SECTION 42

MONITORING, MAINTENANCE, INSPECTIONS AND EXAMINATIONS

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LIST OF REVISIONS DURING PERMIT TERM

REV. NUMBER	REVISION DESCRIPTION	DATE APPROVED

42 MONITORING, MAINTENANCE, INSPECTIONS AND EXAMINATIONS

42.1 Hydrologic Monitoring Reporting

Hydrologic monitoring reports will be submitted to OSM on a quarterly frequency and a detailed monitoring report will be submitted twice during the permit term. The quarterly monitoring report will consist of a summary of the data collected and events for the quarter, identification of anomalies, inconsistencies, or non-compliances, and include an electronic copy of the raw analytical data electronically.

In addition to the quarterly hydrologic monitoring report, an in-depth hydrology report will be submitted twice during the permit term to OSM. This detailed hydrologic monitoring report will provide a detailed reduction, analysis, and interpretation of surface water and groundwater data collected to date, in addition to the raw data. The analysis will include plotting hydrographs, parameter concentration vs. time graphs, trilinear graphs, and statistical summaries. The monitoring data is then compared against historical data trends and water quality standards to identify changes in water quality or quantity. Specifically for the detailed report, flow and water quality data will be provided as detailed below.

Flow - For the nearly perennial Chinde Arroyo stations, CD-1A and CD-2A, quarterly hydrographs will be plotted. A comparison of the flow between the upstream and downstream stations will be provided.

Water Quality and Sediment - Stage and discharge corresponding to each sample will be reported along with the measured concentrations. For Chinde Arroyo, summary statistics will include water yield and sediment and analyte concentrations for each month. A comparison of water quality and sediment concentrations between the upstream and downstream stations will be provided.

A comparison will be made between surface water quality concentrations collected and the applicable water quality Navajo Nation Environmental Protection Agency Surface Water Quality Standards for both the in-depth hydrology report and the quarterly reports.

Additionally, every five years as part of the in-depth hydrology report, NTEC will provide to OSM a potentiometric surface map of Fruitland Formation coals, as both a hard copy and electronic file.

Discussion on requirements of the Clean Water Act, National Pollutant Discharge Elimination System, (NPDES) and the Stormwater Pollution Prevention Plan (SWPPP) is found in Section 8.1 – Compliance with Air and Water Quality Laws and Regulations.

42.2 Surface Water Monitoring Plan

Navajo Mine's surface water monitoring program was established to monitor surface water quality at locations where major watercourses enter and leave the Permit Area and/or lease area. The monitoring program provides the basis for assessment of the impact of mining on the surface water resource. While the chance of surface water impact resulting from mining remains remote, the following monitoring program has been developed to collect water quality information for use in the possible identification of impacts to the prevailing hydrologic regime.

42.2.1 Surface Water Monitoring Locations

The Chinde watershed was selected since it is the most representative watershed of the seven ephemeral arroyos which traverse the Permit Area. In addition, the drainage experiences direct discharges and irrigation return flows from NAPI. The irrigation season occurs generally from April through October. Exhibit 22-4 (Section 22 – Support Facilities) shows the locations of the surface water monitoring stations. Table 42-1 identifies the surface water monitoring stations, and the sampling frequency. The sampling locations are located upstream and downstream within Chinde Wash to sample and assess water entering and leaving the Permit Area.

The remaining six watersheds not selected for monitoring are Hosteen Wash, Barber Wash, Lowe Arroyo, Neck Arroyo, Cottonwood Arroyo, and Bitsui Wash. Of the six, the first three listed were not selected because the watershed has been interrupted by mining and no flow passes through the Permit Area. Upstream check dams and present mining topography do not allow surface water to pass through the Permit Area. The fourth watershed, Neck Arroyo, does pass through the Permit Area, but was not selected for monitoring for the following reasons:

- The Neck Arroyo watershed (666 acres) represents 0.7 percent of the total seven (7) watershed areas (96,980 acres) located within and upstream of the Permit Area.
- The postmining disturbance within the Neck Arroyo watershed (160 acres) represents 0.2 percent of the total seven watershed areas (96,980 acres) located within and upstream of the Permit Area.
- The Neck Arroyo is identified as 100 percent badlands (very erosive) and is not representative of the watersheds in the area.

The Neck Arroyo is not monitored because it represents such a small fraction of the total Permit Area watersheds and is entirely badlands. The Bitsui Wash was not selected for monitoring because the flow passes through prelaw jurisdictional lands on the northern area of the mine lease. Table 42-2 (Watershed Areas Associated with Navajo Mine) shows the percent of the drainage area disturbed, and undisturbed plus the percentage pre-mining badland areas.

Surface water monitoring was discontinued in Cottonwood Arroyo following extensive data collection that adequately characterized baseline conditions. The expansion of mining into Area 4 North will involve the construction of a crossing with culverts in the Cottonwood Arroyo. Navajo Mine will not discharge into Cottonwood Arroyo during the Area 4 North development and there will be minimal mine related impacts. The only effect from mining to Cottonwood Arroyo is the Lowe diversion, which diverts an undisturbed portion of the Lowe watershed into Cottonwood Arroyo (See Section 41 – Probable Hydrologic Consequences). Because the Lowe Diversion increases the Cottonwood watershed by only 4 percent, any water quality effects will likely be so small as to be immeasurable. Monitoring will resume within the Cottonwood Arroyo watershed if conditions change as the result of major NAPI impacts.

42.2.2 Monitoring Equipment

The existing Chinde Wash monitoring stations CD-1 and CD-2 have been relocated to take advantage of stable cross sections afforded by culvert crossings at BIA Highway 3005 (upstream station CD-1A) and at the NTEC railroad embankment (downstream station CD-2A). Exhibit 42-1 shows the locations of the Chinde monitoring stations. Station CD-1A is located outside the mine lease and right of access permission was granted from the Navajo Nation to place the monitoring location within the road right-of-way. Station CD-2A is located within the Navajo Mine permit boundary.

Sampling Equipment – On Chinde Wash, grab samples are collected manually at a pre-established day and time each month.

Upon completion of the Navajo Mine hydrologic monitoring program NTEC Navajo Mine will remove all monitoring equipment and appurtenances. The site of each stream monitoring station will then be reclaimed. Cost involved with the station removal and reclamation will be minor and is sufficiently covered by the contingency line item in the existing Reclamation Bond.

42.2.3 Monitoring Approach

42.2.3.1 Chinde Wash

Due to the NAPI impacted perennial nature of Chinde Wash, the sampling strategy for CD-1A and CD-2A is a grab sample technique, collected manually on a quarterly basis by the end of each quarter. The sampling strategy and methods for each of the two Chinde Wash stations are described in the following paragraphs.

Upper Chinde Wash (CD-1A):

Sample type: Grab.

Sample frequency: Quarterly, before the end of each quarter.

Sampling method/location: At culvert outfall.

Sampling trigger stage: Any flow on the sampling day will be sampled.

Lower Chinde Wash (CD-2A):

Sample type: Grab.

Sample frequency: Quarterly, before the end of each quarter.

Sampling method/location: At culvert outfall.

Sampling trigger stage: Any flow on the sampling day will be sampled.

42.2.4 Water Quality Analysis

The surface water monitoring parameter list provided in Table 42-3 was developed by identifying potential sources of constituents to the surface water which are either on or adjacent to the Navajo Mine and determining which constituents may potentially contribute to the hydrologic balance. The major ions were added to the list such that an ion balance can be performed by the laboratory as a quality control measure. Table 42-3 is the list of parameters that will be analyzed quarterly.

