Hydrologic Assessment

Of

Southern Minerals, Incorporated

SMCRA Permit O-79-82
NPDES Permit WV0048437
UIC Permit 0444-02-047

Mining and associated coal slurry disposal

An environmental concern with the fate and transport of coal slurry injectate into abandoned underground Pocahontas No.3 and No.4 coal seams in McDowell County was considered as part of a legislative SCR-15 UIC study. The Southern Minerals, Inc. site was chosen because slurry injection has been ongoing for several decades and has some historical data available. These abandoned coal seams are also used as sources of public water supplies for the small surrounding communities. The study area is one of 13 active permits (at time of selection) allowing coal slurry injection into abandoned underground mines in West Virginia that are controlled by a Class 5 Type X13 injection permit issued by Division of Water and Waste Management Underground Injection Control program. Prior to 1999 the underground injection activities were under the control of State of West Virginia Department of Natural Resources, NPDES (National Pollution Discharge Elimination System) permits. It is common practice for fine coal slurry from coal processing preparation plants to be injected back into the abandoned mine voids. The short and long term effects of this activity on surface and ground water resources are basically unknown with little or no research data available on the migration of the coal slurry or its chemical constituents from injection wells.

Southern Minerals, Inc., Superior Preparation Plant is located along US Route 52 approximately one mile southeast of Welch, WV in McDowell County. The subject area of investigation is included within the Elkhorn Creek Watershed (Fig. 1).

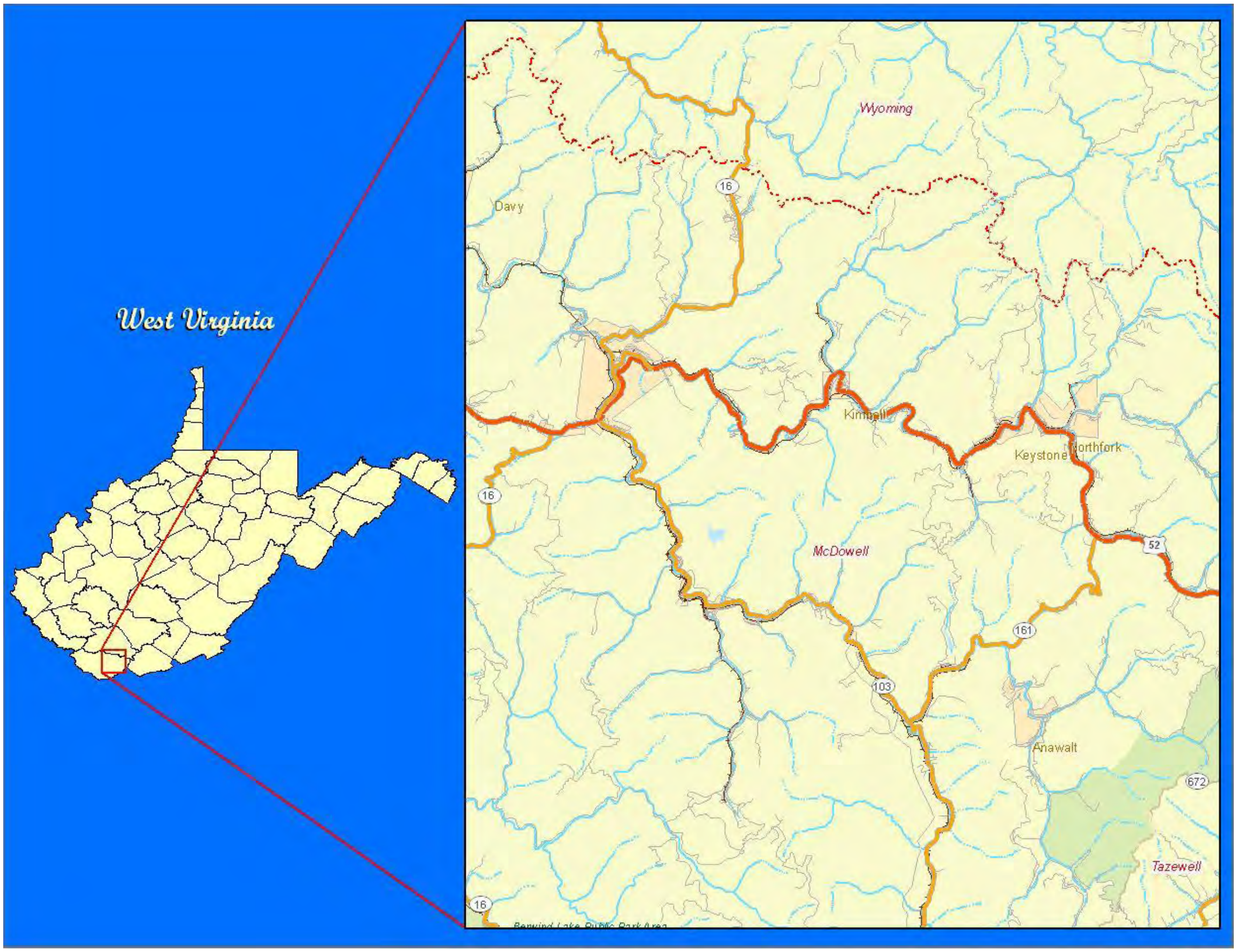

Figure 1 General location map McDowell County.

As previously mentioned underground injection of coal slurry from the Superior Plant into the abandoned Pocahontas No.3 and No.4 coal seam workings of Cannelton Industries, Inc. has been ongoing for decades. The earliest mapping available indicated that slurry injection was practiced in mid 1970's into the Pocahontas No. 3 seam (Fig. 2). Permit application data indicates that injection for Cannelton Industries, Inc., Pocahontas No. 3 mine has been ongoing since at least 1985 and was previously approved under WVDEP Article 3 Permit O001982 and NPDES Permit WV0048437 (Fig. 3). Mine Safety and Health Administration (MSHA) reviewed the permit for any safety issues and approved the permit for slurry disposal on December 20, 1985.

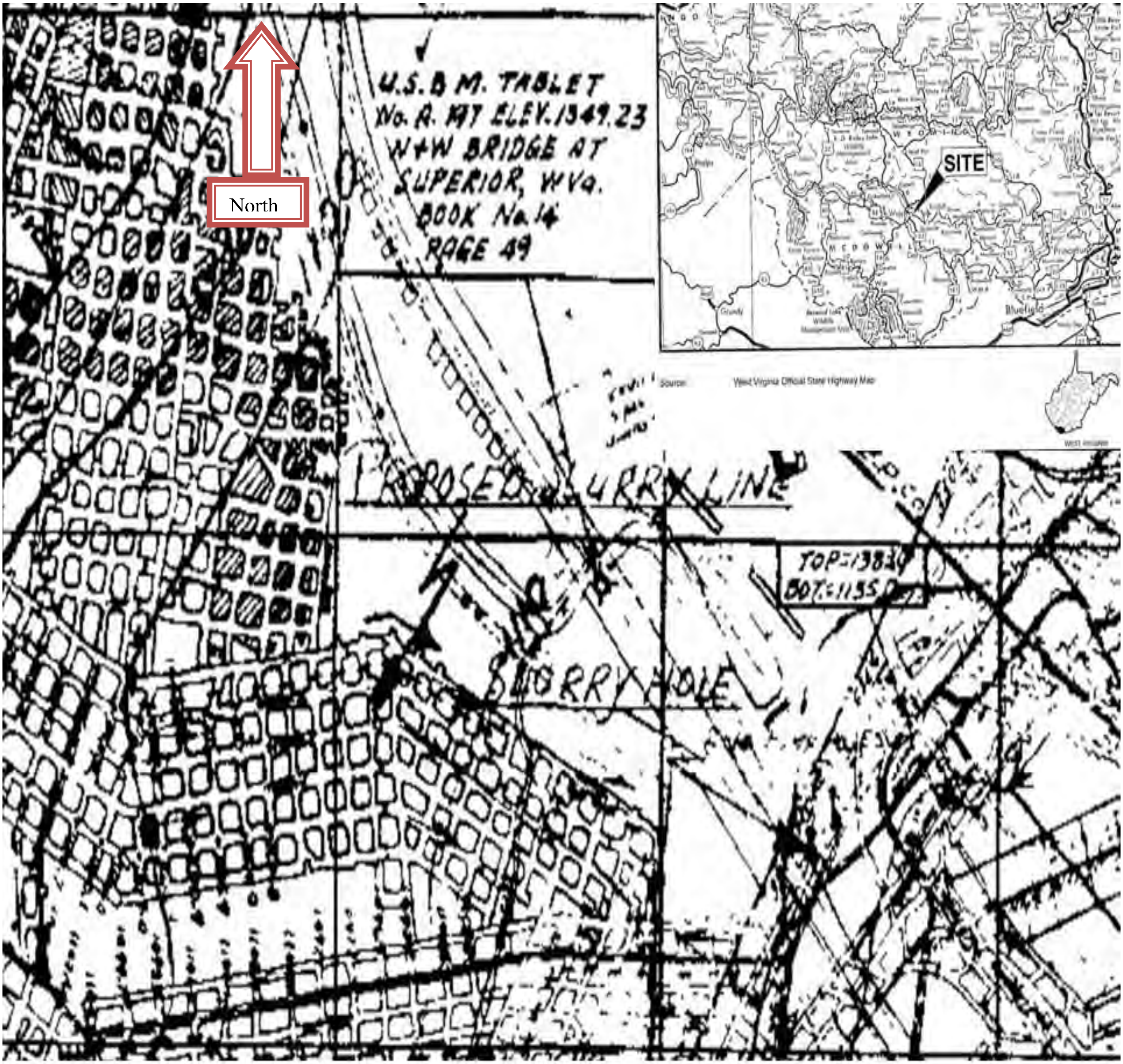

Figure 2 Closure mine map for Cannelton Industries, Inc., Pocahontas Mine No. 3 dated April 16, 1979 and West Virginia Official State Highway Map.

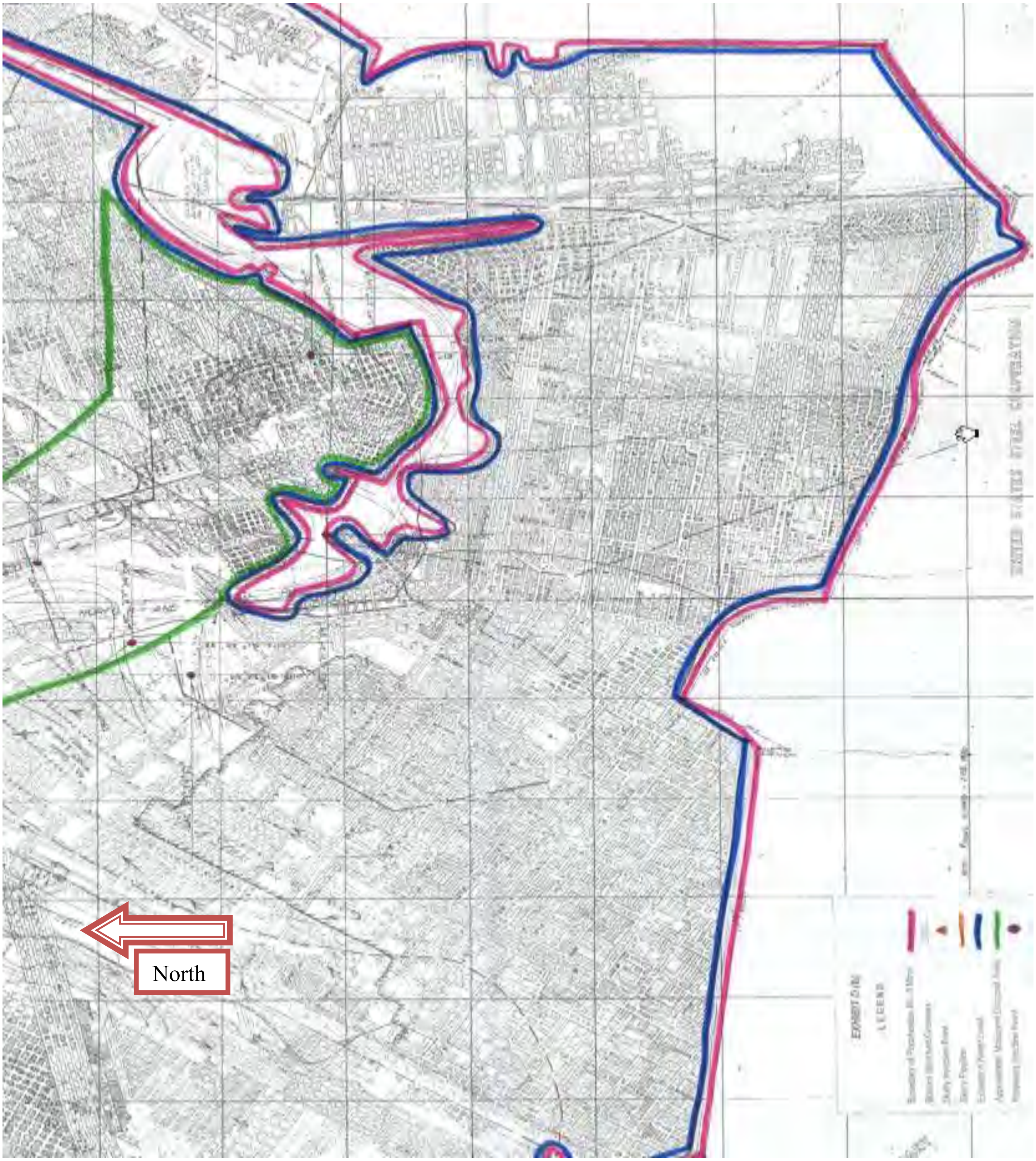

Figure 3 Map of historical injection sites from WVDEP files for NPDES permit WV0048437.

The Article 3 permit O007982 and NPDES permit (WV0048437) associated with Cannelton Industries, Inc. was transferred to Southern Minerals, Inc. in March 2005 and April 2005. Southern Minerals, Inc. was issued an underground injection permit in January 2007 to continue coal slurry injection at five injection sites. According to the company, only site UIC-201 is currently being utilized. Site UIC-202 has been drilled and is adjacent to the active site for future use. No certification of closure was available for the historical sealed injection wells shown in Figure 3 of the NPDES permit renewal map previously referred to in Figure 3.

Phase I of this study involved the compilation and evaluation of existing data, maps and limited amount of field work of a one-time sampling event. Phase I represents a "broad brush" view of the overall area identifying impacted versus unimpacted or vulnerable areas.

Existing data used in this study included an electronic database obtained from West Virginia Department of Environmental Protection, as well as information supplied by West Virginia Geological and Economic Survey (WVGES) and Mine Safety and Health Administration.

HYDROLOGIC BASIN

Groundwater flow in this region is mainly controlled by three factors – the distribution and quantity of recharge infiltration to the flow system, surface topography, and the hydraulic conductivity of the material through which the groundwater flows. These factors may in turn be affected by a host of other elements – soils, climate, lithology, and geologic structure. Mining, both surface and underground, can drastically alter each of these factors. Groundwater recharge rates can be altered depending on how the surface material is handled and how the site is revegetated. Final topography will have an impact on recharge as well. Surface topography can be altered depending on the final reclamation site contours. Hydraulic conductivity of the overburden, which must be removed and replaced at surface mines, is greatly affected. Additionally, mine spoil may be more conductive than parent material by several orders of magnitude (Hawkins, 1995). Hydraulic conductivity also can be dramatically and permanently altered by collapsed and fractured roof rock in underground mining (Kendorski, 1993).

Hydraulic gradient

Groundwater flow is determined by differences in hydraulic head. Groundwater flows from areas with higher hydraulic head to areas with lower hydraulic head. In an unconfined aquifer, the elevation of the water table surface can be used to determine distribution of hydraulic head and indicate the direction of groundwater flow. The flow directions within the local flow system are frequently estimated by assuming they mirror the topography, coupled with spring (discharge area) and, possibly, well (water level) mapping.

In an open flooded mine pool the groundwater flow system is radically different than the aforementioned undisturbed strata. The mine water will flow relatively unimpeded along the pit floor down-dip until a barrier or a flooded section is encountered. Once flooded, the mine water flow system is mostly dominated by the lower hydraulic conductivities of the coal and overlying units. The local flow direction, mine pool elevation, and Pocahontas No. 3 coal seam contours are shown in Figure 4.

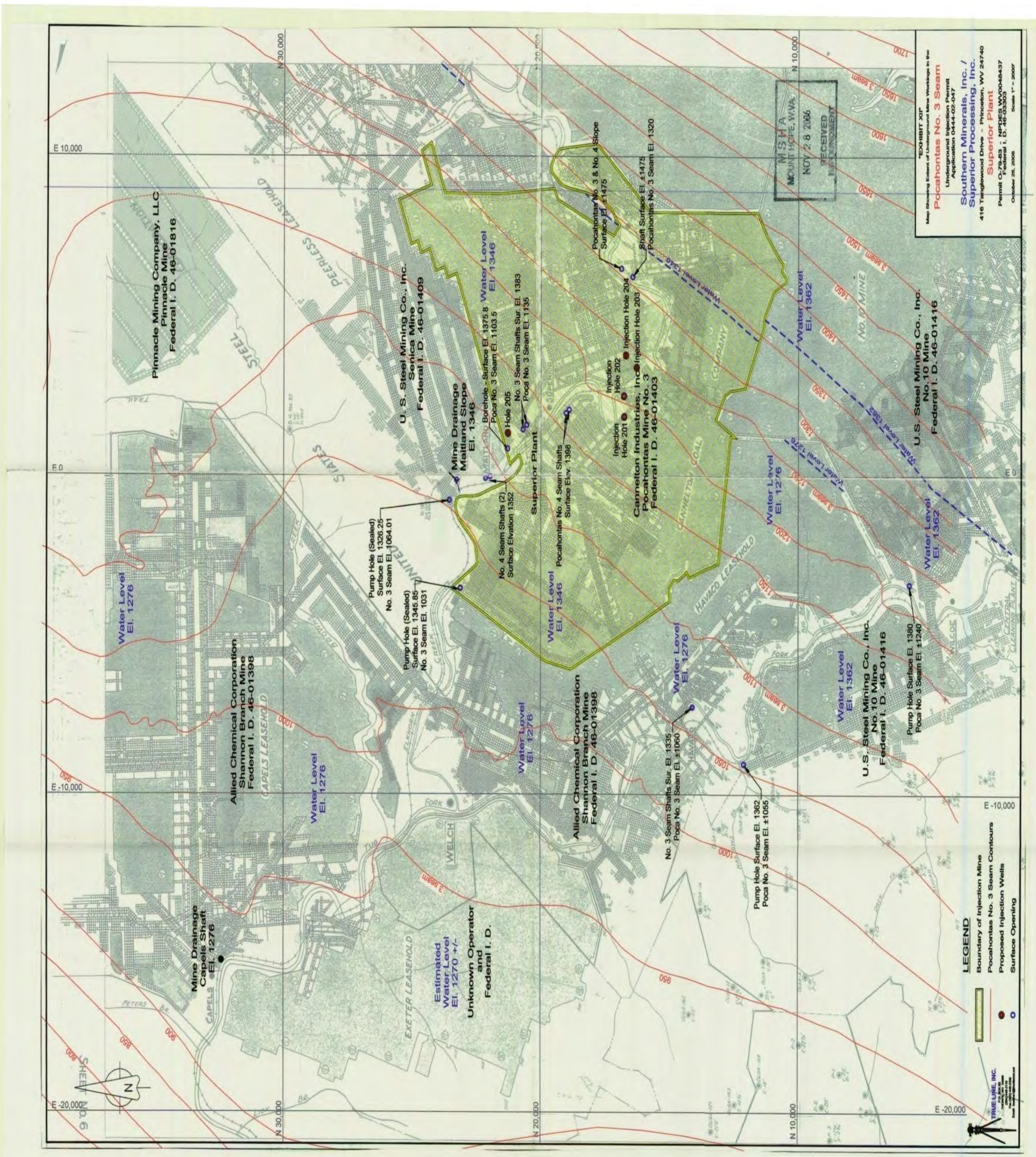

Figure 4 Pocahontas No. 3 Coal seam structure contours and mine pool water levels (Map from MSHA files).

A structural terrace exists on the southeast limb of the northeast trending Mullens Syncline. To the southeast of the injection site the structural slope is 1.8 to the northwest. From the injection site northwest to approximately the Capels discharge area the slope is only 0.4 northwest. Beyond Capels northwest the structural slope is 1.7, nearly the same as approximately five miles to the southeast where a gravity discharge exists of approximately 2500 to 3000 gallons per minute (gpm).

The structural slope in the injection area is 1.8 northwest, the same as the dip of the strata. To the southeast the water fills the Pocahontas No. 3 seam, but not the Pocahontas No. 4 seam; it is likely under watertable conditions. In the area of proposed injection well UIC-205 the water level is 1346 feet above mean sea level (a.m.s.l.) about 30 feet below surface and approximately 200 feet above Pocahontas No. 4 seam (Fig. 4). At that point the water is under an artesian condition where both seams are completely filled with water. Along Elkhorn Creek below Maitland there is an artesian spring, sample site SM-6 where the mine pool potentiometric surface is above ground level. Fracturing of the rock due to nearby room and pillar mining has apparently created fractures (or accentuated existing fractures) to the surface allowing the water to artesian under sufficient hydraulic head. The flow can be seen upwelling through the surface fractures. In the western part of the structural terrace the hydraulic head is approximately 250 feet at the Capels discharge (Fig.4) where the flow averages 2,500 to 3,000 gpm which is also artesian flow. In the area of the Welch PSD the water level is approximately 1270 feet, about 6 feet lower than it is across Elkhorn Creek to the northeast. A designed barrier exists in the old Exeter Mine that may be restricting flow to this area and furthermore, extraction of water by the Welch PSD will tend to lower the water level.

Hydraulic Conductivity

Aquifers may be characterized by their hydraulic conductivity (permeability), described in general terms as either primary or secondary. Primary permeability refers to the intergranular spaces of the transmitting medium. It may be dominant in unconsolidated sediments, but is less important in consolidated bedrock of the Appalachian Plateau. Abandoned underground coal mine voids also serve as large open secondary permeability pathways. The flow is different from intergranular and fracture flow.

Underground mines, because of the scale of the operations, may impact the hydrology of a given locale much more greatly than a surface mine. Underground mines have the potential to impact surface and groundwater systems on a relatively large scale. Interbasin transfer of groundwater is a common event associated with underground mines. During mining the underground extracted voids acts as a large sink which draws in groundwater. Upon abandonment and inundation, it becomes a highly permeable aquifer which can permanently alter the premining flow regime both physically and chemically. Due to the open nature of the mine-void aquifers, there is postmining transfer of the resulting mine-pool potential throughout the interconnected mine workings. This is an important factor regarding the potential for mine pool breakout since areas within and adjacent to the downdip portions of the mine workings can often realize abnormally high postmining heads compared to premining values (Fig. 5).

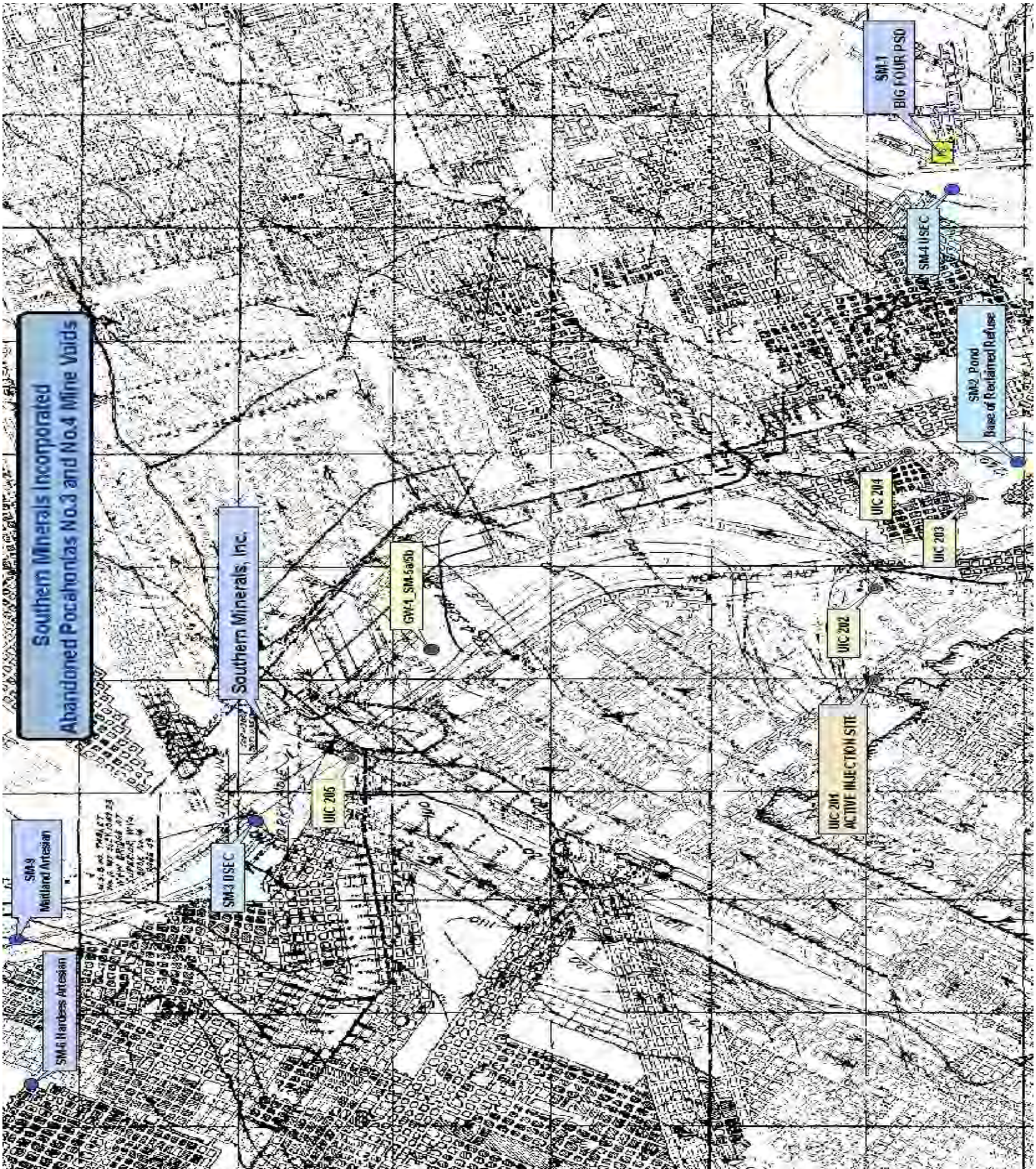

Figure 5 Abandoned mine voids of Poca No. 3 and Poca No. 4 seams that received slurry injection (WVGES).

The primary aquifers in this area are Lower Pennsylvanian aquifers, which include the Pottsville Group (National Water Summary, 1984). Wells are commonly 50 to 300 feet deep and typically produce one to 100 gallons per minute of water (National Water Summary, 1984).

The Pocahontas Formation is the main source of groundwater for public consumption in McDowell County. Fractured sandstone is the principal aquifer but shale and coal also yield water to some wells. The gently dipping coal seams in underground mines create a conduit for groundwater movement beneath ridges and allow it to be dip-controlled rather than topography-controlled. Groundwater flow within the mine voids no longer follows the original drainage divides, and interbasin flow is likely to occur. The extraction of pillars, which has occurred in portions of the study area, creates subsidence fractures in overlying strata that increases the vertical flow of water from overlying strata down to the mine voids. The mine then acts effectively as a catchment basin for infiltrating water, and channels the water to the downdip portions of the mine and can serve as significant mine pool aquifers for public water supply (National Water Summary, 1984).

Well yields are influenced by well depth, location, and the lithology of the rocks. On average, deeper wells have greater yields; however fractures are generally fewer in number and smaller at greater depths (Price and others, 1962). Wells in the valleys of perennial streams may yield as much as 300 gpm from wells extended into sandstone of the Pocahontas Formation. Yields from depths greater than 300 feet are probably from intergranular pore space where sandstone particles are poorly cemented (Price and others, 1962).

Lessing and Hobba's (1981) "Abandoned Coal Mines in West Virginia as Sources of Water Supplies", shows that historically many municipalities in the county have drawn their water supplies from abandoned coal mines.

Structurally, the injection sites lie within one half mile of the Mullens Syncline which runs the entire length of McDowell County. According to Hennen (1915) in the County Geologic Report of Wyoming and McDowell Counties, this syncline is a non-symmetrical, low, downward fold, with the dip of the rocks on the east slope being much more steep and extended than on the western slope. This structural feature will largely determine hydrologic migration in and around the injection sites.

The average depth to groundwater in the Pottsville Group in this region is 29 feet below the surface. Fractures, including faults and joints, occur numerously in the watershed and are responsible for most of the movement of groundwater in the basin. Fractures are more extensive near the axes of anticlines because of the tensile stresses created during folding, leading to highly fractured, water-bearing sandstones in the region that will easily transmit any pollutant into the groundwater system (Bader, 1984).

Hydrochemical data

Due to the differences in rock mineralogy, residence time, and influence of the brine underlying the composite flow system, the chemistry of ground water in different flow systems and subsystems varies somewhat.

Poth (1963) and Rose and Dresel (1990) identify three stages of "flushing that generally correspond with the three levels of the flow systems. The deepest zone, directly affected by concentrated brines which exist at depth throughout all areas west of the Allegheny Front, is a NaCl-rich diluted zone. This zone is diluted with surface water that has leaked from shallower flow systems, but retains appreciable amounts of both Na and Cl. This chemical signature is indicative of the more regional flow system.

A shallower system (intermediate zone) exists in which Cl has been removed by flushing with surface waters, but considerable Na remains adsorbed to clays and similar materials, leading to the $Na\text{-}HCO_3$ (sodium-bicarbonate) waters that are commonly found at intermediate depths. The elevated Na is a result of cation exchange, with Na released from the exchange sites in response to replacement of Ca and Mg.

In the upper-most zone Na is mostly flushed out leaving $Ca\text{-}HCO_3$ (calcium-bicarbonate) water typical of shallow groundwater. The shallow flow system is further divided (Brady et al., 1996) into a low dissolved-solids zone associated with the stress-relief/weathered regolith subsystem, and a zone with higher dissolved solids associated with unweathered rock.

The project area is influenced by all three levels of the flow system, the deeper zone that includes the coal seams, the shallower system (intermediate zone) which receives influence and mixes with infiltrated surface water through primary and secondary fracturing, and the upper zone that receives direct infiltration from surface runoff.

Description of Study Area

The study area lies completely within the 73.23 square miles of Elkhorn Creek Watershed in McDowell County in Brown Creek District. The watershed receives an average of 48.49" of annual precipitation (WVDEP). Elkhorn Creek drains to the northwest and discharges into Tug Fork River. The watershed is mostly forested, and has been extensively mined on the surface and underground. Remnant mining features, including reclaimed surface mines, gravity discharges from old mine portals and subsidence fractures are scattered throughout the watershed and convey a portion of surface runoff nearly directly into underground mine workings (Fig. 6).

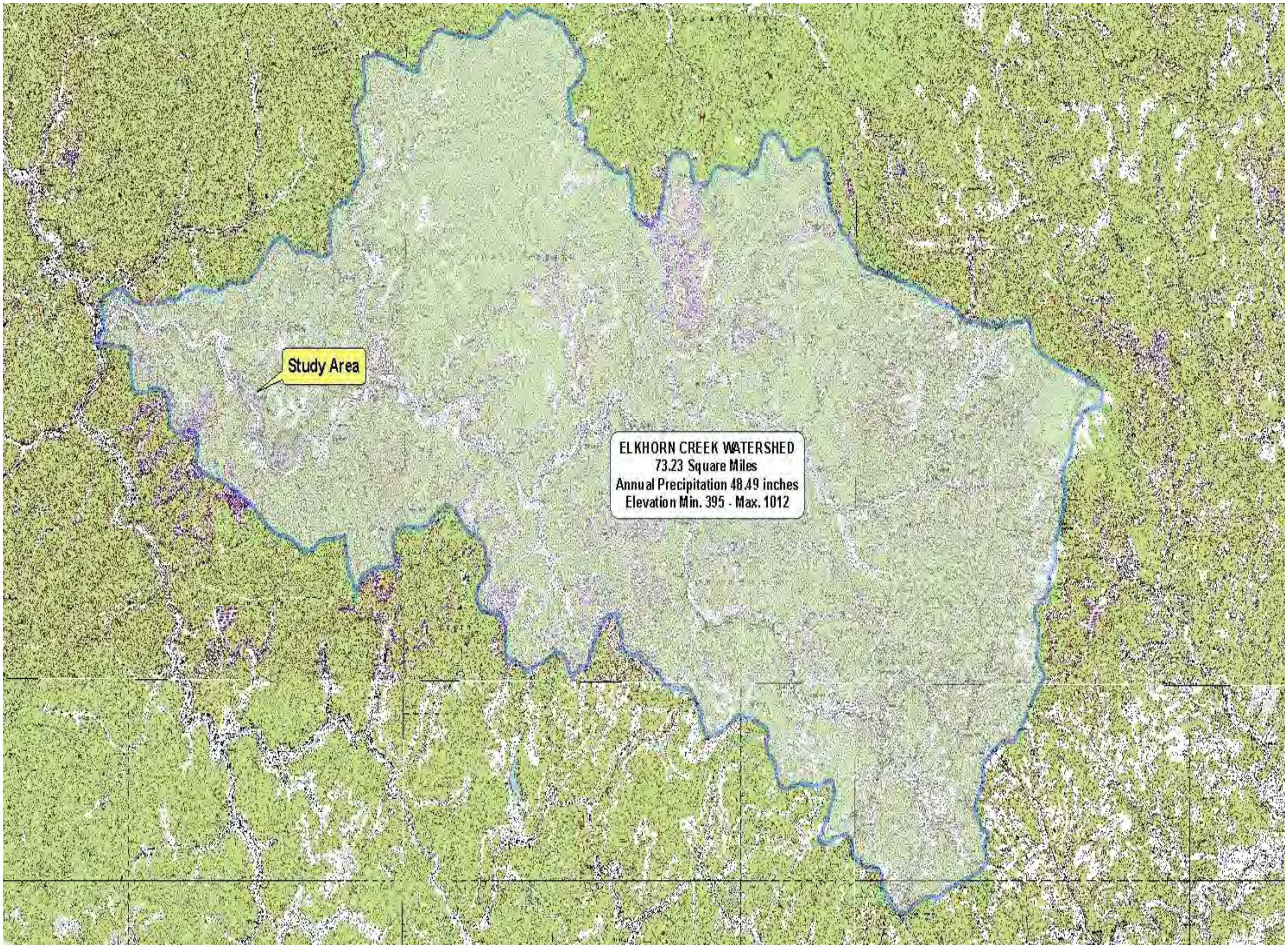

Figure 6 Elkhorn Creek Watershed (From WVDEP GIS data base)

Underground mining has resulted in a vast series of voids in the Pocahontas No. 3 and No. 4 coal beds that are interconnected at many places but are isolated at others. This series of voids and associated tunnels, drifts, and shafts are collectively referred to as mine workings. During active mining, water was pumped from the mine workings to keep the mine dry. These efforts allowed coal extraction to proceed well below the local groundwater table. When the mines were abandoned and pumping ceased the workings flooded with water creating the vast Pocahontas No. 3 and No. 4 mine pools. The workings may be completely flooded in places or may be intermittently flooded in others. Barrier pillars were left in the mines to minimize inter-mine water movement, but when mining efforts were abandoned, the pillars commonly were breached by further extraction of any remaining coal. The present condition of these pillars is unknown, and therefore, the degree of inter-connection between the Pocahontas No. 3 and No. 4 and the adjoining mines is uncertain.

The mine pools receives water from two known sources: (1) direct connection with the surface through the original mine openings and fractures in overlying strata, and (2) groundwater infiltration from adjacent strata. Fractures in strata overlying the mine workings increase infiltration of runoff across the entire area and are of particular concern if an overlying streambed is intercepted. The general mine pool flow is shown in Figure 7.

The elevation of the Pocahontas No. 3 seam ranges from 1100 feet to just over 1300 feet a.m.s.l. and dips to the northwest at approximately 1.8. Near the southeast corner of the permit area Elkhorn Creek is approximately 140 feet above the mine void. The depth of cover increases to approximately 240 feet in the northwestern portion of the site.

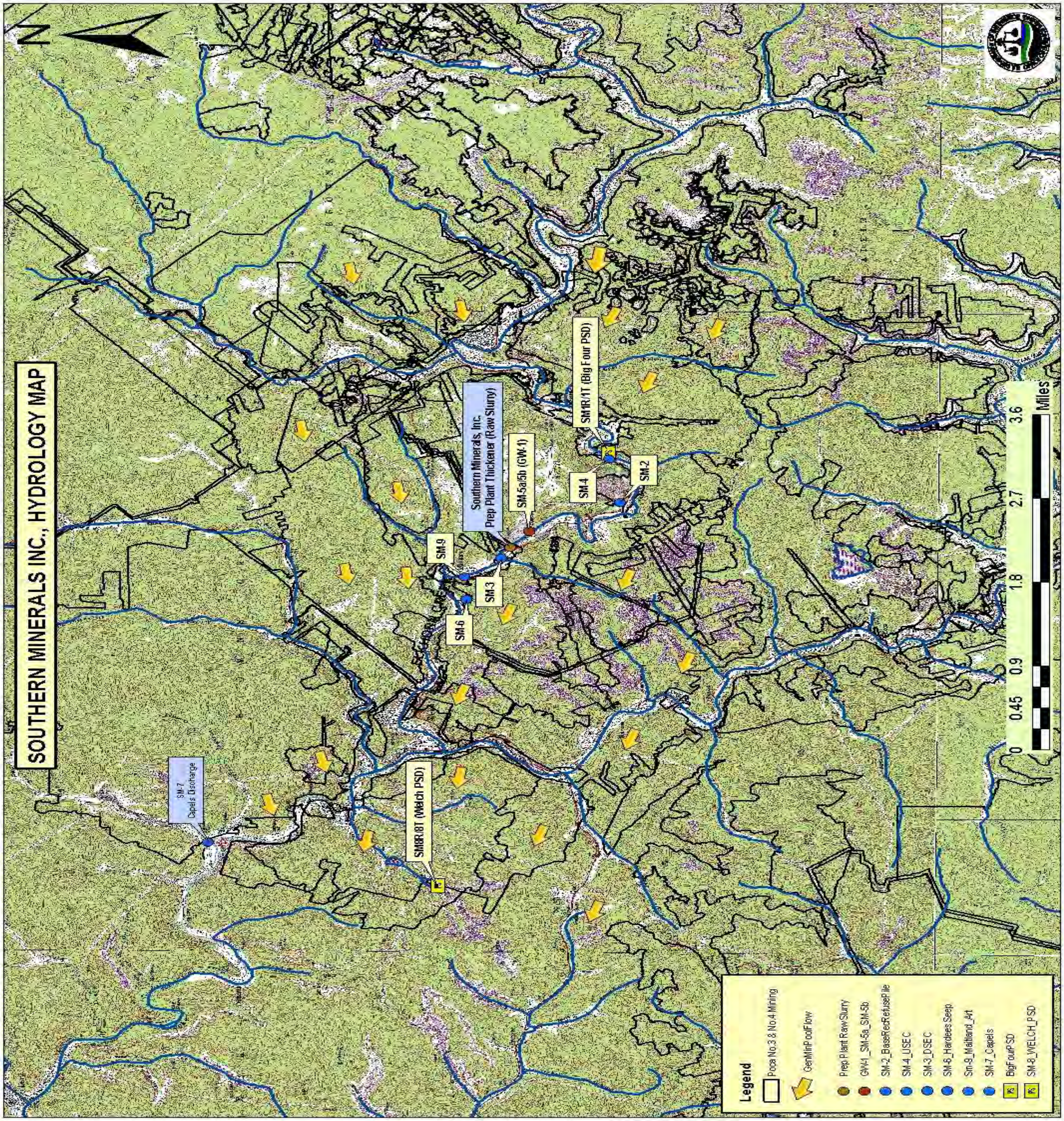

Figure 7 General mine pool flow.

Slurry Disposal History

Historic injection was previously approved under West Virginia Department of Environmental Protection Article 3 permit O001982 and NPDES permit WV0048437. In modification No. 1 Letter of Addendum Cannelton planned to dispose of slurry underground into the abandoned Pocahontas Mine No. 3 and No. 4 seams. According to the permit, the pumping rate was not to exceed 300 gallons per minute. The proposed historical plan was for a fifteen year period and projected an accumulated total of 5,775,400 cu. ft or 1,988.7 ac-ft of solids. This was based on average five foot coal seam height and an estimated 70% coal removal (WVDEP Permit O001982 Modification, No. 1, November 1985).

In compliance with provisions of the West Virginia Code, Chapter 22, Article 11 (Water Pollution Control Act) Section 8, Chapter 22, Article 12 (Groundwater Protection Act), and Legislative Rules, Title 47, Series 13 (Underground Injection Control) Sections 12 and 13, Southern Minerals, Inc was authorized by the area permit to inject Slurry through five Class 5, Type X13 injection wells into the subsurface located in McDowell County (Fig. 8).

Total project capacity storage was 434 acre feet with a projected slurry mass of 8.4 million tons and a pump capacity of 800 gallons per minute (WVDEP SMA Permit Number O007983).

The West Virginia Department of Environmental Protection, Division of Water and Waste Management, approved the use of the following substances in the process that produces the injectate: Nalco DVS4U018 and Nalco 8836 PLUS. These were approved in addition to the Nalco O1DU113 – Collector, Nalco DVS4U18 – Collector, Nalco Nalflote 9747 – Reagent, and Nalco Optimer 8873 – Flocculent (See Appendix II).

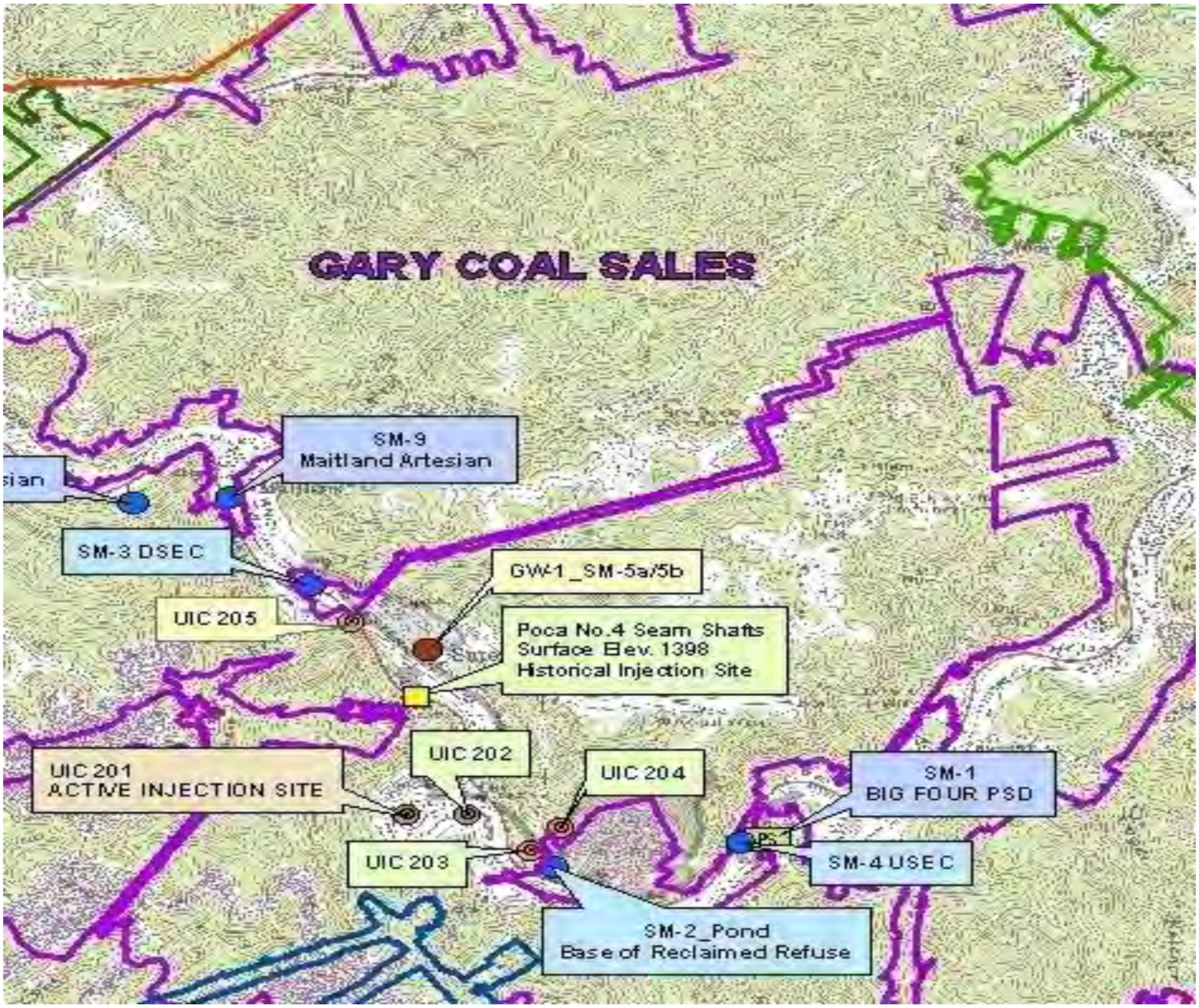

Figure 8 Location of approved injection sites UIC 201-205.

As previously mentioned underground injection of fine coal slurry from the Superior Plant into the abandoned Pocahontas No.3 and No.4 seam workings of Cannelton Industries, Inc. has been ongoing for decades. Numerous violations have been issued spanning those decades prior to the acquisition of the Superior Plant by Southern Minerals, Incorporated. These violations were actions taken for breaches of the terms and conditions of the WVNPDES Permit WV0048437.

Earlier violations included where the slurry injection point spilled into Elkhorn Creek in January 1988; the plant thickener overflowed into stream in November 1992; a slurry spill in July

1993; a black water spill in September 1993; the company failed to keep reclamation current in June 1996; and failure to maintain ponds in July 2000.

A continued review of compliance history for Cannelton Industries, Inc. from WVDEP permit files from September 2003 to March 2005 revealed the following violations:

MONTH	**VIOLATION DETAIL**
September 2003	Refuse compaction
May 2004	Fugitive dust control
February 2005	Method of operation in that slurry disposal system failed creating a black water discharge into Elkhorn Creek. A cease operation order was issued to cease all pumping into slurry disposal system. Remedial measures included repairing slurry line system and clean up all spillage. Notice was terminated the next day.
March 2005	Effluent limits exceeded

No violations were found or were available that indicated a blowout from any coal outcrops or from old disposal well injection sites.

Surface and Ground Water Sampling Sites

The site assessment included 10 sampling sites within the study area. SM-4 is located upstream of the injection sites in Elkhorn Creek. SM-3 is located downstream of the injection sites in Elkhorn Creek. SM-2 sampling site is a remnant pond located at the base of a reclaimed refuse and slurry pile along US Route 52. SM-6 is an artesian spring also located along US Route 52. SM-9 is an artesian discharge along Elkhorn Creek at Maitland. SM-7 is a large downdip artesian discharge from the abandoned adjacent Capels Mine. SM-1 is the raw and treated water from the Big Four Public Service District (PSD) and SM-8 is raw and treated water from the Welch PSD. SM-5a/b is at a different water level and a down-dip monitoring well that has recently been used as a slurry injection site. Lastly, the preparation plant thickener raw slurry was sampled and identified at SM-Slurry (Figs. 9 and 9a).

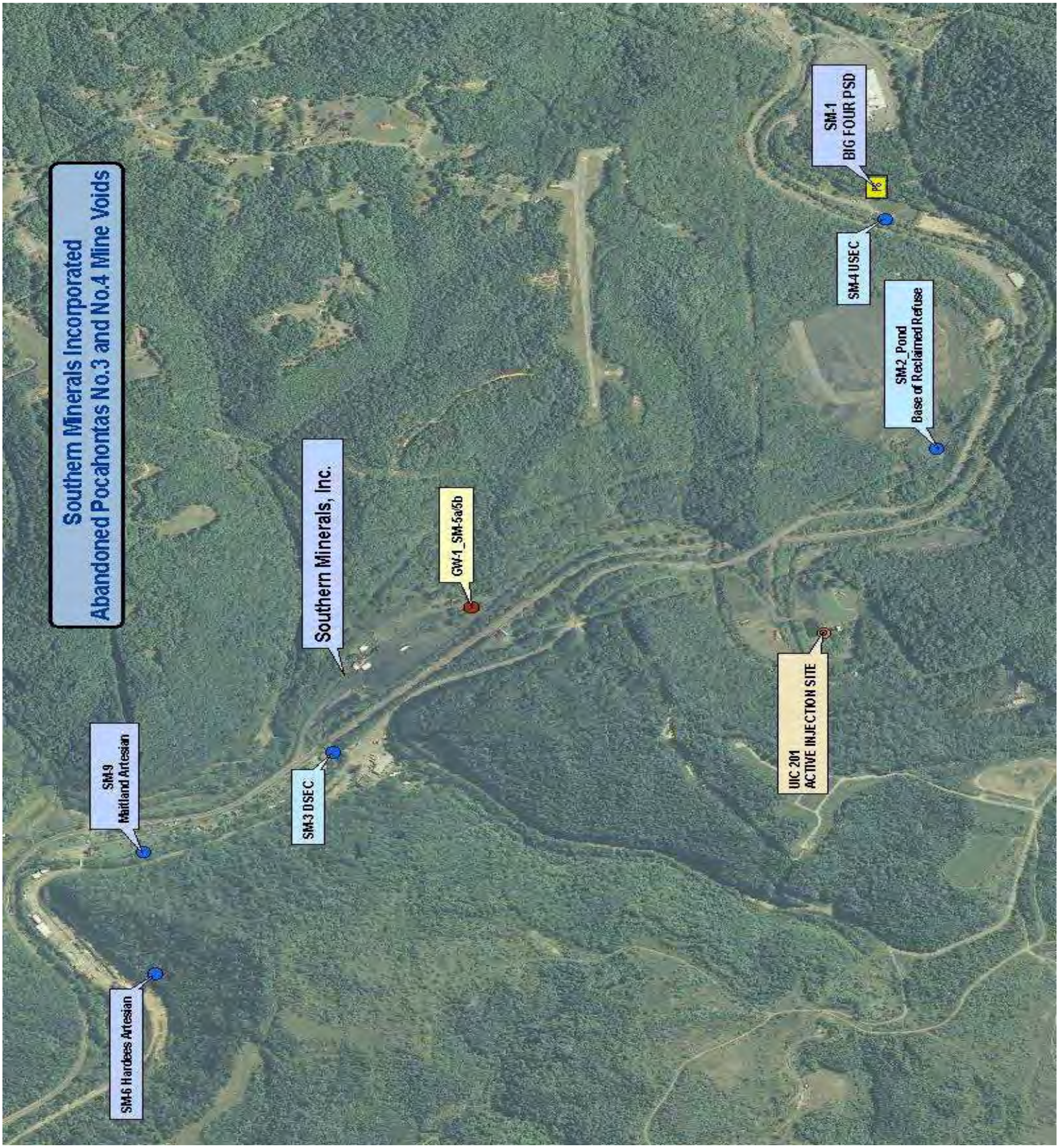

Figure 9 Location of sampling sites.

Figure 9a Location of sampling sites.

Rockware Aq.QA® computer software application was used to assess and graph the water chemistry and characterization of the individual samples. Piper diagrams were created plotting the major cations and anions as percentages of milli-equivalents in two base triangles. The data in these triangles is projected to an integral diamond graph which can reveal useful properties and relationships for large sample groups. Piper diagrams show clustering of data points which indicate samples that have similar compositions. Stiff diagrams were created for individual samples as a method of graphically comparing the relative concentration of selected anions and cations for several individual samples. Shapes formed by the Stiff diagram identify samples that have similar or dissimilar compositions.

All sites have been assessed in detail for general chemistry, metals, organic, and inorganic analytes. The major dissolved cations and anions in the surface and groundwater samples have been analyzed and their relative abundances used to define a "water-type" used to describe the source. The samples range in composition, from acidic to alkaline, typically with elevated concentrations of sulfate (SO_4), iron (Fe), manganese (Mn) and aluminum (Al) as well as common elements such as calcium, sodium, potassium and magnesium. The pH is most commonly in the range of 6 to 7 standard units (SU), with few or extreme values.

The geochemistry of the mine drainage is significantly diluted by ground water and by mixing with surface waters. Drainage waters can become more alkaline as they react with various minerals; mix with other waters especially those rich in HCO_3. Sodium is the dominate cation and bicarbonate is the dominate anion at more than approximately 70 percent of the locations. The most frequent water types found within the study area are Na-HCO_3 (nine locations), followed by Ca-SO_4 and Ca-HCO_3 at two locations each. Principal component and cluster analysis of major ion data offered little in explaining which ions were most influential in explaining water type variances. No discernible organic or inorganic tracer associated to coal slurry constituents was determined from the study sampling data.

A complete list of all laboratory sampled analytes for metals, volatile organic compounds and semi-volatile organic compounds are reported in Appendix II for the following discussion of referenced sample sites.

Surface Water Chemistry

Two instream samples were taken in Elkhorn Creek. One was taken above the injection sites and identified as SM-4. Elkhorn Creek is the immediate receiving stream of any discharges from the Superior Preparation Plant. The second instream sample was taken downstream of the prep plant and identified as SM-3 for the study. Historical instream data included one sampling site 50 feet upstream at the confluence of Pond 11 identified as USEC01 and 50 feet downstream at the confluence of Pond No.4 identified as DSEC02. The analysis for these two sample sites had limited data that was collected for NPDES requirements and did not include organic or inorganic sampling for any comparison.

Sample Site SM-4

The major ions indicate the water type for sample site SM-4 to be Ca-Na-HCO_3 and with a pH of 8.0 SU and alkalinity 204 mg/L. (Figs. 10 and 11). The water chemistry data indicates that SM-4 water could have evolved through a strong reaction of mixing surface waters (fresh water) with deeper circulation of groundwater with a high concentration of deep CO_2-rich water. Such water type could result from a reaction with host rocks (overburden) that contain high clay contents. Analytical results from the lab analysis indicated no detection of semi-volatile organic compounds (SVOCs) or volatile organic compounds (VOCs). However, there was an insignificant trace of SVOCs range organics “Total Petroleum Hydrocarbons” (TPH) was detected.

The list of dissolved metal analytes determined for sample site SM-4 are shown in Table 1. Most of the analytes detected below quantitation limits. When the concentration of an analyte falls below the reporting limit but above the detection limit, it is usually reported as an estimate and qualified with a J on the lab sheet. The analyte was positively identified and the reported result is an estimate. The stream at this site has a bicarbonate-CO_2 buffering capacity. The total dissolved solids (TDS) of the stream at this location were at a relatively low concentration (331 mg/L) which is indicative of mixing with surface water.

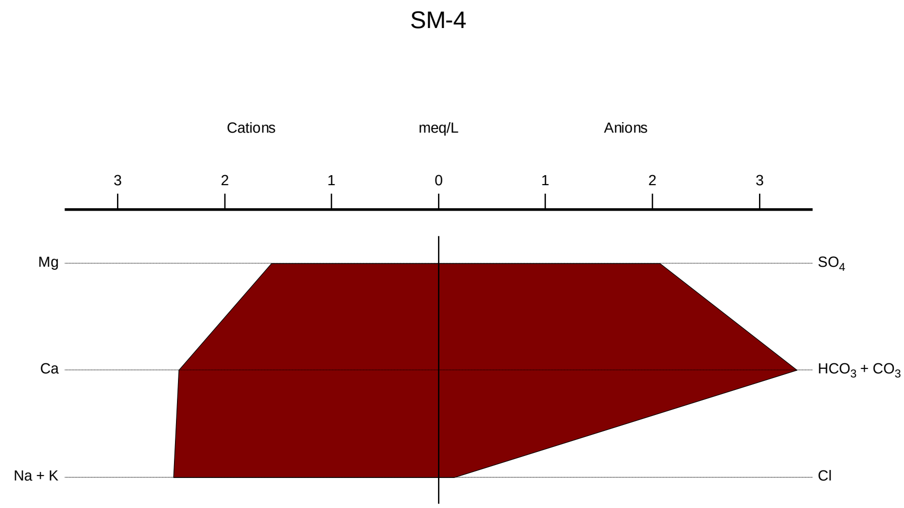

Figure 10 Stiff Diagram SM-4 upstream Elkhorn Creek.

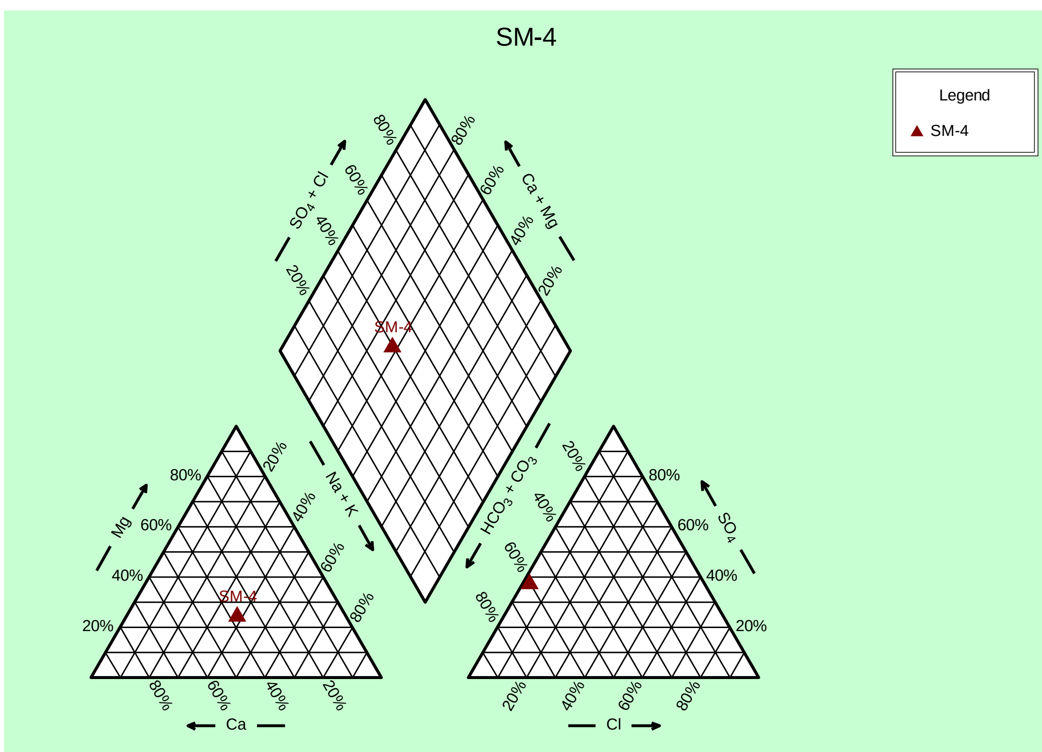

Figure 11 Piper diagram SM-4 upstream Elkhorn Creek.

TABLE 1: Dissolved metals sample site SM-4.

DISSOLVED METALS BY ICP	Result	Units
Aluminum	0.182	mg/L
Calcium	48.8	mg/L
Iron	0.065	mg/L
Magnesium	19.0	mg/L
Potassium	3.24	mg/L
Silicon	3.30	mg/L
Sodium	55.2	mg/L
Zinc	0.016	mg/L

DISSOLVED METALS BY ICP-MS	Result	Units
Antimony	0.0002	mg/L
Arsenic	0.0011	mg/L
Barium	0.0672	mg/L
Beryllium	0.0002	mg/L
Cadmium	ND	mg/L
Chromium	0.0014	mg/L
Cobalt	0.0014	mg/L
Copper	0.0051	mg/L
Lead	0.0014	mg/L
Manganese	0.0171	mg/L
Molybdenum	ND	mg/L
Nickel	0.0042	mg/L
Selenium	0.0020	mg/L
Silver	ND	mg/L
Strontium	1.15	mg/L
Thallium	ND	mg/L
Vanadium	0.0017	mg/L

Sample Site SM-3

The major ions indicate the water type for sample site SM-3 to be Na-HCO_3 and with a pH of 8.14SU and alkalinity of 221 mg/L (Figs. 12 and 13). SM-3 is down-dip of the active slurry injection sites and several remnant reclaimed refuse and abandoned mine sites. The Maitland sample site SM-9 discharges into the stream above reaching the SM-3 sampling location with no change to the Elkhorn Creek instream water chemistry. Water chemistry for this site indicates that these waters could have evolved through mixing surface waters (fresh water) with deeper circulation of groundwater. Such water chemistry type could be from a potential reaction (cation exchange) with host rocks (overburden) that contain high clay contents.

The list of dissolved metal analytes determined for sample site SM-3 are shown in Table 2. Most of the analytes detected below limits. The stream at this site has a bicarbonate-CO_2 buffering capacity. The total dissolved solids (TDS) in the stream were 362 mg/L. Analytical results from the lab analysis indicated no detection of semi-volatile organic compounds or volatile organic compounds as well as, no semi-volatile range organics "Total Petroleum Hydrocarbons".

Bacterial samples were taken for the Southern Mineral, Inc. sites. The samples are reported in Colony-forming units (CFUs) and are a measure of viable bacterial numbers. These results can indicate the existence of bacterial contamination of a water supply. Some types of bacterial contamination are more annoying than harmful. Two of the most common bacterial contaminants are iron and sulfur bacteria. Iron bacteria are generally more common than sulfur bacteria because iron is abundant in ground water. Iron bacteria are oxidizing agents and combine iron or manganese dissolved in ground water with oxygen. Sulfur bacteria have two categories; sulfur oxidizers and sulfur reducers. Sulfur-reducing bacteria are the more common. Sulfur-oxidizing bacteria produce effects similar to those of iron bacteria. They convert sulfide into sulfate. (Colorado Department of Public Health and Environment, http:///www.cdphe.state.co.us/lr)

Table 3 indicates the upstream and downstream sample sites have similar amounts of iron-related and sulfate-reducing bacteria.

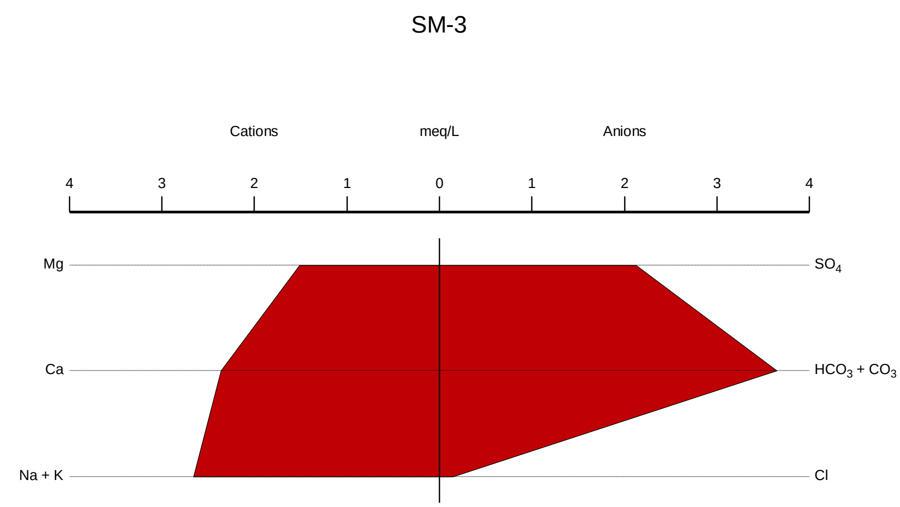

Figure 12 Stiff Diagram SM-3 downstream Elkhorn Creek.

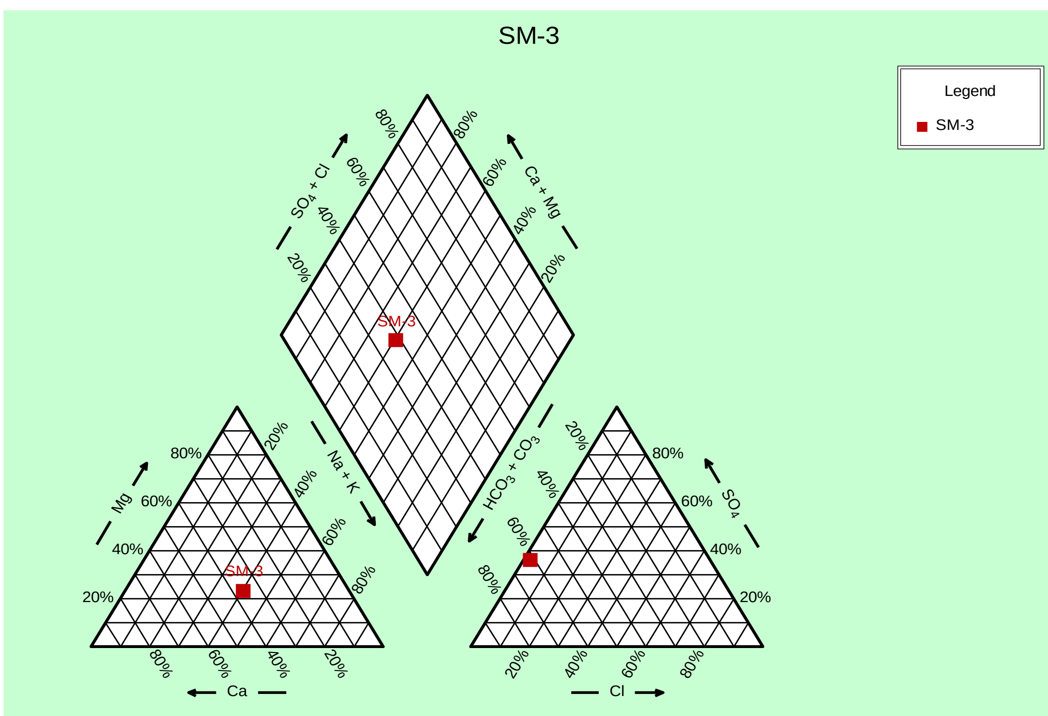

Figure 13 Piper diagram SM-3 downstream Elkhorn Creek.

TABLE 2: Dissolved metals sample site SM-3.

DSSOLVED METALS BY ICP	Result	Units
Aluminum	0.173	mg/L
Calcium	47.3	mg/L
Iron	0.084	mg/L
Magnesium	18.4	mg/L
Potassium	2.97	mg/L
Silicon	3.22	mg/L
Sodium	59.4	mg/L
Zinc	0.007	mg/L

DISSOLVED METALS BY ICP-MS	Result	Units
Antimony	ND	mg/L
Arsenic	ND	mg/L
Barium	0.0638	mg/L
Beryllium	0.0002	mg/L
Cadmium	ND	mg/L
Chromium	0.0014	mg/L
Cobalt	0.0014	mg/L
Copper	0.0023	mg/L
Lead	ND	mg/L
Manganese	0.0263	mg/L
Molybdenum	ND	mg/L
Nickel	0.0031	mg/L
Selenium	0.0020	mg/L
Silver	ND	mg/L
Strontium	1.09	mg/L
Thallium	ND	mg/L
Vanadium	0.0017	mg/L

TABLE 3: Bacterial populations for SM-4 and SM-3.

Bacterial Analyses		***SM-4 (Upstream)***	***SM-3 (Downstream)***
Parameters	*Unit*		
Iron-Related Bacteria	CFU/ml	5,000	5,000
Sulfate-Reducing Bacteria	CFU/ml	10,000	10,000

Sample Site SM-2

The major ions indicate the water type for sample site SM-2 to be Ca-SO_4 (Figs. 14 and 15). SM-2 sampling site is a remnant sediment pond located at the base of a reclaimed refuse pile along US Route 52. The total dissolved solids (TDS) are in the high range of 1,180 mg/L with elevated sulfate of 932 mg/L and low alkalinity of 18.9 mg/L. The pond indicates weathering of sulfide minerals may occur within the slurry and are oxidized after mixing with surface water. Results from the lab analysis indicated no detection of semi-volatile organic compounds or volatile organic compounds as well as, no semi-volatile range organics TPHs. The pond has no discharge and believed to be seeping into the mine void beneath the pond leaving the settleable solids. Table 5 shows the amounts of iron-related and sulfate-reducing bacteria.

The list of dissolved metal analytes determined for sample site SM-2 are shown in Table 4. Most of the analytes detected below limits with the exception of calcium and magnesium.

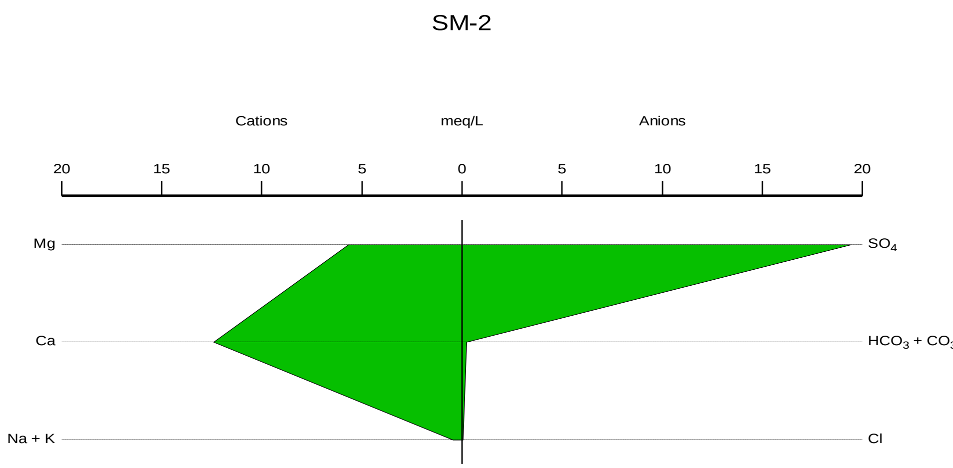

Figure 14 Stiff diagram SM-2 Slurry Impoundment Pond.

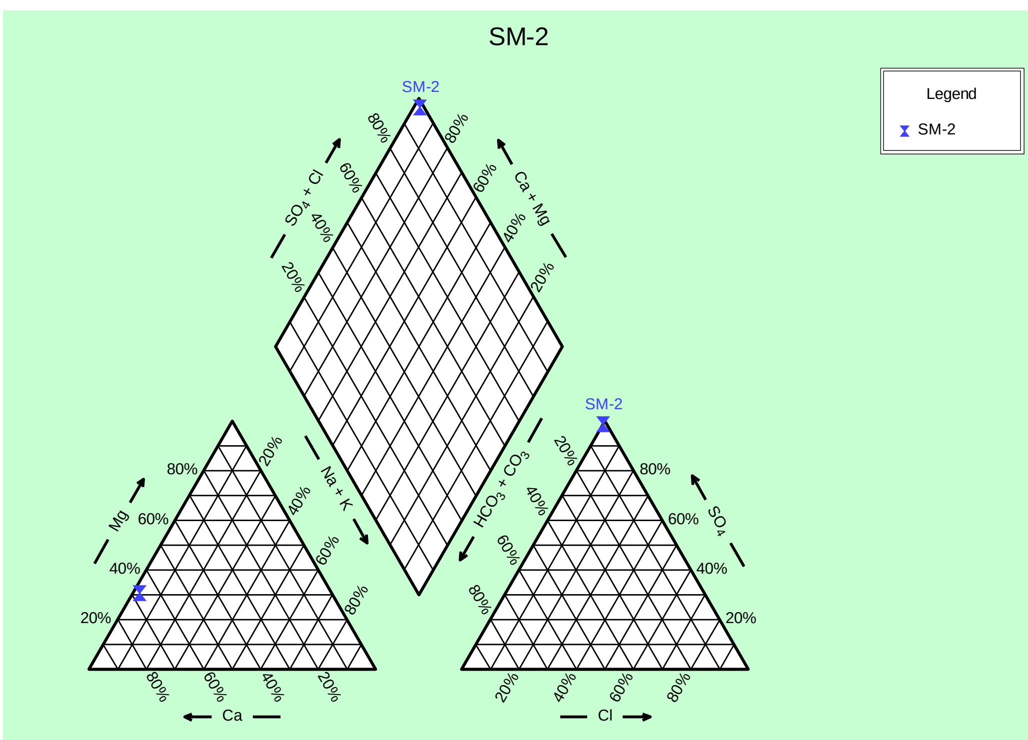

Figure 15 Piper diagram SM-2 Slurry Impoundment Pond.

TABLE 4: Dissolved metals sample site SM-2.

DSSOLVED METALS BY ICP	Result	Units
Aluminum	0.0256	mg/L
Calcium	249.0	mg/L
Iron	ND	mg/L
Magnesium	69.0	mg/L
Potassium	5.03	mg/L
Silicon	0.670	mg/L
Sodium	7.69	mg/L
Zinc	0.116	mg/L

DISSOLVED METALS BY ICP-MS	Result	Units
Antimony	0.0002	mg/L
Arsenic	0.0012	mg/L
Barium	0.0185	mg/L
Beryllium	0.0003	mg/L
Cadmium	0.0007	mg/L
Chromium	0.0013	mg/L
Cobalt	0.0498	mg/L
Copper	0.0022	mg/L
Lead	ND	mg/L
Manganese	0.0974	mg/L
Molybdenum	ND	mg/L
Nickel	0.0135	mg/L
Selenium	0.0069	mg/L
Silver	ND	mg/L
Strontium	0.665	mg/L
Thallium	0.0003	mg/L
Vanadium	0.0016	mg/L

TABLE 5: Bacterial populations for SM-2.

Bacterial Analyses		***SM-2***
Parameters	*Unit*	
Iron-Related Bacteria	CFU/ml	2,550
Sulfate-Reducing Bacteria	CFU/ml	5,500

GROUNDWATER CHEMISTRY

The types and concentrations of minerals present in groundwater depend on the chemistry of the water that recharges the aquifer, the chemical and physical properties of the soil and rock through which the water moves, and the amount of time the water is in the groundwater system. Generally, water becomes more mineralized as it moves through the flow system. Water at depth moves slowly and typically is highly mineralized (Heath, 1983).

Typically, only the first 10 to 30 feet of residential wells in West Virginia are cased. The rest of the well typically is an open borehole that ranges from 10 to several hundred feet in depth and usually is six inches in diameter. Water typically is derived from several water-bearing zones in part because of the lithologic variability of the aquifers. The concentration and chemical properties of the water from each zone can be different; thus, the quality of water pumped from a well depends on which zones are tapped and the proportion of water derived from each zone (Kozar and Brown, 1995).

In much of the State, topography influences the shallow groundwater flowpath. Although recharge does occur at most topographic settings, the flow of groundwater typically is towards valleys; as a result, the youngest groundwater is produced from hilltop wells and the oldest groundwater is produced from valley wells. Variations in this pattern occur, particularly in the steeply folded rocks in the eastern part of the State where the relation of recharge and discharge areas is more complex (Ferrell, 1988).

Because of geochemical changes that occur as groundwater percolates downward into valleys or flows laterally to hillside seeps and springs, the composition of groundwater tends to differ with respect to topography. These differences are governed by the type and solubility of the rocks the water contacts, the length of time it is in contact with a particular type of rock, and the chemical properties of the water itself (Ferrell, 1988).

Concentrations of iron and manganese in rocks of Pennsylvanian age generally are greater in groundwater from valley settings than in groundwater from hilltop settings. Where limestone is common, such as the Upper Pennsylvanian aquifers, hardness is lowest in hilltop settings and greatest in valley settings. The relation between hardness and sodium content primarily is the result of sodium to calcium and magnesium ion exchange, a softening process by which calcium and magnesium ions are exchanged for sodium ions in clays as groundwater percolates through, or flows along, clay-rich layers. Because of differences with respect to topography, the chemical quality of water in the bedrock aquifers cannot be easily mapped on a regional basis. Wells in one topographic setting may yield water of a chemical quality very different from water in nearby wells in another topographic setting (Ferrell, 1988). Overlying strata mineralogy influence and contributions of natural elements to the dissolved inorganic and organic analytes was not considered as part of this SCR-15 UIC study, which could be an additional source of influence in the results.

Groundwater Site GW-1 (SM-5a [deep] and SM-5b [shallow]).

The major ions indicate the water type for sample site GW-1 (SM-5a and SM-5b) to be Na-HCO_3 (Figs. 17 and 18). GW-1 site was previously used as a groundwater monitoring well but for the past several years had also been used as a slurry injection site (Fig. 16). The well is an open borehole and according to the operator has only about twenty-feet of casing. Two zones for the well were sampled. SM-5a which was identified as the deep zone sampled and consisted of the settled solids. SM-5b identified as the shallow zone and represents the “supernatant” or the liquid portion left above the slurry sediment.

Figure 16 GW-1(SM-5a\5b) sampling site.

GW-1 is probably part of a shallower system (intermediate zone) in which Cl has been removed by flushing with surface waters, but considerable Na remains adsorbed to clays and similar materials in the sediment, leading to the Na-HCO_3 waters that are commonly found at intermediate depths, and is evident in the stiff and piper diagrams for GW-1. The elevated Na is a result of cation exchange, with Na released from the exchange sites in response to replacement of Ca and Mg. The Southern Minerals individual site assessment showed that the GW1 monitoring hole was also an injection site, and that the injection (monitoring) hole eventually filled up from the Pocahontas No. 3 seam mine workings to the No. 4 coal seam level. The WVDEP UIC permits have demonstrated that companies apply for permits that allow multiple injection holes because the injection holes tend to fill with the settled solids. This would indicate in general, that the slurry solids do not transport far distances in the abandoned mine, and would depend, in part, on the site-specific hydraulics within the mine. Once the slurry has been injected and is deposited at the bottom of the injection hole, its mobility is dependent upon geochemical and/or hydraulic conditions within each mine. The active injection site UIC-201 was sealed (Fig. 27) and was not available to obtain an additional sample to verify the same findings. Several historical sites have also been sealed due to lack of capacity for additional slurry injection. However, hard data are not available at this time to confirm or dispel this theory.

A field assessment of the well was done by the OSM Pittsburgh hydrologist, Nancy Pointon. An initial shallow water SM-5 sample using clean sampling methods (nylon rope and Teflon bailer with little disturbance to water column) was taken. A 2 inch pump was inserted to a depth of 165 feet to begin purging the well. The volume of one borehole was calculated as 91 gallons. Approximately 60 gallons of water was purged from the well prior to sampling. The bailer was placed at a depth of 165 feet. Sample was gray tinted with hydrogen sulfide smell. The initial depth to water level measurement was at 34.58 feet below grade. SM-5b (shallow) sample was clear to gray tinted water, with no evidence of grease, oil, slime or bacteria. Measured field pH was 9.25 (SU), with specific conductance of 282uS, temperature 18.4C and DO of 2.17 mg/L.

Using the water level measurement tape for sample SM-5a (deep), the depth of the well was measured at 170 feet from the surface. The surface elevation at this point is 1,383 feet a.m.s.l. with the Pocahontas No. 3 coal seam at an elevation of 1,135 feet with a difference of 248 feet of overburden. The well depth was measured to 170 feet which indicates 78 feet of solids within the well. A borehole camera was then used to record the condition of well casing and confirm depth of the well. The camera confirmed total depth between 168 feet to 170 feet. Well casing was intact with no evidence of leakage or cracks. The bottom material found in the well was fine grained black/gray material (slurry). Measured field pH was 9.14, with specific conductance of 327umS, and temperature 20.9C.

The lab results indicate low specific conductance of 228Umhos/cm for sample SM-5b (shallow) and 269Umhos/cm for sample SM-5a (deep) which is comparable to the measured field values. Sulfates are low for both samples with SM-5b having 10.2 mg/L and SM-5a with 11.0 mg/L. Analytical results from the lab analysis indicated no detection of SVOCs or VOCs for SM-5b and results for SM-5a indicated detection of two analytes for SVOCs and no detection of VOC compounds. TPH (Diesel Range) of 0.71 mg/L and TPH (Oil Range) of 1.81 mg/L was detected in 5a with the results showing below EPA Primary Drinking Water standards. GW-1 (5b-shallow) detected TPH (Diesel Range) of 0.15 mg/L and TPH (Oil Range) of 0.37 mg/L which are also below these recommended standards.

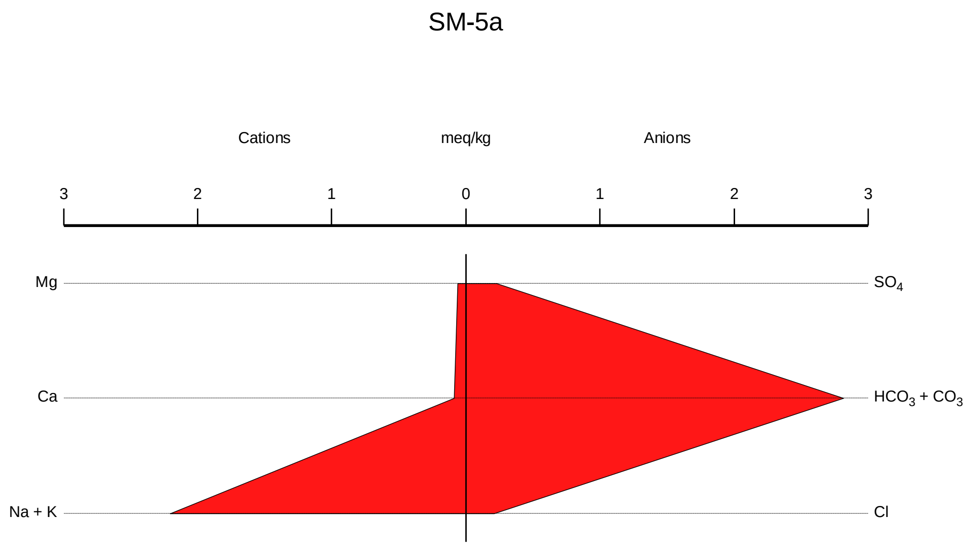

Figure 17 Stiff diagram SM-5a GW-1 (Deep).

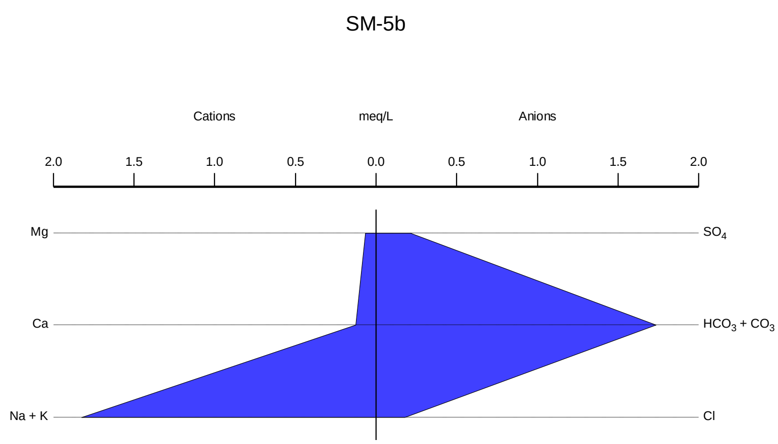

Figure 18 Stiff diagram SM-5b GW-1 (Shallow).

Water type for sample site GW-1 Well (SM-5a and SM-5b) is Na-HCO_3 (Fig. 18 Piper diagram).

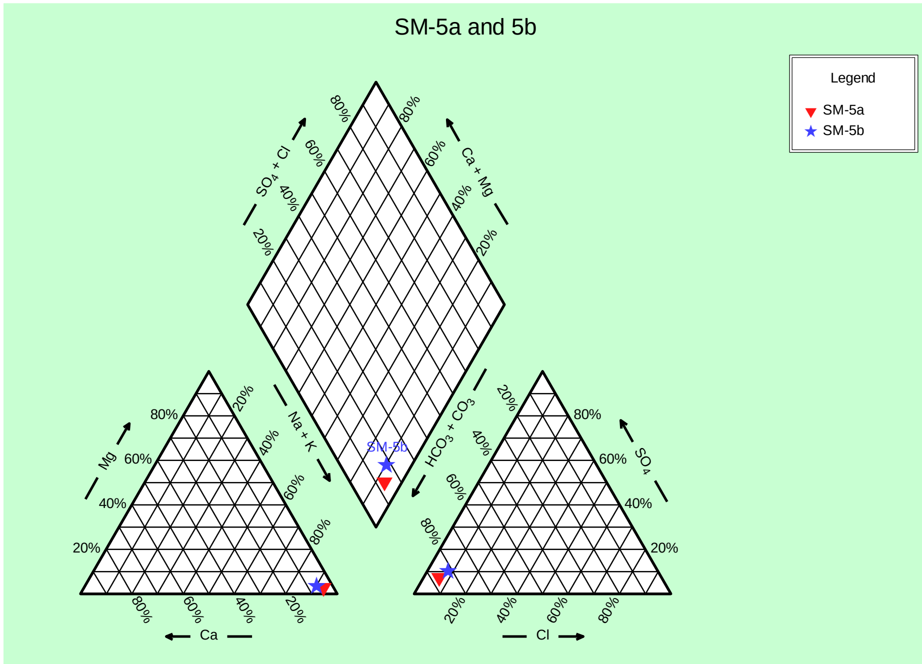

Figure 19 Piper diagram SM-5a (Deep) and SM-5b (Shallow) GW-1 well.

TABLE 6: Dissolved metals sample site SM-5b (shallow).

DSSOLVED METALS BY ICP	Result	Units
Aluminum	0.051	mg/L
Calcium	2.53	mg/L
Iron	0.037	mg/L
Magnesium	0.805	mg/L
Potassium	2.37	mg/L
Silicon	0.175	mg/L
Sodium	40.60	mg/L
Zinc	0.168	mg/L

DISSOLVED METALS BY ICP-MS	Result	Units
Antimony	ND	mg/L
Arsenic	ND	mg/L
Barium	0.0737	mg/L
Beryllium	0.0002	mg/L
Cadmium	ND	mg/L
Chromium	0.0015	mg/L
Cobalt	0.0014	mg/L
Copper	0.0017	mg/L
Lead	0.0028	mg/L
Manganese	0.0065	mg/L
Molybdenum	0.0442	mg/L
Nickel	ND	mg/L
Selenium	ND	mg/L
Silver	ND	mg/L
Strontium	0.0395	mg/L
Thallium	ND	mg/L
Vanadium	0.0016	mg/L

TABLE 7: Dissolved metals sample site SM-5a (deep).

DSSOLVED METALS BY ICP	Result	Units
Aluminum	0.075	mg/L
Calcium	1.79	mg/L
Iron	0.069	mg/L
Magnesium	0.745	mg/L
Potassium	2.42	mg/L
Silicon	0.265	mg/L
Sodium	49.2	mg/L
Zinc	0.206	mg/L

DISSOLVED METALS BY ICP-MS	Result	Units
Antimony	0.0005	mg/L
Arsenic	0.0011	mg/L
Barium	0.0488	mg/L
Beryllium	0.0002	mg/L
Cadmium	ND	mg/L
Chromium	0.0016	mg/L
Cobalt	0.0013	mg/L
Copper	0.0042	mg/L
Lead	0.0022	mg/L
Manganese	0.0060	mg/L
Molybdenum	0.0589	mg/L
Nickel	0.0064	mg/L
Selenium	ND	mg/L
Silver	ND	mg/L
Strontium	0.0319	mg/L
Thallium	ND	mg/L
Vanadium	0.0017	mg/L

TABLE 8: Bacterial populations for SM-5a (shallow) only.

Bacterial Analyses		***SM-5a (shallow)***
Parameters	*Unit*	
Iron-Related Bacteria	CFU/ml	ND
Sulfate-Reducing Bacteria	CFU/ml	1,000

Note: SM-5b (deep-slurry solid) not sampled for bacterial population.

Sample Sites SM-6, SM-9, and SM-7

The major ions indicate the water type for sample sites SM-6, SM-9, and SM-7 is Na-HCO_3. (Figs. 20, 21, and 22 and Figs. 23, 24, and 25). SM-6 is an artesian spring that surfaces along US Route 52. SM-9 is an artesian discharge along Elkhorn Creek at Maitland and the nearest discharge from the active slurry injection site which is approximately one and half mile away. SM-7 is a large downdip artesian discharge from the adjacent abandoned Pocahontas Capels Mine. These sites represent the hydrologically connected discharges from the flooded Pocahontas No.3 and No.4 seam voids. The sites are being influenced by the structurally-induced hydraulic gradient in the mines that allow the deep groundwater to migrate toward the surface within fracture zones that are related to structures of the Mullens Syncline. Water chemistry for these sites indicates that deep ground water is mixing with surface waters (fresh water) within the deeper circulation of the mine pool which is characterized by the Na-HCO_3 water type (Fig. 26). Analytical results from the lab analysis indicated no detection of semi-volatile organic compounds or volatile organic compounds as well as no semi-volatile range organics TPHs. TDS range moderately from 438mg/L to 752 mg/L. Total alkalinity ranging from 398 mg/L to 558 mg/L. The list of dissolved metal analytes determined for sample sites SM-6, SM-9, and SM-7 are shown in Table 9. Most of the analytes detected below limits with the exception of elevated iron in samples SM-6 and SM-9.

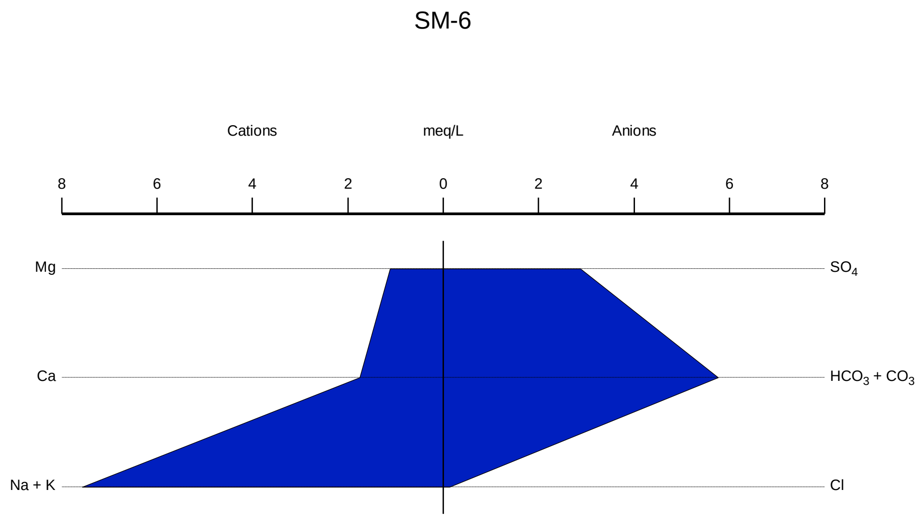

Figure 20 Stiff diagram SM-6 Hardee Artesian.

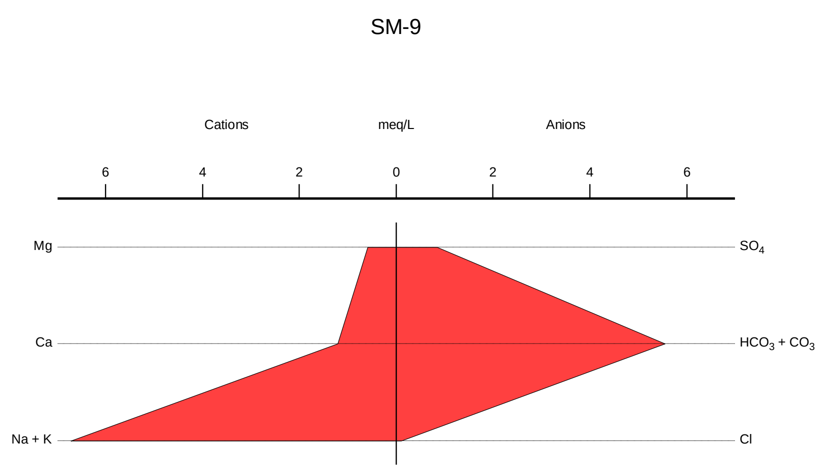

Figure 21 Stiff diagram SM-9 Maitland Discharge

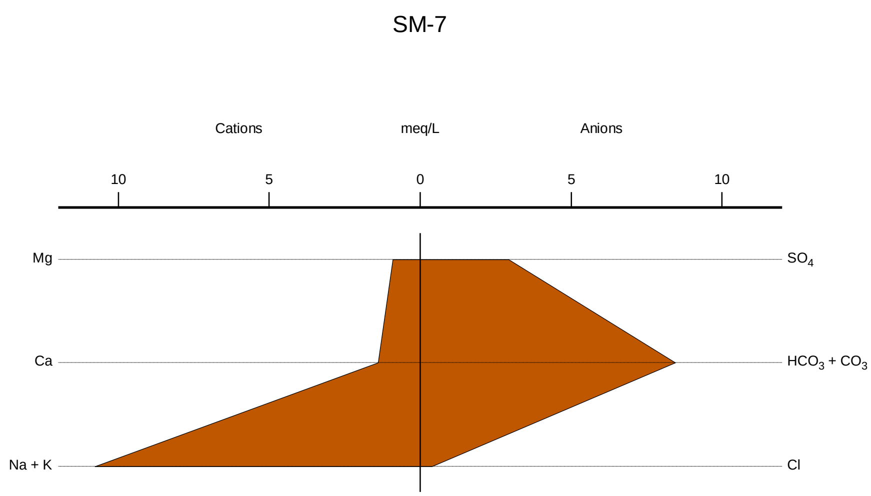

Figure 22 Stiff diagram SM-7 Capels Discharge.

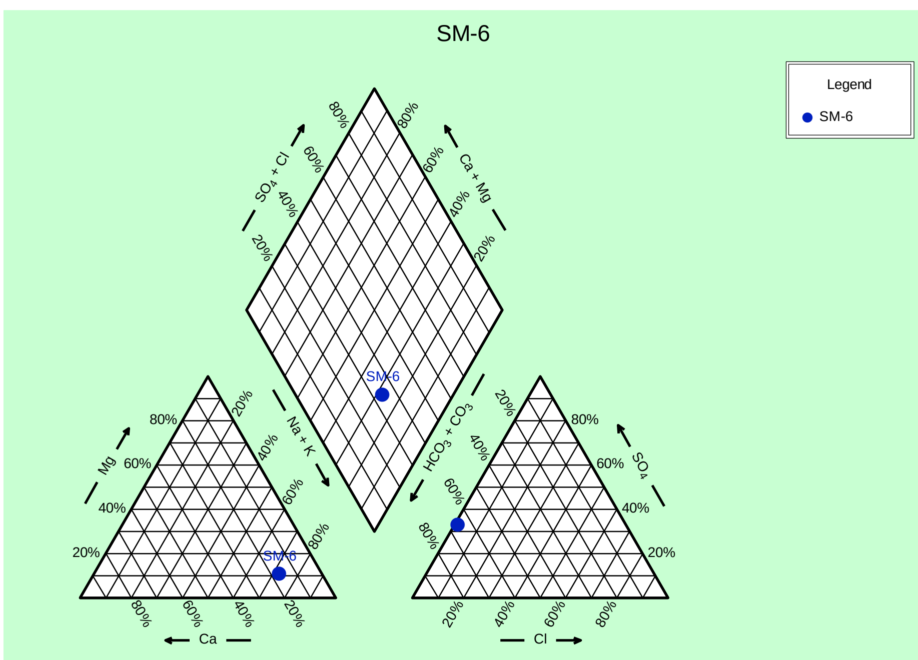

Figure 23 Piper diagram SM-6 Hardee Artesian.

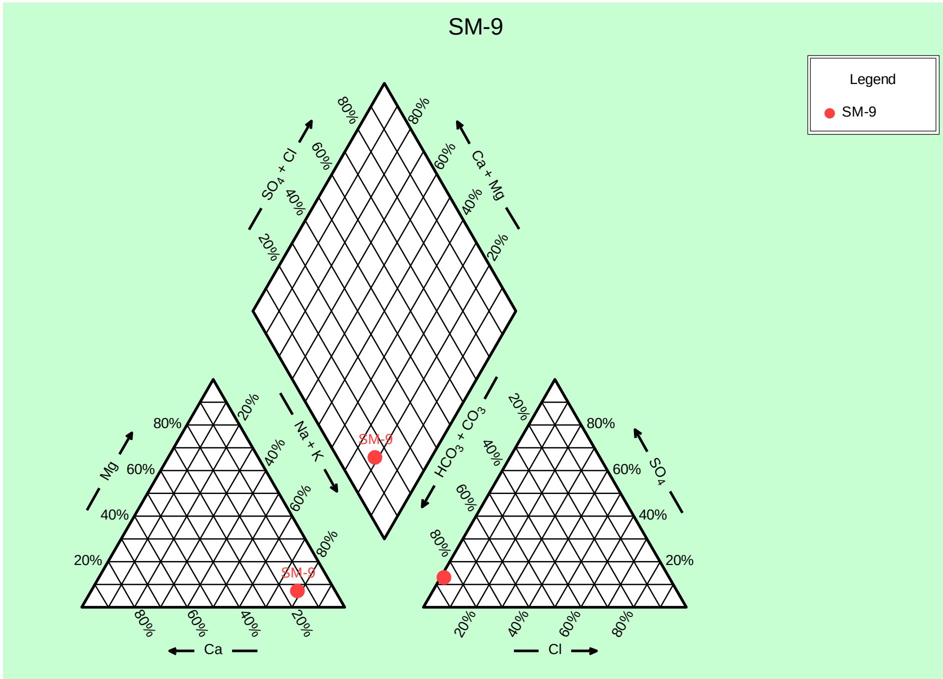

Figure 24 Piper diagram SM-9 Maitland discharge.

