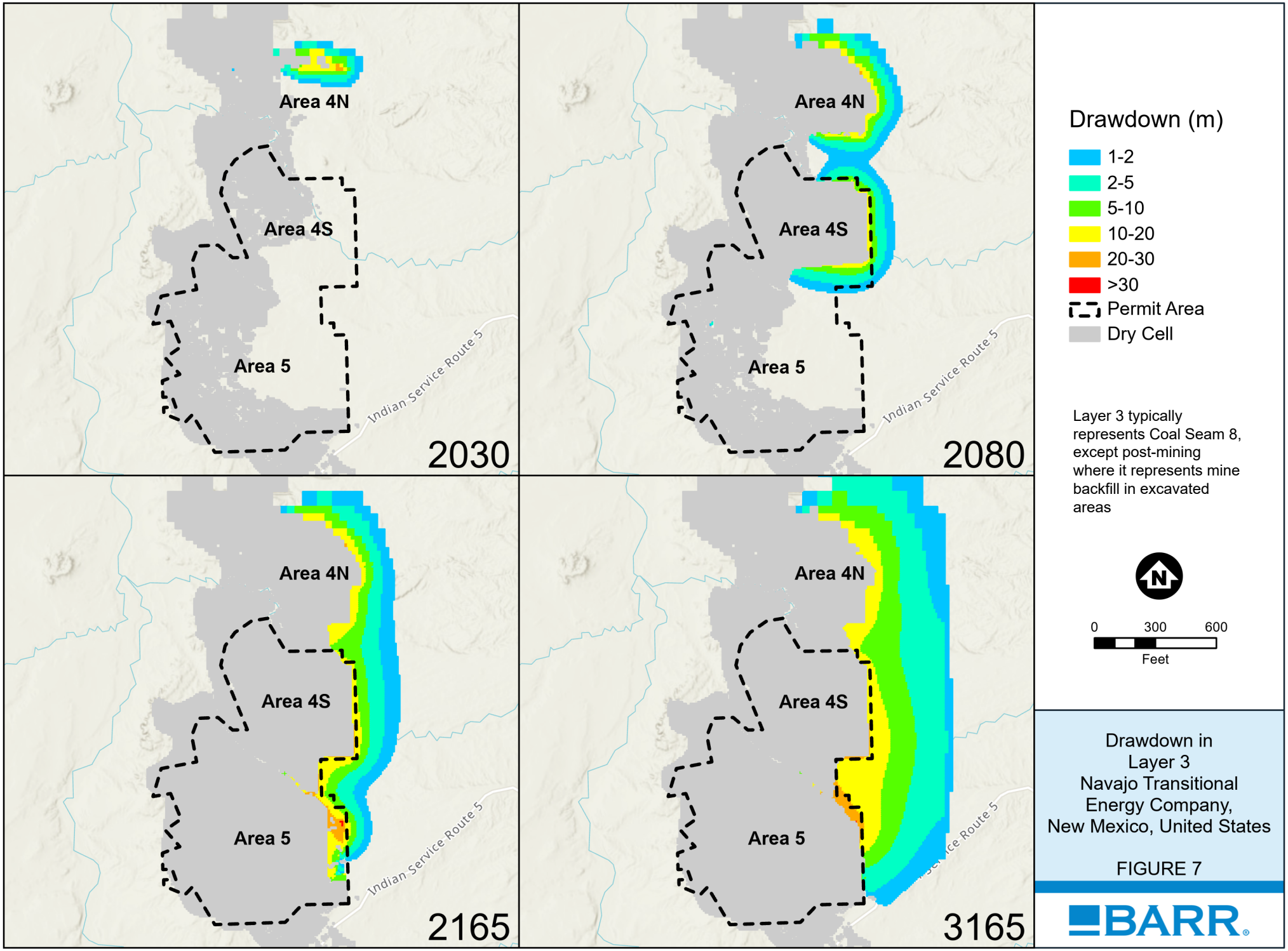
Scatter plot of modeled vs. measured hydraulic heads after model calibration

Navajo Transitional Energy Company, New Mexico, United States

FIGURE 6

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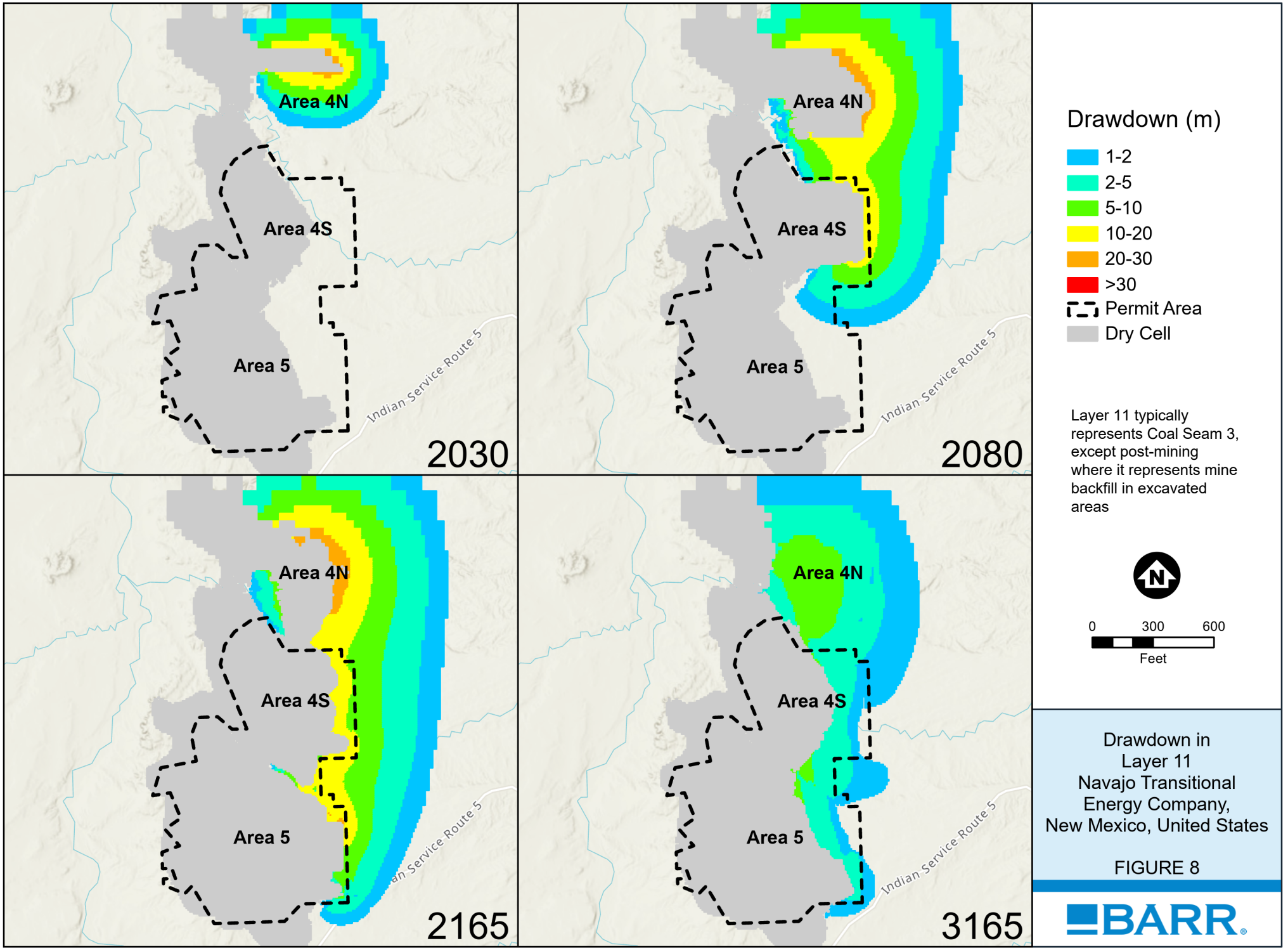


Drawdown in Layer 3 Navajo Transitional Energy Company, New Mexico, United States

FIGURE 7

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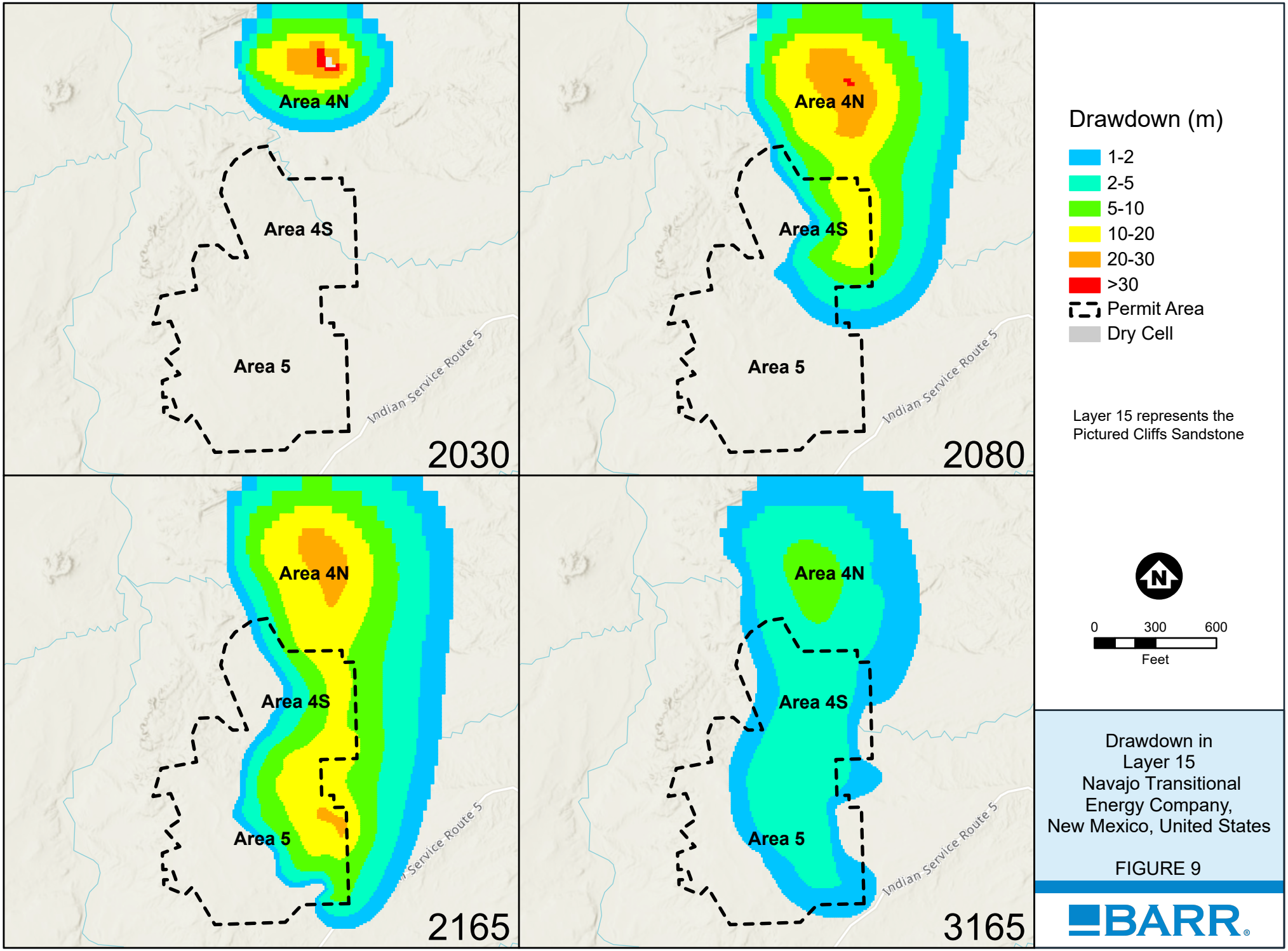


Drawdown in Layer 11 Navajo Transitional Energy Company, New Mexico, United States

FIGURE 8

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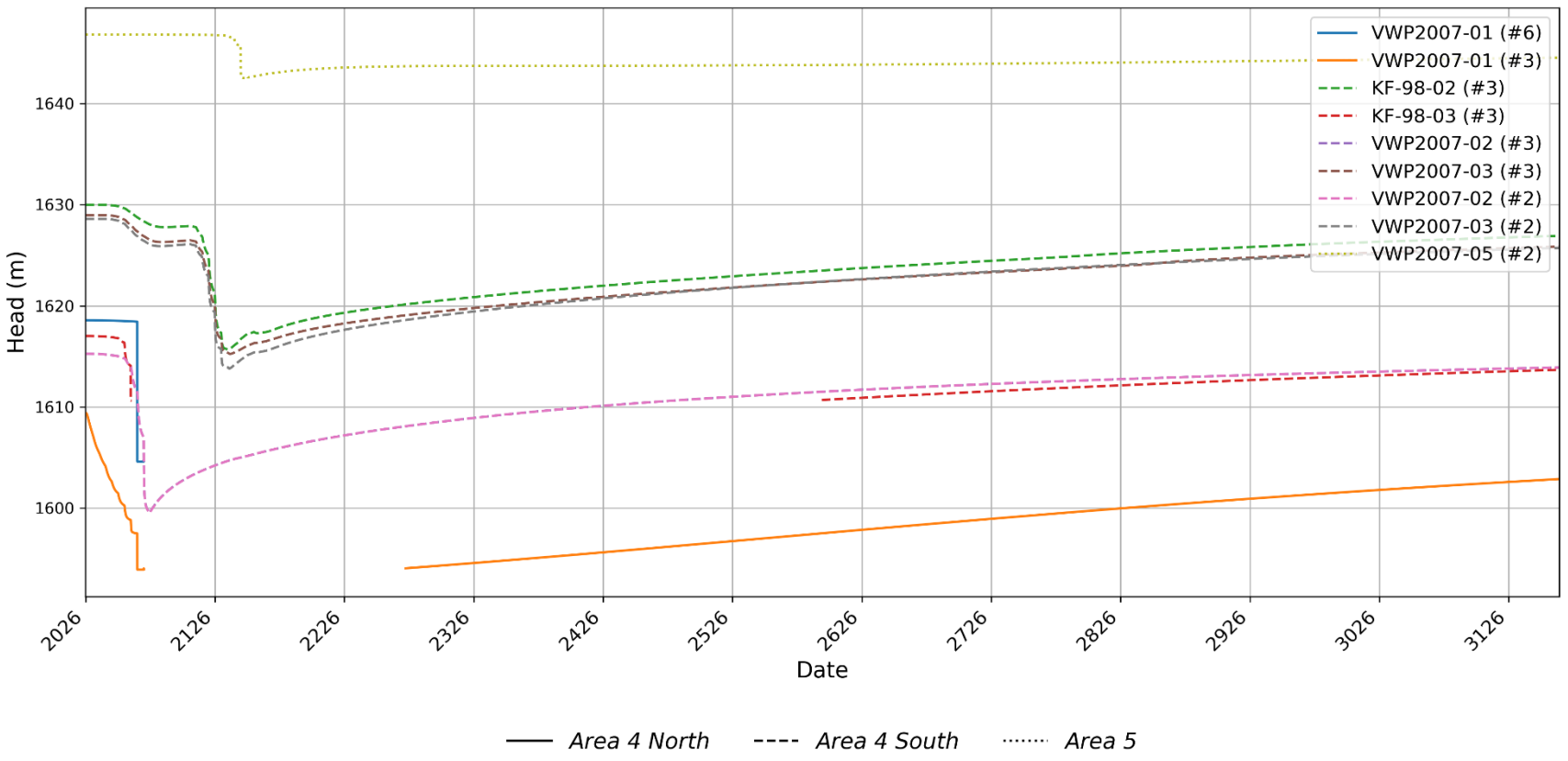
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Drawdown in Layer 15 Navajo Transitional Energy Company, New Mexico, United States

FIGURE 9

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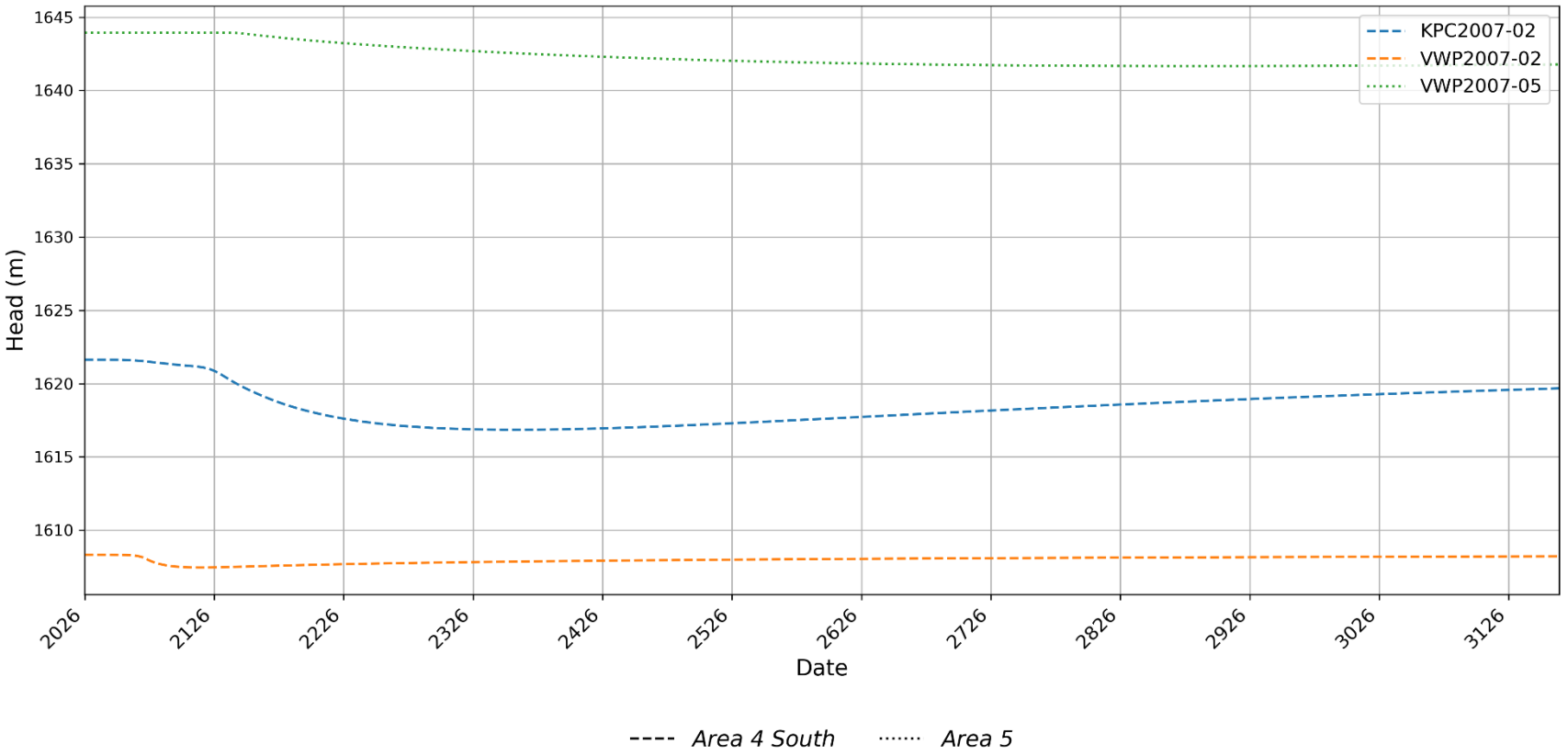
Discontinuous lines indicate periods when wells are dry

Groundwater Level Drawdown and Recovery in Fruitland Formation

Navajo Transitional Energy Company, New Mexico, United States

FIGURE 10

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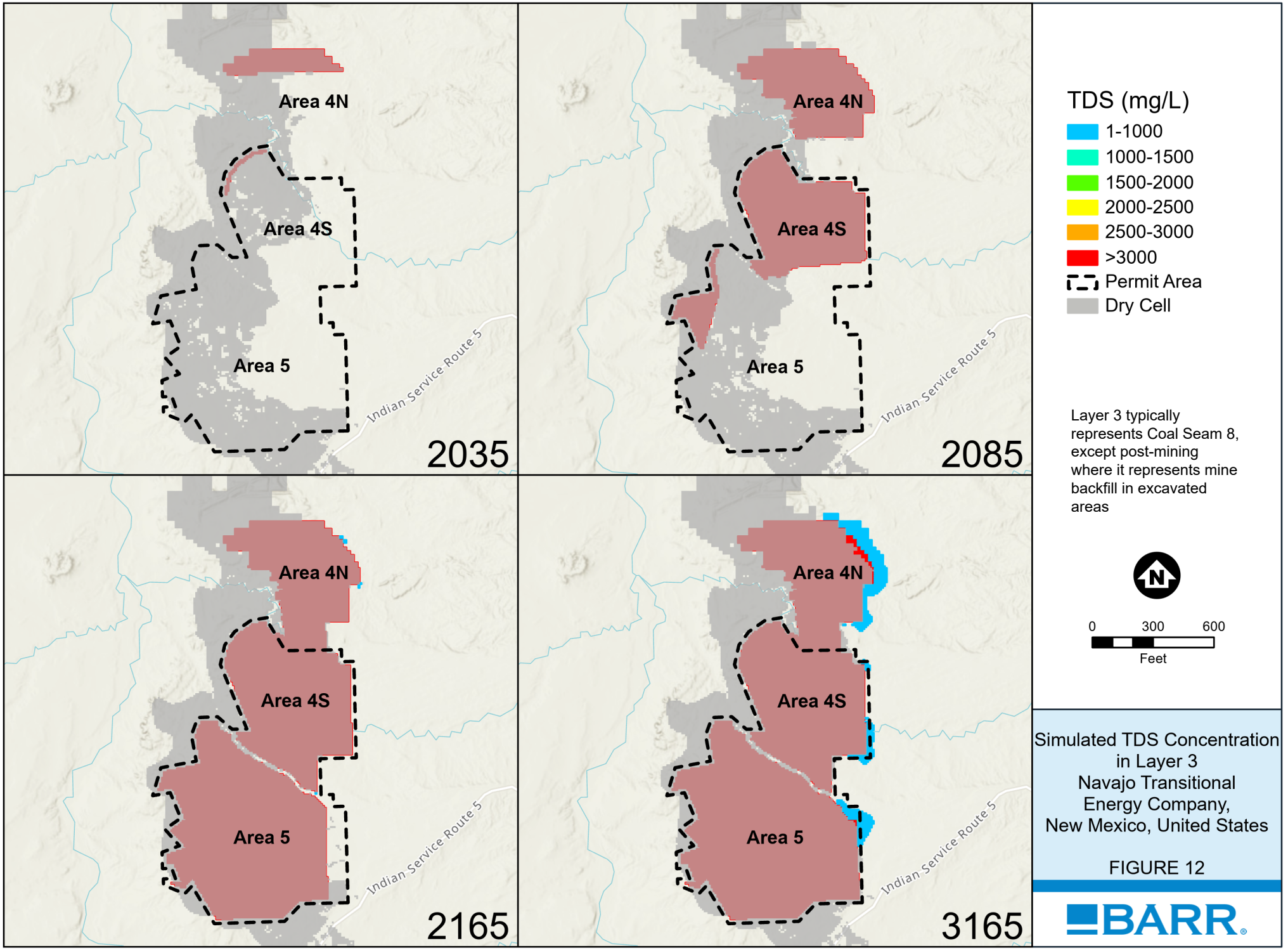
Groundwater Level Drawdown and Recovery in Pictured Cliffs Sandstone

Navajo Transitional Energy Company, New Mexico, united States

FIGURE 11

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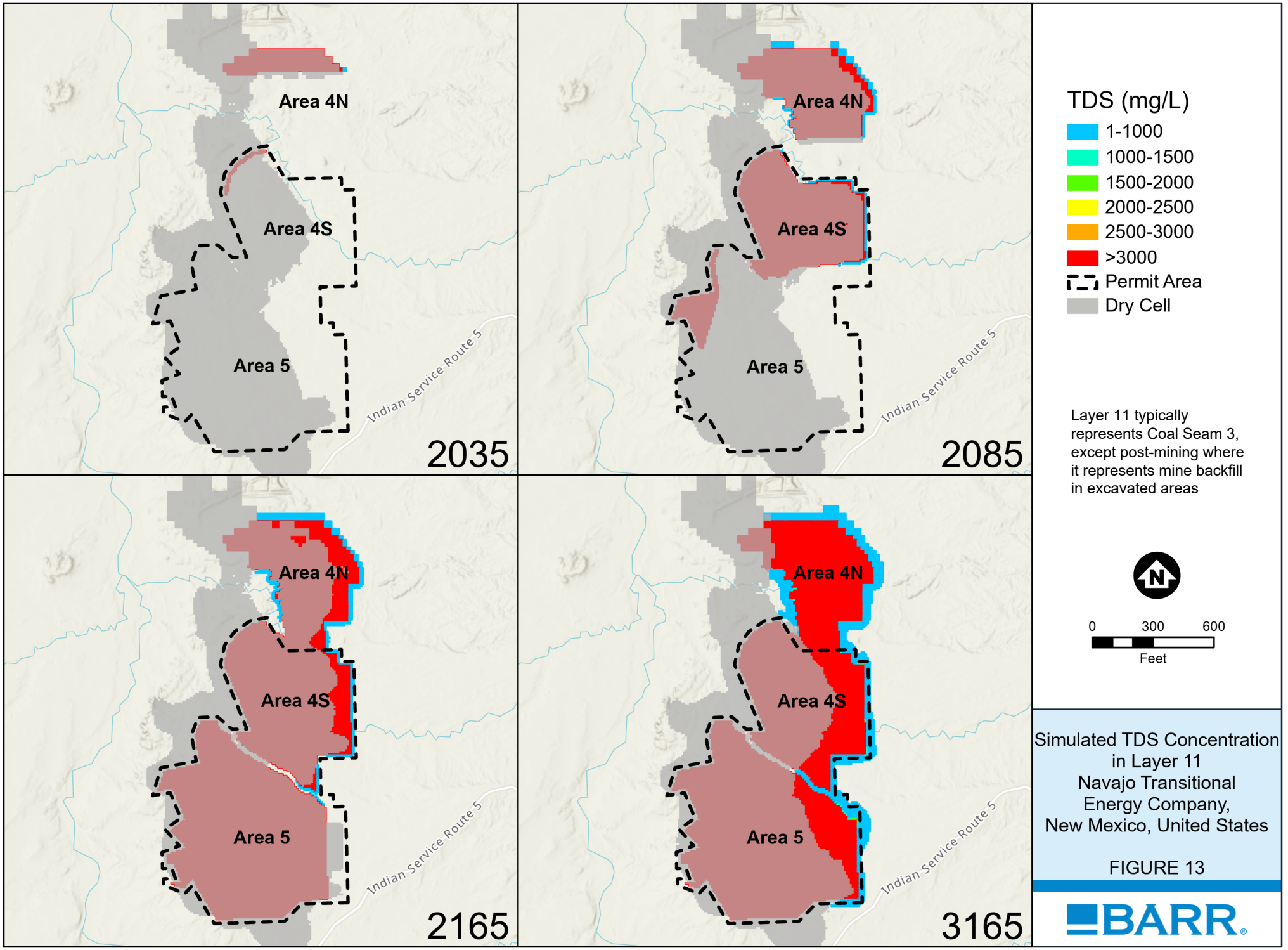


Simulated TDS Concentration in Layer 3
Navajo Transitional Energy Company, New Mexico, United States

FIGURE 12

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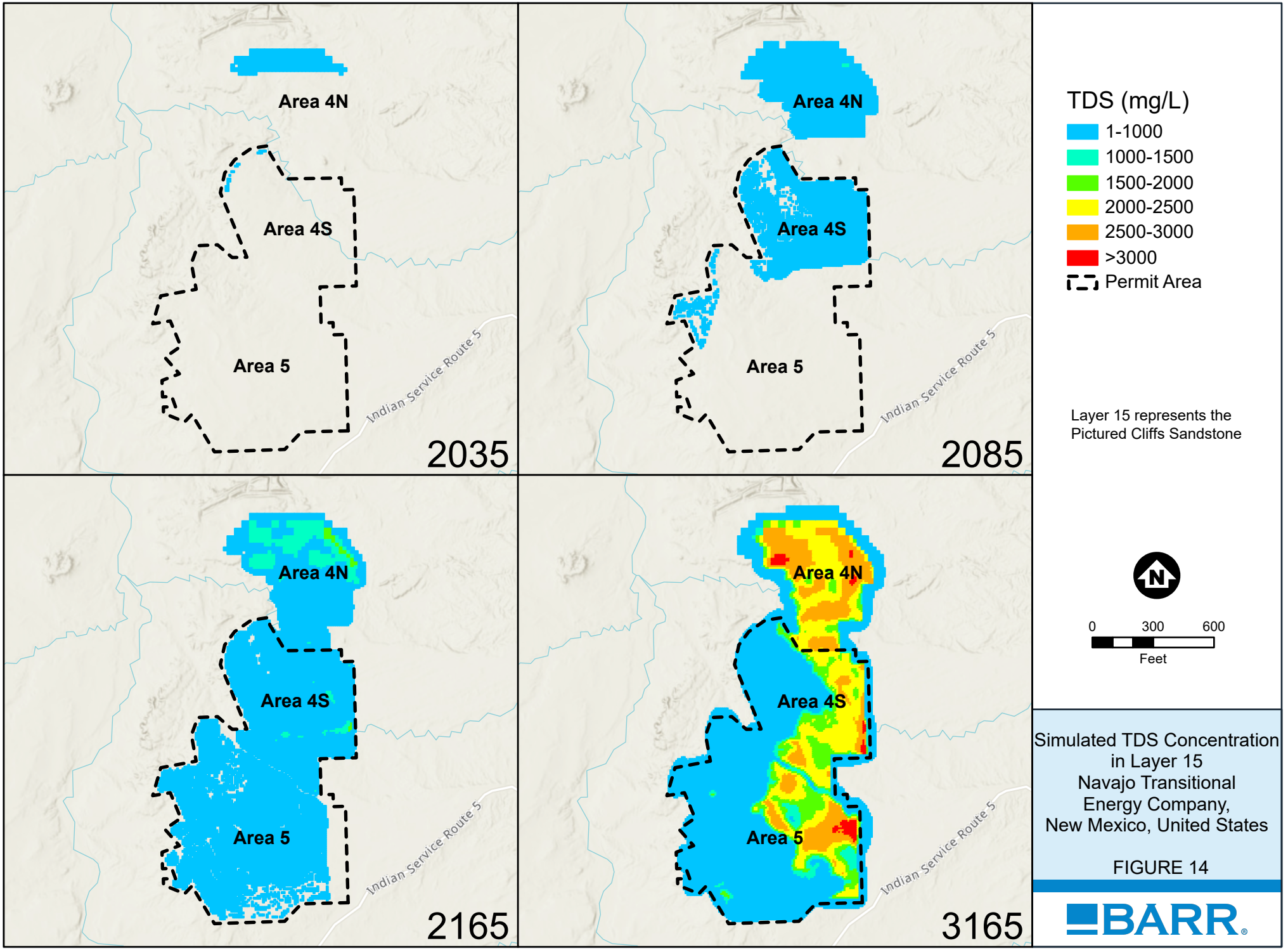


Simulated TDS Concentration in Layer 11
Navajo Transitional Energy Company, New Mexico, United States

FIGURE 13

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Simulated TDS Concentration in Layer 15
Navajo Transitional Energy Company, New Mexico, United States

FIGURE 14

BARR

Appendix 41.C

SEDCAD™4 Modeling of Flood Flows and Sediment Yields for Mining Operation Conditions

APPENDIX 41.C

SEDCAD™4 MODELING OF FLOOD FLOWS AND SEDIMENT YIELDS FOR MINING OPERATION CONDITIONS

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	Subwatershed Designation and Slopes	2
	Time of Concentration	3
	Rainfall Duration, Frequency, and Distribution	3
	Curve Number	3
	Hydrologic Response Class	4
	Sedimentology Evaluation	4
	Erodible Particel Size Distribution	4
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	Results	6
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APPENDIX 41.C

SEDCAD™4 MODELING OF FLOOD FLOWS AND SEDIMENT YIELDS FOR MINING OPERATION CONDITIONS

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41.C-2	Pinabete Arroyo SEDCAD™ Model Erodible Particle Size Distribution (EPSD) Input for Mining Operation Conditions
41.C-3	No Name Arroyo SEDCAD™ Model Erodible Particle Size Distribution (EPSD) Input for Mining Operation Conditions
41.C-4	Cottonwood Arroyo Unnamed Tributary SEDCAD™ Model Erodible Particle Size Distribution (EPSD) Input for Mining Operation Conditions
41.C-5	Brimhall Wash SEDCAD™ Model Erodible Particle Size Distribution (EPSD) Input for Mining Operation Conditions
41.C-6	Chaco River Unnamed Tributaries 1-2 SEDCAD™ Model Erodible Particle Size Distribution (EPSD) Input for Mining Operation Conditions
41.C-7	Cover Factor Canopy and Surface Cover Interpolation

APPENDIX 41.C

SEDCAD™4 MODELING OF FLOOD FLOWS AND SEDIMENT YIELDS FOR MINING OPERATION CONDITIONS

LIST OF EXHIBITS

EXHIBIT NUMBER	EXHIBIT TITLE
41.C-1	No Name Watershed Modeling Scenarios

APPENDIX 41.C

SEDCAD™4 MODELING OF FLOOD FLOWS AND SEDIMENT YIELDS FOR MINING OPERATION CONDITIONS

LIST OF ATTACHMENTS

ATTACHMENT NUMBER	ATTACHMENT TITLE
41.C-1	Pinabete Arroyo Hydrology and Sedimentology SEDCAD™ Model Output with Pinabete Diversion and Pre-Mining in Area 4 South
41.C-2	Pinabete Arroyo Hydrology and Sedimentology SEDCAD™ Model Output During Operations in Area 4 South
41.C-3	No Name Arroyo Hydrology and Sedimentology SEDCAD™ Model Output with Pinabete Diversion During Operations in Area 4 South
41.C-4	No Name Arroyo Hydrology and Sedimentology SEDCAD™ Model Output with Pinabete Diversion During Operations in Area 4 South and Area 5
41.C-5	No Name Arroyo Hydrology and Sedimentology SEDCAD™ Model Output with Pinabete Diversion Reclaimed During Operations in Area 5
41.C-6	Brimhall Wash Hydrology and Sedimentology SEDCAD™ Model Output During Operations in Area 5
41.C-7	Chaco River Unnamed Tributaries Hydrology and Sedimentology SEDCAD™ Model Output During Operations in Area 4 South and Area 5

SEDCAD™4 MODELING OF FLOOD FLOWS AND SEDIMENT YIELDS FOR MINING OPERATION CONDITIONS

The SEDCAD™4 (SEDCAD) hydrology model has been used to determine flood flows and sediment yields for the mining operation watershed conditions of Pinabete Arroyo, No Name Arroyo, tributaries to Cottonwood Arroyo, Brimhall Wash, and tributaries to the Chaco River. Application of the SEDCAD program involves dividing the drainage area into subwatersheds. Designation of subwatersheds with relatively uniform soil and vegetation characteristics helps in the estimation of model parameters required by SEDCAD. Information is required for physical structures located along the channel that may affect flow and sediment routing within the stream channels. SEDCAD null structures are also established at appropriate locations along the channel network where flow and sedimentology predictions are needed.

The SEDCAD input parameters are provided in tables to this appendix and output results for the 10-year 24-hour precipitation event, and the 2-year, 10-year, 25-year, 50-year, and 100-year 6-hour precipitation events are provided as attachments to this appendix. There are two SEDCAD models for Pinabete Arroyo. The first model addresses conditions in Pinabete Arroyo after the Pinabete Diversion has been constructed but before mining operations have begun in Area 4 South (Attachment 41.C-1). The second model addresses conditions in Pinabete Arroyo after mining operations have begun in Area 4 South and the overall contributing watershed has been reduced (Attachment 41.C-2). There are three models for No Name Arroyo. The first model addresses conditions in No Name Arroyo after the Pinabete Diversion has been constructed and mining operations have begun in Area 4 South (Attachment 41.C-3). The second model addresses conditions in No Name Arroyo with the Pinabete Diversion in place and mining operations begun in Area 4 South and Area 5 (Attachment 41.C-4). The third model addresses conditions where the Pinabete Diversion has been reclaimed but mining operations are still underway in Area 5 (Attachment 41.C-5). Another model addresses conditions in Brimhall Wash during operations in Area 5 (Attachment 41.C-6). Three models address conditions in the two unnamed tributaries to the Chaco River during mining operations (Attachment 41.C-7).

Soil erosion by water for a specific watershed is usually calculated using the well known empirical Revised Universal Soil Loss Equation (RUSLE) (Renard et al. 1997) and is given by the following expression:

A is the average soil loss per unit area, expressed in units selected for *K* and the time period specified by *R*. Normal English units are tons/acre/year.

R is the rainfall/runoff factor, which is the number of rainfall units for rainfall energy and runoff, plus the factor for runoff from snowmelt.

K is the soil erodibility factor, which is the rate of soil loss per unit of *R* for a given soil on a slope of 9% with slope length of 72.6 ft.

L is the slope length factor, which is the ratio of soil loss from a defined slope length relative to that from a slope length of 72.6 ft).

S is the slope steepness factor, which is the ratio of soil loss from a slope with a given steepness relative to that from a 9% slope.

C is the cover and management factor, which is the ratio of soil loss from an area with a known cover and management. And,

P is the supporting conservation practice factor.

SEDCAD requires these types of inputs be developed for each watershed being analyzed. To follow is a discussion on how the necessary parameter inputs were developed and calculated for the No Name Permit (NNP). This approach is similar to the one used when assessing the baseline flood flows and sediment yields (Section 18, Appendix 18.B) and the post-reclamation flood flows and sediment yields (Appendix 41.D).

Runoff Modeling

Subwatershed Designation and Slopes

The SEDCAD subwatershed designations and drainage configuration for the watersheds of interest are shown on Exhibit 41.2-1. The subwatershed information was developed using Carlson Civil Suite 2008, AutoCAD®, and ArcGIS® software. The base mapping used to develop these subwatersheds is a combination of 10-ft contoured aerial flight and digital elevation model (DEM) data. The DEM images were based on digital raster graphics, representing US Geologic Survey (USGS) 7.5 minute topographic quadrangle maps (NMRGIS 2009; USGS 2009). All DEM analysis was performed utilizing the Spatial Analyst extension for ArcGIS® on DEM images projected to the North American Datum of 1927- State Plane New Mexico West coordinate system and in standard units (feet) of measure.

A more detailed analysis was prepared for the subwatersheds within the lease boundary because they will be influenced by mining and reclamation activities. The Pinabete Arroyo watershed upstream of the Pinabete Diversion is not included in the models for Pinabete Arroyo. In the first model, Pinabete Arroyo watershed within the permit boundary and downstream to the confluence with the Chaco River was divided into 19 subwatersheds as shown on Exhibit 41.2-1 and SEDCAD runs are found in Attachment 41.C-1. In the second model, only the Pinabete Arroyo watershed downstream of the permit boundary to the confluence with the Chaco River is considered. It is divided into five subwatersheds (Exhibit 41.2-1 and Attachment 41.C-2). Two of the three models for No Name Arroyo include the Pinabete Diversion with the watershed on Pinabete Arroyo upstream of the diversion. The SEDCAD modeling scenarios for the No Name watershed are presented Exhibit 41.C-1. The first considers mining operations in Area 4 South

(Exhibit 41.2-1 and Attachment 41.C-3) while the second considers mining operations in both Area 4 South and Area 5 (Exhibit 41.2-1 and Attachment 41.C-4). The third model for No Name Arroyo does not include the Pinabete Diversion or the Pinabete Arroyo watershed upstream of the diversion but does address mining operations in Area 5. In this model, No Name Arroyo is divided into 22 subwatersheds (Exhibit 41.2-1 and Attachment 41.C-5). The Brimhall Wash watershed was divided into 14 subwatersheds (Exhibit 41.2-1 and Attachment 41.C-6). Only a small portion of the watershed of Brimhall is within the permit boundary, so the model required fewer subwatersheds. The two unnamed tributaries to the Chaco River having watersheds of 3.4, 2.78, and 2.21 sq mi were divided into four, three, and three subwatersheds, respectively. Subwatershed parameters required by the SEDCAD program were determined as described below.

Time of Concentration

The time of concentration for each subwatershed was calculated by the SEDCAD program from the length and slope of the longest flow path that was input from the topographic map using AutoCAD® software.

Rainfall Duration, Frequency, and Distribution

For evaluation purposes, peak flows were estimated for the 6-hour rainfall event at the 2-year, 10-year, 25-year, 50-year, and 100-year frequencies and the 24-hour 10-year storm event. Storm precipitation values provided in Section 18 Water Resources for the various return periods were obtained from the National Oceanic and Atmospheric Administration (NOAA) online frequency estimates (Bonnin et al. 2006) for a location between Area 4 South and Area 5 from Atlas 14, New Mexico for the location of the No Name Arroyo and Pinabete Arroyo watersheds. A Soil Conservation Service (SCS) Type II-70 rainfall distribution was applied to all storms, which is consistent with the rainfall distribution used by Navajo Mine.

Curve Number

Hydrologic group for the various soil types within each watershed was obtained from the *Soil Survey of San Juan County, Eastern Part* (Keetch 1980) for lands outside the NTEC lease area and from the baseline soils study (Section 14) for lands inside the NTEC lease area. These soil surveys classified soil types into four hydrologic group ratings: A, B, C, or D. Runoff curve numbers were developed from the "SEDCAD™4 User Manual" and software (Warner et al. 1998) and from SCS Engineering Division Technical Release *"Urban Hydrology for Small Watersheds*, Table 2-2d, page 2-8, "Runoff curve numbers for arid and semiarid rangelands" (USDA 1986), for each hydrologic soil group assuming a land use/condition between "Herbaceous" and "Desert Shrub" each with a poor cover condition. From this information, runoff curve numbers were derived for each of the four surface texture types. The curve numbers derived for each texture type are summarized in Table 41.C-1. The runoff curve number for a subwatershed was calculated as a weighted average based on the overall surface texture proportions determined for that watershed.

Hydrologic Response Class

A medium hydrologic response class was applied to all subwatersheds. The hydrologic response class determines the shape of the unit hydrograph used in the SEDCAD model. The medium class is typical of agricultural and semiarid rangeland conditions and was determined to be representative of site conditions.

Sedimentology Evaluation

The SEDCAD sedimentology analysis relies on a rainfall factor, erodible particle size data, a soil's erodibility factor, the watershed's topography and the resulting distance of overland flow, cover values and cultural practices at the site. Data for all of these parameters are entered for each subwatershed within the model.

Erodible Particel Size Distribution

Navajo Transitional Energy Company (NTEC) obtained information about soils within and adjacent to the permit area, as part of the rigorous baseline soils investigation for NNP. This information came from site-specific studies (Section 14) and regional soil survey data (Keetch 1980). Soil mapping units were categorized into four surface textures to provide a basis for developing values for sedimentology parameters used in the SEDCAD model. These surface texture classes included: fine, fine loamy, coarse loamy, and sandy. ArcGIS® software was used to overlay the pre-mine subwatersheds with the baseline soils information to produce a database file that contained the areas corresponding to each soil type within each subwatershed. Textures were linked to the soil types, and an evaluation of the percentage of each texture within each watershed was calculated as a function of area. This surface texture distribution was used to calculate the remaining factors needed for SEDCAD modeling.

Erodible particle size distributions (EPSD) were developed for each of the four surface texture classes in a study conducted by Dr. Richard Warner of the Biosystems and Agricultural Engineering Department at the University of Kentucky (Section 18, Attachment 18.B-1). The SEDCAD modeling software has a maximum of 20 ESPD per watershed model. For some watershed models, there were more subwatersheds than the number of EPSDs allowed by SEDCAD. In these cases, average or representative EPSDs were used. This data was entered into the model, and the specific particle size distribution referenced for each structure. Due to formatting difficulties with the SEDCAD output, NTEC has reproduced the particle size distributions for the major model runs in supplemental tables to completely document the assumptions incorporated by the sedimentology analysis. These particle size distributions are specific to each watershed model and are uniquely numbered. Each structure within the watershed models is assigned on of these particle size distributions. Up to 20 particle size distributions were utilized to represent Pinabete Arroyo subwatershed conditions depending on the texture of the soil and may be reviewed on Table 41.C-2. The 15 distributions for No Name Arroyo are summarized Table 41.C-3. The five distributions for tributaries to

Cottonwood Arroyo are summarized on Table 41.C-4. The 13 distributions for Brimhall Wash are summarized on Table 41.C-5. The 10 distributions for tributaries to the Chaco River are summarized on Table 41.C-6.

Erodibiltiy Factor (K)

The RUSLE K-factor is a measure of a soil's resistance to erosive powers of rainfall energy and runoff. Practically, soil erodibility is an integration of the impacts of rainfall and runoff on soil loss for a given soil. Experimentally, soil erodibility is the soil loss per unit rainfall index on a standard erosion plot. K-factor can be obtained through three different sources: published data, the Wischmeier nomograph developed from data collected on 55 different midwestern USA agricultural soils, or the analytical approximation of the Wischmeier nomograph (Renard et al. 1997). Inter-Mountain Labs (IML) determined the K-factor for the four soil texture types using the analytical approximation of the Wischmeier nomograph, which is given by the following relationship:

K is the soil erodibility factor in tons per acre per unit rainfall index (ton/ac/unit rainfall)
Unit rainfall index is in hundreds of feet · tons-force · inches per hour (100s ft tonsf in/hr)
OM is the percentage organic matter,
P_I is the permeability index (1 to 4),
S_I is the soil structure index (1 to 6),
M is a parameter that depends on the parent particle size distribution and is given by the following and is valid for values of $\%MS + \%VFS$ less than 70:

$\%CL$ is percentage clay (size < 0.002 mm in diameter),
$\%MS$ is percentage silt (0.002 – 0.05 mm), and
$\%VFS$ is percentage very fine sand (0.05 – 0.1 mm).

The percentages clay, silt, and very fine sand are obtained directly from the parent particle size distribution using American Society for Testing and Materials D422 – "Standard Test Method for Particle-Size Analysis of Soils" (ASTM 2000). The percentage of organic matter (*OM*) was determined using the Wakley-Black (WB) method (Nelson and Sommers 1982). IML also determined *OM* using the loss on ignition (LOI) described by Nelson and Sommers (1996). The results of these analyses are provided in Attachment 18.B-2. The K-factors for each texture type are summarized in Table 41.C-1. The K-factor for

a subwatershed was then calculated as a weighted average based on the overall the surface texture distribution determined for that watershed.

Cover Factor (C)

Representative vegetative cover and surface cover information was derived for each of the EPSD texture classes from baseline vegetation surveys (Section 15). This information was integrated with the EPSD texture class information using ArcGIS® to generate canopy cover and surface cover values for each of the four soil textures. Between 104 and 131 transects were used to determine the mean percent total vegetative cover (canopy cover) and mean percent surface cover for each of the four EPSD texture classes. The canopy cover and surface cover derived for each texture type are summarized in Table 41.C-1. The canopy cover versus surface cover tables for rangeland contained within SEDCAD were expanded through linear interpolation to provide cover factors for subwatersheds based on the surface texture distribution. The average cover values were calculated for subwatersheds as a weighted average based on area. These values were used to determine the cover factor through interpolation in Table 41.C-7.

Results

The results of the hydrology and sedimentology models for each of the watersheds are provided as attachments. Each attachment contains the summary output from SEDCAD including: storm information, structure networking, structure routing details, EPSD for each structure, subwatershed hydrology details, subwatershed sedimentology details, subwatershed time of concentration details, subwatershed Muskingum routing details. The subwatershed structure networking is shown on Exhibit 41.2-1. The attachments also contain structure summaries for the following storm events: 10-year 24-hour, 2-year 6-hour, 10-year 6-hour, 25-year 6-hour, 50-year 6-hour, and 100-year 6-hour.

Peak flows and sediment yields calculated from the aforementioned SEDCAD models for the 24-hour 10-year and 6-hour rainfall events on 2-year, 10-year, 25-year, 50-year, and 100-year frequencies are reported in Section 41.2-4 to Table 41.2-7 for each of the surface water monitoring stations on Pinabete and No Name arroyos, Brimhall Wash at the confluence with the Chaco River, the unnamed tributaries to Chaco at the confluence, and the unnamed tributaries to Cottonwood at the confluence.

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Attachment 41.C-1

Pinabete Arroyo Hydrology and Sedimentology SEDCAD™ Model Output
with Pinabete Diversion and Pre-Mining in Area 4 South

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General Information

Storm Information:

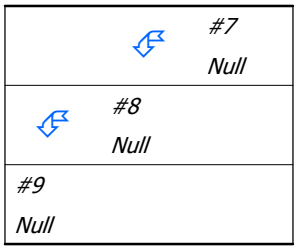
Storm Type:	Type II-70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Particle Size Distribution:

Table 41.C-2

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#7	==>	#8	2.793	0.277	E Lease Bdry Downstrm of P Diversion
Null	#8	==>	#9	2.630	0.259	W Lease Bdry
Null	#9	==>	End	0.000	0.000	Pinabete at Confluence w Chaco



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#7	8. Large gullies, diversions, and low flowing streams	0.49	105.00	21,218.00	2.11	2.793
#7	**Muskingum K:**					**2.793**
#8	8. Large gullies, diversions, and low flowing streams	0.37	64.00	17,238.00	1.82	2.630
#8	**Muskingum K:**					**2.630**

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Particle Size Distribution(s) at Each Structure

Structure #7 (E Lease Bdry Downstrm of P Diversion):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	98.798%
0.0750	85.582%
0.0159	76.743%
0.0100	63.890%
0.0050	25.485%
0.0020	14.075%
0.0010	13.099%
0.0004	11.988%

Structure #8 (W Lease Bdry):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	98.263%
0.0750	89.078%
0.0159	81.149%
0.0100	67.336%
0.0050	24.512%
0.0020	14.363%
0.0010	13.211%
0.0004	12.121%

Structure #9:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	97.375%
0.0159	94.199%

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Size (mm)	In/Out
0.0100	84.183%
0.0050	29.681%
0.0020	17.478%
0.0010	16.119%
0.0004	14.653%

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Structure Detail:

Structure #7 (Null)

E Lease Bdry Downstrm of P Diversion

Structure #8 (Null)

W Lease Bdry

Structure #9 (Null)

Pinabete at Confluence w Chaco

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#7	1	139.010	0.238	0.665	0.285	82.900	M	79.71	4.611
	2	154.010	0.620	0.000	0.000	75.000	M	22.49	2.499
	3	194.900	0.596	0.000	0.000	72.600	M	21.05	2.452
	Σ	**487.920**						**83.23**	**9.561**
#8	1	282.990	0.437	2.912	0.280	93.000	M	264.01	19.620
	2	536.190	0.674	2.659	0.279	92.400	M	372.01	35.605
	3	647.700	0.853	2.311	0.280	87.600	M	260.78	30.470
	4	754.800	1.690	2.328	0.277	76.200	M	57.58	13.788
	5	532.600	0.740	1.423	0.277	79.500	M	113.85	13.178
	6	309.700	0.436	1.168	0.285	85.600	M	166.21	12.570
	7	158.300	0.448	0.938	0.279	83.800	M	71.65	5.586
	8	304.300	0.648	0.566	0.296	80.600	M	80.17	8.278
	9	211.900	0.480	0.921	0.320	83.000	M	85.52	7.027
	10	711.200	0.890	0.436	0.300	83.300	M	190.68	24.108
	11	168.200	0.283	0.000	0.000	83.300	M	92.56	5.727
	Σ	**5,105.800**						**804.01**	**185.519**
#9	1	466.200	0.574	2.401	0.265	89.000	M	277.79	24.314
	2	427.200	0.633	2.204	0.256	84.900	M	169.55	16.405
	3	361.200	0.686	1.864	0.256	84.900	M	135.39	13.872
	4	573.300	0.655	0.983	0.255	85.800	M	240.22	23.605
	5	473.100	0.668	0.000	0.000	84.600	M	176.01	17.771
	Σ	**7,406.800**						**739.55**	**281.486**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#7	1	0.197	280.00	2.70	0.2330	1.0000	5	59.9	16,543	7.54	4.33
	2	0.204	420.00	1.80	0.3270	1.0000	19	24.1	13,239	4.61	2.46
	3	0.171	280.00	2.40	0.3380	1.0000	10	22.7	13,087	3.58	1.86
	Σ							**87.8**	**11,871**	**3.63**	**2.06**
#8	1	0.200	280.00	2.70	0.1410	1.0000	1	162.7	9,355	3.40	2.21
	2	0.204	280.00	2.30	0.1550	1.0000	3	267.3	8,578	2.79	1.79
	3	0.173	280.00	3.00	0.2220	1.0000	6	310.3	11,965	4.25	2.65
	4	0.204	280.00	3.00	0.3180	1.0000	19	144.3	12,459	1.51	0.93
	5	0.187	200.00	5.90	0.2960	1.0000	12	366.8	34,625	12.51	7.31

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	6	0.167	200.00	4.20	0.2740	1.0000	8	264.4	25,618	12.49	7.48
	7	0.215	100.00	9.40	0.2650	1.0000	20	219.1	48,298	23.28	13.69
	8	0.201	100.00	8.10	0.2960	1.0000	13	240.3	36,721	15.14	8.70
	9	0.208	280.00	2.70	0.2120	1.0000	15	76.1	13,686	5.07	2.94
	10	0.225	200.00	4.50	0.2540	1.0000	14	548.6	27,795	10.17	6.07
	11	0.198	100.00	9.20	0.2450	1.0000	6	210.9	47,825	22.37	12.48
	Σ							**2,327.7**	**43,313**	**12.26**	**2.60**
#9	1	0.206	130.00	7.80	0.1800	1.0000	16	600.7	28,616	11.28	7.10
	2	0.189	100.00	11.10	0.2450	1.0000	6	692.7	49,867	19.18	11.75
	3	0.177	100.00	8.30	0.2330	1.0000	6	310.5	26,790	9.96	6.07
	4	0.161	100.00	10.00	0.2220	1.0000	5	664.6	33,921	12.01	7.25
	5	0.175	200.00	5.90	0.2450	1.0000	6	428.6	29,984	11.21	6.57
	Σ							**3,543.6**	**26,384**	**4.22**	**1.47**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#7	1	5. Nearly bare and untilled, and alluvial valley fans	1.70	10.74	632.00	1.300	0.135
		8. Large gullies, diversions, and low flowing streams	1.11	13.05	1,176.00	3.160	0.103
#7	**1**	**Time of Concentration:**					**0.238**
#7	2	5. Nearly bare and untilled, and alluvial valley fans	1.70	16.01	942.00	1.300	0.201
		8. Large gullies, diversions, and low flowing streams	1.50	83.04	5,536.00	3.670	0.419
#7	**2**	**Time of Concentration:**					**0.620**
#7	3	5. Nearly bare and untilled, and alluvial valley fans	2.14	14.00	655.00	1.460	0.124
		8. Large gullies, diversions, and low flowing streams	1.07	56.00	5,255.00	3.090	0.472
#7	**3**	**Time of Concentration:**					**0.596**
#8	1	5. Nearly bare and untilled, and alluvial valley fans	1.97	5.00	254.00	1.400	0.050
		8. Large gullies, diversions, and low flowing streams	1.64	87.82	5,355.00	3.840	0.387
#8	**1**	**Time of Concentration:**					**0.437**
#8	2	5. Nearly bare and untilled, and alluvial valley fans	2.49	8.00	321.01	1.570	0.056
		8. Large gullies, diversions, and low flowing streams	1.16	83.41	7,191.00	3.230	0.618
#8	**2**	**Time of Concentration:**					**0.674**
#8	3	5. Nearly bare and untilled, and alluvial valley fans	3.58	25.00	698.00	1.890	0.102

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	1.12	96.00	8,579.00	3.170	0.751
#8	**3**	**Time of Concentration:**					**0.853**
#8	4	5. Nearly bare and untilled, and alluvial valley fans	0.85	10.00	1,181.00	0.920	0.356
		8. Large gullies, diversions, and low flowing streams	0.90	123.00	13,645.00	2.840	1.334
#8	**4**	**Time of Concentration:**					**1.690**
#8	5	5. Nearly bare and untilled, and alluvial valley fans	6.53	39.00	597.00	2.550	0.065
		8. Large gullies, diversions, and low flowing streams	1.42	123.00	8,678.00	3.570	0.675
#8	**5**	**Time of Concentration:**					**0.740**
#8	6	5. Nearly bare and untilled, and alluvial valley fans	1.45	5.00	344.00	1.200	0.079
		8. Large gullies, diversions, and low flowing streams	2.21	127.00	5,746.00	4.460	0.357
#8	**6**	**Time of Concentration:**					**0.436**
#8	7	5. Nearly bare and untilled, and alluvial valley fans	2.98	12.00	403.00	1.720	0.065
		8. Large gullies, diversions, and low flowing streams	1.97	114.00	5,796.00	4.200	0.383
#8	**7**	**Time of Concentration:**					**0.448**
#8	8	5. Nearly bare and untilled, and alluvial valley fans	20.11	105.00	522.00	4.480	0.032
		8. Large gullies, diversions, and low flowing streams	1.77	157.00	8,849.00	3.990	0.616
#8	**8**	**Time of Concentration:**					**0.648**
#8	9	5. Nearly bare and untilled, and alluvial valley fans	43.35	75.00	173.00	6.580	0.007
		8. Large gullies, diversions, and low flowing streams	1.57	100.00	6,387.00	3.750	0.473
#8	**9**	**Time of Concentration:**					**0.480**
#8	10	5. Nearly bare and untilled, and alluvial valley fans	1.85	40.00	2,159.00	1.360	0.440
		8. Large gullies, diversions, and low flowing streams	1.53	92.00	6,011.00	3.710	0.450
#8	**10**	**Time of Concentration:**					**0.890**
#8	11	5. Nearly bare and untilled, and alluvial valley fans	4.84	24.00	496.00	2.190	0.062
		8. Large gullies, diversions, and low flowing streams	2.79	111.00	3,980.20	5.000	0.221
#8	**11**	**Time of Concentration:**					**0.283**
#9	1	5. Nearly bare and untilled, and alluvial valley fans	7.42	25.00	337.00	2.720	0.034
		8. Large gullies, diversions, and low flowing streams	1.50	107.00	7,136.00	3.670	0.540
#9	**1**	**Time of Concentration:**					**0.574**
#9	2	5. Nearly bare and untilled, and alluvial valley fans	11.19	15.00	134.00	3.340	0.011

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	1.96	184.00	9,391.00	4.190	0.622
#9	**2**	**Time of Concentration:**					**0.633**
#9	3	5. Nearly bare and untilled, and alluvial valley fans	3.14	25.00	796.00	1.770	0.124
		8. Large gullies, diversions, and low flowing streams	1.68	132.00	7,862.00	3.880	0.562
#9	**3**	**Time of Concentration:**					**0.686**
#9	4	5. Nearly bare and untilled, and alluvial valley fans	12.82	35.00	273.00	3.580	0.021
		8. Large gullies, diversions, and low flowing streams	1.93	183.00	9,495.00	4.160	0.634
#9	**4**	**Time of Concentration:**					**0.655**
#9	5	5. Nearly bare and untilled, and alluvial valley fans	2.66	15.00	564.00	1.630	0.096
		8. Large gullies, diversions, and low flowing streams	1.68	135.00	8,020.00	3.890	0.572
#9	**5**	**Time of Concentration:**					**0.668**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#7	1	8. Large gullies, diversions, and low flowing streams	0.57	31.00	5,417.00	2.260	0.665
#7	**1**	**Muskingum K:**					**0.665**
#8	1	8. Large gullies, diversions, and low flowing streams	0.53	120.00	22,753.13	2.170	2.912
#8	**1**	**Muskingum K:**					**2.912**
#8	2	8. Large gullies, diversions, and low flowing streams	0.51	106.00	20,587.00	2.150	2.659
#8	**2**	**Muskingum K:**					**2.659**
#8	3	8. Large gullies, diversions, and low flowing streams	0.53	95.00	18,060.00	2.170	2.311
#8	**3**	**Muskingum K:**					**2.311**
#8	4	8. Large gullies, diversions, and low flowing streams	0.50	88.00	17,689.00	2.110	2.328
#8	**4**	**Muskingum K:**					**2.328**
#8	5	8. Large gullies, diversions, and low flowing streams	0.50	54.00	10,815.00	2.110	1.423
#8	**5**	**Muskingum K:**					**1.423**
#8	6	8. Large gullies, diversions, and low flowing streams	0.57	54.00	9,503.00	2.260	1.168
#8	**6**	**Muskingum K:**					**1.168**
#8	7	8. Large gullies, diversions, and low flowing streams	0.51	37.00	7,229.00	2.140	0.938
#8	**7**	**Muskingum K:**					**0.938**
#8	8	8. Large gullies, diversions, and low flowing streams	0.68	34.00	5,017.00	2.460	0.566

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#8	**8**	**Muskingum K:**					**0.566**
#8	9	8. Large gullies, diversions, and low flowing streams	1.01	101.00	9,985.00	3.010	0.921
#8	**9**	**Muskingum K:**					**0.921**
#8	10	8. Large gullies, diversions, and low flowing streams	0.72	29.00	4,009.00	2.550	0.436
#8	**10**	**Muskingum K:**					**0.436**
#9	1	8. Large gullies, diversions, and low flowing streams	0.41	68.00	16,597.51	1.920	2.401
#9	**1**	**Muskingum K:**					**2.401**
#9	2	8. Large gullies, diversions, and low flowing streams	0.36	51.00	14,207.00	1.790	2.204
#9	**2**	**Muskingum K:**					**2.204**
#9	3	8. Large gullies, diversions, and low flowing streams	0.36	43.00	12,015.00	1.790	1.864
#9	**3**	**Muskingum K:**					**1.864**
#9	4	8. Large gullies, diversions, and low flowing streams	0.35	22.00	6,269.00	1.770	0.983
#9	**4**	**Muskingum K:**					**0.983**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#7	487.920	487.920	83.23	9.56	87.8	11,871	3.63	2.06
#8	4,617.880	5,105.800	804.01	185.52	2,327.7	43,313	12.26	2.60
#9	2,301.000	7,406.800	739.55	281.49	3,543.6	26,384	4.22	1.47

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#7	487.920	487.920	12.40	0.84	7.3	10,171	2.72	1.70
#8	4,617.880	5,105.800	244.49	37.66	386.0	37,510	7.67	1.53
#9	2,301.000	7,406.800	216.41	57.34	641.6	20,596	2.25	0.89

SEDCAD 4 for Windows 10-Year 6-Hour Storm Summary

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#7	487.920	487.920	52.04	4.20	41.9	10,886	3.08	2.07
#8	4,617.880	5,105.800	578.61	102.67	1,306.5	39,351	9.96	2.35
#9	2,301.000	7,406.800	519.89	156.58	2,034.9	23,339	3.30	1.34

SEDCAD 4 for Windows 25-Year 6-Hour Storm Summary

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#7	487.920	487.920	88.71	7.59	79.8	10,943	3.27	2.30
#8	4,617.880	5,105.800	842.88	156.25	2,160.5	40,172	10.99	2.77
#9	2,301.000	7,406.800	759.85	237.48	3,266.7	24,380	3.72	1.53

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#7	487.920	487.920	122.79	10.92	118.5	10,933	3.37	2.45
#8	4,617.880	5,105.800	1,079.00	205.08	2,968.0	40,736	11.57	3.00
#9	2,301.000	7,406.800	974.58	310.84	4,423.9	25,147	4.01	1.66

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#7	487.920	487.920	164.79	15.01	168.1	11,003	3.51	2.62
#8	4,617.880	5,105.800	1,350.90	262.09	3,943.7	41,186	12.06	3.22
#9	2,301.000	7,406.800	1,222.11	396.14	5,810.3	25,866	4.28	1.77

Attachment 41.C-2

Pinabete Arroyo Hydrology and Sedimentology SEDCAD™ Model Output

During Operations in Area 4 South

General Information

Storm Information:

Storm Type:	NRCS TYPE II-70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

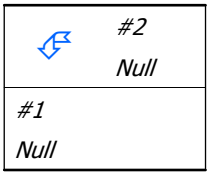
Particle Size Distribution:

See Table 41.C-2

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Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	
Null	#2	==>	#1	0.000	0.000	



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Particle Size Distribution(s) at Each Structure

Structure #2:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	95.681%
0.0159	91.014%
0.0100	80.573%
0.0050	25.183%
0.0020	14.887%
0.0010	13.733%
0.0004	12.355%

Structure #1:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	95.681%
0.0159	91.014%
0.0100	80.573%
0.0050	25.183%
0.0020	14.887%
0.0010	13.733%
0.0004	12.355%

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Structure Detail:

Structure #2 (Null)

Structure #1 (Null)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	466.200	0.574	2.410	0.265	89.000	M	255.28	24.314
	2	427.000	0.633	2.204	0.256	84.900	M	154.41	16.398
	3	361.200	0.686	1.864	0.256	84.900	M	123.76	13.872
	4	573.000	0.655	0.983	0.255	85.800	M	219.40	23.592
	5	473.100	0.668	0.000	0.000	84.600	M	160.65	17.771
	Σ	**2,300.500**						**425.52**	**95.947**
#1	Σ	**2,300.500**						**425.52**	**95.947**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#2	1	0.206	130.00	7.80	0.1800	1.0000	1	572.9	27,267	10.49	6.61
	2	0.189	100.00	11.10	0.2450	1.0000	3	657.1	47,156	17.96	11.06
	3	0.177	100.00	8.30	0.2330	1.0000	3	295.3	25,372	9.35	5.72
	4	0.161	100.00	10.00	0.2220	1.0000	2	631.5	32,132	11.39	6.91
	5	0.175	200.00	5.90	0.2450	1.0000	3	407.2	28,475	10.55	6.19
	Σ							**1,773.6**	**22,806**	**4.31**	**2.55**
#1	Σ							**1,773.6**	**22,806**	**4.31**	**2.55**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	2,300.500	2,300.500	425.52	95.95	1,773.6	22,806	4.31	2.55
#1	0.000	2,300.500	425.52	95.95	1,773.6	22,806	4.31	2.55

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	2,300.500	2,300.500	110.23	19.68	337.7	17,556	2.16	1.55
#1	0.000	2,300.500	110.23	19.68	337.7	17,556	2.16	1.55

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	2,300.500	2,300.500	298.71	53.90	1,049.8	20,177	3.31	2.33
#1	0.000	2,300.500	298.71	53.90	1,049.8	20,177	3.31	2.33

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	2,300.500	2,300.500	448.41	81.22	1,663.3	21,242	3.87	2.72
#1	0.000	2,300.500	448.41	81.22	1,663.3	21,242	3.87	2.72

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	2,300.500	2,300.500	581.74	105.73	2,234.2	21,894	4.22	2.98
#1	0.000	2,300.500	581.74	105.73	2,234.2	21,894	4.22	2.98

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	2,300.500	2,300.500	736.72	134.02	2,915.7	22,503	4.57	3.22
#1	0.000	2,300.500	736.72	134.02	2,915.7	22,503	4.57	3.22

Attachment 41.C-3

No Name Arroyo Hydrology and Sedimentology SEDCAD™ Model Output
with Pinabete Diversion During Operations in Area 4 South

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General Information

Storm Information:

Storm Type:	NRCS TYPE II-70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

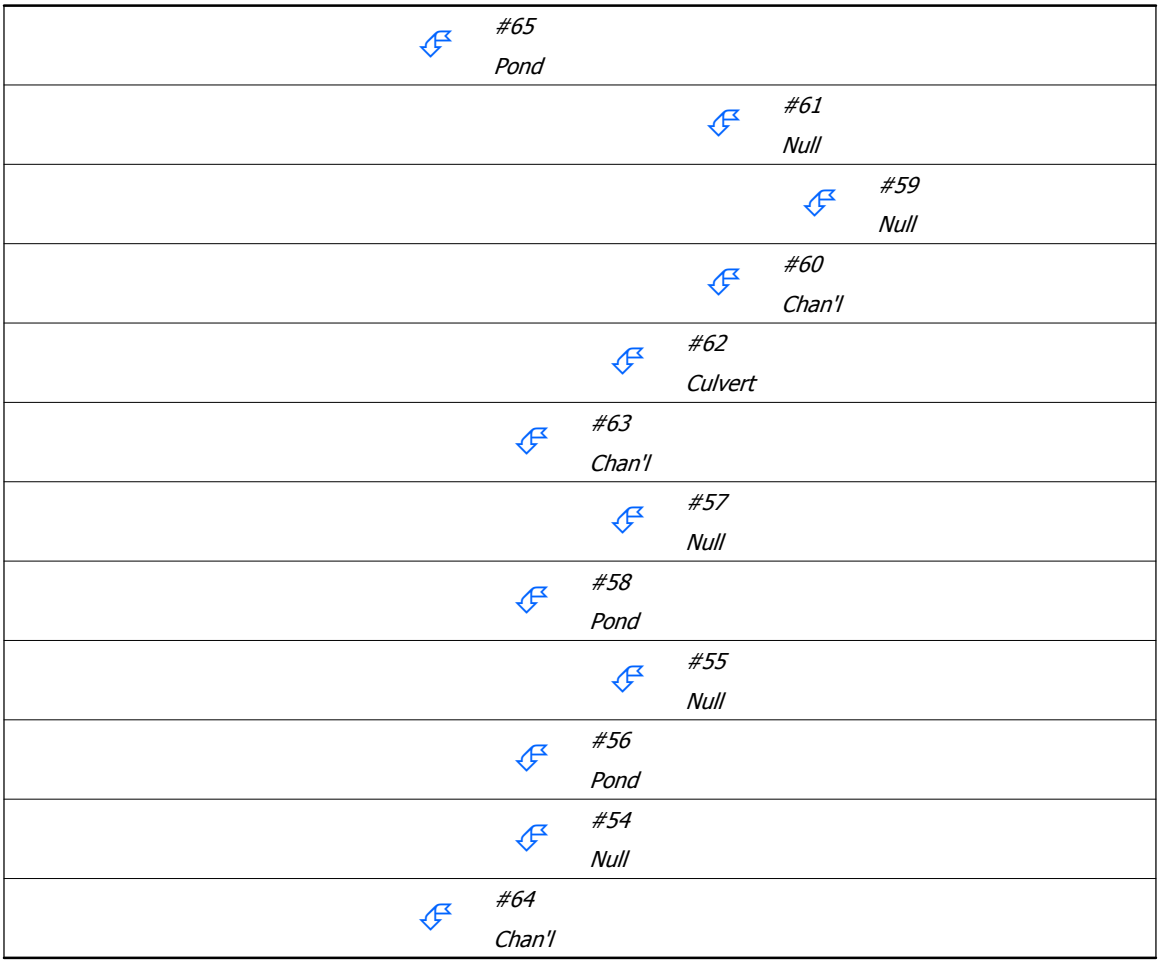
Particle Size Distribution:

Table 41.C-3

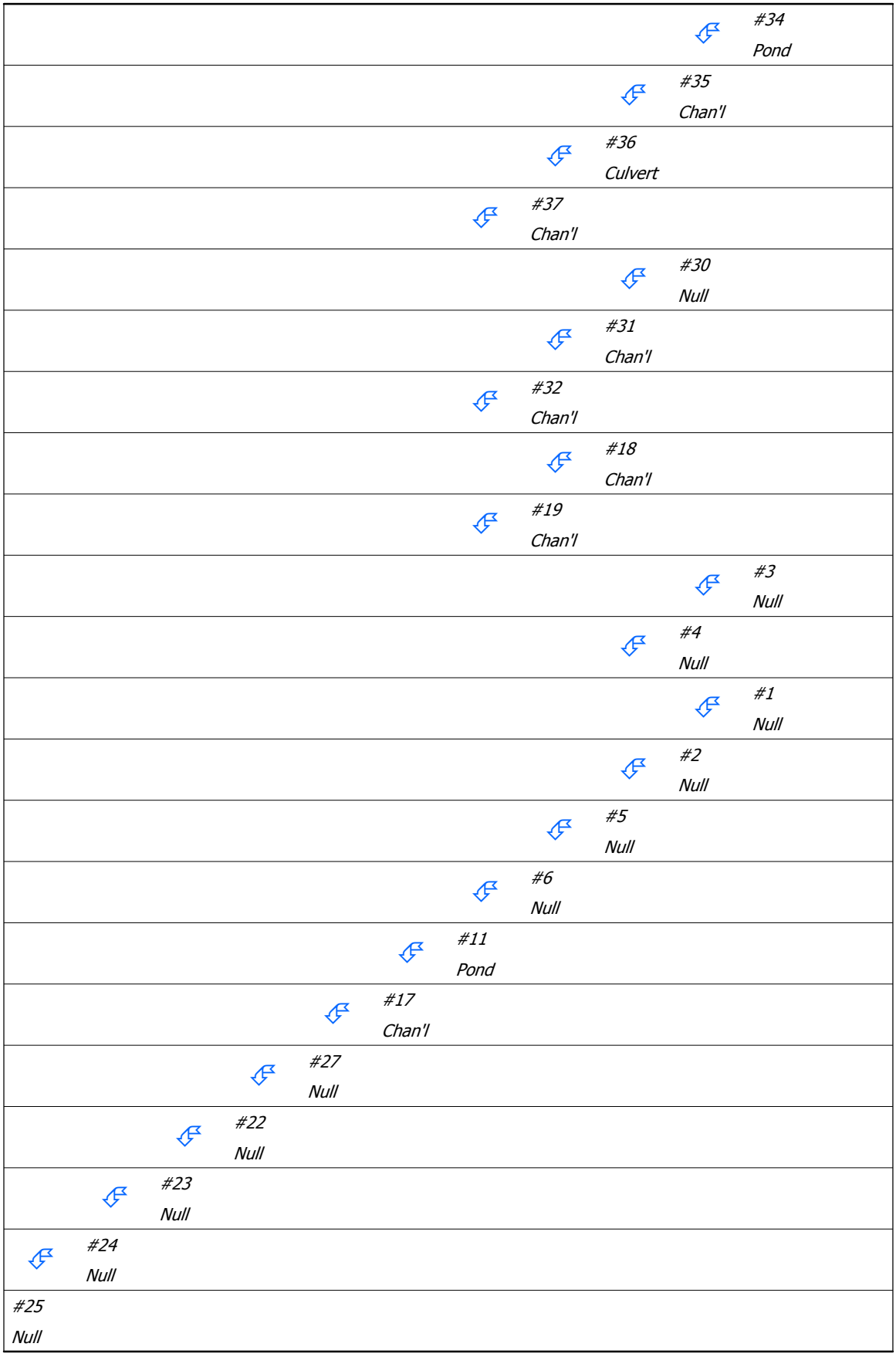
Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	1.674	0.331	
Null	#2	==>	#5	4.188	0.295	
Null	#3	==>	#4	1.961	0.319	
Null	#4	==>	#5	3.103	0.304	
Null	#5	==>	#6	1.300	0.273	
Null	#6	==>	#11	0.000	0.000	EAST LEASE BNDY
Pond	#11	==>	#17	2.406	0.221	Sta:118+00 - U Shaped Impoundment
Channel	#17	==>	#27	0.264	0.305	Pinabete Diversion
Channel	#18	==>	#19	0.074	0.377	Upper East Diversion
Channel	#19	==>	#11	0.576	0.245	Lower E Diversion
Null	#20	==>	#21	0.656	0.345	NN S02 & NN S01
Pond	#21	==>	#26	0.000	0.000	NNS03 (NN Imp),04,05
Null	#22	==>	#23	0.096	0.358	NN SO4 (SWS07)
Null	#23	==>	#24	0.681	0.307	NN S05 (SWS08)
Null	#24	==>	#25	1.027	0.307	NN S06 (SWS09,10,11,12,13,14)
Null	#25	==>	End	0.000	0.000	NN S07 (SWS15,16,17,18,19)
Pond	#26	==>	#28	0.063	0.380	Outlet of NN S03 Impoundment Area
Null	#27	==>	#22	0.250	0.320	End of P Diversion, NNSWS06C,S7SW1
Null	#28	==>	#27	0.241	0.246	NNSWS06A (Drop Structure)
Null	#29	==>	#27	0.205	0.246	NNSWS06B (Drop Structure)
Null	#30	==>	#31	0.000	0.000	WS5-1
Channel	#31	==>	#32	0.137	0.357	DD5-1
Channel	#32	==>	#11	0.000	0.000	Ramp Ditch 5
Null	#33	==>	#34	0.000	0.000	MS4-1 & WS4-1
Pond	#34	==>	#35	0.012	0.335	CB4-1
Channel	#35	==>	#36	0.005	0.357	DD4-1
Culvert	#36	==>	#37	0.026	0.412	C4-1
Channel	#37	==>	#11	0.000	0.000	DD4-2 Ramp Ditch 4
Null	#38	==>	#39	0.000	0.000	WS3-1
Channel	#39	==>	#42	0.025	0.306	DD3-1
Null	#40	==>	#41	0.000	0.000	MS3-1
Pond	#41	==>	#42	0.021	0.329	CB3-1
Channel	#42	==>	#46	0.026	0.412	DD3-2
Null	#43	==>	#44	0.000	0.000	TDS8
Pond	#44	==>	#45	0.043	0.318	CB3-2
Channel	#45	==>	#46	0.026	0.412	DD3-3
Channel	#46	==>	#17	0.000	0.000	DD3-4 Ramp Ditch 3
Channel	#47	==>	#53	0.000	0.000	WS2-1 & DD2-1
Pond	#48	==>	#49	0.679	0.173	TDS6 & CB2-3

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#49	==>	#50	0.000	0.000	MS2-1 & Ditch
Pond	#50	==>	#53	0.052	0.406	MS2-1 Berm and Spillway (CB2-1)
Pond	#51	==>	#52	0.067	0.210	TDS7 & Berm (CB2-2)
Culvert	#52	==>	#53	0.000	0.000	C2-1 & Material Stockpile 2
Channel	#53	==>	#17	0.000	0.000	Ramp Ditch-2
Null	#54	==>	#64	0.026	0.412	WS1-1
Null	#55	==>	#56	0.000	0.000	MS1-1
Pond	#56	==>	#64	0.026	0.412	CB1-1
Null	#57	==>	#58	0.000	0.000	TDS5
Pond	#58	==>	#64	0.026	0.412	CB1-2
Null	#59	==>	#60	0.000	0.000	WS1-2
Channel	#60	==>	#62	0.025	0.306	DD1-1
Null	#61	==>	#62	0.000	0.000	WS1-3
Culvert	#62	==>	#63	0.088	0.312	C1-1
Channel	#63	==>	#64	0.026	0.412	DD1-2
Channel	#64	==>	#27	0.663	0.201	Ramp Ditch 1
Pond	#65	==>	#27	0.000	0.000	MS 1-2 & Pond 1-1




#29
Null
#20
Null
#21
Pond
#26
Pond
#28
Null
#51
Pond
#52
Culvert
#48
Pond
#49
Chan'l
#50
Pond
#47
Chan'l
#53
Chan'l
#43
Null
#44
Pond
#45
Chan'l
#40
Null
#41
Pond
#38
Null
#39
Chan'l
#42
Chan'l
#46
Chan'l
#33
Null


#34
Pond
#35
Chan'l
#36
Culvert
#37
Chan'l
#30
Null
#31
Chan'l
#32
Chan'l
#18
Chan'l
#19
Chan'l
#3
Null
#4
Null
#1
Null
#2
Null
#5
Null
#6
Null
#11
Pond
#17
Chan'l
#27
Null
#22
Null
#23
Null
#24
Null
#25
Null

Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	1.24	250.00	20,136.00	3.34	1.674
#1	**Muskingum K:**					**1.674**
#2	8. Large gullies, diversions, and low flowing streams	0.67	245.00	36,791.00	2.44	4.188
#2	**Muskingum K:**					**4.188**
#3	8. Large gullies, diversions, and low flowing streams	0.99	210.00	21,118.00	2.99	1.961
#3	**Muskingum K:**					**1.961**
#4	8. Large gullies, diversions, and low flowing streams	0.77	227.00	29,388.00	2.63	3.103
#4	**Muskingum K:**					**3.103**
#5	8. Large gullies, diversions, and low flowing streams	0.47	45.00	9,601.00	2.05	1.300
#5	**Muskingum K:**					**1.300**
#11	8. Large gullies, diversions, and low flowing streams	0.20	23.86	11,696.07	1.35	2.406
#11	**Muskingum K:**					**2.406**
#17	8. Large gullies, diversions, and low flowing streams	0.79	20.00	2,535.81	2.66	0.264
#17	**Muskingum K:**					**0.264**
#26	8. Large gullies, diversions, and low flowing streams	3.23	40.00	1,239.00	5.39	0.063
#26	**Muskingum K:**					**0.063**
#27	8. Large gullies, diversions, and low flowing streams	1.02	28.00	2,736.00	3.03	0.250
#27	**Muskingum K:**					**0.250**
#28	8. Large gullies, diversions, and low flowing streams	0.30	4.26	1,423.00	1.64	0.241
#28	**Muskingum K:**					**0.241**
#29	8. Large gullies, diversions, and low flowing streams	0.30	3.64	1,216.00	1.64	0.205
#29	**Muskingum K:**					**0.205**
#31	8. Large gullies, diversions, and low flowing streams	2.00	42.00	2,100.00	4.24	0.137
#31	**Muskingum K:**					**0.137**
#34	8. Large gullies, diversions, and low flowing streams	1.33	1.99	150.00	3.45	0.012
#34	**Muskingum K:**					**0.012**
#35	8. Large gullies, diversions, and low flowing streams	2.00	1.58	79.50	4.24	0.005
#35	**Muskingum K:**					**0.005**
#36	8. Large gullies, diversions, and low flowing streams	7.00	52.48	749.85	7.93	0.026
#36	**Muskingum K:**					**0.026**
#39	8. Large gullies, diversions, and low flowing streams	0.80	2.00	250.00	2.68	0.025
#39	**Muskingum K:**					**0.025**

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#41	8. Large gullies, diversions, and low flowing streams	1.20	3.00	250.00	3.28	0.021
#41	**Muskingum K:**					**0.021**
#42	8. Large gullies, diversions, and low flowing streams	7.00	53.20	760.00	7.93	0.026
#42	**Muskingum K:**					**0.026**
#44	8. Large gullies, diversions, and low flowing streams	0.98	4.50	460.00	2.96	0.043
#44	**Muskingum K:**					**0.043**
#45	8. Large gullies, diversions, and low flowing streams	7.00	53.20	760.00	7.93	0.026
#45	**Muskingum K:**					**0.026**
#48	8. Large gullies, diversions, and low flowing streams	0.09	1.98	2,202.63	0.90	0.679
#48	**Muskingum K:**					**0.679**
#50	8. Large gullies, diversions, and low flowing streams	6.00	82.50	1,375.00	7.34	0.052
#50	**Muskingum K:**					**0.052**
#51	8. Large gullies, diversions, and low flowing streams	0.17	0.51	300.12	1.23	0.067
#51	**Muskingum K:**					**0.067**
#54	8. Large gullies, diversions, and low flowing streams	7.00	52.50	750.00	7.93	0.026
#54	**Muskingum K:**					**0.026**
#56	8. Large gullies, diversions, and low flowing streams	7.00	52.50	750.00	7.93	0.026
#56	**Muskingum K:**					**0.026**
#58	8. Large gullies, diversions, and low flowing streams	7.00	52.50	750.00	7.93	0.026
#58	**Muskingum K:**					**0.026**
#60	8. Large gullies, diversions, and low flowing streams	0.80	2.00	250.00	2.68	0.025
#60	**Muskingum K:**					**0.025**
#62	8. Large gullies, diversions, and low flowing streams	0.89	8.01	900.00	2.83	0.088
#62	**Muskingum K:**					**0.088**
#63	8. Large gullies, diversions, and low flowing streams	7.00	52.50	750.00	7.93	0.026
#63	**Muskingum K:**					**0.026**
#64	8. Large gullies, diversions, and low flowing streams	0.15	4.00	2,725.00	1.14	0.663
#64	**Muskingum K:**					**0.663**

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#65	In	22.110	22.110	19.11	1.15	22.0	23,919	11.90	6.93
	Out			0.00	0.00	22.0	0	0.00	0.00
#61		34.787	34.787	26.53	1.50	30.4	26,424	13.26	7.39
#59		41.030	41.030	24.44	1.75	31.9	23,467	10.76	6.11
#60		0.000	41.030	24.44	1.75	31.9	23,467	10.76	6.11
#62		0.000	75.817	49.34	3.25	62.3	24,695	11.85	6.71
#63		0.000	75.817	47.25	3.25	62.3	25,556	12.26	6.71
#57		4.740	4.740	4.51	0.17	6.5	52,641	30.22	15.54
#58	In	0.000	4.740	4.51	0.17	6.5	52,641	30.22	15.54
	Out			0.00	0.00	0.0	0	0.00	0.00
#55		4.870	4.870	7.22	0.32	135.9	437,976	251.47	153.91
#56	In	0.000	4.870	7.22	0.32	135.9	437,976	251.47	153.91
	Out			0.69	0.12	0.0	11	0.00	0.00
#54		42.850	42.850	30.89	1.83	37.2	26,476	13.03	7.30
#64		0.000	128.277	73.26	5.21	99.5	26,579	12.87	6.75
#29		286.550	286.550	188.76	12.26	354.4	37,147	17.78	10.06
#20		1,855.800	1,855.800	280.42	64.71	462.8	8,331	1.83	1.16
#21	In	2,370.300	4,226.100	611.52	177.79	1,215.1	8,343	1.80	1.08
	Out			571.42	164.97	912.3	6,910	0.40	0.24
#26	In	13.260	4,239.359	571.89	166.13	912.8	6,873	0.40	0.24
	Out			523.94	153.31	783.1	6,264	0.33	0.20
#28		65.680	4,305.040	524.90	156.09	766.1	28,099	2.24	0.30
#51	In	4.820	4.820	4.59	0.18	8.9	69,834	34.82	17.94
	Out			0.00	0.00	8.9	0	0.00	0.00
#52		0.200	5.020	0.30	0.01	11.2	209,067	152.64	0.00
#48	In	8.810	8.810	2.19	0.26	8.2	40,139	7.24	4.17
	Out			0.00	0.00	8.2	0	0.00	0.00
#49		37.570	46.380	18.40	1.96	969.4	482,070	125.00	79.17
#50	In	0.000	46.380	18.40	1.96	969.4	482,070	125.00	79.17
	Out			0.00	0.00	0.0	0	0.00	0.00
#47		29.270	29.270	17.32	0.98	6.5	9,199	3.61	1.92
#53		0.000	80.670	17.35	0.99	17.7	138,605	83.83	3.95
#43		6.207	6.207	3.27	0.19	8.3	61,702	29.13	15.27
#44	In	0.000	6.207	3.27	0.19	8.3	61,702	29.13	15.27
	Out			0.00	0.00	8.3	0	0.00	0.00
#45		0.000	6.207	0.00	0.00	8.3	1	0.00	0.00
#40		12.150	12.150	8.67	0.64	398.3	599,843	267.95	166.27
#41	In	0.000	12.150	8.67	0.64	398.3	599,843	267.95	166.27
	Out			0.00	0.00	398.3	0	0.00	0.00

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#38		66.380	66.380	30.82	2.19	23.3	14,266	6.15	3.35
#39		0.000	66.380	30.82	2.19	23.3	14,266	6.15	3.35
#42		0.000	78.530	30.82	2.19	421.6	14,266	11.08	6.05
#46		0.000	84.737	30.82	2.19	429.9	14,266	11.09	6.06
#33		14.130	14.130	10.93	0.74	493.4	631,974	291.89	180.92
#34	In	0.000	14.130	10.93	0.74	493.4	631,974	291.89	180.92
	Out			0.08	0.01	0.0	0	0.00	0.00
#35		0.000	14.130	0.08	0.01	0.0	0	0.00	0.00
#36		0.000	14.130	0.08	0.01	0.0	0	0.00	0.00
#37		0.000	14.130	0.08	0.01	0.0	0	0.00	0.00
#30		282.150	282.150	65.84	9.27	83.5	11,122	1.38	0.82
#31		0.000	282.150	65.84	9.27	83.5	11,122	1.38	0.82
#32		0.000	282.150	65.06	9.27	83.5	11,234	1.40	0.82
#18		1,500.640	1,500.640	96.95	24.59	184.0	9,178	1.67	1.01
#19		418.020	1,918.660	169.37	38.31	291.3	9,237	1.69	1.02
#3		3,978.700	3,978.700	408.84	103.03	2,245.7	25,890	5.90	3.63
#4		3,216.100	7,194.800	587.18	213.10	4,767.8	41,928	7.86	3.07
#1		8,477.899	8,477.899	906.51	267.99	4,464.9	33,833	7.15	2.58
#2		3,838.900	12,316.800	1,064.62	462.56	7,348.4	33,857	4.72	1.63
#5		5,494.300	25,005.900	1,662.11	956.37	15,938.8	27,400	4.14	1.89
#6		3,036.900	28,042.800	1,673.45	1,093.40	15,130.2	23,312	1.71	0.77
#11	In	53.960	30,311.700	1,687.28	1,145.06	15,592.0	23,037	1.79	0.80
	Out			1,096.78	1,140.76	9,850.2	17,193	0.71	0.30
#17		0.000	30,477.110	1,093.09	1,143.94	10,297.8	599,615	43.84	0.60
#27		43.270	35,262.350	1,132.11	1,319.33	11,566.1	40,935	3.73	0.71
#22		519.990	35,782.340	1,135.09	1,345.28	11,723.9	30,054	2.35	0.61
#23		233.290	36,015.630	1,136.37	1,356.51	11,907.2	30,157	2.39	0.62
#24		1,164.140	37,179.770	1,142.58	1,410.50	12,362.6	30,133	2.50	0.66
#25		648.980	37,828.750	1,145.21	1,438.85	12,804.7	36,846	2.89	0.65

Particle Size Distribution(s) at Each Structure

Structure #65 (MS 1-2 & Pond 1-1):

Size (mm)	In	Out
0.4250	100.000%	0.000%
0.2500	100.000%	0.000%
0.1500	73.408%	0.000%
0.0750	54.889%	0.000%
0.0159	48.305%	0.000%
0.0100	39.282%	0.000%
0.0050	10.233%	0.000%
0.0020	5.655%	0.000%
0.0010	5.090%	0.000%
0.0004	4.663%	0.000%

Structure #61 (WS1-3):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	72.340%
0.0750	54.091%
0.0159	47.602%
0.0100	38.710%
0.0050	10.084%
0.0020	5.573%
0.0010	5.016%
0.0004	4.595%

Structure #59 (WS1-2):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	83.064%
0.0750	62.109%
0.0159	54.659%

Size (mm)	In/Out
0.0100	44.448%
0.0050	11.578%
0.0020	6.399%
0.0010	5.759%
0.0004	5.276%

Structure #60 (DD1-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	83.064%
0.0750	62.109%
0.0159	54.659%
0.0100	44.448%
0.0050	11.578%
0.0020	6.399%
0.0010	5.759%
0.0004	5.276%

Structure #62 (C1-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	77.827%
0.0750	58.193%
0.0159	51.213%
0.0100	41.646%
0.0050	10.848%
0.0020	5.996%
0.0010	5.396%
0.0004	4.943%

Structure #63 (DD1-2):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	77.827%
0.0750	58.193%
0.0159	51.213%
0.0100	41.646%

Size (mm)	In/Out
0.0050	10.848%
0.0020	5.996%
0.0010	5.396%
0.0004	4.943%

Structure #57 (TDS5):

Size (mm)	In/Out
0.4250	100.000%
0.2500	75.578%
0.1500	54.286%
0.0750	40.591%
0.0159	35.722%
0.0100	29.049%
0.0050	7.567%
0.0020	4.182%
0.0010	3.764%
0.0004	3.448%

Structure #58 (CB1-2):

Size (mm)	In	Out
0.4250	100.000%	100.000%
0.2500	75.578%	100.000%
0.1500	54.286%	100.000%
0.0750	40.591%	100.000%
0.0159	35.722%	100.000%
0.0100	29.049%	100.000%
0.0050	7.567%	100.000%
0.0020	4.182%	100.000%
0.0010	3.764%	100.000%
0.0004	3.448%	100.000%

Structure #55 (MS1-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	75.578%
0.1500	54.286%
0.0750	40.591%
0.0159	35.722%
0.0100	29.049%
0.0050	7.567%

Size (mm)	In/Out
0.0020	4.182%
0.0010	3.764%
0.0004	3.448%

Structure #56 (CB1-1):

Size (mm)	In	Out
0.4250	100.000%	100.000%
0.2500	75.578%	100.000%
0.1500	54.286%	100.000%
0.0750	40.591%	100.000%
0.0159	35.722%	100.000%
0.0100	29.049%	100.000%
0.0050	7.567%	100.000%
0.0020	4.182%	100.000%
0.0010	3.764%	100.000%
0.0004	3.448%	100.000%

Structure #54 (WS1-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	74.655%
0.0750	55.821%
0.0159	49.125%
0.0100	39.949%
0.0050	10.406%
0.0020	5.751%
0.0010	5.176%
0.0004	4.742%

Structure #64 (Ramp Ditch 1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	76.640%
0.0750	57.306%
0.0159	50.432%
0.0100	41.011%
0.0050	10.683%
0.0020	5.904%

Size (mm)	In/Out
0.0010	5.314%
0.0004	4.868%

Structure #29 (NNSWS06B (Drop Structure)):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	83.710%
0.0750	62.478%
0.0159	53.791%
0.0100	41.545%
0.0050	10.904%
0.0020	6.624%
0.0010	6.007%
0.0004	5.421%

Structure #20 (NN S02 & NN S01):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	94.220%
0.0100	75.686%
0.0050	30.680%
0.0020	19.082%
0.0010	17.424%
0.0004	16.258%

Structure #21 (NNS03 (NN Imp),04,05):

Size (mm)	In	Out
0.4250	100.000%	100.000%
0.2500	100.000%	100.000%
0.1500	100.000%	100.000%
0.0750	97.857%	100.000%
0.0159	92.252%	100.000%
0.0100	76.789%	100.000%
0.0050	26.105%	34.767%
0.0020	16.388%	21.825%
0.0010	14.775%	19.677%

Size (mm)	In	Out
0.0004	13.800%	18.380%

Structure #26 (Outlet of NN S03 Impoundment Area):

Size (mm)	In	Out
0.4250	100.000%	100.000%
0.2500	100.000%	100.000%
0.1500	100.000%	100.000%
0.0750	100.000%	100.000%
0.0159	100.000%	100.000%
0.0100	100.000%	100.000%
0.0050	34.752%	40.508%
0.0020	21.816%	25.429%
0.0010	19.668%	22.926%
0.0004	18.371%	21.414%

Structure #28 (NNSWS06A (Drop Structure)):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.420%
0.0750	97.534%
0.0159	96.762%
0.0100	95.674%
0.0050	42.375%
0.0020	26.581%
0.0010	23.968%
0.0004	22.371%

Structure #51 (TDS7 & Berm (CB2-2)):

Size (mm)	In	Out
0.4250	100.000%	0.000%
0.2500	85.529%	0.000%
0.1500	72.267%	0.000%
0.0750	58.134%	0.000%
0.0159	49.962%	0.000%
0.0100	38.953%	0.000%
0.0050	9.675%	0.000%
0.0020	6.279%	0.000%
0.0010	6.010%	0.000%
0.0004	4.942%	0.000%

Structure #52 (C2-1 & Material Stockpile 2):

Size (mm)	In/Out
0.4250	20.572%
0.2500	17.595%
0.1500	14.867%
0.0750	11.959%
0.0159	10.278%
0.0100	8.013%
0.0050	1.990%
0.0020	1.292%
0.0010	1.236%
0.0004	1.017%

Structure #48 (TDS6 & CB2-3):

Size (mm)	In	Out
0.4250	100.000%	0.000%
0.2500	100.000%	0.000%
0.1500	100.000%	0.000%
0.0750	100.000%	0.000%
0.0159	100.000%	0.000%
0.0100	82.507%	0.000%
0.0050	20.493%	0.000%
0.0020	13.300%	0.000%
0.0010	12.730%	0.000%
0.0004	10.468%	0.000%

Structure #49 (MS2-1 & Ditch):

Size (mm)	In/Out
0.4250	99.152%
0.2500	99.152%
0.1500	99.152%
0.0750	99.152%
0.0159	92.080%
0.0100	71.790%
0.0050	17.831%
0.0020	11.572%
0.0010	11.076%
0.0004	9.108%

Structure #50 (MS2-1 Berm and Spillway (CB2-1)):

Size (mm)	In	Out
0.4250	99.152%	100.000%
0.2500	99.152%	100.000%
0.1500	99.152%	100.000%
0.0750	99.152%	100.000%
0.0159	92.080%	100.000%
0.0100	71.790%	100.000%
0.0050	17.831%	100.000%
0.0020	11.572%	100.000%
0.0010	11.076%	100.000%
0.0004	9.108%	100.000%

Structure #47 (WS2-1 & DD2-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.298%
0.0750	79.878%
0.0159	68.650%
0.0100	53.523%
0.0050	13.294%
0.0020	8.628%
0.0010	8.258%
0.0004	6.791%

Structure #53 (Ramp Ditch-2):

Size (mm)	In/Out
0.4250	49.926%
0.2500	48.049%
0.1500	46.069%
0.0750	37.060%
0.0159	31.850%
0.0100	24.832%
0.0050	6.168%
0.0020	4.004%
0.0010	3.832%
0.0004	3.151%

Structure #43 (TDS8):

Size (mm)	In/Out
0.4250	100.000%

Size (mm)	In/Out
0.2500	100.000%
0.1500	77.372%
0.0750	59.899%
0.0159	52.574%
0.0100	42.374%
0.0050	12.829%
0.0020	7.391%
0.0010	6.836%
0.0004	6.114%

Structure #44 (CB3-2):

Size (mm)	In	Out
0.4250	100.000%	0.000%
0.2500	100.000%	0.000%
0.1500	77.372%	0.000%
0.0750	59.899%	0.000%
0.0159	52.574%	0.000%
0.0100	42.374%	0.000%
0.0050	12.829%	0.000%
0.0020	7.391%	0.000%
0.0010	6.836%	0.000%
0.0004	6.114%	0.000%

Structure #45 (DD3-3):

Size (mm)	In/Out
0.4250	0.000%
0.2500	0.000%
0.1500	0.000%
0.0750	0.000%
0.0159	0.000%
0.0100	0.000%
0.0050	0.000%
0.0020	0.000%
0.0010	0.000%
0.0004	0.000%

Structure #40 (MS3-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%

Size (mm)	In/Out
0.1500	83.569%
0.0750	64.696%
0.0159	56.784%
0.0100	45.767%
0.0050	13.857%
0.0020	7.983%
0.0010	7.384%
0.0004	6.604%

Structure #41 (CB3-1):

Size (mm)	In	Out
0.4250	100.000%	0.000%
0.2500	100.000%	0.000%
0.1500	83.569%	0.000%
0.0750	64.696%	0.000%
0.0159	56.784%	0.000%
0.0100	45.767%	0.000%
0.0050	13.857%	0.000%
0.0020	7.983%	0.000%
0.0010	7.384%	0.000%
0.0004	6.604%	0.000%

Structure #38 (WS3-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	87.366%
0.0750	67.636%
0.0159	59.364%
0.0100	47.847%
0.0050	14.487%
0.0020	8.346%
0.0010	7.719%
0.0004	6.904%

Structure #39 (DD3-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	87.366%

Size (mm)	In/Out
0.0750	67.636%
0.0159	59.364%
0.0100	47.847%
0.0050	14.486%
0.0020	8.346%
0.0010	7.719%
0.0004	6.904%

Structure #42 (DD3-2):

Size (mm)	In/Out
0.4250	5.517%
0.2500	5.517%
0.1500	4.820%
0.0750	3.732%
0.0159	3.275%
0.0100	2.640%
0.0050	0.799%
0.0020	0.460%
0.0010	0.426%
0.0004	0.381%

Structure #46 (DD3-4 Ramp Ditch 3):

Size (mm)	In/Out
0.4250	5.411%
0.2500	5.411%
0.1500	4.727%
0.0750	3.659%
0.0159	3.212%
0.0100	2.589%
0.0050	0.784%
0.0020	0.452%
0.0010	0.418%
0.0004	0.374%

Structure #33 (MS4-1 & WS4-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	79.892%
0.0750	61.849%

Size (mm)	In/Out
0.0159	54.285%
0.0100	43.754%
0.0050	13.247%
0.0020	7.632%
0.0010	7.059%
0.0004	6.313%

Structure #34 (CB4-1):

Size (mm)	In	Out
0.4250	100.000%	100.000%
0.2500	100.000%	100.000%
0.1500	79.892%	100.000%
0.0750	61.849%	100.000%
0.0159	54.285%	100.000%
0.0100	43.754%	100.000%
0.0050	13.247%	100.000%
0.0020	7.632%	100.000%
0.0010	7.059%	100.000%
0.0004	6.313%	100.000%

Structure #35 (DD4-1):

Size (mm)	In/Out
0.4250	0.000%
0.2500	0.000%
0.1500	0.000%
0.0750	0.000%
0.0159	0.000%
0.0100	0.000%
0.0050	0.000%
0.0020	0.000%
0.0010	0.000%
0.0004	0.000%

Structure #36 (C4-1):

Size (mm)	In/Out
0.4250	0.000%
0.2500	0.000%
0.1500	0.000%
0.0750	0.000%
0.0159	0.000%

Size (mm)	In/Out
0.0100	0.000%
0.0050	0.000%
0.0020	0.000%
0.0010	0.000%
0.0004	0.000%

Structure #37 (DD4-2 Ramp Ditch 4):

Size (mm)	In/Out
0.4250	0.000%
0.2500	0.000%
0.1500	0.000%
0.0750	0.000%
0.0159	0.000%
0.0100	0.000%
0.0050	0.000%
0.0020	0.000%
0.0010	0.000%
0.0004	0.000%

Structure #30 (WS5-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	90.115%
0.0050	22.382%
0.0020	14.526%
0.0010	13.904%
0.0004	11.433%

Structure #31 (DD5-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	90.115%

Size (mm)	In/Out
0.0050	22.382%
0.0020	14.526%
0.0010	13.904%
0.0004	11.433%

Structure #32 (Ramp Ditch 5):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	90.115%
0.0050	22.382%
0.0020	14.526%
0.0010	13.904%
0.0004	11.433%

Structure #18 (Upper East Diversion):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	96.762%
0.0100	79.891%
0.0050	39.150%
0.0020	21.691%
0.0010	20.144%
0.0004	18.805%

Structure #19 (Lower E Diversion):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	97.958%
0.0100	80.484%
0.0050	33.821%

Size (mm)	In/Out
0.0020	18.938%
0.0010	17.568%
0.0004	16.211%

Structure #3:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.560%
0.0750	92.307%
0.0159	88.922%
0.0100	74.573%
0.0050	28.753%
0.0020	15.986%
0.0010	14.496%
0.0004	13.676%

Structure #4:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	97.216%
0.0159	92.116%
0.0100	79.769%
0.0050	31.270%
0.0020	17.739%
0.0010	16.190%
0.0004	15.037%

Structure #1:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	99.347%
0.0159	92.215%
0.0100	77.299%
0.0050	26.233%
0.0020	15.324%

Size (mm)	In/Out
0.0010	14.100%
0.0004	12.850%

Structure #2:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	96.444%
0.0100	87.040%
0.0050	30.725%
0.0020	18.505%
0.0010	17.274%
0.0004	15.211%

Structure #5:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	98.933%
0.0159	96.590%
0.0100	85.206%
0.0050	29.673%
0.0020	17.683%
0.0010	16.433%
0.0004	14.627%

Structure #6 (EAST LEASE BNDY):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	97.418%
0.0050	33.552%
0.0020	20.056%
0.0010	18.654%

Size (mm)	In/Out
0.0004	16.573%

Structure #11 (Sta:118+00 - U Shaped Impoundment):

Size (mm)	In	Out
0.4250	100.000%	100.000%
0.2500	100.000%	100.000%
0.1500	99.845%	100.000%
0.0750	99.766%	100.000%
0.0159	99.683%	100.000%
0.0100	96.736%	100.000%
0.0050	33.364%	52.812%
0.0020	19.929%	31.545%
0.0010	18.537%	29.343%
0.0004	16.474%	26.077%

Structure #17 (Pinabete Diversion):

Size (mm)	In/Out
0.4250	95.965%
0.2500	95.962%
0.1500	95.930%
0.0750	95.870%
0.0159	95.842%
0.0100	95.804%
0.0050	50.560%
0.0020	30.200%
0.0010	28.092%
0.0004	24.964%

Structure #27 (End of P Diversion, NNSWS06C,S7SW1):

Size (mm)	In/Out
0.4250	96.306%
0.2500	96.303%
0.1500	95.529%
0.0750	94.455%
0.0159	94.022%
0.0100	93.415%
0.0050	48.289%
0.0020	28.927%
0.0010	26.851%
0.0004	23.937%

Structure #22 (NN SO4 (SWS07)):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	97.498%
0.0159	96.471%
0.0100	95.026%
0.0050	48.392%
0.0020	28.995%
0.0010	26.904%
0.0004	23.989%

Structure #23 (NN S05 (SWS08)):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	97.872%
0.0159	96.618%
0.0100	94.863%
0.0050	47.990%
0.0020	28.752%
0.0010	26.677%
0.0004	23.784%

Structure #24 (NN S06 (SWS09,10,11,12,13,14)):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.266%
0.0750	96.964%
0.0159	95.888%
0.0100	94.439%
0.0050	47.844%
0.0020	28.617%
0.0010	26.546%
0.0004	23.659%

Structure #25:

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Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.292%
0.0750	97.799%
0.0159	97.138%
0.0100	94.970%
0.0050	47.208%
0.0020	28.208%
0.0010	26.159%
0.0004	23.317%

Structure Detail:

Structure #65 (Pond)

MS 1-2 & Pond 1-1

Pond Inputs:

Initial Pool Elev:	5,442.10 ft
Initial Pool:	0.03 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	0.00 %

**No sediment capacity defined*

Broad-crested Weir

Weir Width (ft)	Spillway Elev (ft)
40.00	5,451.80

Pond Results:

Peak Elevation:	5,445.36 ft
H'graph Detention Time:	0.00 hrs
Pond Model:	CSTRS
Dewater Time:	0.00 days
Trap Efficiency:	0.00 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,442.00	0.260	0.000	0.000		Top of Sed. Storage
5,442.10	0.265	0.026	0.000		
5,442.50	0.285	0.136	0.000		
5,443.00	0.311	0.285	0.000		
5,443.50	0.339	0.448	0.000		
5,444.00	0.367	0.624	0.000		
5,444.50	0.397	0.815	0.000		
5,445.00	0.427	1.021	0.000		
5,445.36	0.450	1.181	0.000	0.00	Peak Stage
5,445.50	0.459	1.242	0.000		
5,446.00	0.492	1.480	0.000		
5,446.50	0.526	1.734	0.000		
5,447.00	0.562	2.006	0.000		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,447.50	0.598	2.296	0.000		
5,448.00	0.636	2.605	0.000		
5,448.50	0.675	2.933	0.000		
5,449.00	0.715	3.280	0.000		
5,449.50	0.756	3.648	0.000		
5,450.00	0.798	4.036	0.000		
5,450.50	0.841	4.446	0.000		
5,451.00	0.886	4.878	0.000		
5,451.50	0.931	5.332	0.000		
5,451.80	0.959	5.615	0.000		Spillway #1
5,452.00	0.978	5.809	11.061		

Detailed Discharge Table

Elevation (ft)	Broad-crested Weir (cfs)	Combined Total Discharge (cfs)
5,442.00	0.000	0.000
5,442.10	0.000	0.000
5,442.50	0.000	0.000
5,443.00	0.000	0.000
5,443.50	0.000	0.000
5,444.00	0.000	0.000
5,444.50	0.000	0.000
5,445.00	0.000	0.000
5,445.50	0.000	0.000
5,446.00	0.000	0.000
5,446.50	0.000	0.000
5,447.00	0.000	0.000
5,447.50	0.000	0.000
5,448.00	0.000	0.000
5,448.50	0.000	0.000
5,449.00	0.000	0.000
5,449.50	0.000	0.000
5,450.00	0.000	0.000
5,450.50	0.000	0.000
5,451.00	0.000	0.000
5,451.50	0.000	0.000
5,451.80	0.000	0.000
5,452.00	11.061	11.061

Structure #61 (Null)

WS1-3

Structure #59 (Null)

WS1-2

Structure #60 (Erodible Channel)

DD1-1

Triangular Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	2.0	0.0300	1.00			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	24.44 cfs	
Depth:	1.27 ft	2.27 ft
Top Width:	7.64 ft	13.64 ft
Velocity:	5.02 fps	
X-Section Area:	4.87 sq ft	
Hydraulic Radius:	0.604 ft	
Froude Number:	1.11	

Structure #62 (Culvert)

C1-1

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
120.00	3.00	0.0150	3.50	2.00	0.90

Culvert Results:

Design Discharge = 49.34 cfs

Minimum pipe diameter: 1 - 45 inch pipe(s) required

Structure #63 (Erodible Channel)

DD1-2

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	2.0:1	2.0:1	1.2	0.0300	1.00			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	47.25 cfs	
Depth:	0.81 ft	1.81 ft
Top Width:	15.23 ft	19.23 ft
Velocity:	4.30 fps	
X-Section Area:	10.98 sq ft	
Hydraulic Radius:	0.703 ft	
Froude Number:	0.89	

Structure #57 (Null)

TDS5

Structure #58 (Pond)

CB1-2

Pond Inputs:

Initial Pool Elev:	5,450.50 ft
Initial Pool:	0.24 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	0.00 %

**No sediment capacity defined*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
5,451.50	15.00	2.00:1	2.00:1	20.00

Pond Results:

Peak Elevation:	5,451.50 ft
H'graph Detention Time:	16.86 hrs
Pond Model:	CSTRS
Dewater Time:	0.00 days
Trap Efficiency:	100.00 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,449.00	0.150	0.000	0.000		Top of Sed. Storage
5,449.50	0.156	0.076	0.000		
5,450.00	0.162	0.156	0.000		
5,450.50	0.168	0.238	0.000		
5,451.00	0.174	0.324	0.000		
5,451.50	0.180	0.413	0.000		Spillway #1
5,451.50	0.181	0.413	0.005	0.00	Peak Stage
5,452.00	0.187	0.504	3.871		
5,452.50	0.193	0.599	51.179		
5,453.00	0.200	0.698	105.737		

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
5,449.00	0.000	0.000
5,449.50	0.000	0.000
5,450.00	0.000	0.000
5,450.50	0.000	0.000
5,451.00	0.000	0.000
5,451.50	0.000	0.000
5,452.00	3.871	3.871
5,452.50	51.179	51.179
5,453.00	105.737	105.737

Structure #55 (Null)

MS1-1

Structure #56 (Pond)

CB1-1

Pond Inputs:

Initial Pool Elev:	5,449.70 ft
Initial Pool:	0.20 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	0.00 %

**No sediment capacity defined*

Emergency Spillway

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Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
5,451.00	15.00	2.00:1	2.00:1	20.00

Pond Results:

Peak Elevation:	5,451.09 ft
H'graph Detention Time:	3.25 hrs
Pond Model:	CSTRS
Dewater Time:	0.75 days
Trap Efficiency:	100.00 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,448.00	0.100	0.000	0.000		Top of Sed. Storage
5,448.50	0.108	0.052	0.000		
5,449.00	0.117	0.108	0.000		
5,449.50	0.131	0.170	0.000		
5,449.70	0.137	0.197	0.000		
5,449.75	0.139	0.204	0.000		
5,450.00	0.146	0.240	0.000		
5,450.25	0.148	0.277	0.000		
5,450.50	0.151	0.314	0.000		
5,451.00	0.156	0.391	0.000		Spillway #1
5,451.09	0.160	0.405	0.690	17.90	Peak Stage
5,451.50	0.166	0.471	3.871		
5,452.00	0.177	0.557	51.179		
5,452.50	0.188	0.648	105.737		
5,453.00	0.200	0.745	174.956		

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
5,448.00	0.000	0.000
5,448.50	0.000	0.000
5,449.00	0.000	0.000
5,449.50	0.000	0.000
5,449.70	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
5,449.75	0.000	0.000
5,450.00	0.000	0.000
5,450.25	0.000	0.000
5,450.50	0.000	0.000
5,451.00	0.000	0.000
5,451.50	3.871	3.871
5,452.00	51.179	51.179
5,452.50	105.737	105.737
5,453.00	174.956	174.956

Structure #54 (Null)

WS1-1

Structure #64 (Riprap Channel)

Ramp Ditch 1

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
12.00	2.0:1	2.0:1	7.0	1.00		

Riprap Channel Results:

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	73.26 cfs	
Depth:	0.82 ft	1.82 ft
Top Width:	15.28 ft	19.28 ft
Velocity:	6.56 fps	
X-Section Area:	11.17 sq ft	
Hydraulic Radius:	0.713 ft	
Froude Number:	1.35	
Manning's n:	0.0480	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Structure #29 (Null)

NNSWS06B (Drop Structure)

Structure #20 (Null)

NN S02 & NN S01

Structure #21 (Pond)

NNS03 (NN Imp),04,05

Pond Inputs:

Initial Pool Elev:	5,441.01 ft
Initial Pool:	0.00 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	20.00 %

**No sediment capacity defined*

Pond Results:

Peak Elevation:	5,448.47 ft
H'graph Detention Time:	1.10 hrs
Pond Model:	CSTRS
Dewater Time:	1.31 days
Trap Efficiency:	24.91 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,441.00	0.000	0.000	0.000		Top of Sed. Storage
5,441.01	0.011	0.000	0.000		
5,442.00	1.075	0.394	0.001		
5,443.00	2.094	1.951	0.001		
5,444.00	2.823	4.400	0.001		
5,445.00	4.127	7.855	0.001		
5,446.00	5.827	12.807	0.001		
5,447.00	7.996	19.690	55.000	26.25	
5,448.00	10.478	28.899	300.000	3.95	
5,448.47	12.100	34.582	571.419	1.35	Peak Stage
5,449.00	13.565	40.888	872.600		
5,449.48	14.889	47.714	933.750		
5,450.00	16.428	55.853	1,000.000		

Detailed Discharge Table

Elevation (ft)	User-input discharge (cfs)	Combined Total Discharge (cfs)
5,441.00	0.000	0.000
5,441.01	0.000	0.000
5,442.00	0.001	0.001
5,443.00	0.001	0.001
5,444.00	0.001	0.001
5,445.00	0.001	0.001
5,446.00	0.001	0.001
5,447.00	55.000	55.000
5,448.00	300.000	300.000
5,449.00	872.600	872.600
5,449.48	933.750	933.750
5,450.00	1,000.000	1,000.000

Structure #26 (Pond)

Outlet of NN S03 Impoundment Area

Pond Inputs:

Initial Pool Elev:	5,441.01 ft
Initial Pool:	0.00 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	0.00 %

**No sediment capacity defined*

Pond Results:

Peak Elevation:	5,448.39 ft
H'graph Detention Time:	1.23 hrs
Pond Model:	CSTRS
Dewater Time:	1.45 days
Trap Efficiency:	14.21 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,441.00	0.000	0.000	0.000		Top of Sed. Storage
5,441.01	0.011	0.000	0.000		
5,442.00	1.075	0.394	0.001		
5,443.00	2.094	1.951	0.001		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,444.00	2.823	4.400	0.001		
5,445.00	4.127	7.855	0.001		
5,446.00	5.827	12.807	0.001		
5,447.00	7.996	19.690	55.000	29.30	
5,448.00	10.478	28.899	300.000	4.35	
5,448.39	11.856	33.311	523.941	1.05	Peak Stage
5,448.48	12.103	34.314	574.837		
5,449.00	13.565	40.984	872.600		
5,450.00	16.428	55.958	1,000.000		

Detailed Discharge Table

Elevation (ft)	User-input discharge (cfs)	Combined Total Discharge (cfs)
5,441.00	0.000	0.000
5,441.01	0.000	0.000
5,442.00	0.001	0.001
5,443.00	0.001	0.001
5,444.00	0.001	0.001
5,445.00	0.001	0.001
5,446.00	0.001	0.001
5,447.00	55.000	55.000
5,448.00	300.000	300.000
5,448.48	574.837	574.837
5,449.00	872.600	872.600
5,450.00	1,000.000	1,000.000

Structure #28 (Null)

NNSWS06A (Drop Structure)

Structure #51 (Pond)

TDS7 & Berm (CB2-2)

Pond Inputs:

Initial Pool Elev:	5,474.20 ft
Initial Pool:	0.01 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	0.00 %

**No sediment capacity defined*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
5,477.00	15.00	2.00:1	2.00:1	15.00

Pond Results:

Peak Elevation:	5,475.70 ft
H'graph Detention Time:	0.00 hrs
Pond Model:	CSTRS
Dewater Time:	0.00 days
Trap Efficiency:	0.00 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,474.00	0.057	0.000	0.000		Top of Sed. Storage
5,474.01	0.058	0.001	0.000		
5,474.20	0.068	0.013	0.000		
5,474.50	0.086	0.036	0.000		
5,475.00	0.118	0.086	0.000		
5,475.50	0.156	0.155	0.000		
5,475.70	0.175	0.190	0.000	0.00	Peak Stage
5,476.00	0.200	0.243	0.000		
5,476.50	0.243	0.354	0.000		
5,477.00	0.291	0.487	0.000		Spillway #1
5,477.50	0.343	0.646	2.913		
5,478.00	0.400	0.832	39.083		
5,478.50	0.446	1.043	81.546		
5,479.00	0.495	1.278	136.186		
5,479.50	0.546	1.538	202.723		
5,480.00	0.600	1.825	281.166		

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
5,474.00	0.000	0.000
5,474.01	0.000	0.000
5,474.20	0.000	0.000
5,474.50	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
5,475.00	0.000	0.000
5,475.50	0.000	0.000
5,476.00	0.000	0.000
5,476.50	0.000	0.000
5,477.00	0.000	0.000
5,477.50	2.913	2.913
5,478.00	39.083	39.083
5,478.50	81.546	81.546
5,479.00	136.186	136.186
5,479.50	202.723	202.723
5,480.00	281.166	281.166

Structure #52 (Culvert)

C2-1 & Material Stockpile 2

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
80.00	1.00	0.0240	1.00	0.50	0.90

Culvert Results:

Design Discharge = 0.30 cfs

Minimum pipe diameter: 1 - 6 inch pipe(s) required

Structure #48 (Pond)

TDS6 & CB2-3

Pond Inputs:

Initial Pool Elev:	5,484.40 ft
Initial Pool:	0.38 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	0.00 %

**No sediment capacity defined*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
5,486.00	100.00	2.00:1	2.00:1	15.00

Pond Results:

Peak Elevation:	5,485.32 ft
H'graph Detention Time:	0.00 hrs
Pond Model:	CSTRS
Dewater Time:	0.00 days
Trap Efficiency:	0.00 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,482.00	0.100	0.000	0.000		Top of Sed. Storage
5,482.50	0.122	0.055	0.000		
5,483.00	0.146	0.122	0.000		
5,483.50	0.172	0.202	0.000		
5,484.00	0.200	0.295	0.000		
5,484.40	0.235	0.382	0.000		
5,484.50	0.244	0.405	0.000		
5,484.70	0.263	0.456	0.000		
5,484.75	0.267	0.469	0.000		
5,485.00	0.291	0.539	0.000		
5,485.32	0.325	0.640	0.000	0.00	Peak Stage
5,485.50	0.343	0.698	0.000		
5,486.00	0.400	0.883	0.000		Spillway #1
5,486.50	0.446	1.095	11.938		
5,487.00	0.495	1.330	23.876		
5,487.50	0.546	1.590	54.567		
5,488.00	0.600	1.877	96.681		

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
5,482.00	0.000	0.000
5,482.50	0.000	0.000
5,483.00	0.000	0.000
5,483.50	0.000	0.000
5,484.00	0.000	0.000
5,484.40	0.000	0.000
5,484.50	0.000	0.000
5,484.70	0.000	0.000
5,484.75	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
5,485.00	0.000	0.000
5,485.50	0.000	0.000
5,486.00	0.000	0.000
5,486.50	11.938	11.938
5,487.00	23.876	23.876
5,487.50	54.567	54.567
5,488.00	96.681	96.681

Structure #49 (Erodible Channel)

MS2-1 & Ditch

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	2.0:1	2.0:1	0.9	0.0300	1.00			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	18.40 cfs	
Depth:	0.50 ft	1.50 ft
Top Width:	14.02 ft	18.02 ft
Velocity:	2.81 fps	
X-Section Area:	6.55 sq ft	
Hydraulic Radius:	0.460 ft	
Froude Number:	0.72	

Structure #50 (Pond)

MS2-1 Berm and Spillway (CB2-1)

Pond Inputs:

Initial Pool Elev:	5,480.00 ft
Initial Pool:	1.89 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	0.00 %

**No sediment capacity defined*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
5,482.00	15.00	2.00:1	2.00:1	25.00

Pond Results:

Peak Elevation:	5,481.81 ft
H'graph Detention Time:	0.00 hrs
Pond Model:	CSTRS
Dewater Time:	0.00 days
Trap Efficiency:	0.00 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,476.00	0.230	0.000	0.000		Top of Sed. Storage
5,476.50	0.268	0.124	0.000		
5,477.00	0.309	0.269	0.000		
5,477.50	0.353	0.434	0.000		
5,478.00	0.400	0.622	0.000		
5,478.50	0.506	0.848	0.000		
5,479.00	0.625	1.130	0.000		
5,479.50	0.758	1.476	0.000		
5,479.75	0.828	1.674	0.000		
5,480.00	0.900	1.890	0.000		
5,480.20	0.938	2.074	0.000		
5,480.50	0.994	2.363	0.000		
5,480.82	1.056	2.691	0.000		
5,481.00	1.091	2.884	0.000		
5,481.50	1.193	3.455	0.000		
5,481.81	1.261	3.847	0.000	0.00	Peak Stage
5,482.00	1.300	4.078	0.000		Spillway #1
5,482.50	1.306	4.730	4.829		
5,483.00	1.312	5.384	63.277		
5,483.50	1.318	6.042	129.940		
5,484.00	1.325	6.703	213.757		

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
5,476.00	0.000	0.000
5,476.50	0.000	0.000
5,477.00	0.000	0.000
5,477.50	0.000	0.000
5,478.00	0.000	0.000
5,478.50	0.000	0.000
5,479.00	0.000	0.000
5,479.50	0.000	0.000
5,479.75	0.000	0.000
5,480.00	0.000	0.000
5,480.20	0.000	0.000
5,480.50	0.000	0.000
5,480.82	0.000	0.000
5,481.00	0.000	0.000
5,481.50	0.000	0.000
5,482.00	0.000	0.000
5,482.50	4.829	4.829
5,483.00	63.277	63.277
5,483.50	129.940	129.940
5,484.00	213.757	213.757

Structure #47 (Erodible Channel)

WS2-1 & DD2-1

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	2.0:1	2.0:1	1.9	0.0300	1.00			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	17.32 cfs	
Depth:	0.39 ft	1.39 ft
Top Width:	13.56 ft	17.56 ft
Velocity:	3.48 fps	
X-Section Area:	4.98 sq ft	
Hydraulic Radius:	0.362 ft	
Froude Number:	1.01	

Structure #53 (Riprap Channel)

Ramp Ditch-2

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	2.0:1	2.0:1	7.0	1.00		

Riprap Channel Results:

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	17.35 cfs	
Depth:	0.49 ft	1.49 ft
Top Width:	7.98 ft	11.98 ft
Velocity:	5.03 fps	
X-Section Area:	3.45 sq ft	
Hydraulic Radius:	0.420 ft	
Froude Number:	1.35	
Manning's n:	0.0440	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

Structure #43 (Null)

TDS8

Structure #44 (Pond)

CB3-2

Pond Inputs:

Initial Pool Elev:	5,468.70 ft
Initial Pool:	0.18 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	0.00 %

**No sediment capacity defined*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
5,470.00	15.00	2.00:1	2.00:1	20.00

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Pond Results:

Peak Elevation:	5,469.41 ft
H'graph Detention Time:	0.00 hrs
Pond Model:	CSTRS
Dewater Time:	0.00 days
Trap Efficiency:	0.00 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,468.00	0.250	0.000	0.000		Top of Sed. Storage
5,468.50	0.256	0.126	0.000		
5,468.70	0.258	0.178	0.000		
5,468.80	0.260	0.204	0.000		
5,469.00	0.262	0.256	0.000		
5,469.20	0.264	0.309	0.000		
5,469.31	0.266	0.338	0.000		
5,469.41	0.267	0.363	0.000	0.00	Peak Stage
5,469.50	0.268	0.388	0.000		
5,470.00	0.274	0.524	0.000		Spillway #1
5,470.50	0.280	0.663	3.871		
5,471.00	0.287	0.804	51.179		
5,471.50	0.293	0.950	105.737		
5,472.00	0.300	1.098	174.956		

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
5,468.00	0.000	0.000
5,468.50	0.000	0.000
5,468.70	0.000	0.000
5,468.80	0.000	0.000
5,469.00	0.000	0.000
5,469.20	0.000	0.000
5,469.31	0.000	0.000
5,469.50	0.000	0.000
5,470.00	0.000	0.000
5,470.50	3.871	3.871
5,471.00	51.179	51.179

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
5,471.50	105.737	105.737
5,472.00	174.956	174.956

Structure #45 (Erodible Channel)

DD3-3

Triangular Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	2.0	0.0300	1.00			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.00 cfs	
Depth:	0.01 ft	1.01 ft
Top Width:	0.06 ft	6.06 ft
Velocity:	0.20 fps	
X-Section Area:	0.00 sq ft	
Hydraulic Radius:	0.005 ft	
Froude Number:	0.49	

Structure #40 (Null)

MS3-1

Structure #41 (Pond)

CB3-1

Pond Inputs:

Initial Pool Elev:	5,464.10 ft
Initial Pool:	0.05 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	0.00 %

**No sediment capacity defined*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
5,466.60	15.00	2.00:1	2.00:1	15.00

Pond Results:

Peak Elevation:	5,465.46 ft
H'graph Detention Time:	0.00 hrs
Pond Model:	CSTRS
Dewater Time:	0.00 days
Trap Efficiency:	0.00 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,464.00	0.450	0.000	0.000		Top of Sed. Storage
5,464.10	0.452	0.045	0.000		
5,464.20	0.455	0.091	0.000		
5,464.50	0.462	0.228	0.000		
5,465.00	0.474	0.462	0.000		
5,465.46	0.485	0.681	0.000	0.00	Peak Stage
5,465.50	0.486	0.702	0.000		
5,465.65	0.490	0.775	0.000		
5,466.00	0.499	0.948	0.000		
5,466.50	0.511	1.201	0.000		
5,466.60	0.514	1.252	0.000		Spillway #1
5,467.00	0.524	1.460	14.423		
5,467.50	0.537	1.725	32.456		
5,468.00	0.550	1.997	72.062		

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
5,464.00	0.000	0.000
5,464.10	0.000	0.000
5,464.20	0.000	0.000
5,464.50	0.000	0.000
5,465.00	0.000	0.000
5,465.50	0.000	0.000

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
5,465.65	0.000	0.000
5,466.00	0.000	0.000
5,466.50	0.000	0.000
5,466.60	0.000	0.000
5,467.00	14.423	14.423
5,467.50	32.456	32.456
5,468.00	72.062	72.062

Structure #38 (Null)

WS3-1

Structure #39 (Erodible Channel)

DD3-1

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	2.0:1	2.0:1	1.4	0.0300	1.00			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	30.82 cfs	
Depth:	0.60 ft	1.60 ft
Top Width:	14.40 ft	18.40 ft
Velocity:	3.89 fps	
X-Section Area:	7.92 sq ft	
Hydraulic Radius:	0.539 ft	
Froude Number:	0.93	

Structure #42 (Erodible Channel)

DD3-2

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	2.0:1	2.0:1	1.5	0.0300	1.00			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	30.82 cfs	
Depth:	0.59 ft	1.59 ft
Top Width:	14.35 ft	18.35 ft
Velocity:	3.98 fps	
X-Section Area:	7.74 sq ft	
Hydraulic Radius:	0.529 ft	
Froude Number:	0.95	

Structure #46 (Riprap Channel)

DD3-4 Ramp Ditch 3

Triangular Riprap Channel Inputs:

Material: Riprap

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.0:1	2.0:1	7.0	1.00		

Riprap Channel Results:

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	30.82 cfs	
Depth:	1.51 ft	2.51 ft
Top Width:	6.04 ft	10.04 ft
Velocity:	6.75 fps	
X-Section Area:	4.57 sq ft	
Hydraulic Radius:	0.676 ft	
Froude Number:	1.37	
Manning's n:	0.0450	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Structure #33 (Null)

MS4-1 & WS4-1

Structure #34 (Pond)

CB4-1

Pond Inputs:

Initial Pool Elev:	5,464.90 ft
Initial Pool:	0.81 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	0.00 %

**No sediment capacity defined*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
5,466.60	15.00	2.00:1	2.00:1	28.00

Pond Results:

Peak Elevation:	5,466.60 ft
H'graph Detention Time:	15.23 hrs
Pond Model:	CSTRS
Dewater Time:	0.04 days
Trap Efficiency:	100.00 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,462.00	0.200	0.000	0.000		Top of Sed. Storage
5,462.01	0.200	0.002	0.000		
5,462.50	0.225	0.106	0.000		
5,463.00	0.252	0.226	0.000		
5,463.50	0.280	0.359	0.000		
5,464.00	0.310	0.506	0.000		
5,464.50	0.341	0.669	0.000		
5,464.90	0.367	0.810	0.000		
5,465.00	0.373	0.847	0.000		
5,465.50	0.407	1.042	0.000		
5,466.00	0.443	1.255	0.000		
5,466.50	0.480	1.485	0.000		
5,466.60	0.487	1.534	0.000		Spillway #1
5,466.60	0.488	1.534	0.076	0.90	Peak Stage

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
5,467.00	0.518	1.735	26.125	
5,467.50	0.558	2.004	58.789	
5,468.00	0.600	2.293	128.129	

Detailed Discharge Table

Elevation (ft)	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
5,462.00	0.000	0.000
5,462.01	0.000	0.000
5,462.50	0.000	0.000
5,463.00	0.000	0.000
5,463.50	0.000	0.000
5,464.00	0.000	0.000
5,464.50	0.000	0.000
5,464.90	0.000	0.000
5,465.00	0.000	0.000
5,465.50	0.000	0.000
5,466.00	0.000	0.000
5,466.50	0.000	0.000
5,466.60	0.000	0.000
5,467.00	26.125	26.125
5,467.50	58.789	58.789
5,468.00	128.129	128.129

Structure #35 (Erodible Channel)

DD4-1

Triangular Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.5	0.0300	1.00			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.08 cfs	
Depth:	0.19 ft	1.19 ft
Top Width:	1.13 ft	7.13 ft

	w/o Freeboard	w/ Freeboard
Velocity:	0.70 fps	
X-Section Area:	0.11 sq ft	
Hydraulic Radius:	0.090 ft	
Froude Number:	0.40	

Structure #36 (Culvert)

C4-1

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
80.00	1.50	0.0150	2.00	1.50	0.90

Culvert Results:

Design Discharge = 0.08 cfs

Minimum pipe diameter: 1 - 4 inch pipe(s) required

Structure #37 (Riprap Channel)

DD4-2 Ramp Ditch 4

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
6.00	2.0:1	2.0:1	7.0	1.00		

Riprap Channel Results:

Simons/OSM Method - Mild Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.08 cfs	
Depth:	0.05 ft	1.05 ft
Top Width:	6.20 ft	10.20 ft
Velocity:	0.25 fps	
X-Section Area:	0.30 sq ft	
Hydraulic Radius:	0.049 ft	
Froude Number:	0.20	
Manning's n:	0.0283	
Dmin:	1.00 in	
D50:	3.00 in	
Dmax:	3.75 in	

Structure #30 (Null)

WS5-1

Structure #31 (Erodible Channel)

DD5-1

Trapezoidal Erodible Channel Inputs:

Material: Graded silts to cobbles when colloidal

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
12.00	2.0:1	2.0:1	1.0	0.0300	1.00			5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	65.84 cfs	
Depth:	1.03 ft	2.03 ft
Top Width:	16.13 ft	20.13 ft
Velocity:	4.54 fps	
X-Section Area:	14.51 sq ft	
Hydraulic Radius:	0.873 ft	
Froude Number:	0.84	

Structure #32 (Riprap Channel)

Ramp Ditch 5

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
12.00	2.0:1	2.0:1	7.0	1.00		

Riprap Channel Results:

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	65.06 cfs	
Depth:	0.74 ft	1.74 ft
Top Width:	14.94 ft	18.94 ft
Velocity:	6.56 fps	
X-Section Area:	9.91 sq ft	

	w/o Freeboard	w/ Freeboard
Hydraulic Radius:	0.648 ft	
Froude Number:	1.42	
Manning's n:	0.0450	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Structure #18 (Erodible Channel)

Upper East Diversion

Trapezoidal Erodible Channel Inputs:

Material: Cobbles and shingles

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
14.00	2.0:1	2.0:1	0.6	0.0350				5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	96.95 cfs	
Depth:	1.50 ft	
Top Width:	20.01 ft	
Velocity:	3.79 fps	
X-Section Area:	25.56 sq ft	
Hydraulic Radius:	1.234 ft	
Froude Number:	0.59	

Structure #19 (Erodible Channel)

Lower E Diversion

Trapezoidal Erodible Channel Inputs:

Material: Cobbles and shingles

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
14.00	2.0:1	2.0:1	0.3	0.0350				5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	169.37 cfs	

	w/o Freeboard	w/ Freeboard
Depth:	2.50 ft	
Top Width:	24.01 ft	
Velocity:	3.56 fps	
X-Section Area:	47.55 sq ft	
Hydraulic Radius:	1.888 ft	
Froude Number:	0.45	

Structure #3 (Null)

Structure #4 (Null)

Structure #1 (Null)

Structure #2 (Null)

Structure #5 (Null)

Structure #6 (Null)

EAST LEASE BNDY

Structure #11 (Pond)

Sta:118+00 - U Shaped Impoundment

Pond Inputs:

Initial Pool Elev:	5,430.01 ft
Initial Pool:	0.00 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	20.00 %

**No sediment capacity defined*

Pond Results:

Peak Elevation:	5,447.52 ft
H'graph Detention Time:	6.79 hrs
Pond Model:	CSTRS
Dewater Time:	1.55 days
Trap Efficiency:	36.83 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,430.00	0.000	0.000	0.000		Top of Sed. Storage
5,430.01	0.002	0.000	0.000		
5,431.00	0.225	0.082	3.900	0.26*	
5,432.00	0.822	0.575	8.230	0.72*	
5,433.00	2.809	2.292	17.280	1.20*	
5,434.00	6.235	6.701	31.060	1.72*	
5,435.00	11.008	15.210	45.120	2.75	
5,436.00	16.934	29.075	65.530	3.05	
5,437.00	24.132	49.503	92.860	3.15	
5,438.00	29.977	76.504	129.180	3.00	
5,439.00	36.455	109.667	168.090	2.75	
5,440.00	39.413	147.592	209.680	2.80	
5,441.00	42.486	188.531	263.440	3.15	
5,442.00	43.250	231.399	329.180	3.00	
5,443.00	44.020	275.033	421.610	2.55	
5,444.00	44.637	319.361	515.750	1.90	
5,445.00	45.259	364.309	594.490	1.65	
5,446.00	46.060	409.968	807.140	1.40	
5,447.00	46.869	456.432	1,021.210	1.15	
5,447.52	47.605	480.889	1,096.779	1.10	Peak Stage
5,448.00	48.100	503.915	1,167.930		
5,449.00	49.346	552.637	1,720.410		
5,450.00	51.291	602.952	2,309.040		
5,451.00	53.274	655.232	2,928.330		
5,452.00	56.392	710.057	3,767.860		
5,452.50	57.976	738.649	4,223.680		
5,453.00	59.573	768.035	4,693.290		
5,454.00	65.520	830.558	5,723.400		
5,455.00	71.750	899.169	6,850.570		

**Designates time(s) to dewater have been extrapolated beyond the 50 hour hydrograph limit.*

Detailed Discharge Table

Elevation (ft)	User-input discharge (cfs)	Combined Total Discharge (cfs)
5,430.00	0.000	0.000
5,430.01	0.000	0.000
5,431.00	3.900	3.900
5,432.00	8.230	8.230
5,433.00	17.280	17.280

Elevation (ft)	User-input discharge (cfs)	Combined Total Discharge (cfs)
5,434.00	31.060	31.060
5,435.00	45.120	45.120
5,436.00	65.530	65.530
5,437.00	92.860	92.860
5,438.00	129.180	129.180
5,439.00	168.090	168.090
5,440.00	209.680	209.680
5,441.00	263.440	263.440
5,442.00	329.180	329.180
5,443.00	421.610	421.610
5,444.00	515.750	515.750
5,445.00	594.490	594.490
5,446.00	807.140	807.140
5,447.00	1,021.210	1,021.210
5,448.00	1,167.930	1,167.930
5,449.00	1,720.410	1,720.410
5,450.00	2,309.040	2,309.040
5,451.00	2,928.330	2,928.330
5,452.00	3,767.860	3,767.860
5,452.50	4,223.680	4,223.680
5,453.00	4,693.290	4,693.290
5,454.00	5,723.400	5,723.400
5,455.00	6,850.570	6,850.570

Structure #17 (Erodible Channel)

Pinabete Diversion

Trapezoidal Erodible Channel Inputs:

Material: Cobbles and shingles

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
45.00	2.0:1	2.0:1	0.2	0.0400		50.00		5.5

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	1,093.09 cfs	
Depth:	4.81 ft	7.21 ft
Top Width:	64.23 ft	73.85 ft
Velocity:	4.16 fps	
X-Section Area:	262.63 sq ft	

	w/o Freeboard	w/ Freeboard
Hydraulic Radius:	3.949 ft	
Froude Number:	0.36	

Structure #27 (Null)

End of P Diversion, NNSWS06C,S7SW1

Structure #22 (Null)

NN SO4 (SWS07)

Structure #23 (Null)

NN S05 (SWS08)

Structure #24 (Null)

NN S06 (SWS09,10,11,12,13,14)

Structure #25 (Null)

NN S07 (SWS15,16,17,18,19)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#65	1	22.110	0.202	0.000	0.000	89.000	M	19.11	1.155
	Σ	**22.110**						**19.11**	**1.155**
#61	1	34.787	0.134	0.000	0.000	86.200	M	26.53	1.505
	Σ	**34.787**						**26.53**	**1.505**
#59	1	41.030	0.320	0.000	0.000	86.200	M	24.44	1.745
	Σ	**41.030**						**24.44**	**1.745**
#60	Σ	**41.030**						**24.44**	**1.745**
#62	Σ	**75.817**						**49.34**	**3.250**
#63	Σ	**75.817**						**47.25**	**3.250**
#57	1	4.740	0.080	0.000	0.000	81.500	M	4.51	0.174
	Σ	**4.740**						**4.51**	**0.174**
#58	Σ	**4.740**						**4.51**	**0.174**
#55	1	4.870	0.122	0.000	0.000	89.000	M	7.22	0.318
	Σ	**4.870**						**7.22**	**0.318**
#56	Σ	**4.870**						**7.22**	**0.318**
#54	1	42.850	0.194	0.000	0.000	86.200	M	30.89	1.830
	Σ	**42.850**						**30.89**	**1.830**
#64	Σ	**128.277**						**73.26**	**5.205**
#29	1	286.550	0.248	0.000	0.000	86.200	M	188.76	12.256
	Σ	**286.550**						**188.76**	**12.256**
#20	1	856.430	1.610	0.000	0.000	85.700	M	167.83	34.941
	2	999.370	1.260	0.814	0.291	81.700	M	162.66	29.766
	Σ	**1,855.800**						**280.42**	**64.707**
#21	1	925.920	1.675	0.409	0.297	88.800	M	230.14	47.520
	2	1,019.220	1.106	0.193	0.261	87.000	M	299.75	45.846
	3	425.160	0.766	0.000	0.000	87.400	M	168.17	19.715
	Σ	**4,226.100**						**611.52**	**177.789**
#26	1	13.260	0.076	0.000	0.000	93.000	M	23.72	1.152
	Σ	**4,239.359**						**571.89**	**166.126**
#28	1	65.680	0.380	0.000	0.000	86.200	M	36.01	2.785
	Σ	**4,305.040**						**524.90**	**156.091**

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#51	1	4.820	0.055	0.000	0.000	81.500	M	4.59	0.177
	Σ	**4.820**						**4.59**	**0.177**
#52	1	0.200	0.004	0.000	0.000	89.000	M	0.30	0.010
	Σ	**5.020**						**0.30**	**0.010**
#48	1	8.810	0.681	0.000	0.000	81.500	M	2.19	0.258
	Σ	**8.810**						**2.19**	**0.258**
#49	1	37.570	0.681	0.000	0.000	89.000	M	18.40	1.958
	Σ	**46.380**						**18.40**	**1.958**
#50	Σ	**46.380**						**18.40**	**1.958**
#47	1	29.270	0.146	0.000	0.000	82.900	M	17.32	0.981
	Σ	**29.270**						**17.32**	**0.981**
#53	Σ	**80.670**						**17.35**	**0.990**
#43	1	6.207	0.137	0.000	0.000	81.500	M	3.27	0.186
	Σ	**6.207**						**3.27**	**0.186**
#44	Σ	**6.207**						**3.27**	**0.186**
#45	Σ	**6.207**						**0.00**	**0.000**
#40	1	12.150	0.354	0.000	0.000	89.000	M	8.67	0.636
	Σ	**12.150**						**8.67**	**0.636**
#41	Σ	**12.150**						**8.67**	**0.636**
#38	1	66.380	0.302	0.000	0.000	82.900	M	30.82	2.187
	Σ	**66.380**						**30.82**	**2.187**
#39	Σ	**66.380**						**30.82**	**2.187**
#42	Σ	**78.530**						**30.82**	**2.187**
#46	Σ	**84.737**						**30.82**	**2.187**
#33	1	14.130	0.291	0.000	0.000	89.000	M	10.93	0.738
	Σ	**14.130**						**10.93**	**0.738**
#34	Σ	**14.130**						**10.93**	**0.738**
#35	Σ	**14.130**						**0.08**	**0.014**
#36	Σ	**14.130**						**0.08**	**0.014**
#37	Σ	**14.130**						**0.08**	**0.014**
#30	1	282.150	0.909	0.000	0.000	82.900	M	65.84	9.266
	Σ	**282.150**						**65.84**	**9.266**

