4.5 Water Resources/Hydrology

This section describes the surface water and groundwater systems in the ROI and impacts of the Proposed Action and alternative actions on those systems.

The ROI for groundwater resources is contained within the San Juan Basin, and is limited to the area within the Basin that could be affected by the actions taken at the Navajo Mine SMCRA Permit Area, proposed Pinabete SMCRA Permit Area, and FCPP. The discussion describes the local groundwater hydrology and water quality of the San Juan Basin, including water balance and a description of the geologic formations and aquifers that comprise the basin. The discussion then provides data related to site-specific hydrology and water quality beneath the Navajo Mine SMCRA Permit Area and Pinabete SMCRA Permit Area and the FCPP. The subject transmission line ROWs are located over the San Juan Basin; however, since operation and maintenance activities associated with these lines would not involve deep excavation or use of water wells, detailed description of the groundwater hydrology or water quality beneath these lines is not provided.

The ROI for surface water is the entire San Juan Basin and includes all perennial, intermittent, and ephemeral streams and lakes that intersect the Navajo Mine SMCRA Permit Area, Pinabete SMCRA Permit Area, FCPP Lease Area, and associated existing transmission lines. The deposition of metals in emissions from power plants has the potential to adversely affect surface water quality. Since FCPP emissions have the potential to travel and deposit a substantial distance from the power plant site itself, the ROI also includes all surface water features within the defined deposition area for the power plant, which extends less than 50 kilometers in all directions as described in Section 4.1, Air Quality and shown on Figure 4.5-4. The affected environment includes a description of the surface water features, existing water quality conditions, and current water uses within the ROI.

4.5.1 <u>Regulatory Compliance Framework</u>

4.5.1.1 Federal Regulations

Clean Water Act

CWA Sections 401, 402, and 404 pertain to regulating impacts to waters of the U.S. and are applicable to the Project. The following subsections discuss each of these CWA sections in detail.

<u>Section 401</u>

Section 401 requires that any applicant pursuing a Federal permit to conduct any activity that may result in a discharge of a pollutant must obtain a water quality certification (or waiver). The NNEPA issues water quality certifications for activities that occur within the Navajo Nation. Under the CWA, the NNEPA must issue or waive Section 401 water quality certification for the Project to be permitted under Section 404. The NNEPA also issues water quality certifications for Section 402 NPDES permits within the Navajo Nation. Water quality certification requires the evaluation of water quality considerations associated with dredging or placement of fill materials into waters of the U.S. and imposes project-specific conditions on development. A Section 401 waiver establishes standard conditions that apply to any project that qualifies for a waiver. Prior to implementation of the Project, MMCo would be required to obtain Section 401 water quality certification or waiver from the NNEPA, if the USACE finds that a Section 404 permit is required.

<u>Section 402</u>

Section 402 establishes the NPDES permit program to control discharges of pollutants from point sources. The EPA administers and enforces the NPDES program for the Navajo Nation. Section 402 addresses both construction and industrial activities, as described below.

Both the Navajo Mine SMCRA Permit Area and FCPP are covered under individual Industrial NPDES permits. APS is authorized to discharge effluent from FCPP to Morgan Lake and an unnamed wash tributary to the Chaco River under NPDES permit NM0000019. NTEC is also authorized to discharge effluent from the coal storage facility to Morgan Lake under NPDES permit NN0028193, held by MMCo (MMCo's permit also authorizes discharges to the San Juan River and Chaco River). The APS NPDES permit sets limits on discharge from four discharge points at the FCPP: the cooling ponds, condenser cooling water, chemical metal cleaning water, and combined waste treatment pond. Monitoring requirements under both the APS and MMCo permits vary by parameter and sampling location. A review of monthly discharge reports submitted to EPA for 2012 indicated that no discharge was released from the chemical metal cleaning water during the year. Discharge from the cooling ponds and condenser cooling water met the permit limits. A review of EPA records also verified that no violations occurred under permit NM0000019 and one violation is recorded for BNCC under permit NN0028193 for non-compliance with discharge limits for total suspended solids and total iron for discharge which occurred between October and December 2013. Reporting violations have been recorded for the subsequent quarters. No enforcement actions are reported to date (EPA 2013f). Table 4.5-1 provides a summary of the FCPP permit limits (EPA 2001; APS 2012b). Table 4.5-2 summarizes the Navajo Mine permit limits (EPA 2008).

Table 4.5-1 FCPP NPDES Discharge Limits into Morgan Lake

	Cooling Ponds (Discharge from Morgan Lake to No Name Wash)	Condenser Cooling Ponds	Chem Metal Cleaning Water	Combined Waste Treatment Pond
Temperature	32.2 moving average/ 36 daily max	N/A	N/A	N/A
pH	Min 6/ max 9	Min 6/ max 9	Min 6/max 9	Min 6/ max 9
Flow	14.7 million gallons daily max	Required monitoring/ no limit	Required monitoring/ no limit	Required monitoring/no limit
TDS	Required monitoring/no limit	N/A	N/A	N/A
TSS	N/A	N/A	N/A	30 mg/L weekly average/ 100 daily max
Chlorine	N/A	954 mg/L daily max		N/A
Oil and grease	N/A	N/A	15 mg/L weekly average/ 20 mg/L daily max	15 mg/L weekly average/ 20 mg/L daily max
Copper	N/A	N/A	1 mg/L weekly average/1 mg/L daily max	N/A
Iron	N/A	N/A	1 mg/L weekly average/1 mg/L daily max	N/A
Static 4 day chronic selenium	N/A	Required monitoring/no limit	N/A	N/A
Static 7 day chronic *Ceriodaphnia dubia*	N/A	Required monitoring/no limit	N/A	N/A
Static 7 day chronic *Pimphales promelas*	N/A	Required monitoring/no limit	N/A	N/A

Table 4.5-2 Navajo Mine NPDES Discharge Limits

	Outfall 002 to Morgan Lake	Outfall 003 to Chaco River
TSS	35 mg/L monthly average/ 70 mg/L daily max	35 mg/L monthly average/ 70 mg/L daily max
Iron, total	3.5 mg/L monthly average/ 7 mg/L daily max	3.5 mg/L monthly average/ 7 mg/L daily max
Manganese, total	2 mg/L monthly average/ 4 mg/L daily max	N/A
Arsenic	Required monitoring/no limit	Required monitoring/no limit
Boron	Required monitoring/no limit	Required monitoring/no limit
Cadmium	Required monitoring/no limit	Required monitoring/no limit
Lead	Required monitoring/no limit	Required monitoring/no limit
Selenium	Required monitoring/no limit	Required monitoring/no limit
Sulfate	Required monitoring/no limit	Required monitoring/no limit
TDS	Required monitoring/no limit	Required monitoring/no limit
pH	6-9	Required monitoring/no limit
Flow	N/A	Required monitoring/no limit

Construction activities that disturb greater than 1 acre are regulated under the NPDES General Permit for Discharges of Storm Water Runoff Associated with Construction Activity (General Construction Permit), Coverage under the General Construction Permit requires the preparation of a SWPPP and Notice of Intent. The SWPPP includes pollution prevention measures (erosion and sediment control measures and measures to control non-stormwater discharges and hazardous spills), demonstration of compliance with all applicable local and regional erosion and sediment control standards, identification of responsible parties, a detailed construction timeline, and a BMP monitoring and maintenance schedule. The Notice of Intent includes site-specific information and the certification of compliance with the terms of the General Construction Permit. NTEC will be required to obtain a construction general permit for extension of transmission lines and construction of new roads associated with the development of the Pinabete SMCRA Permit Area.

Section 404

Section 404 regulates the discharge of dredged and fill materials into "waters of the U.S.," which include oceans, bays, rivers, streams, lakes, ponds, and wetlands. Before any actions that may affect surface waters are implemented, a delineation of jurisdictional waters of the U.S. must be completed, following USACE protocols, to determine whether a project area contains wetlands or other waters of the U.S. that qualify for CWA protection. Such areas include:

- Areas within the ordinary high water mark of a stream, including non-perennial streams with a defined bed and bank and any stream channel that conveys natural runoff, even if it has been realigned; and
- Seasonal and perennial wetlands, including coastal wetlands.

Wetlands are defined for regulatory purposes as areas "inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR 328.3; 40 CFR 230.3).

Project proponents must obtain a permit from the USACE for discharges of dredged or fill material into jurisdictional waters of the US before proceeding with a proposed activity. Delineations of potential waters of the U.S. have been conducted for both the Pinabete SMCRA Permit Area and the proposed DFADA for the FCPP. These studies have been submitted to the USACE. NTEC preferred to move forward a preliminary jurisdictional determination, evaluation, and permitting for the Pinabete SMCRA Permit Area. USACE reviewed and accepted APS/FCPP's delineation materials and approved jurisdictional request showing one isolated exhibit of OHWM and one isolated wetland; USACE moved forward with an isolated-and-not–jurisdictional determination for those isolated waters under current regulations governing isolated waters. As such, USACE has determined that a permit is required for the Pinabete SMCRA Permit Area, but not the FCPP.As per the regulation, the USACE will conduct an alternatives analysis and is required to permit the least environmentally damaging practicable alternative (USACE 2013). This alternatives analysis and permit review process is being conducted concurrent to the OSMRE's review of the Project. USACE's draft decision document is provided in Appendix C.

Other Federal Programs

Under the CWA, states and tribes with approved programs typically establish water quality standards based on EPA-recommended criteria for surface waters. If surface water does not meet standards, the CWA generally requires the state to set a Total Maximum Daily Load (TMDL) to be established that identifies the maximum amount of pollutant that can enter the water and still meet standards. For point sources of pollution, such as an outfall from a sewage treatment plant, CWA permitted discharge limits are to be consistent with the TMDL. However, there is no similar regulatory requirement for nonpoint sources of pollution, such as atmospheric deposition over states, tribal lands, or other regions. States and tribes may take actions, such as providing technical or financial assistance to limit pollution from nonpoint sources through nonpoint source management controls, but legal obstacles arise when atmospheric deposition affecting state waters originates in emissions from another state (GAO 2013).

The EPA has issued numerous CAA regulations over the years (e.g., Acid Rain, Cross-State Air Pollution Rule [CSAPR], MATS) that have reduced stationary- and mobile-source emissions of NO_X and SO_2, and more recently, mercury. In addition to reducing airborne contaminants, these rules also serve to limit the amount of pollution in surface waters. However, even with reduced emissions, NO_X, SO_2, and mercury continue to impact the nation's waters. One control strategy proposed by the EPA is to establish new secondary NAAQS (i.e., standards to protect public welfare) that target the effects of acid rain caused by NO_X (as NO_2) and SO_2 on water bodies. However, initial agency efforts were unsuccessful due to uncertainty in atmospheric modeling results and limitations in available data, which prevented determination of secondary NAAQS adequate to protect against the effects of acid rain. No alternative strategies have been identified; however, the EPA recently announced an integrated nitrogen research effort that includes approaches to reducing atmospheric deposition of nitrogen compounds into waters already impaired by nutrient over-enrichment due to fertilizer runoff (GAO 2013).

On June 7, 2013, EPA proposed a rule to amend the effluent limitations guidelines and standards for the Steam Electric Power Generating category (40 CFR Part 423), within which the FCPP falls. The proposed rule aims to strengthen the existing controls on discharges from these plants; it sets the first federal limits on the levels of toxic metals in wastewater that can be discharged from power plants, based on technological advances over the last three decades. The current effluent guidelines were last updated in 1982 and focus on settling out particulates rather than treating dissolved pollutants, as do the proposed rules. The updated regulation is also proposed because new technologies in the industry and implementation of pollution controls have altered wastewater streams.

The proposed rule would establish new or additional requirements for wastewater streams from flue gas desulfurization, fly ash, bottom ash, flue gas mercury control, and gasification of fuels, including coal. The proposed standards are based on data collected from industry and are designed to provide flexibility in implementation; the rules propose phasing in new requirements between 2017 and 2022. It should be noted that the required new technology is already installed at a number of plants. The proposed rule identifies four possible regulatory options that vary in the number of waste streams covered, size of the units controlled, and stringency of controls. EPA will take comment on all of these options, which it will use to help inform the most appropriate final standard (EPA 2013g).

On December 19, 2014, EPA issued a final rule for the disposal of CCR from electric utilities. The rule establishes technical requirements for existing and new CCR landfills and surface impoundments under solid waste provisions, Subtitle D, of the Resource Conservation and Recovery Act (RCRA). These requirements include:

- structural integrity requirements to reduce the risk of catastrophic failure for surface impoundments,
- liner design criteria (all landfills, impoundments and lateral expansions must have composite liners and a leachate collection system)
- new operating criteria (run-on and run-off controls, erosion control, and air criteria to limit windborne dust)
- groundwater monitoring and corrective action
- closure and post-closure monitoring standards
- record-keeping, notification, and internet posting requirements (compliance records are to be kept in the facility's operating record, submitted to the appropriate state/tribal authorities, and posted on a public website)

The regulations are minimum federal criteria with which facilities must comply without the engagement of another state or federal regulatory authority (e.g., self-implementing regulations). States are not required to adopt these regulations, to develop a permitting program, or to submit a program to EPA for approval. EPA has no formal role in implementation of the rule. EPA does not issue permits, nor can EPA enforce the requirements of the rule (EPA 2014a).

4.5.1.2 State Regulations

New Mexico Standards for Interstate and Intrastate Surface Waters

Water quality standards for the San Juan Basin are set forth in the New Mexico Standards for Interstate and Intrastate Surface Waters (New Mexico Administrative Code 20.6.4). The administrative code specifies general standards that apply to all waters in the state at all times, unless otherwise noted. Specific water quality standards for pH and bacteria (fecal coliform), phosphorus, and temperature have been set for the La Plata and Animas rivers. Specific water quality standards for temperature, phosphorus, bacteria and conductance have been set for all but one segment of the San Juan River.

4.5.1.3 Tribal Standards

The Navajo Nation has adopted the Navajo Nation Surface Water Quality Standards (NNEPA 2008), which establish various surface water use quality standards and have been approved by the EPA. These standards apply to all waters of the Navajo Nation, which include, but are not limited to, ephemeral, intermittent, and perennial streams, springs, wetlands, and any natural or man-made depressions or basins that impound water within the Navajo Nation's jurisdiction. However, NNEPA water quality standards do not apply to Morgan Lake, which is the only surface water into which the FCPP discharges. The Navajo Nation Water Quality Standards do apply to the surface waters into which that Navajo Mine discharges. The standards associate specific uses within specific stream reaches, including Cottonwood Arroyo and Chaco River. Specific uses have not been identified for No Name Arroyo or Pinabete Arroyo. Designated uses for Cottonwood Arroyo and Chaco River include livestock water, aquatic and wildlife habitat, fish consumption, and secondary human contact standards. Applicable standards for the designated uses are provided in Table 4.5-3. The NNEPA has no water quality standard for total dissolved solids (TDS), sulfate, or fluoride. The NNEPA surface water quality standard for suspended sediment applies only to surface water that is at or near baseflow and does not apply to surface water during or soon after a precipitation event and is, therefore, not applicable to ephemeral flows (NNEPA 2008).

Table 4.5-3 Navajo Nation Water Quality Standards for Designated Uses (all in mg/L except pH)

Constituent	Livestock	Aquatic and Wildlife Habitat Acute	Aquatic and Wildlife Habitat Chronic	Secondary Human Contact	Fish Consumption
Aluminum		0.75	0.087		
Arsenic	0.2	0.34	0.15	0.28	0.08
Barium				98	
Boron	5			126	
Cadmium	0.05	0.00217	0.00026	0.47	0.008
Chromium III		0.6068	0.0789	1400	75
Chromium IV		0.016	0.011	2.8	0.15
Copper*	0.5	0.01445	0.00956	9.33	
Lead*	0.1	0.07022	0.00274	0.015	
Mercury		0.0024	0.000001	0.28	0.00015
Nitrate	132			1493.33	
pH	6.5-9.0	6.5-9.0	6.5-9.0		
Radium 226+228	30				
Selenium	0.05	0.033	0.002	4.67	0.67
Silver*		0.00367		0.00467	8
Zinc*	25	0.1251	0.1261	280	5.1

Source: NNEPA 2008.

Notes:

*Aquatic and Wildlife Habitat Criterion are hardness dependent and calculated for a hardness of 108 mg/L as calcium carbonate ($CaCO_3$), which is the median for Pinabete and Cottonwood arroyos.

mg/L = milligram(s) per liter

The Navajo Nation released Draft 2013 Surface Water Standards for public review in 2013. These standards are not yet adopted by the NNEPA and it is uncertain when they will go into effect. As of February 2014, the standards had been given preliminary approval by EPA and were under review by the Navajo Nation Resources Council. Primary changes from the prior standards approved by EPA and Navajo Nation Resources Council include a revision of waterbodies addressed to include only those reaches within the jurisdiction of the Navajo Nation. In addition, a hardness-based standard for aluminum for aquatic and wildlife habitat was developed for waters with pH greater than 7. Water quality standards were also set for mercury and methylmercury with regard to chronic impacts to aquatic and wildlife habitat (NNEPA 2013).

4.5.2 Affected Environment Pre-2014

4.5.2.1 Groundwater

Local Groundwater Overview

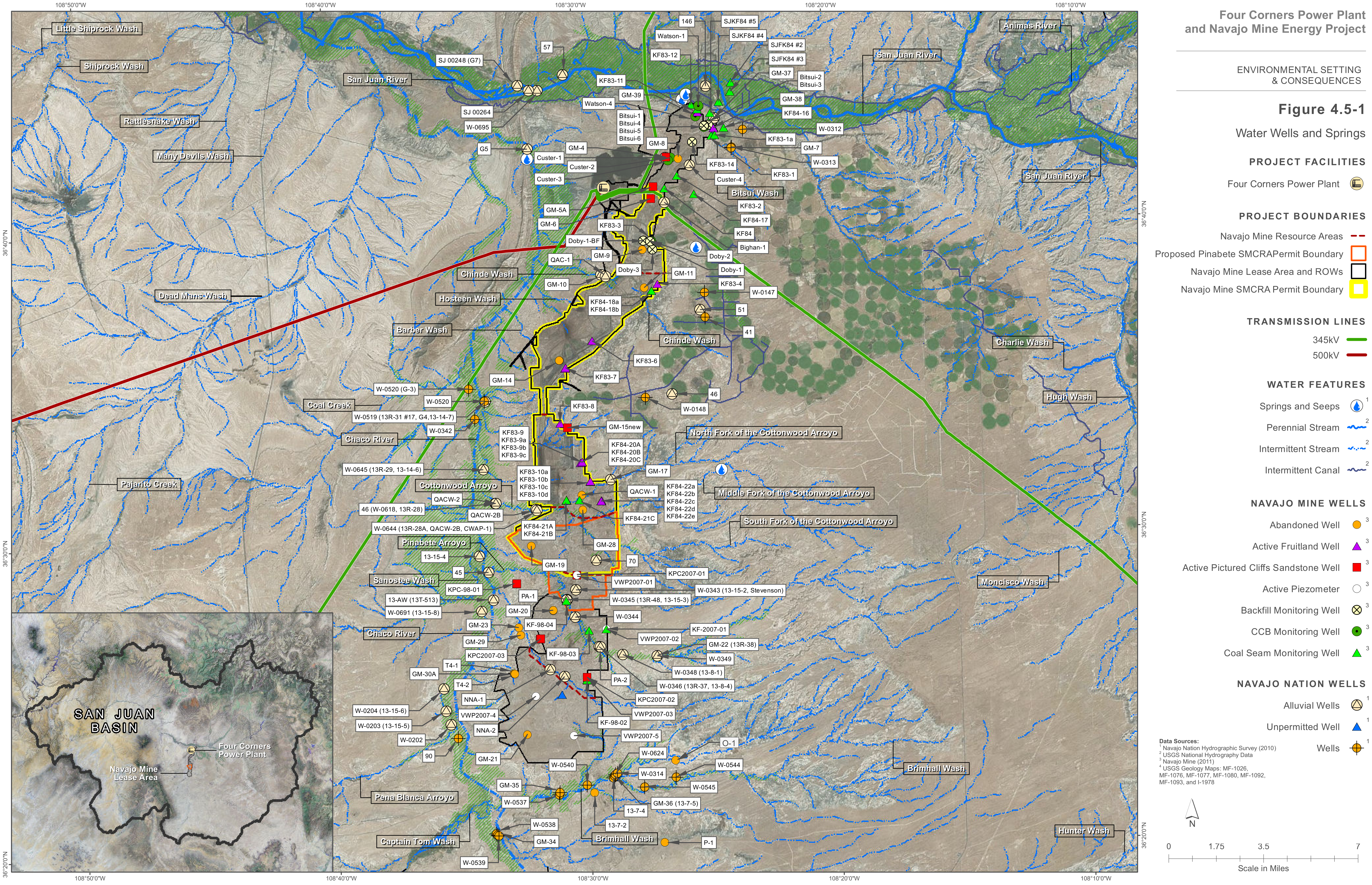
The ROI is contained within the San Juan hydrologic basin (Figure 4.5-1). The specific geologic formation and characterization is described in Section 4.3, Geology. The primary source of groundwater used in the San Juan Basin is from wells constructed in the surficial valley-fill deposits of Quaternary age and sandstones of Tertiary, Cretaceous, Jurassic, and Triassic age (Stone et al. 1983). Groundwater found in sandstone formations is generally under confined conditions resulting in artesian flow. Artesian flows occur when subsurface sources contain groundwater under positive pressure, and if the overlying natural pressure is high enough, the groundwater may reach the ground surface.

Four Corners Power Plant
and Navajo Mine Energy Project

ENVIRONMENTAL SETTING
& CONSEQUENCES

Figure 4.5-1

Water Wells and Springs



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Local groundwater resources considered in this EIS include any groundwater source that could be affected directly or indirectly by the proposed Project and alternatives. These resources include the unconsolidated alluvial sediment or alluvium in the valleys of the San Juan River, the Chaco River, and associated tributaries, including Cottonwood and Pinabete arroyos. Cottonwood and Pinabete arroyos originate in agricultural areas 10 to 12 miles east of the ROI and flow westward across the permit area and into the Chaco River. The Fruitland Formation underlies the alluvial sediment and is the formation that contains the coal resources for the mine. Since the coal seams are discontinuous throughout the formation, the Fruitland Formation is generally treated as a single aquifer unit (Billings and Associates, Inc. 1987). The PCS lies beneath the Fruitland Formation. Available site specific data from within the immediate vicinity of the Project area, used for modeling conducted as part of the CHIA for the Navajo Mine, shows low hydraulic conductivity and does not suggest the presence of significant vertical fracture flow of groundwater between the PCS and Fruitland Formation (insert reference to CHIA). However vertical fracture flow has been observed at other areas in the San Juan Basin (insert reference to document supplied by EPA reference in comment matrix). The evidence of fracture flow at other locations within the San Juan Basin, presents a modeling uncertainty as it presents the possibility that fracture flow may exist within the vicinity of the Project area.

The alluvium, Fruitland Formation, and PCS units have been defined and characterized in a number of technical reports (Thorn 1993; Stone et al. 1983; Myers and Villanueva 1986). In addition, a number of groundwater and hydrogeology studies have been conducted at and around the ROI. BNCC, the New Mexico Bureau of Mines, and the USGS have conducted these studies, which have added to the understanding of the hydrogeologic setting and groundwater flow system of the area.

Almost all of the known water supply wells within the ROI were completed within the alluvium formation, which is characterized by a loose, unconsolidated soils or sediments. No known water supply wells are completed in the Fruitland Formation or the PCS within the ROI or adjacent areas. Four wells are believed to be completed in bedrock formations. These wells are not in the Navajo Mine SMCRA Permit Area or Pinabete SMCRA Permit Area and are under no potential threat or impact from the proposed mining activities.

Groundwater use in the ROI is extremely limited, except from withdrawals in the San Juan River alluvium. A regional study identified no water supply wells constructed in the Fruitland Formation or underlying PCS within several miles of the Navajo Mine Lease Area. This study also concluded that these geologic units are not important water supplying aquifers within the San Juan Basin because of low yields and high salinity. As described in greater detail below, baseline water quality in the Fruitland Formation (based on data collected from monitoring wells in Areas IV North and South and Area V) is poor and exceeds NNEPA surface water quality standards[1] for livestock watering and drinking water. As such, the only groundwater in the area is derived from a few stock wells constructed in the alluvium formation in portions of the San Juan Basin (see Figure 4.5-1) (Stone et al. 1983). Each of these formations is described in more detail below.

<u>Alluvium</u>

Per definitions in 30 CFR 701.5, an Alluvial Valley Floor is "the unconsolidated stream laid deposits holding streams where water availability is sufficient for sub-irrigation or flood irrigation agricultural activities", and does not include upland areas. Under SMCRA, coal-mine related impacts to Alluvial Valley Floors are generally not permitted if the Alluvial Valley Floor is deemed significant to agricultural operations. Baseline characterization was performed for the Chaco River, No Name Wash, and Pinabete and Cottonwood arroyos to determine if the alluvium deposits are considered to be Alluvial Valley Floors. A 1981 study performed by the New Mexico Bureau of Mines and Mineral Resources and additional studies conducted by

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1 Note that there are no NNEPA groundwater quality standards. Comparison to surface water quality standards is provided to indicate general water quality and potential beneficial uses, but is not an enforceable criteria.