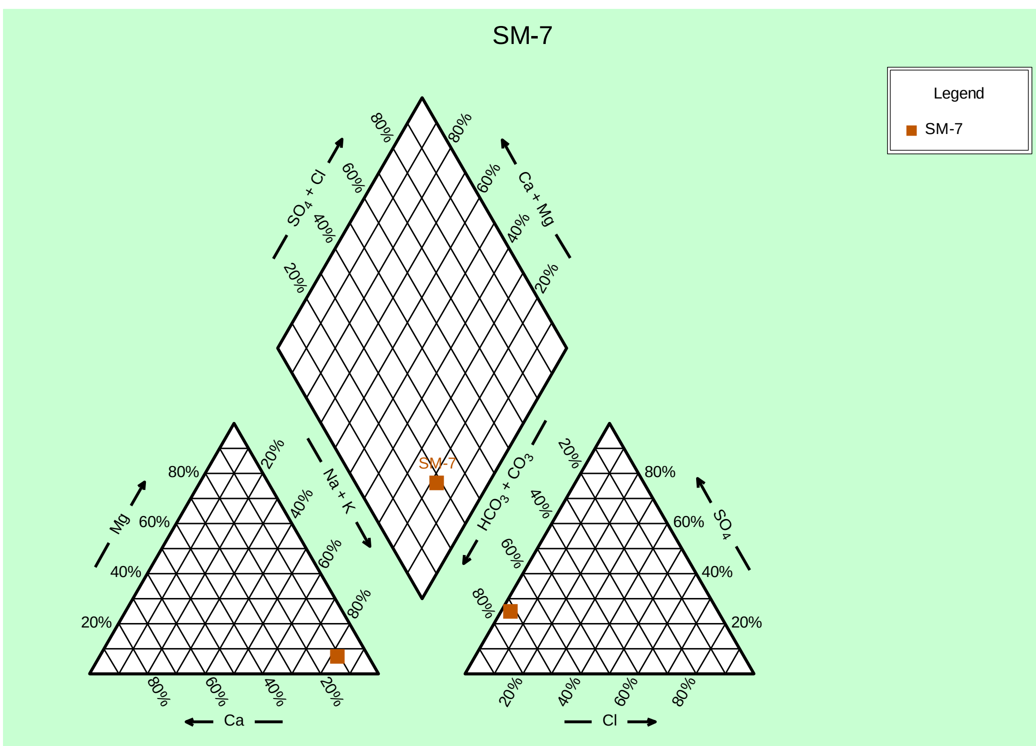

Figure 25 Piper diagram SM-7 Capels discharge.

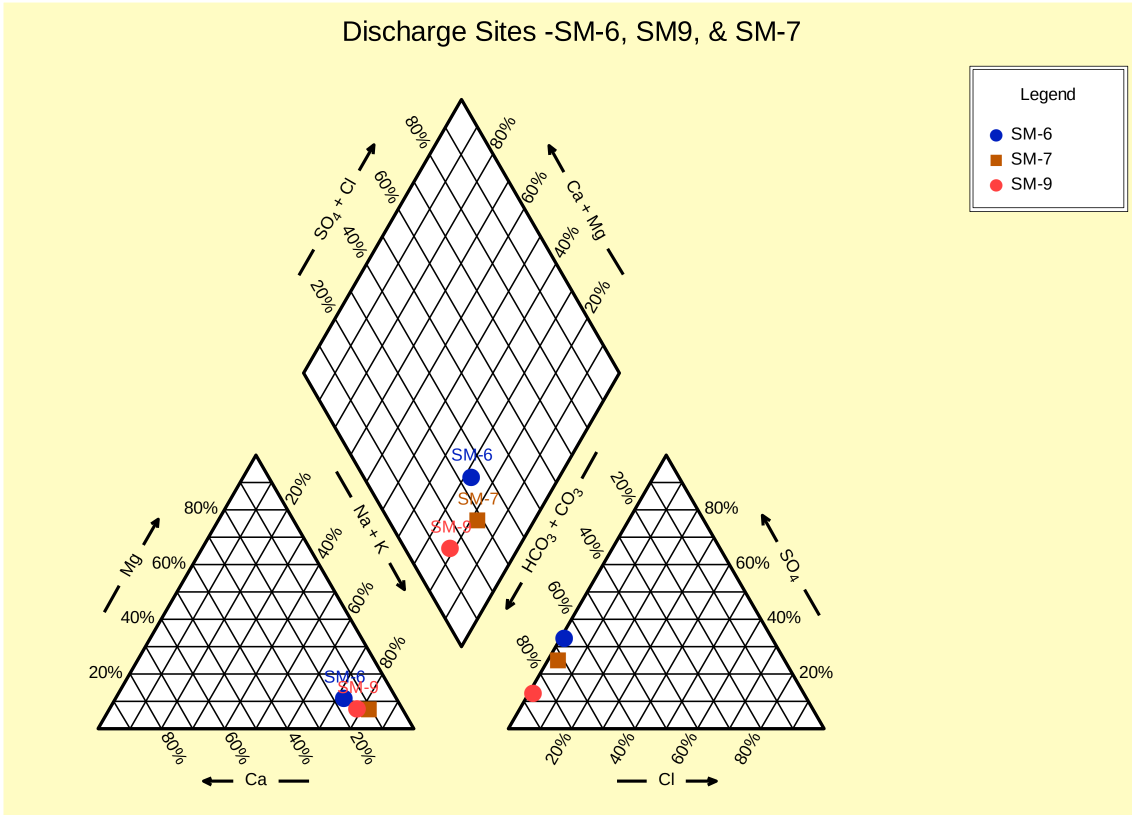

Figure 26 Composite piper diagram SM-6, SM-9, & SM- 7

TABLE 9: Dissolved metals sample sites SM-6, SM-9, and SM-7.

DSSOLVED METALS BY ICP	RESULTS			Units
	SM-6	SM-9	SM-7	
Aluminum	0.192	0.129	0.154	mg/L
Calcium	35.1	24.3	28.8	mg/L
Iron	2.85	5.11	0.356	mg/L
Magnesium	13.6	7.26	11.00	mg/L
Potassium	3.19	2.62	2.72	mg/L
Silicon	2.86	5.92	4.88	mg/L
Sodium	99.8	153.00	246.00	mg/L
Zinc	0.265	ND	0.045	mg/L

DISSOLVED METALS BY ICP-MS	RESULTS			Units
	SM-6	SM-9	SM-7	
Antimony	ND	ND	ND	mg/L
Arsenic	0.0052	0.0052	0.0014	mg/L
Barium	0.115	0.115	0.0667	mg/L
Beryllium	ND	ND	0.0002	mg/L
Cadmium	ND	ND	ND	mg/L
Chromium	ND	ND	0.0012	mg/L
Cobalt	ND	ND	0.0014	mg/L
Copper	ND	ND	0.0010	mg/L
Lead	ND	ND	ND	mg/L
Manganese	0.304	0.175	0.1750	mg/L
Molybdenum	ND	ND	ND	mg/L
Nickel	0.0021	ND	ND	mg/L
Selenium	ND	ND	ND	mg/L
Silver	ND	ND	ND	mg/L
Strontium	0.934	0.579	0.806	mg/L
Thallium	ND	ND	ND	mg/L
Vanadium	0.0016	ND	0.0016	mg/L

TABLE 10: Bacterial populations for SM-6, SM-9 and SM-7.

Bacterial Analyses		***SM-6***	***SM-9***	***SM-7***
Parameters	*Unit*			
Iron-Related Bacteria	CFU/ml	2,500	ND	100
Sulfate-Reducing Bacteria	CFU/ml	10,000	1,000	100

Sample Sites SM-1R and SM-1T

Sample site SM-1 is the Big Four Water System (Fig. 27) and is approximately 1.5 miles from the active injection site UIC-201 (Fig. 28). The Big Four System (Fig. 29) is served by two wells, Well No. 1 and Well No. 2 (Fig. 30).

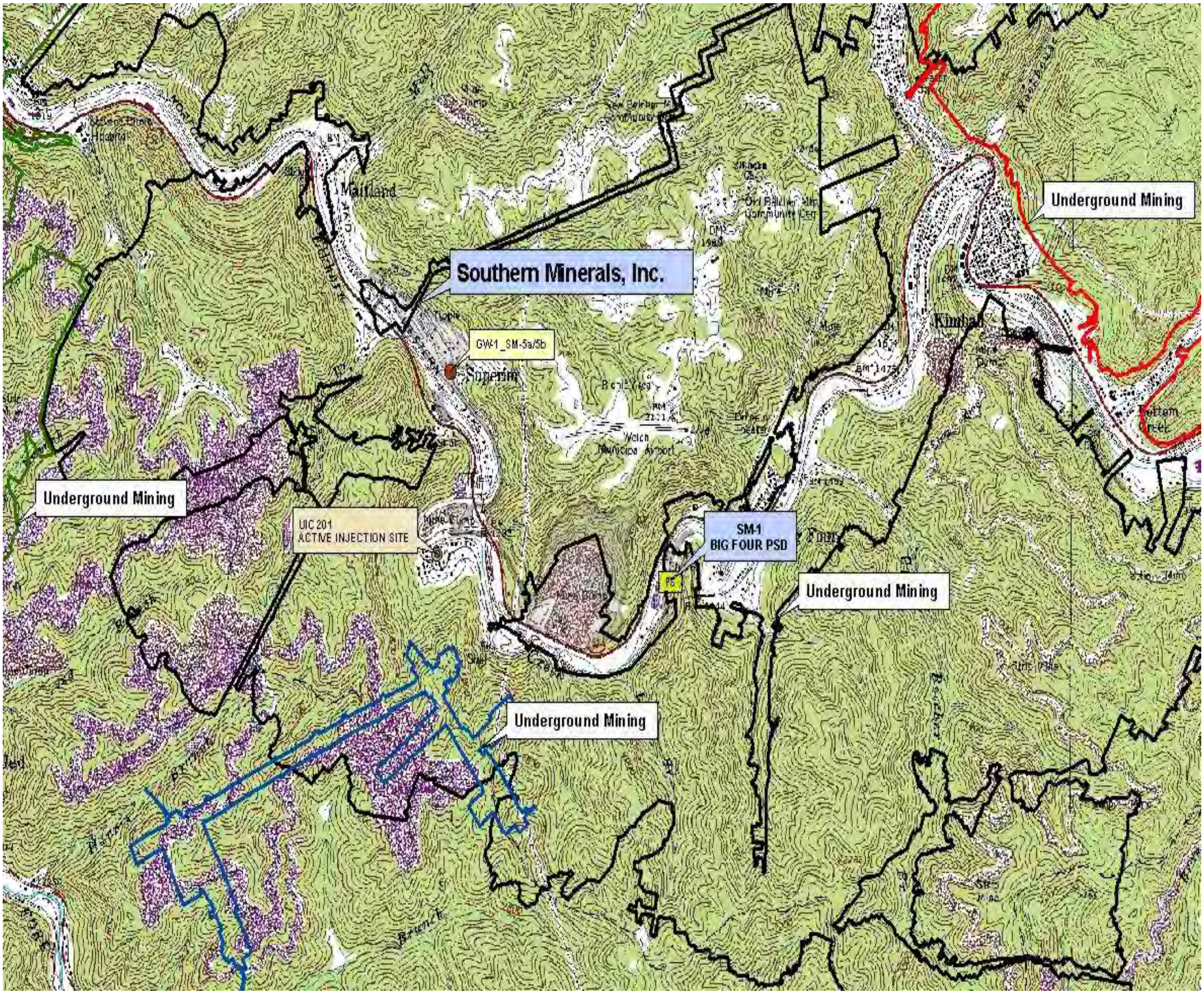

Figure 27 Big Four Water System location.

Figure 28 UIC-201 active slurry injection site.

Figure 29 Big Four PSD Water System (Photo from DHHR files).

Figure 30 Big Four PSD Water System (Photo from DHHR files).

The water supply wells were installed into the abandoned Pocahontas No. 4 and No. 3 coal seams. The Pocahontas No. 4 coal seam is approximately 70 feet above the Pocahontas No. 3 seam. A Source Water Assessment and Protection Plan (SWAPP) was completed for The West Virginia Department of Health and Human Resources (DHHR) Bureau for Public Health Office of Environmental Health Services, Environmental Engineering Division by Gannett Fleming, Inc. in May 2002. According to Gannett Fleming, Inc. the Big Four Water System provides service to approximately 375 people with approximately 150 service connections. There is no raw water storage. The finished water is stored in three 45,000 gallon holding tanks. Water treatment consists of filtration and the addition of chlorine gas. There is no public sewerage coverage within the Town of Big Four with residents utilizing (in general) direct discharge to creeks and streams.

The potential influencing factors on the local water supply listed by Gannett Fleming Inc. included; infiltration of raw sewage from area residents into the water source, influence from local and surrounding coal mining activities, and gas wells located within or adjacent to the SWAPP area. Water quality monitoring results were evaluated with available chemical water quality data. The data included analytical test results from the treated drinking water (finished water) and the untreated water source (raw water) performed by the water supplier from 1995 forward. The SWAPP guidance indicated that the contaminants of concern should include, but not be limited to the water quality parameters regulated under the Safe Drinking Water Act (SDWA) and for contaminants with a maximum contaminant level (MCL) for finished water, contaminants regulated under the Surface Water Treatment Rule, (SWTR), and the microorganism *Cryptosporidium*. The following is an expanded list of contaminants of concern that were evaluated in the SWAPP process:

- Contaminants having a published MCL
- Contaminants having a secondary MCL
- Contaminants that are targeted for regulatory review on the federal contaminant list
- Contaminants that have federal SDWA or state monitoring requirements
- Contaminants included as West Virginia Water Quality Standards developed under the Clean Water Act (CWA)

The consultant noted that the presence of synthetic organic compounds and volatile organic compounds (VOCs) at or above the analytical level of detection indicate an adverse impact and generally indicates an anthropogenic source (origin and development of human beings). The following is a brief summary of the firm's findings:

- No regulated SVOCs or VOCs were detected.
- Unregulated SVOCs or VOCs were detected.
- Regulated inorganic, nitrate, and radiological finished water quality results were within the acceptable limits with the exception of sodium.

One current sample was obtained from DHHR of backwash water for the Big Four Water System (Table 11). Drinking water plants that filter water before sending it to their consumers must periodically clean their filters to remove the particulates that have been captured over time. Water is pumped backwards through the filter to remove these particulates through a process known as "filter backwashing.

TABLE 11: Selected water quality monitoring results for Big Four Water System backwash.

REI Consultants, Inc. **Analytical Results** **Date:** *03-Dec-08*

CLIENT:	MCDOWELL COUNTY PSD	**WorkOrder:**	0811A07 **Lab ID** 0811A07-01
Client Sample ID:	3302471	**DateReceived:**	11/14/2008
Project:	3302471	**Collection Date:**	11/8/2008 8:05:00 AM
Site ID:	BIG FOUR, WV	**Matrix:**	LIQUID

Analyses	Result	Units	Qual	MDL	PQL	Date Analyzed
METALS BY ICP			E200.7			Analyst: BP
Aluminum	0.315	mg/L		0.0300	0.100	12/2/2008 3:43:00 PM
Iron	0.133	mg/L		0.0200	0.100	12/2/2008 3:43:00 PM
Manganese	0.082	mg/L		0.0030	0.050	12/2/2008 3:43:00 PM
RESIDUAL CHLORINE - LAB TEST, HOLD TIME E			SM4500-CL-G			Analyst: GV
Chlorine, Total Residual	ND	µg/L		20.0	100	11/17/2008 6:00:00 AM
ANIONS BY ION CHROMATOGRAPHY			E300.0			Analyst: CC
Fluoride	0.11	mg/L	J	0.050	0.20	11/15/2008 4:03:00 PM
TOTAL SUSPENDED SOLIDS			SM2540 D			Analyst: GV
Total Suspended Solids	17	mg/L	H	1.0	1	11/17/2008 7:25:00 AM
PH - LAB TEST, HOLD TIME EXPIRED			SM4500-H+-B			Analyst: DSA
pH	7.51	SU		NA	NA	11/24/2008 7:45:00 AM

Key:

MCL	Maximum Contaminant Level	J	Analyte detected below quantitation limits
MDL	Minimum Detection Limit	B	Analyte detected in the associated Method Blank
NA	Not Applicable	E	Estimated Value above quantitation range
ND	Not Detected at the PQL or MDL	H	Holding times for preparation or analysis exceeded
PQL	Practical Quantitation Limit	S	Spike/Surrogate Recovery outside accepted recovery limi
TIC	Tentatively Identified Compound, Estimated Concentrati	*	Value exceeds Maximum Contaminant Level

A raw (SM-1R) and treated (SM-1T) water sample was taken at the Big Four PSD for this study. The major ions indicate the water type for SM-1R is Na-HCO_3 sample before treatment. Sample SM-1T is Ca-HCO_3 water type after treatment (Fig. 31 and 32). Water chemistry for these sites indicates that these two types of water are mixing with surface waters (fresh water) with deeper circulation of mine pool groundwater (Fig. 33). Analytical results from the lab analysis indicated no detection of semi-volatile organic compounds or volatile organic compounds for SM-1R (raw). Results for SM-1T (treated) indicated non-detect for SVOCs with a detection of two VOCs which were bromodichloromethane 1.1ug/L and chloroform 1.7ug/L which according to EPA's links between common sources and possible contaminants could be associated with disinfection byproducts. No semi-volatile range organics TPHs were detected in either sample.

The TDS range from 322mg/L SM-1R to 305mg/L SM1-T. The total alkalinity was 236 mg/L for (SM-1R) and 230 mg/L for (SM-1T). The list of dissolved metal analytes determined for sample sites SM-1R and SM-T are shown in Table 12. Most of the analytes detected below quantitation limits. The Southern Minerals Incorporated is also sampling the Big Four Raw water intake which shows little to no change in sampled parameters compared to the current sampling event of July 2007 (Fig. 33).

The Safe Drinking Water Information System (SDWIS) reported one health based violation, followed by monitoring, reporting and other violations that the state reported to EPA for the Big Four PSD. The health-based violation listed was for failure to filter which is a violation of the Surface Water Treatment Rule (LT2ESWTR or LT2 rule). The LT2ESWTR applies to all public water systems (systems) that use surface water or ground water under the direct influence of surface water.

In fiscal year 2005 (the last year for which EPA has complete data) based on information reported to EPA by the states, 1.5 percent of all systems reported a treatment technique violation, 6.1 percent of all systems reported an MCL violation, and 24 percent of all systems reported a reporting/monitoring violation which includes systems not located within the influence of coal mining or slurry injection.

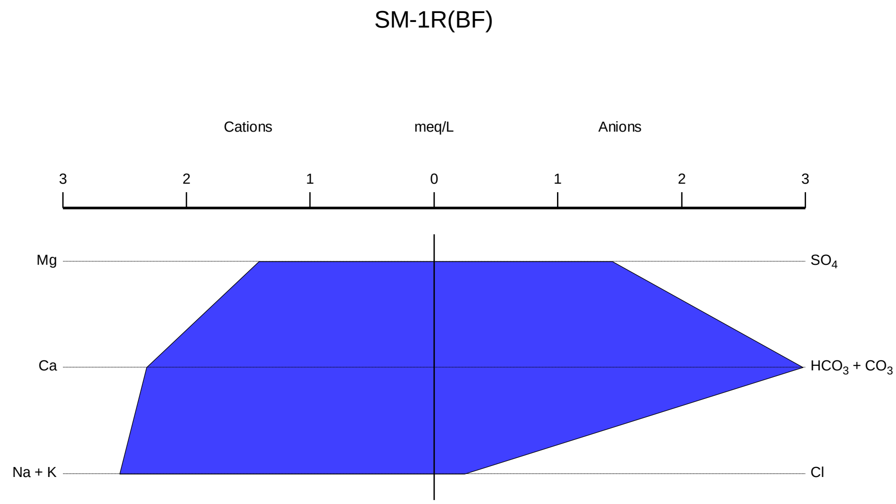

Figure 31 Stiff diagram Big Four PSD SM-1R.

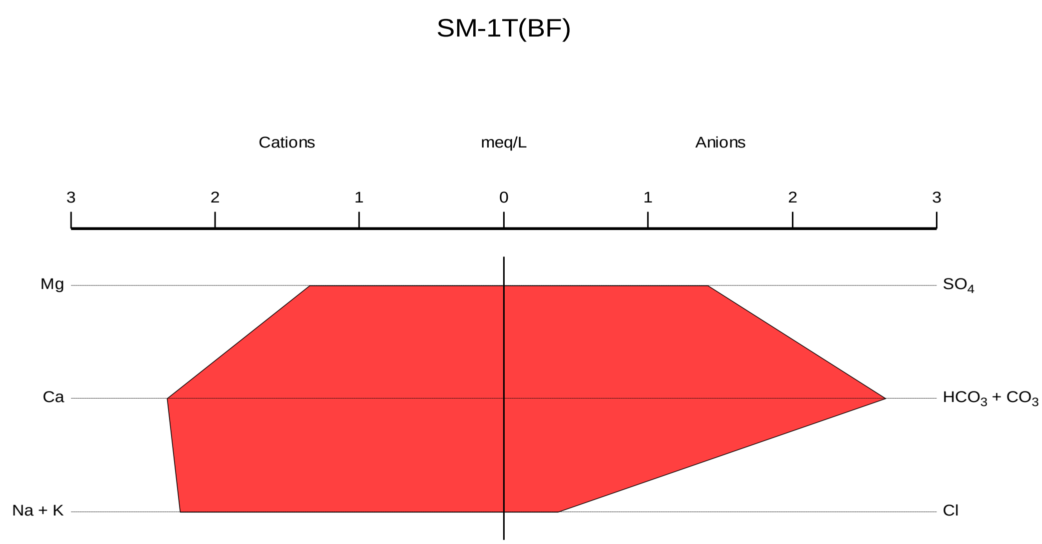

Figure 32 Stiff diagram Big Four PSD SM-1T.

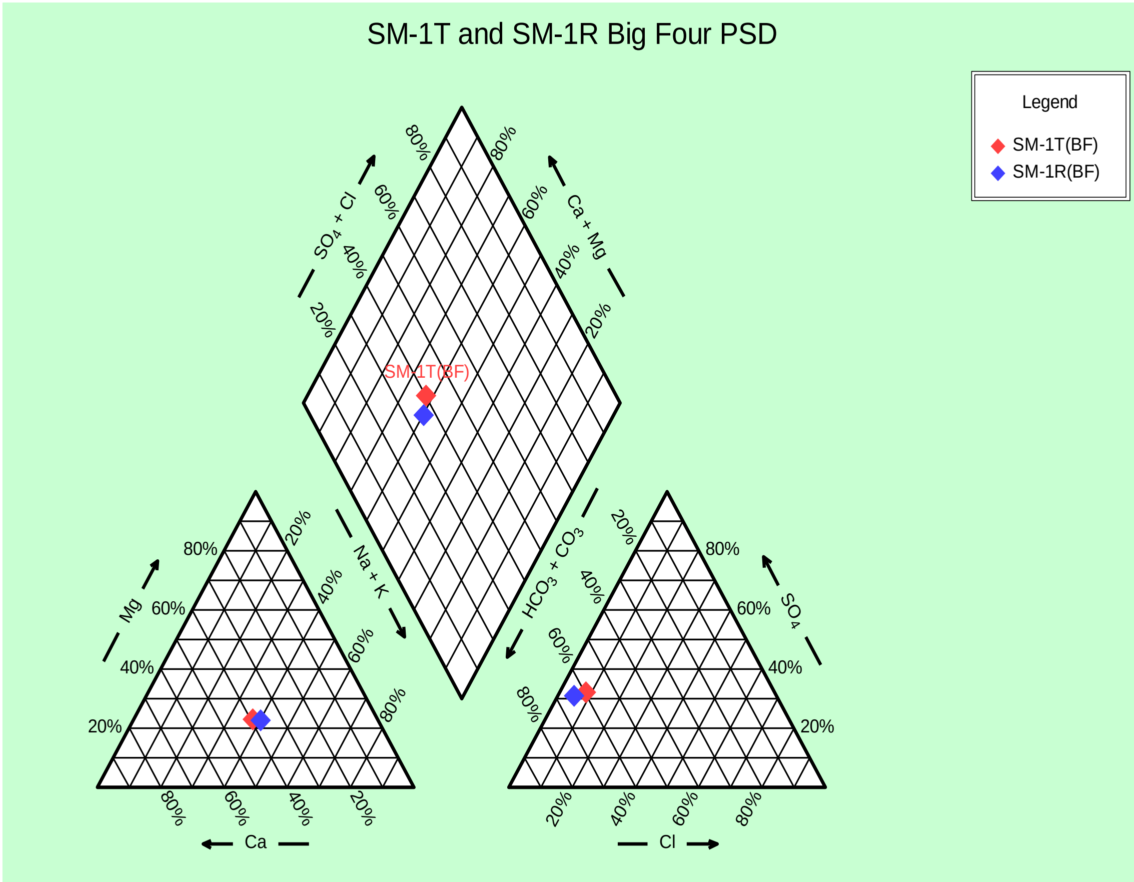

Figure 33 Piper diagram Big Four PSD - SM-1R and SM-1T.

ANALABS, INC.

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E-mail: analabs@mtneer.net

- CERTIFICATE OF ANALYSIS -

True Line Inc.

P.O. Box 85
Thorpe , WV 24888

Attn:
FAX: (304) 448-2339
Report Date: *13-Sep-01*

Our Lab#: 01-11400-001
Your Sample ID: SOU-3 BFPSD
Sample Type: Grab

Collection Date: 8/30/01 **Time:** **By:** CW

Test		Result	Unit	Method	MQL	Analysis Date/By	
Acidity	<	0.20	mg/L	305.1	0.20	9/6/01	KC
Aluminum, Total		0.14	mg/L	202.1	0.10	9/7/01	JS
Alkalinity		220.43	mg/L	310.1	0.20	9/6/01	CR
Iron, Total		1.03	mg/L	236.1	0.03	9/6/01	JS
Manganese, Total		0.21	mg/L	243.1	0.05	9/6/01	JS
pH		8.16	S.U.	150.1		9/6/01	KC
Sulfate		83.70	mg/L	375.2	5.00	9/6/01	CR
Specific Conductance		628	umhos	120.1	1	8/31/01	CR
Total Dissolved Solids		412	mg/L	160.1	1	9/4/01	CR
Total Suspended Solids		1	mg/L	160.2	1	9/4/01	CR

Figure 34 Company's sample of the Big Four raw water intake. (WVDEP Permit O007982).

TABLE 12: Dissolved metals sample sites SM-1R and SM-1T.

DSSOLVED METALS BY ICP	RESULTS		Units
	SM-1R	SM-1T	
Aluminum	0.200	0.206	mg/L
Calcium	46.6	46.8	mg/L
Iron	.950	0.031	mg/L
Magnesium	17.2	16.4	mg/L
Potassium	2.54	2.63	mg/L
Silicon	4.96	4.86	mg/L
Sodium	56.9	50.00	mg/L
Zinc	0.217	0.029	mg/L

DISSOLVED METALS BY ICP-MS	RESULTS		Units
	SM-1R	SM-1T	
Antimony	ND	ND	mg/L
Arsenic	0.0012	ND	mg/L
Barium	0.0840	0.0704	mg/L
Beryllium	0.0002	0.0002	mg/L
Cadmium	ND	ND	mg/L
Chromium	0.0014	0.0015	mg/L
Cobalt	0.0044	0.0014	mg/L
Copper	0.0073	0.0262	mg/L
Lead	0.0007	0.0008	mg/L
Manganese	0.4010	0.0030	mg/L
Molybdenum	ND	ND	mg/L
Nickel	0.0072	0.0104	mg/L
Selenium	ND	ND	mg/L
Silver	ND	ND	mg/L
Strontium	1.0300	0.954	mg/L
Thallium	ND	ND	mg/L
Vanadium	0.0016	0.0016	mg/L

Sample Sites SM-8R and SM-8T

Sample site SM-8 is the Welch Water System (Fig. 35) and is approximately six miles northwest from the active injection site UIC-201 (Refer to Figs. 27 and 28). The Welch Water System (Fig. 36 and Fig. 37) is served by two wells, Well No. 1 and Well No. 2 (Fig. 38).

Water type for sample site Welch PSD, SM-8T and SM-8R is Na-HCO_3 (Fig. 38).

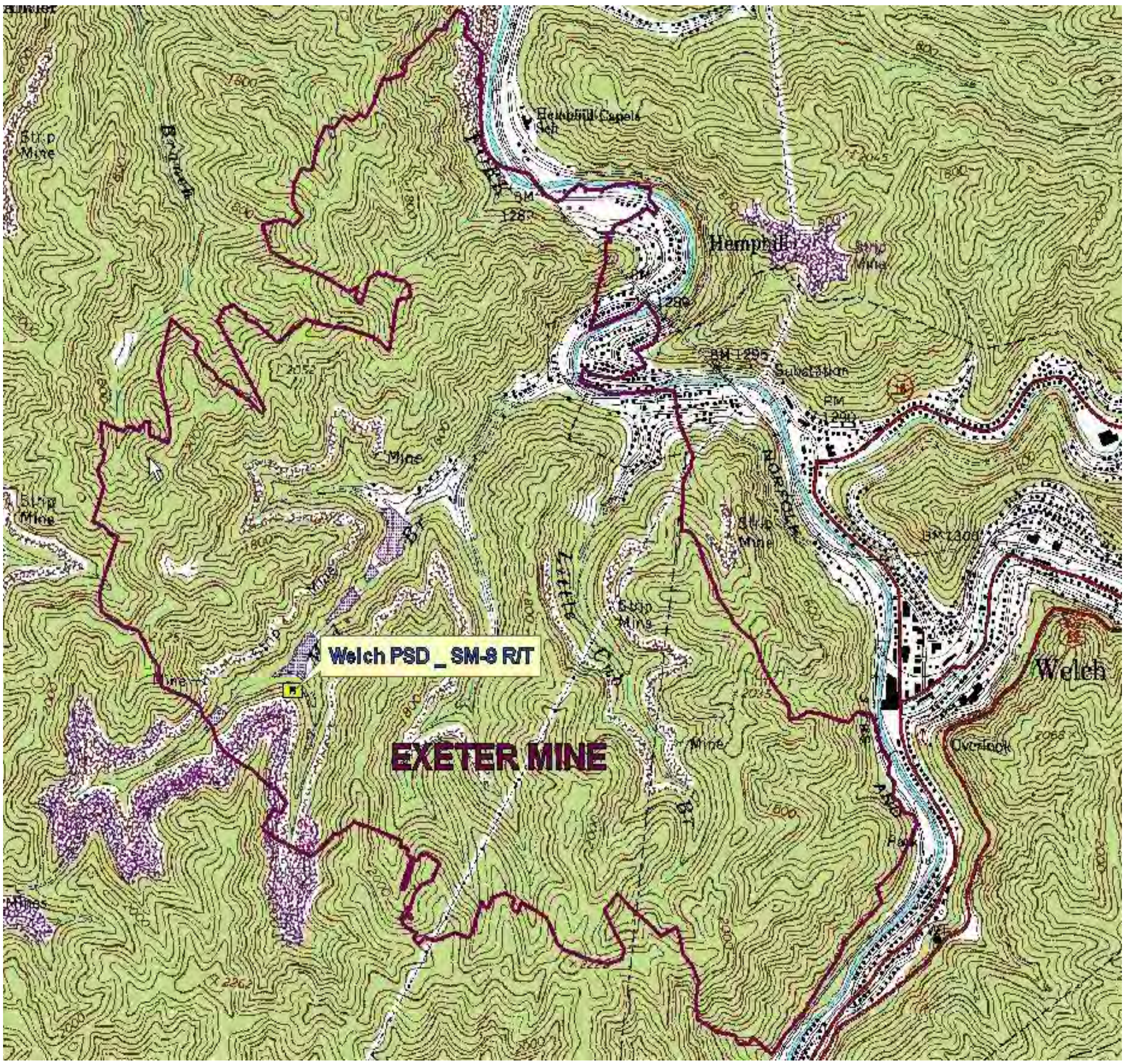


Figure 35 Exeter Mine with Welch PSD location.

Figure 36 Welch Water System (Photo from DHHR files).

Figure 37 Welch Water System (Photo from DHHR files).

Figure 38 Welch PSD Water System (Photo from DHHR files).

The two wells were installed into the abandoned Pocahontas No. 4 mine voidZx for the Welch waterworks. A Source Water Assessment and Protection Plan (SWAPP) was completed for The West Virginia Department of Health and Human Resources Bureau for Public Health Office of Environmental Health Services, Environmental Engineering Division by Draper Aden Associates in May 2000.

These wells were drilled on the western (down-dip) edge of the mine workings and are adjacent to the treatment plant.

The mine workings are over 400 feet below the base level of the Tug Fork River and are completely flooded. The mine was accessed via a shaft several miles away from the wells. Height of the mine workings ranges from about three feet to over ten feet. A much more extensive abandoned mine in the Pocahontas No. 3 seam underlies the No. 4 mine and is hydrologically connected via an abandoned slope. These mine works act as a reservoir for groundwater. In general the coal seams are the main aquifers for the area.

According to the Draper Aden Associates, between the surface and the Pocahontas No. 4 seam there are several massive beds of highly resistant quartz arenite (quartz pebble conglomerate and crystalline sandstone). These confining units protect the underlying coal seam aquifers from potential surface contamination and overlie the coal seam aquifer throughout the SWAPP area. The outcrop of the Pocahontas No. 4 seam is five miles east of the well locations. According to inspection reports within the permit no coal slurry discharge has been observed or detected from the outcrop areas.

The City of Welch water supply serves a population of 3,450 with 1,380 service connections. The City also sells water to the McDowell PSD at Hemphill and to US Steel's No. 50 preparation plant. Raw water storage capacity is in excess of 400,000 gallons and finished water storage capacity at nine tanks and reservoirs is in excess of 1.4 million gallons. The wells were drilled in 1992. The depth of Well No. 1 is 577 feet and Well No. 2 is at 575 feet. Pump rate for Well No. 1 is 850 gallons per minute and Well No. 2 is 1,200 gpm.

Water quality monitoring results were evaluated with available water quality data. The data included analytical test results from the treated drinking water (finished water) and the untreated water source (raw water) performed by the water supplier from 1995 forward. The SWAPP guidance indicated that the contaminants of concern should include, but not be limited to the water quality parameters regulated under the Safe Drinking Water Act (SDWA) and for contaminants with a maximum contaminant level (MCL) for finished water, contaminants regulated under the Surface Water Treatment Rule, (SWTR), and the microorganism *Cryptosporidium*. The following is an expanded list of contaminants of concern that were evaluated in the SWAPP process:

- Contaminants having a published MCL
- Contaminants having a secondary MCL
- Contaminants that are targeted for regulatory review on the federal contaminant list
- Contaminants that have federal SDWA or state monitoring requirements developed under the Clean Water Act (CWA)

Table 13 provides a summary of the groundwater quality monitoring results available from the City of Welch. The analytical laboratory reports for treated water and raw water are presented in (Appendices H respectively, Analytical Report, Draper Aden Associates, May16, 2000).

Table 13: Selected Water Quality Monitoring Results.

TREATED WATER ANALYSIS – (Analytical Report, Appendix H of Draper Aden Associates, May 16, 2000 DAS JN: B99291)

Monitoring	Units	Date	Well # 1	Well #2	Spring #	Spring #
Volatile	ppb	4/28/97	ND			
Barium	ppm	4/18/97	0.25			
Fluoride	ppm	4/17/97	1.21			
Sodium	ppm	4/17/97	289			

All other parameters analyzed were not detected. Raw water analysis for the Welch Water System was not available in the SWAPP.

A raw (SM-8R) and treated (SM-8T) water sample was taken at the Welch PSD for this study. The major ions indicate the water type for both sample sites was Na-HCO_3 (Figs. 39 and 40). Water chemistry for these sites indicates a source of deeper circulation mine pool groundwater (Fig.

41). Analytical results from the lab analysis indicated no detection of semi-volatile organic compounds or volatile organic compounds for SM-1R (raw). Results for SM-1T (treated) indicated non-detect for SVOCs with a detection of two VOCs which were bromodichloromethane 16.7 g/L and dibromochloromethane 2ug/L which according to EPA's links between common sources and possible contaminants could be associated with disinfection byproducts. No semi-volatile range organics TPHs were detected in either sample. The TDS range from 637 mg/L SM-8R to 629 mg/L SM8-T. The total alkalinity was 606 mg/L for (SM-8R) and 580 mg/L for (SM-8T). The list of dissolved metal analytes determined for sample sites SM-8R and SM-8T are shown in Table 15. Most of the analytes detected below quantitation limits.

TABLE 14: Water analysis for Welch PSD.

WV3302421 - City of Welch

SAMPLING POINT	COLLECTION DATE	ANALYTE CODE	ANALYTE NAME	LESS THAN CODE	LESS THAN INDICATOR	DETECT LIMIT	DETECT LIMIT UNIT	CONCEN TRATION	UNIT
TP001	05/11/06	2981	1,1,1-TRICHLOROETHANE	MDL	Y	0.0005	MG/L	0	UG/L
TP001	05/11/06	2985	1,1,2-TRICHLOROETHANE	MDL	Y	0.0005	MG/L	0	UG/L
TP001	05/11/06	2977	1,1-DICHLOROETHYLENE	MDL	Y	0.0005	MG/L	0	UG/L
TP001	05/11/06	2378	1,2,4-TRICHLOROBENZENE	MDL	Y	0.0005	MG/L	0	UG/L
TP001	05/11/06	2980	1,2-DICHLOROETHANE	MDL	Y	0.0005	MG/L	0	UG/L
TP001	05/11/06	2983	1,2-DICHLOROPROPANE	MDL	Y	0.0005	MG/L	0	UG/L
TP001	05/11/06	1005	ARSENIC	MDL	N	0.008	MG/L	0.0017	MG/L
TP001	05/11/06	2990	BENZENE	MDL	Y	0.0005	MG/L	0	UG/L
DS001	01/19/06	2943	BROMODICHLOROMETHANE	MDL	N	1	UG/L	32.9	UG/L
DS001	04/25/06	2943	BROMODICHLOROMETHANE	MDL	N	1	UG/L	33.5	UG/L
DS001	09/20/06	2943	BROMODICHLOROMETHANE	MDL	N	1	UG/L	36	UG/L
DS001	12/21/06	2943	BROMODICHLOROMETHANE	MDL	N	1	UG/L	14.8	UG/L
DS001	01/18/07	2943	BROMODICHLOROMETHANE	MDL	N	1	UG/L	16	UG/L
DS001	01/19/06	2942	BROMOFORM	MDL	N	1	UG/L	8	UG/L
DS001	04/25/06	2942	BROMOFORM	MDL	N	1	UG/L	7.1	UG/L
DS001	09/20/06	2942	BROMOFORM	MDL	N	1	UG/L	12.8	UG/L
DS001	12/21/06	2942	BROMOFORM	MDL	N	1	UG/L	8.8	UG/L
DS001	01/18/07	2942	BROMOFORM	MDL	N	1	UG/L	7.7	UG/L
TP001	05/11/06	2982	CARBON TETRACHLORIDE	MDL	Y	0.0005	MG/L	0	UG/L
DS001	01/19/06	2944	CHLORODIBROMOMETHANE	MDL	N	1	UG/L	30.8	UG/L
DS001	04/25/06	2944	CHLORODIBROMOMETHANE	MDL	N	1	UG/L	24.4	UG/L
DS001	09/20/06	2944	CHLORODIBROMOMETHANE	MDL	N	1	UG/L	37.6	UG/L
DS001	12/21/06	2944	CHLORODIBROMOMETHANE	MDL	N	1	UG/L	21.8	UG/L
DS001	01/18/07	2944	CHLORODIBROMOMETHANE	MDL	N	1	UG/L	21.3	UG/L
DS001	01/19/06	2941	CHLOROFORM	MDL	N	1	UG/L	22.7	UG/L
DS001	04/25/06	2941	CHLOROFORM	MDL	N	1	UG/L	21.1	UG/L
DS001	09/20/06	2941	CHLOROFORM	MDL	N	1	UG/L	30.5	UG/L
DS001	12/21/06	2941	CHLOROFORM	MDL	N	1	UG/L	13	UG/L
DS001	01/18/07	2941	CHLOROFORM	MDL	N	1	UG/L	12.2	UG/L
TP001	05/11/06	2380	CIS-1,2-DICHLOROETHYLENE	MDL	Y	0.0005	MG/L	0	UG/L
DS001	01/10/06	3100	COLIFORM, TOTAL (TCR)			0		0	
DS001	01/10/06	3100	COLIFORM, TOTAL (TCR)			0		0	
DS001	01/10/06	3100	COLIFORM, TOTAL (TCR)			0		0	
DS001	02/01/06	3100	COLIFORM, TOTAL (TCR)			0		0	
DS001	02/01/06	3100	COLIFORM, TOTAL (TCR)			0		0	
DS001	02/01/06	3100	COLIFORM, TOTAL (TCR)			0		0	
DS001	03/01/06	3100	COLIFORM, TOTAL (TCR)			0		0	
DS001	03/01/06	3100	COLIFORM, TOTAL (TCR)			0		0	

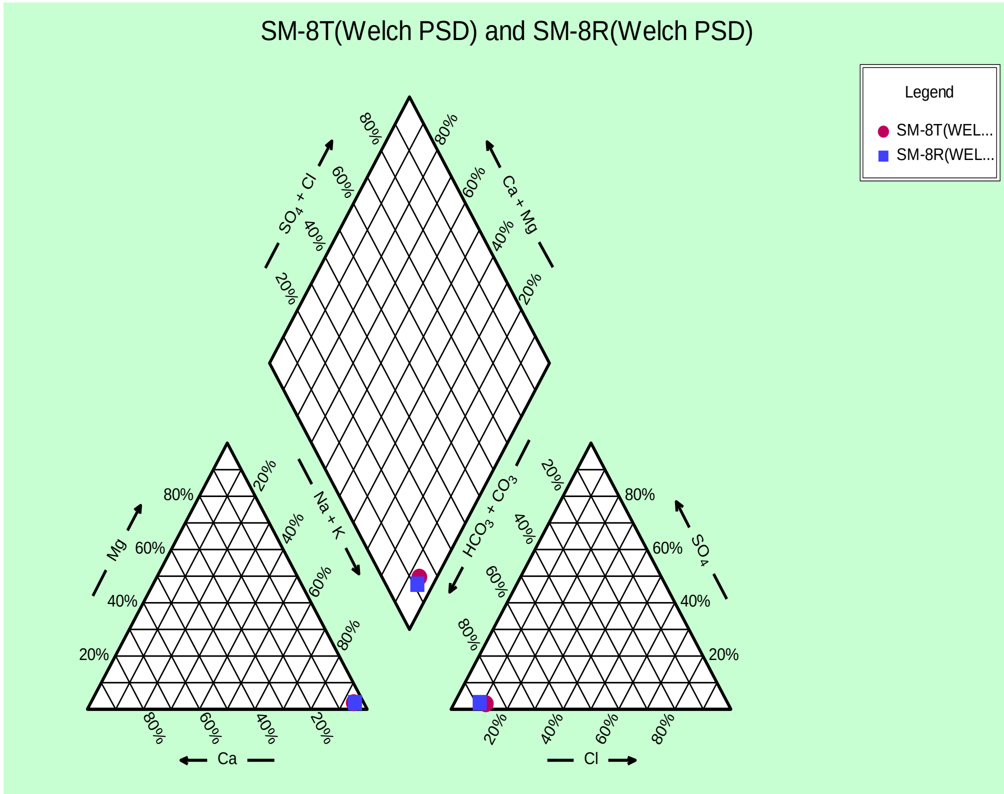


Figure 39 Piper diagram Welch PSD SM-8T and SM-8R.

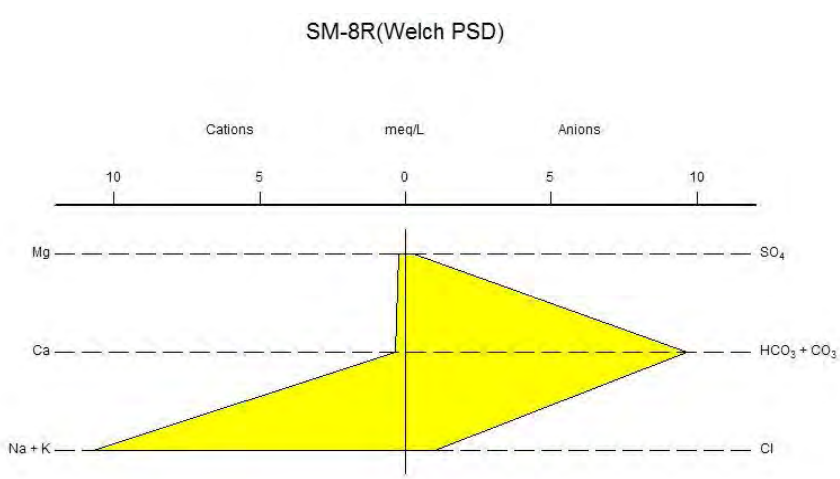


Figure 40 Stiff diagram Welch PSD SM-8R.

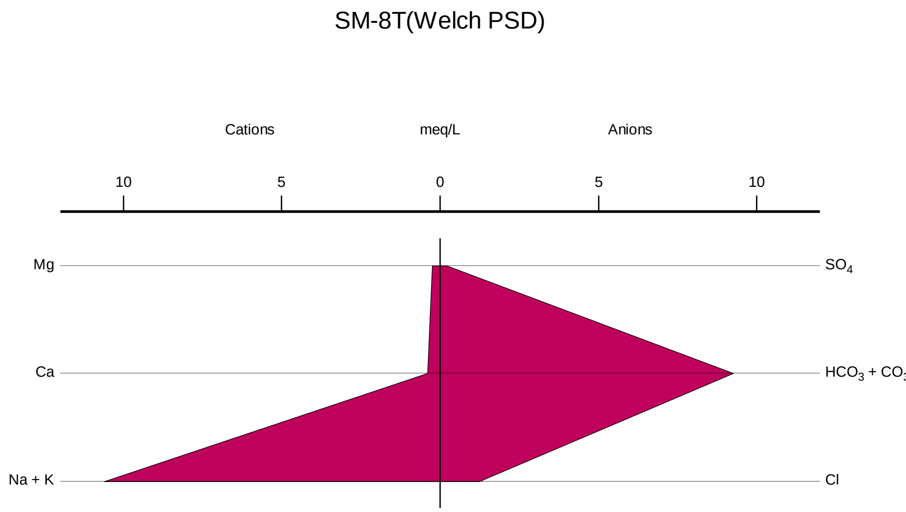


Figure 41 Stiff diagram Welch PSD SM-8T.

TABLE 15: Dissolved metals sample sites SM-8R and SM-8T.

DSSOLVED METALS BY ICP	RESULTS		Units
	SM-8R	SM-8T	
Aluminum	0.062	0.180	mg/L
Calcium	7.20	8.02	mg/L
Iron	.308	0.021	mg/L
Magnesium	2.95	3.06	mg/L
Potassium	1.27	1.27	mg/L
Silicon	4.17	4.26	mg/L
Sodium	245.0	243.00	mg/L
Zinc	0.034	0.086	mg/L

DISSOLVED METALS BY ICP-MS	RESULTS		Units
	SM-8R	SM-8T	
Antimony	ND	ND	mg/L
Arsenic	0.0020	0.0013	mg/L
Barium	0.2830	0.256	mg/L
Beryllium	0.0003	0.0003	mg/L
Cadmium	ND	ND	mg/L
Chromium	0.0014	0.0014	mg/L
Cobalt	0.0013	0.0013	mg/L
Copper	0.0018	0.0078	mg/L
Lead	0.0006	ND	mg/L
Manganese	0.0311	0.0041	mg/L
Mercury	ND	ND	mg/L
Molybdenum	0.0042	0.0039	mg/L
Nickel	ND	ND	mg/L
Selenium	ND	ND	mg/L
Silver	0.0011	ND	mg/L
Strontium	0.314	0.313	mg/L
Thallium	ND	ND	mg/L
Vanadium	0.0021	0.0022	mg/L

Sample Sites SM-Slurry (Liquid and Solid)

The raw slurry sample was taken at the plant thickener and identified as SM-Slurry liquid and solid phase. The major ions indicate the water type for sample SM-Slurry (Liquid) is Ca-SO_4-HCO_3 and SM-Slurry (Solid) is Al-Mg-HCO_3 (Figs. 42 and 43). (Figs. 44 and 45).

Analytical results from the lab analysis indicated no detection of SVOCs or VOCs as well as no TPHs for the liquid phase of the slurry. The TDS were 423mg/L. Total alkalinity was 181 mg/L. The lists of dissolved metal analytes determined for the liquid slurry are shown in Table 16. Most of the analytes detected below quantitation limits with the exception of elevated aluminum and iron, which is part of a list tested only for secondary drinking water standards. Sodium was reported at 58.8 mg/L and is listed as a metal on the contaminant candidate list. The SDWA, as amended in 1996, directs the Environmental Protection Agency (EPA) to publish a list of contaminants (referred to as the Contaminant Candidate List, or CCL) to assist in priority-setting efforts. SDWA also directed the Agency to select five or more contaminants from the current CCL and determine by August 2001 whether or not to regulate these contaminants with a National Primary Drinking Water Regulation (NPDWR). On July 18, 2003, the Agency announced its final determination that no regulatory action is appropriate or necessary for the following nine contaminants: acenthamoeba, aldrin, dieldrin, hexacholorobutadiene, manganese, metribuzin, naphthalene, sodium, and sulfate.

"A Health Advisory (HA) has until now never been issued for sodium, though a Drinking Water Equivalent Level (DWEL) is available. The DWEL of 20 mg/L is a non-enforceable guidance level considered protective against non-carcinogenic adverse health effects and is based on an American Heart Association recommendation issued in 1965. Also, EPA (US Environmental Protection Agency) has issued a non-enforceable guidance of 250mg/L for salinity and dissolved solids in ambient waters (USEPA, 1997; 62 FR 52194)".

"The weight of evidence favors the conclusion that high sodium intakes can have an adverse effect on blood pressure, especially for sodium-hypertensives. It should be stressed that hypertension is influenced more by lifestyle, behavior, and other nutrient intake than by sodium intake. (USEPA, Office of Water Report: EPA 815-R-03-015, July 2003)". Specifically, EPA characterized the human health effects that may result from exposure to a contaminant found in drinking water. Based on this characterization, the Agency estimated a health reference level (HRL) for each contaminant. In the case of sodium, a benchmark was chosen based on taste effects, which occur at lower concentrations than health effects. (USEPA, Office of Water Report: EPA 815-R-03-015, July 2003).

"After reviewing the best available public health and occurrence information, EPA has made a determination not to regulate sodium with a National Primary Drinking Water Regulation

(NPDWR). However, EPA may issue an advisory to provide guidance to communities that may be exposed to drinking water contaminated with sodium chloride or other sodium salts.

The current study is focused on examining the organic compounds present in water supplies from wells penetrating coal seams that have been injected with coal slurry. At present, the identified public wells within the study area were meeting EPA National Primary Drinking Water standards for these organic compounds.

The dissolved concentrations of trace metals, including but not limited to aluminum, barium, iron, magnesium from the slurry samples were not measured and the solubility and the dissolution rates of these metals were not calculated.

A sample of the solid phase slurry from the Fire Creek coal seam was also analyzed. The solid phase sample was a sub-divided portion of the slurry. Analytical results from the lab analysis indicated nine detections of SVOCs which were mostly detected below limits. No VOCs were detected. TPHs were detected in the solids with DRO at 280 mg/Kg and ORO at 391 mg/Kg.

According to the EPA Region 3, Risk Based Concentrations, Soil Screening Levels, Dilution Attenuation Factor 20 guidelines, the solid phase (sediment) showed metals concentrations substantially exceeded sediment quality guidelines. Aluminum, barium, iron, magnesium, potassium, silicon, lead, zinc, copper, and arsenic were common contributors to the exceedances. Among the general chemistry parameters, sulfates were very low with 9.35 mg/Kg with high alkalinity of 451 mg/Kg.

The lists of dissolved metal analytes determined for the slurry solids are shown in Table 17 and 18. Sodium was reported at 44.3 mg/L and is listed as a metal on the contaminant candidate list.

Contaminant concentrations show little, if any, trend with either depth or location in regards to the one-time surface and ground water sites sampled for this study. The high levels of compounds were found only in the solid portion of the sampled sediment. More extensive sampling, both vertically and laterally, might show presently undetected patterns to potential contaminant distribution.

A number of the compounds identified in the solids are known to be toxic, including some PAH's, heterocyclic compounds, and aromatic amines. It was undetermined if these compounds were associated with the coal or from chemicals used in the coal preparation process. Specific compounds from the Material Safety Data Sheets (MSDS) were not given due to proprietary reasons. Many identified compounds have unknown toxicities, but may have health or environmental effects based on structural similarities to known toxins. The human health effects from chronic, low-level exposure to organic compounds in produced water will be further studied by the West Virginia Department of Health and Human Resources Bureau for Public Health Office of Environmental Health Services, for Phase II of this study.

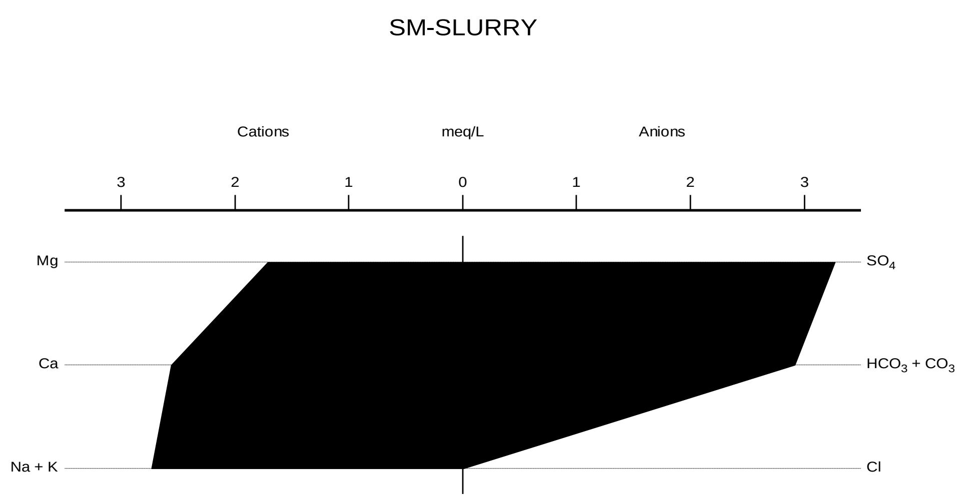


Figure 42 Stiff diagram SM-Slurry Liquid.

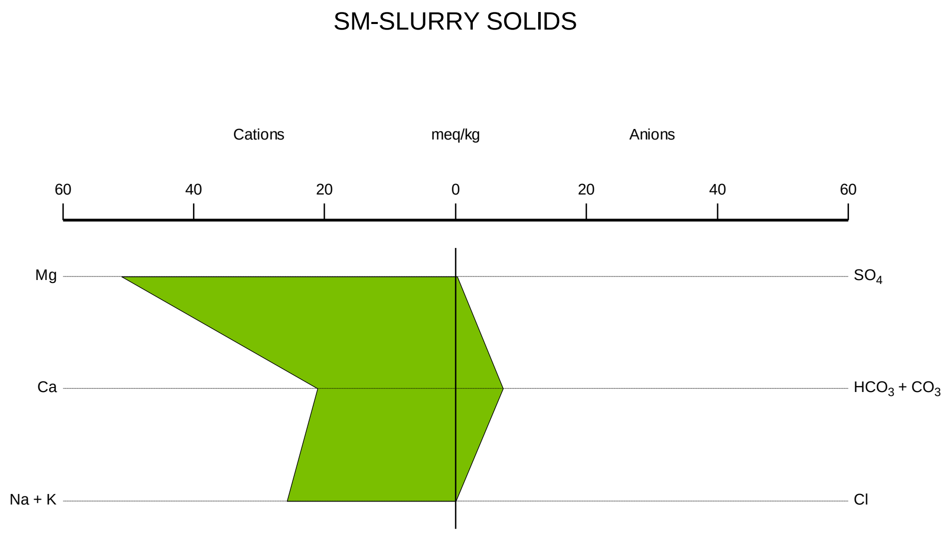


Figure 43 Stiff diagram SM-Slurry Solids.

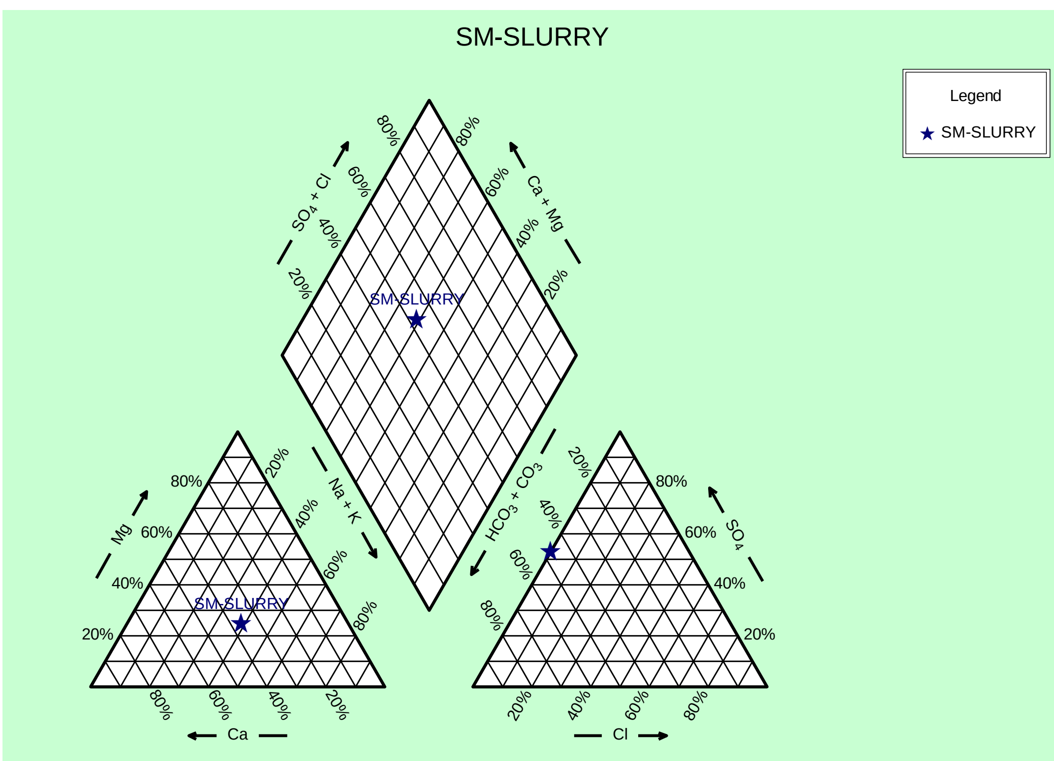


Figure 44 Piper diagram SM-Slurry Liquid.

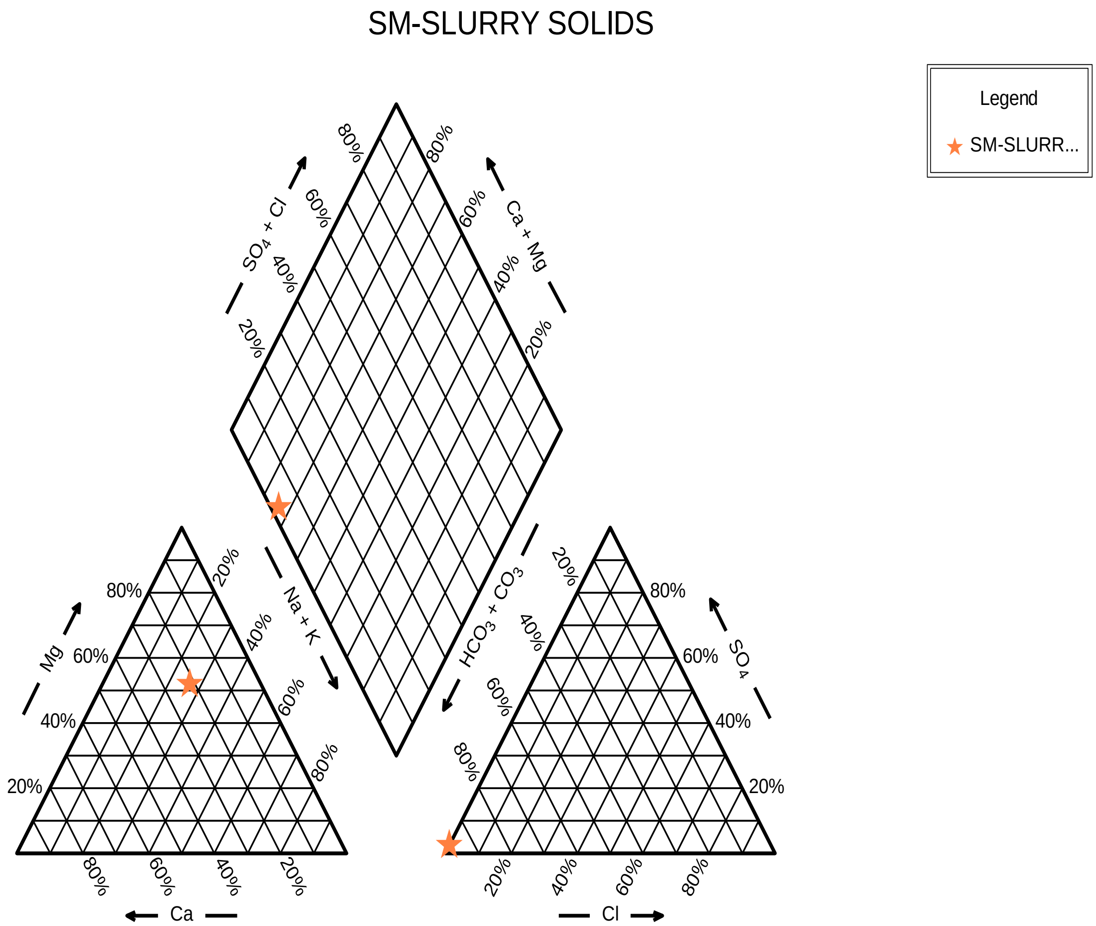


Figure 45 Piper diagram SM-Slurry Solid.

TABLE 16: Metal analytes for the liquid slurry phase.

SM-Liquid Phase Metals		
Analytes	**Sample Results**	
	Unit	***Slurry Liquid***
Sample Date 07/17/2007		
Aluminum	mg/L	0.195
Antimony	mg/L	0.0220
Arsenic	mg/L	0.0039
Barium	mg/L	0.0809
Beryllium	mg/L	0.0002
Cadmium	mg/L	ND
Calcium	mg/L	51.4
Chromium	mg/L	0.0013
Cobalt	mg/L	0.0021
Copper	mg/L	0.0012
Iron	mg/L	ND
Lead	mg/L	ND
Magnesium	mg/L	20.8
Manganese	mg/L	0.0141
Mercury	mg/L	ND
Molybdenum	mg/L	0.0176
Nickel	mg/L	0.0043
Potassium	mg/L	6.90
Selenium	mg/L	0.0082
Silicon	mg/L	3.30
Silver	mg/L	ND
Sodium	mg/L	58.8
Strontium	mg/L	1.16
Thallium	mg/L	ND
Vanadium	mg/L	0.0018
Zinc	mg/L	0.016

TABLE 17: Metal analytes for the solid phase slurry.

SM-Solid Phase Metals		
Analytes	**Sample Results**	
	Unit	***Slurry Solid***
Sample Date 07/17/2007		
Aluminum	mg/kg	1910
Antimony	mg/kg	0.55
Arsenic	mg/kg	1.2
Barium	mg/kg	99.2
Beryllium	mg/kg	0.425
Cadmium	mg/kg	ND
Calcium	mg/kg	424
Chromium	mg/kg	2.77
Cobalt	mg/kg	1.99
Copper	mg/kg	4.59
Iron	mg/kg	2060
Lead	mg/kg	2.95
Magnesium	mg/kg	620
Manganese	mg/kg	22.5
Mercury	mg/kg	ND
Molybdenum	mg/kg	0.395
Nickel	mg/kg	4.34
Potassium	mg/kg	931
Selenium	mg/kg	ND
Silicon	mg/kg	453
Silver	mg/kg	ND
Sodium	mg/kg	44.3
Strontium	mg/kg	16.8
Thallium	mg/kg	ND
Vanadium	mg/kg	3.14
Zinc	mg/kg	8.6

TABLE 18: Slurry Solid Phase Organic Chemistry.

SM-Slurry Solid Phase Organic Chemistry (> ND)

Analyte	Benchmarks			Sample Results	
	ATSDR		EPA R3 RBC SSL(DAF20)	Unit	Southern Mineral
	Value	Basis			Slurry Solid
Sample Date					7/17/2007
Volatile Organic Compound					
***ND_ FOR ALL COMPOUNDS**	*See appendices			ug/Kg	
Semi-Volatile Organic Compounds					
Benzo(a)pyrene(C20H12)	0.1mg/kg	ATSDR CREG	0.12mg/kg(C)	mg/kg	0.167
Benzo(g,h,i)perylene(C22H12)	0.1mg/kg	ATSDR CREG		mg/kg	0.092
Benzo(k)fluoranthene(C20H12)	2.2mg/kg	Reg III, RBC(R. Soil)	15mg/kg©	mg/kg	0.191
Chrysene(C18H12)	22mg/kg	Reg III, RBC(R. Soil)	48 mg/kg©	mg/kg	0.528
Fluoranthene(C16H10)	2000mg/kg	ATSDR RMEG Child	6300mg/kg (N)	mg/kg	0.078
Fluorene(C13H10)	2000 mg/kg	ATSDR RMEG Child	140mg/kg(N)	mg/kg	0.327
Naphthalene(C10H8)			0.15mg/kg(N)	mg/kg	0.069
Phenanthrene(C14H10)				mg/kg	0.949
Pyrene(C16H10)	2,000mg/kg	ATSDR RMEG Child	680mg/kg(N)	mg/kg	0.136
Semi-Volatile Range Organic					
TPH (Diesel Range)				mg/kg	280
TPH (Oil Range)				mg/kg	391

ATSDR- Agency for Toxic Substances and Disease Registry
EPA Region 3, Risk Based Concentrations, Soil Screening Levels, Dilution-Attenuation Factor = 20 (N) - (C) -

Conceptual Findings

The purpose of this study was an environmental concern with the fate and transport of coal slurry injectate into abandoned underground coal seams in McDowell County as is part of a legislative SCR-15 UIC study.

1. The Southern Minerals, Inc. site was chosen because slurry injection has been ongoing for several decades and has some historical data available. These abandoned coal seams are also used as sources of public water supplies for some surrounding communities.

2. The WVDEP records indicated that the Fire Creek seam and possibly the Beckley seams are the current seams being processed at the preparation plant. Historically the Pocahontas No. 3 and No. 4 coal seams were processed at the plant. The latter mine seam voids are the target for decades of slurry injection. These coal seams are hydrologically connected as evidenced from open slopes from one seam to the other.

3. The Pocahontas Formation coal seam voids are the main source of groundwater for public consumption in McDowell County. Wells are commonly 50 to 300 feet deep and typically produce one to 100 gallons per minute of water (National Water Summary, 1984).

4. Two public water supply wells were identified within the study area. The Big Four PSD Water System sample site SM-1 is approximately 1.5 miles up-dip from the active injection site identified as UIC-201.

5. Analytical results for The Big Four PSD indicated no detection of semi-volatile organic compounds or volatile organic compounds for SM-1R (raw water). Results for SM-1T (treated) indicated non-detect for Semi-Volatile Organic Compounds with a detection of two VOCs which were bromodichloromethane 1.1ug/L and chloroform 1.7ug/L which according to EPA's links between common sources and possible contaminants could be associated with disinfection byproducts. No semi-volatile range organics TPHs were detected in either sample.

6. There is no public sewerage coverage within the Town of Big Four with residents utilizing (in general) within the study area direct discharge to creeks and streams. The infiltration of raw sewage from area residents into surface and ground water sources could be a source contributor to the overall water chemistry.

7. The Welch PSD Water System noted as SM-8, is approximately six miles northwest down-dip from the active injection site UIC-201.

8. Analytical results for The Welch PSD indicated no detection of semi-volatile organic compounds or volatile organic compounds for SM-1R (raw water). Results for SM-1T (treated) indicated non-detect for Semi-VOCs with a detection of two Volatile Organic Compounds which were bromodichloromethane 16.7ug/L and dibromochloromethane 2 ug/L which according to EPA's links between common sources and possible contaminants could be associated with disinfection byproducts. No semi-volatile range organics TPHs were detected in either sample.

9. The PSD water systems both met EPA Primary Drinking Water Standards at the time of this sampling event.

10. Sample site GW-1 (SM-5a and SM-5b) was previously used as a groundwater monitoring well but for the past several years had been used as a slurry injection site. Analytical results indicated no detection of semi-volatile organic compounds or volatile organic compounds for SM-5b (shallow sample). The results for SM-5a (deep) indicates no detection with the exception of two analytes detected below quantitation limits for semi-volatile organic compounds with no detection of volatile organic compounds.

11. Two instream samples were taken in Elkhorn Creek. One was taken above the injection sites and denoted as SM-4. The second instream sample was taken downstream of the preparation plant and denoted as SM-3. Elkhorn Creek is the immediate receiving stream of any discharges from the Superior Preparation Plant. Analytical results indicated no detection of

semi-volatile organic compounds or volatile organic compounds. Dissolved metal analytes detected below quantitation limits. The most significant finding for the instream samples is the potential for a significant zone of mineralization due to the high alkalinity. Alkalinity is important for fish and aquatic life because it protects or buffers against rapid pH changes. Living organisms, especially aquatic life, function best in a pH range of 6.0 to 9.0 (SU). Alkalinity is a measure of how much acid can be added to a liquid without causing a large change in pH. Higher alkalinity levels in surface waters will buffer acid rain and other acid wastes and prevent pH changes that are harmful to aquatic life.

12. SM-3 is down-dip of the active slurry injection sites and several remnant reclaimed refuse and abandoned mine sites. Analytical results indicated no detection of semi-volatile organic compounds or volatile organic compounds. Dissolved metal analytes detected below quantitation limits.

13. Sample sites SM-6, SM-9, and SM-7 are artesian discharges. SM-6 is an artesian spring that surfaces along US Route 52. SM-9 is an artesian discharge along Elkhorn Creek at Maitland and the nearest discharge from the active slurry injection site which is approximately one and half mile away. SM-7 is a large downdip artesian discharge from the abandoned adjacent Capels Mine. These sites are being influenced by structural hydraulic gradient allowing the deep groundwater to migrate toward the surface within fracture zones that are related to the Mullens Syncline. Water chemistry for these sites indicates that these waters are mixing with shallow ground water (fresher water) with deeper circulation of mine pool groundwater.

14. Analytical results of SM-6, 7 and 9 indicated no detection of semi-volatile organic compounds or volatile organic compounds. Dissolved metal analytes determined for these samples detected below limits with the exception of elevated iron in samples SM-6 and SM-9. The analyses are characteristic of the Pocahontas No. 3 and No. 4 coal seam inundated discharges when compared to discharges from the same seams outside the scope of slurry injection.

15. SM-2 sampling site is a remnant sediment pond located at the base of a reclaimed refuse pile along US Route 52. TDS are in the high range of 1,180 mg/L with high sulfate of 932 mg/L and low alkalinity of 18.9 mg/L. The pond shows weathering of sulfide minerals that oxidized before mixing of surface water with the refuse material. Analytical results indicated no detection of semi-volatile organic compounds or volatile organic compounds as well as, no semi-volatile range organics TPHs. Dissolved metal analytes detected below quantitation limits with the exception of Calcium and Magnesium.

16. A sample of the liquid slurry phase from the Fire Creek coal seam was analyzed. Analytical results indicated no detection of semi-volatile organic compounds or volatile organic compounds as well as no semi-volatile range organics TPHs for the liquid phase of the slurry. Most of the dissolved metal analytes determined for the liquid slurry detected below quantitation limits with the exception of elevated aluminum and iron. Sodium was reported at 58.8 mg/L and is listed as a metal on the contaminant candidate list.

17. A sample of the solid phase slurry from the Fire Creek coal seam was separated and analyzed from the coal slurry. Analytical results indicated nine detections of semi-volatile organic compounds which were mostly detected below quantitation limits. No volatile organic compounds were detected. Semi-volatile range organics, TPHs were detected in the solids with diesel range organics (DRO) at 280 mg/Kg and ORO at 391 mg/Kg.

18. According to the EPA Region 3, Risk Based Concentrations, Soil Screening Levels, Dilution Attenuation Factor 20 guidelines, the solid phase (sediment) showed metals concentrations substantially exceeded sediment quality guidelines. Aluminum, barium, iron, magnesium, potassium, silicon, lead, zinc, copper, and arsenic were common contributors to the exceedances. It is important to note that these constituents were found at high levels only in the solids. It was undetermined if these compounds were derived from the coal or from the chemicals used in the processing plant.

19. The UIC slurry compliance data gathered from April 01, 2007 to June 01, 2008 listed one sample of chromium at a level of 0.545 mg/L as the only parameter of compliance concern.

20. The numerous gas well production activities were not considered as part of this study and may be a nonpoint source contributor to the overall water chemistry of the high sodium content in the raw water sample of the Welch PSD.

21. The overlying strata mineralogy influence and contributions of naturally elements was not considered as part of the hydrochemistry study which may be a source of influence in the overall water chemistry.

Conclusions

The overall assessment for Southern Minerals, Inc. indicates the surface and ground water sample sites did not show either the presence, or elevated levels of metals, organic or inorganic compound concentrations. The concentrations of metals and organic compounds occurred in the coal slurry solid phase.

Only generalized groundwater levels were collected during this project and it is therefore not possible to make quantifiable statements about the direction or rate and volume of ground and surface water flow. The data collected met only the limited needs of this study to assess baseline concentrations of selected contaminants in water.

To obtain the sustained UIC required mine pool level for injection sites, water levels will need to be measured on a more frequent and regular, long-term basis in order to develop a map of the groundwater surface.

If further study is to be made of groundwater and surface water movement and transport of contaminants for the study area, additional data collection sites will be required for more thorough monitoring of groundwater levels and contaminants.

Coal slurry constituents show little, if any, trend with either depth or location in regards to all sites sampled. More extensive sampling, both vertically and laterally, might show presently undetected patterns to potential contaminant distribution.

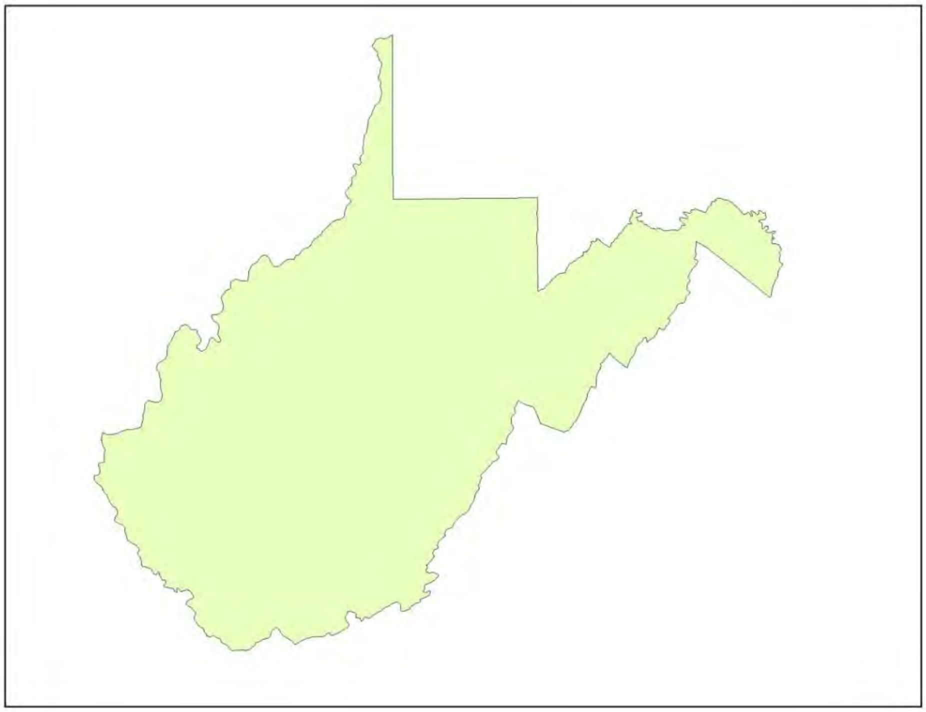
Allowable UIC maintained permitted mine pool elevations exceeded the threshold elevation in several locations as evidence by the artesianing and gravity discharges. Underground mining has resulted in a vast series of voids in the two mined coal beds that are inundated and interconnected at many places and allows for extensive dilution of constituents.

The ultimate goal of the SCR-15 UIC study was to assess whether injection of coal slurry had adversely impacted surrounding groundwater and the receiving streams of Elkhorn Creek watershed.

What effects were detected could not clearly be differentiated from present or past mining activity, dissolution from the slurry injection, or other human activities. The finished consumable water supply from both public water systems met EPA Primary Drinking Water Standards for the one-time sample taken.

Loadout LLC, Hydrologic Assessment Report

For Senate Concurrent Resolution -15



Nick Schaer, West Virginia Division of Environmental Protection

Introduction

All slurry and refuse placement conducted by Loadout, LLC occurred within Fork Creek watershed of the Big Coal River. Fork Creek watershed flow into the Big Coal River near the confluence of Big and Little Coal Rivers. The watershed of Fork Creek was almost devoid of all mining related disturbances prior to 1996. The only mining related disturbance in this watershed prior to 1996, was an artesian deep mine discharge from the abandoned Nellis deep mine that was occurring in Wilderness Fork. After 1996 large scale deep mining, surface mining, refuse placement and the surface and underground disposal of coal slurry began to take place in many areas of the watershed. Because of the timing of these activities, Fork Creek is the only watershed in which coal slurry injection is occurring that comparison of a non-coal influenced baseline is possible.

Map LHAR-1 shows about a dozen permits within the Fork Creek watershed. None of these permits were active prior to 1996. These include a preparation plant O-5021-98, two deep mines, two surface mines and three refuse disposal areas. The large surface mine S-5040-90 and Slurry Impoundment O-5010-99 shown in the southern part of Fork Creek watershed were both not started at the time of this investigation and will have no impact on surface and groundwater quantity and quality at the time of this study.

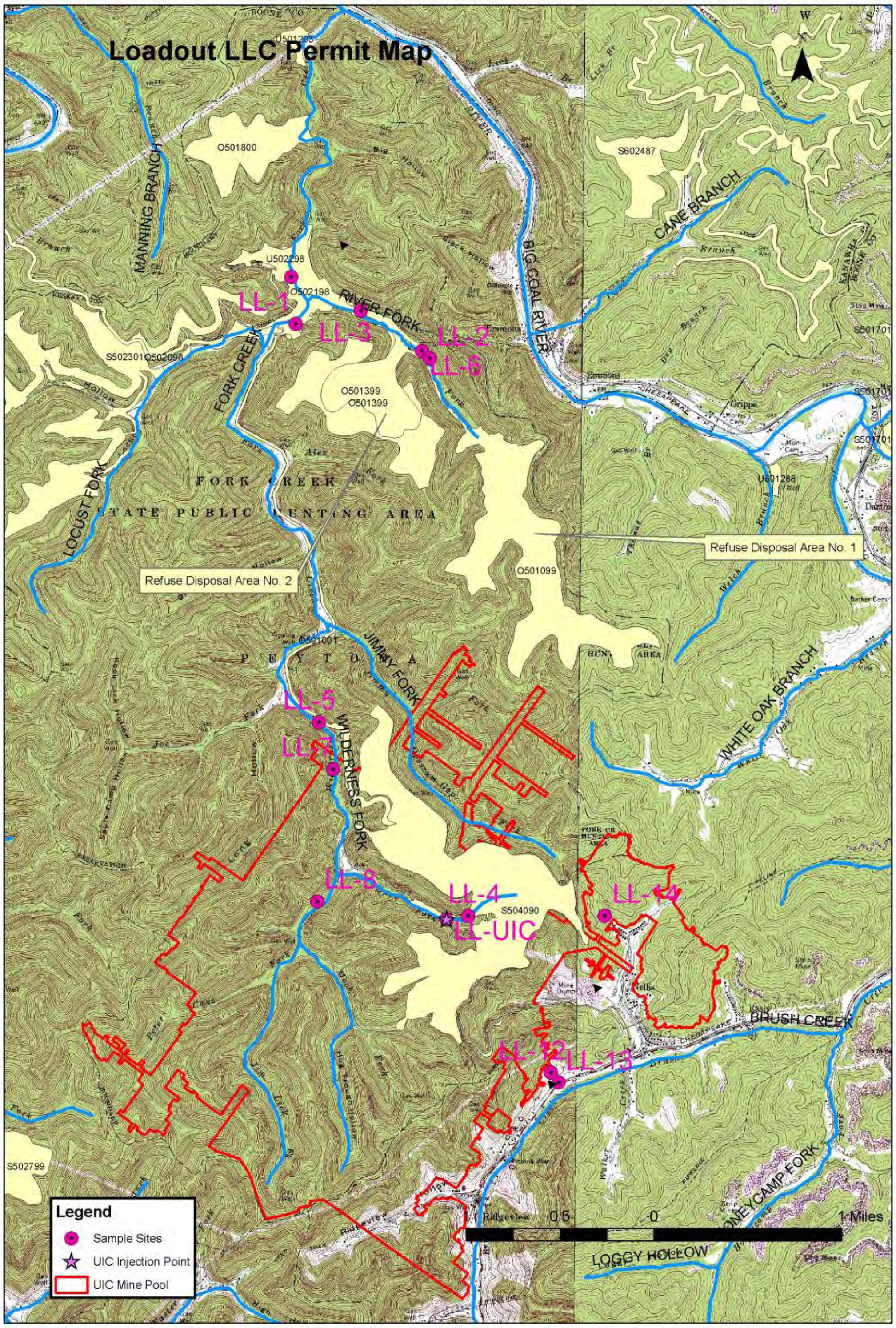


Figure LHAR-1 Permits approved in Fork Creek watershed.

Site History

Loadout, LLC, began the underground injection of coal slurry in 1998 and continued this practice until May of 2006. No slurry injection has taken place since 2006. All slurry was injected into the abandoned Nellis deep mine in the Eagle Coal seam. The Eagle Coal seam has also locally been referred to as the No. 2 Gas coal seam. All slurry was injected at the abandoned Nellis mine slope up Dave Fork labeled as LL-UIC on the Loadout LLC Hydrology map. During the time period of active injection water level was maintained by pumping at the down dip end of the Nellis mine void. At this time Loadout LLC no longer maintains an approved permit to inject slurry underground. Loadout LLC conduct slurry injection under UIC permit 0292-00-005. Coal slurry and refuse created by Loadout LLC is primarily from the Eagle Coal seam. However, smaller amount of #2 Gas and #5 Block Coal seams were also processed at this facility.

Since May of 2006, all coal slurry created by Loadout LLC at this preparation plant has been placed in disposal locations that are above ground. At this time, most of the slurry disposed at the surface was placed in the Loadout, LLC Refuse Area No.2, (shown as O-5013-96 in the map above). Originally, this refuse disposal area acted as a slurry impoundment and it is presently operated as a slurry cell operation. The larger Refuse Area No. 1 O-5010-99 was never fully approved as previously detailed. Because all injection of slurry ceased in 2006, any testing of slurry material conducted as part of SCR-15 cannot be directly correlated to that was actually injected.

Based on interviews with the mine inspector for the Loadout LLC facilities, there was an unplanned slurry release in Wilderness Fork around 2005. A failure in the mine pumping system allowed slurry to build up in the Nellis mine unchecked. Eventually black slurry water emanated as an artesian flow at both LL-7 and the injection point LL-UIC. Blackwater flowed from these two points into Dave and Wilderness Fork.

Picture LHAR-1: This picture shows the injection point LL-UIC with injection pipes still installed. The large opening to the mine shaft is covered with a metal plate. This point leaked slurry during the 2005 event.

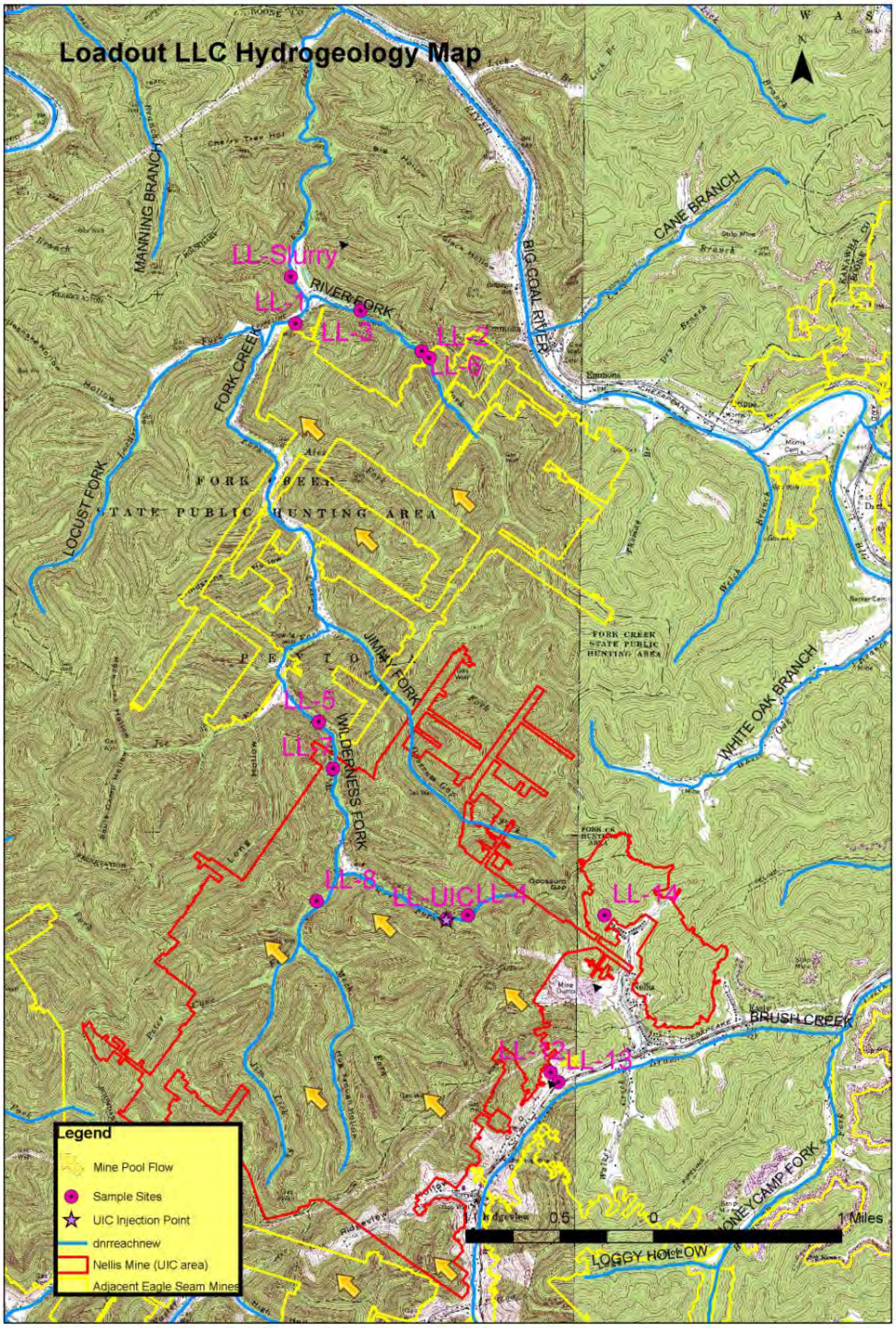


Figure LHAR-2: The hydrology map of the Fork Creek watershed. Note the abandoned Nellis deep mine, which received slurry, is shown in red. General groundwater flow is shown with yellow arrows.

Surface Water Hydrology

The primary operations of Loadout LLC; including its preparation plant, refuse disposal areas and the underground injection site lie within Fork Creek watershed. With the exception of the abandoned Nellis deep mine, all surface disturbances within Fork Creek watershed took place after 1996. For this reason, the southern aspects of Fork Creek watershed are still free from any mining-related impacts. This would include large parts of River Fork and many branches of Wilderness Fork.

NAME	NOTES	Old_Name	POINT_X	POINT_Y	date_	Sample Type
LL-1	Active Mine Raw		431893.9	4228991.7	9/25/2007	Groundwater
LL-2	Upstream of refuse pile	URF-2	433042.3	4228694.6	6/17/2008	Surface water
LL-3	Downstream of refuse pile	URF	432453.0	4229104.3	6/17/2008	Surface water
LL-4	Upstream of pump	UDF-1	433373.0	4223899.7	9/25/2007	Surface water
LL-5	Downstream near mine pump	DWF	432091.6	4225565.4	9/25/2007	Surface water
LL-6	Refuse pile discharge	005	432977.8	4228756.5	9/25/2007	Surface water
LL-7	Nellis Mine Pump	006	432216.7	4225161.6	9/25/2007	Groundwater
LL-8 a/b	Hole 17 a-lower pool b-upper pool	223	432076.3	4224022.1	9/25/2007	Groundwater
LL-12	Possible Seep		434084.7	4222549.5	9/25/2007	Groundwater
LL-13	Private Well		434149.3	4222465.7	9/25/2007	Groundwater
LL-14	Bricktown deep mine flow		434543.5	4223902.5	6/17/2008	Groundwater
LL-Slurry	Raw slurry		431854.2	4229393.8	6/17/2008	Slurry

Table LHAR-1: Water samples taken during the SCR-15 study.

As detailed in Table LHAR-1 and shown the Loadout LLC hydrogeology map there were five surface water samples taken for the SCR-15 study. Two samples were taken upstream of mining related water quality impacts: this includes LL-4 and LL-2. LL-3 was collected at the discharge point for Refuse Disposal Area No. 2. LL-3 and LL-5 were taken at point downstream of mining and potential slurry impacts. The water quality results for these samples are found in Appendix

II-O. In addition groundwater sample LL-7 directly discharged to the Wilderness Fork and would therefore directly impact surface water down stream.

Mercury, cadmium, arsenic, chromium, beryllium, silver, and vanadium all show no detectable levels in any surface waters samples in and in the samples collected at the surface operations of Loadout LLC, including direct runoff from the active refuse and slurry pile. Zinc, lead, antimony, copper, barium, nickel, molybdenum were all at concentrations well below EPA drinking water standards and show no obvious correlation to the proximity of mining activities let alone being indicative of slurry or refuse disposal. SCR-15 surface water sampling results for dissolved aluminum show levels as high as 0.25 mg/L which is above EPA secondary drinking water standards; however some of the highest values found in this study were at waters quality sample locations undisturbed by mining. No mining-related trends in aluminum were seen in the SCR-15 water samples. Concentrations of iron and manganese appear to be slightly higher downstream of mining activities which would include slurry and refuse placement, but these levels are minor compared to those found in the up-dip ground water samples (LL-12 and LL-13). These two sample sites appear to show impacts associated with alkaline iron mine drainage chemistry. An inorganic constituent that appears to show a slight correlation to slurry and refuse disposal is strontium which has a dissolved level of 1.09 mg/L at the refuse pile discharge. It is also elevated in LL-3, just down stream of this discharge. There is no EPA drinking or West Virginia surface water standard for strontium, which appears elevated in water samples downstream of much of mining activity sampled in this study.

Elevated levels of alkalinity, total dissolved solids, sulfates and conductivity appear in SCR-15 samples LL-6 and LL-3. Both of these samples sites are immediately downstream of large scale placement of coal refuse and slurry. These concentrations appear to be the highest at the direct discharge from the refuse disposal area. This same general trend is also seen in the baseline historical data for Fork Creek and in the cation and anion analyses which are discussed later.

The SCR-15 water analyses showed no organic chemicals at delectable levels in any of the surface waters that were collected.

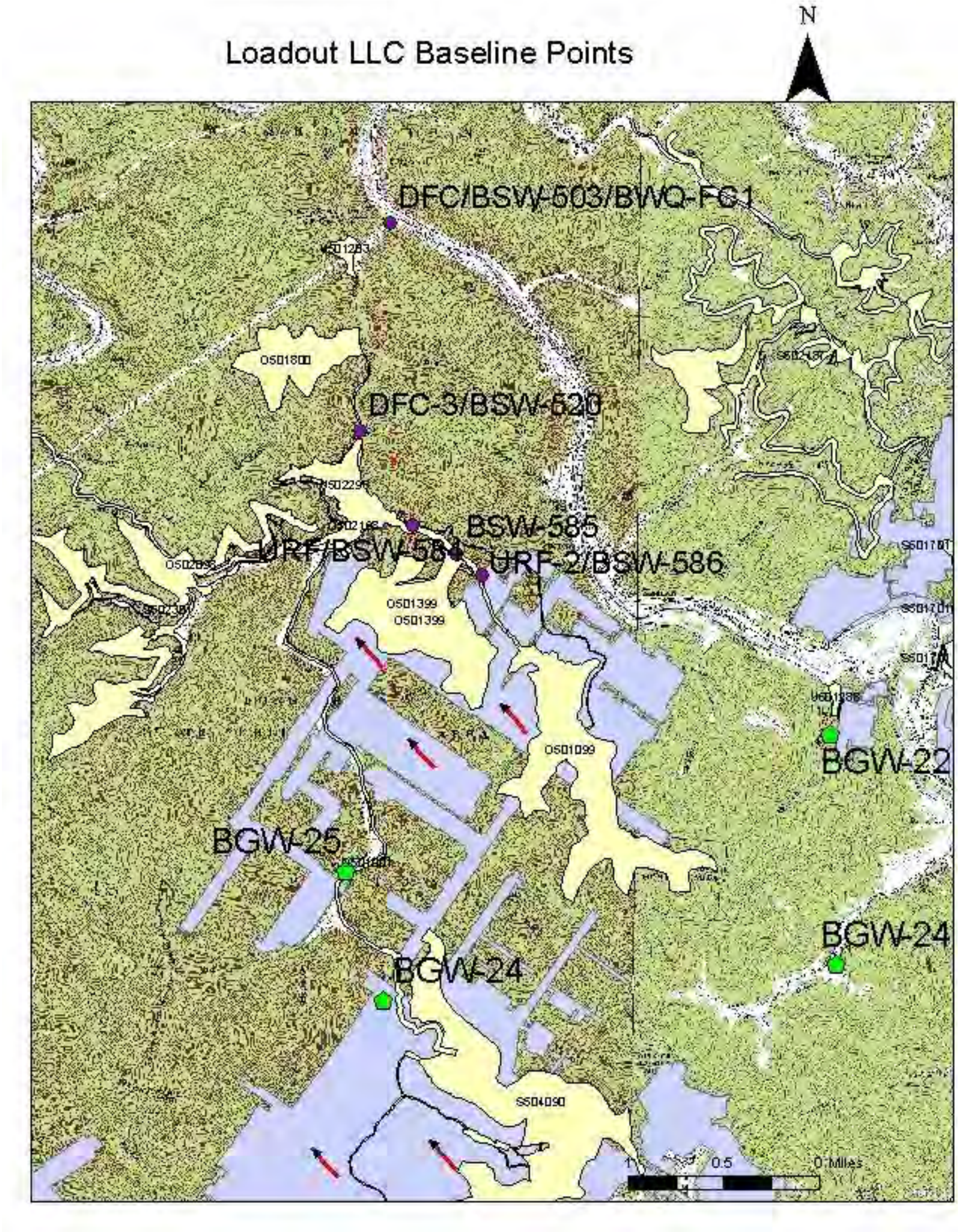


Figure LHAR-3: Location for referenced surface and groundwater baseline monitoring sites.

The historic water sampling conducted in Fork Creek watershed was primarily conducted as baseline data collection for proposed permits and permit amendments in Fork Creek. During-mining water monitoring also occurred on many Loadout, LLC permits. Most during-mining monitoring in Fork Creek appears to be surface water sampling. Surface and ground water monitoring samples were reviewed from O-5013-99 and O-5021-98 and representative data from these two permits were included in the Loadout Appendix. The location of these referenced water sample point are shown in Figure LHAR-3 above. Location DFC-3 has also been sampled by the WVDEP stream sampling program.

No organic chemistry sampling has been conducted in Fork Creek watershed. This includes both WVDEP sampling and mining permit sampling.

Only limited heavy metal sampling has been conducted in Fork Creek watershed prior to the SCR-15 study. Baseline heavy metal data was conducted for the O-5013-99 permit amendment. The baseline water sampling in the Loadout Appendix shows that all tested heavy metal parameters remained below minimum detection limits with the exception of selenium which was detected at a concentration of 3.0 μg/L just below the preparation plant.

There is an abundance of mining permit baseline water quality data throughout Fork Creek watershed from time period prior to all mining up to the present. Baseline water quality parameters show a general trend of increasing levels of total dissolved solids, conductivity, alkalinity and sulfate below active coal mine disturbances. All four of these components appear to rise in tandem below larger scale mining activities, which includes surface mining and refuse/slurry disposal. A comparison of SCR-15 collected data below the active Refuse Disposal Area No. 2 and points farther downstream associated with the Loadout preparation plant and nearby surface mining show that the refuse and slurry contribute less than other mining related sources to concentration increases. The trend of increasing TDS, alkalinity, and sulfate appears to occur over time as mining developed within this watershed and is also visible in an upstream to downstream comparisons.

Iron and sulfur bacteria were generally detected in all surface water samples. Testing throughout this study has shown them to be ubiquitous.

Cation and Anion Surface Water Analysis

Non-mining disturbed surface water can be seen in sample LL-4 and LL-2 and any instream baseline sampling of Fork Creek watershed prior to 1996. Sulfate concentrations below 30 mg/L and total dissolved solids concentrations below 120 mg/L are common for such unimpacted surface water. However even in undisturbed areas precipitation events can cause occasional spikes in these parameters as seen periodically in the long term surface water baseline monitoring points. The Stiff diagrams from undisturbed locations show sulfate levels that are generally low under ambient conditions. The major difference between the two samples (LL-2 and LL-4) is the mildly elevated carbonate/bicarbonate levels found in LL-4.