All samples collected in the field are packed in ice and in coolers and delivered to the laboratory in a sufficient amount of time to meet U.S. EPA established analytical holding times.

Once the samples are received by the contract laboratory, the samples are prepared and analyzed in accordance to Environmental Protection Agency (EPA) guidelines (Guidelines Establishing Test Procedures for the Analysis of Pollutants 40 CFR Part 136).

The contract laboratory is required to have an acceptable Quality Assurance/Quality Control (QA/QC) program Appendix 42.B. A new laboratory will be obtained if frequent analytical problems arise and cannot be corrected satisfactorily, or their QA/QC program has been changed which results in an unacceptable program.

42.2.4.1 Sediment Concentrations

For the Chinde Wash stations, total suspended solids (TSS) settleable solids (SS), and total sediment (TS) will be determined by laboratory analysis for each monthly grab sample.

NTEC has added a procedure for sample sediment load analysis which may provide more accurate values for total sediment concentration. The full sample volume and mass will be measured, the sample will settle for 24 hours, and without splitting the sample the water will be removed from the sediment by decanting and drying. The dry sediment mass will be measured and divided by the full sample volume to compute the concentration in mg/L. A sieve will then be used to separate the silt and clay particles (smaller than

0.0625 mm) from the sand and gravel and the change in dry mass will be recorded. Appendix 42.A contains a detailed description of the proposed method.

The sediment samples collected at the Chinde Wash stations CD-1A and CD-2A will be used to monitor the hydrologic conditions, and assess mining impacts and the impacts due to NAPI upstream land use.

Water quality parameters – For Chinde Wash surface water monitoring stations CD-1A and CD-2A, the first sampled event of each quarter will be analyzed for the constituents listed in Table 42-3.

All other sampled events will be analyzed for the following constituents:

- Conductivity
- PH
- Iron
- Manganese
- Selenium

42.2.5 Data

The analytical data received from the laboratory is entered into an in-house database program. The data is used to determine and assess long-term trends for the parameters monitored and will be used to monitor and assess potential impacts to the hydrologic regime.

The Probable Hydrologic Consequences (PHC) predicts an overall reduction in sediment yields from the reclaimed areas as compared to the pre-mine conditions. The Chinde main channel data collected will be used in conjunction with computer modeling results for the Bond Release Application to support the PHC.

42.2.6 Reporting

Surface water monitoring results will be submitted on a quarterly basis to OSM. NTEC will provide all water quality information to OSMRE in an electronic format on a quarterly basis. In addition, a detailed review of monitoring results will be submitted to OSM twice during the permit term. See Section 42.1 for additional information.

42.3 Ground Water Monitoring Plan

42.3.1 Introduction

A description of the probable hydrologic consequences and the hydrologic regime are presented in Section 41 – Probably Hydrologic Consequences. In addition a description of the geology of the mine is provided in Section 17 – Geologic Information. The review of these sources of information coupled with the a review of the Groundwater Quantity and Groundwater Quality descriptions presented in Section 18 – Water

Resources are necessary for an understanding of the objectives, procedures, and rationale used to develop the Navajo Mine's groundwater monitoring program.

The hydrologic monitoring program at the Navajo Mine was implemented in 1983. The objective of the groundwater monitoring program is to monitor the groundwater quality and quantity that relates to the suitability of the groundwater for the current and approved post mining uses and the protection of the hydrologic balance. The program was developed to address the hydrogeologic monitoring requirements for surface coal mining and reclamation activities on Indian Lands. The purpose of the monitoring plan is to 1) generate hydrogeologic data of sufficient quality and quantity to support the objectives of the groundwater monitoring program and 2) to document the objectives, rationale, and procedures used for the collection of groundwater information. Quality assurance and quality control procedures, found in Appendix 42.B, are followed where applicable and support the objectives of the groundwater-monitoring program.

The groundwater monitoring program for the Navajo Mine is unique for several reasons. Monitoring sites are distributed over a large geographical area (i.e., 26.2 square miles) within which several discrete coal resources have been, are currently, or will be mined over an approximate 60 year period. The coal seams are very lenticular in nature and are mined in localized areas. Lands within the permitted area are classified as several different jurisdictional areas and the mine permit boundary abuts directly against the planned mining activities, which leaves little room for environmental monitoring location~~s~~ outside of undisturbed lands. Furthermore, the development of a monitoring program is challenged by complex groundwater monitoring conditions such as unconfined and confined groundwater flow, naturally low water yielding formations with very poor water quality, and agriculturally impacted and unstable surface drainage channel conditions. In addition, the bedrock formations consist of alternating marine and non-marine geologic formations that contribute elevated concentrations of dissolved constituents (e.g., sulfates, salts, and metals) to the natural groundwater quality (Stone et. al., 1983). Regionally the mine is located adjacent to the western boundary of the San Juan Basin in northwestern New Mexico; Section 17 – Geologic Information contains additional geologic information. All these factors and conditions were evaluated and applied to the development of an effective groundwater monitoring plan at the Navajo Mine. The Navajo Mine was confronted with these factors coupled with technical developments in groundwater monitoring techniques and methods, as well as changing regulatory monitoring guidelines and requirements, when designing and implementing an effective groundwater monitoring program.

42.3.2 Objective

The objective of the Navajo Mine groundwater monitoring plan is to address the hydrologic monitoring requirements for the surface coal mining and reclamation activities at 30 CFR 777.13; 780.21a; 780.21I and 816.41 as well as comply with applicable U.S.EPA groundwater monitoring guidelines. The groundwater monitoring plan is used to define the following:

1. changes in the baseline conditions for groundwater quantity and quality;
2. to validate the Probable Hydrologic Consequences (PHC) results determined for mining and post mining periods (Section 41 – Probable Hydrologic Consequences);
3. assess the trends and magnitude and extent of any measurable impacts from mining or other sources to the hydrogeologic system;
4. determine the seasonal variability and define the ranges of variability;
5. define the degree of interaction between the groundwater and surface water systems;
6. determine when monitoring needs to be improved or when monitoring can be relaxed at sites; and
7. to provide site specific hydrogeologic data which will be utilized in bond release applications.

42.3.3 Background

The Navajo Mine groundwater monitoring program consists of (3) alluvial monitoring wells and (12) bedrock monitoring wells see Table 42-4 and Exhibit 18-1. Groundwater data has been collected annually and quarterly starting in 1983.

In general, the probable consequences of mining activities upon the quality and quantity of groundwater at the Navajo Mine is negligible. As discussed in Section 41 – Probable Hydrologic Consequences, groundwater quality is expected to generally improve (e.g., metal concentrations usually decrease while sulfate values increase) when natural groundwater flows through post mined pits and spoil materials. When groundwater travels through the coal seams, additional attenuation of selected chemical species is also documented, further reducing the potential impacts of mining on the regional groundwater quality.

In addition, the natural water quality of the Fruitland Formation is so poor and production is low, that regional use of this formation as a source of groundwater is nonexistent (Stone et. al., 1983). Mining activities are not expected to have a measurable impact on the human use of the groundwater (see Section 41 – Probable Hydrologic Consequences). Many constituents of the Fruitland Formation groundwater exceed Federal Drinking Water Standards (i.e., Maximum Contaminate Limits for Inorganic Chemicals, 40 CFR, Part 141). In most cases, the waters exceed the New Mexico Water Quality Control Commission standards and criteria for groundwater for fluoride, chloride, sulfate, total dissolved solids, and pH. Moreover, in many cases the groundwater quality exceeds New Mexico Water Quality Commission Standards and criteria for irrigation and livestock.

