3. AFFECTED ENVIRONMENT

This section describes relevant existing environmental conditions for resources potentially affected by the Proposed Action and alternatives, as described in Section 2. In compliance with requirements contained in NEPA, and implementing regulations, and related guidance, the description of the affected environment focuses on those environmental resources potentially subject to impacts. The resources described include geological resources, paleontological resources, water resources, noise, visual resources, air quality, climate change, vegetation, wildlife, threatened and endangered and sensitive species, socioeconomics, environmental justice, land use, cultural resources, traffic and transportation, and health and safety.

The geographic scope of the affected environment depends on the potential impacts to each resource evaluated in this EA. In general, the term Project Area refers to the area where the proposed activities would occur including areas to be mined in Area III, areas proposed to be mined in Area IV North, associated mine activity related to these mining activities (e.g., train operations, haul trucks, etc., that occur in Areas I, II, III, and IV North) and the Burnham Road realignment (approved in 2012 and completed). However, for some resources, the geographic extent of the area potentially affected by the proposed activities is larger than the Project Area and is described for those resources below.

The introduction to Section 4, *Environmental Consequences*, describes the approach to environmental analysis in this EA. Relevant to the description of the Affected Environment is that this EA is being prepared in response to the vacatur of the 2012 EA/FONSI by the Colorado District Court, which in turn followed a March 2, 2015 decision by the District Court ruling that OSMRE failed to adequately consider the reasonably foreseeable combustion-related effects of NTECs proposed expansion of operations at the Navajo Mine. The decision considered the reasonably foreseeable combustion-related effects at FCPP of NTECs proposed expansion of operations at the Navajo Mine to be indirect effects. In this EA, the effects of coal combustion at FCPP are treated and analyzed as indirect effects. The environmental setting has been expanded to accommodate the consideration of the combustion-related effects of mining under this Proposed Action.

3.1 Geological Resources

3.1.1 Definition of Resource

Geological resources are defined for this analysis as geology, soils, and paleontological resources. For geology, the geological resource assessment includes a larger area, as associated with the assessment of groundwater resources in Section 3.2.2. The target solid leasable mineral resource within the geology assessment area is coal. No other leasable or locatable minerals are present within the geological resources assessment area, nor are there economically viable fluid leasable minerals (natural gas or oil) or leases for these minerals located within the assessment area. Therefore, other than coal resources, no other minerals resource is discussed in this EA. The geological resources assessment area for soils and paleontological includes just the areas of proposed mining in Area III and Area IV North, and the corridor of the Burnham Road realignment.

Coal mining is regulated by OSMRE under SMCRA and the BLM approves R2P2 to ensure mining achieves maximum recovery of mineral resources. Maximum economic recovery of the coal resource is

determined by BLM under the R2P2 process. Paleontological resources include the fossilized remains of plants and animals. Federal protection for paleontological resources stems from the Antiquities Act of 1906 (Public Law [PL] 59-209; 16 USC 431 et seq.) and the Paleontological Resources Preservation Act of 2009, which requires protection of historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest, including paleontological resources on Federally-administered lands. In general, "protections" pertain to issues of ownership, collection, and sale. The U.S. holds tribal lands in trust for tribes and BLM manages paleontological resources on tribal lands as a trust asset for tribes' economic benefits. While the Navajo Nation does not have a written policy for dealing with paleontological resources on their lands, these resources are generally administered in accord with the principles and recommendations of the Assessment of Fossil Management on Federal and Indian Lands (DOI 2000).

No alluvial valley floors, as defined under SMCRA, 30 CFR 701.5 are present within or surrounding the geological resources assessment area.