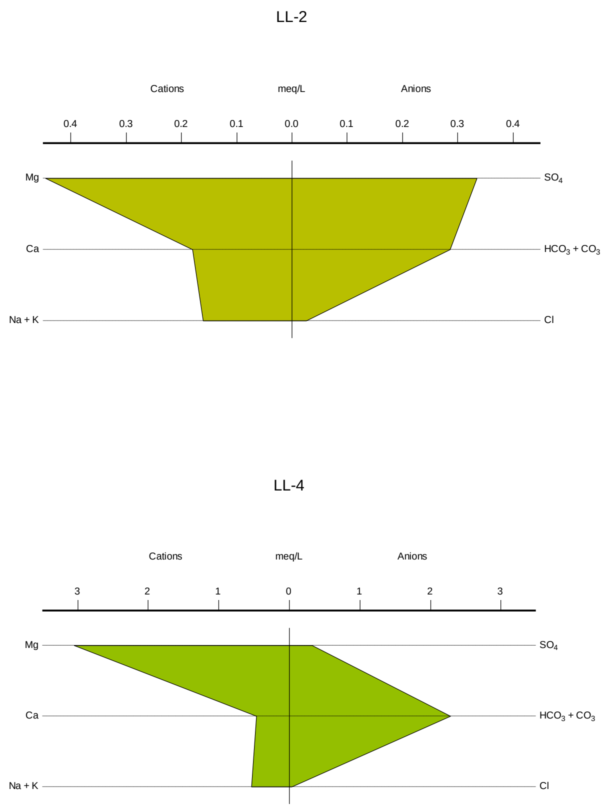


Figure LHAR-4: Stiff diagrams of the two undisturbed by mining samples

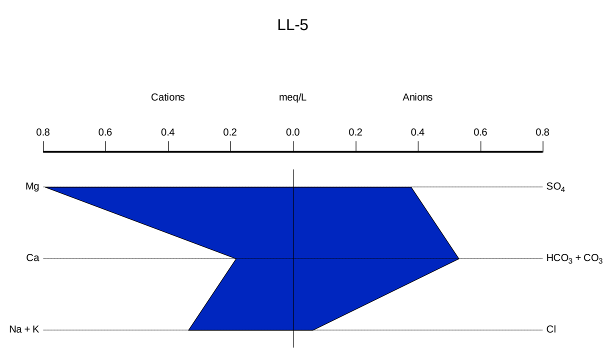
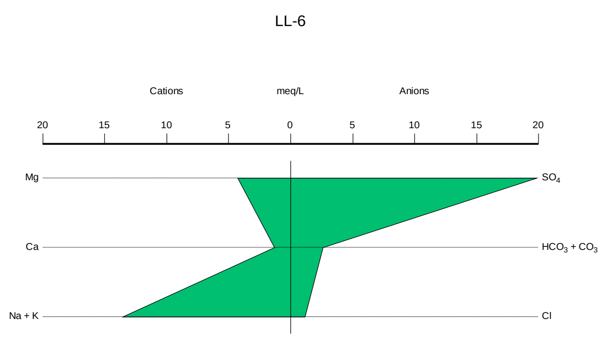


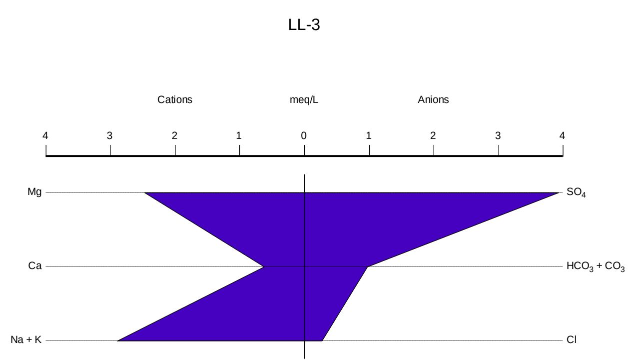
Figure LHAR-5: LL-5 is just downstream of the pump site for the abandoned Nellis deep mine.

Stiff analysis for LL-5, seen in figure above, shows that its water quality character is similar to that of the ambient water quality seen in the two samples included above. This would indicate that the pumped mine water from the Nellis mine had little impact on water quality at this point.

However, pumping of the Nellis mine pool was not conducted on a regular basis. Even though the Nellis mine was being pumped on the day LL-5 was sampled, it may not have impacted water quality downstream. The Stiff diagrams also indicate that the raw slurry artesian discharge event that occurred in 2005 has no discernable impact on present water quality.

Runnoff from Refuse Disposal Area No. 2 was sampled at LL-6. The water sample shows increases in concentrations of dissolved solids, sulfates and other constituents that often elevated downstream of mining activities. No heavy metals or organic compounds showed a unique signature in their association with surface slurry and refuse placement. Strontium was found to be elevated at LL-6, with levels of over 1 µg/L. Strontium levels seem too generally increase downstream of all mining impacts, but these increases are even more pronounced downstream of the Refuse Disposal Area No. 2. Cation and anion analysis conducted as part of PIPER and Stiff diagrams conducted for each sample collected for this study show that LL-6 most closely resembled raw slurry samples of any surface or groundwater sample taken on Fork Creek.





LHAR-6: LL-6 and LL-5 show Stiff diagrams of surface water points down stream of refuse and slurry placement.

As previously detailed, mining disturbances in Fork Creek watershed did not occur prior 1996. Prior this time almost no mining had occurred anywhere in Fork Creek. The most distinct impact of the mining is the increases in dissolved solids and sulfate. This can also be seen in the Stiff diagrams signature of surface waters upstream and down steam of mining. These changes were discussed in greater detail in the (US EPA, 2003). With the exception of the slightly elevated strontium levels and a somewhat distinctive cation to anion relationship no distinctive trace signature of slurry and or refuse can be seen surface water quality samples.

Groundwater Hydrogeology

The groundwater movement in the Fork Creek watershed is governed by the near surface fracture system at a shallow depths(<200 feet) and the dip driven mine voids (Wyrick and Brochers, 1981). The most extensive and deepest of these deep mines is the extensive Eagle Seam mine works. These mine works are shown the Loadout LLC Hydrogeology map. These abandoned and active mine works underlie much of Fork Creek watershed and they dominate groundwater movement in this watershed. Within these open mine voids groundwater will flow in a down dip direction.

All slurry injection at Loadout LLC occurred in the abandoned Nellis mine shown in red on the Map LHAR-2 and the larger Hydrogeology Map. A large mine pool has formed at the down dip end of the Nellis mine. Unless this mine pool is regularly pumped, water will flow under sufficient head in an artesian fashion from the borehole at sample site LL-7. This situation occurred prior to modern mining in 1996 and during the previously discussed pump failure in 2005. If contamination were to occur from slurry injection, it would most likely in the down-dip section of the Nellis mine pool or groundwater sources immediately down-dip (Mine discharge LL-1).

Picture LHAR-2: Picture shows the pump at LL-7 and the associated ponds.

As shown in Table LHAR-1 and the hydrogeology map, groundwater sample points collected as part of the SCR-15 study at Loadout, LLC include LL-1, LL-7, LL-8a, LL-8b, LL-12, LL-13 and LL-14.

Samples LL-1, LL-7, LL-12, LL-8a and LL-8b all represent groundwater associated with mine pools in the Eagle coal seam. Four separate samples were taken from the Nellis mine, which received the coal slurry injection. Sample LL-13 is from a deep mine, located in the #2 Gas seam which lies above the Eagle Coal seam.

The metal concentrations in ground water showed similar trends as those previously discussed for surface waters. However, the ground water samples showed higher levels of sodium, potassium, carbonate and sulfates as compared to surface waters. Strontium also showed up in elevated concentrations in several groundwater samples associated with abandoned deep mine works in the Eagle seam up dip of the slurry injection. These up dip Eagle seam works also appear to have elevated iron and manganese concentrations. Aluminum concentrations show up as elevated in many samples, including both up-dip samples. Aluminum is most notably elevated in total concentrations in the up-dip Eagle seam seep and the active Eagle seam pumped water. In both cases total aluminum levels of greater than 5 mg/L were reported. This indicates elevated aluminum levels do not correlate with slurry or refuse beyond a general association with mining activity. Sample LL-12 appears illustrate alkaline iron mine drainage contamination. It is visibly stained with iron and has elevated levels of iron, manganese, beryllium, aluminum, nickel and sulfate. The raw pumped mine water from active Loadout LLC Eagle seam deep mine show an elevated concentration of total lead of 0.0184 mg/L. This elevated level of lead does not correspond to any similar elevations in the mine pool containing slurry.

With one exception, no groundwater sampling point associated with the SCR-15 study detected any organic constituents; this includes both volatile and non-volatile components. The one exception of this is a 0.6 µg/L detection of 1,2,4-Trimethylbenzene at point LL-7, the Nellis abandoned deep mine pump site. This is a very low concentration and does not appear to be associated with any raw slurry sampled here or elsewhere. This is not a constituent listed in the coal preparation process at Loadout and it was not detected in raw slurry at Loadout. It is possible a fuel material used in the deep mine is the source of this chemical. However the source of this chemical could also be from slurry. Given the extremely low level of this detection a false positive is also possible.

Baseline regulatory samples, included in the Loadout Appendix, show elevated alkalinity and sulfates concentrations in all tested ground water sampled at this site. All groundwater sampled as part of the SCR-15 study at Loadout is at least indirectly impacted by deep mine activity. As shown in Appendix II-O-2 sodium, potassium, carbonate and to a lesser extent sulfates are slightly elevated in all SCR-15 groundwater samples. Aluminum levels show up as elevated in many samples. Aluminum is most notably elevated in total levels in the up-dip Eagle seam seep and the active Eagle seam pumped water. In both cases total aluminum levels of greater than 5 mg/L were noted. These elevated Aluminum levels show no real correlation with slurry or refuse beyond a general association with mining activity. Sample LL-12 appears to have alkaline iron mine drainage contamination. It is visibly stained with iron and has elevated levels of iron, manganese, aluminum, and sulfate.

No baseline groundwater sampling from Loadout, LLC tested for organics and heavy metals. In fact, very little baseline groundwater sampling was found in the area of the Loadout LLC and its injection site. The only baseline groundwater monitoring that occurred in Fork Creek Watershed was conducted at various abandoned deep mines in Eagle Coal seam and at a well down dip of the Nellis deep mine. This data, shown in the Loadout Appendix, showed elevated concentrations of total dissolved solids and sulfates in the abandoned deep mines with the more up-dip unflooded mines having higher concentrations of each parameter. These mine waters also exhibited higher concentrations of iron and aluminum. All of these trends were seen in the ground water sampling associated with SCR-15. The down dip artesian well, BGW-25, no longer flows at this time due to the continual pumping done at site LL-7/BGW-24. Because of this, no sample was taken at this location for the SCR-15 study. Prior to pumping in the Nellis mine the well at BGW-24 was also an artesian discharge. The quality of this well showed little impact from the abandoned mine just up-dip. However its continual flow indicates it had a hydrologic connection water in the abandoned Nellis mine.

Iron-related and sulfur-reducing bacteria were detected in all surface and ground water samples for which they were analyzed. In samples from static ground water, like deep mine pools or wells bacteria counts were found to be the highest.

The abandoned Nellis deep mine is the only deep mine to receive slurry injectate in the Fork Creek watershed. All slurry was injected at the abandoned Nellis mine slope, which is located in Dave Fork. This point is shown as LL-UIC on the Loadout LLC hydrogeology map. This map also shows flow arrows based on coal structure contours for the Eagle seam as mapped by the West Virginia Geologic and Economic Survey. This coal seam contour information shows the stratum dips to the northwest. In the void space of the abandoned Nellis Mine groundwater and the liquid fraction of slurry would quickly move down dip and collect in the northwest part of the deep mine. Prior, during and after underground injection, the Nellis mine pool water has been pumped from the low end of the mine at LL-7/BGW-24. To avoid mine pool discharge problems, the Nellis mine pool has always been pumped. The pumped water at this point is sampled regularly as a NPDES discharge point and is required to meet NPDES permit limits at the outfall for iron, manganese, pH and suspended solids. When the pump worked properly, mine pool in the Nellis deep mine was kept below the elevation of the LL-7/BGW-24 slope at about 765 feet above sea level. One notable exception to this was caused by a 2005 pump failure.

The abandoned mine section in the up dip end of the mine, along Brush Creek, are hydrologically isolated from the main mine pool and any direct impact from slurry injections. This would include the seep at LL-12, the well sampled at LL-13 and abandoned mine sampled at LL-14. However water from these locations could flow from isolated up-dip pools.

Stiff diagrams indicate in figure LHAR-7 below that ground water associated with LL-1, LL-8a, LL-8b and LL-7 (all in the Eagle Coal seam down dip) have a strong similarity.

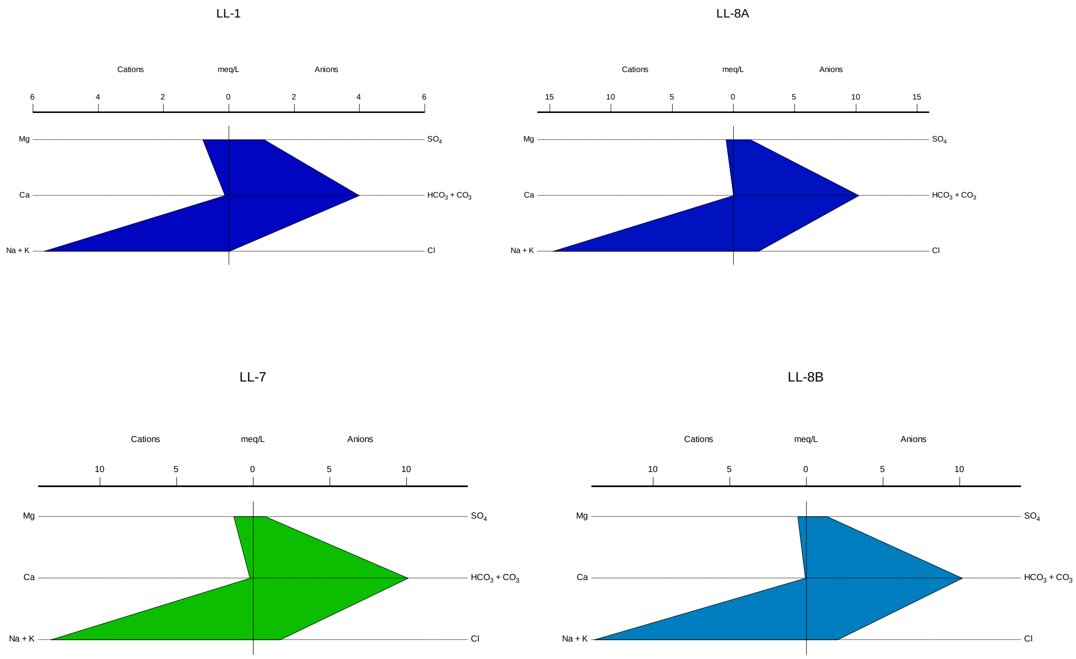


Figure LHAR- 7: Stiff diagram of LL-1, LL-8A, LL-8B, LL-7 all in the Eagle Coal seam.

These test sites all show a very close geochemical association one with higher levels of sodium, potassium, and carbonate. This grouping shows a distinct chemistry for all down dip Eagle Coal seam discharges. The elevation in the mine pool and the absence or presence of slurry does not seem to impact this distinctive signature at all. LL-7 and the LL-8 samples are all in the down dip pooled sections of the Nellis mine pool, however LL-1 is hydrologically separated from this mine pool by over 100 feet of solid coal. This pool water can be transmitted through this barrier, but it would travel much slower than it would through open seam mine void. Low levels of suspended solids in the LL-1 sample would indicate that no raw slurry solids are being transported through the solid coal barrier.

The up-dip aspects of the Eagle seam mine pool seem to have very different signature as seen Figure LHAR-8 seen below.

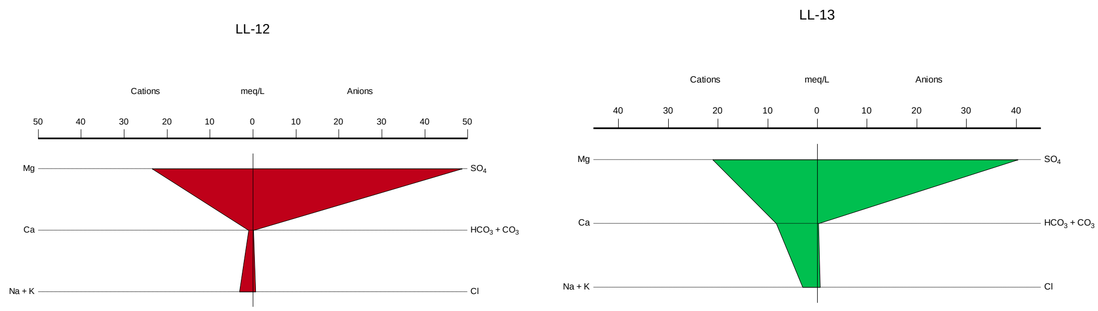


Figure LHAR-8: Stiff diagram of the LL-12 and LL-13.

Sample LL-12 and LL-13 were sampled at and near a residential well just south of the town of Nellis. The private well (LL-13) was shallow with a depth of less than 30 feet. Both LL-12 and LL-13 are on the up-dip side of the Nellis mine, well up-dip from the point of injection. L-12 both LL-13 both show elevated sulfate and magnesium. The greater amount of air in these unflooded mine sections created a different water chemistry then the down-dip samples. As previously detailed this water quality is more associated with coal related acid mine drainage. Given the similar water quality between the deep mine seep LL-12 and the nearby well LL-13 it appears they are both related to up-dip isolated mine pools associated with the Eagle Coal seam. The historic mine over flow event, previously discussed, does indicate a possible avenue for slurry contamination of the citizen well in the past, when head pressure in the mine would be at its greatest. The present sampling, conducted for SCR-15, does not provide a clear indication that any slurry impact is still occurring rather indicates impacts from the nearby abandoned deep mine.

SCR-15 sample LL-14 was taken from a discharge of an abandoned deep mine in the No. 2 Gas/Cedar Grove. It shows a different stiff diagram, compared to all other samples at this site. This groundwater sample appears to have distinctly different chemistry from water in the Eagle seam.

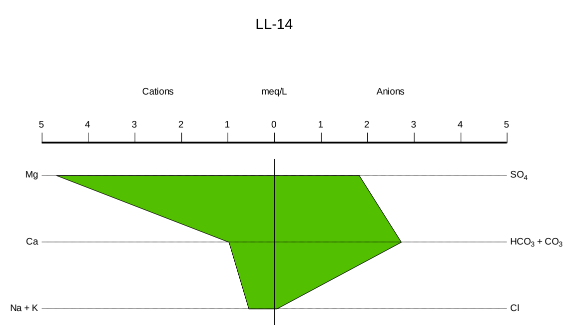


Figure LHAR-9: Stiff diagram of LL-14 and abandoned mine in the #2 Gas.

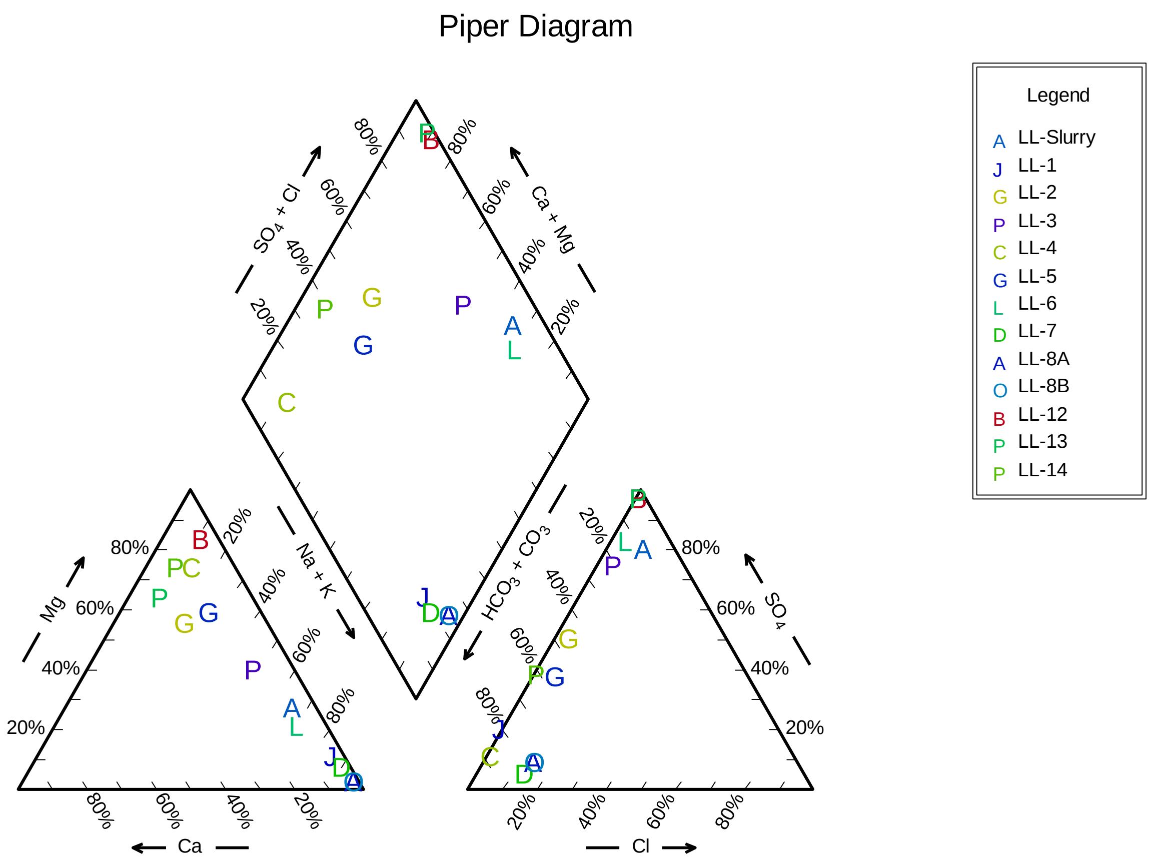


Figure LHAR-10: Piper diagram of SCR-15 Loadout LLC samples.

The Piper diagram of all the surface and ground water sampling from SCR-15, shows the strongest cluster of samples in three locations. LL-1, LL-7, LL-8a and LL-8B have one cluster in lowest sector (as J, D, A and O). These are the four down- dip Eagle Coal seam samples, that also had similar Stiff diagrams. Secondly, LL-12 and LL-13 also show a tight association (B and P). These are the two samples that show unflooded Eagle seam water quality. Finally, LL-Slurry and LL-6 (A and L) are also very close. This shows that that the sample from the refuse pile is closest too raw slurry leachate in this analysis. In addition it appears that LL-3/P is possibly related the two slurry related samples just listed.

Coal and Coal Slurry Characterization

Loadout LLC preparation plant has been in operation since just after it was permitted in 1996. It has primarily processed coal from the Eagle Coal seam, but other seams including #5 Block and # 2 Gas have also been run through this preparation plant. The slurry and coal samples collected for the SCR-15 study were specifically collected coal and slurry from the Eagle Coal seam. The slurry samples were taken at the exit pipe from the primary thickener as shown in the picture below.

Picture LHAR-3: Loadout thickener decant pipe where slurry sample is taken.

The slurry decant pipe is the location where the required WVDEP UIC compliance sampling occurred for this permit when injection was occurring. It should be noted that compliance samples for injection are no longer taken because Loadout no longer injects slurry underground. For this reason, no direct UIC numeric compliance statements can be made from the SCR-15 data.

According to the Loadout LLC UIC permit application, the preparation plant used very few chemicals in its coal separation processes when underground injection was conducted. According to the permit data, except for magnetite which is used to control specific gravity of water, the only true chemical used by the Loadout preparation plant is Nalco CAT-FLOC CFL. Nalco CAT-FLOC CFL is a flocculent often used in public water supplies. The Material Data Safety Sheet for this chemical provided in the original permit application listed the material as non-hazardous. According to the permit no diesel fuel was used by Loadout LLC in the preparation process during the time of period of active injection. A site inspection of the preparation plant by Pavanne Pettigrew and later by the local mine inspector both verified this fact. By the time of the

SCR-15 sampling all injection of slurry had ceased. For this reason it is quite possible that the chemical used in the preparation process have changed without the knowledge of the WVDEP.

Slurry was sampled from the Loadout LLC by the SCR-15 study group as was coal. Both the slurry and the coal were from the Eagle Coal seam, which was the primary coal processed at the preparation plant. Three volatile organic compounds were detected in the liquid leachate from slurry. Tables summarizing both the liquid and solid testing of coal and slurry are included in the slurry characterization section of the main SCR-15 report. These compounds were acetone, methylene chloride, and toluene. Acetone and methyl chloride are used as man-made additives in the mining industry, but these chemical were also present in coal sampled for this study. For each compound, the similar levels were found in the coal and the slurry leachate. Because of these similarities, none of these compounds would be a positive indication of preparation processed slurry. Slurry leachate also returned low level hits on Diesel Range Organics (DRO) and Oil Range Organics (ORO), less than 15 µg/L. Because both of these tests are very wide ranging, it is impossible to determine their exact source.

Naphthalene and phenanthrene were both detected in the semi-volatile range, but both were at levels below 0.015 µg/L. This is a level so low that the accuracy of the test is at question. No other semi-volatile chemicals were detected in the liquid decant from slurry or coal.

The most noticeable baseline parameter seen in the slurry leachate at Loadout is sulfate at 849 mg/L. It is also found in high levels in coal and slurry solids. The liquid leachate derived from raw coal was only exposed to coal for a short time (24 hours) so it did not show sulfate levels quite as high. Over 50% of the total dissolved solids in coal slurry liquid fraction are sulfates. Raw slurry leachate also had mildly elevated levels of strontium and aluminum. No mercury was found in any slurry sample liquid or solid at this site. All other heavy metals were below 0.015 mg/l in the slurry leachate. As previously detailed in the surface water section, the Stiff and Piper diagrams of the slurry leachate was most chemically similar to the run-off from the active Refuse Disposal Area No. 2. The cation and anion signature is distinct from other surface and ground waters at Loadout LLC. As seen in the Piper diagram, the most chemically similar water quality is the stream water quality just down-stream of the refuse area at LL-3. This signature is clearly not seen in the mine pool areas that saw underground injection. Thus it appears, that the chemical signature of the slurry is no longer present in the area of slurry injection only two years after injection ceased.

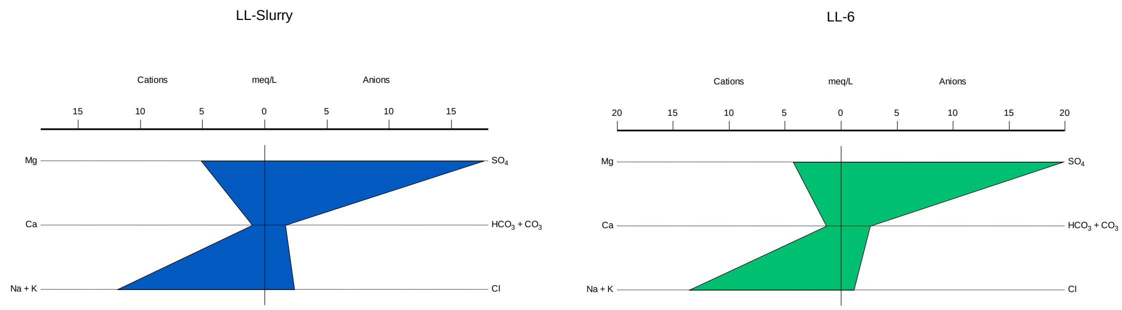


Figure LHAR-11: Stiff diagrams of raw slurry leachate and the discharge from the refuse disposal site.

Figure LHAR-11 shows just how similar the chemistry of coal slurry is to the discharge of the active Refuse Disposal Area No. 2. The water quality from this location was already discussed. No organic analytes were found in this water despite active slurry placement at this permit.

Solid phase analyses were conducted on both slurry solids and coal from Loadout LLC. Both DRO and ORO were found in each at levels above 200 mg/Kg. Both were found in higher level in raw coal than in slurry. Analysis of the solid fraction of slurry for volatile organics showed detectable levels of acetone, chloromethane and toluene. Analysis of solid coal showed these constituents and many more volatile organics. Almost 2 dozen semi-volatile organics were detected in both coal and slurry solids. The components and levels are very similar for each. Both coal and slurry were found to have elevated concentrations of bicarbonate, sulfate and chloride. Solid slurry was found to have lower levels of all tested heavy metals than the levels found in raw coal. It should be noted that the majority of components detected were not mobile in water and were never detected in slurry leachate or in the field samples.

UIC permit monitoring data from 2001 to 2006 is included in the Loadout Appendix at the end of this chapter. During this time period, the injectate appeared to have multiple compliance issues with existing numeric standards for this permit. The raw slurry was non complaint for total petroleum hydrocarbons, arsenic, beryllium, chromium, lead, nickel and selenium at least one instance during this time period. In particular, chromium and total petroleum hydrocarbons were out of compliance chronically. Because the injectate was so frequently out of compliance, it is quite questionable that UIC permit could be renewed if the UIC permit was still valid. This site was visited several times during its active injection to look for possible sources of these reported hydrocarbons. No specific source was located, but this monitoring report data brings into question whether Loadout LLC may have used diesel fuel in their preparation process (without approval). It should be noted that none of the metal or organics detailed here showed up in water quality samples for SCR-15. This included samples from the mine pool that actually received this slurry.

At the time period of this study no active oil and/or natural gas drilling was occurring in Fork Creek watershed. There were a few very old natural gas wells in the watershed, but none of them appear to have had any detectable impact on the surface or groundwater quality in Fork Creek watershed.

Conclusions

Because all slurry production at Loadout occurred after 1996 a comparison of pre-slurry water quality was possible in both surface and groundwater. In stream water quality analysis at Loadout LLC showed no detectable impact from the injection of coal slurry on the water quality of Fork Creek or its tributaries. Despite a significant slurry spill occurred several years ago, surface water quality downstream of where this event occurred shows no detectable impact from this event. The active surface slurry placement site at Loadout showed the strongest chemical signature of coal slurry. This water chemistry is far closer to raw slurry leachate then any other environmental sample collected. This signature was still detectable down-stream of this structure.

The mine pool that received direct injection did show some chemical water quality characteristics associated with slurry. These parameters included elevated concentrations of alkalinity, dissolved solids and strontium. However these and other chemical signatures were higher in the active surface slurry structure discharge. Sampling from the adjacent coal mine immediately down dip in the same seam to the mine pool that received injection showed no detectable migration of solid slurry or dissolved leachate from slurry. The pump failure event does allow for a possible avenue for slurry to have possibly reached the citizen well that was sampled, but the brief nature of that event and the present hydrologic setting no longer allows such communication.

The UIC permit compliance data for Loadout LLC taken at the point of injectate were often out of compliance for chromium and TPH. However, these elevated levels were not found in any of the hydrological samples of this study. This indicates a lack of mobility of these constituents. Any comparison of modern slurry to the slurry that was actually injected is indirect because all slurry injection ceased in 2006.

Bibliography

1. *Mountaintop Mining/Valley Fills in Appalachia Draft Programmatic Environmental Impact Statement,* U.S. Environmental Protection Agency, 2003.

2. Wyrick, G.G. and J. W. Borchers. Hydrologic Effects of Stress-Relief Fracturing in an Appalachian Valley. U. S. Geological Survey, Water Supply Paper 2177, 1981, p. 51.

Loadout Appendix

DMR Data for Loadout LLC UIC permit 0292-0C-005

DMR Data for Loadout LLC UIC permit 0292-00-005

UIC Mining Slurry
0292-00-005

For Date Ending	FTS	Inj. Point	TPH ORO (1.0 Mg/L)	TPH DRO (1.0 Mg/L)	TPH GRO (1.0 Mg/L)	Total Acrylamid (0.001 Mg/L)	Dissolved Arsenic (0.01 Mg/L)	Dissolved Beryllium (0.004 Mg/L)	Dissolved Cadmium (0.005 Mg/L)	Total Chromium (0.1 Mg/L)	Dissolved Lead (0.015 Mg/L)	Dissolved Nickel (0.1 Mg/L)	Dissolved Selenium (0.05 Mg/L)	Report Only FLOW	Report Only pH	Report Only Dissolved Aluminum	Report Only Dissolved Iron	Report Only Dissolved Manganese	Report Only TDS	Mine Pool Level
01-Jan-01		209		12	124						06		.06	1500 gpm	8.04	4.26	.79	.03	1190	698.9
		209	2 8	1.97									.0439	1500 gpm	7.92				420	699.4
01-Feb-01		209											.032	1500 gpm	7.62	.342	.031	.007	1600	706.3
01-Mar-01		209	.9	2.33									.0345	1500 gpm	7.82	.181	.112		3580	713.7
		209		.54			02							1500 gpm	8.3	2.37	.958	.013	2000	715.1
		209											.011	1500 gpm	8.03	.237	.164	.01	300	719.5
		209					022				.003			1500 gpm	8.43	2.32	2.67	.029	560	717.6
4/1/2001		209					002			2.01				1350 gpm	7.88	.29		007	300	713.7
5/1/2001		209								.124				1350 gpm		77				723.1
		209								695				1350 gpm		.08				723.6
		209		3.3	4.0		.02			3.53	003			1350 gpm	8.56	989	847	009	256	724.3
6/1/2001		209					.005			.041				1350 gpm	8.06	047	.039	009	575	724.4
7/1/2001		209		2.42	3.1		.006			1.11			23	1350 gpm	8.23	054		004	500	724.7
8/1/2001		209					.010			2.01				1350 gpm	8.55	.036		008	567	726.2
9/1/2001		209					.008			1.53				1350 gpm	8.63	041	.025	003	830	726.8
10/1/2001		209		2.92	5.1		013			1.41				1350 gpm	8.33	.100	.023	004	918	726.9
11/1/2001		209					.004			.034				1350 gpm	8.31	040		006	735	728.7
12/1/2001		209								500			.0322	1350 gpm	7.91	030		003	789	730.6
1/1/2002		209					004			.060				1350 gpm	8.21	235	200	004	308	730.1
2/1/2002		209		13 60	17.6		.007			1.10				1350 gpm	8.69	081			6860	730.1
3/1/2002	no results	209																		
4/1/2002	no results																			
5/1/2002	no results																			
6/1/2002	no results																			
7/1/2002	no results																			
8/1/2002	no results																			
9/1/2002	no results																			
10/02 thru 06/04	not submitted																			
7/1/2004		209		1.44	249					1.50			.007	1350 gpm	7.48			011	582	719.9
8/1/2004		209								445			.017	1350 gpm	8.04	024		.016	673	719.2
9/1/2004		209								4.20				1350 gpm	8.22			.033	854	719.4
10/1/2004		209	4.31	2.25						4.88			010	1350 gpm	7.66			030	5100	718.9
11/1/2004		209								5.28			.008	1350 gpm	7.98	.028	.020	016	3930	719.0
12/1/2004		209								5.80			.017	1350 gpm	7.25	024	.033	.022	1600	718.8
1/1/2005		209	232 0	2.25			001						.011	1350 gpm	7.48	.038		029	390	721.9
2/1/2005		209					.034			3.90		013	.019	1350 gpm	7.68	.024		.038	1100	822.1
3/1/2005		209	7.03	1.94						6.18			.018	1350 gpm	7.99	038		005	720	722.1
4/1/2005		209	5.12	1.52			001			4.36		010	.011	1350 gpm	7.83	041		021	680	727.1
5/1/2005		209	41.9	25.9						6.24		.011	.018	1350 gpm	8.22			029	1120	727.6
6/1/2005		209								7.52			.039	1350 gpm	7.95			026	1170	726.8
7/1/2005		209								5.74	.001		.022	1250 gpm	7.46	.043		046	900	724.3
8/1/2005		209					.002			3.10	006		.017	1250 gpm	7.83	067	.037	029	1640	729.4
9/1/2005		209							.0005	3.60		.152	.031	1250 gpm	7.53	058	8.35	1.18	1850	729.4
10/1/2005		209	118	93.1						2.22	.001		.020	1250 gpm	7.82	.035		.095	1300	727.4
11/1/2005		209								3.28		.018	.012	1250 gpm	7.28	048		151	1290	726.1
12/1/2005		209	2.53	1.82									.036	1250 gpm	7.62			100	1180	725.8
1/1/2006		209								.800				1250 gpm	8.03			002	714	718.6

Baseline surface water data from O-5021-98 permit application

BASELINE SAMPLING SITE DESCRIPTION

SURFACE WATER

Attachment J-3A

CORRECTED SHEET
CORRECTION NO. 2
CORRECTION DATE 1/28/00

SAMPLING SITE	DESCRIPTION	LATITUDE ° ' "	LONGITUDE ° ' "	ELEVATION (Feet)
BSW-503	Mouth Of Fork Creek	38 13 49	81 46 26	620
BSW-584	River Fork Below 1st Right Fork	38 12 21	81 46 03	710
BSW-585	Mouth Of 1st Right Fork Of River Fork	38 12 19	81 46 02	724
BSW-586	River Fork Above 1st Right Fork	38 12 18	81 46 00	725

BASELINE SURFACE WATER ANALYSIS

Attachment J-3B

Company Name: **Fork Creek Mining Company**
Mine Name: **Refuse Disposal Area No. 2**
Laboratory Name: **Standard Laboratories, Inc.** **Mouth of Fork Creek** **Site BSW-503**

Sample I.D. No.	Date Sampled	pH	Flow gpm	Total Hot Acidity mg/l CaCO3	Mineral Acidity mg/l CaCO3	Total Alkalinity mg/l CaCO3	Total Fe mg/l	Total Mn mg/l	TSS mg/l	TDS mg/l	Spec. Cond. mhos	SO4 mg/l	Al mg/l	Other
BSW-503	10/03/1997	7.80	961.0	0.0	DNA	200.0	0.53	<0.02	<2.8	240.0	435.0	23.4	0.17	N/A
	02/02/1998	6.90	N.P.	0.0	DNA	24.0	0.46	0.12	8.0	180.0	231.0	81.4	0.40	N/A
	02/19/1998	7.10	N.P.	0.0	DNA	17.0	2.15	0.17	70.5	130.0	200.0	64.9	2.63	N/A
	03/20/1998	7.30	N.P.	0.0	DNA	24.0	2.04	0.14	49.0	180.0	221.0	68.8	2.31	N/A
	04/20/1998	7.60	N.P.	0.0	DNA	15.0	3.84	0.24	107.0	94.0	160.0	37.9	4.26	N/A
	05/27/1998	7.70	N.P.	0.0	DNA	44.0	0.38	0.14	9.0	190.0	399.0	129.0	0.19	N/A
	10/97 thru 5/98 data taken from hydrologic baseline study for Fork Creek Preparation Plant and Mine No. 1.													
DNA = Did Not Analyze														
BDL = Below MDL		6.90 - 7.80	961.0	0.0	DNA	54.0	1.57	0.14	41.1	169.0	274.3	67.6	1.66	N/A

BASELINE SURFACE WATER ANALYSIS

Attachment J-3B

Company Name: **Fork Creek Mining Company**
Mine Name: **Refuse Disposal Area No. 2**
Laboratory Name: **Standard Laboratories, Inc.** **River Fork Below 1st Right Fork** **Site BSW-584**

Sample I.D. No.	Date Sampled	pH	Flow gpm	Total Hot Acidity mg/l CaCO3	Mineral Acidity mg/l CaCO3	Total Alkalinity mg/l CaCO3	Total Fe mg/l	Total Mn mg/l	TSS mg/l	TDS mg/l	Spec. Cond. mhos	SO4 mg/l	Al mg/l	Other
BSW-584	03/01/1999	7.50	3,892.0	0.0	DNA	8.6	0.33	0.02	8.0	56.0	60.0	14.3	0.24	N/A
	04/14/1999	7.30	6,498.0	0.0	DNA	68.0	0.33	0.02	<5.0	74.0	180.0	16.0	0.33	N/A
	05/14/1999	8.10	1,145.0	0.0	DNA	170.0	0.21	<0.02	<5.0	150.0	360.0	23.2	0.15	N/A
	06/07/1999	8.10	2,974.0	0.0	DNA	320.0	0.34	0.02	<5.0	340.0	630.0	22.4	0.10	N/A
	07/12/1999	9.00	1,047.0	0.0	DNA	430.0	0.30	0.02	<5.0	430.0	800.0	26.6	0.29	N/A
	08/09/1999	8.80	1,852.0	0.0	DNA	130.0	8.01	0.11	89.0	200.0	280.0	<1.0	13.00	N/A
	12/07/1999	7.10	1,196.0	0.0	DNA	12.0	0.07	<0.02	<5.0	34.0	74.0	17.2	0.19	N/A
	01/10/2000	7.40	4,444.0	0.0	DNA	9.9	0.10	0.02	<5.0	56.0	63.0	17.1	<0.07	N/A
DNA = Did Not Analyze														
		7.10 - 9.00	2,881.0	0.0	DNA	143.6	1.21	0.03	15.9	167.5	305.9	17.2	1.80	N/A

CORRECTED SHEET
CORRECTION NO. 2
CORRECTION DATE 1/28/00

BASELINE SURFACE WATER ANALYSIS

Attachment J-3B

Company Name: **Fork Creek Mining Company**
Mine Name: **Refuse Disposal Area No. 2**
Laboratory Name: **Standard Laboratories, Inc.** **Mouth Of 1st Right Fork** **Site BSW-585**

Sample I.D. No.	Date Sampled	pH	Flow gpm	Total Hot Acidity mg/l CaCO3	Mineral Acidity mg/l CaCO3	Total Alkalinity mg/l CaCO3	Total Fe mg/l	Total Mn mg/l	TSS mg/l	TDS mg/l	Spec. Cond. mhos	SO4 mg/l	Al mg/l	Other
BSW-585	03/02/1999	7.40	596.0	0.3	DNA	5.4	0.06	<0.02	<5.0	56.0	59.0	12.5	<0.07	N/A
	04/14/1999	7.60	2,128.0	0.0	DNA	9.4	0.12	<0.02	<5.0	64.0	65.0	17.0	0.29	N/A
	05/14/1999	6.30	313.0	0.0	DNA	11.0	0.33	0.03	6.0	56.0	61.0	14.2	0.42	N/A
	06/07/1999		0.0											
	07/12/1999		0.0											
	08/09/1999	7.40	200.0	0.0	DNA	37.0	5.03	0.06	63.0	110.0	130.0	11.0	10.10	N/A
DNA = Did Not Analyze														
BDL = Below MDL		6.30 - 7.60	539.5	0.1	DNA	15.7	1.39	0.02	13.2	71.5	78.8	13.7	1.81	N/A

BASELINE SURFACE WATER ANALYSIS

Attachment J-3B

Company Name: Fork Creek Mining Company
Mine Name: Refuse Disposal Area No. 2
Laboratory Name: Standard Laboratories, Inc. River Fork Above 1st Right Fork Site BSW-586

Sample I.D. No.	Date Sampled	pH	Flow gpm	Total Hot Acidity mg/l CaCO3	Mineral Acidity mg/l CaCO3	Total Alkalinity mg/l CaCO3	Total Fe mg/l	Total Mn mg/l	TSS mg/l	TDS mg/l	Spec. Cond. mhos	SO4 mg/l	Al mg/l	Other
BSW-586	03/02/1999	7.50	3,296.0	0.2	DNA	6.4	0.31	<0.02	<5.0	36.0	53.0	14.1	0.21	N/A
	04/14/1999	7.80	2,493.0	0.0	DNA	110.0	0.37	0.02	<5.0	130.0	259.0	24.5	0.18	N/A
	05/14/1999	8.10	1,815.0	0.0	DNA	170.0	0.20	<0.02	<5.0	130.0	360.0	24.4	0.26	N/A
	06/07/1999	8.10	1,970.0	0.0	DNA	330.0	0.31	0.02	<5.0	350.0	630.0	23.7	0.21	N/A
	07/12/1999	9.00	<1.0	0.0	DNA	420.0	0.28	<0.02	<5.0	400.0	790.0	27.1	0.21	N/A
	08/09/1999	8.80	1,545.0	0.0	DNA	130.0	7.81	0.11	87.0	220.0	279.0	10.0	12.20	N/A
	12/07/1999	7.50	842.0	0.0	DNA	12.0	0.14	<0.02	<5.0	64.0	73.0	17.1	<0.07	N/A
	01/10/2000	7.30	8,559.0	0.0	DNA	9.9	0.09	0.02	<5.0	44.0	64.0	17.0	<0.07	N/A
DNA = Did Not Analyze														
BDL = Below MDL		7.30 - 9.00	2,931.4	0.03	DNA	148.5	1.19	0.03	15.3	171.8	313.5	19.7	1.68	N/A

CORRECTED SHEET
CORRECTION NO. 2
CORRECTION DATE 1/28/00

BASELINE SURFACE WATER ANALYSIS

Attachment J-3B

Company Name: Coal River Mining, LLC
Mine Name: Fork Creek No. 3 Mine
Laboratory Name: Acculab, Inc. BWQ & Threshold Monitoring Site - Mouth of Fork Creek Site BWQ-FC1

Sample I.D. No.	Date Sampled	pH	Flow gpm	Total Hot Acidity mg/l CaCO3	Total Alkalinity mg/l CaCO3	Dissolved Aluminum mg/l	Total Fe mg/l	Total Mn mg/l	TSS mg/l	TDS mg/l	Spec. Cond. mhos	SO4 mg/l	Al mg/l	Temp °C
BWQ-FC1	09/12/03	7.24	5296.2	0.5	134.0	0.088	1.52	0.22	7.0	DNA	536.0	130.0	0.147	ND
	09/30/03	8.33	5403.9	0.5	226.0	0.116	0.60	0.17	3.0	DNA	482.0	84.0	0.051	ND
	10/14/03	7.97	4174.1	0.5	140.0	0.026	0.91	0.11	3.0	DNA	903.0	99.0	0.065	ND
	10/30/03	8.34	5655.3	0.5	162.0	0.043	0.47	0.10	0.5	DNA	437.0	216.0	0.265	ND
	11/11/03	7.08	5709.1	0.5	24.0	0.297	0.35	0.33	2.0	DNA	445.0	55.0	0.432	ND
	11/26/03	6.88	7374.3	0.5	106.0	0.326	0.32	0.41	6.0	DNA	256.0	55.0	0.167	ND
	12/16/03	7.36	8079.0	0.5	76.0	0.073	0.35	0.12	5.0	DNA	253.0	38.0	0.146	ND
	12/29/03	7.16	6427.3	0.5	50.0	<0.4	0.44	0.30	0.5	DNA	309.0	47.0	<0.4	ND
	01/14/04	7.64	5134.6	0.5	142	0.034	0.58	0.22	6.0	DNA	277.0	41.0	0.105	ND
	01/29/04	7.65	4557.6	0.5	126	0.075	0.38	0.14	3.0	DNA	498.0	57.0	0.023	ND
	02/11/04	6.36	5942.5	0.5	44	0.096	0.37	0.19	7.0	DNA	127.0	30.0	0.217	ND
	02/26/04	7.68	4254.9	0.5	136	<0.4	0.42	0.16	8.0	DNA	680.0	63.0	<0.4	ND
	Averages*	6.36 - 8.34	5667.4	0.5	DNA	0.165	0.56	0.21	4.3	DNA	433.6	76.3	0.202	ND

* Except range for pH

DNA = Did Not Analyze; ND = Not Determined

Correction Number ADMN
Correction Date 8-1-06
Inserted By dG
Page Number 188.1

Baseline surface water data from O-5013-99 permit application

BASELINE SAMPLING SITE DESCRIPTION

SURFACE WATER

Attachment J-3A

SAMPLING SITE	DESCRIPTION	LATITUDE	LONGITUDE	ELEVATION
DFC-3	Fork Creek below the Prep Plant	38° 12' 50"	81° 46' 37"	643
URF	Fork Creek below Pond No. 1	38° 12' 26"	81° 46' 20"	684
URF-2	Fork Creek above Pond No. 1	38° 12' 13"	81° 45' 54"	735

Correction Number:
Correction Date: 11-9-06
Inserted By: GG
F Number: 184-185

BASELINE SURFACE WATER ANALYSIS

Attachment J-3B

Company Name: **Loadout, LLC**
Mine Name: **Refuse Disposal Area No. 2**
Laboratory Name: **ACULAB, INC.** **URF-2**

Sample I.D. No.	Date Sampled	pH	Flow cfs	Total Hot Acidity mg/l CaCO3	Mineral Acidity mg/l CaCO3	Total Alkalinity mg/l CaCO3	Total Fe mg/l	Total Mn mg/l	TSS mg/l	TDS mg/l	Spec. Cond. mhos	SO4 mg/l	Al mg/l	Temp °C
URF-2	1/23/2003	7.86	393 gpm	DNA	DNA	DNA	0.09	0.00	0.00	130.00	DNA	DNA	0.43	2.00
	3/26/2003	7.33	604 gpm	< 0.00	DNA	8.00	0.06	1.02	4.00	44.00	72.20	14.00	0.07	11.70
	9/15/2003	6.96	1.00	< 1.00	DNA	96.00	0.31	0.03	1.00	84.00	135.00	15.00	0.40	DNA
	8/31/2004	6.66	1.00	< 1.00	DNA	30.00	0.27	0.07	6.00	76.00	86.00	7.00	0.40	19.40
	11/18/2004	7.12	0.78	< 1.00	DNA	240.00	0.09	0.03	1.00	48.00	91.00	14.00	0.40	11.60
	12/30/2004	7.10	1.00	< 1.00	DNA	102.00	0.11	0.04	5.00	76.00	86.00	5.00	0.40	DNA
	2/27/2005	6.43	< 1.50	< 1.00	DNA	12.00	0.05	0.02	5.00	44.00	62.00	6.00	0.40	DNA
	3/31/2005	6.10	1.00	16.00	DNA	10.00	0.21	0.02	7.00	48.00	66.00	5.00	0.40	DNA
	11/30/2005	6.68	0.67	< 1.00	DNA	44.00	0.05	0.02	3.00	480.00	579.00	19.00	0.40	DNA
	12/17/2005	6.89	0.77	< 1.00	DNA	106.00	0.15	0.02	5.00	52.00	62.00	13.00	0.40	DNA
	2/23/2006	7.14	0.67	< 1.00	DNA	118.00	0.08	0.03	1.00	76.00	83.00	26.00	0.40	DNA
	3/29/2006	6.68	0.78	< 1.00	DNA	80.00	0.19	0.03	2.00	80.00	128.00	19.00	0.40	DNA
	5/30/2006	6.50	0.06	< 1.00	DNA	20.00	0.16	0.06	1.00	64.00	94.00	19.00	0.40	DNA
	7/5/2006	7.25	0.33	< 1.00	DNA	18.00	0.14	0.05	1.00	80.00	108.00	18.00	0.40	DNA
	8/21/2006	7.36	0.07	< 1.00	DNA	52.00	0.22	0.26	1.00	108.00	182.00	18.00	0.40	DNA
	9/30/2006	7.80	0.33	< 1.00	DNA	212.00	0.27	0.02	5.00	104.00	161.00	17.00	0.40	DNA
DNA = Did Not Analyze														
	Averages*	**6.10 7.86**	**0.71**	**< 1.93**	**DNA**	**76.53**	**0.15**	**0.11**	**3.00**	**99.63**	**133.01**	**14.33**	**0.38**	**11.18**

184-185

Correction Number 3 -06 GG 174-178

BASELINE SURFACE WATER ANALYSIS

Attachment J-3B

Company Name: **Loadout, LLC**
Mine Name: **Refuse Disposal Area No. 2**
Laboratory Name: **ACULAB, INC.** **DFC-3**

Sample I.D. No.	Date Sampled	pH	Flow cfs	Total Hot Acidity mg/l CaCO3	Mineral Acidity mg/l CaCO3	Total Alkalinity mg/l CaCO3	Total Fe mg/l	Total Mn mg/l	TSS mg/l	TDS mg/l	Spec. Cond. mhos	SO4 mg/l	Al mg/l	Temp °C
DFC-3	1/8/2003	6.72	3450 gpm	< 0.00	DNA	20.00	0.73	0.17	22.00	130.00	154.00	43.80	0.43	9.10
	3/26/2003	7.38	4411 gpm	< 0.00	DNA	30.00	0.11	0.09	4.00	150.00	249.00	48.80	0.07	12.10
	8/31/2004	8.22	5.00	< 1.00	DNA	346.00	0.41	0.02	8.00	452.00	681.00	60.00	0.40	19.40
	9/30/2004	7.40	7.00	< 1.00	DNA	86.00	0.49	0.09	4.00	500.00	507.00	49.00	0.40	18.80
	11/18/2004	7.00	7.00	< 1.00	DNA	28.00	0.32	0.15	1.00	84.00	162.00	30.00	0.40	12.20
	12/30/2004	6.84	5.00	< 1.00	DNA	86.00	0.42	0.22	2.00	148.00	159.00	20.00	0.40	DNA
	9/30/2005	7.70	NS	< 1.00	DNA	356.00	0.05	1.11	2.00	1012.00	1468.00	171.00	0.40	DNA
	11/30/2005	7.33	2.50	< 1.00	DNA	94.00	0.45	0.32	11.00	332.00	638.00	67.00	0.40	DNA
	12/17/2005	6.98	5.00	< 1.00	DNA	100.00	0.47	0.22	9.00	580.00	1001.00	93.00	0.40	DNA
	2/23/2006	7.29	3.00	< 1.00	DNA	128.00	0.17	0.11	3.00	180.00	314.00	92.00	0.40	DNA
	4/4/2006	7.10	6.50	< 1.00	DNA	124.00	0.41	0.26	2.00	208.00	396.00	68.00	0.40	DNA
	5/30/2006	6.56	1.50	< 1.00	DNA	1.00	0.13	0.02	1.00	88.00	131.00	35.00	0.40	DNA
	6/30/2006	7.49	2.50	< 1.00	DNA	1.00	0.38	0.26	1.00	296.00	516.00	72.00	0.40	DNA
	8/30/2006	7.83	0.13	< 1.00	DNA	1.00	0.38	0.04	2.00	428.00	725.00	120.00	0.40	DNA
	9/30/2006	8.15	2.5	< 1.00	DNA	1.00	0.48	0.06	4.00	324.00	635.00	128.00	0.40	DNA
DNA = Did Not Analyze														
	Averages*	**6.56 8.22**	**3.97**	**< 0.87**	**DNA**	**93.47**	**0.36**	**0.21**	**5.07**	**327.47**	**515.73**	**73.17**	**0.38**	**14.32**

174-178

Correction Number
Correction Date 11-9-06
Inserted By GG
Page Number 179

BASELINE SURFACE WATER ANALYSIS

Attachment J-3B

Company Name: **Loadout, LLC**
Mine Name: **Refuse Disposal Area No. 2**
Laboratory Name: **ACULAB, INC.** **URF**

Sample I.D. No.	Date Sampled	pH	Flow cfs	Total Hot Acidity mg/l CaCO3	Mineral Acidity mg/l CaCO3	Total Alkalinity mg/l CaCO3	Total Fe mg/l	Total Mn mg/l	TSS mg/l	TDS mg/l	Spec. Cond. mhos	SO4 mg/l	Al mg/l	Temp °C
URF	1/8/2003	7.44	314 gpm	0.0	DNA	9.0	0.18	0.06	0.00	64.00	102.0	28.5	0.12	8.40
	3/26/2003	7.55	901 gpm	< 0.00	DNA	48.00	0.22	0.15	4.00	340.00	648.00	192.00	0.07	12.00
	9/15/2003	7.07	1.00	< 1.00	DNA	72.00	0.30	0.06	1.00	264.00	450.00	163.00	0.40	DNA
	8/31/2004	7.64	1.00	< 1.00	DNA	112.00	0.13	0.11	4.00	436.00	722.00	88.00	0.40	19.40
	9/15/2004	7.66	200 gpm	< 1.00	DNA	162.00	0.39	0.36	24.00	940.00	962.00	62.00	0.40	20.00
	9/30/2004	7.12	350 gpm	< 1.00	DNA	74.00	0.13	0.03	2.00	52.00	71.00	11.00	0.40	18.30
	11/18/2004	7.00	1.00	< 1.00	DNA	28.00	0.18	0.13	1.00	152.00	303.00	69.00	0.40	12.20
	12/30/2004	8.11	1.00	< 1.00	DNA	212.00	0.14	0.16	7.00	360.00	365.00	60.00	0.40	DNA
	9/30/2005	6.40	0.06	< 1.00	DNA	44.00	0.05	0.04	4.00	128.00	249.00	57.00	0.40	DNA
	11/30/2005	7.09	0.67	< 1.00	DNA	98.00	0.10	0.22	6.00	392.00	562.00	89.00	0.40	DNA
	12/17/2005	7.24	1.00	< 1.00	DNA	128.00	0.14	0.13	1.00	352.00	627.00	93.00	0.40	DNA
	2/28/2006	7.39	1.00	< 1.00	DNA	142.00	0.09	0.08	2.00	288.00	565.00	130.00	0.40	DNA
	3/29/2006	7.19	1.50	< 1.00	DNA	140.00	0.16	0.23	4.00	204.00	396.00	68.00	0.40	DNA
	5/30/2006	6.62	0.22	< 1.00	DNA	36.00	0.17	0.12	1.00	208.00	285.00	19.00	0.40	DNA
	6/30/1986	7.94	0.67	< 1.00	DNA	70.00	0.13	0.09	1.00	320.00	460.00	83.00	0.40	DNA
	8/21/2006	7.79	0.22	< 1.00	DNA	172.00	0.19	0.26	11.00	804.00	1214.00	146.00	0.40	DNA
	9/30/2006	8.10	NS	< 1.00	DNA	240.00	0.13	0.02	4.00	356.00	576.00	114.00	0.40	17.70
DNA = Did Not Analyze														
	Averages*	**6.40 8.11**	**0.78**	**< 0.88**	**DNA**	**105.12**	**0.17**	**0.13**	**4.53**	**332.94**	**503.35**	**86.62**	**0.36**	**15.43**

179-180

Baseline groundwater data from the O-5021-98 permit application

BASELINE SAMPLING SITE DESCRIPTION
GROUND WATER

000254

Attachment J-4A

SAMPLING SITE	DESCRIPTION	LATITUDE ° ' "	LONGITUDE ° ' "	ELEVATION (Feet)	SOURCE/ AQUIFER
BGW-22	Old Zella No. 4 Mine	38 11 31	81 43 52	720	No. 2 Gas Seam
BGW-23	Old Welch Mine	38 10 38	81 43 49	750	No. 2 Gas Seam
BGW-24	Nellis No. 2 Gas Mine Slope	38 10 17	81 46 26	800	No. 2 Gas Seam
BGW-25	Flowing Well	38 10 51	81 46 40	754	Unknown
BGW-26	Lewis "Bob" Smith Well	38 13 08	81 49 26	640	Unknown

BASELINE GROUND WATER ANALYSIS

Attachment J-4B

Company Name: Fork Creek Mining Company
Mine Name: Preparation Plant & Mine No. 1 — Old Zella No. 4 Mine
Laboratory Name: Standard Laboratories, Inc. — Site BGW-22

Sample I.D. No.	Date Sampled	pH	Flow gpm or depth to water (ft)	Total Hot Acidity mg/l CaCO3	Mineral Acidity mg/l CaCO3	Total Alkalinity mg/l CaCO3	Total Fe mg/l	Total Mn mg/l	TSS mg/l	TDS mg/l	Spec. Cond. mhos	SO4 mg/l	Al mg/l	Other
BGW-22	12/3/97	7.80	N.P.	0.0	DNA	13.0	0.47	<0.02	N.P.	53	62.0	8.0	0.25	N/A
	12/17/97	N.P	N.P.	0.0	DNA	9.7	0.11	<0.02	N.P.	50	58.0	18.2	<0.10	N/A
	1/24/98	7.70	3.0	0.0	DNA	27.0	0.53	0.02	12.0	60	64.4	19.0	0.68	N/A
	2/19/98	6.70	72.0	0.0	DNA	6.7	0.54	<0.02	3.0	46	77.0	21.8	0.31	N/A
	3/20/98	6.80	4.0	2.4	DNA	4.8	1.92	0.06	30.0	50	58.8	15.7	2.29	N/A
	4/24/98	7.30	7059.0	0.0	DNA	23.0	0.30	0.02	4.0	60	100.0	13.0	0.36	N/A
	5/26/98	6.60	<1.0	0.0	DNA	9.9	1.12	0.05	16.0	64	69.7	17.2	1.02	N/A
N.P. = Not Provided														
DNA = Did Not Analyze														
		6.60 - 7.80	1427.8	0.34	DNA	13.4	0.71	0.03	13.0	54.7	70.0	16.1	0.72	N/A

000255

BASELINE GROUND WATER ANALYSIS

Attachment J-4B

Company Name: **Fork Creek Mining Company**
Mine Name: **Preparation Plant & Mine No. 1** — **Old Welch Mine**
Laboratory Name: **Standard Laboratories, Inc.** — **Site BGW-23**

Sample I.D. No.	Date Sampled	pH	Flow gpm or depth to water (ft)	Total Hot Acidity mg/l CaCO3	Mineral Acidity mg/l CaCO3	Total Alkalinity mg/l CaCO3	Total Fe mg/l	Total Mn mg/l	TSS mg/l	TDS mg/l	Spec. Cond. mhos	SO4 mg/l	Al mg/l	Other
BGW-23	12/3/97	7.90	N.P.	0.0	DNA	65.0	0.40	0.06	N.P.	540	708.0	163.0	0.19	N/A
	12/17/97	N.P	N.P.	0.0	DNA	56.0	0.04	0.02	N.P.	572	711.0	392.0	0.20	N/A
	1/24/98	7.80	3.0	0.0	DNA	59.0	0.19	<0.02	<2.8	350	499.0	231.0	<0.10	N/A
	2/19/98	7.40	3.0	0.0	DNA	30.0	0.20	<0.02	3.0	200	320.0	132.0	<0.10	N/A
	3/20/98	7.10	3.0	0.0	DNA	31.0	0.53	0.03	12.0	190	261.0	96.6	0.60	N/A
	4/24/98	7.20	5.0	0.0	DNA	23.0	0.25	<0.02	4.0	140	215.0	61.0	0.36	N/A
	5/26/98	7.00	3.0	0.0	DNA	40.0	0.13	<0.02	<2.8	270	450.0	179.0	0.40	N/A
N.P. = Not Provided														
DNA = Did Not Analyze														
		7.00 - 7.90	3.40	0.00	DNA	43.4	0.25	0.03	4.9	323.1	452.0	179.2	0.82	N/A

000256

BASELINE GROUND WATER ANALYSIS

Attachment J-4B

Company Name: Fork Creek Mining Company
Mine Name: Preparation Plant & Mine No. 1 — Nellis No. 2 Gas Mine Slope
Laboratory Name: Standard Laboratories, Inc. — Site BGW-24

Sample I.D. No.	Date Sampled	pH	Flow gpm or depth to water (ft)	Total Hot Acidity mg/l CaCO3	Mineral Acidity mg/l CaCO3	Total Alkalinity mg/l CaCO3	Total Fe mg/l	Total Mn mg/l	TSS mg/l	TDS mg/l	Spec. Cond. mhos	SO4 mg/l	Al mg/l	Other
BGW-24	12/3/97	7.40	N.P.	0.0	DNA	680.0	0.03	0.07	N.P.	717	1100.0	377.0	0.12	N/A
	12/23/97	7.80	N.P.	0.0	DNA	700.0	0.14	0.07	N.P.	674	1000.0	15.3	0.31	N/A
	2/2/98	7.40	532.0	5.0	DNA	5.7	0.07	<0.02	<2.8	56	57.0	15.7	<0.10	N/A
	2/25/98	7.60	484.0	0.0	DNA	590.0	0.04	0.09	<2.8	690	990.0	100.0	0.43	N/A
	3/23/98	7.70	480.0	0.0	DNA	560.0	0.10	0.07	<2.8	650	1010.0	<1.20	0.27	N/A
	4/24/98	7.80	602.0	0.0	DNA	580.0	0.13	0.08	3.0	540	1120.0	45.0	0.36	N/A
	5/27/98	7.80	352.0	0.0	DNA	560.0	0.09	0.08	<2.8	690	1100.0	19.0	0.24	N/A
N.P. = Not Provided														
DNA = Did Not Analyze														
		7.40 - 7.80	490.00	0.71	DNA	525.1	0.09	0.07	2.8	573.9	911.0	81.9	0.26	N/A

000257

BASELINE GROUND WATER ANALYSIS

Attachment J-4B

Company Name: Fork Creek Mining Company
Mine Name: Preparation Plant & Mine No. 1 — Flowing Well On Wilderness Fork
Laboratory Name: Standard Laboratories, Inc. — Site BGW-25

Sample I.D. No.	Date Sampled	pH	Flow gpm or depth to water (ft)	Total Hot Acidity mg/l CaCO3	Mineral Acidity mg/l CaCO3	Total Alkalinity mg/l CaCO3	Total Fe mg/l	Total Mn mg/l	TSS mg/l	TDS mg/l	Spec. Cond. mhos	SO4 mg/l	Al mg/l	Other
BGW-25	12/23/97	7.80	N.P.	0.0	DNA	200.0	0.27	0.04	N.P.	130	330.0	<1.20	0.19	N/A
	2/2/98	7.60	3.0	0.0	DNA	200.0	0.42	0.03	<2.8	200	358.0	<1.20	<0.10	N/A
	2/25/98	7.60	4.0	0.0	DNA	170.0	0.27	0.04	<2.8	200	330.0	3.0	<0.10	N/A
	3/23/98	7.60	3.0	0.0	DNA	170.0	0.28	0.04	<2.8	200	348.0	<1.20	0.33	N/A
	4/24/98	7.70	5.0	0.0	DNA	170.0	0.31	0.04	<2.8	210	380.0	1.9	0.19	N/A
	5/27/98	7.70	4.0	0.0	DNA	170.0	0.29	0.03	<2.8	200	390.0	1.9	0.25	N/A
N.P. = Not Provided														
DNA = Did Not Analyze														
		7.60 - 7.80	3.80	0.00	DNA	180.0	0.31	0.04	<2.8	190.0	356.0	1.7	0.26	N/A

000258

Baseline heavy metal data from O-5013-99 Amendment No. 1 permit application

373

ACCULAB, INC.

1 ACCULAB DRIVE
P.O. BOX 367
MT. GAY, WV 25637
(304) 752-6798, FAX 752-5933

Correction Number 3
Correction Date 11-8-06
Inserted By GG
Page Number 373

LAB NUMBER: 6031701
SAMPLE IDENTIFICATION: FC-18 Upstream River Fork
BOTTLE IDENTIFICATION: FC-18
SAMPLE TYPE: TABLE C

CLIENT: COAL RIVER ENERGY
P.O. BOX 79
ALUM CREEK, WV 25003
DAVE HANCOCK

FIELD DATA

COLLECTION: DATE: 3/15/2006 TIME: 12:40PM

FLOW: 450 gpm pH: 7.0 su

RECEIVED BY LABORATORY: DATE: 3/16/2006 TIME: 4:30PM

LABORATORY DATA:

PARAMETER	VALUE	UNIT	MDL	ANALYTICAL METHOD	ANALYST	DATE	TIME
IV-A							
OIL & GREASE	<10	mg/l	10	SM5520-B	KC	3/20/2006	10:00AM
TOTAL SUSPENDED SOLIDS	2	mg/l	1	SM2540-D	JM	3/20/2006	8:30AM
IV-B							
CHLORIDE	13.3	mg/l	1	SM4500-Cl-C	JM	3/20/2006	5:00PM
SULFATE	172	mg/l	1	EPA375.4	BS	3/20/2006	9:00AM
TOTAL IRON	0.12	mg/l	0.05	SM3111-B	EH	3/21/2006	2:00PM
TOTAL MANGANESE	0.29	mg/l	0.02	SM3111B	EH	3/21/2006	2:00PM
TOTAL ALUMINUM	0.189	mg/l	.020	SM3113B	JB	3/20/2006	1:00PM
DISSOLVED ALUMINUM	0.179	mg/l	.020	SM3113B	JB	3/20/2006	1:00PM
HARDNESS	90	mg/l	0.65	SM2340-B	EH	3/21/2006	10:00AM
IV-C							
ANTIMONY	<1	ug/l	1	SM3113-B	JB	3/30/2006	1:30PM
ARSENIC	<1	ug/l	1	SM3113-B	EH	3/29/2006	3:30PM
BERYLLIUM	<.1	ug/l	0.1	SM3113-B	EH	3/29/2006	11:00AM
CADMIUM	<1	ug/l	1	SM3113-B	EH	3/28/2006	12:30PM
CHROMIUM	<1	ug/l	1	SM3113-B	EH	3/28/2006	4:50PM
COPPER	<1	ug/l	1	SM3113-B	JB	3/27/2006	11:20AM
LEAD	<1	ug/l	1	SM3113-B	JB	3/28/2006	7:20AM
MERCURY	<.1	ug/l	0.1	SM3112-B	KC	3/29/2006	11:00AM
NICKEL	<1	ug/l	1	SM3113-B	EH	3/29/2006	9:20AM
SELENIUM	<2	ug/l	2	SM3113-B	EH	3/23/2006	2:45PM
SILVER	<1	ug/l	1	SM3113-B	EH	3/28/2006	9:30AM
THALLIUM	<1	ug/l	1	SM3113-B	EH	3/29/2006	1:00PM
ZINC	<10	ug/l	10	SM3111-B	EH	3/28/2006	6:00PM
CYANIDE	<5	ug/l	5	SM4500-CN-E	EH	3/28/2006	10:00AM
PHENOLS	<10	ug/l	10	SM5530-B+C	EH	3/28/2006	2:00PM

DATA ENTRY: HM
REVIEWED BY:

ANALYSIS APPROVED BY: ______________________

DATE: 4/3/2006

374

ACCULAB, INC.

1 ACCULAB DRIVE
P.O. BOX 367
MT. GAY, WV 25637
(304) 752-6798, FAX 752-5933

Correction Number 3
Correction Date 11-8-06
Inserted By GG
F... Number 374

LAB NUMBER: 6031702
SAMPLE IDENTIFICATION : FC-19 **Upstream River Fork 2**
BOTTLE IDENTIFICATION: FC-19
SAMPLE TYPE: TABLE C

CLIENT: COAL RIVER ENERGY
P.O. BOX 79
ALUM CREEK, WV 25003
DAVE HANCOCK

FIELD DATA

COLLECTION: DATE: 3/15/2006 TIME: 1:00PM

FLOW: 300 gpm pH: 6.9 su

RECEIVED BY LABORATORY: DATE: 3/16/2006 TIME: 4:30PM

LABORATORY DATA:

PARAMETER	VALUE	UNIT	MDL	ANALYTICAL METHOD	ANALYST	DATE	TIME
IV-A							
OIL & GREASE	<10	mg/l	10	SM5520-B	KC	3/20/2006	10:00AM
TOTAL SUSPENDED SOLIDS	3	mg/l	1	SM2540-D	JM	3/20/2006	8:30AM
IV-B							
CHLORIDE	1	mg/l	1	SM4500-Cl-C	JM	3/20/2006	5:00PM
SULFATE	25	mg/l	1	EPA375.4	BS	3/20/2006	9:00AM
TOTAL IRON	0.11	mg/l	0.05	SM3111-B	EH	3/21/2006	2:00PM
TOTAL MANGANESE	<.02	mg/l	0.02	SM3111B	EH	3/21/2006	2:00PM
TOTAL ALUMINUM	0.127	mg/l	.020	SM3113B	JB	3/20/2006	1:00PM
DISSOLVED ALUMINUM	0.093	mg/l	.020	SM3113B	JB	3/20/2006	1:00PM
HARDNESS	43	mg/l	0.65	SM2340-B	EH	3/21/2006	10:00AM
IV-C							
ANTIMONY	<1	ug/l	1	SM3113-B	JB	3/30/2006	1:30PM
ARSENIC	<1	ug/l	1	SM3113-B	EH	3/29/2006	3:30PM
BERYLLIUM	<.1	ug/l	0.1	SM3113-B	EH	3/29/2006	11:00AM
CADMIUM	<1	ug/l	1	SM3113-B	EH	3/28/2006	12:30PM
CHROMIUM	<1	ug/l	1	SM3113-B	EH	3/28/2006	4:50PM
COPPER	<1	ug/l	1	SM3113-B	JB	3/27/2006	11:20AM
LEAD	<1	ug/l	1	SM3113-B	JB	3/28/2006	7:20AM
MERCURY	<.1	ug/l	0.1	SM3112-B	KC	3/29/2006	11:00AM
NICKEL	<1	ug/l	1	SM3113-B	EH	3/29/2006	9:20AM
SELENIUM	<2	ug/l	2	SM3113-B	EH	3/23/2006	2:45PM
SILVER	<1	ug/l	1	SM3113-B	EH	3/28/2006	9:30AM
THALLIUM	<1	ug/l	1	SM3113-B	EH	3/29/2006	1:00PM
ZINC	<10	ug/l	10	SM3111-B	EH	3/28/2006	6:00PM
CYANIDE	<5	ug/l	5	SM4500-CN-E	EH	3/28/2006	10:00AM
PHENOLS	<10	ug/l	10	SM5530-B+C	EH	3/28/2006	2:00PM

DATA ENTRY: HM
REVIEWED BY:

ANALYSIS APPROVED BY: ______________________

DATE: 4/3/2006

310

ACCULAB, INC.

1 ACCULAB DRIVE
P.O. BOX 367
MT. GAY, WV 25637
(304) 752-6798, FAX 752-5933

Correction Number 3
Correction Date 11-8-06
Inserted By GG
Page Number 375

LAB NUMBER: 6031703
SAMPLE IDENTIFICATION : FC-21
BOTTLE IDENTIFICATION: FC-21 DOWNSTREAM FORK CREEK
SAMPLE TYPE: TABLE C

CLIENT: COAL RIVER ENERGY
P.O. BOX 79
ALUM CREEK, WV 25003
DAVE HANCOCK

FIELD DATA

COLLECTION: DATE: 3/15/2006 TIME: 12:00PM

FLOW: 1800 gpm pH: 7.0 su

RECEIVED BY LABORATORY: DATE: 3/16/2006 TIME: 4:30PM

LABORATORY DATA:

PARAMETER	VALUE	UNIT	MDL	ANALYTICAL METHOD	ANALYST	DATE	TIME
IV-A							
OIL & GREASE	<10	mg/l	10	SM5520-B	KC	3/20/2006	10:00AM
TOTAL SUSPENDED SOLIDS	7	mg/l	1	SM2540-D	JM	3/20/2006	8:30AM
IV-B							
CHLORIDE	3	mg/l	1	SM4500-Cl-C	JM	3/20/2006	5:00PM
SULFATE	33	mg/l	1	EPA375.4	BS	3/20/2006	9:00AM
TOTAL IRON	0.24	mg/l	0.05	SM3111-B	EH	3/21/2006	2:00PM
TOTAL MANGANESE	0.05	mg/l	0.02	SM3111B	EH	3/21/2006	2:00PM
TOTAL ALUMINUM	0.161	mg/l	.020	SM3113B	JB	3/20/2006	1:00PM
DISSOLVED ALUMINUM	0.158	mg/l	.020	SM3113B	JB	3/20/2006	1:00PM
HARDNESS	53.5	mg/l	0.65	SM2340-B	EH	3/21/2006	10:00AM
IV-C							
ANTIMONY	<1	ug/l	1	SM3113-B	JB	3/30/2006	1:30PM
ARSENIC	<1	ug/l	1	SM3113-B	EH	3/29/2006	3:30PM
BERYLLIUM	<.1	ug/l	0.1	SM3113-B	EH	3/29/2006	11:00AM
CADMIUM	<1	ug/l	1	SM3113-B	EH	3/28/2006	12:30PM
CHROMIUM	<1	ug/l	1	SM3113-B	EH	3/28/2006	4:50PM
COPPER	<1	ug/l	1	SM3113-B	JB	3/27/2006	11:20AM
LEAD	<1	ug/l	1	SM3113-B	JB	3/28/2006	7:20AM
MERCURY	<.1	ug/l	0.1	SM3112-B	KC	3/29/2006	11:00AM
NICKEL	<1	ug/l	1	SM3113-B	EH	3/29/2006	9:20AM
SELENIUM	<2	ug/l	2	SM3113-B	EH	3/23/2006	2:45PM
SILVER	<1	ug/l	1	SM3113-B	EH	3/28/2006	9:30AM
THALLIUM	<1	ug/l	1	SM3113-B	EH	3/29/2006	1:00PM
ZINC	<10	ug/l	10	SM3111-B	EH	3/28/2006	6:00PM
CYANIDE	<5	ug/l	5	SM4500-CN-E	EH	3/28/2006	10:00AM
PHENOLS	<10	ug/l	10	SM5530-B+C	EH	3/28/2006	2:00PM

DATA ENTRY: HM
REVIEWED BY:

ANALYSIS APPROVED BY: ____________________

DATE: 4/3/2006

3:14

ACCULAB, INC.

 # 1 ACCULAB DRIVE
P.O. BOX 367
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Correction Number 3
Correction Date 11-8-06
Inserted By GG
F... Number 376

LAB NUMBER: 6031704
SAMPLE IDENTIFICATION: FC-23 Downstream Fork Creek 3
BOTTLE IDENTIFICATION: FC-23
SAMPLE TYPE: TABLE C

CLIENT: COAL RIVER ENERGY
P.O. BOX 79
ALUM CREEK, WV 25003
DAVE HANCOCK

FIELD DATA

COLLECTION: DATE: 3/15/2006 TIME: 11:30AM

FLOW: 2250 gpm pH: 7.0 su

RECEIVED BY LABORATORY: DATE: 3/16/2006 TIME: 4:30PM

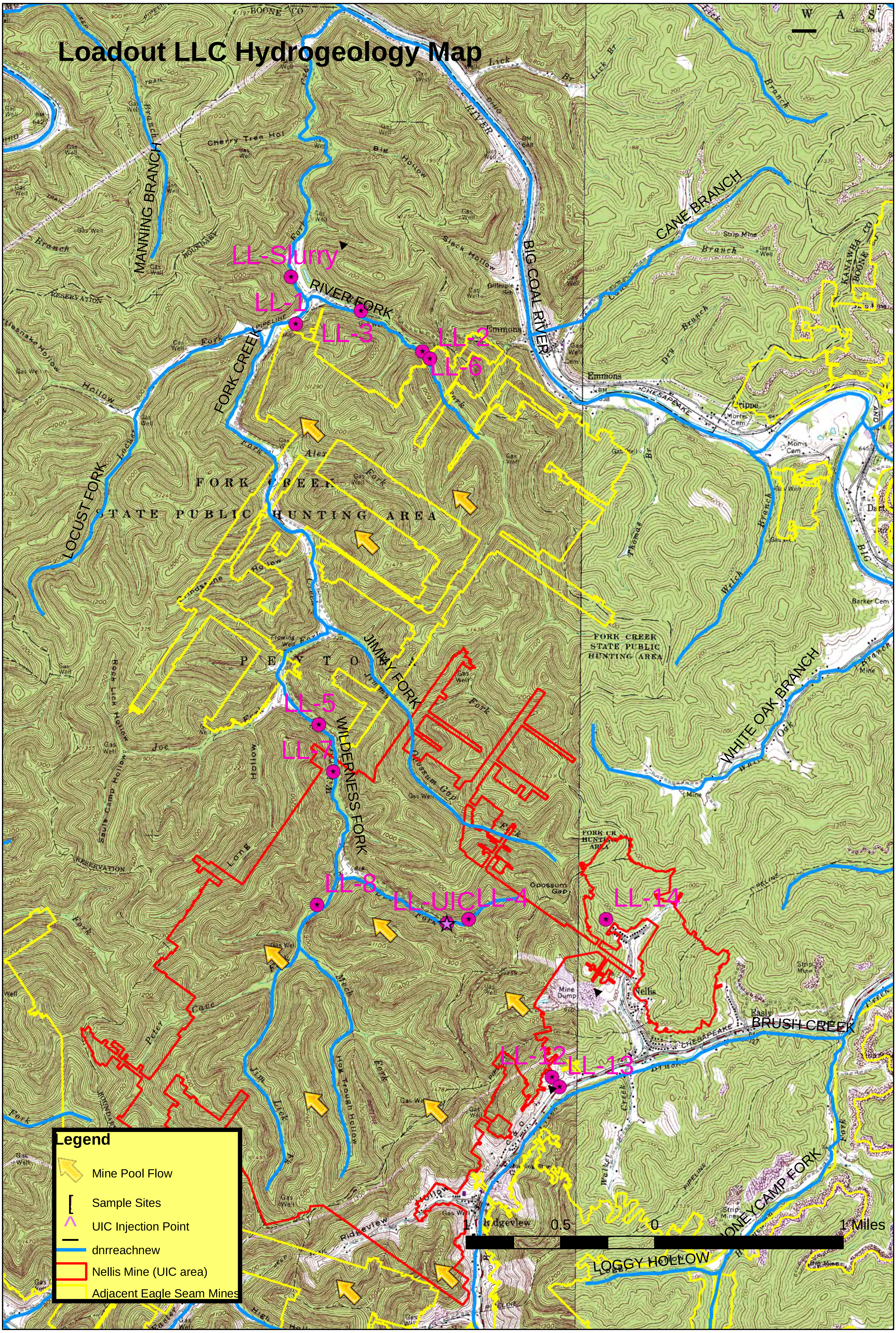
LABORATORY DATA:

PARAMETER	VALUE	UNIT	MDL	ANALYTICAL METHOD	ANALYST	DATE	TIME
IV-A							
OIL & GREASE	<10	mg/l	10	SM5520-B	KC	3/20/2006	10:00AM
TOTAL SUSPENDED SOLIDS	1	mg/l	1	SM2540-D	JM	3/20/2006	8:30AM
IV-B							
CHLORIDE	41	mg/l	1	SM4500-Cl-C	JM	3/20/2006	5:00PM
SULFATE	253	mg/l	1	EPA375.4	BS	3/20/2006	9:00AM
TOTAL IRON	0.41	mg/l	0.05	SM3111-B	EH	3/21/2006	2:00PM
TOTAL MANGANESE	0.27	mg/l	0.02	SM3111B	EH	3/21/2006	2:00PM
TOTAL ALUMINUM	0.167	mg/l	.020	SM3113B	JB	3/20/2006	1:00PM
DISSOLVED ALUMINUM	0.155	mg/l	.020	SM3113B	JB	3/20/2006	1:00PM
HARDNESS	104	mg/l	0.65	SM2340-B	EH	3/21/2006	10:00AM
IV-C							
ANTIMONY	<1	ug/l	1	SM3113-B	JB	3/30/2006	1:30PM
ARSENIC	<1	ug/l	1	SM3113-B	EH	3/29/2006	3:30PM
BERYLLIUM	<.1	ug/l	0.1	SM3113-B	EH	3/29/2006	11:00AM
CADMIUM	<1	ug/l	1	SM3113-B	EH	3/28/2006	12:30PM
CHROMIUM	<1	ug/l	1	SM3113-B	EH	3/28/2006	4:50PM
COPPER	<1	ug/l	1	SM3113-B	JB	3/27/2006	11:20AM
LEAD	<1	ug/l	1	SM3113-B	JB	3/28/2006	7:20AM
MERCURY	<.1	ug/l	0.1	SM3112-B	KC	3/29/2006	11:00AM
NICKEL	<1	ug/l	1	SM3113-B	EH	3/29/2006	9:20AM
SELENIUM	3	ug/l	2	SM3113-B	EH	3/23/2006	2:45PM
SILVER	<1	ug/l	1	SM3113-B	EH	3/28/2006	9:30AM
THALLIUM	<1	ug/l	1	SM3113-B	EH	3/29/2006	1:00PM
ZINC	<10	ug/l	10	SM3111-B	EH	3/28/2006	6:00PM
CYANIDE	<5	ug/l	5	SM4500-CN-E	EH	3/28/2006	10:00AM
PHENOLS	<10	ug/l	10	SM5530-B+C	EH	3/28/2006	2:00PM

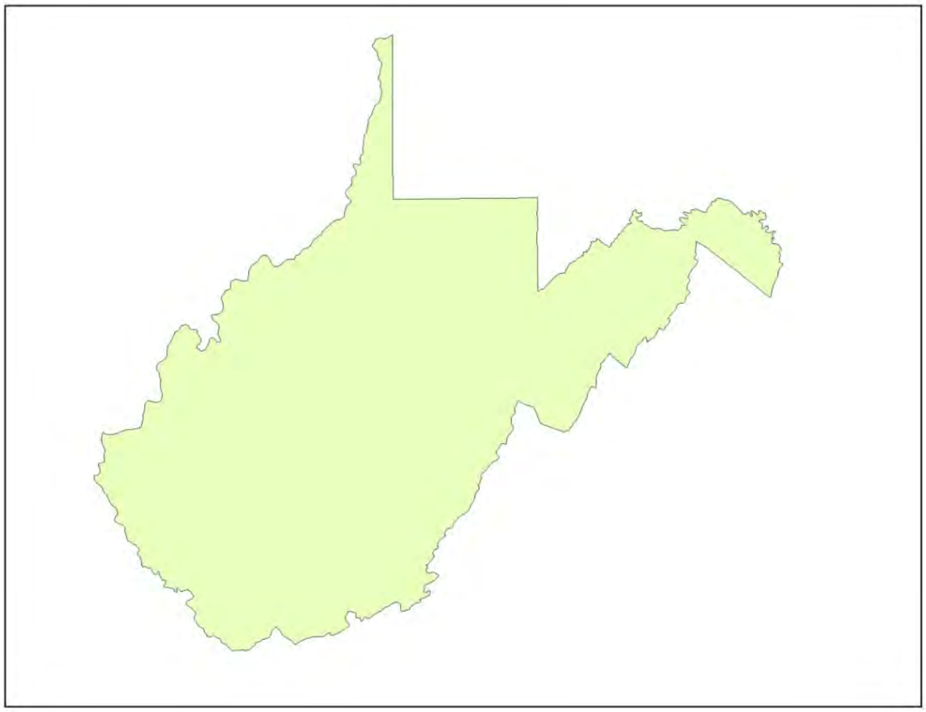
DATA ENTRY: HM
REVIEWED BY:

ANALYSIS APPROVED BY: ______________________

DATE: 4/3/2006


Loadout LLC Hydrogeology Map
LL-Slurry
LL-1
LL-3
LL-2
LL-6
LL-5
LL-7
LL-8
LL-UIC
LL-4
LL-14
LL-12
LL-13
RIVER FORK
BIG COAL RIVER
CANE BRANCH
MANNING BRANCH
FORK CREEK
LOCUST FORK
JIMMY FORK
WILDERNESS FORK
WHITE OAK BRANCH
BRUSH CREEK
HONEYCAMP FORK
LOGGY HOLLOW
FORK CREEK
STATE PUBLIC HUNTING AREA
Legend
Mine Pool Flow
Sample Sites
UIC Injection Point
dnrreachnew
Nellis Mine (UIC area)
Adjacent Eagle Seam Mines
1
0.5
0
1 Miles

Site Hydrological Evaluation:
Injection of Slurry at Panther Mining and Potential Hydrologic Effects: Wet Branch Watershed Kanawha County, West Virginia



Thomas A. Galya, Ph.D., CPG
Physical Scientist- Hydrology
Office of Surface Mining
Charleston Field Office
1027 Virginia Street, East
Charleston, WV 25301
April 27, 2009

Mining History and Associated Refuse/Slurry Disposal

<u>Characterization of the Hydrogeologic Regime, Wet Branch Site</u>

The purpose of this study is to characterize the chemical characteristics of Wet Branch watershed surface and ground water, and the coal slurry associated with the Panther LLC mining activities. An environmental concern with the fate and transport of coal slurry injectate into the abandoned Panther UO-391 mine was considered as part of the WV legislative SCR-15 UIC study. An assessment was conducted as to whether coal slurry injected into the abandoned No. 2 Mine has adversely impacted the area water surface and ground water resources. The short and long term effects of coal preparation plant chemicals on water resources are poorly understood. There is also little or no research data available on the transport and fate of the chemical constituents of the coal slurry liquid and solids (phases) in mine pool environments, in overlying strata, and surface water. This report reflects the underlying premise that the slurry tested for in the SCR-15 study may or may not be the same slurry composition that was injected during 2002 to 2004.

Coal slurry at the UO-391 has been primarily produced from the UO-391 Eagle and No. 2 Coal seams mined at the UO-391 Mine and processed at the Panther LLC preparation plant. Authorized slurry injection occurred from 2002 to 2004; however, active injection has not occurred since 2004. Unauthorized slurry injection occurred during 1996 for approximately six months. Injection of coal slurry produced from the Panther (formerly P-G & H *et al*). Preparation Plant was pumped into the underlying abandoned works of the UO-391 No. 2 Gas Seam mine. Slurry injection ceased when the Permittee acquired a COE 404 permit in 2004 to place coarse coal and coal slurry products on the adjacent Wet Branch Refuse surface area (O-2-82). The No. 2 Gas Mine is now abandoned; however, the operator sloped down to the underlying Eagle seam, which is now known as the Panther LLC American Eagle Mine, UO-391 Longbottom Creek operation. The coal mined at the American Eagle Mine is belted to and processed at the Panther preparation plant. The WVDEP mining permit records show that coarse, slurry, and combined refuse materials from the Panther preparation Plant (WVDEP permit UO-391) continue to be placed on the Wet Branch Refuse Disposal Area (permit O-2-82) located in Wet Branch.

Coal slurry disposal includes both slurry that was injected into abandoned underground mine and placed in coal refuse impoundments as filter cake-coarse refuse mixtures, slurry impoundments, or as cells. Coal slurry is a coal preparation product that is a result from the beneficiation of upgrading Eagle mined coal using various methods at the Panther coal preparation plant. This process results in the improvement of the BTU value of the final product by removing impurities such as sulfur (as pyrite), rock, and other non-coal impurities. Refuse materials produced from the coal preparation beneficiation process occur as coarse and in two fine sizes. Coal slurry is the fine-sized reject (100 mesh x 0) material that is produced from the coal preparation beneficiation process. Alcohols, diesel fuel, and a few other chemicals are commonly used in the preparation process, but it is not known if they are used at the Panther preparation plant.

The Panther No. 2 Gas coal seam Mine UO-391 is located in the lower part of the Wet Branch Watershed, and the American Eagle seam longwall operations are situated in the upper part of the watershed (Figure 1). Significant first mining (room–and-pillar) and retreat mining occurred in areas under and surrounding the Wet Branch refuse area. Sets of mains entries occur that are located east and south of the Wet Branch O-2-82 Refuse Area. The mining processes and subsequent subsidence can result in fractures within the overburden material over the mine and can accentuate or alter the pre-existing character of secondary permeability of the strata by closing or opening up fracture apertures. Movement in the overburden occurs as described by Kendorski (1993) results in altered secondary permeability zones. Fractures within the collapsed overburden material increase the secondary permeability and therefore affect flow paths and the rate of ground water flow. These changes can affect the rate and flow path directions from pre-mining ground water flow paths of the local ground water regime (Hobba, 1981).

The major structural control of drainage is the Wet Branch fracture system lineament or photolinears (fracture zones) impacts the local hydrologic regime. Ferguson (1967) and Wyrick and Borchers (1981) have demonstrated the model for ground water flow in the Appalachian Plateau, which results from infiltrating water that flows downslope in a stair-step fashion through stress-relief fractures. The stress-relief fracture system within the study area controls in part, the movement of water in Wet Branch and its tributaries. Both Ferguson and Wyrick and Borchers recognized that secondary permeability features (stress-relief, lineaments, tectonic fractures, etc) can greatly increase the hydraulic conductivity of strata and may impart a significant anisotropy to the ground water regime; mine-induced fracturing can also accentuate secondary permeability. The increased secondary permeability features develop in response to tectonic stresses or from valley-wall and valley-floor stress-relief fractures that form in response to the removal of rock mass by erosion. This is the model used to understand the hydrologic regime of the Wet Branch watershed.

Naturally-forming fractures created in response to the erosion of strata in the Wet Branch and Cabin Creek valley walls and they are interconnected with the horizontal bedding plane fractures located beneath the valley bottoms. Similarly, as a result, the near-vertical valley wall fractures are hydrologically connected to horizontal bedding plane fractures (separations) that occur, or that are beneath the alluvial material in Wet Branch, Longbottom Creek, and Cabin Creek. In some areas the fracture flow system may not be interconnected, primarily due to lithostratigraphic control. The Wet Branch study area streams are hydrologically connected to the shallow ground water flow regime via the valley stress-relief fracture system, and to some extent with fractures developed from UO-391 mining.

In general ground water in the Wet Branch (of) and Cabin Creek watershed fluctuate in response to seasonal variation in precipitation and evapotranspiration. The lowest ground water levels occurred in late summer and early autumn periods, which have the lowest precipitation and highest transpiration. Precipitation that infiltrates into the Wet Branch-Cabin Creek (and Longbottom Creek) valley hillsides ridgetop and alluvium moves downward through the stress-relief fracture system, which commonly is less than 200 feet deep. The effects upon the UO-391 overburden depend on the factors that control subsidence, such as the depth of cover, topography, stratigraphy, lithology, and fracture systems (including stress-relief fractures and lineaments). The available data indicates that the UO-391 No. 2 Gas mine seam dips towards the west-southwest, following the west limb of the Handley Syncline (WVGES Geologic Map, 1968).

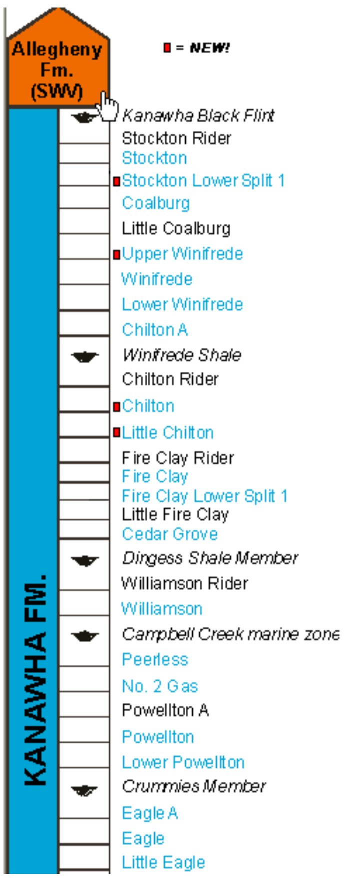


Figure 1

Hydrostratigrahic Units of the Kanawha Formation

Figure 1 shows some of the stratigraphic units in the Kanawha Formation. Panther mining in the No. 2 Gas (WVGES Peerless coal seam) and the Eagle (WVGES Eagle coal seam) occur in the Kanawha Formation. In this region, sandstone units are (leaky) aquitards at best and interbedded shale facies occur as semi to confining stratigraphic (units) layers. The fireclay facies commonly occur below coal seam are essentially impermeable and inhibit the downward movement of water, resulting in the formation of perched ground water systems. Appendices 1A-1B show the WVGES (West Virginia Geological and Economic Survey) general analyses of the No. 2 Gas (Peerless) seam and Eagle seam chemistry from mines in Kanawha County, WV. The data show that both seams are classified as high Hvol HA (high volatile A rank coal) or Hvol Bb (High volatile Bb rank coal) type coal chemistry. Overall, the No. 2 gas seam has a higher fixed carbon and volatile matter concentration than the Eagle seam. Appendices 1C-1D show the trace elements in the ash of the No. 2 Gas (Peerless) and Eagle coal seams. Appendix 1C-1D documents the presence of arsenic, beryllium, cobalt, chromium, manganese, nickel, lead, antimony, and selenium inherent in these coal seams (WVGES, 2009). Appendix 1E shows the Eagle and Peerless seam ash mineralogy (as oxides on a percentile basis), which shows that silicon and aluminum overwhelmingly comprise the coal seams mineralogy.

Summary of Mining Activities, Wet Branch Watershed

The operator history for the UO-391 (MSHA ID 46-05437) No. 2 Gas and the Eagle seam mines show that there have been seven (7) operators from 1977 to current. (M.S.H.A., 2008) (Figure 2A). The last No. 2 Gas Mine No. 2 Mine seam production ceased during 1999. The still active American Eagle seam operation has the same SMA # UO-391. The mine slopes down from the Mine No. 2 (No. 2 Gas seam) in the area of Longbottom Hollow. Coal produced from the Eagle and No. 2 Gas coal seam operations have and are being processed at the Panther preparation plant. The refuse is placed at the Wet Branch area O-2-82). The current operator of Panther is Speed Mining.

Operator History for Mine ID: 4605437

Operator Name	Begin Date	End Date
Speed Mining, LLC	4/17/2001	
Appalachian Eagle Inc	4/6/2000	4/16/2001
Day Mining Inc	10/7/1996	4/5/2000
R & J Mining Inc	11/28/1994	10/6/1996
Wet Branch Energy Inc	9/28/1993	11/27/1994
P G & H Inc	10/1/1992	9/27/1993
Rebb Energy Inc	6/15/1990	9/30/1992
P G & H Inc	1/1/1988	6/14/1990
P G & H Inc	3/1/1977	12/31/1987

Figure 2A –*Operator history*

There are other No. 2 Gas seam operations that are adjacent to the Panther Mine No. 2 operation. Abandoned mines such as the pre-SMCRA Glen Dorothy mine occurs approximately 435 feet downgradient with respect to the UO-391 mine. Other abandoned mines in the No. 2 Gas seam occur to the north.

In addition to the UO-391 No. 2 Gas and Eagle seam mines in the watershed, there are several other underground mines that occur in the upper part of the watershed (refer to Figure 2). The mine permits authorizing UO-172, UO-184, and UO-351 occur in the upper portion of the Wet Branch watershed. As of June 17, 1982 these mines operating in the upper Wet Branch watershed included: the No. 1 Mine that was inactive in June 1982; the No. 2 Mine in the Alma and the Peerless seams; the No. 3 Mine in the Cedar Grove seam; Mine No. 4 in the Stockton-Lewiston seam; and No. 5 Mine in the Winifrede seam.

Associated with the UO-391 Mine No. 2 and Eagle mine are the O-2-82 Wet Branch Refuse Area permit and an area near the mouth of Wet Branch and downstream of the Preparation plant Permit O-112-83. The abandoned mine workings located upstream of the No. 2 Mine include the WVDEP UO-184, UO-351, and the UO-172 operations, which are 540 feet, 400 feet, and 176 feet above the No. 2 mine, respectively. The pre-law underground Belmont and Coalburg Mines in the Cedar Grove and Coalburg seams occur overtop the UO-391 and beneath O-2-82 (refer to Figure 3 and 3A -electronic).