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#31	**Σ**	**282.150**						**65.84**	**9.266**
#32	**Σ**	**282.150**						**65.06**	**9.266**
#18	1	1,352.640	1.370	0.000	0.000	75.000	M	96.66	21.939
	2	148.000	1.315	1.026	0.249	76.000	M	12.41	2.652
	Σ	**1,500.640**						**96.95**	**24.591**
#19	1	418.020	1.293	0.000	0.000	82.900	M	74.99	13.715
	Σ	**1,918.660**						**169.37**	**38.306**
#3	1	791.300	1.145	1.181	0.350	80.800	M	126.48	21.870
	2	1,079.100	0.915	0.596	0.351	80.900	M	205.12	30.087
	3	450.300	0.571	0.319	0.355	81.300	M	124.03	12.992
	4	742.600	0.625	0.000	0.000	78.500	M	142.22	16.799
	5	915.400	1.119	0.000	0.000	78.800	M	120.44	21.280
	Σ	**3,978.700**						**408.84**	**103.028**
#4	1	546.400	0.726	1.710	0.319	81.700	M	132.82	16.285
	2	441.200	0.503	1.429	0.318	86.000	M	203.24	18.445
	3	889.400	0.815	0.998	0.318	82.100	M	207.38	27.379
	4	1,339.100	0.919	0.000	0.000	84.000	M	344.23	47.965
	Σ	**7,194.800**						**587.18**	**213.102**
#1	1	1,242.300	1.349	1.359	0.354	80.800	M	175.38	34.327
	2	1,662.000	1.465	0.865	0.359	80.300	M	209.14	44.015
	3	1,434.000	1.573	1.257	0.357	81.100	M	185.28	40.634
	4	842.700	1.102	0.977	0.364	81.000	M	141.43	23.683
	5	676.100	1.067	1.113	0.365	81.600	M	123.40	19.974
	6	1,223.200	0.778	0.596	0.352	81.800	M	286.04	36.750
	7	743.100	0.745	0.530	0.354	83.600	M	213.41	25.797
	8	654.500	0.801	0.000	0.000	92.200	M	373.82	42.811
	Σ	**8,477.899**						**906.51**	**267.991**
#2	1	609.500	0.668	1.219	0.340	85.700	M	228.33	24.903
	2	537.100	0.610	1.436	0.329	91.600	M	349.86	33.711
	3	455.000	0.546	1.288	0.324	82.000	M	138.36	13.898
	4	627.000	0.634	0.852	0.324	87.900	M	293.17	30.151
	5	653.100	0.452	0.453	0.315	91.200	M	490.31	39.848
	6	957.200	0.984	0.000	0.000	89.600	M	382.21	52.057
	Σ	**12,316.800**						**1,064.62**	**462.559**
#5	1	763.100	0.682	3.507	0.293	84.100	M	244.05	27.555
	2	983.300	1.117	2.231	0.289	89.200	M	346.17	51.945
	3	1,022.000	0.996	1.587	0.291	92.000	M	492.71	65.927
	4	688.700	1.908	1.255	0.291	80.800	M	74.13	19.028
	5	754.300	2.307	1.084	0.287	86.200	M	115.39	31.953

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	6	628.400	0.538	0.595	0.301	93.000	M	491.62	43.517
	7	654.500	0.560	0.000	0.000	91.500	M	445.79	40.785
	Σ	**25,005.900**						**1,662.11**	**956.372**
#6	1	901.400	1.151	1.896	0.315	81.100	M	147.95	25.547
	2	1,011.200	1.871	0.166	0.287	83.500	M	143.70	34.801
	3	1,124.300	1.126	0.000	0.000	92.800	M	528.57	76.684
	Σ	**28,042.800**						**1,673.45**	**1,093.404**
#11	1	53.960	0.000	0.000	0.000	91.000	M	88.24	4.072
	Σ	**30,311.700**						**1,687.28**	**1,145.061**
#17	**Σ**	**30,477.110**						**1,093.09**	**1,143.942**
#27	1	43.270	0.441	0.000	0.000	86.200	M	21.87	1.836
	Σ	**35,262.350**						**1,132.11**	**1,319.330**
#22	1	519.990	0.565	0.000	0.000	88.400	M	273.43	25.945
	Σ	**35,782.340**						**1,135.09**	**1,345.275**
#23	1	233.290	0.469	0.000	0.000	87.900	M	131.66	11.233
	Σ	**36,015.630**						**1,136.37**	**1,356.508**
#24	1	126.980	0.164	0.545	0.308	86.900	M	101.83	5.787
	2	235.630	0.327	0.427	0.341	86.700	M	144.93	10.409
	3	258.380	0.416	0.365	0.294	88.300	M	161.17	12.840
	4	180.930	0.449	0.176	0.301	86.700	M	94.53	7.968
	5	189.850	0.326	0.146	0.330	86.800	M	117.89	8.448
	6	172.370	0.753	0.000	0.000	88.300	M	74.40	8.538
	Σ	**37,179.770**						**1,142.58**	**1,410.498**
#25	1	91.450	0.220	0.854	0.310	86.800	M	65.92	4.081
	2	286.490	0.566	0.642	0.312	87.100	M	134.68	12.994
	3	75.280	0.179	0.610	0.308	86.800	M	58.49	3.393
	4	128.700	0.157	0.270	0.325	86.800	M	102.47	5.822
	5	67.060	0.333	0.000	0.000	82.000	M	27.39	2.057
	Σ	**37,828.750**						**1,145.21**	**1,438.845**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#65	1	0.150	200.00	6.00	0.2320	1.0000	6	22.0	23,919	11.90	6.93
	Σ							**22.0**	**23,919**	**11.90**	**6.93**
#61	1	0.150	200.00	6.00	0.2320	1.0000	6	30.4	26,424	13.26	7.39
	Σ							**30.4**	**26,424**	**13.26**	**7.39**
#59	1	0.150	200.00	6.00	0.2320	1.0000	6	31.9	23,467	10.76	6.11
	Σ							**31.9**	**23,467**	**10.76**	**6.11**
#60	Σ							**31.9**	**23,467**	**10.76**	**6.11**
#62	Σ							**62.3**	**24,695**	**11.85**	**6.71**
#63	Σ							**62.3**	**25,556**	**12.26**	**6.71**
#57	1	0.150	150.00	33.00	0.0700	1.0000	6	6.5	52,641	30.22	15.54
	Σ							**6.5**	**52,641**	**30.22**	**15.54**
#58	Σ							**6.5**	**52,641**	**30.22**	**15.54**
#55	1	0.150	150.00	33.00	0.8000	1.0000	6	135.9	437,976	251.47	153.91
	Σ							**135.9**	**437,976**	**251.47**	**153.91**
#56	Σ							**135.9**	**437,976**	**251.47**	**153.91**
#54	1	0.150	200.00	6.00	0.2320	1.0000	6	37.2	26,476	13.03	7.30
	Σ							**37.2**	**26,476**	**13.03**	**7.30**
#64	Σ							**99.5**	**26,579**	**12.87**	**6.75**
#29	1	0.183	100.00	9.10	0.1990	1.0000	7	354.4	37,147	17.78	10.06
	Σ							**354.4**	**37,147**	**17.78**	**10.06**
#20	1	0.245	420.00	1.40	0.2450	1.0000	2	236.1	7,888	2.53	1.60
	2	0.233	280.00	2.40	0.2650	1.0000	1	308.8	12,388	3.62	2.22
	Σ							**462.8**	**8,331**	**1.83**	**1.16**
#21	1	0.235	280.00	2.20	0.2330	1.0000	3	399.8	9,626	3.28	2.12
	2	0.204	280.00	2.30	0.2330	1.0000	4	410.4	10,604	3.76	2.33
	3	0.158	240.00	3.80	0.2110	1.0000	5	196.1	12,089	4.06	2.45
	Σ							**1,215.1**	**8,343**	**1.80**	**1.08**
#26	1	1.000	0.50	0.10	0.1000	1.0000	15	0.5	501	0.28	0.18
	Σ							**912.8**	**6,873**	**0.40**	**0.24**
#28	1	0.183	100.00	9.10	0.1990	1.0000	7	61.4	28,100	12.53	7.17
	Σ							**766.1**	**28,099**	**2.24**	**0.30**
#51	1	0.200	150.00	33.00	0.0700	1.0000	16	8.9	69,834	34.82	17.94
	Σ							**8.9**	**69,834**	**34.82**	**17.94**

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#52	1	0.200	40.00	33.00	0.8000	1.0000	16	2.3	209,067	104.25	79.88
	Σ							**11.2**	**209,067**	**152.64**	**0.00**
#48	1	0.200	150.00	33.00	0.0700	1.0000	16	8.2	40,139	7.24	4.17
	Σ							**8.2**	**40,139**	**7.24**	**4.17**
#49	1	0.200	150.00	33.00	0.8000	1.0000	16	961.1	482,070	122.83	77.79
	Σ							**969.4**	**482,070**	**125.00**	**79.17**
#50	Σ							**969.4**	**482,070**	**125.00**	**79.17**
#47	1	0.200	280.00	2.70	0.1410	1.0000	16	6.5	9,199	3.61	1.92
	Σ							**6.5**	**9,199**	**3.61**	**1.92**
#53	Σ							**17.7**	**138,605**	**83.83**	**3.95**
#43	1	0.197	150.00	33.00	0.0700	1.0000	20	8.3	61,702	29.13	15.27
	Σ							**8.3**	**61,702**	**29.13**	**15.27**
#44	Σ							**8.3**	**61,702**	**29.13**	**15.27**
#45	Σ							**8.3**	**1**	**0.00**	**0.00**
#40	1	0.200	200.00	33.00	0.8000	1.0000	20	398.3	599,843	267.95	166.27
	Σ							**398.3**	**599,843**	**267.95**	**166.27**
#41	Σ							**398.3**	**599,843**	**267.95**	**166.27**
#38	1	0.197	280.00	2.70	0.2330	1.0000	20	23.3	14,266	6.15	3.35
	Σ							**23.3**	**14,266**	**6.15**	**3.35**
#39	Σ							**23.3**	**14,266**	**6.15**	**3.35**
#42	Σ							**421.6**	**14,266**	**11.08**	**6.05**
#46	Σ							**429.9**	**14,266**	**11.09**	**6.06**
#33	1	0.200	200.00	33.00	0.8000	1.0000	20	493.4	631,974	291.89	180.92
	Σ							**493.4**	**631,974**	**291.89**	**180.92**
#34	Σ							**493.4**	**631,974**	**291.89**	**180.92**
#35	Σ							**0.0**	**0**	**0.00**	**0.00**
#36	Σ							**0.0**	**0**	**0.00**	**0.00**
#37	Σ							**0.0**	**0**	**0.00**	**0.00**
#30	1	0.197	200.00	4.20	0.1460	1.0000	16	83.5	11,122	1.38	0.82
	Σ							**83.5**	**11,122**	**1.38**	**0.82**
#31	Σ							**83.5**	**11,122**	**1.38**	**0.82**

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#32	Σ							**83.5**	**11,234**	**1.40**	**0.82**
#18	1	0.204	420.00	1.80	0.3270	1.0000	34	184.0	10,329	1.88	1.12
	2	0.204	280.00	3.00	0.3220	1.0000	34	24.6	11,276	2.32	1.40
	Σ							**184.0**	**9,178**	**1.67**	**1.01**
#19	1	0.197	280.00	2.70	0.2330	1.0000	20	107.3	9,384	1.73	1.06
	Σ							**291.3**	**9,237**	**1.69**	**1.02**
#3	1	0.150	100.00	9.10	0.3050	1.0000	33	494.7	27,163	7.79	4.73
	2	0.181	100.00	10.10	0.3050	1.0000	28	1,128.2	45,635	16.28	9.70
	3	0.151	200.00	5.50	0.3050	1.0000	33	297.0	29,126	12.03	6.88
	4	0.183	130.00	7.60	0.3160	1.0000	27	511.2	39,439	14.88	8.34
	5	0.185	100.00	8.30	0.2760	1.0000	21	457.7	26,490	5.83	3.45
	Σ							**2,245.7**	**25,890**	**5.90**	**3.63**
#4	1	0.173	130.00	7.00	0.2850	1.0000	22	380.6	28,562	10.73	6.40
	2	0.148	100.00	12.00	0.2220	1.0000	20	645.8	42,085	16.37	9.88
	3	0.185	75.00	13.60	0.2740	1.0000	32	1,248.2	55,008	19.53	11.70
	4	0.213	100.00	10.60	0.2330	1.0000	21	1,886.4	47,509	14.80	8.88
	Σ							**4,767.8**	**41,928**	**7.86**	**3.07**
#1	1	0.220	280.00	2.20	0.2960	1.0000	28	340.4	11,823	3.33	2.05
	2	0.202	240.00	3.30	0.2960	1.0000	28	547.0	14,770	3.82	2.37
	3	0.206	280.00	2.60	0.2960	1.0000	28	419.7	12,159	3.04	1.90
	4	0.188	200.00	5.10	0.2960	1.0000	28	503.6	25,646	8.31	5.03
	5	0.124	240.00	3.60	0.3130	1.0000	33	184.0	11,165	3.44	2.08
	6	0.178	130.00	7.90	0.2850	1.0000	22	1,066.3	35,706	13.05	7.71
	7	0.191	100.00	9.20	0.2540	1.0000	21	784.0	37,166	12.86	7.64
	8	0.199	75.00	15.10	0.1510	1.0000	17	1,509.3	40,966	11.06	6.91
	Σ							**4,464.9**	**33,833**	**7.15**	**2.58**
#2	1	0.188	130.00	7.30	0.2120	1.0000	20	550.2	26,691	9.24	5.57
	2	0.199	75.00	12.60	0.1510	1.0000	17	1,008.2	34,684	10.88	6.82
	3	0.200	100.00	8.60	0.2020	1.0000	26	326.2	29,172	8.45	4.96
	4	0.193	75.00	12.30	0.1730	1.0000	19	923.5	36,588	11.27	6.86
	5	0.187	75.00	14.00	0.1590	1.0000	18	1,517.4	45,203	16.68	10.19
	6	0.198	75.00	13.70	0.1680	1.0000	19	1,669.0	37,482	8.92	5.54
	Σ							**7,348.4**	**33,857**	**4.72**	**1.63**
#5	1	0.213	130.00	6.30	0.2330	1.0000	21	653.9	27,980	10.18	6.29
	2	0.209	130.00	7.10	0.1680	1.0000	19	900.1	19,899	4.08	2.59
	3	0.191	100.00	8.40	0.1500	1.0000	17	1,085.4	18,808	4.17	2.67
	4	0.235	200.00	4.90	0.2870	1.0000	24	362.1	21,952	4.52	2.88
	5	0.220	240.00	3.70	0.1900	1.0000	31	254.7	8,974	0.55	0.36
	6	0.200	130.00	7.30	0.1410	1.0000	16	817.8	21,982	7.28	4.55

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	7	0.204	200.00	4.70	0.1560	1.0000	17	687.2	20,222	6.60	4.01
	Σ							**15,938.8**	**27,400**	**4.14**	**1.89**
#6	1	0.228	280.00	2.70	0.2870	1.0000	24	316.8	14,838	4.79	2.93
	2	0.226	280.00	2.40	0.2330	1.0000	21	268.2	8,937	1.19	0.76
	3	0.200	200.00	4.20	0.1460	1.0000	16	889.2	13,350	2.47	1.57
	Σ							**15,130.2**	**23,312**	**1.71**	**0.77**
#11	1	0.320	300.00	0.50	0.9000	1.0000	16	87.0	25,298	12.61	7.77
	Σ							**15,592.0**	**23,037**	**1.79**	**0.80**
#17	**Σ**							**10,297.8**	**599,615**	**43.84**	**0.60**
#27	1	0.183	100.00	9.10	0.1990	1.0000	7	36.8	25,311	10.89	6.29
	Σ							**11,566.1**	**40,935**	**3.73**	**0.71**
#22	1	0.183	100.00	9.10	0.1990	1.0000	7	667.0	31,398	13.00	7.75
	Σ							**11,723.9**	**30,054**	**2.35**	**0.61**
#23	1	0.170	100.00	10.10	0.1890	1.0000	8	294.8	32,531	12.94	7.60
	Σ							**11,907.2**	**30,157**	**2.39**	**0.62**
#24	1	0.160	100.00	11.50	0.1990	1.0000	5	207.4	44,285	21.62	12.68
	2	0.145	100.00	12.00	0.2110	1.0000	15	360.7	43,171	18.39	10.71
	3	0.171	100.00	8.20	0.1850	1.0000	10	246.1	23,504	9.41	5.60
	4	0.150	75.00	12.10	0.2110	1.0000	11	215.6	33,725	13.34	7.79
	5	0.143	75.00	13.30	0.2110	1.0000	15	271.8	40,504	17.28	9.97
	6	0.164	75.00	13.90	0.1850	1.0000	12	225.3	31,654	9.95	6.04
	Σ							**12,362.6**	**30,133**	**2.50**	**0.66**
#25	1	0.143	100.00	10.40	0.2110	1.0000	15	110.9	33,271	15.18	9.02
	2	0.162	75.00	15.20	0.2220	1.0000	13	527.1	48,820	18.88	11.36
	3	0.143	75.00	20.10	0.2110	1.0000	15	180.8	64,982	30.56	18.04
	4	0.143	100.00	8.10	0.2110	1.0000	15	113.6	24,801	11.77	6.76
	5	0.215	100.00	8.20	0.2760	1.0000	14	61.3	39,773	19.09	10.40
	Σ							**12,804.7**	**36,846**	**2.89**	**0.65**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	2.99	22.00	736.00	1.720	0.118
		8. Large gullies, diversions, and low flowing streams	0.63	66.00	10,511.22	2.370	1.231
#1	**1**	**Time of Concentration:**					**1.349**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	5. Nearly bare and untilled, and alluvial valley fans	6.24	30.00	481.00	2.490	0.053
		8. Large gullies, diversions, and low flowing streams	3.34	406.00	12,141.00	5.480	0.615
#2	**1**	**Time of Concentration:**					**0.668**
#2	2	5. Nearly bare and untilled, and alluvial valley fans	3.16	30.00	950.00	1.770	0.149
		8. Large gullies, diversions, and low flowing streams	4.22	432.00	10,229.00	6.160	0.461
#2	**2**	**Time of Concentration:**					**0.610**
#2	3	5. Nearly bare and untilled, and alluvial valley fans	2.65	10.00	378.00	1.620	0.064
		8. Large gullies, diversions, and low flowing streams	2.72	234.00	8,592.00	4.950	0.482
#2	**3**	**Time of Concentration:**					**0.546**
#2	4	5. Nearly bare and untilled, and alluvial valley fans	3.07	25.00	815.00	1.750	0.129
		8. Large gullies, diversions, and low flowing streams	3.32	330.00	9,931.00	5.460	0.505
#2	**4**	**Time of Concentration:**					**0.634**
#2	5	5. Nearly bare and untilled, and alluvial valley fans	7.45	45.00	604.00	2.720	0.061
		8. Large gullies, diversions, and low flowing streams	3.78	310.00	8,210.00	5.820	0.391
#2	**5**	**Time of Concentration:**					**0.452**
#2	6	5. Nearly bare and untilled, and alluvial valley fans	9.10	80.00	879.00	3.010	0.081
		8. Large gullies, diversions, and low flowing streams	2.32	344.00	14,831.00	4.560	0.903
#2	**6**	**Time of Concentration:**					**0.984**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	1.29	15.00	1,163.00	1.130	0.285
		8. Large gullies, diversions, and low flowing streams	2.37	338.00	14,280.00	4.610	0.860
#3	**1**	**Time of Concentration:**					**1.145**
#3	2	5. Nearly bare and untilled, and alluvial valley fans	3.04	33.00	1,087.00	1.740	0.173
		8. Large gullies, diversions, and low flowing streams	2.06	238.00	11,527.00	4.310	0.742
#3	**2**	**Time of Concentration:**					**0.915**
#3	3	5. Nearly bare and untilled, and alluvial valley fans	5.02	45.00	897.00	2.230	0.111
		8. Large gullies, diversions, and low flowing streams	3.09	270.00	8,741.00	5.270	0.460
#3	**3**	**Time of Concentration:**					**0.571**
#3	4	5. Nearly bare and untilled, and alluvial valley fans	7.41	28.00	378.00	2.720	0.038
		8. Large gullies, diversions, and low flowing streams	3.43	402.00	11,736.00	5.550	0.587
#3	**4**	**Time of Concentration:**					**0.625**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	5	5. Nearly bare and untilled, and alluvial valley fans	3.39	30.00	885.00	1.840	0.133
		8. Large gullies, diversions, and low flowing streams	2.58	442.00	17,121.00	4.820	0.986
#3	**5**	**Time of Concentration:**					**1.119**
#4	1	5. Nearly bare and untilled, and alluvial valley fans	3.59	62.00	1,729.00	1.890	0.254
		8. Large gullies, diversions, and low flowing streams	2.09	154.00	7,372.00	4.330	0.472
#4	**1**	**Time of Concentration:**					**0.726**
#4	2	5. Nearly bare and untilled, and alluvial valley fans	6.83	25.00	366.00	2.610	0.038
		8. Large gullies, diversions, and low flowing streams	2.36	182.00	7,708.00	4.600	0.465
#4	**2**	**Time of Concentration:**					**0.503**
#4	3	5. Nearly bare and untilled, and alluvial valley fans	19.03	47.00	247.00	4.360	0.015
		8. Large gullies, diversions, and low flowing streams	2.13	268.00	12,586.00	4.370	0.800
#4	**3**	**Time of Concentration:**					**0.815**
#4	4	5. Nearly bare and untilled, and alluvial valley fans	14.08	50.00	355.00	3.750	0.026
		8. Large gullies, diversions, and low flowing streams	2.46	372.00	15,119.00	4.700	0.893
#4	**4**	**Time of Concentration:**					**0.919**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	12.55	65.00	518.00	3.540	0.040
		8. Large gullies, diversions, and low flowing streams	1.92	184.00	9,592.00	4.150	0.642
#5	**1**	**Time of Concentration:**					**0.682**
#5	2	5. Nearly bare and untilled, and alluvial valley fans	5.10	30.00	588.00	2.250	0.072
		8. Large gullies, diversions, and low flowing streams	1.77	266.00	15,016.00	3.990	1.045
#5	**2**	**Time of Concentration:**					**1.117**
#5	3	5. Nearly bare and untilled, and alluvial valley fans	1.90	20.00	1,050.00	1.380	0.211
		8. Large gullies, diversions, and low flowing streams	2.19	274.00	12,532.00	4.430	0.785
#5	**3**	**Time of Concentration:**					**0.996**
#5	4	5. Nearly bare and untilled, and alluvial valley fans	2.78	32.00	1,152.00	1.660	0.192
		8. Large gullies, diversions, and low flowing streams	0.99	182.00	18,415.00	2.980	1.716
#5	**4**	**Time of Concentration:**					**1.908**
#5	5	5. Nearly bare and untilled, and alluvial valley fans	2.52	23.00	911.00	1.580	0.160
		8. Large gullies, diversions, and low flowing streams	1.07	256.00	23,965.00	3.100	2.147
#5	**5**	**Time of Concentration:**					**2.307**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	6	5. Nearly bare and untilled, and alluvial valley fans	6.36	25.00	393.00	2.520	0.043
		8. Large gullies, diversions, and low flowing streams	2.39	198.00	8,272.00	4.640	0.495
#5	**6**	**Time of Concentration:**					**0.538**
#5	7	5. Nearly bare and untilled, and alluvial valley fans	9.66	28.00	290.00	3.100	0.025
		8. Large gullies, diversions, and low flowing streams	2.12	179.00	8,427.00	4.370	0.535
#5	**7**	**Time of Concentration:**					**0.560**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	31.83	120.00	377.00	5.640	0.018
		8. Large gullies, diversions, and low flowing streams	1.38	198.00	14,361.00	3.520	1.133
#6	**1**	**Time of Concentration:**					**1.151**
#6	2	5. Nearly bare and untilled, and alluvial valley fans	4.25	40.00	941.00	2.060	0.126
		8. Large gullies, diversions, and low flowing streams	0.96	176.00	18,407.00	2.930	1.745
#6	**2**	**Time of Concentration:**					**1.871**
#6	3	5. Nearly bare and untilled, and alluvial valley fans	4.35	25.00	575.00	2.080	0.076
		8. Large gullies, diversions, and low flowing streams	1.57	224.00	14,223.00	3.760	1.050
#6	**3**	**Time of Concentration:**					**1.126**
#26	1	8. Large gullies, diversions, and low flowing streams	2.35	30.00	1,274.00	4.600	0.076
#26	**1**	**Time of Concentration:**					**0.076**
#27	1	5. Nearly bare and untilled, and alluvial valley fans	2.60	15.60	600.00	1.610	0.103
		8. Large gullies, diversions, and low flowing streams	0.92	32.00	3,493.83	2.870	0.338
#27	**1**	**Time of Concentration:**					**0.441**
#28	1	8. Large gullies, diversions, and low flowing streams	2.92	80.00	2,740.30	5.120	0.148
		8. Large gullies, diversions, and low flowing streams	2.60	105.00	4,042.56	4.830	0.232
#28	**1**	**Time of Concentration:**					**0.380**
#29	1	8. Large gullies, diversions, and low flowing streams	3.69	120.00	3,255.51	5.750	0.157
		8. Large gullies, diversions, and low flowing streams	0.87	8.00	921.20	2.790	0.091
#29	**1**	**Time of Concentration:**					**0.248**
#30	1	5. Nearly bare and untilled, and alluvial valley fans	2.56	42.03	1,642.00	1.590	0.286
		5. Nearly bare and untilled, and alluvial valley fans	1.42	17.99	1,267.00	1.190	0.295
		8. Large gullies, diversions, and low flowing streams	0.94	18.00	1,915.00	2.900	0.183
		8. Large gullies, diversions, and low flowing streams	0.25	1.95	784.00	1.500	0.145

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#30	**1**	**Time of Concentration:**					**0.909**
#33	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	9.39	470.00	1.410	0.092
		8. Large gullies, diversions, and low flowing streams	0.50	7.50	1,500.00	2.120	0.196
		7. Paved area and small upland gullies	33.00	44.55	135.00	11.560	0.003
#33	**1**	**Time of Concentration:**					**0.291**
#38	1	5. Nearly bare and untilled, and alluvial valley fans	2.50	2.00	80.00	1.580	0.014
		7. Paved area and small upland gullies	4.80	16.03	334.00	4.410	0.021
		7. Paved area and small upland gullies	1.80	27.75	1,542.00	2.700	0.158
		8. Large gullies, diversions, and low flowing streams	1.42	19.99	1,408.00	3.570	0.109
#38	**1**	**Time of Concentration:**					**0.302**
#40	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	13.28	664.00	1.410	0.130
		7. Paved area and small upland gullies	33.00	44.55	134.99	11.560	0.003
		8. Large gullies, diversions, and low flowing streams	0.30	3.93	1,310.00	1.640	0.221
#40	**1**	**Time of Concentration:**					**0.354**
#43	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	6.00	300.00	1.410	0.059
		7. Paved area and small upland gullies	33.00	44.55	135.00	11.560	0.003
		8. Large gullies, diversions, and low flowing streams	1.50	15.00	1,000.00	3.670	0.075
#43	**1**	**Time of Concentration:**					**0.137**
#47	1	5. Nearly bare and untilled, and alluvial valley fans	2.33	6.99	300.00	1.520	0.054
		8. Large gullies, diversions, and low flowing streams	3.70	37.00	1,000.00	5.770	0.048
		8. Large gullies, diversions, and low flowing streams	1.87	12.28	657.00	4.100	0.044
#47	**1**	**Time of Concentration:**					**0.146**
#48	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	20.00	1,000.00	1.410	0.197
		7. Paved area and small upland gullies	33.00	44.55	135.00	11.560	0.003
		8. Large gullies, diversions, and low flowing streams	0.18	3.96	2,200.00	1.270	0.481
#48	**1**	**Time of Concentration:**					**0.681**
#49	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	20.00	1,000.00	1.410	0.197
		8. Large gullies, diversions, and low flowing streams	0.18	4.00	2,201.43	1.270	0.481
		7. Paved area and small upland gullies	33.00	44.55	134.99	11.560	0.003

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#49	**1**	**Time of Concentration:**					**0.681**
#51	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	3.00	150.00	1.410	0.029
		8. Large gullies, diversions, and low flowing streams	2.86	12.01	419.94	5.070	0.023
		7. Paved area and small upland gullies	33.00	44.55	135.00	11.560	0.003
#51	**1**	**Time of Concentration:**					**0.055**
#52	1	5. Nearly bare and untilled, and alluvial valley fans	25.00	20.00	80.00	5.000	0.004
#52	**1**	**Time of Concentration:**					**0.004**
#54	1	5. Nearly bare and untilled, and alluvial valley fans	2.03	14.00	690.00	1.420	0.134
		8. Large gullies, diversions, and low flowing streams	2.11	20.00	950.00	4.350	0.060
#54	**1**	**Time of Concentration:**					**0.194**
#55	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	6.00	300.00	1.410	0.059
		7. Paved area and small upland gullies	33.00	44.55	135.00	11.560	0.003
		8. Large gullies, diversions, and low flowing streams	2.50	25.75	1,030.00	4.740	0.060
#55	**1**	**Time of Concentration:**					**0.122**
#57	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	3.00	150.00	1.410	0.029
		7. Paved area and small upland gullies	33.00	44.55	135.00	11.560	0.003
		8. Large gullies, diversions, and low flowing streams	1.33	7.98	600.00	3.450	0.048
#57	**1**	**Time of Concentration:**					**0.080**
#59	1	5. Nearly bare and untilled, and alluvial valley fans	0.81	5.00	620.00	0.890	0.193
		8. Large gullies, diversions, and low flowing streams	1.33	21.00	1,580.00	3.450	0.127
#59	**1**	**Time of Concentration:**					**0.320**
#61	1	5. Nearly bare and untilled, and alluvial valley fans	2.71	16.00	590.01	1.640	0.099
		8. Large gullies, diversions, and low flowing streams	1.89	10.00	530.02	4.120	0.035
#61	**1**	**Time of Concentration:**					**0.134**
#65	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	15.00	750.00	1.410	0.147
		7. Paved area and small upland gullies	33.00	44.55	134.99	11.560	0.003
		9. Small streams flowing bankfull	1.46	29.93	2,050.00	10.870	0.052
#65	**1**	**Time of Concentration:**					**0.202**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.88	378.00	20,112.80	4.110	1.359
#1	**1**	**Muskingum K:**					**1.359**
#2	1	8. Large gullies, diversions, and low flowing streams	1.44	228.00	15,800.00	3.600	1.219
#2	**1**	**Muskingum K:**					**1.219**
#2	2	8. Large gullies, diversions, and low flowing streams	1.19	202.00	16,912.00	3.270	1.436
#2	**2**	**Muskingum K:**					**1.436**
#2	3	8. Large gullies, diversions, and low flowing streams	1.10	160.00	14,568.00	3.140	1.288
#2	**3**	**Muskingum K:**					**1.288**
#2	4	8. Large gullies, diversions, and low flowing streams	1.09	104.00	9,576.00	3.120	0.852
#2	**4**	**Muskingum K:**					**0.852**
#2	5	8. Large gullies, diversions, and low flowing streams	0.93	44.00	4,715.00	2.890	0.453
#2	**5**	**Muskingum K:**					**0.453**
#3	1	8. Large gullies, diversions, and low flowing streams	1.75	294.00	16,845.00	3.960	1.181
#3	**1**	**Muskingum K:**					**1.181**
#3	2	8. Large gullies, diversions, and low flowing streams	1.79	154.00	8,609.00	4.010	0.596
#3	**2**	**Muskingum K:**					**0.596**
#3	3	8. Large gullies, diversions, and low flowing streams	1.93	92.00	4,778.00	4.160	0.319
#3	**3**	**Muskingum K:**					**0.319**
#4	1	8. Large gullies, diversions, and low flowing streams	1.01	186.00	18,477.00	3.000	1.710
#4	**1**	**Muskingum K:**					**1.710**
#4	2	8. Large gullies, diversions, and low flowing streams	0.98	150.00	15,281.00	2.970	1.429
#4	**2**	**Muskingum K:**					**1.429**
#4	3	8. Large gullies, diversions, and low flowing streams	0.98	104.00	10,645.00	2.960	0.998
#4	**3**	**Muskingum K:**					**0.998**
#5	1	8. Large gullies, diversions, and low flowing streams	0.64	195.00	30,309.00	2.400	3.507
#5	**1**	**Muskingum K:**					**3.507**
#5	2	8. Large gullies, diversions, and low flowing streams	0.60	113.00	18,717.00	2.330	2.231
#5	**2**	**Muskingum K:**					**2.231**
#5	3	8. Large gullies, diversions, and low flowing streams	0.63	85.00	13,541.00	2.370	1.587
#5	**3**	**Muskingum K:**					**1.587**
#5	4	8. Large gullies, diversions, and low flowing streams	0.63	67.00	10,710.00	2.370	1.255
#5	**4**	**Muskingum K:**					**1.255**
#5	5	8. Large gullies, diversions, and low flowing streams	0.59	53.00	8,978.00	2.300	1.084

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	**5**	**Muskingum K:**					**1.084**
#5	6	8. Large gullies, diversions, and low flowing streams	0.74	41.00	5,528.00	2.580	0.595
#5	**6**	**Muskingum K:**					**0.595**
#6	1	8. Large gullies, diversions, and low flowing streams	0.94	186.00	19,797.00	2.900	1.896
#6	**1**	**Muskingum K:**					**1.896**
#6	2	8. Large gullies, diversions, and low flowing streams	0.58	8.00	1,372.00	2.290	0.166
#6	**2**	**Muskingum K:**					**0.166**
#27	1	8. Large gullies, diversions, and low flowing streams	0.30	16.15	5,384.09	1.640	0.911
#27	**1**	**Muskingum K:**					**0.000**

SEDCAD 4 for Windows - 10-Year 24-Hour Storm Summary

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Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#65	In	22.110	22.110	19.11	1.15	22.0	23,919	11.90	6.93
	Out			0.00	0.00	22.0	0	0.00	0.00
#61		34.787	34.787	26.53	1.50	30.4	26,424	13.26	7.39
#59		41.030	41.030	24.44	1.75	31.9	23,467	10.76	6.11
#60		0.000	41.030	24.44	1.75	31.9	23,467	10.76	6.11
#62		0.000	75.817	49.34	3.25	62.3	24,695	11.85	6.71
#63		0.000	75.817	47.25	3.25	62.3	25,556	12.26	6.71
#57		4.740	4.740	4.51	0.17	6.5	52,641	30.22	15.54
#58	In	0.000	4.740	4.51	0.17	6.5	52,641	30.22	15.54
	Out			0.00	0.00	0.0	0	0.00	0.00
#55		4.870	4.870	7.22	0.32	135.9	437,976	251.47	153.91
#56	In	0.000	4.870	7.22	0.32	135.9	437,976	251.47	153.91
	Out			0.69	0.12	0.0	11	0.00	0.00
#54		42.850	42.850	30.89	1.83	37.2	26,476	13.03	7.30
#64		0.000	128.277	73.26	5.21	99.5	26,579	12.87	6.75
#29		286.550	286.550	188.76	12.26	354.4	37,147	17.78	10.06
#20		1,855.800	1,855.800	280.42	64.71	462.8	8,331	1.83	1.16
#21	In	2,370.300	4,226.100	611.52	177.79	1,215.1	8,343	1.80	1.08
	Out			571.42	164.97	912.3	6,910	0.40	0.24
#26	In	13.260	4,239.359	571.89	166.13	912.8	6,873	0.40	0.24
	Out			523.94	153.31	783.1	6,264	0.33	0.20
#28		65.680	4,305.040	524.90	156.09	766.1	28,099	2.24	0.30
#51	In	4.820	4.820	4.59	0.18	8.9	69,834	34.82	17.94
	Out			0.00	0.00	8.9	0	0.00	0.00
#52		0.200	5.020	0.30	0.01	11.2	209,067	152.64	0.00
#48	In	8.810	8.810	2.19	0.26	8.2	40,139	7.24	4.17
	Out			0.00	0.00	8.2	0	0.00	0.00
#49		37.570	46.380	18.40	1.96	969.4	482,070	125.00	79.17
#50	In	0.000	46.380	18.40	1.96	969.4	482,070	125.00	79.17
	Out			0.00	0.00	0.0	0	0.00	0.00
#47		29.270	29.270	17.32	0.98	6.5	9,199	3.61	1.92
#53		0.000	80.670	17.35	0.99	17.7	138,605	83.83	3.95
#43		6.207	6.207	3.27	0.19	8.3	61,702	29.13	15.27
#44	In	0.000	6.207	3.27	0.19	8.3	61,702	29.13	15.27
	Out			0.00	0.00	8.3	0	0.00	0.00
#45		0.000	6.207	0.00	0.00	8.3	1	0.00	0.00
#40		12.150	12.150	8.67	0.64	398.3	599,843	267.95	166.27
#41	In	0.000	12.150	8.67	0.64	398.3	599,843	267.95	166.27
	Out			0.00	0.00	398.3	0	0.00	0.00

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#38		66.380	66.380	30.82	2.19	23.3	14,266	6.15	3.35
#39		0.000	66.380	30.82	2.19	23.3	14,266	6.15	3.35
#42		0.000	78.530	30.82	2.19	421.6	14,266	11.08	6.05
#46		0.000	84.737	30.82	2.19	429.9	14,266	11.09	6.06
#33		14.130	14.130	10.93	0.74	493.4	631,974	291.89	180.92
#34	In	0.000	14.130	10.93	0.74	493.4	631,974	291.89	180.92
	Out			0.08	0.01	0.0	0	0.00	0.00
#35		0.000	14.130	0.08	0.01	0.0	0	0.00	0.00
#36		0.000	14.130	0.08	0.01	0.0	0	0.00	0.00
#37		0.000	14.130	0.08	0.01	0.0	0	0.00	0.00
#30		282.150	282.150	65.84	9.27	83.5	11,122	1.38	0.82
#31		0.000	282.150	65.84	9.27	83.5	11,122	1.38	0.82
#32		0.000	282.150	65.06	9.27	83.5	11,234	1.40	0.82
#18		1,500.640	1,500.640	96.95	24.59	184.0	9,178	1.67	1.01
#19		418.020	1,918.660	169.37	38.31	291.3	9,237	1.69	1.02
#3		3,978.700	3,978.700	408.84	103.03	2,245.7	25,890	5.90	3.63
#4		3,216.100	7,194.800	587.18	213.10	4,767.8	41,928	7.86	3.07
#1		8,477.899	8,477.899	906.51	267.99	4,464.9	33,833	7.15	2.58
#2		3,838.900	12,316.800	1,064.62	462.56	7,348.4	33,857	4.72	1.63
#5		5,494.300	25,005.900	1,662.11	956.37	15,938.8	27,400	4.14	1.89
#6		3,036.900	28,042.800	1,673.45	1,093.40	15,130.2	23,312	1.71	0.77
#11	In	53.960	30,311.700	1,687.28	1,145.06	15,592.0	23,037	1.79	0.80
	Out			1,096.78	1,140.76	9,850.2	17,193	0.71	0.30
#17		0.000	30,477.110	1,093.09	1,143.94	10,297.8	599,615	43.84	0.60
#27		43.270	35,262.350	1,132.11	1,319.33	11,566.1	40,935	3.73	0.71
#22		519.990	35,782.340	1,135.09	1,345.28	11,723.9	30,054	2.35	0.61
#23		233.290	36,015.630	1,136.37	1,356.51	11,907.2	30,157	2.39	0.62
#24		1,164.140	37,179.770	1,142.58	1,410.50	12,362.6	30,133	2.50	0.66
#25		648.980	37,828.750	1,145.21	1,438.85	12,804.7	36,846	2.89	0.65

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#65	In	22.110	22.110	6.32	0.29	5.5	21,291	10.07	6.51
	Out			0.00	0.00	5.5	0	0.00	0.00
#61		34.787	34.787	7.22	0.31	6.1	22,829	10.73	6.70
#59		41.030	41.030	6.19	0.36	6.1	19,007	7.72	5.03
#60		0.000	41.030	6.19	0.36	6.1	19,007	7.72	5.03
#62		0.000	75.817	12.57	0.67	12.2	20,441	8.96	5.81
#63		0.000	75.817	11.60	0.67	12.2	21,524	9.43	5.81
#57		4.740	4.740	1.02	0.02	0.9	53,841	30.91	16.47
#58	In	0.000	4.740	1.02	0.02	0.9	53,841	30.91	16.47
	Out			0.00	0.00	0.9	0	0.00	0.00
#55		4.870	4.870	2.75	0.08	36.6	436,591	250.68	165.78
#56	In	0.000	4.870	2.75	0.08	36.6	436,591	250.68	165.78
	Out			0.00	0.00	0.0	0	0.00	0.00
#54		42.850	42.850	8.34	0.38	7.4	22,728	10.41	6.54
#64		0.000	128.277	18.06	1.05	20.5	21,590	9.17	5.83
#29		286.550	286.550	49.77	2.53	69.4	31,288	13.75	8.79
#20		1,855.800	1,855.800	54.20	10.99	65.2	5,658	0.89	0.70
#21	In	2,370.300	4,226.100	162.71	37.28	239.2	6,566	1.11	0.80
	Out			92.99	24.47	114.5	5,806	0.21	0.12
#26	In	13.260	4,239.359	93.16	24.84	114.7	5,346	0.19	0.12
	Out			29.96	12.02	46.8	4,317	0.00	0.00
#28		65.680	4,305.040	29.96	12.59	26.9	23,911	3.86	0.25
#51	In	4.820	4.820	1.04	0.02	1.2	71,415	35.61	19.01
	Out			0.00	0.00	1.2	0	0.00	0.00
#52		0.200	5.020	0.11	0.00	1.9	210,483	145.95	110.40
#48	In	8.810	8.810	0.31	0.03	0.9	26,749	1.75	1.24
	Out			0.00	0.00	0.9	0	0.00	0.00
#49		37.570	46.380	5.42	0.49	224.9	401,377	69.70	50.82
#50	In	0.000	46.380	5.42	0.49	224.9	401,377	69.70	50.82
	Out			0.00	0.00	224.9	0	0.00	0.00
#47		29.270	29.270	3.37	0.15	0.9	7,351	2.39	1.45
#53		0.000	80.670	3.39	0.15	227.7	156,654	1.03	0.05
#43		6.207	6.207	0.54	0.02	1.0	48,118	19.71	11.74
#44	In	0.000	6.207	0.54	0.02	1.0	48,118	19.71	11.74
	Out			0.00	0.00	1.0	0	0.00	0.00
#45		0.000	6.207	0.00	0.00	1.0	1	0.00	0.00
#40		12.150	12.150	2.67	0.16	95.2	520,826	209.52	146.59
#41	In	0.000	12.150	2.67	0.16	95.2	520,826	209.52	146.59
	Out			0.00	0.00	95.2	0	0.00	0.00

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#38		66.380	66.380	5.58	0.34	3.1	10,650	3.76	2.40
#39		0.000	66.380	5.58	0.34	3.1	10,650	3.76	2.40
#42		0.000	78.530	5.58	0.34	98.3	11,344	8.89	5.33
#46		0.000	84.737	5.58	0.34	99.3	11,171	8.76	5.33
#33		14.130	14.130	3.45	0.19	119.4	558,668	237.05	164.67
#34	In	0.000	14.130	3.45	0.19	119.4	558,668	237.05	164.67
	Out			0.00	0.00	0.0	0	0.00	0.00
#35		0.000	14.130	0.00	0.00	0.0	1	0.00	0.00
#36		0.000	14.130	0.00	0.00	0.0	1	0.00	0.00
#37		0.000	14.130	0.00	0.00	0.0	1	0.00	0.00
#30		282.150	282.150	11.39	1.43	11.0	7,833	0.50	0.36
#31		0.000	282.150	11.39	1.43	11.0	7,833	0.50	0.36
#32		0.000	282.150	11.18	1.43	11.0	7,860	0.50	0.36
#18		1,500.640	1,500.640	4.02	1.00	4.9	4,435	1.74	1.43
#19		418.020	1,918.660	15.62	3.12	17.6	6,116	0.55	0.37
#3		3,978.700	3,978.700	53.77	11.55	213.2	18,376	2.13	1.57
#4		3,216.100	7,194.800	93.51	29.65	571.1	29,096	3.32	1.60
#1		8,477.899	8,477.899	151.06	42.61	686.7	27,122	3.75	1.63
#2		3,838.900	12,316.800	322.91	91.74	1,620.4	29,197	3.39	1.50
#5		5,494.300	25,005.900	407.88	194.49	2,449.0	16,101	1.31	0.75
#6		3,036.900	28,042.800	403.97	227.92	2,287.2	12,881	0.66	0.38
#11	In	53.960	30,311.700	404.23	233.63	2,341.6	17,868	1.01	0.42
	Out			184.65	233.63	1,216.5	17,024	0.09	0.02
#17		0.000	30,477.110	184.35	234.13	1,543.5	922,984	50.52	0.23
#27		43.270	35,262.350	187.95	250.67	1,672.5	72,973	5.81	0.34
#22		519.990	35,782.340	187.94	256.95	1,700.4	40,418	2.09	0.23
#23		233.290	36,015.630	187.93	259.57	1,714.9	35,429	1.45	0.18
#24		1,164.140	37,179.770	187.87	271.72	1,787.9	23,825	1.30	0.25
#25		648.980	37,828.750	187.80	277.75	1,862.8	29,376	1.29	0.21

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#65	In	22.110	22.110	14.50	0.69	14.2	22,248	10.89	7.32
	Out			0.00	0.00	14.2	0	0.00	0.00
#61		34.787	34.787	19.30	0.85	18.5	24,315	11.98	7.83
#59		41.030	41.030	17.36	0.98	19.1	21,209	9.41	6.29
#60		0.000	41.030	17.36	0.98	19.1	21,209	9.41	6.29
#62		0.000	75.817	34.68	1.83	37.5	22,389	10.48	7.01
#63		0.000	75.817	33.30	1.83	37.5	23,295	10.90	7.01
#57		4.740	4.740	3.23	0.09	3.7	49,899	28.65	17.54
#58	In	0.000	4.740	3.23	0.09	3.7	49,899	28.65	17.54
	Out			0.00	0.00	3.7	0	0.00	0.00
#55		4.870	4.870	5.73	0.19	89.7	423,153	242.96	170.62
#56	In	0.000	4.870	5.73	0.19	89.7	423,153	242.96	170.62
	Out			0.00	0.00	89.7	0	0.00	0.00
#54		42.850	42.850	22.43	1.03	22.6	24,340	11.75	7.71
#64		0.000	128.277	51.53	2.86	153.4	24,387	4.39	2.76
#29		286.550	286.550	136.29	6.90	214.1	34,056	15.93	10.56
#20		1,855.800	1,855.800	184.80	34.40	254.4	7,291	1.32	1.00
#21	In	2,370.300	4,226.100	431.15	100.44	723.5	7,461	1.48	1.05
	Out			381.77	87.63	523.3	6,327	0.35	0.24
#26	In	13.260	4,239.359	382.17	88.38	523.6	6,250	0.35	0.24
	Out			301.48	75.56	413.2	5,566	0.26	0.19
#28		65.680	4,305.040	302.18	77.12	362.3	25,264	1.85	0.25
#51	In	4.820	4.820	3.28	0.09	5.0	66,221	33.02	20.24
	Out			0.00	0.00	5.0	0	0.00	0.00
#52		0.200	5.020	0.24	0.01	6.5	197,117	142.42	106.45
#48	In	8.810	8.810	1.37	0.13	4.3	34,541	4.54	3.18
	Out			0.00	0.00	4.3	0	0.00	0.00
#49		37.570	46.380	13.35	1.17	606.9	442,194	102.22	75.49
#50	In	0.000	46.380	13.35	1.17	606.9	442,194	102.22	75.49
	Out			0.00	0.00	606.9	0	0.00	0.00
#47		29.270	29.270	11.82	0.51	3.7	8,305	3.13	1.99
#53		0.000	80.670	11.85	0.52	617.0	132,686	1.24	0.07
#43		6.207	6.207	2.16	0.09	4.5	55,263	25.31	15.97
#44	In	0.000	6.207	2.16	0.09	4.5	55,263	25.31	15.97
	Out			0.00	0.00	4.5	0	0.00	0.00
#45		0.000	6.207	0.00	0.00	4.5	1	0.00	0.00
#40		12.150	12.150	6.37	0.38	251.5	555,059	239.20	171.36
#41	In	0.000	12.150	6.37	0.38	251.5	555,059	239.20	171.36
	Out			0.00	0.00	251.5	0	0.00	0.00

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#38		66.380	66.380	20.57	1.14	12.8	12,672	5.21	3.41
#39		0.000	66.380	20.57	1.14	12.8	12,672	5.21	3.41
#42		0.000	78.530	20.57	1.14	264.3	13,364	10.40	6.46
#46		0.000	84.737	20.57	1.14	268.8	14,579	11.36	6.47
#33		14.130	14.130	8.09	0.44	312.9	588,177	263.81	188.54
#34	In	0.000	14.130	8.09	0.44	312.9	588,177	263.81	188.54
	Out			0.00	0.00	312.9	0	0.00	0.00
#35		0.000	14.130	0.00	0.00	312.9	1	0.00	0.00
#36		0.000	14.130	0.00	0.00	312.9	1	0.00	0.00
#37		0.000	14.130	0.00	0.00	312.9	1	0.00	0.00
#30		282.150	282.150	42.61	4.81	45.3	9,707	0.84	0.61
#31		0.000	282.150	42.61	4.81	45.3	9,707	0.84	0.61
#32		0.000	282.150	41.98	4.81	45.3	9,807	0.85	0.60
#18		1,500.640	1,500.640	49.46	9.64	74.3	7,586	0.90	0.68
#19		418.020	1,918.660	96.11	16.75	132.6	7,907	1.01	0.74
#3		3,978.700	3,978.700	247.93	49.23	1,124.5	22,446	4.24	3.16
#4		3,216.100	7,194.800	369.85	107.27	2,525.4	36,423	5.92	2.79
#1		8,477.899	8,477.899	580.46	139.16	2,498.1	30,803	5.48	2.33
#2		3,838.900	12,316.800	770.34	255.55	4,475.9	30,982	3.98	1.64
#5		5,494.300	25,005.900	1,125.36	532.11	8,684.9	22,482	2.34	1.24
#6		3,036.900	28,042.800	1,116.62	612.70	8,154.3	18,867	1.17	0.60
#11	In	53.960	30,311.700	1,117.70	636.81	8,704.7	18,800	1.20	0.61
	Out			574.13	636.81	4,732.0	16,763	0.36	0.13
#17		0.000	30,477.110	572.34	638.46	5,617.8	676,173	37.70	0.34
#27		43.270	35,262.350	578.40	726.38	6,382.9	52,872	4.02	0.46
#22		519.990	35,782.340	578.28	741.72	6,419.1	34,568	1.85	0.33
#23		233.290	36,015.630	578.22	748.30	6,445.5	34,504	1.54	0.27
#24		1,164.140	37,179.770	577.87	779.51	6,597.9	26,840	1.68	0.39
#25		648.980	37,828.750	577.39	795.62	6,799.3	32,954	1.73	0.34

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#65	In	22.110	22.110	20.41	0.99	21.0	22,572	11.18	7.64
	Out			0.00	0.00	21.0	0	0.00	0.00
#61		34.787	34.787	28.43	1.27	28.8	24,749	12.37	8.24
#59		41.030	41.030	25.94	1.48	30.0	21,871	9.94	6.74
#60		0.000	41.030	25.94	1.48	30.0	21,871	9.94	6.74
#62		0.000	75.817	52.41	2.75	58.8	23,433	11.18	7.44
#63		0.000	75.817	50.21	2.75	58.8	25,033	11.94	7.44
#57		4.740	4.740	4.92	0.14	6.1	48,671	27.95	17.84
#58	In	0.000	4.740	4.92	0.14	6.1	48,671	27.95	17.84
	Out			0.00	0.00	6.1	0	0.00	0.00
#55		4.870	4.870	7.80	0.27	130.6	417,902	239.95	172.68
#56	In	0.000	4.870	7.80	0.27	130.6	417,902	239.95	172.68
	Out			0.80	0.08	0.0	409	0.00	0.00
#54		42.850	42.850	33.09	1.55	35.2	24,809	12.16	8.13
#64		0.000	128.277	78.06	4.38	100.2	23,499	10.62	7.08
#29		286.550	286.550	201.95	10.38	335.4	34,844	16.60	11.19
#20		1,855.800	1,855.800	297.11	53.97	431.5	7,932	1.68	1.27
#21	In	2,370.300	4,226.100	643.10	150.71	1,138.9	7,846	1.64	1.16
	Out			603.19	137.90	885.2	6,585	0.39	0.28
#26	In	13.260	4,239.359	603.70	138.91	885.6	6,552	0.39	0.28
	Out			557.93	126.09	763.7	6,012	0.32	0.24
#28		65.680	4,305.040	559.18	128.45	742.4	26,205	2.08	0.34
#51	In	4.820	4.820	5.00	0.15	8.3	64,602	32.21	20.59
	Out			0.00	0.00	8.3	0	0.00	0.00
#52		0.200	5.020	0.32	0.01	10.5	193,993	141.43	107.92
#48	In	8.810	8.810	2.33	0.21	7.6	37,248	6.37	4.48
	Out			0.00	0.00	7.6	0	0.00	0.00
#49		37.570	46.380	19.32	1.69	916.2	457,963	114.76	85.32
#50	In	0.000	46.380	19.32	1.69	916.2	457,963	114.76	85.32
	Out			0.00	0.00	916.2	0	0.00	0.00
#47		29.270	29.270	18.61	0.81	6.1	8,528	3.32	2.16
#53		0.000	80.670	18.65	0.82	932.8	120,297	1.24	0.08
#43		6.207	6.207	3.52	0.15	7.8	57,039	26.80	17.29
#44	In	0.000	6.207	3.52	0.15	7.8	57,039	26.80	17.29
	Out			0.00	0.00	7.8	0	0.00	0.00
#45		0.000	6.207	0.00	0.00	7.8	1	0.00	0.00
#40		12.150	12.150	9.18	0.55	378.3	571,908	253.17	182.70
#41	In	0.000	12.150	9.18	0.55	378.3	571,908	253.17	182.70
	Out			0.00	0.00	378.3	0	0.00	0.00

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#38		66.380	66.380	32.98	1.81	21.8	13,240	5.66	3.76
#39		0.000	66.380	32.98	1.81	21.8	13,240	5.66	3.76
#42		0.000	78.530	32.98	1.81	400.1	13,240	10.29	6.83
#46		0.000	84.737	32.98	1.81	407.8	13,240	10.29	6.83
#33		14.130	14.130	11.61	0.64	469.4	603,488	276.83	199.62
#34	In	0.000	14.130	11.61	0.64	469.4	603,488	276.83	199.62
	Out			0.00	0.00	469.4	0	0.00	0.00
#35		0.000	14.130	0.00	0.00	469.4	1	0.00	0.00
#36		0.000	14.130	0.00	0.00	469.4	1	0.00	0.00
#37		0.000	14.130	0.00	0.00	469.4	1	0.00	0.00
#30		282.150	282.150	69.69	7.68	77.6	10,391	1.20	0.87
#31		0.000	282.150	69.69	7.68	77.6	10,391	1.20	0.87
#32		0.000	282.150	68.89	7.68	77.6	10,501	1.22	0.86
#18		1,500.640	1,500.640	105.10	19.01	166.6	8,761	1.55	1.15
#19		418.020	1,918.660	181.83	30.38	266.3	8,788	1.55	1.13
#3		3,978.700	3,978.700	435.68	83.60	2,070.6	24,176	5.35	4.02
#4		3,216.100	7,194.800	626.52	175.22	4,432.4	39,287	7.16	3.36
#1		8,477.899	8,477.899	964.91	222.07	4,174.9	32,024	6.54	2.80
#2		3,838.900	12,316.800	1,115.80	389.57	6,869.7	31,842	4.28	1.73
#5		5,494.300	25,005.900	1,715.48	806.96	14,674.4	25,413	3.45	1.80
#6		3,036.900	28,042.800	1,702.17	924.31	13,785.3	21,712	1.43	0.72
#11	In	53.960	30,311.700	1,703.88	965.92	14,682.7	21,619	1.47	0.73
	Out			1,104.21	965.92	8,718.8	16,794	0.55	0.23
#17		0.000	30,477.110	1,099.88	968.56	10,059.4	543,377	32.87	0.45
#27		43.270	35,262.350	1,108.41	1,113.33	11,291.4	32,424	2.59	0.58
#22		519.990	35,782.340	1,108.13	1,135.60	11,376.7	28,157	1.77	0.45
#23		233.290	36,015.630	1,107.98	1,145.22	11,430.1	27,634	1.56	0.41
#24		1,164.140	37,179.770	1,107.18	1,191.28	11,736.3	28,102	1.98	0.51
#25		648.980	37,828.750	1,105.95	1,215.35	12,087.7	34,508	2.19	0.47

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#65	In	22.110	22.110	25.58	1.26	27.2	22,883	11.43	7.88
	Out			0.00	0.00	27.2	0	0.00	0.00
#61		34.787	34.787	36.38	1.66	38.3	24,999	12.60	8.50
#59		41.030	41.030	33.78	1.92	40.3	22,475	10.40	7.08
#60		0.000	41.030	33.78	1.92	40.3	22,475	10.40	7.08
#62		0.000	75.817	68.07	3.58	78.6	23,500	11.34	7.73
#63		0.000	75.817	65.13	3.58	78.6	24,288	11.72	7.73
#57		4.740	4.740	6.40	0.20	8.5	48,003	27.56	18.03
#58	In	0.000	4.740	6.40	0.20	8.5	48,003	27.56	18.03
	Out			0.15	0.02	0.0	0	0.00	0.00
#55		4.870	4.870	9.53	0.35	166.8	414,733	238.13	174.02
#56	In	0.000	4.870	9.53	0.35	166.8	414,733	238.13	174.02
	Out			2.38	0.15	1.0	9,388	0.00	0.00
#54		42.850	42.850	42.39	2.02	46.9	25,081	12.41	8.39
#64		0.000	128.277	102.65	5.77	126.5	23,526	11.37	7.73
#29		286.550	286.550	260.53	13.50	448.1	35,467	17.10	11.64
#20		1,855.800	1,855.800	400.93	71.89	602.4	8,341	1.92	1.42
#21	In	2,370.300	4,226.100	832.46	195.77	1,526.0	8,092	1.74	1.23
	Out			793.46	182.95	1,224.0	6,792	0.57	0.41
#26	In	13.260	4,239.359	794.06	184.19	1,224.6	6,771	0.57	0.41
	Out			748.54	171.37	1,083.9	6,264	0.35	0.26
#28		65.680	4,305.040	750.34	174.44	1,072.5	26,971	2.19	0.37
#51	In	4.820	4.820	6.51	0.20	11.5	63,721	31.77	20.81
	Out			0.00	0.00	11.5	0	0.00	0.00
#52		0.200	5.020	0.39	0.01	14.3	190,830	139.84	105.31
#48	In	8.810	8.810	3.24	0.29	10.9	38,927	7.54	5.29
	Out			0.00	0.00	10.9	0	0.00	0.00
#49		37.570	46.380	24.61	2.14	1,198.6	469,145	123.54	90.98
#50	In	0.000	46.380	24.61	2.14	1,198.6	469,145	123.54	90.98
	Out			0.00	0.00	0.0	0	0.00	0.00
#47		29.270	29.270	24.69	1.09	8.5	8,646	3.43	2.26
#53		0.000	80.670	24.74	1.11	22.8	127,830	77.62	4.54
#43		6.207	6.207	4.75	0.21	10.9	57,949	27.60	18.06
#44	In	0.000	6.207	4.75	0.21	10.9	57,949	27.60	18.06
	Out			0.00	0.00	10.9	0	0.00	0.00
#45		0.000	6.207	0.00	0.00	10.9	1	0.00	0.00
#40		12.150	12.150	11.62	0.69	492.7	581,919	261.56	189.76
#41	In	0.000	12.150	11.62	0.69	492.7	581,919	261.56	189.76
	Out			0.00	0.00	492.7	0	0.00	0.00
#38		66.380	66.380	44.15	2.44	30.2	13,536	5.90	3.96

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#39		0.000	66.380	44.15	2.44	30.2	13,536	5.90	3.96
#42		0.000	78.530	44.15	2.44	522.9	13,536	10.51	7.05
#46		0.000	84.737	44.15	2.44	533.8	13,536	10.51	7.06
#33		14.130	14.130	14.64	0.81	610.2	612,556	284.48	206.42
#34	In	0.000	14.130	14.64	0.81	610.2	612,556	284.48	206.42
	Out			0.72	0.08	0.0	1	0.00	0.00
#35		0.000	14.130	0.72	0.08	0.0	1	0.00	0.00
#36		0.000	14.130	0.72	0.08	0.0	1	0.00	0.00
#37		0.000	14.130	0.72	0.08	0.0	1	0.00	0.00
#30		282.150	282.150	94.99	10.33	109.0	10,841	1.45	1.04
#31		0.000	282.150	94.99	10.33	109.0	10,841	1.45	1.04
#32		0.000	282.150	93.83	10.33	109.0	10,944	1.47	1.04
#18		1,500.640	1,500.640	162.86	28.46	267.0	9,426	1.95	1.42
#19		418.020	1,918.660	267.14	43.74	406.9	9,341	1.89	1.38
#3		3,978.700	3,978.700	618.30	116.20	3,026.7	25,296	6.09	4.57
#4		3,216.100	7,194.800	870.12	238.63	6,310.5	41,077	7.97	3.74
#1		8,477.899	8,477.899	1,327.01	298.86	5,794.0	32,830	7.28	3.14
#2		3,838.900	12,316.800	1,467.02	511.26	9,229.0	32,788	4.57	1.84
#5		5,494.300	25,005.900	2,252.56	1,056.00	20,349.1	27,193	4.27	2.21
#6		3,036.900	28,042.800	2,235.28	1,206.07	19,139.2	23,194	1.73	0.87
#11	In	53.960	30,311.700	2,237.69	1,264.63	19,760.5	23,080	1.84	0.91
	Out			1,769.01	1,264.63	12,771.6	16,847	0.72	0.34
#17		0.000	30,477.110	1,758.49	1,268.18	13,328.2	494,053	36.10	0.59
#27		43.270	35,262.350	1,770.54	1,463.91	15,035.3	38,387	3.49	0.72
#22		519.990	35,782.340	1,769.80	1,492.28	15,247.3	28,908	2.30	0.62
#23		233.290	36,015.630	1,769.36	1,504.58	15,469.4	28,832	2.31	0.63
#24		1,164.140	37,179.770	1,767.05	1,563.81	16,065.4	29,094	2.43	0.67
#25		648.980	37,828.750	1,763.67	1,594.99	16,624.2	35,538	2.82	0.65

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#65	In	22.110	22.110	31.43	1.56	34.5	23,207	11.69	8.11
	Out			0.00	0.00	34.5	0	0.00	0.00
#61		34.787	34.787	45.37	2.10	49.5	25,206	12.79	8.72
#59		41.030	41.030	42.70	2.43	52.5	22,975	10.78	7.38
#60		0.000	41.030	42.70	2.43	52.5	22,975	10.78	7.38
#62		0.000	75.817	85.93	4.53	101.9	23,881	11.64	8.00
#63		0.000	75.817	82.12	4.53	101.9	25,727	12.54	8.00
#57		4.740	4.740	8.09	0.26	11.3	47,424	27.23	18.19
#58	In	0.000	4.740	8.09	0.26	11.3	47,424	27.23	18.19
	Out			0.79	0.08	0.0	37	0.00	0.00
#55		4.870	4.870	11.42	0.43	208.1	411,987	236.55	175.26
#56	In	0.000	4.870	11.42	0.43	208.1	411,987	236.55	175.26
	Out			6.51	0.24	4.4	21,773	0.00	0.00
#54		42.850	42.850	52.89	2.55	60.6	25,305	12.61	8.63
#64		0.000	128.277	130.32	7.40	166.9	24,006	11.48	7.87
#29		286.550	286.550	328.39	17.09	582.2	36,150	17.62	12.07
#20		1,855.800	1,855.800	523.14	92.86	810.4	8,707	2.14	1.57
#21	In	2,370.300	4,226.100	1,050.31	247.72	1,985.8	8,320	1.84	1.30
	Out			935.63	234.91	1,617.4	7,003	0.68	0.49
#26	In	13.260	4,239.359	936.13	236.40	1,618.1	6,985	0.68	0.49
	Out			893.76	223.58	1,460.0	6,499	0.38	0.28
#28		65.680	4,305.040	895.51	227.46	1,460.7	27,664	2.29	0.39
#51	In	4.820	4.820	8.22	0.26	15.3	62,958	31.39	21.00
	Out			0.00	0.00	15.3	0	0.00	0.00
#52		0.200	5.020	0.47	0.02	18.8	189,319	139.31	106.26
#48	In	8.810	8.810	4.31	0.38	14.9	40,364	8.52	5.99
	Out			0.00	0.00	14.9	0	0.00	0.00
#49		37.570	46.380	30.63	2.65	1,528.6	479,509	131.65	97.15
#50	In	0.000	46.380	30.63	2.65	1,528.6	479,509	131.65	97.15
	Out			1.72	0.46	0.0	8	0.00	0.00
#47		29.270	29.270	31.67	1.42	11.3	8,743	3.52	2.34
#53		0.000	80.670	31.73	1.90	30.1	107,557	65.62	3.89
#43		6.207	6.207	6.17	0.27	14.8	58,658	28.24	18.73
#44	In	0.000	6.207	6.17	0.27	14.8	58,658	28.24	18.73
	Out			0.00	0.00	14.8	0	0.00	0.00
#45		0.000	6.207	0.00	0.00	14.8	1	0.00	0.00
#40		12.150	12.150	14.35	0.86	625.1	590,405	268.72	195.96
#41	In	0.000	12.150	14.35	0.86	625.1	590,405	268.72	195.96
	Out			0.00	0.00	625.1	0	0.00	0.00

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#38		66.380	66.380	57.12	3.17	40.5	13,797	6.11	4.13
#39		0.000	66.380	57.12	3.17	40.5	13,797	6.11	4.13
#42		0.000	78.530	57.12	3.17	665.6	13,797	10.70	7.24
#46		0.000	84.737	57.12	3.17	680.4	13,797	10.70	7.25
#33		14.130	14.130	18.03	1.00	773.3	620,237	291.06	212.45
#34	In	0.000	14.130	18.03	1.00	773.3	620,237	291.06	212.45
	Out			3.87	0.27	0.0	96	0.00	0.00
#35		0.000	14.130	3.87	0.27	0.0	96	0.00	0.00
#36		0.000	14.130	3.87	0.27	0.0	96	0.00	0.00
#37		0.000	14.130	3.87	0.27	0.0	96	0.00	0.00
#30		282.150	282.150	124.81	13.44	147.1	11,236	1.71	1.22
#31		0.000	282.150	124.81	13.44	147.1	11,236	1.71	1.22
#32		0.000	282.150	123.20	13.44	147.1	11,332	1.72	1.22
#18		1,500.640	1,500.640	235.61	40.22	398.7	9,978	2.29	1.67
#19		418.020	1,918.660	372.40	60.11	587.7	9,822	2.20	1.60
#3		3,978.700	3,978.700	840.39	155.26	4,225.4	26,304	6.75	5.09
#4		3,216.100	7,194.800	1,161.81	313.80	8,625.0	42,641	8.68	4.07
#1		8,477.899	8,477.899	1,758.29	389.46	7,763.8	33,478	8.03	3.49
#2		3,838.900	12,316.800	1,925.66	652.91	12,204.1	33,903	4.93	1.98
#5		5,494.300	25,005.900	2,878.92	1,345.50	27,209.5	28,612	4.89	2.52
#6		3,036.900	28,042.800	2,856.64	1,533.12	25,357.1	24,271	2.06	1.02
#11	In	53.960	30,311.700	2,859.73	1,612.33	26,221.5	24,123	2.17	1.07
	Out			2,430.85	1,612.33	18,186.9	16,904	0.80	0.41
#17		0.000	30,477.110	2,422.72	1,617.40	18,897.4	441,354	32.75	0.66
#27		43.270	35,262.350	2,439.03	1,871.92	21,182.2	848,790	76.97	0.78
#22		519.990	35,782.340	2,438.42	1,907.22	21,442.8	29,452	2.37	0.69
#23		233.290	36,015.630	2,438.02	1,922.59	21,707.2	29,338	2.36	0.69
#24		1,164.140	37,179.770	2,436.00	1,996.90	22,681.7	29,909	2.55	0.74
#25		648.980	37,828.750	2,433.05	2,036.27	23,408.2	36,273	2.98	0.73

Attachment 41.C-4

No Name Arroyo Hydrology and Sedimentology SEDCAD™ Model Output
with Pinabete Diversion During Operations in Area 4 South and Area 5

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General Information

Storm Information:

Storm Type:	NRCS TYPE II-70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Particle Size Distribution:

Table 41.C-3

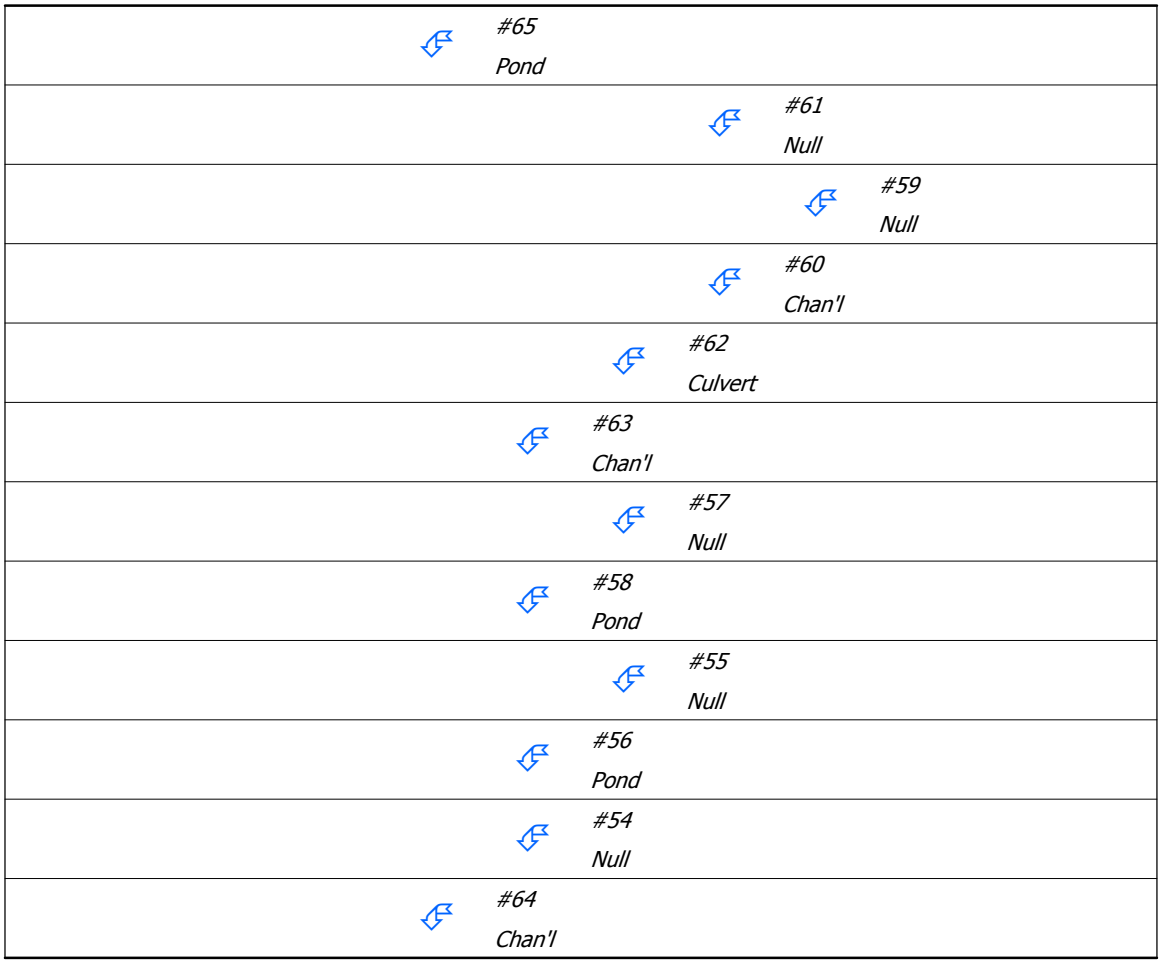
Structure details for the Pinabete Diversion are included in Attachment 41.C-3 for reference.