The only potential human health impacts of concern are to the San Juan River aquifer and this has been determined to be so small as to be unmeasureable (see Section 41 – Probable Hydrologic Consequences).

42.3.4 Geologic Units to be Monitored

The two formations monitored as part of the Navajo Mine's groundwater monitoring program include the Quaternary formations and the Cretaceous coal seams within the Fruitland Formation.

42.3.5 Quaternary Formations

The quaternary formations consist of alluvial and eolian deposits found in the upland areas east of the permit boundary and within the arroyo drainage channels within and adjacent to the mine. These formations make-up the unconfined groundwater flow conditions monitored within and adjacent to the mine.

The quaternary deposits in the upland areas generally abut up against the eastern boundary of the mine lease and are used for agricultural activities (USGS, 1979). The deposits vary in the degree of saturation, but are generally saturated from the extensive agricultural activities along the eastern mine boundary. The upland deposits contribute appreciable amounts of groundwater return flows to the topographically lower quaternary sediments within the arroyos. The upland quaternary formations are separated from the coal seams of the Fruitland Formation by the low permeability of the upper shales of the Fruitland Formation and therefore are not hydrogeologically connected to the coal seams. Moreover, the upland deposits along the eastern boundary are located hydrogeologically upgradient from the Navajo Mine's activities and are not and will not be impacted by mining activities. Therefore these upland quaternary deposits are not monitored.

The alluvial and eolian sediments found within the arroyos that pass through the Navajo Mine lease boundary are monitored by the alluvial wells adjacent to the arroyos. The arroyo deposits exhibit varying degrees of saturation along the drainage channel. The arroyo sediments are principally recharged by the upland deposits impacted by the agricultural irrigation activities of the Navajo Agricultural Product Industry (NAPI). Irrigation water is also directly discharged from the Navajo Indian Irrigation Project (NIIP) irrigation channels down the arroyo channels. Natural recharge contributions from meteoric precipitation to the arroyo sediments is limited because of the high evaporation rates in the region being a factor of seven times greater than the total precipitation at the mine (see Section 12 – Climate). The hydrologic regime of the quaternary formations is dynamic and will continue to be a changing hydrologic regime based on the changing agricultural activities.

42.3.6 Bedrock Formations

The coal seams within the Fruitland Formation at the Navajo Mine are the geologic units capable of transmitting groundwater away from the mining area. The Fruitland Formation coal seams are monitored because they are the formations that are disturbed by mining activities. The coal seams monitored are identified as the No. 2-3, No. 4-6, No. 7, and No. 8 coal seams. These coal seams are monitored by the

bedrock wells shown on Exhibit 18-4. The coal seams within the Fruitland Formations generally strike north south and dip 1 to 2 degrees to the east-southeast toward the center of the San Juan Basin. Neither the coal seams nor the Fruitland Formation itself are considered significant as a groundwater resource because of their poor aquifer characteristics and water quality (Stone, et al. 1983). The coal seams are monitored because they represent the zones of greatest hydrologic conductivity within the Fruitland Formation and therefore should facilitate the early detection of the potential migration of constituents.

The shale, mudstones, and siltstones of the Fruitland Formation act as aquatards or confining layers between the coal seams to potentially vertically migrating groundwater (see Section 41 – Probable Hydrologic Consequences). The potential for vertical permeability within the Fruitland Formation is limited. The presence of perched groundwater conditions within the coal seams and the absence of water in the adjacent interburden support this assertion.

The unit underlying the Fruitland Formation is a clean marine sandstone, the Pictured Cliffs Sandstone. The Pictured Cliffs Sandstone is a natural gas reservoir in the San Juan Basin (Stone et. al., 1983). The unit cannot be considered an aquifer because of its poor water quality and porosities (Stone et. al., 1983). The Pictured Cliffs Sandstone is hydrogeologically separated by an overlying ten to twenty-five feet of Fruitland Formation shale below the deepest coal seam mined. The layer of shale below the coal seam serves to restrict interconnected flow between the coal seam and the underlying Pictured Cliffs Sandstone. Underlying the Pictured Cliffs is an extensive thickness of the Lewis Shale.

42.3.7 Groundwater Flow Characteristics

The approximate groundwater flow directions, gradients, and movement rates are determined by precise groundwater level information collected from the alluvial and bedrock monitoring wells and the existing groundwater information in this Section and in Section 41 – Probable Hydrologic Consequences.

In general, the groundwater flow direction in the bedrock Fruitland Formation is from topographically high outcrop areas in the west to the east toward the center of the basin as well as towards lower outcrop areas to the north (i.e., San Juan River Valley) and to a minor extent the Cottonwood Wash to the south. The groundwater flow direction changes locally within the mine's major drainages (i.e., discharge areas). Section 41 – Probable Hydrologic Consequences summarizes the coal seams, the general groundwater flow directions, and the potential discharge locations.

The general regional flow direction in the quaternary formations is from the topograghically elevated agricultural areas in the east towards the west and towards adjacent major dissecting drainages north and south. The major drainages impacted by the irrigation return flows are the Bitsui, Chinde, and Cottonwood arroyos.

The groundwater movement rates in the Fruitland Formations coal seams is judged to be no greater than 0.076 feet per day using worst case conditions (see Section 41 – Probable Hydrologic Consequences). The groundwater velocities when the Fruitland Formation is considered as one unit is much lower than the 0.076 feet per day.

The groundwater flow in the alluvial sediments is unconfined and fluctuates seasonally with the irrigation season. The hydraulic conductivities of the alluvial and eolian formations are generally estimated to range between 1 to 10 feet per day.

42.3.8 Monitoring Well Locations

While the chance of groundwater impact from mining remains remote, the following monitoring well locations were developed to collect water quality and quantity information to insure protection of the hydrologic balance.

The rationale used for the placement of the monitoring wells was based on historic groundwater information collected (see Section 41 – Probable Hydrologic Consequences) spatial occurrence of the coals seams; the bedrock potentiometric surface maps; and locations of groundwater discharge and recharge areas. The nine monitoring wells that are part of the Navajo Mine Monitoring Program are located within the mine lease boundary and are shown on Exhibit 22-4. Of these wells, seven bedrock monitoring wells are installed in the Fruitland Formation coal seams with the remaining two wells monitoring the alluvial formations. The bedrock coal seams and Quaternary units and their associated monitoring wells are listed in Table 42-2. Table 42-2 provides the number of wells per unit monitored, the unit being monitored, and the frequency of monitoring. Access to each well site is made on existing roads.

The San Juan River alluvial aquifer is the most significant groundwater resource in the area. The water data collected from the bedrock wells in the northern area of the mine are utilized to monitor the water quantity and quality potentially flowing towards the San Juan River. The bedrock wells installed in the southern area of the mine monitor the potential impacts to the Cottonwood Wash. Wells located in the central area of the mine monitor groundwater flows towards the middle of the San Juan Basin. Hydrologic data provided in Section 41 – Probable Hydrologic Consequences describes the degree of saturation in each coal unit and spatial occurrence of the coal seams throughout the mine.

The bedrock wells are utilized to estimate the hydrogeologic characteristics and the quality and quantity of groundwater in the four major coal seams downgradient of the mining activities. The information will also support hydrologic consequence predictions found in Section 41 – Probable Hydrologic Consequences.