3.1.2 Affected Environment

3.1.2.1 Geology

The assessment area for geology includes the Lowe Arroyo to the north, lands to 5 miles east of the Navajo Mine Lease Area boundary, the No Name Arroyo to the south, and the Chaco River to the west. Topography in this area is highly variable, and varies from flat valley bottoms and mesa tops to steep and eroded cliff faces associated with incised canyons and geologic outcrop areas. The mesa tops associated with the outcrop areas are local high points, with vistas of the Chuska Mountains to the west and badlands of the interior San Juan Basin to the east. Badlands are defined as an area of severe erosion, usually found in semiarid climates, and characterized by countless gullies, steep ridges, and sparse vegetation. The Proposed Action would be located on the western edge of the San Juan Basin, a near circular 100-mile wide structural depression located on the eastern flank of the Colorado Plateau physiographic unit. The San Juan Basin consists of near horizontal layers of sedimentary material deposited during shifting depositional environments of a shallow inland sea during the late Cretaceous to early Tertiary period. The deposited material consists of marine and non-marine coastal deposits (Stone et al. 1983). No major faults cut the geology assessment area, although minor low angle compaction faults and slumps up to 8 feet in displacement are common within the Navajo Mine permit area. Seismically, the area is very stable with no historically recorded earthquakes of sufficient magnitude to damage structures.

The rock strata in the geology assessment area strike north-south. The average dip in the area is two degrees to the east. The target geologic formation for the Proposed Action is the lower 250 feet of the Fruitland Formation, the principal coal-bearing formation in San Juan Basin. The Fruitland Formation is overlain by the Kirtland Shale Formation and deposited above the Pictured Cliffs Sandstone (PCS) and Lewis Shale formations. Kirtland Shale consists of inter-fingered siltstone, sandstone, and claystone beds. The Fruitland Formation contains interbedded sandy shale, carbonaceous shale, sandstone, and multiple coal layers. The sedimentary material was deposited by rivers in a swampy delta plain and back beach environment. The PCS consists of alternating sandstone, gray siltstone, and mudstone beds that inter-finger with the Lewis Shale Formation. The Lewis Shale Formation consists of silty marine shale with inter-bedded limestone, sandstones, and clays. Other surface material present within the geological resources assessment area includes Quaternary period alluvium and eolian sand deposits. Several deposits of Quaternary alluvial and

eolian sands occur. These are important sources of topdressing material for reclamation from mining disturbance in the Navajo Mine.

Fruitland Formation coal seams are very lenticular in nature and most are only mineable in localized areas. Up to seven different mineable seams may occur within the geology assessment area. The seven mineable coal seams (greater than 2-feet thick, at least 6,000 BTU/pound, and having an aerial tent and stratigraphic position that makes the seam economically viable to mine) are shown in Table 3.1-1. Some of the coal seams in the permit area are water-bearing, though classifying these strata as aquifers is questionable due to their low permeability and production rates, and the naturally poor quality of their water precluding use as a water source in the region. A description of groundwater hydrology is provided in Section 3.2.2.1 – Groundwater.

Table 3.1-1. Mineable Coal Seams in Area III and Area IV North

Coal Seam	Position	Characteristic	Average Mineable Thickness (feet)
2A	Directly over PCS	Split by Seam 2B	3.2
2B	Directly over PCS, bottom-most mineable coal seam	Becomes thicker to southwest and pinches out in Area III and along east boundary of Area IV North	2.0 to 11.0
3	8 to 27 feet above No. 2 coal seam	In the southwest portion of Area IV North, merges with No. 4 coal seam to form single seam	4.5
4	At, and up to 19 feet above No. 3 coal seam	Pinches out in the southwest portion of Area III and merges with No. 3 coal seam along western edge of Area IV North	6.0
5	13 to 23 feet above No. 4 coal seam	In western half of Area IV North	2.7
6A	9 to 54 feet above No. 4 coal seam	In southern portion of Area III, seam splits from No. 6B coal seam	2.3
6B	5 to 37 feet above No. 4 coal seam and 6 feet above No. 5 coal seam (as it exists)	Good quality coal seam in terms of thickness and coal grade in Area IV North and southern part of Area III	4.5
7	4 to 128 feet above No. 6 coal seam	Most consistent coal seam, extending from Area IV North through Area III	4.9
8A	4 to 25 feet above No. 7 coal seam	Extensive and widespread, pinches out along eastern boundary of Area IV North and splits from No. 8B coal seam in Area III	6.0
8B	16 feet above No. 8A coal seam in Area IV North and Area III	Exists throughout Area IV North and Area III	11.5