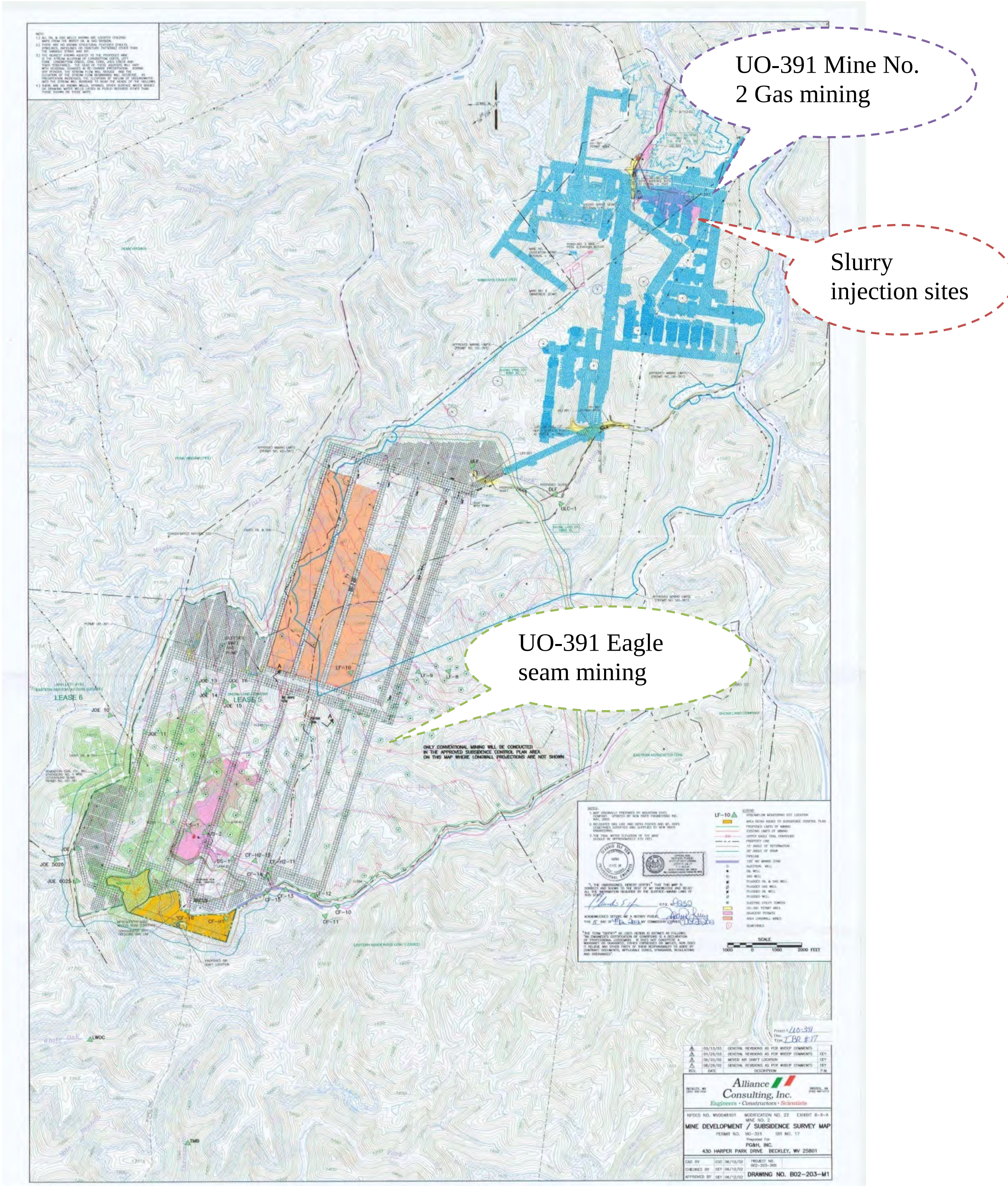


Figure 2- Relationship between UO-391 Eagle seam mine and No. 2 Gas Mine, May, 2002)

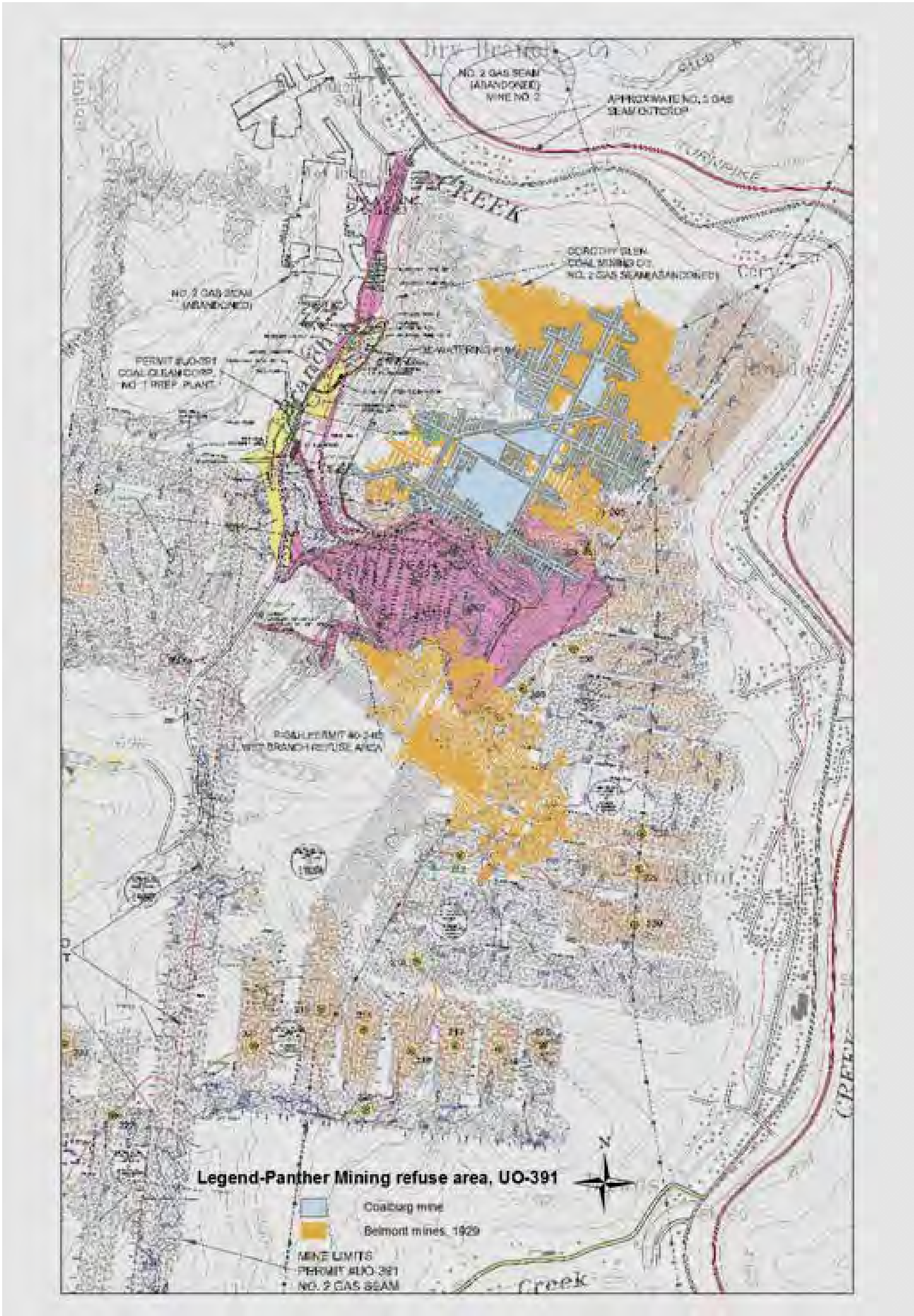


Figure 3- Map showing the relationship of pre-law underground mines overlying Panther UO-391 Mine No. 2 and associated O-2-82 Wet Branch Refuse Area (May 2006)

Slurry Disposal History

The operator (P-G &H, Inc.) received NOV's for Permit O-112-83 (Notice of Violation) for activities resulting from slurry ponds upstream of Pond #4 full of sediment (Figure 3A). According to the WVDEP permit records NOV N27 was written on September 14, 1994 and terminated on September 14, 1994).The Permittee at the time injected preparation plant coal slurry underground apparently because Pond #4 was full. This pond occurs at the downstream terminus of the P-H &H (now Panther LLC) preparation plant and upstream of the mouth of Wet Branch.

Also, in July 8, 1994 P-G &H received a Notice of Violation (NOV 27N) for injecting slurry into old underground mine works without an underground injection permit. The abatement and remedial measures for this violation were to cease all slurry injection activities and grout all injection holes, and obtain an approved slurry injection permit. Panther staff stated that the active injection had been occurring for approximately six months when the WVDEP Inspector issued the NOV to cease slurry injection (Accord, 2008). There was no information available in order to determine which mine the pre-permit slurry was pumped into; Company officials nor WVDEP records or the inspector did not know the injection site location or the mine injected. Available mine maps show the proximity of the Dorothy Glen Mine that is also in the No. 2 Gas seam, which is likely that was the site of slurry injection.

In 1995 the Company installed a belt filter press at the Panther preparation plant, which reduced the amount of coal fines that entered the plant slurry pond system. The plant thickener underflow that was once pumped as slurry is now captured and fed into the plant press where the press "squeezes" water out of the slurry. Since that time, filter cake is routinely mixed with the coarse refuse material, and then disposed of at the O-2-82 Wet Branch Refuse Area.

The No. 2 Gas seam mined at Mine No. 2 was processed at the Panther preparation plant. A sample of the refuse showed a total sulfur of 0.66 percent and pyritic sulfur 0.187 percent, and organic sulfur content of 0.45 percent. The NPDES Revision No. 1 permit records show that the preparation facility consisted of heavy media cyclones, spiral concentrators, floc flotation devices, and a belt press. Eagle seam refuse material (including some slurry) processed at the Panther plant had been injected into the abandoned No. 2 mine, and the coarse refuse placed in the WVDEP O-2-82 Wet Branch Refuse Facility permit(s).

The November 2000 P-G & H, Inc. Mine No. 2 Mine map shows the area that had been planned for coal slurry into Mine No.2 (Figure 3). The area of the mine that was proposed at that time was underneath and surrounding the Wet Branch O-2-82 Refuse Area. The permit notes that only three (3) injection holes were planned. A Class 5 UIC (Underground Injection Control) Permit 0308-09-039 was issued to P-G & H FEIN (now Panther, LLC) on October 30, 2001, which authorized the injection of coal slurry into abandoned sections of the UO-391 mine.

In December 2001, P-G&H, Inc. applied for WVDEP- UIC and M.S.H.A. (Miners Safety and Health Administration) permits through the WVDEP-UIC program that authorized an emergency UIC permit # 0308-00-039 for installation of numerous injection holes (22 holes) for slurry injection into the No. 2 Mine, which was effective May 9, 2002 through May 1, 2007 (permit Modification No. 1). This modification authorized disposal of coal slurry from the Panther Preparation Plant into sealed sections of the mine, which lies directly below the Wet Branch Refuse Facility.

The MSHA permit stated that the set of seals which would have a water discharge is the "A" Seals (refer to Figure 7 for locations of A-H seals). Abandoned sections of Mine No. 2 received slurry that were sealed-off from active portions of the mine at that time through the construction of (Omega) mine seals. The injection well sites enter the old mine works at an approximate elevation of 670 feet MSL (mean seal level) (bottom of mine void); the UIC permit states that the Permittee had to maintain a pool level of 680 feet MSL. The MSHA permit stated that monitoring at the dewatering pump (PL-2) occurs near the "A" seals behind which slurry would be injected, and would maintain the water level to the 670 ft pool elevation. The WVDEP-DMR Mod No. 10 permit stated that a maximum 460 feet of head could develop from the injection of the proposed volume of slurry (assuming no dewatering). The mine seals have been arbitrarily assigned letter designations. A through G for reference; refer to Figure 3A for locations (MSHA permit, December, 2001).

The MSHA also stated that the Permittee proposed to install a dewatering pump on the downgradient side of the abandoned Dorothy Glen No. 2 Gas seam mine (aka Wet Branch Mining Company, Powellton No. 2 Gas Seam mine). The water will be used to as preparation plant make-up water and dewatering the mine should minimize the potential for problems should an interconnection develop between the UO-391 mine and the Dorothy Glen Mine (MSHA permit, December, 2001).

The area of the mine that was proposed for slurry injection is depicted on Figure 4 map, which is highlighted in blue. The Wet Branch Refuse Area (O-2-82) was the site for original three (3) injection holes. In addition to the coarse coal and filter cake refuse materials come from the Panther preparation plant. The O-2-82 Site was also approved to place coal ash at the facility as well (WVDEP permit O-2-82, Revision No. 3).

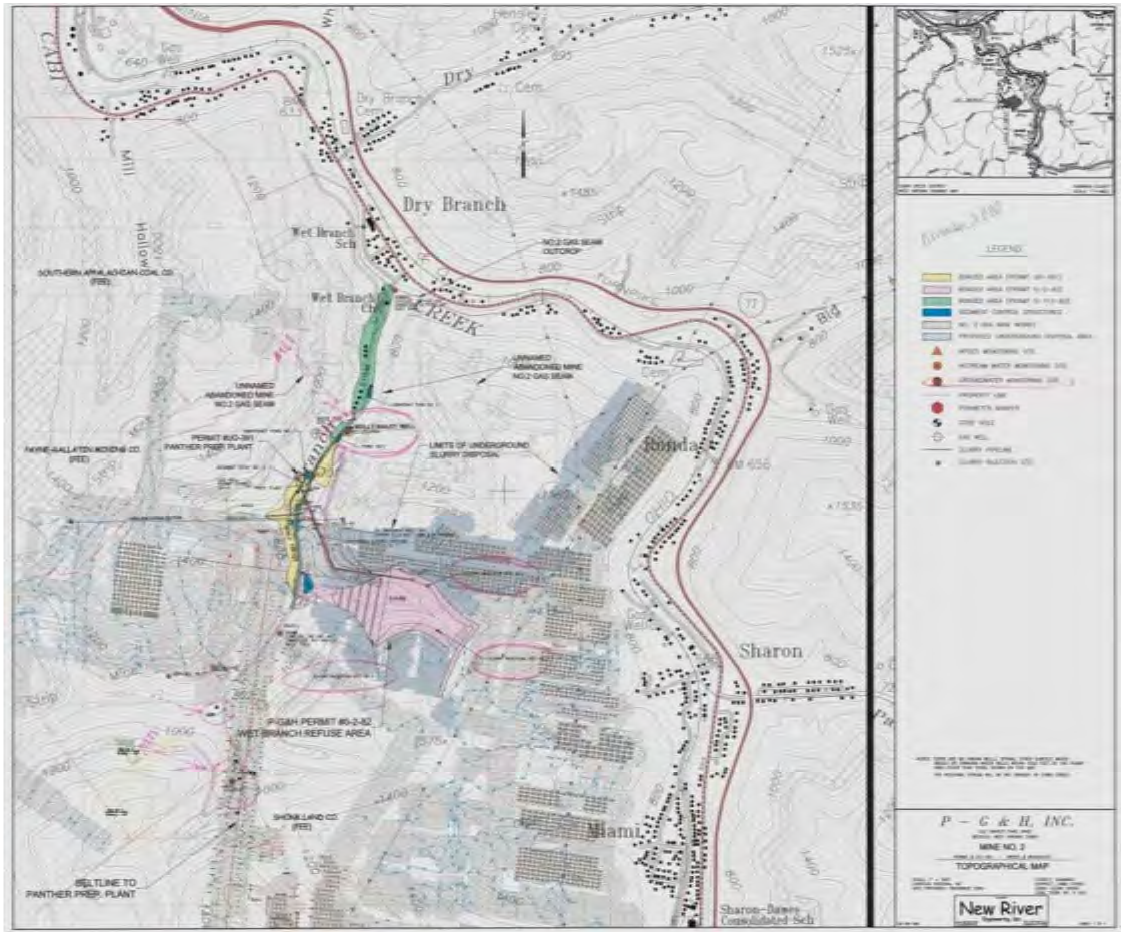


Figure 4- Location of P-G & H Mine No. 2 (UO-391) proposed underground slurry disposal area, November, 2000

The February 2001 P-G & H, Inc. Mine No. 2 Mine UIC map shows that the area of coal slurry placement in the mine was modified by that time (Figure 5). The mining areas in the northeast panels and the mine area south of the refuse area were dropped from the permit from slurry injection. Subsequent permit modifications allowed additional injection holes that were drilled in the southern portions of Mine No. 2. Eastern and southern mine workings were proposed sites of slurry injection. Mine workings with proposed injection sites are located immediately adjacent to the communities of Dawes, Miami, and Ronda (WVDEP UO-301 Permit Re-Issuance Map, May, 2006). A blow-up of the mine that was proposed for slurry injection as of 2001 is depicted on Figure 6 highlighted in blue.

In 1997, the Permitee at the time was authorized to place other coal ash to the O-2-82 Wet Branch refuse area**.** Appendix 2 shows the toxic characteristic leaching procedure) TCLP analysis for the proposed coal ash, which reflects both metals and organic compounds.

Figure 5- Mine No. 2 UO-391 (Revision No. 10) to the UIC permit, February 2001

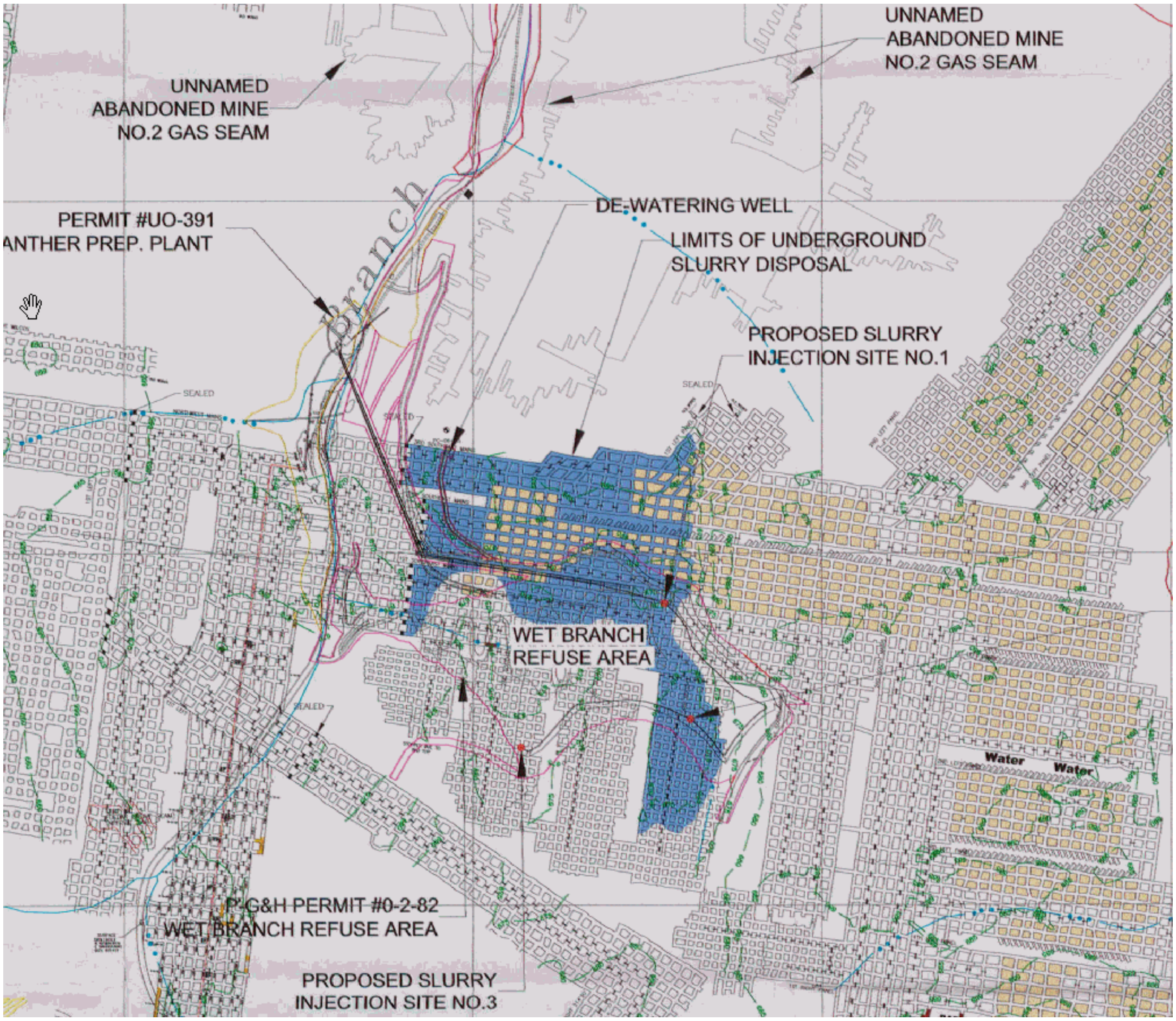


Figure 6- UO-391 Revision No. 10 underground injection via 3 injection holes, February 2001

The WVDEP-DMR Permit UO-391, modification No. 10 authorized the Permittee to add an underground slurry injection disposal plan to the existing permit (approved January 9, 2002). The Wet Branch Refuse Disposal Area shown by Figure 6 (Permit O-2-82) is located in Wet Branch of Cabin Creek continued to receive coarse refuse products from the Panther Preparation Plant (UO-391) during this period.

The underground disposal plan as outline in the permit Modification No. 10 allowed coal slurry from the Panther preparation plant to be pumped into abandoned sections of the mine workings of the P-G & H Mine No. 2. Figure 7 shows the revised slurry injection plan for the UO-391 mine

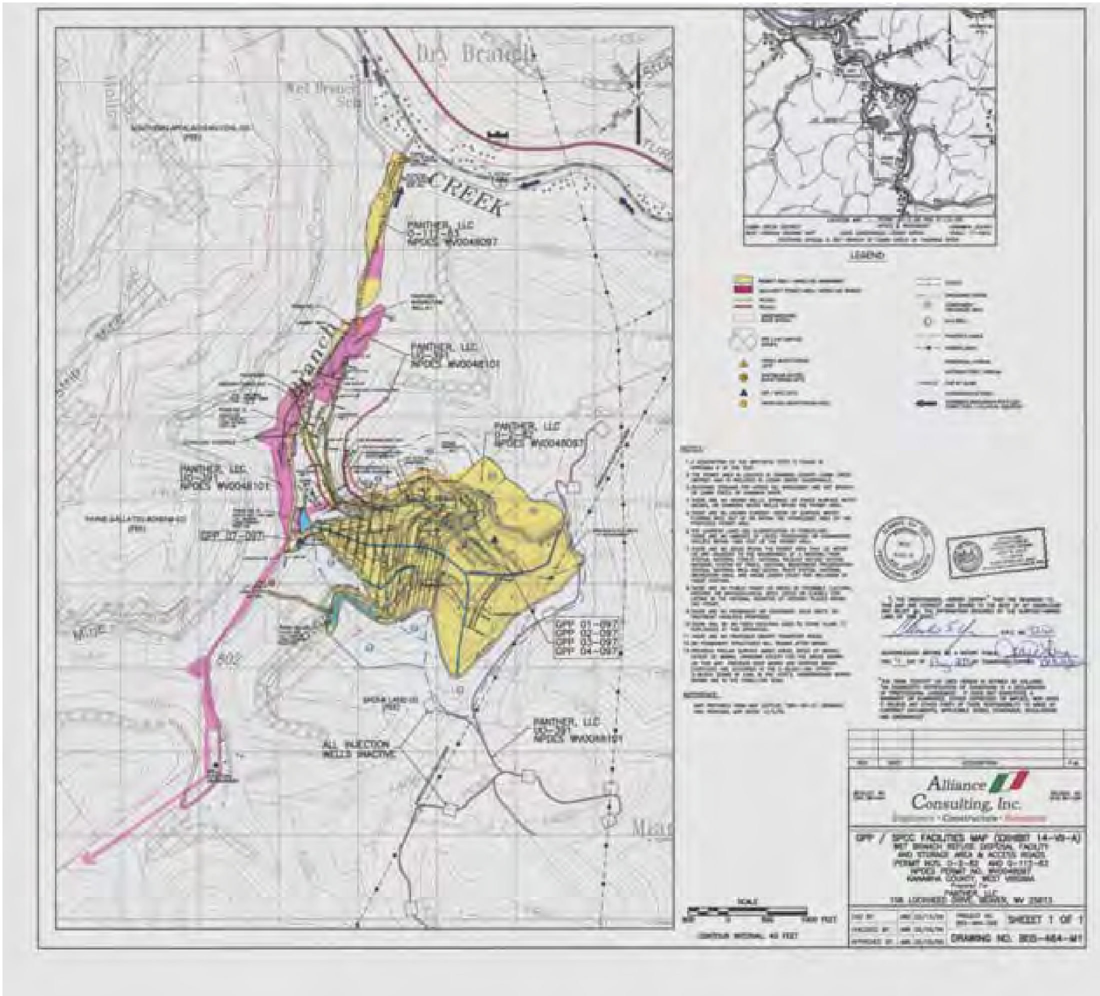


Figure 7- Panther LLC, Wet Branch O-2-82 Refuse Area, May 2006

The permit stated that as the course refuse rises above each of the slurry injection well sites, casing was to be added to each well. During the raising of the well casing, slurry was pumped to one of the other well sites to allow continuous slurry injection (WVDEP Modification No. 10 permit files, UO-391). Figure 8 shows a typical Panther slurry injection hole and pipeline. The injection occurred by gravity that was fed from the top of the injection hole to the coal seam, which is 460 feet of head. The average rate of disposal was stated as 25,000 gallons per hour or 600,000 gallon per day. The maximum daily rate of disposal was stated as 33,000 gallons per hour. The total volume of coal slurry to enter UO-391 via the injections wells was estimated to be at 650,000 gallons per day .

The slurry injection sites have been located at the site of the Wet Branch Refuse area. As the slurry injection activities expanded the number and locations of the injection holes expanded out radially to the south, SE, and SW areas.

Figure 8- Inactive Panther slurry pipeline into injection hole

A typical slurry injection well that was depicted in the UIC permit application showed that the current elevation on top of the refuse area was approximately 1130 feet MSL. The bottom of the mined coal seam at the injection well sites averaged 665 feet MSL; The Permittee mine maps show that slurry injection holes #205 to 223 would have a coal seam elevation of 665 feet MSL to 695 feet MSL. The WVDEP permits stated that the mine void would fill from the Southeast Mains (bottom elevation 670 feet MSL) to elevation 680 feet MSL, and that the injected coal slurry solids would fill the approximately 30 percent of the mine in the area of the Southeast Mains.

The Permittee provided designed plans in the WVDEP-DMR permit in order to prevent slurry from migrating from the injection site. Water traps at seals were monitored in order to detect slurry being discharged through the water trap(s). If slurry as seen in the water traps, injection activities would be ordered to be stopped and no additional slurry would be pumped into the area until a revised plan had been submitted and approved by all affected agencies. The design criterion was to prevent slurry from building up behind the (Omega) mine seals to an unsafe level and jeopardizing the integrity of the seals. As an additional protection measure, the Mine No. 2 de-watering monitoring well (sample site SCR-15 PL-2) was approved in IBR No. 10 for Permit O-2-82 and was operational before the slurry injection activities began.

The UO-391 mine dewatering pump site (SCR-15 PL-2) is used in part to determine the level of slurry in the No. 2 mine. The initial pump setting was set at approximately 665 feet MSL. If slurry was encountered from the pump discharge, then the pump would be raised to the 680 feet MSL elevation level in order to continue dewatering operations. Water traps were located in three sealed sections of the mine that were used as monitoring points. A contingency plan was submitted to appropriate agencies before slurry injection activities commenced (WVDEP Modification No. 10 permit files, UO-391). The dewatering site pumped water from the abandoned area of Mine No. 2 to the refuse area where it was discharged to the Wet Branch refuse area slurry cells. The slurry cells decant into the Wet Branch Refuse Area rock underdrain flows into Pond No. 10, which is located at the O-2-82 refuse toe of the refuse area (refer to Figure 3A).

In February 2002 permission was requested by P-G&H, Inc. to the WVDEP-UIC to install and use three of the 27 slurry injection holes that had been added through Modification No. 1. The company at that time was withdrawing water from the mine for use at its preparation facility. The company requested this modification because the water being withdrawn from the mine might become turbid due to the close proximity of the injection hole and the dewatering borehole. The request for three injection holes are in the same watershed as the other approved injection holes that were approved.

On June 6, 2006 P-G & H Fein transferred the UIC Permit to Panther FEIN Number 55-0763722. Slurry injection is not currently being used since all coarse coal is mixed with slurry filter cake from the preparation plant and is placed on the surface at the Wet Branch Refuse Area (O-2-82).

Surface Water Chemistry

There were seven (7) SCR-15 UIC study samples that were obtained from around the Panther Mining mine, preparation plant area, and refuse area (refer to Figure 9). There are two in-stream sites that sampled from Wet Branch, which are located upstream and downstream of the Wet Branch Refuse Area. In addition, a slurry sample from the processing of the Eagle seam was obtained from the Panther preparation plant thickener. Analyses of the solid and liquid phases from the slurry were reported produced by the laboratory.

Wet Branch of Cabin Creek is the receiving stream for the Panther O-2-82 Wet Branch (Left Fork) Refuse Area that has been the site of slurry injection holes into Mine No. 2. Attempts were made for the selected SCR-15 upstream and downstream sample sites to coincide with historical WVDEP permit monitoring sites in order to compare and better determine if any effects occurred from slurry injection activities.

A sample of the raw Eagle seam mined coal was obtained to determine the leachate (decant) from the Eagle seam. Water samples from the UO-391 mine dewatering borehole and above the NPDES outlet 002, Wet Branch Refuse Area were obtained. All samples described above were submitted to REIC Laboratory for: inorganic analysis, organic analysis, including volatile and semi-volatile organic compounds.

The Rockware computer software application AQUA was used to assess and illustrate the water chemistry from each SCR-15 UIC study area sample site. Piper, Schoeller, and Stiff diagrams were created with these data. A complete list of all constituents that were analyzed for occur in the report appendices; however, some summary inorganic and organic analytes tables will be utilized in this section to aid the discussions. It cannot be overstated that the SCR-15 UIC study sampling project reflects a one-time "snapshot" sampling event of each sample site. This type of data cannot be used to discern how the hydrologic regime responds to seasonal variation and temporal changes.

These SCR-15 UIC sample site ID's are denoted as:

PL-Slurry from the Panther preparation plant
PL-2- Mine No. 2, UO-391 dewatering borehole
PL-3-Downstream of Wet Branch Refuse area
PL-4- Upstream of Wet Branch Refuse area
PL-5- NPDES permit WV0048101, outlet 002
PL-6- Mr. Owen Stout residential water well
PL-Coal Leachate, Eagle seam

Metals chemistry

The list of analytes determined for Sample sites PL-3 and PL-4 are shown below in Table 1; complete laboratory results are located in the appendix of this report. Table 1 shows the SMCRA-related water chemistry parameters (dissolved basis) from the downstream and upstream sites of Wet Branch. The data indicate that higher concentrations of all cations and anions were higher downstream of the O-2-82 Refuse area. Discussions below will relate stream water chemistry with the Panther slurry injection chemistry.

In-stream water sample was obtained for sample site PL-4, which is upstream of the O-2-82 Wet Branch Refuse Area. Sample site PL-3, is located downstream of the O-2-82 Wet Branch Refuse Area and located near the Panther preparation plant. The UO-391 permit downstream in-stream monitoring site is DSWBJ, which is located near the mouth of Wet Branch and near Cabin Creek. The locations of the in-stream monitoring sites associated with the mine permits UO-391, O-2-82, and O-112-83 do not coincide with the UIC/SCR-15 study sample sites. Figure 10 shows that sample site PL-5 is a sample from the O-2-82 Wet Branch Refuse Area and is located above NPDES Outlet 002.

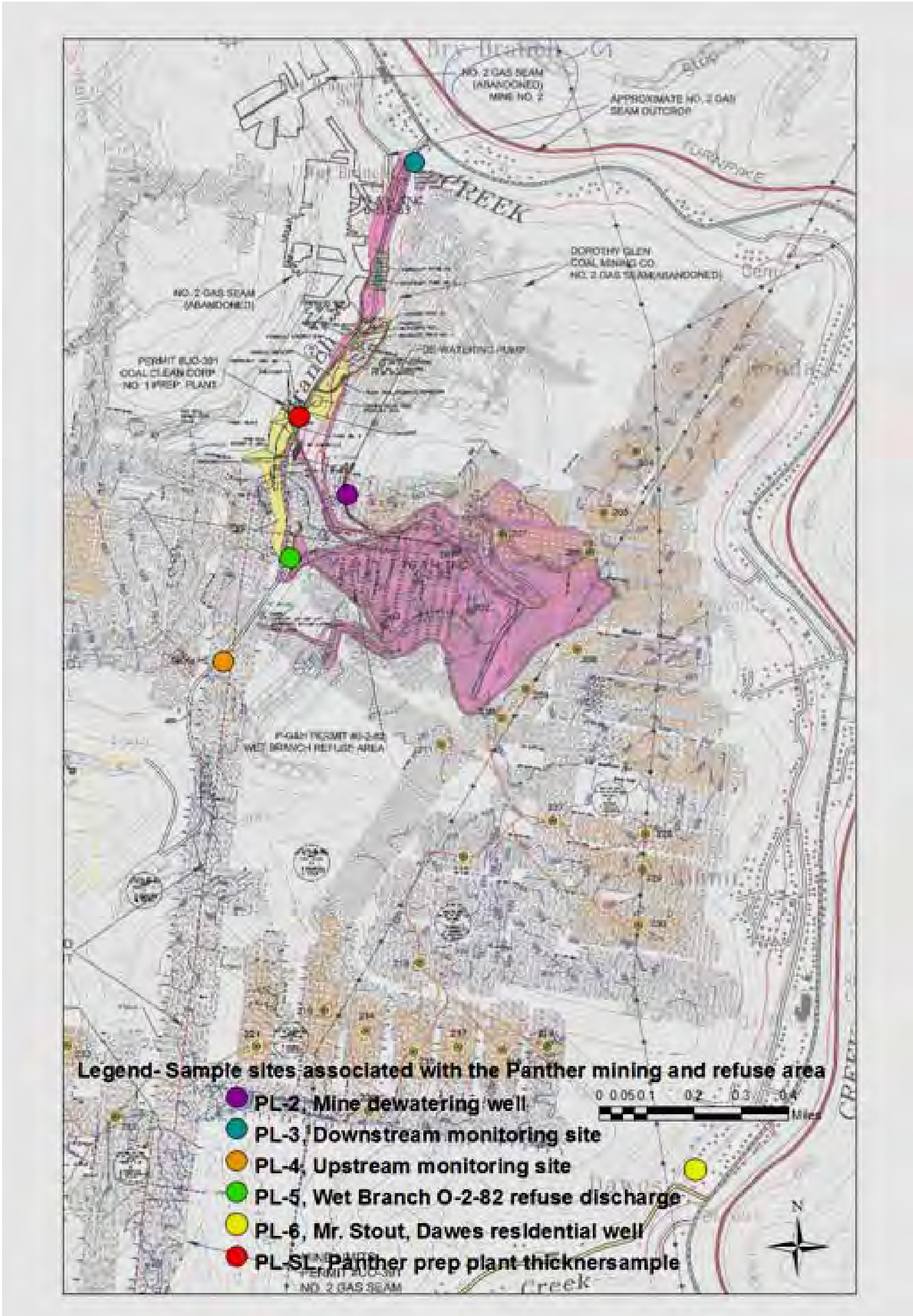


Figure 9- Sample Sites for the SCR-15 UIC Study Area

Figure 10- Site PL-5 Water Being Sampled as it Discharge, O-2-82 Refuse Toe Underdrain

For this report, Sample Site PL-5 is used to characterize the Wet Branch seep from the refuse area discharge as a ground and surface water site. A seep started on top of the refuse area and entered the refuse pile; the seep subsequently discharged from the refuse toe. The PL-5 site water that was sampled at a point isolated from any adjacent surface runoff from O-2-82. The PL-5 site chemistry will also be used to contrast the water chemistry of the water leaving the refuse area to the overall chemistry of the receiving stream, Wet Branch. Overall, PL-5 indicates a significant degree of mineralization as ground water flow migrated through the refuse pile and became mineralized, and most probably co-mingled with ground water within the refuse pile.

Table 1 and Figure 11 (Schoeller Diagram) show the water chemistry for sample sites, PL-3, PL-4, and PL-5.The water chemistry from site PL-3 show that the specific conductance is 463 umhos/cm as compared to the upstream site PL-4 conductance of 150 umhos/cm. The upstream and downstream concentrations of strontium showed concentrations of 0.093 mg/L and 0.43 mg/L, respectively. Sample Site PL-5 contributes to elevated metals concentrations that enter Wet Branch. NPDES outlet 002 at Pond No. 10 monitors the water quality leaving the refuse area. Appendix 3 shows the WVDEP NPDES non-compliance warnings concerning exceedences of TSS, Mn, Al, Fe, and pH at Pond 8, 10, 12, and Ditch 4.

Table 1- Sample Sites PL-3, PL-4, PL-5 Water Chemistry (dissolved basis)

Name	Unit	PL-3	PL-4	PL-5
Sample ID		PL-3	PL-4	PL-5
Date		1/23/2008	1/23/2008	1/23/2008
Manganese	mg/L	0.033	0.008	0.78
Aluminum	mg/L	0.074	0.077	0.142
Calcium	mg/L	8.74	3.79	24.2
Iron	mg/L	0.023	0.01	0.039
Magnesium	mg/L	6.29	2.95	9.36
Potassium	mg/L	0.761	0.583	3.69
Silicon	mg/L	0.397	0.32	0.654
Sodium	mg/L	9.44	0.828	174
Sulfate	mg/L	106	39.3	334
Bicarbonate	mg/L	32.7	13.5	303
Carbonate	mg/L	0.5	0.5	2.4
Chloride	mg/L	31.3	2.25	194
Nitrate	mg/L	0.7	0.95	2.24
Conductivity	µmho/cm	463	150	3100
Acidity	mg $CaCO_3$/L	1.4	1.2	4.7
Dissolved Solids	mg/L	251	86	1660

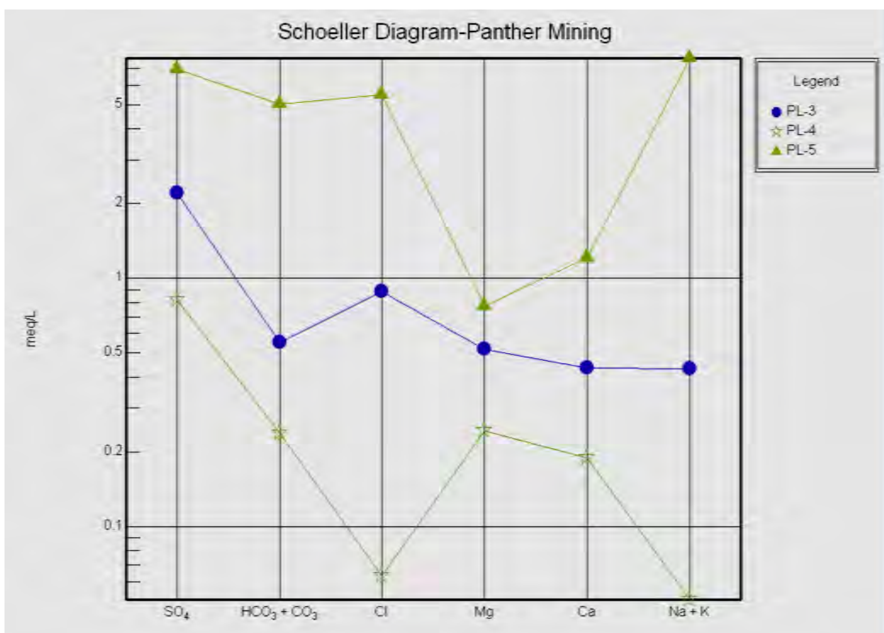


***Figure 11**-Schoeller Diagram Showing Water Chemistry at Wet Branch sites PL-3, PL-4, and PL-5 the O-2-82 Refuse Discharge Leachate*

Stiff and Piper diagrams were generated from the water quality data. The cations used in these analyses were Ca, Mg, Na, K, Si, Fe, Al, (dissolved basis), and PO_4 (total basis). The cations from the SCR-15 UIC study water samples are depicted in the Piper ternary analysis, which also includes Ca, Mg, and Na + K. The anions used in the SCR-15 UIC study include: HCO_3+ CO_3, SO_4, Cl, and NO_3 (dissolved basis).

The Stiff diagrams show that the PL-3 Wet Branch in-stream (downstream) sample site (Figure 12) is a weak Mg-SO_4 (magnesium sulfate) water chemistry type. Figure 13 show that he PL-4 Wet Branch (upstream) sample site is also a weak Mg-SO_4 water chemistry type.

Sample Site-5 (Figure 14) is characterized as a Na-Cl-SO_4 type (sodium, chloride, sulfate), which shows levels of bicarbonate, sulfate, and sodium (303 mg/L, sulfate of 334 mg/L, and 174 mg/L, respectively).

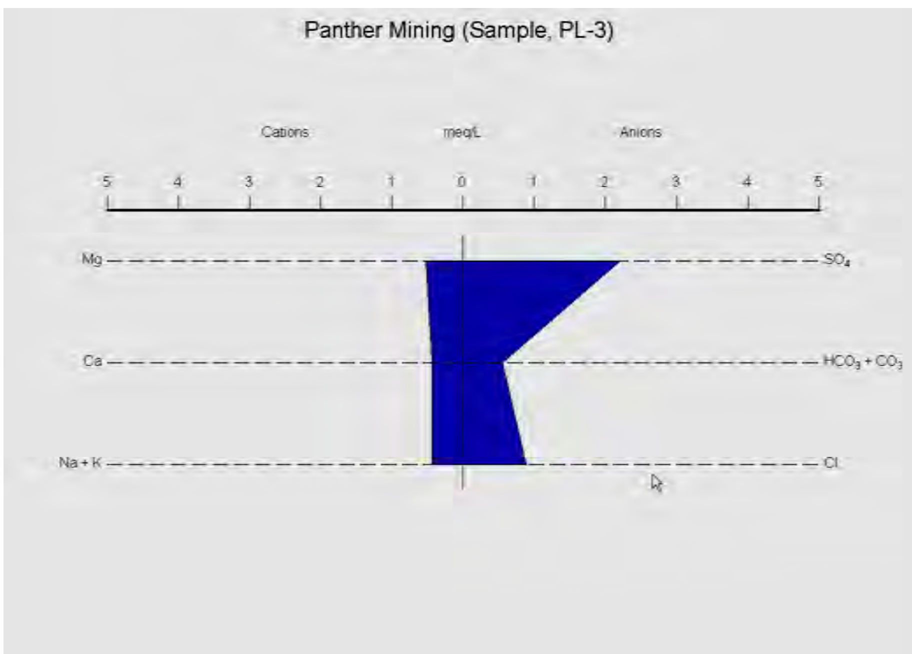


Figure 12- Stiff Diagrams of Water Chemistry (dissolved basis) at Site PL-3

The SCR-15 UIC study water chemistry data (PL-3, PL-4, and PL-5) reflects the degraded water quality leaving the refuse area. The chemistry data shows that the water chemistry is similar; however, the water at the downstream site is more mineralized.

Figure 15 shows the Piper diagram shows the ternary four sides that include sulfate + chloride; calcium + magnesium; sodium + potassium; and carbonate + bicarbonate for the PL-3, PL-4, and PL-5 sample sites shows that the in-stream sites PL-3 and PL-4 sites are associated, and that the PL-5 site is not chemically associated with the two surface water site, especially PL-4.

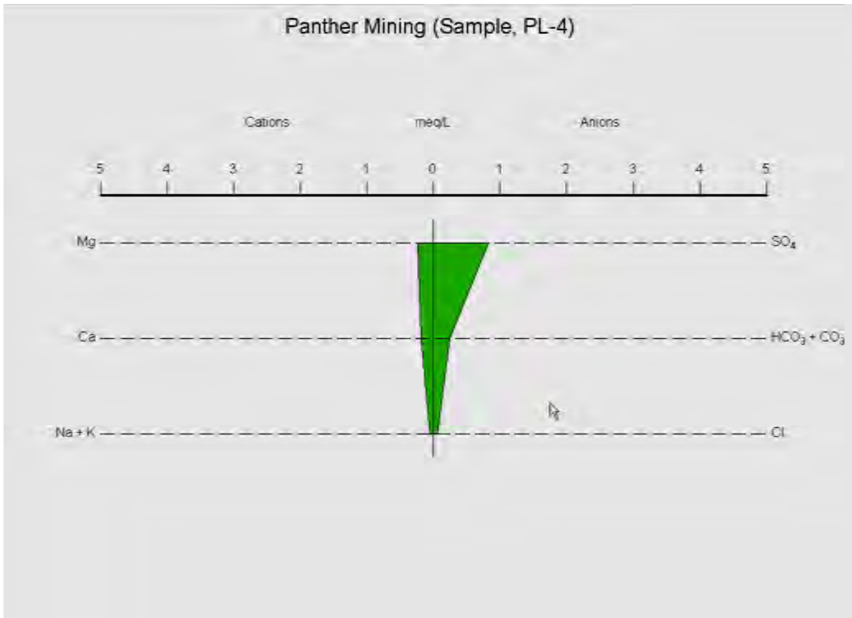


Figure 13- Stiff Diagrams of Water Chemistry (dissolved basis) at Site PL-4

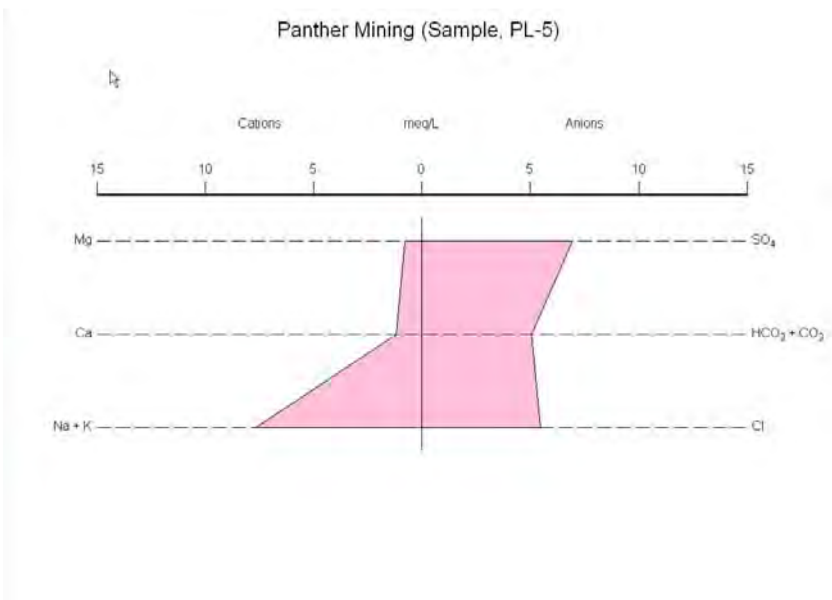


Figure 14- Stiff Diagrams Water Chemistry (dissolved basis) at Site PL-5

The water chemistry at Site PL-5 contributes to the overall water chemistry leaving the refuse area. Overall, PL-5 indicates a greater degree of mineralization since it reflects ground water that migrated through the refuse pile and became mineralized. The Wet Branch Refuse Area has and continues to receive slurry-related Panther Eagle seam refuse material.

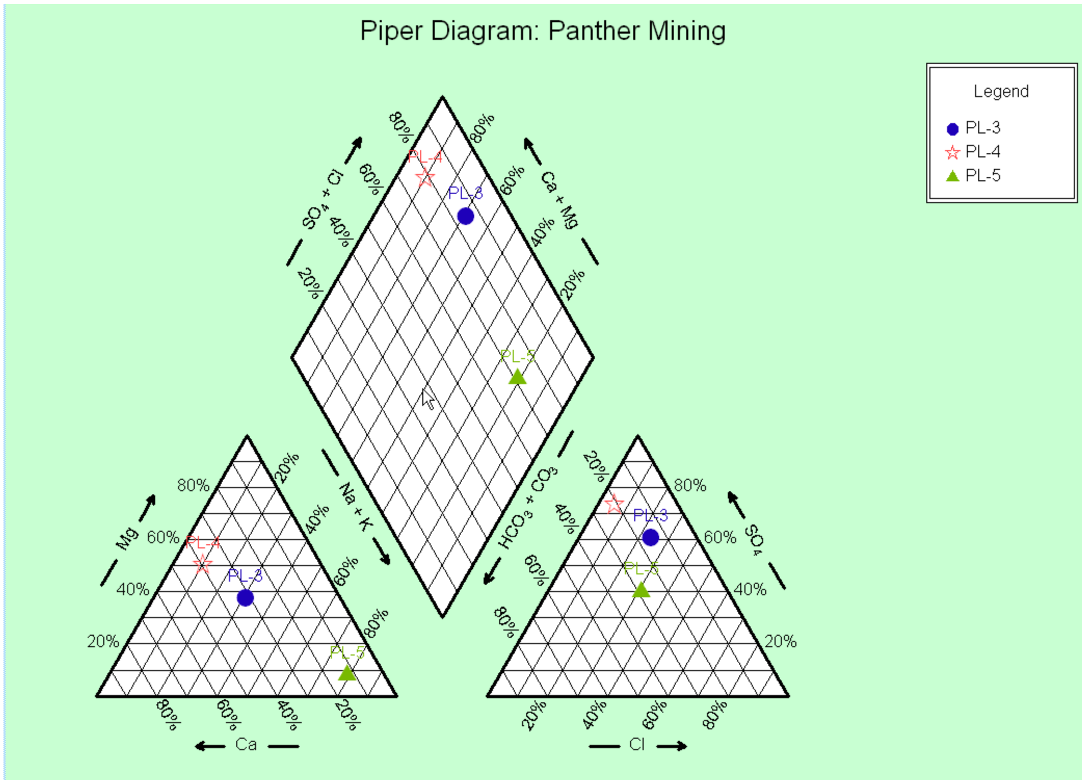


Figure 15- ***Stiff Diagrams Water Chemistry (dissolved basis, Sites PL-3, PL-4, PL-5***

Volatile and Semi-Volatile Organic Chemistry Data: Surface Water Sample Sites PL-3, PL-4, and PL-5

The list of Volatile Organic Compounds (VOCs) were analyzed in the in-stream Sample sites PL-3 (downstream) and PL-4 (upstream), and the Wet Branch Refuse Area seep discharge (PL-5) are shown below in Appendix 4; original laboratory results are located in the appendix of this report. The analysis for the suite of VOCs showed no detections at the in-stream sample sites PL-3, PL-4, or refuse seep PL-5.

The Semi-Volatile Organic Compounds (SVOCs) were determined for sample sites PL-3, PL-4, and PL-5 and are shown in Appendix 5. The results of this analysis showed no detection of any SVOCs at the in-stream sites PL-3, PL-4, or refuse seep PL-5.

The data in Table 2 show no presence of acrylamide, glycol, and total petroleum hydrocarbons, which may have indicated slurry constituents. The absence of TPH indicates that previously injected slurry nor the surface placement of the slurry material on-top of the O-2-82 refuse area indicates that slurry constituents have not migrated upward from the mine pool. Although THP was noted in the mine pool discharge, it was not detected in the PL-5 refuse seep.

Table 2- Wet Branch Water Chemistry (dissolved basis) at Sites PL-3, PL-4, PL-5

Related analyses		***PL-3***	***PL-4***	***PL-5***
Parameters	**Unit**			
Acrylamide	mg/L	ND	ND	ND
Glycol	mg/L	ND	ND	ND
TPH (Diesel Range)	mg/L	ND	ND	ND
TPH (Oil Range)	mg/L	ND	ND	ND
Oil and Grease	mg/L	ND	ND	ND

Table 3 shows that the upstream and upstream sample sites have equal amounts of iron–related, but different sulfate-reducing bacteria.

Table 3- Bacterial populations at Wet Branch Sample Sites PL-3, PL-4, and PL-5

Analyte				
Bacterial Analyses	**Unit**	***PL-3***	***PL-4***	***PL-5***
Iron-Related Bacteria	CFU/ml	5000	5000	5000
Sulfate-Reducing Bacteria	CFU/ml	10000	10000	100000

The Wet Branch refuse seep (Sample Site PL-5) shows an equal amount of iron-related bacteria as Wet Branch in-stream samples; however the refuse seep shows elevated sulfate reducing bacteria, with respect to sites PL-3 or PL-4. The presence of concentrated sulfate reducing bacteria indicates an anaerobic environment of the PL-5 refuse area seep, and contrasts markedly with the oxygenated water of the in-stream reaches of Wet Branch.

Comparison of Historical vs SCR-15 UIC Study Wet Branch In-Stream

Wet Branch of Cabin Creek is the receiving stream for the Panther O-2-82 Wet Branch (Left Fork) Refuse Area has been the site the slurry injection holes into Mine No. 2. Mooney (2009) reported that slurry (spills) incidents have occurred from injection activities in Wet Branch. The locations of the UO-391 permit upstream and downstream in-stream monitoring sites, or SCR-15 sample sites PL-3 and PL-4, did not record any effects from the surface placement of slurry at the O-2-82 refuse area, or from UO-391 mine pool artesian effects.

The receiving stream for the Panther mining complex that includes UO-391, O-2-82, and O-112-83 is Wet Branch, which is a tributary of Cabin Creek. The upper reaches of Wet Branch reflect the discharges from older mining, which Table 4 below illustrates. The discharges from the UO-351, UO-184, and the UO-171 mines also contribute to the streamflow in the upper Wet Branch watershed, but WVDEP records do not indicate show that the mine discharges have impacted the water quality of the receiving stream.

Site 001 is located in the upper reaches of Wet Branch and Site 002 is located near the mouth of Wet Branch. The locations of the upstream in-stream site USWB and the downstream site DSWB do not coincide with Sites 001 and 002. The data in Table 4 shows no specific general chemistry trend (Figures 1 and 2). Table 4 shows a compilation of historical and current surface water chemistry data in the Wet Branch Watershed, which illustrates the water chemistry changes over the period from 1981 to 2007. The data shows the parameters that were similar to the historical and current data that was acquired for the SCR-15 UIC study. Historical Cabin Creek water quality is shown by BCM-2 (above Wet branch) and BCM-1 (below Wet Branch).

Table 4-Historical and Current Surface Water Chemistry, Wet Branch

Site	***Date***	***pH, s.u.***	***Acidity, mg/L***	***Alkalinity, mg/L***	***TSS***	***Iron, Total***	***Sulfate, mg/L***	***Spec Cond***
	Range	s.u.	mg/L	mg/L	mg/L	mg/L	mg/L	umhos
001	5-11/'81	6.1-7.7	0-16	3-176	8-234	0.1-0.15		
002	5-11/'81	6.6-8.3	0-4	7-17	1-15	<0.02-68		
USWB	12-1-'94/'95	6.29-8.4	2-40	<0.2-8	1-19	<0.01-0.59	35-108	123-463
DSWB	12-1-'94/'95	6.9-7.37	<0.2-4	8-24	1-65	0.19-0.83	73-205	188-525
PL-3	1/23/08	7.21	1.4	32.8	2	0.053	106	463
PL-4	1/23/08	6.78	1.2	13.5	86	0.025	39.3	150
BCM-2	3-8/82	4.9-7.1	3-24	2-15	1-130	0.57-5.0	NA	460-920
BCM-1	3-8/82	4.9-7.1	2-23	2-150	2-140	1.23-5.0	NA	460-920

The SCR-15 UIC study data is a snapshot of the water chemistry on the sample date and is limited in scope and cannot be strictly compared to current permit data, nor used to show seasonal or temporal trends.

There are no surface water organic chemistry data available for sample sites 001, 002, USWB or DSWB.

Ground Water Chemistry

There is no recent ground water data available in the Wet Branch Watershed. Historical data in the WVDEP permit applications from 1980-1990's confirm that two ground water monitoring wells (Bailey and Estep wells) were used. The earlier permit maps did not show the locations of these wells; however, the P-G & H permit map (November 2000) did show the location of the Bailey well.

The Permittee planned to relocate the Bailey well in 2001, but during a 2008 site visit, the Permittee reported that the Molly Bailey monitoring well was eliminated and a replacement monitoring well has not been drilled to-date. This well was apparently buried by the Permittee and the replacement well although proposed (and appears on permit maps) was never drilled.

Attachment XIII of the Panther WVDEP-UIC permit states that one ground water monitoring well was to be employed for the UIC permit, which was to be located quarter mile of the permit. This monitoring site has been referenced as a ground water monitoring site for the adjacent NPDES Permit No. WV0048097. No information was found determining if this monitoring well was to be used to determine the mine pool level inside Mine No.2.

Therefore, in effect, there are no ground water monitoring sites for the UO-391, O-2-82 or the UO-112-83 permits. There is no way to determine if any impacts to the ground water have, or will occur from any past slurry injection activities in the Wet Branch-Cabin Creek watershed. The Permittee submitted plans (IBR 16) in March 2002 to install two (2) other dewatering wells on UO-391, but this apparently has not occurred. Three additional water wells monitor the ground water in the area of the UO-391 Longbottom Eagle seam mining operation, but this is outside the Wet Branch watershed.

Two ground water sample sites were chosen to be included in the UIC/SCR-15 study, which reflect activities from the Panther Mine #2 preparation plant area, refuse area, and adjacent residential areas, which are denoted as Samples Sites PL-2 and PL-6. Sample Site PL-2 is the dewatering borehole for UO-391 Mine No. 2 and a water sample was obtained in order to characterize the mine pool water chemistry. All samples described above were submitted to REIC Laboratory for detailed inorganic analysis, organic analysis, including VOCs and SVOCs, and bacterial analyses.

Residents of Dawes and Miami have access to PSD water systems and largely do not use their water wells to any significant degree. Figure 16 shows the second ground water sample site (PL-6), which is the Owen Stout (residential) water well. This well has not been used since it was drilled since the early 1990’s. Mr. Stout of Dawes stated that the well has been unusable with elevated levels of iron since it was drilled. The Stout well is located on the Cabin Creek alluvial floor at an elevation approximately 710 feet MSL. The well was completed in bedrock and is approximately 65 feet deep. Therefore, the elevation of the bottom of the Stout well is approximately 645 feet MSL and the Stout well is located upgradient with respect to the No. 2 mine workings. Mine maps show that where slurry had been projected to be injected into No. 2 Mine workings, seam elevations range from 675 to 690 feet MSL; 680 feet MSL is the upper limit for mine pool development that was allowed by the UIC permit when active injection occurred during 2002-2004.The closest injection well to the Stout residence is UIC hole #219, which is located approximately 1500 feet from the #219 to the Stout well. Based on these data, the well bottom would be approximately 40 feet below the level of the UO-391 seam elevation.

Figure 16- Sample Site PL-6 is a well water sample from Mr. Owen Stout's well

The Stout well water chemistry shows elevated concentrations (dissolved basis) of iron, with respect to the PL-2 and PL-5 SCR-15 ground water samples sites, barium was slightly elevated. This well has a low sulfate concentration of 18.3 mg/L, and specific conductance of 309 umhos/cm, which do not indicate an influence from mining or slurry contamination. No impacts from coal mining activities, including slurry injection, were detected in the tout well. Elevated levels of sulfate, TDS, and specific conductance if found, would be indicators of slurry injectate, and the Stout well water chemistry does not exhibit these characteristics. For example, contamination of well water by slurry injection was demonstrated by the Danny and Dreama Peters, and Irene Peters, water well complaint study in adjacent Logan County, West Virginia (WVDEP, Galya, 1999).

The Peters' wells showed sulfate levels of 441 to 594 mg/L and 468 to 628 mg/L, respectively, and specific conductance levels 1018 to 1590 umhos/cm and 1420 to 2570 umhos/cm, respectively. Residents adjacent to the Peters' wells did not experience similar effects of elevated sulfate and conductance levels in their well water. The data indicates that the injected coal slurry had migrated to the Peters' wells capture zones.

Table 5 and Figure 17 show the Schoeller diagram of the chemistry of the two ground water sample sites and the Wet Branch refuse underdrain seep. An assessment of the sample sites PL-2, PL-5, and PL-6 water chemistry shows that the water chemistry types are: Na-HCO_3 (sodium bicarbonate); Na-SO_4 (sodium sulfate), and Ca-HCO_3 (calcium bicarbonate), respectively.

Site PL-2 is enriched with respect to sodium, chloride, sulfate, and (bicarbonate) alkalinity; elevated acidity concentration occurs in the Stout well water, but PL-5 shows the highest concentration of sodium, chloride, sulfate, and conductivity. The Stout well water shows higher levels of calcium, magnesium, iron, and acidity than the mine water. The Piper and Stiff diagrams (Figures 17-20) illustrate the differences in chemistry at the three sample sites. The Piper diagrams also show that the water chemistry from these three sites is somewhat dissimilar, even though the dewatering water and the refuse area discharges are genetically related.

Table 5- Characterization of the Ground Water Chemistry, Sample Sites PL-2, PL-5, and PL-6

Name	Unit	PL-2	PL-5	PL-6
Sample ID		PL-2	PL-5	PL-6
Date		1/23/2008	1/23/2008	1/23/2008
Manganese	mg/L	0.024	0.78	0.915
Aluminum	mg/L	0.111	0.142	0.067
Calcium	mg/L	4.13	24.2	10.4
Iron	mg/L	0.146	0.039	10.5
Magnesium	mg/L	1.55	9.36	3.02
Potassium	mg/L	1.38	3.69	1.26
Silicon	mg/L	0.514	0.654	1.04
Sodium	mg/L	98.6	174	3.39
Sulfate	mg/L	78.1	334	18.3
Bicarbonate	mg/L	532	303	123
Carbonate	mg/L	1.3	2.4	0.5
Chloride	mg/L	69.9	194	16.5
Nitrate	mg/L	0.08	2.24	0.02
Conductivity	µmho/cm	1430	3100	309
Acidity	mg $CaCO_3$/L	40.5	4.7	74.6
Dissolved Solids	mg/L	791	1660	161

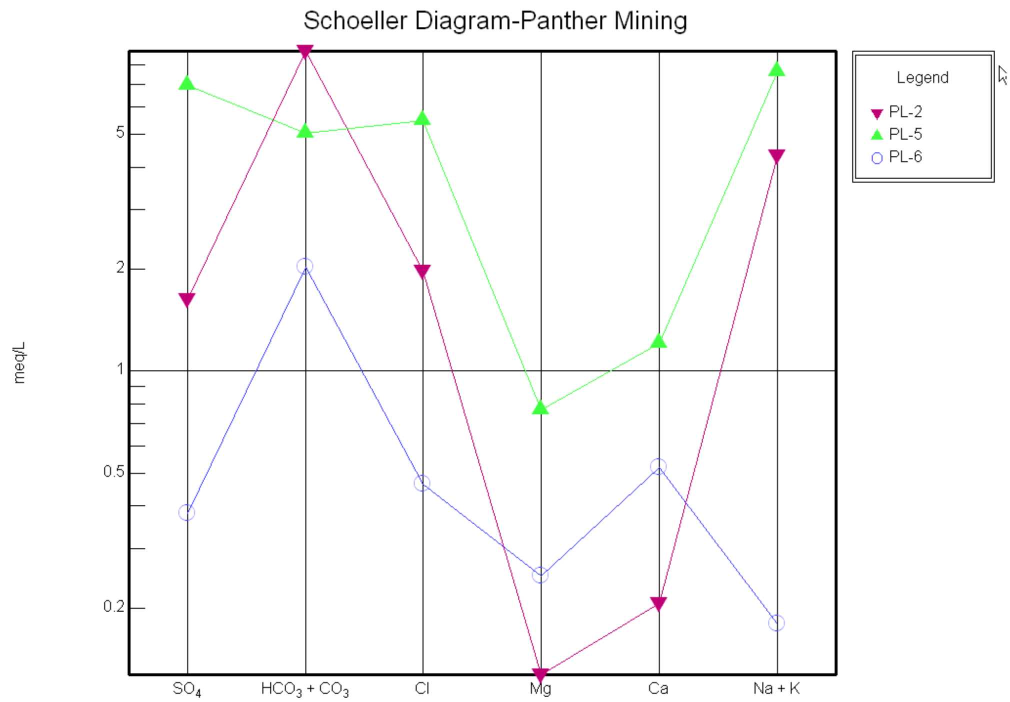


Figure 17- In-stream ionic characterization (Schoeller diagram) of ground water sample sites PL-, PL-5, and PL-6

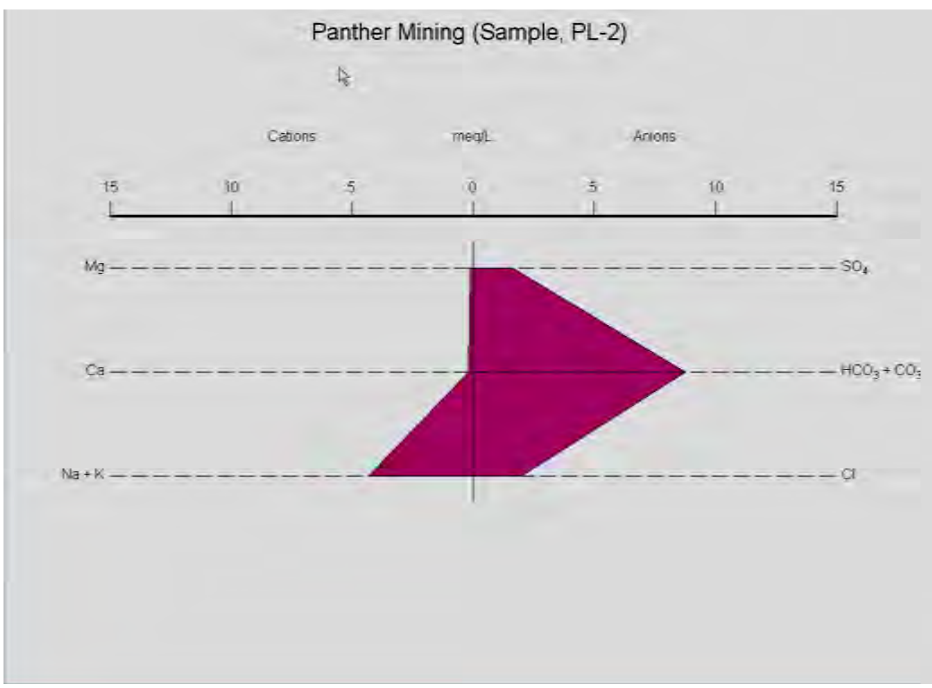


Figure 18- Stiff diagram water chemistry of Site PL-2, Mine No. 2 dewatering borehole

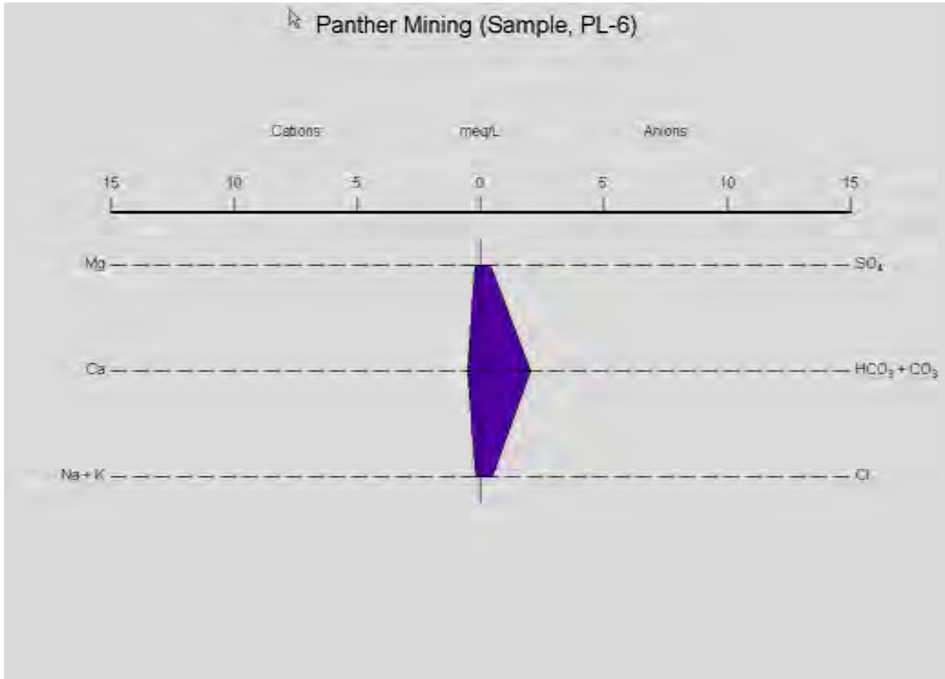


Figure 18- Stiff Diagram of PL-6, Owen Stout Residential Well Water Chemistry

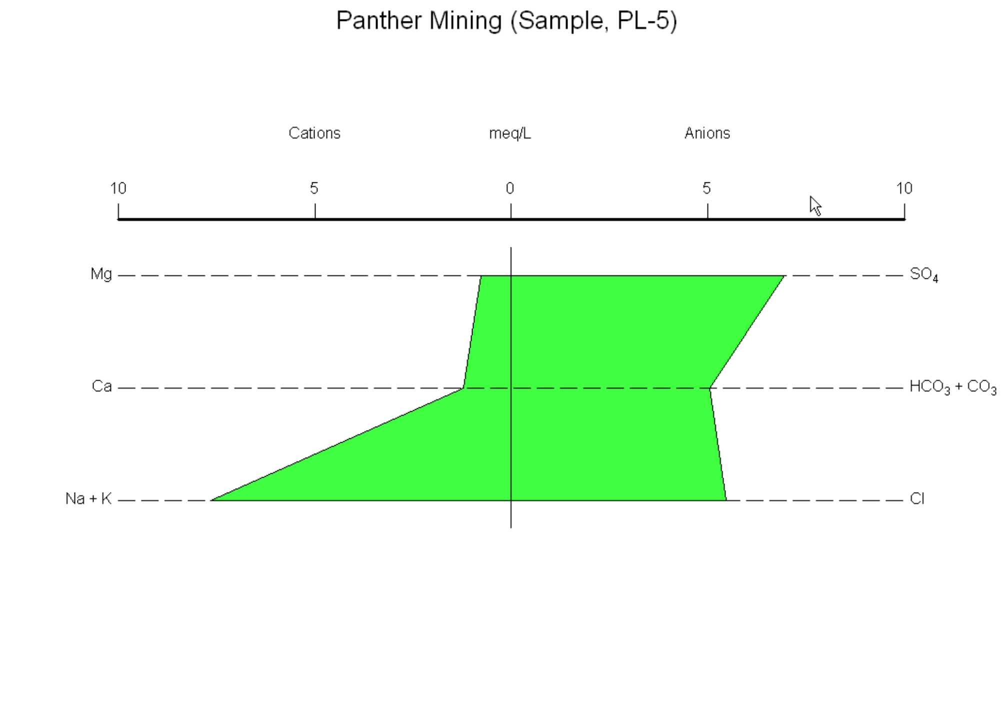


Figure 19- Stiff Diagram of PL-5, O-2-82 Wet Branch Refuse Water Chemistry

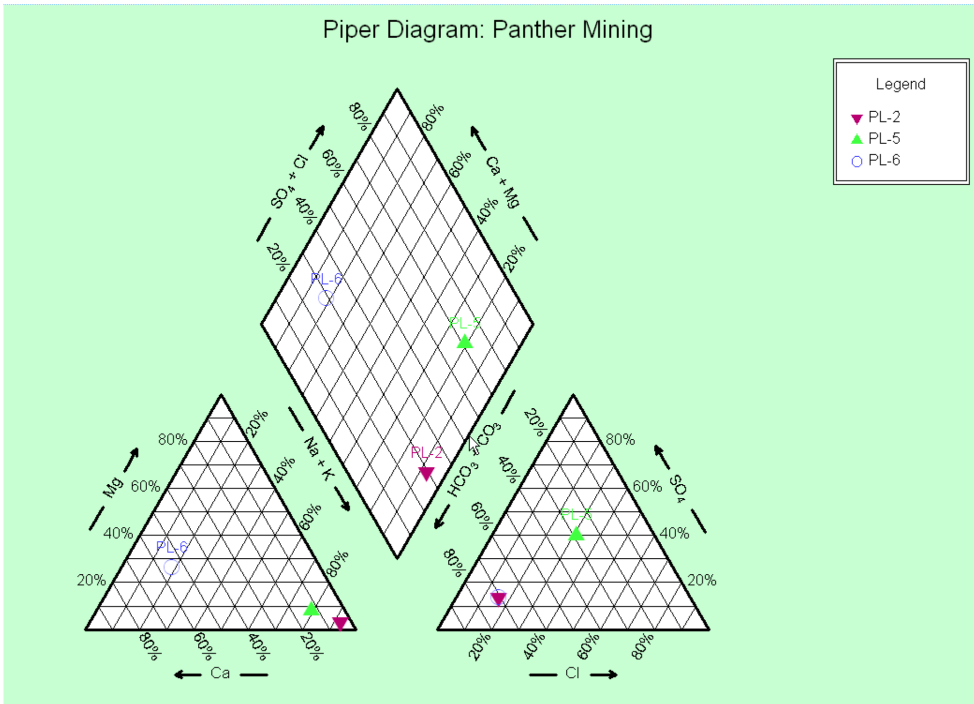


Figure 20- Piper Diagram Showing the Association of Sample Sites PL-2, PL-5, and PL-6

<u>Volatile and Semi-Volatile Organic Chemistry Data, Ground Water Sample Sites: PL-2, PL-5, and PL-6</u>

The VOCs were tested at the ground water sample sites PL-2 (mine discharge), PL-6 (Stout well), and PL-5 (the Wet Branch Refuse Area seep discharge) and are shown in Appendix 6; original laboratory results are located in the appendix of this report. The analysis for the VOCs showed no detections at downstream sites PL-2, PL-5, or PL-6.

There was one TIC (Tentatively Identified Compound) VOC that was determined for Sample site PL-2, which was 1-butanol at a concentration of 2.8 ug/L. Sample Site PL-2 also showed the presence of total petroleum hydrocarbons (TPH): DRO at 0.92 kg/L, ORO at 4.16 mg/L, and oil and grease at 2.20 mg/L. The organic compound 2-butanone was detected in the slurry- liquid phase at a concentration of 64.4 ug/L, but not detected in the coal leachate.

The SVOCs were also tested at sample sites PL-2, PL-5, and PL-6 are shown in Appendix 7. The results of this analysis showed no detection of any SVOCs at the PL-2, PL-5, and PL-6 sites.

Appendix 8 summarizes all the inorganic trace element chemistry for the surface and ground water SCR-15 data. The organic slurry liquid and coal leachate chemistry from all hydrologic sites is also presented in this appendix, and complements the site-specific data that are shown in the other appendicies.

<u>Comparison of Historical and SCR-15 UIC Ground Water Sample Site Chemistry</u>

Table 6 shows that the Mollie Bailey well water chemistry well is significantly different the two sample sites, the mine discharge (PL-2), refuse (PL-5) and the Stout well, PL-6. The WVDEP permit records indicate that there were two water wells were established to monitor the UO-391 permit, PCG-3 and PCG-4. However, no details of the locations, or chemistry were available. Historical permit data from the Mollie Bailey monitoring well was available and assesses, but current data from this well were not available, because the well has been buried. Table 6 shows that the Wet Branch refuse discharge is highly mineralized with respect to the mine discharge water and Stout residential well water.

Table 6- Historical and Current Ground Water Data, Wet Branch Area

Site	*Date*	*pH*	*Acidity*	*Alkalinity*	*TSS*	*Fe-t*	*Sulfate*	*Sp. con*
	Or Range	s u.	mg/L	mg/L	mg/L	mg/L	mg/L	umhos
Mollie Bailey	5-8/'82	6.1-8.0	3-8	9-20	2-7	0.17-1.19	NA	67-86
Mollie Bailey	4/11/'97	6.8	12	45	1	8.93	89	457
PL-2	1/23/'08	7.4	40.5	532	2	0.5	78	1430
PL-5	1/23/'08	7.93	4.7	303	7	0.4	334	3100
PL-6	1/23/'08	6.52	74.6	123	40	27.9	18.3	309

The Piper Diagram (refer to Figure 20) shows that there is no clustering of sample sites PL-2, PL-5 and PL-6 indicating they are not associated. The Piper diagram also demonstrates that the Stout well water is not associated with the Mine No. 2 discharge water chemistry or the seep discharge from O-2-82 refuse seep discharge.

The data in Table 7 shows no presence of acrylamide, glycol at the PL-2, PL-5, or PL-6 sites. Total petroleum hydrocarbons, which include diesel, oil range hydrocarbons, and oil and grease, were detected at sample site PL-2. The data in Table 7 shows no presence of acrylamide or glycol, but the presence of the TPH's (total petroleum hydrocarbons) DRO, GRO, and ORO. There were occurrences of TPH from the Mine No. 2 UO-391 dewatering borehole (PL-2), which were found only from the mine discharge at the dewatering borehole. The TPH values occur in the diesel range (0.92 mg/L), oil range (4.16 mg/L), and oil/grease (2.2 mg/L). A TPH-DRO compound was found in the slurry liquid phase at 0.51 mg/L, but not found in the slurry solid phase. These data indicates that TPH slurry constituents originated from the injected slurry and migrated in the mine pool environment that were discharged from the mine pool.

Table 7- Ground Water Chemistry (dissolved basis) at Sites PL-2, PL-5, and PL-6

Miscellaneous Analyses		**PL-2**	**PL-5**	**PL-6**
Parameters	**Unit**			
Acrylamide	mg/L	ND	ND	ND
Glycol	mg/L	ND	ND	ND
TPH (Diesel Range)	mg/L	**0.92**	ND	ND
TPH (Oil Range)	mg/L	**4.16**	ND	ND
Oil and Grease	mg/L	**2.20**	ND	ND

Table 8- Microbiological analysis at Sites PL-2, PL-5, and PL-6

Miscellaneous Analyses		**PL-2**	**PL-5**	**PL-6**
Parameters	**Unit**			
Iron-Related Bacteria	CFU/ml	5000	5000	ND
Sulfate-Reducing Bacteria	CFU/ml	100000	100000	10000

Table 8 shows that the Stout well water has considerably lower concentration of sulfate-reducing bacteria than the Wet Branch refuse seep (SCR-15 PL-5) or UO-391 mine discharge (SCR-15 PL-2). The Wet Branch refuse seep shows an equal amount of iron-related bacteria as compared to the Wet Branch in-stream (PL-3 and PL-4) sample sites. The Stout well did not show the presence of iron related bacteria; however, there was an iron level of 27.9 mg/L in the well water, but it is not interpreted as resulting from mining activities.

The Piper diagram in Figure 21 shows the differences in general water chemistry at all the six SCR-15 hydrologic sample sites. The Piper diagram illustrates that the water chemistry from these sites are somewhat dissimilar.

The PL-3 and PL-4 sample sites are closest together because they reflect upstream and downstream reaches of Wet Branch, with respect to the O-2-82 refuse area. There is a striking dissimilarity between the (raw) refuse discharge chemistry and dewatering borehole chemistry even they are genetically related.

Comparison: Ground and Surface Sites Inorganic Water Chemistry

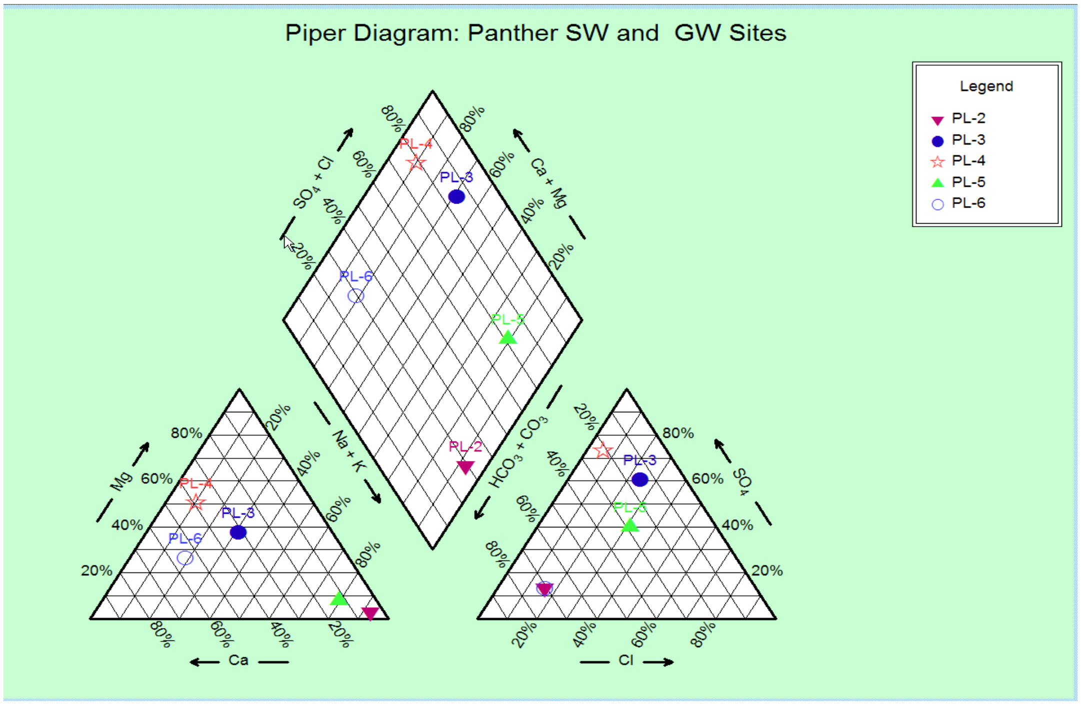


Figure 21- Piper Diagram showing the association of all hydrologic sites

UO-391 Mine Pool Characteristics

The Wet Branch watershed receives recharge from precipitation averaging approximately 44 inches per year. Subsequently ground water is recharged and infiltrates downward into mine overburden and which contributes to mine pool development. The available maps show that the structure of the UO-391 No. 2 Gas seam in the study area dips to the west-southwest. Active slurry injection injected into the No. 2 Mine occurred during 2002 to 2004 and was designed to be contained behind a series of mine seals. Mine seals were installed in Mine No. 2 to manage the locations of slurry placement.

The water and slurry will flow downgradient from the UIC injection holes to authorized areas of the mine (Figures 22-23). It was noted during the SCR-15 UIC Panther field observations in December 2007 and the sampling in January 2008 demonstrated that the area of the UO-391 mine and injection hole # 202 were dry. There was no access to other UIC injection wells to obtain water level measurements. The available information shows that although a mine pool existed during the time of active injection, the SCR-15 UIC field observations indicated that the upgradient portion of the mine was dry. The downgradient portion of the mine pool was still present and utilized by the Permittee as make-up water for the preparation plant.

The WVDEP-UIC permit stated that the maximum pool elevation could not exceed 680 feet MSL as depicted in Figure 22; however, pool levels were not submitted to the RA with the other required compliance monitoring data in order to verify this. Figure 23 also shows that the structural elevations of the UO-391 No. 2 Mine (No. 2 Gas seam), and shows that the elevations in the injection areas range from 662 to 690 feet MSL.

The distance from injection holes 201 and 202 to the UO-391 Mine discharge point (PL-2) is approximately 1509 feet and 2079 feet, respectively. The mine map shows that there is approximately 6 feet to 7 feet of hydraulic head developed in these distances. This results in hydraulic gradients of 0.0040 to 0.0034 feet, respectively.

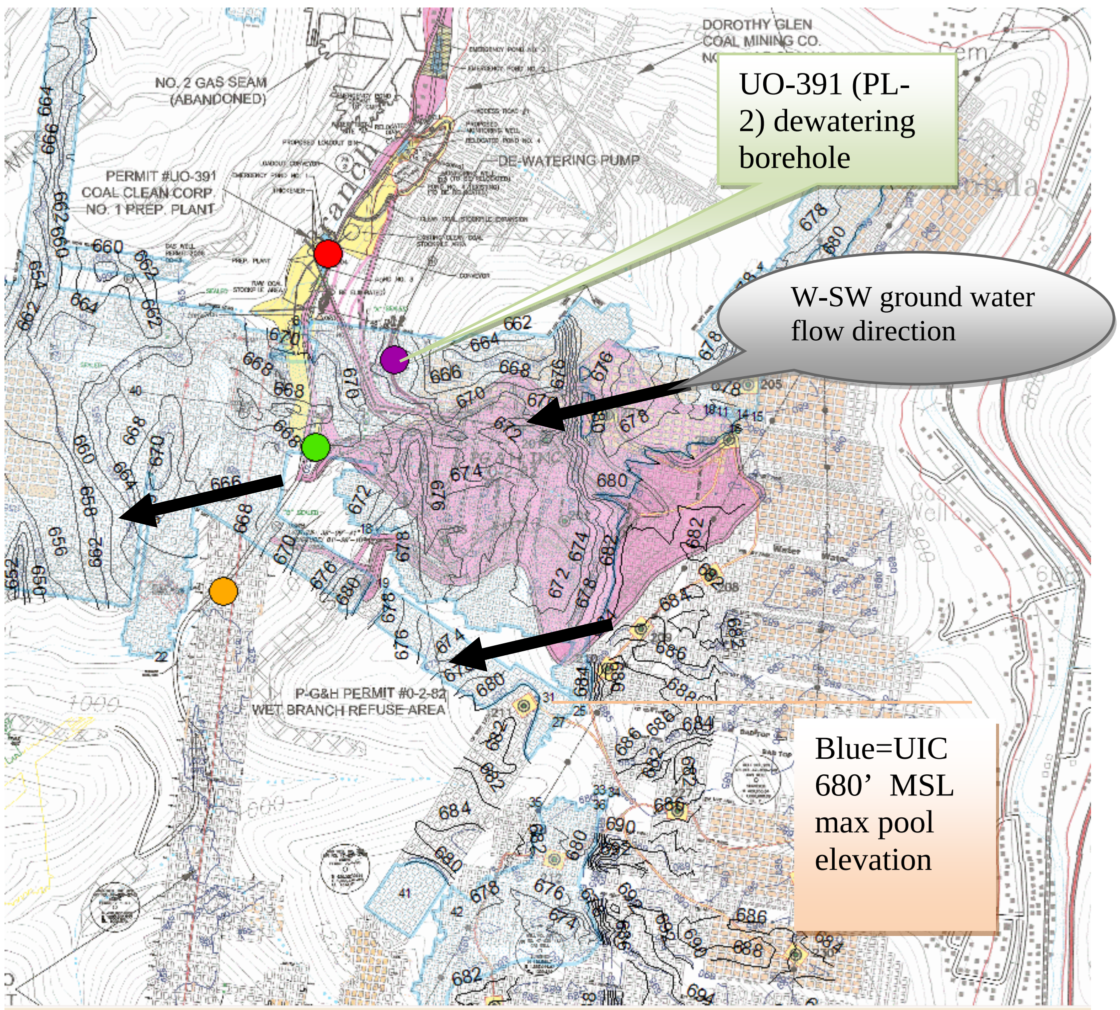


***Figure 22**-Extent of WVDEP-UIC authorized mine pool level of 680 feet MSL during active coal slurry injection at the UO-391 No. 2 Mine (during 2002-2004)*

Fate and mixing of coal slurry constituents within the UO-391 mine pool

The projected flow paths of slurry migration that might have occurred from injection holes 201 and 202 to the UO-391 discharge borehole (PL-2) are depicted on Figure 23 The flow path that would transport the injected coal slurry constituents is dependent upon several factors. These factors that were evaluated to determine the flowpath included: mine size; mining extraction percent; occurrence and distribution of roof falls; hydrogeologic conditions such as geologic structure, fracturing from the mining process, and hydraulic gradient. All of these factors influenced mine pool development, which results in the movement of water in the mine and the effectiveness of the transport of injected coal slurry constituents.

The movement of solutes by ground water movement is accomplished by advection. The rate of advective transport and the tendency of solutes to spread out from the flowpath (advective flow) is accomplished as dispersion. However, the transport of VOCs dissolved in ground water also may be slowed by sorption to organic carbon in the aquifer material (USGS, 1992). The presence of VOCs in the Mine No. 2 Mine pool therefore, is in part dependent on the solubility of the VOCs. The contact of organic compounds with carbon in the (coal se, and mining-induced fracturing

The analysis of the Panther slurry (9/27/2008) from the preparation plant underdrain reflects a combination of both the liquid and solid phases. The UIC permit reported that approximately 600,000 gallons/day of slurry would be injected during active periods. The analysis showed a concentration of 39 percent total solids, a TSS concentration of 311,000 mg/L, TDS of 1250 mg/L, and total organic carbon concentration of 22.0 mg/L. It is not known what the hydraulics would be required to transport the slurry through the mine (pool) in order for any slurry constituents to be discharged at the UO-391 dewatering borehole.

Aljoe and Hawkins (1993; 1994) reported that average velocities located approximately 555 feet to a discharge point showed that through a completely flooded section of a mine ranged from 11 to 65 feet/day (and 1-8 feet/day from individual mine entries). Aljoe and Hawkins (1993) also conducted tracer test in a free draining (or non-pooled) underground mine. The average velocities within the mine were approximately 14 feet/day; however, the water velocity was 3.02 $x10^{-4}$ feet/minute in collapsed portions of the mine, which shows the importance of a free flowing flow. These higher velocity flows were again recorded near the discharge point so that the flow rates were presumably more concentrated due to the proximity of the observation and to the discharge point.

UO-391 mine pool data were not available to understand the hydraulics of water movement in the mine, and as a result the Panther SCR-15 study could not resolve whether the slurry solids when injected were deposited within close proximity to the injection hole, or whether some solids were in suspension and transported through the mine pool. The Southern Minerals individual site assessment showed that the GW1 monitoring hole was also an injection site, and that the injection (monitoring) hole filled up from the Pocahontas No. 3 seam mine workings to the No. 4 seam level (Bailey, 2009). Moreover, the WVDEP UIC permits have demonstrated that companies apply for permits that allow multiple injection holes because the injection holes tend to fill up with the settled solids. This would indicate in general, that the slurry solids do not transport very far in the abandoned mine, and would depend, in large part, on the site-specific hydraulics within the mine. Once the slurry has been injected and is deposited at the bottom of the injection hole, it may not become mobile again, depending upon geochemical and/or hydraulic conditions within each mine. However, hard data are not available to confirm this theory.

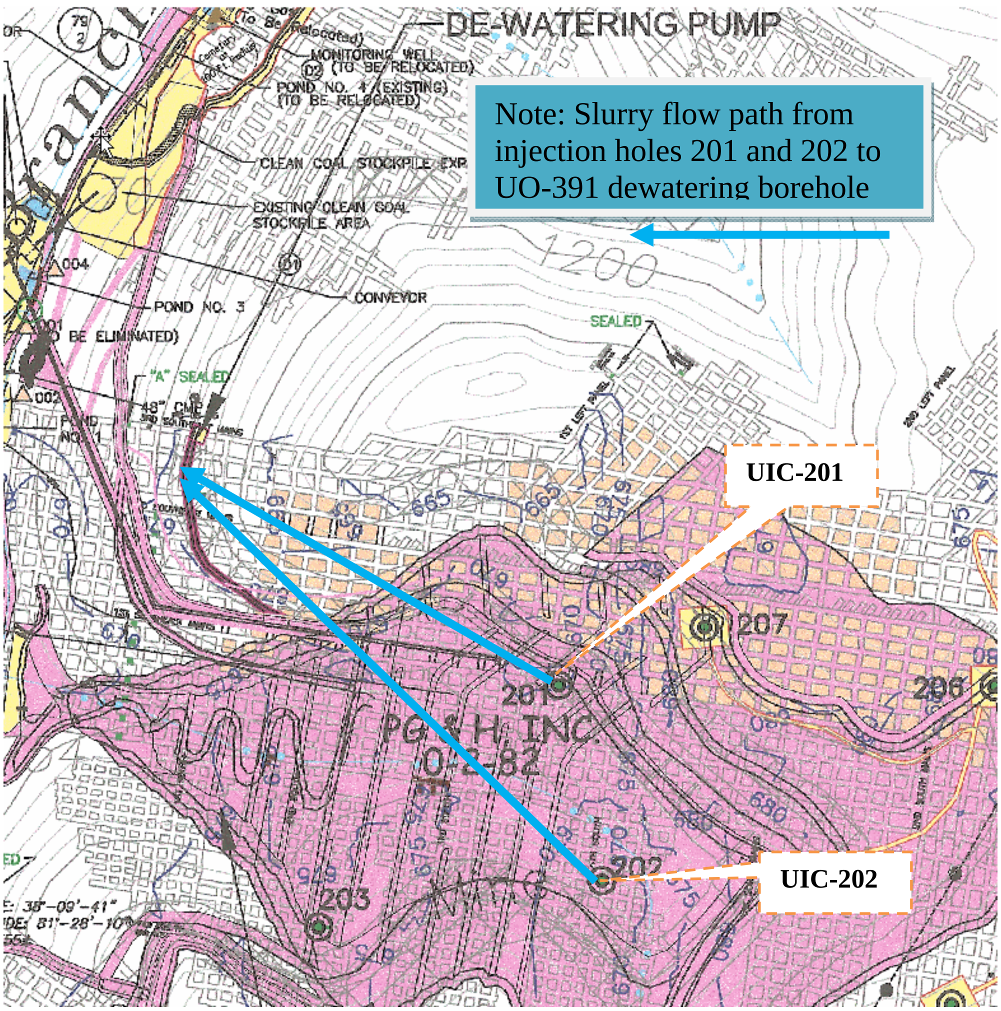


***Figure 23**-The Location of Injection Holes in the UO-391 Mine No. 2 and the Overlying Wet Branch Refuse Area*

The Panther data shows the occurrences of acetone, n,1-butanone, and naphthalene in the slurry. Although acetone was detected in the slurry liquid phase it was not detected in the slurry solids. Acetone was present in the slurry liquid phase at 16.7 ug/L, and the coal leachate was at 9.9 ug/L. Perhaps the absence of acetone in the slurry solids could be related to the presence of butanone. The Panther data suggests that butanone, naphthalene (and perhaps acetone) can be used as tracers to determine the movement of ground water flow, and the fate and transport of these compounds.

The chemical n-butanol is authorized to use at the Panther preparation plant and 2-butanone and 1-butanol (n-butanol) were detected in the slurry- liquid phase at a concentration of 64.4 ug/L and 3.4 ug/mL, respectively, but are not detected in the coal leachate, which indicates that these organic compounds are not found naturally in the coal. The VOC 1-butanol was detected at Sample site PL-2, the mine dewatering borehole at 2.8 ug/L indicating that some slurry injectate constituents migrated through the mine pool to the area of the mine near the dewatering borehole.

The use of n-butanol at the Panther preparation plant and the presence of 1-butanol (n-butanol) in the slurry and the mine pool dewatering borehole, indicate that injected slurry constituents are migrating through the UO-391 mine pool (perhaps the remnant of the 2002 to 2004 injected slurry, or the downward infiltration of slurry constituents into the mine pool from the surface refuse area placement of slurry). The BTEX (benzene, toluene, ethylene, and xylene) and PAH (polycyclic aromatic hydrocarbons) organic compounds can occur naturally. These compounds can also occur as a result of pollutants in the environment, contributions from surrounding manufacturing, industrial discharges, and gasoline-related product, etc that may provide a source of these compounds. However, the presence of 1-butanol, naphthalene is interpreted as resulting from the Panther coal preparation process (and perhaps acetone).

The Panther data suggests however, that n,1-butanol, 2-butanone, and naphthalene might be used as tracers to determine the fate and transport of these compounds. However, the other sites sampled during this project do not indicate this conclusion.

Comparison to Other Mine Pools

The Mine No. 2 dewatering borehole water sample shows the mine pool water chemistry of sulfate at 78 mg/L, specific conductivity 1430 umhos/cm, and TDS of 791 mg/L. The concentration of these three parameters indicates that the mine pool chemistry had been influenced by the addition of injected slurry. A comparison of the UO-391 mine pool chemistry to a non-injected mine pool can be made with the pre-SMCRA Guyan mine, which is in the No. 2 Gas seam in neighboring Boone County. The Guyan mine data

(9/9/1997) characterizes a non-injected slurry No. 2 Gas seam mine pool water chemistry of sulfate of 122 mg/L, specific conductance of 432 umhos/cm, and TDS of 244 mg/L (WVDEP, Galya, et al., 1997).

In neighboring Nicholas County, Pointon (2009) reported that the Power Mountain Eagle seam Jerry Fork underground mine (5/1/2000) showed a non-injected slurry mine pool water chemistry of sulfate of 80 mg/L, specific conductance of 469 umhos/cm, and TDS of 320 mg/L. Also, the non-injected Power Mountain Rader Eagle seam mine pool chemistry (7/8/2009) shows a water chemistry of sulfate 56 mg/L, specific conductance of 211 umhos/cm, and TDS of 114 mg/L. These data indicates a pattern in which the non-injected mine pools show a range of sulfate 56 to 122 mg/L, specific conductance of 211 to 432 umhos/cm, and TDS of 114 to 320 mg/L. Mine pools that have been injected with slurry show elevated levels of sulfate, specific conductance, and TDS concentrations. The Power Mountain data indicates that during active injection into the Terry Eagle/Hutchinson Mine the injected mine had concentrations of sulfate of 373 mg/L, specific conductance of 1912 umhos/cm, and TDS of 1157 mg/L.

The other three individual site assessments in the SCR-15 report do not have non-injection mine pool chemistry characterization (as Power Mountain), in which to compare non injection and post injection mine pool chemistry. This is an example of the importance of site-specific mine pool background data and monitoring that are absolutely necessary in order to understand the consequences of slurry injection.

Upwelling Events

According to the WVDEP permit files and discussions with DMR, UIC, and Permittee staff there have not been any upwelling incidents as a result of coal slurry injection in the Wet Branch watershed.

Coal Slurry

Reagents and Chemicals Authorized for Use in the Panther Coal Preparation Plant

This report reflects the underlying premise that the slurry tested for in the SCR-15 study may or may not be the same slurry composition that was injected during 2002 to 2004.

The permit data stated that the Panther Refuse Plant refuse produces three sizes of material, which are: 2.5”x1 mm; 1 mm x 1 mesh; and 100 mesh x 0. Since slurry is no longer injected underground, it is currently being added to the course refuse and placed on the O-2-82 West Branch Refuse Area.

The Panther preparation plant uses Ashland Magnalime product that is commonly used at many local preparation plants. The ingredients that comprise Magnalime include: calcium oxide; calcium sulfate; magnesium oxide; dolomite; calcium carbonate; calcium hydroxide; and silicon dioxide. None of these chemicals are not classified as hazardous.

Numerous chemicals are used by the coal preparation process involved in the solid-solid, solid-liquid, and liquid-liquid separation processes. The solid-solid separation types include: froth flotation that include alcohols, ethers, polyglycols, pine oils, and proprietary surfactants. Another solid-solid separation is the flotation collector in which hydrocarbons such as fuel oil, kerosene, diesel fuel, and natural oils are used. The pH modifier separation process involves acids and caustics (Chemicals used at preparation plants presentation, Virginia Tech., July, 2006).

In general, the solid-liquid separation processes in West Virginia coal preparation plants involve coagulants such as inorganic salts (NaCl, CaCl, and FeCl), aluminum sulfate, lime soda ash, and polyelectrolytes. Another solid-liquid separation process is pH modifiers involving acids and caustics. Also, dewatering aids such as coagulants, flocculants, polyacrylamides, and a non-chemical process of using a belt filter press to separates slurry solids from the liquid (Chemicals used at preparation plants presentation, Virginia Tech., July, 2006).

Certain alcohols are used in the coal froth flotation process where it is used to create a froth and diesel fuel is added to enhance coal recovery by dropping out non-coal (higher specific gravity) impurities as reject, enhancing the sink/float process, and resulting in higher percent (recovery) of clean coal. The most commonly used types are: methyl isobutyl carbinol (aliphatic alcohol); ethylhexanol alcohol; ethoxylated alcohol; glycol ether alcohol; amyl alcohol; and butyl alcohol (Chemicals used at preparation plants presentation, Virginia Tech., July, 2006).