The bedrock wells also provide information used to support potentiometric surface maps for each of the four coal seams. The existing potentiometric surface maps in the mine's current Permit Application Package (PAP) were derived from data from the 12 bedrock wells and the information provided from the wells shown on Exhibit 18-10. The hydrogeologic data collected from the bedrock and alluvial wells will provide data that is used to assess the trends and magnitude and extent of potential impacts from mining or other sources to the hydrologic regime and the San Juan River alluvial aquifer.

The alluvial wells are located adjacent to the arroyos and monitor water quality within the alluvial sediments adjacent to the arroyos. The downstream alluvial monitoring well locations were selected to quantify the alluvial groundwater quality and quantity. The upstream alluvial location is monitored to provide upgradient background water quality and quantity information. In addition, the upstream water quality data will be used to detect constituents related to NIIP irrigation return flows and wastewater entering and flowing through the mine. The wells also provide data to characterize the hydrogeologic connection between surface water flows and the groundwater regime. The hydrologic connection information will be used to determine the characteristics of base flows within the arroyo sediments and the potential for impacts to the alluvial formation from NIIP flows. Generally, the arroyos are considered gaining channels, that is groundwater (i.e., irrigation return flows) are flowing towards the channel and recharging the alluvial sediments. The alluvial sediment cover usually conceals the evidence of discharge, and white salt or alkali deposits are the only evidence of groundwater discharge in these locations.

42.3.9 Well Construction

The alluvial and bedrock wells are constructed of two inch inside diameter flush joint threaded PVC. The screened interval of the wells generally consists of factory slotted PVC casing surrounded by silica sand. The wells completed in the Fruitland Formation were screened across the individual coal seams. The wells in the quaternary and bedrock formations are screened across the upper saturated zone. In most cases the wells are constructed with a bentonite seal above the sand pack and a cement bentonite grout to the surface. All the wells are surveyed from a designated point marked on the well casing and groundwater measurements are collected from this marked point only. The wells are protected with an outer metal casing with a locking cap and secured with an inner waterproof locking well cap. Wells are clearly marked in the field for identification and protection.

42.3.10 Sample Equipment

A dedicated bladder pump or a non-dedicated centrifugal pump is primarily used for purging and sample collection. A bailer may be used for sample collection where appropriate on shallow alluvial wells or when pumping is not practical. Well QACW-2 is an existing hand dug alluvial well and a dedicated bailer is used for sample collection. These types of sample collection equipment are generally recognized as the

best overall sampling devices for collection of water samples for the analysis of inorganic and organic constituents in groundwater (Barcelona et al., 1985; Barcelona, 1988; and USEPA 1986).

Water quality instruments which measure pH, conductivity, and temperature are used to determine the end point of well development; the basic chemistry of the groundwater; and compliance with regulatory guidelines (U.S. EPA, 1986). Field water quality instruments used to collect field parameters are calibrated before each sampling event. Water level measuring instruments are used to determine the static water level and total depth of the well to the nearest .01 of a foot from a consistent surveyed point on the well. Water level monitoring instruments are calibrated annually for accuracy. Calibration logs are kept for all applicable field instruments to document accuracy and performance. Field test kits may also be used in addition to laboratory analysis for parameters being evaluated that are physically or chemically unstable. Sampling and monitoring equipment is decontaminated between each sampling location to minimize cross contamination using a laboratory grade biodegradable phosphate free soap wash and a deionized water rinse. Decontamination, equipment operation, and calibration procedures are found in Appendix 42.B.

42.3.11 Well Monitoring

42.3.11.1 Frequency

The groundwater wells at the Navajo Mine are sampled at different frequencies based on the hydrogeologic characteristics of the formation being monitored. The quaternary monitoring wells are sampled on a quarterly frequency because of the high transmissivities that increase the hydrogeologic responsiveness of the alluvial formations. The bedrock wells on the other hand are sampled on an annual frequency because of the very low transmissivities of the coal seams. The quarterly and annual sampling frequencies will allow for the determination of seasonal and temporal changes to the quantity and quality of the hydrologic regime. Groundwater sampling of the alluvial wells is conducted in the last month of each quarter of the calendar year and Annual wells are sampled in the last month of the third quarter of the calendar year. The sampling frequency may be altered if analytical results indicate changes in the water quality or a need for additional or less information. Changes in sampling frequency will not be made without OSM approval.

42.3.11.2 Groundwater Level Measurements

Prior to well purging and sample collection at each well, static water level measurements are accurately measured to the nearest .01 of a foot (U.S. EPA, 1986). Water level measurements are collected from all the wells being sampled during each sampling event. The water level measurements provide a snapshot of the potentiometric surface at the time of sample collection.

42.3.11.3 Well Purging

Each well is purged of a minimum of two times the volume of groundwater that is standing in the casing prior to sample collection. Field measurements of pH, conductivity, and temperature are monitored in the

field prior to well purging and after each purge volume until the groundwater field parameters have stabilized within approximately 10 percent between at least two successive measurements during purging. Stabilization of the field parameter measurements made in the purge stream will be considered evidence of satisfactory well development. An effort is made during purging and sampling to decrease the agitation of the water to minimize changes in water quality. The purging process will proceed at a pump rate that will not draw the water down to the pump intake. This will minimize sample alteration due to introduction of air into the sample collected.

42.3.11.4 Sample Collection

When the field parameter readings during the well purging process have stabilized, it will be assumed that the water being removed is representative of formational waters and a groundwater sample will be collected immediately. In cases where well production is very slow and does not allow for a minimum of two well purge volumes to be extracted the well is purged to near dryness once and samples are collected when sufficient water is available. Samples are collected at lower flow rate than purging in an effort to minimize sample agitation and therefore collection of a more representative sample. Field measurements of the pH, conductivity, and temperature of the sample collected for laboratory analysis are measured and documented in the field before submittal to the laboratory.

The samples collected from the wells are marked with the well number, sampling date and time, name of sampler's name, and mine. Samples are collected and preserved in the field following EPA guidelines found at 40 CFR, Part 136 Guidelines Establishing Test Procedures for the Analysis of Pollutants, Table II. The samples are then packed in ice, placed in a cooler, and delivered to the analytical laboratory. The samples will be submitted to the laboratory in sufficient time to meet the required EPA analytical holding times for chemical analysis found at 40 CFR, Part 136 Guidelines Establishing Test Procedures for the Analysis of Pollutants, Table II.

42.3.11.5 Quality Assurance Quality Control Samples

Additional samples are collected in the field for the purposes of field and laboratory quality assurance and quality control (QA/QC) measures and follow EPA guidelines (U.S. EPA, 1993). QA/QC samples collected include the following:

- Replicates (duplicates) to provide sampling and analytical precision data. Replicates are collected, numbered, packaged, assigned separate numbers, and submitted blind to the Laboratory. Replicates will be collected at a frequency of 10 percent of the total samples collected.
- Equipment blank samples are collected when sampling equipment is decontaminated and reused in the field. Equipment blanks provide a check for cross contamination during sample collection, verification of decontamination procedures, introduction of contaminates from sampling equipment, and a check

on the laboratory. Metal free deionzed water is used for inorganic parameters. Blanks are collected, numbered, packaged in the same manner as other samples, and submitted blind to the laboratory. Equipment blanks will be collected at a frequency of 1 per sampling event.

- Lab QC samples are collected to perform laboratory QC analysis. Laboratories routinely perform matrix spike and lab duplicate analyses on field samples as a quality control check. One sample will be collected per sampling event and designated as a "Lab QC Sample" for the matrix spike and lab duplicate analyses. This is not an additional sample but merely additional volume of the same collected. QA/QC samples will be collected at a frequency of 20 percent of the total samples collected.