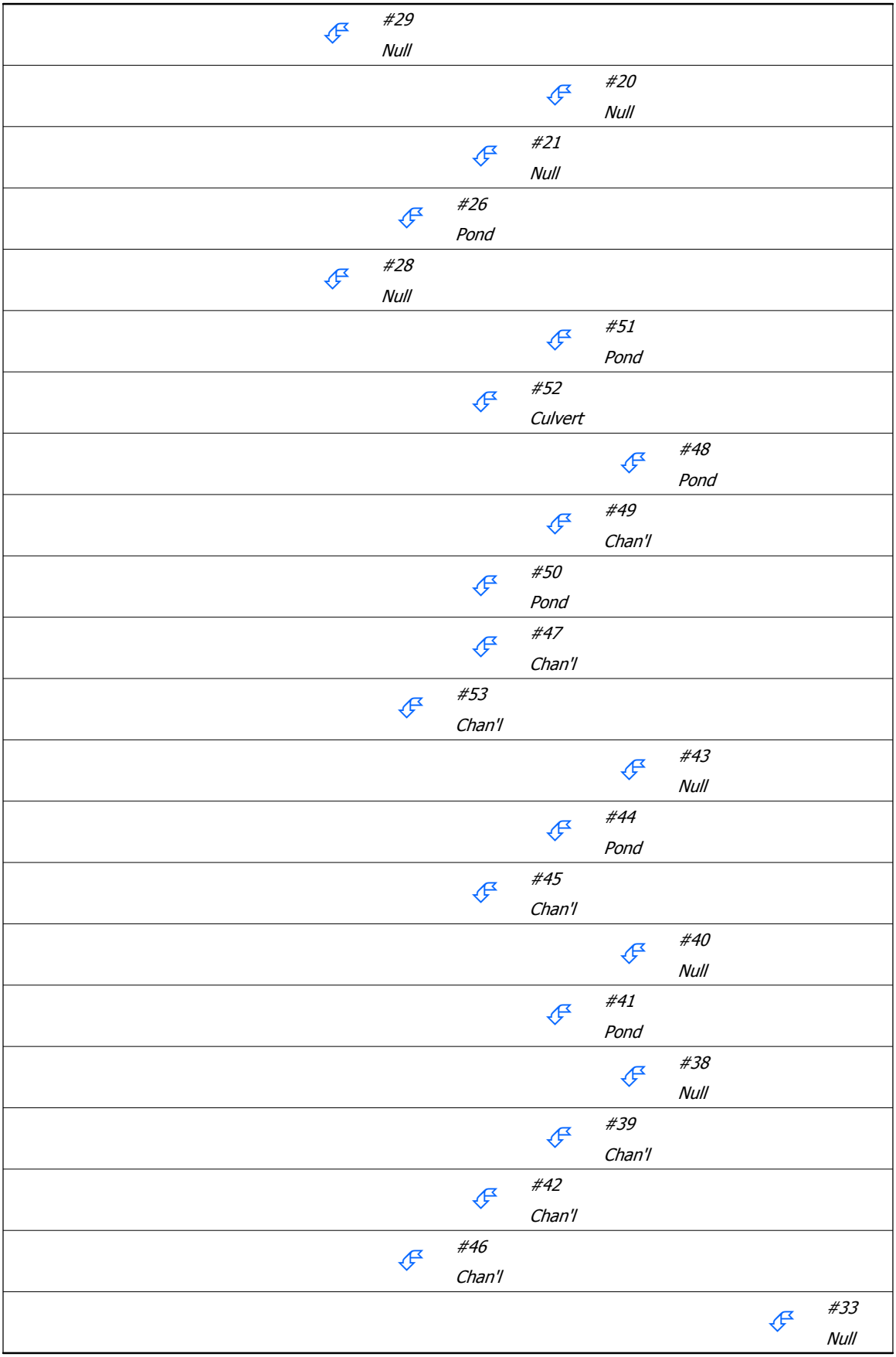
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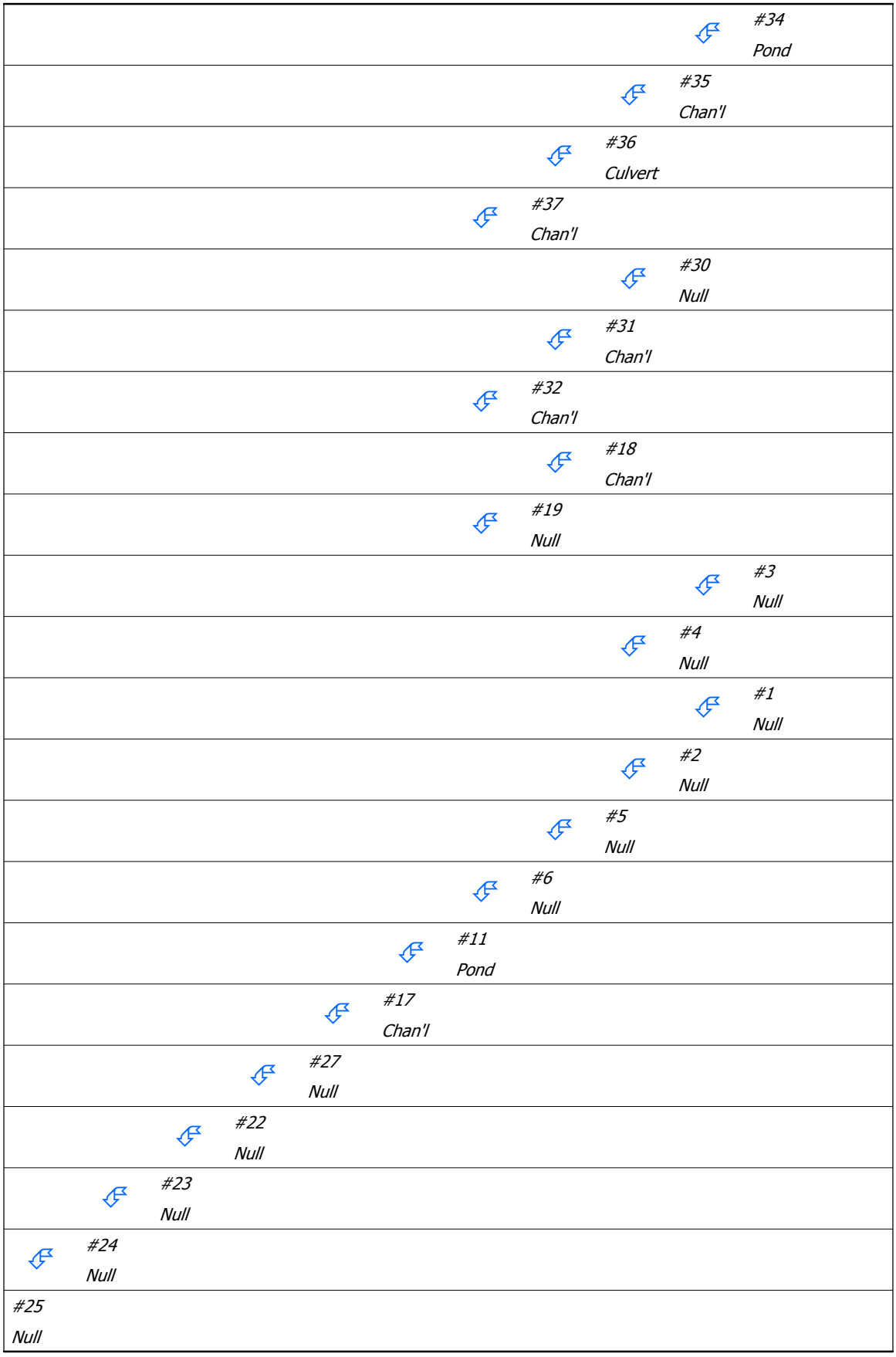
Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	1.674	0.331	Pinabete Headwaters
Null	#2	==>	#5	4.188	0.295	Upper Pinabete S Fk
Null	#3	==>	#4	1.961	0.319	Upper Pinabete N Fk
Null	#4	==>	#5	3.103	0.304	Pinabete
Null	#5	==>	#6	1.300	0.273	Mid Pinabete above Mine
Null	#6	==>	#11	0.000	0.000	EAST LEASE BNDY
Pond	#11	==>	#17	2.406	0.221	Sta:118+00 - U Shaped Impoundment
Channel	#17	==>	#27	0.264	0.305	Pinabete Diversion
Channel	#18	==>	#19	0.074	0.377	Upper East Diversion
Null	#19	==>	#11	0.576	0.245	Lower East Diversion
Null	#20	==>	#21	0.656	0.345	Upper NN (Orig NN S2 & S1)
Null	#21	==>	#26	0.000	0.000	NN Imp & Watersheds Unaffected by Mining (Portions of NN S3
Null	#22	==>	#23	0.096	0.358	NN S4
Null	#23	==>	#24	0.681	0.307	NN S5
Null	#24	==>	#25	1.027	0.307	NN S6
Null	#25	==>	End	0.000	0.000	NN S7
Pond	#26	==>	#28	0.063	0.380	Outlet of NN Impoundment Area
Null	#27	==>	#22	0.250	0.320	End of P Diversion, NN24C,S25SW1
Null	#28	==>	#27	0.241	0.246	NNSWS6A (Prior Drop Structure)
Null	#29	==>	#27	0.205	0.246	NNSWS6B (Prior Drop Structure)
Null	#30	==>	#31	0.000	0.000	WS5-1
Channel	#31	==>	#32	0.137	0.357	DD5-1
Channel	#32	==>	#11	0.000	0.000	Ramp Ditch 5
Null	#33	==>	#34	0.000	0.000	MS4-1 & WS4-1
Pond	#34	==>	#35	0.012	0.335	CB4-1
Channel	#35	==>	#36	0.005	0.357	DD4-1
Culvert	#36	==>	#37	0.026	0.412	C4-1
Channel	#37	==>	#11	0.000	0.000	DD4-2 Ramp Ditch 4
Null	#38	==>	#39	0.000	0.000	WS3-1
Channel	#39	==>	#42	0.025	0.306	DD3-1
Null	#40	==>	#41	0.000	0.000	MS3-1
Pond	#41	==>	#42	0.021	0.329	CB3-1
Channel	#42	==>	#46	0.026	0.412	DD3-2
Null	#43	==>	#44	0.000	0.000	TDS8
Pond	#44	==>	#45	0.043	0.318	CB3-2
Channel	#45	==>	#46	0.026	0.412	DD3-3
Channel	#46	==>	#17	0.000	0.000	DD3-4 Ramp Ditch 3
Channel	#47	==>	#53	0.000	0.000	WS2-1 & DD2-1
Pond	#48	==>	#49	0.679	0.173	TDS6 & CB2-3

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#49	==>	#50	0.000	0.000	MS2-1 & Ditch
Pond	#50	==>	#53	0.052	0.406	MS2-1 Berm and Spillway (CB2-1)
Pond	#51	==>	#52	0.067	0.210	TDS7 & Berm (CB2-2)
Culvert	#52	==>	#53	0.000	0.000	C2-1 & Material Stockpile 2
Channel	#53	==>	#17	0.000	0.000	Ramp Ditch-2
Null	#54	==>	#64	0.026	0.412	WS1-1
Null	#55	==>	#56	0.000	0.000	MS1-1
Pond	#56	==>	#64	0.026	0.412	CB1-1
Null	#57	==>	#58	0.000	0.000	TDS5
Pond	#58	==>	#64	0.026	0.412	CB1-2
Null	#59	==>	#60	0.000	0.000	WS1-2
Channel	#60	==>	#62	0.025	0.306	DD1-1
Null	#61	==>	#62	0.000	0.000	WS1-3
Culvert	#62	==>	#63	0.088	0.312	C1-1
Channel	#63	==>	#64	0.026	0.412	DD1-2
Channel	#64	==>	#27	0.663	0.201	Ramp Ditch 1
Pond	#65	==>	#27	0.000	0.000	WS1-3 & Pond 1-1




#29
Null
#20
Null
#21
Null
#26
Pond
#28
Null
#51
Pond
#52
Culvert
#48
Pond
#49
Chan'l
#50
Pond
#47
Chan'l
#53
Chan'l
#43
Null
#44
Pond
#45
Chan'l
#40
Null
#41
Pond
#38
Null
#39
Chan'l
#42
Chan'l
#46
Chan'l
#33
Null


#34
Pond
#35
Chan'l
#36
Culvert
#37
Chan'l
#30
Null
#31
Chan'l
#32
Chan'l
#18
Chan'l
#19
Null
#3
Null
#4
Null
#1
Null
#2
Null
#5
Null
#6
Null
#11
Pond
#17
Chan'l
#27
Null
#22
Null
#23
Null
#24
Null
#25
Null

Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	1.24	250.00	20,136.00	3.34	1.674
#1	**Muskingum K:**					**1.674**
#2	8. Large gullies, diversions, and low flowing streams	0.67	245.00	36,791.00	2.44	4.188
#2	**Muskingum K:**					**4.188**
#3	8. Large gullies, diversions, and low flowing streams	0.99	210.00	21,118.00	2.99	1.961
#3	**Muskingum K:**					**1.961**
#4	8. Large gullies, diversions, and low flowing streams	0.77	227.00	29,388.00	2.63	3.103
#4	**Muskingum K:**					**3.103**
#5	8. Large gullies, diversions, and low flowing streams	0.47	45.00	9,601.00	2.05	1.300
#5	**Muskingum K:**					**1.300**
#11	8. Large gullies, diversions, and low flowing streams	0.20	23.86	11,696.07	1.35	2.406
#11	**Muskingum K:**					**2.406**
#17	8. Large gullies, diversions, and low flowing streams	0.79	20.00	2,535.81	2.66	0.264
#17	**Muskingum K:**					**0.264**
#26	8. Large gullies, diversions, and low flowing streams	3.23	40.00	1,239.00	5.39	0.063
#26	**Muskingum K:**					**0.063**
#27	8. Large gullies, diversions, and low flowing streams	1.02	28.00	2,736.00	3.03	0.250
#27	**Muskingum K:**					**0.250**
#28	8. Large gullies, diversions, and low flowing streams	0.30	4.26	1,423.00	1.64	0.241
#28	**Muskingum K:**					**0.241**
#29	8. Large gullies, diversions, and low flowing streams	0.30	3.64	1,216.00	1.64	0.205
#29	**Muskingum K:**					**0.205**
#31	8. Large gullies, diversions, and low flowing streams	2.00	42.00	2,100.00	4.24	0.137
#31	**Muskingum K:**					**0.137**
#34	8. Large gullies, diversions, and low flowing streams	1.33	1.99	150.00	3.45	0.012
#34	**Muskingum K:**					**0.012**
#35	8. Large gullies, diversions, and low flowing streams	2.00	1.58	79.50	4.24	0.005
#35	**Muskingum K:**					**0.005**
#36	8. Large gullies, diversions, and low flowing streams	7.00	52.48	749.85	7.93	0.026
#36	**Muskingum K:**					**0.026**
#39	8. Large gullies, diversions, and low flowing streams	0.80	2.00	250.00	2.68	0.025
#39	**Muskingum K:**					**0.025**

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#41	8. Large gullies, diversions, and low flowing streams	1.20	3.00	250.00	3.28	0.021
#41	**Muskingum K:**					**0.021**
#42	8. Large gullies, diversions, and low flowing streams	7.00	53.20	760.00	7.93	0.026
#42	**Muskingum K:**					**0.026**
#44	8. Large gullies, diversions, and low flowing streams	0.98	4.50	460.00	2.96	0.043
#44	**Muskingum K:**					**0.043**
#45	8. Large gullies, diversions, and low flowing streams	7.00	53.20	760.00	7.93	0.026
#45	**Muskingum K:**					**0.026**
#48	8. Large gullies, diversions, and low flowing streams	0.09	1.98	2,202.63	0.90	0.679
#48	**Muskingum K:**					**0.679**
#50	8. Large gullies, diversions, and low flowing streams	6.00	82.50	1,375.00	7.34	0.052
#50	**Muskingum K:**					**0.052**
#51	8. Large gullies, diversions, and low flowing streams	0.17	0.51	300.12	1.23	0.067
#51	**Muskingum K:**					**0.067**
#54	8. Large gullies, diversions, and low flowing streams	7.00	52.50	750.00	7.93	0.026
#54	**Muskingum K:**					**0.026**
#56	8. Large gullies, diversions, and low flowing streams	7.00	52.50	750.00	7.93	0.026
#56	**Muskingum K:**					**0.026**
#58	8. Large gullies, diversions, and low flowing streams	7.00	52.50	750.00	7.93	0.026
#58	**Muskingum K:**					**0.026**
#60	8. Large gullies, diversions, and low flowing streams	0.80	2.00	250.00	2.68	0.025
#60	**Muskingum K:**					**0.025**
#62	8. Large gullies, diversions, and low flowing streams	0.89	8.01	900.00	2.83	0.088
#62	**Muskingum K:**					**0.088**
#63	8. Large gullies, diversions, and low flowing streams	7.00	52.50	750.00	7.93	0.026
#63	**Muskingum K:**					**0.026**
#64	8. Large gullies, diversions, and low flowing streams	0.15	4.00	2,725.00	1.14	0.663
#64	**Muskingum K:**					**0.663**

Particle Size Distribution(s) at Each Structure

Structure #65 (WS1-3 & Pond 1-1):

Size (mm)	In	Out
0.4250	100.000%	0.000%
0.2500	98.282%	0.000%
0.1500	70.594%	0.000%
0.0750	52.785%	0.000%
0.0159	46.453%	0.000%
0.0100	37.776%	0.000%
0.0050	9.840%	0.000%
0.0020	5.438%	0.000%
0.0010	4.895%	0.000%
0.0004	4.484%	0.000%

Structure #61 (WS1-3):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	72.340%
0.0750	54.091%
0.0159	47.602%
0.0100	38.710%
0.0050	10.084%
0.0020	5.573%
0.0010	5.016%
0.0004	4.595%

Structure #59 (WS1-2):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	83.064%
0.0750	62.109%
0.0159	54.659%

Size (mm)	In/Out
0.0100	44.448%
0.0050	11.578%
0.0020	6.399%
0.0010	5.759%
0.0004	5.276%

Structure #60 (DD1-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	83.064%
0.0750	62.109%
0.0159	54.659%
0.0100	44.448%
0.0050	11.578%
0.0020	6.399%
0.0010	5.759%
0.0004	5.276%

Structure #62 (C1-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	77.827%
0.0750	58.193%
0.0159	51.213%
0.0100	41.646%
0.0050	10.848%
0.0020	5.996%
0.0010	5.396%
0.0004	4.943%

Structure #63 (DD1-2):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	77.827%
0.0750	58.193%
0.0159	51.213%
0.0100	41.646%

Size (mm)	In/Out
0.0050	10.848%
0.0020	5.996%
0.0010	5.396%
0.0004	4.943%

Structure #57 (TDS5):

Size (mm)	In/Out
0.4250	100.000%
0.2500	75.578%
0.1500	54.286%
0.0750	40.591%
0.0159	35.722%
0.0100	29.049%
0.0050	7.567%
0.0020	4.182%
0.0010	3.764%
0.0004	3.448%

Structure #58 (CB1-2):

Size (mm)	In	Out
0.4250	100.000%	100.000%
0.2500	75.578%	100.000%
0.1500	54.286%	100.000%
0.0750	40.591%	100.000%
0.0159	35.722%	100.000%
0.0100	29.049%	100.000%
0.0050	7.567%	100.000%
0.0020	4.182%	100.000%
0.0010	3.764%	100.000%
0.0004	3.448%	100.000%

Structure #55 (MS1-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	98.282%
0.1500	70.594%
0.0750	52.785%
0.0159	46.453%
0.0100	37.776%
0.0050	9.840%

Size (mm)	In/Out
0.0020	5.438%
0.0010	4.895%
0.0004	4.484%

Structure #56 (CB1-1):

Size (mm)	In	Out
0.4250	100.000%	100.000%
0.2500	98.282%	100.000%
0.1500	70.594%	100.000%
0.0750	52.785%	100.000%
0.0159	46.453%	100.000%
0.0100	37.776%	100.000%
0.0050	9.840%	100.000%
0.0020	5.438%	100.000%
0.0010	4.895%	100.000%
0.0004	4.484%	100.000%

Structure #54 (WS1-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	74.655%
0.0750	55.821%
0.0159	49.125%
0.0100	39.949%
0.0050	10.406%
0.0020	5.751%
0.0010	5.176%
0.0004	4.742%

Structure #64 (Ramp Ditch 1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	76.640%
0.0750	57.306%
0.0159	50.432%
0.0100	41.011%
0.0050	10.683%
0.0020	5.904%

Size (mm)	In/Out
0.0010	5.314%
0.0004	4.868%

Structure #29 (NNSWS6B (Prior Drop Structure)):

Size (mm)	In/Out
0.4250	100.000%
0.2500	77.393%
0.1500	57.877%
0.0750	43.197%
0.0159	37.191%
0.0100	28.724%
0.0050	7.539%
0.0020	4.580%
0.0010	4.153%
0.0004	3.748%

Structure #20 (Upper NN (Orig NN S2 & S1)):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	82.613%
0.0159	69.188%
0.0100	48.543%
0.0050	18.210%
0.0020	11.794%
0.0010	10.629%
0.0004	10.018%

Structure #21 (NN Imp & Watersheds Unaffected by Mining (Portions of NN S3):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	97.817%
0.0750	86.709%
0.0159	76.473%
0.0100	54.787%
0.0050	17.658%

Size (mm)	In/Out
0.0020	11.378%
0.0010	10.185%
0.0004	9.566%

Structure #26 (Outlet of NN Impoundment Area):

Size (mm)	In	Out
0.4250	99.873%	100.000%
0.2500	99.873%	100.000%
0.1500	97.693%	100.000%
0.0750	86.599%	100.000%
0.0159	76.375%	100.000%
0.0100	54.717%	100.000%
0.0050	17.635%	38.696%
0.0020	11.364%	24.934%
0.0010	10.172%	22.319%
0.0004	9.554%	20.964%

Structure #28 (NNSWS6A (Prior Drop Structure)):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	100.000%
0.0050	38.696%
0.0020	24.934%
0.0010	22.319%
0.0004	20.964%

Structure #51 (TDS7 & Berm (CB2-2)):

Size (mm)	In	Out
0.4250	100.000%	0.000%
0.2500	85.529%	0.000%
0.1500	72.267%	0.000%
0.0750	58.134%	0.000%
0.0159	49.962%	0.000%
0.0100	38.953%	0.000%
0.0050	9.675%	0.000%
0.0020	6.279%	0.000%

Size (mm)	In	Out
0.0010	6.010%	0.000%
0.0004	4.942%	0.000%

Structure #52 (C2-1 & Material Stockpile 2):

Size (mm)	In/Out
0.4250	20.572%
0.2500	17.595%
0.1500	14.867%
0.0750	11.959%
0.0159	10.278%
0.0100	8.013%
0.0050	1.990%
0.0020	1.292%
0.0010	1.236%
0.0004	1.017%

Structure #48 (TDS6 & CB2-3):

Size (mm)	In	Out
0.4250	100.000%	0.000%
0.2500	100.000%	0.000%
0.1500	100.000%	0.000%
0.0750	100.000%	0.000%
0.0159	100.000%	0.000%
0.0100	82.507%	0.000%
0.0050	20.493%	0.000%
0.0020	13.300%	0.000%
0.0010	12.730%	0.000%
0.0004	10.468%	0.000%

Structure #49 (MS2-1 & Ditch):

Size (mm)	In/Out
0.4250	99.235%
0.2500	99.235%
0.1500	99.235%
0.0750	96.461%
0.0159	82.902%
0.0100	64.634%
0.0050	16.054%
0.0020	10.419%
0.0010	9.972%

Size (mm)	In/Out
0.0004	8.200%

Structure #50 (MS2-1 Berm and Spillway (CB2-1)):

Size (mm)	In	Out
0.4250	99.235%	100.000%
0.2500	99.235%	100.000%
0.1500	99.235%	100.000%
0.0750	96.461%	100.000%
0.0159	82.902%	100.000%
0.0100	64.634%	100.000%
0.0050	16.054%	100.000%
0.0020	10.419%	100.000%
0.0010	9.972%	100.000%
0.0004	8.200%	100.000%

Structure #47 (WS2-1 & DD2-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.298%
0.0750	79.878%
0.0159	68.650%
0.0100	53.523%
0.0050	13.294%
0.0020	8.628%
0.0010	8.258%
0.0004	6.791%

Structure #53 (Ramp Ditch-2):

Size (mm)	In/Out
0.4250	99.188%
0.2500	99.158%
0.1500	99.126%
0.0750	98.980%
0.0159	98.895%
0.0100	98.782%
0.0050	98.479%
0.0020	98.444%
0.0010	98.441%
0.0004	98.430%

Structure #43 (TDS8):

Size (mm)	In/Out
0.4250	100.000%
0.2500	74.981%
0.1500	55.996%
0.0750	43.350%
0.0159	38.049%
0.0100	30.667%
0.0050	9.285%
0.0020	5.349%
0.0010	4.948%
0.0004	4.425%

Structure #44 (CB3-2):

Size (mm)	In	Out
0.4250	100.000%	0.000%
0.2500	74.981%	0.000%
0.1500	55.996%	0.000%
0.0750	43.350%	0.000%
0.0159	38.049%	0.000%
0.0100	30.667%	0.000%
0.0050	9.285%	0.000%
0.0020	5.349%	0.000%
0.0010	4.948%	0.000%
0.0004	4.425%	0.000%

Structure #45 (DD3-3):

Size (mm)	In/Out
0.4250	0.000%
0.2500	0.000%
0.1500	0.000%
0.0750	0.000%
0.0159	0.000%
0.0100	0.000%
0.0050	0.000%
0.0020	0.000%
0.0010	0.000%
0.0004	0.000%

Structure #40 (MS3-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	83.569%
0.0750	64.696%
0.0159	56.784%
0.0100	45.767%
0.0050	13.857%
0.0020	7.983%
0.0010	7.384%
0.0004	6.604%

Structure #41 (CB3-1):

Size (mm)	In	Out
0.4250	100.000%	0.000%
0.2500	100.000%	0.000%
0.1500	83.569%	0.000%
0.0750	64.696%	0.000%
0.0159	56.784%	0.000%
0.0100	45.767%	0.000%
0.0050	13.857%	0.000%
0.0020	7.983%	0.000%
0.0010	7.384%	0.000%
0.0004	6.604%	0.000%

Structure #38 (WS3-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	79.641%
0.0750	61.655%
0.0159	54.115%
0.0100	43.616%
0.0050	13.206%
0.0020	7.608%
0.0010	7.037%
0.0004	6.294%

Structure #39 (DD3-1):

Size (mm)	In/Out
0.4250	100.000%

Size (mm)	In/Out
0.2500	100.000%
0.1500	79.641%
0.0750	61.655%
0.0159	54.115%
0.0100	43.616%
0.0050	13.206%
0.0020	7.608%
0.0010	7.037%
0.0004	6.294%

Structure #42 (DD3-2):

Size (mm)	In/Out
0.4250	6.020%
0.2500	6.020%
0.1500	4.795%
0.0750	3.712%
0.0159	3.258%
0.0100	2.626%
0.0050	0.795%
0.0020	0.458%
0.0010	0.424%
0.0004	0.379%

Structure #46 (DD3-4 Ramp Ditch 3):

Size (mm)	In/Out
0.4250	5.861%
0.2500	5.861%
0.1500	4.668%
0.0750	3.614%
0.0159	3.172%
0.0100	2.557%
0.0050	0.774%
0.0020	0.446%
0.0010	0.412%
0.0004	0.369%

Structure #33 (MS4-1 & WS4-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%

Size (mm)	In/Out
0.1500	79.892%
0.0750	61.849%
0.0159	54.285%
0.0100	43.754%
0.0050	13.247%
0.0020	7.632%
0.0010	7.059%
0.0004	6.313%

Structure #34 (CB4-1):

Size (mm)	In	Out
0.4250	100.000%	100.000%
0.2500	100.000%	100.000%
0.1500	79.892%	100.000%
0.0750	61.849%	100.000%
0.0159	54.285%	100.000%
0.0100	43.754%	100.000%
0.0050	13.247%	100.000%
0.0020	7.632%	100.000%
0.0010	7.059%	100.000%
0.0004	6.313%	100.000%

Structure #35 (DD4-1):

Size (mm)	In/Out
0.4250	0.000%
0.2500	0.000%
0.1500	0.000%
0.0750	0.000%
0.0159	0.000%
0.0100	0.000%
0.0050	0.000%
0.0020	0.000%
0.0010	0.000%
0.0004	0.000%

Structure #36 (C4-1):

Size (mm)	In/Out
0.4250	0.000%
0.2500	0.000%
0.1500	0.000%

Size (mm)	In/Out
0.0750	0.000%
0.0159	0.000%
0.0100	0.000%
0.0050	0.000%
0.0020	0.000%
0.0010	0.000%
0.0004	0.000%

Structure #37 (DD4-2 Ramp Ditch 4):

Size (mm)	In/Out
0.4250	0.000%
0.2500	0.000%
0.1500	0.000%
0.0750	0.000%
0.0159	0.000%
0.0100	0.000%
0.0050	0.000%
0.0020	0.000%
0.0010	0.000%
0.0004	0.000%

Structure #30 (WS5-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	90.075%
0.0050	22.373%
0.0020	14.520%
0.0010	13.898%
0.0004	11.428%

Structure #31 (DD5-1):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%

Size (mm)	In/Out
0.0159	100.000%
0.0100	90.075%
0.0050	22.373%
0.0020	14.520%
0.0010	13.898%
0.0004	11.428%

Structure #32 (Ramp Ditch 5):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	90.075%
0.0050	22.373%
0.0020	14.520%
0.0010	13.898%
0.0004	11.428%

Structure #18 (Upper East Diversion):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	96.761%
0.0100	79.890%
0.0050	39.147%
0.0020	21.687%
0.0010	20.140%
0.0004	18.801%

Structure #19 (Lower East Diversion):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	93.022%

Size (mm)	In/Out
0.0100	74.446%
0.0050	34.972%
0.0020	19.904%
0.0010	18.437%
0.0004	17.174%

Structure #3 (Upper Pinabete N Fk):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.560%
0.0750	92.307%
0.0159	88.922%
0.0100	74.573%
0.0050	28.753%
0.0020	15.986%
0.0010	14.496%
0.0004	13.676%

Structure #4 (Pinabete):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	97.216%
0.0159	92.116%
0.0100	79.769%
0.0050	31.270%
0.0020	17.739%
0.0010	16.190%
0.0004	15.037%

Structure #1 (Pinabete Headwaters):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	99.347%
0.0159	92.215%
0.0100	77.299%

Size (mm)	In/Out
0.0050	26.233%
0.0020	15.324%
0.0010	14.100%
0.0004	12.850%

Structure #2 (Upper Pinabete S Fk):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	96.444%
0.0100	87.040%
0.0050	30.725%
0.0020	18.505%
0.0010	17.274%
0.0004	15.211%

Structure #5 (Mid Pinabete above Mine):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	98.933%
0.0159	96.590%
0.0100	85.206%
0.0050	29.673%
0.0020	17.683%
0.0010	16.433%
0.0004	14.627%

Structure #6 (EAST LEASE BNDY):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	97.688%
0.0050	33.632%

Size (mm)	In/Out
0.0020	20.106%
0.0010	18.700%
0.0004	16.613%

Structure #11 (Sta:118+00 - U Shaped Impoundment):

Size (mm)	In	Out
0.4250	100.000%	100.000%
0.2500	100.000%	100.000%
0.1500	99.845%	100.000%
0.0750	99.766%	100.000%
0.0159	99.590%	100.000%
0.0100	96.884%	100.000%
0.0050	33.463%	52.881%
0.0020	19.995%	31.597%
0.0010	18.599%	29.391%
0.0004	16.531%	26.123%

Structure #17 (Pinabete Diversion):

Size (mm)	In/Out
0.4250	96.321%
0.2500	96.318%
0.1500	96.270%
0.0750	96.215%
0.0159	96.190%
0.0100	96.156%
0.0050	55.264%
0.0020	36.820%
0.0010	34.909%
0.0004	32.077%

Structure #27 (End of P Diversion, NN24C,S25SW1):

Size (mm)	In/Out
0.4250	96.265%
0.2500	96.260%
0.1500	96.004%
0.0750	95.709%
0.0159	95.595%
0.0100	95.436%
0.0050	54.327%
0.0020	36.167%

Size (mm)	In/Out
0.0010	34.261%
0.0004	31.489%

Structure #22 (NN S4):

Size (mm)	In/Out
0.4250	97.346%
0.2500	97.341%
0.1500	97.085%
0.0750	96.466%
0.0159	96.211%
0.0100	95.853%
0.0050	54.356%
0.0020	36.176%
0.0010	34.265%
0.0004	31.492%

Structure #23 (NN S5):

Size (mm)	In/Out
0.4250	98.315%
0.2500	98.310%
0.1500	97.884%
0.0750	96.851%
0.0159	96.417%
0.0100	95.816%
0.0050	54.043%
0.0020	35.949%
0.0010	34.046%
0.0004	31.285%

Structure #24 (NN S6):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.271%
0.0750	96.961%
0.0159	95.881%
0.0100	94.425%
0.0050	53.993%
0.0020	35.761%
0.0010	33.843%

Size (mm)	In/Out
0.0004	31.067%

Structure #25:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.293%
0.0750	97.797%
0.0159	97.132%
0.0100	95.226%
0.0050	53.291%
0.0020	35.202%
0.0010	33.296%
0.0004	30.553%

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#65	1	22.110	0.131	0.000	0.000	89.000	M	20.49	1.175
	Σ	**22.110**						**20.49**	**1.175**
#61	1	34.787	0.134	0.000	0.000	86.200	M	26.53	1.505
	Σ	**34.787**						**26.53**	**1.505**
#59	1	41.030	0.320	0.000	0.000	86.200	M	24.44	1.745
	Σ	**41.030**						**24.44**	**1.745**
#60	Σ	**41.030**						**24.44**	**1.745**
#62	Σ	**75.817**						**49.34**	**3.250**
#63	Σ	**75.817**						**47.25**	**3.250**
#57	1	4.740	0.107	0.000	0.000	81.500	M	4.51	0.174
	Σ	**4.740**						**4.51**	**0.174**
#58	Σ	**4.740**						**4.51**	**0.174**
#55	1	4.870	0.161	0.000	0.000	89.000	M	4.51	0.259
	Σ	**4.870**						**4.51**	**0.259**
#56	Σ	**4.870**						**4.51**	**0.259**
#54	1	42.850	0.194	0.000	0.000	86.200	M	30.89	1.830
	Σ	**42.850**						**30.89**	**1.830**
#64	Σ	**128.277**						**73.07**	**5.146**
#29	1	1.420	0.065	0.000	0.000	86.200	M	1.81	0.073
	Σ	**1.420**						**1.81**	**0.073**
#20	1	621.290	0.898	0.000	0.000	85.700	M	189.63	25.364
	Σ	**621.290**						**189.63**	**25.364**
#21	1	431.580	0.682	0.409	0.297	88.800	M	207.61	22.168
	2	151.300	0.348	0.193	0.261	87.000	M	92.73	6.841
	3	168.370	0.413	0.000	0.000	87.400	M	97.87	7.833
	Σ	**1,372.540**						**356.36**	**62.206**
#26	1	16.428	0.000	0.000	0.000	93.000	M	29.38	1.427
	Σ	**1,388.968**						**357.68**	**63.633**
#28	Σ	**1,388.968**						**225.69**	**50.820**
#51	1	4.820	0.035	0.000	0.000	81.500	M	4.59	0.177

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	Σ	**4.820**						**4.59**	**0.177**
#52	1	0.200	0.004	0.000	0.000	89.000	M	0.30	0.010
	Σ	**5.020**						**0.30**	**0.010**
#48	1	8.810	0.681	0.000	0.000	81.500	M	2.19	0.258
	Σ	**8.810**						**2.19**	**0.258**
#49	1	37.500	0.506	0.000	0.000	89.000	M	22.19	1.956
	Σ	**46.310**						**22.19**	**1.956**
#50	**Σ**	**46.310**						**22.19**	**1.956**
#47	1	29.270	0.146	0.000	0.000	82.900	M	17.32	0.981
	Σ	**29.270**						**17.32**	**0.981**
#53	**Σ**	**80.600**						**17.35**	**0.990**
#43	1	6.207	0.074	0.026	0.357	81.500	M	5.91	0.228
	Σ	**6.207**						**5.91**	**0.228**
#44	**Σ**	**6.207**						**5.91**	**0.228**
#45	**Σ**	**6.207**						**0.00**	**0.000**
#40	1	12.150	0.354	0.000	0.000	89.000	M	8.67	0.636
	Σ	**12.150**						**8.67**	**0.636**
#41	**Σ**	**12.150**						**8.67**	**0.636**
#38	1	66.380	0.203	0.000	0.000	82.900	M	36.36	2.185
	Σ	**66.380**						**36.36**	**2.185**
#39	**Σ**	**66.380**						**36.36**	**2.185**
#42	**Σ**	**78.530**						**36.36**	**2.185**
#46	**Σ**	**84.737**						**36.36**	**2.185**
#33	1	14.130	0.291	0.000	0.000	89.000	M	10.93	0.738
	Σ	**14.130**						**10.93**	**0.738**
#34	**Σ**	**14.130**						**10.93**	**0.738**
#35	**Σ**	**14.130**						**0.08**	**0.014**
#36	**Σ**	**14.130**						**0.08**	**0.014**
#37	**Σ**	**14.130**						**0.08**	**0.014**
#30	1	282.150	0.908	0.000	0.000	82.900	M	65.89	9.266
	Σ	**282.150**						**65.89**	**9.266**

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#31	**Σ**	**282.150**						**65.89**	**9.266**
#32	**Σ**	**282.150**						**65.11**	**9.266**
#18	1	148.000	1.315	0.504	0.342	76.000	M	12.41	2.652
	2	1,352.640	1.370	0.000	0.000	75.000	M	96.66	21.939
	Σ	**1,500.640**						**102.20**	**24.591**
#19	1	418.020	1.290	0.000	0.000	82.900	M	75.12	13.716
	Σ	**1,918.660**						**172.69**	**38.307**
#3	1	791.300	1.145	1.181	0.350	80.800	M	126.48	21.870
	2	1,079.100	0.915	0.596	0.351	80.900	M	205.12	30.087
	3	450.300	0.571	0.319	0.355	81.300	M	124.03	12.992
	4	742.600	0.625	0.000	0.000	78.500	M	142.22	16.799
	5	915.400	1.119	0.000	0.000	78.800	M	120.44	21.280
	Σ	**3,978.700**						**408.84**	**103.028**
#4	1	546.400	0.726	1.710	0.319	81.700	M	132.82	16.285
	2	441.200	0.503	1.429	0.318	86.000	M	203.24	18.445
	3	889.400	0.815	0.998	0.318	82.100	M	207.38	27.379
	4	1,339.100	0.919	0.000	0.000	84.000	M	344.23	47.965
	Σ	**7,194.800**						**587.18**	**213.102**
#1	1	1,242.300	1.349	1.359	0.354	80.800	M	175.38	34.327
	2	1,662.000	1.465	0.865	0.359	80.300	M	209.14	44.015
	3	1,434.000	1.573	1.257	0.357	81.100	M	185.28	40.634
	4	842.700	1.102	0.977	0.364	81.000	M	141.43	23.683
	5	676.100	1.067	1.113	0.365	81.600	M	123.40	19.974
	6	1,223.200	0.778	0.596	0.352	81.800	M	286.04	36.750
	7	743.100	0.745	0.530	0.354	83.600	M	213.41	25.797
	8	654.500	0.801	0.000	0.000	92.200	M	373.82	42.811
	Σ	**8,477.899**						**906.51**	**267.991**
#2	1	609.500	0.668	1.219	0.340	85.700	M	228.33	24.903
	2	537.100	0.610	1.436	0.329	91.600	M	349.86	33.711
	3	455.000	0.546	1.288	0.324	82.000	M	138.36	13.898
	4	627.000	0.634	0.852	0.324	87.900	M	293.17	30.151
	5	653.100	0.452	0.453	0.315	91.200	M	490.31	39.848
	6	957.200	0.984	0.000	0.000	89.600	M	382.21	52.057
	Σ	**12,316.800**						**1,064.62**	**462.559**
#5	1	763.100	0.682	3.507	0.293	84.100	M	244.05	27.555
	2	983.300	1.117	2.231	0.289	89.200	M	346.17	51.945
	3	1,022.000	0.996	1.587	0.291	92.000	M	492.71	65.927
	4	688.700	1.908	1.255	0.291	80.800	M	74.13	19.028
	5	754.300	2.307	1.084	0.287	86.200	M	115.39	31.953

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	6	628.400	0.538	0.595	0.301	93.000	M	491.62	43.517
	7	654.500	0.560	0.000	0.000	91.500	M	445.79	40.785
	Σ	**25,005.900**						**1,662.11**	**956.372**
#6	1	901.400	1.151	1.896	0.315	81.100	M	147.95	25.547
	2	1,011.200	1.871	0.166	0.287	83.500	M	143.70	34.801
	3	1,152.430	1.126	0.000	0.000	92.800	M	541.80	78.602
	Σ	**28,070.930**						**1,673.74**	**1,095.322**
#11	1	53.960	0.000	0.000	0.000	91.000	M	88.24	4.072
	Σ	**30,339.830**						**1,687.37**	**1,146.981**
#17	**Σ**	**30,505.170**						**1,094.20**	**1,145.854**
#27	1	43.270	0.441	0.000	0.000	86.200	M	21.87	1.836
	Σ	**32,089.210**						**1,104.93**	**1,203.729**
#22	1	144.330	0.565	0.000	0.000	88.400	M	75.89	7.201
	Σ	**32,233.540**						**1,105.56**	**1,210.930**
#23	1	179.300	0.362	0.000	0.000	87.900	M	116.07	8.648
	Σ	**32,412.840**						**1,106.52**	**1,219.578**
#24	1	126.980	0.164	0.545	0.308	86.900	M	101.83	5.787
	2	235.630	0.327	0.427	0.341	86.700	M	144.93	10.409
	3	258.380	0.416	0.365	0.294	88.300	M	161.17	12.840
	4	180.930	0.449	0.176	0.301	86.700	M	94.53	7.968
	5	189.850	0.326	0.146	0.330	86.800	M	117.89	8.448
	6	172.370	0.753	0.000	0.000	88.300	M	74.40	8.538
	Σ	**33,576.980**						**1,112.72**	**1,273.568**
#25	1	91.450	0.220	0.854	0.310	86.800	M	65.92	4.081
	2	286.490	0.566	0.642	0.312	87.100	M	134.68	12.994
	3	75.280	0.179	0.610	0.308	86.800	M	58.49	3.393
	4	128.700	0.157	0.270	0.325	86.800	M	102.47	5.822
	5	67.060	0.333	0.000	0.000	82.000	M	27.39	2.057
	Σ	**34,225.970**						**1,115.34**	**1,301.915**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#65	1	0.150	200.00	6.00	0.2320	1.0000	6	22.9	24,518	12.47	7.24
	Σ							**22.9**	**24,518**	**12.47**	**7.24**
#61	1	0.150	200.00	6.00	0.2320	1.0000	6	30.4	26,424	13.26	7.39
	Σ							**30.4**	**26,424**	**13.26**	**7.39**
#59	1	0.150	200.00	6.00	0.2320	1.0000	6	31.9	23,467	10.76	6.11
	Σ							**31.9**	**23,467**	**10.76**	**6.11**
#60	Σ							**31.9**	**23,467**	**10.76**	**6.11**
#62	Σ							**62.3**	**24,695**	**11.85**	**6.71**
#63	Σ							**62.3**	**25,556**	**12.26**	**6.71**
#57	1	0.150	150.00	33.00	0.0700	1.0000	6	6.5	52,641	30.22	15.54
	Σ							**6.5**	**52,641**	**30.22**	**15.54**
#58	Σ							**6.5**	**52,641**	**30.22**	**15.54**
#55	1	0.150	150.00	33.00	0.8000	1.0000	6	104.5	425,428	216.44	130.50
	Σ							**104.5**	**425,428**	**216.44**	**130.50**
#56	Σ							**104.5**	**425,428**	**216.44**	**130.50**
#54	1	0.150	200.00	6.00	0.2320	1.0000	6	37.2	26,476	13.03	7.30
	Σ							**37.2**	**26,476**	**13.03**	**7.30**
#64	Σ							**99.5**	**26,596**	**12.88**	**6.83**
#29	1	0.183	100.00	9.10	0.1990	1.0000	7	1.3	23,225	13.35	7.75
	Σ							**1.3**	**23,225**	**13.35**	**7.75**
#20	1	0.245	420.00	1.40	0.2450	1.0000	2	211.2	10,132	4.30	2.59
	Σ							**211.2**	**10,132**	**4.30**	**2.59**
#21	1	0.235	280.00	2.20	0.2330	1.0000	3	246.1	13,345	6.40	3.90
	2	0.204	280.00	2.30	0.2330	1.0000	4	73.1	13,470	6.72	3.90
	3	0.158	240.00	3.80	0.2110	1.0000	5	86.2	13,897	5.87	3.40
	Σ							**502.8**	**10,639**	**4.04**	**2.25**
#26	1	1.000	0.50	0.10	0.1000	1.0000	36	0.6	514	0.41	0.26
	Σ							**503.5**	**10,463**	**3.98**	**2.21**
#28	Σ							**229.5**	**314,706**	**17.06**	**0.18**
#51	1	0.200	150.00	33.00	0.0700	1.0000	16	8.9	69,834	34.82	17.94
	Σ							**8.9**	**69,834**	**34.82**	**17.94**
#52	1	0.200	40.00	33.00	0.8000	1.0000	16	2.3	209,067	104.25	79.88

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	Σ							**11.2**	**209,067**	**152.64**	**0.00**
#48	1	0.200	150.00	33.00	0.0700	1.0000	16	8.2	40,139	7.24	4.17
	Σ							**8.2**	**40,139**	**7.24**	**4.17**
#49	1	0.200	150.00	33.00	0.8000	1.0000	16	1,066.2	532,086	163.96	102.53
	Σ							**1,074.4**	**532,086**	**165.90**	**103.74**
#50	Σ							**1,074.4**	**532,086**	**165.90**	**103.74**
#47	1	0.200	280.00	2.70	0.1410	1.0000	16	6.5	9,199	3.61	1.92
	Σ							**6.5**	**9,199**	**3.61**	**1.92**
#53	Σ							**1,092.1**	**138,592**	**1.30**	**0.06**
#43	1	0.197	150.00	33.00	0.0700	1.0000	20	11.6	70,876	39.86	20.54
	Σ							**11.5**	**70,283**	**39.39**	**20.29**
#44	Σ							**11.5**	**70,283**	**39.39**	**20.29**
#45	Σ							**11.5**	**1**	**0.00**	**0.00**
#40	1	0.200	200.00	33.00	0.8000	1.0000	20	398.3	599,843	267.95	166.27
	Σ							**398.3**	**599,843**	**267.95**	**166.27**
#41	Σ							**398.3**	**599,843**	**267.95**	**166.27**
#38	1	0.197	280.00	2.70	0.2330	1.0000	20	25.5	15,963	7.39	3.95
	Σ							**25.5**	**15,963**	**7.39**	**3.95**
#39	Σ							**25.5**	**15,963**	**7.39**	**3.95**
#42	Σ							**423.8**	**16,710**	**12.98**	**6.64**
#46	Σ							**435.3**	**18,454**	**14.35**	**6.64**
#33	1	0.200	200.00	33.00	0.8000	1.0000	20	493.4	631,974	291.89	180.92
	Σ							**493.4**	**631,974**	**291.89**	**180.92**
#34	Σ							**493.4**	**631,974**	**291.89**	**180.92**
#35	Σ							**0.0**	**0**	**0.00**	**0.00**
#36	Σ							**0.0**	**0**	**0.00**	**0.00**
#37	Σ							**0.0**	**0**	**0.00**	**0.00**
#30	1	0.197	200.00	4.20	0.1460	1.0000	16	83.5	11,128	1.39	0.82
	Σ							**83.5**	**11,128**	**1.39**	**0.82**
#31	Σ							**83.5**	**11,128**	**1.39**	**0.82**

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#32	Σ							**83.5**	**11,240**	**1.40**	**0.82**
#18	1	0.197	280.00	2.70	0.2330	1.0000	20	15.6	7,218	0.71	0.43
	2	0.204	420.00	1.80	0.3270	1.0000	34	184.0	10,329	1.88	1.12
	Σ							**184.0**	**9,276**	**1.69**	**1.00**
#19	1	0.197	280.00	2.70	0.2330	1.0000	1	107.4	9,395	2.80	1.71
	Σ							**291.4**	**9,257**	**2.08**	**1.26**
#3	1	0.150	100.00	9.10	0.3050	1.0000	33	494.7	27,163	7.79	4.73
	2	0.181	100.00	10.10	0.3050	1.0000	28	1,128.2	45,635	16.28	9.70
	3	0.151	200.00	5.50	0.3050	1.0000	33	297.0	29,126	12.03	6.88
	4	0.183	130.00	7.60	0.3160	1.0000	27	511.2	39,439	14.88	8.34
	5	0.185	100.00	8.30	0.2760	1.0000	21	457.7	26,490	5.83	3.45
	Σ							**2,245.7**	**25,890**	**5.90**	**3.63**
#4	1	0.173	130.00	7.00	0.2850	1.0000	22	380.6	28,562	10.73	6.40
	2	0.148	100.00	12.00	0.2220	1.0000	20	645.8	42,085	16.37	9.88
	3	0.185	75.00	13.60	0.2740	1.0000	32	1,248.2	55,008	19.53	11.70
	4	0.213	100.00	10.60	0.2330	1.0000	21	1,886.4	47,509	14.80	8.88
	Σ							**4,767.8**	**41,928**	**7.86**	**3.07**
#1	1	0.220	280.00	2.20	0.2960	1.0000	28	340.4	11,823	3.33	2.05
	2	0.202	240.00	3.30	0.2960	1.0000	28	547.0	14,770	3.82	2.37
	3	0.206	280.00	2.60	0.2960	1.0000	28	419.7	12,159	3.04	1.90
	4	0.188	200.00	5.10	0.2960	1.0000	28	503.6	25,646	8.31	5.03
	5	0.124	240.00	3.60	0.3130	1.0000	33	184.0	11,165	3.44	2.08
	6	0.178	130.00	7.90	0.2850	1.0000	22	1,066.3	35,706	13.05	7.71
	7	0.191	100.00	9.20	0.2540	1.0000	21	784.0	37,166	12.86	7.64
	8	0.199	75.00	15.10	0.1510	1.0000	17	1,509.3	40,966	11.06	6.91
	Σ							**4,464.9**	**33,833**	**7.15**	**2.58**
#2	1	0.188	130.00	7.30	0.2120	1.0000	20	550.2	26,691	9.24	5.57
	2	0.199	75.00	12.60	0.1510	1.0000	17	1,008.2	34,684	10.88	6.82
	3	0.200	100.00	8.60	0.2020	1.0000	26	326.2	29,172	8.45	4.96
	4	0.193	75.00	12.30	0.1730	1.0000	19	923.5	36,588	11.27	6.86
	5	0.187	75.00	14.00	0.1590	1.0000	18	1,517.4	45,203	16.68	10.19
	6	0.198	75.00	13.70	0.1680	1.0000	19	1,669.0	37,482	8.92	5.54
	Σ							**7,348.4**	**33,857**	**4.72**	**1.63**
#5	1	0.213	130.00	6.30	0.2330	1.0000	21	653.9	27,980	10.18	6.29
	2	0.209	130.00	7.10	0.1680	1.0000	19	900.1	19,899	4.08	2.59
	3	0.191	100.00	8.40	0.1500	1.0000	17	1,085.4	18,808	4.17	2.67
	4	0.235	200.00	4.90	0.2870	1.0000	24	362.1	21,952	4.52	2.88
	5	0.220	240.00	3.70	0.1900	1.0000	31	254.7	8,974	0.55	0.36
	6	0.200	130.00	7.30	0.1410	1.0000	16	817.8	21,982	7.28	4.55

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	7	0.204	200.00	4.70	0.1560	1.0000	17	687.2	20,222	6.60	4.01
	Σ							**15,938.8**	**27,400**	**4.14**	**1.89**
#6	1	0.228	280.00	2.70	0.2870	1.0000	24	316.8	14,838	4.79	2.93
	2	0.226	280.00	2.40	0.2330	1.0000	21	268.2	8,937	1.19	0.76
	3	0.200	200.00	4.20	0.1460	1.0000	16	914.1	13,390	2.48	1.57
	Σ							**15,109.3**	**23,232**	**1.66**	**0.75**
#11	1	0.320	300.00	0.50	0.9000	1.0000	16	87.0	25,298	12.61	7.77
	Σ							**15,571.2**	**22,964**	**1.76**	**0.79**
#17	Σ							**11,380.9**	**598,921**	**39.60**	**0.54**
#27	1	0.183	100.00	9.10	0.1990	1.0000	7	36.8	25,311	10.89	6.29
	Σ							**11,768.8**	**1,428,289**	**102.63**	**0.58**
#22	1	0.183	100.00	9.10	0.1990	1.0000	7	158.7	26,970	11.17	6.65
	Σ							**11,801.2**	**27,499**	**1.88**	**0.56**
#23	1	0.170	100.00	10.10	0.1890	1.0000	8	237.1	34,393	14.65	8.50
	Σ							**11,925.9**	**32,290**	**2.22**	**0.56**
#24	1	0.160	100.00	11.50	0.1990	1.0000	5	207.4	44,285	21.62	12.68
	2	0.145	100.00	12.00	0.2110	1.0000	15	360.7	43,171	18.39	10.71
	3	0.171	100.00	8.20	0.1850	1.0000	10	246.1	23,504	9.41	5.60
	4	0.150	75.00	12.10	0.2110	1.0000	11	215.6	33,725	13.34	7.79
	5	0.143	75.00	13.30	0.2110	1.0000	15	271.8	40,504	17.28	9.97
	6	0.164	75.00	13.90	0.1850	1.0000	12	225.3	31,654	9.95	6.04
	Σ							**12,308.0**	**30,587**	**2.36**	**0.64**
#25	1	0.143	100.00	10.40	0.2110	1.0000	15	110.9	33,271	15.18	9.02
	2	0.162	75.00	15.20	0.2220	1.0000	13	527.1	48,820	18.88	11.36
	3	0.143	75.00	20.10	0.2110	1.0000	15	180.8	64,982	30.56	18.04
	4	0.143	100.00	8.10	0.2110	1.0000	15	113.6	24,801	11.77	6.76
	5	0.215	100.00	8.20	0.2760	1.0000	14	61.3	39,773	19.09	10.40
	Σ							**12,714.3**	**36,776**	**2.63**	**0.62**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	2.99	22.00	736.00	1.720	0.118
		8. Large gullies, diversions, and low flowing streams	0.63	66.00	10,511.22	2.370	1.231
#1	**1**	**Time of Concentration:**					**1.349**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	5. Nearly bare and untilled, and alluvial valley fans	6.24	30.00	481.00	2.490	0.053
		8. Large gullies, diversions, and low flowing streams	3.34	406.00	12,141.00	5.480	0.615
#2	**1**	**Time of Concentration:**					**0.668**
#2	2	5. Nearly bare and untilled, and alluvial valley fans	3.16	30.00	950.00	1.770	0.149
		8. Large gullies, diversions, and low flowing streams	4.22	432.00	10,229.00	6.160	0.461
#2	**2**	**Time of Concentration:**					**0.610**
#2	3	5. Nearly bare and untilled, and alluvial valley fans	2.65	10.00	378.00	1.620	0.064
		8. Large gullies, diversions, and low flowing streams	2.72	234.00	8,592.00	4.950	0.482
#2	**3**	**Time of Concentration:**					**0.546**
#2	4	5. Nearly bare and untilled, and alluvial valley fans	3.07	25.00	815.00	1.750	0.129
		8. Large gullies, diversions, and low flowing streams	3.32	330.00	9,931.00	5.460	0.505
#2	**4**	**Time of Concentration:**					**0.634**
#2	5	5. Nearly bare and untilled, and alluvial valley fans	7.45	45.00	604.00	2.720	0.061
		8. Large gullies, diversions, and low flowing streams	3.78	310.00	8,210.00	5.820	0.391
#2	**5**	**Time of Concentration:**					**0.452**
#2	6	5. Nearly bare and untilled, and alluvial valley fans	9.10	80.00	879.00	3.010	0.081
		8. Large gullies, diversions, and low flowing streams	2.32	344.00	14,831.00	4.560	0.903
#2	**6**	**Time of Concentration:**					**0.984**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	1.29	15.00	1,163.00	1.130	0.285
		8. Large gullies, diversions, and low flowing streams	2.37	338.00	14,280.00	4.610	0.860
#3	**1**	**Time of Concentration:**					**1.145**
#3	2	5. Nearly bare and untilled, and alluvial valley fans	3.04	33.00	1,087.00	1.740	0.173
		8. Large gullies, diversions, and low flowing streams	2.06	238.00	11,527.00	4.310	0.742
#3	**2**	**Time of Concentration:**					**0.915**
#3	3	5. Nearly bare and untilled, and alluvial valley fans	5.02	45.00	897.00	2.230	0.111
		8. Large gullies, diversions, and low flowing streams	3.09	270.00	8,741.00	5.270	0.460
#3	**3**	**Time of Concentration:**					**0.571**
#3	4	5. Nearly bare and untilled, and alluvial valley fans	7.41	28.00	378.00	2.720	0.038
		8. Large gullies, diversions, and low flowing streams	3.43	402.00	11,736.00	5.550	0.587
#3	**4**	**Time of Concentration:**					**0.625**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	5	5. Nearly bare and untilled, and alluvial valley fans	3.39	30.00	885.00	1.840	0.133
		8. Large gullies, diversions, and low flowing streams	2.58	442.00	17,121.00	4.820	0.986
#3	**5**	**Time of Concentration:**					**1.119**
#4	1	5. Nearly bare and untilled, and alluvial valley fans	3.59	62.00	1,729.00	1.890	0.254
		8. Large gullies, diversions, and low flowing streams	2.09	154.00	7,372.00	4.330	0.472
#4	**1**	**Time of Concentration:**					**0.726**
#4	2	5. Nearly bare and untilled, and alluvial valley fans	6.83	25.00	366.00	2.610	0.038
		8. Large gullies, diversions, and low flowing streams	2.36	182.00	7,708.00	4.600	0.465
#4	**2**	**Time of Concentration:**					**0.503**
#4	3	5. Nearly bare and untilled, and alluvial valley fans	19.03	47.00	247.00	4.360	0.015
		8. Large gullies, diversions, and low flowing streams	2.13	268.00	12,586.00	4.370	0.800
#4	**3**	**Time of Concentration:**					**0.815**
#4	4	5. Nearly bare and untilled, and alluvial valley fans	14.08	50.00	355.00	3.750	0.026
		8. Large gullies, diversions, and low flowing streams	2.46	372.00	15,119.00	4.700	0.893
#4	**4**	**Time of Concentration:**					**0.919**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	12.55	65.00	518.00	3.540	0.040
		8. Large gullies, diversions, and low flowing streams	1.92	184.00	9,592.00	4.150	0.642
#5	**1**	**Time of Concentration:**					**0.682**
#5	2	5. Nearly bare and untilled, and alluvial valley fans	5.10	30.00	588.00	2.250	0.072
		8. Large gullies, diversions, and low flowing streams	1.77	266.00	15,016.00	3.990	1.045
#5	**2**	**Time of Concentration:**					**1.117**
#5	3	5. Nearly bare and untilled, and alluvial valley fans	1.90	20.00	1,050.00	1.380	0.211
		8. Large gullies, diversions, and low flowing streams	2.19	274.00	12,532.00	4.430	0.785
#5	**3**	**Time of Concentration:**					**0.996**
#5	4	5. Nearly bare and untilled, and alluvial valley fans	2.78	32.00	1,152.00	1.660	0.192
		8. Large gullies, diversions, and low flowing streams	0.99	182.00	18,415.00	2.980	1.716
#5	**4**	**Time of Concentration:**					**1.908**
#5	5	5. Nearly bare and untilled, and alluvial valley fans	2.52	23.00	911.00	1.580	0.160
		8. Large gullies, diversions, and low flowing streams	1.07	256.00	23,965.00	3.100	2.147
#5	**5**	**Time of Concentration:**					**2.307**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	6	5. Nearly bare and untilled, and alluvial valley fans	6.36	25.00	393.00	2.520	0.043
		8. Large gullies, diversions, and low flowing streams	2.39	198.00	8,272.00	4.640	0.495
#5	**6**	**Time of Concentration:**					**0.538**
#5	7	5. Nearly bare and untilled, and alluvial valley fans	9.66	28.00	290.00	3.100	0.025
		8. Large gullies, diversions, and low flowing streams	2.12	179.00	8,427.00	4.370	0.535
#5	**7**	**Time of Concentration:**					**0.560**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	31.83	120.00	377.00	5.640	0.018
		8. Large gullies, diversions, and low flowing streams	1.38	198.00	14,361.00	3.520	1.133
#6	**1**	**Time of Concentration:**					**1.151**
#6	2	5. Nearly bare and untilled, and alluvial valley fans	4.25	40.00	941.00	2.060	0.126
		8. Large gullies, diversions, and low flowing streams	0.96	176.00	18,407.00	2.930	1.745
#6	**2**	**Time of Concentration:**					**1.871**
#6	3	5. Nearly bare and untilled, and alluvial valley fans	4.35	25.00	575.00	2.080	0.076
		8. Large gullies, diversions, and low flowing streams	1.57	224.00	14,223.00	3.760	1.050
#6	**3**	**Time of Concentration:**					**1.126**
#20	1	5. Nearly bare and untilled, and alluvial valley fans	2.24	9.99	446.20	1.490	0.083
		8. Large gullies, diversions, and low flowing streams	0.82	65.23	7,955.70	2.710	0.815
#20	**1**	**Time of Concentration:**					**0.898**
#21	1	8. Large gullies, diversions, and low flowing streams	0.92	64.91	7,055.50	2.870	0.682
#21	**1**	**Time of Concentration:**					**0.682**
#21	2	8. Large gullies, diversions, and low flowing streams	1.72	84.83	4,932.40	3.930	0.348
#21	**2**	**Time of Concentration:**					**0.348**
#21	3	8. Large gullies, diversions, and low flowing streams	1.60	90.24	5,640.40	3.790	0.413
#21	**3**	**Time of Concentration:**					**0.413**
#23	1	5. Nearly bare and untilled, and alluvial valley fans	0.93	5.00	540.30	0.960	0.156
		8. Large gullies, diversions, and low flowing streams	3.57	150.07	4,203.79	5.660	0.206
#23	**1**	**Time of Concentration:**					**0.362**
#27	1	5. Nearly bare and untilled, and alluvial valley fans	2.60	15.60	600.00	1.610	0.103
		8. Large gullies, diversions, and low flowing streams	0.92	32.00	3,493.83	2.870	0.338
#27	**1**	**Time of Concentration:**					**0.441**
#29	1	8. Large gullies, diversions, and low flowing streams	3.69	120.00	3,255.51	5.750	0.157

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	0.87	8.00	921.20	2.790	0.091
#29	**1**	**Time of Concentration:**					**0.065**
#30	1	5. Nearly bare and untilled, and alluvial valley fans	2.56	42.03	1,641.80	1.590	0.286
		5. Nearly bare and untilled, and alluvial valley fans	1.42	17.99	1,267.00	1.190	0.295
		8. Large gullies, diversions, and low flowing streams	0.94	18.00	1,915.00	2.900	0.183
		8. Large gullies, diversions, and low flowing streams	0.25	1.95	780.00	1.500	0.144
#30	**1**	**Time of Concentration:**					**0.908**
#33	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	9.38	469.50	1.410	0.092
		8. Large gullies, diversions, and low flowing streams	0.50	7.50	1,500.00	2.120	0.196
		7. Paved area and small upland gullies	33.00	44.55	135.00	11.560	0.003
#33	**1**	**Time of Concentration:**					**0.291**
#38	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	13.29	664.50	1.410	0.130
		9. Small streams flowing bankfull	0.30	3.93	1,310.00	4.920	0.073
#38	**1**	**Time of Concentration:**					**0.203**
#43	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	6.00	300.00	1.410	0.059
		9. Small streams flowing bankfull	2.00	14.00	700.00	12.720	0.015
#43	**1**	**Time of Concentration:**					**0.074**
#47	1	5. Nearly bare and untilled, and alluvial valley fans	2.33	6.99	300.00	1.520	0.054
		8. Large gullies, diversions, and low flowing streams	3.70	37.00	1,000.00	5.770	0.048
		8. Large gullies, diversions, and low flowing streams	1.87	12.28	657.00	4.100	0.044
#47	**1**	**Time of Concentration:**					**0.146**
#48	1	5. Nearly bare and untilled, and alluvial valley fans	1.38	9.00	650.00	1.170	0.154
#48	**1**	**Time of Concentration:**					**0.681**
#49	1	5. Nearly bare and untilled, and alluvial valley fans	8.52	23.00	270.00	2.910	0.025
		8. Large gullies, diversions, and low flowing streams	0.18	4.00	2,200.00	1.270	0.481
#49	**1**	**Time of Concentration:**					**0.506**
#51	1	5. Nearly bare and untilled, and alluvial valley fans	11.33	16.99	150.00	3.360	0.012
		8. Large gullies, diversions, and low flowing streams	2.86	12.01	420.00	5.070	0.023
#51	**1**	**Time of Concentration:**					**0.035**
#52	1	5. Nearly bare and untilled, and alluvial valley fans	25.00	20.00	80.00	5.000	0.004
#52	**1**	**Time of Concentration:**					**0.004**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#54	1	5. Nearly bare and untilled, and alluvial valley fans	2.03	14.00	690.00	1.420	0.134
		8. Large gullies, diversions, and low flowing streams	2.11	20.00	950.00	4.350	0.060
#54	**1**	**Time of Concentration:**					**0.194**
#55	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	14.00	700.00	1.410	0.137
		8. Large gullies, diversions, and low flowing streams	1.71	6.00	350.00	3.920	0.024
#55	**1**	**Time of Concentration:**					**0.161**
#57	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	10.00	500.00	1.410	0.098
		9. Small streams flowing bankfull	1.86	7.99	429.56	12.270	0.009
#57	**1**	**Time of Concentration:**					**0.107**
#59	1	5. Nearly bare and untilled, and alluvial valley fans	0.81	5.00	620.00	0.890	0.193
		8. Large gullies, diversions, and low flowing streams	1.33	21.00	1,580.00	3.450	0.127
#59	**1**	**Time of Concentration:**					**0.320**
#61	1	5. Nearly bare and untilled, and alluvial valley fans	2.71	16.00	590.01	1.640	0.099
		8. Large gullies, diversions, and low flowing streams	1.89	10.00	530.02	4.120	0.035
#61	**1**	**Time of Concentration:**					**0.134**
#65	1	5. Nearly bare and untilled, and alluvial valley fans	2.00	12.00	600.00	1.410	0.118
		9. Small streams flowing bankfull	2.39	16.01	670.01	13.910	0.013
#65	**1**	**Time of Concentration:**					**0.131**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.88	378.00	20,112.80	4.110	1.359
#1	**1**	**Muskingum K:**					**1.359**
#2	1	8. Large gullies, diversions, and low flowing streams	1.44	228.00	15,800.00	3.600	1.219
#2	**1**	**Muskingum K:**					**1.219**
#2	2	8. Large gullies, diversions, and low flowing streams	1.19	202.00	16,912.00	3.270	1.436
#2	**2**	**Muskingum K:**					**1.436**
#2	3	8. Large gullies, diversions, and low flowing streams	1.10	160.00	14,568.00	3.140	1.288
#2	**3**	**Muskingum K:**					**1.288**
#2	4	8. Large gullies, diversions, and low flowing streams	1.09	104.00	9,576.00	3.120	0.852
#2	**4**	**Muskingum K:**					**0.852**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	5	8. Large gullies, diversions, and low flowing streams	0.93	44.00	4,715.00	2.890	0.453
#2	**5**	**Muskingum K:**					**0.453**
#3	1	8. Large gullies, diversions, and low flowing streams	1.75	294.00	16,845.00	3.960	1.181
#3	**1**	**Muskingum K:**					**1.181**
#3	2	8. Large gullies, diversions, and low flowing streams	1.79	154.00	8,609.00	4.010	0.596
#3	**2**	**Muskingum K:**					**0.596**
#3	3	8. Large gullies, diversions, and low flowing streams	1.93	92.00	4,778.00	4.160	0.319
#3	**3**	**Muskingum K:**					**0.319**
#4	1	8. Large gullies, diversions, and low flowing streams	1.01	186.00	18,477.00	3.000	1.710
#4	**1**	**Muskingum K:**					**1.710**
#4	2	8. Large gullies, diversions, and low flowing streams	0.98	150.00	15,281.00	2.970	1.429
#4	**2**	**Muskingum K:**					**1.429**
#4	3	8. Large gullies, diversions, and low flowing streams	0.98	104.00	10,645.00	2.960	0.998
#4	**3**	**Muskingum K:**					**0.998**
#5	1	8. Large gullies, diversions, and low flowing streams	0.64	195.00	30,309.00	2.400	3.507
#5	**1**	**Muskingum K:**					**3.507**
#5	2	8. Large gullies, diversions, and low flowing streams	0.60	113.00	18,717.00	2.330	2.231
#5	**2**	**Muskingum K:**					**2.231**
#5	3	8. Large gullies, diversions, and low flowing streams	0.63	85.00	13,541.00	2.370	1.587
#5	**3**	**Muskingum K:**					**1.587**
#5	4	8. Large gullies, diversions, and low flowing streams	0.63	67.00	10,710.00	2.370	1.255
#5	**4**	**Muskingum K:**					**1.255**
#5	5	8. Large gullies, diversions, and low flowing streams	0.59	53.00	8,978.00	2.300	1.084
#5	**5**	**Muskingum K:**					**1.084**
#5	6	8. Large gullies, diversions, and low flowing streams	0.74	41.00	5,528.00	2.580	0.595
#5	**6**	**Muskingum K:**					**0.595**
#6	1	8. Large gullies, diversions, and low flowing streams	0.94	186.00	19,797.00	2.900	1.896
#6	**1**	**Muskingum K:**					**1.896**
#6	2	8. Large gullies, diversions, and low flowing streams	0.58	8.00	1,372.00	2.290	0.166
#6	**2**	**Muskingum K:**					**0.166**
#27	1	8. Large gullies, diversions, and low flowing streams	0.30	16.15	5,384.09	1.640	0.911
#27	**1**	**Muskingum K:**					**0.000**
#43	1	8. Large gullies, diversions, and low flowing streams	2.00	8.00	400.00	4.240	0.026