BNCC were used to form the Alluvial Valley Floors determination, taking into consideration both geomorphic/geologic and water availability criteria. Alluvial well drilling along Pinabete and Cottonwood arroyos revealed the occurrence of unconsolidated stream-laid deposits, meeting the geologic criteria for an Alluvial Valley Floors. However, water is inadequate to support agriculture; the arroyos are ephemeral and only flow in response to precipitation events, making flood irrigation implausible. As such, it was concluded that no Alluvial Valley Floors are within the Navajo Mine SMCRA Permit Area and Pinabete SMCRA Permit Area (BNCC 2012a).

Fruitland Formation

Groundwater availability in the Fruitland Formation is limited by its low rates of recharge and relatively low hydraulic conductivity (0.002 to 0.00013 feet per day), which means that water cannot move easily through pores or fractures in the formation. Based on past mining within the Fruitland Formation of the Navajo Mine SMCRA Permit Area, the coals, overburden, and interburden do not yield much water during mining. The existing mine pits have generally remained dry except during precipitation events when surface flows are captured in the pits.

Pictured Cliffs Sandstones

Although water is found throughout most of the Navajo Mine Lease Area in the PCS, no known water supply wells are completed in this formation within or adjacent to the current Navajo Mine SMCRA Permit Area or FCPP. One water supply well was completed near the Burnham Chapter house but was abandoned due to poor yield and poor water quality (BNCC 2012a). Water yields from monitoring wells in the vicinity are low (most are pumped dry within minutes; the yield of one well that can sustain a constant rate during a pump test was 0.4 gpm). The PCS is also a natural gas reservoir in the San Juan Basin. The PCS cannot be considered a major aquifer and it is important primarily because it is the water-bearing horizon immediately underlying the coals in the Fruitland Formation (Stone et.al. 1983).

Springs and Seeps

No springs or seeps have been observed during hydrologic investigations conducted within and adjacent to the ROI (BNCC 2012a). However, springs and seeps do occur along upper Chinde Wash, above the Navajo Mine Lease Area boundary. These springs and seeps are due to NAPI irrigation return flows. Individual springs have not been verified but approximate locations are shown on Figure 4.5-1. In addition, comments from the Navajo Nation have indicated the presence of a seep at the base of the Hogback near the mouth of the Chinde Wash that may be the result of an abandoned well. Two areas of groundwater seepage are also present within the FCPP Lease Area near the ash disposal areas.

Groundwater Quantity

Extensive exploration drilling and data from the active Navajo Mine SMCRA Permit Area provides information about the groundwater hydrology for the ROI Monitoring wells and vibrating wire piezometers where installed in the alluvium of the Pinabete and No Name arroyos, in the Fruitland Formation and in the PCS to characterize the baseline hydrogeology setting of Areas III, IV North, IV South, and V. Additional monitoring wells and piezometers were installed in various coal seams in these resource areas (Table 4.5-4). Figure 4.5-1 shows the location of all the monitoring wells and piezometers.

Table 4.5-4 Groundwater Monitoring Wells Installed in Navajo Mine Lease Area Coal Seams

Coal Seam	Number of Monitoring Wells	Number of Piezometers
No. 2	2	4
No. 3	5	3
No. 6	1	1
No. 7	5	1
No. 8	16	1

Historical water level data collected during the mid-1970s are also available for six wells that were completed in the PCS within or adjacent to the NTEC mining lease. These data, together with data from NTEC and other local sources, supplement the recent baseline groundwater information obtained for Area IV South and Area V of the Navajo Mine Lease Area and are summarized below (BNCC 2012a).

Pressure testing on monitoring wells within the Navajo Mine SMCRA Permit Area also provides the range of hydraulic conductivity and transmissivity of each formation. Hydraulic conductivity is the ability of water (or other fluids) to move through the soil or rock. Transmissivity is the rate at which groundwater flows through the formation. Only one well (well KF 2007-0), completed in the No. 8 coal seam within Area IV South, has sufficient yield to allow for a constant rate-pumping test to determine hydraulic characteristics of the coal. The majority of the wells are quickly pumped or bailed dry during conventional sampling. Table 4.5-5 below summarizes the results of BNCC's tests.

Table 4.5-5 Groundwater Aquifer Properties in the San Juan Basin

Formation	Transmissivity	Hydraulic Conductivity
Pinabete Arroyo alluvium	230.7 square foot per day and 75.6 square foot per day	51.3 feet per day and 11.1 foot/day
No Name alluvium	No measurement provided	Insufficient yield to measure
Cottonwood alluvium	No measurement provided	No measurement provided
• Fruitland Formation No. 3	0.01 to 0.001 square foot per day	0.002 to 0.00013 foot/day
• Fruitland Formation No. 2	0.09 to 0.1 square foot per day	0.001 foot/day
• Fruitland Formation No. 4, 5, 6	0.04 square foot per day	0.0014 foot/day
• Fruitland Formation No. 7	0.01 to 0.04 square foot per day	0.003 foot/day
• Fruitland Formation No. 8	1.398 square foot per day	0.056 foot/day
Pictured Cliffs Sandstone	0.12 to 0.79 square foot per day	0.032 foot/day to 0.0001 foot/day

Source: BNCC 2012a
Note:
These results are only for the No. 8 coal seam wells within Area IV North and Area IV South. The test results for No. 2, No. 4-6, and No. 7 coal seams are from wells located in Area III. The PCS results include tests at wells within Area IV North, Area IV South, Area V and adjacent to Area V.

Alluvium Aquifer

Baseline alluvium monitoring has been conducted within the Navajo Mine Lease Area at four alluvial monitoring wells in Cottonwood Arroyo, two alluvial monitoring wells in the Pinabete Arroyo alluvium, two alluvial monitoring wells in the No Name Arroyo alluvium, and 44 alluvial monitoring wells at the FCPP in the vicinity of the existing ash disposal areas. Based on data collected from these wells, groundwater beneath the Navajo Mine Lease Area is considered perched in localized areas.

Within the Navajo Mine Lease Area, water levels for the Cottonwood and Pinabete alluvial monitoring wells were measured monthly to capture seasonal variation. Water levels in the Pinabete Arroyo alluvium monitoring wells ranged from approximately 8-12 feet below ground surface between 1998 and 2008, and elevation was approximately 5,340 and 5,420 feet above mean sea level in the two wells. Water levels in the Cottonwood Arroyo alluvium monitoring wells ranged from approximately 8-21 feet below ground surface between 1974 and 2004, when water was detected. All wells were dry during tests from 2005 to 2008 (the most recent data provided).

A pump test was conducted at two wells to measure hydraulic conductivity in the Pinabete Arroyo alluvium (one well near Pinabete Arroyo in Area IV North and the other in Area IV South). The measured conductivity was 51.3 feet per day and 11.1 feet per day, respectively. These results are within the range expected for sand. Well yields from the alluvium are limited by a low saturated thickness (the vertical thickness in which pores are filled with water) of about 5 feet or less. Saturated thickness in the No Name alluvial wells was insufficient to permit a pumping test or slug test, which is a test used to determine hydraulic conductivity of a material. The hydraulic conductivity of the No Name alluvium is expected to be considerably lower than the Pinabete Arroyo alluvium due to the high percentage of fine-grained alluvial silts and clays, as evidenced by the well logs.

Beneath the ash disposal ponds at the FCPP, groundwater flows to the west, mainly in the weathered shale and in local alluvial channels that drain towards the Chaco River. APS began groundwater evaluations in 1971 and installed initial monitoring wells in 1974 to determine the source of water in the alluvium (e.g., if the hydraulic head was either the ash disposal ponds or Morgan Lake). Figure 4.5-2 shows the location of existing monitoring wells. Wells 1 through 23 were first installed and have the longest period of record. Wells 25 through 44 were installed after 2009. A review of monitoring data over the period of 1987 to 2012 indicates that groundwater levels in the vicinity of the ash disposal ponds is variable; water level in some wells has remained relatively constant, others have increased and some slightly decreased over time (APS 2013). The hydraulic gradient calculated based on water level data for monitoring wells 41, 42, and 43 (all upgradient of the ash disposal area) indicates that groundwater flows northwest from Morgan Lake at a rate of approximately 0.017 foot per foot. The hydraulic gradient calculated based on water level data for monitoring wells 41, 43, and 12R indicates that groundwater flows southwest from Morgan Lake at a rate of approximately 0.005 foot per foot. Based on these calculations Morgan Lake is a hydraulic mound and groundwater flows radially in all directions, including beneath the FCPP ash disposal area.

Fruitland Formation

Groundwater production within the Fruitland Formation is limited. The majority of exploratory drill holes within the Navajo Mine Lease Area have not produced measurable groundwater during drilling, and measurable water was only encountered at a few locations. Specifically, three boreholes located within the northeastern portion of Area IV South produced water at rates estimated at greater than 10 gpm. This groundwater is believed to be associated with the No. 6 and the No. 8 coal seams. Measurable groundwater was encountered in the unconsolidated sand and gravel above the No. 8 coal seam at a depth of about 22 feet below ground surface. The No. 8 coal seam was encountered in the 24 to 38 foot depth interval. Water was produced at a rate of about two to three gpm from the coal and the overlying sand and gravel. The general flow direction of groundwater in the Fruitland Formation is north toward the San Juan River and downward through the interbedded shale and coal units to the lower strata of the Fruitland Formation, with marginal upward movement from the PCS into the Fruitland Formation.

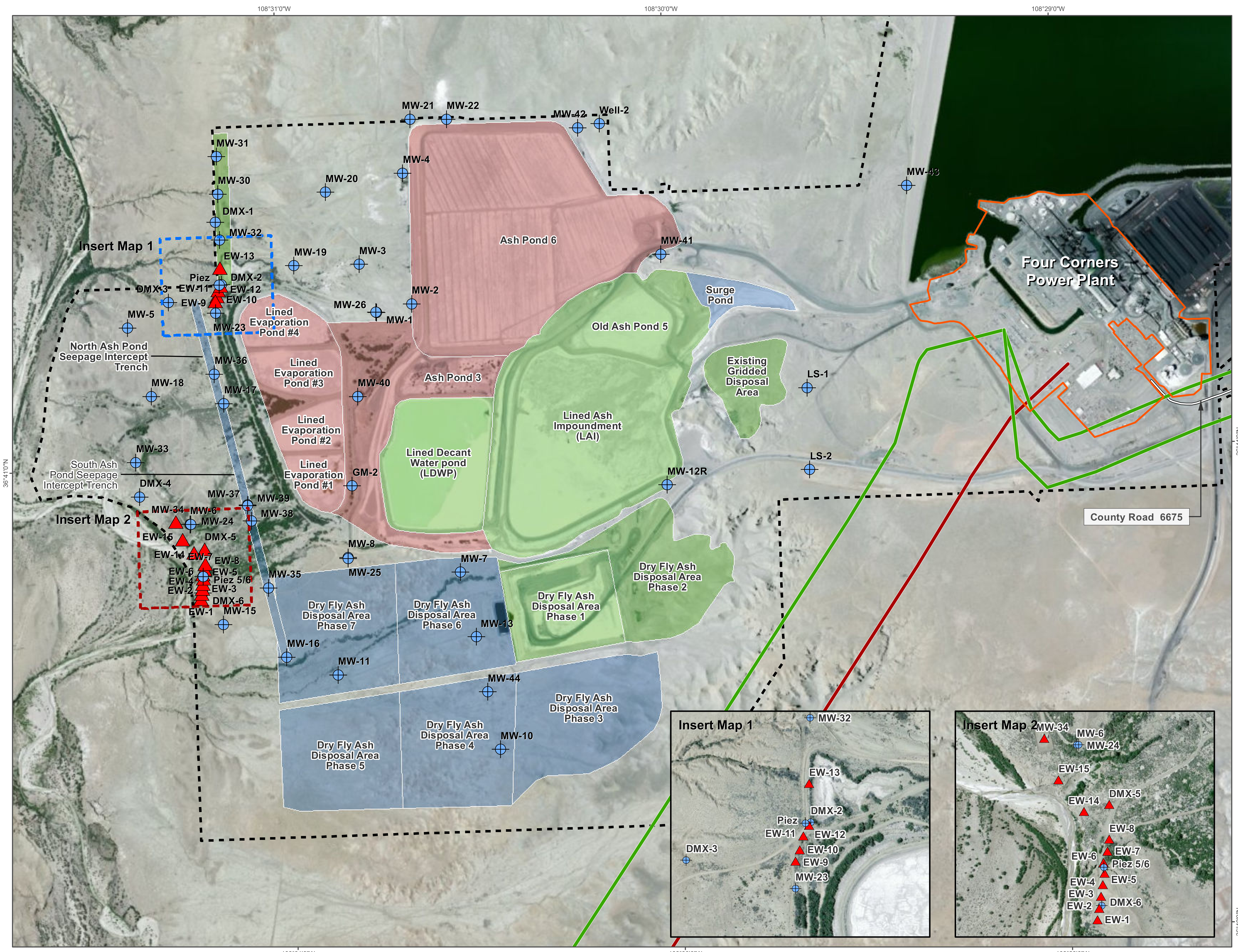

Figure 4.5-2

Monitoring and Extraction Well Locations

PROJECT BOUNDARIES

Power Plant Lease Boundary

Fence Line

TRAMISSION LINES

345kV

500kV

WELL LOCATIONS

Extraction Well

Monitor Well

ASH FACILITIES

Existing Active Facility

Existing Inactive Facility

Future Facility

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Pictured Cliffs Sandstone

The PCS underlies the Fruitland Formation and follows the structure of the Fruitland coal seams. It is a marginal water resource due to low permeability, poor water quality, gas production, and low yields (Stone et al. 1983). The PCS appears to be in the range of 110 to 120 feet thick within the ROI.

Water levels in the PCS were also measured using piezometers installed at six locations in the Navajo Mine Lease Area. The measurements were used to estimate potentiometric surfaces and gradients. The potentiometric gradients in both the No. 2 and No. 3 coal units indicate groundwater flow components toward the north-northeast in the vicinity of these monitoring wells and piezometers. Flow directions in the upper coal seams are expected to be generally toward the northeast, similar to the gradients observed in the No. 2 and No. 3 coals, although local gradients may be influenced by the lower elevations along Pinabete, No Name, and Cottonwood arroyos. The No. 6, No. 7, and No. 8 coal seams outcrop along the valleys of Pinabete, No Name, and Cottonwood arroyos.

Historical water level data collected during the mid-1970s was reviewed for six wells that were completed in the PCS within or adjacent to the Navajo Mine Lease Area (BNCC 2012a). Recent and historical water level data were used to estimate the potentiometric surface and flow gradients. The potentiometric gradients in PCS indicate an overall northerly gradient and a slight easterly component in the gradients at the southern end of the site due to a structural high in the formation along the southeast perimeter of Area V. Also, local gradients exist toward the topographic lows along No Name, Pinabete, and Cottonwood arroyos.

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Groundwater Quality

The water quality characteristics of Cottonwood, Pinabete, and No Name arroyos, the Fruitland coal seams, and the underlying PCS have been determined from the baseline groundwater monitoring. These results show that the groundwater within and adjacent to the Pinabete SMCRA Permit Area is poor and suitable only for marginal livestock use. Table 4.5-6 provides a summary of groundwater quality monitoring results by formation within the Navajo Mine Lease Area.

Table 4.5-6 Summary of Groundwater Quality Monitoring within the Navajo Mine Lease Area

Constituents[1]	Average Values for Water Quality in the Fruitland Coals at the BNCC Lease[2] (2007–2008)	Average Values for Water Quality in the Pinabete Arroyo Alluvium[3] (2008)	Average Values for Water Quality in the Picture Cliffs Sandstone[4] (2008)	Average Values for Water Quality in the No Name Arroyo Alluvium[5] (1998)	Median Values for Water Quality in the Cottonwood Arroyo Alluvium[6] (1974-1999)
pH (SU)	8.405	7.47	8.59125	7.6	7.8
TDS	3310	2895	6061.25	13000	3015
Arsenic	0.002	0.001	0.013	<0.005	NS
Barium	0.03	0.017	0.033	0.46	NS
Bicarbonate as HCO_3	1409.5	366.55	825	679	9
Boron	0.3645	0.45	0.5875	1.62	NS
Cadmium	<0.0005	0.00005	0.00005	<0.001	NS
Calcium	5.05	108.61	18.78	8625	NS

Constituents[1]	Average Values for Water Quality in the Fruitland Coals at the BNCC Lease[2] (2007–2008)	Average Values for Water Quality in the Pinabete Arroyo Alluvium[3] (2008)	Average Values for Water Quality in the Picture Cliffs Sandstone[4] (2008)	Average Values for Water Quality in the No Name Arroyo Alluvium[5] (1998)	Median Values for Water Quality in the Cottonwood Arroyo Alluvium[6] (1974-1999)
Carbonate as CO_3	150	<10	745	<1	12.25
Chloride	631.5	30.63	318.13	<0.01	14
Chromium	0.028	0.005	0.019	<0.01	NS
Copper	0.057	0.01515	0.127275	<0.01	NS
Fluoride	2.175	2.6	1.525	1.45	NS
Iron, total	0.40	11.21	68.33	.865	0.62
Lead	0.007	0.0002	0.0002	<0.005	9
Magnesium	1.3	17.91	6.98	0.267	22.7
Manganese, total	0.026	0.93	1.28	0.395	0.37
Mercury	0.0002	0.0002	0.0002	NS	NS
Nitrate as N	0.16	0.0675	1.475	5.26	NS
Potassium	15.25	2.29	21.76	21.65	NS
Selenium	0.005	0.008	0.006	0.0255	0.0025
Silver	0.0003	0.00006	0.00005	<0.01	NS
Sodium	1175	705	1906	2930	NS
Sulfate	429.5	1632	2610	8625	1605
Uranium	0.0005	0.026	0.006	NS	NS
Zinc	0.006	0.015	0.014	<0.1175	NS

Source: BNCC 2012a

Notes:

[1] All units in mg/l, unless indicated otherwise.

[2] As sampled at monitoring well KF-98-02.

[3] As sampled at monitoring wells PA-1 and PA-2.

[4] As sampled at monitoring wells KPC-98-01 and KPC-2007-01.

[5] As sampled at monitoring well NNA-1.

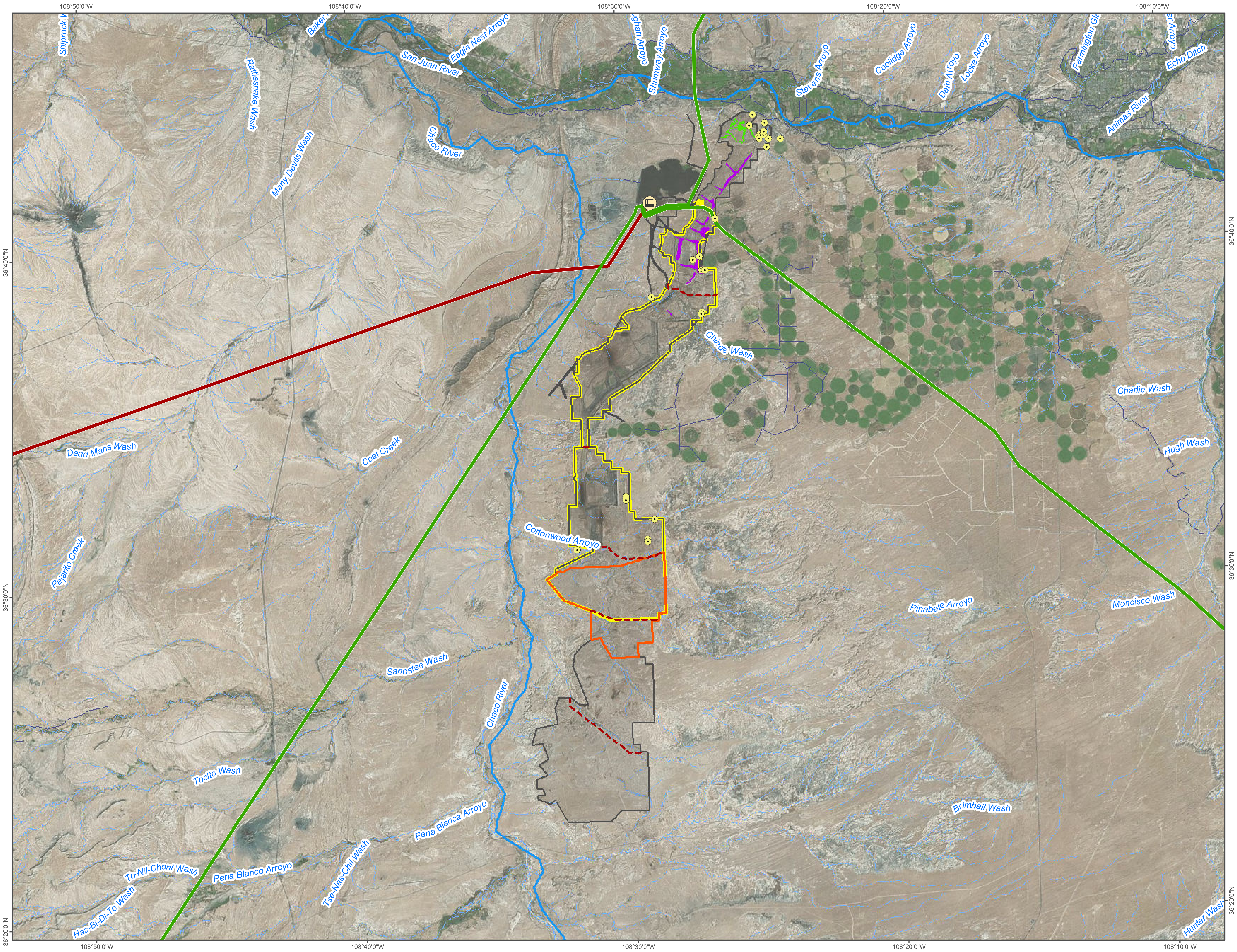
[6] As sampled at monitoring wells QACW-2, QACW-2B, GM-17.

NS = Not Sampled

Water Quality Data provided in the Pinabete SMCRA Permit application for the Cottonwood Arroyo was provided as median values.

Historic CCR Placement

Materials that remain after burning coal (including fly ash, bottom ash, coal slag, and flue gas desulfurization residue) are referred to as coal combustion byproducts when placed in the mine (a practice discontinued in 2008) and as CCR when disposed in the FCPP ash disposal area (the current and ongoing practice). CCR from FCPP was placed in mined out pits or ramps within the Navajo Mine SMCRA Permit Area during the period from 1971 to 2008. Continued operations of the FCPP do not include placement of CCR materials in the mine backfill for reclamation at the Navajo Mine SMCRA Permit Area or Pinabete SMCRA Permit Area. Historic CCR placement occurred primarily within Area I with limited placement in Area II. Figure 4.5-3 shows the locations of the CCR placement along with the monitoring wells used to monitor possible contaminants of concern from these areas.



Four Corners Power Plant and Navajo Mine Energy Project

ENVIRONMENTAL SETTING & CONSEQUENCES

Figure 4.5-3

Monitoring Wells in the Vicinity of Former CCR Placement Areas at the Navajo Mine

PROJECT FACILITIES

Four Corners Power Plant

Groundwater Monitoring Wells

Coal Combustion Residue Placement

Approximate Coal Combustion Residue Placement

PROJECT BOUNDARIES

Navajo Mine Resource Areas

Navajo Mine Lease Area and ROWs

Navajo Mine SMCRA Permit Boundary

Proposed Pinabete SMCRA Permit Boundary

TRANSMISSION LINES

345kV

500kV

N

0 1.75 3.5 7

Scale in Miles

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A National Academy of Sciences study (NRC 2006) identified potential impacts to water quality from CCR which was conducted in response to national public concern. The study suggested that, while no cases existed where water quality exceedances were directly attributable to CCR burial, concern about proper management was warranted. The report recommended characterization of a power plant CCR disposal site and the materials placed in it, including recommended characterization methods and leach tests. Reclamation plans need to specify how CCR would be used and what sorts of covers are placed to prevent root invasion and uptake of trace elements. The report also suggested design of monitoring plans to target potential releases from CCR disposal areas and establishment of performance standards.

The potential impacts of CCR to groundwater for Navajo Mine have been previously addressed in the Cumulative Hydrological Impact Assessment (CHIA). It was concluded that "[t]he reclamation of the CCR placement areas at the mine has been sufficient in part because of the natural conditions prevalent in the area and also because precautions were taken when engineering the CCR placement and reclamation. Thus far, negligible impacts have resulted from the CCR placement. It is also unlikely that any significant future impacts will ensue from the CCR placement within the Navajo Mine Lease Area because of the very slow groundwater movement and the likely attenuation of contaminants of concern as they migrate through the subsurface;" however, there is no hydrologic connection between Areas III /IV and Area I/II. Further, transport directions for mine spoil water would be laterally down dip in the Fruitland Formation, toward the outcrop areas to the south and west of Area III, and vertically into the Pictured Cliff Sandstone. Lateral flow from the mine spoils through the Fruitland Formation and vertical fracture flow into the Pictured Cliff Sandstone is very low due to the low hydraulic conductivity of these units and due to the relatively flat gradients that can be expected based on pre-mine conditions. Therefore, OSMRE's CHIA analysis found that past CCR placement within the Navajo Mine SMCRA Permit Area would not impact groundwater in the short- or long-term (OSMRE 2012c). Lack of impact from previous CCR placement within Areas I and II is further substantiated through the following analysis.