The TPH compounds refer to petroleum hydrocarbon mixtures composed of compounds with carbon numbers ranging from C5 to C36 that originated from petroleum. Total petroleum hydrocarbons are mixtures of 175 hydrocarbon compounds. Such various petroleum hydrocarbons products and mixtures produced by the manufacturers are based upon physical and performance- based formulas (ATSDR, Agency for Toxic Substances and Disease Registry, 1999)

Petroleum hydrocarbon products are also subjected to changes in composition once they released in to the environment. The lower molecular weight hydrocarbons are generally more volatile and water soluble than are the higher molecular weight hydrocarbons. Some of the lower molecular weight hydrocarbons are also more subject to microbial decomposition and the degradation products might include compounds (daughter products) not originally found in the product (ATSDR, Agency for Toxic Substances and Disease Registry, 1999)

The UO-391 permit data shows that the types of chemical and reagents authorized for use at the Panther Preparation plant include: Nalco 8855 coagulant; Nalco 9843 flotation reagent; Nalco 9850 cationic; Optimizer PULV Flocculant; and Nalco 9850 Cationic flocculant (WVDEP UIC Permit 0308-00-039). MSDS data sheets were reviewed for chemicals that were authorized for use at the Panther preparation plant.

The chemicals authorized for use at the Panther plant by the UIC permit are:

1. The Nalco 8855 product lists it as a coagulant that is involved with the preparation froth flotation process. This product is characterized in the MSDS "as being toxic to fish, and should not be directly discharged into lakes, ponds, streams, waterways or public water supplies". Federal regulations do not classify this product as hazardous and risk to human life low, and environmental risk is assessed as moderate on the MSDS sheet).

2. The Nalco 9843 Flotation Reagent. The main ingredients in this C2-C12 product are alcohols and aldehydes, and esters; n-Butanol; and 2-Ethylhexanol. This Nalco product does not meet the criteria to be classified as a hazardous chemical. This product has a biological rating of moderately toxic (MSDS sheet, 1997).

3. The Nalco Optimer 9880 Pulv Flocculant as an acrylamide/acrylate polymer. Federal regulations do not classify this product as hazardous and has a human risk and environmental assessment as low (MSDS, 1997).

4. The Nalco 9850 (WT2900) product is described as a polyamine that is a cationic polyelectrolyte The MSDS sheet describes this chemical product as an organic cationic polyelectrolyte. The MSDS sheet describes the chemical environmental hazard and exposure characterization as hazardous (CERCLA); however, Nalco classifies this chemical as a moderate environmental impact.

Constituents in the Panther Coal Slurry Samples

WVDEP-UIC Panther Permit Data

During the field visit to the Panther permit preparation plant, I noticed a strong odor of diesel or fuel oil was noticed in the preparation plant. The MSDS sheet for No. 2 fuel oil shows contains naphthalene, which was detected in the Panther coal slurry solids sample

(PL-Slurry), which may not reflect the slurry constituents from the 2002-2004 slurry injection activities.

The WVDEP-UIC program dictates that during active injection, monitoring sampling occurs at each active site, which is the last accessible point (the injection hole proper) prior to the coal slurry being released into the well. The injectate background parameters include the following: flow; pH; total petroleum hydrocarbons (DRO, GRO, ORO), total acrylamide; dissolved aluminum; dissolved arsenic; dissolved beryllium; dissolved cadmium; total chromium; dissolved iron; dissolved lead; dissolved manganese; dissolved nickel; dissolved selenium; total dissolved solids, and the volatile and semi-volatile organic compounds (Appendix 9).

In addition to the organic compounds identified in the REIC lab results, TIC (Tentatively Identified Compounds) data that even though were not formally requested by the study group, were identified as TIC data and were therefore used in the overall interpretation of the Panther data, such as the presence of a TIC compound identified as 1-butanol.

The slurry injectate that was sampled came from injection holes 201 and 202 and are located on the Wet Branch refuse Area (Figures 22 and 23). The compliance data reports TPH compounds in the forms of ORO (oil range hydrocarbons), DRO (diesel range hydrocarbons), and GRO (gasoline range hydrocarbons). Additional analytes that were analyzed for include: total acrylamide, and the following metals on a dissolved basis, arsenic, cadmium, lead, nickel, selenium, aluminum, iron, and manganese; chromium was reported on a total basis. The other UIC data were pH, and TDS; however, mine pool levels were not provided to the UIC program.

Appendix 10 shows the Permittee compliance data for slurry injection activities at the Panther UO-391 Mine No. 2 (for 5/1/2002 though 4/1/2004). The WVDEP-UIC compliance data shows permit limits exceedences of TPH-ORO occurred at Injection site # 202 of 4.8 mg/L (on 8/1/2002) and 11.2 mg/L (on 3/1/2003). Permit limits exceedences occurred of TPH-DRO Diesel Range of 12.6 mg/L (on 2/1/2003) and 10.1 mg/L (on 8/1/2002). There were no exceedences of GRO (Gasoline Range). The compliance data also showed three permit limits exceedences for total chromium of 0.1522 mg/l, 0.5413mg/L, and 0.2767 mg/L (on 10/1/2002, 1/3/2003, and 4/1/2003, respectively). There was one selenium permit limits exceedence during March 2004 of 0.1298 mg/L.

Comparison: Constituents in the Martin County Slurry Spill

The Martin County, Kentucky spill in October 2000 released approximately 300 million gallons of slurry into area streams. The federal study showed that the levels of metals in the slurry were similar to those in the background soils. Also, the levels of metals were similar to the area drinking water supply after the spill and were below EPA's Maximum Contaminant Levels (MCL's). None of the VOCs and SVOCs, including PAH compounds, or acrylamide were detected from the spill. Some residential water wells had elevated concentrations of some metals such as arsenic, barium, and lead, but these were interpreted as being unrelated to the slurry spill (U.S. DHHS- ATSDR, 2006).

Coal Slurry SCR-15 Samples

Coal Slurry: Solids Phase Inorganic Chemistry

A sample of the mined Eagle coal seam slurry was obtained from the Panther preparation plant thickener underflow. The slurry sample was sub-divided by the laboratory into two phases, the solids phase and the liquid phase. Identical laboratory analyses were conducted on each phase.

The data in Table 9 show the general chemistry of the Panther coal slurry thickener underflow solids; this slurry sample showed a total solids concentration of 39 percent.

Table 9- General Chemistry

Parameters	**Unit**	**Slurry Solids**
Total solids	Wt%	**38.9**
Nitrogen, Nitrate	mg/kg	ND
Nitrogen, Nitrite	mg/kg	**9.06**
Chloride	mg/kg	**554**
Cyanide	mg/kg	**ND**
Fluoride	mg/kg	**1.86**
Sulfate	mg/kg	**144**
Nitrogen, Ammonia	mg/kg	**33.6**
Acidity, Total	mg/kg	**ND**
Alkalinity, Bicarbonate	mg/kg	**ND**
Alkalinity, Carbonate	mg/kg	**ND**
Alkalinity, Total	mg/kg	**1390**
pH	SU	**9.44**

The data in Table 10 show the inorganic (metals) chemistry of the coal slurry-solids

Table 10- Slurry Solids Phase- Metals Analyses

Slurry Solids Phase- Metals		
Parameters	**Unit**	**Slurry Solids**
Aluminum	mg/kg	**3600**
Antimony	mg/kg	**ND**

Arsenic	mg/kg	**ND**
Barium	mg/kg	**52.3**
Beryllium	mg/kg	**0.385**
Cadmium	mg/kg	**0.0809**
Calcium	mg/kg	**1220**
Chromium	mg/kg	**4.82**
Cobalt	mg/kg	**2.31**
Copper	mg/kg	**7.54**
Iron	mg/kg	**6080**
Lead	mg/kg	**4.79**
Magnesium	mg/kg	**908**
Manganese	mg/kg	**51.9**
Mercury	mg/kg	**ND**
Molybdenum	mg/kg	**ND**
Nickel	mg/kg	**5.06**
Potassium	mg/kg	**1210**
Selenium	mg/kg	**ND**
Silicon	mg/kg	**46.3**
Silver	mg/kg	**ND**
Sodium	mg/kg	**754**
Strontium	mg/kg	**13.6**
Thallium	mg/kg	**ND**
Vanadium	mg/kg	**6.61**
Zinc	mg/kg	**17.4**

The data in Table 10 show that elevated concentrations of several heavy metals occur such as aluminum; barium; chromium; lead; nickel; strontium; vanadium; and zinc. In the slurry solids, strontium was detected at 13.6 mg/kg, and was also found to occur at all detectable levels at all the SCR-15 UIC sample sites.

WVDEP-UIC permit data shown in Appendix 11 reflect a slurry sample from the Panther preparation plant thickener underdrain (November 29, 2000); the slurry sample was not split into liquid and solid phases as the SCR-15 UIC samples were. Slurry total metals such as aluminum and iron were elevated at 3740 mg/L and 10,900 mg/L, respectively; heavy metals (total basis) showed elevated concentrations of lead, nickel, and chromium. Slurry metals on a dissolved basis were not detected at such elevated concentrations, save sodium and moderate concentrations of metals such as potassium, calcium, and magnesium (WVDEP-UIC permit, 2000).

Coal Slurry Solids Phase- Organic Chemistry

Table 11 shows the results of the laboratory analysis to determine the volatile and semi-volatile organic compounds in the coal slurry-solids phase, these VOCs that are shown in this table have been identified and shown in concentrations of ug/kg. The table shows that DRO and ORO were identified in the coal slurry-solid phase at 144 mg/kg and 159 mg/kg, respectively. The VOC analysis showed that benzene, ethylbenzene, butylbenzene, isopropyl benzene, m,p-xylene, naphthalene (C10H8), and o-Xylene (C8H10) were present. Appendix 12 and 13 show all the VOC and SVOC data.

***Table 11**- Coal Slurry-Organic Chemistry Solids Phase VOCs and SMOCs Solids Phase VOCs and SMOCs Detections*

Analyte	Sample Results	
	Unit	Panther
		Slurry Solids
Sample Date		**1/24/2008**
TPH (Diesel Range)	mg/kg	**144**
TPH (Oil Range)	mg/kg	**159**
Volatile Organic Compounds		
1,2,4-Trimethylbenzene(C9H12)	ug/kg	**216**
1,3,5-Trimethylbenzene(C9H12)	ug/kg	**76.8**
Acetone (C3H7O)	ug/kg	**ND**
Benzene(C6H6)	ug/kg	**166**
Ethylbenzene(C8H10)	ug/kg	**122**
Isopropylbenzene(C9H12)	ug/kg	**30.2**
m,p-Xylene(C8H10)	ug/kg	**585**
Naphthalene(C10H8)	ug/kg	**259**
n-Propylbenzene(C9H12)	ug/kg	**45.5**
o-Xylene(C8H10)	ug/kg	**284**
Sec-Butylbenzene(C10H14)	ug/kg	**8.5**
Toluene(C7H8)	ug/kg	**1040**
Acetone	ug/kg	**ND**
2-Ethyl hexanal	ug/kg	**433**
Methyl butane	ug/kg	**107**
Methyl pentane	ug/kg	**133**
Butane	ug/kg	**135**
Cyclohexane	ug/kg	**333**
Hexane	ug/kg	**73.5**
Isobutene	ug/kg	**94.8**
Methyl cyclohexane	ug/kg	**580**
Methyl cyclopentane	ug/kg	**81**
Pentane	ug/kg	**99.8**
SemiVolatile Organic Compounds		
2,4-Dimethylphenol(C8H10O)	mg/kg	**0.167**
Benzo(a)anthracene(C18H12)	mg/kg	**0.036**
Benzo(a)pyrene(C20H12)	mg/kg	**0.07**
Benzo(b)fluoranthene(C20H12)	mg/kg	**0.082**

Benzo(g,h,i)perylene(C22H12)	mg/kg	**0.155**
Chrysene(C18H12)	mg/kg	**0.206**
Dibenzo(a,h)anthracene(C22H14)	mg/kg	**0.032**
Fluoranthene(C16H10)	mg/kg	**0.07**
Fluorene(C13H10)	mg/kg	**0.202**
Naphthalene(C10H8)	mg/kg	**1.5**
Phenanthrene(C14H10)	mg/kg	**0.903**
Phenol(C7H6O)	mg/kg	**0.045**
Pyrene(C16H10)	mg/kg	**0.095**
Butane, 1,1 –dibutoxy	mg/kg	**1.07**
Butanioc acid, butyl ester	mg/kg	**1.32**
Hexadecane	mg/kg	**0.683**
Napthalene, 1,3-dimethyl	mg/kg	**1.28**
Napthalene, 1,4-dimethyl	mg/kg	**1.08**
: Napthalene, 1-methyl	mg/kg	**1.09**
Pentadecane 2,6,10, 14 tetramethyl	mg/kg	**1.34**
Propanoic acid, 2-methyl, 2-ethyl	mg/kg	**1.05**
Tetradecane	mg/kg	**0.886**
Tridecane	mg/kg	**1.01**

In general, TPH refers to petroleum hydrocarbon mixtures composed of compounds with carbon numbers ranging from C5 to C36 that originated from petroleum. The Panther data showed that the SVOC naphthalene showed a concentration of 1.5 mg/kg and also detected as a VOC naphthalene that had a concentration of 259 ug/kg. Naphthalene C10H8 is largely derived from coal tar where naphthalene is the most abundant component of coal tar.

TPH are mixtures of 175 hydrocarbon compounds and such various petroleum hydrocarbons products and mixtures produced by the manufacturers. These organic products are also subjected to changes in composition once they released in to the environment. (Montgomery, 2007)

The lower molecular weight hydrocarbons are generally more volatile and water soluble than are the higher molecular weight hydrocarbons. Some of the lower molecular weight hydrocarbons are easily more subject to microbial decomposition and the degradation (daughter) products might include compounds not originally found in the product (ATSDR, Agency for Toxic Substances and Disease Registry, 1999).

Table 11 also shows the results of the laboratory analysis for the Semi-Volatile Organic Compounds (SVOCs) in the coal slurry-solid phase, shown in concentrations of ug/kg. There were eleven VOC detected and 13 SVOCs that were identified. The concentration of 1,2,4 trimethylbenze was determined at 216 ug/kg; this compound can occur naturally in coal tar and petroleum. However, 1, 3, 5 trimethylbenzene, or meistylene was determined at 76.8 ug/kg. This compound is commonly used as a solvent in research and industry.

The BTEX suite includes VOCs such as benzene, toulene, ethylbenzene, and xylene; Napthalene may also be included in the BTEX group. Diesel fuel contains these BTEX constituents that are of potential concern under SDWA (Safe Drinking Water Act, 1974). Diesel fuel is commonly used in the coal preparation process to enhance the float/sink process. Diesel fuels are covered by the ASTM D 975-04a specification that describes seven grades of diesel fuel (Montgomery, 2007).

According to an United Nations Environment Programme-WHO (World Health organization) report that the half lives of many of the VOCs and SVOCs PAH compounds are very short. The organic compounds identified in the UN report have organic compounds similar to those detected in the Eagle slurry, which can range up to 6 years in sediment, but only weeks to 2 months in water. The UN data shows that the presence of organic compounds have half lives that range from 1 day for air, 1 week for water, 2 months to 2 years for soil, 8 months for sediment, and 1 day to one week for air.

In addition to naphthalene, other PAH compounds that were found in the slurry solids phase include the SVOCs benzo a pyrene, chyrsene, phenanthrene, pyrene, but all were detected in very low concentrations; phenanthrene occurred at 0.9 mg/kg. These data however, may not reflect similar hydrologic conditions in underground mine pool environmental conditions. None of the identified PAH compound exceeded the guidance benchmarks and have very short half-lives in water; however, certain PAHs pass through soil to contaminate ground water (ATSDR, 1996).

Stahl, et al. (2005) showed that phenanthrene was identified from simulated leaching rainfall conditions of Illinois # 6 (and of western Kentucky), Montana, and Wyoming coal piles. The phenanthrene concentrations did not exceed 50 ug/L at those sites These authors concluded that runoff from coal piles may contain numerous organic compounds including many PAHs.

Characterization of the Preparation Plant Raw Coal (Leachate) Chemistry

Raw coal sample chemistry

The analysis of the metals from the raw run-of-mine Eagle seam sample came from the leachate from the raw coal. The liquid phase-coal leachate was derived at REIC Laboratories from crushed mined Eagle coal mixed with distilled water and then tumbled for 16 hours in the laboratory; the laboratory analyzed the parameters as shown below. The following analyses were determined to characterize the leachate: metals; general chemistry; and volatile and semi-volatile organic compounds.

The following tables show the two liquid phases: 1. the slurry –liquid (decant) phase, and 2. the mined Eagle seam liquid leachate. Tables 13 and 14 shows the Panther preparation plant metals concentration of the slurry liquid and the coal leachate samples, and shows that elevated strontium occurs not only in all the hydrologic sites, but also in the slurry liquid phase only and the coal leachate.

<u>Coal Slurry- Liquid Phase Inorganic Chemistry</u>

Table 12- Eagle Coal Slurry and Raw Coal Liquid Phase (leachate) Chemistry

General Chemistry Analytes	Unit	PL-Slurry (Liquid)	PL-Raw Coal (LQ) Phase Leachate
Nitrogen, Nitrate	mg/L	**0.59**	**0.03**
Nitrogen, Nitrite	mg/L	**ND**	**ND**
Chloride	mg/L	**423.00**	**7.12**
Fluoride	mg/L	**1.53**	**0.51**
Sulfate	mg/L	**261.00**	**2.60**
Nitrogen, Ammonia	mg/l	**1.96**	**0.44**
Cyanide, Total	mg/l	**ND**	**ND**
Specific Conductance	µmhos/cm	**5000.00**	**170.00**
Total Dissolved Solids	mg/L	**2540.00**	**87.00**
Total Suspended Solids	mg/l	**74.00**	**6.00**
Acidity, Total	mg/L	**ND**	**ND**
Alkalinity, Bicarbonate	mg/L	**412.00**	**42.00**
Alkalinity, Carbonate	mg/L	**7.10**	**14.30**
Alkalinity, Total	mg/L	**420.00**	**58.20**
pH	SU	**8.26**	**9.56**

Table 12 shows elevated levels chloride, sulfate, and alkalinity of the coal slurry liquid. The elevated chloride levels correspond to elevated levels of sodium shown in Table 15. The higher concentration of sulfate levels in the slurry with respect to the raw coal leachate most probably reflects the higher concentrations of sulfide (higher specific gravity) sink materials in the preparation plant reject.

Table 13 shows the metals concentration of the slurry liquid phase and the coal leachate. It should be noted that the following Panther slurry liquid data reflects the liquid phase of the slurry (injectate) that was analyzed separately from the slurry solids fraction (phase), and that what was sampled may not be reflective of the 2002 to 2004 slurry injectate. The combined slurry liquid and solids phases would normally be injected (together) into the mine pool during authorized active injection periods.

Table 13 also shows that all the trace metals on a dissolved basis are less than 1 mg/L. The raw coal leachate shows that the trace metals are less than 1 mg/L. Sodium occurs in elevated concentrations with a concentration of 266 mg/L in the slurry liquid phase and 10.1 mg/L in the raw coal leachate.

Table 13- Metals Concentrations for the Eagle Seam, Raw Coal Leachate

Dissolved & Total Metals Analytes	Unit	PL-Slurry (Liquid)		PL-Raw Coal (LQ) Phase Leachate
		Dissolved	Total	Dissolved
Aluminum	mg/L	**0.029**	0.046	**0.398**
Antimony	mg/L	**0.0146**	0.016	**0.0012**
Arsenic	mg/L	**0.0104**	0.0113	**0.012**
Barium	mg/L	**0.243**	0.269	**0.0129**
Beryllium	mg/L	**ND**	ND	**ND**
Cadmium	mg/L	**ND**	0.0011	**ND**
Calcium	mg/L	**2.83**	3.51	**0.464**
Chromium	mg/L	**0.0272**	0.0342	**ND**
Cobalt	mg/L	**0.0142**	0.0161	**ND**
Copper	mg/L	**0.0248**	0.0278	**ND**
Iron	mg/L	**0.068**	0.089	**ND**
Lead	mg/L	**0.0762**	0.0775	**ND**
Magnesium	mg/L	**0.591**	0.771	**ND**
Manganese	mg/L	**0.021**	0.028	**ND**
Mercury	mg/L	**ND**	ND	**ND**
Molybdenum	mg/L	**0.198**	0.217	**ND**
Nickel	mg/L	**0.0386**	0.0432	**ND**
Potassium	mg/L	**5.38**	7.05	**1.23**
Selenium	mg/L	**0.0224**	0.0255	**0.0087**
Silicon	mg/L	**0.346**	0.358	**0.384**
Silver	mg/L	**ND**	ND	**ND**
Sodium	mg/L	**266**	341	**10.1**
Strontium	mg/L	**0.571**	0.632	**0.0222**
Thallium	mg/L	**ND**	ND	**ND**
Vanadium	mg/L	**0.0103**	0.0131	**0.007**
Zinc	mg/L	**0.019**	0.014	**ND**

1. Antimony (Sb): the Panther antimony concentration in the slurry liquid on a total basis was 0.016 mg/L (or 16.0 ppb); the dissolved concentration was 0.0146 mg/L (or 14.6 ppb). The EPA Primary Drinking Water Standard is 0.006 mg/L

2. Arsenic (As): the Panther arsenic concentration in the slurry liquid on a total basis was 0.113 mg/L (or 11.3 ppb); the dissolved concentration was 0.0104 mg/L (or 10.4 ppb). The EPA Primary Drinking Water Standard is 0.010 mg/L
3. Lead (Pb): the Panther lead concentration in the slurry liquid on a total basis was 0.0775 mg/L (or 77.5 ppb); the dissolved concentration was 0.0762 mg/L (or 76.2 ppb). The EPA Primary Drinking Water Standard is 0.015 mg/L

Table 14 shows no presence of iron-related or sulfate reducing bacteria

Table 14- Eagle Coal and Slurry Phases Bacteria Analyses

Miscellaneous Analyses		PL-Slurry (LQ)	PL-Coal LQ	Solids phase
Parameters	Unit			
Iron-Related Bacteria	CFU/ml	ND	ND	NA
Sulfate-Reducing Bacteria	CFU/ml	ND	ND	NA

The raw coal leachate data in Table 15 indicates that it is a Na-HCO3 (sodium bicarbonate) type chemistry and conversely does not exhibit any elevated parameter like the coal slurry liquid phase. The coal slurry liquid phase is characterized as a Na-Cl (sodium chloride) type chemistry shown in this table with elevated concentrations of sulfate, chloride, TDS, conductivity, and sodium.

Table 15- Slurry Liquid Phase and Eagle Seam General and Metals Chemistry

Name	Unit	PL-Slurry (Liquid)	PL-Coal
Sample ID		PL-Slurry (Liquid)	PL-Coal
Date		1/23/2008	1/23/2008
Manganese	mg/L	0.021	500E-6
Aluminum	mg/L	0.029	0.398
Calcium	mg/L	2.83	0.464
Iron	mg/L	0.068	0.01
Magnesium	mg/L	0.591	0.02
Potassium	mg/L	5.38	1.23
Silicon	mg/L	0.346	0.384
Sodium	mg/L	266	10.1
Sulfate	mg/L	261	2.6
Bicarbonate	mg/L	412	42
Carbonate	mg/L	7.1	14.3
Chloride	mg/L	423	7.12
Nitrate	mg/L	0.59	0.03
Conductivity	µmho/cm	5000	170
Acidity	mg $CaCO_3$/L	0.0	0.0
Dissolved Solids	mg/L	2540	87

Figures 24 and 25 illustrate the chemistry of the coal and slurry liquid phases. Figures 26 and 27 show the Piper and Schoeller diagrams of all sample sites and slurry composition.

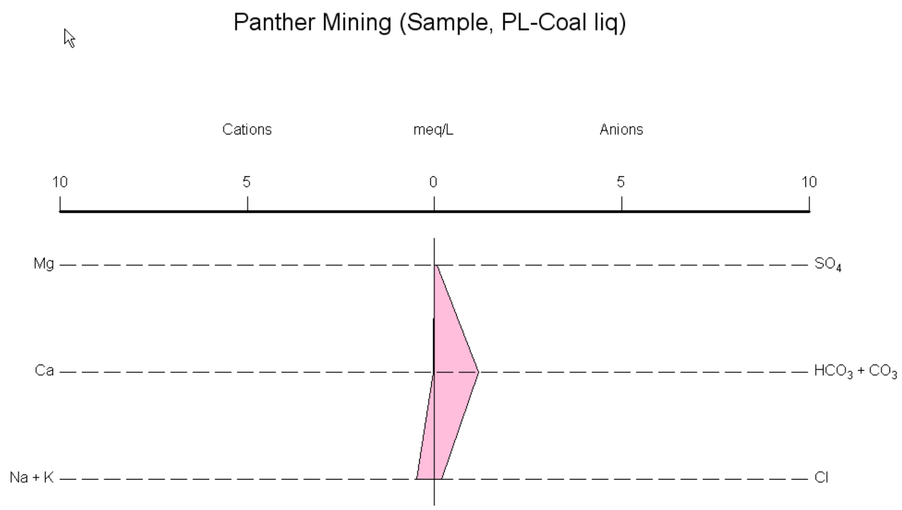


Figure 24- Stiff Diagram of Panther PL-Coal (Leachate) Liquid Phase Chemistry

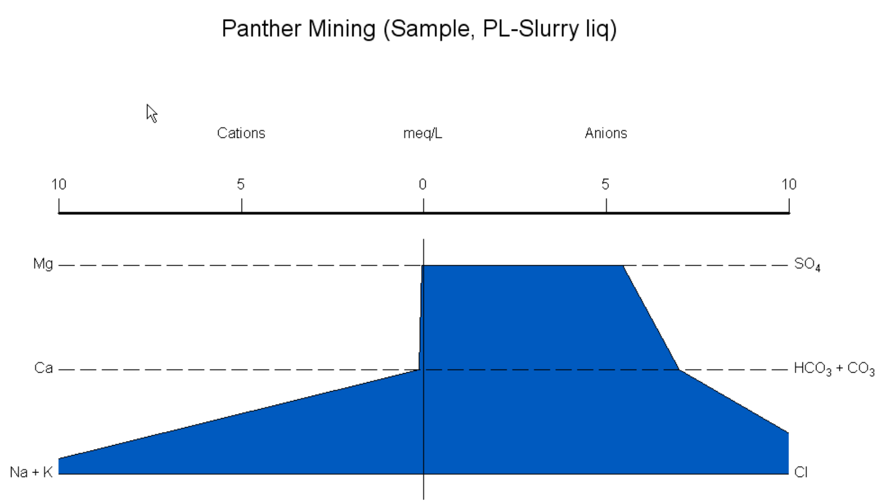


Figure 25- Stiff Diagram of PL-Slurry Liquid Phase Chemistry

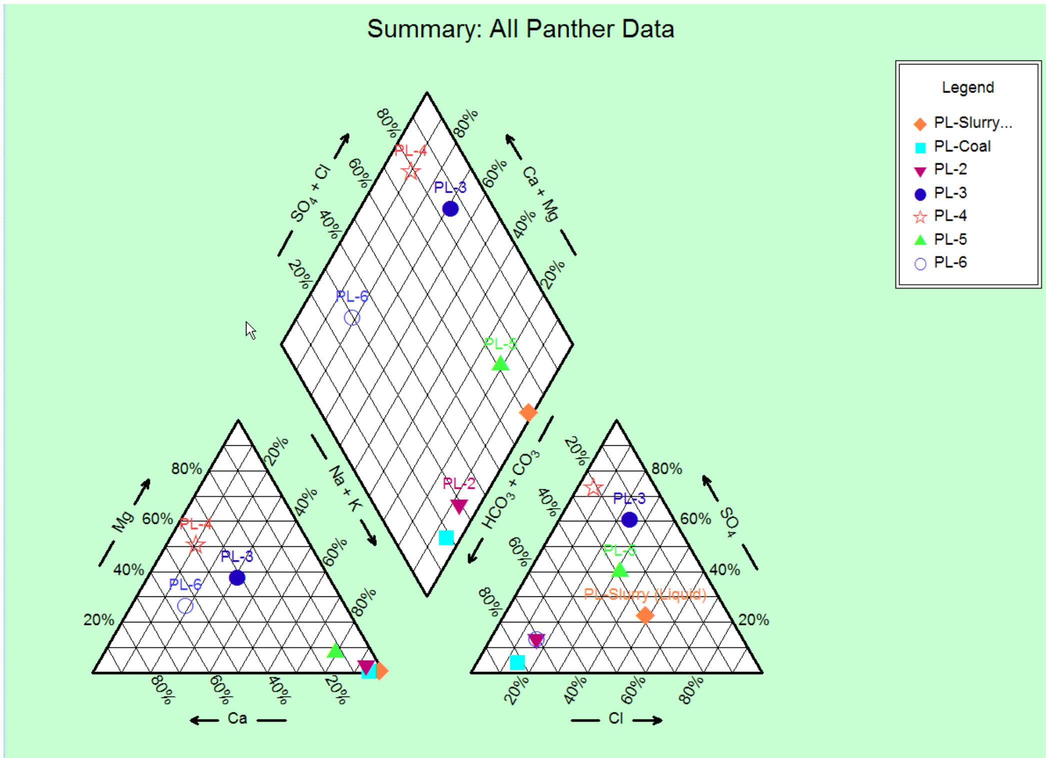


Figure 26- Piper Diagram Showing the Association of SCR-15 Sample sites in relation to PL-Slurry (Liquid Phase) and the PL-Coal Leachate Liquid

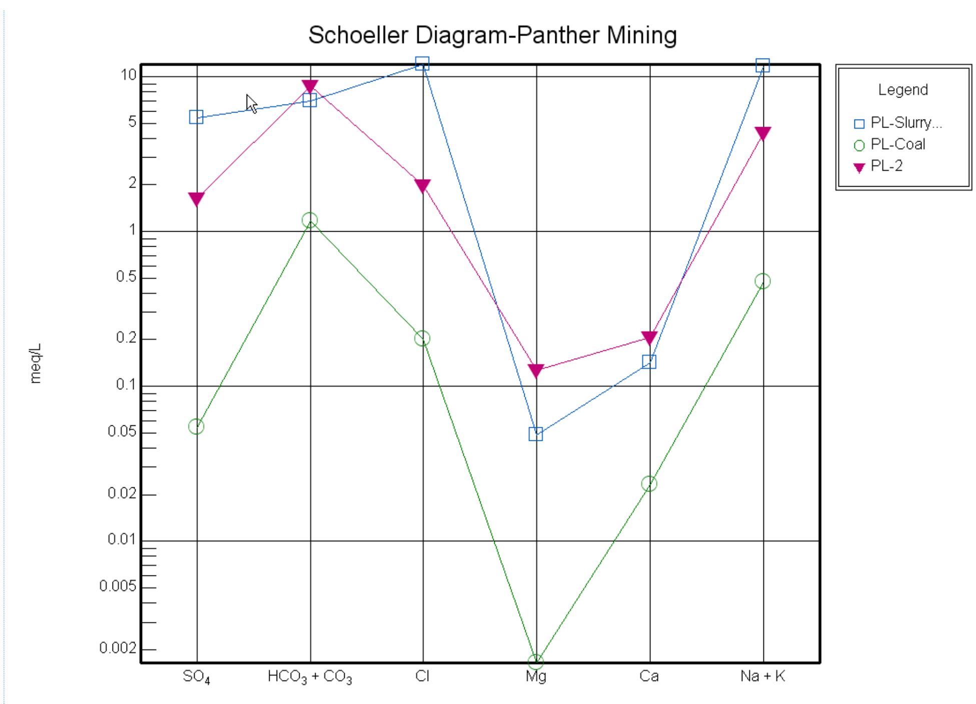


Figure 27- Ionic characterization (Schoeller diagram) of Eagle Seam Coal Slurry and Coal Samples

Figures 26 and 27 show that the Eagle seam (liquid) slurry and coal leachate are very similar in chemistry, but the coal leachate contains lower levels of mineralization. The UO-391 Mine No. 2 (PL-2) pump discharge chemistry is very similar to the water chemistry of the coal leachate and some similarities with the coal (liquid) slurry. There is a close association between the refuse discharge and slurry liquid chemistry. This diagrams show that the PL-5 Site discharge from the O-2-82 refuse reflects the refuse material chemical composition, and is similar to the PL-SL slurry chemical composition.

Table 16 did not show the presence of either iron-related bacteria or sulfate-reducing bacteria from either the slurry liquid or raw coal (liquid) leachate.

Table 16- Eagle coal slurry Bacterial Analyses

Analytes	Unit	PL-Slurry (Liquid)	PL-Coal leachate
Iron-Related Bacteria	CFU/ml	ND	ND
Sulfate-Reducing Bacteria	CFU/ml	ND	ND

Coal Slurry: Solids Phase Inorganic Chemistry

Table 17 shows a summary of the sample site occurrence of the organic compounds that have been identified in the coal slurry-liquid phases. This table shows the nine (9) detects for the VOCs from the mined Eagle coal seam coal slurry-liquid phase and the leachate from the mined Eagle seam. The VOCs that were detected included: 2-butanone; acetone; benzene; m,p-xylene; o-xylene; and toulene. This summary table shows that only the mine PL-2 dewatering borehole of the Panther surface and ground water sites showed the occurrence of 1-butanol. All the BTEX compounds that were detected in the slurry liquid and coal leachate phases were also observed in the slurry solids phase. Appendix 14 and 15 show all the VOC and SVOC data.

Table 17- Volatile Organic Compounds (VOCs) from the Coal Slurry-Liquid at Sample Sites

Slurry Liquid: Volatile Organic Compounds Analyses Results		PL-2	PL-3	PL-4	PL-5	PL-6	PL	PL
Analytes	**Unit**	**DW Well**	**DSWB**	**USWB**	**Wet Branch Refuse**	**Stout well**	**Slurry (liquid)**	**Coal leachate**
2-Butanone	µg/L	ND	ND	ND	ND	ND	**68.4**	**ND**
Acetone	µg/L	ND	ND	ND	ND	ND	**16.7**	**9.9**
Benzene	µg/L	ND	ND	ND	ND	ND	**1.8**	**1.6**

m,p-Xylene	µg/L	ND	ND	ND	ND	ND	**0.8**	**0.4**
o-Xylene	µg/L	ND	ND	ND	ND	ND	**0.6**	**0.3**
Toluene	µg/L	ND	ND	ND	ND	ND	**2.8**	**2.1**
1-Butanol	ug/L	**2.8**	ND	ND	ND	ND	**3.4**	**ND**
2-Methyl 2-propane	ug/L	ND	ND	ND	ND	ND	**5.4**	**2.4**
2-Methyl butane	ug/L	ND	ND	ND	ND	ND	**1.2**	**ND**

The concentration of 2-butanone in the coal slurry liquid was 68.4 ug/L; however, the Eagle mined coal leachate liquid phase did not show the TIC presence of 2-butanone.
2- methyl-propane (TIC) detected at 5.4 ug/L in the coal slurry liquid phase is a gasoline component and an organic synthesis product (Montgomery, 2007). As stated above, the PL-2 UO-391 mine discharge showed the TIC presence of 1-butanol at 2.8 mg/L The concentration of 2-butanone in the coal slurry liquid was 68.4 ug/L; however, the Eagle mined coal leachate liquid phase did not show the presence of 2-butanone.

The n-butanol chemical that is authorized for use at the Panther, LLC preparation plant and was detected in the mine discharge (WVDEP-UIC permit). Also, 1-butanol (synonym for n-butanol.) was detected in the SCR-15 UIC PL-2 mine discharge and the coal slurry liquid. Orem (2009) stated that this chemical was introduced from the preparation process, and is attested to by the presence of n-butanol that Panther, LLC uses in its preparation process. Jones and Woods (1986) have shown that butanol-acetone can form from the fermentation of anaerobic bacteria. Geilsman (1999) has demonstrated that 2-butanone (an alcohol) can be derived from n-butanol.

The occurrence of (TPH-DRO) was found to occur in the slurry solids, liquid, and at the UO-391 dewatering borehole (PL-2). Butylbenzene was found to occur in only the slurry solids. The other organic compounds such as (1), n-butanol, (and 2-butanone), and naphthalene can potentially be used as a tracers; acetone remains problematic as a potential tracer as it occurred in the coal leachate, but there is a strong likelihood that there is an association with n-butanol.

Table 18 shows the occurrence of these organic compounds that have been identified in the coal slurry-liquid phases.

Table 18- Additional Coal Slurry-Liquid Phase Organic Compounds at Sample Sites

Sample Sites		**PL-2**	**PL-3**	**PL-4**	**PL-5**	**PL-6**	**PL-LQ slurry**
Analytes	**Unit**	**DW Well**	**DSWB**	**USWB**	**Wet Branch Refuse**	**Stout_well**	

Acrylamide	mg/L	ND	ND	ND	ND	ND	ND
Glycol	mg/L	ND	ND	ND	ND	ND	ND
TPH (Diesel Range)	mg/L	**0.92**	ND	ND	ND	ND	**0.51**
TPH (Oil Range)	mg/L	**4.16**	ND	ND	ND	ND	ND
Oil and Grease	mg/L	**2.20**	ND	ND	ND	ND	ND

The occurrence of these organic compounds in Table 18 have been identified in the coal slurry-liquid phases. This table shows that none of the Panther surface and ground water sample sites showed the occurrence of acrylamide. There were occurrences of TPH (total petroleum hydrocarbons) from the Mine No. 2 UO-391 dewatering borehole PL-2). The TPH-DRO concentration was 0.92 mg/L, TPH-ORO was 4.16 mg/L, and oil/grease was 2.8 mg/L.

Table 19 shows the occurrence of these organic compounds that have been identified in the coal slurry-liquid phases.

Table 19- Eagle coal slurry Organic Chemistry Analyses
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Analytes	Unit	PL-Slurry (Liquid)	PL-Raw Coal Leachate
Acrylamide	mg/L	**ND**	**ND**
Glycol	mg/L	**ND**	**ND**
TPH (Diesel Range)	mg/L	**0.5100**	**ND**
TPH (Oil Range)	mg/L	**ND**	**ND**
Oil and Grease	mg/L	**ND**	**ND**

There were no occurrence of acrylamide, glycol, TPH (ORO), or oil and grease in the slurry liquid or raw coal leachate (Table 19). TPH (DRO) was detected in the slurry liquid; however, there was not an occurrence of DRO in the Eagle coal leachate. This indicates that the DRO found in the Panther preparation plant slurry liquid may have originated from the coal preparation process rather than the raw coal itself.

Findings

1. Due to time constraints for this project, sampling in general for the SCR-15 UIC project was restricted to a one-time event. The January 23, 2008 sampling resulted in a "snapshot" determination of the water quality at the sample sites. Since there was no seasonal variation sampling, only a gross characterization of the Wet Branch Watershed water chemistry can be advanced.

2. This study included WVDEP-DMR and UIC permit baseline and compliance data and narratives, discussions with the DMR inspector, UIC permits staff for all Panther injection data and history; and site-specific field observations.

3. Site-specific in-stream water chemistry data were gathered at each of the sampling points during the January 23, 2008 sampling event. An effort was made to locate the SCR-15 UIC study sampling sites with the permit monitoring sites, but they did not coincide exactly. Comparisons with the historical permit data are therefore less rigorous.

4. UO-391 mine pool data were not available to understand the hydraulics of water movement in the mine, and as a result the Panther SCR-15 study could not resolve whether during active slurry injection, the slurry solids separated out from the slurry liquid phase and were deposited within close proximity to the injection hole, or whether the solids were in transport even through the mine pool.

5. The Panther SCR-15 data indicate that the surface or ground water sample sites showed neither the presence nor elevated levels of metals, or organic compounds concentrations. Concentrations of metals occurred under one mg/L in both the slurry liquid phase and the coal leachate. Concentrations of metals and organic compounds occur in the coal slurry solids phase.

6. The water chemistry of the PL-5 refuse area seep contributes to the degraded water quality of the receiving stream (downstream site PL-3 compared to upstream site PL-4), Wet Branch. The PL-5 seep reflects ground water that has been degraded as it migrates through the Wet Branch Refuse Area pile and becomes more mineralized. Surface placement of slurry contributions from this source are difficult to quantify and differentiate from any contributions from slurry injection.

7. The Panther LLC permits show that there are proposed ground water monitoring, but the wells have not been drilled. The lack of ground water monitoring sites makes it tenuous at best, to draw any valid conclusions that can adequately assess the ground water chemistry of the Wet Branch watershed.

8. The Stout well water chemistry shows elevated concentrations (dissolved basis) of iron, with respect to the other SCR-15 samples sites; barium was slightly elevated. The Stout well water has a low sulfate level of 16.8 mg/L and specific conductance level of 309 umhos/cm. No impacts from coal mining activities, including slurry injection, were detected in this residential well.

9. Concentrations of chloride, aluminum, sulfate, TDS (and specific conductance), and sodium in the coal slurry liquid phase are significantly elevated (10 times or greater) than occur in the coal leachate. The elevated chloride concentrations correspond to elevated levels of sodium, which most likely reflect commonly used chemicals in the coal preparation process. The higher concentration of sulfate concentrations in the slurry (with respect to the raw coal leachate) most probably reflects the higher concentrations of sulfide materials (higher specific gravity) in the sink fraction in the reject.

10. The Panther coal slurry solids phase data shows that elevated concentrations of several metals occur in the solid phase, such as aluminum; iron; barium; chromium; lead; nickel; strontium; vanadium; manganese; and zinc. Previous permittee UIC permit data shows that slurry solids total metals such as aluminum and iron were elevated at 3740 mg/L and 10,800 mg/L, respectively. However, the SCR-15 slurry solids data showed 3600 mg/kg and 6080 mg/kg, respectively. Permit data shows that background slurry injectate metals were not detected at such elevated concentrations, except sodium (WVDEP-UIC permit, 2000).

11. In the slurry solids, strontium was detected at 13.6 mg/kg and was also detected at all SCR-15 UIC sample sites, ranging from 0.009 mg/L to 2.04 mg/L. The No. 2 Gas and Eagle seams may contain strontium bearing calcium-barium carbonates; however, an organically bound origin may explain the presence of strontium at all the Panther sample sites.

12. Chromium and selenium occurred below 1 mg/l in the coal slurry liquid phase and coal leachate, but chromium showed a concentration of 4.82 mg/kg in the coal slurry solids phase. The UIC compliance data showed three exceedences for total chromium (permit limits 0.1 mg/L) of 0.1522 mg/l, 0.5413mg/L, and 0.2767 mg/L (on 10/1/2002, 1/3/2003, and 4/1/2003, respectively). There was one

selenium exceedence that occurred during March 2004 of 0.1298 mg/L (permit limit 0.05 mg/L). Selenium was not detected in the coal slurry solids phase.

13. The WVDEP-UIC compliance data shows exceedences of TPH-ORO (permit limit 1.0 mg/L) occurred at injection site # 202 of 4.8 mg/L (8/1/2002) and 11.2 mg/L (on 3/1/2003). Exceedences occurred of TPH-DRO Diesel Range (permit limits 1.0 mg/L) of 12.6 mg/L (2/1/2003) and 10.1 mg/L (8/1/2002). There were no exceedences of TPH- GRO (Gasoline Range) hydrocarbons.

14. There were occurrences of TPH from the Mine No. 2 UO-391 dewatering borehole (PL-2). The TPH values occur in the diesel range (0.92 mg/L), oil range (4.16 mg/L), and oil/grease (2.2 mg/L). A TPH-DRO compound was found in the slurry liquid phase at 0.51 mg/L, but not found in the slurry solid phase. All of these organic compounds are interpreted as resulting from the Panther coal preparation process.

15. Elevated levels of diesel range (DRO) and oil range hydrocarbons (GRO) that were identified in the coal slurry-solid phase at 144 mg/kg and 159 mg/kg, respectively It is not certain whether these TPH compounds are from the injected 2002-2004 injected slurry, the coal seam, the mine pool water chemistry, infiltration of slurry constituents from surface placement of slurry refuse downward into the UO-391 mine pool. This report reflects the underlying premise that the slurry tested for in the SCR-15 study may or may not be the same slurry composition that was injected during 2002 to 2004.

16. The compound n-butanol (1-butanol) is an authorized chemical to use at the Panther preparation plant. The compound 2-Butanone was detected in the slurry-liquid phase at a concentration of 64.4 ug/L, but not detected in the coal leachate. Moreover, the 1-butanol compound was detected in the coal slurry liquid phase at 3.4 ug/L and at sample site PL-2, at 2.8 ug/L. In addition to the occurrences of n, 1-butanol, butanone, acetone, and naphthalene were detected. Acetone was detected in the slurry liquid phase at 16.7 ug/L, and the coal leachate at 9.9 ug/L. All of these organic compounds are interpreted as resulting from the Panther coal preparation process.

17. The analysis for BTEX compounds showed the presence of benzene, ethylbenzene, isopropyl benzene, m,p-xylene in the coal seam coal slurry-liquid phase and the leachate from the mined Eagle seam. These compounds are largely interpreted as primarily occurring naturally from the Eagle and No. 2 Gas seam coal chemistry. Panther preparation process, and gasoline-related product, etc may also provide a source of these compounds. The Panther data suggests however,

that 2-butanone, 1-butanol, naphthalene, TPH DRO (and perhaps acetone) can be used as potential tracers to determine the fate and transport of these compounds.

18. Certain organic compounds were found in the slurry liquid, but not found in the slurry solids. The organic compounds 1-butanol and acetone were detected in the coal slurry liquid and at the mine dewatering borehole; 1-butanol is an UIC authorized chemical that is used at the Panther preparation plant. It is not certain whether 1-butanol is a result from the injected 2002-2004 injected slurry still being in the mine pool water, or infiltration of slurry constituents from surface placement of slurry refuse downward into the UO-391 mine pool.

19. The presence of 1-butanol and TPH-DRO compound in the slurry and the mine discharge indicates that slurry constituents are migrating downgradient from the injection holes, through the mine pool to the mine dewatering borehole. The available water quality data of the mine discharge does not demonstrate that the receiving stream Wet Branch has been affected by slurry influenced elevated metals and/or the presence of organic compounds.

20. The available data could not be used to determine if the injected coal slurry adversely affected Wet Branch surface and ground water resources, largely in part that the organic compounds can occur naturally, or as a result of pollutants in the environment. Discriminating between naturally occurring sources, the chemicals used in the coal preparation process, and the coal seam proper is problematic with the existing data.

21. The available WVDEP-UIC Panther permit data does not provide specific information as to the chemicals used in the coal preparation plant process. The UIC permit data does not provide meaningful information to indicate what chemicals (especially, any blends or proprietary chemicals) are being used.

22. Relevant site-specific monitoring sites (and analytes) would have had to been in place in order to determine if any effects to surface or ground water resources has occurred from coal slurry injection.

Appendix 1A –Panther -No. 2 Gas (WVGES Peerless), Proximate Analysis, Kanawha County Mines

UTM East	UTM North	Moisture	Vol.Mat. (dry)	Ash (dry)	Fix.Car.(dry)	Vol.Mat (as rec.)	Ash (as rec.)	FixCar (as rec.)	VolMat (m-mmf)	FC (m-mmf)	Rank	BTU
454120	4228730	0.62	37.56	3.66	58.77	37.33	3.64	58.41	38.99	61.01	hvBb	14490
452440	4228340	1.06	44.39	7.87	47.74	43.92	7.79	47.23	48.18	51.82	unk	13358
458190	4226670	0.59	35.97	4.81	59.22	35.76	4.78	58.87	37.79	62.21	hvAb	14309
463270	4204430	6.90	31.90	7.95	60.15	29.70	7.40	56.00	34.66	65.34	hvAb	13989
469421	4246351			22.47								11497
464654	4220730	0.82	33.76	21.62	44.62	33.48	21.44	44.25	43.07	56.93	hvCb?	11569
463150	4214640	2.50	36.31	6.46	57.23	35.40	6.30	55.80	38.82	61.18	hvBb	14068
463150	4214640	2.44	35.08	8.36	56.56	34.22	8.16	55.18	38.28	61.72		13796
461400	4215750	2.70	37.72	4.83	57.45	36.70	4.70	55.90	39.63	60.37	hvBb	14251
461988	4215184	2.50	36.62	2.56	60.82	35.70	2.50	59.30	37.58	62.42	hvAb	14645
461988	4215184	2.37	35.88	5.33	58.80	35.03	5.20	57.40	37.90	62.11		14232
460243	4213410	2.93	33.29	9.38	57.33	32.32	9.10	55.65	36.74	63.26		13656
457159	4212914			7.33								13872
458240	4213615			14.43								13008
459533	4214370			8.30								14003
459063	4213524			10.87								13478
457768	4212274			12.09								13344
457695	4211530	2.53	34.34	9.54	56.12	33.47	9.30	54.70	37.96	62.04	hvAb	13720
459231	4217744			5.21								14241
462156	4215626	1.78	35.50	7.28	57.19	34.87	7.15	56.17	38.30	61.70	hvAb	13937
455300	4222116			8.15								
465730	4212655	1.40	34.20	9.40	56.40	33.72	9.27	55.61	37.75	62.25	hvAb	13619
458770	4225445	1.50	40.00	4.30	55.70	39.40	4.24	54.86	41.80	58.20	hvBb	14197

Appendix 1B – Panther- Eagle Coal Seam (and WVGES), Proximate Analysis, Kanawha County Mines

UTM East	UTM North	Moisture	Vol.Mat. (dry)	Ash (dry)	Fix.Car.(dry)	Vol.Mat (as rec.)	Ash (as rec.)	FixCar (as rec.)	VolMat (m-mmf)	FC (m-mmf)	Rank	BTU
447420	4230410	1.05	29.36	7.58	63.06	29.05	7.50	62.40	31.77	68.23	hvAb	14170
447560	4229610	0.64	37.39	5.09	57.52	37.15	5.06	57.15	39.40	60.60	hvBb	14210
466260	4204380	1.30	28.98	7.83	63.19	28.60	7.73	62.37	31.44	68.56	hvAb	14126
465930	4204640	1.05	30.42	3.70	65.88	30.10	3.66	65.19	31.59	68.41	hvAb	14762
466180	4218600	1.30	32.73	5.79	61.49	32.30	5.71	60.69	34.73	65.27	hvAb	14318
466430	4217310	0.75	35.47	3.37	61.17	35.20	3.34	60.71	36.70	63.30	hvAb	14582
466760	4214170	0.75	30.68	3.86	65.46	30.45	3.83	64.97	31.91	68.09	hvAb	14743
465740	4211220	0.80	32.54	3.13	64.33	32.28	3.10	63.82	33.59	66.41	hvAb	14767
465790	4210560	0.65	30.65	4.24	65.11	30.45	4.21	64.69	32.01	67.99	hvAb	14631
466910	4210930	0.80	30.44	3.74	65.82	30.20	3.71	65.29	31.63	68.37	hvAb	14756
449040	4228200	3.30	36.71	8.07	55.22	35.50	7.80	53.40	39.93	60.07	hvBb	13768
464136	4220501	0.86	34.59	7.33	58.08	34.29	7.27	57.58	37.33	62.67	hvAb	13927
450900	4222120	1.90	35.47	5.50	59.02	34.80	5.40	57.90	37.54	62.46	hvAb	14203
450882	4222147	1.76	36.38	7.92	55.71	35.74	7.78	54.73	39.50	60.50		13755
450040	4222860	2.50	35.90	9.13	54.97	35.00	8.90	53.60	39.50	60.50	hvBb	13607
465220	4205270	1.40	37.93	3.35	58.72	37.40	3.30	57.90	39.24	60.76	hvBb	14471
465220	4205270	1.80	33.30	5.09	61.61	32.70	5.00	60.50	35.09	64.91	hvAb	14368
476240	4231940	1.61	36.36	7.44	56.20	35.77	7.32	55.30	39.28	60.72	hvBb	13858
476160	4231000	1.90	35.07	6.83	58.10	34.40	6.70	57.00	37.64	62.36	hvAb	14004
457159	4212488			11.70								13389
457159	4212914			8.90								13799
458240	4213615			6.70								14334
459063	4213524			5.32								14410
454824	4217399			4.91								14588
457695	4211530	1.22	33.45	9.67	56.88	33.04	9.55	56.19	37.03	62.97	hvAb	12778

Appendix 1C- Peerless seam trace element chemistry (WVGES, 2009)

Coal Bed Name	Element	As	Be	Cd	Co	Cr	Hg	Mn	Ni	Pb	Sb	Se	Cl	F	U	Th
PEERLESS	Mean	17.69	3.21	0.07	7.10	18.70	0.15	13.37	12.20	5.26	1.10	4.00	2030.00	62.73	1.06	2.14
	St. Dev.	24.14	1.65	0.08	3.31	28.57	0.21	14.43	3.87	3.17	0.60	2.01	551.54	41.96	0.63	1.27
	max	95.90	6.72	0.34	12.80	131.80	0.91	63.00	19.70	12.35	2.55	9.40	2420.00	160.00	2.78	4.20
	min	1.30	0.86	0.01	2.30	4.10	0.01	2.87	6.30	1.13	0.24	1.40	1640.00	23.00	0.22	0.40
	n	18	18	16	18	18	18	18	18	18	18	18	2	15	18	17

Appendix 1D- Eagle seam trace element chemistry (WVGES, 2009)

Coal Bed Name	Element	As	Be	Cd	Co	Cr	Hg	Mn	Ni	Pb	Sb	Se	Cl	F	U	Th
EAGLE	Mean	8.45	2.77	0.06	5.36	12.25	0.11	28.98	10.69	5.48	0.91	3.60	1536.40	47.13	1.30	2.28
	St. Dev.	12.06	1.66	0.05	2.94	6.05	0.13	70.59	6.42	2.87	0.65	1.38	670.50	29.70	0.80	1.24
	max	55.00	[illegible]	0.31	17.90	29.05	0.55	535.60	39.90	17.17	3.70	7.90	2470.00	170.00	4.74	6.20
	min	0.08	0.32	0.01	1.40	2.72	0.01	2.08	3.03	1.06	0.18	0.99	610.00	10.00	0.22	0.32
	n	68	69	66	69	69	68	69	69	69	69	69	11	61	68	65

Appendix 1E-HTA of Panther Area- Eagle and Peerless seams (USGS, 2006

WV HTA Ash % oxides	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3
Seams	%	%	%	%	%	%	%
Eagle	51.9	30.2	2.14	1.35	0.53	3.3	3.4
Peerless	41.5	23.4	1.46	0.89	0.36	2.90	21.3

Appendix 2-TCLP Analysis of Boiler FlyAsh Disposed at Wet Branch O-2-82

TOXICITY CHARACTERISTIC
LEACHING PROCEDURE (TCLP)

Contaminant	Regulatory Level (mg/l)
Arsenic	8.0
Barium	100
Benzene	0.5
Cadmium	1.0
carbon Tetrachloride	0.5
o-Cresol	200.0
m-Cresol	200.0
p-Cresol	200.0
Cresol	200.0
2,4-D	10.0
1,4-Dichlorobenzene	7.5
1,2-Dichlorosthene	0.8
1,1-Dichloroethylene	0.7
2,4-Dinitrataluene	0.13
Endrin	0.02
Heptachlor	0.008
Hexachlorobenzene	0.13
Hexachlorobutadene	0.5
Hexachloroethane	3.0
Lead	5.0
Lindane	0.4
Mercury	0.2
Methoxychlor	10.0
Methyl Ethyl Ketone (MEK)	200.0
Nitrobenzene	2.0
Pentachlorophenal	100.0
Pyridins	5.0
Selenium	1.0
Silver	5.0
Tetrachloroethylene	0.7
Toxaphene	0.5
Trichloroethylene	0.5
2,4,5-Trichlorophenol	400.0
2,4,6-Trichlorophenol	2.0
2,4,5-TP (Silvex)	1.0
Vinyl Chloride	0.2

Appendix 3–Panther WVDEP-NPDES Non-compliance Monitoring

structure_id	chemical_report_date	chem	rpt_minimum	rpt_average	rpt_maximum	rpt_unit	lmt_minimum	lmt_average	lmt_maximum	lmt_units	noncompliance
Ditch 4	10/31/2006 00:00:00	00530 - Total Suspended Solids	57	57	57	MG/L		35	70	MG/L	030 - Exceeds Concentration Average
Ditch 4	10/31/2006 00:00:00	00530 - Total Suspended Solids	57	57	57	MG/L		35	70	MG/L	040 - Exceeds 1.4 * Concentration Average
Pond 10	10/31/2006 00:00:00	01045 - Iron, Total (As Fe)	3.15	3.15	3.15	MG/L		1.5	1.5	MG/L	132 - Exceeds 1.4 * Concentration Maximum
Pond 10	10/31/2006 00:00:00	01045 - Iron, Total (As Fe)	3.15	3.15	3.15	MG/L		1.5	1.5	MG/L	040 - Exceeds 1.4 * Concentration Average
Pond 10	10/31/2006 00:00:00	01045 - Iron, Total (As Fe)	3.15	3.15	3.15	MG/L		1.5	1.5	MG/L	010 - Exceeds Concentration Maximum
Pond 10	10/31/2006 00:00:00	01045 - Iron, Total (As Fe)	3.15	3.15	3.15	MG/L		1.5	1.5	MG/L	030 - Exceeds Concentration Average
Pond 10	10/31/2006 00:00:00	00530 - Total Suspended Solids	45	45	45	MG/L		35	70	MG/L	030 - Exceeds Concentration Average
Pond 12	9/30/2006 00:00:00	00400 - pH	5.06	5.06	5.06	Std Uni	6		9	Std Unit	031 - Below Concentration Minimum
Pond 12	9/30/2006 00:00:00	01055 - Manganese, Total	4.57	4.57	4.57	MG/L		2	4	MG/L	040 - Exceeds 1.4 * Concentration Average
Pond 12	9/30/2006 00:00:00	01055 - Manganese, Total	4.57	4.57	4.57	MG/L		2	4	MG/L	030 - Exceeds Concentration Average
Pond 12	9/30/2006 00:00:00	01105 - Aluminum, Total (as Al)	3.47	3.47	3.47	MG/L		.08	.14	MG/L	040 - Exceeds 1.4 * Concentration Average
Pond 12	9/30/2006 00:00:00	01105 - Aluminum, Total (as Al)	3.47	3.47	3.47	MG/L		.08	.14	MG/L	010 - Exceeds Concentration Maximum
Pond 12	9/30/2006 00:00:00	01105 - Aluminum, Total (as Al)	3.47	3.47	3.47	MG/L		.08	.14	MG/L	132 - Exceeds 1.4 * Concentration Maximum
Pond 12	9/30/2006 00:00:00	01105 - Aluminum, Total (as Al)	3.47	3.47	3.47	MG/L		.08	.14	MG/L	030 - Exceeds Concentration Average
Pond 12	9/30/2006 00:00:00	01055 - Manganese, Total	4.57	4.57	4.57	MG/L		2	4	MG/L	010 - Exceeds Concentration Maximum
Pond 12	4/30/2007 00:00:00	01105 - Aluminum, Total (as Al)	1.54	1.54	1.54	MG/L	R/O	.43	.75	MG/L	132 - Exceeds 1.4 * Concentration Maximum
Pond 12	4/30/2007 00:00:00	01105 - Aluminum, Total (as Al)	1.54	1.54	1.54	MG/L	R/O	.43	.75	MG/L	010 - Exceeds Concentration Maximum
Pond 12	4/30/2007 00:00:00	01105 - Aluminum, Total (as Al)	1.54	1.54	1.54	MG/L	R/O	.43	.75	MG/L	030 - Exceeds Concentration Average
Pond 12	4/30/2007 00:00:00	01055 - Manganese, Total	2.54	2.54	2.54	MG/L	R/O	2	4	MG/L	030 - Exceeds Concentration Average
Pond 12	4/30/2007 00:00:00	01105 - Aluminum, Total (as Al)	1.54	1.54	1.54	MG/L	R/O	.43	.75	MG/L	040 - Exceeds 1.4 * Concentration Average
TK Ldout	12/31/2003 00:00:00	00530 - Total Suspended Solids	27	156	285	MG/L		35	70	MG/L	010 - Exceeds Concentration Maximum
TK Ldout	12/31/2003 00:00:00	00530 - Total Suspended Solids	27	156	285	MG/L		35	70	MG/L	030 - Exceeds Concentration Average
TK Ldout	12/31/2003 00:00:00	00530 - Total Suspended Solids	27	156	285	MG/L		35	70	MG/L	040 - Exceeds 1.4 * Concentration Average
TK Ldout	12/31/2003 00:00:00	00530 - Total Suspended Solids	27	156	285	MG/L		35	70	MG/L	132 - Exceeds 1.4 * Concentration Maximum
pond 7	1/31/2004 00:00:00	00530 - Total Suspended Solids	17	59.5	102	MG/L	R/O	35	70	MG/L	010 - Exceeds Concentration Maximum
pond 7	1/31/2004 00:00:00	00530 - Total Suspended Solids	17	59.5	102	MG/L	R/O	35	70	MG/L	040 - Exceeds 1.4 * Concentration Average
pond 7	1/31/2004 00:00:00	00530 - Total Suspended Solids	17	59.5	102	MG/L	R/O	35	70	MG/L	030 - Exceeds Concentration Average
pond 7	1/31/2004 00:00:00	00530 - Total Suspended Solids	17	59.5	102	MG/L	R/O	35	70	MG/L	132 - Exceeds 1.4 * Concentration Maximum
Ditch 4	12/31/2003 00:00:00	00530 - Total Suspended Solids	48	48	48	MG/L		35	70	MG/L	030 - Exceeds Concentration Average
Ditch 4	2/29/2004 00:00:00	00530 - Total Suspended Solids	11	67.5	124	MG/L		35	70	MG/L	132 - Exceeds 1.4 * Concentration Maximum
Ditch 4	2/29/2004 00:00:00	00530 - Total Suspended Solids	11	67.5	124	MG/L		35	70	MG/L	010 - Exceeds Concentration Maximum
Ditch 4	2/29/2004 00:00:00	00530 - Total Suspended Solids	11	67.5	124	MG/L		35	70	MG/L	040 - Exceeds 1.4 * Concentration Average
Ditch 4	2/29/2004 00:00:00	00530 - Total Suspended Solids	11	67.5	124	MG/L		35	70	MG/L	030 - Exceeds Concentration Average
Ditch 4	4/30/2004 00:00:00	00530 - Total Suspended Solids	4	160.5	317	MG/L		35	70	MG/L	040 - Exceeds 1.4 * Concentration Average
Ditch 4	4/30/2004 00:00:00	00530 - Total Suspended Solids	4	160.5	317	MG/L		35	70	MG/L	030 - Exceeds Concentration Average
Ditch 4	4/30/2004 00:00:00	00530 - Total Suspended Solids	4	160.5	317	MG/L		35	70	MG/L	132 - Exceeds 1.4 * Concentration Maximum
Ditch 4	4/30/2004 00:00:00	00530 - Total Suspended Solids	4	160.5	317	MG/L		35	70	MG/L	010 - Exceeds Concentration Maximum
pond 8	4/30/2005 00:00:00	00530 - Total Suspended Solids	2	79	156	MG/L		35	70	MG/L	132 - Exceeds 1.4 * Concentration Maximum

Appendix 4- Wet Branch Volatile Organic Compounds Chemistry at Sample Sites PL-3, PL-4, PL-5

Volatile Organic Compounds Analyses Results		**PL-3**	**PL-4**	**PL-5**
Parameters	**Unit**			
1,1,1,2-Tetrachloroethane	µg/L	ND	ND	ND
1,1,1-Trichloroethane	µg/L	ND	ND	ND
1,1,2,2-Tetrachloroethane	µg/L	ND	ND	ND
1,1,2-Trichloroethane	µg/L	ND	ND	ND
1,1-Dichloroethane	µg/L	ND	ND	ND
1,1-Dichloroethene	µg/L	ND	ND	ND
1,1-Dichloropropene	µg/L	ND	ND	ND
1,2,3-Trichlorobenzene	µg/L	ND	ND	ND
1,2,3-Trichloropropane	µg/L	ND	ND	ND
1,2,4-Trichlorobenzene	µg/L	ND	ND	ND
1,2,4-Trimethylbenzene	µg/L	ND	ND	ND
1,2-Dibromo-3-chloropropane	µg/L	ND	ND	ND
1,2-Dibromoethane	µg/L	ND	ND	ND
1,2-Dichlorobenzene	µg/L	ND	ND	ND
1,2-Dichloroethane	µg/L	ND	ND	ND
1,2-Dichloropropane	µg/L	ND	ND	ND
1,3,5-Trimethylbenzene	µg/L	ND	ND	ND
1,3-Dichlorobenzene	µg/L	ND	ND	ND
1,3-Dichloropropane	µg/L	ND	ND	ND
1,4-Dichlorobenzene	µg/L	ND	ND	ND
2,2-Dichloropropane	µg/L	ND	ND	ND
2-Butanone	µg/L	ND	ND	ND
2-Chlorotoluene	µg/L	ND	ND	ND
2-Hexanone	µg/L	ND	ND	ND
4-Chlorotoluene	µg/L	ND	ND	ND
4-Isopropyltoluene	µg/L	ND	ND	ND
4-Methyl-2-pentanone	µg/L	ND	ND	ND
Acetone	µg/L	ND	ND	ND
Acrolein	µg/L	ND	ND	ND
Acrylonitrile	µg/L	ND	ND	ND
Benzene	µg/L	ND	ND	ND
Bromobenzene	µg/L	ND	ND	ND
Bromochloromethane	µg/L	ND	ND	ND
Bromodichloromethane	µg/L	ND	ND	ND
Bromoform	µg/L	ND	ND	ND
Bromomethane	µg/L	ND	ND	ND
Carbon disulfide	µg/L	ND	ND	ND
Carbon tetrachloride	µg/L	ND	ND	ND
Chlorobenzene	µg/L	ND	ND	ND
Chloroethane	µg/L	ND	ND	ND
Chloroform	µg/L	ND	ND	ND
Chloromethane	µg/L	ND	ND	ND
cis-1,2-Dichloroethene	µg/L	ND	ND	ND
cis-1,3-Dichloropropene	µg/L	ND	ND	ND

Dibromochloromethane	µg/L	ND	ND	ND
Dibromomethane	µg/L	ND	ND	ND
Dichlorodifluoromethane	µg/L	ND	ND	ND
Ethylbenzene	µg/L	ND	ND	ND
Hexachlorobutadiene	µg/L	ND	ND	ND
Iodomethane	µg/L	ND	ND	ND
Isopropylbenzene	µg/L	ND	ND	ND
m,p-Xylene	µg/L	ND	ND	ND
Methyl tert-butyl ether	µg/L	ND	ND	ND
Methylene chloride	µg/L	ND	ND	ND
Naphthalene	µg/L	ND	ND	ND
n-Butylbenzene	µg/L	ND	ND	ND
n-Propylbenzene	µg/L	ND	ND	ND
o-Xylene	µg/L	ND	ND	ND
sec-Butylbenzene	µg/L	ND	ND	ND
Styrene	µg/L	ND	ND	ND
tert-Butylbenzene	µg/L	ND	ND	ND
Tetrachloroethene	µg/L	ND	ND	ND
Toluene	µg/L	ND	ND	ND
trans-1,2-Dichloroethene	µg/L	ND	ND	ND
trans-1,3-Dichloropropene	µg/L	ND	ND	ND
Trichloroethene	µg/L	ND	ND	ND
Trichlorofluoromethane	µg/L	ND	ND	ND
Vinyl acetate	µg/L	ND	ND	ND
Vinyl chloride	µg/L	ND	ND	ND

Appendix 5- Semi-Volatile Organic Compounds Chemistry at Sample Sites PL-3, PL-4, PL-5

Semi-volatile Organic Compounds Analyses		**PL-3**	**PL-4**	**PL-5**
Parameters	**Unit**			
1,2,4-Trichlorobenzene	mg/L	ND	ND	ND
1,2-Dichlorobenzene	mg/L	ND	ND	ND
1,2-Diphenylhydrazine	mg/L	ND	ND	ND
1,3-Dichlorobenzene	mg/L	ND	ND	ND
1,4-Dichlorobenzene	mg/L	ND	ND	ND
2,4,5-Trichlorophenol	mg/L	ND	ND	ND
2,4,6-Trichlorophenol	mg/L	ND	ND	ND
2,4-Dichlorophenol	mg/L	ND	ND	ND
2,4-Dimethylphenol	mg/L	ND	ND	ND
2,4-Dinitrophenol	mg/L	ND	ND	ND
2,4-Dinitrotoluene	mg/L	ND	ND	ND
2,6-Dinitrotoluene	mg/L	ND	ND	ND
2-Chloronaphthalene	mg/L	ND	ND	ND
2-Chlorophenol	mg/L	ND	ND	ND
2-Nitrophenol	mg/L	ND	ND	ND
3,3´-Dichlorobenzidine	mg/L	ND	ND	ND
4,6-Dinitro-2-methylphenol	mg/L	ND	ND	ND
4-Bromophenyl phenyl ether	mg/L	ND	ND	ND
4-Chloro-3-methylphenol	mg/L	ND	ND	ND
4-Chlorophenyl phenyl ether	mg/L	ND	ND	ND
4-Nitrophenol	mg/L	ND	ND	ND
Acenaphthene	mg/L	ND	ND	ND
Acenaphthylene	mg/L	ND	ND	ND
Anthracene	mg/L	ND	ND	ND
Benzidine	mg/L	ND	ND	ND
Benzo(a)anthracene	mg/L	ND	ND	ND
Benzo(a)pyrene	mg/L	ND	ND	ND
Benzo(b)fluoranthene	mg/L	ND	ND	ND
Benzo(g,h,i)perylene	mg/L	ND	ND	ND
Benzo(k)fluoranthene	mg/L	ND	ND	ND
Bis(2-chloroethoxy)methane	mg/L	ND	ND	ND
Bis(2-chloroethyl)ether	mg/L	ND	ND	ND
Bis(2-chloroisopropyl)ether	mg/L	ND	ND	ND
Bis(2-ethylhexyl)phthalate	mg/L	ND	ND	ND
Butyl benzyl phthalate	mg/L	ND	ND	ND
Chrysene	mg/L	ND	ND	ND
Dibenzo(a,h)anthracene	mg/L	ND	ND	ND
Diethyl phthalate	mg/L	ND	ND	ND
Dimethyl phthalate	mg/L	ND	ND	ND
Di-n-butyl phthalate	mg/L	ND	ND	ND
Di-n-octyl phthalate	mg/L	ND	ND	ND
Fluoranthene	mg/L	ND	ND	ND
Fluorene	mg/L	ND	ND	ND
Hexachlorobenzene	mg/L	ND	ND	ND
Hexachlorobutadiene	mg/L	ND	ND	ND

Hexachlorocyclopentadiene	mg/L	ND	ND	ND
Hexachloroethane	mg/L	ND	ND	ND
Indeno(1,2,3-cd)pyrene	mg/L	ND	ND	ND
Isophorone	mg/L	ND	ND	ND
m,p-Cresol	mg/L	ND	ND	ND
Naphthalene	mg/L	ND	ND	ND
Nitrobenzene	mg/L	ND	ND	ND
N-Nitrosodimethylamine	mg/L	ND	ND	ND
N-Nitrosodi-n-propylamine	mg/L	ND	ND	ND
N-Nitrosodiphenylamine	mg/L	ND	ND	ND
o-Cresol	mg/L	ND	ND	ND
Pentachlorophenol	mg/L	ND	ND	ND
Phenanthrene	mg/L	ND	ND	ND
Phenol	mg/L	ND	ND	ND
Pyrene	mg/L	ND	ND	ND

Appendix 6-Volatile Organic Compounds Chemistry, Sample Sites PL-2, PL-5 and PL-6

Volatile Organic Compounds Analyses Results		**PL-2**	**PL-5**	**PL-6**
Parameters	**Unit**			
1,1,1,2-Tetrachloroethane	µg/L	ND	ND	ND
1,1,1-Trichloroethane	µg/L	ND	ND	ND
1,1,2,2-Tetrachloroethane	µg/L	ND	ND	ND
1,1,2-Trichloroethane	µg/L	ND	ND	ND
1,1-Dichloroethane	µg/L	ND	ND	ND
1,1-Dichloroethene	µg/L	ND	ND	ND
1,1-Dichloropropene	µg/L	ND	ND	ND
1,2,3-Trichlorobenzene	µg/L	ND	ND	ND
1,2,3-Trichloropropane	µg/L	ND	ND	ND
1,2,4-Trichlorobenzene	µg/L	ND	ND	ND
1,2,4-Trimethylbenzene	µg/L	ND	ND	ND
1,2-Dibromo-3-chloropropane	µg/L	ND	ND	ND
1,2-Dibromoethane	µg/L	ND	ND	ND
1,2-Dichlorobenzene	µg/L	ND	ND	ND
1,2-Dichloroethane	µg/L	ND	ND	ND
1,2-Dichloropropane	µg/L	ND	ND	ND
1,3,5-Trimethylbenzene	µg/L	ND	ND	ND
1,3-Dichlorobenzene	µg/L	ND	ND	ND
1,3-Dichloropropane	µg/L	ND	ND	ND
1,4-Dichlorobenzene	µg/L	ND	ND	ND
2,2-Dichloropropane	µg/L	ND	ND	ND
2-Butanone	µg/L	ND	ND	ND
2-Chlorotoluene	µg/L	ND	ND	ND
2-Hexanone	µg/L	ND	ND	ND
4-Chlorotoluene	µg/L	ND	ND	ND
4-Isopropyltoluene	µg/L	ND	ND	ND
4-Methyl-2-pentanone	µg/L	ND	ND	ND
Acetone	µg/L	ND	ND	ND
Acrolein	µg/L	ND	ND	ND
Acrylonitrile	µg/L	ND	ND	ND
Benzene	µg/L	ND	ND	ND
Bromobenzene	µg/L	ND	ND	ND
Bromochloromethane	µg/L	ND	ND	ND
Bromodichloromethane	µg/L	ND	ND	ND
Bromoform	µg/L	ND	ND	ND
Bromomethane	µg/L	ND	ND	ND
Carbon disulfide	µg/L	ND	ND	ND
Carbon tetrachloride	µg/L	ND	ND	ND
Chlorobenzene	µg/L	ND	ND	ND
Chloroethane	µg/L	ND	ND	ND
Chloroform	µg/L	ND	ND	ND
Chloromethane	µg/L	ND	ND	ND
cis-1,2-Dichloroethene	µg/L	ND	ND	ND
cis-1,3-Dichloropropene	µg/L	ND	ND	ND
Dibromochloromethane	µg/L	ND	ND	ND

Dibromomethane	µg/L	ND	ND	ND
Dichlorodifluoromethane	µg/L	ND	ND	ND
Ethylbenzene	µg/L	ND	ND	ND
Hexachlorobutadiene	µg/L	ND	ND	ND
Iodomethane	µg/L	ND	ND	ND
Isopropylbenzene	µg/L	ND	ND	ND
m,p-Xylene	µg/L	ND	ND	ND
Methyl tert-butyl ether	µg/L	ND	ND	ND
Methylene chloride	µg/L	ND	ND	ND
Naphthalene	µg/L	ND	ND	ND
n-Butylbenzene	µg/L	ND	ND	ND
n-Propylbenzene	µg/L	ND	ND	ND
o-Xylene	µg/L	ND	ND	ND
sec-Butylbenzene	µg/L	ND	ND	ND
Styrene	µg/L	ND	ND	ND
tert-Butylbenzene	µg/L	ND	ND	ND
Tetrachloroethene	µg/L	ND	ND	ND
Toluene	µg/L	ND	ND	ND
trans-1,2-Dichloroethene	µg/L	ND	ND	ND
trans-1,3-Dichloropropene	µg/L	ND	ND	ND
Trichloroethene	µg/L	ND	ND	ND
Trichlorofluoromethane	µg/L	ND	ND	ND
Vinyl acetate	µg/L	ND	ND	ND
Vinyl chloride	µg/L	ND	ND	ND

Appendix 7 -Semi-volatile Organic Compounds Chemistry, Sample Sites PL-2, PL-5, and Pl-6

Semi-volatile Organic Compounds Analyses Results		**PL-2**	**PL-5**	**PL-6**
Parameters	**Unit**			
1,2,4-Trichlorobenzene	mg/L	ND	ND	ND
1,2-Dichlorobenzene	mg/L	ND	ND	ND
1,2-Diphenylhydrazine	mg/L	ND	ND	ND
1,3-Dichlorobenzene	mg/L	ND	ND	ND
1,4-Dichlorobenzene	mg/L	ND	ND	ND
2,4,5-Trichlorophenol	mg/L	ND	ND	ND
2,4,6-Trichlorophenol	mg/L	ND	ND	ND
2,4-Dichlorophenol	mg/L	ND	ND	ND
2,4-Dimethylphenol	mg/L	ND	ND	ND
2,4-Dinitrophenol	mg/L	ND	ND	ND
2,4-Dinitrotoluene	mg/L	ND	ND	ND
2,6-Dinitrotoluene	mg/L	ND	ND	ND
2-Chloronaphthalene	mg/L	ND	ND	ND
2-Chlorophenol	mg/L	ND	ND	ND
2-Nitrophenol	mg/L	ND	ND	ND
3,3´-Dichlorobenzidine	mg/L	ND	ND	ND
4,6-Dinitro-2-methylphenol	mg/L	ND	ND	ND
4-Bromophenyl phenyl ether	mg/L	ND	ND	ND
4-Chloro-3-methylphenol	mg/L	ND	ND	ND
4-Chlorophenyl phenyl ether	mg/L	ND	ND	ND
4-Nitrophenol	mg/L	ND	ND	ND
Acenaphthene	mg/L	ND	ND	ND
Acenaphthylene	mg/L	ND	ND	ND
Anthracene	mg/L	ND	ND	ND
Benzidine	mg/L	ND	ND	ND
Benzo(a)anthracene	mg/L	ND	ND	ND
Benzo(a)pyrene	mg/L	ND	ND	ND
Benzo(b)fluoranthene	mg/L	ND	ND	ND
Benzo(g,h,i)perylene	mg/L	ND	ND	ND
Benzo(k)fluoranthene	mg/L	ND	ND	ND
Bis(2-chloroethoxy)methane	mg/L	ND	ND	ND
Bis(2-chloroethyl)ether	mg/L	ND	ND	ND
Bis(2-chloroisopropyl)ether	mg/L	ND	ND	ND
Bis(2-ethylhexyl)phthalate	mg/L	ND	ND	ND
Butyl benzyl phthalate	mg/L	ND	ND	ND
Chrysene	mg/L	ND	ND	ND
Dibenzo(a,h)anthracene	mg/L	ND	ND	ND
Diethyl phthalate	mg/L	ND	ND	ND
Dimethyl phthalate	mg/L	ND	ND	ND
Di-n-butyl phthalate	mg/L	ND	ND	ND
Di-n-octyl phthalate	mg/L	ND	ND	ND

Fluoranthene	mg/L	ND	ND	ND
Fluorene	mg/L	ND	ND	ND
Hexachlorobenzene	mg/L	ND	ND	ND
Hexachlorobutadiene	mg/L	ND	ND	ND
Hexachlorocyclopentadiene	mg/L	ND	ND	ND
Hexachloroethane	mg/L	ND	ND	ND
Indeno(1,2,3-cd)pyrene	mg/L	ND	ND	ND
Isophorone	mg/L	ND	ND	ND
m,p-Cresol	mg/L	ND	ND	ND
Naphthalene	mg/L	ND	ND	ND
Nitrobenzene	mg/L	ND	ND	ND
N-Nitrosodimethylamine	mg/L	ND	ND	ND
N-Nitrosodi-n-propylamine	mg/L	ND	ND	ND
N-Nitrosodiphenylamine	mg/L	ND	ND	ND
o-Cresol	mg/L	ND	ND	ND
Pentachlorophenol	mg/L	ND	ND	ND
Phenanthrene	mg/L	ND	ND	ND
Phenol	mg/L	ND	ND	ND
Pyrene	mg/L	ND	ND	ND

Appendix 8 –Summary of inorganic and organic chemistry from all ground and surface sample sites

Dissolved & Total Metals Analyses		PL-2		PL-3		PL-4		PL-5		PL-6		PL-Slurry (Liquid)		PL-Coal Leachate
Parameters	Unit	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Aluminum	mg/L	0.111	0.088	0.074	0.093	0.077	0.068	0.142	0.259	0.067	0.174	0.029	0.046	0.398
Antimony	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0146	0.016	0.0012
Arsenic	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	0.0055	0.0054	0.0104	0.0113	0.012
Barium	mg/L	0.0882	0.11	0.0414	0.0418	0.0344	0.0354	0.0718	0.078	0.483	0.483	0.243	0.269	0.0129
Beryllium	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0011	ND
Calcium	mg/L	4.13	12.3	8.74	8.89	3.79	3.67	24.2	22	10.4	28	2.83	3.51	0.464
Chromium	mg/L	ND	ND	ND	ND	ND	ND	0.0156	0.0158	0.009	0.0055	0.0272	0.0342	ND
Cobalt	mg/L	ND	ND	ND	ND	ND	ND	0.0207	0.0231	ND	ND	0.0142	0.0161	ND
Copper	mg/L	ND	0.0083	ND	ND	ND	ND	0.0054	0.0065	ND	ND	0.0248	0.0278	ND
Iron	mg/L	0.146	0.514	0.023	0.053	ND	0.025	0.039	0.4	10.5	27.9	0.068	0.089	ND
Lead	mg/L	ND	0.0019	ND	ND	ND	ND	0.002	0.002	ND	0.001	0.0762	0.0775	ND
Magnesium	mg/L	1.55	4.72	6.29	6.55	2.95	3.21	9.36	9.55	3.02	8.35	0.591	0.771	ND
Manganese	mg/L	0.024	0.064	0.033	0.033	0.008	0.014	0.78	0.777	ND	2.43	0.021	0.028	ND
Mercury	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Molybdenum	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.198	0.217	ND
Nickel	mg/L	ND	ND	ND	ND	ND	ND	0.027	0.0298	ND	ND	0.0386	0.0432	ND
Potassium	mg/L	1.38	4.74	0.761	0.81	0.583	0.639	3.69	3.71	1.26	3.52	5.38	7.05	1.23
Selenium	mg/L	ND	ND	ND	ND	ND	ND	0.0074	0.0079	ND	ND	0.0224	0.0255	0.0087
Silicon	mg/L	0.514	4.71	0.397	0.414	0.32	0.494	0.654	0.478	1.04	6.21	0.346	0.358	0.384
Silver	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	mg/L	98.6	291	9.44	9.73	0.828	0.873	174	176	3.39	9.58	266	341	10.1
Strontium	mg/L	0.989	1.16	0.427	0.428	0.0925	0.0903	2.04	2.01	0.267	0.264	0.571	0.632	0.0222
Thallium	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	mg/L	ND	ND	ND	ND	ND	ND	0.0052	0.0053	ND	ND	0.0103	0.0131	0.007
Zinc	mg/L	0.015	0.01	0.018	0.008	0.021	0.006	0.014	0.016	0.041	0.106	0.019	0.014	ND

Appendix 9- WVDEP-UIC Slurry Injectate Monitoring Parameters

Monitoring Requirements

5x13rev15May2001

Underground Injection Control Permit #0308-00-039 TEMPORARY MODIFICATION
P-G & H. Incorporated Page 10

Authorized Point(s) of Injection*

Number: 206	Number: 209	Number: 210
Latitude: 38°09'46"	Latitude: 38°09'31"	Latitude: 38°09'28"
Longitude: 81°27'26"	Longitude: 81°27'34"	Longitude: 81°27'38"

**The last accessible sampling point prior to waste fluids being released into the subsurface environment through a class V injection well.*

Note: Mine pool levels MUST be monitored monthly as described on Page 11, Construction Requirements.

INJECTATE PARAMETERS	LIMITS	UNITS	SAMPLING FREQUENCY	SAMPLE TYPE
Flow 00058	Report Only	GPM	Monthly	Estimated
pH 00400	6.5 – 8.5	S.U.	Monthly	Grab
Total Petroleum Hydrocarbon 45501 (DRO04585, GRO04584, ORO00567)	1.0 (each)	Mg/L	Monthly	Grab
Total Acrylamide 50796	0.001	Mg/L	Monthly	Grab
Dissolved Aluminum 01106	0.2	Mg/L	Monthly	Grab
Dissolved Arsenic 01000	0.05	Mg/L	Monthly	Grab
Dissolved Beryllium 01010	0.004	Mg/L	Monthly	Grab
Dissolved Cadmium 01025	0.005	Mg/L	Monthly	Grab
Total Chromium 01034	0.1	Mg/L	Monthly	Grab
Dissolved Iron 01046	Report Only	Mg/L	Monthly	Grab
Dissolved Lead 01049	0.015	Mg/L	Monthly	Grab
Dissolved Manganese 01056	Report Only	Mg/L	Monthly	Grab
Dissolved Nickel 01065	0.1	Mg/L	Monthly	Grab
Dissolved Selenium 01147	0.05	Mg/L	Monthly	Grab
Total Dissolved Solids 70296	Report Only	Mg/L	Monthly	Grab

Appendix 10- WVDEP-UIC Panther Slurry 2002-2004 Compliance Data

Panther Mining
UIC Slurry
Injection
0308-00-039

For Date Ending	FTS	Inj. Point	TPH ORO (1.0 Mg/L)	TPH DRO (1.0 Mg/L)	TPH GRO (1.0 Mg/L)	Total Acrylamid (0.001 Mg/L)	Dissolved Arsenic (0.01 Mg/L)	Dissolved Beryllium (0.004 Mg/L)	Dissolved Cadmium (0.005 Mg/L)	Total Chromium (0.1 Mg/L)	Dissolved Lead (0.015 Mg/L)	Dissolved Nickel (0.1 Mg/L)	Dissolved Selenium (0.05 Mg/L)	Report Only FLOW
5/1/2002		202	<.5	<.21	<.5	<.001	<.0139	<.0015	<.0018	<.0021	<.0071	<.0013	<.0177	
6/1/2002		202	<.6	<.23	<.5	<.001	<.0139	<.0015	<.0018	.0039	<.0071	.0130	<.0177	
1-Aug-02		202	4.8	10.1	<.5	<.001	<.0139	<.0015	<.0018	<.0021	<.0071	.0072	<.0177	
1-Sep-02		202	<.60	<.24	<.50	<.001	<.0139	<.0015	<.0018	.0024	<.0071	<.0013	<.0177	
1-Oct-02		202	<.80	<.34	<.50	<.001	<.0139	<.0015	<.0018	.1552	<.0071	<.013	<.0177	
1-Nov-02	not submitted													
1-Dec-02	not submitted													
1-Jan-03		202	<.2	<.1	<.5	<.001	<.0139	<.0015	<.0018	<.0021	<.0071	<.0013	<.0177	
1-Feb-03		202	11.2	12.6	<.50	<.001	<.0139	<.0015	<.0018	.5413	<.0071	.0070	<.0177	
1-Mar-03		202	<.5	<.22	<.5	<.001	<.0139	<.0015	<.0018	<.0021	<.0071	.0079	.0258	
1-Apr-03		201	<.5	<.19	<1.0	<.001	<.0139	<.0015	<.0018	.2767	<.0071	<.0013	<.0177	
05/03 thru 12/03	not submitted													
1-Jan-04		202	<.8	<.33	<1.0	<.0010	<.0065	<.0018	<.0023	<.0056	.0090	.0140	.0325	
1-Feb-04		202	<.9	<.35	<1.0	<.0010	<.0065	<.0018	<.0023	<.0056	<.0012	.0229	.0404	
1-Mar-04		202	<.5	<.20	<.60	<.0010	<.0065	<.0018	<.0023	<.0056	<.0012	.0248	.1298	
01-Apr-04		202	<.34	<.14	<.50	<.0010	<.0065	<.0018	<.0023	.0186	<.0012	.0172	<.0022	

Appendix 11- WVDEP-UIC Panther UIC permit data

10/17/00 TUE 15:39 FAX 304 255 2595 REI CONSULTING 004

SHEET ADDED
PAGE # 20
CORRECTION # 1
CORRECTION DATE 11/29/00
NEW RIVER ENGINEERING, INC
BY P.A.M.

REI Consultants Inc. Date: 17-Oct-00

CLIENT:	CLINE RESOURCE AND DEVELOPME	**Client Sample ID:**	THICKNER U-FLOW
Lab Order:	0009953	**Site ID:**	CABIN CREEK
Project:	UNDERGROUND INJECTION PERMIT	**Collection Date:**	9/27/00
Lab ID:	0009953-01A	**Matrix:**	SLUDGE

Analyses	Result	Units	MDL	PQL	Qual	Date Analyzed	Analyst
pH		E150.1					
pH	7.96	SU	NA	NA		9/28/00	JC
CHLORIDE		E300					
Chloride	310	mg/L	NA	1.0		10/2/00	LK
CHLORIDE (DISSOLVED)		E300					
Chloride, Dissolved	310	mg/L	NA	1.0		10/2/00	LK
FLUORIDE, DISSOLVED		E300					
Fluoride, Dissolved	3.54	mg/L	NA	0.10		10/2/00	LK
FLUORIDE		E300					
Fluoride	3.54	mg/L	NA	0.10		10/2/00	LK
NITRATE and NITRITE		E300					
Nitrogen, Nitrate-Nitrite	0.57	mg/L	NA	0.10		10/2/00	LK
NITRATE and NITRITE, DISSOLVED		E300					
Nitrogen, Nitrate-Nitrite, Dissolved	0.57	mg/L	NA	0.10		10/2/00	LK
SULFATE		E300					
Sulfate	220	mg/L	NA	5.0		10/2/00	LK
SULFATE, DISSOLVED		E300					
Sulfate, Dissolved	220	mg/L	NA	5.0		10/2/00	LK
CHEMICAL OXYGEN DEMAND		E410.4					
Chemical Oxygen Demand	6,800	mg/L	NA	10		10/2/00	KM
PHENOLS		E604					
2,4,6-Trichlorophenol	ND	mg/L	NA	0.001		10/6/00	GM
2,4-Dichlorophenol	ND	mg/L	NA	0.001		10/6/00	GM
2,4-Dimethylphenol	ND	mg/L	NA	0.001		10/6/00	GM
2,4-Dinitrophenol	ND	mg/L	NA	0.006		10/6/00	GM
2-Chlorophenol	ND	mg/L	NA	0.001		10/6/00	GM
2-Nitrophenol	ND	mg/L	NA	0.001		10/6/00	GM
4,6-Dinitro-2-methyphenol	ND	mg/L	NA	0.001		10/6/00	GM
4-Chloro-3-methylphenol	ND	mg/L	NA	0.001		10/6/00	GM
4-Nitrophenol	ND	mg/L	NA	0.001		10/6/00	GM
Pentachlorophenol	ND	mg/L	NA	0.001		10/6/00	GM
Phenol	ND	mg/L	NA	0.001		10/6/00	GM
Surr: o-Terphenyl	125	%REC	NA	30-130		10/6/00	GM

Abbreviations: ND - Not Detected at the PQL or MDL; PQL - Practical Quantitation Limit; MDL - Minimum Detection Limit; NA - Not Applicable

Qualifiers: J - Analyte detected below PQL; S - Spike Recovery outside accepted recovery limits; E - Value above quantitation range; * - Value exceeds Maximum Contaminant Level

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Appendix 11- WVDEP-UIC Panther UIC permit data

10/17/00 TUE 15:40 FAX 304 255 2595 REI CONSULTING 005

SHEET ADDED
PAGE # 21
CORRECTION # 1
CORRECTION DATE 11/29/00
NEW RIVER ENGINEERING, INC
BY P.A.M.

REI Consultants Inc.

Date: 17-Oct-00

CLIENT:	CLINE RESOURCE AND DEVELOPME	Client Sample ID:	THICKNER U-FLOW
Lab Order:	0009953	Site ID:	CABIN CREEK
Project:	UNDERGROUND INJECTION PERMIT	Collection Date:	9/27/00
Lab ID:	0009953-01A	Matrix:	SLUDGE

Analyses	Result	Units	MDL	PQL	Qual	Date Analyzed	Analyst
GLYCOLS, Total		GC-FID					
Diethylene Glycol	ND	mg/L	NA	100		10/9/00	GM
Monoethylene Glycol	ND	mg/L	NA	100		10/9/00	GM
Triethylene Glycol	ND	mg/L	NA	100		10/9/00	GM
ACIDITY		SM2310 B					
Acidity, Total	ND	mg/L	NA	1.0		9/28/00	JC
ALKALINITY		SM2320 B					
Alkalinity, Total (As CaCO3)	993	mg/L	NA	1.0		9/28/00	JC
BICARBONATE (DISSOLVED)		SM2320 B					
Alkalinity, Dissolved Bicarbonate (As CaCO3)	246	mg/L	NA	1.0		9/28/00	JC
BICARBONATE		SM2320 B					
Alkalinity, Bicarbonate (As CaCO3)	912	mg/L	NA	1.0		9/28/00	JC
CONDUCTIVITY		SM2510 B					
Specific Conductivity	1,560	µmhos/cm	NA	1.0		9/28/00	JC
TOTAL DISSOLVED SOLIDS		SM2540 C					
Total Dissolved Solids	1,290	mg/L	1	10		9/28/00	JC
TOTAL SUSPENDED SOLIDS		SM2540 D					
Total Suspended Solids	311,000	mg/L	1	10		9/28/00	JC
CYANIDE		SM4500-CN CE					
Cyanide, Total	ND	mg/L	0.004	0.020		10/11/00	TS
CYANIDE (DISSOLVED)		SM4500-CN CE					
Cyanide, Dissolved	ND	mg/L	0.004	0.020		10/11/00	TS
ORGANIC NITROGEN		SM4500-NH3 BE/351.3					
Nitrogen, Organic	282	mg/L	NA	1.00		10/10/00	CH
BOD, 5 Day, 20°C		SM5210 B					
Biochemical Oxygen Demand	190	mg/L	NA	2		10/4/00	KM

Abbreviations: ND - Not Detected at the PQL or MDL
PQL - Practical Quantitation Limit
MDL - Minimum Detection Limit
NA - Not Applicable

Qualifiers: J - Analyte detected below PQL
S - Spike Recovery outside accepted recovery limits
E - Value above quantitation range
* - Value exceeds Maximum Contaminant Level

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Appendix 11- WVDEP-UIC Panther UIC permit data

SHEET ADDED
PAGE # 22
CORRECTION #
CORRECTION DATE 11/25/06
NEW RIVER ENGINEERING, INC
BY P.A.M.

REI Consultants Inc. Date: 17-Oct-00

CLIENT:	CLINE RESOURCE AND DEVELOPME	**Client Sample ID:**	THICKNER U-FLOW
Lab Order:	0009953	**Site ID:**	CABIN CREEK
Project:	UNDERGROUND INJECTION PERMIT	**Collection Date:**	9/27/00
Lab ID:	0009953-01A	**Matrix:**	SLUDGE

Analyses	Result	Units	MDL	PQL	Qual	Date Analyzed	Analyst
TOTAL METALS by ICP		SW6010B					
Aluminum	3,740	mg/L	NA	100		10/2/00	LC
Barium	37.1	mg/L	NA	1.00		10/2/00	LC
Beryllium	0.656	mg/L	NA	0.040		10/2/00	LC
Boron	10.7	mg/L	NA	1.00		10/7/00	LC
Calcium	1,180	mg/L	NA	5.00		10/2/00	LC
Chromium	4.69	mg/L	NA	1.00		10/2/00	LC
Copper	13.7	mg/L	NA	1.00		10/2/00	LC
Iron	10,900	mg/L	NA	1,000		10/7/00	LC
Lead	5.43	mg/L	NA	5.00		10/2/00	LC
Magnesium	1,860	mg/L	NA	1.00		10/2/00	LC
Manganese	77.2	mg/L	NA	0.500		10/2/00	LC
Nickel	8.37	mg/L	NA	1.00		10/2/00	LC
Potassium	489	mg/L	NA	5.00		10/2/00	LC
Sodium	394	mg/L	NA	5.00		10/2/00	LC
Zinc	20.6	mg/L	NA	0.500		10/2/00	LC
DISSOLVED METALS by ICP		SW6010B					
Aluminum	0.060	mg/L	0.030	0.100	J	10/2/00	LC
Barium	0.113	mg/L	0.002	0.100		10/2/00	LC
Beryllium	ND	mg/L	0.001	0.004		10/2/00	LC
Boron	0.088	mg/L	0.020	0.100	J	10/7/00	LC
Calcium	10.1	mg/L	0.020	0.500		10/2/00	LC
Chromium	ND	mg/L	0.010	0.100		10/2/00	LC
Copper	0.009	mg/L	0.005	0.100	J	10/2/00	LC
Iron	0.029	mg/L	0.020	0.100	J	10/7/00	LC
Lead	ND	mg/L	0.060	0.500		10/2/00	LC
Magnesium	2.04	mg/L	0.001	0.100		10/2/00	LC
Manganese	0.001	mg/L	0.001	0.050	J	10/2/00	LC
Nickel	ND	mg/L	0.030	0.100		10/2/00	LC
Potassium	22.9	mg/L	0.040	0.500		10/2/00	LC
Sodium	389	mg/L	0.600	5.00		10/2/00	LC
Zinc	0.007	mg/L	0.002	0.050	J	10/2/00	LC
ANTIMONY, Dissolved		SW7041					
Antimony	ND	mg/L	NA	0.010		10/12/00	LC
ANTIMONY, Total		SW7041					
Antimony	ND	mg/L	NA	0.100		10/12/00	LC
ARSENIC, Dissolved		SW7060A					
Arsenic	ND	mg/L	NA	0.500		10/6/00	FP

Abbreviations:
ND - Not Detected at the PQL or MDL
PQL - Practical Quantitation Limit
MDL - Minimum Detection Limit
NA - Not Applicable

Qualifiers:
J - Analyte detected below PQL
S - Spike Recovery outside accepted recovery limits
E - Value above quantitation range
* - Value exceeds Maximum Contaminant Level

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Appendix 11- WVDEP-UIC Panther UIC permit data

REI CONSULTING 007

SHEET ADDED
PAGE # 23
CORRECTION # 1
CORRECTION DATE 11/29/0?
NEW RIVER ENGINEERING, INC
BY P.A.M.