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Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#43	**1**	**Muskingum K:**					**0.026**

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#65	In	22.110	22.110	20.49	1.18	22.9	24,518	12.47	7.24
	Out			0.00	0.00	22.9	0	0.00	0.00
#61		34.787	34.787	26.53	1.50	30.4	26,424	13.26	7.39
#59		41.030	41.030	24.44	1.75	31.9	23,467	10.76	6.11
#60		0.000	41.030	24.44	1.75	31.9	23,467	10.76	6.11
#62		0.000	75.817	49.34	3.25	62.3	24,695	11.85	6.71
#63		0.000	75.817	47.25	3.25	62.3	25,556	12.26	6.71
#57		4.740	4.740	4.51	0.17	6.5	52,641	30.22	15.54
#58	In	0.000	4.740	4.51	0.17	6.5	52,641	30.22	15.54
	Out			0.00	0.00	0.0	0	0.00	0.00
#55		4.870	4.870	4.51	0.26	104.5	425,428	216.44	130.50
#56	In	0.000	4.870	4.51	0.26	104.5	425,428	216.44	130.50
	Out			0.14	0.07	0.0	0	0.00	0.00
#54		42.850	42.850	30.89	1.83	37.2	26,476	13.03	7.30
#64		0.000	128.277	73.07	5.15	99.5	26,596	12.88	6.83
#29		1.420	1.420	1.81	0.07	1.3	23,225	13.35	7.75
#20		621.290	621.290	189.63	25.36	211.2	10,132	4.30	2.59
#21		751.250	1,372.540	356.36	62.21	502.8	10,639	4.04	2.25
#26	In	16.428	1,388.968	357.68	63.63	503.5	10,463	3.98	2.21
	Out			226.08	50.82	229.5	5,950	0.32	0.18
#28		0.000	1,388.968	225.69	50.82	229.5	314,706	17.06	0.18
#51	In	4.820	4.820	4.59	0.18	8.9	69,834	34.82	17.94
	Out			0.00	0.00	8.9	0	0.00	0.00
#52		0.200	5.020	0.30	0.01	11.2	209,067	152.64	0.00
#48	In	8.810	8.810	2.19	0.26	8.2	40,139	7.24	4.17
	Out			0.00	0.00	8.2	0	0.00	0.00
#49		37.500	46.310	22.19	1.96	1,074.4	532,086	165.90	103.74
#50	In	0.000	46.310	22.19	1.96	1,074.4	532,086	165.90	103.74
	Out			0.00	0.00	1,074.4	0	0.00	0.00
#47		29.270	29.270	17.32	0.98	6.5	9,199	3.61	1.92
#53		0.000	80.600	17.35	0.99	1,092.1	138,592	1.30	0.06
#43		6.207	6.207	5.91	0.23	11.5	70,283	39.39	20.29
#44	In	0.000	6.207	5.91	0.23	11.5	70,283	39.39	20.29
	Out			0.00	0.00	11.5	0	0.00	0.00
#45		0.000	6.207	0.00	0.00	11.5	1	0.00	0.00
#40		12.150	12.150	8.67	0.64	398.3	599,843	267.95	166.27
#41	In	0.000	12.150	8.67	0.64	398.3	599,843	267.95	166.27
	Out			0.00	0.00	398.3	0	0.00	0.00
#38		66.380	66.380	36.36	2.19	25.5	15,963	7.39	3.95

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#39		0.000	66.380	36.36	2.19	25.5	15,963	7.39	3.95
#42		0.000	78.530	36.36	2.19	423.8	16,710	12.98	6.64
#46		0.000	84.737	36.36	2.19	435.3	18,454	14.35	6.64
#33		14.130	14.130	10.93	0.74	493.4	631,974	291.89	180.92
#34	In	0.000	14.130	10.93	0.74	493.4	631,974	291.89	180.92
	Out			0.08	0.01	0.0	0	0.00	0.00
#35		0.000	14.130	0.08	0.01	0.0	0	0.00	0.00
#36		0.000	14.130	0.08	0.01	0.0	0	0.00	0.00
#37		0.000	14.130	0.08	0.01	0.0	0	0.00	0.00
#30		282.150	282.150	65.89	9.27	83.5	11,128	1.39	0.82
#31		0.000	282.150	65.89	9.27	83.5	11,128	1.39	0.82
#32		0.000	282.150	65.11	9.27	83.5	11,240	1.40	0.82
#18		1,500.640	1,500.640	102.20	24.59	184.0	9,276	1.69	1.00
#19		418.020	1,918.660	172.69	38.31	291.4	9,257	2.08	1.26
#3		3,978.700	3,978.700	408.84	103.03	2,245.7	25,890	5.90	3.63
#4		3,216.100	7,194.800	587.18	213.10	4,767.8	41,928	7.86	3.07
#1		8,477.899	8,477.899	906.51	267.99	4,464.9	33,833	7.15	2.58
#2		3,838.900	12,316.800	1,064.62	462.56	7,348.4	33,857	4.72	1.63
#5		5,494.300	25,005.900	1,662.11	956.37	15,938.8	27,400	4.14	1.89
#6		3,065.030	28,070.930	1,673.74	1,095.32	15,109.3	23,232	1.66	0.75
#11	In	53.960	30,339.830	1,687.37	1,146.98	15,571.2	22,964	1.76	0.79
	Out			1,097.88	1,142.68	9,853.4	17,138	0.71	0.30
#17		0.000	30,505.170	1,094.20	1,145.85	11,380.9	598,921	39.60	0.54
#27		43.270	32,089.210	1,104.93	1,203.73	11,768.8	1,428,289	102.63	0.58
#22		144.330	32,233.540	1,105.56	1,210.93	11,801.2	27,499	1.88	0.56
#23		179.300	32,412.840	1,106.52	1,219.58	11,925.9	32,290	2.22	0.56
#24		1,164.140	33,576.980	1,112.72	1,273.57	12,308.0	30,587	2.36	0.64
#25		648.980	34,225.970	1,115.34	1,301.92	12,714.3	36,776	2.63	0.62

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#65	In	22.110	22.110	6.83	0.30	5.7	21,957	10.68	6.86
	Out			0.00	0.00	5.7	0	0.00	0.00
#61		34.787	34.787	7.22	0.31	6.1	22,829	10.73	6.70
#59		41.030	41.030	6.19	0.36	6.1	19,007	7.72	5.03
#60		0.000	41.030	6.19	0.36	6.1	19,007	7.72	5.03
#62		0.000	75.817	12.57	0.67	12.2	20,441	8.96	5.81
#63		0.000	75.817	11.60	0.67	12.2	21,524	9.43	5.81
#57		4.740	4.740	1.02	0.02	0.9	53,841	30.91	16.47
#58	In	0.000	4.740	1.02	0.02	0.9	53,841	30.91	16.47
	Out			0.00	0.00	0.0	0	0.00	0.00
#55		4.870	4.870	1.50	0.07	26.1	387,542	188.42	125.69
#56	In	0.000	4.870	1.50	0.07	26.1	387,542	188.42	125.69
	Out			0.00	0.00	0.0	0	0.00	0.00
#54		42.850	42.850	8.34	0.38	7.4	22,728	10.41	6.54
#64		0.000	128.277	18.06	1.05	19.6	21,283	9.47	6.13
#29		1.420	1.420	0.59	0.02	0.3	23,183	13.33	8.03
#20		621.290	621.290	43.38	5.03	37.4	7,661	2.68	1.91
#21		751.250	1,372.540	93.28	13.80	102.3	8,489	2.63	1.68
#26	In	16.428	1,388.968	93.91	14.26	102.5	8,209	2.55	1.64
	Out			6.00	1.45	4.3	5,112	0.00	0.00
#28		0.000	1,388.968	6.00	1.45	4.3	164,656	0.00	0.00
#51	In	4.820	4.820	1.04	0.02	1.2	71,415	35.61	19.01
	Out			0.00	0.00	1.2	0	0.00	0.00
#52		0.200	5.020	0.11	0.00	1.9	210,483	145.95	110.40
#48	In	8.810	8.810	0.31	0.03	0.9	26,749	1.75	1.24
	Out			0.00	0.00	0.9	0	0.00	0.00
#49		37.500	46.310	6.63	0.49	251.2	449,180	107.70	76.66
#50	In	0.000	46.310	6.63	0.49	251.2	449,180	107.70	76.66
	Out			0.00	0.00	0.0	0	0.00	0.00
#47		29.270	29.270	3.37	0.15	0.9	7,351	2.39	1.45
#53		0.000	80.600	3.39	0.15	2.8	156,654	89.46	4.14
#43		6.207	6.207	1.33	0.03	1.6	71,873	40.29	21.51
#44	In	0.000	6.207	1.33	0.03	1.6	71,873	40.29	21.51
	Out			0.00	0.00	1.6	0	0.00	0.00
#45		0.000	6.207	0.00	0.00	1.6	1	0.00	0.00
#40		12.150	12.150	2.67	0.16	95.2	520,826	209.52	146.59
#41	In	0.000	12.150	2.67	0.16	95.2	520,826	209.52	146.59
	Out			0.00	0.00	95.2	0	0.00	0.00
#38		66.380	66.380	6.95	0.34	3.6	12,531	5.04	3.09
#39		0.000	66.380	6.95	0.34	3.6	12,531	5.04	3.09

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#42		0.000	78.530	6.95	0.34	98.7	12,531	9.82	6.03
#46		0.000	84.737	6.95	0.34	100.3	12,531	9.82	6.03
#33		14.130	14.130	3.45	0.19	119.4	558,668	237.05	164.67
#34	In	0.000	14.130	3.45	0.19	119.4	558,668	237.05	164.67
	Out			0.00	0.00	0.0	0	0.00	0.00
#35		0.000	14.130	0.00	0.00	0.0	1	0.00	0.00
#36		0.000	14.130	0.00	0.00	0.0	1	0.00	0.00
#37		0.000	14.130	0.00	0.00	0.0	1	0.00	0.00
#30		282.150	282.150	11.40	1.43	11.0	7,837	0.50	0.36
#31		0.000	282.150	11.40	1.43	11.0	7,837	0.50	0.36
#32		0.000	282.150	11.19	1.43	11.0	7,864	0.50	0.36
#18		1,500.640	1,500.640	4.35	1.00	5.0	4,695	1.79	1.41
#19		418.020	1,918.660	15.63	3.12	17.6	6,155	1.10	0.74
#3		3,978.700	3,978.700	53.77	11.55	213.2	18,376	2.13	1.56
#4		3,216.100	7,194.800	93.51	29.65	571.1	29,096	3.32	1.60
#1		8,477.899	8,477.899	151.06	42.61	686.7	27,122	3.75	1.63
#2		3,838.900	12,316.800	322.91	91.74	1,620.4	29,197	3.39	1.50
#5		5,494.300	25,005.900	407.88	194.49	2,449.0	16,101	1.31	0.75
#6		3,065.030	28,070.930	403.97	228.53	2,281.7	12,797	0.66	0.38
#11	In	53.960	30,339.830	404.21	234.25	2,336.1	17,793	1.02	0.42
	Out			184.92	234.25	1,216.6	16,964	0.09	0.02
#17		0.000	30,505.170	184.62	234.74	1,319.8	922,785	60.34	0.27
#27		43.270	32,089.210	184.65	237.63	1,355.4	1,347,077	100.33	0.32
#22		144.330	32,233.540	184.63	239.37	1,359.2	91,261	5.89	0.27
#23		179.300	32,412.840	184.62	241.39	1,377.2	73,103	4.23	0.25
#24		1,164.140	33,576.980	184.56	253.54	1,486.1	33,578	2.15	0.29
#25		648.980	34,225.970	184.47	259.57	1,575.8	29,554	1.63	0.27

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#65	In	22.110	22.110	15.59	0.70	14.8	22,847	11.46	7.68
	Out			0.00	0.00	14.8	0	0.00	0.00
#61		34.787	34.787	19.30	0.85	18.5	24,315	11.98	7.83
#59		41.030	41.030	17.36	0.98	19.1	21,209	9.41	6.29
#60		0.000	41.030	17.36	0.98	19.1	21,209	9.41	6.29
#62		0.000	75.817	34.68	1.83	37.5	22,389	10.48	7.01
#63		0.000	75.817	33.30	1.83	37.5	23,295	10.90	7.01
#57		4.740	4.740	3.23	0.09	3.7	49,899	28.65	17.54
#58	In	0.000	4.740	3.23	0.09	3.7	49,899	28.65	17.54
	Out			0.00	0.00	0.0	0	0.00	0.00
#55		4.870	4.870	3.43	0.16	67.3	400,859	201.10	139.39
#56	In	0.000	4.870	3.43	0.16	67.3	400,859	201.10	139.39
	Out			0.00	0.00	0.1	0	0.00	0.00
#54		42.850	42.850	22.43	1.03	22.6	24,340	11.75	7.71
#64		0.000	128.277	51.53	2.86	60.2	24,300	11.50	7.28
#29		1.420	1.420	1.39	0.04	0.8	22,065	12.69	8.30
#20		621.290	621.290	129.45	14.12	122.9	8,960	3.59	2.56
#21		751.250	1,372.540	250.11	35.80	302.7	9,569	3.40	2.21
#26	In	16.428	1,388.968	251.21	36.72	303.2	9,378	3.34	2.16
	Out			120.57	23.91	115.2	5,567	0.25	0.16
#28		0.000	1,388.968	120.46	23.91	115.2	294,401	13.18	0.16
#51	In	4.820	4.820	3.28	0.09	5.0	66,221	33.02	20.24
	Out			0.00	0.00	5.0	0	0.00	0.00
#52		0.200	5.020	0.24	0.01	6.5	197,117	142.42	106.45
#48	In	8.810	8.810	1.37	0.13	4.3	34,541	4.54	3.18
	Out			0.00	0.00	4.3	0	0.00	0.00
#49		37.500	46.310	16.12	1.17	673.5	488,454	140.09	101.25
#50	In	0.000	46.310	16.12	1.17	673.5	488,454	140.09	101.25
	Out			0.00	0.00	0.0	0	0.00	0.00
#47		29.270	29.270	11.82	0.51	3.7	8,305	3.13	1.99
#53		0.000	80.600	11.85	0.52	10.2	132,686	79.21	4.37
#43		6.207	6.207	4.22	0.11	6.5	66,647	37.36	22.90
#44	In	0.000	6.207	4.22	0.11	6.5	66,647	37.36	22.90
	Out			0.00	0.00	6.5	0	0.00	0.00
#45		0.000	6.207	0.00	0.00	6.5	1	0.00	0.00
#40		12.150	12.150	6.37	0.38	251.5	555,059	239.20	171.36
#41	In	0.000	12.150	6.37	0.38	251.5	555,059	239.20	171.36
	Out			0.00	0.00	251.5	0	0.00	0.00
#38		66.380	66.380	24.73	1.13	14.2	14,381	6.46	4.13
#39		0.000	66.380	24.73	1.13	14.2	14,381	6.46	4.13

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#42		0.000	78.530	24.73	1.13	265.7	14,381	11.20	7.16
#46		0.000	84.737	24.73	1.13	272.2	14,381	11.21	7.16
#33		14.130	14.130	8.09	0.44	312.9	588,177	263.81	188.54
#34	In	0.000	14.130	8.09	0.44	312.9	588,177	263.81	188.54
	Out			0.00	0.00	0.0	0	0.00	0.00
#35		0.000	14.130	0.00	0.00	0.0	1	0.00	0.00
#36		0.000	14.130	0.00	0.00	0.0	1	0.00	0.00
#37		0.000	14.130	0.00	0.00	0.0	1	0.00	0.00
#30		282.150	282.150	42.64	4.81	45.3	9,711	0.84	0.60
#31		0.000	282.150	42.64	4.81	45.3	9,711	0.84	0.60
#32		0.000	282.150	42.02	4.81	45.3	9,812	0.85	0.60
#18		1,500.640	1,500.640	53.12	9.64	74.3	7,680	0.91	0.67
#19		418.020	1,918.660	97.79	16.76	132.3	7,898	1.44	1.05
#3		3,978.700	3,978.700	247.93	49.23	1,124.5	22,446	4.24	3.15
#4		3,216.100	7,194.800	369.85	107.27	2,525.4	36,423	5.92	2.79
#1		8,477.899	8,477.899	580.46	139.16	2,498.1	30,803	5.48	2.33
#2		3,838.900	12,316.800	770.34	255.55	4,475.9	30,982	3.98	1.64
#5		5,494.300	25,005.900	1,125.36	532.11	8,684.9	22,482	2.34	1.24
#6		3,065.030	28,070.930	1,116.63	613.95	8,140.2	18,789	1.16	0.60
#11	In	53.960	30,339.830	1,117.59	638.05	8,377.4	18,728	1.25	0.64
	Out			574.80	638.05	4,594.6	16,707	0.43	0.15
#17		0.000	30,505.170	573.01	639.70	4,877.0	676,066	46.58	0.41
#27		43.270	32,089.210	573.12	667.55	5,085.1	1,409,681	107.17	0.46
#22		144.330	32,233.540	573.00	671.81	5,058.7	29,196	1.87	0.38
#23		179.300	32,412.840	572.94	676.87	5,099.9	31,097	1.83	0.35
#24		1,164.140	33,576.980	572.58	708.09	5,373.1	27,134	2.12	0.48
#25		648.980	34,225.970	572.07	724.19	5,627.3	32,890	2.31	0.45

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#65	In	22.110	22.110	21.91	1.01	21.9	23,148	11.74	8.00
	Out			0.00	0.00	21.9	0	0.00	0.00
#61		34.787	34.787	28.43	1.27	28.8	24,749	12.37	8.24
#59		41.030	41.030	25.94	1.48	30.0	21,871	9.94	6.74
#60		0.000	41.030	25.94	1.48	30.0	21,871	9.94	6.74
#62		0.000	75.817	52.41	2.75	58.8	23,433	11.18	7.44
#63		0.000	75.817	50.21	2.75	58.8	25,033	11.94	7.44
#57		4.740	4.740	4.92	0.14	6.1	48,671	27.95	17.84
#58	In	0.000	4.740	4.92	0.14	6.1	48,671	27.95	17.84
	Out			0.00	0.00	6.1	0	0.00	0.00
#55		4.870	4.870	4.83	0.22	99.8	405,319	205.51	144.81
#56	In	0.000	4.870	4.83	0.22	99.8	405,319	205.51	144.81
	Out			0.21	0.03	0.0	1	0.00	0.00
#54		42.850	42.850	33.09	1.55	35.2	24,809	12.16	8.13
#64		0.000	128.277	77.62	4.33	100.2	23,629	10.68	7.17
#29		1.420	1.420	1.96	0.06	1.3	21,684	12.47	8.41
#20		621.290	621.290	199.87	21.42	197.9	9,501	3.97	2.83
#21		751.250	1,372.540	374.45	53.00	472.6	9,976	3.72	2.44
#26	In	16.428	1,388.968	375.87	54.26	473.2	9,808	3.66	2.39
	Out			243.19	41.45	225.2	5,711	0.31	0.22
#28		0.000	1,388.968	242.85	41.45	225.2	297,689	16.42	0.22
#51	In	4.820	4.820	5.00	0.15	8.3	64,602	32.21	20.59
	Out			0.00	0.00	8.3	0	0.00	0.00
#52		0.200	5.020	0.32	0.01	10.5	193,993	141.43	107.92
#48	In	8.810	8.810	2.33	0.21	7.6	37,248	6.37	4.47
	Out			0.00	0.00	7.6	0	0.00	0.00
#49		37.500	46.310	23.34	1.68	1,016.6	505,352	153.88	111.85
#50	In	0.000	46.310	23.34	1.68	1,016.6	505,352	153.88	111.85
	Out			0.00	0.00	1,016.6	0	0.00	0.00
#47		29.270	29.270	18.61	0.81	6.1	8,528	3.32	2.16
#53		0.000	80.600	18.65	0.82	1,033.3	120,297	1.12	0.07
#43		6.207	6.207	6.44	0.19	10.8	65,018	36.44	23.30
#44	In	0.000	6.207	6.44	0.19	10.8	65,018	36.44	23.30
	Out			0.00	0.00	10.8	0	0.00	0.00
#45		0.000	6.207	0.00	0.00	10.8	1	0.00	0.00
#40		12.150	12.150	9.18	0.55	378.3	571,908	253.17	182.70
#41	In	0.000	12.150	9.18	0.55	378.3	571,908	253.17	182.70
	Out			0.00	0.00	378.3	0	0.00	0.00
#38		66.380	66.380	39.06	1.81	23.9	14,811	6.82	4.45

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#39		0.000	66.380	39.06	1.81	23.9	14,811	6.82	4.45
#42		0.000	78.530	39.06	1.81	402.2	14,811	11.51	7.51
#46		0.000	84.737	39.06	1.81	413.0	14,811	11.52	7.58
#33		14.130	14.130	11.61	0.64	469.4	603,488	276.83	199.62
#34	In	0.000	14.130	11.61	0.64	469.4	603,488	276.83	199.62
	Out			0.00	0.00	469.4	0	0.00	0.00
#35		0.000	14.130	0.00	0.00	469.4	1	0.00	0.00
#36		0.000	14.130	0.00	0.00	469.4	1	0.00	0.00
#37		0.000	14.130	0.00	0.00	469.4	1	0.00	0.00
#30		282.150	282.150	69.75	7.68	77.6	10,396	1.21	0.86
#31		0.000	282.150	69.75	7.68	77.6	10,396	1.21	0.86
#32		0.000	282.150	68.94	7.68	77.6	10,506	1.22	0.86
#18		1,500.640	1,500.640	110.80	19.01	166.6	8,857	1.56	1.13
#19		418.020	1,918.660	185.46	30.38	266.4	8,812	1.93	1.41
#3		3,978.700	3,978.700	435.68	83.60	2,070.6	24,176	5.35	4.00
#4		3,216.100	7,194.800	626.52	175.22	4,432.4	39,287	7.16	3.36
#1		8,477.899	8,477.899	964.91	222.07	4,174.9	32,024	6.54	2.80
#2		3,838.900	12,316.800	1,115.80	389.57	6,869.7	31,842	4.28	1.73
#5		5,494.300	25,005.900	1,715.48	806.96	14,674.4	25,413	3.45	1.80
#6		3,065.030	28,070.930	1,702.17	926.00	13,763.8	21,636	1.43	0.72
#11	In	53.960	30,339.830	1,703.68	967.61	14,661.3	21,551	1.48	0.74
	Out			1,105.11	967.61	8,707.9	16,737	0.54	0.23
#17		0.000	30,505.170	1,100.79	970.24	10,154.2	543,334	32.66	0.44
#27		43.270	32,089.210	1,100.81	1,017.64	10,535.9	2,312,409	153.51	0.48
#22		144.330	32,233.540	1,100.54	1,023.82	10,562.2	37,965	2.37	0.46
#23		179.300	32,412.840	1,100.38	1,031.23	10,686.8	29,248	1.85	0.46
#24		1,164.140	33,576.980	1,099.51	1,077.29	11,008.5	28,558	2.03	0.53
#25		648.980	34,225.970	1,098.28	1,101.36	11,366.1	34,454	2.20	0.49

SEDCAD 4 for Windows - 50-Year 6-Hour Storm Summary

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#65	In	22.110	22.110	27.32	1.28	28.3	23,330	11.90	8.21
	Out			0.00	0.00	28.3	0	0.00	0.00
#61		34.787	34.787	36.38	1.66	38.3	24,999	12.60	8.50
#59		41.030	41.030	33.78	1.92	40.3	22,475	10.40	7.08
#60		0.000	41.030	33.78	1.92	40.3	22,475	10.40	7.08
#62		0.000	75.817	68.07	3.58	78.6	23,500	11.34	7.73
#63		0.000	75.817	65.13	3.58	78.6	24,288	11.72	7.73
#57		4.740	4.740	6.40	0.20	8.5	48,003	27.56	18.03
#58	In	0.000	4.740	6.40	0.20	8.5	48,003	27.56	18.03
	Out			0.15	0.02	0.0	0	0.00	0.00
#55		4.870	4.870	6.02	0.28	128.9	408,013	208.19	148.25
#56	In	0.000	4.870	6.02	0.28	128.9	408,013	208.19	148.25
	Out			1.01	0.09	0.0	68	0.00	0.00
#54		42.850	42.850	42.39	2.02	46.9	25,081	12.41	8.39
#64		0.000	128.277	100.69	5.71	125.5	23,801	11.59	7.82
#29		1.420	1.420	2.45	0.08	1.7	21,456	12.34	8.49
#20		621.290	621.290	263.35	27.99	268.3	9,842	4.21	3.01
#21		751.250	1,372.540	485.57	68.30	629.9	10,261	3.94	2.59
#26	In	16.428	1,388.968	487.24	69.83	630.7	10,093	3.88	2.54
	Out			367.83	57.02	327.5	5,819	0.34	0.25
#28		0.000	1,388.968	366.37	57.02	327.5	303,829	17.91	0.25
#51	In	4.820	4.820	6.51	0.20	11.5	63,721	31.77	20.81
	Out			0.00	0.00	11.5	0	0.00	0.00
#52		0.200	5.020	0.39	0.01	14.3	190,830	139.84	105.31
#48	In	8.810	8.810	3.24	0.29	10.9	38,927	7.54	5.29
	Out			0.00	0.00	10.9	0	0.00	0.00
#49		37.500	46.310	29.69	2.13	1,329.0	516,821	163.10	118.94
#50	In	0.000	46.310	29.69	2.13	1,329.0	516,821	163.10	118.94
	Out			0.00	0.00	0.0	0	0.00	0.00
#47		29.270	29.270	24.69	1.09	8.5	8,646	3.43	2.26
#53		0.000	80.600	24.74	1.11	22.8	127,830	77.62	4.54
#43		6.207	6.207	8.38	0.26	14.9	64,131	35.95	23.54
#44	In	0.000	6.207	8.38	0.26	14.9	64,131	35.95	23.54
	Out			0.00	0.00	14.9	0	0.00	0.00
#45		0.000	6.207	0.00	0.00	14.9	1	0.00	0.00
#40		12.150	12.150	11.62	0.69	492.7	581,919	261.56	189.76
#41	In	0.000	12.150	11.62	0.69	492.7	581,919	261.56	189.76
	Out			0.00	0.00	492.7	0	0.00	0.00
#38		66.380	66.380	51.89	2.44	33.1	15,039	7.02	4.64
#39		0.000	66.380	51.89	2.44	33.1	15,039	7.02	4.64

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#42		0.000	78.530	51.89	2.44	525.8	16,015	12.43	7.72
#46		0.000	84.737	51.89	2.44	540.7	17,864	13.88	7.72
#33		14.130	14.130	14.64	0.81	610.2	612,556	284.48	206.42
#34	In	0.000	14.130	14.64	0.81	610.2	612,556	284.48	206.42
	Out			0.72	0.08	0.0	1	0.00	0.00
#35		0.000	14.130	0.72	0.08	0.0	1	0.00	0.00
#36		0.000	14.130	0.72	0.08	0.0	1	0.00	0.00
#37		0.000	14.130	0.72	0.08	0.0	1	0.00	0.00
#30		282.150	282.150	95.07	10.33	109.0	10,847	1.46	1.04
#31		0.000	282.150	95.07	10.33	109.0	10,847	1.46	1.04
#32		0.000	282.150	93.90	10.33	109.0	10,949	1.47	1.04
#18		1,500.640	1,500.640	171.57	28.46	267.0	9,521	1.97	1.42
#19		418.020	1,918.660	273.10	43.75	407.1	9,370	2.26	1.64
#3		3,978.700	3,978.700	618.30	116.20	3,026.7	25,296	6.09	4.57
#4		3,216.100	7,194.800	870.12	238.63	6,310.5	41,077	7.97	3.74
#1		8,477.899	8,477.899	1,327.01	298.86	5,794.0	32,830	7.28	3.14
#2		3,838.900	12,316.800	1,467.02	511.26	9,229.0	32,788	4.57	1.84
#5		5,494.300	25,005.900	2,252.56	1,056.00	20,349.1	27,193	4.27	2.21
#6		3,065.030	28,070.930	2,235.29	1,208.13	19,111.5	23,120	1.69	0.85
#11	In	53.960	30,339.830	2,237.39	1,266.70	19,732.9	23,016	1.81	0.90
	Out			1,770.29	1,266.70	12,773.4	16,800	0.72	0.34
#17		0.000	30,505.170	1,759.82	1,270.24	13,336.9	493,985	36.25	0.59
#27		43.270	32,089.210	1,759.53	1,335.08	13,852.8	1,433,797	112.94	0.63
#22		144.330	32,233.540	1,758.79	1,342.95	13,912.3	28,835	2.20	0.61
#23		179.300	32,412.840	1,758.37	1,352.42	14,075.2	30,567	2.35	0.62
#24		1,164.140	33,576.980	1,756.02	1,411.65	14,724.4	29,504	2.53	0.70
#25		648.980	34,225.970	1,752.63	1,442.84	15,306.0	35,491	2.92	0.69

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#65	In	22.110	22.110	33.32	1.59	35.6	23,486	12.05	8.39
	Out			0.00	0.00	35.6	0	0.00	0.00
#61		34.787	34.787	45.37	2.10	49.5	25,206	12.79	8.72
#59		41.030	41.030	42.70	2.43	52.5	22,975	10.78	7.38
#60		0.000	41.030	42.70	2.43	52.5	22,975	10.78	7.38
#62		0.000	75.817	85.93	4.53	101.9	23,881	11.64	8.00
#63		0.000	75.817	82.12	4.53	101.9	25,727	12.54	8.00
#57		4.740	4.740	8.09	0.26	11.3	47,424	27.23	18.19
#58	In	0.000	4.740	8.09	0.26	11.3	47,424	27.23	18.19
	Out			0.79	0.08	0.0	37	0.00	0.00
#55		4.870	4.870	7.34	0.35	162.5	410,319	210.49	151.33
#56	In	0.000	4.870	7.34	0.35	162.5	410,319	210.49	151.33
	Out			1.82	0.16	0.2	2,850	0.00	0.00
#54		42.850	42.850	52.89	2.55	60.6	25,305	12.61	8.63
#64		0.000	128.277	127.32	7.32	162.7	24,065	11.81	7.96
#29		1.420	1.420	2.99	0.11	2.1	21,249	12.22	8.56
#20		621.290	621.290	336.79	35.57	352.1	10,146	4.43	3.17
#21		751.250	1,372.540	613.40	85.84	815.9	10,529	4.13	2.74
#26	In	16.428	1,388.968	615.34	87.68	816.8	10,368	4.08	2.68
	Out			513.38	74.87	450.3	5,951	0.49	0.36
#28		0.000	1,388.968	512.27	74.87	450.3	301,255	24.81	0.36
#51	In	4.820	4.820	8.22	0.26	15.3	62,958	31.39	21.00
	Out			0.00	0.00	0.7	0	0.00	0.00
#52		0.200	5.020	0.47	0.02	4.3	1,175,625	482.37	100.68
#48	In	8.810	8.810	4.31	0.38	14.9	40,364	8.52	5.99
	Out			0.00	0.00	0.0	0	0.00	0.00
#49		37.500	46.310	36.87	2.64	1,677.5	526,831	168.96	123.62
#50	In	0.000	46.310	36.87	2.64	1,677.5	526,831	168.96	123.62
	Out			1.66	0.45	0.0	12	0.00	0.00
#47		29.270	29.270	31.67	1.42	11.3	8,743	3.52	2.34
#53		0.000	80.600	31.73	1.89	15.6	107,557	43.34	3.06
#43		6.207	6.207	10.59	0.34	19.8	63,363	35.52	23.76
#44	In	0.000	6.207	10.59	0.34	19.8	63,363	35.52	23.76
	Out			0.00	0.00	0.0	0	0.00	0.00
#45		0.000	6.207	0.00	0.00	0.0	1	0.00	0.00
#40		12.150	12.150	14.35	0.86	625.1	590,405	268.72	195.96

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#41	In	0.000	12.150	14.35	0.86	625.1	590,405	268.72	195.96
	Out			0.00	0.00	21.0	0	0.00	0.00
#38		66.380	66.380	66.66	3.17	44.1	15,226	7.18	4.80
#39		0.000	66.380	66.66	3.17	44.1	15,226	7.18	4.80
#42		0.000	78.530	66.66	3.17	65.2	75,781	24.00	8.75
#46		0.000	84.737	66.66	3.17	65.2	75,781	24.00	8.75
#33		14.130	14.130	18.03	1.00	773.3	620,237	291.06	212.45
#34	In	0.000	14.130	18.03	1.00	773.3	620,237	291.06	212.45
	Out			3.87	0.27	0.0	96	0.00	0.00
#35		0.000	14.130	3.87	0.27	0.0	96	0.00	0.00
#36		0.000	14.130	3.87	0.27	0.0	96	0.00	0.00
#37		0.000	14.130	3.87	0.27	0.0	96	0.00	0.00
#30		282.150	282.150	124.90	13.44	147.2	11,242	1.71	1.22
#31		0.000	282.150	124.90	13.44	147.2	11,242	1.71	1.22
#32		0.000	282.150	123.29	13.44	147.2	11,338	1.73	1.22
#18		1,500.640	1,500.640	248.52	40.22	398.7	10,071	2.31	1.69
#19		418.020	1,918.660	381.44	60.11	587.9	9,855	2.55	1.85
#3		3,978.700	3,978.700	840.39	155.26	4,225.4	26,304	6.75	5.11
#4		3,216.100	7,194.800	1,161.81	313.80	8,625.0	42,641	8.68	4.07
#1		8,477.899	8,477.899	1,758.29	389.46	7,763.8	33,478	8.03	3.49
#2		3,838.900	12,316.800	1,925.66	652.91	12,204.1	33,903	4.93	1.98
#5		5,494.300	25,005.900	2,878.92	1,345.50	27,209.5	28,612	4.89	2.52
#6		3,065.030	28,070.930	2,856.64	1,535.61	25,584.6	24,461	2.18	1.08
#11	In	53.960	30,339.830	2,859.34	1,614.82	26,449.2	24,325	2.30	1.13
	Out			2,431.60	1,614.82	18,237.1	16,855	0.79	0.41
#17		0.000	30,505.170	2,423.46	1,619.89	18,317.8	441,179	21.36	0.43
#27		43.270	32,089.210	2,423.57	1,704.75	19,025.3	35,785	1.99	0.49
#22		144.330	32,233.540	2,422.95	1,714.55	19,105.6	31,306	1.68	0.47
#23		179.300	32,412.840	2,422.58	1,726.38	19,299.3	33,525	1.85	0.49
#24		1,164.140	33,576.980	2,420.65	1,800.69	20,355.2	30,405	2.65	0.78
#25		648.980	34,225.970	2,417.58	1,840.06	21,127.7	36,229	3.08	0.78

Attachment 41.C-5

No Name Arroyo Hydrology and Sedimentology SEDCAD™ Model Output
with Pinabete Diversion Reclaimed During Operations in Area 5

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General Information

Storm Information:

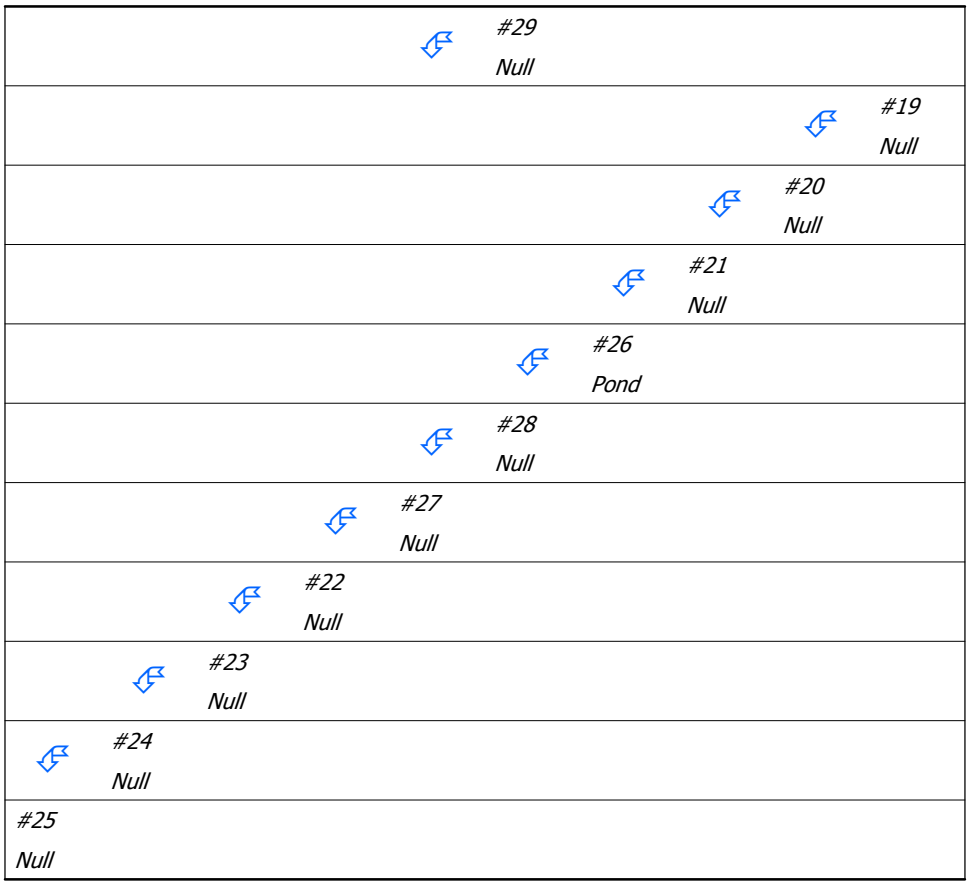
Storm Type:	NRCS TYPE II-70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Particle Size Distribution:

Table 41.C-3

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#19	==>	#20	0.814	0.291	NN SWS01
Null	#20	==>	#21	0.656	0.345	NN SWS02
Null	#21	==>	#26	0.000	0.000	NN SWS03,04,05
Null	#22	==>	#23	0.096	0.358	NN SWS07
Null	#23	==>	#24	0.681	0.307	NN SWS08
Null	#24	==>	#25	1.027	0.307	NN SWS09,10,11,12,13,14
Null	#25	==>	End	0.000	0.000	NN SWS15,16,17,18,19
Pond	#26	==>	#28	0.063	0.380	S03 Impoundment Area
Null	#27	==>	#22	0.250	0.320	NNSWS06C
Null	#28	==>	#27	0.240	0.246	NNSWS06A
Null	#29	==>	#27	0.205	0.246	NNSWS06B



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#26	8. Large gullies, diversions, and low flowing streams	3.23	40.00	1,239.00	5.39	0.063
#26	**Muskingum K:**					**0.063**
#27	8. Large gullies, diversions, and low flowing streams	1.02	28.00	2,736.00	3.03	0.250
#27	**Muskingum K:**					**0.250**
#28	8. Large gullies, diversions, and low flowing streams	0.30	4.26	1,420.00	1.64	0.240
#28	**Muskingum K:**					**0.240**
#29	8. Large gullies, diversions, and low flowing streams	0.30	3.64	1,216.00	1.64	0.205
#29	**Muskingum K:**					**0.205**

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Particle Size Distribution(s) at Each Structure

Structure #29 (NNSWS06B):

Size (mm)	In/Out
0.4250	100.000%
0.2500	77.393%
0.1500	57.877%
0.0750	43.197%
0.0159	37.191%
0.0100	28.724%
0.0050	7.539%
0.0020	4.580%
0.0010	4.153%
0.0004	3.748%

Structure #19 (NN SWS01):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	87.633%
0.0100	65.880%
0.0050	28.144%
0.0020	17.046%
0.0010	15.702%
0.0004	14.553%

Structure #20 (NN SWS02):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	89.638%
0.0159	81.638%

Size (mm)	In/Out
0.0100	69.335%
0.0050	35.359%
0.0020	21.872%
0.0010	20.007%
0.0004	18.643%

Structure #21 (NN SWS03,04,05):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	95.500%
0.0750	86.283%
0.0159	79.255%
0.0100	66.436%
0.0050	27.845%
0.0020	17.407%
0.0010	15.798%
0.0004	14.743%

Structure #26 (S03 Impoundment Area):

Size (mm)	In	Out
0.4250	99.899%	100.000%
0.2500	99.899%	100.000%
0.1500	95.403%	100.000%
0.0750	86.196%	100.000%
0.0159	79.175%	100.000%
0.0100	66.369%	100.000%
0.0050	27.817%	48.170%
0.0020	17.389%	30.113%
0.0010	15.782%	27.330%
0.0004	14.728%	25.504%

Structure #28 (NNSWS06A):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	97.915%
0.0750	96.131%
0.0159	95.402%
0.0100	94.373%

Size (mm)	In/Out
0.0050	59.516%
0.0020	37.190%
0.0010	33.753%
0.0004	31.482%

Structure #27 (NNSWS06C):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	96.137%
0.0750	86.166%
0.0159	82.086%
0.0100	76.335%
0.0050	43.611%
0.0020	27.162%
0.0010	24.650%
0.0004	22.906%

Structure #22 (NN SWS07):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	84.593%
0.0159	76.270%
0.0100	64.536%
0.0050	27.199%
0.0020	16.815%
0.0010	15.256%
0.0004	14.055%

Structure #23 (NN SWS08):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	98.843%
0.0750	83.377%
0.0159	74.886%
0.0100	62.961%
0.0050	25.522%

Size (mm)	In/Out
0.0020	15.732%
0.0010	14.288%
0.0004	13.127%

Structure #24 (NN SWS09,10,11,12,13,14):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	97.960%
0.0750	86.463%
0.0159	76.762%
0.0100	63.448%
0.0050	20.982%
0.0020	12.552%
0.0010	11.459%
0.0004	10.369%

Structure #25:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	97.846%
0.0750	92.192%
0.0159	81.596%
0.0100	67.059%
0.0050	21.172%
0.0020	12.546%
0.0010	11.457%
0.0004	10.348%

Structure Detail:

Structure #29 (Null)

NNSWS06B

Structure #19 (Null)

NN SWS01

Structure #20 (Null)

NN SWS02

Structure #21 (Null)

NN SWS03,04,05

Structure #26 (Pond)

S03 Impoundment Area

Pond Inputs:

Initial Pool Elev:	5,441.01 ft
Initial Pool:	0.00 ac-ft
*Sediment Storage:	0.00 ac-ft
Dead Space:	0.00 %

**No sediment capacity defined*

Pond Results:

Peak Elevation:	5,447.76 ft
H'graph Detention Time:	1.60 hrs
Pond Model:	CSTRS
Dewater Time:	1.27 days
Trap Efficiency:	42.25 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,441.00	0.000	0.000	0.000		Top of Sed. Storage
5,441.01	0.011	0.000	0.000		
5,442.00	1.075	0.394	0.001		
5,443.00	2.094	1.951	0.001		
5,444.00	2.823	4.400	0.001		

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
5,445.00	4.127	7.855	0.001		
5,446.00	5.827	12.807	0.001		
5,447.00	7.996	19.690	55.000	27.15	
5,447.76	9.919	26.685	241.090	3.25	Peak Stage
5,448.00	10.478	28.899	300.000		
5,448.48	12.103	34.314	574.837		
5,449.00	13.565	40.984	872.600		
5,450.00	16.428	55.958	1,000.000		

Detailed Discharge Table

Elevation (ft)	User-input discharge (cfs)	Combined Total Discharge (cfs)
5,441.00	0.000	0.000
5,441.01	0.000	0.000
5,442.00	0.001	0.001
5,443.00	0.001	0.001
5,444.00	0.001	0.001
5,445.00	0.001	0.001
5,446.00	0.001	0.001
5,447.00	55.000	55.000
5,448.00	300.000	300.000
5,448.48	574.837	574.837
5,449.00	872.600	872.600
5,450.00	1,000.000	1,000.000

Structure #28 (Null)

NNSWS06A

Structure #27 (Null)

NNSWS06C

Structure #22 (Null)

NN SWS07

Structure #23 (Null)

NN SWS08

Structure #24 (Null)

NN SWS09,10,11,12,13,14

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Structure #25 (Null)

NN SWS15,16,17,18,19

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#29	1	1.420	0.041	0.000	0.000	86.200	M	1.81	0.073
	Σ	**1.420**						**1.81**	**0.073**
#19	1	999.370	1.261	0.000	0.000	81.700	M	162.56	29.766
	Σ	**999.370**						**162.56**	**29.766**
#20	1	621.290	0.898	0.000	0.000	85.700	M	189.63	25.364
	Σ	**1,620.660**						**201.63**	**55.130**
#21	1	431.580	0.682	0.409	0.297	88.800	M	207.61	22.168
	2	151.130	0.000	0.193	0.261	87.000	M	201.26	8.536
	3	172.140	0.414	0.000	0.000	87.400	M	99.93	8.008
	Σ	**2,375.510**						**342.91**	**93.842**
#26	1	16.428	0.000	0.000	0.000	93.000	M	29.38	1.427
	Σ	**2,391.938**						**344.22**	**95.269**
#28	1	27.060	0.127	0.000	0.000	86.200	M	20.63	1.170
	Σ	**2,418.998**						**241.73**	**83.626**
#27	1	184.960	0.357	0.000	0.000	86.200	M	104.69	7.871
	Σ	**2,605.378**						**245.92**	**91.570**
#22	1	516.780	0.565	0.000	0.000	88.400	M	271.74	25.785
	Σ	**3,122.158**						**374.76**	**117.355**
#23	1	127.290	0.362	0.000	0.000	87.900	M	82.40	6.139
	Σ	**3,249.448**						**404.50**	**123.495**
#24	1	126.980	0.164	0.545	0.308	86.900	M	101.83	5.787
	2	235.630	0.327	0.427	0.341	86.700	M	144.93	10.409
	3	258.380	0.416	0.365	0.294	88.300	M	161.17	12.840
	4	180.930	0.449	0.176	0.301	86.700	M	94.53	7.968
	5	189.850	0.326	0.146	0.330	86.800	M	117.89	8.448
	6	172.360	0.753	0.000	0.000	88.300	M	74.40	8.537
	Σ	**4,413.578**						**622.91**	**177.484**
#25	1	91.450	0.220	0.854	0.310	86.800	M	65.92	4.081
	2	286.490	0.566	0.642	0.312	87.100	M	134.68	12.994
	3	75.280	0.179	0.610	0.308	86.800	M	58.49	3.393
	4	128.700	0.157	0.270	0.325	86.800	M	102.47	5.822
	5	67.060	0.333	0.000	0.000	82.000	M	27.39	2.057
	Σ	**5,062.558**						**647.51**	**205.832**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#29	1	0.183	100.00	9.10	0.1990	1.0000	7	1.3	23,225	13.35	7.75
	Σ							**1.3**	**23,225**	**13.35**	**7.75**
#19	1	0.233	280.00	2.40	0.2650	1.0000	1	308.7	12,523	3.66	2.22
	Σ							**308.7**	**12,523**	**3.66**	**2.22**
#20	1	0.245	420.00	1.40	0.2450	1.0000	2	211.2	10,132	4.30	2.59
	Σ							**354.5**	**10,021**	**2.60**	**1.22**
#21	1	0.235	280.00	2.20	0.2330	1.0000	3	246.1	13,345	6.40	3.90
	2	0.204	280.00	2.30	0.2330	1.0000	4	112.7	17,004	10.21	5.80
	3	0.158	240.00	3.80	0.2110	1.0000	5	88.3	13,922	5.87	3.41
	Σ							**631.8**	**12,640**	**3.61**	**1.41**
#26	1	1.000	0.50	0.10	0.1000	1.0000	36	0.6	514	0.41	0.26
	Σ							**632.4**	**12,483**	**3.57**	**1.40**
#28	1	0.183	100.00	9.10	0.1990	1.0000	7	27.4	30,526	15.36	8.57
	Σ							**300.2**	**30,524**	**2.23**	**0.19**
#27	1	0.183	100.00	9.10	0.1990	1.0000	7	199.4	32,293	14.59	8.33
	Σ							**464.2**	**1,306,580**	**272.14**	**0.77**
#22	1	0.183	100.00	9.10	0.1990	1.0000	7	662.4	31,375	12.99	7.74
	Σ							**1,066.6**	**30,093**	**9.04**	**2.00**
#23	1	0.170	100.00	10.10	0.1890	1.0000	8	161.5	33,026	14.07	8.16
	Σ							**1,217.9**	**30,158**	**9.44**	**2.26**
#24	1	0.160	100.00	11.50	0.1990	1.0000	5	207.4	44,285	21.62	12.68
	2	0.145	100.00	12.00	0.2110	1.0000	15	360.7	43,171	18.39	10.71
	3	0.171	100.00	8.20	0.1850	1.0000	10	246.1	23,504	9.41	5.60
	4	0.150	75.00	12.10	0.2110	1.0000	11	215.6	33,725	13.34	7.79
	5	0.143	75.00	13.30	0.2110	1.0000	15	271.8	40,504	17.28	9.97
	6	0.164	75.00	13.90	0.1850	1.0000	12	225.3	31,654	9.95	6.04
	Σ							**2,436.6**	**29,141**	**9.13**	**3.14**
#25	1	0.143	100.00	10.40	0.2110	1.0000	15	110.9	33,271	15.18	9.02
	2	0.162	75.00	15.20	0.2220	1.0000	13	527.1	48,820	18.88	11.36
	3	0.143	75.00	20.10	0.2110	1.0000	15	180.8	64,982	30.56	18.04
	4	0.143	100.00	8.10	0.2110	1.0000	15	113.6	24,801	11.77	6.76
	5	0.215	100.00	8.20	0.2760	1.0000	14	61.3	39,773	19.09	10.40
	Σ							**3,029.3**	**34,723**	**10.01**	**3.10**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#20	1	5. Nearly bare and untilled, and alluvial valley fans	2.24	10.00	446.20	1.490	0.083
		8. Large gullies, diversions, and low flowing streams	0.82	65.00	7,955.70	2.710	0.815
#20	**1**	**Time of Concentration:**					**0.898**
#21	1	8. Large gullies, diversions, and low flowing streams	0.92	65.00	7,055.50	2.870	0.682
#21	**1**	**Time of Concentration:**					**0.682**
#21	2		1.72	85.00	4,932.40	0.000	0.000
#21	**2**	**Time of Concentration:**					**0.000**
#21	3	8. Large gullies, diversions, and low flowing streams	1.60	90.00	5,640.40	3.780	0.414
#21	**3**	**Time of Concentration:**					**0.414**
#23	1	5. Nearly bare and untilled, and alluvial valley fans	0.93	5.00	540.30	0.960	0.156
		8. Large gullies, diversions, and low flowing streams	3.57	150.00	4,203.79	5.660	0.206
#23	**1**	**Time of Concentration:**					**0.362**
#27	1	5. Nearly bare and untilled, and alluvial valley fans	3.24	10.00	309.00	1.790	0.047
		8. Large gullies, diversions, and low flowing streams	1.64	70.00	4,280.00	3.830	0.310
#27	**1**	**Time of Concentration:**					**0.357**
#28	1	8. Large gullies, diversions, and low flowing streams	2.37	50.00	2,113.00	4.610	0.127
#28	**1**	**Time of Concentration:**					**0.127**
#29	1	5. Nearly bare and untilled, and alluvial valley fans	4.13	5.00	121.00	2.030	0.016
		8. Large gullies, diversions, and low flowing streams	2.39	10.00	419.00	4.630	0.025
#29	**1**	**Time of Concentration:**					**0.041**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#27	1	8. Large gullies, diversions, and low flowing streams	0.30	16.15	5,384.09	1.640	0.911
#27	**1**	**Muskingum K:**					**0.000**

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#29		1.420	1.420	1.81	0.07	1.3	23,225	13.35	7.75
#19		999.370	999.370	162.56	29.77	308.7	12,523	3.66	2.22
#20		621.290	1,620.660	201.63	55.13	354.5	10,021	2.60	1.22
#21		754.850	2,375.510	342.91	93.84	631.8	12,640	3.61	1.41
#26	In	16.428	2,391.938	344.22	95.27	632.4	12,483	3.57	1.40
	Out			241.09	82.46	365.2	6,910	0.31	0.15
#28		27.060	2,418.998	241.73	83.63	300.2	30,524	2.23	0.19
#27		184.960	2,605.378	245.92	91.57	464.2	1,306,580	272.14	0.77
#22		516.780	3,122.158	374.76	117.36	1,066.6	30,093	9.04	2.00
#23		127.290	3,249.448	404.50	123.49	1,217.9	30,158	9.44	2.26
#24		1,164.130	4,413.578	622.91	177.48	2,436.6	29,141	9.13	3.14
#25		648.980	5,062.558	647.51	205.83	3,029.3	34,723	10.01	3.10

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#29		1.420	1.420	0.59	0.02	0.3	23,183	13.33	8.03
#19		999.370	999.370	24.54	4.06	35.1	8,569	1.37	1.01
#20		621.290	1,620.660	43.50	9.09	51.7	7,641	1.94	1.06
#21		754.850	2,375.510	90.06	18.26	117.3	11,265	3.06	1.28
#26	In	16.428	2,391.938	90.69	18.73	117.5	11,017	3.00	1.25
	Out			19.74	5.91	20.3	5,926	0.00	0.00
#28		27.060	2,418.998	19.74	6.15	9.7	26,374	6.90	0.30
#27		184.960	2,605.378	29.59	7.79	45.8	1,096,464	386.13	1.51
#22		516.780	3,122.158	101.42	14.03	193.8	24,976	8.88	3.58
#23		127.290	3,249.448	108.97	15.46	221.6	24,044	8.28	3.60
#24		1,164.130	4,413.578	162.85	27.61	450.9	22,622	5.98	3.15
#25		648.980	5,062.558	171.82	33.64	569.3	27,921	6.37	2.82

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#29		1.420	1.420	1.39	0.04	0.8	22,065	12.69	8.30
#19		999.370	999.370	102.78	14.94	162.3	10,997	2.81	2.03
#20		621.290	1,620.660	131.39	29.06	190.7	8,900	2.32	1.26
#21		754.850	2,375.510	241.27	51.81	368.8	11,753	3.38	1.50
#26	In	16.428	2,391.938	242.37	52.73	369.2	11,581	3.33	1.48
	Out			153.73	39.92	187.7	6,381	0.24	0.13
#28		27.060	2,418.998	154.04	40.58	138.6	28,091	1.85	0.17
#27		184.960	2,605.378	156.08	45.06	238.6	1,253,785	274.31	0.85
#22		516.780	3,122.158	266.11	60.30	622.9	27,159	8.38	2.33
#23		127.290	3,249.448	288.10	63.90	709.5	26,953	8.47	2.55
#24		1,164.130	4,413.578	436.80	95.11	1,430.9	25,964	7.68	3.25
#25		648.980	5,062.558	455.84	111.22	1,788.2	31,271	8.38	3.14

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#29		1.420	1.420	1.96	0.06	1.3	21,684	12.47	8.41
#19		999.370	999.370	172.71	24.46	286.1	11,847	3.37	2.44
#20		621.290	1,620.660	214.15	45.88	330.3	9,408	2.41	1.35
#21		754.850	2,375.510	360.90	79.05	590.3	11,844	3.31	1.53
#26	In	16.428	2,391.938	362.32	80.30	590.9	11,694	3.28	1.51
	Out			257.48	67.49	351.0	6,551	0.30	0.18
#28		27.060	2,418.998	258.23	68.48	286.0	28,592	2.09	0.22
#27		184.960	2,605.378	262.81	75.21	439.8	1,418,111	291.21	0.88
#22		516.780	3,122.158	394.45	97.35	1,003.0	28,075	8.21	2.20
#23		127.290	3,249.448	426.47	102.60	1,146.4	28,150	8.60	2.49
#24		1,164.130	4,413.578	653.52	148.67	2,284.7	27,210	8.28	3.41
#25		648.980	5,062.558	679.28	172.74	2,839.5	32,564	9.07	3.34

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#29		1.420	1.420	2.45	0.08	1.7	21,456	12.34	8.49
#19		999.370	999.370	238.50	33.34	407.6	12,383	3.74	2.70
#20		621.290	1,620.660	291.51	61.33	467.1	9,722	2.47	1.42
#21		754.850	2,375.510	467.72	103.68	798.6	11,903	3.28	1.56
#26	In	16.428	2,391.938	469.39	105.22	799.4	11,764	3.25	1.54
	Out			379.45	92.40	508.6	6,665	0.33	0.20
#28		27.060	2,418.998	379.68	93.69	448.5	28,882	2.19	0.27
#27		184.960	2,605.378	383.52	102.45	651.5	1,318,062	261.00	0.92
#22		516.780	3,122.158	508.75	130.64	1,348.2	28,433	7.80	2.07
#23		127.290	3,249.448	548.37	137.36	1,536.8	28,487	8.27	2.37
#24		1,164.130	4,413.578	846.26	196.59	3,065.6	28,083	8.52	3.45
#25		648.980	5,062.558	878.83	227.78	3,806.6	33,421	9.38	3.42

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#29		1.420	1.420	2.99	0.11	2.1	21,249	12.22	8.56
#19		999.370	999.370	317.38	43.86	557.8	12,883	4.07	2.94
#20		621.290	1,620.660	383.02	79.43	634.8	10,021	2.54	1.48
#21		754.850	2,375.510	590.54	132.26	1,047.7	11,955	3.26	1.58
#26	In	16.428	2,391.938	592.48	134.11	1,048.6	11,826	3.23	1.57
	Out			516.67	121.30	701.4	6,790	0.35	0.22
#28		27.060	2,418.998	517.18	122.93	650.3	29,120	2.25	0.30
#27		184.960	2,605.378	521.98	134.01	912.2	30,469	5.89	0.96
#22		516.780	3,122.158	638.98	169.10	1,764.8	28,873	7.76	2.05
#23		127.290	3,249.448	687.91	177.50	2,006.1	28,906	8.26	2.36
#24		1,164.130	4,413.578	1,067.16	251.81	3,993.8	28,812	8.85	3.55
#25		648.980	5,062.558	1,107.64	291.18	4,954.9	34,063	9.70	3.53

Attachment 41.C-6

Brimhall Wash Hydrology and Sedimentology SEDCAD™ Model Output

During Operations in Area 5

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General Information

Storm Information:

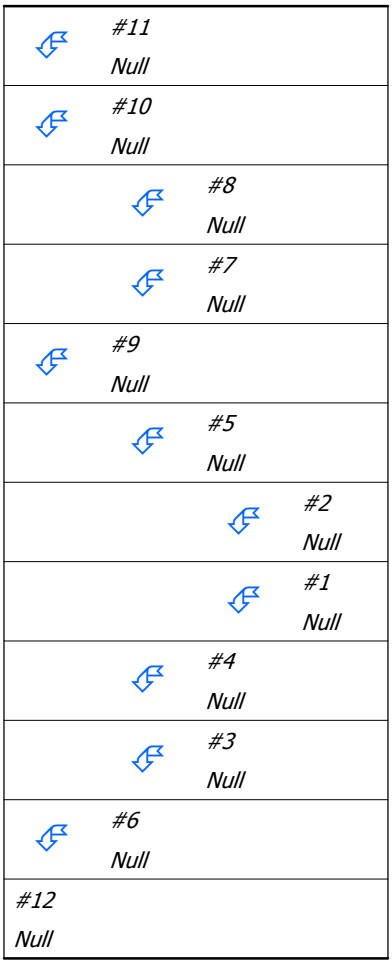
Storm Type:	Type II-70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Particle Size Distribution:

Table 41.C-5

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#4	7.026	0.289	
Null	#2	==>	#4	6.888	0.289	
Null	#3	==>	#6	2.906	0.256	
Null	#4	==>	#6	1.008	0.263	
Null	#5	==>	#6	0.075	0.263	
Null	#6	==>	#12	3.138	0.266	
Null	#7	==>	#9	1.050	0.280	
Null	#8	==>	#9	0.683	0.314	
Null	#9	==>	#12	2.860	0.269	
Null	#10	==>	#12	1.670	0.267	
Null	#11	==>	#12	1.194	0.263	
Null	#12	==>	End	0.000	0.000	



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Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.60	354.00	58,687.00	2.32	7.026
#1	**Muskingum K:**					**7.026**
#2	8. Large gullies, diversions, and low flowing streams	0.61	350.00	57,784.38	2.33	6.888
#2	**Muskingum K:**					**6.888**
#3	8. Large gullies, diversions, and low flowing streams	0.35	66.00	18,623.02	1.78	2.906
#3	**Muskingum K:**					**2.906**
#4	8. Large gullies, diversions, and low flowing streams	0.40	27.00	6,828.00	1.88	1.008
#4	**Muskingum K:**					**1.008**
#5	8. Large gullies, diversions, and low flowing streams	0.39	2.00	509.00	1.88	0.075
#5	**Muskingum K:**					**0.075**
#6	8. Large gullies, diversions, and low flowing streams	0.42	92.00	21,916.00	1.94	3.138
#6	**Muskingum K:**					**3.138**
#7	8. Large gullies, diversions, and low flowing streams	0.52	43.00	8,206.00	2.17	1.050
#7	**Muskingum K:**					**1.050**
#8	8. Large gullies, diversions, and low flowing streams	0.92	65.00	7,064.00	2.87	0.683
#8	**Muskingum K:**					**0.683**
#9	8. Large gullies, diversions, and low flowing streams	0.44	89.00	20,387.00	1.98	2.860
#9	**Muskingum K:**					**2.860**
#10	8. Large gullies, diversions, and low flowing streams	0.43	50.00	11,726.07	1.95	1.670
#10	**Muskingum K:**					**1.670**
#11	8. Large gullies, diversions, and low flowing streams	0.40	32.00	8,087.00	1.88	1.194
#11	**Muskingum K:**					**1.194**

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Particle Size Distribution(s) at Each Structure

Structure #11:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	95.527%
0.0750	71.860%
0.0159	63.980%
0.0100	53.252%
0.0050	14.787%
0.0020	7.865%
0.0010	7.090%
0.0004	6.551%

Structure #10:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	87.822%
0.0750	66.065%
0.0159	58.820%
0.0100	48.958%
0.0050	13.596%
0.0020	7.232%
0.0010	6.520%
0.0004	6.024%

Structure #8:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	93.561%
0.0159	81.978%

Size (mm)	In/Out
0.0100	64.996%
0.0050	20.839%
0.0020	11.591%
0.0010	10.280%
0.0004	9.883%

Structure #7:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	93.704%
0.0159	80.886%
0.0100	61.493%
0.0050	22.975%
0.0020	13.628%
0.0010	12.334%
0.0004	11.628%

Structure #9:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	90.339%
0.0159	81.319%
0.0100	67.946%
0.0050	26.226%
0.0020	15.871%
0.0010	14.324%
0.0004	13.437%

Structure #5:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	100.000%

Size (mm)	In/Out
0.0050	59.461%
0.0020	33.940%
0.0010	31.453%
0.0004	28.382%

Structure #2:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	100.000%
0.0050	40.426%
0.0020	23.075%
0.0010	21.385%
0.0004	19.296%

Structure #1:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	100.000%
0.0050	33.256%
0.0020	18.805%
0.0010	17.471%
0.0004	15.526%

Structure #4:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	100.000%
0.0050	50.016%

Size (mm)	In/Out
0.0020	28.083%
0.0010	26.043%
0.0004	23.505%

Structure #3:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	100.000%
0.0050	49.029%
0.0020	29.298%
0.0010	27.565%
0.0004	23.997%

Structure #6:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	100.000%
0.0050	50.027%
0.0020	29.178%
0.0010	27.255%
0.0004	24.117%

Structure #12:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.810%
0.0750	98.976%
0.0159	98.530%
0.0100	97.895%
0.0050	48.342%
0.0020	28.241%

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Size (mm)	In/Out
0.0010	26.326%
0.0004	23.358%

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Structure Detail:

Structure #11 (Null)

Structure #10 (Null)

Structure #8 (Null)

Structure #7 (Null)

Structure #9 (Null)

Structure #5 (Null)

Structure #2 (Null)

Structure #1 (Null)

Structure #4 (Null)

Structure #3 (Null)

Structure #6 (Null)

Structure #12 (Null)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#11	1	16.740	0.116	0.378	0.366	76.900	M	12.74	0.410
	2	475.070	0.557	0.000	0.000	84.400	M	197.05	17.565
	Σ	**491.810**						**206.38**	**17.975**
#10	1	28.940	0.138	0.426	0.348	78.000	M	12.66	0.639
	2	426.600	0.436	0.000	0.000	84.200	M	203.31	15.549
	Σ	**455.540**						**204.38**	**16.188**
#8	1	92.410	1.279	0.000	0.000	83.400	M	18.78	3.156
	Σ	**92.410**						**18.78**	**3.156**
#7	1	857.100	1.173	0.000	0.000	83.100	M	181.72	28.585
	Σ	**857.100**						**181.72**	**28.585**
#9	1	634.700	0.936	0.000	0.000	86.400	M	215.10	27.307
	Σ	**1,584.210**						**224.59**	**59.048**
#5	1	7,064.500	6.995	0.000	0.000	83.500	M	335.55	243.080
	Σ	**7,064.500**						**335.55**	**243.080**
#2	1	6,633.800	3.130	0.000	0.000	83.000	M	609.44	219.407
	Σ	**6,633.800**						**609.44**	**219.407**
#1	1	4,622.300	2.422	0.000	0.000	84.700	M	618.35	174.694
	Σ	**4,622.300**						**618.35**	**174.694**
#4	1	12,415.200	9.741	0.000	0.000	81.600	M	370.95	365.237
	Σ	**23,671.300**						**1,395.56**	**759.338**
#3	1	9,427.600	4.941	0.000	0.000	86.200	M	770.69	399.334
	Σ	**9,427.600**						**770.69**	**399.334**
#6	1	7,063.800	5.356	0.000	0.000	89.000	M	678.40	367.720
	Σ	**47,227.200**						**1,858.97**	**1,769.472**
#12	1	2,976.500	3.249	0.000	0.000	86.700	M	367.33	130.893
	Σ	**52,735.260**						**1,869.65**	**1,993.577**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#11	1	0.176	200.00	4.60	0.3157	1.0000	10	10.7	37,203	21.87	11.18
	2	0.140	130.00	7.40	0.2520	1.0000	13	373.8	26,840	10.53	6.09
	Σ							**373.8**	**26,425**	**10.37**	**5.95**
#10	1	0.184	200.00	4.70	0.2962	1.0000	9	15.5	33,356	16.60	8.78
	2	0.139	130.00	6.50	0.2630	1.0000	13	325.8	26,846	11.41	6.49
	Σ							**325.8**	**25,658**	**10.90**	**6.24**
#8	1	0.173	280.00	2.40	0.2851	1.0000	7	20.9	8,018	2.44	1.48
	Σ							**20.9**	**8,018**	**2.44**	**1.48**
#7	1	0.209	280.00	2.70	0.2762	1.0000	6	333.7	14,206	4.66	2.80
	Σ							**333.7**	**14,206**	**4.66**	**2.80**
#9	1	0.212	240.00	3.70	0.2445	1.0000	8	409.5	18,118	6.93	4.19
	Σ							**581.1**	**18,035**	**4.99**	**1.99**
#5	1	0.180	200.00	4.30	0.2445	1.0000	12	2,022.6	8,725	0.31	0.22
	Σ							**2,022.6**	**8,725**	**0.31**	**0.22**
#2	1	0.179	100.00	8.40	0.2427	1.0000	12	3,642.3	18,568	0.98	0.65
	Σ							**3,642.3**	**18,568**	**0.98**	**0.65**
#1	1	0.164	100.00	8.00	0.2219	1.0000	1	2,507.5	16,355	0.97	0.63
	Σ							**2,507.5**	**16,355**	**0.97**	**0.63**
#4	1	0.170	200.00	4.70	0.2651	1.0000	3	3,004.9	8,421	0.17	0.13
	Σ							**9,122.4**	**15,079**	**0.66**	**0.41**
#3	1	0.190	100.00	10.30	0.1857	1.0000	2	6,612.5	17,732	0.79	0.55
	Σ							**6,612.5**	**17,732**	**0.79**	**0.55**
#6	1	0.200	130.00	6.50	0.1727	1.0000	4	3,549.2	10,278	0.49	0.34
	Σ							**21,288.4**	**13,085**	**0.57**	**0.40**
#12	1	0.196	200.00	4.80	0.2219	1.0000	11	1,654.3	14,005	0.85	0.57
	Σ							**23,631.5**	**17,971**	**1.07**	**0.54**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	3.13	25.00	799.00	1.760	0.126
		8. Large gullies, diversions, and low flowing streams	1.77	581.00	32,907.00	3.980	2.296
#1	**1**	**Time of Concentration:**					**2.422**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	5. Nearly bare and untilled, and alluvial valley fans	4.24	25.00	589.00	2.060	0.079
		8. Large gullies, diversions, and low flowing streams	1.47	585.00	39,874.00	3.630	3.051
#2	**1**	**Time of Concentration:**					**3.130**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	5.58	30.00	538.00	2.360	0.063
		8. Large gullies, diversions, and low flowing streams	1.41	876.00	62,341.00	3.550	4.878
#3	**1**	**Time of Concentration:**					**4.941**
#4	1	5. Nearly bare and untilled, and alluvial valley fans	2.90	40.00	1,380.00	1.700	0.225
		8. Large gullies, diversions, and low flowing streams	0.88	855.00	96,614.00	2.820	9.516
#4	**1**	**Time of Concentration:**					**9.741**
#5	1	8. Large gullies, diversions, and low flowing streams	0.77	160.00	20,876.00	2.620	2.213
		8. Large gullies, diversions, and low flowing streams	1.41	320.00	22,637.00	3.560	1.766
		8. Large gullies, diversions, and low flowing streams	0.51	120.00	23,347.00	2.150	3.016
#5	**1**	**Time of Concentration:**					**6.995**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	5.43	45.00	829.00	2.320	0.099
		8. Large gullies, diversions, and low flowing streams	1.03	597.00	57,726.00	3.050	5.257
#6	**1**	**Time of Concentration:**					**5.356**
#7	1	8. Large gullies, diversions, and low flowing streams	1.02	130.00	12,761.00	3.020	1.173
#7	**1**	**Time of Concentration:**					**1.173**
#8	1	5. Nearly bare and untilled, and alluvial valley fans	1.72	10.00	581.00	1.310	0.123
		8. Large gullies, diversions, and low flowing streams	1.91	45.00	2,350.00	4.150	0.157
		8. Large gullies, diversions, and low flowing streams	0.68	60.00	8,853.00	2.460	0.999
#8	**1**	**Time of Concentration:**					**1.279**
#9	1	5. Nearly bare and untilled, and alluvial valley fans	1.20	5.00	417.00	1.090	0.106
		8. Large gullies, diversions, and low flowing streams	1.38	145.00	10,519.00	3.520	0.830
#9	**1**	**Time of Concentration:**					**0.936**
#10	1	5. Nearly bare and untilled, and alluvial valley fans	6.44	15.00	233.00	2.530	0.025
		5. Nearly bare and untilled, and alluvial valley fans	4.09	20.00	489.00	2.020	0.067
		8. Large gullies, diversions, and low flowing streams	5.49	65.00	1,184.00	7.020	0.046
#10	**1**	**Time of Concentration:**					**0.138**
#10	2	5. Nearly bare and untilled, and alluvial valley fans	2.30	10.00	434.00	1.510	0.079