42.3.11.6 Parameter Selection

The parameters listed in Table 42-5 will be used for sample analysis of samples collected from bedrock and quaternary wells. The parameter list was developed based on the identification of potential sources of constituents, a review of Federal (i.e., Clean Water Act, NPDES programs) a State of New Mexico (i.e., New Mexico, 1995) regulatory requirements for groundwater quality for human health, irrigation, and livestock; the Office of Surface Mining hydrologic information requirements; and historic groundwater data. The listed parameters will allow for the characterization of groundwater quality and evaluation of changes in groundwater chemistry.

42.3.11.7 Laboratory Analysis

A chain of custody (COC) accompanies all samples submitted to the laboratory for analysis. The COC lists the analysis requested and detailed sample information. The samples submitted to the laboratory are analyzed for the parameters on Table 42-5 in accordance to U.S. EPA approved analytical methodology and laboratory QA/QC procedures. Moreover, every effort will be made to meet the analytical holding times provided at 40 CFR, Part 136 Guidelines Establishing Test Procedures for the Analysis of Pollutants, TABLE II The analytical methods for all the samples collected are specified so that the chemical results will be of a known quality and comparable with previous laboratory data. Laboratory QA/QC procedures, guidelines, and QA/QC requirements are found in Appendix 42.B.

42.3.11.8 Data Management

The groundwater data collected is entered into an environmental database to accurately track and manage the data generated and develop a well history for water quality and quantity. Spatial variability in the hydrogeologic conditions requires that each well result be compared against its own sampling history. The monitoring data generated will include general field data, well and water quality field measurements, and water quality laboratory results. The field data collected is documented on field groundwater monitoring forms and later entered into the database management system. The data is evaluated and checked against historic groundwater concentrations for any anomalies or trends. Parameters that are determined to be

outside the limits of historical values will be verified to determine if any errors occurred during sample collection, handling and/or analysis. The data verification steps will include checking field and chain-of-custody forms to determine if irregularities occurred during the sample collection or handling and the laboratory data will be validated to determine if errors occurred in the sample analysis or reporting.

Generally, groundwater parameter concentrations do not change rapidly, any significant differences between the historic and new data collected might indicate potential errors in sample collection or analysis. If the differences cannot be explained, the well will be re-sampled to confirm the results. If a value is confirmed to be accurate and representative of the groundwater quality it will be reported to OSM.

42.3.11.9 Data Analysis

The data analysis goals are to identify changes in the hydrologic balance and to insure that groundwater quality and quantity is being maintained. To meet these goals various statistical analyses of the groundwater data will be performed based on the data collected. At a minimum standard statistical analyses (means, standard deviations, etc.) will be performed to assess the quality of water information and parameter specific time verse concentration plots will be performed to detect trends.

42.3.11.10 Groundwater Reference Criteria

Groundwater reference criteria were developed from the historic record of groundwater monitoring data collected through 2001 to aid in the evaluation of future groundwater monitoring data. The reference criteria were established for parameters that represent potential constituents resulting from mining associated activities as further discussed in Section 41 – Probable Hydrologic Consequences. The reference level for each criterion is the mean parameter concentration, determined through 2001, plus two standard deviations. Reference parameters and levels are listed in Table 42-6.

42.3.11.11 Data Evaluation

Groundwater data will be evaluated and compared to reference criteria as a part of the Hydrologic Monitoring Report submitted twice during the permit term as discussed in this section. Data evaluation will consist of comparing data to reference criteria and determining if analysis for additional parameters, to further evaluate potential sources of changing groundwater quality, will be required during subsequent groundwater monitoring collection periods.

When two (2) or more reference criteria are exceeded at any one well through four (4), consecutive sample collection periods, then a more detailed analysis of groundwater samples will be conducted during the next scheduled sample collection period. The detailed analysis will include dissolved iron, dissolved manganese, nitrate-nitrite, boron, and fluoride in addition to the approved suite of parameters listed in Table 42-5. The results from the detailed analysis will be reviewed with OSM to evaluate potential sources of

changing groundwater chemistry and to determine if any measures should be taken. Analysis for the detailed suite of parameters will continue for the documented well until OSM approves a discontinuation of the expanded parameter suite or groundwater quality is below reference levels during subsequent sample collection periods.

42.3.11.12 Data Validation

Data validation is performed initially on a random selection of 10 percent of the total samples collected for laboratory analysis for each quarter. If problems are identified that may qualify the data unusable for its intended purposes 100 percent of the data will be validated for that quarter. The data validation will provide a check of the data to document the accuracy, precision, and completeness of the analyses performed. Data validation problems will be identified and explained to the extent possible. At a minimum, the following is checked, as part of the validation process, to insure that they meet the objectives of the groundwater plan:

- Documentation of sample collection , COC, and analysis,
- Transcription errors,
- Detection limits,
- Holding times and sample preservation,
- Comparison with blank samples,
- Matrix spikes and matrix spike duplicates,
- Laboratory duplicates for metals, and
- Field replicates.

42.3.12 Reporting

Groundwater monitoring results will be submitted on a quarterly basis to OSM. In addition, a detailed review of monitoring results will be submitted to OSM twice during the permit term. See Section 40 – Environmental Protection for additional information.

42.4 Air Pollution Control Plan

42.4.1 Air Quality

No quantitative air quality data existed for the Four Corners Region and pre-mining activities. Power generation, mining, agricultural, oil and gas, and transportation activities have started or increased substantially in the region since the early 1960s. The Grand Canyon Visibility Transport Commission is currently conducting the study of the air quality in the Four Corners Region.

The only potential air emission caused by the Navajo Mine is fugitive dust. Fugitive dust at the Navajo Mine is generated as a result of coal mining, transportation, and handling operations. The fugitive dust produced by the mine is primarily surface soil particles, and minor coal dust.

42.4.2 Air Pollution Control Compliance

The Navajo Mine monitors air quality for PM_{10} concentrations and is in compliance with 30 CFR § 780.15 Air Pollution Control Plan.

Navajo Mine air monitoring program is operated in compliance with the following applicable regulations and guidance: 40 CFR, Appendix J-Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere; Quality Assurance Handbook for Air Pollution Measurement Systems: Volume I Principles (U.S. EPA 600/9-76-005, Dec. 1984), Volume II Ambient Air Specific Methods (U.S. EPA 600/R-94/038A), and Volume IV. Meteorological Measurements (U.S. EPA 600/4-90/003, August 1989).

The Navajo Mine is in the Four Corners Interstate Air Quality Control Region as designated by the U.S. EPA). The ambient air quality attainment status for PM_{10} in this region was designated as "Unclassifiable" per 40 CFR § 81, 11/06/91.

42.4.3 Air Monitoring Program

The air-monitoring program at Navajo Mine started with a Total Suspended Particulate (TSP) monitoring program established in 1988 that consisted of four General Metal Works (GMW) high volume air TSP samplers. The program was later improved in 1991 with an expanded PM_{10} and TSP monitoring program. The current sampling network consists of two high volume PM_{10} General Metal Works samplers and three BGI PQ 100 PM_{10} monitors. The samplers run simultaneously on a 24-hour, once every six days schedule as per the U.S. EPA Ambient Air Particulate Monitoring National 6 Day Schedule. Particulate sampling instrumentation, procedures, data reporting, and interpretation follow the applicable methodology described in 40 CFR Part 50, National Primary and Secondary Ambient Air Quality Standards. Calibration and quality assurance procedures are performed in accordance with U.S. EPA guidelines, 40 CFR Part 50, 58, and the U.S. EPA Quality Assurance Handbook for Air Pollution Measurement Systems: Volume II Ambient Air Specific Methods.