REI Consultants Inc. Date: 17-Oct-00

CLIENT: CLINE RESOURCE AND DEVELOPME
Lab Order: 0009953
Project: UNDERGROUND INJECTION PERMIT
Lab ID: 0009953-01A

Client Sample ID: THICKNER U-FLOW
Site ID: CABIN CREEK
Collection Date: 9/27/00
Matrix: SLUDGE

Analyses	Result	Units	MDL	PQL	Qual	Date Analyzed	Analyst
ARSENIC, Total		SW7060A					
Arsenic	ND	mg/L	NA	5.00		10/6/00	FP
CADMIUM, Dissolved		SW7131					
Cadmium	ND	mg/L	NA	0.0010		10/12/00	BJ
CADMIUM, Total		SW7131					
Cadmium	0.0360	mg/L	NA	0.0100		10/12/00	BJ
MERCURY, Dissolved		SW7470					
Mercury	ND	mg/L	NA	0.0010		10/3/00	GD
MERCURY, Total		SW7470					
Mercury	ND	mg/L	NA	0.0200		10/3/00	GD
SELENIUM, Dissolved		SW7740					
Selenium	ND	mg/L	NA	1.00		10/2/00	FP
SELENIUM, Total		SW7740					
Selenium	ND	mg/L	NA	5.00		10/2/00	FP
THALLIUM, Dissolved		SW7841					
Thallium	ND	mg/L	NA	0.005		10/12/00	LC
THALLIUM, Total		SW7841					
Thallium	ND	mg/L	NA	5.00		10/12/00	LC
DIESEL RANGE ORGANICS		SW8015B					
TPH (Diesel)	ND	mg/L	NA	0.32		10/5/00	GM
Surr: o-Terphenyl	97	%REC	NA	30-150		10/5/00	GM
KEROSENE RANGE ORGANICS		SW8015B					
TPH (Kerosene)	ND	mg/L	NA	0.316		10/4/00	GM
Surr: o-Terphenyl	97	%REC	NA	30-150		10/4/00	GM
GASOLINE RANGE ORGANICS		SW8015B					
TPH (Gasoline)	ND	mg/kg	NA	25		10/3/00	AB
Surr: 2,5-D bromotoluene	57	%REC	NA	61-135	S	10/4/00	AB
VOLATILE ORGANIC COMPOUNDS		SW8021B					
Benzene	21	µg/kg	NA	5		9/29/00	TC
Toluene	59	µg/kg	NA	5		9/29/00	TC
Ethylbenzene	ND	µg/kg	NA	5		9/29/00	TC
m,p-Xylene	14	µg/kg	NA	10		9/29/00	TC
o-Xylene	9	µg/kg	NA	5		9/29/00	TC
Methyl tert-butyl ether	ND	µg/kg	NA	50		9/29/00	TC
Surr: 1,1,1-Trifluorotoluene	46	%REC	NA	61-135	S	9/29/00	TC

Abbreviations: ND - Not Detected at the PQL or MDL
PQL - Practical Quantitation Limit
MDL - Minimum Detection Limit
NA - Not Applicable

Qualifiers: J - Analyte detected below PQL
S - Spike Recovery outside accepted recovery limits
E - Value above quantitation range
* - Value exceeds Maximum Contaminant Level

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Appendix 11- WVDEP-UIC Panther UIC permit data

10/17/00 TUE 15:41 FAX 304 255 2595 REI CONSULTING 008

SHEET ADDED
PAGE # 24
CORRECTION # 1
CORRECTION DATE 11/29/00
NEW RIVER ENGINEERING, INC.
BY P.A. M.

REI Consultants Inc. Date: 17-Oct-00

CLIENT:	CLINE RESOURCE AND DEVELOPME	**Client Sample ID:**	THICKNER U-FLOW
Lab Order:	0009953	**Site ID:**	CABIN CREEK
Project:	UNDERGROUND INJECTION PERMIT	**Collection Date:**	9/27/00
Lab ID:	0009953-01A	**Matrix:**	SLUDGE

Analyses	Result	Units	MDL	PQL	Qual	Date Analyzed	Analyst
VOLATILE ORGANIC COMPOUNDS		SW8021B					
Vinyl chloride	ND	µg/kg	NA	1		9/29/00	TC
Surr: 1,4-Dichlorobutane	10	%REC	NA	70-130	S	9/29/00	TC
SEMIVOLATILE ORGANIC COMPOUNDS		SW8032A					
Acrylamide	ND	mg/L	NA	0.010		9/28/00	TKC
SEMIVOLATILE ORGANIC COMPOUNDS		SW8270C					
Acenaphthene	ND	mg/L	NA	0.020		10/3/00	WP
Acenaphthylene	ND	mg/L	NA	0.029		10/3/00	WP
Anthracene	ND	mg/L	NA	0.029		10/3/00	WP
Benzo(a)anthracene	ND	mg/L	NA	0.029		10/3/00	WP
Benzo(a)pyrene	ND	mg/L	NA	0.029		10/3/00	WP
Benzo(b)fluoranthene	ND	mg/L	NA	0.029		10/3/00	WP
Benzo(g,h,i)perylene	ND	mg/L	NA	0.029		10/3/00	WP
Benzo(k)fluoranthene	ND	mg/L	NA	0.029		10/3/00	WP
Chrysene	ND	mg/L	NA	0.029		10/3/00	WP
Dibenzo(a,h)anthracene	ND	mg/L	NA	0.029		10/3/00	WP
Fluoranthene	ND	mg/L	NA	0.029		10/3/00	WP
Fluorene	ND	mg/L	NA	0.029		10/3/00	WP
Indeno(1,2,3-cd)pyrene	ND	mg/L	NA	0.029		10/3/00	WP
Naphthalene	0.067	mg/L	NA	0.029		10/3/00	WP
Phenanthrene	0.034	mg/L	NA	0.029		10/3/00	WP
Pyrene	ND	mg/L	NA	0.029		10/3/00	WP
Surr: 2-Fluorobiphenyl	72	%REC	NA	43-116		10/3/00	WP
Surr: 4-Terphenyl-d14	59	%REC	NA	33-141		10/3/00	WP
Surr: Nitrobenzene-d5	35	%REC	NA	35-114	S	10/3/00	WP
ORGANIC CARBON, Total		SW9060					
Total Organic Carbon	22.0	mg/L	NA	1.0		10/5/00	MS

Abbreviations:		Qualifiers:	
	ND - Not Detected at the PQL or MDL		J - Analyte detected below PQL
	PQL - Practical Quantitation Limit		S - Spike Recovery outside accepted recovery limits
	MDL - Minimum Detection Limit		E - Value above quantitation range
	NA - Not Applicable		* - Value exceeds Maximum Contaminant Level

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Appendix 12- Coal Slurry- Solid Phase, VOCs (Volatile Organic Compounds)

Volatile Organic Compounds - Solid Phase		
Parameters		**Slurry Solid**
	Unit	**Dissolved**
1,1,1,2-Tetrachloroethane	ug/kg	ND
1,1,1-Trichloroethane	ug/kg	ND
1,1,2,2-Tetrachloroethane	ug/kg	ND
1,1,2-Trichloroethane	ug/kg	ND
1,1-Dichloroethane	ug/kg	ND
1,1-Dichloroethene	ug/kg	ND
1,1-Dichloropropene	ug/kg	ND
1,2,3-Trichlorobenzene	ug/kg	ND
1,2,3-Trichloropropane	ug/kg	ND
1,2,4-Trichlorobenzene	ug/kg	ND
1,2,4-Trimethylbenzene	ug/kg	**216**
1,2-Dibromo-3-chloropropane	ug/kg	ND
1,2-Dibromoethane	ug/kg	ND
1,2-Dichlorobenzene	ug/kg	ND
1,2-Dichloroethane	ug/kg	ND
1,2-Dichloropropane	ug/kg	ND
1,3,5-Trimethylbenzene	ug/kg	**76.8**
1,3-Dichlorobenzene	ug/kg	ND
1,3-Dichloropropane	ug/kg	ND
1,4-Dichlorobenzene	ug/kg	ND
2,2-Dichloropropane	ug/kg	ND
2-Butanone	ug/kg	ND
2-Chlorotoluene	ug/kg	ND
2-Hexanone	ug/kg	ND
4-Chlorotoluene	ug/kg	ND
4-Isopropyltoluene	ug/kg	ND
4-Methyl-2-pentanone	ug/kg	ND
Acetone	ug/kg	ND
Acrolein	ug/kg	ND
Acrylonitrile	ug/kg	ND
Benzene	ug/kg	**166**
Bromobenzene	ug/kg	ND
Bromochloromethane	ug/kg	ND
Bromodichloromethane	ug/kg	ND
Bromoform	ug/kg	ND
Bromomethane	ug/kg	ND
Carbon disulfide	ug/kg	ND
Carbon tetrachloride	ug/kg	ND
Chlorobenzene	ug/kg	ND
Chloroethane	ug/kg	ND
Chloroform	ug/kg	ND
Chloromethane	ug/kg	ND
cis-1,2-Dichloroethene	ug/kg	ND
cis-1,3-Dichloropropene	ug/kg	ND
Dibromochloromethane	ug/kg	ND
Dibromomethane	ug/kg	ND

Dichlorodifluoromethane	ug/kg	ND
Ethylbenzene	ug/kg	**122**
Hexachlorobutadiene	ug/kg	ND
Iodomethane	ug/kg	ND
Isopropylbenzene	ug/kg	**30.2**
m,p-Xylene	ug/kg	**585**
Methyl tert-butyl ether	ug/kg	ND
Methylene chloride	ug/kg	ND
Naphthalene	ug/kg	**259**
n-Butylbenzene	ug/kg	ND
n-Propylbenzene	ug/kg	**45.5**
o-Xylene	ug/kg	**284**
sec-Butylbenzene	ug/kg	**8.5**
Styrene	µg/L	ND
tert-Butylbenzene	ug/kg	ND
Tetrachloroethene	ug/kg	ND
Toluene	ug/kg	**1,040**
trans-1,2-Dichloroethene	ug/kg	ND
trans-1,3-Dichloropropene	ug/kg	ND
Trichloroethene	ug/kg	ND
Trichlorofluoromethane	ug/kg	ND
Vinyl acetate	ug/kg	ND
Vinyl chloride	ug/kg	ND

Appendix 13-Coal Slurry, Solid Phase, SVOCs (Semi-Volatile Organic Compounds)

Semi-Volatile Organic Compounds - Solid Phase		
Parameters		**Slurry Solid**
	Unit	**Dissolved**
1,2,4-Trichlorobenzene	mg/kg	ND
1,2-Dichlorobenzene	mg/kg	ND
1,2-Diphenylhydrazine	mg/kg	ND
1,3-Dichlorobenzene	mg/kg	ND
1,4-Dichlorobenzene	mg/kg	ND
2,4,5-Trichlorophenol	mg/kg	ND
2,4,6-Trichlorophenol	mg/kg	ND
2,4-Dichlorophenol	mg/kg	ND
2,4-Dimethylphenol	mg/kg	**0.167**
2,4-Dinitrophenol	mg/kg	ND
2,4-Dinitrotoluene	mg/kg	ND
2,6-Dinitrotoluene	mg/kg	ND
2-Chloronaphthalene	mg/kg	ND
2-Chlorophenol	mg/kg	ND
2-Nitrophenol	mg/kg	ND
3,3´-Dichlorobenzidine	mg/kg	ND
4,6-Dinitro-2-methylphenol	mg/kg	ND
4-Bromophenyl phenyl ether	mg/kg	ND
4-Chloro-3-methylphenol	mg/kg	ND
4-Chlorophenyl phenyl ether	mg/kg	ND
4-Nitrophenol	mg/kg	ND
Acenaphthene	mg/kg	ND
Acenaphthylene	mg/kg	ND
Anthracene	mg/kg	ND
Benzidine	mg/kg	ND
Benzo(a)anthracene	mg/kg	**0.036**
Benzo(a)pyrene	mg/kg	**0.07**
Benzo(b)fluoranthene	mg/kg	**0.082**
Benzo(g,h,i)perylene	mg/kg	**0.155**
Benzo(k)fluoranthene	mg/kg	ND
Bis(2-chloroethoxy)methane	mg/kg	ND
Bis(2-chloroethyl)ether	mg/kg	ND
Bis(2-chloroisopropyl)ether	mg/kg	ND
Bis(2-ethylhexyl)phthalate	mg/kg	ND
Butyl benzyl phthalate	mg/kg	ND
Chrysene	mg/kg	**0.206**
Dibenzo(a,h)anthracene	mg/kg	**0.032**
Diethyl phthalate	mg/kg	ND
Dimethyl phthalate	mg/kg	ND
Di-n-butyl phthalate	mg/kg	ND
Di-n-octyl phthalate	mg/kg	ND
Fluoranthene	mg/kg	**0.07**
Fluorene	mg/kg	**0.202**
Hexachlorobenzene	mg/kg	ND
Hexachlorobutadiene	mg/kg	ND

Hexachlorocyclopentadiene	mg/kg	ND
Hexachloroethane	mg/kg	ND
Indeno(1,2,3-cd)pyrene	mg/kg	ND
Isophorone	mg/kg	ND
m,p-Cresol	mg/kg	**0.089**
Naphthalene	mg/kg	**1.5**
Nitrobenzene	mg/kg	ND
N-Nitrosodimethylamine	mg/kg	ND
N-Nitrosodi-n-propylamine	mg/kg	ND
N-Nitrosodiphenylamine	mg/kg	ND
o-Cresol	mg/kg	ND
Pentachlorophenol	mg/kg	ND
Phenanthrene	mg/kg	**0.903**
Phenol	mg/kg	**0.045**
Pyrene	mg/kg	**0.095**

Appendix 14- Volatile Organic Compounds (VOCs) Detected from the Coal Slurry-Liquid Phase

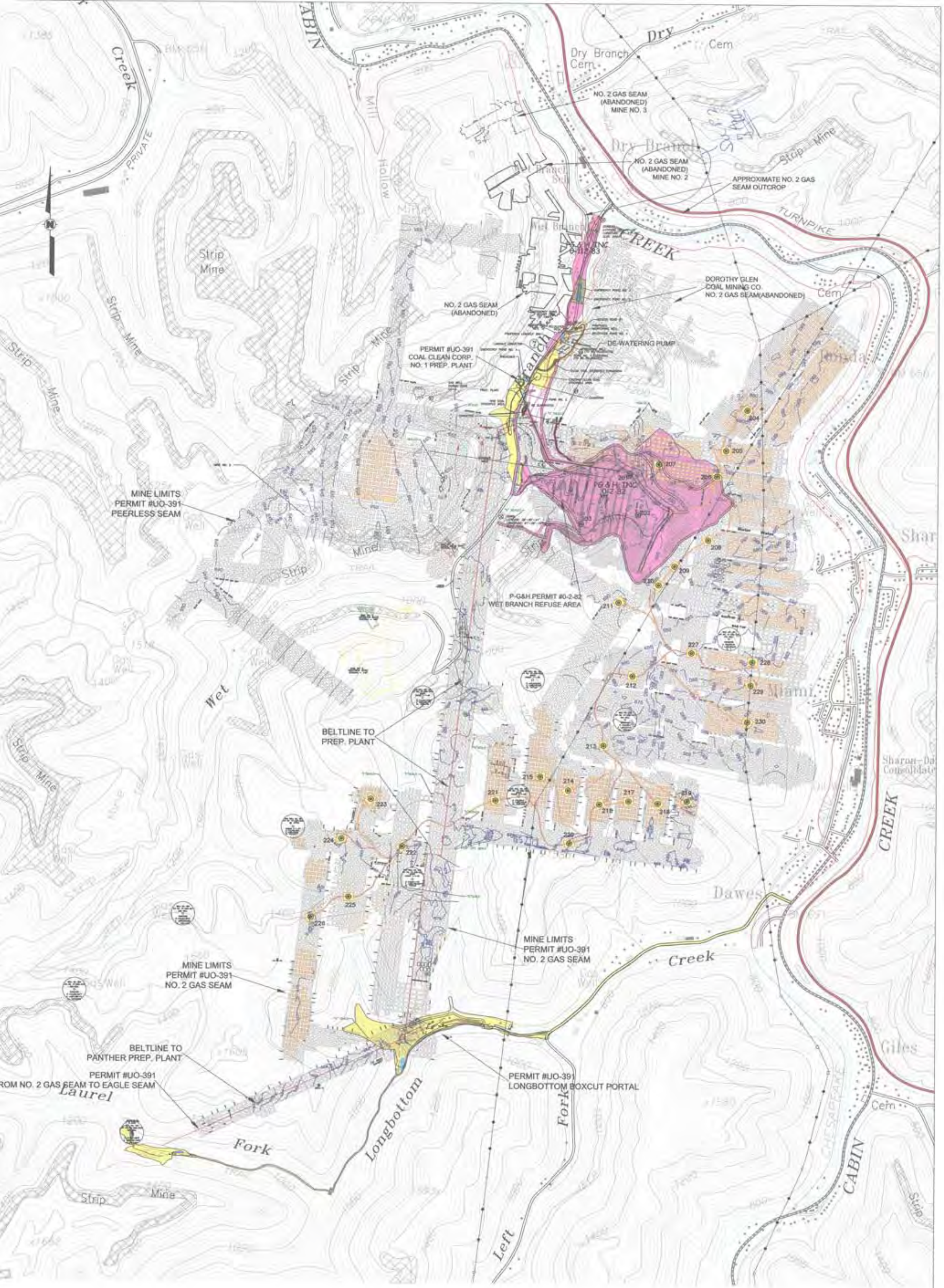
Volatile Organic Compounds Analyses Results		**PL-Slurry (Liquid)**	**PL-Raw Coal Leachate**
Parameters	**Unit**		
1,1,1,2-Tetrachloroethane	µg/L	ND	ND
1,1,1-Trichloroethane	µg/L	ND	ND
1,1,2,2-Tetrachloroethane	µg/L	ND	ND
1,1,2-Trichloroethane	µg/L	ND	ND
1,1-Dichloroethane	µg/L	ND	ND
1,1-Dichloroethene	µg/L	ND	ND
1,1-Dichloropropene	µg/L	ND	ND
1,2,3-Trichlorobenzene	µg/L	ND	ND
1,2,3-Trichloropropane	µg/L	ND	ND
1,2,4-Trichlorobenzene	µg/L	ND	ND
1,2,4-Trimethylbenzene	µg/L	ND	ND
1,2-Dibromo-3-chloropropane	µg/L	ND	ND
1,2-Dibromoethane	µg/L	ND	ND
1,2-Dichlorobenzene	µg/L	ND	ND
1,2-Dichloroethane	µg/L	ND	ND
1,2-Dichloropropane	µg/L	ND	ND
1,3,5-Trimethylbenzene	µg/L	ND	ND
1,3-Dichlorobenzene	µg/L	ND	ND
1,3-Dichloropropane	µg/L	ND	ND
1,4-Dichlorobenzene	µg/L	ND	ND
2,2-Dichloropropane	µg/L	ND	ND
2-Butanone	µg/L	**68.4**	ND
2-Chlorotoluene	µg/L	ND	ND
2-Hexanone	µg/L	ND	ND
4-Chlorotoluene	µg/L	ND	ND
4-Isopropyltoluene	µg/L	ND	ND
4-Methyl-2-pentanone	µg/L	ND	ND
Acetone	µg/L	**16.7**	**9.9**
Acrolein	µg/L	ND	ND
Acrylonitrile	µg/L	ND	ND
Benzene	µg/L	**1.8**	**1.6**
Bromobenzene	µg/L	ND	ND
Bromochloromethane	µg/L	ND	ND
Bromodichloromethane	µg/L	ND	ND
Bromoform	µg/L	ND	ND
Bromomethane	µg/L	ND	ND
Carbon disulfide	µg/L	ND	ND
Carbon tetrachloride	µg/L	ND	ND
Chlorobenzene	µg/L	ND	ND
Chloroethane	µg/L	ND	ND
Chloroform	µg/L	ND	ND
Chloromethane	µg/L	ND	ND
cis-1,2-Dichloroethene	µg/L	ND	ND
cis-1,3-Dichloropropene	µg/L	ND	ND

Dibromochloromethane	µg/L	ND	ND
Dibromomethane	µg/L	ND	ND
Dichlorodifluoromethane	µg/L	ND	ND
Ethylbenzene	µg/L	ND	ND
Hexachlorobutadiene	µg/L	ND	ND
Iodomethane	µg/L	ND	ND
Isopropylbenzene	µg/L	ND	ND
m,p-Xylene	µg/L	**0.8**	**0.4**
Methyl tert-butyl ether	µg/L	ND	ND
Methylene chloride	µg/L	ND	ND
Naphthalene	µg/L	ND	ND
n-Butylbenzene	µg/L	ND	ND
n-Propylbenzene	µg/L	ND	ND
o-Xylene	µg/L	**0.6**	**0.3**
sec-Butylbenzene	µg/L	ND	ND
Styrene	µg/L	ND	ND
tert-Butylbenzene	µg/L	ND	ND
Tetrachloroethene	µg/L	ND	ND
Toluene	µg/L	**2.8**	**2.1**
trans-1,2-Dichloroethene	µg/L	ND	ND
trans-1,3-Dichloropropene	µg/L	ND	ND
Trichloroethene	µg/L	ND	ND
Trichlorofluoromethane	µg/L	ND	ND
Vinyl acetate	µg/L	ND	ND
Vinyl chloride	µg/L	ND	ND

Appendix 15- Semi-volatile Organic Compounds Chemistry, Slurry Liquid and Coal Leachate

Semi-volatile organic Compounds Analyses		**PL-Slurry (Liquid)**	**PL-Raw Coal Leachate**
Parameters	**Unit**		
1,2,4-Trichlorobenzene	mg/L	ND	ND
1,2-Dichlorobenzene	mg/L	ND	ND
1,2-Diphenylhydrazine	mg/L	ND	ND
1,3-Dichlorobenzene	mg/L	ND	ND
1,4-Dichlorobenzene	mg/L	ND	ND
2,4,5-Trichlorophenol	mg/L	ND	ND
2,4,6-Trichlorophenol	mg/L	ND	ND
2,4-Dichlorophenol	mg/L	ND	ND
2,4-Dimethylphenol	mg/L	ND	ND
2,4-Dinitrophenol	mg/L	ND	ND
2,4-Dinitrotoluene	mg/L	ND	ND
2,6-Dinitrotoluene	mg/L	ND	ND
2-Chloronaphthalene	mg/L	ND	ND
2-Chlorophenol	mg/L	ND	ND
2-Nitrophenol	mg/L	ND	ND
3,3´-Dichlorobenzidine	mg/L	ND	ND
4,6-Dinitro-2-methylphenol	mg/L	ND	ND
4-Bromophenyl phenyl ether	mg/L	ND	ND
4-Chloro-3-methylphenol	mg/L	ND	ND
4-Chlorophenyl phenyl ether	mg/L	ND	ND
4-Nitrophenol	mg/L	ND	ND
Acenaphthene	mg/L	ND	ND
Acenaphthylene	mg/L	ND	ND
Anthracene	mg/L	ND	ND
Benzidine	mg/L	ND	ND
Benzo(a)anthracene	mg/L	ND	ND
Benzo(a)pyrene	mg/L	ND	ND
Benzo(b)fluoranthene	mg/L	ND	ND
Benzo(g,h,i)perylene	mg/L	ND	ND
Benzo(k)fluoranthene	mg/L	ND	ND
Bis(2-chloroethoxy)methane	mg/L	ND	ND
Bis(2-chloroethyl)ether	mg/L	ND	ND
Bis(2-chloroisopropyl)ether	mg/L	ND	ND
Bis(2-ethylhexyl)phthalate	mg/L	ND	ND
Butyl benzyl phthalate	mg/L	ND	ND
Chrysene	mg/L	ND	ND
Dibenzo(a,h)anthracene	mg/L	ND	ND
Diethyl phthalate	mg/L	ND	ND
Dimethyl phthalate	mg/L	ND	ND
Di-n-butyl phthalate	mg/L	ND	ND
Di-n-octyl phthalate	mg/L	ND	ND
Fluoranthene	mg/L	ND	ND
Fluorene	mg/L	ND	ND
Hexachlorobenzene	mg/L	ND	ND
Hexachlorobutadiene	mg/L	ND	ND

Hexachlorocyclopentadiene	mg/L	ND	ND
Hexachloroethane	mg/L	ND	ND
Indeno(1,2,3-cd)pyrene	mg/L	ND	ND
Isophorone	mg/L	ND	ND
m,p-Cresol	mg/L	ND	ND
Naphthalene	mg/L	ND	ND
Nitrobenzene	mg/L	ND	ND
N-Nitrosodimethylamine	mg/L	ND	ND
N-Nitrosodi-n-propylamine	mg/L	ND	ND
N-Nitrosodiphenylamine	mg/L	ND	ND
o-Cresol	mg/L	ND	ND
Pentachlorophenol	mg/L	ND	ND
Phenanthrene	mg/L	ND	ND
Phenol	mg/L	ND	ND
Pyrene	mg/L	ND	ND



LEGEND:

◉ INJECTION HOLE

SCALE 500 0 500 1000 FEET

"I, THE UNDERSIGNED, HEREBY CERTIFY" THAT THIS MAP IS CORRECT AND SHOWS TO THE BEST OF MY KNOWLEDGE AND BELIEF ALL THE INFORMATION REQUIRED BY THE SURFACE-MINING LAWS OF THIS STATE."

P.E. NO.

ACKNOWLEDGED BEFORE ME A NOTARY PUBLIC

THIS ___ DAY OF ___ MY COMMISSION EXPIRES ___

REV.	DATE	DESCRIPTION	P.M.

Alliance Consulting, Inc.
Engineers • Constructors • Scientists

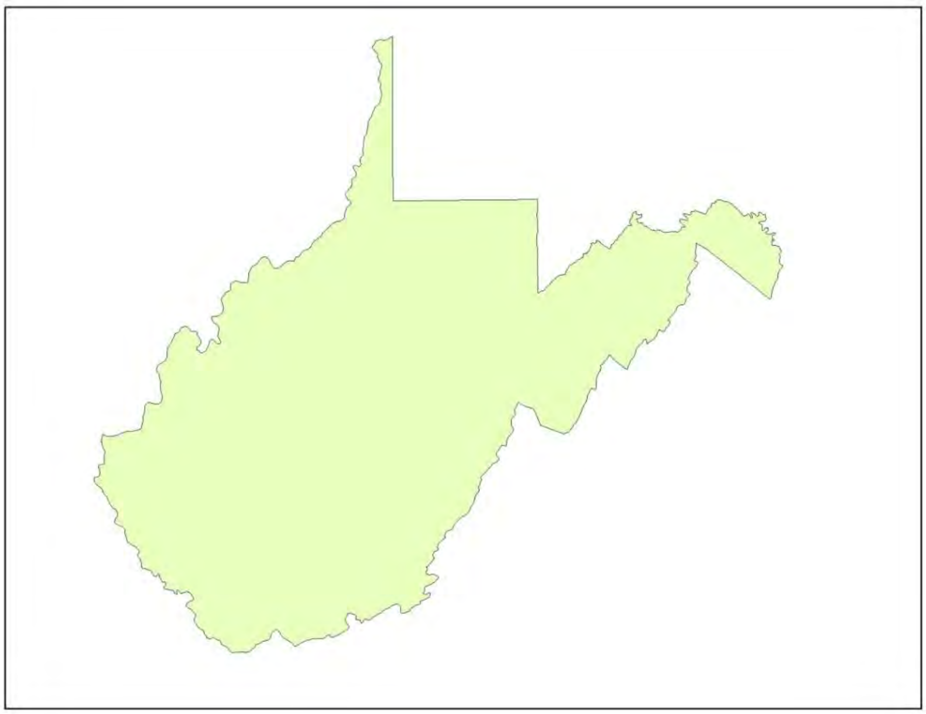
REISSUANCE APPLICATION
PERMIT NO. 0308-00-039

Prepared For

PANTHER LLC
106 LOCKHEED DRIVE, BEAVER, WEST VIRGINIA 25813

CAD BY	CHD 05/04/08	PROJECT NO. B06-152-388	
CHECKED BY		DRAWING NO. B06-152-M1	
APPROVED BY			

POWER MOUNTAIN HYDROLOGIC ASSESSMENT



Nancy Pointon, Office of Surface Mining

April 27. 2009

This study, named the Power Mountain Hydrologic Site Assessment, includes a detailed hydrogeologic evaluation of the migration of coal slurry and its constituents from injection wells into the ground and surface waters. The Power Mountain Site Assessment is part of a larger comprehensive study on the potential effects of underground injection of coal slurry on the environment and human health authorized by Senate Concurrent Resolution No. 15 (SCR-15).

Site Location and General Setting

The Power Mountain hydrologic assessment site is located in central West Virginia, saddled between Jefferson and Grant Districts in Nicholas County. The study site includes deep mine complexes on the Eagle coal seam where coal slurry is currently and previously been injected in abandoned mine workings. It also includes the surrounding surface and groundwater resources that could be impacted by the slurry injection activities. Figures 1, 2 3 and 4 delineate the boundaries of the study site. The figures and tables referenced in this report are located in separate sections in the back of this report.

Topographically, the site lies between two drainage features; to the north is the Twentymile Creek Watershed and to the south is the Peters Creek watershed. Both watersheds drain into the Gauley River which combines with the New River to form the Kanawha River.

Geomorphologically, Nicholas County lies within the Appalachian Plateau Physiographic Province. The area is characterized by steeply incised valleys and adjacent ridges. Generally, the strata consist of sandstones, siltstones, shales, coals and coal underclays.

Structurally, the study area lies between two sets of large geologic features. To the west is the Lockwood Syncline paired with the Mann Mount Anticline and to the East is the Enon Anticline and Clifftop Syncline. Structure contours on the Eagle Coal are depicted on Figure 1 in addition to the geologic structural features noted above. Dip of the coal and the overlying strata within the study area is to the Northwest at three percent (1.7 degree) with local variations.

The deep mine complexes within the study site are located south of the "hinge line" which is a term that represents the boundary between the northern and southern coal fields of West Virginia. The southern coal field is generally of higher overall quality; higher rank and heating value and lower sulfur and ash contents than the younger coals of the northern field. (Coal & Coal Mining in West Virginia, 1974, Coal-Geology Bulletin No.2, by James A. Barlow). All of the five deep mine complexes receiving coal slurry are located on the Eagle Coal Seam. The Eagle Coal is of Pennsylvanian age and from the Kanawha Group of the Pottsville Series. It is an exceedingly pure coal, being high in volatile matter and very low in sulphur, ash, and phosphorus. (West Virginia Geological Survey, Nicholas County Reports, 1921).

The overlying Sugar Camp/ Winifred Mine complex, which is discussed in this report, is located within the Winifred Coal. It too is from the Kanawha Group of the Pottsville Series. In this locality, the Winifred is approximately 550 feet stratigraphically above the Eagle Coal. Its quality is similar to the Eagle Coal, high in volatile matter and low in sulphur, phosphorus and ash. (Nicholas County Report). Table 1 depicts the coal stratigraphy of the Study Area.

Mining and associated coal slurry disposal

Power Mountain Coal Company (company) operates the coal preparation plant, known as the High Power Mountain Preparation Plant. As part of the operations at the plant, the company has been approved to inject coal slurry into five separate abandoned deep mines. The plant was initially permitted to Bethlehem Mines Corporation on January 7, 1985, then transferred to Power Mountain Coal Company on February 19, 1998. Currently, the plant processes the Five Block, Coalburg, Winifrede and Stockton coal seams. Coarse coal refuse from the preparation plan is disposed of at a coal refuse disposal area located in the Sugarcamp Branch watershed, part of the Twentymile Creek watershed. A recently permitted coal slurry impoundment at Sugarcamp Branch was activated in the summer of 2008.

Authorization from the West Virginia Department of Environmental Resources (WVDEP) to inject coal slurry into abandoned mine sites is provided through several regulatory programs and permits. Underground Injection Control (UIC) Permit Number 0199-99-067 authorizes the injection of slurry into 5 separate Eagle seam mine complexes and was originally issued in July of 2000. The UIC permit was recently renewed in September of 2007. UIC permit 0597-03-067 was processed in 2007 but never issued to allow for the injection of coal slurry into the Sugarcamp Winifred Mine. That mine is located on the Winifred coal seam and there is no documentation that injection has ever occurred. Since injection has never been initiated, no further analysis of the mine is necessary for this report.

The West Virginia Coal Mining and Reclamation Act (WVCMRA) permit O-2-85 and U007085 as well as NPDES WV0090603 provides authorization from WVDEP to inject slurry into the deep mines. These permits cover the activities related to the preparation plant and injection into the deep mines. Permit Number O-2-85 authorized the activities associated with the preparation plant and the support facilities such as roads, ponds, and coal stockpiles. This permit also covers the approvals for fine coal slurry injection in abandoned deep mines. Access roads, injection boreholes, and monitoring wells are all covered under Permit O-2-85. The outline of the permit area for O-2-85 is shown on Figure 3.

This area of Nicholas County has been heavily coal mined by both the surface and deep mine methods. The study site includes numerous deep mine complexes on the Eagle Coal and a couple on the Winifred Coal. Large surface mines are located within the site including mountain- top removal operations and valley fills. Numerous mineable coal seams exist in this area. The coal seams that have been mountain top mined are the Coalburg seam up through the Five Block. Table 1, found in the section labeled Tables, shows the generalized stratigraphic section with the relative location of the coal seams and their regional intervals.

Of primary importance to this study are the five deep mine complexes where injected coal slurry from the preparation plant occurred intermittently from 1993 to 2007. WVDEP, UIC Permits provide documentation for injection activities occurring from July 2000 to November 2007. The deep mines where injection occurred are South Fork Energy No 2/ Flying Eagle, Beth Energy Mine 81, Hutchinson/ Terry Eagle, Rhonda Eagle and William Eagle which are all located within the Eagle coal seam as the name suggests. Figure 2, outlines numerous deep mine complexes superimposed on an aerial photograph of the study area. The figure clearly shows the extensive concentration of mining activities in the area.

INDIVIDUAL HYDROGEOLOGIC EVALUATIONS:

In order to attain the objectives set forth in the study, two essential evaluations must be performed.

(1) Evaluate the potential for a surface discharge from each underground mine which received slurry through injection and determine the impacts the discharge will have on the receiving stream.

(2) Evaluate the potential for mine pool water migration into the surrounding groundwater and determine the impacts from the migration.

Using background data, post-mining pool elevations, the surface topography and the mine/ slurry injection plans, areas have been identified which have the potential to develop surface discharges. Assessing the potential for mine pool migration from the mine to the groundwater is a more difficult task, which requires a considerable amount of site specific information much of which is not available.

Below is a summary of each individual deep mine describing the mining and slurry injection activities and site specific hydrologic information regarding the mine pools. Figure 4 shows the areal extent of the deep mines that received slurry and their mine pool extent based on the maximum mine pool level authorized in the underground injection permits. These levels may not reflect current pool conditions.

South Fork Energy/ Flying Eagle Deep Mine

The South Fork Energy No 2/ Flying Eagle Deep Mine is a room and pillar deep mine located on the Eagle Coal Seam which was deep mined between June of 1996 and October of 1999. The areal extent of the deep mine workings is approximately 300 acres. Alex Energy, a subsidiary of Massey Coal is currently the permittee. An Incidental Boundary Revision to the permit, IBR No. 12, was approved January of 2005 which authorized the fine coal refuse disposal through four (4) injection holes FE-A, FE-B, FE-C and FE-D. Additionally, four monitoring wells FE-MW-1 through FE-MW-4 and one dewatering hole FE-DH-1 were approved. The monitoring wells are drilled and installed in the mine to monitor the mine pool level and the migration of the fine coal slurry during the injection process. Based on monitoring reports submitted by the company under the UIC permit, injection occurred during the years 2005, 2006 and 2007.

This mine is a "mostly below drainage mine" where the majority of the coal seam is at an elevation lower than the topographic drainage features with the exception of a drift entry or entries located at or near the outcrop. The UIC permit designates a maximum mine pool elevation. The purpose in setting the maximum mine pool elevation is to prevent leakage from the mine pool and or the fine slurry to the surface. An elevation of 1350' above mean sea level (a.m.s.l.) was designated for this mine.

Details on the Mine Pool Hydrology are as follows:

Mine Floor elevations - 1180' - 1405' [elevations are based on mine maps rather than the generalized regional contours]

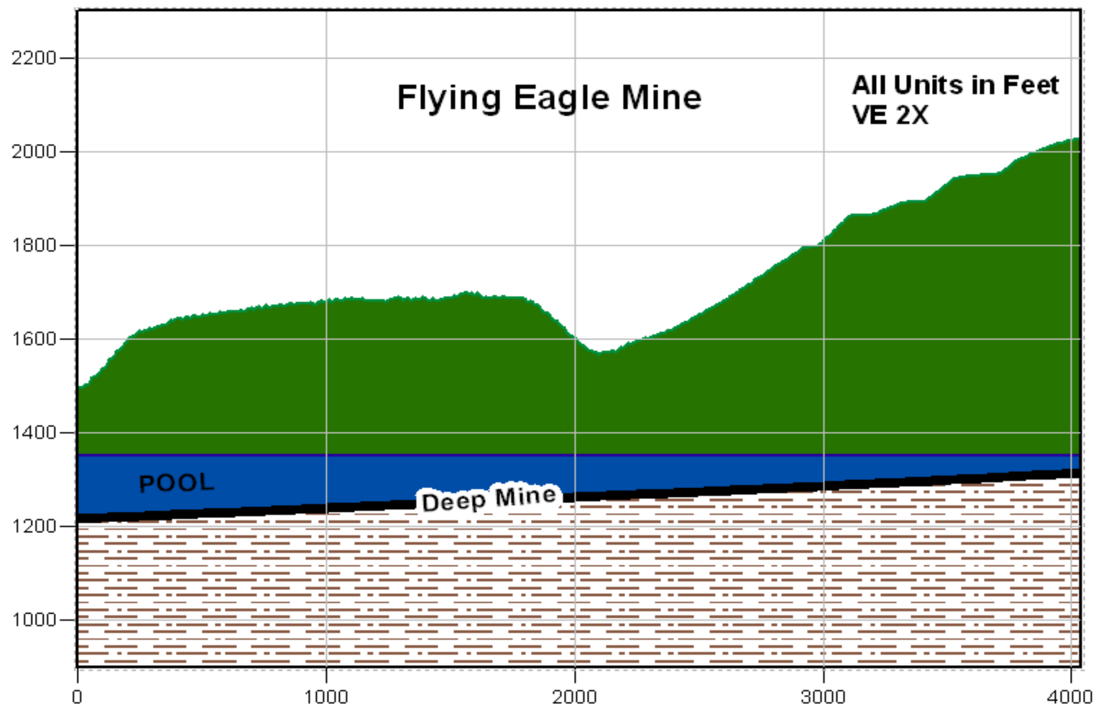
Depth to Mine Floor from surface – 0 - 690'

Maximum pool elevation – 1350' (based on UIC permit)

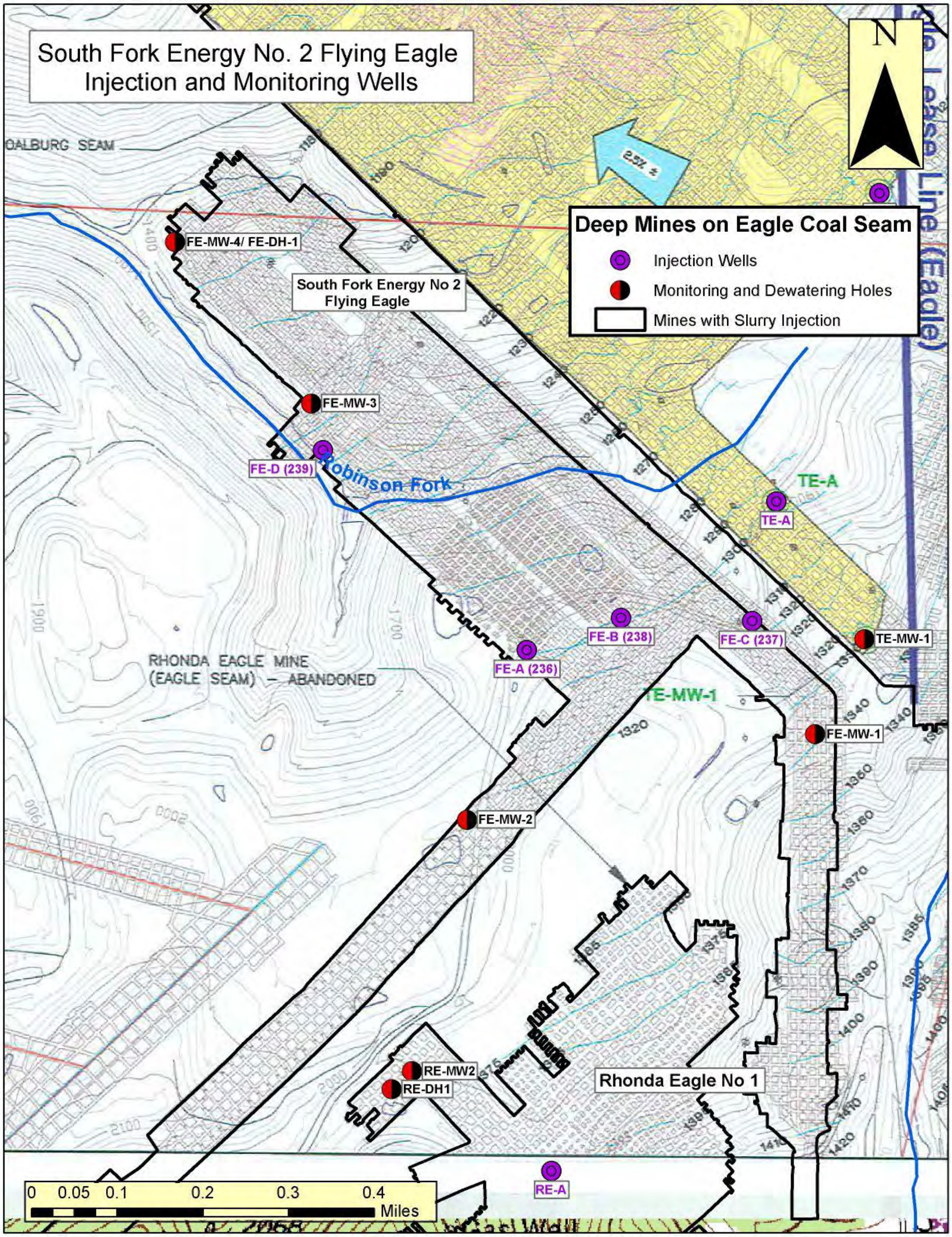
Injection Wells – 4 wells - FE-A (236), FE-B (238), FE-C (237), FE-D (239)

Monitoring Wells and Dewatering Wells – FE-MW-1, FE-MW-2, FE-MW-3, FE-MW-4, FE-DH-1

Water and slurry flow within the mine is inferred to move in a downdip direction, based on the local geologic structure. The downdip direction is generally to the northwest. The area for potential mine pool leakage to the surface is near the upper reaches of Robinson Fork. This location has the shallowest cover, and the greatest potential head within the mine. The cover is approximately 220' near the stream, which is at an elevation of 1400'. If the mine pool is maintained at an elevation of 1350' through pumping, there is no potential for seepage from the pool to the surface. If, however, the pool is not maintained at 1350', the mine could potentially fill to a maximum elevation of 1405'. If that would occur, there would be a significant potential for seepage near the upper reaches of Robinson Run. Additionally, once the mine becomes flooded, overflowing of mine water may occur at the drift opening (if not properly sealed). The opening is located within the upper valley of Jones Branch at an elevation of 1405'. Water quality impacts to Jones Branch would then become a concern. Based on the mine pool level measurement taken at FE-MW 2 in July of 2008, the mine pool was at 1345', below the 1350' target level. At this elevation there is little to no potential for seepage to the surface drainages (Robinson Fork).



Above is a schematic of a NW to SE oriented cross section of the Flying Eagle Deep Mine. The relative elevations of the coal mine, mine pool (based on level required by UIC permit) and the topography are shown.



South Fork Energy No. 2 Flying Eagle
Injection and Monitoring Wells
N
Deep Mines on Eagle Coal Seam
Injection Wells
Monitoring and Dewatering Holes
Mines with Slurry Injection
FE-MW-4/ FE-DH-1
South Fork Energy No 2
Flying Eagle
FE-MW-3
FE-D (239)
Robinson Fork
TE-A
FE-B (238)
FE-C (237)
TE-MW-1
FE-A (236)
RHONDA EAGLE MINE
(EAGLE SEAM) - ABANDONED
FE-MW-1
FE-MW-2
RE-MW2
RE-DH1
Rhonda Eagle No 1
RE-A
0 0.05 0.1 0.2 0.3 0.4
Miles

Hutchinson Branch No 1 Deep Mine / Terry Eagle Deep Mine

The Hutchinson Branch No 1/ Terry Eagle Deep Mine is a completed room and pillar deep mine located on the Eagle Coal Seam. The areal extent of the deep mine workings is approximately 1800 acres. Alex Energy, a sister company to Power Mountain Coal is currently the responsible party of the mine complex. Based on a review of the permitting records, the mine was permitted in 1990 with deep mining activities completed prior to 2001. Slurry injection began late in 1993, which was then permitted and operated by Terry Eagle Coal Company under Permit No. U-3002-90. There is little documentation on the injection activities under Terry Eagle Coal Company.

In October of 2002, Power Mountain Coal Company, submitted an Incidental Boundary Revision (IBR 10) to the existing permit. The company proposed to add four slurry injection holes and two monitoring holes under IBR No. 10, which was approved December 2003. There was also a West Virginia Surface Mine Board decision dated March 2005 regarding this IBR. The Board's decision and the permit document placed specific conditions on the slurry injection operation.

Permit conditions required alkaline amendments to the coal slurry to ensure that the water in the mine would meet all applicable water quality standards. Other conditions included; the installation of a dewatering borehole to be used to maintain the mine pool elevation at 1140', the installation of a monitoring well placed between 1000 and 2000 feet updip from the dewatering hole, and the dismantling and grouting of the previous injection system of holes. The locations of the Dewatering hole TE-DH-1 and monitoring well TE-MW-3 are shown on the mine map following this narrative. One of the purposes for the conditions was to eliminate the possibility of artesian flow from the mine to the surface waters if sufficient head was allowed to occur.

Due to leasing arrangements between Alex Energy and Terry Eagle Coal Company (Fola), coal slurry injection was to be confined to the western portion of the mine which is operated by Alex Energy (Power Mountain). The company proposed to maintain the mine pool elevation at 1140', thereby confining the slurry to the area prescribed by the arrangement.

IBR No 14 approved the injection of coal slurry into three (3) additional holes. Based on the UIC monitoring data, Power Mountain injection activities began in 2005 and continued throughout 2006 and 2007. Injection of slurry in this mine is currently occurring sporadically and it is the only mine where injection is occurring within this site. Most of the slurry if not all of the slurry produced at the preparation plant is being placed in the coal slurry impoundment at Sugarcamp Branch.

Hutchinson/Terry Eagle Mine Pool Hydrology

Mine Floor elevations – 990' – 1465' [elevations are based on mine maps rather than the generalized regional contours]

Depth to Mine Floor from surface – 0 – 800'

Maximum Pool Elevation – 1140'

Injection Wells – TE-A (240), TE-B (241), TE-C (242), TE-D (243), TE-E (247), TE-F (248), TE-G (249)

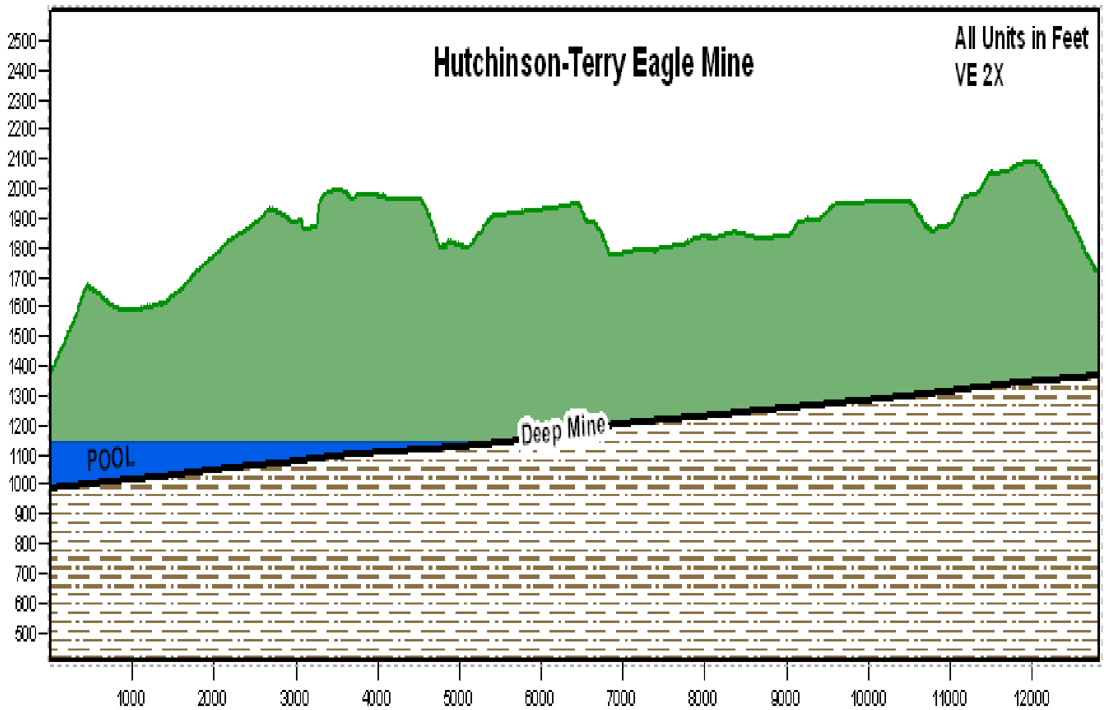
Monitoring Wells and Dewatering Wells – TE-MW-1, TE-MW-2, TE-MW-3, TE-DH-1

This mine is considered a "mostly below drainage mine" with two entries located at the surface within the upper valley of Jones Branch at elevations of 1460' and 1465'

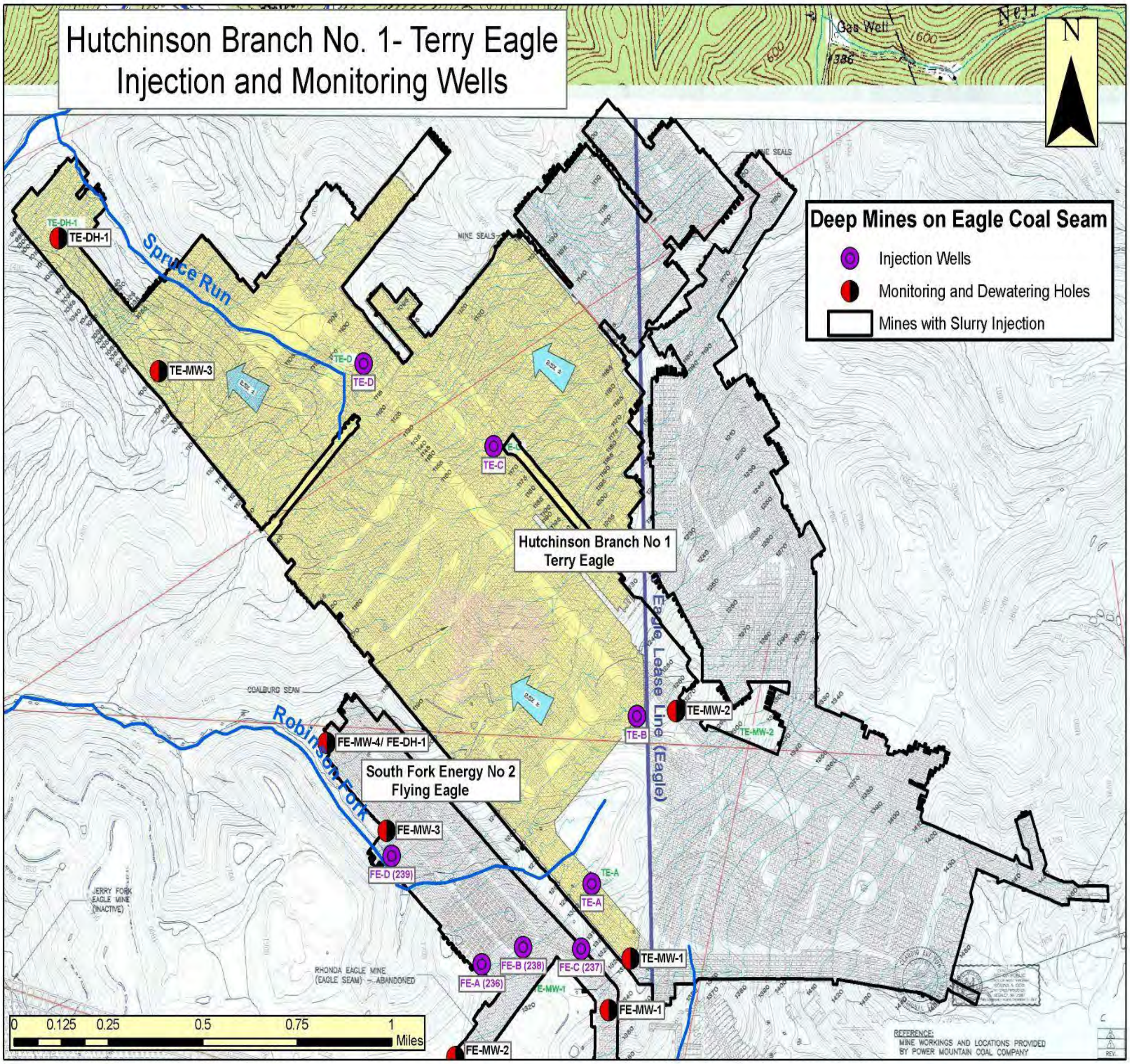
It is inferred, based on the coal structure, that infiltrating water which reaches the mine, flows generally in a northwest direction. During the July 2008 field investigation, pumping from the dewatering hole (DH-1) located in the most downgradient portion of the mine was actively occurring. During that same investigation, a measurement of the mine pool elevation was attempted at TE-MW1 (1390' - mine floor elevation) and found to be dry. The dry well was expected as the mine pool elevation is to be maintained below 1140'. Monitoring of the mine pool is required under the UIC permit. A review of the UIC annual report reveals that the pool had exceeded the maximum level by eight to nine feet during the winter season of 2007. According to the report injection activities were not occurring during those times.

The greatest potential for leakage from the mine pool is in an area near the confluence of Spruce Run and Twentymile Creek at a surface elevation of 1140'. This is where the edge of the mine workings is approximately 200 feet below and 400 feet horizontally from the stream. The potential mine pool head in that location is 150' if the pool is being maintained at the 1140' however, the head has the potential to be substantially greater if the pumping ceased and the mine were to naturally fill. Additionally, there is a potential for water to overflow from the pool to the surface via the surface entries. Such overflowing would result in discharges from the updip portion of the mine into Jones Branch.

Below is a NW to SE oriented cross section of the Terry Eagle Deep Mine. The relative elevations of the coal mine, mine pool (based on level required by UIC permit) and the topography are shown.



The Coalburg coal seam, which is located approximately 590 feet stratigraphically above the Eagle coal, was deep mined above portions of the Terry Eagle Mine. Given the amount of interburden between the two mines, it is expected that the overlying mine has very little influence on the amount of water infiltrating to the underlying Terry Eagle Mine.



Hutchinson Branch No. 1- Terry Eagle
Injection and Monitoring Wells
Deep Mines on Eagle Coal Seam
Injection Wells
Monitoring and Dewatering Holes
Mines with Slurry Injection
TE-DH-1
TE-MW-3
TE-D
TE-C
TE-B
TE-A
TE-MW-1
TE-MW-2
Spruce Run
Robinson Fork
Hutchinson Branch No 1
Terry Eagle
South Fork Energy No 2
Flying Eagle
Eagle Lease Line (Eagle)
FE-MW-4/ FE-DH-1
FE-MW-3
FE-D (239)
FE-A (236)
FE-B (238)
FE-C (237)
FE-MW-1
FE-MW-2
0
0.125
0.25
0.5
0.75
1
Miles
N

William Eagle Deep Mine

Deep mining activities in the Eagle coal seam occurred from 1974 through 1983. The mine is a room and pillar mine where second mining occurred throughout the central portion of the mine. The areal extent of the mine is approximately 290 acres. Currently the deep mine is not covered under a WVSCMRA permit, as it is closed. However, a discharge from the mine's wet seal is covered under NPDES Permit No. WV0091. A wet seal is a sealed mine opening with a pipe through the seal to allow the discharge of mine water while preventing the inflow of air.

In November of 2001 with the approval of IBR No. 6, Power Mountain received authorization to inject fine coal slurry into the mine.

On July 7, 2003 a surface water discharge exceeding allowable limits; specifically total suspended solids, occurred from the wet seal into Jones Branch. A violation was issued by the WVDEP. Shortly following that event, slurry injection into the mine ceased. Based on the UIC monitoring reports, injection activities only occurred in the year 2003.

William Eagle Mine Hydrology

Mine Floor elevations – 1365' – 1525' [elevations are based on mine maps rather than the generalized regional contours]

Depth to Mine Floor from surface – 0-625'

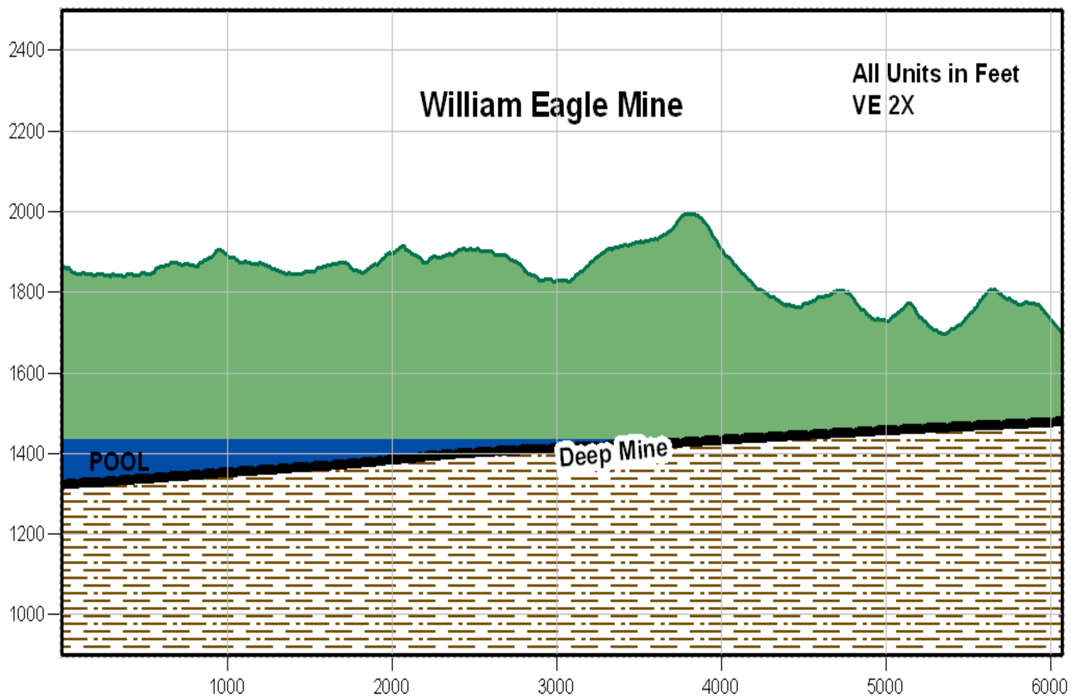
Maximum Mine Pool Elevation - 1435'

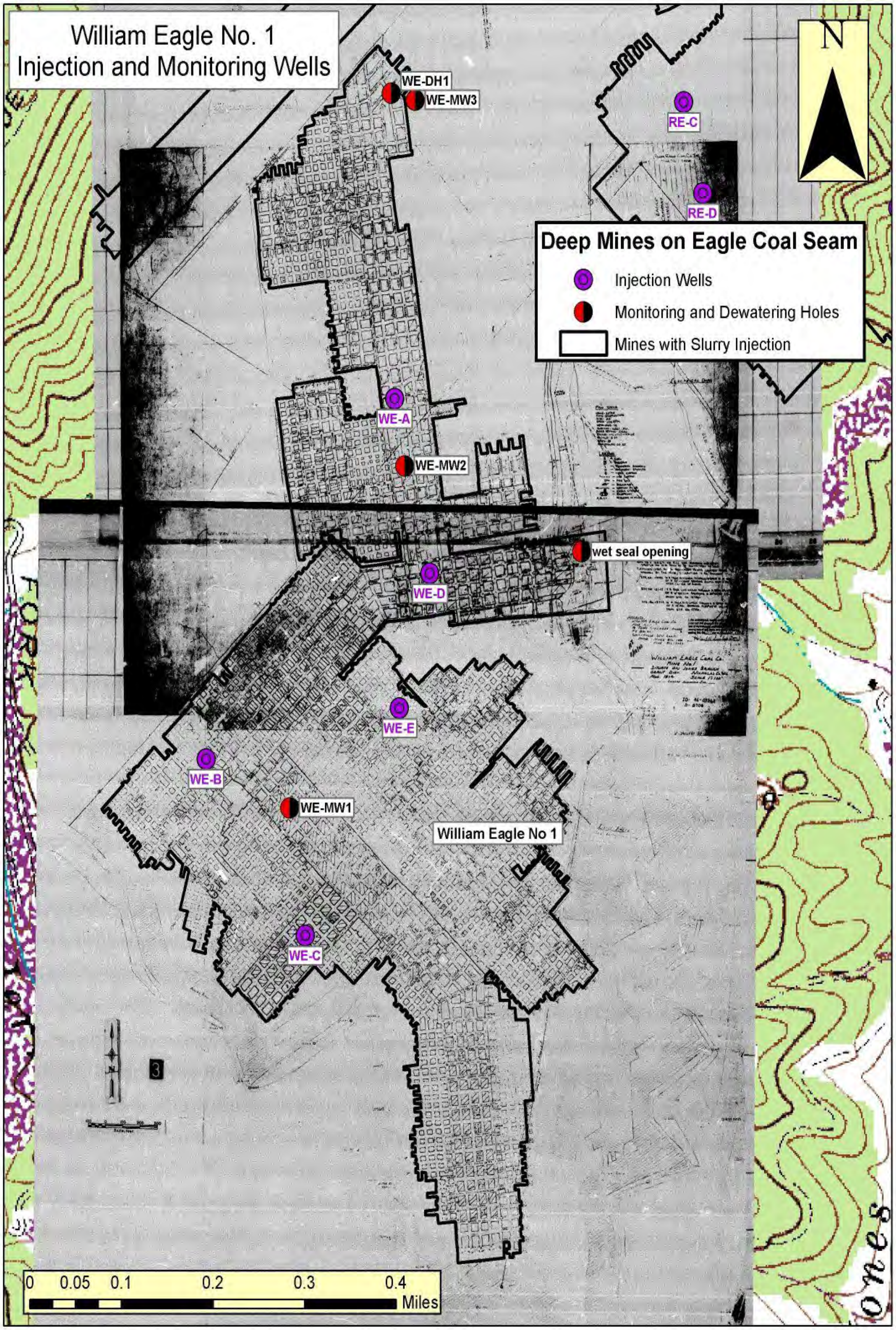
Injection Wells – WE-A, WE-B, WE-C, WE-D, WE-E.

Monitoring Wells and Dewatering Wells – WE- MW1, WE-MW2, WE-MW3, WE-DH1

The mine is a mostly below drainage mine with a wet seal opening located at the coal outcrop at an elevation of 1420'. The area of potential leakage from the mine pool to the surface water is the area of the wet seal which would discharge toward Jones Branch. The mine pool head in this location, if the pool is maintained at 1435', would be 30'and since the wet seal is at 1420', the pipe would be discharging toward Jones Branch. The pool is not being maintained by pumping. There is a discharge from the wet seal, which is being monitored in compliance with a NPDES permit which appears to be controlling the pool elevation. A review of the discharge reports shows a highly variable flow influenced by seasonality. The pH of the discharge is consistently alkaline (>7.0 Standard Units (SU)). This area was not investigated during the July field trip.

Below is an N to S oriented cross section of the William Eagle Deep Mine. The relative elevations of the coal mine, mine pool (based on level required by UIC permit) and topography are shown.





William Eagle No. 1
Injection and Monitoring Wells
N
WE-DH1
WE-MW3
RE-C
RE-D
Deep Mines on Eagle Coal Seam
Injection Wells
Monitoring and Dewatering Holes
Mines with Slurry Injection
WE-A
WE-MW2
wet seal opening
WE-D
WE-E
WE-B
WE-MW1
William Eagle No 1
WE-C
0 0.05 0.1 0.2 0.3 0.4
Miles

a

Rhonda Eagle Deep Mine

Deep mining of the Eagle coal seam within the Rhonda Eagle Mine began sometime after 1975. The mine, which is approximately 225 acres, is currently closed. During 2001, WVDEP issued a revision for Permit 0-2-85 which authorized the injection of slurry into the deep mine. According to the UIC discharge reports and annual report, injection occurred during 2003.

Details regarding the Rhonda Eagle Mine Hydrology are as follows:

Mine Floor Elevation – 1365' – 1435' [elevations are based on mine maps rather than the generalized regional contours]

Depth to Mine Floor – 0 – 660'

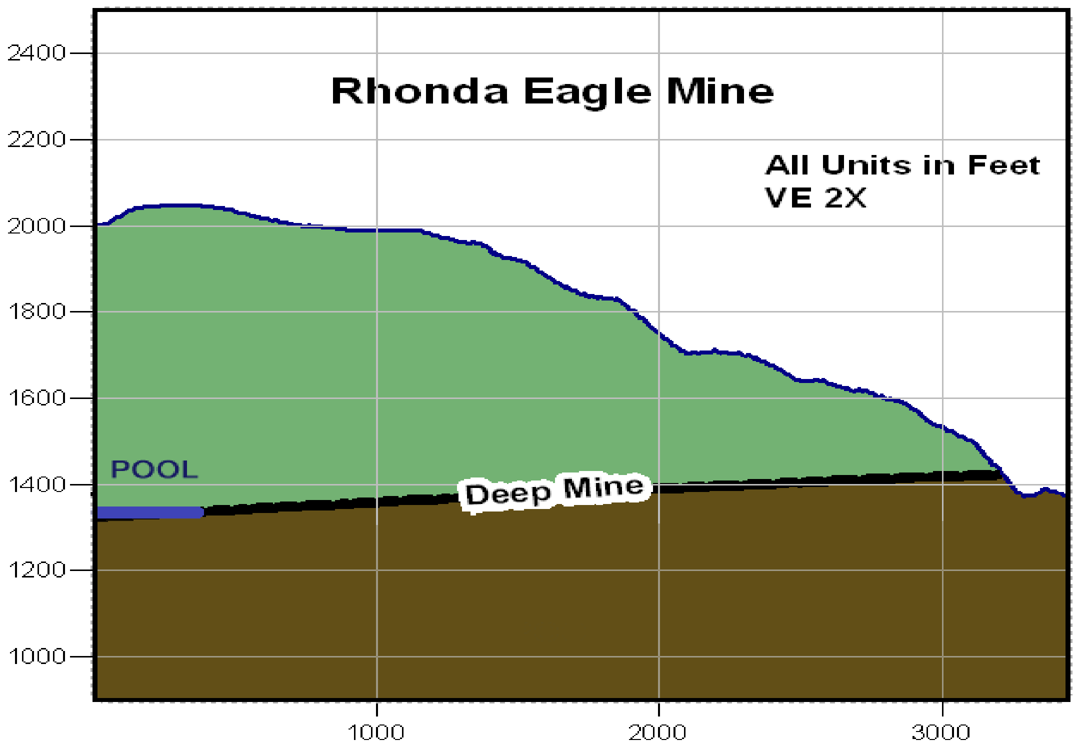
Maximum Pool Elevation – 1425'

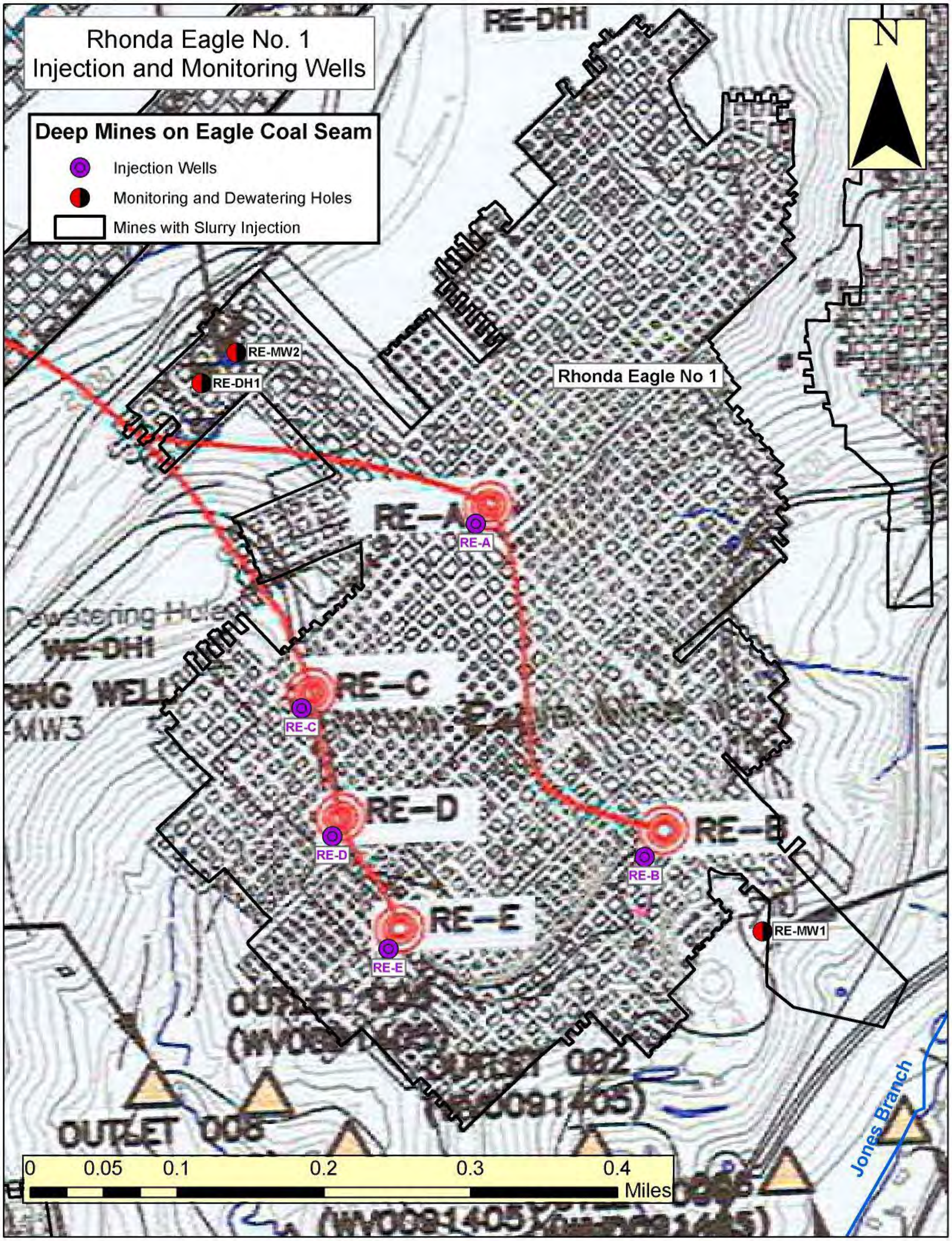
The injection holes were RE-A, RE-B, RE-C, RE-D, and RE-E

Dewatering hole and monitoring well – RE-MW1, RE-MW2, RE-DH1

Two portals to the mine are located along Jones Branch at an elevation of 1425' at the southern edge of the mine. This is the updip portion of the mine and is the location of the shallowest cover. Depending on the mine pool elevation, discharges could occur within the Jones Branch watershed. During the July field investigation and sampling event, a seep was collected in the vicinity of the entry prior to flowing into a treatment pond equipped with a lime dispensing wheel. The treatment pond also receives discharges from surface flow from the upslope coal transfer station. The pond discharge is monitored and regulated under a NPDES permit. Seepage near the mine entry indicates that the mine pool or portions of it is at or near the elevation of the entry. Because the injection activities are completed, the mine pool is not maintained at the elevation prescribed in the UIC permit, discharges to the surface can and do occur. Given the areal extent of the mine and a generally accepted recharge rate of 0.5 gpm, flow from the mine should be approximately 100 gpm on the average. There may be other discharge points unaccounted for.

Below is a NW to SE oriented cross section of the Rhonda Eagle Deep Mine. The relative elevations of the coal mine, mine pool (based on level required by UIC permit) and the topography are shown.





Rhonda Eagle No. 1
Injection and Monitoring Wells
Deep Mines on Eagle Coal Seam
Injection Wells
Monitoring and Dewatering Holes
Mines with Slurry Injection
N
RE-DH1
RE-MW2
RE-DH1
Rhonda Eagle No 1
RE-A
RE-A
Dewatering Holes
WE-DH1
RE-C
RE-C
MW3
RE-D
RE-D
RE-B
RE-B
RE-E
RE-E
RE-MW1
OUTLET 005
OUTLET 002
OUTLET 006
Jones Branch
0 0.05 0.1 0.2 0.3 0.4
Miles

Beth Energy Mine #81 Deep Mine

Bethlehem Energy mined the Eagle Coal seam at Mine #81 using the room and pillar method from 1985 until December 1991. The areal extent of the mine is approximately 1800 acres.

In February of 1994, WVDEP approved the application authorizing underground slurry injection activities into Mine No. 81. The activities were to be conducted in connection with the coal preparation plant permit. The permits were then subsequently transferred to Power Mountain Coal Company in February of 1998. IBR #4, #5, #11 and #13, issued between 1999 and 2003 approved additional injection boreholes and the relocation of boreholes.

Based on a review of the WVDEP documents and interviews with DEP personnel, the southernmost portion of Bethlehem #81 mine including the entry at Right Fork, tributary to Line Creek, was at times referred to as Mine No.131.

Of the five mines within the study area, this mine was the first to receive injected slurry and probably received more slurry than any other mine. Based on a review of the UIC annual reports, injection occurred from 2000 until 2004.

Details on the mine pool hydrology are as follows:

Mine Floor elevations – 1000' – 1400'

Depth to Mine Floor from surface – 950' – 0

Maximum Mine Pool Elevation – 1200'

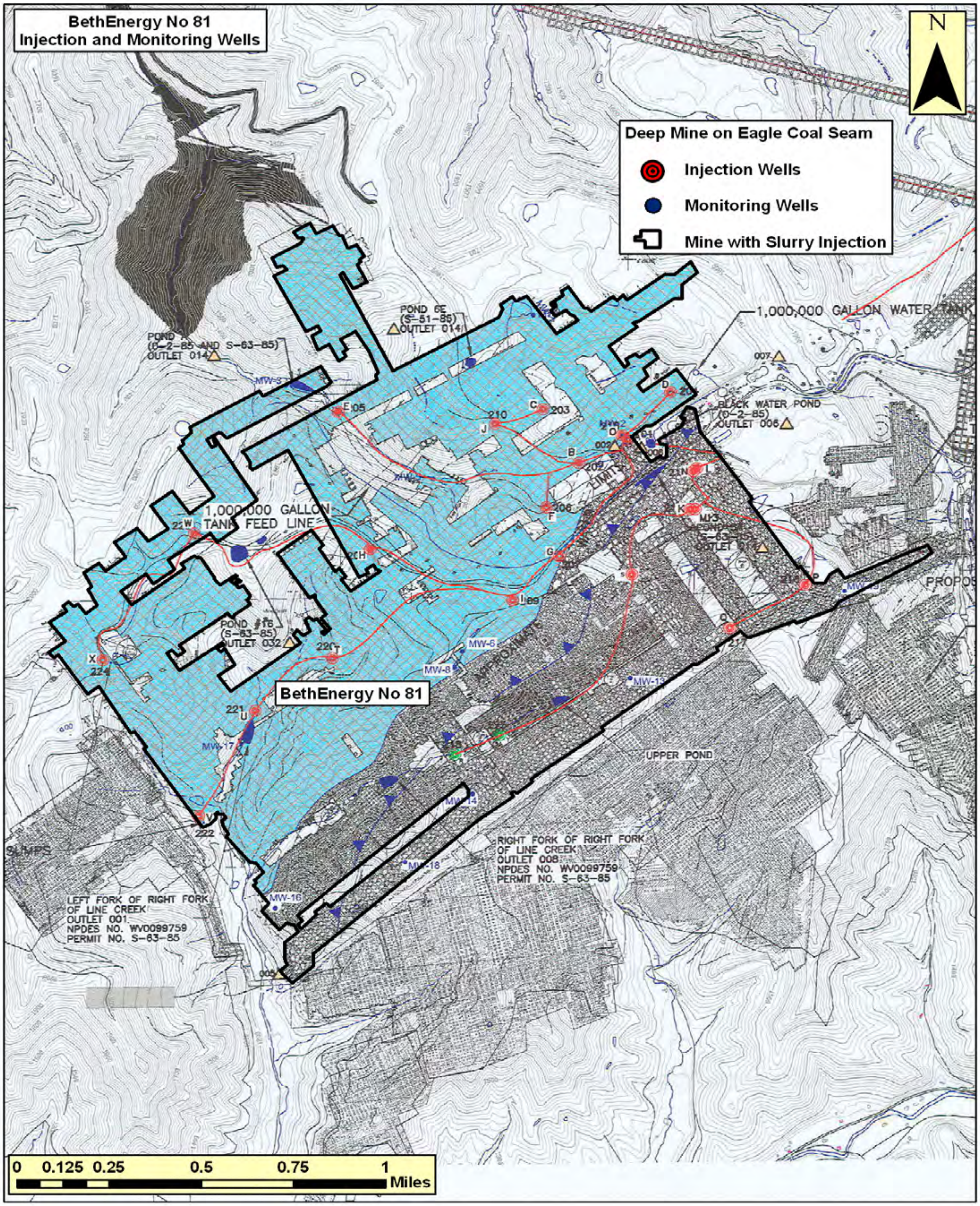
Injection Wells – 210, 211, 212, 213, 214, 219, 220 (based on UIC annual reports)

Monitoring Wells and Dewatering Wells – MW-3 (based on UIC annual reports)

The mine is a mostly below drainage mine. There are two main openings; one is located in the up dip portion of the mine near the surface coal outcrop at Jerry Fork, a tributary to Peters Creek at an elevation of 1400'. The other entry is located in the down dip portion of the mine near the outcrop at Right Fork, a tributary of Line Creek which drains to Peters Creek.

In January of 2003, a violation occurred regarding the injection of coal slurry into Mine #81. Coal slurry from the deep mine was seeping into the Right Fork of Line Creek in several locations along the stream. Coal slurry was also observed to be discharging from the sealed and backfilled portal located near the stream at Right Fork. Remedial action by the company was taken which resulted in the stoppage of discharges and seeps to the Right Fork. Based on a review of the violation report, remediation actions included ceasing the injection of slurry into the mine and the stabilization of the mine pool through pumping at an elevation that provided equilibrium to the “in place” slurry and mine pool.

A very limited assessment of this deep mine is included in the study as no sampling of the mine pool or surrounding surface and ground waters occurred during the July 2008 sampling event. During the planning stages of the study, the mine was sealed and all injection and monitoring wells were sealed and abandoned. These facts were considered in the decision to delete this site from the sampling event.


BethEnergy No 81
Injection and Monitoring Wells
N
Deep Mine on Eagle Coal Seam
Injection Wells
Monitoring Wells
Mine with Slurry Injection
1,000,000 GALLON WATER TANK
1,000,000 GALLON TANK FEED LINE
BLACK WATER POND
OUTLET 006
BethEnergy No 81
UPPER POND
RIGHT FORK OF RIGHT FORK OF LINE CREEK OUTLET 008 NPDES NO. WV0099759 PERMIT NO. S-63-85
LEFT FORK OF RIGHT FORK OF LINE CREEK OUTLET 001 NPDES NO. WV0099759 PERMIT NO. S-63-85
POND #16 (S-63-85) OUTLET 032
POND 6E (S-51-85) OUTLET 014
0 0.125 0.25 0.5 0.75 1 Miles

Background surface water chemistry and trends

A one-time sampling event and investigation, which occurred on July 8, 2009 was conducted as part of the Power Mountain Site assessment. The sample sites identifications and descriptions are shown on Table 2. A limited number of samples were collected during this study. It would have been beneficial to collect additional samples to demonstrate seasonal trends as well as spatial variability. A more complete water quality data set would have also bolstered the statistical strength of the data.

Surface Water Impacts – Twentymile Creek Watershed

Twenty mile Creek has had mining operations covering virtually the entire watershed. Surface, mountaintop, deep, auger and high wall mining have all occurred within the watershed. According to a Cumulative Hydrologic Impact Assessment (CHIA) Report written in 2004 by the WVDEP, greater than 175 mining sites over a period of 16 years have been in operation within the watershed. Approximately thirty to forty percent of the watershed is included in the study site; therefore, an estimated 60 mining sites may have occurred within the study site. Based on the hydrologic flow systems of the Hutchinson/Terry Eagle and the Flying Eagle, slurry injection activities have the potential to impact the quantity and quality of this watershed. However, due to the extensive mining history of the watershed, and the limited availability of site specific mining and water data, a determination of water quality impacts due solely to slurry injection on the watershed is tenuous.

Water monitoring data, associated with the numerous WVDEP permits, for the main branch of Twentymile Creek and Robinson Fork, a major tributary to Twentymile Creek, are available. Based on a cursory review of the data, some general statements on the water quality associated with coal mining within the watershed can be made. Most mining in the watershed when conducted properly produces alkaline water with little to no elevated metals; however, there are known overburden problem areas which have produced discharges requiring treatment. According to the 2004 CHIA report, increases in total dissolved solids and manganese concentrations have been the most significant water quality issues in the watershed.

As part of this study, the collection and analyses of several water samples on Twentymile Creek were attempted. Collection of a grab sample upgradient of TE-DH-1, the dewatering borehole for Terry Eagle mine, was attempted, however, it was inaccessible during the sampling event. The collection of a sample from the water supply at Twentymile Creek Church was also attempted however, the sample was not collected as the well was dry. These two sites were chosen because they are in the same location as previously established monitoring points USTC and GW-1.

Two samples were however, collected farther downstream on Twentymile Creek. PM-3 is located on the steam below the confluence with Robinson Fork and PM-7 is located below the confluence with Sugarcamp Creek. Figure 2 and Figure 3 show the location of these and all the sampling points collected during the July 8, 2008, Slurry Study sampling event.

Table 3 provides a comparison of recent water data for Twentymile Creek with historical data of the Creek from 1983 surface mining documents. Mining activities within the watershed during 1983 were not very extensive. Table 3 shows significant concentration increases in total dissolved solids, sulfate and alkalinity from the time period of 1983 to 2007. The 1983 sample point (#9) located in the vicinity of PM-7 shows sulfate concentrations below 100 mg/L while sample point PM-7 shows concentrations greater than 1200 mg/L. Table 3 provides the comparison water data for Twentymile Creek, while Table 4 provides the comparison data for Robinson Fork and Sugarcamp Creek. The complete analyses for all water samples are found in the separate Appendix II-O-4.

A Stiff diagram is a convenient way of displaying water chemistry The diagram itself is a symbol which represents the relative proportions of major cations and anions in the water. Simply stated it is a water fingerprint. Similar shapes illustrate similar chemical compositions and can be used as a tool in source determination. The affects of dilution are generally removed by Stiff diagrams. Figure B shows the stiff diagrams for the surface water samples. Their water quality can be characterized as strongly impacted from mining activities as evidenced by the elevated sulfate concentrations.

There were no organic compounds found in any of the surface water samples on Twentymile Creek (PM-3 and PM-7) nor were there organic compounds found in the surface sample taken near the mouth of Sugarcamp Creek (PM-8).

Sampling point PM-8 is located downslope of a large valley fill associated with a mountain top removal operation in addition to the preparation plant, a coarse coal refuse and a recently developed fine coal slurry impoundment. The coal slurry impoundment was not in operation at the time of the sampling. All these mining activities likely influence the water quality of this sampling point. Based on the very limited surface water sampling, no organic compounds were detected in Sugarcamp Branch downstream of the valley fill, coarse coal refuse and preparation plant. The water quality of the sample is alkaline with significant concentrations of total dissolved solids, 1380 mg/l and sulfate of 777 mg/L. Metal concentrations are relatively low with the exception of a manganese concentration of 2.1 mg/L.

In October of 1990, a blackwater discharge occurred at Sugarcamp Branch due to an overflow from a pond holding coal slurry. The discharge was ceased and remediation of the stream began within a day.

<u>Surface Water Impacts – Jones Branch, Right Branch, Line Creek and tributaries of Peters Creek</u>

As stated previously, a portion of Peters Creek is included in the study area. Specifically, Jones Branch and the Right Fork of Line Creek are located in areas that may receive drainage from several of the slurry injected deep mines. Water quality impacts from slurry injection at these deep mines may not be detected due to masking from the numerous other mining operations both past and present in surrounding areas.

A close examination of the Jones Branch watershed will help illustrate this condition. Based on several document searches, there are approximately eight inactive deep mines on the Eagle coal seam located within the Jones Branch watershed. Their locations are outlined on Figure 2. Four of the deep mines received slurry and are included in this assessment while four did not. Depending on the mine pool elevation, hydraulic gradient (head differences) and site-specific hydrogeologic conditions, all eight mines have the potential to discharge or leak mine water to the surface. Site specific data from all the mines are needed to determine the type and percent of water quality contribution from each mine on the receiving stream. Site-specific data, particularly mine pool conditions, including quantity and quality is not readily available for these deep mines. In fact, this type of information is very difficult to find in the permit documents. In addition to deep mine water quality contributions to the watershed, a coal transfer station with associated coal stockpiles and ponds are all located within the watershed. Previous surface mining on stratigraphically higher coal seams and their associated valley fills and ponds are also located within this watershed with both quantity and quality contributions to the receiving stream. Although the William Eagle, Rhonda Eagle, Flying Eagle and portions of Hutchinson/Terry Eagle have the potential to impact surface waters within the Jones Branch watershed, a determination of their impacts have not been made. Due to the conservation of time and resources, no water samples were collected in this location.

Beth Energy #81 is located structurally up dip of Right Fork of Line Creek; water flowing in the downdip direction from the mine pool has the potential to impact the water quality of the stream. Additionally, located midway upstream on the Right Fork is a drift entry to the mine. As mentioned in a previous section, black water discharges from Beth Energy #81 occurred in 2003 which impacted the Right Fork. Such events, where coal slurry flows out of the mine for short periods of time, have not been evaluated in this report. These events are relatively short and unanticipated.

For the same reasons discussed above, a determination of the impacts caused by slurry injection at Beth Energy #81 on the surface waters within Right Fork has not been determined. There are significant spatial and temporal water quality impacts in the watershed from mining activities, therefore distinguishing the impacts from deep mine slurry injection is not possible given the scope of this study.

Due to the conservation of time and resources, no water samples were collected in this location.

Mine Pool Water Characterization

Five water samples representing four separate mine pools were collected and analyzed as part of this study. The complete analyses for each water sample are found in the Appendix II-O-4. Approximately 50 inorganic and 125 organic parameters were analyzed. However, based on an evaluation of the data, only a limited number of parameters are of importance in discussing water quality impacts from slurry injection. Table 5 provides some of the water quality data from the July, 2008 sampling event for the mine pools.

In determining groundwater impacts solely from slurry injection, an evaluation of the water quality data in an upgradient portion of a mine pool and the downgradient portion of a mine pool after slurry injection occurred is very useful. Water data from PM-2 and PM-6 affords us this opportunity. PM-2 is a sample of the mine pool from the Flying Eagle deep mine taken from the dewatering borehole and PM- 6 is a sample taken from the monitoring well installed in the same mine pool located upgradient of the slurry injection. A review of the water quality data from these samples indicates that the TDS concentration for the downgradient sample, PM-2, is higher than the upgradient sample, PM-6. This is in part due to the increase in alkalinity concentrations. Water from PM-6, had a concentration of 377 mg/L while the downgradient concentration was 568 mg/L. Other parameters such as sulfate, sodium, dissolved iron, manganese and arsenic all increased in the downgradient sample. Table 5 shows the comparison data while Figure C illustrates the water chemistry.

Sampling of monitoring well PM-6 on July 8, 2008. Well is installed in the upgradient portion of the Flying Eagle deep mine.

The increase in TDS and alkalinity is likely the result of the alkaline addition which is part of the slurry injection procedure for this mine. Increases in the other parameters mentioned above may be due to the increased flow path of the water through the mine. The roof and floor rock may be contributing to the increased dissolved concentrations. This enrichment of the mine pool quality in downgradient portions of mine pools has been documented in several mine sites throughout WV and Southwest PA. [Eric Perry, Water Quality Trends in a Flooded 35 Year Old Mine Pool, 2005] However, leaching of coal slurry, based on its composition, also has the potential to increase dissolved solids concentrations in the mine pool. Therefore, the increase in TDS concentration in the downgradient portion of the pool is due to residence time, contacting strata, flow path and/or the injection slurry in the mine pool or a combination of both. Also, other waters within and outside the mine could be affecting the ultimate water quality.

The only organic compounds detected in any of the water samples, with the exception of a compound due to lab contamination*, is found in sample PM-6 which represents the Flying Eagle mine pool upgradient of the slurry injection. Low concentrations of benzene and toluene were found. This may be the result of leachate from the coal seam within the deep mine or remnants of equipment and or supplies left in the mine. Due to the upgradient location of the sample, it would appear that the slurry was not the source of the benzene and toluene concentrations. Coal is made up of many organic compounds particularly a group of compounds referred to as PAHs (Polycyclic Aromatic Hydrocarbons). These organic compounds make up oils, fuels, coals and tars and are ubiquitous in nature.

> *REIC Labs which provided the lab analyses for all samples taken in support of this assessement, confirmed that the concentrations reported for the semi-volatile organic compound, Bis(2-ethylhexyl)phthalate were lab artifacts and not associated with the site samples.

PM-1 is a sample representing Terry Eagle mine pool located downgradient of the slurry injection. It shows very similar water quality to the downgradient sample of the Flying Eagle mine pool. The attached Stiff diagram, Figure C, shows both mine pools with very similar geochemistry. It can be characterized as a sodium-sulfate type water. As seen in this diagram, their shapes are the same and their water quality very similar.

PM- 13 is a water sample collected from a seep located downslope of a mine entry to the Rhonda Eagle deep mine. The seep flows into a treatment pond which discharges to Jones Branch. Water quality of PM-13 can be characterized as a calcium-sulfate type water, as shown on Figure D. The TDS concentration of the sample is greater than 1000 mg/L. Because the sample was taken near the updip location of the Rhonda Eagle mine, it is not clear whether the influence of the slurry injection is represented in the sample. Although the exact pathway of this sample is not known, its quality is characteristic of mine impacted water.

Sampling of the seep below the Rhonda Eagle deep mine above the treatment pond on July 8, 2008.

PM-14 is a sample collected from the collapsed entry of the Radar Eagle deep mine. No slurry injection activities occurred within this mine. This sample was collected to provide water quality data on an Eagle deep mine without the influence of slurry. Based on the Stiff analyses, Figure D, the water is a weak calcium-sulfate type. The water quality is alkaline and the concentrations of dissolved solids, sulfates, sodium and calcium are an order of magnitude lower than the concentrations found in the waters from the Flying Eagle, Terry Eagle and Rhonda Eagle mines. The water quality is indicative of ground water with little to no mining impacts. Based on the shallow cover in the vicinity of the mine where the sample was collected, PM-14 appears to have a short flow path, one that short circuits much of the mine. At shallow depths, vertical infiltration from overlying strata is usually the main source of recharge. With decreasing cover, a greater concentration and frequency of fractures occurs than at depth. Increased fractures allows for increased flow into and through the mine. Such short flow paths can account for the low concentration of total dissolved solids noted in the water quality data. This water may be decanting off the top of the mine pool.

Factors such as length of flow path, surrounding strata composition, type and amount of infiltrating (recharge) water and residence time, length of time water is in contact with the surrounding material all affect the types and amount of dissolved solids concentrations. When comparing and contrasting the water quality of various samples to determine impacts from coal slurry injection, these factors must be considered.

A review of some historical data on mine pool water quality for selected mines prior to slurry injection reveals lower TDS and sulfate concentrations than those shown in the recent sampling of mine pools post slurry injection. Table 6 outlines mine pool data for the Terry Eagle and William Eagle mines before, during and after injection activities. The table also shows water data for the mine pool at the Jerry Fork Mine, an adjacent mine on the Eagle coal seam where slurry injection did not occur. Water quality of the Jerry Fork Mine shows lower sulfate and TDS concentrations than those noted in the samples representative of slurry injection. Based solely on these historical data, slurry injection increases the total dissolved solids and sulfate concentrations in mine pool water quality.

In summary, a review of the water quality data available for the mine pools concludes that slurry injection activities increases the concentrations of total dissolved solids and sulfates.

Background groundwater chemistry data and trends

A total of 8 groundwater sampling points were collected as part of the Coal Slurry Study, 5 represent mine pools while 3 represent private water supply wells.

Private Water Supplies

Three private water supplies were sampled during the July 2008 sampling event. All three private water wells are located along Jones Branch and appear to be connected to the aquifer associated with the stream alluvium. Well construction data is not available for any of the wells and very little information on their depths was provided by the landowners. Table 8 shows the wells' general water quality. For a complete list of all parameters and concentrations analyzed see the Appendix II-O-4. There were no organic compounds detected in any of the wells and all inorganic parameters were within the Federal EPA primary drinking water standards. EPA drinking water standards do not apply as a regulatory measure to private wells but are used in this report for comparative purposes.

Based on the location of the wells in the stream valley and a general knowledge of private water wells in the coal regions of West Virginia, it is reasonable to assume that all or part of the water supplying the wells are from the stream alluvium. As outlined in previous sections, the stream receives drainage from numerous mining sources, these sources have the distinct potential to influence the quality of the alluvium and therefore the well water. There are approximately eight deep mines that are located in the recharge area of the stream and several surface mining sources. Determining the amount of influence from each source has not been attempted, however, a review of the available data may provide insight on mining impacts on the private water supplies.

There are some historical samples of a well located within the Twentymile Creek watershed in addition to a seep and a spring located in the Sugarcamp Branch watershed taken prior to mining activities. The church well is supplied by shallow groundwater as the water level was recorded at approximately 30 feet below surface in addition to the spring and seep. These data may be used for general comparison of shallow groundwater pre and post mining effects. The water quality of the historical groundwater samples are alkaline with low total dissolved solids and very low sulfate concentrations, less than 25 mg/l. Table 7 provides the comparison data.

PM-9 is a sample taken from the Naylor's well. According to the home owner, there is no treatment on the well and the depth is unknown. A stiff diagram of the well water is presented in Figure E. It is a magnesium-sulfate type water, which is slightly acidic with a pH of 6.0. Metal concentrations in the water are very low while sulfate concentrations appear to be slightly elevated (72 mg/L) from background levels. The background sulfate concentrations used for this comparison are those found on Table 7 and represent shallow groundwater within the study site. The type and composition of the well water is similar to mine water, however, the exact source of influence is not known.

PM-10 is a sample of the Corbett's well which is located the farthest downstream on Jones Branch. According to the home owner the well is between 40 to 60 feet deep, confirming that the well is completed through or partially completed through the stream's alluvium. The alkalinity concentration of the water is 177 mg/L with a pH of 7.7. Overall the metal concentrations are low. iron and manganese concentrations are slightly above the federal secondary drinking water quality standard and the sulfate concentrations were measured at non-detect. The water type, based on the Stiff diagram, as shown on Figure E, is a sodium-bicarbonate type water and is not characteristic of mine impacted water.

A sample of the well water from the Mullin's residence was collected and labeled PM-11. The home and well is located in close proximity to the Naylor's residence, however, its water quality is very different. The depth of the well is not known. According to the Mullins's residence, a water softener is used to treat the water. An attempt was made to collect the water sample prior to the treatment system. The water quality of the well can be characterized as a sodium-bicarbonate type based on the Stiff diagram. The alkalinity concentration of the water is 191 mg/L and the pH value is 7.4. All metal concentrations are very low. The sodium value was relatively high at 103 mg/L while the calcium and magnesium values were very low at 0.2 mg/L and non-detect respectively. This water type is often associated with treated water from a water softener. The well water quality is not characteristic of mine impacted water.

All of the private water wells sampled for this assessment were along Jones Branch which is upgradient of the subject mines. There was only one private water supply that was located on the down dip side of mining adjacent to the flooded sections and that was GW-1, Twentymile Church. As stated previously, the supply was not sampled because it was dry during the sampling event.

Groundwater Impacts from Slurry Injection

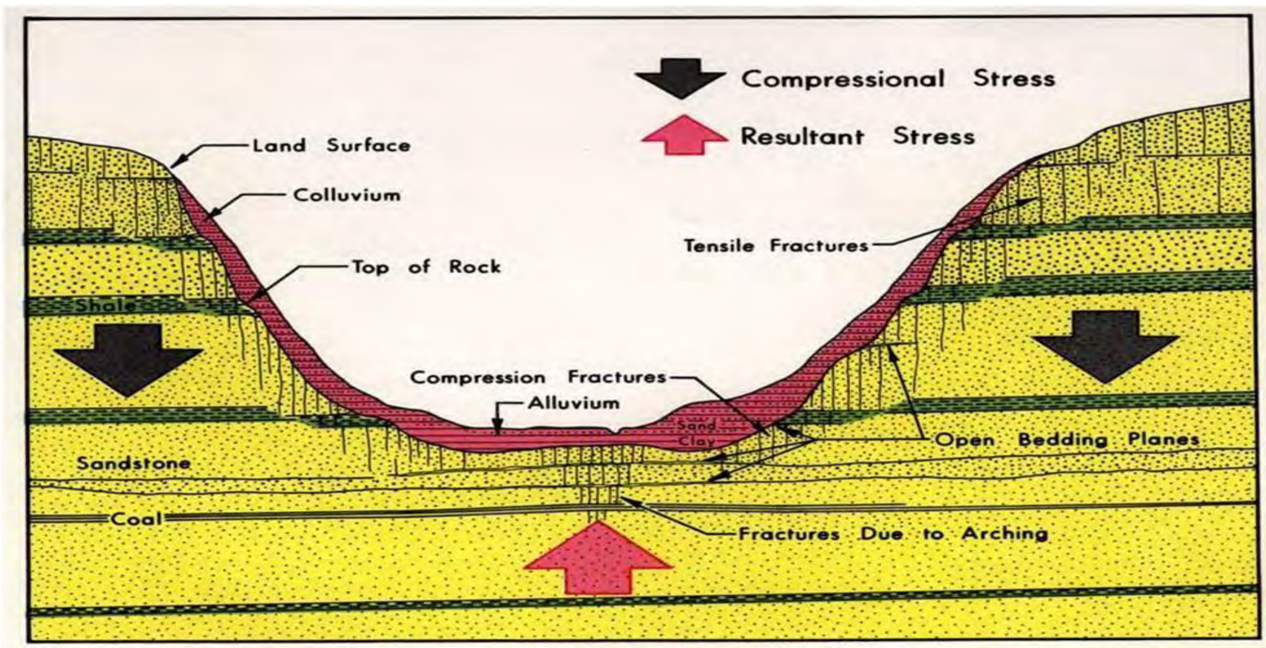
Assessing the potential for mine pool migration from the mine to the groundwater requires a considerable amount of site specific information. Generally aquifers in this region of West Virginia can be divided into several types; a) perched aquifers associated with coal seams and generally located within the hill and mountain tops, b) side hill and valley fracture zone systems c) alluvium aquifers associated with the stream valleys and d) deeper regional aquifers.