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	2.01	110.00	5,472.00	4.250	0.357
#10	**2**	**Time of Concentration:**					**0.436**
#11	1	5. Nearly bare and untilled, and alluvial valley fans	2.16	10.00	464.00	1.460	0.088
		8. Large gullies, diversions, and low flowing streams	6.38	50.00	784.00	7.570	0.028
#11	**1**	**Time of Concentration:**					**0.116**
#11	2	5. Nearly bare and untilled, and alluvial valley fans	3.50	20.00	572.00	1.860	0.085
		8. Large gullies, diversions, and low flowing streams	4.12	190.00	4,613.00	6.080	0.210
		8. Large gullies, diversions, and low flowing streams	1.46	50.00	3,423.00	3.620	0.262
#11	**2**	**Time of Concentration:**					**0.557**
#12	1	5. Nearly bare and untilled, and alluvial valley fans	4.16	20.00	481.00	2.030	0.065
		5. Nearly bare and untilled, and alluvial valley fans	3.65	20.00	548.00	1.910	0.079
		8. Large gullies, diversions, and low flowing streams	0.67	45.00	6,726.00	2.450	0.762
		8. Large gullies, diversions, and low flowing streams	0.44	75.00	16,870.00	2.000	2.343
#12	**1**	**Time of Concentration:**					**3.249**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#7	1	8. Large gullies, diversions, and low flowing streams	0.87	39.00	4,508.00	2.790	0.448
#7	**1**	**Muskingum K:**					**0.000**
#10	1	8. Large gullies, diversions, and low flowing streams	1.70	102.00	6,003.17	3.910	0.426
#10	**1**	**Muskingum K:**					**0.426**
#11	1	8. Large gullies, diversions, and low flowing streams	2.40	152.00	6,329.00	4.640	0.378
#11	**1**	**Muskingum K:**					**0.378**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#11	491.810	491.810	206.38	17.98	373.8	26,425	10.37	5.95
#10	455.540	455.540	204.38	16.19	325.8	25,658	10.90	6.24
#8	92.410	92.410	18.78	3.16	20.9	8,018	2.44	1.48
#7	857.100	857.100	181.72	28.59	333.7	14,206	4.66	2.80
#9	634.700	1,584.210	224.59	59.05	581.1	18,035	4.99	1.99
#5	7,064.500	7,064.500	335.55	243.08	2,022.6	8,725	0.31	0.22
#2	6,633.800	6,633.800	609.44	219.41	3,642.3	18,568	0.98	0.65
#1	4,622.300	4,622.300	618.35	174.69	2,507.5	16,355	0.97	0.63
#4	12,415.200	23,671.300	1,395.56	759.34	9,122.4	15,079	0.66	0.41
#3	9,427.600	9,427.600	770.69	399.33	6,612.5	17,732	0.79	0.55
#6	7,063.800	47,227.200	1,858.97	1,769.47	21,288.4	13,085	0.57	0.40
#12	2,976.500	52,735.260	1,869.65	1,993.58	23,631.5	17,971	1.07	0.54

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#11	491.810	491.810	42.92	3.15	60.0	20,870	6.31	4.20
#10	455.540	455.540	43.69	2.77	51.9	20,825	7.19	4.72
#8	92.410	92.410	3.57	0.51	3.0	6,000	1.07	0.76
#7	857.100	857.100	33.46	4.51	46.0	10,556	2.16	1.53
#9	634.700	1,584.210	53.52	10.74	99.8	14,261	3.40	1.62
#5	7,064.500	7,064.500	67.46	39.86	299.3	7,489	0.17	0.13
#2	6,633.800	6,633.800	113.63	34.28	502.8	14,498	0.63	0.46
#1	4,622.300	4,622.300	133.84	31.90	410.7	12,882	0.67	0.49
#4	12,415.200	23,671.300	270.45	115.58	1,266.2	12,144	0.42	0.30
#3	9,427.600	9,427.600	191.59	82.36	1,252.9	15,120	0.54	0.40
#6	7,063.800	47,227.200	411.88	330.38	3,651.0	10,555	0.37	0.29
#12	2,976.500	52,735.260	416.54	375.08	4,034.7	13,995	0.64	0.37

SEDCAD 4 for Windows: 10-Yr 6-Hr Storm Summary

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#11	491.810	491.810	138.97	9.65	212.8	23,646	8.67	5.90
#10	455.540	455.540	139.04	8.63	185.4	23,068	9.28	6.31
#8	92.410	92.410	12.31	1.66	11.5	7,143	1.91	1.36
#7	857.100	857.100	118.48	14.92	182.4	12,608	3.68	2.62
#9	634.700	1,584.210	150.17	32.03	329.0	16,170	4.34	2.02
#5	7,064.500	7,064.500	221.51	128.20	1,120.2	8,769	0.27	0.20
#2	6,633.800	6,633.800	397.33	114.19	1,988.4	17,356	0.87	0.64
#1	4,622.300	4,622.300	415.43	94.95	1,426.4	15,087	0.86	0.63
#4	12,415.200	23,671.300	902.00	392.62	4,968.5	14,266	0.58	0.41
#3	9,427.600	9,427.600	533.40	224.92	3,901.7	17,305	0.72	0.53
#6	7,063.800	47,227.200	1,169.91	965.99	12,200.0	12,643	0.52	0.39
#12	2,976.500	52,735.260	1,180.69	1,090.86	13,489.3	16,291	0.89	0.51

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#11	491.810	491.810	217.60	15.03	348.5	24,577	9.47	6.52
#10	455.540	455.540	216.46	13.51	304.0	23,848	9.99	6.88
#8	92.410	92.410	19.76	2.63	19.4	7,591	2.24	1.60
#7	857.100	857.100	191.37	23.73	309.5	13,402	4.28	3.05
#9	634.700	1,584.210	236.35	49.52	541.8	16,955	4.62	2.18
#5	7,064.500	7,064.500	351.49	202.37	1,873.3	9,301	0.32	0.24
#2	6,633.800	6,633.800	641.49	182.01	3,376.0	18,514	0.96	0.71
#1	4,622.300	4,622.300	648.78	146.59	2,334.9	16,001	0.94	0.68
#4	12,415.200	23,671.300	1,438.75	629.63	8,423.8	15,145	0.65	0.45
#3	9,427.600	9,427.600	807.15	338.30	6,184.0	18,252	0.80	0.59
#6	7,063.800	47,227.200	1,795.01	1,487.05	19,806.0	13,496	0.58	0.44
#12	2,976.500	52,735.260	1,800.89	1,676.34	21,834.9	17,146	0.99	0.56

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#11	627.900	627.900	298.09	23.33	467.5	20,570	8.19	5.83
#10	621.200	621.200	312.02	23.48	423.3	18,931	7.08	4.92
#8	782.600	782.600	196.14	23.54	136.8	6,002	1.73	1.23
#7	1,648.200	1,648.200	560.86	80.32	531.9	6,609	1.85	1.36
#9	652.600	3,083.400	662.64	134.77	1,176.7	16,465	5.38	2.09
#5	7,064.500	7,064.500	513.70	270.38	2,724.9	10,120	0.39	0.29
#2	6,633.800	6,633.800	867.47	244.49	4,715.9	19,263	1.03	0.75
#1	4,622.300	4,622.300	861.22	193.44	3,195.9	16,594	0.99	0.72
#4	12,415.200	23,671.300	1,933.76	848.67	11,760.3	15,718	0.70	0.48
#3	9,427.600	9,427.600	1,052.85	439.85	8,312.7	18,878	0.85	0.62
#6	7,063.800	47,227.200	2,355.04	1,960.16	27,134.8	14,130	0.63	0.47
#12	2,976.500	54,536.200	2,390.15	2,285.66	30,972.2	15,600	1.01	0.67

SEDCAD 4 for Windows: 100-Yr 6-Hr Storm Summary

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#11	491.810	491.810	374.51	25.66	633.8	25,912	10.57	7.34
#10	455.540	455.540	370.48	23.19	553.5	25,030	10.98	7.63
#8	92.410	92.410	34.65	4.55	36.2	8,127	2.64	1.89
#7	857.100	857.100	337.45	41.36	580.4	14,347	4.99	3.57
#9	634.700	1,584.210	411.49	83.91	993.8	17,982	4.99	2.40
#5	7,064.500	7,064.500	611.29	350.03	3,470.9	9,975	0.37	0.28
#2	6,633.800	6,633.800	1,133.66	317.89	6,346.0	19,941	1.08	0.79
#1	4,622.300	4,622.300	1,108.68	247.90	4,230.2	17,131	1.04	0.75
#4	12,415.200	23,671.300	2,515.25	1,106.60	15,820.3	16,243	0.74	0.51
#3	9,427.600	9,427.600	1,336.36	556.86	10,841.8	19,452	0.90	0.66
#6	7,063.800	47,227.200	3,092.39	2,510.61	35,649.7	14,559	0.66	0.49
#12	2,976.500	52,735.260	3,048.14	2,824.86	38,955.6	18,283	1.10	0.62

Attachment 41.C-7

Chaco River Unnamed Tributaries Hydrology and Sedimentology SEDCAD™ Model Output
During Operations in Area 4 South and Area 5

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TRIBUTARY 1 TO CHACO DRAINAGE OPERATIONS HYDROLOGY AND SEDIMENTOLOGY

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General Information

Storm Information:

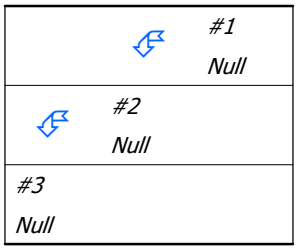
Storm Type:	Type II-70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Particle Size Distribution:

Table 41.C-6

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.195	0.373	
Null	#2	==>	#3	0.616	0.336	
Null	#3	==>	End	0.000	0.000	



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	2.78	98.00	3,527.00	5.00	0.195
#1	**Muskingum K:**					**0.195**
#2	8. Large gullies, diversions, and low flowing streams	1.35	104.00	7,726.00	3.48	0.616
#2	**Muskingum K:**					**0.616**

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Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	98.663%
0.0159	85.777%
0.0100	67.379%
0.0050	19.687%
0.0020	11.430%
0.0010	10.313%
0.0004	9.529%

Structure #2:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	80.417%
0.0750	64.533%
0.0159	58.394%
0.0100	50.134%
0.0050	14.417%
0.0020	8.161%
0.0010	7.436%
0.0004	6.707%

Structure #3:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	93.575%
0.0750	77.562%
0.0159	70.231%

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Size (mm)	In/Out
0.0100	58.069%
0.0050	18.244%
0.0020	10.310%
0.0010	9.463%
0.0004	8.587%

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Structure Detail:

Structure #1 (Null)

Structure #2 (Null)

Structure #3 (Null)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	554.900	0.848	0.767	0.329	85.800	M	192.46	22.829
	2	8.460	0.956	0.000	0.000	86.500	M	2.85	0.367
	Σ	**563.360**						**182.07**	**23.196**
#2	1	256.460	0.199	0.000	0.000	86.700	M	206.43	11.331
	Σ	**819.820**						**206.86**	**34.527**
#3	1	707.290	0.459	0.000	0.000	83.300	M	301.59	23.975
	Σ	**1,527.110**						**329.18**	**58.502**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.178	280.00	2.00	0.2427	1.0000	1	173.8	9,230	3.31	2.00
	2	0.178	280.00	2.70	0.2630	1.0000	2	2.3	7,611	3.04	1.84
	Σ							**151.1**	**7,898**	**2.28**	**1.38**
#2	1	0.147	75.00	15.50	0.2106	1.0000	3	546.9	59,863	28.21	16.41
	Σ							**627.0**	**59,748**	**24.95**	**5.48**
#3	1	0.173	75.00	13.50	0.2539	1.0000	4	1,226.0	64,796	26.54	15.10
	Σ							**1,608.4**	**61,949**	**21.93**	**7.04**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	2.64	30.00	1,135.00	1.620	0.194
		8. Large gullies, diversions, and low flowing streams	0.87	57.00	6,569.00	2.790	0.654
#1	**1**	**Time of Concentration:**					**0.848**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	1.16	10.00	861.00	1.070	0.223
		8. Large gullies, diversions, and low flowing streams	1.32	120.00	9,080.00	3.440	0.733
#1	**2**	**Time of Concentration:**					**0.956**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	8.96	30.00	335.00	2.990	0.031

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	3.90	140.00	3,592.00	5.920	0.168
#2	**1**	**Time of Concentration:**					**0.199**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	4.36	20.00	459.00	2.080	0.061
		8. Large gullies, diversions, and low flowing streams	1.56	20.00	1,279.00	3.750	0.094
		8. Large gullies, diversions, and low flowing streams	3.97	260.00	6,544.00	5.970	0.304
#3	**1**	**Time of Concentration:**					**0.459**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.19	108.00	9,039.00	3.270	0.767
#1	**1**	**Muskingum K:**					**0.767**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	563.360	563.360	182.07	23.20	151.1	7,898	2.28	1.38
#2	256.460	819.820	206.86	34.53	627.0	59,748	24.95	5.48
#3	707.290	1,527.110	329.18	58.50	1,608.4	61,949	21.93	7.04

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	563.360	563.360	42.72	4.64	27.3	6,109	1.10	0.78
#2	256.460	819.820	61.51	7.07	133.1	54,133	21.23	5.35
#3	707.290	1,527.110	68.71	10.93	252.2	49,341	12.36	4.20

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	563.360	563.360	124.69	12.95	88.3	7,030	1.79	1.27
#2	256.460	819.820	153.39	19.40	386.1	55,794	22.88	5.91
#3	707.290	1,527.110	215.14	31.98	904.3	55,871	17.99	6.59

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	563.360	563.360	190.94	19.60	141.3	7,410	2.07	1.48
#2	256.460	819.820	221.53	29.23	594.4	56,330	23.42	6.12
#3	707.290	1,527.110	344.25	49.16	1,498.2	58,078	20.12	7.64

SEDCAD 4 for Windows: 50-Year 6-Hour Storm Summary

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	563.360	563.360	250.48	25.58	190.9	7,653	2.25	1.61
#2	256.460	819.820	281.13	38.04	785.7	56,871	23.87	6.27
#3	707.290	1,527.110	463.65	64.73	2,066.3	59,485	21.48	8.33

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	563.360	563.360	319.15	32.49	249.9	7,872	2.41	1.73
#2	256.460	819.820	349.87	48.20	1,012.0	57,571	24.39	6.43
#3	707.290	1,527.110	603.91	82.81	2,752.7	61,442	22.94	8.97

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TRIBUTARY 2 TO CHACO DRAINAGE OPERATIONS HYDROLOGY AND SEDIMENTOLOGY

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General Information

Storm Information:

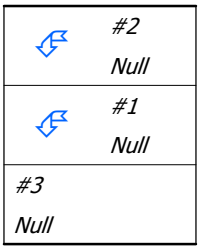
Storm Type:	Type II-70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Particle Size Distribution:

Table 41.C-6

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#3	0.770	0.336	
Null	#2	==>	#3	0.806	0.339	
Null	#3	==>	End	0.000	0.000	



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	1.34	129.00	9,631.00	3.47	0.770
#1	**Muskingum K:**					**0.770**
#2	8. Large gullies, diversions, and low flowing streams	1.42	147.00	10,368.00	3.57	0.806
#2	**Muskingum K:**					**0.806**

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Particle Size Distribution(s) at Each Structure

Structure #2:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	84.303%
0.0750	65.712%
0.0159	57.206%
0.0100	45.642%
0.0050	11.965%
0.0020	7.155%
0.0010	6.672%
0.0004	5.774%

Structure #1:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	86.801%
0.0750	69.316%
0.0159	62.348%
0.0100	52.340%
0.0050	20.488%
0.0020	11.234%
0.0010	10.472%
0.0004	9.549%

Structure #3:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	97.321%
0.0750	79.042%
0.0159	68.710%

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Size (mm)	In/Out
0.0100	54.180%
0.0050	15.525%
0.0020	9.150%
0.0010	8.376%
0.0004	7.549%

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	289.700	0.235	0.000	0.000	88.600	M	255.47	14.812
	Σ	**289.700**						**255.47**	**14.812**
#1	1	450.500	0.414	0.000	0.000	79.000	M	137.81	10.705
	Σ	**450.500**						**137.81**	**10.705**
#3	1	1,037.500	0.754	0.000	0.000	87.500	M	453.74	48.462
	Σ	**1,777.700**						**509.61**	**73.980**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#2	1	0.172	75.00	12.20	0.1802	1.0000	6	524.6	43,382	19.47	11.52
	Σ							**524.6**	**43,382**	**19.47**	**11.52**
#1	1	0.176	130.00	6.40	0.2851	1.0000	5	286.1	36,163	14.28	7.68
	Σ							**286.1**	**36,163**	**14.28**	**7.68**
#3	1	0.181	100.00	8.80	0.2219	1.0000	7	1,317.5	32,847	12.43	7.48
	Σ							**2,063.4**	**32,440**	**12.50**	**7.82**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	1.41	10.00	707.00	1.180	0.166
		8. Large gullies, diversions, and low flowing streams	4.02	216.00	5,371.00	6.010	0.248
#1	**1**	**Time of Concentration:**					**0.414**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	4.02	21.00	522.00	2.000	0.072
		8. Large gullies, diversions, and low flowing streams	3.55	118.00	3,325.00	5.650	0.163
#2	**1**	**Time of Concentration:**					**0.235**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	10.96	25.00	228.00	3.310	0.019
		8. Large gullies, diversions, and low flowing streams	2.35	285.00	12,151.00	4.590	0.735

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	**1**	**Time of Concentration:**					**0.754**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	289.700	289.700	255.47	14.81	524.6	43,382	19.47	11.52
#1	450.500	450.500	137.81	10.70	286.1	36,163	14.28	7.68
#3	1,037.500	1,777.700	509.61	73.98	2,063.4	32,440	12.50	7.82

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	289.700	289.700	83.25	3.63	127.4	38,593	15.97	10.55
#1	450.500	450.500	14.63	1.02	21.9	24,740	6.06	3.83
#3	1,037.500	1,777.700	131.44	15.66	425.7	29,143	9.74	6.62

SEDCAD 4 for Windows - 10-Year 6-Hour Storm Summary

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	289.700	289.700	191.34	8.80	333.2	40,059	17.47	11.99
#1	450.500	450.500	82.98	4.93	139.6	31,349	11.31	7.43
#3	1,037.500	1,777.700	355.90	41.83	1,271.9	30,761	11.55	8.31

SEDCAD 4 for Windows - 25-Year 6-Hour Storm Summary

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	289.700	289.700	272.06	12.73	499.2	40,973	18.25	12.67
#1	450.500	450.500	147.14	8.61	262.7	33,300	12.97	8.65
#3	1,037.500	1,777.700	537.85	62.72	1,999.0	31,788	12.43	9.07

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	289.700	289.700	341.38	16.18	648.4	41,523	18.73	13.11
#1	450.500	450.500	207.49	12.13	385.9	34,347	13.87	9.34
#3	1,037.500	1,777.700	701.94	81.46	2,660.8	32,115	12.79	9.47

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	289.700	289.700	418.81	20.11	821.1	41,988	19.13	13.49
#1	450.500	450.500	279.12	16.39	539.2	35,182	14.59	9.92
#3	1,037.500	1,777.700	891.87	103.10	3,364.8	32,089	12.71	9.53

Pinabete Arroyo
No Name Arroyo
Chaco River
Brimhall Wash

Area 4 South Operations with Pinabete Diversion

Area 4 South and Area 5 Operations with Pinabete Diversion

Area 5 Operations

Legend

- Pinabete Diversion
- Eastern Diversion
- Major Watersheds
- **Mining Disturbance**
- Ponds
- Streams
- Modeled Subwatersheds

Units: US Feet

1:56,000

Exhibit 41.C-1

Navajo Transitional Energy Company

P.O.BOX 1717 FRUITLAND,NEW MEXICO 87416/PHONE 505-598-4200/FAX 505-598-4229

No Name Permit

No Name Watershed
Modeling Scenarios

REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	ENG.	EQD.	PE.
				APPROVALS		

PREPARED BY: SS	DRAWN BY: SS	PAPER SIZE: ARCH D
APPROVED BY: SS	DATE: 09/30/25	

Table 41.C-1 SEDCAD™ Model Input Factors Based on Erodible Particle Size Distribution (EPSD) Texture Class for Mining Operation Conditions

EPSD texture	K-factor	Run-off curve number	Canopy cover	Surface cover
Fine	0.20	93.0	4.7	30.8
Fine loamy	0.27	92.4	9.2	18.1
Coarse loamy	0.10	81.9	14.5	7.9
Sandy	0.20	65.6	13.9	1.6

Table 41.C-2 Pinabete Arroyo SEDCAD Model Erobible Particle Size Distribution Input for Mining Operation Conditions

EPSD designation Diameter (mm)	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
0.450	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
0.250	85.529	83.954	83.494	79.684	74.336	71.800	68.824	73.040	66.130	59.234
0.150	72.267	70.070	68.714	64.718	55.514	53.158	47.671	50.320	47.750	40.272
0.075	58.134	56.187	54.477	51.673	42.977	40.816	35.579	35.798	36.084	33.795
0.01585	49.962	48.376	46.844	44.689	37.721	35.600	31.445	31.104	31.122	31.492
0.01000	38.953	37.808	36.471	35.083	30.403	28.065	25.380	24.310	23.407	28.022
0.005012	9.675	9.683	9.177	10.018	9.205	9.529	8.929	6.708	10.343	13.538
0.001995	6.279	6.204	5.875	6.237	5.303	5.591	4.938	3.770	6.209	7.108
0.001000	6.010	5.917	5.567	5.908	4.905	5.155	4.462	3.276	5.698	6.676
0.000398	4.942	4.914	4.659	5.035	4.387	4.686	4.216	3.184	5.329	6.156

Note: Values reported as percent of sample passing through sieve with corresponding diameter

Table 41.C-2 Pinabete Arroyo SEDCAD Model Erobible Particle Size Distribution Input for Mining Operation Conditions

EPSD designation Diameter (mm)	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20
0.450	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
0.250	71.599	65.531	66.688	69.479	71.446	76.546	69.115	68.866	61.049	69.805
0.150	57.036	45.088	46.416	50.980	55.482	60.175	48.743	45.562	42.198	50.039
0.075	47.507	34.380	34.657	38.320	44.594	46.743	36.650	33.437	33.563	36.737
0.01585	42.049	30.640	30.363	32.920	39.040	40.133	32.221	30.098	30.211	31.517
0.01000	34.448	25.007	23.816	24.755	31.086	30.717	25.703	25.355	24.943	23.611
0.005012	12.666	10.180	9.557	9.532	11.375	9.459	9.189	8.126	12.221	8.675
0.001995	7.405	5.608	5.458	5.794	6.757	5.929	5.194	4.149	6.769	5.233
0.001000	7.069	5.126	4.956	5.304	6.368	5.532	4.723	3.674	6.286	4.726
0.000398	6.144	4.829	4.693	4.918	5.635	4.866	4.420	3.561	5.868	4.456

Note: Values reported a

Table 41.C-3 No Name Arroyo SEDCAD Model Erodible Particle Size Distribution Input for Mining Operation Conditions

EPSD Designation Diameter (mm)	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
0.450	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
0.250	67.238	70.939	74.655	74.155	77.281	75.578	77.393	77.993	77.038	78.922
0.150	49.361	52.171	54.870	54.074	57.254	54.286	57.877	59.294	57.936	60.447
0.075	37.563	37.728	38.718	39.358	43.405	40.591	43.197	45.545	44.741	46.776
0.01585	32.342	31.597	32.157	33.572	37.974	35.722	37.191	39.656	39.265	40.830
0.01000	24.314	22.169	22.246	25.073	30.556	29.049	28.724	31.575	31.827	32.779
0.005012	10.387	8.316	6.741	7.496	7.842	7.567	7.539	8.344	8.573	8.418
0.001995	6.291	5.386	4.536	4.624	4.493	4.182	4.580	4.932	4.921	4.949
0.001000	5.795	4.854	4.004	4.140	4.097	3.764	4.153	4.551	4.545	4.587
0.000398	5.371	4.575	3.806	3.867	3.665	3.448	3.748	4.009	4.014	3.998

Note: Values reported as percent of sample passing through sieve with corresponding diameter

Table 41.C-3 No Name Arroyo SEDCAD Model Erodible Particle Size Distribution Input for Mining Operation Conditions

EPSD Designation Diameter (mm)	N11	N12	N13	N14	N15
0.450	100.000	100.000	100.000	100.000	100.000
0.250	76.892	78.922	76.672	68.115	77.333
0.150	57.043	60.447	56.704	49.351	57.313
0.075	43.798	46.776	42.929	37.400	44.056
0.01585	38.581	40.830	37.514	32.436	38.895
0.01000	31.549	32.779	30.059	24.922	32.007
0.005012	8.280	8.418	7.941	9.925	8.186
0.001995	4.655	4.949	4.571	5.882	4.556
0.001000	4.275	4.587	4.167	5.396	4.184
0.000398	3.798	3.998	3.743	5.013	3.706

Note: Values reported a

Table 41.C-4 Brimhall Wash SEDCAD Model Erodible Particle Size Distribution Input for Mining Operation Conditions

EPSD designation Diameter (mm)	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
0.450	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
0.250	74.410	76.157	69.997	79.508	76.475	69.135	70.448	73.216	64.912	63.749
0.150	55.605	59.686	50.748	64.050	57.775	49.241	48.380	53.670	45.705	43.918
0.075	43.516	47.428	39.813	50.694	41.347	36.360	35.105	39.285	36.176	34.808
0.01585	38.456	41.399	35.485	43.752	34.236	31.386	30.759	33.457	32.518	31.586
0.01000	31.531	33.052	29.389	34.156	23.595	23.861	24.387	24.817	27.095	26.802
0.005012	9.472	10.126	10.232	9.667	6.873	8.915	7.819	7.936	11.353	11.435
0.001995	5.356	6.051	5.668	6.037	4.758	5.288	4.349	4.929	6.238	6.147
0.001000	4.976	5.693	5.255	5.694	4.247	4.786	3.857	4.440	5.789	5.695
0.000398	4.422	4.956	4.771	4.879	3.949	4.512	3.708	4.138	5.346	5.293

Note: Values reported as percent of sample passing through sieve with corresponding diameter

Table 41.C-4 Brimhall Wash SEDCAD Model Erodible Particle Size Distribution Input for Mining Operation Conditions

EPSD designation Diameter (mm)	B11	B12	B13
0.450	100.000	100.000	100.000
0.250	74.634	71.793	73.540
0.150	55.269	53.049	51.760
0.075	41.168	41.322	38.936
0.01585	35.392	36.426	34.666
0.01000	27.046	29.501	28.853
0.005012	8.087	9.853	8.011
0.001995	4.915	5.624	4.260
0.001000	4.462	5.212	3.840
0.000398	4.085	4.703	3.548

Note: Values reported a

Table 41.C-5 Chaco River SEDCAD™ Model Erodible Particle Size Distribution (EPSD) Input for Mining Operation Conditions

EPSD designation Diameter (mm)	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
0.450	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
0.250	73.959	73.616	76.935	71.698	66.758	79.271	76.186	71.332	69.252	72.826
0.150	53.513	51.156	56.809	52.203	47.867	61.614	56.371	51.737	48.234	50.060
0.075	39.786	36.094	43.470	40.227	38.225	48.027	42.009	39.807	37.339	37.063
0.01585	34.594	31.049	38.314	35.500	34.382	41.810	36.270	35.142	33.701	33.090
0.01000	27.184	23.672	31.377	28.812	28.863	33.358	28.141	28.519	28.666	27.663
0.005012	7.949	6.458	8.122	9.441	11.298	8.745	7.683	9.452	9.653	7.592
0.001995	4.615	3.761	4.540	5.331	6.195	5.229	4.600	5.328	5.087	3.938
0.001000	4.166	3.257	4.157	4.909	5.775	4.876	4.165	4.901	4.664	3.500
0.000398	3.847	3.172	3.703	4.467	5.266	4.220	3.790	4.473	4.307	3.302

Note: Values reported as percent of sample passing through sieve with corresponding diameter

Table 41.C-6: Cover Factor Canopy and Surface Cover Interpolation

	Cover that Contacts the Surface																								
Canopy Cover (%)	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	22%	23%	24%	25%
0%	0.45	0.438	0.425	0.413	0.4	0.388	0.375	0.363	0.35	0.338	0.325	0.313	0.3	0.288	0.275	0.263	0.25	0.238	0.225	0.213	0.2	0.195	0.19	0.185	0.18	0.175
1%	0.446	0.434	0.422	0.409	0.397	0.385	0.372	0.36	0.347	0.335	0.323	0.31	0.298	0.285	0.273	0.261	0.248	0.236	0.224	0.211	0.199	0.194	0.189	0.184	0.179	0.174
2%	0.443	0.431	0.418	0.406	0.394	0.382	0.369	0.357	0.345	0.332	0.32	0.308	0.296	0.283	0.271	0.259	0.247	0.234	0.222	0.21	0.198	0.193	0.188	0.183	0.178	0.173
3%	0.439	0.427	0.415	0.403	0.391	0.379	0.366	0.354	0.342	0.33	0.318	0.306	0.294	0.281	0.269	0.257	0.245	0.233	0.221	0.209	0.196	0.192	0.186	0.182	0.177	0.172
4%	0.436	0.424	0.412	0.4	0.388	0.376	0.363	0.351	0.339	0.327	0.315	0.303	0.291	0.279	0.267	0.255	0.243	0.231	0.219	0.207	0.195	0.19	0.185	0.181	0.176	0.171
5%	0.432	0.42	0.408	0.396	0.384	0.373	0.361	0.349	0.337	0.325	0.313	0.301	0.289	0.277	0.265	0.254	0.242	0.23	0.218	0.206	0.194	0.189	0.184	0.18	0.175	0.17
6%	0.428	0.417	0.405	0.393	0.381	0.37	0.358	0.346	0.334	0.322	0.311	0.299	0.287	0.275	0.263	0.252	0.24	0.228	0.216	0.205	0.193	0.188	0.183	0.179	0.174	0.169
7%	0.425	0.413	0.401	0.39	0.378	0.367	0.355	0.343	0.332	0.32	0.308	0.297	0.285	0.273	0.262	0.25	0.238	0.227	0.215	0.203	0.192	0.187	0.181	0.177	0.173	0.168
8%	0.421	0.41	0.398	0.387	0.375	0.364	0.352	0.34	0.329	0.317	0.306	0.294	0.283	0.271	0.26	0.248	0.237	0.225	0.213	0.202	0.19	0.186	0.18	0.176	0.172	0.167
9%	0.418	0.406	0.395	0.383	0.372	0.361	0.349	0.338	0.326	0.315	0.303	0.292	0.281	0.269	0.258	0.246	0.235	0.223	0.212	0.201	0.189	0.185	0.179	0.175	0.171	0.166
10%	0.414	0.403	0.391	0.38	0.369	0.358	0.346	0.335	0.324	0.312	0.301	0.29	0.278	0.267	0.256	0.245	0.233	0.222	0.211	0.199	0.188	0.183	0.178	0.174	0.17	0.165
11%	0.41	0.399	0.388	0.377	0.366	0.355	0.343	0.332	0.321	0.31	0.299	0.287	0.276	0.265	0.254	0.243	0.232	0.22	0.209	0.198	0.187	0.182	0.176	0.173	0.169	0.164
12%	0.407	0.396	0.385	0.374	0.363	0.352	0.34	0.329	0.318	0.307	0.296	0.285	0.274	0.263	0.252	0.241	0.23	0.219	0.208	0.197	0.186	0.181	0.175	0.172	0.168	0.163
13%	0.403	0.392	0.381	0.37	0.359	0.349	0.338	0.327	0.316	0.305	0.294	0.283	0.272	0.261	0.25	0.239	0.228	0.217	0.206	0.195	0.184	0.18	0.174	0.171	0.166	0.162
14%	0.4	0.389	0.378	0.367	0.356	0.346	0.335	0.324	0.313	0.302	0.291	0.281	0.27	0.259	0.248	0.237	0.226	0.216	0.205	0.194	0.183	0.179	0.173	0.17	0.165	0.161
15%	0.396	0.385	0.375	0.364	0.353	0.343	0.332	0.321	0.31	0.3	0.289	0.278	0.268	0.257	0.246	0.236	0.225	0.214	0.203	0.193	0.182	0.178	0.172	0.169	0.164	0.16
16%	0.392	0.382	0.371	0.361	0.35	0.34	0.329	0.318	0.308	0.297	0.287	0.276	0.265	0.255	0.244	0.234	0.223	0.213	0.202	0.191	0.181	0.176	0.17	0.168	0.163	0.159
17%	0.389	0.378	0.368	0.357	0.347	0.337	0.326	0.316	0.305	0.295	0.284	0.274	0.263	0.253	0.242	0.232	0.221	0.211	0.201	0.19	0.18	0.175	0.169	0.167	0.162	0.158
18%	0.385	0.375	0.365	0.354	0.344	0.334	0.323	0.313	0.302	0.292	0.282	0.271	0.261	0.251	0.24	0.23	0.22	0.209	0.199	0.189	0.178	0.174	0.168	0.166	0.161	0.157
19%	0.382	0.371	0.361	0.351	0.341	0.331	0.32	0.31	0.3	0.29	0.279	0.269	0.259	0.249	0.239	0.228	0.218	0.208	0.198	0.187	0.177	0.173	0.167	0.164	0.16	0.156
20%	0.378	0.368	0.358	0.348	0.338	0.328	0.317	0.307	0.297	0.287	0.277	0.267	0.257	0.247	0.237	0.227	0.216	0.206	0.196	0.186	0.176	0.172	0.165	0.163	0.159	0.155
21%	0.374	0.364	0.354	0.344	0.334	0.325	0.315	0.305	0.295	0.285	0.275	0.265	0.255	0.245	0.235	0.225	0.215	0.205	0.195	0.185	0.175	0.171	0.164	0.162	0.158	0.154
22%	0.371	0.361	0.351	0.341	0.331	0.322	0.312	0.302	0.292	0.282	0.272	0.262	0.252	0.243	0.233	0.223	0.213	0.203	0.193	0.183	0.174	0.169	0.163	0.161	0.157	0.153
23%	0.367	0.357	0.348	0.338	0.328	0.319	0.309	0.299	0.289	0.28	0.27	0.26	0.25	0.241	0.231	0.221	0.211	0.202	0.192	0.182	0.172	0.168	0.162	0.16	0.156	0.152
24%	0.364	0.354	0.344	0.335	0.325	0.316	0.306	0.296	0.287	0.277	0.267	0.258	0.248	0.239	0.229	0.219	0.21	0.2	0.19	0.181	0.171	0.167	0.16	0.159	0.155	0.151
25%	0.36	0.351	0.341	0.332	0.322	0.313	0.303	0.294	0.284	0.275	0.265	0.256	0.246	0.237	0.227	0.218	0.208	0.199	0.189	0.18	0.17	0.166	0.162	0.158	0.154	0.15
50%	0.26	0.254	0.247	0.241	0.234	0.228	0.221	0.215	0.208	0.202	0.195					0.163					0.13					0.115
75%	0.17	0.167	0.163	0.16	0.156	0.153	0.149	0.146	0.142	0.139	0.135					0.118					0.1					0.09

Developed from SedCAD Tables
Blue text is from SedCAD Table, Black Text is linear interpolation calculation

Table 41.C-6: Cover Factor Canopy and Surface Cover Interpolation

	Cover that Contacts the Surface																						
Canopy Cover (%)	26%	27%	28%	29%	30%	31%	32%	33%	34%	35%	36%	37%	38%	39%	40%	45%	50%	55%	60%	61%	62%	65%	80%	95%
0%	0.17	0.165	0.16	0.155	0.15	0.145	0.14	0.135	0.13	0.125	0.12	0.115	0.11	0.105	0.1	0.086	0.071	0.057	0.042	0.041	0.039	0.035	0.013	0.003
1%	0.169	0.164	0.159	0.154	0.149	0.144	0.139							0.105	0.1				0.042	0.04	0.039			
2%	0.168	0.163	0.158	0.153	0.148	0.143	0.139							0.104	0.099				0.042	0.04	0.039			
3%	0.167	0.162	0.157	0.152	0.148	0.143	0.138							0.104	0.099				0.042	0.04	0.039			
4%	0.166	0.161	0.156	0.152	0.147	0.142	0.137							0.103	0.098				0.041	0.04	0.038			
5%	0.165	0.16	0.156	0.151	0.146	0.141	0.136							0.103	0.098				0.041	0.04	0.038			
6%	0.164	0.159	0.155	0.15	0.145	0.14	0.136							0.102	0.098				0.041	0.04	0.038			
7%	0.163	0.159	0.154	0.149	0.144	0.14	0.135							0.102	0.097				0.041	0.039	0.038			
8%	0.162	0.158	0.153	0.148	0.144	0.139	0.134							0.101	0.097				0.041	0.039	0.038			
9%	0.161	0.157	0.152	0.147	0.143	0.138	0.134							0.101	0.096				0.041	0.039	0.038			
10%	0.16	0.156	0.151	0.147	0.142	0.137	0.133							0.101	0.096				0.04	0.039	0.038			
11%	0.159	0.155	0.15	0.146	0.141	0.137	0.132							0.1	0.096				0.04	0.039	0.037			
12%	0.158	0.154	0.149	0.145	0.14	0.136	0.131							0.1	0.095				0.04	0.039	0.037			
13%	0.158	0.153	0.149	0.144	0.14	0.135	0.131							0.099	0.095				0.04	0.038	0.037			
14%	0.157	0.152	0.148	0.143	0.139	0.134	0.13							0.099	0.094				0.04	0.038	0.037			
15%	0.156	0.151	0.147	0.142	0.138	0.134	0.129							0.098	0.094				0.04	0.038	0.037			
16%	0.155	0.15	0.146	0.142	0.137	0.133	0.128							0.098	0.094				0.039	0.038	0.037			
17%	0.154	0.149	0.145	0.141	0.136	0.132	0.128							0.098	0.093				0.039	0.038	0.036			
18%	0.153	0.148	0.144	0.14	0.136	0.131	0.127							0.097	0.093				0.039	0.038	0.036			
19%	0.152	0.148	0.143	0.139	0.135	0.131	0.126							0.097	0.092				0.039	0.038	0.036			
20%	0.151	0.147	0.142	0.138	0.134	0.13	0.126							0.096	0.092				0.039	0.037	0.036			
21%	0.15	0.146	0.142	0.137	0.133	0.129	0.125							0.096	0.092				0.039	0.037	0.036			
22%	0.149	0.145	0.141	0.137	0.132	0.128	0.124							0.095	0.091				0.038	0.037	0.036			
23%	0.148	0.144	0.14	0.136	0.132	0.128	0.123							0.095	0.091				0.038	0.037	0.035			
24%	0.147	0.143	0.139	0.135	0.131	0.127	0.123							0.094	0.09				0.038	0.037	0.035			
25%	0.146	0.142	0.138	0.134	0.13	0.126	0.122	0.118	0.114	0.11	0.106	0.102	0.098	0.094	0.09	0.077	0.064	0.051	0.038	0.037	0.035	0.032	0.012	0.003
50%					0.1					0.085					0.07	0.061	0.053	0.044	0.035			0.029	0.012	0.003
75%					0.08					0.07					0.06	0.053	0.046	0.038	0.031			0.026	0.011	0.003

Developed from SedCAD Tables
Blue text is from SedCAD Table, Black Text is linear interpolation calculation

Appendix 41.D

SEDCAD™4 Modeling of Flood Flows and Sediment Yields for Post-reclamation Conditions

APPENDIX 41.D

SEDCAD™4 MODELING OF FLOOD FLOWS AND SEDIMENT YIELDS FOR POST-RECLAMATION CONDITIONS

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APPENDIX 41.D

SEDCAD™4 MODELING OF FLOOD FLOWS AND SEDIMENT YIELDS FOR POST-RECLAMATION CONDITIONS

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41.D-4	Brimhall Wash SEDCAD™ Model Erodible Particle Size Distribution (EPSD) Input for Post-reclamation Conditions
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APPENDIX 41.D

SEDCAD™4 MODELING OF FLOOD FLOWS AND SEDIMENT YIELDS FOR POST-RECLAMATION CONDITIONS

LIST OF ATTACHMENTS

ATTACHMENT NUMBER	ATTACHMENT TITLE
41.D-1	Pinabete Arroyo Post-reclamation Hydrology and Sedimentology SEDCAD™ Model Output
41.D-2	No Name Arroyo Post-reclamation Hydrology and Sedimentology SEDCAD™ Model Output
41.D-3	Brimhall Wash Post-reclamation Hydrology and Sedimentology SEDCAD™ Model Output
41.D-4	Chaco River Unnamed Tributaries Post-reclamation Hydrology and Sedimentology SEDCAD™ Model Output

SEDCAD™4 MODELING OF FLOOD FLOWS AND SEDIMENT YIELDS FOR POST-RECLAMATION CONDITIONS

The SEDCAD™4 (SEDCAD) hydrology model has been used to determine flood flows and sediment yields for the post-reclamation watershed conditions of Pinabete Arroyo, No Name Arroyo, tributaries to Cottonwood Arroyo, Brimhall Wash, and tributaries to the Chaco River. Application of the SEDCAD program involves dividing the drainage area into subwatersheds. Designation of subwatersheds with relatively uniform soil and vegetation characteristics helps in the estimation of model parameters required by SEDCAD. Information is required for physical structures located along the channel that may affect flow and sediment routing within the stream channels. SEDCAD null structures are also established at appropriate locations along the channel network where flow and sedimentology predictions are needed.

The SEDCAD input parameters are provided in tables to this appendix and output results for the 10-year 24-hour precipitation event, and the 2-year, 10-year, 25-year, 50-year and 100-year, 6-hour precipitation events are provided as attachments to this appendix. There is one SEDCAD model for Pinabete Arroyo under post-reclamation conditions (Attachment 41.D-1) and one model for No Name Arroyo under post-reclamation conditions (Attachment 41.D-2). One model addresses post-reclamation conditions in Brimhall Wash (Attachment 41.D-3). Two models address conditions in the three unnamed tributaries on the Chaco River (Attachment 41.D-4).

Soil erosion by water for a specific watershed is usually calculated using the well known empirical Revised Universal Soil Loss Equation (RUSLE) (Renard et al. 1997) and is given by the following expression:

$$A = RKLSCP$$

A is the average soil loss per unit area, expressed in units selected for *K* and the time period specified by *R*. Normal English units are tons/acre/year.

R is the rainfall/runoff factor, which is the number of rainfall units for rainfall energy and runoff, plus the factor for runoff from snowmelt.

K is the soil erodibility factor, which is the rate of soil loss per unit of *R* for a given soil on a slope of 9% with slope length of 72.6 ft.

L is the slope length factor, which is the ratio of soil loss from a defined slope length relative to that from a slope length of 72.6 ft.

S is the slope steepness factor, which is the ratio of soil loss from a slope with a given steepness relative to that from a 9% slope.

C is the cover and management factor, which is the ratio of soil loss from an area with a known cover and management. And,

P is the supporting conservation practice factor.

SEDCAD requires these types of inputs be developed for each watershed being analyzed. To follow is a discussion on how the necessary parameter inputs were developed and calculated for the No Name Permit (NNP). This approach is similar to the one used when assessing the baseline flood flows and sediment yields (Appendix 18.B) and the mining operation flood flows and sediment yields (Appendix 41.C).

Runoff Modeling

Subwatershed Designation and Slopes

The SEDCAD subwatershed designations and drainage configuration for the watersheds of interest are shown on Exhibit 41.2-2. The subwatershed information was developed using Carlson Civil Suite 2008, AutoCAD®, and ArcGIS® software. The base mapping used to develop the off-lease subwatersheds are a combination of 10-ft contoured aerial flight and digital elevation model (DEM) data. The DEM images were based on digital raster graphics, representing US Geologic Survey (USGS) 7.5 minute topographic quadrangle maps (NMRGIS 2009 and USGS 2009). All DEM analysis was performed utilizing the Spatial Analyst extension for ArcGIS® on DEM images projected to the North American Datum of 1927- State Plane New Mexico West coordinate system and in standard units (feet) of measure.

The base mapping used to develop the on-lease subwatershed was developed using Natural Regrade® software for AutoCAD®. This mapping represents the conceptual final surface configuration using fluvial geomorphic principles. The development of this surface, the post-reclamation surface stabilization, and sediment control performance are discussed in detail in Section 34 Post-Reclamation Topography and Section 38 Post-Reclamation Surface Stabilization and Sediment Control. The 59.1-sq-mi Pinabete Arroyo watershed was divided into 51 subwatersheds as shown on Exhibit 41.2-2. The 11.5-sq-mi No Name Arroyo was divided into 19 subwatersheds (Exhibit 41.2-2). The 85.2-sq-mi Brimhall Wash watershed was divided into 15 subwatersheds (Exhibit 41.2-2). Only a small portion of the watershed of Brimhall is within the permit boundary, so the model required fewer subwatersheds. The two unnamed tributaries to the Chaco River having watersheds of 3.4, 2.78, and 2.21 sq mi were divided into four and three subwatersheds, respectively (Exhibit 41.2-2). Subwatershed parameters required by the SEDCAD program were determined as described below.

Time of Concentration

The time of concentration for each subwatershed was calculated by the SEDCAD program from the length and slope of the longest flow path that was input from the topographic map using AutoCAD® software.

Rainfall Duration, Frequency, and Distribution

For evaluation purposes, peak flows were estimated for the 6-hour rainfall event at the 2-year, 10-year, 25-year, 50-year, and 100-year frequencies and the 24-hour 10-year storm event. Storm precipitation values

provided in Section 18 Water Resources for the various return periods were obtained from the National Oceanic and Atmospheric Administration (NOAA) online frequency estimates (Bonnin et al. 2006) for a location between Area 4 South and Area 5, and from Atlas 14, New Mexico for the location of the No Name Arroyo and Pinabete Arroyo watersheds. A Soil Conservation Service (SCS) Type II-70 rainfall distribution was applied to all storms, which is consistent with the rainfall distribution used by Navajo Mine.

Curve Number

Hydrologic group for the various soil types within each watershed was obtained from the "Soil Survey of San Juan County, Eastern Part" (Keetch 1980) for lands outside the NTEC lease area and from the baseline soils study (Section 14) for lands inside the NTEC lease area. These soil surveys classified soil types into four hydrologic group ratings: A, B, C, or D. Runoff curve numbers were developed from the "SEDCAD™4 User Manual" and software (Warner et al. 1998) and from SCS Engineering Division Technical Release *"Urban Hydrology for Small Watersheds*, Table 2-2d, page 2-8, "Runoff curve numbers for arid and semiarid rangelands" (USDA 1986), for each hydrologic soil group assuming a land use/condition between "Herbaceous" and "Desert Shrub" each with a poor cover condition. From this information, runoff curve numbers were derived for each of the four surface texture types. The curve numbers derived for each texture type are summarized in Table 41.D-1. The runoff curve number for a subwatershed was calculated as a weighted average based on overall the surface texture proportions determined for that watershed.

Hydrologic Response Class

A medium hydrologic response class was applied to all subwatersheds. The hydrologic response class determines the shape of the unit hydrograph used in the SEDCAD model. The medium class is typical of agricultural and semiarid rangeland conditions and was determined to be representative of site conditions.

Sedimentology Evaluation

The SEDCAD sedimentology analysis relies on a rainfall factor, erodible particle size data, a soil's erodibility factor, the watershed's topography and the resulting distance of overland flow, cover values and cultural practices at the site. Data for all of these parameters are entered for each subwatershed within the model.

Erodible Particle Size Distributions

Navajo Transitional Energy Company (NTEC) obtained information about soils within and adjacent to the permit area as part of the rigorous baseline soils investigation for NNP. This information came from site-specific studies (Section 14) and regional soil survey data (Keetch 1980). Soil mapping units were categorized into four surface textures to provide a basis for developing values for sedimentology

parameters used in the SEDCAD model. These surface texture classes included: fine, fine loamy, coarse loamy, and sandy. ArcGIS® software was used to overlay the pre-mine subwatersheds with the baseline soils information to produce a database file that contained the areas corresponding to each soil type within each subwatershed. Textures were linked to the soil types, and an evaluation of the percentage of each texture within each watershed was calculated as a function of area. This surface texture distribution was used to calculate the remaining factors needed for SEDCAD modeling.

Erodible particle size distributions (EPSD) were developed for each of the four surface texture classes in a study conducted by Dr. Richard Warner of the Biosystems and Agricultural Engineering Department at the University of Kentucky (Section 18, Attachment 18.B-1). The SEDCAD modeling software has a maximum of 20 ESPD per watershed model. For some watershed models, there were more subwatersheds than the number of ESPDs allowed by SEDCAD. In these cases, average or representative EPSDs were used. This data was entered into the model, and the specific particle size distribution referenced for each structure. These particle size distributions are specific to each watershed model and are uniquely numbered. Due to formatting difficulties with the SEDCAD output, NTEC has reproduced the particle size distributions for the major model runs in supplemental tables to completely document the assumptions incorporated by the sedimentology analysis. Nineteen particle size distributions were utilized to represent Pinabete Arroyo subwatershed conditions as summarized on Table 41.D-2. The 15 particle distributions for No Name Arroyo are summarized on Table 41.D-3. The 13 particle distributions for Brimhall Wash are summarized on Table 41.D-4. The 10 particle distributions for tributaries to the Chaco River are summarized on Table 41.D-5.

Erodibiltiy Factor (K)

The RUSLE K-Factor is a measure of a soil's resistance to erosive powers of rainfall energy and runoff. Practically, soil erodibility is an integration of the impacts of rainfall and runoff on soil loss for a given soil. Experimentally, soil loss erodibility is the soil loss per unit rainfall index on a standard erosion plot. K-factor can be obtained through three different sources: published data, the Wischmeier nomograph developed from data collected on 55 different midwestern USA agricultural soils, or the analytical approximation of the Wischmeier nomograph (Renard et al. 1997). Inter-Mountain Labs (IML) determined the K-factor for the four soil texture types using the analytical approximation of the Wischmeier nomograph, which is given by the following relationship:

$$K = \frac{2.1\times10^{-4}(12-OM)M^{1.14} + 3.25(S_1-2) + 2.5(P_1-3)}{100}$$

K is the soil erodibility factor in tons per acre per unit rainfall index (ton/ac/unit rainfall)
Unit rainfall index is in hundreds of feet · tons-force · inches per hour (100s ft tonsf in/hr)

OM is the percentage organic matter,

P_1 is the permeability index (1 to 4),

S_1 is the soil structure index (1 to 6),

M is a parameter that depends on the parent particle size distribution and is given by the following and is valid for values of *%MS* + *%VFS* less than 70:

$$M = (\%MS + \%VFS)(100 - \%CL)$$

%CL is percentage clay (size < 0.002 mm in diameter),

%MS is percentage silt (0.002 – 0.05 mm) and

%VFS is percentage very fine sand (0.05 – 0.1 mm).

The percentage clay, silt, and very fine sand are obtained directly from the parent particle size distribution using American Society for Testing and Materials (ASTM) D422 – "Standard Test Method for Particle-Size Analysis of Soils" (ASTM 2000). The percentage of organic matter (*OM*) was determined using the Wakley-Black (WB) method (Nelson and Sommers 1982). IML also determined *OM* using the loss on ignition (LOI) described by Nelson and Sommers (1996). The results of these analyses are provided in Attachment 18.B-2. The K-factors for each texture type are summarized in Table 41.D-1. The K-factor for a subwatershed was then calculated as a weighted average based on the overall surface texture distribution determined for that watershed.

Cover Factor (C)

Representative vegetative cover and surface cover information was derived for each of the EPSD texture classes from baseline vegetation surveys (Section 15). This information was integrated with the EPSD texture class information using ArcGIS® to generate canopy cover and surface cover values for each of the four soil textures. Between 104 and 131 transects were used to determine the mean percent total vegetative cover (canopy cover) and mean percent surface cover for each of the four EPSD texture classes. The canopy cover and surface cover derived for each texture type are summarized in Table 41.D-1. The canopy cover versus surface cover tables for rangeland contained within SEDCAD were expanded through linear interpolation to provide cover factors for subwatersheds based on the surface texture distribution. The average cover values were calculated for subwatersheds as a weighted average based on area. These values were used to determine the cover factor through interpolation in Table 41.D-6.

Results

The results of the hydrology and sedimentology models for each of the watersheds are provided as attachments. Each attachment contains the summary output from SEDCAD including: storm information, structure networking, structure routing details, EPSD for each structure, subwatershed hydrology details,

subwatershed sedimentology details, subwatershed time of concentration details, subwatershed Muskingum routing details. The subwatershed structure networking is shown on Exhibit 41.2-2. The attachments also contain structure summaries for the following storm events: 10-year 24-hour, 2-year 6-hour, 10-year 6-hour, 25-year 6-hour, 50-year 6-hour, and 100-year 6-hour.

Peak flows and sediment yields calculated from the aforementioned SEDCAD models for the 24-hour 10-year and 6-hour rainfall events on 2-year, 10-year, 25-year, 50-year, and 100-year frequencies are reported in Section 41.3 in Table 41.3-6 through Table 41.3-9 for each of the surface water monitoring stations on Pinabete and No Name arroyos, Brimhall Wash at the confluence with Chaco, and the unnamed tributaries to Chaco at the confluence.

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Attachment 41.D-1

Pinabete Arroyo Post-reclamation Hydrology and Sedimentology SEDCAD™ Model Output

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General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Particle Size Distribution:

Table 41.D-2

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	1.674	0.331	
Null	#2	==>	#5	4.188	0.295	
Null	#3	==>	#4	1.961	0.319	
Null	#4	==>	#5	3.103	0.304	
Null	#5	==>	#6	1.323	0.273	
Null	#6	==>	#7	2.502	0.273	EAST LEASE BNDY
Null	#7	==>	#8	1.503	0.279	
Null	#8	==>	#9	2.695	0.258	WEST LEASE BNDY
Null	#9	==>	End	0.000	0.000	



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	1.24	250.00	20,135.88	3.34	1.674
#1	**Muskingum K:**					**1.674**
#2	8. Large gullies, diversions, and low flowing streams	0.67	245.00	36,791.19	2.44	4.188
#2	**Muskingum K:**					**4.188**

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	8. Large gullies, diversions, and low flowing streams	0.99	210.00	21,117.50	2.99	1.961
#3	**Muskingum K:**					**1.961**
#4	8. Large gullies, diversions, and low flowing streams	0.77	227.00	29,387.50	2.63	3.103
#4	**Muskingum K:**					**3.103**
#5	8. Large gullies, diversions, and low flowing streams	0.46	45.00	9,722.43	2.04	1.323
#5	**Muskingum K:**					**1.323**
#6	8. Large gullies, diversions, and low flowing streams	0.47	87.00	18,471.41	2.05	2.502
#6	**Muskingum K:**					**2.502**
#7	8. Large gullies, diversions, and low flowing streams	0.52	60.00	11,633.46	2.15	1.503
#7	**Muskingum K:**					**1.503**
#8	8. Large gullies, diversions, and low flowing streams	0.36	64.00	17,564.84	1.81	2.695
#8	**Muskingum K:**					**2.695**

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Particle Size Distribution(s) at Each Structure

Structure #3:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	99.260%
0.0750	91.911%
0.0159	88.675%
0.0100	74.957%
0.0050	29.096%
0.0020	16.175%
0.0010	14.670%
0.0004	13.839%

Structure #4:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	97.132%
0.0159	92.309%
0.0100	80.310%
0.0050	32.213%
0.0020	18.272%
0.0010	16.677%
0.0004	15.490%

Structure #1:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	99.770%
0.0159	92.527%

Size (mm)	In/Out
0.0100	78.305%
0.0050	26.864%
0.0020	15.682%
0.0010	14.428%
0.0004	13.157%

Structure #2:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	96.263%
0.0100	86.829%
0.0050	31.336%
0.0020	18.862%
0.0010	17.605%
0.0004	15.511%

Structure #5:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	98.899%
0.0159	97.134%
0.0100	86.879%
0.0050	30.811%
0.0020	18.351%
0.0010	17.051%
0.0004	15.185%

Structure #6 (EAST LEASE BNDY):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	98.471%

Size (mm)	In/Out
0.0050	35.306%
0.0020	21.082%
0.0010	19.603%
0.0004	17.431%

Structure #7:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	99.845%
0.0159	99.669%
0.0100	99.356%
0.0050	36.588%
0.0020	21.787%
0.0010	20.260%
0.0004	18.033%

Structure #8 (WEST LEASE BNDY):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	99.362%
0.0159	99.044%
0.0100	98.460%
0.0050	38.037%
0.0020	22.567%
0.0010	20.979%
0.0004	18.716%

Structure #9:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	98.217%
0.0159	96.606%
0.0100	94.314%
0.0050	39.166%

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Size (mm)	In/Out
0.0020	23.216%
0.0010	21.576%
0.0004	19.260%

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Structure Detail:

Structure #3 (Null)

Structure #4 (Null)

Structure #1 (Null)

Structure #2 (Null)

Structure #5 (Null)

Structure #6 (Null)

EAST LEASE BNDY

Structure #7 (Null)

Structure #8 (Null)

WEST LEASE BNDY

Structure #9 (Null)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#3	1	791.300	1.145	1.181	0.350	80.800	M	137.26	21.870
	2	1,079.100	0.915	0.596	0.351	80.800	M	223.54	29.835
	3	450.300	0.571	0.319	0.355	81.300	M	138.88	12.992
	4	742.600	0.625	0.000	0.000	78.500	M	162.13	16.799
	5	915.400	1.119	0.000	0.000	78.800	M	131.60	21.280
	Σ	**3,978.700**						**440.83**	**102.777**
#4	1	546.400	0.726	1.710	0.319	81.700	M	147.20	16.285
	2	441.200	0.503	1.426	0.318	86.000	M	224.45	18.445
	3	889.400	0.815	0.999	0.318	82.100	M	228.19	27.379
	4	1,339.100	0.919	0.000	0.000	84.000	M	373.16	47.965
	Σ	**7,194.800**						**603.64**	**212.850**
#1	1	1,242.320	1.349	1.345	0.354	80.800	M	188.55	34.328
	2	1,662.150	1.465	0.849	0.360	80.300	M	224.10	44.019
	3	1,434.010	1.573	1.241	0.357	81.100	M	197.43	40.634
	4	842.690	1.102	0.977	0.364	81.000	M	153.76	23.683
	5	676.090	1.067	1.113	0.365	81.600	M	134.22	19.973
	6	1,223.150	0.778	0.596	0.352	81.800	M	315.92	36.749
	7	743.140	0.745	0.524	0.354	83.600	M	233.84	25.798
	8	654.480	0.801	0.000	0.000	92.200	M	397.47	42.809
	Σ	**8,478.029**						**932.58**	**267.993**
#2	1	609.450	0.668	1.219	0.340	85.700	M	249.68	24.901
	2	537.100	0.610	1.436	0.329	91.600	M	374.99	33.711
	3	454.990	0.546	1.288	0.324	82.000	M	154.39	13.898
	4	626.980	0.634	0.852	0.324	87.900	M	320.24	30.150
	5	653.070	0.452	0.453	0.315	91.200	M	527.54	39.846
	6	957.180	0.984	0.000	0.000	89.600	M	407.81	52.056
	Σ	**12,316.800**						**1,096.46**	**462.555**
#5	1	763.100	0.682	3.508	0.293	84.100	M	267.48	27.555
	2	983.300	1.117	2.231	0.289	89.200	M	367.53	51.945
	3	1,021.900	0.996	1.587	0.291	92.000	M	521.28	65.921
	4	688.700	1.908	1.255	0.291	80.800	M	78.28	19.028
	5	754.300	2.307	1.084	0.287	86.200	M	119.98	31.953
	6	628.400	0.538	0.595	0.301	93.000	M	524.05	43.517
	7	654.500	0.560	0.000	0.000	91.500	M	478.48	40.785
	Σ	**25,005.800**						**1,684.75**	**956.110**
#6	1	901.350	1.151	1.880	0.316	81.100	M	160.39	25.545
	2	1,011.240	1.871	0.149	0.291	83.500	M	151.24	34.803

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
	3	1,166.450	1.145	0.000	0.000	92.000	M	534.68	75.238
	Σ	**28,084.840**						**1,693.34**	**1,091.697**
#7	1	935.150	0.763	2.250	0.267	77.500	M	157.43	19.340
	2	386.880	1.710	3.116	0.265	74.200	M	22.76	5.777
	3	244.890	1.321	2.285	0.262	72.900	M	14.87	3.180
	4	369.500	0.705	2.283	0.262	72.900	M	36.73	4.800
	5	492.930	0.715	1.466	0.268	72.900	M	48.48	6.404
	6	606.410	1.158	0.000	0.000	72.900	M	40.97	7.876
	Σ	**31,120.600**						**1,677.39**	**1,139.075**
#8	1	1,637.130	2.598	2.654	0.280	74.300	M	68.95	24.707
	2	753.660	2.086	1.900	0.281	79.000	M	66.03	17.832
	3	320.510	0.755	0.850	0.294	72.900	M	30.25	4.165
	4	643.270	1.067	0.597	0.299	73.100	M	47.74	8.542
	5	451.720	1.104	0.486	0.309	75.600	M	45.37	7.782
	6	357.060	0.657	0.486	0.309	83.400	M	120.85	12.212
	7	238.440	0.607	0.000	0.000	78.200	M	51.51	5.260
	Σ	**35,522.390**						**1,686.64**	**1,219.575**
#9	1	484.600	0.681	2.383	0.256	88.900	M	255.46	25.074
	2	434.900	0.634	2.155	0.259	82.000	M	132.98	13.279
	3	361.170	0.686	1.865	0.256	84.900	M	135.38	13.871
	4	573.300	0.655	0.983	0.255	85.700	M	238.16	23.427
	5	473.090	0.668	0.000	0.000	84.500	M	174.45	17.633
	Σ	**37,849.450**						**1,678.61**	**1,312.858**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#3	1	0.150	100.00	9.10	0.3050	1.0000	18	517.9	28,671	8.11	4.88
	2	0.181	100.00	10.10	0.3050	1.0000	13	1,178.3	48,541	17.28	10.19
	3	0.151	200.00	5.50	0.3050	1.0000	18	316.4	31,264	13.05	7.40
	4	0.183	130.00	7.60	0.3160	1.0000	12	550.1	42,933	16.42	9.09
	5	0.185	100.00	8.30	0.2760	1.0000	6	481.0	28,197	6.04	3.53
	Σ							**2,338.6**	**27,282**	**6.12**	**3.73**
#4	1	0.173	130.00	7.00	0.2850	1.0000	7	403.2	30,444	11.52	6.82
	2	0.148	100.00	12.00	0.2220	1.0000	5	682.7	44,553	17.59	10.60
	3	0.185	75.00	13.60	0.2740	1.0000	17	1,316.9	58,425	20.84	12.39
	4	0.213	100.00	10.60	0.2330	1.0000	6	1,973.6	49,931	15.56	9.28

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	Σ							**4,860.5**	**43,255**	**7.92**	**3.06**
#1	1	0.220	280.00	2.20	0.2962	1.0000	13	354.1	12,395	3.41	2.08
	2	0.202	240.00	3.30	0.2962	1.0000	13	569.0	15,504	3.87	2.36
	3	0.206	280.00	2.60	0.2962	1.0000	13	436.0	12,729	3.06	1.91
	4	0.188	200.00	5.10	0.2962	1.0000	13	527.3	27,087	8.71	5.22
	5	0.124	240.00	3.60	0.3130	1.0000	18	192.8	11,797	3.62	2.17
	6	0.178	130.00	7.90	0.2851	1.0000	7	1,126.6	38,010	13.97	8.19
	7	0.191	100.00	9.20	0.2539	1.0000	6	824.5	39,322	13.69	8.08
	8	0.199	75.00	15.10	0.1508	1.0000	2	1,560.0	42,317	11.58	7.23
	Σ							**4,563.2**	**34,130**	**6.93**	**2.53**
#2	1	0.188	130.00	7.30	0.2120	1.0000	5	578.4	28,165	9.86	5.92
	2	0.199	75.00	12.60	0.1508	1.0000	2	1,046.7	35,968	11.45	7.19
	3	0.200	100.00	8.60	0.2019	1.0000	11	346.7	31,111	9.19	5.36
	4	0.193	75.00	12.30	0.1727	1.0000	4	968.6	38,445	12.09	7.34
	5	0.187	75.00	14.00	0.1595	1.0000	3	1,585.9	46,915	17.54	10.78
	6	0.198	75.00	13.70	0.1680	1.0000	4	1,730.7	38,951	9.35	5.80
	Σ							**7,498.7**	**34,767**	**4.88**	**1.67**
#5	1	0.213	130.00	6.30	0.2330	1.0000	6	688.3	29,562	10.84	6.67
	2	0.209	130.00	7.10	0.1680	1.0000	4	930.8	20,627	4.23	2.68
	3	0.191	100.00	8.40	0.1500	1.0000	2	1,120.1	19,452	4.36	2.78
	4	0.235	200.00	4.90	0.2870	1.0000	9	373.4	22,778	4.39	2.78
	5	0.220	240.00	3.70	0.1900	1.0000	16	260.3	9,212	0.56	0.37
	6	0.200	130.00	7.30	0.1410	1.0000	1	847.6	22,769	7.65	4.77
	7	0.204	200.00	4.70	0.1560	1.0000	2	714.9	20,930	6.93	4.24
	Σ							**16,005.4**	**27,782**	**3.87**	**1.76**
#6	1	0.228	280.00	2.70	0.2870	1.0000	9	331.5	15,641	4.99	3.03
	2	0.226	280.00	2.40	0.2330	1.0000	6	276.0	9,265	1.14	0.72
	3	0.199	200.00	4.10	0.1460	1.0000	14	861.2	13,257	2.37	1.50
	Σ							**14,978.3**	**23,067**	**1.52**	**0.68**
#7	1	0.189	280.00	2.70	0.2330	1.0000	10	188.8	12,250	3.50	2.05
	2	0.193	280.00	2.60	0.3270	1.0000	8	45.0	9,307	0.55	0.34
	3	0.164	280.00	3.00	0.3320	1.0000	8	25.0	9,709	1.05	0.62
	4	0.165	280.00	2.10	0.1790	1.0000	8	20.5	5,569	1.52	0.85
	5	0.164	280.00	2.70	0.3150	1.0000	8	61.7	12,708	3.42	1.90
	6	0.164	240.00	3.80	0.3380	1.0000	8	88.5	14,576	2.13	1.20
	Σ							**14,849.8**	**22,445**	**1.35**	**0.61**
#8	1	0.195	420.00	1.80	0.3050	1.0000	8	145.1	6,738	0.25	0.16
	2	0.183	280.00	2.70	0.2500	1.0000	15	115.3	7,509	1.18	0.75
	3	0.164	130.00	6.40	0.2220	1.0000	8	52.5	16,790	4.31	2.37

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	4	0.166	130.00	7.10	0.1790	1.0000	8	91.4	13,774	2.38	1.35
	5	0.182	240.00	3.10	0.2960	1.0000	8	74.9	12,196	2.46	1.42
	6	0.233	240.00	3.60	0.2650	1.0000	15	219.5	22,408	9.88	5.79
	7	0.185	100.00	11.60	0.1810	1.0000	10	144.4	36,289	12.25	6.74
	Σ							**15,029.1**	**32,998**	**2.14**	**0.62**
#9	1	0.204	130.00	7.90	0.1860	1.0000	19	604.3	27,912	10.23	6.44
	2	0.178	100.00	10.70	0.2320	1.0000	10	454.9	41,434	14.98	8.99
	3	0.177	100.00	8.30	0.2330	1.0000	6	310.5	26,789	9.96	6.07
	4	0.161	100.00	10.00	0.2220	1.0000	5	658.6	33,894	11.97	7.23
	5	0.175	200.00	5.90	0.2450	1.0000	6	424.6	29,958	11.18	6.54
	Σ							**15,756.6**	**32,007**	**2.89**	**0.87**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	2.99	22.00	736.00	1.720	0.118
		8. Large gullies, diversions, and low flowing streams	0.63	66.00	10,511.22	2.370	1.231
#1	**1**	**Time of Concentration:**					**1.349**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	1.02	8.00	785.08	1.000	0.218
		8. Large gullies, diversions, and low flowing streams	1.48	242.00	16,352.75	3.640	1.247
#1	**2**	**Time of Concentration:**					**1.465**
#1	3	5. Nearly bare and untilled, and alluvial valley fans	0.88	10.00	1,136.10	0.930	0.339
		8. Large gullies, diversions, and low flowing streams	1.31	200.00	15,245.06	3.430	1.234
#1	**3**	**Time of Concentration:**					**1.573**
#1	4	5. Nearly bare and untilled, and alluvial valley fans	1.85	10.00	542.00	1.350	0.111
		8. Large gullies, diversions, and low flowing streams	1.62	220.00	13,596.19	3.810	0.991
#1	**4**	**Time of Concentration:**					**1.102**
#1	5	5. Nearly bare and untilled, and alluvial valley fans	1.23	10.00	812.01	1.100	0.205
		8. Large gullies, diversions, and low flowing streams	1.41	156.00	11,048.72	3.560	0.862
#1	**5**	**Time of Concentration:**					**1.067**
#1	6	5. Nearly bare and untilled, and alluvial valley fans	3.12	22.00	706.01	1.760	0.111
		8. Large gullies, diversions, and low flowing streams	2.85	346.00	12,152.29	5.060	0.667