Unsaturated conditions currently exist at CCR backfill placement locations except for two locations at the northern end of Area I. CCR materials placed in the Bitsui Pit are saturated as are an isolated location of basal saturation of CCR material around the Watson-4 well. Current groundwater flow directions from the Bitsui Pit are toward the subcrop of the Fruitland Formation along the alluvium of the San Juan River (BNCC 2011a). Any groundwater flow in the future from Area I and portions of Area II is also expected to be to the northeast toward Fruitland Formation subcrop along the alluvium of the San Juan River. Consequently, groundwater from CCR placement locations and associated mine backfill within Areas I and II are not expected to affect the alluvium of the Chaco River.

A supplemental groundwater study program and monitoring well installation was implemented to assess possible impacts to groundwater from historic mine placement of CCR at the Navajo Mine SMCRA Permit Area (BNCC 2009). BNCC also completed a series of detailed laboratory batch leaching studies of the constituents leached from CCR and mine spoil for the Probable Hydrologic Consequences determination (BNCC 2011a). Both of these results—the field monitoring and the laboratory leach studies—show that TDS and sulfate concentrations do not increase in CCR that become saturated with spoil water (water that flows through the backfilled mine spoils after mining). Arsenic, boron, fluoride, and selenium concentrations may increase in CCR leachate. Boron and fluoride in the CCR monitoring wells were above the livestock watering criteria. Arsenic concentrations in the CCR wells were close to the livestock watering criteria, while selenium concentrations were below the livestock watering criteria. Other trace constituents were below detection limits in the majority of the samples from both CCR and spoil wells (BNCC 2011a). The arsenic, boron, and fluoride concentrations in a spoil monitoring well immediately downgradient of a CCR well showed that spoil attenuates or reduces the concentrations of these constituents (BNCC 2011a).

Transport modeling of spoil water from Area I through the Fruitland Formation to its discharge location at the formation subcrop beneath the alluvium of San Juan River indicates that changes in sulfate concentrations in the San Juan River alluvial groundwater are not expected to occur. Furthermore, groundwater flow in the

San Juan River alluvium is estimated to be approximately two orders of magnitude higher than the estimates of groundwater flow discharging to the San Juan River alluvium from the Fruitland Formation (BNCC 2011a). Thus, TDS and trace constituents such as boron that may be above livestock suitability levels in CCR or mine spoil leachate would be reduced by mixing with the groundwater in the San Juan River alluvium even if they are not attenuated during transport to the Fruitland Formation. The existing water quality in the San Juan River alluvial aquifer is quite variable as indicated by the available water quality data from San Juan River alluvial wells provided in the Mine Plan Revision (BNCC 2011a). There are no cumulative adverse impacts to surface water quality from CCR placement at the Navajo Mine SMCRA Permit Area. CCR materials have not been placed within mine backfill in Area III and there are no plans for placement of CCR within mine backfill within either Area III or Area IV North or South. CCR materials were placed within Area I and portions of Area II but there is no cumulative groundwater impact or connection between Areas III and IV North and South and Area I and II.

Within the Pinabete SMCRA Permit Area, groundwater quality samples have been gathered from monitoring wells installed in Pinabete Arroyo, Cottonwood Arroyo, and the No Name alluvium. Analytical results for the water quality samples from these wells are summarized in Table 4.5-6 (BNCC 2012a).

The baseline results for the Cottonwood alluvial wells show water quality to be a sodium-sulfate type with relatively high but variable TDS concentrations. TDS concentrations ranged from 2,590 to 3,615 milligrams per liter (mg/L). Median sulfate concentrations exceed recommended livestock use criteria at all the Cottonwood alluvial wells. Median concentrations of TDS and sulfate in the groundwater within the Cottonwood alluvial wells also exceed EPA's Secondary Drinking water use criteria. Fluoride concentrations fluctuate in the alluvial groundwater and are often above relevant criteria for livestock and drinking water use.

The baseline results for the Pinabete alluvial wells show the water quality to be a sodium-sulfate type with TDS concentrations ranging from 1,500 to 4,300 mg/L. Water within the alluvium is unsuitable for drinking water use due to TDS, sulfate, fluoride, iron, and manganese concentrations above secondary drinking water standards. The quality of the alluvial groundwater varies, although the TDS, sulfate, and fluoride concentrations usually exceed relevant criteria for livestock use.

The baseline results for the No Name Arroyo alluvial wells show the water to be a sodium-sulfate type similar to Pinabete Arroyo but with much higher sulfate, sodium, and TDS concentrations. Water quality within the alluvium downstream of the No Name Impoundment is unsuitable for either drinking water or livestock water use.

<u>Alluvium Aquifer</u>

Water derived from alluvial wells in the vicinity of the FCPP and the Navajo Mine Lease Area is predominantly used for livestock watering; therefore, alluvial water quality is compared to the applicable livestock water criteria. The criteria are not enforceable standards with respect to groundwater and are included only as a reference for the suitability of the groundwater quality for livestock use. Generally the alluvial systems are of sodium-sulfate type with variable TDS concentrations.

Pinabete Arroyo alluvium generally shows consistent pH at all monitoring wells, although iron and mercury tends to increase moving downstream while arsenic, boron, cadmium, copper, lead, selenium, zinc, and nitrate tends to decrease, and other constituents did not show any apparent trend. All pH values for samples within the Pinabete Arroyo alluvium were within the ranges for livestock water criteria. Arsenic, selenium, chloride, fluoride, sulfate and TDS exceeded livestock criteria for the Pinabete Arroyo alluvium for 5 percent, 4 percent, 4 percent, 86 percent, 75 percent and 46 percent of all samples, respectively. All median values for arsenic, selenium, and chloride were below the criteria indicating that the criteria exceedances are generally more characteristic of the high variability in the data set as compared to the general water quality. The median fluoride, sulfate and TDS values exceed the livestock criteria. Based on these relevant use criteria, the water in the Pinabete Arroyo alluvium system is a poor source of supply for livestock watering use. This is especially apparent when considering fluoride, sulfate, and TDS concentrations. These water quality parameters often exceed relevant criteria for livestock use, although the alluvium has been historically and is currently used for this purpose.

Moving downstream along the Cottonwood Arroyo alluvium pH, selenium, and fluoride tended to increase while boron, manganese, mercury, nitrate, sulfate and TDS tended to decrease, and other constituents did not show any apparent trend.

All pH values for all samples within the No Name Wash alluvium were within the appropriate range. Sulfate and TDS exceeded livestock criteria for the No Name Wash alluvium for 100 percent and 100 percent of all samples, respectively. The median sulfate and TDS values exceed the livestock criteria. Based on these relevant use criteria, the water in the No Name alluvium system is a poor source of supply for livestock watering use. This is especially apparent when considering sulfate and TDS concentrations. These water quality parameters often exceed relevant criteria for livestock use, although the alluvium has been historically used for this purpose (OSMRE 2012c).

Most of the monitoring wells at the FCPP are in the Alluvial Aquifer (two are located in the Lewis Shale). The FCPP ash ponds are built upon the Lewis Shale, a marine shale that contains substantial amounts of evaporite deposits, including gypsum, and tends to cause relatively high levels of TDSs in the water. All monitoring wells at the FCPP, including those that would represent "background" or pre-power plant levels have relatively high boron concentrations (greater than the State of New Mexico surface water standard of 0.75 mg/L) at various times during the period of record (1987-2012) (APS 2013). Wells considered “background” are those upgradient of the ash disposal areas (MW-43, MW-12R, MW-41, LS-1, LS-2). Table 4.5-7 provides a summary of groundwater quality monitoring results beneath the ash disposal area at the FCPP.

Table 4.5-7 Summary of Groundwater Quality Monitoring Results at FCPP

Constituent	Non-Baseline Monitoring Wells Minimum	Non-Baseline Monitoring Wells Maximum	Non-Baseline Monitoring Wells Average	Baseline Monitoring Wells (MW-41, MW-12R, MW-43) Minimum	Baseline Monitoring Wells (MW-41, MW-12R, MW-43) Maximum	Baseline Monitoring Wells (MW-41, MW-12R, MW-43) Average	EPA MCL	NNEPA
Primary Drinking Water Standards								
Antimony[1]	0.0001	0.0060	0.0021	<0.001	<0.0025	<0.001	0.006	0.006
Arsenic	<0.001	0.2260	0.0244	0.0041	0.0085	0.0063	0.010	0.010
Barium	0.0036	1.10	0.03	0.05	0.54	0.24	2.0	2.0
Beryllium	<0.0005	0.001	0.001	0.0012	0.0023	0.0016	0.004	0.004
Cadmium	0.00013	0.0160	0.0029	<0.001	<0.001	<0.001	0.005	0.005
Chromium	<0.0001	0.240	0.0136	0.0029	0.065	0.028	0.10	0.10
Copper	0.0015	0.551	0.0780	0.0093	0.013	0.011	1.3	1.3
Fluoride	0.05	100	1.0	<2.0	8.0	6.0	4.0	4.0
Lead	0.0002	0.130	0.0155	0.011	0.013	0.012	0.015	0.015
Mercury	0.0001	<0.001	0.0001	<0.0002	<0.0002	<0.0002	0.002	0.002
Nitrate (N)	0.0100	1,422	134	N/A	N/A	N/A	10	10
Selenium	0.0018	1.710	0.2595	0.0064	0.59	0.2988	0.05	0.050
Thallium	0.0001	0.2030	0.0239	0.0004	0.002	0.0012	0.002	0.002

Constituent	Non-Baseline Monitoring Wells Minimum	Non-Baseline Monitoring Wells Maximum	Non-Baseline Monitoring Wells Average	Baseline Monitoring Wells (MW-41, MW-12R, MW-43) Minimum	Baseline Monitoring Wells (MW-41, MW-12R, MW-43) Maximum	Baseline Monitoring Wells (MW-41, MW-12R, MW-43) Average	EPA MCL	NNEPA
Uranium	0.0028	270	3.518	0.056	0.098	0.079	30	30
Secondary Drinking Water Standards								
Chloride	200	12,051	1,385	620	1,800	1,180	250	250
Iron	0.0030	12.3	0.941	N/A	N/A	N/A	0.3	0.3
Manganese	0.0371	204	3.0	N/A	N/A	N/A	0.05	0.05
pH	5.52	8.17	7.18	N/A	N/A	6.85[3]	6.5-8.5	6.5-8.5
Silver	0.0001	0.1160	0.0165	N/A	N/A	N/A	0.10	0.1
Sulfate	2,039	131,822	23,602	4,700	35,000	26,925	250	250
TDS	5,230	186,360	38,959	7,500	55,000	40,875	500	500
Zinc	0.0060	0.2500	0.0391	N/A	N/A	N/A	5.0	5.0
Constituents with No Applicable Drinking Water Standards								
Temperature (C)	8.23	22.5	15.53	N/A	N/A	18.61[3]		
Field Conductance (μmhos)	962	101,800	26,368	N/A	N/A	35,662[3]		
Alkalinity ($CaC0_3$)	140	13,750	713	730	900	842		
Boron	0.20	70.7	8.91	0.58	0.94	0.70		
Calcium	30	7,800	448	220	420	333		
Bicarbonate (HCO_3)	0	16,775	870	N/A	N/A	N/A		
Magnesium	144	17,000	2,656	370	2,900	1,656		
Nickel	0.0140	0.750	0.0998	N/A	N/A	N/A		
Silica (Si02)	0.0	96	10	N/A	N/A	N/A		
Sodium	220	56,000	7,092	1,500	14,000	10,750		
Potassium	8	360	80	28	130	103		

Source: APS 2013

Notes:

1 All results and limits are in mg/L, unless indicated otherwise.

2 NNEPA Domestic Water Supply Standards are part of the surface water quality standards. No specific groundwater quality standards have been adopted by the Navajo Nation.

3 Results are for a single well (either MW-41, 43, or 12R) for a single sample event.

Fruitland Formation

The pH levels within the No. 3 coal seam range from 7 to 9, which is characteristic of the Fruitland coals within the San Juan Basin. The water quality is unsuitable for drinking water use due to concentrations of TDS, chloride, and boron above the Navajo Nation surface water quality criteria for drinking water (the Navajo Nation does not have groundwater quality standards). The TDS concentrations also exceed the relevant criterion for livestock use. The groundwater in the No. 3 coal seam is a sodium-bicarbonate-chloride type, with TDS of about 3,300 mg/L. The ion composition results are consistent with the baseline coal water quality monitoring data at the Navajo Mine Lease Area.

Water quality monitoring data from the coal wells located within or adjacent to the Navajo Mine SMCRA Permit Area show very high TDS concentrations in the coal seam groundwater, with median concentrations at individual wells ranging from 2,770 to 13,400 mg/L. The coal seam water quality results show that TDS concentrations increase with depth and distance from the outcrop. Furthermore, TDS concentrations as high as 50,000 mg/L have been observed in the Fruitland coal units located east and down slope of the Navajo Mine SMCRA Permit Area.

Water quality analytical results from the baseline sampling of the No. 8 coal seam are unsuitable for drinking water due to concentrations of TDS, chloride, fluoride, and sulfate that are above EPA's secondary drinking water use criteria. The sulfate and TDS concentrations often exceed relevant criteria for livestock use and would not be sufficient to use for livestock water supply.

Based on the trends observed from sampling of coal wells within the permit area, concentrations of TDS, bicarbonate, and chloride appear to increase with depth and distance from the outcrop, but sulfate concentrations appear to decrease. The groundwater chemistry changes as soluble minerals dissolve and cation exchange processes reduce the proportion of calcium and increase the proportion of sodium in solution. Sulfate reduction also occurs when groundwater transitions from oxidizing to reducing conditions, particularly within the coals.

Pictured Cliffs Sandstone

Data from monitoring wells located within and adjacent to the permit area indicate the groundwater in the PCS has high TDS concentrations, ranging from 5,000 to over 9,000 mg/L. Sulfate is the dominant anion, although the concentrations of chloride and bicarbonate are also relatively high. Sodium is the dominant cation. Magnesium and calcium concentrations are quite low and are typically less than potassium concentrations, although potassium was not included in the historic samples collected during the 1970s.

The high concentrations of TDS, sulfate, chloride, and boron in the water from the PCS within and adjacent to the permit area preclude its use for domestic purposes. The PCS is also a poor source for livestock watering due to the very high TDS and sulfate concentrations, as well as low permeability and low yield.

Table 4.5-7 depicts the summary of groundwater quality monitoring results at the FCPP and compares results to the EPA Maximum Contaminant Level and the NNEPA drinking water standards.

4.5.2.2 Surface Water (including waters of the US)

The Navajo Mine, FCPP, and associated existing transmission lines are located within the San Juan Basin Watershed, which extends across portions of four states, including northwestern New Mexico, southwestern Colorado, southeastern Utah, and northwestern Arizona (Figure 4.5-4). The San Juan Basin Watershed encompasses a 24,908-square-mile drainage within USGS Hydrologic Unit Code (HUC) 1408. The northern portion of the Navajo Mine Lease Area is located within the Middle San Juan River HUC 14080105. The other resources areas of the Navajo Mine Lease Area and FCPP Lease Area are within Chaco River Watershed HUC 14080106, which drains 4,563 square miles. The transmission lines intersect numerous HUCs within the San Juan Basin Watershed. The following subsections provide an overview of surface water resources and water quality issues within the FCPP's region of influence, based on an air deposition model conducted for the proposed Project (EPRI 2013), as well as a description of the surface water resources present at the Navajo Mine Lease Area, and FCPP Lease Area. Water quality data and existing water use at the Navajo Mine and FCPP are also described below. As described in Chapter 2, no water is used in the operation or maintenance of the subject transmission lines; therefore, details regarding water quality and water use of the water bodies crossed by the lines are not provided below.

Regional Surface Water Resources

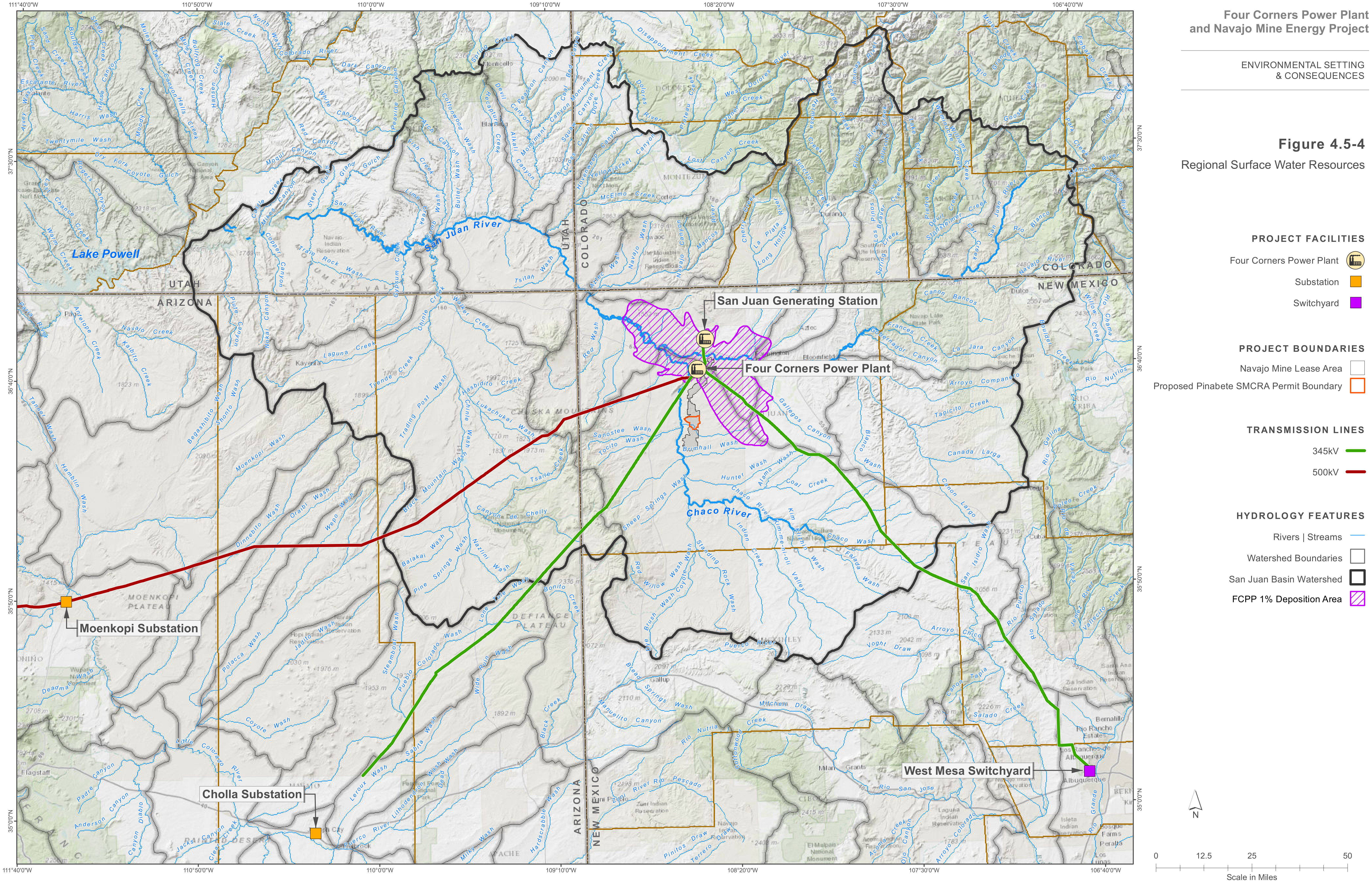
The ROI is located within the main portion of San Juan Basin Watershed, which covers approximately 4,600 square miles and encompasses most of the Four Corners geographic region. An estimated 670,000 acre-feet of water are available from the San Juan Basin for domestic, agricultural, commercial, and industrial use (BNCC 2012a). The most prominent surface water feature in the watershed is the San Juan River, which flows generally east to west, originating along the southern slope of the San Juan Mountains in southwestern Colorado. The San Juan River flows through Farmington and passes about 5 miles north of the FCPP before it drains into the Colorado River at Lake Powell in Utah. Other major surface water bodies in the area include the Animas, La Plata, and Chaco rivers. The Animas River flows south from its headwaters in the San Juan Mountains in southwestern Colorado. The La Plata River originates in the La Plata Mountains, also in southwestern Colorado, 35 miles north of the New Mexico Border. Both the Animas and La Plata rivers join the San Juan River just west of Farmington. The Chaco River is an intermittent wash that flows northwest through Chaco Canyon. It joins the San Juan River west of Farmington and the FCPP. Other water features in the watershed include numerous arroyos and washes. Two larger arroyos near the Navajo Mine Lease Area, Pinabete and Cottonwood, are intermittent waterways with only seasonal water present. Most other washes are ephemeral, receiving and carrying water only during heavy rains that come during the spring rains or the summer monsoons (San Juan Water Commission 2003).

The USGS located three stream gaging stations along the San Juan River in the Project vicinity. Station 09368000 is active and located on the San Juan River approximately 0.9 mile south of Shiprock, New Mexico, and 2 miles west of the Chaco River confluence. Station 09367540 is inactive and located approximately 0.4 mile west of Fruitland, New Mexico, 13.8 miles east of the Chaco River confluence, and 8.3 miles west of the La Plata River confluence. Station 09365000 is active and located approximately 0.9 mile southwest of Farmington, New Mexico, 1.7 miles southeast of the La Plata River confluence, and 0.7 mile northwest of the confluence with the Animas River (Figure 4.5-5). Review of data collected at these three stations demonstrates variability of flow along the San Juan, with a general decreasing flow trend for the period of record (1931-2010). Although flows initially increased upstream to downstream along the San Juan, this trend reversed around 1972 such that downstream flows were less than upstream flows (OSMRE 2012c). Recent drought conditions in the Southwest have further decreased flow rates in the San Juan River.

The NMED set a standard for temperature of 32.2°C or less for the main stem of the San Juan River from the Navajo Nation boundary to its confluence with the Animas River. The San Juan River is listed as impaired for sedimentation between the Animas River and Canon Largo. The Navajo Reservoir is also listed as impaired for mercury in fish tissue and temperature (NMED 2014). TMDLs for the San Juan River Watershed were approved in 2005 for sedimentation, bacteria, and selenium (NMED 2005). Additional TMDLs were approved in 2006 for nutrients in the Animas River and dissolved oxygen in the La Plata River (NMED 2006). An additional TMDL for E. coli was approved for San Juan River in 2010 and Animas River in 2013 (EPA 2010c).