Most ground-water movement occurs through undisturbed strata through secondary permeability and porosity of fractures in the rock. There is evidence for the alluvium aquifer associated with Twentymile Creek and Jones Fork. There are documented private water wells along the stream valleys which obtain their water from the shallow aquifer associated with the stream. Slurry injection activities can impact these aquifers by impacting the mine pools quantity and quality. Injection of slurry fluids, if unchecked, increases the volume of water in the mine in addition to altering the water quality. The increased mine level may fill the mine, increase hydraulic head and ultimately overflow into stream valleys. Once in the stream valley the impacted mine water may infiltrate shallow aquifers through fractures. Migration of impacted mine water through slurry injection can occur in other ways. Impacted mine water may seep through the coal seam and or fractured overburden into the surrounding groundwater. These flow regimes are possible and probable to some degree at the five subject deep mine.

Migration of the slurry and/or its leachate can occur underground through the coal seam and or the overlying strata. Depending on the depth of the coal seam, the hydrologic properties of the mine pool and the competency of the strata, flow from the mine out to surrounding aquifers is possible. Most underground mine aquifers (pools) behave like confined aquifers (a very transmissive unit between two low-permeability units) and thus do not transmit much water into underlying or overlying units unless they are leaky aquitards (Hawkins and Dunn 2007).

Movement of mine water through the coal seam and the overburden is less likely the deeper the mine is. With increased depths, the frequency and intensity of fractures are decreased (Hawkins and others, 1996). Fractures formed by stress relief forces are generally found at depths less than 200 feet. These are most often associated with shallow groundwater flow in the Appalachian Plateau (Wyrick and Borchers, 1981). There are, however, fractures created through tectonic activity which provides secondary permeability in deeper bedrock and will facilitate water movement. Deeper aquifers generally have slower velocities and lower recharge rates than the shallow systems. The five subject deep mines have a significant portion of the workings below the surface and below the shallow fractured groundwater systems. These deep workings receive less infiltration from the surface and the water associated with them will have a longer residence time. Conceptually, waters associated with the deep mine workings are less likely to impact surrounding ground waters due to their slow velocities in addition to the low permeability of the rock formations surrounding the deeper parts of the pools. Therefore, it is less likely for the slurry and its constituents located in the deep pools to impact the surrounding ground waters. However, due to the minimal amount of data this study does not confirm this statement nor does it disprove it. Additional comprehensive and site specific investigations would be required which includes identification and monitoring of the surrounding ground waters.

Below is a generalized section showing a shallow fracture system and alluvium associated with valley bottom [after Ferguson (1974)]



<u>*Preparation Plant / Coal slurry and raw coal characterization*</u>

Fine coal slurry is the by-product of the coal preparation process. All preparation plants are designed to separate the non-combustible material from the coal and the use of selected chemicals facilitates this process. Power Mountain Preparation Plant is no exception, according to a company representative; the following chemicals are available at the plant and could be used or have been used in the recent past.

1. FLOERGER EM 533 - polymer
2. FLOMIN F 122 - 90% Hexanol and 10% Octanol
3. FLOMIN 54 WB - de-foamer (used infrequently)
4. REAGENT S-9628 - promoter
5. ANHYDROUS AMMONIA – pH control

All of the chemicals used at the plant must be approved in the UIC permit and have an accompanying MSDS sheet. For further descriptions of preparation plant processes and specific uses of these chemicals refer to the section labeled Preparation Plant in the General Report. Additionally, the use and importance of MSDS sheets in the regulation and permitting of slurry injection is also described in a separate section of the General Report.

Samples of the slurry and coal were collected at the plant during the July 8, 2008 sampling event. The coal was taken from a stockpile prior to processing and may represent the Five Block, Coalburg, Winifrede or Stockton coal seams. This is due to several mining operations supplying different coal seams to the Preparation Plant for processing. The slurry sample, which was 10 to 15% solid, was collected from the thickener underflow. The sample only represents the slurry that was produced at the time of the sampling and may not represent the slurry that was injected into the mines. The liquid phase of the sample was separated at the lab through settling of the solids and decanting of the liquid. The solid and liquid phase of the slurry was then analyzed separately. To further understand the composition of the slurry, a solid coal and a simulated coal leachate was also analyzed. The coal was crushed to a size similar to that of the slurry and mixed with deionized water for a period of 24 hours to produce a simulated coal leachate. For further explanation of the method used to simulate leachate from the coal, see Chapter 3, labeled Coal Slurry Characterization in the main report.

Summary tables for the solid and liquid phase of the coal slurry in addition to the solid coal and simulated coal leachate can be found in the section titled Coal Slurry Characterization in the General Report. The complete analytical results for all the samples are in the Appendix II-O-4.

Fine coal particles which are not separated during the preparation process become a component of the slurry which results in the similarity of coal and slurry composition. This is evidenced in the data tables showing organic compound concentrations in both the solid and liquid phase. Most of the organic compounds detected in the solid sample of the slurry and coal are part of a group of compounds associated with coal, fuels, oils and tars called PAHs (Polycyclic Aromatic Hydrocarbons). Most PAHs have an affinity for the solid phase rather than the liquid phase and this can be seen in the solid and liquid data. Only one organic compound, chloromethane, was detected in the slurry solid phase that was not detected in the coal solid phase. Chloromethane also known as methyl chloride was measured above the detection limit but below the lab's quantitation limit. It is a known solvent and lab extractant and not commonly found in coal. Such a low concentration may be a lab artifact. Ten tentatively identified compounds (TICs); the majority of them forms of Naphthalene, were measured in the solid slurry sample. Naphthalene is a common PAH and as stated above can be found in fuels and many chemicals. A TIC is a compound that can be seen by the analytical testing method, but its identity and concentration cannot be confirmed without further analytical investigation.

Based on the type of sampling conducted on the slurry and coal, the exact source of the organic compounds detected in the various phases of the material, cannot be identified. A more comprehensive set of data is necessary to identify the sources. A chemical fingerprint analyses which entails the review of organic compound rations from potential sources i.e. chemicals used at the preparation plant and the "samples in question" may be useful in the identification process if future studies are performed.

Generally, there were no detections of confirmed volatile organic or semi-volatile organic compounds found in the liquid phase of the slurry; however, there was a very low concentration of Total Petroleum Hydrocarbons (TPH) recorded at 0.26 mg/l. TPH is a gross quantity measurement without identification of its constituents. One TIC, identified as hexyl-silane, was documented at a very low concentration.

The results of the inorganic constituents for the solid phase of the slurry and coal were very similar. The solid sample showed iron, aluminum and calcium as the greatest proportion of the metal composition. Silver, antimony, selenium or thallium concentrations were not present in the solid phase of the slurry.

Results of the general chemistry and metal analyses for the liquid phase of the slurry is consistent with the mine pool data downgradient of slurry injection (PM-1 and PM-2). Generally, the water is alkaline with high concentrations of total dissolved solids and sulfate. Calcium, magnesium and sodium concentrations were relatively high, concentrations were 124.0, 81.4, and 236 mg/L. Other metal concentrations were relatively low with the exception of manganese at 0.9 mg/L and strontium at 1.6 mg/L.

The concentration and constituents found in the solid phase of the slurry are evaluated to determine the composition of the material; it does not consider the mobility or availability of the constituents in the environment, whereas the liquid phase provides data on those constituents that have been dissolved in water and can be mobilized in the environment. Based solely on the results of the coal characterization test, calcium, magnesium, sodium and manganese may be the most mobile constituents in the slurry.

Another set of data that is useful in the characterization of the slurry is the monthly monitoring data of the injectate which is required by the UIC permit. The liquid phase of the injectate is sampled and analyzed for a list of parameters and assigned permit limits based on EPA's Drinking Water Quality – Primary Standards. Observations based on a review of the UIC Annual Reports and Discharge Monitoring Reports (DMR) is outlined below. Additionally, Table 9 provides a summary of the permit limit exceedences with the sample concentrations and date of occurrence.

During November of 2000 to July 2001, monitoring of the coal slurry injectate showed numerous excursions from the concentration limits. The injectate exceeded the Total Petroleum Hydrocarbons concentration limit of 1.0 mg/L for the majority of the year and its concentration was significantly greater than the limit. The majority of the beryllium and chromium limit exceedences occurred during the same period of time and may be related to an additive used at the preparation plant. According to the annual report, no diesel fuel or any other hydrocarbon additive was in use at the preparation plant during this time.

The median pH of the injectate throughout the total monitored period is 7.3 with the values ranging from 6.3 to 8.4. Monitoring records are available from the year 2000 to 2007. The total dissolved solids (TDS) concentrations range from 274 mg/l to 2068 mg/l with a median concentration of 1072 mg/L. Manganese concentrations often exceeded the Federal Secondary Drinking Water Limit of 0.05 mg/L, although this is not a limit set in the permit.

November 2000 – July 2001

- Injection occurring at Mine #81
- DMR monthly reports show the following exceedences from the permit limits set on the injectate:
  Ten occurrences for TPH [Permit Limit = 1.0 mg/L] with six of the ten concentrations greater than 100 mg/L,
  Six occurrences for Beryllium [Permit Limit = 0.004 mg/L]
  Four for Chromium [Permit Limit = 0.1 mg/L]
  One for Lead [Permit Limit = 0.015 mg/L]

July 2001 – July 2002

- Injection occurring at Mine #81
- Incomplete reporting of monitoring data
- DMR monthly reports show the following exceedences from the concentration limits set on the injectate:
  One (1) for TPH [Permit Limit = 1.0 mg/L]

July 2003 – July 2004

- Injection occurring at Mine #81, William Eagle and Rhonda Eagle for part of the time then discontinued in all three mines with injection only occurring at Terry Eagle
- Incomplete reporting of monitoring data
- DMR monthly reports show the following exceedences from the permit limits set on the injectate:
  One for Total Chromium [Permit Limit = 0.1mg/L]

July 2005 – July 2006

- Injection occurring at Terry Eagle and Flying Eagle.
- Incomplete reporting of monitoring data
- DMR monthly reports show the following exceedences from the permit limits set on the injectate:
  One for Aluminum [Permit Limit = 0.2 mg/L]

July 2006 – July 2007

- Injection occurring at Terry Eagle and Flying Eagle.
- DMR monthly reports show the following exceedences from the permiton limits set on the injectate:
  One for TPH [Permit Limit = 1.0 mg/L]
  One for Beryllium [Permit Limit = 0.004 mg/L]
  One for Chromium [Permit Limit = 0.1 mg/L]
  One Nickel [Permit Limit = 0.1 mg/L]
  One for Aluminum [Permit Limit = 0.2 mg/L]

Summary Findings

- There are significant spatial and temporal water quality impacts within the watersheds of the study area from various mining activities, therefore distinguishing impacts on surface waters from deep mine slurry injection is not possible given the scope of this study.

- A review of the water quality data available for the mine pools concludes that slurry injection activities increases the concentrations of total dissolved solids, sulfates and in some cases manganese downgradient of the injection site.

- The water quality of a private well located within the study area, was determined to be influenced by mining activities which included slurry injection, however the exact contribution from the various mining sources could not be determined. Although influenced by mine water, the well did not exceed standards set for safe drinking water at public water supplies.

- The study did not determine impacts to the surrounding groundwaters from slurry injection. There was insufficient information on the groundwater resources to make a determination.

- All of the deep mines evaluated in this study are partially below drainage. The majority of the mine workings are located below surface drainages with the exception of entries located at the up dip end of the mines. Conceptually, waters associated with the deep mine workings below drainage are less likely to impact surrounding ground waters due the low permeability of the strata surrounding the pools. Therefore, it is less likely for the slurry and its constituents located in the deep pools to impact the surrounding ground waters. However, this study does not provide evidence to confirm this statement nor does it disprove it. Additional comprehensive and site specific investigations would be required which includes identification and monitoring of the surrounding ground waters.

- Based on the sample results, the inorganic and organic chemical composition of the coal slurry is similar to that of the coal seams. Accordingly, this similarity creates difficulty in isolating water quality impacts due solely to the injection of coal slurry in underground mines.

- Three of the five deep mines within the Power Mountain study site had documented "black water events". Coal slurry flowed from the deep mine to the surface due to increased water pressure within the deep mine. These events have the potential to impact surface and groundwater resources. The report did not address these episodic events.

- WVDEP-IUC compliance DMR data showed exceedences of UIC permit limits for the coal slurry injectate. Total Petroleum Hydrocarbons (TPHs) and total chromium were the most common parameters that exceeded the limits.

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TABLES 1 THROUGH 9

TABLE 1

POWER MOUNTAIN COAL SLURRY STUDY

COAL BED STRATIGRAPHY

KANAWHA GROUP OF THE POTTSVILLE SERIES - NICHOLAS COUNTY

	COAL NAME	TOTAL FEET
KANAWHA FORMATION		0
	STOCKTON	160
	COALBURG	210
	LITTLE COALBURG	229
	WINIFRED	290
	CHILTON	370
	LOWER CHILTON	395
	WILLIAMSON	490
	CEDAR GROVE	540
	NO 2 GAS	700
	POWELLTON	760
	EAGLE	800

Source - Compilation from http/ims.wvgs.wnet.edu and Nicholas County Report 1921

TABLE 2 - WATER SAMPLE POINTS

POWER MOUNTAIN COAL SLURRY STUDY
WATER SAMPLE POINT DESCRIPTIONS

Sampling Date - July 8, 2008

PM-1	TE-DH-1	Hutchenson pump - mine pool - downgradient
PM-2	FE-DH-1	Flying Eagle pump - mine pool - downgradient
PM-6	FE-MW-2	Flying Eagle well - mine pool - upgradient
PM-3	Mid-Stream Twentymile Creek	Instream - below confluence with Robinson Fork
PM-7	Down Stream Twentymile Creek	Instream - below confluence with Robinson Fork & Sugarcamp Branch
PM-8	Sugar Camp VF Pond	Pond spillway - Sugarcamp Branch at confluence with Twentymile Creek
PM-Slurry	Raw Slurry Site	Main prep plant
PM-9	Naylor Well	private water well along Jones Branch
PM-10	Corbett Well	private water well along Jones Branch
PM-11	Mullins Well	private water well along Jones Branch
PM-13	Pond 001 O-27-85 (seep)	Seep from Rhonda Eagle mine - mine pool
PM-14	Radar Eagle discharge	Mine pool - downgradient - control mine

TABLE 3

POWER MOUNTAIN COAL SLURRY STUDY
WATER QUALITY DATA SUMMARY - TWENTYMILE CREEK

SAMPLE DATE	FLOW (gpm)	pH lab	SPC (umhos/cm)	Total ALK (mg/l)	Total Acidity (mg/l)	TSS (mg/l)	Total FE (mg/l)	Dissolved FE (mg/l)	Total MN (mg/l)	Total AL (mg/l)	SO4 (mg/l)	TDS (mg/l)
Twentymile Creek - Site #10* (upstream of Preparation Plant)												
6/1/1983	26325	6.7	117.18	10	0	10	0.115	0.1	0		30.24	?
3/12/1984	14500	7.2	110.58	25	3	4	0.17	0.155	0.19		27.2	?
Twentymile - Creek - Site #9 (downstream of Sugarcamp Branch)												
6/1/1983	27750	6.43	101.99	20	16	10	0.050	0.047	0		26.32	52.00
Twentymile Creek - USTC (upstream Hutchinson deep mine)												
12/13/2003	1000	6.56F						0.06				95.00
6/15/2004		6.61F	266	12.93	ND	6	0.01		0.01	ND	108.14	180.00
Twentymile Creek - DSTC (downstream Hutchinson deep mine)												
6/9/2004	7297	7.33	542.00	32.4	ND	ND	0.1		0.62	0.04	237.04	392.00
Twentymile Creek - PM-3 (downstream Robinson Fork)												
7/8/2008		7.87	2090	79.1	3.3	7	0.095	0.064	0.493	0.449	1110	1810.00
Twentymile Creek - PM-7 (downstream Sugarcamp Branch)												
7/8/2008		7.96	2240	87.7	3.3	1	0.161	0.077	0.263	0.255	1220	1820.00

* Same general location as PM-3

F- Field pH

TABLE 4

POWER MOUNTAIN COAL SLURRY STUDY

WATER QUALITY DATA SUMMARY - ROBINSON RUN & SUGARCAMP BRANCH (tributaries of Twentymile Creek)

SAMPLE DATE	FLOW (gpm)	pH lab	SPC umh/cm	Total ALK (mg/l)	Total Acidity (mg/l)	TSS (mg/l)	Total FE (mg/l)	Dis FE (mg/l)	Total MN (mg/l)	Total AL (mg/l)	SO4 (mg/l)	TDS (mg/l)
Robinson Run (Site #20) upper reaches near discharge at Flying Eagle deep mine												
6/1/1983	350	6.65	99.87	25	8	12	0.27	0.245	0		25.76	50.00
Sugarcamp Branch (Site # 8)												
6//1/1983	1400	6.45	107.45	20	6	4	0.02	0.018	0.15		27.72	54.00
Sugarcamp Branch (PM-8)												
7/8/2008		8.2	1820	63.9	ND	5	0.114	0.023	2.21	0.482	777	1380.00

TABLE 5

POWER MOUNTAIN COAL SLURRY STUDY

WATER QUALITY DATA SUMMARY - MINE POOLS - JULY 8, 2009

SAMPLE ID	pH	SPC (umhos/cm)	TDS (mg/l)	Total ALK (mg/l)	SO4 (mg/l)	NA (mg/l)	CA (mg/l)	CL (mg/l)	Dis FE (mg/l)	Dis MN (mg/l)	Dis AL (mg/l)	Dis AS (mg/l)	Dis SE (mg/l)	Dis SR (mg/l)
PM1	7.68	2860	1670	572.0	733.0	537.00	41.30	45.00	3.7	0.325	0.325	0.0034	ND	1.13
Terry Eagle (down)														
PM2	7.56	2810	1540	568.0	752.0	536.00	40.30	46.80	3.06	0.559	0.407	0.0031	ND	1.05
Flying Eagle (down)														
PM6	7.53	2230	1450	377.0	696.0	346.00	81.20	33.00	0.064	0.05	0.498	0.0015	ND	2.09
Flying Eagle (up)														
PM13	7.57	1340	1040	78.1	544.0	36.80	165.00	14.30	1.21	4.31	0.465	0.0013	0.0027	0.66
Rhonda Eagle														
PM14	6.96	211	114	32.8	56.0	7.58	19.20	5.11	0.091	0.043	0.224	0.0012	ND	0.31
Rader Eagle (control)														

TABLE 6

POWER MOUNTAIN COAL SLURRY STUDY

WATER QUALITY DATA SUMMARY - HISTORICAL MINE POOLS

Sample Date	FLOW (gpm)	pH (lab)	SPC umhos/cm	Total ALK (mg/l)	Total Acidity (mg/l)	TSS (mg/l)	Total FE (mg/l)	Dissolved FE (mg/l)	Total MN (mg/l)	Total AL (mg/l)	SO4 (mg/l)	TDS (mg/l)	CL (mg/l)
Terry Eagle/Hutchinson Branch Mine Water [before slurry injection]													
1/30/2004	NA	9.2						0.05	ND	0.09	32.96	354.00	
Terry Eagle/Hutchinson Mine - Dewatering Borehole - TE-DH 1 [during slurry injection]													
1/10/2005		7.34 F	1912	401.98	ND	9.00	0.77		ND	ND	373.92	1157.00	121.99
William Eagle Mine Water [before slurry injection]													
10/22/2000	0.5	6.38	350.00	110.00	<2.0	12.00	1.33		0.29	0.12	164	252.00	1.50
Jerry Fork Deep Mine - Adjacent Mine - [no slurrry injection]													
3/23/2000		8.4 F	515	147.00	137	5.00		0.03	0.01	0.1	37.5	260.00	
5/1/2000		7.6 F	469	104.00	<2.0	2	0.07		0.69	0.51	80.00	320.00	6.1

F- Field ph reported

TABLE 7

WATER QUALITY DATA SUMMARY - HISTORICAL GROUNDWATER DATA

Sample Date	Depth to Water (gpm)	pH (lab)	SPC umhos/cm	Total ALK (mg/l)	Total Acidity (mg/l)	TSS (mg/l)	Total FE (mg/l)	Dissolved FE (mg/l)	Total MN (mg/l)	Total AL (mg/l)	SO4 (mg/l)	TDS (mg/l)	CL (mg/l)
GW-1 (Twentymile Church)													
2/2/2004	32	6.5	303.00	145.21		23.00	18.28		0.81	0.03	7.14	192.00	1.02
6/9/2004	29.4	6.4	286.00			100.00	25.36		1.07	0.001	19.17	171	1.62
Spring 2 within Sugarcamp Branch at 1700' elevation													
6/11/1983		6.4	86.8	10	6	8.00	0.1	0.085	0		22.4	44.00	
Seep 4 within Sugarcamp Branch at 1400' elevation													
6/1/1983		6.5	80.29	20	4	8	0.08	0.07	0		20.72	40.00	
3/12/1984*		5.7	492.8	3	44	4.00	0.005	0.00	0.05		123.2	222.00	

* - may have mining impacts

TABLE 8

POWER MOUNTAIN COAL SLURRY STUDY

WATER QUALITY DATA SUMMARY - PRIVATE WATER SUPPLIES - JULY 8, 2009

SAMPLE Point	pH	SPC (umh/cm)	TDS (mg/l)	Total ALK (mg/l)	SO4 (mg/l)	NA (mg/l)	CA (mg/l)	CL (mg/l)	Dis FE (mg/l)	Dis MN (mg/l)	Dis AL (mg/l)
PM-9 Naylor	6.02	224	106.0	17.2	72.4	4.73	19.7	5.8	0.024	0.083	0.214
PM-10 Corbett	7.7	336	158.0	177	ND	58.70	15.7	5.64	0.604	0.196	0.228
PM-11 Mullins	7.4	394	236.0	191	2.64	103	0.199	12.6	0.032	0.024	0.039

TABLE 9

OVER MOUNTAIN - UIC Permit - Summary Report of Samples Exceeding Permit Limits based on Discharge Monitoring Reports

For Date Ending	Inj. Point	TPH ORO (1.0 Mg/L) (Permit Limit)	TPH DRO (1.0 Mg/L (Permit Limit)	Dissolved Beryllium (0.004 Mg/L) (Permit Limit)	Dissolved Cadmium (0.005 Mg/L) [Permit Limit]	Total Chromium (0.1 Mg/L) [Permit Limit]	Dissolved Lead (0.015 Mg/L) [Permit Limit]	Dissolved Nickel (0.1 Mg/L) [Permit Limit)
1-Nov-00	214	447	182	0.0145				
	212	381	138	0.0144				
1-Dec-00	214	1.4		0.0081				
	212	2.2	1.18	0.0107				
1-Jan-01	212		1.13					
1-Feb-01	212	4.5	4.16					
1-Mar-01	212	224	256					
	214	<199	221					
1-Apr-01	212	225	256			0.189		
	214	230	185			0.3976		
1-May-01	212			0.0071				
	214			0.0068				
1-Jul-01	212	2.7	2.18			0.2524	0.0158	
	214					0.3994		
1-May-02	213	3	2.09					
1-Jul-02	213	2	2.22					
1-Dec-02	213					0.1533		
1-May-03	230	8.1	2.41					
1-Apr-04	240					0.1386		
1-Nov-06	237			0.009				0.271
1-Feb-07	237					0.181		
1-Jul-07	237	4.47	2.15					

FIGURES A THROUGH F

FIGURE A

COAL LEACHATE & SLURRY LIQUID

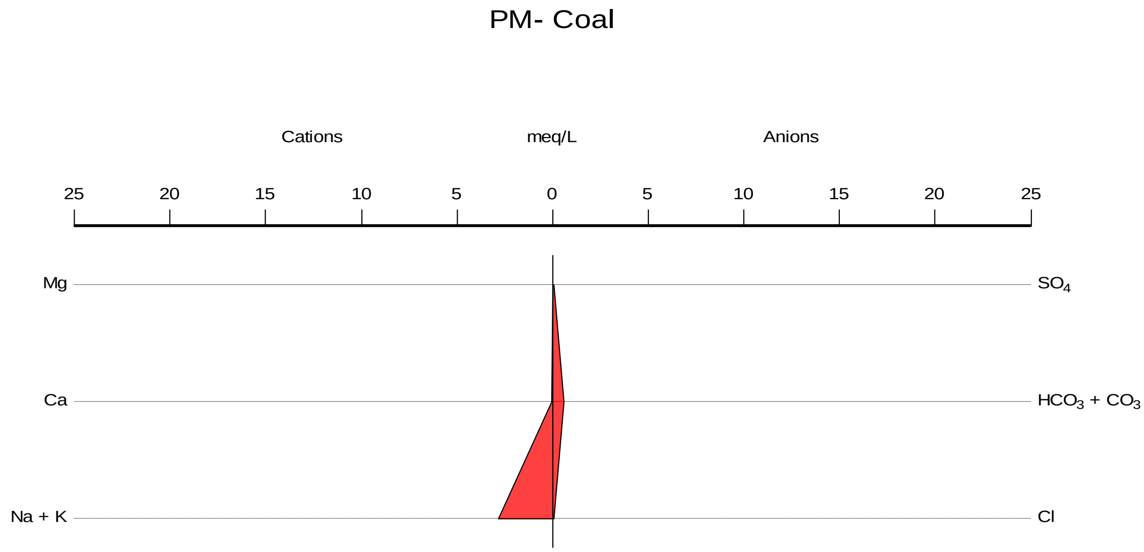
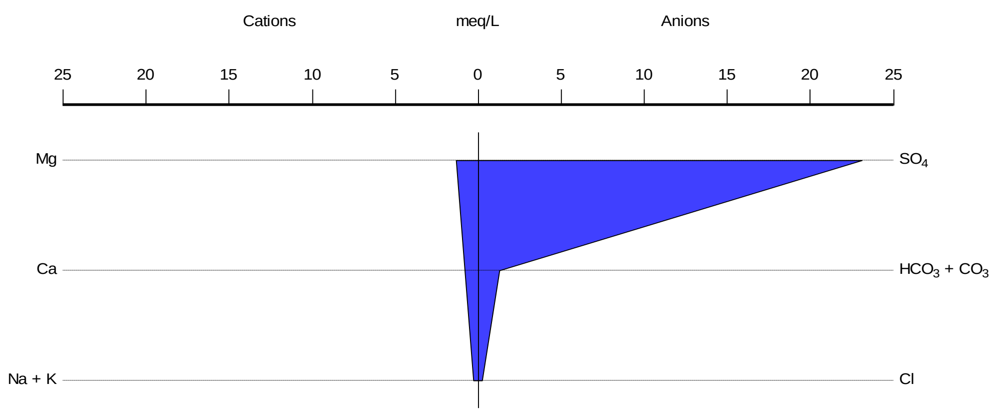


FIGURE B

SURFACE SAMPLES - TWENTYMILE CREEK

PM- 3 Twentymile Creek (mid-stream)



PM- 7 Twentymile Creek (downstream)

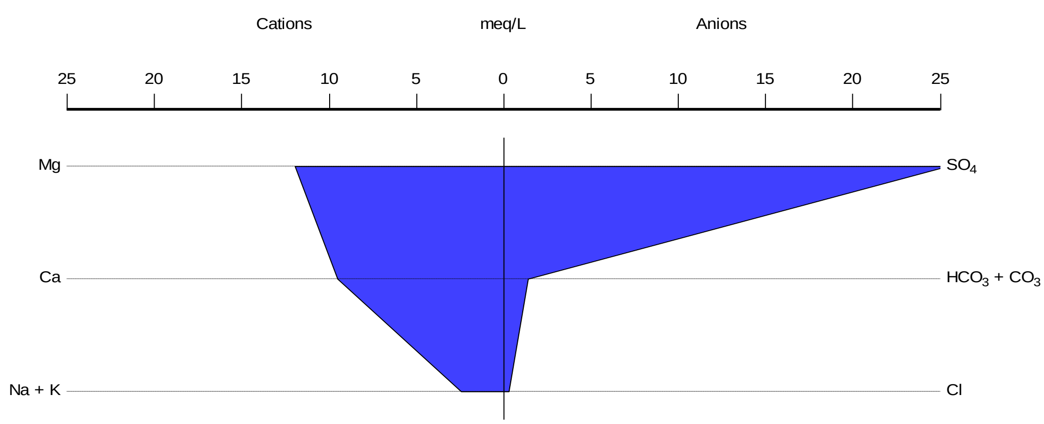
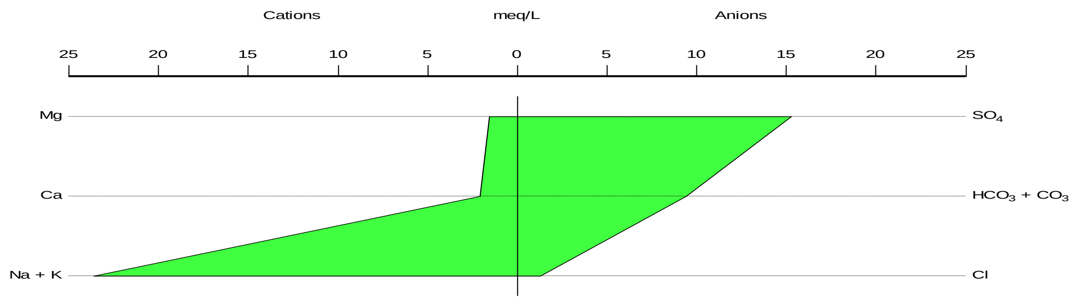


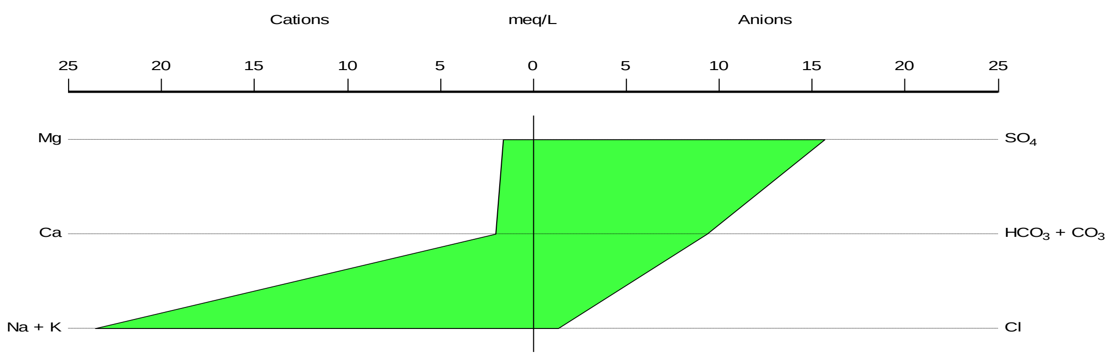
FIGURE – C

MINE POOLS – FLYING EAGLE & HUTCHINSON/TERRY EAGLE

PM- 1 Terry Eagle Mine - Downgradient



PM- 2 Flying Eagle Mine - Downgradient



PM- 6 Flying Eagle Mine - Upgradient

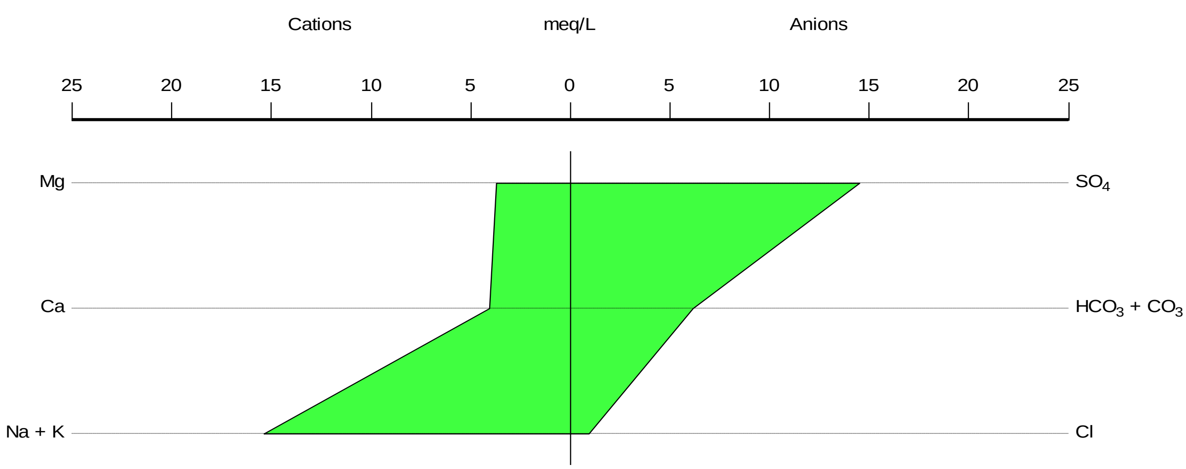
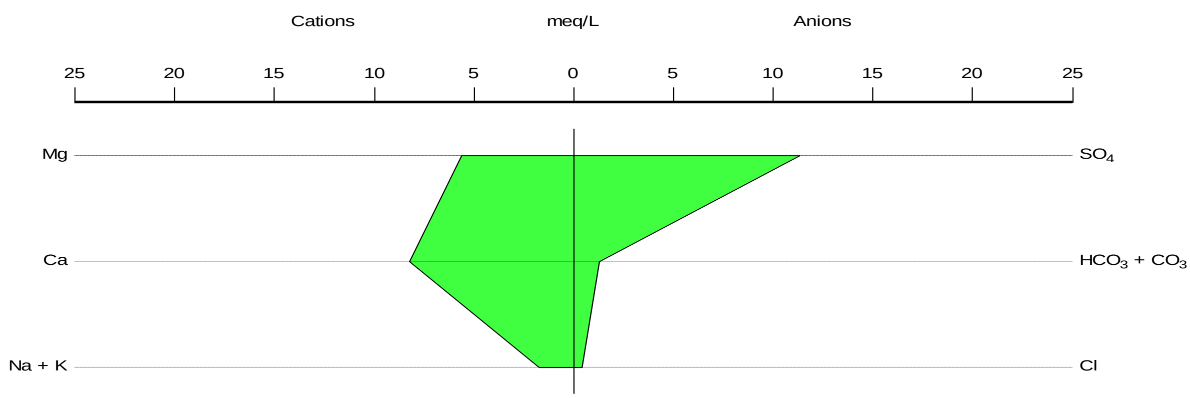


FIGURE D

MINE POOLS - RHONDA EAGLE & RADAR EAGLE

PM- 13 Mine Pool Seep



PM- 14 Radar Eagle Mine

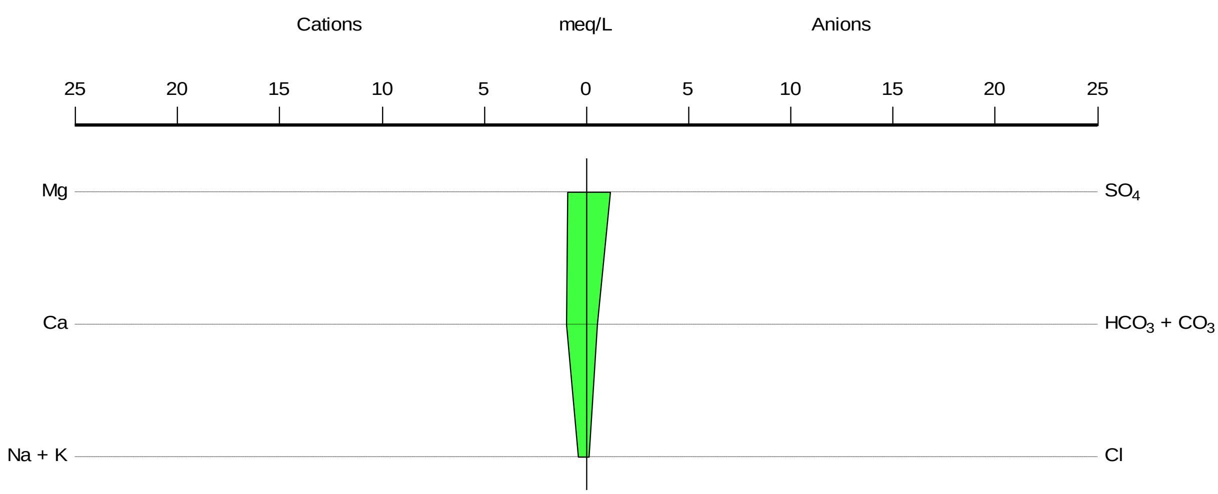
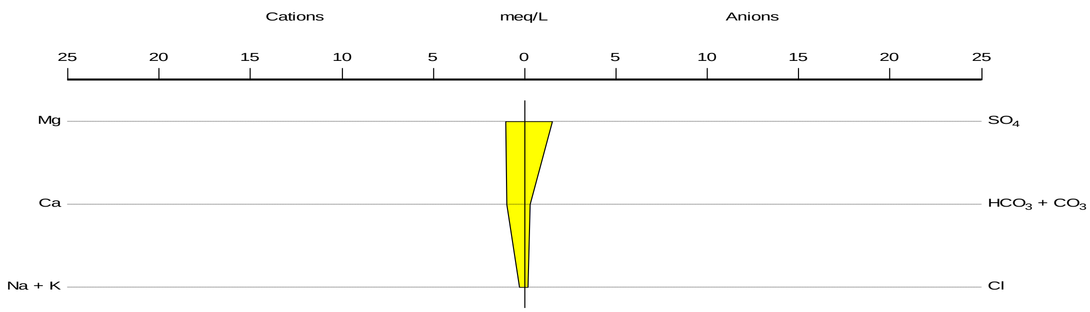


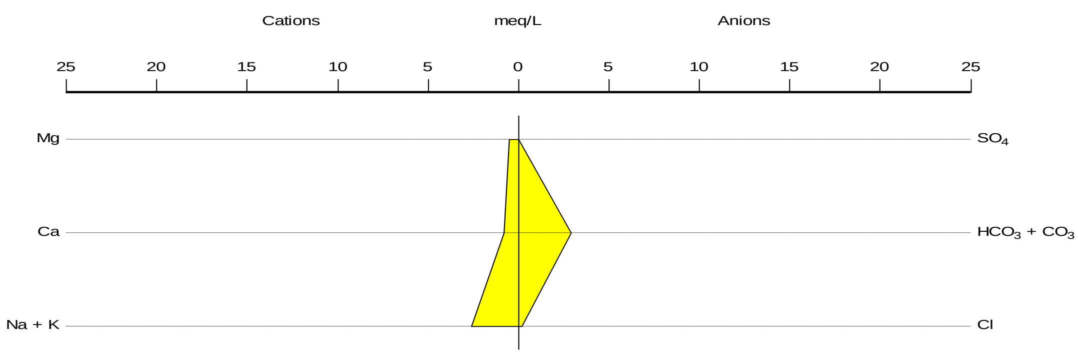
FIGURE E

PRIVATE WATER SUPPLIES

PM- 9 Naylor Well



PM- 10 Corbett Well



PM- 11 Mullins Well

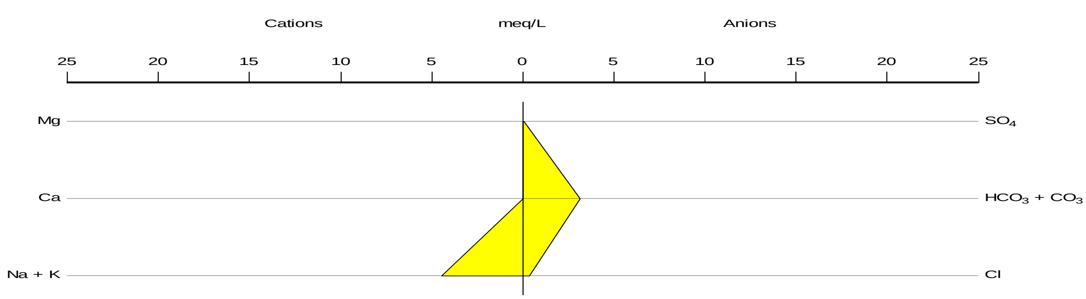
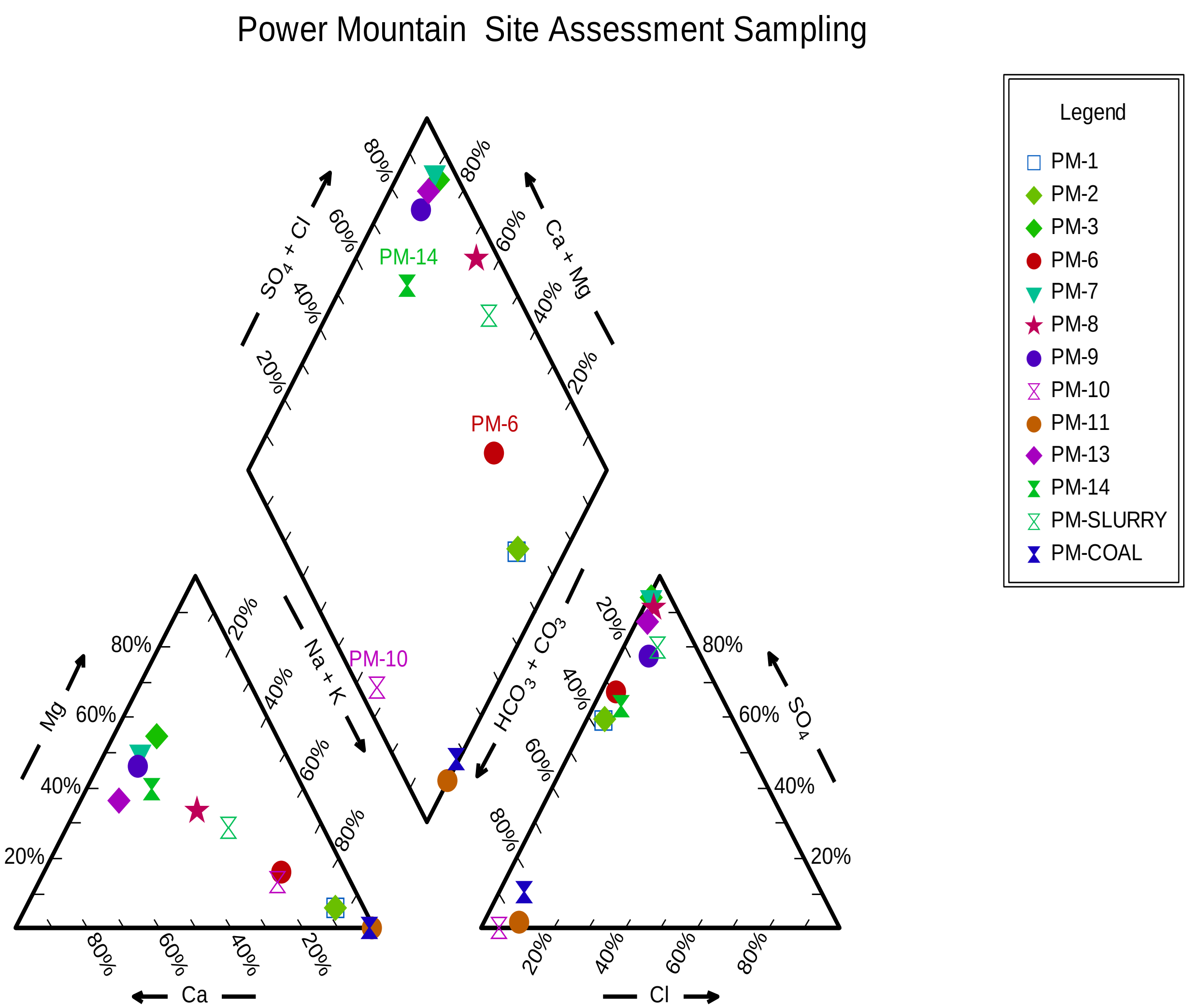


FIGURE F



Power Mountain Site Assessment Sampling
Legend
PM-1
PM-2
PM-3
PM-6
PM-7
PM-8
PM-9
PM-10
PM-11
PM-13
PM-14
PM-SLURRY
PM-COAL
PM-14
PM-6
PM-10
SO4 + Cl
Ca + Mg
Na + K
HCO3 + CO3
Mg
Ca
Cl
SO4
80%
60%
40%
20%

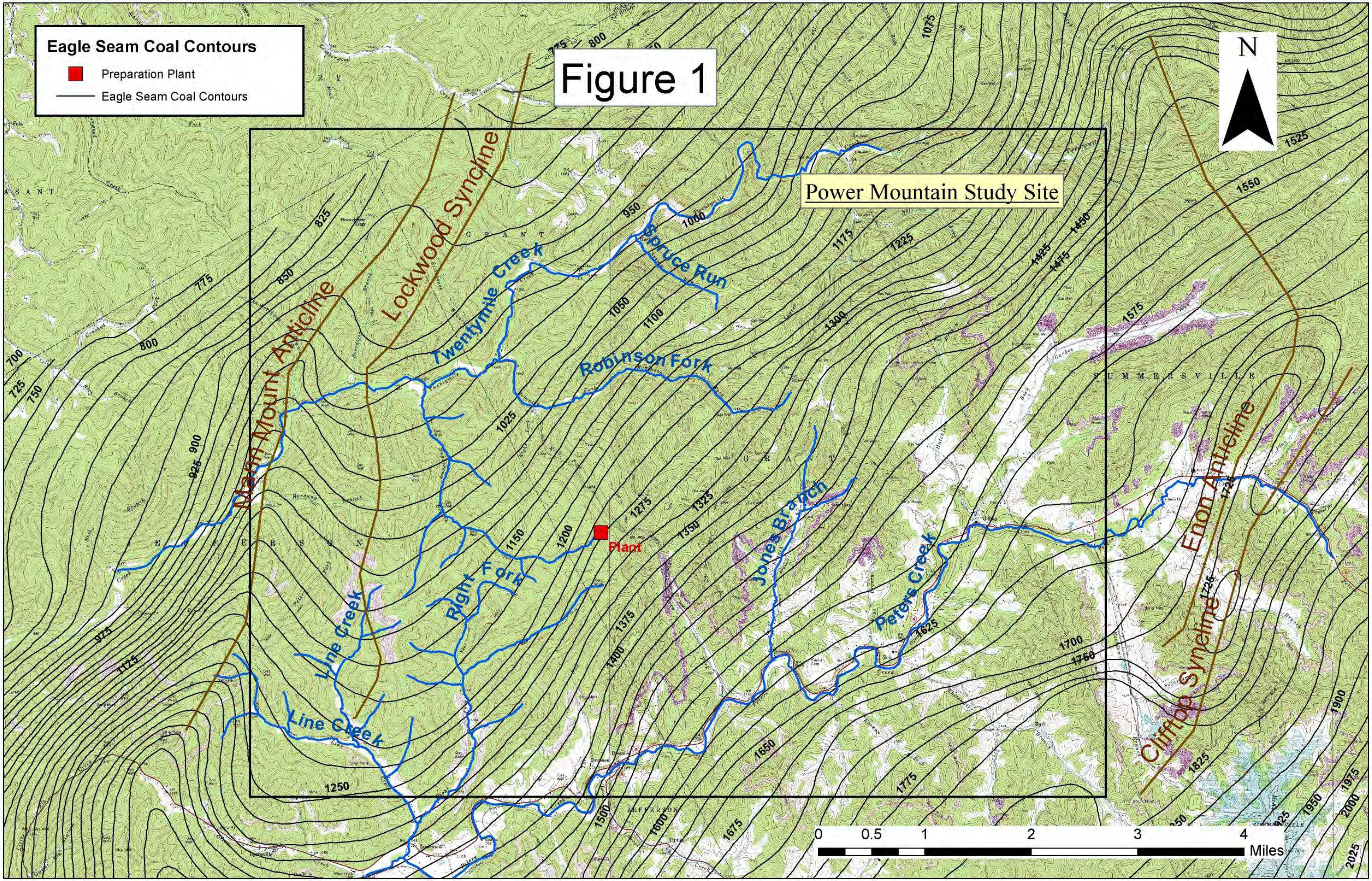
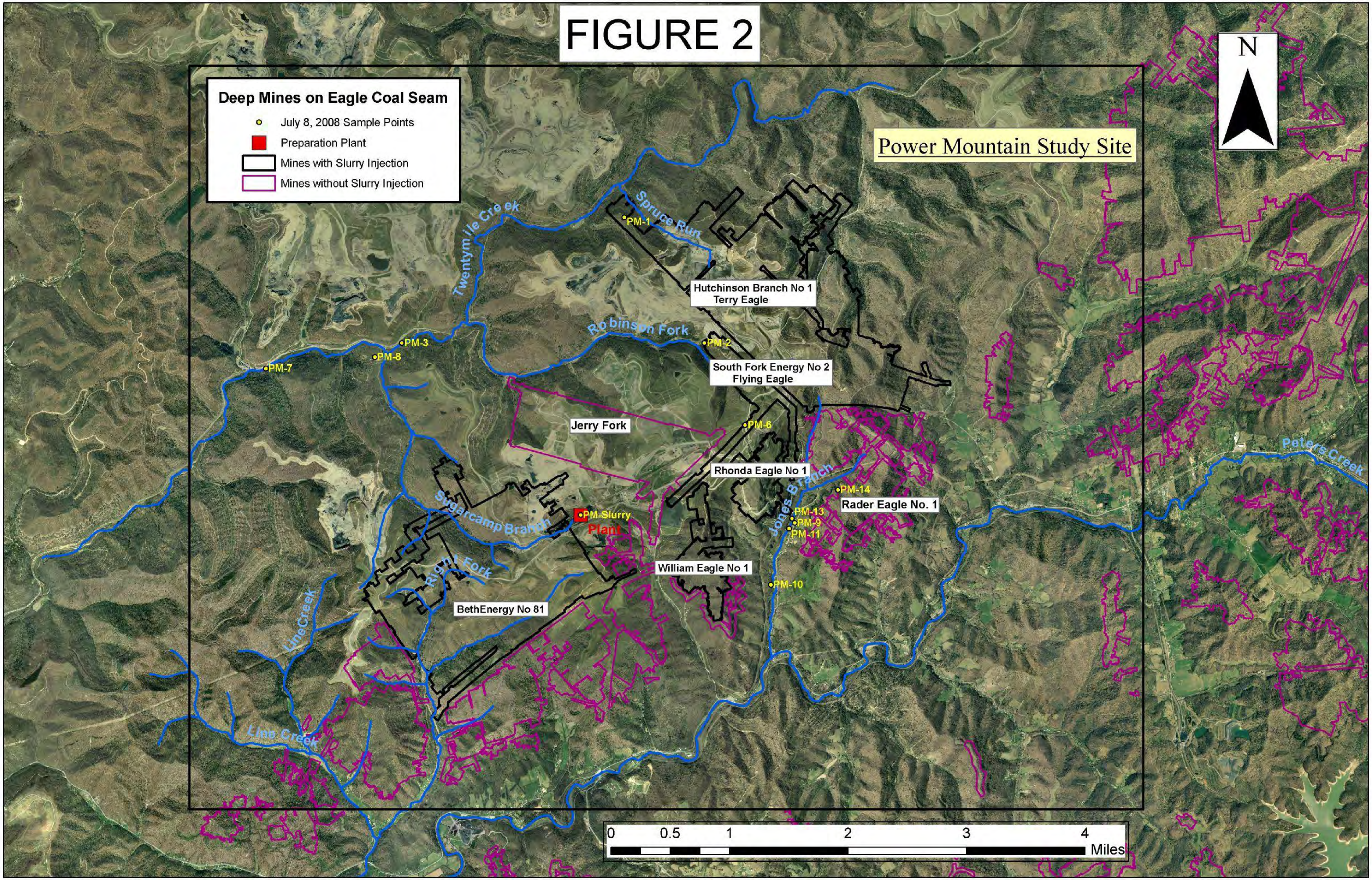


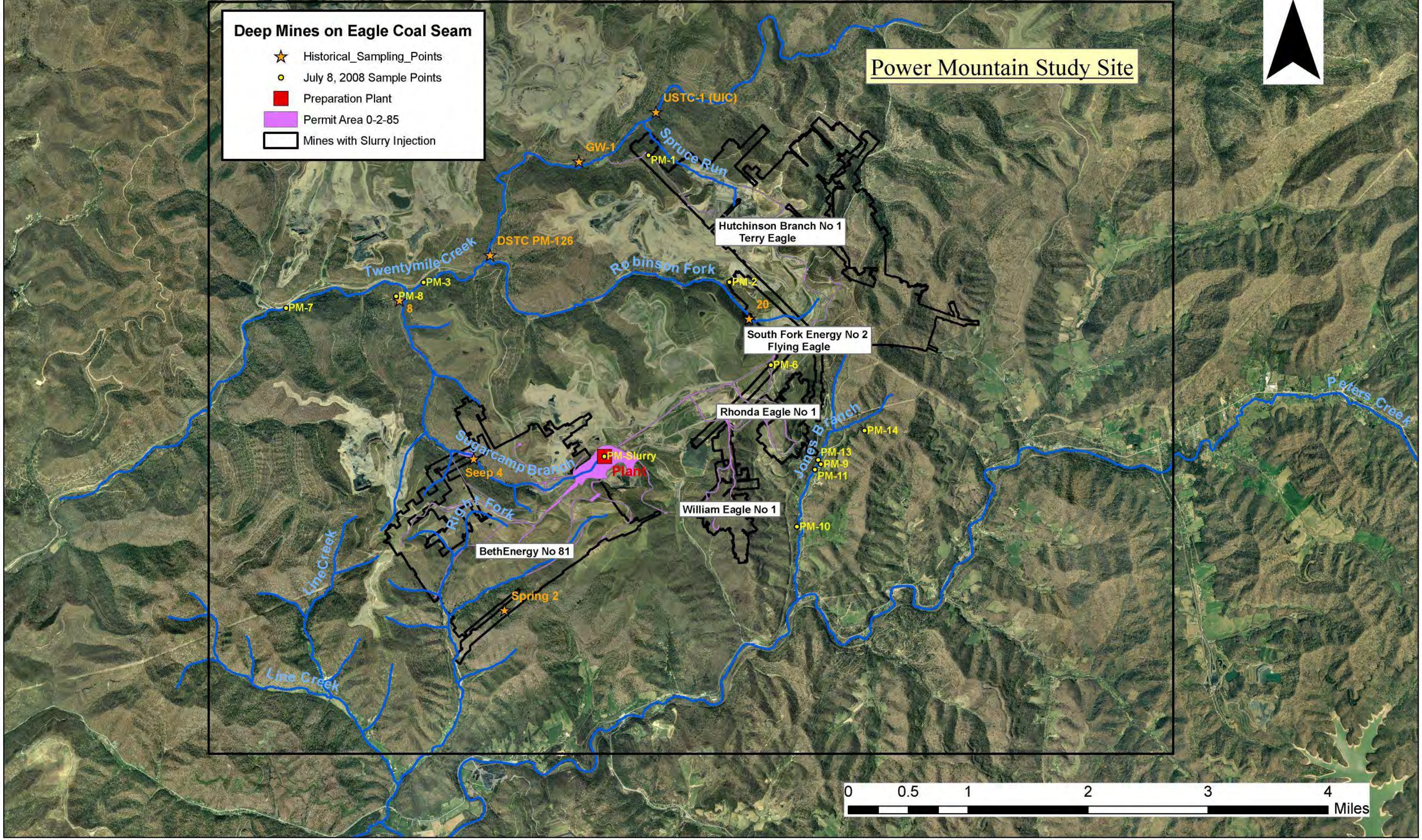
Figure 1
Eagle Seam Coal Contours
Preparation Plant
Eagle Seam Coal Contours
Power Mountain Study Site
Mann Mount Anticline
Lockwood Syncline
Twentymile Creek
Spruce Run
Robinson Fork
Right Fork
Line Creek
Line Creek
Jones Branch
Peters Creek
Plant
Enon Anticline
Clifftop Syncline
N
0 0.5 1 2 3 4 Miles

FIGURE 2



Deep Mines on Eagle Coal Seam
July 8, 2008 Sample Points
Preparation Plant
Mines with Slurry Injection
Mines without Slurry Injection
Power Mountain Study Site
N
Spruce Run
Twentymile Creek
Robinson Fork
PM-1
PM-2
PM-3
PM-6
PM-7
PM-8
PM-9
PM-10
PM-11
PM-13
PM-14
PM-Slurry
Plant
Hutchinson Branch No 1
Terry Eagle
South Fork Energy No 2
Flying Eagle
Jerry Fork
Rhonda Eagle No 1
Rader Eagle No. 1
Jones Branch
Peters Creek
Sugarcamp Branch
Right Fork
William Eagle No 1
BethEnergy No 81
Line Creek
0 0.5 1 2 3 4
Miles

FIGURE 3


Deep Mines on Eagle Coal Seam
Historical_Sampling_Points
July 8, 2008 Sample Points
Preparation Plant
Permit Area 0-2-85
Mines with Slurry Injection
Power Mountain Study Site
N
USTC-1 (UIC)
GW-1
PM-1
Spruce Run
Hutchinson Branch No 1
Terry Eagle
DSTC PM-126
Twentymile Creek
Robinson Fork
PM-3
PM-2
PM-8
8
PM-7
20
South Fork Energy No 2
Flying Eagle
PM-6
Rhonda Eagle No 1
Jones Branch
PM-14
Peters Creek
Sugarcamp Branch
PM-Slurry
Plant
Seep 4
PM-13
PM-9
PM-11
Right Fork
William Eagle No 1
PM-10
BethEnergy No 81
Line Creek
Spring 2
Line Creek
0
0.5
1
2
3
4
Miles

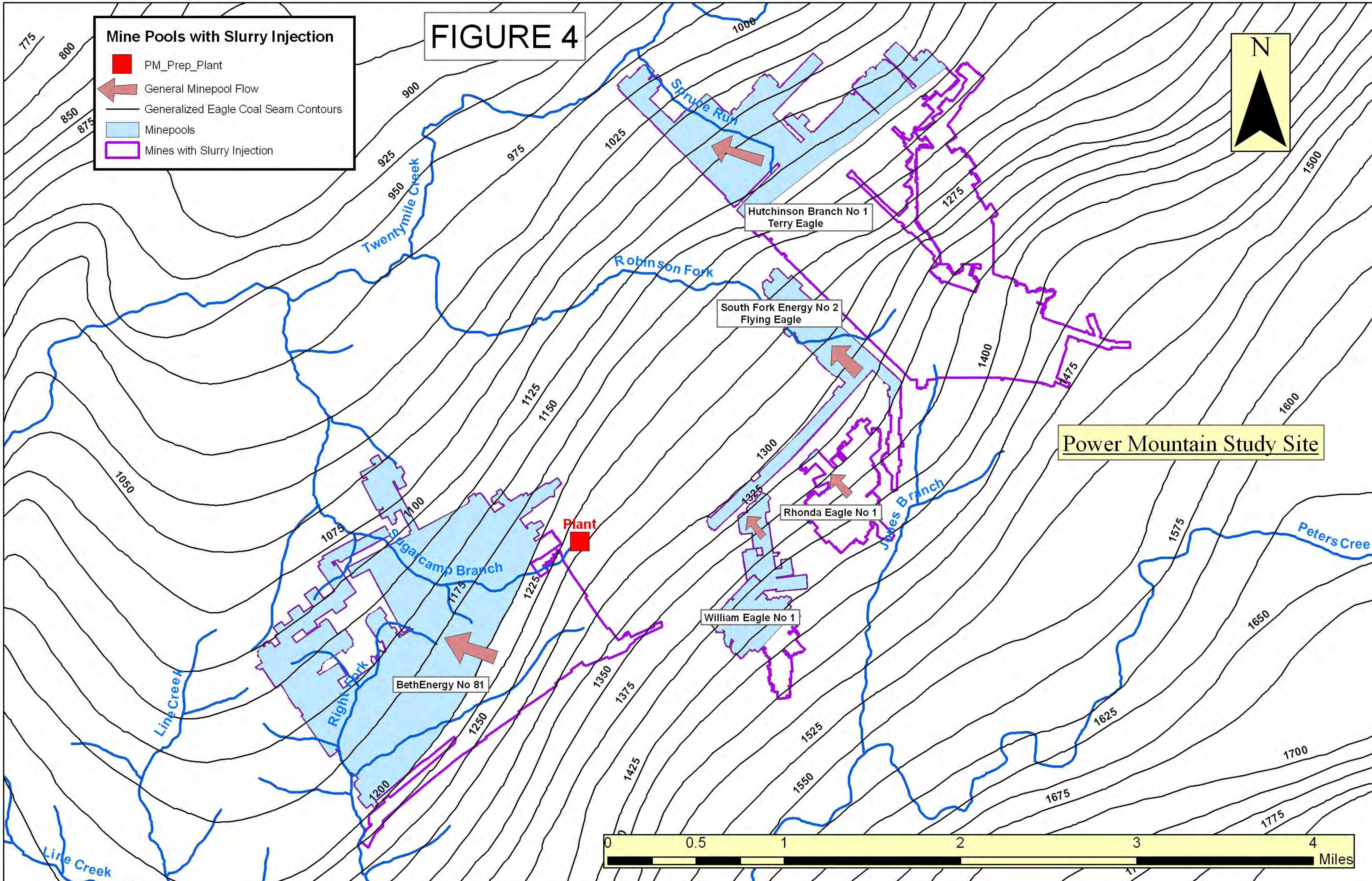


FIGURE 4
Mine Pools with Slurry Injection
PM_Prep_Plant
General Minepool Flow
Generalized Eagle Coal Seam Contours
Minepools
Mines with Slurry Injection
Power Mountain Study Site
N
Hutchinson Branch No 1
Terry Eagle
South Fork Energy No 2
Flying Eagle
Rhonda Eagle No 1
William Eagle No 1
BethEnergy No 81
Plant
Spruce Run
Twentymile Creek
Robinson Fork
Sugarcamp Branch
Right Fork
Line Creek
Jones Branch
Peters Creek
0
0.5
1
2
3
4
Miles

POWER MOUNTAIN HYDROLOGIC ASSESSMENT

Nancy Pointon, Office of Surface Mining

April 27. 2009

This study, named the Power Mountain Hydrologic Site Assessment, includes a detailed hydrogeologic evaluation of the migration of coal slurry and its constituents from injection wells into the ground and surface waters. The Power Mountain Site Assessment is part of a larger comprehensive study on the potential effects of underground injection of coal slurry on the environment and human health authorized by Senate Concurrent Resolution No. 15 (SCR-15).

Site Location and General Setting

The Power Mountain hydrologic assessment site is located in central West Virginia, saddled between Jefferson and Grant Districts in Nicholas County. The study site includes deep mine complexes on the Eagle coal seam where coal slurry is currently and previously been injected in abandoned mine workings. It also includes the surrounding surface and groundwater resources that could be impacted by the slurry injection activities. Figures 1, 2 3 and 4 delineate the boundaries of the study site. The figures and tables referenced in this report are located in separate sections in the back of this report.

Topographically, the site lies between two drainage features; to the north is the Twentymile Creek Watershed and to the south is the Peters Creek watershed. Both watersheds drain into the Gauley River which combines with the New River to form the Kanawha River.

Geomorphologically, Nicholas County lies within the Appalachian Plateau Physiographic Province. The area is characterized by steeply incised valleys and adjacent ridges. Generally, the strata consist of sandstones, siltstones, shales, coals and coal underclays.

Structurally, the study area lies between two sets of large geologic features. To the west is the Lockwood Syncline paired with the Mann Mount Anticline and to the East is the Enon Anticline and Clifftop Syncline. Structure contours on the Eagle Coal are depicted on Figure 1 in addition to the geologic structural features noted above. Dip of the coal and the overlying strata within the study area is to the Northwest at three percent (1.7 degree) with local variations.

The deep mine complexes within the study site are located south of the "hinge line" which is a term that represents the boundary between the northern and southern coal fields of West Virginia. The southern coal field is generally of higher overall quality; higher rank and heating value and lower sulfur and ash contents than the younger coals of the northern field. (Coal & Coal Mining in West Virginia, 1974, Coal-Geology Bulletin No.2, by James A. Barlow). All of the five deep mine complexes receiving coal slurry are located on the Eagle Coal Seam. The Eagle Coal is of Pennsylvanian age and from the Kanawha Group of the Pottsville Series. It is an exceedingly pure coal, being high in volatile matter and very low in sulphur, ash, and phosphorus. (West Virginia Geological Survey, Nicholas County Reports, 1921).

The overlying Sugar Camp/ Winifred Mine complex, which is discussed in this report, is located within the Winifred Coal. It too is from the Kanawha Group of the Pottsville Series. In this locality, the Winifred is approximately 550 feet stratigraphically above the Eagle Coal. Its quality is similar to the Eagle Coal, high in volatile matter and low in sulphur, phosphorus and ash. (Nicholas County Report). Table 1 depicts the coal stratigraphy of the Study Area.

Mining and associated coal slurry disposal

Power Mountain Coal Company (company) operates the coal preparation plant, known as the High Power Mountain Preparation Plant. As part of the operations at the plant, the company has been approved to inject coal slurry into five separate abandoned deep mines. The plant was initially permitted to Bethlehem Mines Corporation on January 7, 1985, then transferred to Power Mountain Coal Company on February 19, 1998. Currently, the plant processes the Five Block, Coalburg, Winifrede and Stockton coal seams. Coarse coal refuse from the preparation plan is disposed of at a coal refuse disposal area located in the Sugarcamp Branch watershed, part of the Twentymile Creek watershed. A recently permitted coal slurry impoundment at Sugarcamp Branch was activated in the summer of 2008.

Authorization from the West Virginia Department of Environmental Resources (WVDEP) to inject coal slurry into abandoned mine sites is provided through several regulatory programs and permits. Underground Injection Control (UIC) Permit Number 0199-99-067 authorizes the injection of slurry into 5 separate Eagle seam mine complexes and was originally issued in July of 2000. The UIC permit was recently renewed in September of 2007. UIC permit 0597-03-067 was processed in 2007 but never issued to allow for the injection of coal slurry into the Sugarcamp Winifred Mine. That mine is located on the Winifred coal seam and there is no documentation that injection has ever occurred. Since injection has never been initiated, no further analysis of the mine is necessary for this report.

The West Virginia Coal Mining and Reclamation Act (WVCMRA) permit O-2-85 and U007085 as well as NPDES WV0090603 provides authorization from WVDEP to inject slurry into the deep mines. These permits cover the activities related to the preparation plant and injection into the deep mines. Permit Number O-2-85 authorized the activities associated with the preparation plant and the support facilities such as roads, ponds, and coal stockpiles. This permit also covers the approvals for fine coal slurry injection in abandoned deep mines. Access roads, injection boreholes, and monitoring wells are all covered under Permit O-2-85. The outline of the permit area for O-2-85 is shown on Figure 3.

This area of Nicholas County has been heavily coal mined by both the surface and deep mine methods. The study site includes numerous deep mine complexes on the Eagle Coal and a couple on the Winifred Coal. Large surface mines are located within the site including mountain- top removal operations and valley fills. Numerous mineable coal seams exist in this area. The coal seams that have been mountain top mined are the Coalburg seam up through the Five Block. Table 1, found in the section labeled Tables, shows the generalized stratigraphic section with the relative location of the coal seams and their regional intervals.

Of primary importance to this study are the five deep mine complexes where injected coal slurry from the preparation plant occurred intermittently from 1993 to 2007. WVDEP, UIC Permits provide documentation for injection activities occurring from July 2000 to November 2007. The deep mines where injection occurred are South Fork Energy No 2/ Flying Eagle, Beth Energy Mine 81, Hutchinson/ Terry Eagle, Rhonda Eagle and William Eagle which are all located within the Eagle coal seam as the name suggests. Figure 2, outlines numerous deep mine complexes superimposed on an aerial photograph of the study area. The figure clearly shows the extensive concentration of mining activities in the area.

INDIVIDUAL HYDROGEOLOGIC EVALUATIONS:

In order to attain the objectives set forth in the study, two essential evaluations must be performed.

(1) Evaluate the potential for a surface discharge from each underground mine which received slurry through injection and determine the impacts the discharge will have on the receiving stream.

(2) Evaluate the potential for mine pool water migration into the surrounding groundwater and determine the impacts from the migration.

Using background data, post-mining pool elevations, the surface topography and the mine/ slurry injection plans, areas have been identified which have the potential to develop surface discharges. Assessing the potential for mine pool migration from the mine to the groundwater is a more difficult task, which requires a considerable amount of site specific information much of which is not available.

Below is a summary of each individual deep mine describing the mining and slurry injection activities and site specific hydrologic information regarding the mine pools. Figure 4 shows the areal extent of the deep mines that received slurry and their mine pool extent based on the maximum mine pool level authorized in the underground injection permits. These levels may not reflect current pool conditions.

South Fork Energy/ Flying Eagle Deep Mine

The South Fork Energy No 2/ Flying Eagle Deep Mine is a room and pillar deep mine located on the Eagle Coal Seam which was deep mined between June of 1996 and October of 1999. The areal extent of the deep mine workings is approximately 300 acres. Alex Energy, a subsidiary of Massey Coal is currently the permittee. An Incidental Boundary Revision to the permit, IBR No. 12, was approved January of 2005 which authorized the fine coal refuse disposal through four (4) injection holes FE-A, FE-B, FE-C and FE-D. Additionally, four monitoring wells FE-MW-1 through FE-MW-4 and one dewatering hole FE-DH-1 were approved. The monitoring wells are drilled and installed in the mine to monitor the mine pool level and the migration of the fine coal slurry during the injection process. Based on monitoring reports submitted by the company under the UIC permit, injection occurred during the years 2005, 2006 and 2007.

This mine is a "mostly below drainage mine" where the majority of the coal seam is at an elevation lower than the topographic drainage features with the exception of a drift entry or entries located at or near the outcrop. The UIC permit designates a maximum mine pool elevation. The purpose in setting the maximum mine pool elevation is to prevent leakage from the mine pool and or the fine slurry to the surface. An elevation of 1350' above mean sea level (a.m.s.l.) was designated for this mine.

Details on the Mine Pool Hydrology are as follows:

Mine Floor elevations - 1180' - 1405' [elevations are based on mine maps rather than the generalized regional contours]

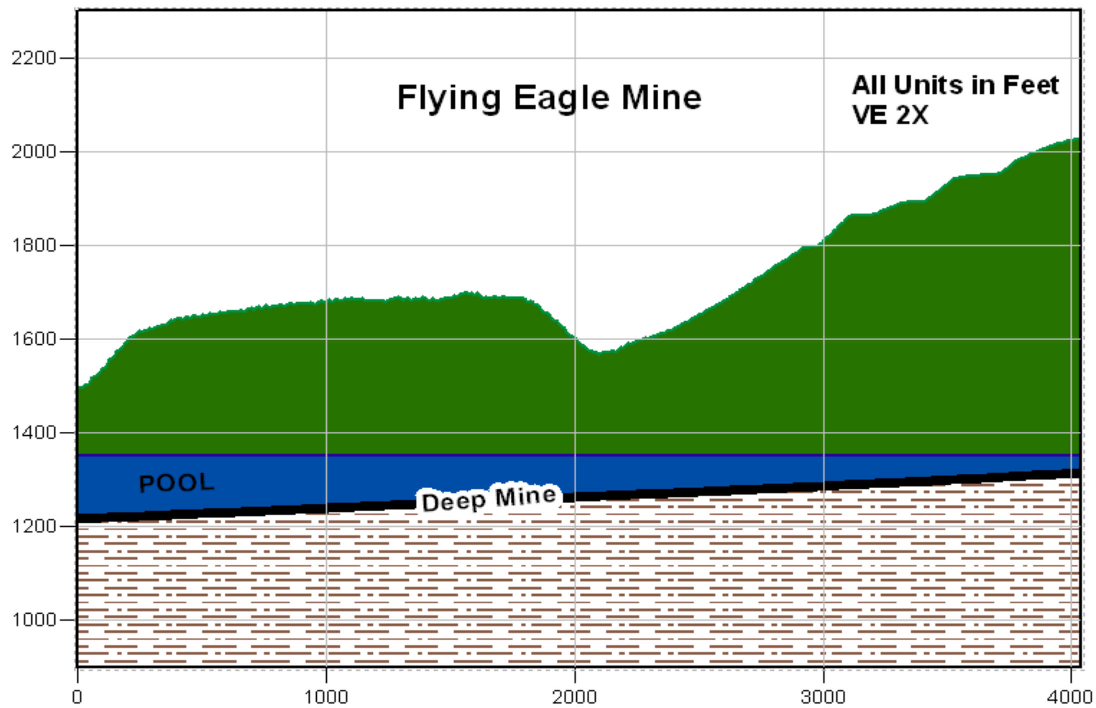
Depth to Mine Floor from surface – 0 - 690'

Maximum pool elevation – 1350' (based on UIC permit)

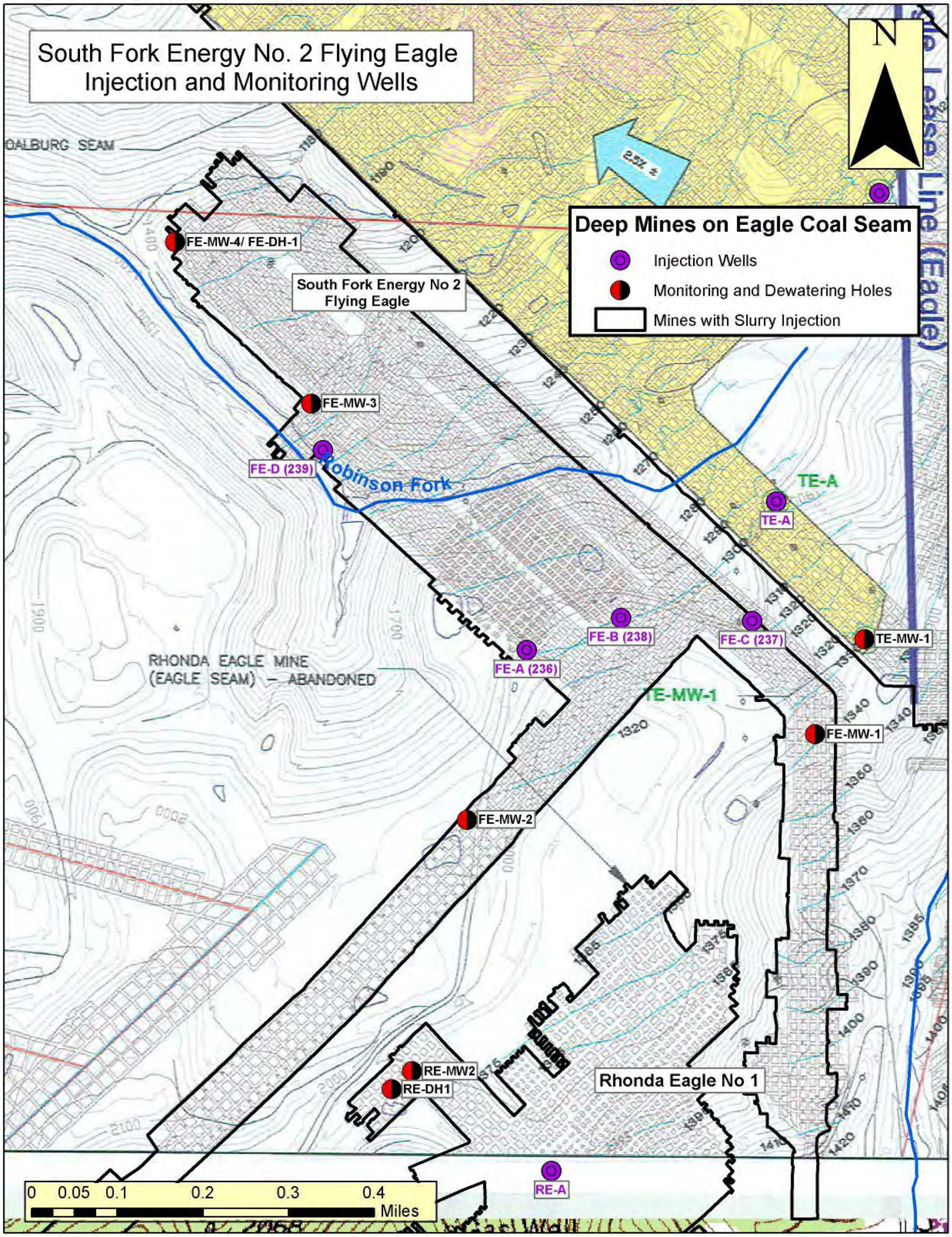
Injection Wells – 4 wells - FE-A (236), FE-B (238), FE-C (237), FE-D (239)

Monitoring Wells and Dewatering Wells – FE-MW-1, FE-MW-2, FE-MW-3, FE-MW-4, FE-DH-1

Water and slurry flow within the mine is inferred to move in a downdip direction, based on the local geologic structure. The downdip direction is generally to the northwest. The area for potential mine pool leakage to the surface is near the upper reaches of Robinson Fork. This location has the shallowest cover, and the greatest potential head within the mine. The cover is approximately 220' near the stream, which is at an elevation of 1400'. If the mine pool is maintained at an elevation of 1350' through pumping, there is no potential for seepage from the pool to the surface. If, however, the pool is not maintained at 1350', the mine could potentially fill to a maximum elevation of 1405'. If that would occur, there would be a significant potential for seepage near the upper reaches of Robinson Run. Additionally, once the mine becomes flooded, overflowing of mine water may occur at the drift opening (if not properly sealed). The opening is located within the upper valley of Jones Branch at an elevation of 1405'. Water quality impacts to Jones Branch would then become a concern. Based on the mine pool level measurement taken at FE-MW 2 in July of 2008, the mine pool was at 1345', below the 1350' target level. At this elevation there is little to no potential for seepage to the surface drainages (Robinson Fork).



Above is a schematic of a NW to SE oriented cross section of the Flying Eagle Deep Mine. The relative elevations of the coal mine, mine pool (based on level required by UIC permit) and the topography are shown.


South Fork Energy No. 2 Flying Eagle
Injection and Monitoring Wells
N
Deep Mines on Eagle Coal Seam
Injection Wells
Monitoring and Dewatering Holes
Mines with Slurry Injection
FE-MW-4/ FE-DH-1
South Fork Energy No 2
Flying Eagle
FE-MW-3
FE-D (239)
Robinson Fork
TE-A
TE-A
FE-B (238)
FE-C (237)
TE-MW-1
FE-A (236)
RHONDA EAGLE MINE
(EAGLE SEAM) - ABANDONED
TE-MW-1
FE-MW-1
FE-MW-2
RE-MW2
RE-DH1
Rhonda Eagle No 1
RE-A
0 0.05 0.1 0.2 0.3 0.4
Miles

Hutchinson Branch No 1 Deep Mine / Terry Eagle Deep Mine

The Hutchinson Branch No 1/ Terry Eagle Deep Mine is a completed room and pillar deep mine located on the Eagle Coal Seam. The areal extent of the deep mine workings is approximately 1800 acres. Alex Energy, a sister company to Power Mountain Coal is currently the responsible party of the mine complex. Based on a review of the permitting records, the mine was permitted in 1990 with deep mining activities completed prior to 2001. Slurry injection began late in 1993, which was then permitted and operated by Terry Eagle Coal Company under Permit No. U-3002-90. There is little documentation on the injection activities under Terry Eagle Coal Company.

In October of 2002, Power Mountain Coal Company, submitted an Incidental Boundary Revision (IBR 10) to the existing permit. The company proposed to add four slurry injection holes and two monitoring holes under IBR No. 10, which was approved December 2003. There was also a West Virginia Surface Mine Board decision dated March 2005 regarding this IBR. The Board's decision and the permit document placed specific conditions on the slurry injection operation.

Permit conditions required alkaline amendments to the coal slurry to ensure that the water in the mine would meet all applicable water quality standards. Other conditions included; the installation of a dewatering borehole to be used to maintain the mine pool elevation at 1140', the installation of a monitoring well placed between 1000 and 2000 feet updip from the dewatering hole, and the dismantling and grouting of the previous injection system of holes. The locations of the Dewatering hole TE-DH-1 and monitoring well TE-MW-3 are shown on the mine map following this narrative. One of the purposes for the conditions was to eliminate the possibility of artesian flow from the mine to the surface waters if sufficient head was allowed to occur.

Due to leasing arrangements between Alex Energy and Terry Eagle Coal Company (Fola), coal slurry injection was to be confined to the western portion of the mine which is operated by Alex Energy (Power Mountain). The company proposed to maintain the mine pool elevation at 1140', thereby confining the slurry to the area prescribed by the arrangement.

IBR No 14 approved the injection of coal slurry into three (3) additional holes. Based on the UIC monitoring data, Power Mountain injection activities began in 2005 and continued throughout 2006 and 2007. Injection of slurry in this mine is currently occurring sporadically and it is the only mine where injection is occurring within this site. Most of the slurry if not all of the slurry produced at the preparation plant is being placed in the coal slurry impoundment at Sugarcamp Branch.

Hutchinson/Terry Eagle Mine Pool Hydrology

Mine Floor elevations – 990' – 1465' [elevations are based on mine maps rather than the generalized regional contours]

Depth to Mine Floor from surface – 0 – 800'

Maximum Pool Elevation – 1140'

Injection Wells – TE-A (240), TE-B (241), TE-C (242), TE-D (243), TE-E (247), TE-F (248), TE-G (249)

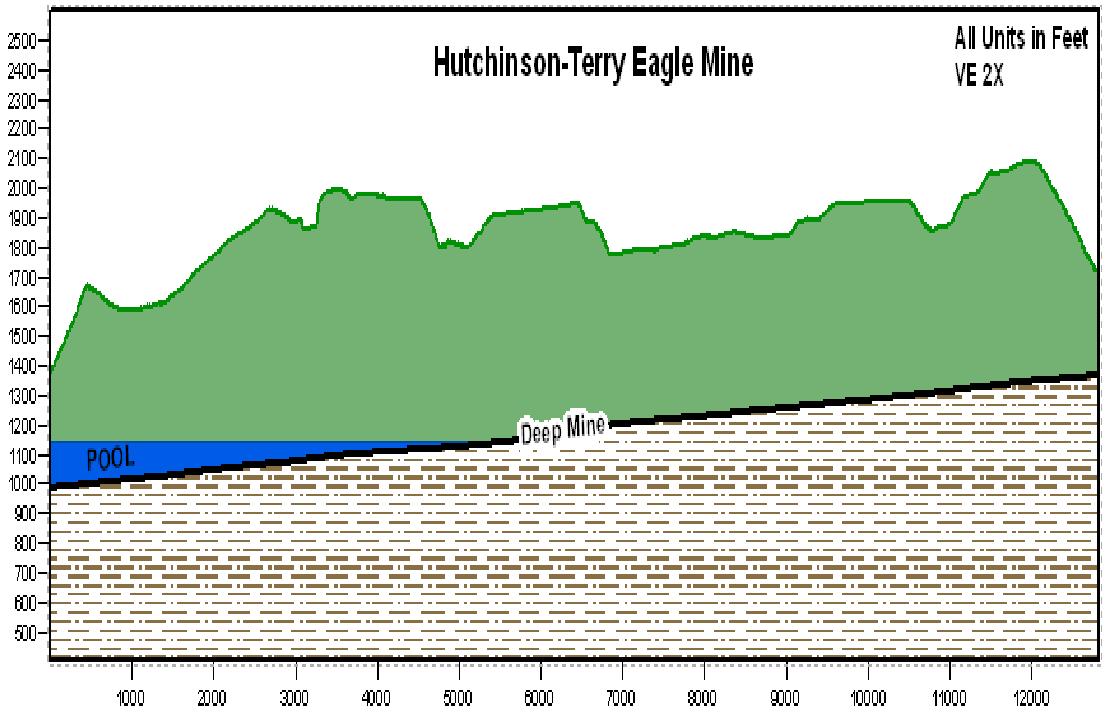
Monitoring Wells and Dewatering Wells – TE-MW-1, TE-MW-2, TE-MW-3, TE-DH-1

This mine is considered a "mostly below drainage mine" with two entries located at the surface within the upper valley of Jones Branch at elevations of 1460' and 1465'

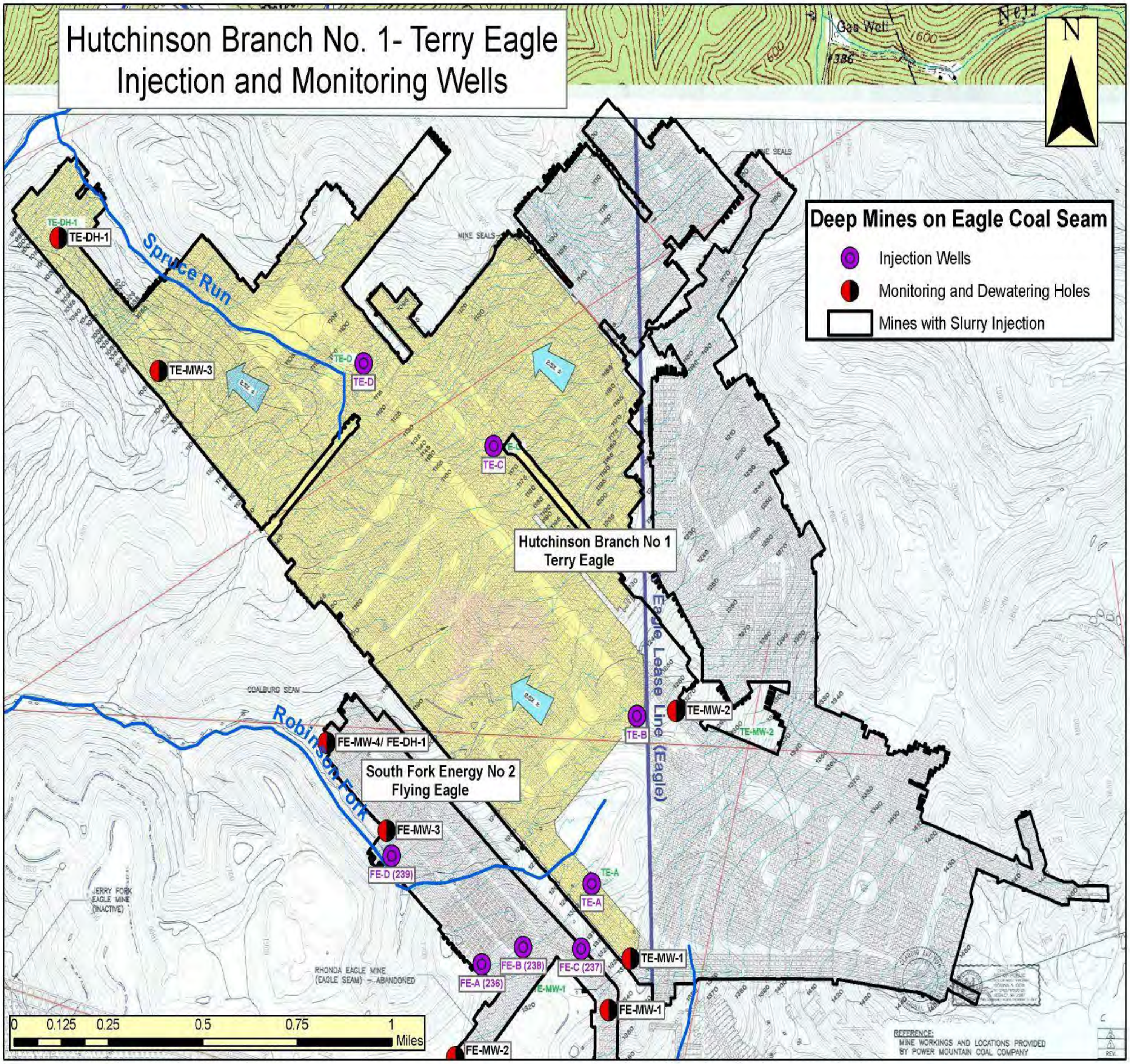
It is inferred, based on the coal structure, that infiltrating water which reaches the mine, flows generally in a northwest direction. During the July 2008 field investigation, pumping from the dewatering hole (DH-1) located in the most downgradient portion of the mine was actively occurring. During that same investigation, a measurement of the mine pool elevation was attempted at TE-MW1 (1390' - mine floor elevation) and found to be dry. The dry well was expected as the mine pool elevation is to be maintained below 1140'. Monitoring of the mine pool is required under the UIC permit. A review of the UIC annual report reveals that the pool had exceeded the maximum level by eight to nine feet during the winter season of 2007. According to the report injection activities were not occurring during those times.

The greatest potential for leakage from the mine pool is in an area near the confluence of Spruce Run and Twentymile Creek at a surface elevation of 1140'. This is where the edge of the mine workings is approximately 200 feet below and 400 feet horizontally from the stream. The potential mine pool head in that location is 150' if the pool is being maintained at the 1140' however, the head has the potential to be substantially greater if the pumping ceased and the mine were to naturally fill. Additionally, there is a potential for water to overflow from the pool to the surface via the surface entries. Such overflowing would result in discharges from the updip portion of the mine into Jones Branch.

Below is a NW to SE oriented cross section of the Terry Eagle Deep Mine. The relative elevations of the coal mine, mine pool (based on level required by UIC permit) and the topography are shown.



The Coalburg coal seam, which is located approximately 590 feet stratigraphically above the Eagle coal, was deep mined above portions of the Terry Eagle Mine. Given the amount of interburden between the two mines, it is expected that the overlying mine has very little influence on the amount of water infiltrating to the underlying Terry Eagle Mine.



Hutchinson Branch No. 1- Terry Eagle
Injection and Monitoring Wells
N
Deep Mines on Eagle Coal Seam
Injection Wells
Monitoring and Dewatering Holes
Mines with Slurry Injection
Spruce Run
Robinson Fork
TE-DH-1
TE-MW-3
TE-D
TE-C
TE-B
TE-A
TE-MW-2
TE-MW-1
Hutchinson Branch No 1
Terry Eagle
Eagle Lease Line (Eagle)
FE-MW-4/ FE-DH-1
South Fork Energy No 2
Flying Eagle
FE-MW-3
FE-D (239)
FE-A (236)
FE-B (238)
FE-C (237)
FE-MW-1
FE-MW-2
COALBURG SEAM
MINE SEALS
Gas Well
JERRY FORK EAGLE MINE (INACTIVE)
RHONDA EAGLE MINE (EAGLE SEAM) - ABANDONED
0 0.125 0.25 0.5 0.75 1
Miles
REFERENCE:
MINE WORKINGS AND LOCATIONS PROVIDED BY POWER MOUNTAIN COAL COMPANY

William Eagle Deep Mine

Deep mining activities in the Eagle coal seam occurred from 1974 through 1983. The mine is a room and pillar mine where second mining occurred throughout the central portion of the mine. The areal extent of the mine is approximately 290 acres. Currently the deep mine is not covered under a WVSCMRA permit, as it is closed. However, a discharge from the mine's wet seal is covered under NPDES Permit No. WV0091. A wet seal is a sealed mine opening with a pipe through the seal to allow the discharge of mine water while preventing the inflow of air.

In November of 2001 with the approval of IBR No. 6, Power Mountain received authorization to inject fine coal slurry into the mine.

On July 7, 2003 a surface water discharge exceeding allowable limits; specifically total suspended solids, occurred from the wet seal into Jones Branch. A violation was issued by the WVDEP. Shortly following that event, slurry injection into the mine ceased. Based on the UIC monitoring reports, injection activities only occurred in the year 2003.

William Eagle Mine Hydrology

Mine Floor elevations – 1365' – 1525' [elevations are based on mine maps rather than the generalized regional contours]

Depth to Mine Floor from surface – 0-625'

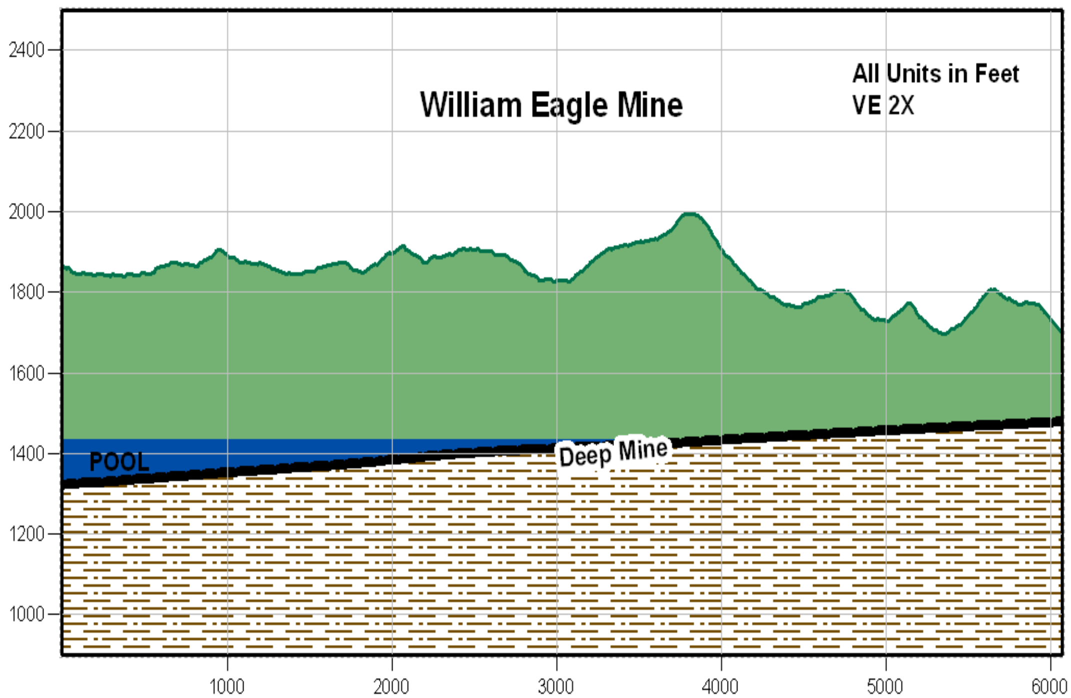
Maximum Mine Pool Elevation - 1435'

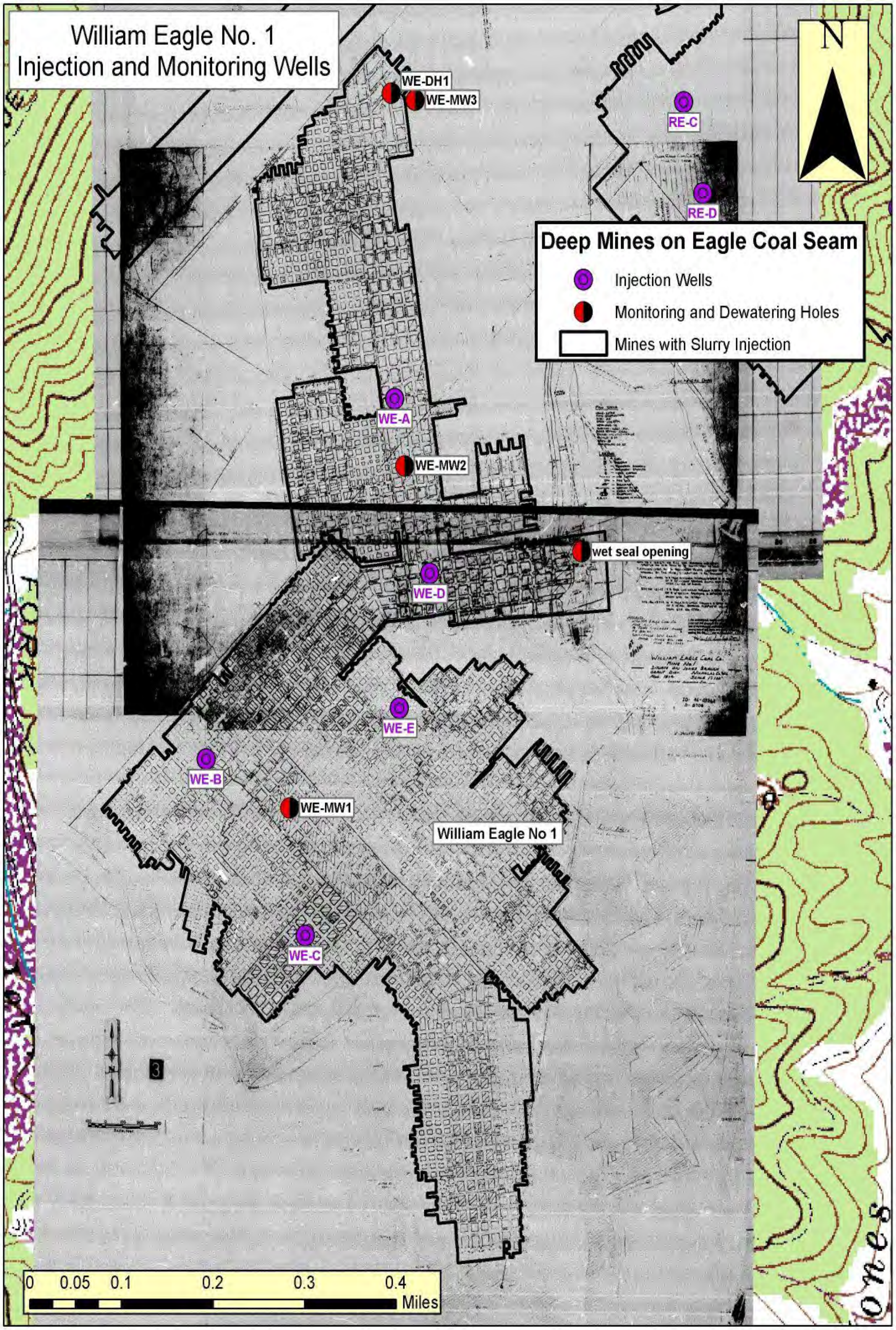
Injection Wells – WE-A, WE-B, WE-C, WE-D, WE-E.