The samplers and their locations are listed in Table 9-1. Locations are given using the New Mexico Base Coordinate System. The location of each sampler is shown in Exhibit No. 9-1.

42.4.4 Reporting

Quarterly air monitoring report will be submitted to the Office of Surface Mining (OSM) (Section 42 – Monitoring, Maintenance, Inspections, and Examinations). The air monitoring report generally contains

particulate monitoring results, analysis of samples collected, detailed particulate data, and quality assurance quality control summaries.

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USEPA, 1993. Preparation of a U.S. EPA Region 9 Field Sampling Plan for Private and State-Lead Superfund Projects. San Francisco, CA.

Table 42-1 Navajo Mine Surface Water Monitoring

Monitoring Station	Station Drainage	Sampling Frequency Quality
CD-1A	Chinde Wash – Upstream	Quarterly
CD-2A	Chinde Wash - Downstream	Quarterly

Table 42-2 Watershed Areas Associated with Navajo Mine

Watershed Size		Undisturbed Post-mining Area		Disturbed Post-mining Area		Pre-mining Badlands Area	
Watershed	Acres	Acres	Percent	Acres	Percent	Acres	Percent
Bitsui Wash	7,835	6,464	82.5	1,371	17.5	3,134	40.0
Chinde Wash	29,638	26,526	89.5	3,112	10.5	5,928	20.0
Hosteen Wash	8,384	6,036	72.0	2,348	28.0	4,192	50.0
Barber Wash	1,766	1,651	93.5	115	6.5	530	30.0
Neck Arroyo	666	506	76.0	160	24.0	666	100.0
Lowe Arroyo	5,837	3,444	59.0	1,393	41.0	1,634	28.0
Cottonwood Arroyo	42,854	39,854	93.0	3,000	7.0	24,855	58.0
Totals	96,980	84,481	87.0	11,499	13.0	40,939	42.0

Table 42-3 Surface Water Quality Parameters (All Surface Water Stations)

Parameter
Aluminum
pH
Total Dissolved Solids (TDS)
Total Suspended Solids (TSS)
Conductivity
Settleable Solids
Total Sediment
Arsenic
Boron
Cadmium
Calcium
Chloride
Fluoride
Iron
Iron (Total)
Lead
Magnesium
Manganese
Manganese (Total)
Mercury[1]
Nitrate
Potassium
Selenium
Sulfate
Sodium
Bicarbonate
Carbonate
Cation/Anion Balance

[1] Monitoring for mercury to be conducted for three (3) years after OSM's record of decision on the Area 4 North Mine Plan Revision (submitted to OSM on 15 February 2011, OSM No. NM-0003-F-R03). After which time, NTEC and OSM will reevaluate if continued monitoring is required.

Table 42-4 Navajo Mine Groundwater Wells

Well Number	Owner	Location	Status	Date Installed	Well Case	Completed Depth (ft)	Aquifer Formation	Use
Bighan-1	BHP	E: 32203.63 N: 2067306.70	Non active	06/10/94	PVC 2”	35.00	Qal	Env.
Bitsui-1	BHP	E: 330254.76 N: 2081799.31	Non active	06/15/94	PVC 2”	73.00	Ash	Env.
Bitsui-2	BHP	E: 331199.69 N: 2082772.08	Non active	07/14/94	PVC 2”	120.00	Kf CS# 8	Env.
Bitsui-3	BHP	E: 33215.40 N: 2081610.27	Non active	07/14/94	PVC 2”	170.00	Kf CS# 8	Env.
Bitsui-4	BHP	E: 330338.30 N: 2082170.54	Non active	01/26/96	PVC 2”	76.00	Spoil	Env.
Bitsui-5	BHP	E: 33108827 N: 2082170.54	Non active	01/26/96	PVC 2”	65.00	Spoil	Env.
Bitsui-6	BHP	E: 330240.43 N: 2081972.15	Non active	01/26/96	PVC 2”	76.00	Spoil	Env.
Custer-1	BHP	E: 322494.27 N: 2075983.66	Non active	06/17/94	PVC 2”	15.00	Spoil	Env.
Custer-2	BHP	E: 323500.87 N: 2076001.28	Non active	06/16/94	PVC 2”	65.00	Ash	Env.
Custer-3	BHP	E: 323001.69 N: 2075501.48	Non active	06/17/94	PVC 2”	45.00	Ash	Env.
Custer-4	BHP	E: 327192.80 N: 2074351.27	Non active	06/21/94	PVC 2”	14.00	Spoil	Env.
Doby-1	BHP	E: 318972.80 N: 2059769.30	Non active	06/22/94	PVC 2”	51.00	Qal	Env.
Doby-3	BHP	E: 319412.95 N: 2058177.66	Non-active	08/28/96	PVC 2”	38.00	Qal	Env.
Doby-5	BHP	E: 319640.00 N: 2058175.00	Non active	08/28/96	PVC 2”	37.80	Qal	Env.
Doby-8	BHP	E: 319405.00 N: 2058175.00	Non active	08/28/96	PVC 2”	38.00	Qal	Env.
GM-17	BHP	E: 309800 N: 2013500	Non active	06/05/05	PVC 4”	20.30	Qal	Env.

Table 42-4 (Continued)

KF83-1	BHP	E: 331600.00 N: 2080050.00	Non active	08/19/83	PVC 4”	147.00	Kf CS# 8	Env.
KF84-16	BHP	E: 334100.00 N: 2081500.00	Non active	01/01/95	PVC 2”	294.00	Kf CS# 8	Env.
KF84-18A	BHP	E: 318950.00 N: 2050180.00	active	05/01/84	PVC 2”	180.00	Kf CS# 4-6	Env.
KF84-18B	BHP	E: 318950.00 N: 2050180.00	active	05/01/84	PVC 2”	135.00	Kf CS# 8	Env.
KF84-20A	BHP	E: 304307.65 N: 2017120.64	active	03/06/84	PVC 2”	227.00	Kf CS#2-3	Env.
KF84-20B	BHP	E: 304319.22 N: 2017144.83	active	03/07/84	PVC 2”	187.00	Kf CS4-6	Env.
KF84-20C	BHP	E: 304310.70 N: 2017093.50	active	03/07/84	PVC 2”	187.00	Kf CS# 7	Env.
KF84-22A	BHP	E: 307822.16 N: 2009510.05	active	05/03/95	PVC 2”	126.00	Kf CS# 8	Env.
KF84-22B	BHP	E: 307829.36 N: 2009513.79	active	04/26/84	PVC 2”	142.00	Kf CS# 7	Env.
QAC-1	BHP	E: 310080.00 N: 2053200.00	active	01/01/84	PVC 2”	19.00	Qal	Env.
QACW-2	BHP	E: 287032.58 N: 2009420.7	active	n/a	PVC 2”	N	Qal	Env.
Watson-1	BHP	E: 32928.13 N: 2085893.97	Non active	06/08/94	PVC 2”	66.00	Ash	Env.
Watson-4	BHP	E: 328648.35 N: 2083899.52	Non active	06/07/94	PVC 2”	93.00	Ash	Env.