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	**6**	**Time of Concentration:**					**0.778**
#1	7	5. Nearly bare and untilled, and alluvial valley fans	4.66	43.00	922.01	2.150	0.119
		8. Large gullies, diversions, and low flowing streams	2.67	295.00	11,057.38	4.900	0.626
#1	**7**	**Time of Concentration:**					**0.745**
#1	8	5. Nearly bare and untilled, and alluvial valley fans	7.46	65.00	871.01	2.730	0.088
		8. Large gullies, diversions, and low flowing streams	2.61	324.00	12,433.32	4.840	0.713
#1	**8**	**Time of Concentration:**					**0.801**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	6.24	30.00	481.00	2.490	0.053
		8. Large gullies, diversions, and low flowing streams	3.34	406.00	12,141.14	5.480	0.615
#2	**1**	**Time of Concentration:**					**0.668**
#2	2	5. Nearly bare and untilled, and alluvial valley fans	3.16	30.00	950.02	1.770	0.149
		8. Large gullies, diversions, and low flowing streams	4.22	432.00	10,229.21	6.160	0.461
#2	**2**	**Time of Concentration:**					**0.610**
#2	3	5. Nearly bare and untilled, and alluvial valley fans	2.65	10.00	378.00	1.620	0.064
		8. Large gullies, diversions, and low flowing streams	2.72	234.00	8,592.20	4.950	0.482
#2	**3**	**Time of Concentration:**					**0.546**
#2	4	5. Nearly bare and untilled, and alluvial valley fans	3.07	25.00	815.02	1.750	0.129
		8. Large gullies, diversions, and low flowing streams	3.32	330.00	9,931.08	5.460	0.505
#2	**4**	**Time of Concentration:**					**0.634**
#2	5	5. Nearly bare and untilled, and alluvial valley fans	7.45	45.00	604.00	2.720	0.061
		8. Large gullies, diversions, and low flowing streams	3.78	310.00	8,210.18	5.820	0.391
#2	**5**	**Time of Concentration:**					**0.452**
#2	6	5. Nearly bare and untilled, and alluvial valley fans	9.10	80.00	879.00	3.010	0.081
		8. Large gullies, diversions, and low flowing streams	2.32	344.00	14,831.42	4.560	0.903
#2	**6**	**Time of Concentration:**					**0.984**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	1.29	15.00	1,163.06	1.130	0.285
		8. Large gullies, diversions, and low flowing streams	2.37	338.00	14,280.28	4.610	0.860
#3	**1**	**Time of Concentration:**					**1.145**
#3	2	5. Nearly bare and untilled, and alluvial valley fans	3.04	33.00	1,087.02	1.740	0.173
		8. Large gullies, diversions, and low flowing streams	2.06	238.00	11,527.65	4.310	0.742
#3	**2**	**Time of Concentration:**					**0.915**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	3	5. Nearly bare and untilled, and alluvial valley fans	5.02	45.00	897.02	2.230	0.111
		8. Large gullies, diversions, and low flowing streams	3.09	270.00	8,741.25	5.270	0.460
#3	**3**	**Time of Concentration:**					**0.571**
#3	4	5. Nearly bare and untilled, and alluvial valley fans	7.41	28.00	378.00	2.720	0.038
		8. Large gullies, diversions, and low flowing streams	3.43	402.00	11,736.19	5.550	0.587
#3	**4**	**Time of Concentration:**					**0.625**
#3	5	5. Nearly bare and untilled, and alluvial valley fans	3.39	30.00	885.00	1.840	0.133
		8. Large gullies, diversions, and low flowing streams	2.58	442.00	17,121.16	4.820	0.986
#3	**5**	**Time of Concentration:**					**1.119**
#4	1	5. Nearly bare and untilled, and alluvial valley fans	3.59	62.00	1,729.04	1.890	0.254
		8. Large gullies, diversions, and low flowing streams	2.09	154.00	7,372.30	4.330	0.472
#4	**1**	**Time of Concentration:**					**0.726**
#4	2	5. Nearly bare and untilled, and alluvial valley fans	6.83	25.00	366.00	2.610	0.038
		8. Large gullies, diversions, and low flowing streams	2.36	182.00	7,708.27	4.600	0.465
#4	**2**	**Time of Concentration:**					**0.503**
#4	3	5. Nearly bare and untilled, and alluvial valley fans	19.03	47.00	247.00	4.360	0.015
		8. Large gullies, diversions, and low flowing streams	2.13	268.00	12,586.29	4.370	0.800
#4	**3**	**Time of Concentration:**					**0.815**
#4	4	5. Nearly bare and untilled, and alluvial valley fans	14.08	50.00	355.00	3.750	0.026
		8. Large gullies, diversions, and low flowing streams	2.46	372.00	15,119.49	4.700	0.893
#4	**4**	**Time of Concentration:**					**0.919**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	12.55	65.00	518.00	3.540	0.040
		8. Large gullies, diversions, and low flowing streams	1.92	184.00	9,592.32	4.150	0.642
#5	**1**	**Time of Concentration:**					**0.682**
#5	2	5. Nearly bare and untilled, and alluvial valley fans	5.10	30.00	588.00	2.250	0.072
		8. Large gullies, diversions, and low flowing streams	1.77	266.00	15,016.37	3.990	1.045
#5	**2**	**Time of Concentration:**					**1.117**
#5	3	5. Nearly bare and untilled, and alluvial valley fans	1.90	20.00	1,050.03	1.380	0.211
		8. Large gullies, diversions, and low flowing streams	2.19	274.00	12,532.01	4.430	0.785
#5	**3**	**Time of Concentration:**					**0.996**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	4	5. Nearly bare and untilled, and alluvial valley fans	2.78	32.00	1,152.03	1.660	0.192
		8. Large gullies, diversions, and low flowing streams	0.99	182.00	18,415.45	2.980	1.716
#5	**4**	**Time of Concentration:**					**1.908**
#5	5	5. Nearly bare and untilled, and alluvial valley fans	2.52	23.00	911.03	1.580	0.160
		8. Large gullies, diversions, and low flowing streams	1.07	256.00	23,965.55	3.100	2.147
#5	**5**	**Time of Concentration:**					**2.307**
#5	6	5. Nearly bare and untilled, and alluvial valley fans	6.36	25.00	393.00	2.520	0.043
		8. Large gullies, diversions, and low flowing streams	2.39	198.00	8,272.05	4.640	0.495
#5	**6**	**Time of Concentration:**					**0.538**
#5	7	5. Nearly bare and untilled, and alluvial valley fans	9.66	28.00	290.00	3.100	0.025
		8. Large gullies, diversions, and low flowing streams	2.12	179.00	8,427.09	4.370	0.535
#5	**7**	**Time of Concentration:**					**0.560**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	31.83	120.00	377.00	5.640	0.018
		8. Large gullies, diversions, and low flowing streams	1.38	198.00	14,361.35	3.520	1.133
#6	**1**	**Time of Concentration:**					**1.151**
#6	2	5. Nearly bare and untilled, and alluvial valley fans	4.25	40.00	941.02	2.060	0.126
		8. Large gullies, diversions, and low flowing streams	0.96	176.00	18,408.11	2.930	1.745
#6	**2**	**Time of Concentration:**					**1.871**
#6	3	5. Nearly bare and untilled, and alluvial valley fans	4.02	22.00	547.62	2.000	0.076
		8. Large gullies, diversions, and low flowing streams	1.55	223.00	14,361.21	3.730	1.069
#6	**3**	**Time of Concentration:**					**1.145**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	2.76	11.00	399.20	1.650	0.067
		8. Large gullies, diversions, and low flowing streams	1.24	104.00	8,380.33	3.340	0.696
#7	**1**	**Time of Concentration:**					**0.763**
#7	2	5. Nearly bare and untilled, and alluvial valley fans	0.32	2.00	620.15	0.560	0.307
		8. Large gullies, diversions, and low flowing streams	0.43	42.00	9,854.52	1.950	1.403
#7	**2**	**Time of Concentration:**					**1.710**
#7	3	5. Nearly bare and untilled, and alluvial valley fans	1.82	10.00	548.42	1.350	0.112
		8. Large gullies, diversions, and low flowing streams	0.53	51.00	9,538.05	2.190	1.209
#7	**3**	**Time of Concentration:**					**1.321**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#7	4	5. Nearly bare and untilled, and alluvial valley fans	3.00	22.00	733.16	1.730	0.117
		8. Large gullies, diversions, and low flowing streams	1.08	71.00	6,592.99	3.110	0.588
#7	**4**	**Time of Concentration:**					**0.705**
#7	5	5. Nearly bare and untilled, and alluvial valley fans	3.10	22.00	708.78	1.760	0.111
		8. Large gullies, diversions, and low flowing streams	1.38	106.00	7,656.74	3.520	0.604
#7	**5**	**Time of Concentration:**					**0.715**
#7	6	5. Nearly bare and untilled, and alluvial valley fans	2.97	12.00	403.48	1.720	0.065
		8. Large gullies, diversions, and low flowing streams	0.71	71.00	9,963.51	2.530	1.093
#7	**6**	**Time of Concentration:**					**1.158**
#8	1	5. Nearly bare and untilled, and alluvial valley fans	0.85	7.00	821.00	0.920	0.247
		8. Large gullies, diversions, and low flowing streams	1.00	254.00	25,397.46	3.000	2.351
#8	**1**	**Time of Concentration:**					**2.598**
#8	2	5. Nearly bare and untilled, and alluvial valley fans	0.76	9.00	1,180.94	0.870	0.377
		8. Large gullies, diversions, and low flowing streams	0.80	132.00	16,491.75	2.680	1.709
#8	**2**	**Time of Concentration:**					**2.086**
#8	3	5. Nearly bare and untilled, and alluvial valley fans	1.91	10.00	523.25	1.380	0.105
		8. Large gullies, diversions, and low flowing streams	1.20	92.00	7,678.18	3.280	0.650
#8	**3**	**Time of Concentration:**					**0.755**
#8	4	5. Nearly bare and untilled, and alluvial valley fans	0.35	2.00	572.24	0.590	0.269
		8. Large gullies, diversions, and low flowing streams	1.46	152.00	10,412.38	3.620	0.798
#8	**4**	**Time of Concentration:**					**1.067**
#8	5	5. Nearly bare and untilled, and alluvial valley fans	18.94	82.00	432.84	4.350	0.027
		8. Large gullies, diversions, and low flowing streams	1.19	150.00	12,649.68	3.260	1.077
#8	**5**	**Time of Concentration:**					**1.104**
#8	6	5. Nearly bare and untilled, and alluvial valley fans	0.65	2.00	307.69	0.800	0.106
		8. Large gullies, diversions, and low flowing streams	1.32	90.00	6,829.56	3.440	0.551
#8	**6**	**Time of Concentration:**					**0.657**
#8	7	5. Nearly bare and untilled, and alluvial valley fans	1.40	10.00	715.05	1.180	0.168
		8. Large gullies, diversions, and low flowing streams	0.75	31.00	4,116.31	2.600	0.439
#8	**7**	**Time of Concentration:**					**0.607**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#9	1	5. Nearly bare and untilled, and alluvial valley fans	6.54	22.00	336.56	2.550	0.036
		8. Large gullies, diversions, and low flowing streams	1.44	120.00	8,343.18	3.590	0.645
#9	**1**	**Time of Concentration:**					**0.681**
#9	2	5. Nearly bare and untilled, and alluvial valley fans	8.94	12.00	134.17	2.990	0.012
		8. Large gullies, diversions, and low flowing streams	1.94	182.00	9,369.85	4.180	0.622
#9	**2**	**Time of Concentration:**					**0.634**
#9	3	5. Nearly bare and untilled, and alluvial valley fans	3.14	25.00	796.00	1.770	0.124
		8. Large gullies, diversions, and low flowing streams	1.68	132.00	7,862.29	3.880	0.562
#9	**3**	**Time of Concentration:**					**0.686**
#9	4	5. Nearly bare and untilled, and alluvial valley fans	12.82	35.00	273.00	3.580	0.021
		8. Large gullies, diversions, and low flowing streams	1.93	183.00	9,495.14	4.160	0.634
#9	**4**	**Time of Concentration:**					**0.655**
#9	5	5. Nearly bare and untilled, and alluvial valley fans	2.66	15.00	564.03	1.630	0.096
		8. Large gullies, diversions, and low flowing streams	1.68	135.00	8,020.43	3.890	0.572
#9	**5**	**Time of Concentration:**					**0.668**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.89	378.00	19,958.22	4.120	1.345
#1	**1**	**Muskingum K:**					**1.345**
#1	2	8. Large gullies, diversions, and low flowing streams	2.11	282.00	13,337.14	4.360	0.849
#1	**2**	**Muskingum K:**					**0.849**
#1	3	8. Large gullies, diversions, and low flowing streams	2.02	384.00	19,036.00	4.260	1.241
#1	**3**	**Muskingum K:**					**1.241**
#1	4	8. Large gullies, diversions, and low flowing streams	2.28	364.00	15,948.82	4.530	0.977
#1	**4**	**Muskingum K:**					**0.977**
#1	5	8. Large gullies, diversions, and low flowing streams	2.33	428.00	18,360.43	4.580	1.113
#1	**5**	**Muskingum K:**					**1.113**
#1	6	8. Large gullies, diversions, and low flowing streams	1.82	158.00	8,675.12	4.040	0.596
#1	**6**	**Muskingum K:**					**0.596**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	7	8. Large gullies, diversions, and low flowing streams	1.91	149.00	7,814.62	4.140	0.524
#1	**7**	**Muskingum K:**					**0.524**
#2	1	8. Large gullies, diversions, and low flowing streams	1.44	228.00	15,800.41	3.600	1.219
#2	**1**	**Muskingum K:**					**1.219**
#2	2	8. Large gullies, diversions, and low flowing streams	1.19	202.00	16,912.25	3.270	1.436
#2	**2**	**Muskingum K:**					**1.436**
#2	3	8. Large gullies, diversions, and low flowing streams	1.10	160.00	14,569.29	3.140	1.288
#2	**3**	**Muskingum K:**					**1.288**
#2	4	8. Large gullies, diversions, and low flowing streams	1.09	104.00	9,576.42	3.120	0.852
#2	**4**	**Muskingum K:**					**0.852**
#2	5	8. Large gullies, diversions, and low flowing streams	0.93	44.00	4,715.46	2.890	0.453
#2	**5**	**Muskingum K:**					**0.453**
#3	1	8. Large gullies, diversions, and low flowing streams	1.75	294.00	16,845.24	3.960	1.181
#3	**1**	**Muskingum K:**					**1.181**
#3	2	8. Large gullies, diversions, and low flowing streams	1.79	154.00	8,609.12	4.010	0.596
#3	**2**	**Muskingum K:**					**0.596**
#3	3	8. Large gullies, diversions, and low flowing streams	1.93	92.00	4,778.22	4.160	0.319
#3	**3**	**Muskingum K:**					**0.319**
#4	1	8. Large gullies, diversions, and low flowing streams	1.01	186.00	18,478.04	3.000	1.710
#4	**1**	**Muskingum K:**					**1.710**
#4	2	8. Large gullies, diversions, and low flowing streams	0.98	150.00	15,250.76	2.970	1.426
#4	**2**	**Muskingum K:**					**1.426**
#4	3	8. Large gullies, diversions, and low flowing streams	0.98	104.00	10,645.92	2.960	0.999
#4	**3**	**Muskingum K:**					**0.999**
#5	1	8. Large gullies, diversions, and low flowing streams	0.64	195.00	30,309.38	2.400	3.508
#5	**1**	**Muskingum K:**					**3.508**
#5	2	8. Large gullies, diversions, and low flowing streams	0.60	113.00	18,717.90	2.330	2.231
#5	**2**	**Muskingum K:**					**2.231**
#5	3	8. Large gullies, diversions, and low flowing streams	0.63	85.00	13,543.65	2.370	1.587
#5	**3**	**Muskingum K:**					**1.587**
#5	4	8. Large gullies, diversions, and low flowing streams	0.63	67.00	10,709.63	2.370	1.255
#5	**4**	**Muskingum K:**					**1.255**
#5	5	8. Large gullies, diversions, and low flowing streams	0.59	53.00	8,978.48	2.300	1.084

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	**5**	**Muskingum K:**					**1.084**
#5	6	8. Large gullies, diversions, and low flowing streams	0.74	41.00	5,528.58	2.580	0.595
#5	**6**	**Muskingum K:**					**0.595**
#6	1	8. Large gullies, diversions, and low flowing streams	0.94	186.00	19,697.50	2.910	1.880
#6	**1**	**Muskingum K:**					**1.880**
#6	2	8. Large gullies, diversions, and low flowing streams	0.63	8.00	1,272.73	2.370	0.149
#6	**2**	**Muskingum K:**					**0.149**
#7	1	8. Large gullies, diversions, and low flowing streams	0.42	67.00	15,801.88	1.950	2.250
#7	**1**	**Muskingum K:**					**2.250**
#7	2	8. Large gullies, diversions, and low flowing streams	0.41	89.00	21,539.20	1.920	3.116
#7	**2**	**Muskingum K:**					**3.116**
#7	3	8. Large gullies, diversions, and low flowing streams	0.39	60.00	15,388.56	1.870	2.285
#7	**3**	**Muskingum K:**					**2.285**
#7	4	8. Large gullies, diversions, and low flowing streams	0.39	60.00	15,372.79	1.870	2.283
#7	**4**	**Muskingum K:**					**2.283**
#7	5	8. Large gullies, diversions, and low flowing streams	0.43	45.00	10,399.81	1.970	1.466
#7	**5**	**Muskingum K:**					**1.466**
#8	1	8. Large gullies, diversions, and low flowing streams	0.52	107.00	20,640.43	2.160	2.654
#8	**1**	**Muskingum K:**					**2.654**
#8	2	8. Large gullies, diversions, and low flowing streams	0.53	79.00	14,916.91	2.180	1.900
#8	**2**	**Muskingum K:**					**1.900**
#8	3	8. Large gullies, diversions, and low flowing streams	0.66	49.00	7,437.76	2.430	0.850
#8	**3**	**Muskingum K:**					**0.850**
#8	4	8. Large gullies, diversions, and low flowing streams	0.72	39.00	5,442.36	2.530	0.597
#8	**4**	**Muskingum K:**					**0.597**
#8	5	8. Large gullies, diversions, and low flowing streams	0.85	41.00	4,831.48	2.760	0.486
#8	**5**	**Muskingum K:**					**0.486**
#8	6	8. Large gullies, diversions, and low flowing streams	0.85	41.00	4,831.48	2.760	0.486
#8	**6**	**Muskingum K:**					**0.486**
#9	1	8. Large gullies, diversions, and low flowing streams	0.36	55.00	15,358.83	1.790	2.383
#9	**1**	**Muskingum K:**					**2.383**
#9	2	8. Large gullies, diversions, and low flowing streams	0.37	53.00	14,201.50	1.830	2.155
#9	**2**	**Muskingum K:**					**2.155**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#9	3	8. Large gullies, diversions, and low flowing streams	0.36	43.00	12,021.24	1.790	1.865
#9	**3**	**Muskingum K:**					**1.865**
#9	4	8. Large gullies, diversions, and low flowing streams	0.35	22.00	6,269.59	1.770	0.983
#9	**4**	**Muskingum K:**					**0.983**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#3	3,978.700	3,978.700	440.83	102.78	2,338.6	27,282	6.12	3.73
#4	3,216.100	7,194.800	603.64	212.85	4,860.5	43,255	7.92	3.05
#1	8,478.029	8,478.029	932.58	267.99	4,563.2	34,130	6.93	2.52
#2	3,838.770	12,316.800	1,096.46	462.56	7,498.7	34,767	4.88	1.66
#5	5,494.200	25,005.800	1,684.75	956.11	16,005.4	27,782	3.87	1.72
#6	3,079.040	28,084.840	1,693.34	1,091.70	14,978.3	23,067	1.52	0.67
#7	3,035.760	31,120.600	1,677.39	1,139.08	14,849.8	22,445	1.35	0.59
#8	4,401.790	35,522.390	1,686.64	1,219.57	15,029.1	32,998	2.14	0.60
#9	2,327.060	37,849.450	1,678.61	1,312.86	15,756.6	32,007	2.89	0.84

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#3	3,978.700	3,978.700	54.16	11.47	213.2	19,166	1.80	1.28
#4	3,216.100	7,194.800	98.81	29.58	588.9	31,021	3.41	1.60
#1	8,478.029	8,478.029	154.93	42.61	703.0	27,399	3.83	1.68
#2	3,838.770	12,316.800	330.95	91.74	1,664.0	30,498	3.50	1.52
#5	5,494.200	25,005.800	410.50	194.41	2,431.0	16,102	1.29	0.74
#6	3,079.040	28,084.840	405.77	226.25	2,269.1	12,876	0.60	0.34
#7	3,035.760	31,120.600	398.01	228.17	2,261.3	14,274	0.61	0.31
#8	4,401.790	35,522.390	395.26	233.62	2,276.9	19,890	0.93	0.33
#9	2,327.060	37,849.450	390.65	252.15	2,426.4	24,544	1.66	0.48

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#3	3,978.700	3,978.700	265.53	49.06	1,165.5	23,780	4.29	3.13
#4	3,216.100	7,194.800	377.11	107.10	2,541.9	37,707	5.84	2.68
#1	8,478.029	8,478.029	592.45	139.16	2,549.6	31,179	5.37	2.30
#2	3,838.770	12,316.800	789.85	255.55	4,558.8	31,974	4.08	1.66
#5	5,494.200	25,005.800	1,134.40	531.94	8,679.6	22,742	2.23	1.17
#6	3,079.040	28,084.840	1,123.79	610.82	8,124.7	19,034	1.13	0.58
#7	3,035.760	31,120.600	1,104.47	629.10	8,011.5	19,372	1.04	0.50
#8	4,401.790	35,522.390	1,098.33	662.93	8,054.8	28,241	1.64	0.52
#9	2,327.060	37,849.450	1,084.18	714.80	8,450.1	28,231	2.35	0.72

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#3	3,978.700	3,978.700	466.46	83.38	2,147.3	25,470	5.50	4.05
#4	3,216.100	7,194.800	639.30	175.00	4,501.2	40,587	7.18	3.31
#1	8,478.029	8,478.029	985.36	222.07	4,253.8	32,433	6.30	2.72
#2	3,838.770	12,316.800	1,143.76	389.57	6,995.1	32,812	4.41	1.76
#5	5,494.200	25,005.800	1,730.42	806.73	14,678.7	25,835	3.18	1.63
#6	3,079.040	28,084.840	1,714.28	922.51	13,741.8	21,700	1.38	0.69
#7	3,035.760	31,120.600	1,684.95	958.99	13,531.4	21,010	1.23	0.60
#8	4,401.790	35,522.390	1,676.23	1,022.22	13,568.1	30,533	1.92	0.61
#9	2,327.060	37,849.450	1,654.27	1,100.96	14,146.9	29,655	2.61	0.83

SEDCAD 4 for Windows 50-Year 6-Hour Storm Summary

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#3	3,978.700	3,978.700	658.49	115.93	3,130.7	26,537	6.27	4.65
#4	3,216.100	7,194.800	887.97	238.37	6,403.4	42,241	8.00	3.70
#1	8,478.029	8,478.029	1,354.73	298.87	5,896.1	33,131	7.03	3.06
#2	3,838.770	12,316.800	1,487.50	511.26	9,342.5	33,581	4.69	1.86
#5	5,494.200	25,005.800	2,272.63	1,055.72	20,388.3	27,557	4.05	2.07
#6	3,079.040	28,084.840	2,251.38	1,204.43	19,103.4	23,236	1.54	0.77
#7	3,035.760	31,120.600	2,212.77	1,259.38	18,744.5	22,475	1.38	0.67
#8	4,401.790	35,522.390	2,201.98	1,351.79	18,766.9	31,711	2.08	0.67
#9	2,327.060	37,849.450	2,173.07	1,454.75	19,527.3	30,678	2.78	0.89

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#3	3,978.700	3,978.700	890.75	154.95	4,359.5	27,516	6.97	5.19
#4	3,216.100	7,194.800	1,185.61	313.49	8,747.4	43,825	8.76	4.06
#1	8,478.029	8,478.029	1,795.39	389.47	7,895.1	33,817	7.71	3.37
#2	3,838.770	12,316.800	1,953.19	652.90	12,351.9	34,647	5.05	2.01
#5	5,494.200	25,005.800	2,905.44	1,345.17	27,277.9	28,870	4.67	2.39
#6	3,079.040	28,084.840	2,877.78	1,531.74	25,317.0	24,245	1.78	0.89
#7	3,035.760	31,120.600	2,828.42	1,609.80	24,773.3	23,219	1.47	0.71
#8	4,401.790	35,522.390	2,815.27	1,738.21	24,786.6	32,604	2.21	0.71
#9	2,327.060	37,849.450	2,777.95	1,869.21	25,793.6	31,630	2.94	0.94

Attachment 41.D-2

No Name Arroyo Post-reclamation Hydrology and Sedimentology SEDCAD™ Model Output

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General Information

Storm Information:

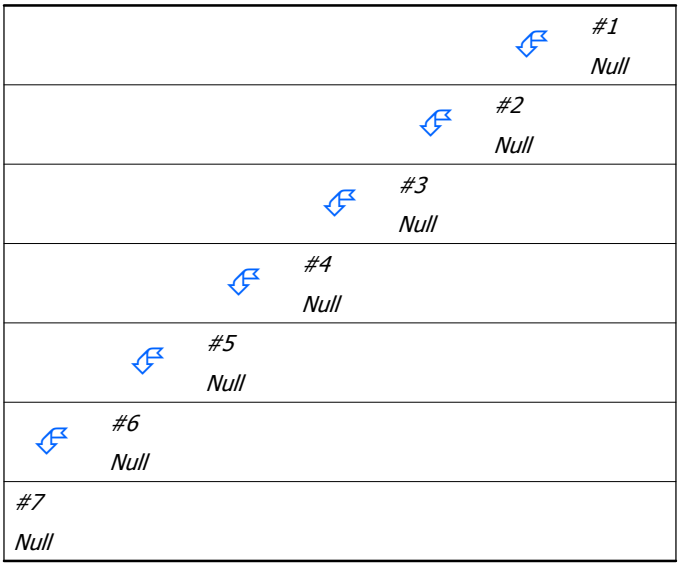
Storm Type:	Type II-70
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.700 inches

Particle Size Distribution:

Table 41.D-3

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.814	0.291	SWS01
Null	#2	==>	#3	0.656	0.345	SWS02
Null	#3	==>	#4	0.581	0.313	SWS03, 04, 05
Null	#4	==>	#5	0.101	0.352	SWS06, 07
Null	#5	==>	#6	0.681	0.307	SWS08
Null	#6	==>	#7	1.027	0.307	SWS09, 10, 11, 12, 13, 14
Null	#7	==>	End	0.000	0.000	SWS15, 16, 17, 18, 19



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.62	43.00	6,923.20	2.36	0.814
#1	**Muskingum K:**					**0.814**
#2	8. Large gullies, diversions, and low flowing streams	1.59	142.00	8,936.43	3.78	0.656
#2	**Muskingum K:**					**0.656**
#3	8. Large gullies, diversions, and low flowing streams	0.91	54.00	5,964.21	2.85	0.581
#3	**Muskingum K:**					**0.581**
#4	8. Large gullies, diversions, and low flowing streams	1.82	27.00	1,480.01	4.05	0.101
#4	**Muskingum K:**					**0.101**

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#5	8. Large gullies, diversions, and low flowing streams	0.82	54.00	6,623.32	2.70	0.681
#5	**Muskingum K:**					**0.681**
#6	8. Large gullies, diversions, and low flowing streams	0.82	82.00	10,028.12	2.71	1.027
#6	**Muskingum K:**					**1.027**

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Particle Size Distribution(s) at Each Structure

Structure #1 (SWS01):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	88.454%
0.0100	66.498%
0.0050	28.409%
0.0020	17.206%
0.0010	15.848%
0.0004	14.691%

Structure #2 (SWS02):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	97.976%
0.0100	74.696%
0.0050	31.102%
0.0020	18.542%
0.0010	17.032%
0.0004	15.843%

Structure #3 (SWS03, 04, 05):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	96.538%
0.0750	91.433%
0.0159	89.457%

Size (mm)	In/Out
0.0100	84.668%
0.0050	36.089%
0.0020	20.519%
0.0010	18.725%
0.0004	17.543%

Structure #4 (SWS06, 07):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	97.791%
0.0750	89.768%
0.0159	86.607%
0.0100	82.078%
0.0050	33.783%
0.0020	18.824%
0.0010	17.142%
0.0004	16.104%

Structure #5 (SWS08):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	98.059%
0.0750	90.253%
0.0159	86.242%
0.0100	80.526%
0.0050	32.342%
0.0020	17.977%
0.0010	16.361%
0.0004	15.363%

Structure #6 (SWS09, 10, 11, 12, 13, 14):

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	98.864%
0.0750	87.791%
0.0159	82.262%
0.0100	74.823%

Size (mm)	In/Out
0.0050	27.012%
0.0020	14.982%
0.0010	13.683%
0.0004	12.623%

Structure #7:

Size (mm)	In/Out
0.4250	100.000%
0.2500	100.000%
0.1500	97.253%
0.0750	91.804%
0.0159	86.760%
0.0100	77.040%
0.0050	26.434%
0.0020	14.672%
0.0010	13.417%
0.0004	12.311%

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Structure Detail:

Structure #1 (Null)

SWS01

Structure #2 (Null)

SWS02

Structure #3 (Null)

SWS03, 04, 05

Structure #4 (Null)

SWS06, 07

Structure #5 (Null)

SWS08

Structure #6 (Null)

SWS09, 10, 11, 12, 13, 14

Structure #7 (Null)

SWS15, 16, 17, 18, 19

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	999.370	1.261	0.000	0.000	81.700	M	175.09	29.766
	Σ	**999.370**						**175.09**	**29.766**
#2	1	856.430	1.610	0.000	0.000	81.100	M	115.65	24.265
	Σ	**1,855.800**						**249.19**	**54.031**
#3	1	925.920	1.675	0.417	0.294	82.800	M	142.42	30.146
	2	1,019.220	1.106	0.217	0.247	80.600	M	178.21	27.695
	3	428.940	0.768	0.000	0.000	87.000	M	177.50	19.310
	Σ	**4,229.880**						**404.84**	**131.181**
#4	1	536.770	0.787	0.355	0.295	78.100	M	94.32	11.722
	2	523.990	0.561	0.000	0.000	81.500	M	166.68	15.363
	Σ	**5,290.640**						**435.04**	**158.267**
#5	1	233.280	0.469	0.000	0.000	82.900	M	94.69	7.670
	Σ	**5,523.919**						**439.21**	**165.936**
#6	1	126.980	0.163	0.551	0.306	85.000	M	97.34	5.014
	2	235.630	0.327	0.427	0.341	86.700	M	159.85	10.409
	3	265.560	0.654	0.365	0.294	83.100	M	87.80	8.869
	4	170.780	0.449	0.176	0.301	86.600	M	97.76	7.465
	5	189.850	0.326	0.146	0.330	86.800	M	129.94	8.448
	6	174.490	0.791	0.000	0.000	83.100	M	50.21	5.820
	Σ	**6,687.209**						**484.15**	**211.961**
#7	1	91.450	0.220	0.854	0.310	86.800	M	72.31	4.081
	2	280.200	0.586	0.642	0.312	84.500	M	113.28	10.449
	3	75.280	0.183	0.590	0.312	86.800	M	63.13	3.386
	4	128.700	0.154	0.283	0.320	86.800	M	111.56	5.822
	5	67.060	0.307	0.000	0.000	82.000	M	31.89	2.056
	Σ	**7,329.899**						**500.75**	**237.756**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.233	280.00	2.40	0.2650	1.0000	1	321.8	13,191	3.79	2.27
	Σ							**321.8**	**13,191**	**3.79**	**2.27**
#2	1	0.195	420.00	1.30	0.2300	1.0000	2	109.8	5,436	1.16	0.72

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
	Σ							**399.1**	**9,501**	**2.15**	**1.24**
#3	1	0.178	280.00	2.20	0.1970	1.0000	3	151.7	5,938	1.22	0.76
	2	0.149	280.00	2.30	0.1800	1.0000	4	130.5	5,829	1.57	0.93
	3	0.151	240.00	3.70	0.1790	1.0000	5	158.0	10,001	4.01	2.40
	Σ							**627.8**	**6,946**	**1.09**	**0.55**
#4	1	0.151	200.00	5.60	0.1790	1.0000	6	143.7	15,783	5.13	2.92
	2	0.154	100.00	8.40	0.1800	1.0000	7	253.1	21,363	8.63	4.86
	Σ							**898.5**	**18,779**	**3.35**	**0.74**
#5	1	0.155	100.00	9.60	0.1970	1.0000	8	169.1	28,424	12.08	6.83
	Σ							**1,018.0**	**21,983**	**4.16**	**0.85**
#6	1	0.145	100.00	11.40	0.1980	1.0000	9	166.3	41,134	20.01	11.70
	2	0.145	100.00	11.90	0.2106	1.0000	15	376.0	44,473	19.21	11.31
	3	0.155	100.00	8.10	0.1980	1.0000	10	135.6	19,181	6.40	3.72
	4	0.145	75.00	12.50	0.2106	1.0000	11	213.4	35,422	14.18	8.32
	5	0.143	75.00	13.20	0.2106	1.0000	15	283.7	41,812	18.09	10.54
	6	0.153	75.00	12.90	0.2092	1.0000	12	139.7	29,871	8.86	5.19
	Σ							**1,896.4**	**29,363**	**6.81**	**1.52**
#7	1	0.143	100.00	10.40	0.2106	1.0000	15	116.6	34,612	15.95	9.57
	2	0.151	75.00	15.10	0.2092	1.0000	13	368.7	43,397	15.50	9.14
	3	0.143	75.00	19.80	0.2106	1.0000	15	185.1	65,808	31.04	18.56
	4	0.143	100.00	8.00	0.2106	1.0000	15	116.9	24,916	11.90	6.99
	5	0.215	100.00	8.10	0.2762	1.0000	14	65.5	42,024	20.62	11.34
	Σ							**2,385.7**	**33,324**	**7.13**	**1.57**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	1.30	9.00	692.04	1.140	0.168
		8. Large gullies, diversions, and low flowing streams	1.35	186.00	13,736.06	3.490	1.093
#1	**1**	**Time of Concentration:**					**1.261**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	1.06	11.00	1,041.07	1.020	0.283
		8. Large gullies, diversions, and low flowing streams	0.41	37.00	9,126.78	1.910	1.327
#2	**1**	**Time of Concentration:**					**1.610**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	0.13	1.00	743.49	0.360	0.573

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	0.79	84.00	10,596.69	2.670	1.102
#3	**1**	**Time of Concentration:**					**1.675**
#3	2	5. Nearly bare and untilled, and alluvial valley fans	3.79	40.00	1,056.02	1.940	0.151
		8. Large gullies, diversions, and low flowing streams	1.20	135.00	11,283.85	3.280	0.955
#3	**2**	**Time of Concentration:**					**1.106**
#3	3	5. Nearly bare and untilled, and alluvial valley fans	1.48	14.00	945.05	1.210	0.216
		8. Large gullies, diversions, and low flowing streams	1.66	128.00	7,691.00	3.870	0.552
#3	**3**	**Time of Concentration:**					**0.768**
#4	1	5. Nearly bare and untilled, and alluvial valley fans	0.96	7.00	731.07	0.970	0.209
		8. Large gullies, diversions, and low flowing streams	1.96	171.00	8,725.38	4.190	0.578
#4	**1**	**Time of Concentration:**					**0.787**
#4	2	5. Nearly bare and untilled, and alluvial valley fans	4.40	43.00	978.00	2.090	0.129
		8. Large gullies, diversions, and low flowing streams	2.39	173.00	7,224.00	4.640	0.432
#4	**2**	**Time of Concentration:**					**0.561**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	2.11	22.00	1,044.03	1.450	0.200
		8. Large gullies, diversions, and low flowing streams	3.14	162.00	5,158.08	5.310	0.269
#5	**1**	**Time of Concentration:**					**0.469**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	4.94	12.00	243.00	2.220	0.030
		8. Large gullies, diversions, and low flowing streams	4.65	145.00	3,117.00	6.470	0.133
#6	**1**	**Time of Concentration:**					**0.163**
#6	2	5. Nearly bare and untilled, and alluvial valley fans	4.52	46.00	1,017.00	2.120	0.133
		8. Large gullies, diversions, and low flowing streams	3.40	132.00	3,879.04	5.530	0.194
#6	**2**	**Time of Concentration:**					**0.327**
#6	3	5. Nearly bare and untilled, and alluvial valley fans	0.32	2.00	619.19	0.560	0.307
		8. Large gullies, diversions, and low flowing streams	2.55	153.00	5,995.06	4.790	0.347
#6	**3**	**Time of Concentration:**					**0.654**
#6	4	5. Nearly bare and untilled, and alluvial valley fans	4.43	28.00	632.01	2.100	0.083
		8. Large gullies, diversions, and low flowing streams	2.77	182.00	6,575.38	4.990	0.366
#6	**4**	**Time of Concentration:**					**0.449**
#6	5	5. Nearly bare and untilled, and alluvial valley fans	6.63	41.00	618.00	2.570	0.066

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	2.36	102.00	4,321.11	4.600	0.260
#6	**5**	**Time of Concentration:**					**0.326**
#6	6	5. Nearly bare and untilled, and alluvial valley fans	0.24	2.00	849.36	0.480	0.491
		8. Large gullies, diversions, and low flowing streams	3.07	174.00	5,673.00	5.250	0.300
#6	**6**	**Time of Concentration:**					**0.791**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	18.35	60.00	327.00	4.280	0.021
		8. Large gullies, diversions, and low flowing streams	3.36	133.00	3,954.09	5.500	0.199
#7	**1**	**Time of Concentration:**					**0.220**
#7	2	5. Nearly bare and untilled, and alluvial valley fans	1.40	10.00	715.71	1.180	0.168
		8. Large gullies, diversions, and low flowing streams	2.59	188.00	7,257.00	4.820	0.418
#7	**2**	**Time of Concentration:**					**0.586**
#7	3	5. Nearly bare and untilled, and alluvial valley fans	9.63	69.00	716.14	3.100	0.064
		8. Large gullies, diversions, and low flowing streams	4.63	129.00	2,785.00	6.450	0.119
#7	**3**	**Time of Concentration:**					**0.183**
#7	4	5. Nearly bare and untilled, and alluvial valley fans	19.32	42.00	217.40	4.390	0.013
		8. Large gullies, diversions, and low flowing streams	3.62	105.00	2,899.00	5.700	0.141
#7	**4**	**Time of Concentration:**					**0.154**
#7	5	5. Nearly bare and untilled, and alluvial valley fans	2.85	6.00	210.76	1.680	0.034
		8. Large gullies, diversions, and low flowing streams	1.06	32.00	3,028.00	3.080	0.273
#7	**5**	**Time of Concentration:**					**0.307**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	1	8. Large gullies, diversions, and low flowing streams	0.66	24.00	3,656.00	2.430	0.417
#3	**1**	**Muskingum K:**					**0.417**
#3	2	8. Large gullies, diversions, and low flowing streams	0.31	4.00	1,298.70	1.660	0.217
#3	**2**	**Muskingum K:**					**0.217**
#4	1	8. Large gullies, diversions, and low flowing streams	0.67	21.00	3,139.01	2.450	0.355
#4	**1**	**Muskingum K:**					**0.355**
#6	1	8. Large gullies, diversions, and low flowing streams	0.81	43.00	5,337.63	2.690	0.551

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#6	**1**	**Muskingum K:**					**0.551**
#6	2	8. Large gullies, diversions, and low flowing streams	1.47	82.00	5,593.07	3.630	0.427
#6	**2**	**Muskingum K:**					**0.427**
#6	3	8. Large gullies, diversions, and low flowing streams	0.66	21.00	3,199.26	2.430	0.365
#6	**3**	**Muskingum K:**					**0.365**
#6	4	8. Large gullies, diversions, and low flowing streams	0.74	12.00	1,631.09	2.570	0.176
#6	**4**	**Muskingum K:**					**0.176**
#6	5	8. Large gullies, diversions, and low flowing streams	1.21	21.00	1,737.11	3.290	0.146
#6	**5**	**Muskingum K:**					**0.146**
#6	6	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#6	**6**	**Muskingum K:**					**0.000**
#7	1	8. Large gullies, diversions, and low flowing streams	0.86	73.00	8,524.05	2.770	0.854
#7	**1**	**Muskingum K:**					**0.854**
#7	2	8. Large gullies, diversions, and low flowing streams	0.89	58.00	6,527.12	2.820	0.642
#7	**2**	**Muskingum K:**					**0.642**
#7	3	8. Large gullies, diversions, and low flowing streams	0.88	53.00	5,997.00	2.820	0.590
#7	**3**	**Muskingum K:**					**0.590**
#7	4	8. Large gullies, diversions, and low flowing streams	1.01	31.00	3,071.00	3.010	0.283
#7	**4**	**Muskingum K:**					**0.283**
#7	5	8. Large gullies, diversions, and low flowing streams	0.00	0.00	0.00	0.000	0.000
#7	**5**	**Muskingum K:**					**0.000**

SEDCAD 4 for Windows - 10-Year 24-Hour Storm Summary

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	999.370	999.370	175.09	29.77	321.8	13,191	3.79	2.27
#2	856.430	1,855.800	249.19	54.03	399.1	9,501	2.15	1.24
#3	2,374.080	4,229.880	404.84	131.18	627.8	6,946	1.09	0.55
#4	1,060.760	5,290.640	435.04	158.27	898.5	18,779	3.35	0.74
#5	233.280	5,523.919	439.21	165.94	1,018.0	21,983	4.16	0.85
#6	1,163.290	6,687.209	484.15	211.96	1,896.4	29,363	6.81	1.52
#7	642.690	7,329.899	500.75	237.76	2,385.7	33,324	7.13	1.57

SEDCAD 4 for Windows - 2-Year 6-Hour Storm Summary

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	999.370	999.370	27.50	4.06	37.4	9,482	1.26	0.90
#2	856.430	1,855.800	39.03	7.14	46.9	7,058	0.60	0.41
#3	2,374.080	4,229.880	70.87	19.30	82.9	6,120	0.90	0.46
#4	1,060.760	5,290.640	74.90	22.31	109.4	14,435	1.68	0.42
#5	233.280	5,523.919	76.45	23.49	126.5	17,121	2.11	0.49
#6	1,163.290	6,687.209	109.62	32.39	314.3	25,217	5.40	1.52
#7	642.690	7,329.899	112.79	37.42	395.5	29,303	4.90	1.29

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	999.370	999.370	110.66	14.94	169.2	11,647	2.85	2.03
#2	856.430	1,855.800	157.22	26.91	209.7	8,439	1.54	1.04
#3	2,374.080	4,229.880	261.18	67.04	341.6	6,408	0.95	0.56
#4	1,060.760	5,290.640	279.24	79.94	477.9	16,774	2.65	0.69
#5	233.280	5,523.919	282.38	83.92	544.1	19,643	3.29	0.80
#6	1,163.290	6,687.209	328.28	109.33	1,080.6	26,649	5.99	1.62
#7	642.690	7,329.899	338.45	123.61	1,359.1	30,679	6.04	1.58

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	999.370	999.370	184.77	24.46	297.1	12,467	3.47	2.47
#2	856.430	1,855.800	263.11	44.31	368.4	8,993	1.94	1.32
#3	2,374.080	4,229.880	427.84	108.29	581.7	6,511	1.00	0.61
#4	1,060.760	5,290.640	459.61	130.25	830.3	17,475	3.06	0.82
#5	233.280	5,523.919	464.16	136.61	941.7	20,473	3.79	0.94
#6	1,163.290	6,687.209	509.03	175.38	1,763.0	27,391	6.27	1.68
#7	642.690	7,329.899	525.59	197.13	2,218.1	31,325	6.53	1.71

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	999.370	999.370	254.11	33.34	422.4	12,978	3.85	2.75
#2	856.430	1,855.800	362.37	60.59	524.0	9,340	2.20	1.50
#3	2,374.080	4,229.880	583.95	146.58	820.2	6,624	1.05	0.65
#4	1,060.760	5,290.640	628.41	177.14	1,179.3	17,945	3.30	0.90
#5	233.280	5,523.919	634.13	185.69	1,334.0	20,938	4.07	1.02
#6	1,163.290	6,687.209	675.98	236.54	2,415.4	27,916	6.45	1.72
#7	642.690	7,329.899	696.52	265.03	3,033.6	31,790	6.81	1.79

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	999.370	999.370	336.34	43.86	576.2	13,430	4.18	3.00
#2	856.430	1,855.800	480.35	79.90	715.1	9,651	2.44	1.66
#3	2,374.080	4,229.880	770.50	191.79	1,113.7	6,728	1.09	0.69
#4	1,060.760	5,290.640	828.74	232.68	1,608.7	18,356	3.51	0.97
#5	233.280	5,523.919	836.16	243.81	1,816.5	21,377	4.33	1.10
#6	1,163.290	6,687.209	887.83	308.65	3,230.9	28,564	6.69	1.79
#7	642.690	7,329.899	900.22	344.94	4,017.0	32,130	6.95	1.84

Attachment 41.D-3

Brimhall Wash Post-reclamation Hydrology and Sedimentology SEDCAD™ Model Output

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Brimhall Wash Hydrology and Sedimentology for LOM Reclamation Plan

2-year, 6-hour Precipation Event
10-year, 6-hour Precipation Event
25-year, 6-hour Precipitation Event
50-year, 6-hour Precipitation Event
100-year, 6-hour Precipitation Event

General Information

Storm Information:

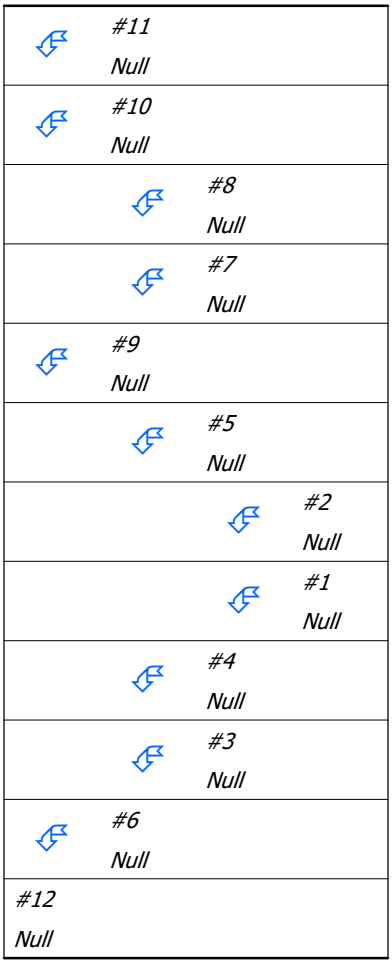
Storm Type:	Type II-70
Design Storm:	2 yr - 6 hr
Rainfall Depth:	0.823 inches

Particle Size Distribution:

Size (mm)	B1	B2	B3	B4	B5	B6	B7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	74.410%	76.157%	69.997%	79.508%	76.475%	69.135%	70.448%
0.1500	55.605%	59.686%	50.748%	64.050%	57.775%	49.241%	48.380%
0.0750	43.516%	47.428%	39.813%	50.694%	41.347%	36.360%	35.105%
0.0159	38.456%	41.399%	35.485%	43.752%	34.236%	31.386%	30.759%
0.0100	31.531%	33.052%	29.389%	34.156%	23.595%	23.861%	24.387%
0.0050	9.472%	10.126%	10.232%	9.667%	6.873%	8.915%	7.819%
0.0020	5.356%	6.051%	5.668%	6.037%	4.758%	5.288%	4.349%
0.0010	4.976%	5.693%	5.255%	5.694%	4.247%	4.786%	3.857%
0.0004	4.422%	4.956%	4.771%	4.879%	3.949%	4.512%	3.708%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#4	7.026	0.289	
Null	#2	==>	#4	6.888	0.289	
Null	#3	==>	#6	2.906	0.256	
Null	#4	==>	#6	1.008	0.263	
Null	#5	==>	#6	0.075	0.263	
Null	#6	==>	#12	3.138	0.266	
Null	#7	==>	#9	1.050	0.280	
Null	#8	==>	#9	0.683	0.314	
Null	#9	==>	#12	2.860	0.269	
Null	#10	==>	#12	1.670	0.267	
Null	#11	==>	#12	1.194	0.263	
Null	#12	==>	End	0.000	0.000	



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	0.60	354.00	58,687.00	2.32	7.026
#1	**Muskingum K:**					**7.026**
#2	8. Large gullies, diversions, and low flowing streams	0.61	350.00	57,784.38	2.33	6.888
#2	**Muskingum K:**					**6.888**
#3	8. Large gullies, diversions, and low flowing streams	0.35	66.00	18,623.02	1.78	2.906
#3	**Muskingum K:**					**2.906**
#4	8. Large gullies, diversions, and low flowing streams	0.40	27.00	6,828.00	1.88	1.008
#4	**Muskingum K:**					**1.008**
#5	8. Large gullies, diversions, and low flowing streams	0.39	2.00	509.00	1.88	0.075
#5	**Muskingum K:**					**0.075**
#6	8. Large gullies, diversions, and low flowing streams	0.42	92.00	21,916.00	1.94	3.138
#6	**Muskingum K:**					**3.138**
#7	8. Large gullies, diversions, and low flowing streams	0.52	43.00	8,206.00	2.17	1.050
#7	**Muskingum K:**					**1.050**
#8	8. Large gullies, diversions, and low flowing streams	0.92	65.00	7,064.00	2.87	0.683
#8	**Muskingum K:**					**0.683**
#9	8. Large gullies, diversions, and low flowing streams	0.44	89.00	20,387.00	1.98	2.860
#9	**Muskingum K:**					**2.860**
#10	8. Large gullies, diversions, and low flowing streams	0.43	50.00	11,726.07	1.95	1.670
#10	**Muskingum K:**					**1.670**
#11	8. Large gullies, diversions, and low flowing streams	0.40	32.00	8,087.00	1.88	1.194
#11	**Muskingum K:**					**1.194**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#11	627.900	627.900	4.49	0.66	6.6	9,751	1.42	1.07
#10	621.200	621.200	28.97	2.79	39.4	15,411	4.44	2.98
#8	782.600	782.600	15.10	1.92	14.0	7,377	1.78	1.29
#7	1,648.200	1,648.200	8.36	2.38	11.8	6,107	0.97	0.58
#9	652.600	3,083.400	45.98	9.67	94.8	13,035	3.56	1.96
#5	7,064.500	7,064.500	64.64	35.67	275.1	7,636	0.23	0.17
#2	6,633.800	6,633.800	97.09	30.54	430.8	13,738	0.63	0.47
#1	4,622.300	4,622.300	114.32	28.82	354.7	12,094	0.65	0.48
#4	12,415.200	23,671.300	237.64	102.73	1,089.4	11,547	0.44	0.32
#3	9,427.600	9,427.600	170.88	75.13	1,118.5	14,671	0.56	0.42
#6	7,063.800	47,227.200	373.33	299.26	3,239.4	10,293	0.39	0.31
#12	2,976.500	54,536.200	378.98	338.03	3,548.7	11,177	0.51	0.36

Particle Size Distribution(s) at Each Structure

Structure #11:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	86.293%
0.0050	26.590%
0.0020	14.184%
0.0010	12.887%
0.0004	11.927%

Structure #10:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	90.728%
0.0159	80.779%
0.0100	67.235%
0.0050	18.674%
0.0020	9.934%
0.0010	8.955%
0.0004	8.275%

Structure #8:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	92.868%

Size (mm)	In/Out
0.0100	73.630%
0.0050	23.607%
0.0020	13.131%
0.0010	11.645%
0.0004	11.195%

Structure #7:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	83.717%
0.0050	35.399%
0.0020	22.094%
0.0010	19.901%
0.0004	18.673%

Structure #9:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	90.690%
0.0100	69.172%
0.0050	23.206%
0.0020	14.200%
0.0010	12.764%
0.0004	11.962%

Structure #5:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	100.000%

Size (mm)	In/Out
0.0050	65.246%
0.0020	37.242%
0.0010	34.514%
0.0004	31.143%

Structure #2:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	100.000%
0.0050	48.023%
0.0020	27.411%
0.0010	25.403%
0.0004	22.922%

Structure #1:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	100.000%
0.0050	39.585%
0.0020	22.383%
0.0010	20.795%
0.0004	18.480%

Structure #4:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	100.000%
0.0050	56.274%

Size (mm)	In/Out
0.0020	31.641%
0.0010	29.345%
0.0004	26.457%

Structure #3:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	100.000%
0.0050	56.147%
0.0020	33.552%
0.0010	31.567%
0.0004	27.480%

Structure #6:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	100.000%
0.0050	56.061%
0.0020	33.012%
0.0010	30.890%
0.0004	27.192%

Structure #12:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	99.656%
0.0100	98.908%
0.0050	55.013%
0.0020	32.451%

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Size (mm)	In/Out
0.0010	30.296%
0.0004	26.752%

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Structure Detail:

Structure #11 (Null)

Structure #10 (Null)

Structure #8 (Null)

Structure #7 (Null)

Structure #9 (Null)

Structure #5 (Null)

Structure #2 (Null)

Structure #1 (Null)

Structure #4 (Null)

Structure #3 (Null)

Structure #6 (Null)

Structure #12 (Null)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#11	1	130.300	0.303	0.378	0.366	77.000	M	1.07	0.137
	2	497.600	0.677	0.000	0.000	77.000	M	3.45	0.523
	Σ	**627.900**						**4.49**	**0.661**
#10	1	179.800	0.606	0.426	0.348	78.000	M	1.92	0.260
	2	441.400	0.558	0.000	0.000	84.200	M	28.90	2.528
	Σ	**621.200**						**28.97**	**2.788**
#8	1	782.600	0.708	0.000	0.000	80.000	M	15.10	1.919
	Σ	**782.600**						**15.10**	**1.919**
#7	1	791.100	2.222	0.448	0.311	78.000	M	4.20	1.142
	2	857.100	0.948	0.000	0.000	78.000	M	7.46	1.238
	Σ	**1,648.200**						**8.36**	**2.380**
#9	1	652.600	0.936	0.000	0.000	86.400	M	45.32	5.371
	Σ	**3,083.400**						**45.98**	**9.670**
#5	1	7,064.500	6.361	0.000	0.000	83.500	M	64.64	35.666
	Σ	**7,064.500**						**64.64**	**35.666**
#2	1	6,633.800	3.130	0.000	0.000	83.000	M	97.09	30.538
	Σ	**6,633.800**						**97.09**	**30.538**
#1	1	4,622.300	2.422	0.000	0.000	84.700	M	114.32	28.816
	Σ	**4,622.300**						**114.32**	**28.816**
#4	1	12,415.200	9.741	0.000	0.000	81.600	M	53.61	43.376
	Σ	**23,671.300**						**237.64**	**102.730**
#3	1	9,427.600	4.941	0.000	0.000	86.200	M	170.88	75.135
	Σ	**9,427.600**						**170.88**	**75.135**
#6	1	7,063.800	5.356	0.000	0.000	89.000	M	185.13	85.725
	Σ	**47,227.200**						**373.33**	**299.256**
#12	1	2,976.500	3.747	0.000	0.000	86.700	M	73.52	25.655
	Σ	**54,536.200**						**378.98**	**338.029**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#11	1	0.176	200.00	4.60	0.3157	1.0000	10	1.7	11,596	2.96	2.25
	2	0.140	130.00	7.40	0.2520	1.0000	13	5.4	10,134	1.73	1.30
	Σ							**6.6**	**9,751**	**1.42**	**1.07**
#10	1	0.184	200.00	4.70	0.2962	1.0000	9	3.3	12,497	2.23	1.65
	2	0.139	130.00	6.50	0.2630	1.0000	13	39.4	16,676	4.81	3.29
	Σ							**39.4**	**15,411**	**4.44**	**2.98**
#8	1	0.173	280.00	2.40	0.2851	1.0000	7	14.0	7,377	1.78	1.29
	Σ							**14.0**	**7,377**	**1.78**	**1.29**
#7	1	0.243	280.00	2.00	0.2006	1.0000	5	4.3	3,618	0.22	0.17
	2	0.209	280.00	2.70	0.2762	1.0000	6	9.6	7,590	1.44	1.09
	Σ							**11.8**	**6,107**	**0.97**	**0.58**
#9	1	0.212	240.00	3.70	0.2445	1.0000	8	68.9	13,194	3.94	2.81
	Σ							**94.8**	**13,035**	**3.56**	**1.96**
#5	1	0.180	200.00	4.30	0.2445	1.0000	12	275.1	7,636	0.23	0.17
	Σ							**275.1**	**7,636**	**0.23**	**0.17**
#2	1	0.179	100.00	8.40	0.2427	1.0000	12	430.8	13,738	0.63	0.47
	Σ							**430.8**	**13,738**	**0.63**	**0.47**
#1	1	0.164	100.00	8.00	0.2219	1.0000	1	354.7	12,094	0.65	0.48
	Σ							**354.7**	**12,094**	**0.65**	**0.48**
#4	1	0.170	200.00	4.70	0.2651	1.0000	3	307.8	7,077	0.06	0.05
	Σ							**1,089.4**	**11,547**	**0.44**	**0.32**
#3	1	0.190	100.00	10.30	0.1857	1.0000	2	1,118.5	14,671	0.56	0.42
	Σ							**1,118.5**	**14,671**	**0.56**	**0.42**
#6	1	0.200	130.00	6.50	0.1727	1.0000	4	758.8	8,800	0.37	0.28
	Σ							**3,239.4**	**10,293**	**0.39**	**0.31**
#12	1	0.196	200.00	4.80	0.2219	1.0000	11	269.5	10,345	0.56	0.42
	Σ							**3,548.7**	**11,177**	**0.51**	**0.36**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	3.13	25.00	799.00	1.760	0.126
		8. Large gullies, diversions, and low flowing streams	1.77	581.00	32,908.52	3.980	2.296
#1	**1**	**Time of Concentration:**					**2.422**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	5. Nearly bare and untilled, and alluvial valley fans	4.24	25.00	589.00	2.060	0.079
		8. Large gullies, diversions, and low flowing streams	1.47	585.00	39,874.00	3.630	3.051
#2	**1**	**Time of Concentration:**					**3.130**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	5.58	30.00	538.00	2.360	0.063
		8. Large gullies, diversions, and low flowing streams	1.41	876.00	62,341.00	3.550	4.878
#3	**1**	**Time of Concentration:**					**4.941**
#4	1	5. Nearly bare and untilled, and alluvial valley fans	2.90	40.00	1,380.00	1.700	0.225
		8. Large gullies, diversions, and low flowing streams	0.88	855.00	96,614.00	2.820	9.516
#4	**1**	**Time of Concentration:**					**9.741**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	1.19	13.00	1,096.00	1.080	0.281
		8. Large gullies, diversions, and low flowing streams	0.93	590.00	63,262.00	2.890	6.080
#5	**1**	**Time of Concentration:**					**6.361**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	5.43	45.00	829.00	2.320	0.099
		8. Large gullies, diversions, and low flowing streams	1.03	597.00	57,726.00	3.050	5.257
#6	**1**	**Time of Concentration:**					**5.356**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	0.12	1.00	844.59	0.340	0.690
		8. Large gullies, diversions, and low flowing streams	0.85	20.08	2,373.24	2.750	0.239
		8. Large gullies, diversions, and low flowing streams	0.66	72.01	10,854.68	2.440	1.235
		8. Large gullies, diversions, and low flowing streams	0.85	5.00	586.09	2.770	0.058
#7	**1**	**Time of Concentration:**					**2.222**
#7	2	5. Nearly bare and untilled, and alluvial valley fans	0.10	0.50	506.58	0.310	0.453
		8. Large gullies, diversions, and low flowing streams	1.46	65.51	4,482.38	3.620	0.343
		8. Large gullies, diversions, and low flowing streams	1.50	30.00	2,006.68	3.660	0.152
#7	**2**	**Time of Concentration:**					**0.948**
#8	1	5. Nearly bare and untilled, and alluvial valley fans	5.01	47.00	938.81	2.230	0.116
		8. Large gullies, diversions, and low flowing streams	1.59	99.85	6,277.50	3.780	0.461
		8. Large gullies, diversions, and low flowing streams	1.53	26.90	1,754.95	3.710	0.131
#8	**1**	**Time of Concentration:**					**0.708**
#9	1	5. Nearly bare and untilled, and alluvial valley fans	1.20	5.00	417.00	1.090	0.106

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
		8. Large gullies, diversions, and low flowing streams	1.38	145.00	10,519.00	3.520	0.830
#9	**1**	**Time of Concentration:**					**0.936**
#10	1	5. Nearly bare and untilled, and alluvial valley fans	0.30	1.98	654.11	0.550	0.330
		8. Large gullies, diversions, and low flowing streams	2.06	60.54	2,939.40	4.300	0.189
		8. Large gullies, diversions, and low flowing streams	3.28	56.28	1,715.33	5.430	0.087
#10	**1**	**Time of Concentration:**					**0.606**
#10	2	5. Nearly bare and untilled, and alluvial valley fans	2.92	20.00	686.00	1.700	0.112
		8. Large gullies, diversions, and low flowing streams	2.26	164.00	7,248.00	4.510	0.446
#10	**2**	**Time of Concentration:**					**0.558**
#11	1	5. Nearly bare and untilled, and alluvial valley fans	1.91	4.04	211.29	1.380	0.042
		8. Large gullies, diversions, and low flowing streams	1.53	26.35	1,722.78	3.710	0.128
		8. Large gullies, diversions, and low flowing streams	1.24	12.72	1,028.79	3.330	0.085
		8. Large gullies, diversions, and low flowing streams	5.06	59.83	1,182.06	6.740	0.048
#11	**1**	**Time of Concentration:**					**0.303**
#11	2	5. Nearly bare and untilled, and alluvial valley fans	0.71	5.00	706.00	0.840	0.233
		8. Large gullies, diversions, and low flowing streams	3.10	262.00	8,453.00	5.280	0.444
#11	**2**	**Time of Concentration:**					**0.677**
#12	1	5. Nearly bare and untilled, and alluvial valley fans	2.61	20.00	766.00	1.610	0.132
		8. Large gullies, diversions, and low flowing streams	0.49	134.00	27,333.00	2.100	3.615
#12	**1**	**Time of Concentration:**					**3.747**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#7	1	8. Large gullies, diversions, and low flowing streams	0.87	39.00	4,508.00	2.790	0.448
#7	**1**	**Muskingum K:**					**0.448**
#10	1	8. Large gullies, diversions, and low flowing streams	1.70	102.00	6,003.17	3.910	0.426
#10	**1**	**Muskingum K:**					**0.426**
#11	1	8. Large gullies, diversions, and low flowing streams	2.40	152.00	6,329.00	4.640	0.378
#11	**1**	**Muskingum K:**					**0.378**

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Particle Size Distribution:

Size (mm)	B1	B2	B3	B4	B5	B6	B7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	74.410%	76.157%	69.997%	79.508%	76.475%	69.135%	70.448%
0.1500	55.605%	59.686%	50.748%	64.050%	57.775%	49.241%	48.380%
0.0750	43.516%	47.428%	39.813%	50.694%	41.347%	36.360%	35.105%
0.0159	38.456%	41.399%	35.485%	43.752%	34.236%	31.386%	30.759%
0.0100	31.531%	33.052%	29.389%	34.156%	23.595%	23.861%	24.387%
0.0050	9.472%	10.126%	10.232%	9.667%	6.873%	8.915%	7.819%
0.0020	5.356%	6.051%	5.668%	6.037%	4.758%	5.288%	4.349%
0.0010	4.976%	5.693%	5.255%	5.694%	4.247%	4.786%	3.857%
0.0004	4.422%	4.956%	4.771%	4.879%	3.949%	4.512%	3.708%

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Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#11	627.900	627.900	46.73	4.61	72.4	16,856	3.61	2.46
#10	621.200	621.200	99.66	9.36	147.6	16,662	5.92	4.10
#8	782.600	782.600	86.46	8.57	86.2	10,549	3.65	2.55
#7	1,648.200	1,648.200	60.12	13.91	97.1	9,431	2.21	1.20
#9	652.600	3,083.400	164.22	37.04	400.7	14,875	4.80	2.56
#5	7,064.500	7,064.500	215.25	116.15	1,045.4	8,965	0.32	0.24
#2	6,633.800	6,633.800	347.24	103.21	1,739.5	16,623	0.85	0.63
#1	4,622.300	4,622.300	363.64	86.49	1,254.9	14,421	0.83	0.61
#4	12,415.200	23,671.300	804.20	354.39	4,362.7	13,724	0.58	0.41
#3	9,427.600	9,427.600	480.21	206.12	3,510.7	16,888	0.73	0.54
#6	7,063.800	47,227.200	1,064.31	880.59	10,929.3	12,217	0.52	0.40
#12	2,976.500	54,536.200	1,080.53	1,000.07	12,197.5	13,196	0.74	0.51

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#11	1	130.300	0.303	0.378	0.366	77.000	M	15.83	0.959
	2	497.600	0.677	0.000	0.000	77.000	M	35.55	3.653
	Σ	**627.900**						**46.73**	**4.613**
#10	1	179.800	0.606	0.426	0.348	78.000	M	16.37	1.519
	2	441.400	0.558	0.000	0.000	84.200	M	98.43	7.840
	Σ	**621.200**						**99.66**	**9.359**
#8	1	782.600	0.708	0.000	0.000	80.000	M	86.46	8.568
	Σ	**782.600**						**86.46**	**8.568**
#7	1	791.100	2.222	0.448	0.311	78.000	M	28.03	6.673
	2	857.100	0.948	0.000	0.000	78.000	M	57.34	7.233
	Σ	**1,648.200**						**60.12**	**13.906**
#9	1	652.600	0.936	0.000	0.000	86.400	M	130.12	14.570
	Σ	**3,083.400**						**164.22**	**37.044**
#5	1	7,064.500	6.361	0.000	0.000	83.500	M	215.25	116.149
	Σ	**7,064.500**						**215.25**	**116.149**
#2	1	6,633.800	3.130	0.000	0.000	83.000	M	347.24	103.213
	Σ	**6,633.800**						**347.24**	**103.213**
#1	1	4,622.300	2.422	0.000	0.000	84.700	M	363.64	86.488
	Σ	**4,622.300**						**363.64**	**86.488**
#4	1	12,415.200	9.741	0.000	0.000	81.600	M	206.77	164.686
	Σ	**23,671.300**						**804.20**	**354.387**
#3	1	9,427.600	4.941	0.000	0.000	86.200	M	480.21	206.121
	Σ	**9,427.600**						**480.21**	**206.121**
#6	1	7,063.800	5.356	0.000	0.000	89.000	M	447.04	203.930
	Σ	**47,227.200**						**1,064.31**	**880.586**
#12	1	2,976.500	3.747	0.000	0.000	86.700	M	202.40	68.467
	Σ	**54,536.200**						**1,080.53**	**1,000.069**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#11	1	0.176	200.00	4.60	0.3157	1.0000	10	22.2	25,537	10.21	6.74
	2	0.140	130.00	7.40	0.2520	1.0000	13	59.5	17,020	3.99	2.79
	Σ							**72.4**	**16,856**	**3.61**	**2.46**
#10	1	0.184	200.00	4.70	0.2962	1.0000	9	29.3	20,078	5.91	4.15
	2	0.139	130.00	6.50	0.2630	1.0000	13	147.6	19,998	7.11	4.89
	Σ							**147.6**	**16,662**	**5.92**	**4.10**
#8	1	0.173	280.00	2.40	0.2851	1.0000	7	86.2	10,549	3.65	2.55
	Σ							**86.2**	**10,549**	**3.65**	**2.55**
#7	1	0.243	280.00	2.00	0.2006	1.0000	5	33.5	4,946	0.41	0.31
	2	0.209	280.00	2.70	0.2762	1.0000	6	81.1	11,462	3.17	2.27
	Σ							**97.1**	**9,431**	**2.21**	**1.20**
#9	1	0.212	240.00	3.70	0.2445	1.0000	8	217.6	15,319	5.41	3.86
	Σ							**400.7**	**14,875**	**4.80**	**2.56**
#5	1	0.180	200.00	4.30	0.2445	1.0000	12	1,045.4	8,965	0.32	0.24
	Σ							**1,045.4**	**8,965**	**0.32**	**0.24**
#2	1	0.179	100.00	8.40	0.2427	1.0000	12	1,739.5	16,623	0.85	0.63
	Σ							**1,739.5**	**16,623**	**0.85**	**0.63**
#1	1	0.164	100.00	8.00	0.2219	1.0000	1	1,254.9	14,421	0.83	0.61
	Σ							**1,254.9**	**14,421**	**0.83**	**0.61**
#4	1	0.170	200.00	4.70	0.2651	1.0000	3	1,383.9	8,421	0.15	0.11
	Σ							**4,362.7**	**13,724**	**0.58**	**0.41**
#3	1	0.190	100.00	10.30	0.1857	1.0000	2	3,510.7	16,888	0.73	0.54
	Σ							**3,510.7**	**16,888**	**0.73**	**0.54**
#6	1	0.200	130.00	6.50	0.1727	1.0000	4	2,019.8	9,885	0.45	0.34
	Σ							**10,929.3**	**12,217**	**0.52**	**0.40**
#12	1	0.196	200.00	4.80	0.2219	1.0000	11	823.4	11,931	0.69	0.51
	Σ							**12,197.5**	**13,196**	**0.74**	**0.51**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	3.13	25.00	799.00	1.760	0.126
		8. Large gullies, diversions, and low flowing streams	1.77	581.00	32,908.52	3.980	2.296
#1	**1**	**Time of Concentration:**					**2.422**

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.500 inches

Particle Size Distribution:

Size (mm)	B1	B2	B3	B4	B5	B6	B7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	74.410%	76.157%	69.997%	79.508%	76.475%	69.135%	70.448%
0.1500	55.605%	59.686%	50.748%	64.050%	57.775%	49.241%	48.380%
0.0750	43.516%	47.428%	39.813%	50.694%	41.347%	36.360%	35.105%
0.0159	38.456%	41.399%	35.485%	43.752%	34.236%	31.386%	30.759%
0.0100	31.531%	33.052%	29.389%	34.156%	23.595%	23.861%	24.387%
0.0050	9.472%	10.126%	10.232%	9.667%	6.873%	8.915%	7.819%
0.0020	5.356%	6.051%	5.668%	6.037%	4.758%	5.288%	4.349%
0.0010	4.976%	5.693%	5.255%	5.694%	4.247%	4.786%	3.857%
0.0004	4.422%	4.956%	4.771%	4.879%	3.949%	4.512%	3.708%

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Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#11	627.900	627.900	94.54	8.74	153.5	18,711	4.86	3.33
#10	621.200	621.200	162.01	15.14	251.3	17,242	6.43	4.52
#8	782.600	782.600	155.65	14.84	162.9	11,482	4.30	3.01
#7	1,648.200	1,648.200	117.47	25.49	198.1	10,549	2.82	1.52
#9	652.600	3,083.400	277.77	62.38	710.0	15,650	5.38	2.86
#5	7,064.500	7,064.500	346.73	185.60	1,775.1	9,549	0.37	0.27
#2	6,633.800	6,633.800	570.09	166.65	3,002.8	17,830	0.94	0.70
#1	4,622.300	4,622.300	576.17	134.98	2,083.5	15,369	0.91	0.67
#4	12,415.200	23,671.300	1,300.33	575.85	7,517.6	14,633	0.65	0.45
#3	9,427.600	9,427.600	734.57	312.96	5,627.7	17,859	0.80	0.59
#6	7,063.800	47,227.200	1,639.89	1,369.83	17,971.9	13,103	0.58	0.44
#12	2,976.500	54,536.200	1,665.07	1,559.13	20,202.8	14,057	0.84	0.59