Figure 4.5-4

Regional Surface Water Resources



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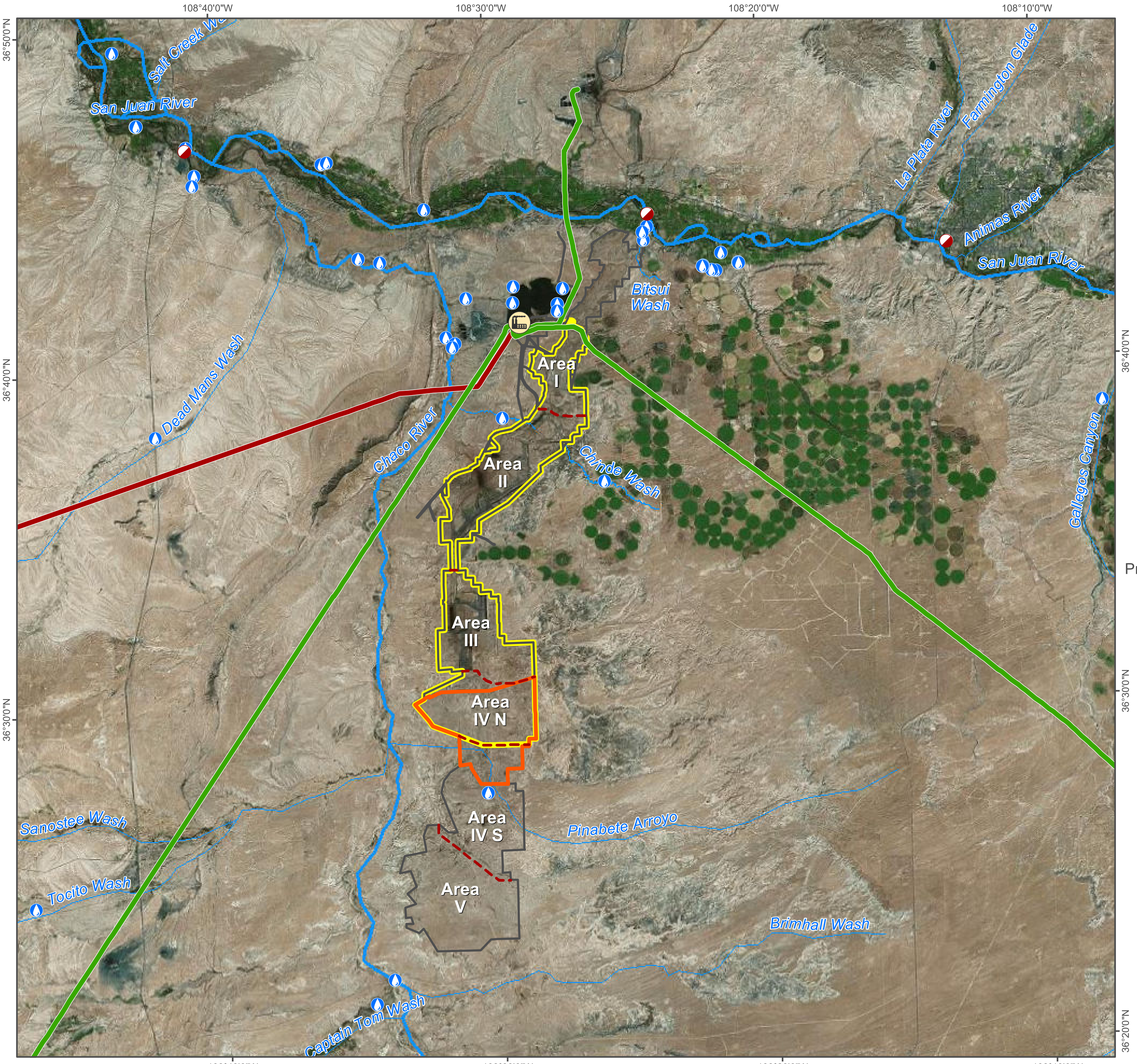
Four Corners Power Plant
and Navajo Mine Energy Project

ENVIRONMENTAL SETTING
& CONSEQUENCES

Figure 4.5-5
Water Quality Stations



PROJECT FACILITIES
Four Corners Power Plant
NNEPA Water Quality Station

PROJECT BOUNDARIES
Navajo Mine Resource Areas
Navajo Mine Lease Area and ROWs
Navajo Mine SMCRA Permit Boundary
Proposed Pinabete SMCRA Permit Boundary

TRANSMISSION LINES
345kV
500kV

OTHER FEATURES
USGS Gaging Station

N

0 5 10
Scale in Miles

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The NNEPA maintains a number of water quality monitoring sites along surface waterbodies in the Navajo Nation. Monitoring locations are located along the Chaco River, Chinde Wash, Bitsui Wash, and the San Juan River. Monitoring data for all sample locations for all years collected was compared to NNEPA surface water quality standards for designated uses (NNEPA 2008). The Chaco River had the longest dataset of record with sampling from 1998 to 2013. Chinde Wash data covered the period 2001, 2003, 2004, and 2009-2011; Bitsui Wash only had data for 2001-2003, 2010, and 2011. Based on the data collected, nearly all sample sites met the standards for the designated beneficial uses. The exceptions are listed below:

- Mercury levels in Chaco River in all samples in which it was detected are above the standards for acute and chronic wildlife habitat and fish consumption. Concentrations detected range from 0.000001 mg/L to 0.002 mg/L.
- Two samples in 2005 and two in 2011 in the Chaco River were above the acute and chronic wildlife habitat standards for cadmium. One sample collected during a sample event in 2013 was above the standard for acute and chronic wildlife habitat for aluminum and cadmium.
- A sample collected during one sample event in the Bitsui Wash in 2011 was above the standards for secondary human contact and acute wildlife habitat for lead.

NNEPA collected data at various stations in the San Juan River in 2006 and 2011-2013. Based on the data collected a number of exceedances of standards for designated beneficial uses were observed. All stations exceeded standards for chronic Samples collected in the San Juan River at various stations were above surface water quality standards:

- San Juan River at Hogback: two samples in 2012 above the standard for acute wildlife habitat for aluminum, two samples in 2011 and two samples in 2012 above the standard for chronic wildlife habitat for aluminum. One sample in 2006 and two samples in 2012 above the standard for chronic wildlife habitat for mercury. One sample in 2006 and one sample in 2011 above the standard for domestic water supply and primary and secondary human contact for lead.
- San Juan River Upstream from Shiprock WWTF: two samples in 2011 above the standard for acute wildlife habitat for aluminum and chronic wildlife habitat for mercury, three samples in 2011 above the standard for chronic wildlife habitat for aluminum. One sample in 2011 was above the standard for domestic water supply and primary and secondary human contact for lead.
- San Juan River Downstream from Shiprock WWTF: two samples in 2011 above the standard for acute wildlife habitat for aluminum and chronic wildlife habitat for mercury, three samples in 2011 above the standard for chronic wildlife habitat for aluminum.
- San Juan River 15 Miles Downstream from Shiprock: two samples in 2011 and 2012 above the standards for acute and chronic wildlife habitat for aluminum. One sample in 2006, two samples in 2011 and two samples in 2012 above the standard for chronic wildlife habitat for mercury. One sample in 2012 above the chronic aquatic and wildlife habitat for selenium. One sample in 2006 and 2012 above the standard for domestic water supply for arsenic and barium. One sample in 2006 above the standard for domestic water supply for beryllium and chromium; fish consumption for mercury; and livestock watering for lead. One sample in 2012 above the standard for fish consumption for thallium.
- San Juan River Near Four Corners: one sample in 2012 and three samples in 2013 above the standard for both acute and chronic wildlife habitat for aluminum, Two samples in 2012 and three samples in 2013 above the standard for chronic wildlife habitat for mercury. One sample in 2013 above the standard for domestic water supply for thallium, uranium, and zinc; above the standard for fish consumption for mercury and thallium, and above the standard for primary human contact for arsenic.

- San Juan River Near Montezuma Creek: Two samples in 2012 and three samples in 2013 above the standards for acute and chronic wildlife habitat for aluminum. Three samples in 2013 above the standard for chronic wildlife habitat for mercury and selenium; above the standard for domestic water supply for arsenic, barium, beryllium, chromium, and lead; above the standard for livestock watering for lead; above the standard for fish consumption for thallium; and above the standard for primary human contact for arsenic. One sample in 2013 above the standard for domestic water supply for thallium and zinc. One sample in 2012 above the standard for fish consumption for mercury.
- San Juan River Near Bluff: Two samples in 2012 and three samples in 2013 above the standards for acute and chronic wildlife habitat for aluminum. Three samples in 2013 above the standard for chronic wildlife habitat for mercury. Three samples in 2013 above the standard for chronic wildlife habitat for mercury and selenium; above the standard for domestic water supply for arsenic, barium, beryllium, chromium, and lead; above the standard for livestock watering for lead; and above the standard for primary human contact for arsenic. One sample in 2013 above the standard for chronic wildlife habitat for selenium. One sample in 2013 above the standards for domestic water supply and fish consumption for thallium (NNEPA 2014).

Navajo Mine

The San Juan River is a perennial water body located adjacent to the northern boundary of the Navajo Mine Lease Area, which lies on the terrace above the floodplain. Surface water in the Navajo Mine SMCRA Permit Area, Pinabete SMCRA Permit Area, and immediately adjacent areas is characterized by ephemeral or intermittent streams that convey water only after precipitation events. The climate of the ROI includes summer rains that fall almost entirely during brief, but frequently intense, thunderstorms. As such, stream flows are widely variable, going from no discharge (dry channels) to peak discharge followed by a gradually diminishing discharge over several subsequent hours. These rapidly varying flows can transport large amounts of sediment and cause extensive changes in the shape of the channels after single events.

<u>Navajo Mine SMCRA Permit Area</u>

The primary ephemeral or intermittent streams that pass through the Navajo Mine SMCRA Permit Area and adjacent areas include the Chaco River, Bitsui Wash, Chinde Wash, Hosteen Wash, Barber Wash, Neck Arroyo, Lowe Arroyo, Cottonwood Arroyo, and Pinabete Arroyo, all described in more detail below. All eventually drain into the San Juan River to the north of the permit area.

Cottonwood Arroyo is a major sand bed intermittent drainage that passes through the southern portion of the permit area. Cottonwood Arroyo is one of the largest of the Chaco River tributaries with a drainage area of approximately 80.1 square miles, though only approximately six percent of the drainage area is within the permit area. Approximately half of the watershed is located on badlands, which accounts for the high discharge and sediment load. Cottonwood Arroyo is also seasonally influenced by irrigation activities in the NAPI lands just east of the Navajo Mine Lease Area.

Bitsui Wash is located near the northernmost portion of the permit area. It originates to the east of the permit area at the Navajo Indian Irrigation Project (NIIP), flows into the permit area, and then flows north into the San Juan River. Chinde Wash is located near the southern boundary of Navajo Mine Area I. It flows from east to west across the permit area, originating near the NIIP and flowing into the Chaco River. Under natural conditions, Bitsui and Chinde washes would flow ephemerally after large precipitation events, but both flow intermittently due to irrigation and direct discharges associated with the NIIP. Chinde Wash flows throughout the year with short-term peak flows caused by precipitation or NIIP direct canal discharges.

Hosteen Wash, Barber Wash, Neck Arroyo, and Lowe Arroyo are all ephemeral streams that flow in response to precipitation events. All flow across the permit area from east to west and into the Chaco River. Hosteen Wash is located in the northern portion of Area II and originates near the NIIP. The Hosteen Wash watershed area is about 9.1 square miles, approximately 3.7 square miles of which is disturbed by mining activity. Barber Wash originates just east of the permit boundary; the watershed area is about 5.3 square miles, approximately 1.4 square miles of which is disturbed by mining activities. Neck Arroyo is located south of the Area III shop complex and just north of Lowe Pit in the Area III mining area. The Neck Arroyo watershed area is 1.88 square miles, approximately 14 percent of which is within the permit area. The South Barber Drainage is a tributary to the Neck Arroyo that is 0.82 square mile, approximately 0.03 square mile of which is disturbed by mining activities. Lowe Arroyo flows through the middle of the Navajo Mine SMCRA Permit Area and has a drainage area of about 11.25 square miles, approximately 41 percent of which lies within the permit area.

Pinabete SMCRA Permit Area

BNCC conducted a delineation of jurisdictional waters of the U.S. and wetlands within the Pinabete SMCRA Permit Area in April 2012 (Ecosphere 2012b). The delineation identified three primary surface water features in the Pinabete SMCRA Permit Area: Pinabete Arroyo, the south forks of Cottonwood and No Name arroyos. The arroyos in the Pinabete SMCRA Permit Area all eventually drain into the Chaco River to the west, and ultimately to the San Juan River to the north. The mainstem of Cottonwood Arroyo is outside of the Pinabete SMCRA Permit Area, but the arroyo (described in detail above) passes through Area IV North and borders the permit area to the northwest. Pinabete and No Name arroyos pass through Area IV South and border the permit area to the southwest and south, respectively. Pinabete Arroyo has a drainage area of about 60 square miles; approximately 16 percent is within the Navajo Mine Lease Area. No Name Arroyo has a drainage area of about 11 square miles, of which approximately 16 percent lies within the lease area. The headwaters of No Name Arroyo are within the Navajo Mine Lease Area. Table 4.5-8 provides the dimensions of these drainages within the ROI.

Table 4.5-8 Intermittent and Ephemeral Drainages within or in Proximity to the Pinabete SMCRA Permit Area

Drainage	Length (miles)	Area (acres)
Cottonwood Arroyo	7.6	10.4
Pinabete Arroyo	19.2	34
No Name Arroyo	2.8	1.1
Total	29.8	46.5

Source: Ecosphere 2012b.

In addition to the intermittent and ephemeral drainages, three stock ponds in the Pinabete SMCRA Permit Area were identified as jurisdictional. All three have defined channels upstream and are connected to defined channels downstream either by an active spillway or a diversion channel. These ponds catch surface flows from some tributary drainages and are often dry. Table 4.5-9 summarizes the area of each of these ponds. The USACE has reviewed the delineation report and verified its findings (USACE 2013). Figure 4.5-6 shows the location of the identified jurisdictional features within the Pinabete SMCRA Permit Area.

Table 4.5-9 Stock Ponds in the Pinabete SMCRA Permit Area

Drainage	Site	Area (acre)	Classification
Pinabete Arroyo	Pond 1	0.58	Palustrine unconsolidated shore
Pinabete Arroyo	Pond 2	0.34	Palustrine unconsolidated shore
Pinabete Arroyo	Pond 3	1.13	Palustrine unconsolidated shore

Source: Ecosphere 2012b.

The USACE used the California Rapid Assessment Method (CRAM) to evaluate the background condition of the arid ephemeral streams and channels within Area IV North and Area IV South to estimate the effects of post-project direct and indirect impacts. CRAM is a technique that was originally intended to provide a rapid and repeatable assessment method that can be used routinely for wetland monitoring and assessment throughout the state of California; however, the constructs of CRAM can be applied to a wide range of arid, ephemeral streams similar to those found throughout the arid southwestern U.S. CRAM assesses four overarching attributes of stream condition: 1) buffer and landscape context; 2) hydrology; 3) physical structure; and 4) biotic structure. Within each of these attributes are a number of metrics that assess more specific aspects of stream condition. Metric scores under each attribute are aggregated in CRAM to yield scores at the level of attributes, and attribute scores are aggregated to yield a single overall index score, via simple arithmetic formulas. Attribute and index scores are expressed as percent possible, ranging from 25 (lowest possible to a maximum of 100). Table 4.5-10 shows the overall CRAM index and attribute scores.

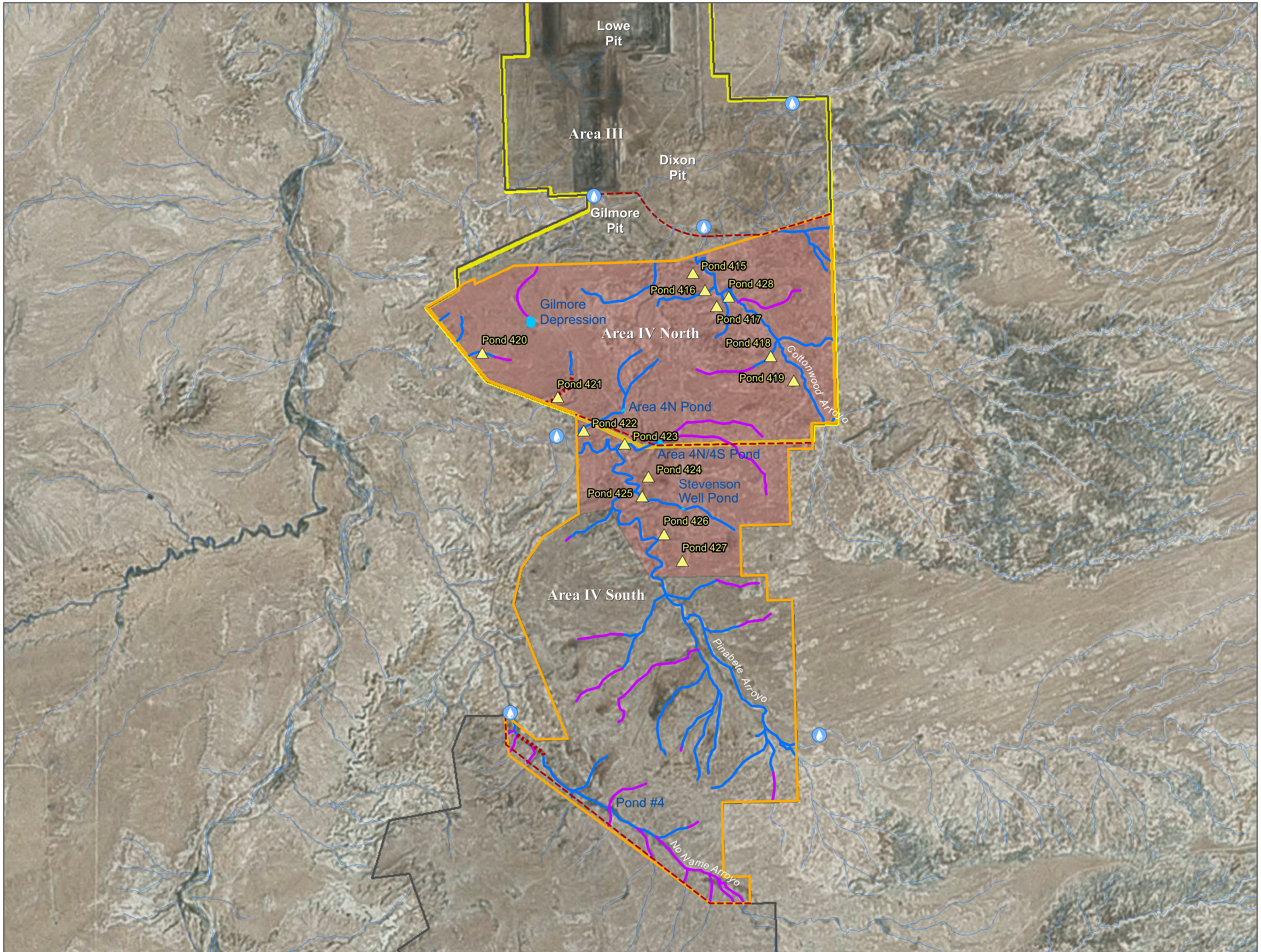
Table 4.5-10 Overall CRAM Index and Attribute Scores

CRAM Index and Attribute Scores	Headwater Systems	Cottonwood and Pinabete Arroyos	Overall
Overall Index Score	56	68	59
Buffer and Landscape Context	93	93	93
Hydrology	70	87	73
Physical Structure	32	43	34
Biotic Structure	35	49	38

Source: USACE 2013.

Water Quality

Historic data were analyzed for over 20 physical and chemical constituents collected by the USGS along the San Juan River at the three gaging stations between 1958 and 2010. In addition, OSMRE reviewed 2012 and 2013 water quality data collected by NNEPA along the San Juan River. The analysis indicated high variability, generally increasing pH, and generally decreasing or relatively unchanged concentrations in constituents over time (OSMRE 2012c). Naturally occurring selenium is one of the water quality issues in both the Animas and San Juan rivers. In 2005, it was determined that the background level of selenium in the Animas River exceeded the prior standard of two parts per billion. Subsequently, the standard was changed from 2 to 5 ppb by the New Mexico State Water Quality Board. The Navajo Nation also has standards for the segments of the San Juan River which flow through tribal lands, as shown on Table 4.5-3. The natural water in the region now generally complies with the EPA's adjusted livestock water quality standard for selenium (0.05 mg/L). The natural water is generally of higher quality and more consistent over time and space in the Animas River than in the San Juan River. The Animas River is a newer and steeper river than the San Juan River and as a result has weathered and eroded its watershed less (San Juan County 2007).



Four Corners Power Plant
and Navajo Mine Energy Project

ENVIRONMENTAL SETTING
& CONSEQUENCES

Figure 4.5-6

Jursidictional Waters of the U.S.
within the Pinabete Permit Area

PROJECT BOUNDARIES

Navajo Mine Resource Areas
Navajo Mine Lease Area
Preliminary Jurisdictional Determination
Navajo Mine SMCRA Permit Boundary
Proposed Pinabete SMCRA Permit Boundary

JURISDICTIONAL STATUS

Yes
Discontinuous
No
Stock Pond

HYDROLOGIC FEATURES

Monitoring Locations
Proposed Sediment Ponds
Rivers | Streams

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Surface water studies associated with permitting of the existing Navajo Mine SMCRA Permit Area and the proposed Pinabete SMCRA Permit Area indicate that under baseline conditions, the drainages that cross the permit area carry a very high concentration of suspended solids and bed loads during storm runoff events, averaging 98,000 mg/L (BNCC 2011b, 2012a). At the active Navajo Mine SMCRA Permit Area, north of the Pinabete SMCRA Permit Area, sediment control measures prevent additional contributions of sediment to stream flow or to runoff during operations. The baseline water quality data for Cottonwood Arroyo within the Pinabete SMCRA Permit Area is from 1997 to 1999. At that time, the general characterization of water quality was alkaline with moderate saline sodium sulfate levels and hardness. The average selenium concentration ranged from 0.003 to 0.006 mg/L, and exceeded the NNEPA standard for chronic aquatic and wildlife habitat — Chronic of 0.002 mg/L. Total sediment and TDS concentrations in Cottonwood Arroyo average 97,989 and 656 mg/L, respectively (BNCC 2012a). Similarly, suspended sediment concentrations in Pinabete Arroyo during storm runoff events are very high with total suspended solids concentrations ranging from 10,200 to 521,000 mg/L as collected in samples between 1998 and 2007 (BNCC 2012a).

The NNEPA (2008) has identified designated uses of Cottonwood Arroyo to include secondary human contact (direct contact to skin associated with recreation or cultural uses), fish consumption, aquatic and wildlife habitat, and livestock watering. Water quality was collected for a brief period between 1990 and 1999 on Cottonwood Arroyo. The moderately saline (median TDS ranged from 610 to 780 mg/L) sodium sulfate waters are alkaline with a moderate hardness (BNCC 2011a). The median total selenium concentration at all sites of 0.0025 mg/L exceeds the chronic wildlife habitat standard of 0.002 mg/L. Levels of selenium were highest at the upstream, North Fork of Cottonwood Arroyo. Suspended sediment concentrations are high, greater than 100,000 mg/L, during storm runoff events, and the sandy channel bed and bank materials can be extensively modified by the larger flood events.

A comparison of surface water quality data at USGS gaging stations on the Chaco River upstream and downstream of the Navajo Mine Lease Area was conducted. The analysis indicates that the downstream gage is also downstream of the FCPP and Morgan Lake discharge; therefore, it is impossible to differentiate the impact of the Navajo Mine from the FCPP. The analysis found that water quality downstream of the two facilities had relatively high variability in comparison to the upstream data, where the median percent relative standard deviation for all constituents was 96 percent compared to 44 percent. The downstream data were also compared to NNEPA criteria. Mercury exceeded the NNEPA fish consumption criteria for 85 percent of all sample data. Cadmium exceeded NNEPA secondary human contact, fish consumption, and livestock criteria for eight percent of all samples. It is important to note however that water quality sampling conducted by NNEPA at various stations along the Chaco River have not indicated any exceedances of NNEPA standards for cadmium, secondary human contact (NNEPA 2013). NNEPA acute aquatic and wildlife habitat criteria for cadmium, copper, mercury, selenium, and zinc were exceeded for 100, 25, 100, 85, and eight percent of all samples, respectively. Further, the median cadmium, mercury, and selenium concentrations were 1.2, 300, and 3 times greater than NNEPA chronic aquatic and wildlife habitat standards. All other median values were below all criteria indicating that the criteria exceedances were generally more characteristic of the high variability in the dataset compared to the general water quality (OSMRE 2012c). NNEPA sampling also found exceedances of the lead standard for all designated beneficial uses at all stations in the Chaco River (NNEPA 2013).

A similar analysis was conducted for Chinde Wash. The watersheds include the Morgan Lake-Chaco River, Chinde Wash-Chaco River, Coal Creek-Chaco River, and Cottonwood Arroyo watersheds. The Chinde Wash and Cottonwood Arroyo Watersheds are both representative of the same hydrologic unit, and they were modeled directly in the Probable Hydraulic Consequences (OSMRE 2012c). Four monitoring stations within the Chinde Wash provided data for the analysis, two upstream of the mine and two downstream. However, both upstream stations are located downstream of NAPI activities, and therefore, are subject to direct and indirect NAPI influences. The downstream data were found to have slightly higher variability relative to the baseline data where the median percent relative standard deviation for all constituents was 100 percent compared to 85 percent. The NNEPA fish consumption criterion was not exceeded for any samples, but the acute aquatic and wildlife habitat criteria were exceeded for cadmium, chromium, selenium, silver, and zinc for 4, 100, 1, 2, and 60 percent of all samples, respectively. Lead exceeded the NNEPA secondary human contact standard for 4 percent of all samples. Livestock criteria for boron, chloride, selenium, sulfate, and TDS were exceeded for 0.5, 5, 23, 0.5, and 6 percent of all samples. All other median values were below established criteria, indicating that exceedances were generally more characteristic of high variability in the dataset rather than indicative of the general water quality (OSMRE 2012c).

Water Use

BBNMC holds all rights under New Mexico Office of the State Engineer Permit 2838 which provides a total diversionary right of 51,600 acre-feet annually and a consumptive use right of 39,000 acre-feet annually for surface water from the San Juan River. Although BBNMC also holds associated groundwater permit number SJ-2917, the water available under Permit 2838 supplies all the water needs of FCPP and Navajo Mine. Water is diverted from the San Juan River into Morgan Lake where it is stored for use at the plant, for all operations (cooling and related purposes), and the mine, for mining, coal processing, and reclamation operations, and by APS for FCPP operations. Flow in the Chaco River is ephemeral, except for releases of water from Morgan Lake that provide perennial flow in the Chaco River downstream of the discharge point in the lower, northern reaches of the watershed near its confluence with the San Juan River.

Based on monthly reports submitted to the New Mexico Water Rights Division, BNCC used approximately 301 acre-feet of water per year for dust control purposes and 340 acre-feet of water per year for irrigation of reclaimed areas in 2011 (BNCC 2012d). The previous year, water use was approximately double with 633 acre-feet used for dust control and 1,166 acre-feet for irrigation (BNCC 2011b).

Surface water within the Navajo Mine Lease Area is not used for drinking water by humans, or for irrigation, but has been used for livestock watering.

Four Corners Power Plant

The site of the primary FCPP facilities (Units 1-5 and associated facilities and parking lots) is a generally paved area, graded locally to surface inlets and catch basins and eventually to the discharge canal. The low-volume wastewater facility collects, treats, and disposes of surface water runoff and wastewater resulting from the operation of Units 4 and 5. Types of wastewater include chemical and oily wastewater, process wastewater, and ash-handling wastewater. More information regarding wastewater handling can be found in the Hazardous and Solid Waste Section (Section 4.15).