Kf = Cretaceous Fruitland Formation

CS# = Coal Seam Number

Qal = Quaternary Alluvium

n/a = not available

Table 42-5 Navajo Mine Groundwater Sampling Parameter List (Bedrock and Alluvial Wells)

Category	Parameter
General	Temperature
	Water level
Water Quality	Carbonate
	Bicarbonate
	Sulfate
	Chloride
	Fluoride
	Total Dissolved Solids (TDS)
	Conductivity
	pH
Metals	Selenium
	Calcium
	Magnesium
	Sodium
	Potassium

Table 42-6 Groundwater Monitoring Reference Criteria[1]

Monitoring Parameter[2/3]	Reference Criteria by Well[4]							
	KF84-20A	KF84-21A	KF84-18A	KF84-20C	KF84-22B	KF84-18B	KF84-22A	QAC-1
Total Dissolved Solids (mg/l)	8,952	9,777	14,358	4,364	7,445	10,387	6,749	15,073
Magnesium (mg/l)	17.2	19.5	60.6	3.67	19.5	34.1	13.4	151
Potassium (mg/l)	21.3	30.6	42.1	9.91	33.0	58.9	50.9	28.4
Sulfate (mg/l)	385	972	348	1,267	64.1	107	3,333	5,651
Selenium (mg/l)	0.004	0.022	0.004	0.005	0.027	0.001	0.024	0.169

1. If two or more groundwater reference criteria are exceeded, at any one monitoring location, over four consecutive sample collection periods, then subsequent groundwater samples from that location will be analyzed for dissolved iron, dissolved manganese, nitrate-nitrite, boron, and fluoride in addition to the standard suite of parameters listed in Table 42-5.
2. Monitoring parameters were selected because they are considered indicators for potential constituents resulting from mining activities as discussed in the Probable Hydrologic Part 6, Section 41.
3. Specific conductance, pH, calcium, sodium, carbonate, bicarbonate, and chloride are analyzed, in addition to monitoring parameters, to assess general groundwater chemistry and for determining water type. Reference criteria are not established for these parameters because they are not considered indicator parameters for potential source constituents.
4. Reference criteria are mean values plus two (2) standard deviations calculated from historic data collected through 2002. Detection values were calculated as the product of 0.5 and the detection limit.

Table 42-7 Analytical Methods and Detection Limits

PARAMETERS	**EPA METHOD**	**DETECTION LIMITS**
Temperature	170.1	0.2^0 C
Total Dissolved Solids (TDS)	160.1	10 mg/L
Conductivity	120.1	10 µmh/cm
pH	150.1	0.5 S.I. units
Water level	(*)	0.01 feet
Calcium	200.7	0.10 mg/L
Magnesium	200.7	0.05mg/L
Sodium	200.7	0.50 mg/L
Potassium	200.7	0.50 mg/L
Carbonate	310.1	2.00 mg/L
Bicarbonate	310.1	2.00 mg/L
Sulfate	300.0	1.00 mg/L
Chloride	300.0	1.00 mg/L
Selenium	270.3	0.01 mg/L
Fluoride	A4500-F C	1.5 mg/L

* RCRA Ground Water Monitoring Technical Enforcement Guidance Document, 1986

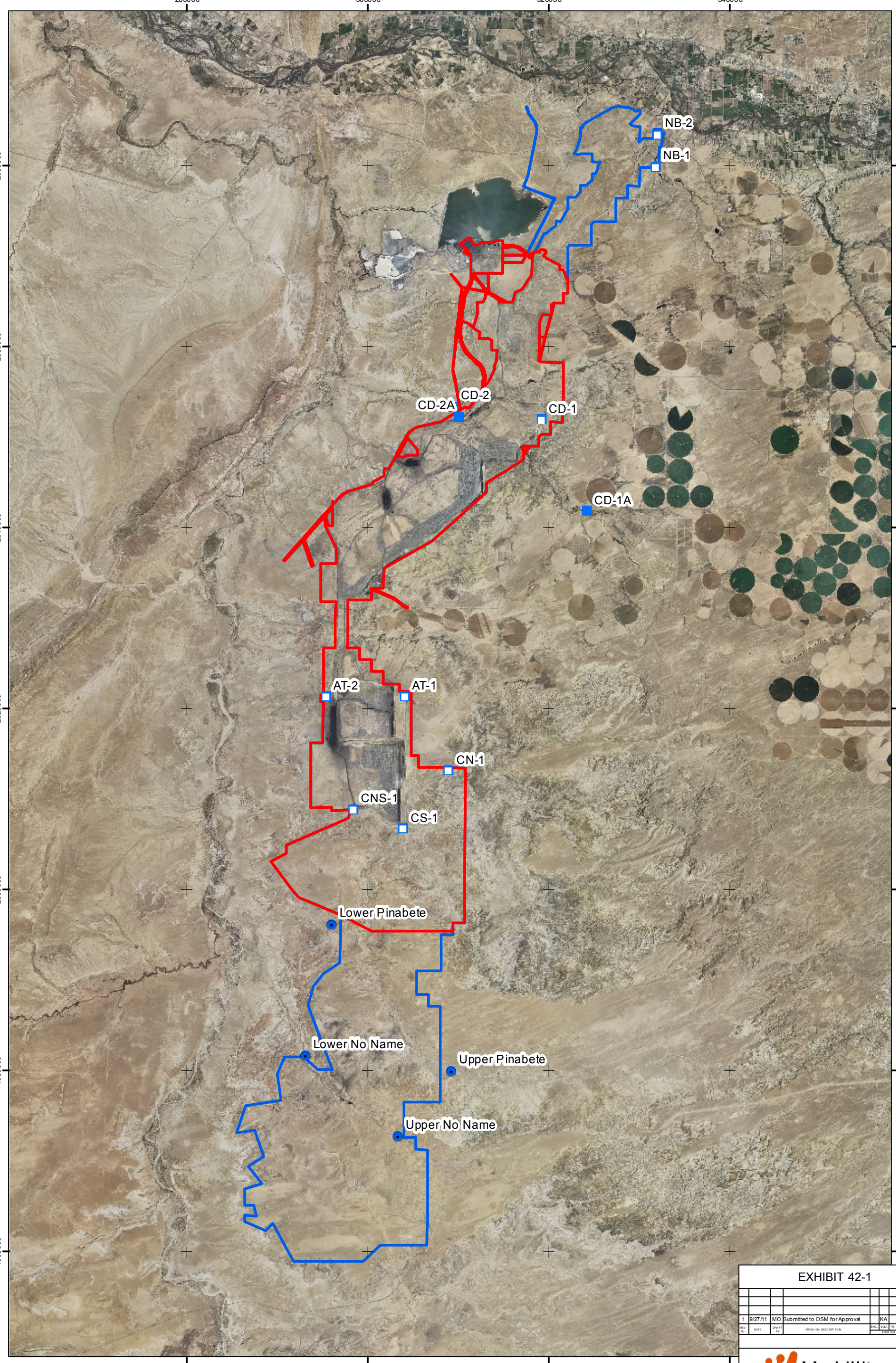

EXHIBIT 42-1

REV. No.	DATE	DRAFT BY	REVISION DESCRIPTION	ENG.	EGD.	PE.	APPROVALS
1	9/27/11	MO	Submitted to OSM for Approval		KA		

bhpbilliton

BHP NAVAJO COAL COMPANY
Location Map
Surface Water
Monitoring Stations

PREPARED BY: MPO	DRAWN BY: MPO	PAPER SIZE: 11 X17
APPROVED BY: CKA	DATE: 9/27/2011	

Coordinate System: NAD 1927
State Plane NM West FIPS 3003
Projection: Transverse Mercator
Datum: North American 1927