Characterization of the surface geological material for proposed mining in Area III and Area IV North was completed as part of the 2009 mine permit renewal (BNCC 2009a). The target coal seams for mining activities are located within the lower 250 feet of the Fruitland Formation. Overburden and interburden material is defined as the consolidated geologic strata from the geologic formations that lie above and between mineable coal seams (BNCC 2009a). A comprehensive sampling of overburden material within the adjacent Navajo Mine and proposed mining areas is Area III and Area IV North, was completed in 1987 to characterize the material for suitability for reclamation and to identify any potentially acid or toxic forming materials. The findings for overburden sampling activities indicate that the overburden material is generally acceptable as reclamation rooting zone material. Two naturally occurring trace elements of concern—boron and selenium—have been detected in core samples of overburden material. However, elevated levels of the soluble forms are uncommon when averaged throughout the overburden and therefore is not considered a limiting factor for reclamation.

3.1.2.2 Soils

The United States Department of Agriculture (USDA) Soil Conservation service (now Natural Resources Conservation Service [NRCS]) conducted an Order 3 soils survey in 1980 (NRCS 1980) and another Order 3 soil survey, entitled Soil Survey of Shiprock Area, Parts of San Juan County, New Mexico and Apache County, Arizona (NRCS 2001). Many of the soils in the survey area are formed from alluvium and eolian sediments derived from shale and sandstone. Some soils are formed in place and are considered residual. Most of the soils in the survey area have been forming only since the late-Pleistocene and during the Holocene Era. It is very common to find buried soils that date back to the Pleistocene Era.

BNCC conducted Order 1 and 2 soil surveys between 1984 and 1989 within Area III and Area IV North. In addition, Buchanan Consultants conducted a pre-strip soil survey of the Area 4 North Boxcut area (Buchanan 2008). These surveys generally follow the taxonomic system utilized by the NRCS and focus on identification of soil mapping units and salvageable topdressing material within the survey area (topdressing refers to all unconsolidated material capable of supporting plant growth in the upper 60 inches of the native in-situ soil profile). Results of BNCC's soil surveys classify soils into Badlands, Natragrids, and potential topdressing sources. The three types of material each cover approximately one-third of the geological resource assessment area (33 percent each). Badland soils are not suitable as topdressing material and Natragrids soils have limited suitability as topdressing material due to elevated concentrations of sodium. The topdressing material is utilized as cover material in post-mining reclaimed areas. Characterization of topdressing material quality and quantity was completed by BNCC in 1994 for the areas identified by the 1984 and 1989 soil studies as having soil types that are potentially suitable for topdressing material (BNCC 1994). The Buchanan Consultants pre-strip soil survey (Buchanan 2008) also evaluated the Area IV North Boxcut area for potentially suitable topdressing material.

3.1.2.3 Paleontological Resources

The vertebrate faunas of the Fruitland Formation and Kirtland Formation represent the largest and most diverse Late Cretaceous faunas of the southern Western Interior (Hunt and Lucas 1992). Examples of fossils that can occur in the formations, include teeth and jaw fragments of Crocodilia sp. (*Crocodiles*), isolated occurrence of teeth, vertebra, and other bones related to Elasmosauridae (*Plesiosaurs*), Platecarpus sp. (*Mosasaur*), Tyrannosauridae (possibly *Albertosaur*, *Tyrannosaur*), Hadrosauridae (*Duck-billed*), and Ceratopsiudae (*Pentaceratops*), also abundant are Turtle (*Turtilia*) shell fragments—these are among the

vertebrate species that have been documented from the region. Evidence of vertebrate soft tissue is uncommon to rare in the fossil record. Invertebrate fossils include several mollusk species. The majority of the invertebrate fossils are unionid bivalves, oysters, and non-marine gastropods, which are common in the Fruitland Formation (Hunt and Lucas 1992). Microfossils in the Fruitland Formation include unidentified fish teeth and gar scales, as well as molars and stingers of freshwater manta rays.