Outside of the area described above, the remaining portions of the FCPP lease area are unpaved and consist of Morgan Lake, the ash disposal areas, and other open, undeveloped areas. Morgan Lake, located within the FCPP lease and directly to the west of the FCPP, is a man-made lake built to support the FCPP. Water for Morgan Lake is drawn from the San Juan River, which is approximately 2.5 miles away. The lake encompasses 1,287 surface acres and has a capacity of 39,000 acre-feet of water. Built in 1961, Morgan Lake was constructed to supply water to mining and power generation activities.

A delineation of wetlands and waters of the U.S. was conducted in the existing and proposed DFADAs in April 2012. The purpose of the delineation was to determine the jurisdiction of wetlands and drainages in the ROI under CWA Section 404. Per joint USACE and EPA guidance regarding jurisdictional determinations (dated June 5, 2007), for potentially isolated waters of the U.S., or non-navigable tributaries, USACE and EPA are required to coordinate on the jurisdictional determination decision. As such, the USACE prepares the initial jurisdictional determination and submits it to the regional EPA office. The agencies coordinate and attempt to resolve any jurisdictional delineation issues at the local level within 15 calendar days after EPA's receipt of the form. EPA may notify the USACE at any time within the 15-day period that it does not intend to provide comments on a particular draft jurisdictional delineation. Within these 15 calendar days, the EPA regional office may elect to elevate the review to their Regional Administrator. If the review is elevated, the Regional Administrator has 10 days to resolve the issue. The agencies will then prepare a mutual decision document for the jurisdictional determination (USACE and EPA 2007). Accordingly, the USACE, in coordination with the EPA, has reviewed the FCPP delineation report and concurs with its findings (USACE 2013). A brief summary of the delineation findings is provided below.

The Chaco River, which flows south to north just west of the proposed DFADA, is identified as a perennial river by the National Hydrography Dataset; however, the portion of the river in the ROI was field verified as intermittent. Typical flow characteristics of this section of the river vary from low to no discharge (dry channel) to peak discharge after intense rain events followed by a recession to low discharge over several hours. In contrast, irrigation return flows from NAPI lands and discharge from Morgan Lake consistently lend to perennially wet conditions in the portion of the Chaco River near its confluence with the San Juan River. Approximately 1.7 acres of the Chaco River was delineated within the survey area (APS 2012b).

In addition to the Chaco River, three ephemeral drainages are located near the center of the proposed DFADAs (Drainages 11, 12, and 13 on Figure 4.5-7). No bed, bank, or ordinary high water mark was observed within the segments of these three drainages within the proposed DFADAs; therefore, these segments of the drainages were determined to not be jurisdictional under CWA Section 404 (AECOM 2012b).

Other surface water areas within the FCPP lease area include, the proposed surge pond area, and the lined impoundment captures generated FGD waste and historic ash seepage intercept water that is currently used as a staging area for piping and other equipment. A concrete v-ditch along the perimeter conveys slurry waste to the disposal ponds below. The area of the proposed surge pond is 9.4 acres and has no vegetation cover. The delineation determined that the v-ditch is not a jurisdictional Water of the US (AECOM 2012b).

Three potential wetland areas were surveyed within the ROI. One 0.07-acre wetland was observed along the base of the existing southwestern detention pond along Drainage 10. The wetland drains into a concrete-lined detention pond downstream at the pump house. The wetland is located along a non-jurisdictional ephemeral drainage and is considered isolated due to lack of connectivity with the Chaco River. Therefore, this wetland is considered non-jurisdictional. Two additional wetlands were observed adjacent to the ordinary high water mark of the Chaco River within the ROI. The wetlands are characterized as seeps and are approximately 0.02 and 0.09 acre in size, respectively. Based on their location adjacent to the Chaco River, both wetlands are considered jurisdictional (AECOM 2012b).

Water Quality

No tribal, state, or federal water quality standards apply to discharges from FCPP or water quality in Morgan Lake; comparison to NNEPA standards is for context only. However, the NNEPA (2008) has identified designated uses of Morgan Lake to include primary and secondary human contact, fish consumption, aquatic and wildlife habitat, and livestock watering. The NNEPA conducted water quality sampling of Morgan Lake in 2002, 2006, 2008, 2009, and 2010. The sampling included field parameters (temperature, pH, dissolved oxygen, TDS, and salinity) as well as laboratory analysis for metals and nutrients. With regard to field parameters, data for all years collected was similar. Temperature ranged between 32 and 33°C at the surface with little change with depth for all years. The only year with any noticeable change in temperature with depth was 2008, which was 33.5°C at the surface and decreased to 25°C at approximately 23 meters below surface. Similarly, pH for all years ranged between 8.3 and 8.6 at the surface and 7 and 7.5 at depth. The largest range between sampling events appeared for dissolved oxygen which ranged between 59 and 87 percent saturation at the surface and decreased to 0 to 8 percent saturation at depth. For all years, a steep decrease in dissolved oxygen levels began at 12 to 14 meters below surface. TDS levels varied year to year. In 2002 and 2010, TDS levels were between 725 and 750 mg/L. In 2006 and 2008, TDS concentration was approximately 825 mg/L. While in 2009, the concentration of TDS averaged 1,000 mg/L. APS and NNEPA also collected samples for metals and nutrients between 2003 and 2010. Figure 4.5-8 displays the results of sampling for those parameters that were detected in comparison to Navajo Nation Water Quality Standards for Aquatic and Wildlife Habitat and Secondary Fish Consumption.

Water quality data for samples collected in the Chaco River both upstream and downstream of the FCPP discharge location were also available (see Figure 4.5-9). Samples were collected by APS between October 2008 and August 2009 (APS 2013). In addition, the data includes samples collected by NNEPA between 1998 and 2013, although samples upstream and downstream of FCPP were only collected by NNEPA through 2012 (NNEPA 2013). An independent comparison of the upstream and downstream sample data was conducted and found no statistically significant difference between the sample sets for any of the constituents tested, with the exception of boron and sulfate. The data sets for sulfate, while significantly different between upstream and downstream do not exhibit a systematic pattern of either location having higher concentration than the other. All sample results for boron are well below all beneficial use water quality standards, as shown in Figure 4.5-9; however, the boron concentrations (total and dissolved) are higher downstream of the FCPP than upstream.

Designated uses of the Chaco River include aquatic and wildlife habitat, livestock watering, fish consumption, and secondary human contact. No reaches of Chaco River are defined as a drinking water source. The concentration of chemical constituents varies according to the sediment load in the river. For example, the total aluminum concentrations at the upstream station varied from 0.44 to 613 mg/L with a median concentration of 2.98 mg/L. The dissolved concentrations for the same location varied from 0.12 to 0.53 mg/L. Aluminum is found within the natural clays in the area; therefore, it is likely that instances of high aluminum in the samples are indicative of high sediment load in the river. The high concentrations of aluminum also correspond with high TDS in the river (APS 2013). A comparison of the sample results indicates that aluminum exceeded the Navajo Nation standard for aquatic and wildlife habitat (both acute and chronic) in all upstream samples and all but two of the downstream samples. The lead standard for livestock watering was exceeded on two occasions (the same date for both upstream and downstream samples). The standard for aquatic and wildlife habitat for lead is dependent on the hardness value at the time of sampling.

A comparison of the sample data found that the average lead standard for aquatic and wildlife habitat, livestock watering, fish consumption, and secondary human contact was 3.74 mg/L and all samples, both upstream and downstream, were well below this limit. The chronic aquatic and wildlife habitat standard for mercury was exceeded in all samples, while the acute standard was exceeded only in two upstream samples and three downstream samples over the monitored period. The results for all other constituents met Navajo Nation standards over the entire monitoring period (APS 2013; NNEPA 2014).

Water quality results from a single sample event in 2010 in the Chaco River at the point of Morgan Lake blowdown were also reviewed. For this sample event, pH was 8.4, TDS was 723, and all metals and other constituents met NNEPA standards, with the exception of aluminum which was elevated above acute and chronic wildlife habitat at 4 mg/L.

Water Use

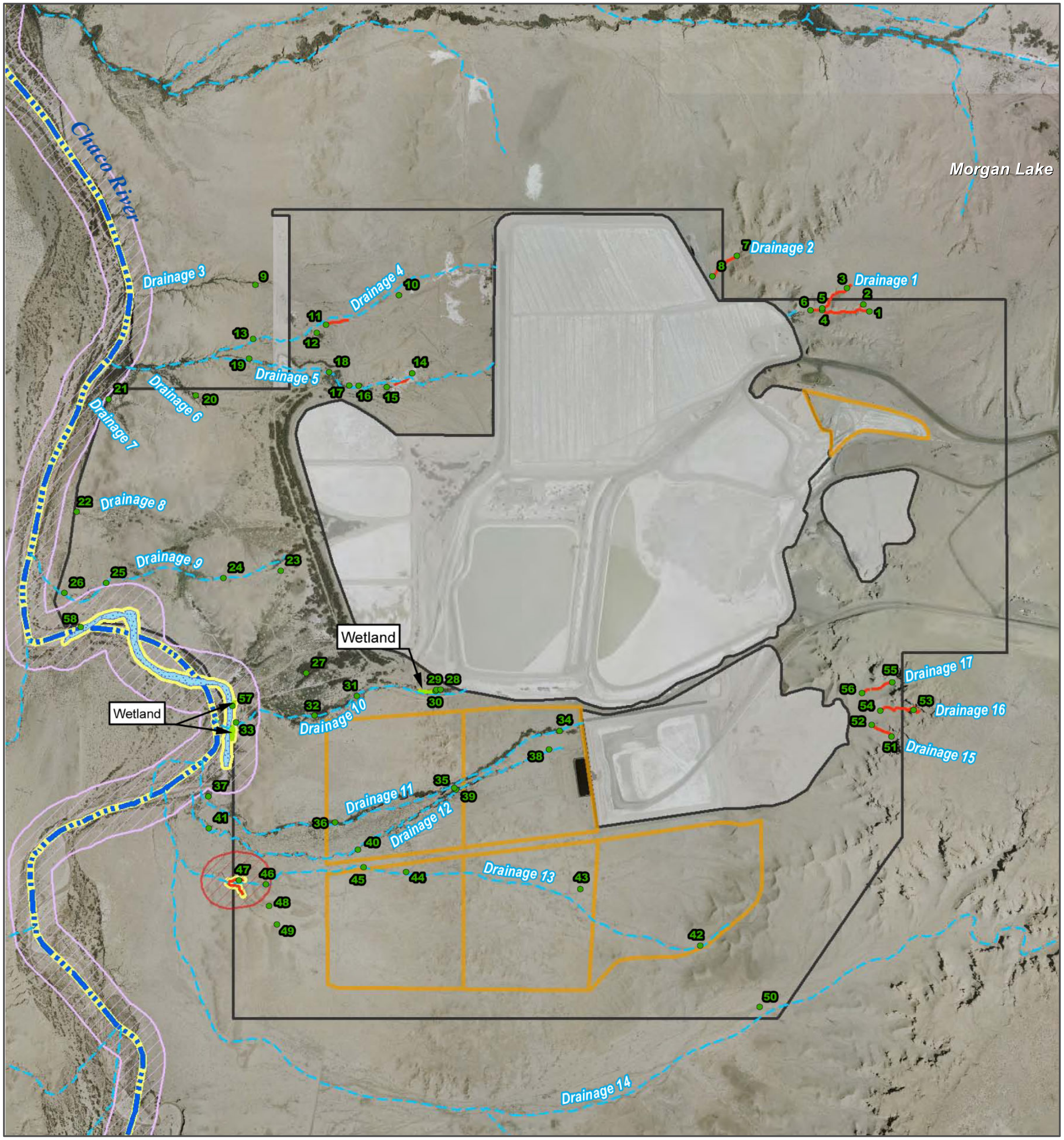
The main uses of water for the FCPP are for heat transfer in the primary cooling systems, for steam production in the turbine systems, and as cooling water for the condenser cooling system. Water supply for the power plant comes from Morgan Lake which draws water from the San Juan River. Water is fed from the river to man-made Morgan Lake, adjacent to the FCPP. Water is then directed to a water treatment plant where it is treated in a lime/soda water softener to reduce the overall dissolved solids. From the treatment plant, the water is moved to cooling ponds, and then enters the on-site closed loop circulating water system. Oil-free power plant wastewater is drained to the circulating water discharge canal and released back into Morgan Lake. Water discharged into Morgan Lake is typically around 40.5°C (105°F). Water from Morgan Lake is released via canal into Chaco Wash, which flows back into the San Juan River.

Four Corners Power Plant
and Navajo Mine Energy Project

ENVIRONMENTAL SETTING
& CONSEQUENCES

Figure 4.5-7

Jurisdictional Waters of the US
in the Vicinity of the FCPP
Proposed Ash Disposal Facility



GPS Survey Point (#)

Wetland

Chaco River OHWM

Ephemeral

Intermittent

Ordinary High Water Mark Observed*

Jurisdictional (highlighted)

Waters of the U.S. Delineation Boundary

Existing Fly Ash Disposal Facilities

Proposed Fly Ash Facility

Chaco River Avoidance Area

Avoidance Area

*Observed Ordinary High Water Mark without jurisdiction is considered isolated.

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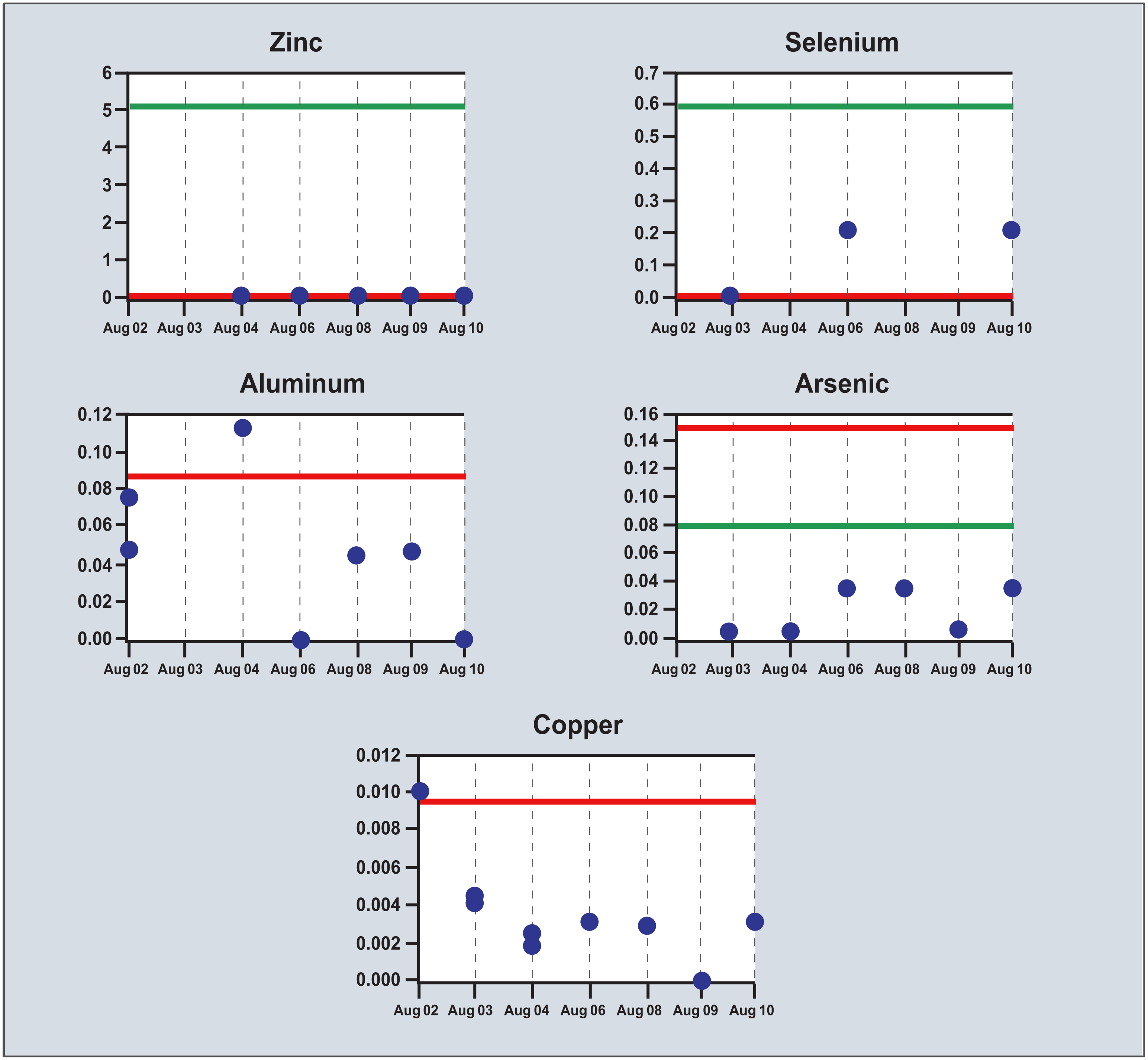
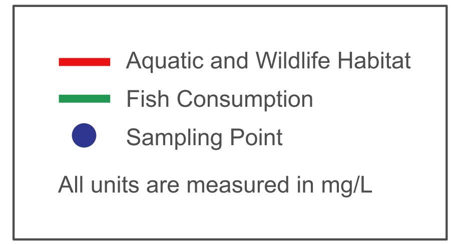


Figure 4.5-8

Comparison of
Morgan Lake Sampling
to Navajo Nation Standards



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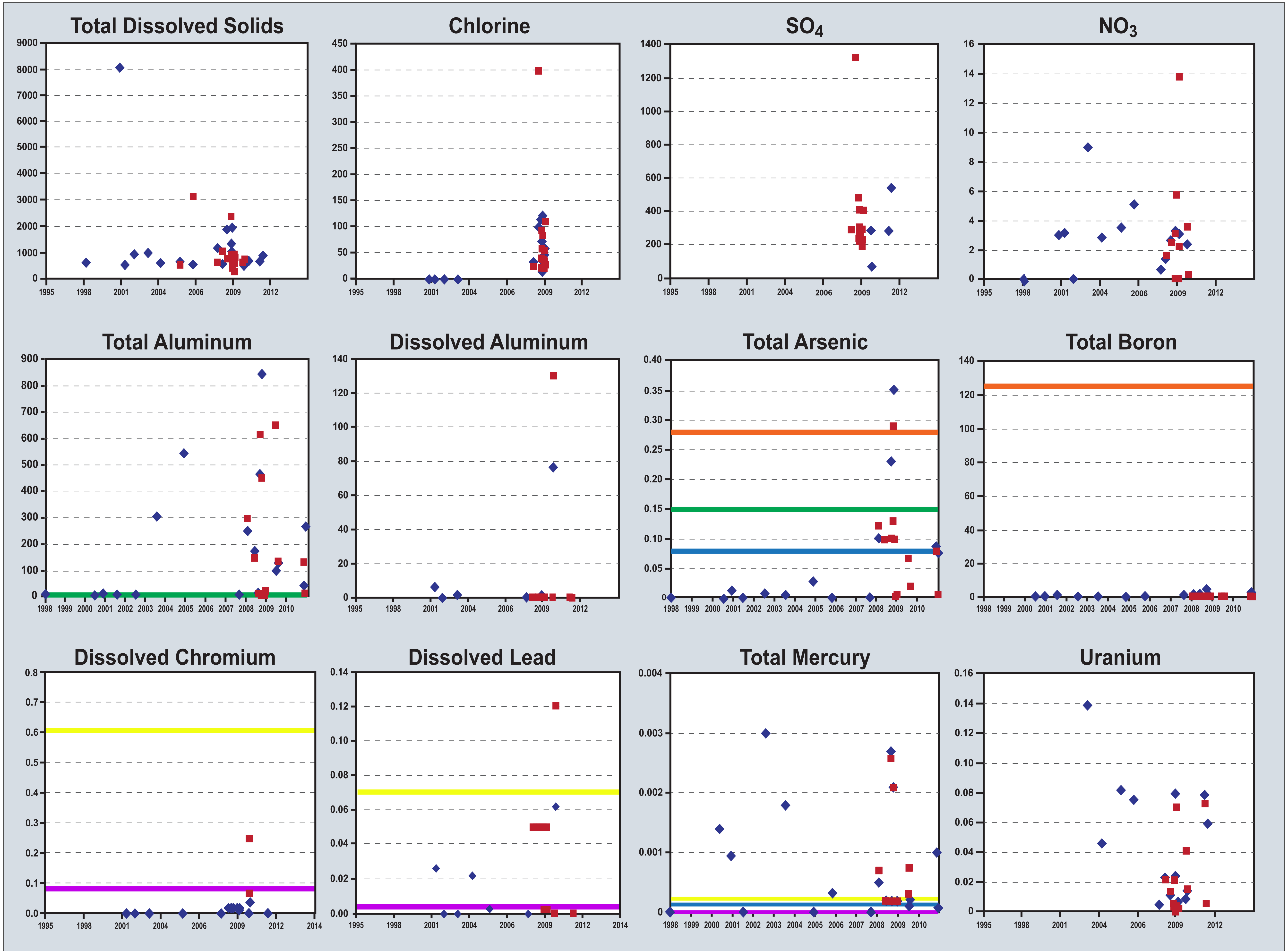

Figure 4.5-9

Chaco River Water Quality in the Vicinity of the FCPP

- Downstream
- Upstream
- Aquatic and Wildlife Habitat
- Aquatic and Wildlife Habitat (Acute)
- Aquatic and Wildlife Habitat (Chronic)
- Secondary Human Contact
- Fish Consumption
- Livestock Watering

All units are measured in mg/L

Upstream data is from NNEPA WQ station 06-33 and Downstream data is from NNEPA WQ station 06-01

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The circulating water system provides cooling water flow through the condensers and provides water for ash sluicing. The water comes from the cooling pond through an intake canal extending from the canal feeding the other three units. The canal is an unlined earth channel designed to sustain a flow of 1,850 cubic feet per second (cfs) for the two units at a velocity of 3 feet per second at a 5,327.5-foot low water elevation. The concrete intake structure has four wells for four vertical, half-capacity, mixed flow pumps, each rated at 206,000 gpm.

Transmission Lines

With the exception of the FCPP to San Juan Switchyard line, which only crosses the San Juan River, the associated existing transmission lines and associated ROWs cross numerous surface water features as displayed in Table 4.5-11 and shown on the regional surface water features map (Figure 4.5-2).

Table 4.5-11 Surface Waters that Intersect with the Subject Transmission Lines

FCPP-Moenkopi	FCPP-Cholla	FCPP-West Mesa
Shiprock Wash	Sanostee Wash	Gallegos Canyon
Little Shiprock Wash	Tocito Wash	Alamo Wash
Lukachukai Wash	Kinlichee Creek	Kimdeto Wash
Agua Sal Wash	Canyon de Chelly	Betonnie Tsosie Wash
Sheep Dip Creek	Lone Tule Wash	Escavada Wash
Chinde Wash	Pueblo Colorado Wash	De na-zin Wash
Polacca Wash	Little Colorado River	Canada Alemita
Wepo Wash		Chaco Wash
Oraibi Wash		Torreon Wash
Dinnebito Wash		San Isidro Wash
Ha Ho No Geh Canyon		Rio Puerco Creek
Little Colorado River		Arroyo de las Calabacillas
Tappan Wash		Numerous unnamed creeks, washes, and arroyos

4.5.3 Changes to Water Resources/Hydrology Affected Environment Post-2014

Two completed Federal actions have been incorporated into the baseline for this analysis: (1) the EPA has made its ruling with respect to BART to control air emissions, and (2) OSMRE has approved the SMCRA permit transfer from BNCC to NTEC (Section 2.4). These completed Federal actions are considered part of the environmental baseline to which the impacts of continuing operations and the Proposed Action are compared in the following section. Neither of these completed Federal actions would change the affected environment for water resources/hydrology.

4.5.4 Environmental Consequences

This section provides an analysis of potential environmental impacts on groundwater and surface water resources (including waters of the U.S.) that could occur under each of the Project alternatives, addressing the cumulative effects over the 25 years of continued operation. Information on existing water resources was used as the baseline to measure and identify potential impacts from the Proposed Action and alternatives. The primary focus of this impact assessment is to predict the effects of the Project alternatives on the prevailing hydrologic balance with respect to the quality and quantity of surface water and groundwater systems. The impact assessment considers the severity of potential direct and indirect impacts as well as the geographic extent, duration, and overall context of potential impacts. Magnitude of impacts to water resources (both surface water and groundwater) are determined by the following criteria:

- *Major.* Adverse impacts: Impacts that are outside the random fluctuations of natural processes that would likely result in a violation of water-quality standards (e.g., NPDES permit limits or NNEPA Surface Water Quality Standards for Beneficial Uses) or that economically, technically, or legally eliminate use of the resource. Beneficial impacts: those that would improve water quality or contribute to or restore water resources capability to the region, such as to greatly increase the potential for human or ecological use.
- *Moderate.* Impacts that are outside of the random fluctuations of natural processes but do not cause a significant loss of the use of the resource. Moderate beneficial impacts would simply extend the beneficial use beyond natural variations about the current mean value.
- *Minor.* Changes that would affect the quantity or quality but not the use of water or are similar to those caused by random fluctuations in natural processes.
- *Negligible.* Impacts of lesser magnitude, but still predictable under current technology (e.g., computer models) or measurable under commonly employed monitoring technology.
- *None.* Impacts that are not discerned or cannot be measured.