Monitoring Wells and Dewatering Wells – WE- MW1, WE-MW2, WE-MW3, WE-DH1

The mine is a mostly below drainage mine with a wet seal opening located at the coal outcrop at an elevation of 1420'. The area of potential leakage from the mine pool to the surface water is the area of the wet seal which would discharge toward Jones Branch. The mine pool head in this location, if the pool is maintained at 1435', would be 30'and since the wet seal is at 1420', the pipe would be discharging toward Jones Branch. The pool is not being maintained by pumping. There is a discharge from the wet seal, which is being monitored in compliance with a NPDES permit which appears to be controlling the pool elevation. A review of the discharge reports shows a highly variable flow influenced by seasonality. The pH of the discharge is consistently alkaline (>7.0 Standard Units (SU)). This area was not investigated during the July field trip.

Below is an N to S oriented cross section of the William Eagle Deep Mine. The relative elevations of the coal mine, mine pool (based on level required by UIC permit) and topography are shown.




William Eagle No. 1
Injection and Monitoring Wells
WE-DH1
WE-MW3
RE-C
RE-D
Deep Mines on Eagle Coal Seam
Injection Wells
Monitoring and Dewatering Holes
Mines with Slurry Injection
WE-A
WE-MW2
wet seal opening
WE-D
WE-E
WE-B
WE-MW1
William Eagle No 1
WE-C
0 0.05 0.1 0.2 0.3 0.4
Miles

a

Rhonda Eagle Deep Mine

Deep mining of the Eagle coal seam within the Rhonda Eagle Mine began sometime after 1975. The mine, which is approximately 225 acres, is currently closed. During 2001, WVDEP issued a revision for Permit 0-2-85 which authorized the injection of slurry into the deep mine. According to the UIC discharge reports and annual report, injection occurred during 2003.

Details regarding the Rhonda Eagle Mine Hydrology are as follows:

Mine Floor Elevation – 1365' – 1435' [elevations are based on mine maps rather than the generalized regional contours]

Depth to Mine Floor – 0 – 660'

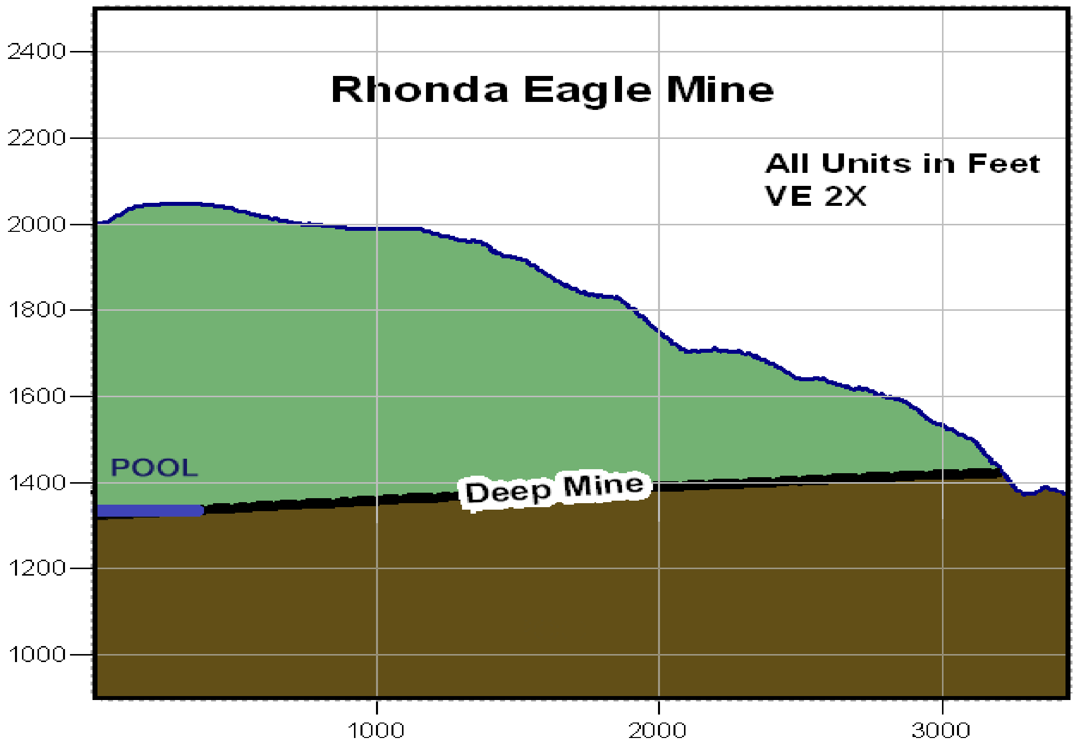
Maximum Pool Elevation – 1425'

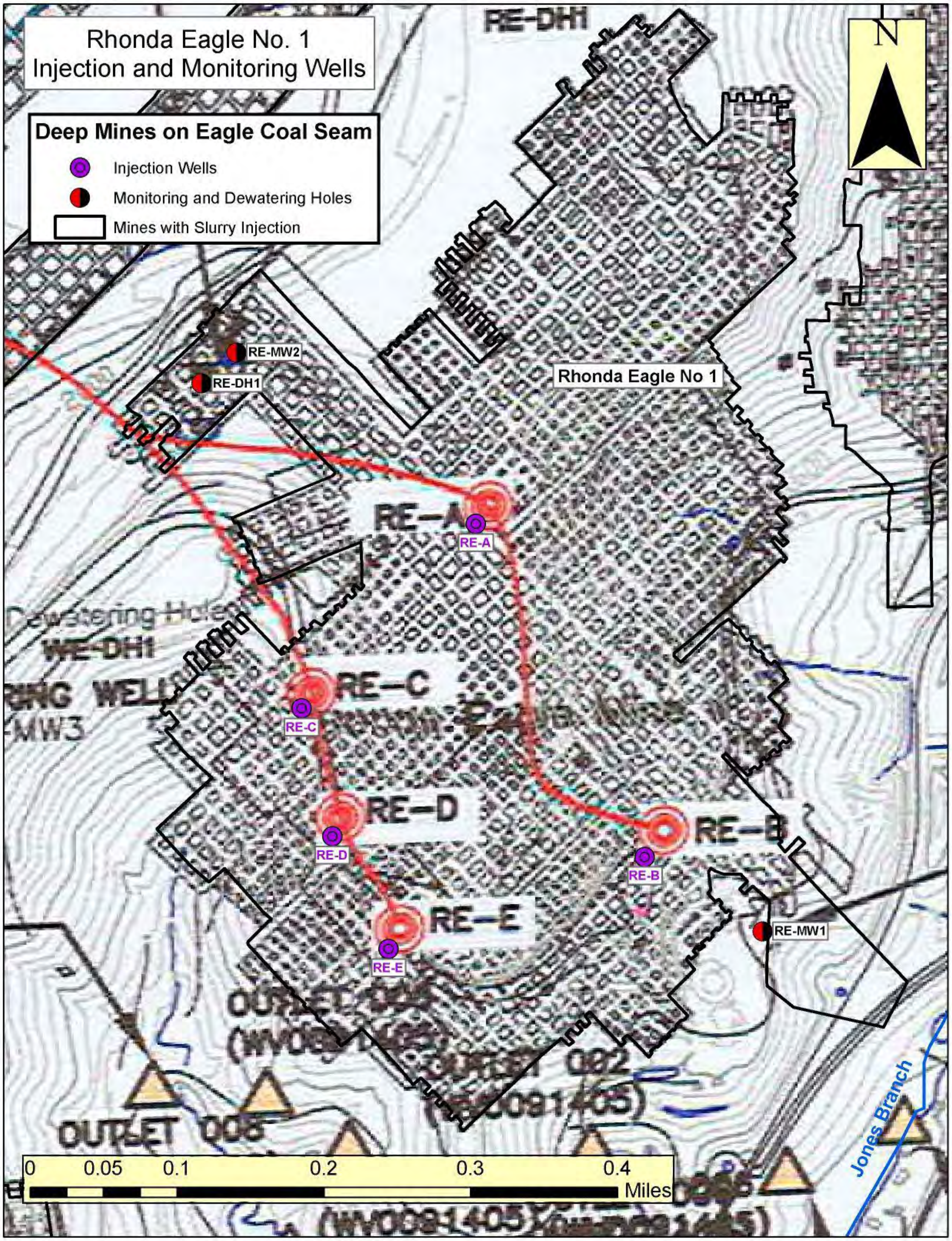
The injection holes were RE-A, RE-B, RE-C, RE-D, and RE-E

Dewatering hole and monitoring well – RE-MW1, RE-MW2, RE-DH1

Two portals to the mine are located along Jones Branch at an elevation of 1425' at the southern edge of the mine. This is the updip portion of the mine and is the location of the shallowest cover. Depending on the mine pool elevation, discharges could occur within the Jones Branch watershed. During the July field investigation and sampling event, a seep was collected in the vicinity of the entry prior to flowing into a treatment pond equipped with a lime dispensing wheel. The treatment pond also receives discharges from surface flow from the upslope coal transfer station. The pond discharge is monitored and regulated under a NPDES permit. Seepage near the mine entry indicates that the mine pool or portions of it is at or near the elevation of the entry. Because the injection activities are completed, the mine pool is not maintained at the elevation prescribed in the UIC permit, discharges to the surface can and do occur. Given the areal extent of the mine and a generally accepted recharge rate of 0.5 gpm, flow from the mine should be approximately 100 gpm on the average. There may be other discharge points unaccounted for.

Below is a NW to SE oriented cross section of the Rhonda Eagle Deep Mine. The relative elevations of the coal mine, mine pool (based on level required by UIC permit) and the topography are shown.





Rhonda Eagle No. 1
Injection and Monitoring Wells
Deep Mines on Eagle Coal Seam
Injection Wells
Monitoring and Dewatering Holes
Mines with Slurry Injection
N
RE-MW2
RE-DH1
Rhonda Eagle No 1
RE-A
RE-C
RE-D
RE-B
RE-E
RE-MW1
Jones Branch
0
0.05
0.1
0.2
0.3
0.4
Miles

Beth Energy Mine #81 Deep Mine

Bethlehem Energy mined the Eagle Coal seam at Mine #81 using the room and pillar method from 1985 until December 1991. The areal extent of the mine is approximately 1800 acres.

In February of 1994, WVDEP approved the application authorizing underground slurry injection activities into Mine No. 81. The activities were to be conducted in connection with the coal preparation plant permit. The permits were then subsequently transferred to Power Mountain Coal Company in February of 1998. IBR #4, #5, #11 and #13, issued between 1999 and 2003 approved additional injection boreholes and the relocation of boreholes.

Based on a review of the WVDEP documents and interviews with DEP personnel, the southernmost portion of Bethlehem #81 mine including the entry at Right Fork, tributary to Line Creek, was at times referred to as Mine No.131.

Of the five mines within the study area, this mine was the first to receive injected slurry and probably received more slurry than any other mine. Based on a review of the UIC annual reports, injection occurred from 2000 until 2004.

Details on the mine pool hydrology are as follows:

Mine Floor elevations – 1000’ – 1400’

Depth to Mine Floor from surface – 950’ – 0

Maximum Mine Pool Elevation – 1200’

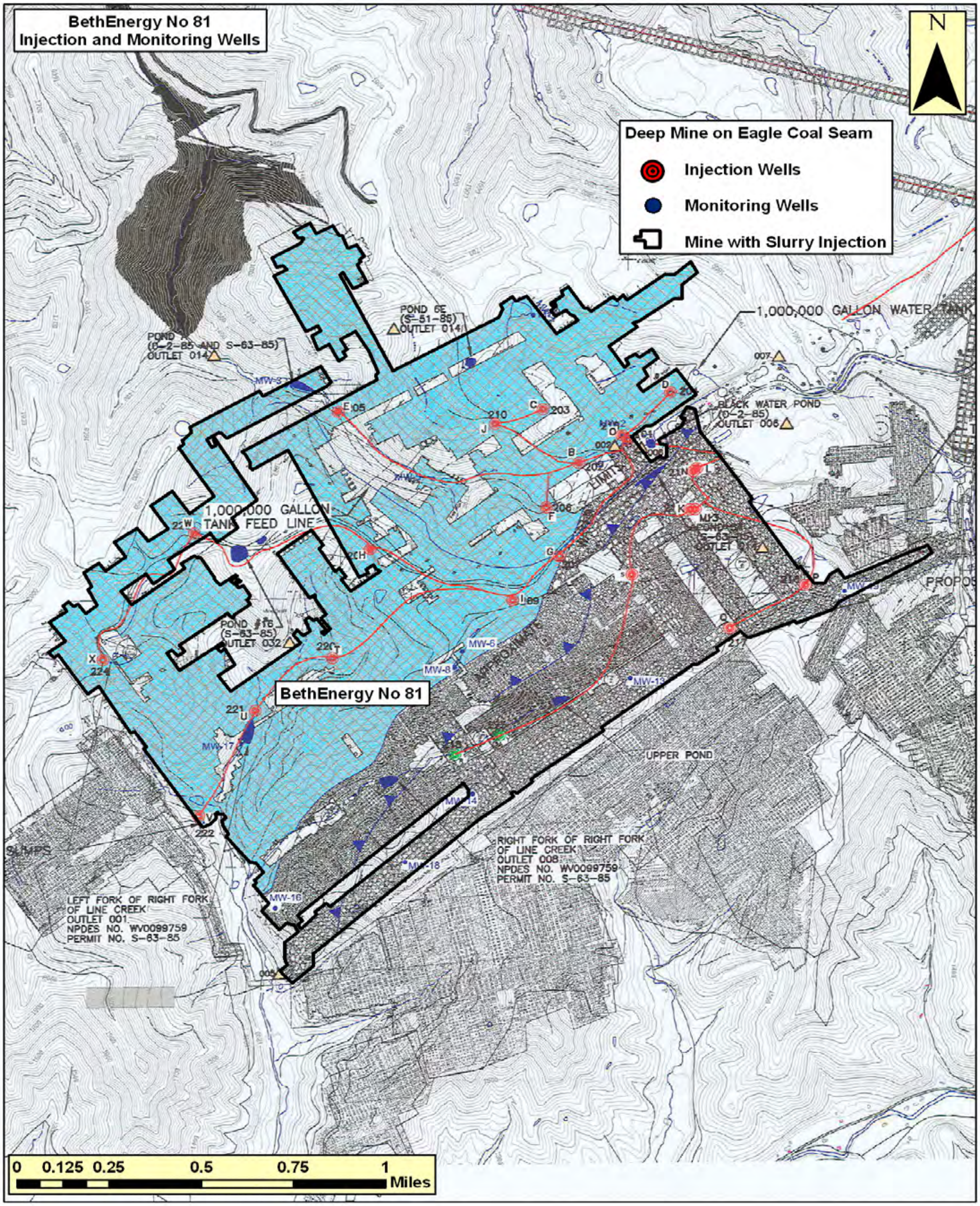
Injection Wells – 210, 211, 212, 213, 214, 219, 220 (based on UIC annual reports)

Monitoring Wells and Dewatering Wells – MW-3 (based on UIC annual reports)

The mine is a mostly below drainage mine. There are two main openings; one is located in the up dip portion of the mine near the surface coal outcrop at Jerry Fork, a tributary to Peters Creek at an elevation of 1400’. The other entry is located in the down dip portion of the mine near the outcrop at Right Fork, a tributary of Line Creek which drains to Peters Creek.

In January of 2003, a violation occurred regarding the injection of coal slurry into Mine #81. Coal slurry from the deep mine was seeping into the Right Fork of Line Creek in several locations along the stream. Coal slurry was also observed to be discharging from the sealed and backfilled portal located near the stream at Right Fork. Remedial action by the company was taken which resulted in the stoppage of discharges and seeps to the Right Fork. Based on a review of the violation report, remediation actions included ceasing the injection of slurry into the mine and the stabilization of the mine pool through pumping at an elevation that provided equilibrium to the “in place” slurry and mine pool.

A very limited assessment of this deep mine is included in the study as no sampling of the mine pool or surrounding surface and ground waters occurred during the July 2008 sampling event. During the planning stages of the study, the mine was sealed and all injection and monitoring wells were sealed and abandoned. These facts were considered in the decision to delete this site from the sampling event.



BethEnergy No 81
Injection and Monitoring Wells
N
Deep Mine on Eagle Coal Seam
Injection Wells
Monitoring Wells
Mine with Slurry Injection
BethEnergy No 81
1,000,000 GALLON WATER TANK
1,000,000 GALLON TANK FEED LINE
BLACK WATER POND (O-2-85) OUTLET 006
POND 6E (S-51-85) OUTLET 014
POND #16 (S-63-85) OUTLET 032
UPPER POND
RIGHT FORK OF RIGHT FORK OF LINE CREEK OUTLET 008 NPDES NO. WV0099759 PERMIT NO. S-63-85
LEFT FORK OF RIGHT FORK OF LINE CREEK OUTLET 001 NPDES NO. WV0099759 PERMIT NO. S-63-85
0 0.125 0.25 0.5 0.75 1 Miles

Background surface water chemistry and trends

A one-time sampling event and investigation, which occurred on July 8, 2009 was conducted as part of the Power Mountain Site assessment. The sample sites identifications and descriptions are shown on Table 2. A limited number of samples were collected during this study. It would have been beneficial to collect additional samples to demonstrate seasonal trends as well as spatial variability. A more complete water quality data set would have also bolstered the statistical strength of the data.

Surface Water Impacts – Twentymile Creek Watershed

Twenty mile Creek has had mining operations covering virtually the entire watershed. Surface, mountaintop, deep, auger and high wall mining have all occurred within the watershed. According to a Cumulative Hydrologic Impact Assessment (CHIA) Report written in 2004 by the WVDEP, greater than 175 mining sites over a period of 16 years have been in operation within the watershed. Approximately thirty to forty percent of the watershed is included in the study site; therefore, an estimated 60 mining sites may have occurred within the study site. Based on the hydrologic flow systems of the Hutchinson/Terry Eagle and the Flying Eagle, slurry injection activities have the potential to impact the quantity and quality of this watershed. However, due to the extensive mining history of the watershed, and the limited availability of site specific mining and water data, a determination of water quality impacts due solely to slurry injection on the watershed is tenuous.

Water monitoring data, associated with the numerous WVDEP permits, for the main branch of Twentymile Creek and Robinson Fork, a major tributary to Twentymile Creek, are available. Based on a cursory review of the data, some general statements on the water quality associated with coal mining within the watershed can be made. Most mining in the watershed when conducted properly produces alkaline water with little to no elevated metals; however, there are known overburden problem areas which have produced discharges requiring treatment. According to the 2004 CHIA report, increases in total dissolved solids and manganese concentrations have been the most significant water quality issues in the watershed.

As part of this study, the collection and analyses of several water samples on Twentymile Creek were attempted. Collection of a grab sample upgradient of TE-DH-1, the dewatering borehole for Terry Eagle mine, was attempted, however, it was inaccessible during the sampling event. The collection of a sample from the water supply at Twentymile Creek Church was also attempted however, the sample was not collected as the well was dry. These two sites were chosen because they are in the same location as previously established monitoring points USTC and GW-1.

Two samples were however, collected farther downstream on Twentymile Creek. PM-3 is located on the steam below the confluence with Robinson Fork and PM-7 is located below the confluence with Sugarcamp Creek. Figure 2 and Figure 3 show the location of these and all the sampling points collected during the July 8, 2008, Slurry Study sampling event.

Table 3 provides a comparison of recent water data for Twentymile Creek with historical data of the Creek from 1983 surface mining documents. Mining activities within the watershed during 1983 were not very extensive. Table 3 shows significant concentration increases in total dissolved solids, sulfate and alkalinity from the time period of 1983 to 2007. The 1983 sample point (#9) located in the vicinity of PM-7 shows sulfate concentrations below 100 mg/L while sample point PM-7 shows concentrations greater than 1200 mg/L. Table 3 provides the comparison water data for Twentymile Creek, while Table 4 provides the comparison data for Robinson Fork and Sugarcamp Creek. The complete analyses for all water samples are found in the separate Appendix II-O-4.

A Stiff diagram is a convenient way of displaying water chemistry The diagram itself is a symbol which represents the relative proportions of major cations and anions in the water. Simply stated it is a water fingerprint. Similar shapes illustrate similar chemical compositions and can be used as a tool in source determination. The affects of dilution are generally removed by Stiff diagrams. Figure B shows the stiff diagrams for the surface water samples. Their water quality can be characterized as strongly impacted from mining activities as evidenced by the elevated sulfate concentrations.

There were no organic compounds found in any of the surface water samples on Twentymile Creek (PM-3 and PM-7) nor were there organic compounds found in the surface sample taken near the mouth of Sugarcamp Creek (PM-8).

Sampling point PM-8 is located downslope of a large valley fill associated with a mountain top removal operation in addition to the preparation plant, a coarse coal refuse and a recently developed fine coal slurry impoundment. The coal slurry impoundment was not in operation at the time of the sampling. All these mining activities likely influence the water quality of this sampling point. Based on the very limited surface water sampling, no organic compounds were detected in Sugarcamp Branch downstream of the valley fill, coarse coal refuse and preparation plant. The water quality of the sample is alkaline with significant concentrations of total dissolved solids, 1380 mg/l and sulfate of 777 mg/L. Metal concentrations are relatively low with the exception of a manganese concentration of 2.1 mg/L.

In October of 1990, a blackwater discharge occurred at Sugarcamp Branch due to an overflow from a pond holding coal slurry. The discharge was ceased and remediation of the stream began within a day.

<u>Surface Water Impacts – Jones Branch, Right Branch, Line Creek and tributaries of Peters Creek</u>

As stated previously, a portion of Peters Creek is included in the study area. Specifically, Jones Branch and the Right Fork of Line Creek are located in areas that may receive drainage from several of the slurry injected deep mines. Water quality impacts from slurry injection at these deep mines may not be detected due to masking from the numerous other mining operations both past and present in surrounding areas.

A close examination of the Jones Branch watershed will help illustrate this condition. Based on several document searches, there are approximately eight inactive deep mines on the Eagle coal seam located within the Jones Branch watershed. Their locations are outlined on Figure 2. Four of the deep mines received slurry and are included in this assessment while four did not. Depending on the mine pool elevation, hydraulic gradient (head differences) and site-specific hydrogeologic conditions, all eight mines have the potential to discharge or leak mine water to the surface. Site specific data from all the mines are needed to determine the type and percent of water quality contribution from each mine on the receiving stream. Site-specific data, particularly mine pool conditions, including quantity and quality is not readily available for these deep mines. In fact, this type of information is very difficult to find in the permit documents. In addition to deep mine water quality contributions to the watershed, a coal transfer station with associated coal stockpiles and ponds are all located within the watershed. Previous surface mining on stratigraphically higher coal seams and their associated valley fills and ponds are also located within this watershed with both quantity and quality contributions to the receiving stream. Although the William Eagle, Rhonda Eagle, Flying Eagle and portions of Hutchinson/Terry Eagle have the potential to impact surface waters within the Jones Branch watershed, a determination of their impacts have not been made. Due to the conservation of time and resources, no water samples were collected in this location.

Beth Energy #81 is located structurally up dip of Right Fork of Line Creek; water flowing in the downdip direction from the mine pool has the potential to impact the water quality of the stream. Additionally, located midway upstream on the Right Fork is a drift entry to the mine. As mentioned in a previous section, black water discharges from Beth Energy #81 occurred in 2003 which impacted the Right Fork. Such events, where coal slurry flows out of the mine for short periods of time, have not been evaluated in this report. These events are relatively short and unanticipated.

For the same reasons discussed above, a determination of the impacts caused by slurry injection at Beth Energy #81 on the surface waters within Right Fork has not been determined. There are significant spatial and temporal water quality impacts in the watershed from mining activities, therefore distinguishing the impacts from deep mine slurry injection is not possible given the scope of this study.

Due to the conservation of time and resources, no water samples were collected in this location.

Mine Pool Water Characterization

Five water samples representing four separate mine pools were collected and analyzed as part of this study. The complete analyses for each water sample are found in the Appendix II-O-4. Approximately 50 inorganic and 125 organic parameters were analyzed. However, based on an evaluation of the data, only a limited number of parameters are of importance in discussing water quality impacts from slurry injection. Table 5 provides some of the water quality data from the July, 2008 sampling event for the mine pools.

In determining groundwater impacts solely from slurry injection, an evaluation of the water quality data in an upgradient portion of a mine pool and the downgradient portion of a mine pool after slurry injection occurred is very useful. Water data from PM-2 and PM-6 affords us this opportunity. PM-2 is a sample of the mine pool from the Flying Eagle deep mine taken from the dewatering borehole and PM- 6 is a sample taken from the monitoring well installed in the same mine pool located upgradient of the slurry injection. A review of the water quality data from these samples indicates that the TDS concentration for the downgradient sample, PM-2, is higher than the upgradient sample, PM-6. This is in part due to the increase in alkalinity concentrations. Water from PM-6, had a concentration of 377 mg/L while the downgradient concentration was 568 mg/L. Other parameters such as sulfate, sodium, dissolved iron, manganese and arsenic all increased in the downgradient sample. Table 5 shows the comparison data while Figure C illustrates the water chemistry.

Sampling of monitoring well PM-6 on July 8, 2008. Well is installed in the upgradient portion of the Flying Eagle deep mine.

The increase in TDS and alkalinity is likely the result of the alkaline addition which is part of the slurry injection procedure for this mine. Increases in the other parameters mentioned above may be due to the increased flow path of the water through the mine. The roof and floor rock may be contributing to the increased dissolved concentrations. This enrichment of the mine pool quality in downgradient portions of mine pools has been documented in several mine sites throughout WV and Southwest PA. [Eric Perry, Water Quality Trends in a Flooded 35 Year Old Mine Pool, 2005] However, leaching of coal slurry, based on its composition, also has the potential to increase dissolved solids concentrations in the mine pool. Therefore, the increase in TDS concentration in the downgradient portion of the pool is due to residence time, contacting strata, flow path and/or the injection slurry in the mine pool or a combination of both. Also, other waters within and outside the mine could be affecting the ultimate water quality.

The only organic compounds detected in any of the water samples, with the exception of a compound due to lab contamination*, is found in sample PM-6 which represents the Flying Eagle mine pool upgradient of the slurry injection. Low concentrations of benzene and toluene were found. This may be the result of leachate from the coal seam within the deep mine or remnants of equipment and or supplies left in the mine. Due to the upgradient location of the sample, it would appear that the slurry was not the source of the benzene and toluene concentrations. Coal is made up of many organic compounds particularly a group of compounds referred to as PAHs (Polycyclic Aromatic Hydrocarbons). These organic compounds make up oils, fuels, coals and tars and are ubiquitous in nature.

*REIC Labs which provided the lab analyses for all samples taken in support of this assessement, confirmed that the concentrations reported for the semi-volatile organic compound, Bis(2-ethylhexyl)phthalate were lab artifacts and not associated with the site samples.

PM-1 is a sample representing Terry Eagle mine pool located downgradient of the slurry injection. It shows very similar water quality to the downgradient sample of the Flying Eagle mine pool. The attached Stiff diagram, Figure C, shows both mine pools with very similar geochemistry. It can be characterized as a sodium-sulfate type water. As seen in this diagram, their shapes are the same and their water quality very similar.

PM- 13 is a water sample collected from a seep located downslope of a mine entry to the Rhonda Eagle deep mine. The seep flows into a treatment pond which discharges to Jones Branch. Water quality of PM-13 can be characterized as a calcium-sulfate type water, as shown on Figure D. The TDS concentration of the sample is greater than 1000 mg/L. Because the sample was taken near the updip location of the Rhonda Eagle mine, it is not clear whether the influence of the slurry injection is represented in the sample. Although the exact pathway of this sample is not known, its quality is characteristic of mine impacted water.

Sampling of the seep below the Rhonda Eagle deep mine above the treatment pond on July 8, 2008.

PM-14 is a sample collected from the collapsed entry of the Radar Eagle deep mine. No slurry injection activities occurred within this mine. This sample was collected to provide water quality data on an Eagle deep mine without the influence of slurry. Based on the Stiff analyses, Figure D, the water is a weak calcium-sulfate type. The water quality is alkaline and the concentrations of dissolved solids, sulfates, sodium and calcium are an order of magnitude lower than the concentrations found in the waters from the Flying Eagle, Terry Eagle and Rhonda Eagle mines. The water quality is indicative of ground water with little to no mining impacts. Based on the shallow cover in the vicinity of the mine where the sample was collected, PM-14 appears to have a short flow path, one that short circuits much of the mine. At shallow depths, vertical infiltration from overlying strata is usually the main source of recharge. With decreasing cover, a greater concentration and frequency of fractures occurs than at depth. Increased fractures allows for increased flow into and through the mine. Such short flow paths can account for the low concentration of total dissolved solids noted in the water quality data. This water may be decanting off the top of the mine pool.

Factors such as length of flow path, surrounding strata composition, type and amount of infiltrating (recharge) water and residence time, length of time water is in contact with the surrounding material all affect the types and amount of dissolved solids concentrations. When comparing and contrasting the water quality of various samples to determine impacts from coal slurry injection, these factors must be considered.

A review of some historical data on mine pool water quality for selected mines prior to slurry injection reveals lower TDS and sulfate concentrations than those shown in the recent sampling of mine pools post slurry injection. Table 6 outlines mine pool data for the Terry Eagle and William Eagle mines before, during and after injection activities. The table also shows water data for the mine pool at the Jerry Fork Mine, an adjacent mine on the Eagle coal seam where slurry injection did not occur. Water quality of the Jerry Fork Mine shows lower sulfate and TDS concentrations than those noted in the samples representative of slurry injection. Based solely on these historical data, slurry injection increases the total dissolved solids and sulfate concentrations in mine pool water quality.

In summary, a review of the water quality data available for the mine pools concludes that slurry injection activities increases the concentrations of total dissolved solids and sulfates.

Background groundwater chemistry data and trends

A total of 8 groundwater sampling points were collected as part of the Coal Slurry Study, 5 represent mine pools while 3 represent private water supply wells.

Private Water Supplies

Three private water supplies were sampled during the July 2008 sampling event. All three private water wells are located along Jones Branch and appear to be connected to the aquifer associated with the stream alluvium. Well construction data is not available for any of the wells and very little information on their depths was provided by the landowners. Table 8 shows the wells' general water quality. For a complete list of all parameters and concentrations analyzed see the Appendix II-O-4. There were no organic compounds detected in any of the wells and all inorganic parameters were within the Federal EPA primary drinking water standards. EPA drinking water standards do not apply as a regulatory measure to private wells but are used in this report for comparative purposes.

Based on the location of the wells in the stream valley and a general knowledge of private water wells in the coal regions of West Virginia, it is reasonable to assume that all or part of the water supplying the wells are from the stream alluvium. As outlined in previous sections, the stream receives drainage from numerous mining sources, these sources have the distinct potential to influence the quality of the alluvium and therefore the well water. There are approximately eight deep mines that are located in the recharge area of the stream and several surface mining sources. Determining the amount of influence from each source has not been attempted, however, a review of the available data may provide insight on mining impacts on the private water supplies.

There are some historical samples of a well located within the Twentymile Creek watershed in addition to a seep and a spring located in the Sugarcamp Branch watershed taken prior to mining activities. The church well is supplied by shallow groundwater as the water level was recorded at approximately 30 feet below surface in addition to the spring and seep. These data may be used for general comparison of shallow groundwater pre and post mining effects. The water quality of the historical groundwater samples are alkaline with low total dissolved solids and very low sulfate concentrations, less than 25 mg/l. Table 7 provides the comparison data.

PM-9 is a sample taken from the Naylor's well. According to the home owner, there is no treatment on the well and the depth is unknown. A stiff diagram of the well water is presented in Figure E. It is a magnesium-sulfate type water, which is slightly acidic with a pH of 6.0. Metal concentrations in the water are very low while sulfate concentrations appear to be slightly elevated (72 mg/L) from background levels. The background sulfate concentrations used for this comparison are those found on Table 7 and represent shallow groundwater within the study site. The type and composition of the well water is similar to mine water, however, the exact source of influence is not known.

PM-10 is a sample of the Corbett's well which is located the farthest downstream on Jones Branch. According to the home owner the well is between 40 to 60 feet deep, confirming that the well is completed through or partially completed through the stream's alluvium. The alkalinity concentration of the water is 177 mg/L with a pH of 7.7. Overall the metal concentrations are low. iron and manganese concentrations are slightly above the federal secondary drinking water quality standard and the sulfate concentrations were measured at non-detect. The water type, based on the Stiff diagram, as shown on Figure E, is a sodium-bicarbonate type water and is not characteristic of mine impacted water.

A sample of the well water from the Mullin's residence was collected and labeled PM-11. The home and well is located in close proximity to the Naylor's residence, however, its water quality is very different. The depth of the well is not known. According to the Mullins's residence, a water softener is used to treat the water. An attempt was made to collect the water sample prior to the treatment system. The water quality of the well can be characterized as a sodium-bicarbonate type based on the Stiff diagram. The alkalinity concentration of the water is 191 mg/L and the pH value is 7.4. All metal concentrations are very low. The sodium value was relatively high at 103 mg/L while the calcium and magnesium values were very low at 0.2 mg/L and non-detect respectively. This water type is often associated with treated water from a water softener. The well water quality is not characteristic of mine impacted water.

All of the private water wells sampled for this assessment were along Jones Branch which is upgradient of the subject mines. There was only one private water supply that was located on the down dip side of mining adjacent to the flooded sections and that was GW-1, Twentymile Church. As stated previously, the supply was not sampled because it was dry during the sampling event.

Groundwater Impacts from Slurry Injection

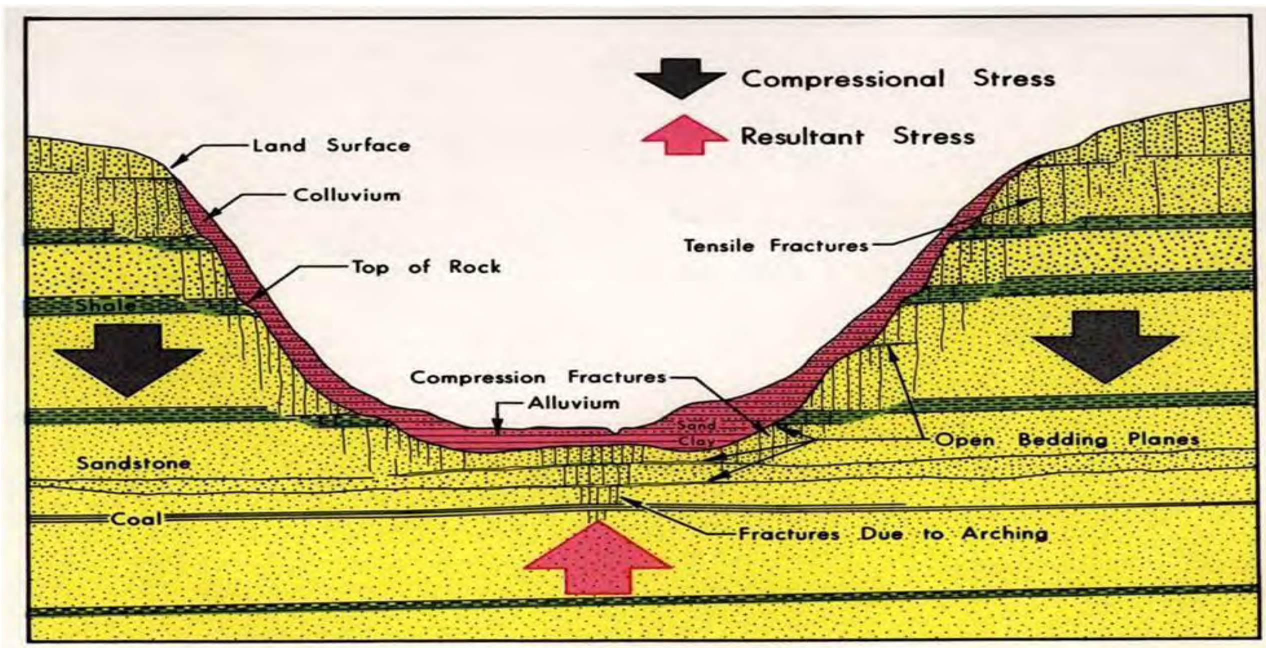
Assessing the potential for mine pool migration from the mine to the groundwater requires a considerable amount of site specific information. Generally aquifers in this region of West Virginia can be divided into several types; a) perched aquifers associated with coal seams and generally located within the hill and mountain tops, b) side hill and valley fracture zone systems c) alluvium aquifers associated with the stream valleys and d) deeper regional aquifers.

Most ground-water movement occurs through undisturbed strata through secondary permeability and porosity of fractures in the rock. There is evidence for the alluvium aquifer associated with Twentymile Creek and Jones Fork. There are documented private water wells along the stream valleys which obtain their water from the shallow aquifer associated with the stream. Slurry injection activities can impact these aquifers by impacting the mine pools quantity and quality. Injection of slurry fluids, if unchecked, increases the volume of water in the mine in addition to altering the water quality. The increased mine level may fill the mine, increase hydraulic head and ultimately overflow into stream valleys. Once in the stream valley the impacted mine water may infiltrate shallow aquifers through fractures. Migration of impacted mine water through slurry injection can occur in other ways. Impacted mine water may seep through the coal seam and or fractured overburden into the surrounding groundwater. These flow regimes are possible and probable to some degree at the five subject deep mine.

Migration of the slurry and/or its leachate can occur underground through the coal seam and or the overlying strata. Depending on the depth of the coal seam, the hydrologic properties of the mine pool and the competency of the strata, flow from the mine out to surrounding aquifers is possible. Most underground mine aquifers (pools) behave like confined aquifers (a very transmissive unit between two low-permeability units) and thus do not transmit much water into underlying or overlying units unless they are leaky aquitards (Hawkins and Dunn 2007).

Movement of mine water through the coal seam and the overburden is less likely the deeper the mine is. With increased depths, the frequency and intensity of fractures are decreased (Hawkins and others, 1996). Fractures formed by stress relief forces are generally found at depths less than 200 feet. These are most often associated with shallow groundwater flow in the Appalachian Plateau (Wyrick and Borchers, 1981). There are, however, fractures created through tectonic activity which provides secondary permeability in deeper bedrock and will facilitate water movement. Deeper aquifers generally have slower velocities and lower recharge rates than the shallow systems. The five subject deep mines have a significant portion of the workings below the surface and below the shallow fractured groundwater systems. These deep workings receive less infiltration from the surface and the water associated with them will have a longer residence time. Conceptually, waters associated with the deep mine workings are less likely to impact surrounding ground waters due to their slow velocities in addition to the low permeability of the rock formations surrounding the deeper parts of the pools. Therefore, it is less likely for the slurry and its constituents located in the deep pools to impact the surrounding ground waters. However, due to the minimal amount of data this study does not confirm this statement nor does it disprove it. Additional comprehensive and site specific investigations would be required which includes identification and monitoring of the surrounding ground waters.

Below is a generalized section showing a shallow fracture system and alluvium associated with valley bottom [after Ferguson (1974)]



<u>*Preparation Plant / Coal slurry and raw coal characterization*</u>

Fine coal slurry is the by-product of the coal preparation process. All preparation plants are designed to separate the non-combustible material from the coal and the use of selected chemicals facilitates this process. Power Mountain Preparation Plant is no exception, according to a company representative; the following chemicals are available at the plant and could be used or have been used in the recent past.

1. FLOERGER EM 533 - polymer
2. FLOMIN F 122 - 90% Hexanol and 10% Octanol
3. FLOMIN 54 WB - de-foamer (used infrequently)
4. REAGENT S-9628 - promoter
5. ANHYDROUS AMMONIA – pH control

All of the chemicals used at the plant must be approved in the UIC permit and have an accompanying MSDS sheet. For further descriptions of preparation plant processes and specific uses of these chemicals refer to the section labeled Preparation Plant in the General Report. Additionally, the use and importance of MSDS sheets in the regulation and permitting of slurry injection is also described in a separate section of the General Report.

Samples of the slurry and coal were collected at the plant during the July 8, 2008 sampling event. The coal was taken from a stockpile prior to processing and may represent the Five Block, Coalburg, Winifrede or Stockton coal seams. This is due to several mining operations supplying different coal seams to the Preparation Plant for processing. The slurry sample, which was 10 to 15% solid, was collected from the thickener underflow. The sample only represents the slurry that was produced at the time of the sampling and may not represent the slurry that was injected into the mines. The liquid phase of the sample was separated at the lab through settling of the solids and decanting of the liquid. The solid and liquid phase of the slurry was then analyzed separately. To further understand the composition of the slurry, a solid coal and a simulated coal leachate was also analyzed. The coal was crushed to a size similar to that of the slurry and mixed with deionized water for a period of 24 hours to produce a simulated coal leachate. For further explanation of the method used to simulate leachate from the coal, see Chapter 3, labeled Coal Slurry Characterization in the main report.

Summary tables for the solid and liquid phase of the coal slurry in addition to the solid coal and simulated coal leachate can be found in the section titled Coal Slurry Characterization in the General Report. The complete analytical results for all the samples are in the Appendix II-O-4.

Fine coal particles which are not separated during the preparation process become a component of the slurry which results in the similarity of coal and slurry composition. This is evidenced in the data tables showing organic compound concentrations in both the solid and liquid phase. Most of the organic compounds detected in the solid sample of the slurry and coal are part of a group of compounds associated with coal, fuels, oils and tars called PAHs (Polycyclic Aromatic Hydrocarbons). Most PAHs have an affinity for the solid phase rather than the liquid phase and this can be seen in the solid and liquid data. Only one organic compound, chloromethane, was detected in the slurry solid phase that was not detected in the coal solid phase. Chloromethane also known as methyl chloride was measured above the detection limit but below the lab's quantitation limit. It is a known solvent and lab extractant and not commonly found in coal. Such a low concentration may be a lab artifact. Ten tentatively identified compounds (TICs); the majority of them forms of Naphthalene, were measured in the solid slurry sample. Naphthalene is a common PAH and as stated above can be found in fuels and many chemicals. A TIC is a compound that can be seen by the analytical testing method, but its identity and concentration cannot be confirmed without further analytical investigation.

Based on the type of sampling conducted on the slurry and coal, the exact source of the organic compounds detected in the various phases of the material, cannot be identified. A more comprehensive set of data is necessary to identify the sources. A chemical fingerprint analyses which entails the review of organic compound rations from potential sources i.e. chemicals used at the preparation plant and the "samples in question" may be useful in the identification process if future studies are performed.

Generally, there were no detections of confirmed volatile organic or semi-volatile organic compounds found in the liquid phase of the slurry; however, there was a very low concentration of Total Petroleum Hydrocarbons (TPH) recorded at 0.26 mg/l. TPH is a gross quantity measurement without identification of its constituents. One TIC, identified as hexyl-silane, was documented at a very low concentration.

The results of the inorganic constituents for the solid phase of the slurry and coal were very similar. The solid sample showed iron, aluminum and calcium as the greatest proportion of the metal composition. Silver, antimony, selenium or thallium concentrations were not present in the solid phase of the slurry.

Results of the general chemistry and metal analyses for the liquid phase of the slurry is consistent with the mine pool data downgradient of slurry injection (PM-1 and PM-2). Generally, the water is alkaline with high concentrations of total dissolved solids and sulfate. Calcium, magnesium and sodium concentrations were relatively high, concentrations were 124.0, 81.4, and 236 mg/L. Other metal concentrations were relatively low with the exception of manganese at 0.9 mg/L and strontium at 1.6 mg/L.

The concentration and constituents found in the solid phase of the slurry are evaluated to determine the composition of the material; it does not consider the mobility or availability of the constituents in the environment, whereas the liquid phase provides data on those constituents that have been dissolved in water and can be mobilized in the environment. Based solely on the results of the coal characterization test, calcium, magnesium, sodium and manganese may be the most mobile constituents in the slurry.

Another set of data that is useful in the characterization of the slurry is the monthly monitoring data of the injectate which is required by the UIC permit. The liquid phase of the injectate is sampled and analyzed for a list of parameters and assigned permit limits based on EPA's Drinking Water Quality – Primary Standards. Observations based on a review of the UIC Annual Reports and Discharge Monitoring Reports (DMR) is outlined below. Additionally, Table 9 provides a summary of the permit limit exceedences with the sample concentrations and date of occurrence.

During November of 2000 to July 2001, monitoring of the coal slurry injectate showed numerous excursions from the concentration limits. The injectate exceeded the Total Petroleum Hydrocarbons concentration limit of 1.0 mg/L for the majority of the year and its concentration was significantly greater than the limit. The majority of the beryllium and chromium limit exceedences occurred during the same period of time and may be related to an additive used at the preparation plant. According to the annual report, no diesel fuel or any other hydrocarbon additive was in use at the preparation plant during this time.

The median pH of the injectate throughout the total monitored period is 7.3 with the values ranging from 6.3 to 8.4. Monitoring records are available from the year 2000 to 2007. The total dissolved solids (TDS) concentrations range from 274 mg/l to 2068 mg/l with a median concentration of 1072 mg/L. Manganese concentrations often exceeded the Federal Secondary Drinking Water Limit of 0.05 mg/L, although this is not a limit set in the permit.

November 2000 – July 2001

- Injection occurring at Mine #81
- DMR monthly reports show the following exceedences from the permit limits set on the injectate:
  Ten occurrences for TPH [Permit Limit = 1.0 mg/L] with six of the ten concentrations greater than 100 mg/L,
  Six occurrences for Beryllium [Permit Limit = 0.004 mg/L]
  Four for Chromium [Permit Limit = 0.1 mg/L]
  One for Lead [Permit Limit = 0.015 mg/L]

July 2001 – July 2002

- Injection occurring at Mine #81
- Incomplete reporting of monitoring data
- DMR monthly reports show the following exceedences from the concentration limits set on the injectate:
  One (1) for TPH [Permit Limit = 1.0 mg/L]

July 2003 – July 2004

- Injection occurring at Mine #81, William Eagle and Rhonda Eagle for part of the time then discontinued in all three mines with injection only occurring at Terry Eagle
- Incomplete reporting of monitoring data
- DMR monthly reports show the following exceedences from the permit limits set on the injectate:
  One for Total Chromium [Permit Limit = 0.1mg/L]

July 2005 – July 2006

- Injection occurring at Terry Eagle and Flying Eagle.
- Incomplete reporting of monitoring data
- DMR monthly reports show the following exceedences from the permit limits set on the injectate:
  One for Aluminum [Permit Limit = 0.2 mg/L]

July 2006 – July 2007

- Injection occurring at Terry Eagle and Flying Eagle.
- DMR monthly reports show the following exceedences from the permiton limits set on the injectate:
  One for TPH [Permit Limit = 1.0 mg/L]
  One for Beryllium [Permit Limit = 0.004 mg/L]
  One for Chromium [Permit Limit = 0.1 mg/L]
  One Nickel [Permit Limit = 0.1 mg/L]
  One for Aluminum [Permit Limit = 0.2 mg/L]

Summary Findings

- There are significant spatial and temporal water quality impacts within the watersheds of the study area from various mining activities, therefore distinguishing impacts on surface waters from deep mine slurry injection is not possible given the scope of this study.

- A review of the water quality data available for the mine pools concludes that slurry injection activities increases the concentrations of total dissolved solids, sulfates and in some cases manganese downgradient of the injection site.

- The water quality of a private well located within the study area, was determined to be influenced by mining activities which included slurry injection, however the exact contribution from the various mining sources could not be determined. Although influenced by mine water, the well did not exceed standards set for safe drinking water at public water supplies.

- The study did not determine impacts to the surrounding groundwaters from slurry injection. There was insufficient information on the groundwater resources to make a determination.

- All of the deep mines evaluated in this study are partially below drainage. The majority of the mine workings are located below surface drainages with the exception of entries located at the up dip end of the mines. Conceptually, waters associated with the deep mine workings below drainage are less likely to impact surrounding ground waters due the low permeability of the strata surrounding the pools. Therefore, it is less likely for the slurry and its constituents located in the deep pools to impact the surrounding ground waters. However, this study does not provide evidence to confirm this statement nor does it disprove it. Additional comprehensive and site specific investigations would be required which includes identification and monitoring of the surrounding ground waters.

- Based on the sample results, the inorganic and organic chemical composition of the coal slurry is similar to that of the coal seams. Accordingly, this similarity creates difficulty in isolating water quality impacts due solely to the injection of coal slurry in underground mines.

- Three of the five deep mines within the Power Mountain study site had documented “black water events”. Coal slurry flowed from the deep mine to the surface due to increased water pressure within the deep mine. These events have the potential to impact surface and groundwater resources. The report did not address these episodic events.

- WVDEP-IUC compliance DMR data showed exceedences of UIC permit limits for the coal slurry injectate. Total Petroleum Hydrocarbons (TPHs) and total chromium were the most common parameters that exceeded the limits.

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TABLES 1 THROUGH 9

TABLE 1

POWER MOUNTAIN COAL SLURRY STUDY

COAL BED STRATIGRAPHY

KANAWHA GROUP OF THE POTTSVILLE SERIES - NICHOLAS COUNTY

	COAL NAME	***TOTAL FEET***
KANAWHA FORMATION		0
	STOCKTON	160
	COALBURG	210
	LITTLE COALBURG	229
	WINIFRED	290
	CHILTON	370
	LOWER CHILTON	395
	WILLIAMSON	490
	CEDAR GROVE	540
	NO 2 GAS	700
	POWELLTON	760
	EAGLE	800

Source - Compilation from http/ims.wvgs.wnet.edu and Nicholas County Report 1921

TABLE 2 - WATER SAMPLE POINTS

POWER MOUNTAIN COAL SLURRY STUDY
WATER SAMPLE POINT DESCRIPTIONS

Sampling Date - July 8, 2008

PM-1	TE-DH-1	Hutchenson pump - mine pool - downgradient
PM-2	FE-DH-1	Flying Eagle pump - mine pool - downgradient
PM-6	FE-MW-2	Flying Eagle well - mine pool - upgradient
PM-3	Mid-Stream Twentymile Creek	Instream - below confluence with Robinson Fork
PM-7	Down Stream Twentymile Creek	Instream - below confluence with Robinson Fork & Sugarcamp Branch
PM-8	Sugar Camp VF Pond	Pond spillway - Sugarcamp Branch at confluence with Twentymile Creek
PM-Slurry	Raw Slurry Site	Main prep plant
PM-9	Naylor Well	private water well along Jones Branch
PM-10	Corbett Well	private water well along Jones Branch
PM-11	Mullins Well	private water well along Jones Branch
PM-13	Pond 001 O-27-85 (seep)	Seep from Rhonda Eagle mine - mine pool
PM-14	Radar Eagle discharge	Mine pool - downgradient - control mine

TABLE 3

POWER MOUNTAIN COAL SLURRY STUDY
WATER QUALITY DATA SUMMARY - TWENTYMILE CREEK

SAMPLE DATE	FLOW (gpm)	pH lab	SPC (umhos/cm)	Total ALK (mg/l)	Total Acidity (mg/l)	TSS (mg/l)	Total FE (mg/l)	Dissolved FE (mg/l)	Total MN (mg/l)	Total AL (mg/l)	SO4 (mg/l)	TDS (mg/l)
Twentymile Creek - Site #10* (upstream of Preparation Plant)												
6/1/1983	26325	6.7	117.18	10	0	10	0.115	0.1	0		30.24	?
3/12/1984	14500	7.2	110.58	25	3	4	0.17	0.155	0.19		27.2	?
Twentymile - Creek - Site #9 (downstream of Sugarcamp Branch)												
6/1/1983	27750	6.43	101.99	20	16	10	0.050	0.047	0		26.32	52.00
Twentymile Creek - USTC (upstream Hutchinson deep mine)												
12/13/2003	1000	6.56F						0.06				95.00
6/15/2004		6.61F	266	12.93	ND	6	0.01		0.01	ND	108.14	180.00
Twentymile Creek - DSTC (downstream Hutchinson deep mine)												
6/9/2004	7297	7.33	542.00	32.4	ND	ND	0.1		0.62	0.04	237.04	392.00
Twentymile Creek - PM-3 (downstream Robinson Fork)												
7/8/2008		7.87	2090	79.1	3.3	7	0.095	0.064	0.493	0.449	1110	1810.00
Twentymile Creek - PM-7 (downstream Sugarcamp Branch)												
7/8/2008		7.96	2240	87.7	3.3	1	0.161	0.077	0.263	0.255	1220	1820.00

* Same general location as PM-3

F- Field pH

TABLE 4

POWER MOUNTAIN COAL SLURRY STUDY

WATER QUALITY DATA SUMMARY - ROBINSON RUN & SUGARCAMP BRANCH (tributaries of Twentymile Creek)

SAMPLE DATE	FLOW (gpm)	pH lab	SPC umh/cm	Total ALK (mg/l)	Total Acidity (mg/l)	TSS (mg/l)	Total FE (mg/l)	Dis FE (mg/l)	Total MN (mg/l)	Total AL (mg/l)	SO4 (mg/l)	TDS (mg/l)
Robinson Run (Site #20) upper reaches near discharge at Flying Eagle deep mine												
6/1/1983	350	6.65	99.87	25	8	12	0.27	0.245	0		25.76	50.00
Sugarcamp Branch (Site # 8)												
6//1/1983	1400	6.45	107.45	20	6	4	0.02	0.018	0.15		27.72	54.00
Sugarcamp Branch (PM-8)												
7/8/2008		8.2	1820	63.9	ND	5	0.114	0.023	2.21	0.482	777	1380.00

TABLE 5

POWER MOUNTAIN COAL SLURRY STUDY
WATER QUALITY DATA SUMMARY - MINE POOLS - JULY 8, 2009

SAMPLE ID	pH	SPC (umhos/cm)	TDS (mg/l)	Total ALK (mg/l)	SO4 (mg/l)	NA (mg/l)	CA (mg/l)	CL (mg/l)	Dis FE (mg/l)	Dis MN (mg/l)	Dis AL (mg/l)	Dis AS (mg/l)	Dis SE (mg/l)	Dis SR (mg/l)
PM1 Terry Eagle (down)	7.68	2860	1670	572.0	733.0	537.00	41.30	45.00	3.7	0.325	0.325	0.0034	ND	1.13
PM2 Flying Eagle (down)	7.56	2810	1540	568.0	752.0	536.00	40.30	46.80	3.06	0.559	0.407	0.0031	ND	1.05
PM6 Flying Eagle (up)	7.53	2230	1450	377.0	696.0	346.00	81.20	33.00	0.064	0.05	0.498	0.0015	ND	2.09
PM13 Rhonda Eagle	7.57	1340	1040	78.1	544.0	36.80	165.00	14.30	1.21	4.31	0.465	0.0013	0.0027	0.66
PM14 Rader Eagle (control)	6.96	211	114	32.8	56.0	7.58	19.20	5.11	0.091	0.043	0.224	0.0012	ND	0.31

TABLE 6

POWER MOUNTAIN COAL SLURRY STUDY

WATER QUALITY DATA SUMMARY - HISTORICAL MINE POOLS

Sample Date	FLOW (gpm)	pH (lab)	SPC umhos/cm	Total ALK (mg/l)	Total Acidity (mg/l)	TSS (mg/l)	Total FE (mg/l)	Dissolved FE (mg/l)	Total MN (mg/l)	Total AL (mg/l)	SO4 (mg/l)	TDS (mg/l)	CL (mg/l)
Terry Eagle/Hutchinson Branch Mine Water [before slurry injection]													
1/30/2004	NA	9.2						0.05	ND	0.09	32.96	354.00	
Terry Eagle/Hutchinson Mine - Dewatering Borehole - TE-DH 1 [during slurry injection]													
1/10/2005		7.34 F	1912	401.98	ND	9.00	0.77		ND	ND	373.92	1157.00	121.99
William Eagle Mine Water [before slurry injection]													
10/22/2000	0.5	6.38	350.00	110.00	<2.0	12.00	1.33		0.29	0.12	164	252.00	1.50
Jerry Fork Deep Mine - Adjacent Mine - [no slurrry injection]													
3/23/2000		8.4 F	515	147.00	137	5.00		0.03	0.01	0.1	37.5	260.00	
5/1/2000		7.6 F	469	104.00	<2.0	2	0.07		0.69	0.51	80.00	320.00	6.1

F- Field ph reported

TABLE 7

WATER QUALITY DATA SUMMARY - HISTORICAL GROUNDWATER DATA

Sample Date	Depth to Water (gpm)	pH (lab)	SPC umhos/cm	Total ALK (mg/l)	Total Acidity (mg/l)	TSS (mg/l)	Total FE (mg/l)	Dissolved FE (mg/l)	Total MN (mg/l)	Total AL (mg/l)	SO4 (mg/l)	TDS (mg/l)	CL (mg/l)
GW-1 (Twentymile Church)													
2/2/2004	32	6.5	303.00	145.21		23.00	18.28		0.81	0.03	7.14	192.00	1.02
6/9/2004	29.4	6.4	286.00			100.00	25.36		1.07	0.001	19.17	171	1.62
Spring 2 within Sugarcamp Branch at 1700' elevation													
6/11/1983		6.4	86.8	10	6	8.00	0.1	0.085	0		22.4	44.00	
Seep 4 within Sugarcamp Branch at 1400' elevation													
6/1/1983		6.5	80.29	20	4	8	0.08	0.07	0		20.72	40.00	
3/12/1984*		5.7	492.8	3	44	4.00	0.005	0.00	0.05		123.2	222.00	

* - may have mining impacts

TABLE 8

POWER MOUNTAIN COAL SLURRY STUDY

WATER QUALITY DATA SUMMARY - PRIVATE WATER SUPPLIES - JULY 8, 2009

SAMPLE Point	pH	SPC (umh/cm)	TDS (mg/l)	Total ALK (mg/l)	SO4 (mg/l)	NA (mg/l)	CA (mg/l)	CL (mg/l)	Dis FE (mg/l)	Dis MN (mg/l)	Dis AL (mg/l)
PM-9 Naylor	6.02	224	106.0	17.2	72.4	4.73	19.7	5.8	0.024	0.083	0.214
PM-10 Corbett	7.7	336	158.0	177	ND	58.70	15.7	5.64	0.604	0.196	0.228
PM-11 Mullins	7.4	394	236.0	191	2.64	103	0.199	12.6	0.032	0.024	0.039

TABLE 9

OVER MOUNTAIN - UIC Permit - Summary Report of Samples Exceeding Permit Limits based on Discharge Monitoring Reports

For Date Ending	Inj. Point	TPH ORO (1.0 Mg/L) (Permit Limit)	TPH DRO (1.0 Mg/L) (Permit Limit)	Dissolved Beryllium (0.004 Mg/L) (Permit Limit)	Dissolved Cadmium (0.005 Mg/L) [Permit Limit]	Total Chromium (0.1 Mg/L) [Permit Limit]	Dissolved Lead (0.015 Mg/L) [Permit Limit]	Dissolved Nickel (0.1 Mg/L) [Permit Limit]
1-Nov-00	214	447	182	0.0145				
	212	381	138	0.0144				
1-Dec-00	214	1.4		0.0081				
	212	2.2	1.18	0.0107				
1-Jan-01	212		1.13					
1-Feb-01	212	4.5	4.16					
1-Mar-01	212	224	256					
	214	<199	221					
1-Apr-01	212	225	256			0.189		
	214	230	185			0.3976		
1-May-01	212			0.0071				
	214			0.0068				
1-Jul-01	212	2.7	2.18			0.2524	0.0158	
	214					0.3994		
1-May-02	213	3	2.09					
1-Jul-02	213	2	2.22					
1-Dec-02	213					0.1533		
1-May-03	230	8.1	2.41					
1-Apr-04	240					0.1386		
1-Nov-06	237			0.009				0.271
1-Feb-07	237					0.181		
1-Jul-07	237	4.47	2.15					

FIGURES A THROUGH F

FIGURE A

COAL LEACHATE & SLURRY LIQUID

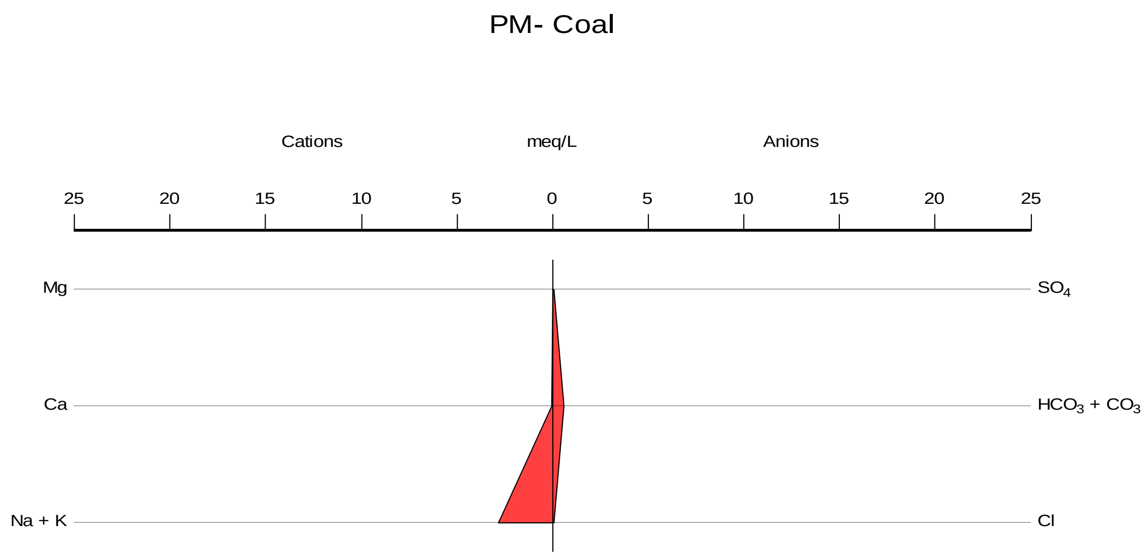
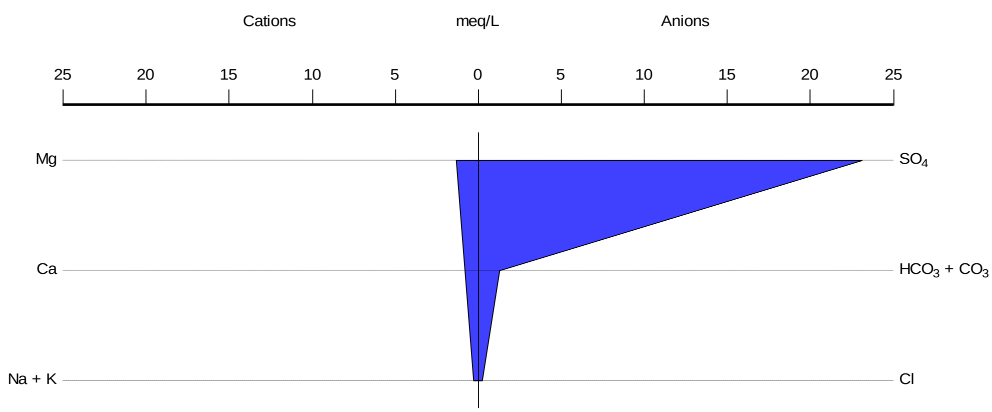


FIGURE B

SURFACE SAMPLES - TWENTYMILE CREEK

PM- 3 Twentymile Creek (mid-stream)



PM- 7 Twentymile Creek (downstream)

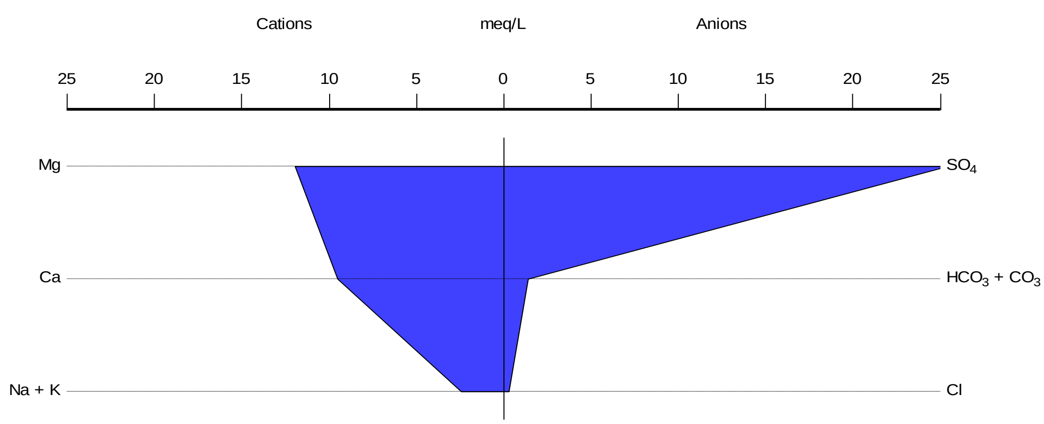
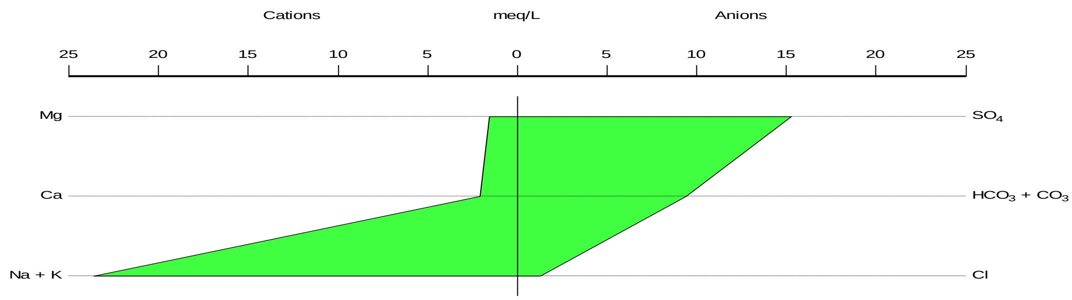


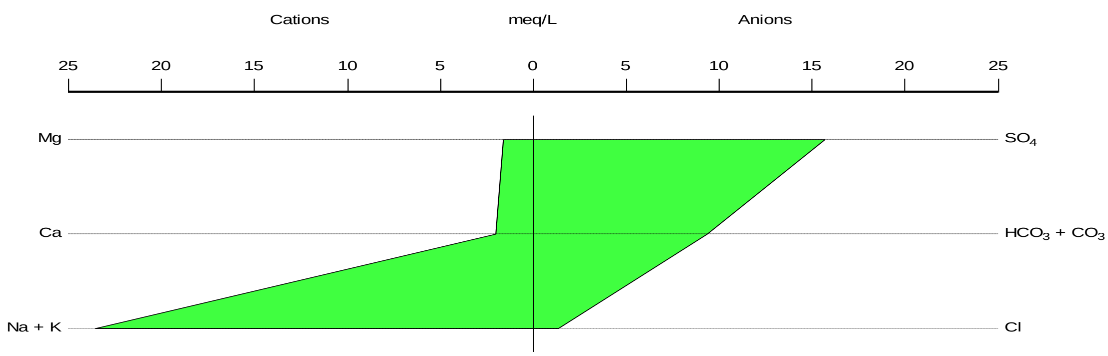
FIGURE – C

MINE POOLS – FLYING EAGLE & HUTCHINSON/TERRY EAGLE

PM- 1 Terry Eagle Mine - Downgradient



PM- 2 Flying Eagle Mine - Downgradient



PM- 6 Flying Eagle Mine - Upgradient

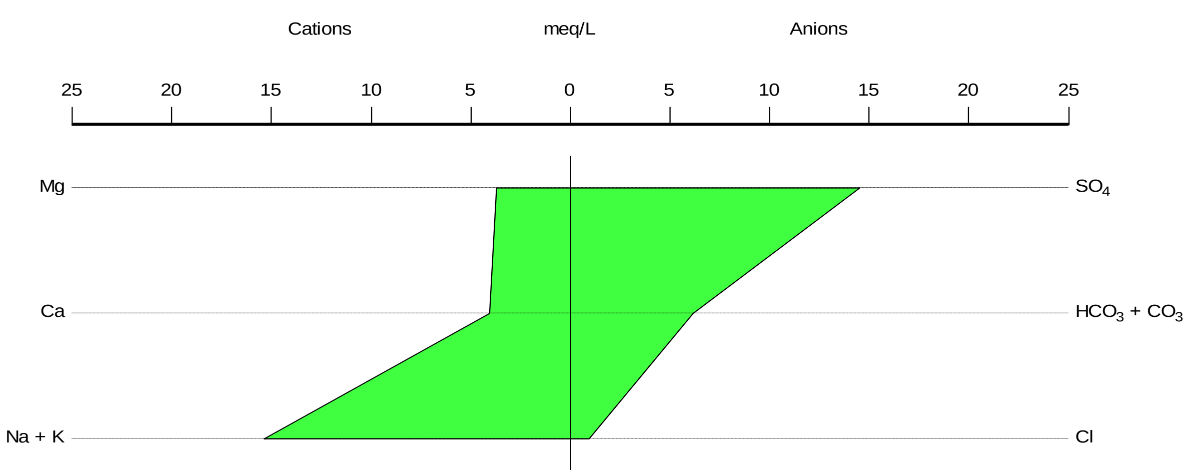
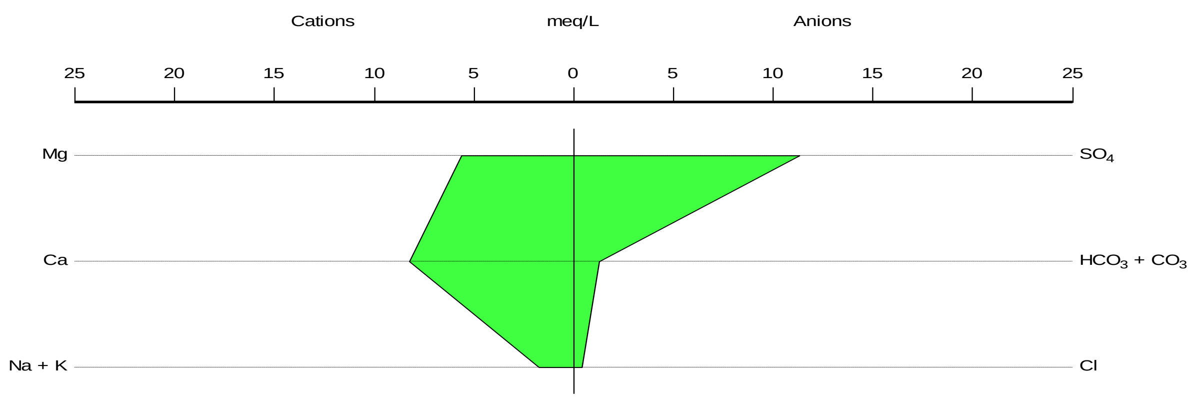


FIGURE D

MINE POOLS - RHONDA EAGLE & RADAR EAGLE

PM- 13 Mine Pool Seep



PM- 14 Radar Eagle Mine

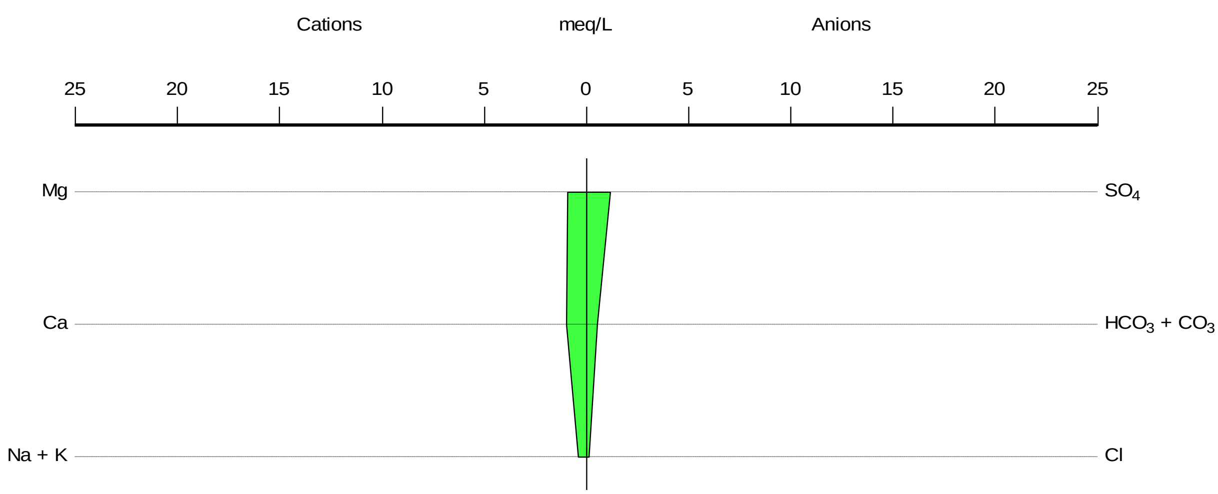
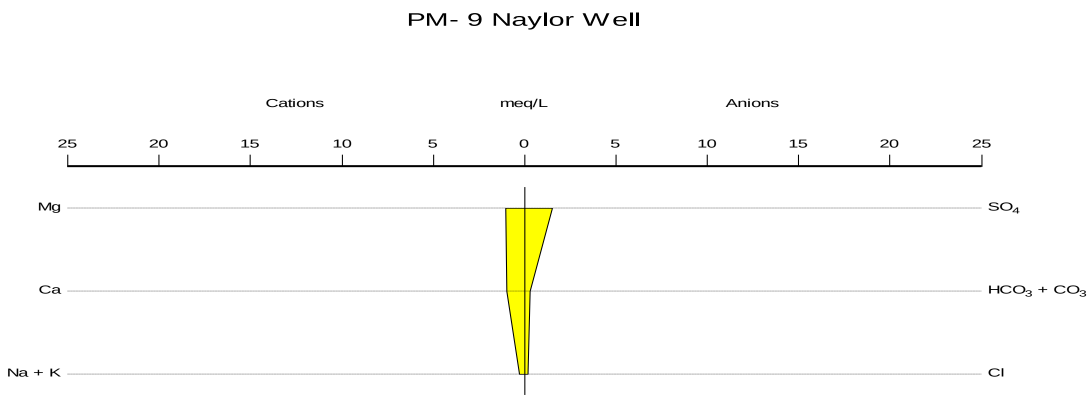
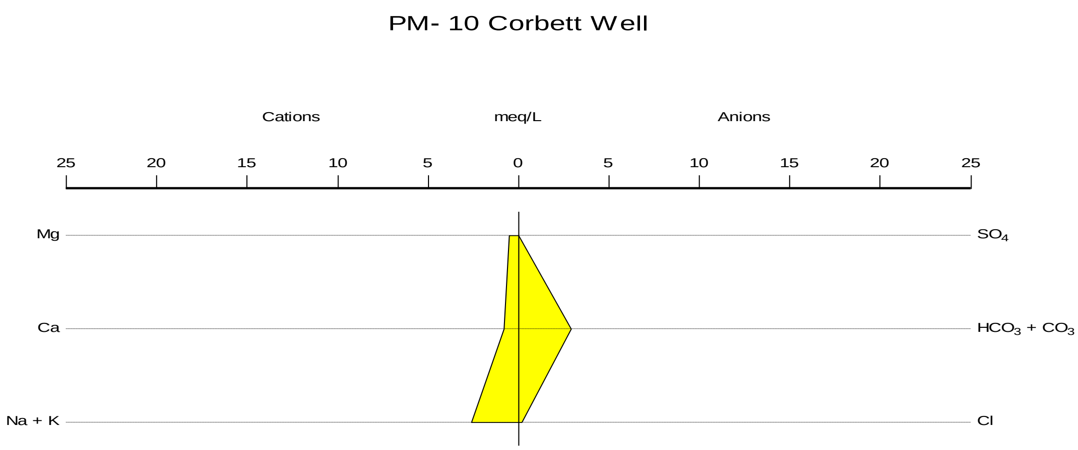


FIGURE E

PRIVATE WATER SUPPLIES





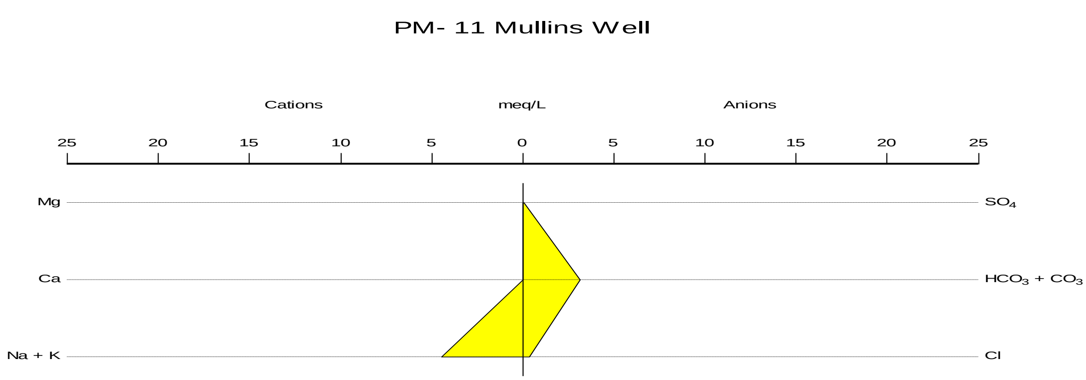
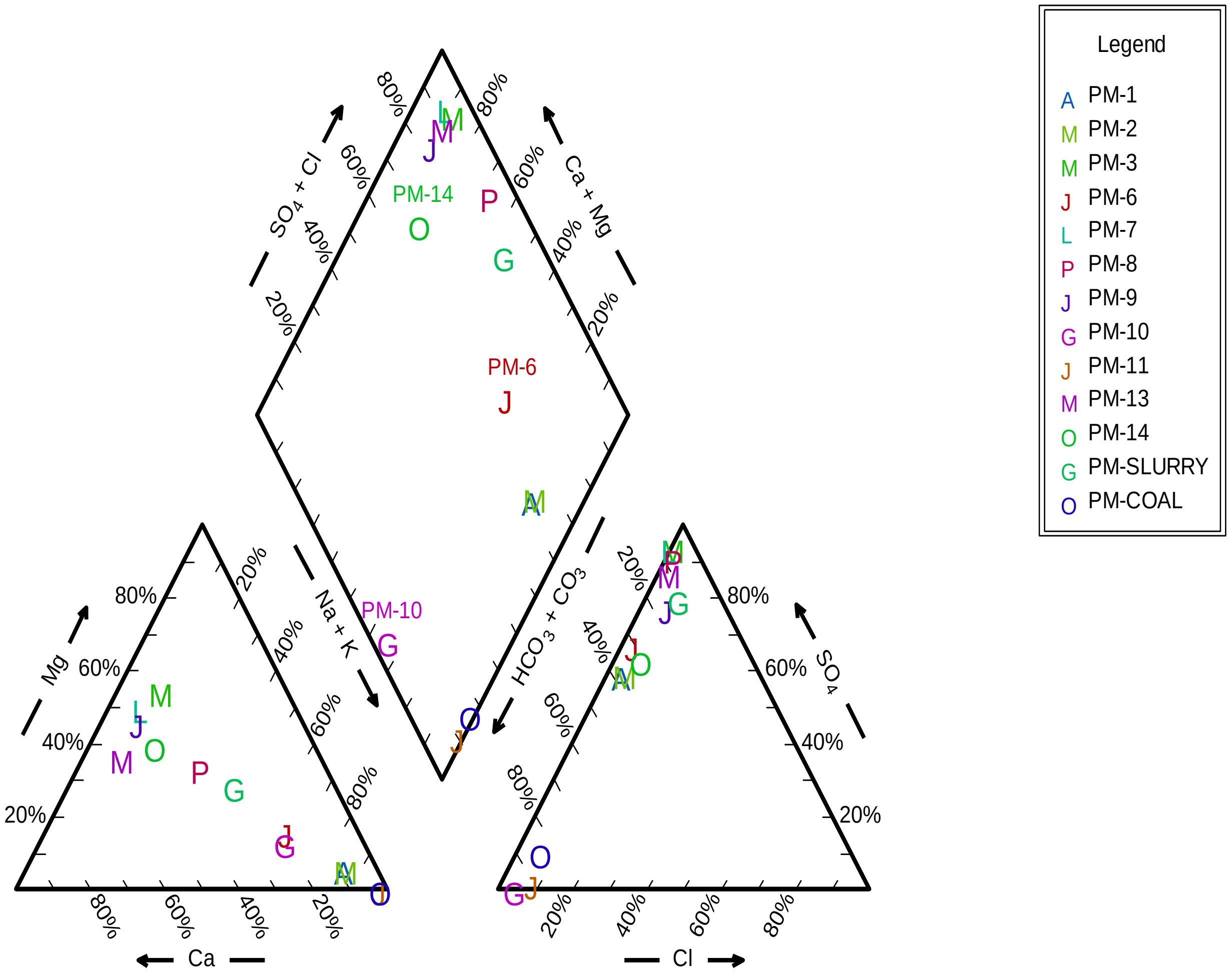


FIGURE F

Power Mountain Site Assessment Sampling



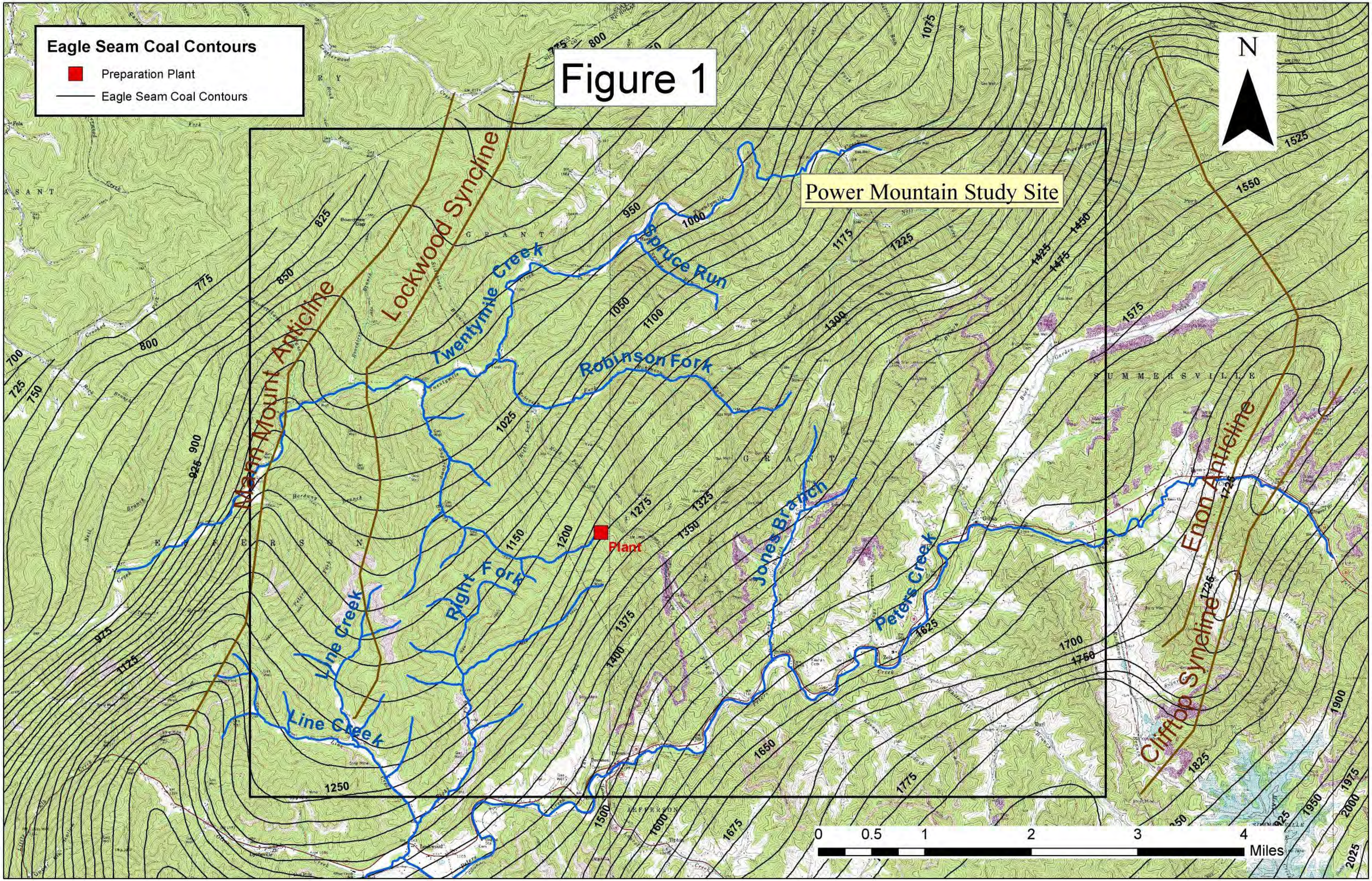
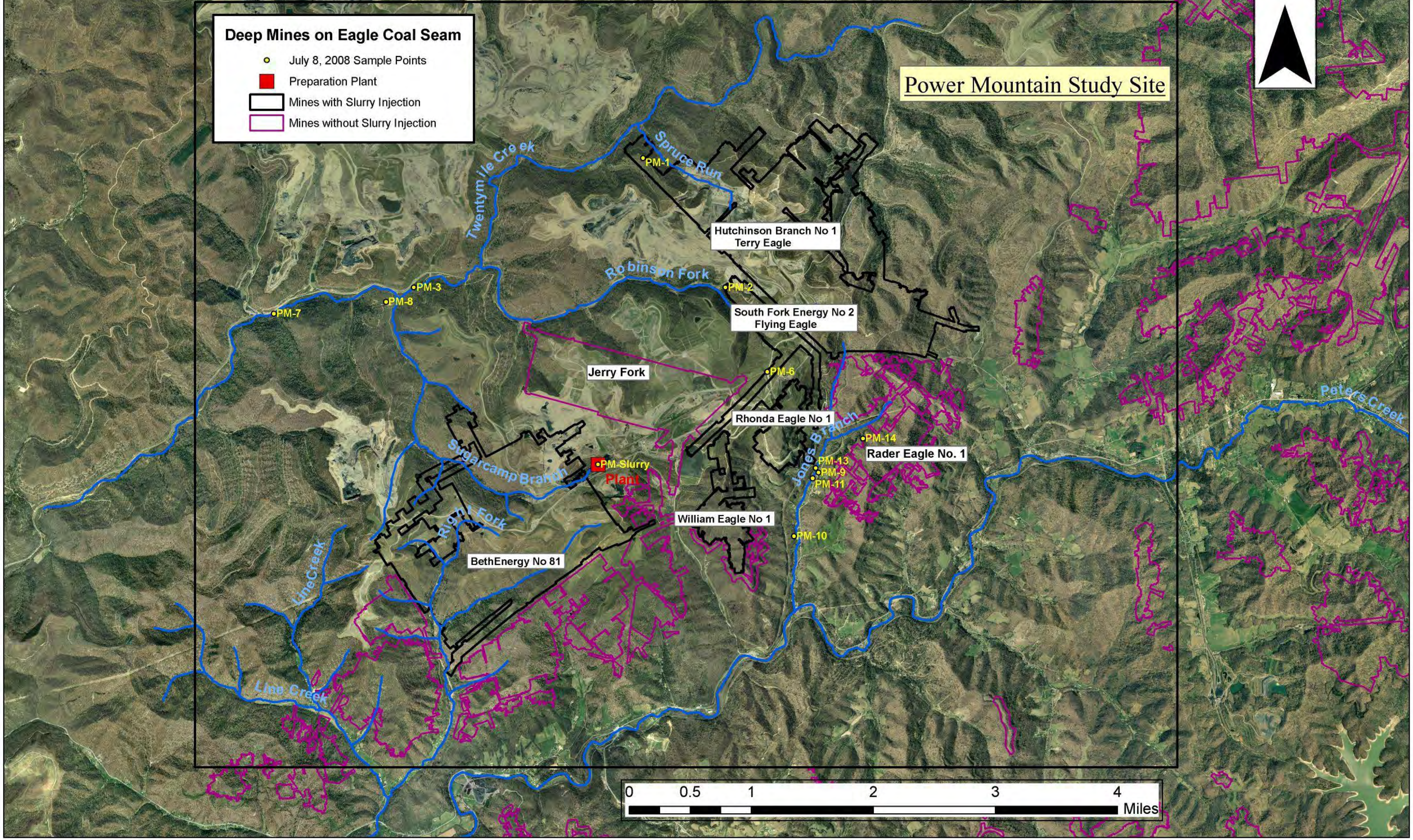
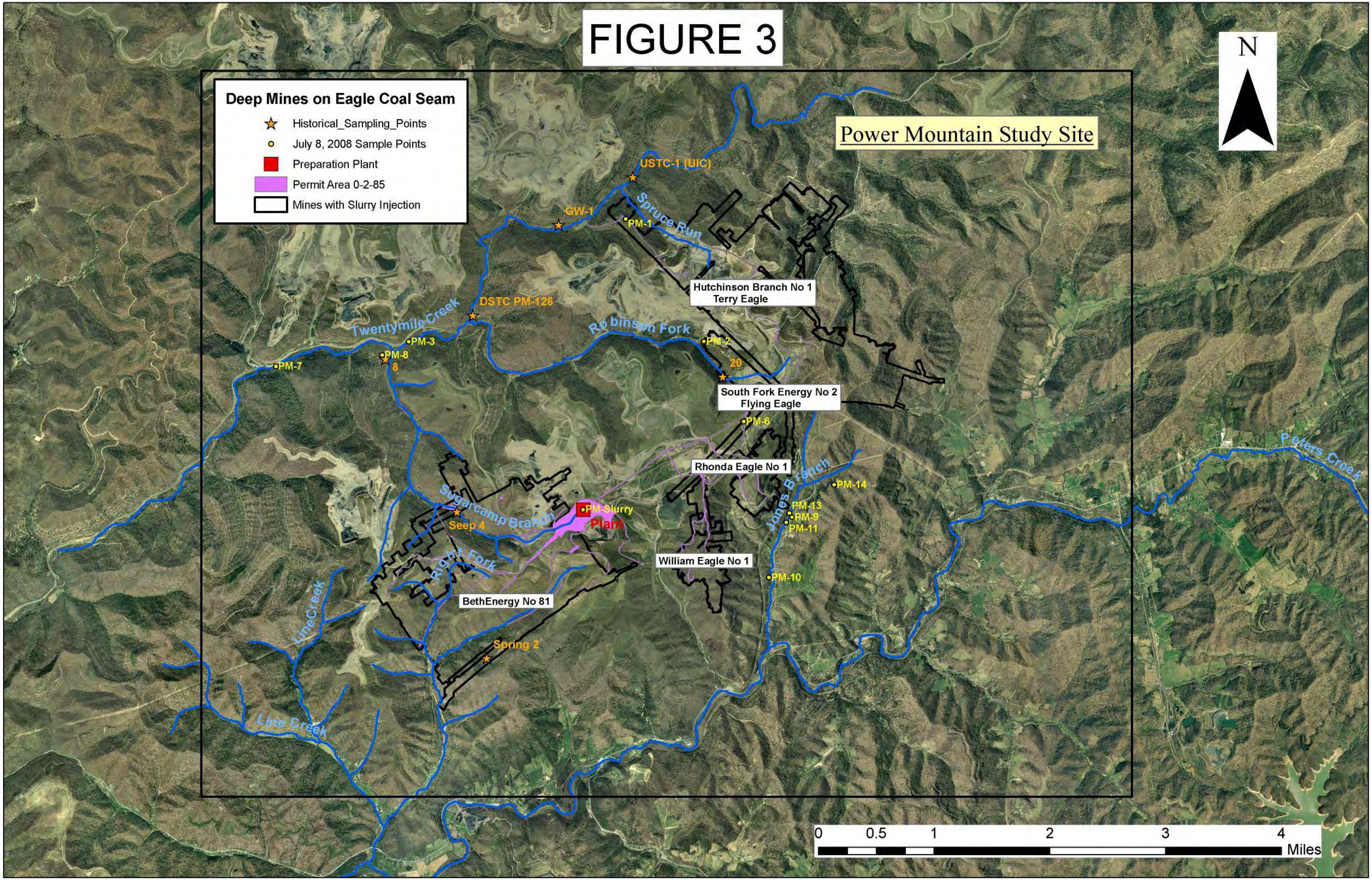

Eagle Seam Coal Contours
Preparation Plant
Eagle Seam Coal Contours
Figure 1
N
Power Mountain Study Site
Lockwood Syncline
Mann Mount Anticline
Enon Anticline
Clifftop Syncline
Twentymile Creek
Spruce Run
Robinson Fork
Right Fork
Line Creek
Jones Branch
Peters Creek
Plant
0 0.5 1 2 3 4
Miles

FIGURE 2



Deep Mines on Eagle Coal Seam
July 8, 2008 Sample Points
Preparation Plant
Mines with Slurry Injection
Mines without Slurry Injection
Power Mountain Study Site
N
Twentymile Creek
Spruce Run
Robinson Fork
Hutchinson Branch No 1
Terry Eagle
South Fork Energy No 2
Flying Eagle
Jerry Fork
Rhonda Eagle No 1
Jones Branch
Rader Eagle No. 1
Peters Creek
Sugarcamp Branch
Right Fork
PM-Slurry
Plant
William Eagle No 1
BethEnergy No 81
Line Creek
PM-1
PM-2
PM-3
PM-6
PM-7
PM-8
PM-9
PM-10
PM-11
PM-13
PM-14
0
0.5
1
2
3
4
Miles

FIGURE 3


Deep Mines on Eagle Coal Seam
Historical_Sampling_Points
July 8, 2008 Sample Points
Preparation Plant
Permit Area 0-2-85
Mines with Slurry Injection
Power Mountain Study Site
N
USTC-1 (UIC)
GW-1
PM-1
Spruce Run
Hutchinson Branch No 1
Terry Eagle
DSTC PM-126
Twentymile Creek
PM-3
PM-8
8
PM-7
Robinson Fork
PM-2
20
South Fork Energy No 2
Flying Eagle
PM-6
Rhonda Eagle No 1
Jones Branch
PM-14
PM-13
PM-9
PM-11
Peters Creek
Sugarcamp Branch
Seep 4
PM-Slurry
Plant
Right Fork
William Eagle No 1
PM-10
BethEnergy No 81
Line Creek
Spring 2
Line Creek
0
0.5
1
2
3
4
Miles

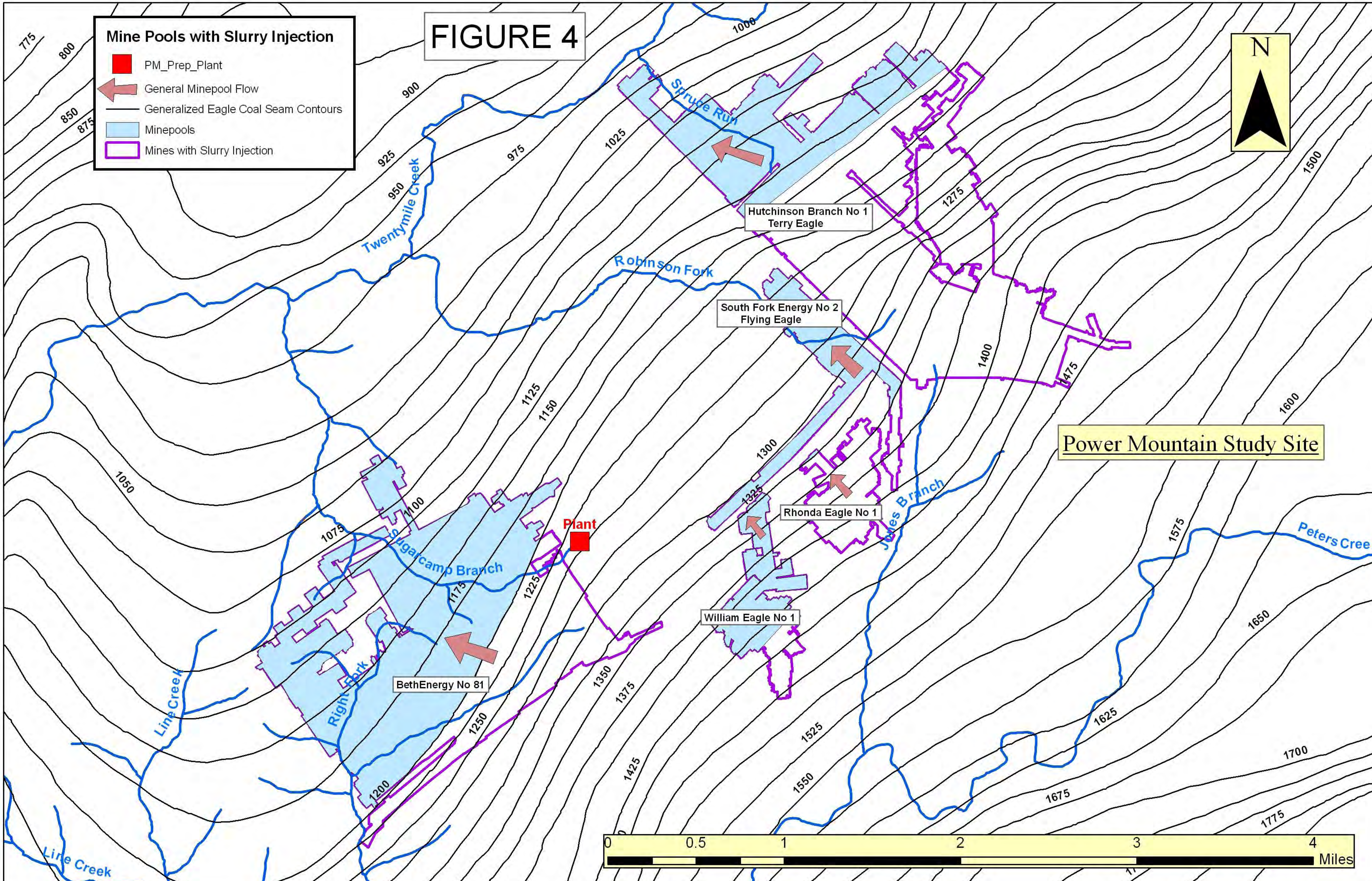


FIGURE 4
Mine Pools with Slurry Injection
PM_Prep_Plant
General Minepool Flow
Generalized Eagle Coal Seam Contours
Minepools
Mines with Slurry Injection
N
Power Mountain Study Site
Hutchinson Branch No 1
Terry Eagle
South Fork Energy No 2
Flying Eagle
Rhonda Eagle No 1
William Eagle No 1
BethEnergy No 81
Plant
Spruce Run
Twentymile Creek
Robinson Fork
Sugarcamp Branch
Right Fork
Line Creek
Line Creek
Jones Branch
Peters Creek
775
800
850
875
900
925
950
975
1000
1025
1050
1075
1100
1125
1150
1175
1200
1225
1250
1275
1300
1325
1350
1375
1400
1425
1475
1500
1525
1550
1575
1600
1625
1650
1675
1700
1775
0
0.5
1
2
3
4
Miles