Feet
0 5,000 10,000
1:120,000

Active Monitoring Stations
Historic Monitoring Stations
Non-SMCRA Surface Water Monitoring
BNCC Coal Lease
SMCRA Permit Boundary

Appendix 42.A

Total Sediment Analysis Procedure

DETERMINATION OF SUSPENDED CONCENTRATION BY EVAPORATION-RECOMMENDED LABORATORY PROCEDURE

1. Measure the volume of the entire sample (water plus sediment) to the nearest ml.
2. Measure the mass of the entire sample (water plus sediment) to the nearest mg. This value will not be used in the mg/ml concentration calculation but will be good to have for future computations, such as concentration in parts per million or back-calculation of the specific gravity.
3. Allow the sample to settle for at least 24 hours.
4. If colloidal material is in suspension add a small quantity of flocculating agent and allow enough time for the colloids to settle.
5. Decant the supernatant liquid to a point where a small amount (about 20 ml) of water remains with the sample. Be careful not to remove any of the sediment during decanting.
6. Wash the remaining sediment and water into an evaporation container.
7. Dry the contents of the dish in an oven at a temperature of 5 degrees C below the boiling point. If the contents are allowed to boil some of the sediment could be lost from the container.
8. Remove the evaporation container from the oven and place in a desiccator until cool, to avoid the reacquisition of moisture into the sample. The desiccator may not be necessary in an extremely arid environment.
9. Measure the gross and tare mass of the dried sample and compute the net mass of the sediment to the nearest 0.1 mg.
10. Compute the concentration by dividing the sediment mass in mg by the sample volume (as determined in step 1) in L.
11. Determine the particle size distribution of the sediment in the sample. Performing a washed sieve of the sediment analysis after steps 1 through 10 have been completed should make this determination. The sieve analysis procedure is described in ASTM standards C-117 and C-136. Determine the mass of the silt and clay fraction by measuring the dry mass of all sediment retained above the No. 230 (0.063 mm) sieve and subtracting it from the total sediment mass. Dividing the silt and clay mass by the total sediment mass will give the percentage of the total sediment concentration attributable to silt and clay.

When this method is used, any dissolved solids in the sample will be included in the sediment mass. There are documented procedures for determining a dissolved solids correction, but we believe this will not be necessary given the sediment concentrations typical of these samples.

Appendix 42.B

Quality Assurance and Quality Control Water Quality

QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC) PROGRAM
WATER QUALITY

GENERAL REQUIREMENTS

BHP Minerals will contract with a single laboratory to provide water analytical services. If there is an anticipated change in laboratory, BHP Minerals will notify OSMRE within 60 days of the contract. If another lab is selected in the bidding process, OSM will be informed. BHP Minerals will coordinate planning, procedures and techniques of sampling programs with the contract laboratory.

SAMPLE COLLECTION, HANDLING, AND TRANSPORT:

1. Ground Water

Prepared sample kits and sampling instructions will be provided by the contract laboratory prior to sampling dates. The sample kits will be preserved and prepared according to the specified parameter lists in Tables 27.15 and 27.16 in Chapter 27 of the current approved PAP (NM-0003B). Water samples will be collected in a clean one gallon plastic bucket. At each site, the bucket will be thoroughly rinsed twice with distilled water before the sample is collected. The bottles from the prepared kits will be immediately filled. The samples will be packed in ice and transported expeditiously to the contract lab.

2. Surface Water

Surface water samples are automatically collected in clean and dry 1-liter polypropylene bottles. These are replaced when the bottles are filled. Samples are packed in ice and shipped expeditiously to the contract lab.

SAMPLE DOCUMENTATION FORM:

1. All samples submitted for analysis will be documented and kept on file. Instructions for type of analysis will be submitted to the laboratory with a list of samples being submitted for analysis. Time and date of sample and pertinent field data will be provided for all samples.

QUALITY ASSURANCE/QUALITY CONTROL PROGRAM ELEMENTS:

GENERAL

1. The contract laboratory must be EPA-certified or certified by other national or regionally recognized external accreditation;

2. A statement of qualifications of all laboratory personnel handling the samples and data will be provided to the company;

3. A detailed internal laboratory QA/QC program on all analytical work will be provided to the company;

4. All internal laboratory QA/QC data will be supplied to the company upon request;

5. A laboratory Standard Operating Procedure (SOP) outlining analytical procedures, calibrations, data reduction, etc. will be provided to the company for review;

6. If procedure modifications are made, the laboratory must describe the modifications in detail and supply the information to the company prior to an approved change.

DUPLICATE SAMPLING

Duplicate samples from five (5) monitoring wells will be submitted annually to the laboratory as blind samples. The sites will be selected in such a manner that within three years, a duplicate sample will be submitted once for all the wells listed in Table 27.11 of Chapter 27 of the approved PAP. Two (2) bottle sets from any one station will be filled, preserved and shipped in an identical manner. Furthermore, the location and other information given on the label will not reveal that the sample is a duplicate. This will provide a check for data precision, repeatability, and consistency from the laboratory.

LABORATORY

1. At least 20% of all samples will be run in duplicate;

2. At least 20% of all samples will be spiked for recovery;

3. 2-6 standards will be run for each set, depending on the given parameter;

4. Additional standards should be run throughout the series of samples at the rate of at least one (1) per 20 or less samples;

5. A standard and a blank will be run at the end of each set;

6. An EPA or NTIS traceable standard (known) will be run for each set of 20 or less samples;

7. All major equipment and balances will be under an inspection program;

8. The laboratory will at a minimum meet the laboratory procedures for the parameters listed in Tables 27.15-27.17 in Chapter 27 of the current approved PAP (NM-0003B) as outlined in "Methods for Chemical Analysis of Water and Wastes". Any modification to any of the methodology will be approved in advance.

ANALYTICAL QUALITY CONTROL

1. CATION-ANION BALANCE

   The formulas outlined in Method #1030 F in "Standard Methods for the Examination of Water and Wastewater" will be used to calculate cation-anion balance.

2. TDS RATIO CALCULATION

   The formulas outlined in Method #1030 F in "Standard Methods for the Examination of Water and Wastewater" will be used to calculate TDS ratio.

3. At a minimum, cation-anion balance will be used for laboratory data checks.

SAMPLE LOG MANUAL:

All samples delivered to the laboratory will be logged into the permanent record book, and the information will also be recorded on an internal lab information sheet (lab control sheet). This sheet will become part of the permanent files.

QUALITY CONTROL RECORDS MANUAL:

All quality control data will be maintained in the permanent records. The data for each parameter (i.e. duplicate and spiked samples, "known" and "unknown", audit samples and "splits") and their relationship to the +/- two (2) standard deviations will be kept in the chart form or other tabular to allow easy review of the control of the methods.

DATA ANALYSIS

The hydrology data will be statistically summarized and a trend analysis will be run on all the ground water and surface water parameters being analyzed. Further, the data will serve to determine background levels except the data generated as a result of the Navajo Indian Irrigation Project (NIIP) irrigation runoff. This data does not represent precipitation runoff.

REFERENCES

American Public Health Association. Standard Methods for the Examination of Water and Wastewater. 17th Edition or most current edition. Published jointly by: American Public Health Association, American Water Works Association, and Water Pollution Control Federation. Washington, D.C.

EPA. 1979. Methods for Chemical Analysis of Water and Wastes. EPA - 600/4-79-202. Cincinnati, OH.