The assessment of impacts related to the Navajo Mine SMCRA Permit Area (both during mining and after reclamation) builds on the baseline hydrologic and geologic information contained in the Navajo Mine SMCRA Permit (NM-0003F), Pinabete SMCRA Permit Application (BNCC 2012a), the Cumulative Hydrologic Impact Assessment of the Navajo Mine (OSMRE 2012c), and observations of hydrologic consequences of mining at the adjacent areas of the Navajo Mine Lease Area. This impact assessment also couples those data with detailed SEDCAD™ 4 (SEDCAD) modeling of surface flows, sediment yields, spoil leaching test results, and groundwater flow and chemical transport modeling, to develop projections about potential hydrologic impacts in the Pinabete SMCRA Permit Area. SEDCAD is an integrated hydrologic model that evaluates flows, water, and sediment yield and effects of sediment control measures, including sediment ponds on downstream resources. SEDCAD uses the Revised Universal Soil Loss Equation (RUSLE) to generate storm-based erosion predictions. The impact assessment from past mining relied upon relevant published and unpublished reports and papers, experience from past mining, reclamation operations at Navajo Mine and other mines located along the western rim of the San Juan Basin, observations made by BNCC staff during day-to-day operations of the mine, and surface water and groundwater monitoring performed in conjunction with historic, ongoing mining, and reclamation activities at Navajo Mine. OSMRE has since updated the 2012 CHIA for Navajo Mine to reflect the following: (1) Change in permit applicant from BNCC to NTEC, which occurred on February 4, 2014; (2) References changes from the Navajo Mine paper permit application package to the re-organized electronic permit application package, which was accepted on June 30, 2014; and (3) Minor modifications to figures delineating the proposed Pinabete SMCRA permit area. These updates are administrative and OSMRE does not anticipate modification to the technical analysis that would cause revision to the 2012 CHIA findings.

The analysis of potential impacts to groundwater from FCPP operations is based on a qualitative assessment of water use at the power plant and a statistical analysis (Mann-Kendall Test) of groundwater movement beneath the DFADAs. The impact assessment relies upon limited groundwater monitoring and site characterization, as well as information on groundwater use and hydrogeology at the FCPP lease site provided by APS. The analysis of potential impacts to surface water from FCPP operations are based on a qualitative assessment of water use at the power plant as well as the incorporation of the results of air deposition modeling.

The analysis of potential impacts to water quality is based on a comparison of water quality monitoring data at the FCPP and Navajo Mine Lease Area to NNEPA standards. These standards, although not applicable to the FCPP[2], provide a consistent metric against which to evaluate potential changes to water quality as a result of the project alternatives. Further, the NPDES permit includes monitoring for some constituents for which NNEPA standards exist; these permit limits match the NNEPA standards.

The impact analysis of continued operation of the subject transmission lines is a qualitative assessment of potential effects of ongoing maintenance activities to water quality. No impacts to surface water hydrology would occur as a result of continued operation of the transmission lines because operation of the transmission lines would not involve water use or require any surface water diversions; therefore, these impacts are not discussed within the analysis.

4.5.4.1 Alternative A – Proposed Action

Navajo Mine

<u>Groundwater</u>

The analysis below is separated into two discussions. The first addresses potential impacts to groundwater quantity and the second addresses potential impacts to groundwater quality.

<u>Groundwater Quantity Impacts</u>

The primary groundwater impact due to mining operations would be the loss of the coal-seam aquifers within the Fruitland Formation. Mining the coal would remove the portion of the aquifer supported by the coal seam and any permeable interburden. The amount of groundwater encountered during the proposed mining is expected to be limited based on prior mining operations at the Navajo Mine SMCRA Permit Area and observations at existing monitoring wells. No water supply wells are located in the Fruitland Formation within the ROI. Additionally, the projected drawdown during mining would not affect any existing or anticipated future use based on drawdowns from the modeling simulations. The projected drawdown in the PCS would not be expected to affect any existing or anticipated future use; therefore, impacts to coal seam aquifers would be considered negligible (BNCC 2012a).

Drawdown in the Fruitland Formation could result in the subsequent groundwater drawdown in the alluvium in areas where the saturated Fruitland Formation is hydraulically connected to the alluvium. Locations may exist in Cottonwood Arroyo where drawdown could occur as a result of the proposed mining. This drawdown would likely be along the South Fork of Cottonwood Arroyo and would be short-term as precipitation and surface flow events would recharge the groundwater within the Cottonwood Arroyo once mining operations cease. Two livestock wells, W-0618 and QACW-2, could be affected by a reduction in flow, but because the water quality exceeds livestock criteria, neither well is used for livestock watering (BNCC 2012a).

As discussed in the Environmental Setting, there is limited water of suitable quality and quantity in the proposed mine areas. Proposed mining would be expected to result in limited drawdown of groundwater within the Pinabete Arroyo alluvium based on BNCC surveys of nested wells and the location of perched groundwater in the alluvium. Existing water use of the Chaco River alluvium is limited and based on drawdown modeling conducted by BNCC, groundwater in the Chaco River alluvium would not be affected by mining, as it is beyond the projected drawdown of water levels in the Fruitland Formation expected to occur as a result of mining (BNCC 2012a).

The post-mine groundwater gradients are predicted to change slightly from an overall northeastern gradient to a northwest gradient flowing towards the Cottonwood Arroyo. Based on a review of the model input parameters and results, impacts to groundwater flow within the permit area would be expected to be moderate due to the long rate of groundwater recovery (OSMRE 2012c). Mining and reclamation activities in the ROI would not adversely impact the groundwater recharge capacity of the disturbed area, as the

[2] As described in Section 3, in accordance with Lease Amendment No. 3, the Navajo Nation does not apply tribal regulation to the FCPP Lease Area.

pits are replaced with unconsolidated backfill material. BNCC modeled the post-reclamation recharge rate for the Pinabete SMCRA Permit Area as approximately 0.04 inch per year, about twice the modeled pre-mine groundwater recharge rate. The pre-mine groundwater recharge rate estimated by Stone et al. (1983) for undisturbed areas at the Navajo Mine SMCRA Permit Area and Pinabete SMCRA Permit Area ranged from 0.002 to 0.09 inch per year. Once water levels rise sufficiently in the mine backfill, groundwater would flow at a slow rate from the backfill into the lower coal seams of the Fruitland Formation, into the PCS, and toward the topographic lows along the alluvial channels of Cottonwood Arroyo. NTEC would use unconsolidated backfill material, which has a higher hydraulic conductivity than the undisturbed formation (i.e., the backfill would be less compact than the undisturbed formation and allow for quicker recharge of the aquifer). It is anticipated that the recharge rate would approximately double the historic rate (0.04 inch per year).

BNCC developed a groundwater monitoring plan, which NTEC will implement as part of the SMCRA permit, to monitor changes in the quantity of the groundwater resource during mining and subsequent reclamation. The monitoring plan will collect groundwater information from specified hydrogeologic units (coal seams from Fruitland Formation, PCS, and alluvium of Cottonwood Arroyo, and Pinabete Arroyo) as well as backfill locations. The goal of the monitoring plan is to collect data on groundwater quality and quantity to monitor any changes that may occur as a result of mining and reclamation such that if changes are detected mining and reclamation operations can be adjusted and BMPs installed to prevent adverse effects (BNCC 2012a). However, based on the lack of usable groundwater (both quality and quantity), no adverse effects are anticipated to result from mining or reclamation operations. Any impacts would be minor.

Potential use of groundwater, (i.e., livestock needs) within and adjacent to the ROI is limited, due to low permeability, low yield, and poor water quality; therefore, the potential future use of groundwater in the reclaimed area would be negligible due to the low yield and poor water quality.

Groundwater Quality Impacts

It is expected that mining operations may slightly alter groundwater quality; however, water quality studies of the few coal-seam aquifers at the Navajo Mine Lease Area indicate that the water available is of limited quantity and of poor water quality, with TDS up to 17,800 ppm (Thorn 1993).

Consequently, the coal-seam aquifers are not currently used for drinking or other domestic purposes. Based on water quality data collected, some of these aquifers meet Navajo Nation standards for agricultural water supply or other nondrinking water uses; however, alternate sources of higher quality water (e.g., Chaco River) can accommodate the current projected demand in the area.

Modeling conducted to assess the impact of historic CCR placement near alluvial systems showed it is unlikely that any detrimental future effect will occur from past CCR placement. This is due to very slow groundwater movement and the attenuation of contaminates of concern as they percolate through the subsurface. Therefore, impacts to groundwater from historic placement of CCR are negligible (OSMRE 2012c). Past mitigation efforts included reclamation of approximate original contour, mining limited in ephemeral channels, mixing of overburden/ backfill materials, and proper material classification and handling procedures (OSMRE 2012c). A comparison of monitoring data from wells within the areas of CCR placement to the baseline Fruitland coals (see Figure 4.5-1) showed a negligible impact for chloride; minor impacts for conductivity and manganese; moderate impacts for total iron and TDS; and major impacts for pH, boron, selenium, fluoride and sulfate. While the median pH and concentrations of selenium values met the criteria for livestock watering. The median concentrations for boron, fluoride, sulfate, and TDS exceeded livestock criteria. Therefore, groundwater beneath the reclamation areas is considered to be of concern relative to baseline and livestock criteria for boron, fluoride, sulfate and TDS (OSMRE 2012c).

While high levels of chemical constituents of concern exist within the wells in the historic mining area, there are no current economic uses of the Fruitland Formation in or adjacent to this area and no foreseeable uses other than oil and gas extraction. In order for disposal areas to have a major impact, CCR leachate would need to have sufficient mobility to reach alluvial strata within the vicinity of the historic disposal sites at high concentrations. A simple advection/dispersion modeling exercise was conducted to assess the impact of historic CCR placement relative to nearby alluvial systems, which could impact current and reasonably foreseeable uses. Modeling showed that it is unlikely that any major future impacts would ensue from the CCR placement at the Navajo Mine SMCRA Permit Area because of the very slow groundwater movement and the likely attenuation of contaminants of concern as they migrate through the subsurface (OSMRE 2012c). Based on this analysis the potential impacts to current and future water uses from CCR placement at the Navajo Mine SMCRA Permit Area are minor.

With regard to potential impacts of continued operations of the mine, changes to groundwater quality beyond the ROI would be minor during mining and reclamation operations. Since groundwater flow beneath the mine is generally perched and would be in the direction of the mining pits, little change to groundwater quality would be expected beyond the mining pit limits during mining operations. The impacts to water quality due to mine backfilling were determined through laboratory leaching tests.

The test results for spoil leached with coal seam water are believed to provide the best estimates for the groundwater source concentrations for long-term post-reclamation transport modeling. Based on the leaching test results, the concentrations of sulfate, calcium, magnesium, sodium, TDS, boron, and manganese would be expected to initially increase in surface water infiltration or groundwater as they saturate mine spoils. Fluoride, sulfate, and TDS concentrations were above the livestock water criteria in background groundwater collected from the PCS, alluvial deposits, and the Fruitland Formation. The groundwater yields from wells completed in the Fruitland Formation and in the PCS, which underlies the Fruitland Formation, are quite low and wells are typically pumped dry during testing and well purging for sampling. Also, the water quality in the PCS and Fruitland Formation is poor and is generally unsuitable for domestic or livestock use (BNCC 2012a). In summary, groundwater in the mine spoils, after reclamation, is predicted to have higher TDS concentrations than the pre-mine Fruitland Formation and Cottonwood Arroyo alluvium. However, the TDS concentrations in the alluvium of Cottonwood Arroyo are not expected to increase substantially as a result of mining because the contribution from spoil water is much smaller than the contribution from alluvial recharge and up-gradient alluvial flows.

The groundwater FEFLOW flow model was also used to quantify groundwater impacts due to the mining and reclamation operations for the chemical transport simulations. The transport model simulated the TDS migration from the mine spoil backfill. The results from the leaching tests were used as the groundwater source concentrations for the transport modeling. The primary factor controlling the fate and transport of water in mine spoils is the extremely low rate of flow from the mine backfill that would occur as a result of the low recharge rates and low hydraulic conductivity of the mine backfill. Based on these results, mining is estimated to have little effect on the long-term post-reclamation TDS concentrations in the groundwater within the PCS and the Cottonwood Arroyo alluvium down-gradient of the mine areas.

With the implementation of this alternative, groundwater beneath mine spoils is expected to have higher concentrations of TDS and sulfate than the pre-mine Fruitland Formation coal seams. This water would contribute to higher TDS and sulfate concentrations in the Cottonwood Arroyo alluvium. However, any increase in the post-reclamation concentrations of TDS and sulfate or in the trace constituents of aluminum, boron, iron, and manganese in the Cottonwood Arroyo alluvium are estimated to be minor and within the variation measured baseline concentrations of these constituents in alluvial monitoring wells. This increase however, is not expected to materially affect the suitability of the alluvial groundwater for livestock use. As stated previously, the Cottonwood Arroyo alluvium is an unreliable supply for stock water because the quality is a poor source for livestock supply due to high TDS and sulfate concentrations (BNCC 2012a).

Therefore, impact to groundwater due to a potential increase in TDS in the Cottonwood Arroyo alluvium is minor due to existing poor groundwater quality (above recommended livestock use criteria) and limited water quantity.

The modeling results for the TDS transport in the PCS show that the primary direction of TDS migration from the mine spoils is vertically into the PCS. This direction signifies the migration is moving into a water-bearing zone that has TDS concentrations similar to, if not higher than, the TDS levels expected from the spoil water. Groundwater flow and TDS transport in the PCS then flows toward the alluvium and topographic lows along Cottonwood Arroyo. Transport to the north and east is limited.

Surface Water Quality

Several recharge mechanisms influence surface water quality within the Navajo Mine Lease Area. Precipitation and NAPI discharges generate runoff in the ephemeral washes, entraining sands, silts, and clays, inducing elevated concentrations of total suspended solids. The elevated total suspended solid concentrations influence the chemical composition of the surface water. Active mining and reclamation involve use of a number of activities that could potentially affect surface water quality, including topdressing removal; overburden drilling, storage, and stripping; pits; spoil rows or piles; regraded spoils; and primary/final regrading of the last spoil row. Ground disturbance associated with construction, mining, and reclamation also has the potential to increase sediments carried by stormwater during or after a rain event. Interaction between stormwater runoff and newly exposed overburden, interburden, coals, and mine spoils may result in increases in contaminants in surface runoff. The largest source of potential runoff from the proposed mining operation is stormwater.

In accordance with OSMRE, EPA, and NNEPA regulations for surface water discharges, no surface water from disturbed areas is permitted to commingle with stormwater and discharge offsite without an NPDES permit. As described in Section 4.5.1, discharges from disturbed areas would occur only after the area is adequately reclaimed (i.e., area is regraded to approved topography, topsoil replaced, and area is revegetated) and the operator has demonstrated using established models (e.g., SEDCAD) that post-mine sediment yields would vary slightly from pre-mine levels (in the instance of Pinabete Arroyo and South Fork Cottonwood Arroyo, post-mine yields would be greater than pre-mine yields), although NPDES Regulations (40 CFR 434 Subpart H) require that post-mine yields are equal to or less than pre-mine levels. Variation in sediment yield is dependent on amount and duration of the rain event in the disturbed area. Table 4.5-12 compares sediment yield variations of the pre-mine with mine operations and post-reclamation in the Pinabete Arroyo, Cottonwood Arroyo, and the Unnamed Tributary to the Chaco River.

NTEC would implement a Sediment Control Plan to help minimize sediment loss from water and wind erosion. The Plan includes such methods as, stabilizing stockpiles by mulching and seeding, retaining sediment in disturbed areas using berms, sumps, or sediment ponds to capture runoff. The primary control measure to decrease sediment runoff would be the use of sedimentation ponds. Sedimentation ponds are designed to retain the surface runoff and sediment from either the 100 year-6 hour or 10 year-24 hour storm event. There would be no discharge onto undisturbed areas or beyond the permit area from precipitation events up to and including the 10 year-24 hour event. All discharges from the disturbed areas would be covered under an NPDES permit where required. MMCo would acquire general NPDES stormwater permits as applicable, such as the MSGP under Sector H for coal mining (i.e., haul roads and access roads). Professional Engineers would design and certify that sedimentation ponds would contain runoff from a 100-year, 6-hour or 10-year, 24-hour storm event. Should discharges occur from these ponds, they would be subject to the applicable NPDES discharge effluent limitations of MSGP Subpart H. The watershed areas for the NPDES individual permit outfall points and sediment control structures are presented in Table 4.5-12.

Ponds 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, and 426 are sediment ponds, within the proposed Pinabete SMCRA Permit Area, that would retain the surface runoff and sediment from the disturbed area associated with current and proposed mining and reclamation operations. Berms, v-ditches, or channels would be used to divert flows from the disturbed areas into the ponds. Retaining the effluent or surface runoff from the disturbed areas in the pond for evaporation would ensure compliance with the applicable effluent standards set forth in the NPDES permit.

Table 4.5-12 NPDES Outfall Points and Sediment Control Measures

Watershed ID	NPDES Outfall Point ID	Watershed Area (acres)	Disturbed Area (acres)	Disturbance Type	Type of Control Measure	Structure ID
Area IV North Pond 415	NPDES Outfall #1	5.6	5.6	Disturbed area surface drainage	Sedimentation Pond	Pond 415
Area IV North Pond 416	NPDES Outfall #2	128.1	128.1	Disturbed area surface drainage	Sedimentation Pond	Pond 416
Area IV North Pond 417	NPDES Outfall #3	261.8	261.8	Disturbed area surface drainage	Sedimentation Pond	Pond 417
Area IV North Pond 418	NPDES Outfall #4	233.5	233.5	Disturbed area surface drainage	Sedimentation Pond	Pond 418
Area IV North Pond 419	NPDES Outfall #5	199.3	199.3	Disturbed area surface drainage	Sedimentation Pond	Pond 419
Area IV North Pond 420	NPDES Outfall #6	387.4	387.4	Disturbed area surface drainage	Sedimentation Pond	Pond 420
Area IV North Pond 421	NPDES Outfall #7	148.8	148.8	Disturbed area surface drainage	Sedimentation Pond	Pond 421
Area IV South Pond 422	NPDES Outfall #8	476.7	464.3	Disturbed area surface drainage	Sedimentation Pond	Pond 422
Area IV South Pond 423	NPDES Outfall #9	949.3	900.3	Disturbed area surface drainage	Sedimentation Pond	Pond 423
Area IV South Pond 424	NPDES Outfall #10	45.0	45.0	Disturbed area surface drainage	Sedimentation Pond	Pond 424
Area IV South Pond 425	NPDES Outfall #11	218.2	190.4	Disturbed area surface drainage	Sedimentation Pond	Pond 425
Area IV South Pond 426	NPDES Outfall #12	81.5	70.0	Disturbed area surface drainage	Sedimentation Pond	Pond 426
Area IV South Pond 427	NPDES Outfall #13	23.1	23.1	Disturbed area surface drainage	Sedimentation Pond	TS-404 Pond 427
Area IV North Pond 428	NPDES Outfall #14	5.4	5.4	Disturbed area surface drainage	Sedimentation Pond	TS-406 Pond 428

Source: BNCC 2012a.

Pond 427 is a sediment pond located at NPDES Outfall #12 that would retain the surface runoff and sediment from the disturbed area associated with proposed Topdressing Stockpile TS-404. Pond 428 is a sediment pond located at NPDES Outfall #14 that would retain the surface runoff and sediment from the disturbed area associated with future Topdressing Stockpile TS-406. A perimeter berm adjacent to the toe of each stockpile would divert flows from the stockpile area to the respective pond. Retaining the surface runoff from the disturbed areas in the pond for evaporation would ensure compliance with the applicable effluent standards.

SEDCAD modeling was performed to evaluate sediment generation under pre-mine, operational, and post-reclamation conditions for drainages traversing or intersecting the permit area. Projections on sediment yield were developed based on storm-specific flows and six parameters associated with sediment yield: soil texture, soil erodibility constants, representative slopes of overland flow within the watershed, representative lengths, cover, and management practices. Operational and pre-mine sediment yield projections from SEDCAD modeling are summarized and compared in Table 4.5-13. Results are quantified by sediment yield in tons/event.

The impacts were assessed with the modeling of Pinabete Arroyo at the confluence with the Chaco River, Cottonwood Arroyo at the confluence with the Chaco River, and the unnamed tributary to Chaco River downstream of the permit boundary. As detailed in Table 4.5-13, sediment yields reaching the Chaco River from Pinabete Arroyo, Cottonwood Arroyo, and the Unnamed Tributary to Chaco River would be lower under operational conditions in comparison with the pre-mine baseline yields. In addition, the results suggest that the replacement of poor quality sodic soils with suitable topdressing materials would reduce sediment generation from pre-mine to post-reclamation levels.

As part of reclamation, NTEC would remove temporary post-reclamation structures. After erosion control measures sufficient to minimize the erosion rate to less than or equal to pre-mine levels have been installed, the reclamation areas would be reconnected to the native drainages that surround the permit area in accordance with SMCRA regulations. If the surface runoff from an active mining area has the potential to leave the permit area, or enter a reclaimed area downstream, a sediment pond would be constructed to retain the surface runoff and sediment. The pond would be located in either an existing drainage adjacent to the disturbed area or a reestablished drainage in the reclamation area. As reclamation progresses and drainages are reestablished, watershed sizes can increase. NTEC may need to place additional ponds in series to retain the runoff and meet 40 CFR Part 434 standards until the area can be completely reclaimed. In such cases, NTEC would submit a revision to the Reclamation Plan to OSMRE for review and approval at least 60 days prior to initiating construction activities for additional ponds. Berms may be used to prevent sediment and flows from leaving the disturbed area and to convey flows to sedimentation ponds.

As mining progresses, disturbed areas would be reclaimed as described in Chapter 2. To prevent possible degradation of the downstream reclaimed or topdressed and seeded areas, berms and ditches would remain in place as long as practicably possible during topdressing placement. Generally, berms would be removed by blending the material into the adjacent regraded spoils. In the process of removing the berms, positive drainage must be maintained in the drainage ways and on sloping surfaces. To achieve such drainage, the area or distance adjacent to the berm must be sufficient to spread and blend in the material. Therefore, as topdressing placement approaches a berm, the berm would be removed while sufficient distance still remains to spread and blend in the material. Impacts to surface water quality would be minor due to erosion control measures and adherence to SMCRA regulations.

If a large storm event were to occur, excess water accumulated in the pit would be pumped to one or more sediment ponds. The design volume of the ponds would be maintained; the pumping would be only to ponds with sufficient capacity to accommodate additional water without jeopardizing the design volume. If the ponds have no extra capacity, the water or effluent could be pumped to an existing drainage for discharge if the standards of the appropriate NPDES permit are met.

Table 4.5-13 Comparison of Sediment Yield Pre-mine with Mine Operations and Post-Reclamation for Pinabete Arroyo, Cottonwood Arroyo, and Unnamed Tributary to Chaco River

SEDCAD Designation	Watershed Location	Sediment Yield (tons) Area (square miles)	Sediment Yield (tons) 2yr-6hr Event (0.85 inch)	Sediment Yield (tons) 10yr-6hr Event (1.28 inches)	Sediment Yield (tons) 25yr-6hr Event (1.56 inches)	Sediment Yield (tons) 50yr-6hr Event (1.76 inches)	Sediment Yield (tons) 100yr-6hr Event (2.04 inches)
Structure 7	Pinabete upstream, pre-mine	43.88	2,703	9,489	15,694	18,130	28,885
Structure 9	Pinabete at mouth, pre-mine	59.37	2,821	9,886	16,325	18,581	25,646
Structure 9	Pinabete at mouth, post-reclamation	60.83	2,252	7,839	13,233	17,349	24,210
Structure 21	South Fork Cottonwood, pre-mine	21.08	4,561	11,292	16,455	20,341	26,631
Structure 21	South Fork Cottonwood, post-reclamation	20.80	4,774	11,791	17,141	21,456	27,964
Structure 37	Cottonwood at mouth, pre-mine	80.11	10,744	27,242	40,586	51,493	67,180
Structure 37	Cottonwood at mouth, post-reclamation	79.19	10,915	27,932	41,715	52,790	69,580
Structure 1	Chaco Tribe , pre-mine	0.45	158	497	788	1,023	1,380
Structure 2	Chaco Tribe, post-reclamation	0.93	51	199	336	450	629

After reclamation, the following water quality changes would be anticipated:

- Sediment contributions from reclaimed areas are projected to increase slightly, or be the same as pre-mine conditions in the South Fork of Cottonwood and at the mouth of Cottonwood. These projections are approximately 5 percent, and are within the anticipated error of the SEDCAD model. Sediment contributions from the Pinabete Arroyo and the unnamed tributary of Chaco River are likely to decrease between pre-mine and post-reclamation conditions. Sediment contribution from channel erosion would be likely to decrease as incised unstable channels are replaced by stable channel and floodplain configurations.
- Poor quality and sodic soils would be buried within the backfill, and overland flow from the reclaimed areas would be expected to exhibit lower sodium and TDS concentrations.

Aluminum concentrations should decline with the reduction in suspended solids associated with reduced surface and channel erosion.