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#11	1	130.300	0.303	0.378	0.366	77.000	M	31.90	1.817
	2	497.600	0.677	0.000	0.000	77.000	M	72.38	6.921
	Σ	**627.900**						**94.54**	**8.739**
#10	1	179.800	0.606	0.426	0.348	78.000	M	31.79	2.785
	2	441.400	0.558	0.000	0.000	84.200	M	158.35	12.354
	Σ	**621.200**						**162.01**	**15.139**
#8	1	782.600	0.708	0.000	0.000	80.000	M	155.65	14.837
	Σ	**782.600**						**155.65**	**14.837**
#7	1	791.100	2.222	0.448	0.311	78.000	M	53.51	12.234
	2	857.100	0.948	0.000	0.000	78.000	M	111.29	13.261
	Σ	**1,648.200**						**117.47**	**25.495**
#9	1	652.600	0.936	0.000	0.000	86.400	M	200.23	22.045
	Σ	**3,083.400**						**277.77**	**62.377**
#5	1	7,064.500	6.361	0.000	0.000	83.500	M	346.73	185.604
	Σ	**7,064.500**						**346.73**	**185.604**
#2	1	6,633.800	3.130	0.000	0.000	83.000	M	570.09	166.647
	Σ	**6,633.800**						**570.09**	**166.647**
#1	1	4,622.300	2.422	0.000	0.000	84.700	M	576.17	134.979
	Σ	**4,622.300**						**576.17**	**134.979**
#4	1	12,415.200	9.741	0.000	0.000	81.600	M	346.38	274.222
	Σ	**23,671.300**						**1,300.33**	**575.848**
#3	1	9,427.600	4.941	0.000	0.000	86.200	M	734.57	312.958
	Σ	**9,427.600**						**734.57**	**312.958**
#6	1	7,063.800	5.356	0.000	0.000	89.000	M	650.62	295.419
	Σ	**47,227.200**						**1,639.89**	**1,369.830**
#12	1	2,976.500	3.747	0.000	0.000	86.700	M	307.36	103.049
	Σ	**54,536.200**						**1,665.07**	**1,559.133**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#11	1	0.176	200.00	4.60	0.3157	1.0000	10	46.9	28,390	12.23	8.11
	2	0.140	130.00	7.40	0.2520	1.0000	13	126.6	19,193	5.38	3.75
	Σ							**153.5**	**18,711**	**4.86**	**3.33**
#10	1	0.184	200.00	4.70	0.2962	1.0000	9	59.6	22,334	7.41	5.19
	2	0.139	130.00	6.50	0.2630	1.0000	13	248.5	21,264	8.02	5.54
	Σ							**251.3**	**17,242**	**6.43**	**4.52**
#8	1	0.173	280.00	2.40	0.2851	1.0000	7	162.9	11,482	4.30	3.01
	Σ							**162.9**	**11,482**	**4.30**	**3.01**
#7	1	0.243	280.00	2.00	0.2006	1.0000	5	67.6	5,474	0.67	0.49
	2	0.209	280.00	2.70	0.2762	1.0000	6	165.1	12,790	4.04	2.88
	Σ							**198.1**	**10,549**	**2.82**	**1.52**
#9	1	0.212	240.00	3.70	0.2445	1.0000	8	349.3	16,229	6.04	4.31
	Σ							**710.0**	**15,650**	**5.38**	**2.86**
#5	1	0.180	200.00	4.30	0.2445	1.0000	12	1,775.1	9,549	0.37	0.27
	Σ							**1,775.1**	**9,549**	**0.37**	**0.27**
#2	1	0.179	100.00	8.40	0.2427	1.0000	12	3,002.8	17,830	0.94	0.70
	Σ							**3,002.8**	**17,830**	**0.94**	**0.70**
#1	1	0.164	100.00	8.00	0.2219	1.0000	1	2,083.5	15,369	0.91	0.67
	Σ							**2,083.5**	**15,369**	**0.91**	**0.67**
#4	1	0.170	200.00	4.70	0.2651	1.0000	3	2,458.0	9,000	0.19	0.15
	Σ							**7,517.6**	**14,633**	**0.65**	**0.45**
#3	1	0.190	100.00	10.30	0.1857	1.0000	2	5,627.7	17,859	0.80	0.59
	Σ							**5,627.7**	**17,859**	**0.80**	**0.59**
#6	1	0.200	130.00	6.50	0.1727	1.0000	4	3,067.1	10,371	0.49	0.37
	Σ							**17,971.9**	**13,103**	**0.58**	**0.44**
#12	1	0.196	200.00	4.80	0.2219	1.0000	11	1,308.1	12,614	0.74	0.55
	Σ							**20,202.8**	**14,057**	**0.84**	**0.59**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	3.13	25.00	799.00	1.760	0.126
		8. Large gullies, diversions, and low flowing streams	1.77	581.00	32,908.52	3.980	2.296
#1	**1**	**Time of Concentration:**					**2.422**

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	50 yr - 6 hr
Rainfall Depth:	1.720 inches

Particle Size Distribution:

Size (mm)	B1	B2	B3	B4	B5	B6	B7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	74.410%	76.157%	69.997%	79.508%	76.475%	69.135%	70.448%
0.1500	55.605%	59.686%	50.748%	64.050%	57.775%	49.241%	48.380%
0.0750	43.516%	47.428%	39.813%	50.694%	41.347%	36.360%	35.105%
0.0159	38.456%	41.399%	35.485%	43.752%	34.236%	31.386%	30.759%
0.0100	31.531%	33.052%	29.389%	34.156%	23.595%	23.861%	24.387%
0.0050	9.472%	10.126%	10.232%	9.667%	6.873%	8.915%	7.819%
0.0020	5.356%	6.051%	5.668%	6.037%	4.758%	5.288%	4.349%
0.0010	4.976%	5.693%	5.255%	5.694%	4.247%	4.786%	3.857%
0.0004	4.422%	4.956%	4.771%	4.879%	3.949%	4.512%	3.708%

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#11	627.900	627.900	142.32	12.79	239.0	19,828	5.61	3.86
#10	621.200	621.200	219.35	20.47	352.4	17,668	6.71	4.78
#8	782.600	782.600	222.85	20.78	240.5	12,099	4.72	3.31
#7	1,648.200	1,648.200	174.17	36.74	302.8	11,196	3.17	1.71
#9	652.600	3,083.400	385.58	86.22	1,014.3	16,070	5.71	3.06
#5	7,064.500	7,064.500	467.27	249.10	2,473.7	9,926	0.40	0.30
#2	6,633.800	6,633.800	775.95	224.91	4,221.1	18,596	1.00	0.74
#1	4,622.300	4,622.300	769.23	178.82	2,867.4	15,974	0.96	0.70
#4	12,415.200	23,671.300	1,756.24	779.98	10,560.4	15,215	0.69	0.48
#3	9,427.600	9,427.600	962.07	408.25	7,596.2	18,492	0.85	0.63
#6	7,063.800	47,227.200	2,158.29	1,812.45	24,622.6	13,669	0.62	0.47
#12	2,976.500	54,536.200	2,191.63	2,065.69	27,802.0	14,721	0.92	0.64

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#11	1	130.300	0.303	0.378	0.366	77.000	M	47.89	2.661
	2	497.600	0.677	0.000	0.000	77.000	M	108.87	10.133
	Σ	**627.900**						**142.32**	**12.794**
#10	1	179.800	0.606	0.426	0.348	78.000	M	47.04	4.013
	2	441.400	0.558	0.000	0.000	84.200	M	212.62	16.454
	Σ	**621.200**						**219.35**	**20.467**
#8	1	782.600	0.708	0.000	0.000	80.000	M	222.85	20.777
	Σ	**782.600**						**222.85**	**20.777**
#7	1	791.100	2.222	0.448	0.311	78.000	M	78.60	17.629
	2	857.100	0.948	0.000	0.000	78.000	M	164.19	19.109
	Σ	**1,648.200**						**174.17**	**36.738**
#9	1	652.600	0.936	0.000	0.000	86.400	M	262.82	28.700
	Σ	**3,083.400**						**385.58**	**86.216**
#5	1	7,064.500	6.361	0.000	0.000	83.500	M	467.27	249.096
	Σ	**7,064.500**						**467.27**	**249.096**
#2	1	6,633.800	3.130	0.000	0.000	83.000	M	775.95	224.914
	Σ	**6,633.800**						**775.95**	**224.914**
#1	1	4,622.300	2.422	0.000	0.000	84.700	M	769.23	178.815
	Σ	**4,622.300**						**769.23**	**178.815**
#4	1	12,415.200	9.741	0.000	0.000	81.600	M	476.81	376.249
	Σ	**23,671.300**						**1,756.24**	**779.979**
#3	1	9,427.600	4.941	0.000	0.000	86.200	M	962.07	408.255
	Σ	**9,427.600**						**962.07**	**408.255**
#6	1	7,063.800	5.356	0.000	0.000	89.000	M	828.36	375.124
	Σ	**47,227.200**						**2,158.29**	**1,812.453**
#12	1	2,976.500	3.747	0.000	0.000	86.700	M	400.87	133.762
	Σ	**54,536.200**						**2,191.63**	**2,065.692**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#11	1	0.176	200.00	4.60	0.3157	1.0000	10	73.0	29,853	13.34	8.93
	2	0.140	130.00	7.40	0.2520	1.0000	13	197.0	20,344	6.15	4.29
	Σ							**239.0**	**19,828**	**5.61**	**3.86**
#10	1	0.184	200.00	4.70	0.2962	1.0000	9	91.1	23,670	8.34	5.84
	2	0.139	130.00	6.50	0.2630	1.0000	13	344.1	22,015	8.56	5.94
	Σ							**352.4**	**17,668**	**6.71**	**4.78**
#8	1	0.173	280.00	2.40	0.2851	1.0000	7	240.5	12,099	4.72	3.31
	Σ							**240.5**	**12,099**	**4.72**	**3.31**
#7	1	0.243	280.00	2.00	0.2006	1.0000	5	102.9	5,796	0.85	0.63
	2	0.209	280.00	2.70	0.2762	1.0000	6	251.8	13,536	4.54	3.24
	Σ							**302.8**	**11,196**	**3.17**	**1.71**
#9	1	0.212	240.00	3.70	0.2445	1.0000	8	471.5	16,801	6.44	4.60
	Σ							**1,014.3**	**16,070**	**5.71**	**3.06**
#5	1	0.180	200.00	4.30	0.2445	1.0000	12	2,473.7	9,926	0.40	0.30
	Σ							**2,473.7**	**9,926**	**0.40**	**0.30**
#2	1	0.179	100.00	8.40	0.2427	1.0000	12	4,221.1	18,596	1.00	0.74
	Σ							**4,221.1**	**18,596**	**1.00**	**0.74**
#1	1	0.164	100.00	8.00	0.2219	1.0000	1	2,867.4	15,974	0.96	0.70
	Σ							**2,867.4**	**15,974**	**0.96**	**0.70**
#4	1	0.170	200.00	4.70	0.2651	1.0000	3	3,509.3	9,375	0.22	0.17
	Σ							**10,560.4**	**15,215**	**0.69**	**0.48**
#3	1	0.190	100.00	10.30	0.1857	1.0000	2	7,596.2	18,492	0.85	0.63
	Σ							**7,596.2**	**18,492**	**0.85**	**0.63**
#6	1	0.200	130.00	6.50	0.1727	1.0000	4	4,013.8	10,693	0.52	0.39
	Σ							**24,622.6**	**13,669**	**0.62**	**0.47**
#12	1	0.196	200.00	4.80	0.2219	1.0000	11	1,756.7	13,059	0.78	0.57
	Σ							**27,802.0**	**14,721**	**0.92**	**0.64**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	3.13	25.00	799.00	1.760	0.126
		8. Large gullies, diversions, and low flowing streams	1.77	581.00	32,908.52	3.980	2.296
#1	**1**	**Time of Concentration:**					**2.422**

General Information

Storm Information:

Storm Type:	Type II-70
Design Storm:	100 yr - 6 hr
Rainfall Depth:	1.960 inches

Particle Size Distribution:

Size (mm)	B1	B2	B3	B4	B5	B6	B7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	74.410%	76.157%	69.997%	79.508%	76.475%	69.135%	70.448%
0.1500	55.605%	59.686%	50.748%	64.050%	57.775%	49.241%	48.380%
0.0750	43.516%	47.428%	39.813%	50.694%	41.347%	36.360%	35.105%
0.0159	38.456%	41.399%	35.485%	43.752%	34.236%	31.386%	30.759%
0.0100	31.531%	33.052%	29.389%	34.156%	23.595%	23.861%	24.387%
0.0050	9.472%	10.126%	10.232%	9.667%	6.873%	8.915%	7.819%
0.0020	5.356%	6.051%	5.668%	6.037%	4.758%	5.288%	4.349%
0.0010	4.976%	5.693%	5.255%	5.694%	4.247%	4.786%	3.857%
0.0004	4.422%	4.956%	4.771%	4.879%	3.949%	4.512%	3.708%

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#11	627.900	627.900	202.26	17.81	350.0	20,735	6.26	4.34
#10	621.200	621.200	287.19	26.79	477.1	18,136	6.97	5.00
#8	782.600	782.600	304.37	27.95	338.2	12,626	5.09	3.57
#7	1,648.200	1,648.200	244.37	50.53	437.2	11,736	3.48	1.88
#9	652.600	3,083.400	516.03	114.89	1,392.2	16,514	6.03	3.24
#5	7,064.500	7,064.500	609.68	323.97	3,326.2	10,271	0.42	0.31
#2	6,633.800	6,633.800	1,020.35	293.85	5,715.2	19,287	1.06	0.78
#1	4,622.300	4,622.300	996.68	230.12	3,817.9	16,537	1.00	0.74
#4	12,415.200	23,671.300	2,296.63	1,022.06	14,294.3	15,749	0.73	0.51
#3	9,427.600	9,427.600	1,226.34	518.76	9,951.4	19,074	0.90	0.66
#6	7,063.800	47,227.200	2,796.56	2,330.84	32,668.6	14,185	0.66	0.49
#12	2,976.500	54,536.200	2,806.50	2,659.59	36,760.5	15,274	0.99	0.67

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#11	1	130.300	0.303	0.378	0.366	77.000	M	67.32	3.704
	2	497.600	0.677	0.000	0.000	77.000	M	155.00	14.105
	Σ	**627.900**						**202.26**	**17.809**
#10	1	179.800	0.606	0.426	0.348	78.000	M	65.99	5.520
	2	441.400	0.558	0.000	0.000	84.200	M	276.03	21.267
	Σ	**621.200**						**287.19**	**26.786**
#8	1	782.600	0.708	0.000	0.000	80.000	M	304.37	27.953
	Σ	**782.600**						**304.37**	**27.953**
#7	1	791.100	2.222	0.448	0.311	78.000	M	109.58	24.247
	2	857.100	0.948	0.000	0.000	78.000	M	229.36	26.282
	Σ	**1,648.200**						**244.37**	**50.528**
#9	1	652.600	0.936	0.000	0.000	86.400	M	335.38	36.408
	Σ	**3,083.400**						**516.03**	**114.889**
#5	1	7,064.500	6.361	0.000	0.000	83.500	M	609.68	323.968
	Σ	**7,064.500**						**609.68**	**323.968**
#2	1	6,633.800	3.130	0.000	0.000	83.000	M	1,020.35	293.849
	Σ	**6,633.800**						**1,020.35**	**293.849**
#1	1	4,622.300	2.422	0.000	0.000	84.700	M	996.68	230.116
	Σ	**4,622.300**						**996.68**	**230.116**
#4	1	12,415.200	9.741	0.000	0.000	81.600	M	632.80	498.098
	Σ	**23,671.300**						**2,296.63**	**1,022.063**
#3	1	9,427.600	4.941	0.000	0.000	86.200	M	1,226.34	518.757
	Σ	**9,427.600**						**1,226.34**	**518.757**
#6	1	7,063.800	5.356	0.000	0.000	89.000	M	1,031.68	466.048
	Σ	**47,227.200**						**2,796.56**	**2,330.836**
#12	1	2,976.500	3.747	0.000	0.000	86.700	M	509.41	169.269
	Σ	**54,536.200**						**2,806.50**	**2,659.589**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#11	1	0.176	200.00	4.60	0.3157	1.0000	10	106.3	30,969	14.20	9.58
	2	0.140	130.00	7.40	0.2520	1.0000	13	289.0	21,413	6.88	4.81
	Σ							**350.0**	**20,735**	**6.26**	**4.34**
#10	1	0.184	200.00	4.70	0.2962	1.0000	9	131.7	24,809	9.16	6.43
	2	0.139	130.00	6.50	0.2630	1.0000	13	459.8	22,661	9.04	6.30
	Σ							**477.1**	**18,136**	**6.97**	**5.00**
#8	1	0.173	280.00	2.40	0.2851	1.0000	7	338.2	12,626	5.09	3.57
	Σ							**338.2**	**12,626**	**5.09**	**3.57**
#7	1	0.243	280.00	2.00	0.2006	1.0000	5	148.1	6,078	1.04	0.77
	2	0.209	280.00	2.70	0.2762	1.0000	6	363.0	14,164	4.98	3.55
	Σ							**437.2**	**11,736**	**3.48**	**1.88**
#9	1	0.212	240.00	3.70	0.2445	1.0000	8	617.5	17,314	6.80	4.87
	Σ							**1,392.2**	**16,514**	**6.03**	**3.24**
#5	1	0.180	200.00	4.30	0.2445	1.0000	12	3,326.2	10,271	0.42	0.31
	Σ							**3,326.2**	**10,271**	**0.42**	**0.31**
#2	1	0.179	100.00	8.40	0.2427	1.0000	12	5,715.2	19,287	1.06	0.78
	Σ							**5,715.2**	**19,287**	**1.06**	**0.78**
#1	1	0.164	100.00	8.00	0.2219	1.0000	1	3,817.9	16,537	1.00	0.74
	Σ							**3,817.9**	**16,537**	**1.00**	**0.74**
#4	1	0.170	200.00	4.70	0.2651	1.0000	3	4,811.6	9,717	0.24	0.19
	Σ							**14,294.3**	**15,749**	**0.73**	**0.51**
#3	1	0.190	100.00	10.30	0.1857	1.0000	2	9,951.4	19,074	0.90	0.66
	Σ							**9,951.4**	**19,074**	**0.90**	**0.66**
#6	1	0.200	130.00	6.50	0.1727	1.0000	4	5,125.3	10,996	0.54	0.40
	Σ							**32,668.6**	**14,185**	**0.66**	**0.49**
#12	1	0.196	200.00	4.80	0.2219	1.0000	11	2,292.0	13,474	0.81	0.60
	Σ							**36,760.5**	**15,274**	**0.99**	**0.67**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	3.13	25.00	799.00	1.760	0.126
		8. Large gullies, diversions, and low flowing streams	1.77	581.00	32,908.52	3.980	2.296
#1	**1**	**Time of Concentration:**					**2.422**

Attachment 41.D-4

Chaco River Unnamed Tributaries Post-reclamation Hydrology and Sedimentology

SEDCAD™ Model Output

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Chaco River Unnamed Tributary 1 Hydrology and Sedimentology for LOM Reclamation Plan

2-year, 6-hour Precipation Event
10-year, 6-hour Precipation Event
25-year, 6-hour Precipitation Event
50-year, 6-hour Precipitation Event
100-year, 6-hour Precipitation Event

General Information

Storm Information:

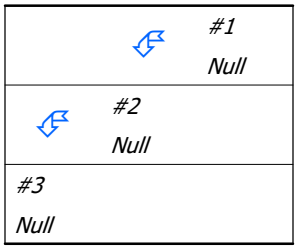
Storm Type:	Type II- 70
Design Storm:	2 yr - 6 hr
Rainfall Depth:	0.823 inches

Particle Size Distribution:

Size (mm)	C1	C2	C3	C4	C5	C6	C7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	73.959%	73.616%	76.935%	71.698%	79.271%	76.186%	76.186%
0.1500	53.513%	51.156%	56.809%	52.203%	61.614%	56.371%	56.371%
0.0750	39.786%	36.094%	43.470%	40.227%	48.027%	42.009%	42.009%
0.0159	34.594%	31.049%	38.314%	35.500%	41.810%	36.270%	36.270%
0.0100	27.184%	23.672%	31.377%	28.812%	33.358%	28.141%	28.141%
0.0050	7.949%	6.458%	8.122%	9.441%	8.745%	7.683%	7.683%
0.0020	4.615%	3.761%	4.540%	5.331%	5.229%	4.600%	4.600%
0.0010	4.166%	3.257%	4.157%	4.909%	4.876%	4.165%	4.165%
0.0004	3.847%	3.172%	3.703%	4.467%	4.220%	3.790%	3.790%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.195	0.373	
Null	#2	==>	#3	0.616	0.336	
Null	#3	==>	End	0.000	0.000	



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	2.78	97.99	3,526.72	5.00	0.195
#1	**Muskingum K:**					**0.195**
#2	8. Large gullies, diversions, and low flowing streams	1.35	103.99	7,726.00	3.48	0.616
#2	**Muskingum K:**					**0.616**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	1,130.000	1,130.000	3.44	1.01	3.8	4,203	0.78	0.51
#2	308.400	1,438.400	42.45	3.67	102.0	41,281	14.54	7.10
#3	738.200	2,176.600	58.46	7.27	205.2	38,355	8.78	4.70

Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	81.024%
0.0050	25.768%
0.0020	14.993%
0.0010	13.143%
0.0004	12.603%

Structure #2:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	80.467%
0.0159	71.131%
0.0100	58.571%
0.0050	15.656%
0.0020	8.773%
0.0010	8.011%
0.0004	7.169%

Structure #3:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	98.392%
0.0159	90.819%

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Size (mm)	In/Out
0.0100	75.270%
0.0050	22.906%
0.0020	12.901%
0.0010	11.846%
0.0004	10.720%

Structure Detail:

Structure #1 (Null)

Structure #2 (Null)

Structure #3 (Null)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	554.900	1.665	0.767	0.329	76.000	M	1.62	0.403
	2	575.100	1.127	0.000	0.000	77.000	M	3.17	0.604
	Σ	**1,130.000**						**3.44**	**1.007**
#2	1	308.400	0.366	0.000	0.000	86.700	M	42.45	2.666
	Σ	**1,438.400**						**42.45**	**3.673**
#3	1	738.200	0.569	0.000	0.000	83.300	M	39.38	3.599
	Σ	**2,176.600**						**58.46**	**7.272**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.178	280.00	2.00	0.2427	1.0000	1	1.2	2,912	0.64	0.50
	2	0.178	280.00	2.70	0.2630	1.0000	2	3.2	5,148	1.09	0.84
	Σ							**3.8**	**4,203**	**0.78**	**0.51**
#2	1	0.147	75.00	15.50	0.2106	1.0000	3	100.2	41,282	14.79	9.77
	Σ							**102.0**	**41,281**	**14.54**	**7.10**
#3	1	0.173	75.00	13.50	0.2539	1.0000	4	135.6	39,764	10.64	7.32
	Σ							**205.2**	**38,355**	**8.78**	**4.70**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	0.33	4.80	1,471.03	0.570	0.716
		8. Large gullies, diversions, and low flowing streams	0.63	27.14	4,327.16	2.370	0.507
		8. Large gullies, diversions, and low flowing streams	0.45	14.45	3,203.99	2.010	0.442
#1	**1**	**Time of Concentration:**					**1.665**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	2.35	33.08	1,406.22	1.530	0.255
		8. Large gullies, diversions, and low flowing streams	0.82	69.69	8,510.19	2.710	0.872
#1	**2**	**Time of Concentration:**					**1.127**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	5. Nearly bare and untilled, and alluvial valley fans	2.99	20.00	669.00	1.720	0.108
		8. Large gullies, diversions, and low flowing streams	3.24	163.00	5,025.00	5.400	0.258
#2	**1**	**Time of Concentration:**					**0.366**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	3.08	9.99	325.00	1.750	0.051
		8. Large gullies, diversions, and low flowing streams	3.11	306.99	9,872.00	5.290	0.518
#3	**1**	**Time of Concentration:**					**0.569**

Subwatershed Muskingum Routing Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	8. Large gullies, diversions, and low flowing streams	1.19	108.00	9,039.00	3.270	0.767
#1	**1**	**Muskingum K:**					**0.767**

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General Information

Storm Information:

Storm Type:	Type II- 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Particle Size Distribution:

Size (mm)	C1	C2	C3	C4	C5	C6	C7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	73.959%	73.616%	76.935%	71.698%	79.271%	76.186%	76.186%
0.1500	53.513%	51.156%	56.809%	52.203%	61.614%	56.371%	56.371%
0.0750	39.786%	36.094%	43.470%	40.227%	48.027%	42.009%	42.009%
0.0159	34.594%	31.049%	38.314%	35.500%	41.810%	36.270%	36.270%
0.0100	27.184%	23.672%	31.377%	28.812%	33.358%	28.141%	28.141%
0.0050	7.949%	6.458%	8.122%	9.441%	8.745%	7.683%	7.683%
0.0020	4.615%	3.761%	4.540%	5.331%	5.229%	4.600%	4.600%
0.0010	4.166%	3.257%	4.157%	4.909%	4.876%	4.165%	4.165%
0.0004	3.847%	3.172%	3.703%	4.467%	4.220%	3.790%	3.790%

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Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	1,130.000	1,130.000	30.91	7.73	39.8	6,404	1.27	0.75
#2	308.400	1,438.400	118.80	14.84	338.8	45,933	16.95	6.12
#3	738.200	2,176.600	175.42	26.73	759.7	46,692	12.91	5.71

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	554.900	1.665	0.767	0.329	76.000	M	17.67	3.509
	2	575.100	1.127	0.000	0.000	77.000	M	28.83	4.217
	Σ	**1,130.000**						**30.91**	**7.726**
#2	1	308.400	0.366	0.000	0.000	86.700	M	117.56	7.115
	Σ	**1,438.400**						**118.80**	**14.842**
#3	1	738.200	0.569	0.000	0.000	83.300	M	145.76	11.892
	Σ	**2,176.600**						**175.42**	**26.734**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.178	280.00	2.00	0.2427	1.0000	1	16.0	4,501	0.28	0.21
	2	0.178	280.00	2.70	0.2630	1.0000	2	33.1	7,907	1.87	1.36
	Σ							**39.8**	**6,404**	**1.27**	**0.75**
#2	1	0.147	75.00	15.50	0.2106	1.0000	3	307.2	46,401	18.61	12.55
	Σ							**338.8**	**45,933**	**16.95**	**6.12**
#3	1	0.173	75.00	13.50	0.2539	1.0000	4	551.0	48,614	16.62	11.47
	Σ							**759.7**	**46,692**	**12.91**	**5.71**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	0.33	4.80	1,471.03	0.570	0.716
		8. Large gullies, diversions, and low flowing streams	0.63	27.14	4,327.16	2.370	0.507
		8. Large gullies, diversions, and low flowing streams	0.45	14.45	3,203.99	2.010	0.442
#1	**1**	**Time of Concentration:**					**1.665**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	2.35	33.08	1,406.22	1.530	0.255
		8. Large gullies, diversions, and low flowing streams	0.82	69.69	8,510.19	2.710	0.872
#1	**2**	**Time of Concentration:**					**1.127**

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General Information

Storm Information:

Storm Type:	Type II- 70
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.500 inches

Particle Size Distribution:

Size (mm)	C1	C2	C3	C4	C5	C6	C7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	73.959%	73.616%	76.935%	71.698%	79.271%	76.186%	76.186%
0.1500	53.513%	51.156%	56.809%	52.203%	61.614%	56.371%	56.371%
0.0750	39.786%	36.094%	43.470%	40.227%	48.027%	42.009%	42.009%
0.0159	34.594%	31.049%	38.314%	35.500%	41.810%	36.270%	36.270%
0.0100	27.184%	23.672%	31.377%	28.812%	33.358%	28.141%	28.141%
0.0050	7.949%	6.458%	8.122%	9.441%	8.745%	7.683%	7.683%
0.0020	4.615%	3.761%	4.540%	5.331%	5.229%	4.600%	4.600%
0.0010	4.166%	3.257%	4.157%	4.909%	4.876%	4.165%	4.165%
0.0004	3.847%	3.172%	3.703%	4.467%	4.220%	3.790%	3.790%

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	1,130.000	1,130.000	61.37	14.88	84.4	7,111	1.67	0.98
#2	308.400	1,438.400	180.42	25.59	551.9	47,471	17.83	5.88
#3	738.200	2,176.600	273.73	44.67	1,284.5	49,913	14.88	6.22

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	554.900	1.665	0.767	0.329	76.000	M	36.95	6.894
	2	575.100	1.127	0.000	0.000	77.000	M	58.35	7.989
	Σ	**1,130.000**						**61.37**	**14.883**
#2	1	308.400	0.366	0.000	0.000	86.700	M	176.44	10.709
	Σ	**1,438.400**						**180.42**	**25.593**
#3	1	738.200	0.569	0.000	0.000	83.300	M	240.05	19.082
	Σ	**2,176.600**						**273.73**	**44.674**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.178	280.00	2.00	0.2427	1.0000	1	35.3	5,093	0.47	0.34
	2	0.178	280.00	2.70	0.2630	1.0000	2	70.2	8,945	2.51	1.81
	Σ							**84.4**	**7,111**	**1.67**	**0.98**
#2	1	0.147	75.00	15.50	0.2106	1.0000	3	484.8	48,031	19.90	13.58
	Σ							**551.9**	**47,471**	**17.83**	**5.88**
#3	1	0.173	75.00	13.50	0.2539	1.0000	4	949.5	51,965	18.96	13.13
	Σ							**1,284.5**	**49,913**	**14.88**	**6.22**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	0.33	4.80	1,471.03	0.570	0.716
		8. Large gullies, diversions, and low flowing streams	0.63	27.14	4,327.16	2.370	0.507
		8. Large gullies, diversions, and low flowing streams	0.45	14.45	3,203.99	2.010	0.442
#1	**1**	**Time of Concentration:**					**1.665**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	2.35	33.08	1,406.22	1.530	0.255
		8. Large gullies, diversions, and low flowing streams	0.82	69.69	8,510.19	2.710	0.872
#1	**2**	**Time of Concentration:**					**1.127**

General Information

Storm Information:

Storm Type:	Type II- 70
Design Storm:	50 yr - 6 hr
Rainfall Depth:	1.720 inches

Particle Size Distribution:

Size (mm)	C1	C2	C3	C4	C5	C6	C7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	73.959%	73.616%	76.935%	71.698%	79.271%	76.186%	76.186%
0.1500	53.513%	51.156%	56.809%	52.203%	61.614%	56.371%	56.371%
0.0750	39.786%	36.094%	43.470%	40.227%	48.027%	42.009%	42.009%
0.0159	34.594%	31.049%	38.314%	35.500%	41.810%	36.270%	36.270%
0.0100	27.184%	23.672%	31.377%	28.812%	33.358%	28.141%	28.141%
0.0050	7.949%	6.458%	8.122%	9.441%	8.745%	7.683%	7.683%
0.0020	4.615%	3.761%	4.540%	5.331%	5.229%	4.600%	4.600%
0.0010	4.166%	3.257%	4.157%	4.909%	4.876%	4.165%	4.165%
0.0004	3.847%	3.172%	3.703%	4.467%	4.220%	3.790%	3.790%

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	1,130.000	1,130.000	91.97	21.97	131.6	7,530	1.92	1.12
#2	308.400	1,438.400	235.22	35.87	751.0	48,558	18.41	5.76
#3	738.200	2,176.600	363.00	61.53	1,786.6	51,747	16.08	6.54

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	554.900	1.665	0.767	0.329	76.000	M	56.63	10.269
	2	575.100	1.127	0.000	0.000	77.000	M	87.79	11.697
	Σ	**1,130.000**						**91.97**	**21.966**
#2	1	308.400	0.366	0.000	0.000	86.700	M	229.85	13.901
	Σ	**1,438.400**						**235.22**	**35.867**
#3	1	738.200	0.569	0.000	0.000	83.300	M	326.30	25.666
	Σ	**2,176.600**						**363.00**	**61.533**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.178	280.00	2.00	0.2427	1.0000	1	56.1	5,443	0.64	0.47
	2	0.178	280.00	2.70	0.2630	1.0000	2	109.3	9,525	2.90	2.08
	Σ							**131.6**	**7,530**	**1.92**	**1.12**
#2	1	0.147	75.00	15.50	0.2106	1.0000	3	650.6	49,426	20.93	14.34
	Σ							**751.0**	**48,558**	**18.41**	**5.76**
#3	1	0.173	75.00	13.50	0.2539	1.0000	4	1,331.2	53,933	20.37	14.15
	Σ							**1,786.6**	**51,747**	**16.08**	**6.54**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	0.33	4.80	1,471.03	0.570	0.716
		8. Large gullies, diversions, and low flowing streams	0.63	27.14	4,327.16	2.370	0.507
		8. Large gullies, diversions, and low flowing streams	0.45	14.45	3,203.99	2.010	0.442
#1	**1**	**Time of Concentration:**					**1.665**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	2.35	33.08	1,406.22	1.530	0.255
		8. Large gullies, diversions, and low flowing streams	0.82	69.69	8,510.19	2.710	0.872
#1	**2**	**Time of Concentration:**					**1.127**

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General Information

Storm Information:

Storm Type:	Type II- 70
Design Storm:	100 yr - 6 hr
Rainfall Depth:	1.960 inches

Particle Size Distribution:

Size (mm)	C1	C2	C3	C4	C5	C6	C7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	73.959%	73.616%	76.935%	71.698%	79.271%	76.186%	76.186%
0.1500	53.513%	51.156%	56.809%	52.203%	61.614%	56.371%	56.371%
0.0750	39.786%	36.094%	43.470%	40.227%	48.027%	42.009%	42.009%
0.0159	34.594%	31.049%	38.314%	35.500%	41.810%	36.270%	36.270%
0.0100	27.184%	23.672%	31.377%	28.812%	33.358%	28.141%	28.141%
0.0050	7.949%	6.458%	8.122%	9.441%	8.745%	7.683%	7.683%
0.0020	4.615%	3.761%	4.540%	5.331%	5.229%	4.600%	4.600%
0.0010	4.166%	3.257%	4.157%	4.909%	4.876%	4.165%	4.165%
0.0004	3.847%	3.172%	3.703%	4.467%	4.220%	3.790%	3.790%

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	1,130.000	1,130.000	130.55	30.76	193.2	7,888	2.12	1.24
#2	308.400	1,438.400	298.86	48.35	992.7	49,405	18.91	5.70
#3	738.200	2,176.600	468.17	81.79	2,400.7	53,679	17.27	6.84

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	554.900	1.665	0.767	0.329	76.000	M	81.42	14.478
	2	575.100	1.127	0.000	0.000	77.000	M	124.46	16.282
	Σ	**1,130.000**						**130.55**	**30.760**
#2	1	308.400	0.366	0.000	0.000	86.700	M	291.23	17.591
	Σ	**1,438.400**						**298.86**	**48.351**
#3	1	738.200	0.569	0.000	0.000	83.300	M	427.77	33.442
	Σ	**2,176.600**						**468.17**	**81.793**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.178	280.00	2.00	0.2427	1.0000	1	83.3	5,747	0.81	0.60
	2	0.178	280.00	2.70	0.2630	1.0000	2	159.9	10,013	3.22	2.32
	Σ							**193.2**	**7,888**	**2.12**	**1.24**
#2	1	0.147	75.00	15.50	0.2106	1.0000	3	847.5	50,640	21.84	15.03
	Σ							**992.7**	**49,405**	**18.91**	**5.70**
#3	1	0.173	75.00	13.50	0.2539	1.0000	4	1,796.6	55,617	21.60	15.07
	Σ							**2,400.7**	**53,679**	**17.27**	**6.84**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	0.33	4.80	1,471.03	0.570	0.716
		8. Large gullies, diversions, and low flowing streams	0.63	27.14	4,327.16	2.370	0.507
		8. Large gullies, diversions, and low flowing streams	0.45	14.45	3,203.99	2.010	0.442
#1	**1**	**Time of Concentration:**					**1.665**
#1	2	5. Nearly bare and untilled, and alluvial valley fans	2.35	33.08	1,406.22	1.530	0.255
		8. Large gullies, diversions, and low flowing streams	0.82	69.69	8,510.19	2.710	0.872
#1	**2**	**Time of Concentration:**					**1.127**

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Chaco River Unnamed Tributary 2 Hydrology and Sedimentology for LOM Reclamation Plan

2-year, 6-hour Precipation Event
10-year, 6-hour Precipation Event
25-year, 6-hour Precipitation Event
50-year, 6-hour Precipitation Event
100-year, 6-hour Precipitation Event

General Information

Storm Information:

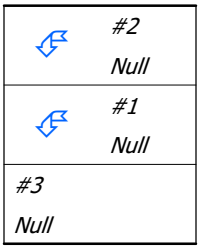
Storm Type:	Type II- 70
Design Storm:	2 yr - 6 hr
Rainfall Depth:	0.823 inches

Particle Size Distribution:

Size (mm)	C1	C2	C3	C4	C5	C6	C7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	73.959%	73.616%	76.935%	71.698%	79.271%	76.186%	76.186%
0.1500	53.513%	51.156%	56.809%	52.203%	61.614%	56.371%	56.371%
0.0750	39.786%	36.094%	43.470%	40.227%	48.027%	42.009%	42.009%
0.0159	34.594%	31.049%	38.314%	35.500%	41.810%	36.270%	36.270%
0.0100	27.184%	23.672%	31.377%	28.812%	33.358%	28.141%	28.141%
0.0050	7.949%	6.458%	8.122%	9.441%	8.745%	7.683%	7.683%
0.0020	4.615%	3.761%	4.540%	5.331%	5.229%	4.600%	4.600%
0.0010	4.166%	3.257%	4.157%	4.909%	4.876%	4.165%	4.165%
0.0004	3.847%	3.172%	3.703%	4.467%	4.220%	3.790%	3.790%

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#3	0.770	0.336	
Null	#2	==>	#3	0.806	0.339	
Null	#3	==>	End	0.000	0.000	



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	8. Large gullies, diversions, and low flowing streams	1.34	129.00	9,631.00	3.47	0.770
#1	**Muskingum K:**					**0.770**
#2	8. Large gullies, diversions, and low flowing streams	1.42	147.00	10,368.00	3.57	0.806
#2	**Muskingum K:**					**0.806**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	289.700	289.700	68.49	3.36	109.2	36,542	17.02	11.02
#1	450.000	450.000	4.45	0.65	8.7	13,235	0.85	0.64
#3	1,037.500	1,777.200	113.91	14.12	353.8	27,507	9.45	6.28

Particle Size Distribution(s) at Each Structure

Structure #2:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	86.567%
0.0750	64.512%
0.0159	55.699%
0.0100	43.215%
0.0050	11.799%
0.0020	7.064%
0.0010	6.396%
0.0004	5.820%

Structure #1:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	100.000%
0.0750	100.000%
0.0159	100.000%
0.0100	100.000%
0.0050	27.299%
0.0020	16.323%
0.0010	15.221%
0.0004	13.174%

Structure #3:

Size (mm)	In/Out
0.4500	100.000%
0.2500	100.000%
0.1500	95.882%
0.0750	88.423%
0.0159	76.680%

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Size (mm)	In/Out
0.0100	60.048%
0.0050	16.395%
0.0020	9.815%
0.0010	8.898%
0.0004	8.080%

Structure Detail:

Structure #2 (Null)

Structure #1 (Null)

Structure #3 (Null)

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	289.700	0.235	0.000	0.000	88.600	M	68.49	3.355
	Σ	**289.700**						**68.49**	**3.355**
#1	1	450.000	0.727	0.000	0.000	78.000	M	4.45	0.650
	Σ	**450.000**						**4.45**	**0.650**
#3	1	1,037.500	0.754	0.000	0.000	87.500	M	101.03	10.115
	Σ	**1,777.200**						**113.91**	**14.120**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#2	1	0.172	75.00	12.20	0.1802	1.0000	6	109.2	36,542	17.02	11.02
	Σ							**109.2**	**36,542**	**17.02**	**11.02**
#1	1	0.176	130.00	6.40	0.2851	1.0000	5	8.7	13,235	0.85	0.64
	Σ							**8.7**	**13,235**	**0.85**	**0.64**
#3	1	0.181	100.00	8.80	0.2219	1.0000	7	236.0	24,197	7.21	5.07
	Σ							**353.8**	**27,507**	**9.45**	**6.28**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	0.72	7.34	1,024.99	0.840	0.338
		8. Large gullies, diversions, and low flowing streams	1.86	57.03	3,059.71	4.090	0.207
		8. Large gullies, diversions, and low flowing streams	0.94	2.03	216.07	2.900	0.020
		8. Large gullies, diversions, and low flowing streams	3.68	123.60	3,357.05	5.750	0.162
#1	**1**	**Time of Concentration:**					**0.727**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	4.02	21.00	522.00	2.000	0.072
		8. Large gullies, diversions, and low flowing streams	3.55	118.00	3,325.00	5.650	0.163
#2	**1**	**Time of Concentration:**					**0.235**

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Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	1	5. Nearly bare and untilled, and alluvial valley fans	10.96	25.00	228.00	3.310	0.019
		8. Large gullies, diversions, and low flowing streams	2.35	285.00	12,151.00	4.590	0.735
#3	**1**	**Time of Concentration:**					**0.754**

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General Information

Storm Information:

Storm Type:	Type II- 70
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.230 inches

Particle Size Distribution:

Size (mm)	C1	C2	C3	C4	C5	C6	C7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	73.959%	73.616%	76.935%	71.698%	79.271%	76.186%	76.186%
0.1500	53.513%	51.156%	56.809%	52.203%	61.614%	56.371%	56.371%
0.0750	39.786%	36.094%	43.470%	40.227%	48.027%	42.009%	42.009%
0.0159	34.594%	31.049%	38.314%	35.500%	41.810%	36.270%	36.270%
0.0100	27.184%	23.672%	31.377%	28.812%	33.358%	28.141%	28.141%
0.0050	7.949%	6.458%	8.122%	9.441%	8.745%	7.683%	7.683%
0.0020	4.615%	3.761%	4.540%	5.331%	5.229%	4.600%	4.600%
0.0010	4.166%	3.257%	4.157%	4.909%	4.876%	4.165%	4.165%
0.0004	3.847%	3.172%	3.703%	4.467%	4.220%	3.790%	3.790%

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	289.700	289.700	162.02	8.13	290.4	38,588	18.73	12.59
#1	450.000	450.000	36.16	3.80	76.0	20,787	3.11	2.18
#3	1,037.500	1,777.200	293.64	37.82	1,061.4	28,417	10.55	7.59

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	289.700	0.235	0.000	0.000	88.600	M	162.02	8.134
	Σ	**289.700**						**162.02**	**8.134**
#1	1	450.000	0.727	0.000	0.000	78.000	M	36.16	3.800
	Σ	**450.000**						**36.16**	**3.800**
#3	1	1,037.500	0.754	0.000	0.000	87.500	M	271.90	25.883
	Σ	**1,777.200**						**293.64**	**37.817**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#2	1	0.172	75.00	12.20	0.1802	1.0000	6	290.4	38,588	18.73	12.59
	Σ							**290.4**	**38,588**	**18.73**	**12.59**
#1	1	0.176	130.00	6.40	0.2851	1.0000	5	76.0	20,787	3.11	2.18
	Σ							**76.0**	**20,787**	**3.11**	**2.18**
#3	1	0.181	100.00	8.80	0.2219	1.0000	7	695.3	27,728	9.64	6.81
	Σ							**1,061.4**	**28,417**	**10.55**	**7.59**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	0.72	7.34	1,024.99	0.840	0.338
		8. Large gullies, diversions, and low flowing streams	1.86	57.03	3,059.71	4.090	0.207
		8. Large gullies, diversions, and low flowing streams	0.94	2.03	216.07	2.900	0.020
		8. Large gullies, diversions, and low flowing streams	3.68	123.60	3,357.05	5.750	0.162
#1	**1**	**Time of Concentration:**					**0.727**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	4.02	21.00	522.00	2.000	0.072
		8. Large gullies, diversions, and low flowing streams	3.55	118.00	3,325.00	5.650	0.163
#2	**1**	**Time of Concentration:**					**0.235**

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General Information

Storm Information:

Storm Type:	Type II- 70
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.500 inches

Particle Size Distribution:

Size (mm)	C1	C2	C3	C4	C5	C6	C7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	73.959%	73.616%	76.935%	71.698%	79.271%	76.186%	76.186%
0.1500	53.513%	51.156%	56.809%	52.203%	61.614%	56.371%	56.371%
0.0750	39.786%	36.094%	43.470%	40.227%	48.027%	42.009%	42.009%
0.0159	34.594%	31.049%	38.314%	35.500%	41.810%	36.270%	36.270%
0.0100	27.184%	23.672%	31.377%	28.812%	33.358%	28.141%	28.141%
0.0050	7.949%	6.458%	8.122%	9.441%	8.745%	7.683%	7.683%
0.0020	4.615%	3.761%	4.540%	5.331%	5.229%	4.600%	4.600%
0.0010	4.166%	3.257%	4.157%	4.909%	4.876%	4.165%	4.165%
0.0004	3.847%	3.172%	3.703%	4.467%	4.220%	3.790%	3.790%

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	289.700	289.700	232.74	11.86	439.3	39,437	19.43	13.25
#1	450.000	450.000	70.30	6.97	154.8	23,128	4.66	3.26
#3	1,037.500	1,777.200	438.38	57.25	1,683.6	28,971	11.11	8.21

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	289.700	0.235	0.000	0.000	88.600	M	232.74	11.859
	Σ	**289.700**						**232.74**	**11.859**
#1	1	450.000	0.727	0.000	0.000	78.000	M	70.30	6.966
	Σ	**450.000**						**70.30**	**6.966**
#3	1	1,037.500	0.754	0.000	0.000	87.500	M	408.70	38.429
	Σ	**1,777.200**						**438.38**	**57.254**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#2	1	0.172	75.00	12.20	0.1802	1.0000	6	439.3	39,437	19.43	13.25
	Σ							**439.3**	**39,437**	**19.43**	**13.25**
#1	1	0.176	130.00	6.40	0.2851	1.0000	5	154.8	23,128	4.66	3.26
	Σ							**154.8**	**23,128**	**4.66**	**3.26**
#3	1	0.181	100.00	8.80	0.2219	1.0000	7	1,090.0	29,169	10.66	7.55
	Σ							**1,683.6**	**28,971**	**11.11**	**8.21**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	0.72	7.34	1,024.99	0.840	0.338
		8. Large gullies, diversions, and low flowing streams	1.86	57.03	3,059.71	4.090	0.207
		8. Large gullies, diversions, and low flowing streams	0.94	2.03	216.07	2.900	0.020
		8. Large gullies, diversions, and low flowing streams	3.68	123.60	3,357.05	5.750	0.162
#1	**1**	**Time of Concentration:**					**0.727**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	4.02	21.00	522.00	2.000	0.072
		8. Large gullies, diversions, and low flowing streams	3.55	118.00	3,325.00	5.650	0.163
#2	**1**	**Time of Concentration:**					**0.235**

General Information

Storm Information:

Storm Type:	Type II- 70
Design Storm:	50 yr - 6 hr
Rainfall Depth:	1.720 inches

Particle Size Distribution:

Size (mm)	C1	C2	C3	C4	C5	C6	C7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	73.959%	73.616%	76.935%	71.698%	79.271%	76.186%	76.186%
0.1500	53.513%	51.156%	56.809%	52.203%	61.614%	56.371%	56.371%
0.0750	39.786%	36.094%	43.470%	40.227%	48.027%	42.009%	42.009%
0.0159	34.594%	31.049%	38.314%	35.500%	41.810%	36.270%	36.270%
0.0100	27.184%	23.672%	31.377%	28.812%	33.358%	28.141%	28.141%
0.0050	7.949%	6.458%	8.122%	9.441%	8.745%	7.683%	7.683%
0.0020	4.615%	3.761%	4.540%	5.331%	5.229%	4.600%	4.600%
0.0010	4.166%	3.257%	4.157%	4.909%	4.876%	4.165%	4.165%
0.0004	3.847%	3.172%	3.703%	4.467%	4.220%	3.790%	3.790%

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Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	289.700	289.700	294.97	15.11	574.7	40,181	20.01	13.74
#1	450.000	450.000	103.64	10.04	236.0	24,407	5.51	3.87
#3	1,037.500	1,777.200	567.71	74.65	2,261.6	29,721	11.62	8.62

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	289.700	0.235	0.000	0.000	88.600	M	294.97	15.115
	Σ	**289.700**						**294.97**	**15.115**
#1	1	450.000	0.727	0.000	0.000	78.000	M	103.64	10.039
	Σ	**450.000**						**103.64**	**10.039**
#3	1	1,037.500	0.754	0.000	0.000	87.500	M	529.31	49.495
	Σ	**1,777.200**						**567.71**	**74.648**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#2	1	0.172	75.00	12.20	0.1802	1.0000	6	574.7	40,181	20.01	13.74
	Σ							**574.7**	**40,181**	**20.01**	**13.74**
#1	1	0.176	130.00	6.40	0.2851	1.0000	5	236.0	24,407	5.51	3.87
	Σ							**236.0**	**24,407**	**5.51**	**3.87**
#3	1	0.181	100.00	8.80	0.2219	1.0000	7	1,451.7	30,072	11.30	8.02
	Σ							**2,261.6**	**29,721**	**11.62**	**8.62**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	0.72	7.34	1,024.99	0.840	0.338
		8. Large gullies, diversions, and low flowing streams	1.86	57.03	3,059.71	4.090	0.207
		8. Large gullies, diversions, and low flowing streams	0.94	2.03	216.07	2.900	0.020
		8. Large gullies, diversions, and low flowing streams	3.68	123.60	3,357.05	5.750	0.162
#1	**1**	**Time of Concentration:**					**0.727**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	4.02	21.00	522.00	2.000	0.072
		8. Large gullies, diversions, and low flowing streams	3.55	118.00	3,325.00	5.650	0.163
#2	**1**	**Time of Concentration:**					**0.235**

General Information

Storm Information:

Storm Type:	Type II- 70
Design Storm:	100 yr - 6 hr
Rainfall Depth:	1.960 inches

Particle Size Distribution:

Size (mm)	C1	C2	C3	C4	C5	C6	C7
0.4500	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%	100.000%
0.2500	73.959%	73.616%	76.935%	71.698%	79.271%	76.186%	76.186%
0.1500	53.513%	51.156%	56.809%	52.203%	61.614%	56.371%	56.371%
0.0750	39.786%	36.094%	43.470%	40.227%	48.027%	42.009%	42.009%
0.0159	34.594%	31.049%	38.314%	35.500%	41.810%	36.270%	36.270%
0.0100	27.184%	23.672%	31.377%	28.812%	33.358%	28.141%	28.141%
0.0050	7.949%	6.458%	8.122%	9.441%	8.745%	7.683%	7.683%
0.0020	4.615%	3.761%	4.540%	5.331%	5.229%	4.600%	4.600%
0.0010	4.166%	3.257%	4.157%	4.909%	4.876%	4.165%	4.165%
0.0004	3.847%	3.172%	3.703%	4.467%	4.220%	3.790%	3.790%

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#2	289.700	289.700	365.14	18.84	732.6	40,817	20.51	14.18
#1	450.000	450.000	145.51	13.81	341.2	25,637	6.33	4.45
#3	1,037.500	1,777.200	717.28	94.87	2,856.8	30,557	11.75	8.43

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	289.700	0.235	0.000	0.000	88.600	M	365.14	18.838
	Σ	**289.700**						**365.14**	**18.838**
#1	1	450.000	0.727	0.000	0.000	78.000	M	145.51	13.807
	Σ	**450.000**						**145.51**	**13.807**
#3	1	1,037.500	0.754	0.000	0.000	87.500	M	667.86	62.228
	Σ	**1,777.200**						**717.28**	**94.872**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#2	1	0.172	75.00	12.20	0.1802	1.0000	6	732.6	40,817	20.51	14.18
	Σ							**732.6**	**40,817**	**20.51**	**14.18**
#1	1	0.176	130.00	6.40	0.2851	1.0000	5	341.2	25,637	6.33	4.45
	Σ							**341.2**	**25,637**	**6.33**	**4.45**
#3	1	0.181	100.00	8.80	0.2219	1.0000	7	1,879.7	30,880	11.87	8.45
	Σ							**2,856.8**	**30,557**	**11.75**	**8.43**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	0.72	7.34	1,024.99	0.840	0.338
		8. Large gullies, diversions, and low flowing streams	1.86	57.03	3,059.71	4.090	0.207
		8. Large gullies, diversions, and low flowing streams	0.94	2.03	216.07	2.900	0.020
		8. Large gullies, diversions, and low flowing streams	3.68	123.60	3,357.05	5.750	0.162
#1	**1**	**Time of Concentration:**					**0.727**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	4.02	21.00	522.00	2.000	0.072
		8. Large gullies, diversions, and low flowing streams	3.55	118.00	3,325.00	5.650	0.163
#2	**1**	**Time of Concentration:**					**0.235**

Table 41.D-1 SEDCAD™ Model Input Factors Based on Erodible Particle Size Distribution (EPSD) Texture Class for Post-reclamation Conditions

EPSD texture	K-factor	Run-off curve number	Canopy cover	Surface cover
Fine	0.20	93.0	4.7	30.8
Fine loamy	0.27	92.4	9.2	18.1
Coarse loamy	0.10	81.9	14.5	7.9
Sandy	0.20	65.6	13.9	1.6

Table 41.D-2 Pinabete Arroyo SEDCAD Model Erobible Particle Size Distribution Input for Post-reclamation Conditions

EPSD designation Diameter (mm)	P1	P2	P3	P4	P5	P6	P7	PR1	P9	PR2
0.450	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
0.250	85.529	83.954	83.494	79.684	74.336	71.800	68.824	59.708	66.130	66.555
0.150	72.267	70.070	68.714	64.718	55.514	53.158	47.671	39.864	47.750	47.703
0.075	58.134	56.187	54.477	51.673	42.977	40.816	35.579	32.451	36.084	37.767
0.01585	49.962	48.376	46.844	44.689	37.721	35.600	31.445	30.046	31.122	33.776
0.01000	38.953	37.808	36.471	35.083	30.403	28.065	25.380	26.345	23.407	27.949
0.005012	9.675	9.683	9.177	10.018	9.205	9.529	8.929	12.646	10.343	11.148
0.001995	6.279	6.204	5.875	6.237	5.303	5.591	4.938	6.647	6.209	6.190
0.001000	6.010	5.917	5.567	5.908	4.905	5.155	4.462	6.189	5.698	5.755
0.000398	4.942	4.914	4.659	5.035	4.387	4.686	4.216	5.779	5.329	5.272

Note: Values reported as percent of sample passing through sieve with corresponding diameter

Table 41.D-2 Pinabete Arroyo SEDCAD Model Erobible Particle Size Distribution Input for Post-reclamation Conditions

EPSD designation Diameter (mm)	P11	P12	P13	PR3	PR4	P16	P17	P18	PR5
0.450	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
0.250	71.599	65.531	66.688	84.341	66.364	76.546	69.115	68.866	78.238
0.150	57.036	45.088	46.416	70.811	47.418	60.175	48.743	45.562	61.247
0.075	47.507	34.380	34.657	57.016	35.438	46.743	36.650	33.437	47.106
0.01585	42.049	30.640	30.363	49.109	30.544	40.133	32.221	30.098	40.390
0.01000	34.448	25.007	23.816	38.440	22.931	30.717	25.703	25.355	30.915
0.005012	12.666	10.180	9.557	9.841	9.934	9.459	9.189	8.126	8.725
0.001995	7.405	5.608	5.458	6.312	5.945	5.929	5.194	4.149	5.492
0.001000	7.069	5.126	4.956	6.035	5.428	5.532	4.723	3.674	5.099
0.000398	6.144	4.829	4.693	4.992	5.109	4.866	4.420	3.561	4.474

Note: Values reported a

Table 41.D-3 No Name Arroyo SEDCAD Model Erodible Particle Size Distribution Input for Post-reclamation Conditions

EPSD designation Diameter (mm)	N1	NR1	NR2	NR3	NR4	NR5	NR6	NR7	NR8	NR9
0.450	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
0.250	67.238	67.438	70.036	68.287	65.150	65.271	69.306	71.117	74.810	72.354
0.150	49.361	47.354	49.078	46.087	43.153	43.193	47.387	49.628	54.282	52.382
0.075	37.563	35.643	36.534	34.647	33.004	32.960	35.521	37.303	41.594	40.726
0.01585	32.342	31.292	32.109	31.210	30.110	30.056	31.776	33.171	36.905	36.322
0.01000	24.314	24.745	25.650	26.323	25.908	25.842	26.444	27.358	30.569	30.292
0.005012	10.387	9.622	8.672	8.960	9.962	9.877	8.757	8.544	8.474	9.416
0.001995	6.291	5.481	4.866	4.672	5.134	5.086	4.648	4.612	4.632	5.140
0.001000	5.795	4.994	4.394	4.213	4.669	4.620	4.190	4.167	4.237	4.742
0.000398	5.371	4.694	4.134	3.997	4.436	4.395	3.959	3.892	3.821	4.287

Note: Values reported as percent of sample passing through sieve with corresponding diameter

Table 41.D-3 No Name Arroyo SEDCAD Model Erodible Particle Size Distribution Input for Post-reclamation Conditions

EPSD designation Diameter (mm)	NR10	NR11	NR12	NR13	N15
0.450	100.000	100.000	100.000	100.000	100.000
0.250	76.910	72.354	74.126	68.115	77.333
0.150	56.858	52.382	54.170	49.351	57.313
0.075	43.665	40.726	41.898	37.400	44.056
0.01585	38.548	36.322	37.190	32.436	38.895
0.01000	31.692	30.292	30.791	24.922	32.007
0.005012	8.235	9.416	8.963	9.925	8.186
0.001995	4.585	5.140	4.939	5.882	4.556
0.001000	4.208	4.742	4.549	5.396	4.184
0.000398	3.739	4.287	4.086	5.013	3.706

Note: Values reported a

Table 41.D-5 Chaco River SEDCAD™ Model Erodible Particle Size Distribution (EPSD) Input for Post-reclamation Conditions

EPSD designation Diameter (mm)	CR1	CR2	CR3	C4	CR4	CR5	C7	CR6	CR7	C10
0.450	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
0.250	67.464	68.297	76.719	71.698	66.870	77.601	76.186	70.948	69.719	72.826
0.150	44.674	45.874	56.506	52.203	46.518	59.419	56.371	51.273	48.655	50.060
0.075	33.275	33.979	43.249	40.227	36.160	46.254	42.009	39.527	37.474	37.063
0.01585	30.086	30.418	38.166	35.500	32.537	40.440	36.270	34.979	33.719	33.090
0.01000	25.515	25.267	31.332	28.812	27.305	32.512	28.141	28.527	28.508	27.663
0.005012	8.815	8.614	8.150	9.441	10.343	8.894	7.683	9.552	9.443	7.592
0.001995	4.526	4.540	4.534	5.331	5.576	5.215	4.600	5.350	5.002	3.938
0.001000	4.055	4.064	4.151	4.909	5.131	4.849	4.165	4.923	4.577	3.500
0.000398	3.897	3.896	3.703	4.467	4.763	4.243	3.790	4.497	4.230	3.302

Note: Values reported as percent of sample passing through sieve with corresponding diameter

Table 41.D-6: Cover Factor Canopy and Surface Cover Interpolation

	Cover that Contacts the Surface																								
Canopy Cover (%)	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	22%	23%	24%	25%
0%	0.45	0.438	0.425	0.413	0.4	0.388	0.375	0.363	0.35	0.338	0.325	0.313	0.3	0.288	0.275	0.263	0.25	0.238	0.225	0.213	0.2	0.195	0.19	0.185	0.18	0.175
1%	0.446	0.434	0.422	0.409	0.397	0.385	0.372	0.36	0.347	0.335	0.323	0.31	0.298	0.285	0.273	0.261	0.248	0.236	0.224	0.211	0.199	0.194	0.189	0.184	0.179	0.174
2%	0.443	0.431	0.418	0.406	0.394	0.382	0.369	0.357	0.345	0.332	0.32	0.308	0.296	0.283	0.271	0.259	0.247	0.234	0.222	0.21	0.198	0.193	0.188	0.183	0.178	0.173
3%	0.439	0.427	0.415	0.403	0.391	0.379	0.366	0.354	0.342	0.33	0.318	0.306	0.294	0.281	0.269	0.257	0.245	0.233	0.221	0.209	0.196	0.192	0.186	0.182	0.177	0.172
4%	0.436	0.424	0.412	0.4	0.388	0.376	0.363	0.351	0.339	0.327	0.315	0.303	0.291	0.279	0.267	0.255	0.243	0.231	0.219	0.207	0.195	0.19	0.185	0.181	0.176	0.171
5%	0.432	0.42	0.408	0.396	0.384	0.373	0.361	0.349	0.337	0.325	0.313	0.301	0.289	0.277	0.265	0.254	0.242	0.23	0.218	0.206	0.194	0.189	0.184	0.18	0.175	0.17
6%	0.428	0.417	0.405	0.393	0.381	0.37	0.358	0.346	0.334	0.322	0.311	0.299	0.287	0.275	0.263	0.252	0.24	0.228	0.216	0.205	0.193	0.188	0.183	0.179	0.174	0.169
7%	0.425	0.413	0.401	0.39	0.378	0.367	0.355	0.343	0.332	0.32	0.308	0.297	0.285	0.273	0.262	0.25	0.238	0.227	0.215	0.203	0.192	0.187	0.181	0.177	0.173	0.168
8%	0.421	0.41	0.398	0.387	0.375	0.364	0.352	0.34	0.329	0.317	0.306	0.294	0.283	0.271	0.26	0.248	0.237	0.225	0.213	0.202	0.19	0.186	0.18	0.176	0.172	0.167
9%	0.418	0.406	0.395	0.383	0.372	0.361	0.349	0.338	0.326	0.315	0.303	0.292	0.281	0.269	0.258	0.246	0.235	0.223	0.212	0.201	0.189	0.185	0.179	0.175	0.171	0.166
10%	0.414	0.403	0.391	0.38	0.369	0.358	0.346	0.335	0.324	0.312	0.301	0.29	0.278	0.267	0.256	0.245	0.233	0.222	0.211	0.199	0.188	0.183	0.178	0.174	0.17	0.165
11%	0.41	0.399	0.388	0.377	0.366	0.355	0.343	0.332	0.321	0.31	0.299	0.287	0.276	0.265	0.254	0.243	0.232	0.22	0.209	0.198	0.187	0.182	0.176	0.173	0.169	0.164
12%	0.407	0.396	0.385	0.374	0.363	0.352	0.34	0.329	0.318	0.307	0.296	0.285	0.274	0.263	0.252	0.241	0.23	0.219	0.208	0.197	0.186	0.181	0.175	0.172	0.168	0.163
13%	0.403	0.392	0.381	0.37	0.359	0.349	0.338	0.327	0.316	0.305	0.294	0.283	0.272	0.261	0.25	0.239	0.228	0.217	0.206	0.195	0.184	0.18	0.174	0.171	0.166	0.162
14%	0.4	0.389	0.378	0.367	0.356	0.346	0.335	0.324	0.313	0.302	0.291	0.281	0.27	0.259	0.248	0.237	0.226	0.216	0.205	0.194	0.183	0.179	0.173	0.17	0.165	0.161
15%	0.396	0.385	0.375	0.364	0.353	0.343	0.332	0.321	0.31	0.3	0.289	0.278	0.268	0.257	0.246	0.236	0.225	0.214	0.203	0.193	0.182	0.178	0.172	0.169	0.164	0.16
16%	0.392	0.382	0.371	0.361	0.35	0.34	0.329	0.318	0.308	0.297	0.287	0.276	0.265	0.255	0.244	0.234	0.223	0.213	0.202	0.191	0.181	0.176	0.17	0.168	0.163	0.159
17%	0.389	0.378	0.368	0.357	0.347	0.337	0.326	0.316	0.305	0.295	0.284	0.274	0.263	0.253	0.242	0.232	0.221	0.211	0.201	0.19	0.18	0.175	0.169	0.167	0.162	0.158
18%	0.385	0.375	0.365	0.354	0.344	0.334	0.323	0.313	0.302	0.292	0.282	0.271	0.261	0.251	0.24	0.23	0.22	0.209	0.199	0.189	0.178	0.174	0.168	0.166	0.161	0.157
19%	0.382	0.371	0.361	0.351	0.341	0.331	0.32	0.31	0.3	0.29	0.279	0.269	0.259	0.249	0.239	0.228	0.218	0.208	0.198	0.187	0.177	0.173	0.167	0.164	0.16	0.156
20%	0.378	0.368	0.358	0.348	0.338	0.328	0.317	0.307	0.297	0.287	0.277	0.267	0.257	0.247	0.237	0.227	0.216	0.206	0.196	0.186	0.176	0.172	0.165	0.163	0.159	0.155
21%	0.374	0.364	0.354	0.344	0.334	0.325	0.315	0.305	0.295	0.285	0.275	0.265	0.255	0.245	0.235	0.225	0.215	0.205	0.195	0.185	0.175	0.171	0.164	0.162	0.158	0.154
22%	0.371	0.361	0.351	0.341	0.331	0.322	0.312	0.302	0.292	0.282	0.272	0.262	0.252	0.243	0.233	0.223	0.213	0.203	0.193	0.183	0.174	0.169	0.163	0.161	0.157	0.153
23%	0.367	0.357	0.348	0.338	0.328	0.319	0.309	0.299	0.289	0.28	0.27	0.26	0.25	0.241	0.231	0.221	0.211	0.202	0.192	0.182	0.172	0.168	0.162	0.16	0.156	0.152
24%	0.364	0.354	0.344	0.335	0.325	0.316	0.306	0.296	0.287	0.277	0.267	0.258	0.248	0.239	0.229	0.219	0.21	0.2	0.19	0.181	0.171	0.167	0.16	0.159	0.155	0.151
25%	0.36	0.351	0.341	0.332	0.322	0.313	0.303	0.294	0.284	0.275	0.265	0.256	0.246	0.237	0.227	0.218	0.208	0.199	0.189	0.18	0.17	0.166	0.162	0.158	0.154	0.15
50%	0.26	0.254	0.247	0.241	0.234	0.228	0.221	0.215	0.208	0.202	0.195					0.163					0.13					0.115
75%	0.17	0.167	0.163	0.16	0.156	0.153	0.149	0.146	0.142	0.139	0.135					0.118					0.1					0.09

Developed from SedCAD Tables
Blue text is from SedCAD Table, Black Text is linear interpolation calculation

Table 41.D-6: Cover Factor Canopy and Surface Cover Interpolation

	Cover that Contacts the Surface																						
Canopy Cover (%)	26%	27%	28%	29%	30%	31%	32%	33%	34%	35%	36%	37%	38%	39%	40%	45%	50%	55%	60%	61%	62%	65%	80%	95%
0%	0.17	0.165	0.16	0.155	0.15	0.145	0.14	0.135	0.13	0.125	0.12	0.115	0.11	0.105	0.1	0.086	0.071	0.057	0.042	0.041	0.039	0.035	0.013	0.003
1%	0.169	0.164	0.159	0.154	0.149	0.144	0.139							0.105	0.1				0.042	0.04	0.039			
2%	0.168	0.163	0.158	0.153	0.148	0.143	0.139							0.104	0.099				0.042	0.04	0.039			
3%	0.167	0.162	0.157	0.152	0.148	0.143	0.138							0.104	0.099				0.042	0.04	0.039			
4%	0.166	0.161	0.156	0.152	0.147	0.142	0.137							0.103	0.098				0.041	0.04	0.038			
5%	0.165	0.16	0.156	0.151	0.146	0.141	0.136							0.103	0.098				0.041	0.04	0.038			
6%	0.164	0.159	0.155	0.15	0.145	0.14	0.136							0.102	0.098				0.041	0.04	0.038			
7%	0.163	0.159	0.154	0.149	0.144	0.14	0.135							0.102	0.097				0.041	0.039	0.038			
8%	0.162	0.158	0.153	0.148	0.144	0.139	0.134							0.101	0.097				0.041	0.039	0.038			
9%	0.161	0.157	0.152	0.147	0.143	0.138	0.134							0.101	0.096				0.041	0.039	0.038			
10%	0.16	0.156	0.151	0.147	0.142	0.137	0.133							0.101	0.096				0.04	0.039	0.038			
11%	0.159	0.155	0.15	0.146	0.141	0.137	0.132							0.1	0.096				0.04	0.039	0.037			
12%	0.158	0.154	0.149	0.145	0.14	0.136	0.131							0.1	0.095				0.04	0.039	0.037			
13%	0.158	0.153	0.149	0.144	0.14	0.135	0.131							0.099	0.095				0.04	0.038	0.037			
14%	0.157	0.152	0.148	0.143	0.139	0.134	0.13							0.099	0.094				0.04	0.038	0.037			
15%	0.156	0.151	0.147	0.142	0.138	0.134	0.129							0.098	0.094				0.04	0.038	0.037			
16%	0.155	0.15	0.146	0.142	0.137	0.133	0.128							0.098	0.094				0.039	0.038	0.037			
17%	0.154	0.149	0.145	0.141	0.136	0.132	0.128							0.098	0.093				0.039	0.038	0.036			
18%	0.153	0.148	0.144	0.14	0.136	0.131	0.127							0.097	0.093				0.039	0.038	0.036			
19%	0.152	0.148	0.143	0.139	0.135	0.131	0.126							0.097	0.092				0.039	0.038	0.036			
20%	0.151	0.147	0.142	0.138	0.134	0.13	0.126							0.096	0.092				0.039	0.037	0.036			
21%	0.15	0.146	0.142	0.137	0.133	0.129	0.125							0.096	0.092				0.039	0.037	0.036			
22%	0.149	0.145	0.141	0.137	0.132	0.128	0.124							0.095	0.091				0.038	0.037	0.036			
23%	0.148	0.144	0.14	0.136	0.132	0.128	0.123							0.095	0.091				0.038	0.037	0.035			
24%	0.147	0.143	0.139	0.135	0.131	0.127	0.123							0.094	0.09				0.038	0.037	0.035			
25%	0.146	0.142	0.138	0.134	0.13	0.126	0.122	0.118	0.114	0.11	0.106	0.102	0.098	0.094	0.09	0.077	0.064	0.051	0.038	0.037	0.035	0.032	0.012	0.003
50%					0.1					0.085					0.07	0.061	0.053	0.044	0.035			0.029	0.012	0.003
75%					0.08					0.07					0.06	0.053	0.046	0.038	0.031			0.026	0.011	0.003

Developed from SedCAD Tables
Blue text is from SedCAD Table, Black Text is linear interpolation calculation