A spoil testing program was conducted (i.e., Synthetic Precipitation Leaching Procedure) to generate the information on spoil properties and leaching characteristics. The leaching test results indicate that interaction between stormwater runoff and newly exposed overburden, interburden, coals, and mine spoils may result in increases in the concentrations of sulfate, calcium, magnesium, sodium, TDS, boron, and manganese. These constituents are expected to initially increase in surface water infiltration or groundwater as they saturate mine spoils (BNCC 2012a). However, surface runoff from disturbed areas would be retained in the mine pit, sediment ponds, or berms. Thus, potential impacts to surface water quality would be expected to be negligible in Pinabete Arroyo, Cottonwood Arroyo, and the Chaco River during mining and reclamation operations as mine water is unlikely to reach these arroyos except during extreme precipitation events that exceed the designs of the containment structures.

With regard to potential impacts of mining, including coal dust, on water quality of stock ponds, two samples were obtained in 2008 from Stevenson's Well Pond located immediately adjacent to Area IV North. The results of these samples are presented in Table 4.5-14. Results from both samples meet applicable surface water criteria for livestock use. The samples meet all the relevant aquatic use criteria except for cadmium, which exceeds the chronic aquatic criterion for the estimated hardness of the pond water. These results indicate that impacts to stock ponds located adjacent to active mining operations would be minor with respect to livestock use.

NTEC would implement BMPs to avoid and minimize water quality impacts during mining by controlling runoff and sedimentation into nearby channels, including minimization of disturbance footprints, establishment of stream buffer zones, employment of upstream diversions or highwall impoundments, use of sediment ponds, perimeter berms or containment features, and reseeding of areas prepared for reclamation as soon as practicable. NTEC would comply with SMCRA requirements and EPA NPDES permits under CWA Section 402 to control the discharge of sediment within the active mining sectors of the Pinabete SMCRA Permit Area and Navajo Mine SMCRA Permit Area. In addition, NTEC would conduct regular monitoring of surface water quantity and quality in Pinabete and Cottonwood arroyos for the duration of the permit period. Monitoring would be conducted at five stations (three historic and two new stations) and would be collected quarterly in accordance with the Surface Water Monitoring Plan submitted as part of the Pinabete SMCRA Permit Application to OSMRE. Water quality monitoring results would be submitted quarterly to OSMRE. Motor fuel storage and equipment maintenance would be provided at the Navajo Mine facilities located outside of the Pinabete SMCRA Permit Area. Nevertheless, equipment repair may on occasion need to be conducted within the active mining or reclamation areas. NTEC maintains and implements a SPCC Plan that identifies areas of risk, specifies appropriate controls for bulk storage areas, identifies control strategies for managing potential spills, and lists procedures for safely disposing of any contaminated materials.

Table 4.5-14 Surface Water Quality at Stevenson's Well Pond

Analysis Parameter	Sample Date July 21, 2008	Sample Date August 12, 2008
Arsenic, T (mg/L)		<0.0025
Barium, D (mg/L)	0.208	-
Barium, T (mg/L)	-	0.1550
Bicarbonate as CaCO3 (mg/L)	312	-
Boron, D (mg/L)	0.2	0.1
Cadmium, D (mg/L)	0.0083	0.01397
Calcium, D (mg/L)	44.6	-
Carbonate as CaCO3 (mg/L)	<10	
Chloride (mg/L)	19	-
Chromium, D (mg/L)	<0.01	<0.01
Cobalt, D (mg/L)	-	0.00030
Electrical conductivity (EC) (µs/cm)	608	-
Copper, D (mg/L)	0.014	0.0068
Fluoride (mg/L)	1.2	-
Hydroxide as CaCO3 (mg/L)	<10	
Iron, D (mg/L)	0.05	-
Iron, T (mg/L)	383	-
Lead, D (mg/L)	0.001	<0.0016
Magnesium, D (mg/L)	<0.5	
Manganese, D (mg/L)	0.357	-
Manganese, T (mg/L)	9.26	-
Mercury, T (mg/L)	0.0008	<0.0002
Nitrate/Nitrite as N (mg/L)	0.03	
pH (su)	7.80	-
Phosphorous, T (mg/L)	<0.05	
Potassium, D (mg/L)	7.5	-
Sodium adsorption ratio (SAR)	0.7	-
Selenium, D (mg/L)	<0.010	
Selenium, T (mg/L)		0.002
Settleable solids (mL/L)	37.9	
Silver, D (mg/L)	<0.0005	
Sodium, D (mg/L)	86.4	-
Sulfate (mg/L)	39	
TDS (mg/L)	380	-
Total suspended solids (mg/L)	9200	-
Vanadium, D (mg/L)	-	0.0064
Zinc, D (mg/L)	0.02	0.006

Source: BNCC 2012a.
µS/cm = microSiemen(s) per centimeter
D = Dissolved
mg/L = milligram(s) per liter
su = standard unit(s)
T = Total

With regard to potential water quality impacts associated with the realignment of Burnham Road, no perennial water resources exist in the form of rivers, lakes, ponds, or streams within the proposed realignment of Burnham Road, nor do any wetlands or riparian habitats. However, the proposed realignment crosses six intermittent or ephemeral drainages, including Cottonwood Arroyo, with stream channels ranging from approximately one to three feet wide by approximately one foot deep. Each of the crossings would be constructed with culverts to ensure safe travel during precipitation events. Specifically, culverts would be installed where drainages cross the road. The Burnham Road crossings were designed and constructed to minimize their effect on channel flow hydraulics and sediment transport ability. Water would continue to flow past each culvert road crossing with only minimal and localized hydraulic effect. Culvert crossings would be constructed to ensure that no downstream headcutting occurred and that flow was not affected. All primary culverts would be designed to safely pass peak discharge from 10 year-6 hour event or larger and installed with erosion prevention measures (i.e., riprap at end of culvert). The culverts' length and diameter would be determined by watershed area and location. Road construction would not commence until regulatory authorities approve proposed designs (BNCC 2012a).

To control erosion, riprap would be placed in steep sloping relief and side ditches. Water and sediment control for the Burnham Road realignment construction would be performed in accordance with the Project SWPPP. BMPs would be implemented under this plan to control water and sediment. During construction activities, any spilled petroleum products would be cleaned up immediately. Should petroleum be absorbed into the soil, the stained area would be shoveled out and disposed of at an approved disposal site. Potential impacts resulting from hazardous substances spilled during construction would be negligible and short term. Overall, hydrology and water quality impacts would be minor.

Impacts to Waters of the U.S.

A delineation of potential waters of the U.S. within the Pinabete SMCRA Permit Area was conducted in April 2012. The survey area included approximately 10,133 acres of the Navajo Mine Lease Area. Overall 16.2 miles and 29 acres of waters of the U.S. were delineated within the Pinabete SMCRA Permit Area, as well as 2.05 acres of stock ponds, as described previously. The delineation did not identify any potential wetland areas. Any mining activities that occur in jurisdictional waters of the U.S. within the ROI would require a permit from the USACE pursuant to CWA Section 404 (33 CFR Section 320-331). Implementation of the Proposed Action would result in permanent impacts to 5.0 acres of waters of the U.S. Table 4.5-15 describes the impacts to waters of the U.S. by activity. BNCC applied for an Individual Permit from the USACE, which will be transferred to MMCo. With the implementation of post-mining compensatory mitigation requirements that would be required by the permit, impacts to waters of the US would be minimized to the extent feasible (see Section 4.5.5 for details). Appendix B includes the USACE 404B Alternatives Analysis for the submitted permit application.

Table 4.5-15 Impacts to Waters of the U.S. by Activity

Type of Activity	Impacts to Waters of the U.S. (acres)	Type of Disturbance
Area IV North and Area IV South Mining Activity	2.98	Permanent
Haul Roads, Light Vehicle Roads, and the Burnham Road Realignment	0.92[3]	Permanent
Transmission Line[1]	0	None
Infrastructure (Sediment and Drainage Control Ponds, Soil and Coal Stockpiles)[2]	1.1[3]	Permanent
Total	**5.0**	**Permanent**

Notes:

1 The power line crosses four jurisdictional channels, but no poles would be placed within the ordinary high water mark and no access roads would cross the channels.

2 No buildings would be located within jurisdictional streams. Retention ponds or stockpiles could be located within jurisdictional channels.

3 Estimated acreage of impacts to waters of the US resulting from construction of haul roads, light vehicle roads, and sediment ponds.

The NPDES General Permit for Discharges of Storm Water Runoff Associated with Industrial Activity (General Industrial Permit) regulates stormwater and non-stormwater discharges of 10 specific activities, including mining operations. Accordingly, prior to operation of the Pinabete SMCRA Permit Area, MMCo would be required to obtain coverage under the General Industrial Permit. Similar to the General Construction Permit, MMCo must prepare and file a Notice of Intent with the EPA and prepare and implement a SWPPP for the operation of the mine area. MMCo would also be required to conduct monitoring to determine the amount of pollutants, if any, leaving the site. The mine would be required to amend their existing NPDES permit for potential discharges from the Pinabete SMCRA Permit Area, apply for a new individual permit or apply for coverage under EPA's MSGP. For the mine to be covered under the MSGP, a Notice of Intent must be submitted to the EPA to certify that the mine meets eligibility requirements.

Realignment of Burnham Road would require greater than 1 acre of ground disturbance; therefore, prior to implementation of the proposed construction activities, both MMCo would be required to obtain coverage under the General Construction Permit and a construction SWPPP would be prepared.

Surface Water Quantity

The primary changes in the hydrologic balance during the surface mining and reclamation operations would be changes in intermittent stream flows in Pinabete and Cottonwood arroyos that would occur as a result of the containment of surface runoff within the mine area. These changes in flow would not be expected to measurably affect the Chaco River due to the intermittent nature of tributary flows and the relatively small drainage area of the tributaries relative to the drainage area of the Chaco River. The drainage areas of Pinabete and Cottonwood arroyos represent only 1.4 and 1.8 percent, respectively, of the total Chaco River drainage basin.

Cottonwood and Pinabete arroyos would not be mined under this alternative. Mining operations would temporarily intercept precipitation runoff from the tributary drainages that flow into Cottonwood and Pinabete arroyos from the permit area. No stream diversions would be required for the Pinabete Mine Plan. The up-gradient areas that drain to the mine pits are small and would either be intercepted by the mine pit or captured in temporary pit protection ponds located up-gradient of mining. Precipitation runoff collected in the pit or in the pit protection ponds could be used for dust suppression, other mine needs, or would naturally diminish from evaporation and seepage. Once reclamation is completed within the permit area, precipitation runoff from these reclaimed areas would flow through reclaimed channels to Cottonwood Arroyo, Pinabete Arroyo, and the unnamed tributary to the Chaco River, and then into the Chaco River.

Prior to reclamation, NTEC would contain all mine-disturbed area drainage in the mine pit or in designed runoff containment structures. The bermed containment structures and the mine pit would function to contain the runoff from a 100-year, 6-hour precipitation event or larger. During reclamation, sediment ponds would be designed to retain at a minimum the volume of runoff from a 10-year storm, for 24 hours plus additional volume for sediment storage. Sediment ponds would be used to contain and treat water until approval is obtained for use of alternative sediment controls in accordance with 40 CFR Part 434 Subpart H, which applies to alkaline mine drainage from reclamation areas, brushing and grubbing areas, topsoil stockpiling area, and regraded areas at western coal mines. It allows operations to employ alternative sediment controls that are established in accordance with a sediment control plan that is designed to prevent an increase in the average annual sediment yield from pre-mine undisturbed conditions.

Post-reclamation standards include SMCRA requirements on Indian Land for reclaiming the affected land (30 USC 1265), including surface area stabilization/erosion control, revegetation, creating impoundments for water quality, minimizing disturbance to original hydrologic balances, and proper disposal of mine waste products and other requirements. These measures are designed to reduce surface erosion and sediment yield. BNCC has designed the post-reclamation topography and drainages to conform to existing drainages along the mine's perimeter to safely convey water from upstream, off-lease watersheds to either Pinabete Arroyo or Cottonwood Arroyo.

SEDCAD modeling was performed to evaluate peak flows and storm volumes under pre-mine, operational, and post-reclamation conditions on Pinabete Arroyo, Cottonwood Arroyo, and the unnamed tributary to the Chaco River. This tributary is located south of Cottonwood Arroyo and north of Pinabete Arroyo and drains an area of about 0.45 square mile on the western side of the permit area. The 2-year, 10-year, 25-year, and 100-year, 6-hour events were modeled with SEDCAD. The SEDCAD modeling results are presented in Table 4.5-16. The worst-case results in this table are based on no discharge up to the flows from a 100-year, 6-hour precipitation event in the mine area.

The SEDCAD results indicate that peak flows and runoff volumes to Pinabete and Cottonwood arroyos would be reduced during operations with maximum disturbance acreages representing worst-case projections. These direct impacts would be long-term (lasting for the duration of the mining operations, yet negligible in severity, because the mine site is in a desert environment, and the Pinabete and Cottonwood arroyos are a small portion (1.4 percent and 1.8 percent, respectively) of the regional Chaco watershed. Results show little difference between pre-mine conditions and post-reclamation conditions, except for the unnamed tributary to the Chaco River, where post-reclamation flows would increase due to an increase in drainage area following reclamation. However, the impact on the unnamed tributary and Chaco River would be considered negligible because the predicted change is considered to be within background levels.

During surface coal mining operations, a temporary reduction in surface water flows could occur in Pinabete and Cottonwood arroyos. Three ponds located within the permit area would also be removed by mining operations: Stevenson's Well Pond, Pond 4N/4S, and one unnamed pond located within the northwestern portion of the permit area on a tributary to Cottonwood Arroyo. Pond 4N/4S and Stevenson's Well Pond are located on tributaries to Pinabete Arroyo. No surface water right filings exist within the permit area, although livestock may occasionally use these ponds when water is available. Livestock grazing does not occur within permit area during active mining. An alternate water supply (e.g., water tanks) would be provided for any off-lease livestock grazing that has used these ponds located within the permit area.

Following reclamation, the water supplies for existing livestock use would be replaced. Additional water supplies may be available if new ponds are constructed or some of the sediment and/or drainage control ponds are converted to permanent stock water use at the request of the Navajo Nation or local water users in accordance with the Hydrologic Reclamation Plan (BNCC 2012a). Should pond retention occur, on-channel ponds would modify the hydrograph associated with each storm event by lowering the peak flows, extending the runoff over a longer period of time, and reducing storm runoff volumes. For small runoff events, the ponds may retain all of the storm runoff from upstream. Pond reconstruction would be performed to approximate the storage capacity and surface area of the original pre-mine impoundment. Accordingly, minor changes in intermittent or ephemeral flow may occur if some of the sediment and drainage control ponds are converted to permanent replacement livestock water ponds at the request of the Navajo Nation or the local water user.

<u>Channel Morphology</u>

Changes in runoff or in sediment yield from watersheds affected by mining have the potential to disrupt the existing stability of receiving streams, and in extreme circumstances, cause major changes in the existing channel pattern and geometry. Sediment control systems for mining operations are typically designed to yield a sediment load below equilibrium with the natural hydraulic regime. Erosion of streambeds and banks is usually expected for a short distance downstream of any discharge point, as the stream regains geomorphic equilibrium. Sediment pond discharge structures are designed in anticipation of this behavior, and allow the water (using grade-control structures, gabion aprons, and bank stabilizers) to attain equilibrium in a gradual and nondestructive fashion.

Table 4.5-16 Pre-mine, Operation, and Post-Reclamation Flows for Pinabete Arroyo, Cottonwood Arroyo, and Unnamed Tributary to Chaco River in Area IV North

SEDCAD Designation	Watershed Location	Area (square miles)	2-year, 6-hour Event (0.85 inch) Flow (cfs)	2-year, 6-hour Event (0.85 inch) Volume (acre-feet)	10-year, 6-hour Event (1.28 inches) Flow (cfs)	10-year, 6-hour Event (1.28 inches Volume (acre-feet)	25-year, 6-hour Event (1.56 inches) Flow (cfs)	25-year, 6-hour Event (1.56 inches) Volume (acre-feet)	50-year, 6-hour Event (1.76 inches) Flow (cfs)	50-year, 6-hour Event (1.76 inches) Volume (acre-feet)	100-year, 6-hour Event (2.04 inches) Flow (cfs)	100-year, 6-hour Event (2.04 inches) Volume (acre-feet)
Structure 7	Pinabete upstream, pre-mine	47.80	401	294	1,113	802	1,698	1,217.1	2,159	1,017	2,851	2,033.0
Structure 9	Pinabete at mouth, pre-mine	59.37	390	378	1,081	1,011	1,649	1,531.5	2,096	1,545	2,767	2,526
Structure 13	Pinabete at mouth, post-reclamation	60.83	386	295	1,070	805	1,633	1,209	2,075	1,551	2,740	2,044
Structure 21	South Fork Cottonwood, pre-mine	21.08	729	195	1,588	411	2,220	627.0	2,714	767	3,439	971
Structure 21	South Fork Cottonwood, post-reclamation	20.80	719	186	1,574	424	2,204	604	2,693	740	3,413	940
Structure 37	Cottonwood at mouth, pre-mine	80.11	1,250	460	2,839	1,165.0	4,049	1,732.0	4,971	2,175	6,325	2,836.0
Structure 37	Cottonwood at mouth, post-reclamation	79.19	1,257	433	2,866	1,114	4,084	1,645	5,011	2,096	6,369	2,742
Structure 1	Chaco Tribe, pre-mine	0.45	50	2.3	137	6.4	205	9.8	257.2	12.4	334	16.3
Structure 1	Chaco Tribe, post-reclamation	0.98	28,8	3.6	100	11.4	162	18	211,2	23.2	286	31

Source: BNCC 2012a.

cfs = cubic feet per second

Diversions of natural stream flow also are designed to preserve geomorphic stability and prevent uncontrolled or destructive erosion and sedimentation. Channel diversions on the Navajo Mine Lease Area are designed using quantitative hydraulic modeling programs (e.g., SEDIMOT II) that simulate the geometry required to maintain geomorphic equilibrium in a natural channel. Where not possible, specific structures (such as grade-control structures) are designed and constructed in the channel to correct the problem. As with pond discharges, these channels and structures are regularly inspected and maintained by NTEC staff and reviewed by OSMRE and tribal inspectors.

BNCC has prepared, and NTEC would implement, a Hydrologic Reclamation Plan (BNCC 2012a) for the Pinabete SMCRA Permit Area and Navajo Mine SMCRA Permit Area. These plans are predicated on the use of geomorphic principles that have been employed to create the reconstructed landforms, drainage density, and channels. Drainages and watersheds that had previously been mined or altered would be reclaimed in accordance with the Reclamation Plan. Although many of the pre-mine channels are incised with little or no active floodplain, reclaimed channels for higher-order drainages are designed for long-term stability with a low-flow or pilot channel capable of accommodating average annual peak flows or flows from a 2-year, 6-hour event and a floodplain to contain more extreme flows, as appropriate, based on slope. Post-reclamation channels for first-order drainages are typically designed as vegetated swales. Accordingly, any impacts of the mine drainage system on natural stream patterns would be temporary and confined to the ROI. Because these variations would be far less than the natural variability of these arroyos and washes and would include a small proportion of the affected washes, the impact of the mine on the geometry, morphology, or location of the natural stream patterns is expected to be negligible post-reclamation.

Four Corners Power Plant

<u>Groundwater</u>

The continued operation of Units 4 and 5 would not affect groundwater quantity. The water demands for the operation of the power plant come from Morgan Lake, and no groundwater is pumped or otherwise used for this operation. No injection of material into the subsurface is planned. FCPP would continue monitoring groundwater quality and level. However, operation of the ash disposal facility, including existing trenches and extraction wells would result in a decline in groundwater flow, as described below.

As described in the Affected Environment, selenium concentrations in the DFADA exceed EPA drinking water quality standards. Boron, nickel, and uranium are also elevated in some instances. Although boron and uranium are naturally-occurring elements found in the geologic formations of the region, it is unclear if the ash ponds or native material is the source of these and the other constituents. TDS concentration is a general indicator of total metals within the groundwater. A statistical analysis was conducted of TDS sample results between 1986 and 2012 (APS 2013) for 9 wells selected in order to cover the entire ash pond area (monitoring wells 2, 4, 8, 15, 16, 17, 18, 19, and 20). Mann-Kendall time series tests were conducted to analyze TDS levels over time to determine if there is any trend in the data (Table 4.5-17). For those monitoring wells near Ash Pond 6 and heading west, all selected wells showed a statistically significant downward trend in TDS, thus indicating that metals have decreased over time. South of Ash Pond 6, monitoring wells nearest to the lined evaporation ponds showed no correlation between TDS concentration and time; however, wells further west did. The lack of correlation could be due to a disconnect between CCR in the lined ponds and the groundwater (i.e., little to no seepage into groundwater beneath these ponds, thus TDS concentrations may be indicative of background levels). In accordance with the Final Rule for Disposal of CCR at Electric Utilities, APS will continue groundwater monitoring at the ash disposal area at FCPP, on at least a semi-annual basis and data will be analyzed to detect potential leaching. If sample analysis determines the presence of leaching, APS will implement appropriate corrective measures, as outlined in the Final Rule. Groundwater monitoring records will be kept in the FCPP operating records and posted on a public website, as specified in the Final Rule.

Table 4.5-17. Results of FCPP Groundwater Statistical Analysis

Monitoring Well	Sample Size	p-value	Statistical Summary
2	40	0.00	there is a downward trend in the series
4	40	<0.0001	there is a downward trend in the series
8	40	0.991	there is no trend in the series
15	39	0.672	there is no trend in the series
16	40	<0.0001	there is a downward trend in the series
17	40	0.322	there is no trend in the series
18	41	0.00	there is a downward trend in the series
19	37	<0.0001	there is a downward trend in the series
20	40	<0.0001	there is a downward trend in the series

Previous studies found two primary areas of groundwater seepage beneath the ash disposal areas, the "north seep" and "south seepage area" (APS 2013). In 1977, APS constructed an open ditch system to collect seepage water from the ash disposal facilities as part of the NPDES permits for the FCPP. In 1993 and 2011, extraction wells were installed. These systems are designed to prevent contamination of the Chaco wash. In October 2011, APS constructed a north intercept trench excavated to the Lewis shale formation. A review of groundwater level data and water quality data in three wells located downgradient of the trench show declines in all constituents and groundwater level. APS installed a second south intercept trench to collect groundwater in early 2014. The finished project entailed the construction of two French drains adjoining each other in a north to south direction. Both French drains are approximately 2 miles long and the trenches for the drains were excavated to the Lewis shale formation. The bottom of the trench was filled with a granular media and slotted pipe, to allow the collection of water at two points approximately mid-length in location. Water that is collected at these points is pumped to FCPP's Lined Decant Water Pond. With the operation of the intercept trenches, continued operation of wet ash ponds and expansion of the DFADAs would have less potential to contaminate local groundwater and water quality in Chaco Wash.

As discussed in more detail in Section 4.15, an ongoing investigation is underway at FCPP analyzing potential impacts to groundwater in the vicinity of a potential fuel release near the garage storage facility. The initial investigation found that groundwater near the garage storage facility is 6 feet below ground surface and flows northwest at a gradient of 0.009 foot per foot, away from Morgan Lake. The groundwater grab sample contained 170 mg/L of total petroleum hydrocarbon (Mongollan 2013).

A limited Phase II Environmental Site Assessment of the garage fueling area was conducted in December 2013 to identify VOCs to soil and groundwater. Analytical groundwater monitoring results indicate detections of benzene and trichloroethylene exceeding the maximum contamination level of 5 micrograms per liter in the samples collected from one of the monitoring wells (FCPP-GF-3). Vinyl chloride and 1,1-DCE were detected in excess of maximum contaminant levels of 2 and 7 micrograms per liter, respectively, in the samples collected in FCPP-GF-2. All other analytes were either detected below the respective maximum contaminant levels, where established, or below the lower reading limit. These data indicate the petroleum levels are not continuing to be released into soils or groundwater.

APS has committed to fully characterize the impacts at the site in the groundwater, identify the source of the impacts, evaluate remedial measures, and, if appropriate, initiate remediation. The objective of any proposed remedial action is to reduce contaminant concentrations in the soil to levels below appropriate risk-based cleanup criteria and to remove source material that may potentially impact or further impact the groundwater, to the extent technically feasible. To achieve the objective, the site will be remediated in a manner that ensures concentrations remaining in the soil and groundwater are protective of human health and the environment and will reclaim the site, to the extent necessary to support existing and proposed future uses (APS 2014b).

Surface Water Quality

Water used at the FCPP is cycled from Morgan Lake through the power plant condenser for cooling and discharged back into the lake. The continued operation of Units 4 and 5 would result in no changes to the quality of water released to Morgan Lake or ultimately the San Juan River. The temperature of the water discharged into Morgan Lake and ultimately No Name Canal and the Chaco River is greater than that brought into the FCPP. However, this increase in temperature allows for year-round recreation at Morgan Lake and does not increase temperature in No Name Canal or Chaco River above water quality standards. Therefore, continued operations regarding uptake and discharge of water from Morgan Lake would not adversely affect surface water quality of water bodies in the vicinity of the plant.

The operation of selective catalytic reduction devices on Units 4 and 5 requires the use of ammonia. Any potential spills of ammonia during transport could drain to nearby surface water features; the potential likelihood of such a spill and its associated impacts are discussed in Section 4.17, Health and Safety. Once at the FCPP, the ammonia would be used to operate the selective catalytic reduction devices and would be contained within a closed system. No ammonia would mingle with water cycled through the power plant or discharged to Morgan Lake. Therefore, no adverse impacts on surface water quality from ammonia use would be anticipated. In the unlikely event of a spill, the FCPP SPCC Plan, as described in Section 4.15, would be implemented to contain the spill and prevent adverse impacts of the spilled material to the surrounding environment.

In accordance with their NPDES permit, FCPP operates under a SWPPP. As described above, stormwater within the lease area either is contained via berms, discharged to Morgan Lake, or drains to one of three outfalls on site.

In addition, the following Structural Controls are used on site:

- Oil and chemicals stored inside buildings at Main and Chemical Warehouses;
- Reduced number of oil and chemicals stored outside, at the 345 switchyard;
- Concrete apron over the dirt bank at 4/5 Intake (SW1);
- Prompt cleanup of spills and leaks using absorbents to prevent the discharge of pollutants;
- Drip pans and absorbents used under or around leaky vehicles and equipment;
- Washwater drains to a proper collection system; and
- Rock and concrete barriers surrounding the perimeter of the plant proper next to Morgan Lake and cooling water canals leaving and entering the Lake (APS 2012b).

Should this alternative be implemented, FCPP would continue to operate in accordance with the existing NPDES permit and the SWPPP. Therefore, stormwater discharge during continued operations would have no adverse impacts on water quality.

In the ash disposal area, BMPs such as silt fences, berms, and settling basins are and will be utilized for stormwater control. The new DFADA cells would be lined with synthetic liners to minimize infiltration. The cells would be surrounded by a berm whose size is designed to capture a 100-year, 24-hour storm event without runoff. The stormwater that lands on the DFADA flows to an adjacent lined depression (stormwater pond), which is used for dust control or pumped to the Lined Decant Water Pond. Stormwater that falls on surrounding areas, outside the DFADA cells, would be channeled around the cells to the Chaco Wash by a system of berms so that the unaffected runoff does not comingle with the DFADA area.

Therefore, no adverse impacts to water quality would result from stormwater runoff associated with the proposed new DFADAs.

In 2009, a survey was conducted of the existing Lined Ash Impoundment and lined decant water impoundment located on top of old Ash Pond 3. The impoundments were assessed for their potential for failure, as discussed in greater detail in Section 4.15, Hazardous and Solid Wastes. Although as discussed in Section 4.15, failure of the impoundments is unlikely; if an impoundment failed, the potential exists for wet ash to enter Chaco River. If this were to occur, it would be regulated under the CWA and EPA would have regulatory oversight and the area of inundation is expected to be smaller than the evacuation area shown. In the event of a dam failure at the LAI, the dry material would result in the dry ash contents slumping downslope. This material is unlikely to extend much past the angle of repose. As such, if there were a release, the material is unlikely to reach the Chaco River. This may result in some slight increase in turbidity in the Chaco River if there were flow in the river at the time of the failure (the area where the ash would enter the river is upstream of the area that is perennially wetted). In the event of a dam failure at the LDWP, a maximum of 517 acre-feet of water would be released, although the normal operating level is 135 to 435 acre-feet. This water would likely carry some ash with it, as well as material from the dam. This would result in increased flow, turbidity, and sedimentation in the Chaco River. Most of the solid materials would settle close to the dam, and the amount of material carried along would attenuate with distance from the breach. The assessment also provides insight into the potential for surficial runoff from the facilities to Chaco River. The assessment found no evidence of substantial seepage from the embankments. At the time of the survey, some minor seepage was observed at the southern toe of the lined ash impoundment embankment, which was associated with construction activity occurring at the time (GEI Consultants 2009). Flow rate of the seep, as measured during the latter half of 2011, was 0.0 gpm (i.e., no seepage) from July to August, peaked at 0.60 gpm at the beginning of August 2011 and then steadily decreased to 0.0 gpm by the beginning of October, where it remained dry through the rest of the year. The embankment serves as an impediment to discharge of stormwater or drainage from the two areas. APS plans to raise the embankment in 10-foot rise construction intervals until the embankment is 70 feet. Continued operation of these facilities would, therefore, have no adverse impact on nearby surface waters.

Ash Pond 6, located on the northwest side of the existing Ash Disposal Area, is currently inactive, and was used to impound the fly ash and solids from Units 1, 2, and 3. The final lift of Ash Pond 6 is approximately 80 feet higher than natural grade on the West Embankment. This embankment serves as an impediment to discharge of stormwater drainage from this area; therefore, no adverse impacts to nearby surface waters would result from the existence of this area.

In addition to potential water quality impacts resulting from operations at the plant lease site itself, coal-fired power plants represent a source of atmospheric mercury and selenium in the Four Corners region. As emissions deposit in the region, recent studies have determined that emissions from coal-fired power plants in the region contribute mercury, selenium, and other pollutants to local surface waters (EPRI 2013). Because prevailing winds are generally from the southwest to the north and northeast, emissions from the FCPP have the potential to affect surface water quality beyond the Navajo Nation. Air quality modeling and emissions deposition modeling have defined the area that would be affected by FCPP emissions as less than 50 km (31 miles). As described in Section 4.1, Air Quality, it is estimated that the FCPP would emit approximately 136 pounds of mercury and 566 pounds of selenium annually for the duration of the Project. The emitted mercury and selenium would consist of both particulates and vapors. However, as described in Air Quality, these emissions would represent a 72 and 93 percent reduction over baseline conditions. Therefore, while mercury and selenium would continue to be deposited into the San Juan River watershed, surface water quality impacts would be minor compared to baseline conditions.

Impacts to Waters of the U.S.

Construction of the new ash pond facilities would result in the permanent filling of three ephemeral drainages that historically discharged to the Chaco River but those headwaters were previously impacted by the existing ash pond to the extent that they no longer convey flow or exhibit an ordinary high water mark. Of these drainages, only a portion of one is considered a jurisdictional water of the U.S. APS would avoid impacts to this portion of the drainage and maintain a 300-foot buffer from it during construction of the proposed ash pond. The USACE, in coordination with the EPA, concurred with the findings of the delineation (USACE 2013). Therefore, no impacts to waters of the U.S. would result from the Proposed Action. Based on a review of the delineation and the Project plans, removal of the non-jurisdictional segments of these drainages would alter stormwater runoff and hydrology in the ROI; however, these impacts would not adversely affect surface water quantity or quality. Further, expansion of the ash pond facilities would disturb greater than 1 acre; therefore, APS would be required to obtain coverage under a General Construction NPDES Permit and prepare and implement a construction SWPPP.

Surface Water Quantity

Surface water drawn from the San Juan River into Morgan Lake for use at the FCPP is obtained according to water rights held by BBNMC. The final disposition of the water rights is still pending and will be resolved between BNCC and NTEC. No changes to the water use would occur under the Proposed Action and NTEC (and the FCPP) would maintain the ability to draw as much water as the rights allow for the Project life. Given the current water right appropriations, water drawn from the San Juan River would continue as stated in the agreement; therefore, impacts to surface water quantity in the San Juan River would be negligible and would not change under the Proposed Action.

Transmission Lines

Groundwater

Continued operation of the existing transmission lines would not be expected to impact groundwater quality or quantity. No water demands or groundwater use exist for the existing transmission lines. General maintenance of the transmission lines could affect groundwater resources by way of contamination from equipment and activities infiltrating the subsurface. To protect groundwater, hazardous fluid spill prevention and protection practices would be implemented (see Section 4.15, Hazardous and Solid Wastes). Therefore, impacts to groundwater would be considered negligible as maintenance activities and normal operation would not involve any ground disturbing activities.

Surface Water

The associated existing transmission lines and their ROWs cross numerous surface water features as displayed in Table 4.5-8. Short-term impacts to surface water from the operation of the transmission lines would occur only during maintenance and repair to the lines. Clearing of natural vegetation would be required on an as needed basis to ensure electrical safety, long-term maintenance, and reliability of the transmission line.

General transmission line maintenance activities could indirectly affect surface water resources by increased stormwater runoff from the site carrying sediment and contamination loads into surface water, and by contamination from construction equipment and activities infiltrating area surface waters. However, implementation of standard construction BMPs would prevent degradation of surface waters. During site clearing and grading activities, soils in the construction area could become exposed, rutted, and compacted. Soil exposure, rutting, and compaction have the potential to increase water yields from the site, concentrate and channelize sheetflow, increase erosion rates, and increase sediment delivery to nearby water bodies.

General maintenance activities within the ROWs could indirectly affect surface water resources by increased stormwater runoff from the site carrying sediment and contamination loads into surface water and by contamination from construction equipment and activities infiltrating area surface waters. Mitigation for these possible impacts would include revegetation of temporarily disturbed areas. Proper native seed selection would result in grasses with deep root systems and denser foliage, which would increase local retention times and reduce site outflows. Internal site drainage would be accomplished through the use of open ditches and culverts. The ditches would be constructed to encourage infiltration of stormflows and would further reduce site outflows. Specific plans or proposed measures for fugitive-dust control, erosion, and sedimentation control, site reclamation, and stormwater-runoff control would be implemented as part of the construction process.

BMPs would be implemented requiring that temporary measures, such as silt fences and straw bales, should be placed in ditches and along portions of the site perimeter to control erosion and meet NPDES requirements during all maintenance activities that involve construction or site disturbance (e.g., tower replacement, ROW clearing). To protect the water quality of area surface waters during maintenance activities, any and all of the BMPs required by the appropriate authorities should be implemented and maintained. These BMPs could include such measures as the installation of a double-walled silt curtain in the river or wash surrounding construction activities and installation of silt fencing and other erosion and sediment control measures when working in the floodplain to protect all adjacent wetland and drainage ways.

4.5.4.2 Alternative B – Navajo Mine Extension Project

Navajo Mine

<u>Groundwater</u>

Under Alternative B, NTEC would implement an alternative mine plan for the Pinabete SMCRA Permit Area. The mining for the current Navajo Mine SMCRA Permit Area would occur as described for the Proposed Action. Alternative B would directly affect a portion of Pinabete Arroyo, thereby requiring diverting the flows from the arroyo around mining activities into No Name Arroyo for the duration of the mine period. Groundwater impacts due to the diversion would be negligible because the channel design of the reconstructed Pinabete Arroyo would incorporate design features to reduce the effect of mining to the alluvial groundwater post-reclamation; therefore, impacts to groundwater quantity and quality during operation would be as described for the Proposed Action. Operation and reclamation activities would be similar to those described for the Proposed Action, except that the mine plan would involve mining through Pinabete Arroyo.

<u>Surface Water Resources</u>

Under Alternative B, NTEC would implement a revised mine plan for the Pinabete SMCRA Permit Area; the mining for the Navajo Mine SMCRA Permit Area would occur as described for the Proposed Action. Under this alternative, long-term impacts to waters of the U.S. would be greater than described for the Proposed Action. Mining would occur within Pinabete Arroyo; therefore, flows from the arroyo would be diverted around mining activities into No Name Arroyo for the duration of the mine period (through 2041). Engineering for the Pinabete diversion would be designed to minimize additional downcutting in No Name Arroyo by attenuation of peak flows from the diversion and stabilizing the No Name Channel at existing head cut locations downstream of the diversion. Reconstruction of Pinabete Arroyo post-mining would include geomorphic reclamation strategies designed to emulate the pre-mine channel. Based on the delineation of waters of the U.S. conducted in April 2012, approximately 33 acres of waters of the U.S. would be affected under Alternative B, in comparison to 5 acres that would be affected under the Proposed Action. To implement this mine plan, MMCo would be required to obtain a permit from the USACE under CWA Section 404. If a permit is granted, it would include required compensatory mitigation to offset impacts to waters of the U.S. such as rehabilitation or creation of an agreed upon acreage of waters of the U.S. at an off-site location. Under Alternative B, MMCo would submit a mitigation plan to the USACE for review with the USACE Section 404 permit application.

In addition to long-term impacts associated with the Pinabete Arroyo diversion, under this alternative a greater number of miles of roadway and transmission lines would require construction. As with the Proposed Action, erosion and leaks from construction equipment could result in potential impacts to surface water quality. Although the duration and extent of construction activities under Alternative B would be greater than the Proposed Action, implementation of BMPs as described in Drainage and Sediment Control Plans and SWPPP, would minimize impacts to water quality; therefore, no greater intensity of short-term impacts to surface water quality would be anticipated. Following completion of short-term construction activities, mining would occur as described for the Proposed Action. Therefore, impacts to surface water quality and hydrology, during operation, would be as described for the Proposed Action. Following completion of the mining activities, NTEC would reclaim mined areas in accordance with an approved reclamation plan. NTEC would prepare a Hydrologic Reclamation Plan for this alternative. Drainages and watersheds that were mined or altered would be reclaimed in accordance with the Reclamation Plan. Therefore, impacts to surface water quality and channel morphology would be the same as described for the Proposed Action.

Four Corners Power Plant

Under Alternative B, the lease for the FCPP would be renewed, and the FCPP would continue to operate as described in Chapter 2. Impacts to both surface water and groundwater resources would be as described for the Proposed Action.

Transmission Lines

Under Alternative B, the ROW for the subject transmission lines would be approved and the transmission lines would operate as described in Chapter 2. Impacts to surface water resources and groundwater would be negligible, as described for the Proposed Action.

4.5.4.3 Alternative C – Alternative Pinabete Mine Plan

Navajo Mine

Groundwater

Although Alternative C would have a greater disturbance footprint than the Proposed Action, the groundwater quantity and quality impacts during operation would be as described for the Proposed Action. Operation and reclamation activities would be the same as described for the Proposed Action.

Surface Water Resources

Under Alternative C, NTEC would seek a SMCRA permit for an alternative mine plan for the Pinabete SMCRA Permit Area; the mining for the Navajo Mine SMCRA Permit Area would occur as described for the Proposed Action. Under Alternative C, long-term impacts to waters of the U.S. would be greater than described for the Proposed Action. Based on the delineation of waters of the U.S. conducted in April 2012, approximately 6.6 acres of waters of the U.S. would be affected under this alternative, in comparison to 5 acres that would be affected under the Proposed Action. To implement this mine plan, NTEC would be required to obtain a permit from the USACE under CWA Section 404. If a permit was granted, it would include required compensatory mitigation to offset impacts to waters of the U.S., such as rehabilitation or creation of an agreed upon acreage of waters of the U.S. at an off-site location. Under Alternative C, MMCo would submit a mitigation plan to OSMRE, BIA, and the USACE for review with the USACE Section 404 permit application.

In addition, under Alternative C a greater number of miles of roadway and transmission lines would require construction. As with the Proposed Action, erosion and leaks from construction equipment could result in potential impacts to surface water quality. Although the duration and extent of construction activities under Alternative C would be greater than the Proposed Action, implementation of BMPs as described in an Erosion Control and Sediment Plan and SWPPP would minimize impacts to water quality; therefore, no greater intensity of short-term impacts to surface water quality would be anticipated. Following completion of short-term construction activities, mining would occur as described for the Proposed Action. Therefore, impacts to surface water quality and hydrology, during operation, would be as described for the Proposed Action. Following completion of the mining activities, NTEC would reclaim mined areas in accordance with an approved Reclamation Plan. As part of the SMCRA permit application, NTEC would prepare a Hydrologic Reclamation Plan for the Alternative Pinabete Mine Plan. Drainages and watersheds that had previously been mined or altered would be reclaimed in accordance with the Reclamation Plan. Therefore, impacts to surface water quality and channel morphology would be the same as described for the Proposed Action.

Four Corners Power Plant

Under Alternative C, the lease for the FCPP would be renewed, and the FCPP would continue to operate as described in Chapter 2. Impacts to both surface water and groundwater would be as described for the Proposed Action.

Transmission Lines

Under Alternative C, the ROW for the subject transmission lines would be approved and the transmission lines would operate as described in Chapter 2. Impacts to surface water resources and groundwater would be negligible, as described for the Proposed Action.

4.5.4.4 Alternative D – Alternative Ash Disposal Area Configuration

Navajo Mine

Under this alternative, OSMRE would approve the Pinabete SMCRA Permit application and renew the Navajo Mine SMCRA Permit. The Navajo Mine would operate as described under the Proposed Action.

<u>Groundwater</u>

The groundwater impacts of quantity and quality during operation would be as described for the Proposed Action. Operation and reclamation activities would be the same as described for the Proposed Action. As such, impacts would be the same as described for the Proposed Action.

<u>Surface Water Resources</u>

Impacts to surface water would be as described under the Proposed Action.

Four Corners Power Plant

Under this alternative, the area of disturbance required for the DFADA would be 350 acres instead of 385 acres. The 10 percent reduction in surface area of the DFADA would result in the same ground water and surface water related impacts as described for the Proposed Action. All other FCPP components of this alternative are the same as for the Proposed Action. Therefore, impacts would be the same as described for the Proposed Action.

Transmission Lines

Under this alternative, the transmission line ROWs would be approved and they would continue to be operated and maintained as described for the Proposed Action. As such, impacts would be the same as described for the proposed action.

4.5.4.5 Alternative E – No Action Alternative

Navajo Mine

Groundwater

During demolition activities associated with the Navajo Mine, short-term impacts to near-surface groundwater quality could occur; however, prior to conducting any demolition activities, NTEC would be required to obtain the necessary permits which prescribe BMPs to minimize impacts to groundwater.

Areas that had previously been mined or altered would be reclaimed in accordance with the Reclamation Plan; therefore, impacts to subsurface hydrogeology would be beneficial over the long-term. In addition, reclamation of mined lands would potentially restore natural groundwater flow.

Surface Water Resources

Under the No Action Alternative, the Pinabete SMCRA Permit would not be approved, and mining at the Navajo Mine SMCRA Permit Area would cease when the ROD is issued in 2015 and previously mined areas would be reclaimed in accordance with approved reclamation plans. During demolition activities associated with the Navajo Mine, NTEC would maintain the same level of BMPs and sediment control as during mining operations. Short-term impacts to surface water quality could occur; however, prior to conducting any such demolition (building removal, etc.), MMCo would be required to obtain necessary permits which may include a Construction Stormwater General Permit under CWA Section 402. Compliance with this permit requires the preparation of an Erosion Control and Sediment Plan and SWPPP describing BMPs to prevent discharge into waters of the U.S. Implementation of the plans would minimize impacts to nearby waters of the U.S. In addition, NTEC would be required to satisfy existing USACE mitigation requirements as specified in the pre-2016 Individual 404 permit for the Navajo Mine SMCRA Permit Area.

Drainages and watersheds that had previously been mined or altered would be reclaimed in accordance with the Reclamation Plan; there would be no change in its management of surface water or ground water during reclamation activities. Therefore, impacts to surface water hydrology would be beneficial over the long-term. In addition, reclamation of mined lands would restore surface water drainage and natural stormwater flow; therefore, impacts to water quality would likely be beneficial as well.

Four Corners Power Plant

Under the No Action Alternative, FCPP Units 4 and 5 would shut down and remain in place until such time that a decommissioning plan is approved and implemented. Under the No Action Alternative, APS would cease drawing water from the San Juan River to operate the plant and would also cease discharges into Morgan Lake. If the river pumping plant and the pipeline to Morgan Lake were removed, Morgan Lake would evaporate and cease to exist over time. If APS chooses to leave the river pumping plant and the pipeline intact, and the Navajo Nation took possession of those facilities, it is not known the extent to which the river pump station would be operated. If the river pump station was not operated to provide water to Morgan Lake, it would evaporate and cease to exist over time. As a result of the evaporation there may be concentrations of metals in the resultant salts overlaying the remaining sediment. To address this concern OSMRE has recommended a mitigation measure to sample the lake bed sediments. Without the warm discharge from Morgan Lake, water temperature in San Juan River and Chaco Wash would be reduced.

Similarly, with the shutdown of the power plant, emissions of criteria pollutants and GHGs would cease (see Section 4.1, Air Quality); deposition of mercury, selenium, and other pollutants from the FCPP would also stop. As a result, water quality in surface water bodies within the deposition area, particularly the San Juan River, would improve at least incrementally, since deposition from FCPP was only one of the sources of deposition into these water bodies. With regard to groundwater, since the historic ash ponds would remain in place and the DFADAs are lined, impacts would be similar as described for the Proposed Action. Further, in accordance with the Final Rule for disposal of CCR at Electric Utilities, APS would implement post-closure monitoring of water resources and corrective action if impacts are detected.

Transmission Lines

Under the No Action Alternative, the ROWs for the transmission lines would not be approved. The transmission lines may be decommissioned or left in place. Short-term impacts to surface water and groundwater quality during decommissioning could occur; however, as with the Navajo Mine, APS and PNM would be required to comply with all environmental laws and obtain necessary permits, including a Stormwater General Permit prior to implementing such activities. Compliance with the Stormwater General Permit would include development of an Erosion Control and Sediment Management Plan and a SWPPP. Implementation of these plans would minimize runoff from decommissioning activities into waters of the U.S. Therefore, impacts would be negligible. If the transmission lines are left in place, no impacts to water resources would occur.

4.5.5 Water Resources/Hydrology Mitigation Measures

The Project Applicants have proposed measures that would be implemented to reduce or eliminate some of the environmental impacts of the Proposed Action. These measures include specific mitigating measures for certain environmental impacts, standard operating procedures that reduce or avoid environmental impacts, and BMPs for specific activities. These are described in Section 3.2.6.5. These measures are part of their application materials and are enforceable through permit or lease conditions. In addition, the Project Applicants must comply with additional protective regulatory requirements including laws, ordinances, regulations, and standards that are enforceable by the responsible agency over that activity. These are described in the Regulatory Compliance Framework Section for each resource category. Where the environmental analysis in this EIS recommends additional protective measures, over and above the applicant proposed measures and regulatory compliance, they are listed below as specific mitigation measures.

The Proposed Action, including the continuing operations of Navajo Mine, FCPP, and the transmission lines, would not result in major adverse impacts to water resources or hydrology. Therefore, no additional mitigation is recommended.

With regard to the proposed permanent impacts to waters of the U.S. that would occur within the Pinabete SMCRA Permit Area, the USACE will consider these impacts in its decision to approve a CWA 404 Individual Permit. In addition, consistent with USACE guidance provided in the Final Compensatory Mitigation Rule (April 10, 2008), Regulatory Guidance Letter No. 02-2 (December 24, 2002), and the Memorandum of Agreement Between the EPA and USACE Concerning the Determination of Mitigation Under the Final Compensatory Mitigation Rule, the USACE will include compensatory mitigation requirements as part of the 404 Permit for the Navajo Mine that are designed to compensate for the loss of jurisdictional areas in the Pinabete SMCRA Permit Area, so as to ensure no net loss of functions and services of waters of the U.S. as a result of the permitted activity. The primary mechanisms for mitigating the loss of jurisdictional areas are re-establishment and creation.

To offset the loss of functionality impacts of waters of the U.S. during active mining, MMCo has proposed the re-establishment of native riparian habitat and the creation of wetland habitat. Because MMCo's impacts to waters of the U.S. would occur incrementally per year of operation, the USACE is working with MMCo to prepare a phased approach when addressing compensatory mitigation requirements. Among the compensatory mitigation measures proposed, are: reestablishing wetland habitat in a section of the San Juan River; removing exotic species (e.g., tamarisk, knapweed, and Russian olive); and planting riparian species along the banks of the river.

MMCo plans to complete its compensatory mitigation requirements in two phases that correlate to the two coal supply agreements anticipated with APS. Phase I would involve mitigation within the Upper Chinde Wetland Complex within the central northeastern Navajo Mine lease boundary. Mitigation at site would include enhancement, establishment, and preservation. During Phase 2, MMCo would reclaim the remainder of the Area III mining disturbance with a hybrid geomorphic reclamation approach based on the fluvial geomorphic principles in hydrologic restorations.

Impacts to waters of the U.S. anticipated for the initial 15-year coal supply agreement are estimated at 2.0 acres. To achieve the goal of no net loss of aquatic species for the initial coal supply agreement, the USACE will establish a compensatory mitigation ratio in the Individual 404 Permit that includes specified acres of reestablishment or creation. The second 10-year coal supply agreement would result in approximately 3.0 acres of impacts to waters of the U.S. Similar to the initial coal supply agreement, the USACE will establish a compensatory mitigation ratio in the Individual 404 Permit that will include specified acres of reestablishment of native riparian habitat and specific acres of wetland creation. The ratios will be determined by analyzing the functional loss of ephemeral streams in the Project Area to the functional gain proposed by mitigation efforts along the San Juan River and Areas III and Areas IV North of the Navajo Mine, as illustrated in the South Pacific Division Mitigation Ratio-Setting Checklist. The compensatory mitigation ratio will also take into account any delays in the establishment of planted trees and shrubs, the location of the proposed mitigation sites, and any other pertinent factors. As a point of reference, the USACE required a compensatory mitigation ratio of 3.9:1 in the 2011 Pre-2016 Area III and Area IV North Mining Individual Permit (SPA-2011-00122-ABQ).

Under the No Action Alternative, the remaining salts in the evaporated Morgan Lake lakebed could potentially contain elevated levels of metals. To address this concern, OSMRE recommends that APS conduct sediment sampling and analysis for salts and metals. If the results indicate elevated levels above EPA Preliminary Remediation Goals, the need for remediation of the lakebed should be evaluated and implemented, if necessary.