There are no regional classification systems that rank the geological resource assessment areas as containing common or rare paleontological resources—only geological formations are known or have potential to yield resources. However, comments received during the public workshops indicated this area in general is valued for its high diversity of paleontological resources, including dinosaur, crocodiles, sharks, small fish, reptiles, hadrosaur, mosasaurus, triceratopses, and allosaurus. Currently, there is a Memorandum of Understanding (MOU) between the Navajo Nation and the Museum of Northern Arizona (MNA), Flagstaff, Arizona for curatorial services regarding paleontological specimens collected from Navajo Nation land. Recent surveys within the Navajo Mine Lease Area in or near the geological resource assessment area (Clifford 2005) confirm the literature described above. These surveys yielded crocodile teeth and fragmented scute plates, turtle shells, fish gar scale, fish teeth, brackish water ray stingers and teeth, plant fragments (including stems and leaves), crocodile teeth and bone fragments, dinosaur (plesiosaur) vertebra, hadrosaur bones, tyrannosaurus bones, unionid bivalves, freshwater gastropods, and numerous scattered petrified logs and stumps. These resources represent a mix of common fossils such as the petrified logs and stumps to more uncommon dinosaur fossils as determined by the population abundance of the particular animal.

To date, few areas of the Navajo Nation have been surveyed for paleontological resources. The MNA University undertook a larger-scale paleontological survey and collection project in 1974 in Areas III, IV, and V of the Navajo Mine Lease Area, and the construction of the FCPP facilities. This survey examined outcrops for four Late Cretaceous (65 to 75 million years) age formations within the lease area (Lewis Shale, PCS, Fruitland Formation, and the Kirtland Formation) to identify significant localities. In 1997, the MNA's localities were reassessed and additional significant localities were identified. In 2005, a survey was conducted of Area IV North (Clifford 2005). Forty-six significant fossil localities containing plants, invertebrates, and vertebrates were found within Area IV North. The majority of the significant fossil localities contain macrovertebrate fossils. Twenty-nine significant macrovertebrate localities containing the remains of dinosaurs, crocodiles, alligators, and turtles were also identified. Thirteen significant fossil plant localities, five significant invertebrate localities, and three significant microvertebrate fossil (fossil of teeth and small bones) localities were also identified within Area IV North (Table 3.1-2).

Table 3.1-2. Significant Fossil Localities in Area IV North

Fossil Type	Significant Localities Within Area IV North
Plants	1, 3-12, 14, 70
Invertebrates	2, 34, 35, 67, 71
Microinvertebrates	87, 88, 93
Macroinvertebrates	13, 42, 49, 54-68, 70, 80-82, 87, 88, 90, 93, 94, 96, 97

Sources: Marshall and Breed 1974, Wolberg 1997, Clifford 2005.

MMCo completed an updated paleontological inventory within unmined portions of Area Ill and Area IV North of the Navajo Mine SMCRA Permit Area and the proposed Pinabete Permit Area in the fall of 2013 (Wolberg 2013). The Navajo Nation retains ownership of all paleontological resources. From the paleontological resource information gathered during the inventory, MMCo in consultation with the Navajo Nation Minerals Department developed the Paleontological Resources Management Plan (PRMP) to document and protect known and previously unknown paleontological resources within the Navajo Mine Lease Area. The PRMP is a management tool which establishes the inventory methodology, the criteria to be used to determine significance, and mitigation strategies for affected paleontological resources. The PRMP also includes procedures and requirements for reporting and curation. MMCo submitted copies of the PRMP to both the Navajo Nation Minerals Department and OSMRE in February 2014. The paleontological inventory identified two significant localities (53 and 88) located within Area IV North and thus require further management actions.

3.1.2.4 Disposal of FCPP Coal Combustion Residue

When coal is burned as a fuel source, the solid by-products of the process are different types of ash collectively known as CCR, coal combustion residue, or in the mining industry, they are collectively known as coal combustion by-product (CCBs). The types of CCRs that are generated at the FCPP are fly ash, bottom ash, and FGD materials (predominantly calcium sulfate compounds):

- Fly ash is a product of burning finely ground coal in a boiler to produce electricity. Fly ash is removed from the exhaust gases primarily by electrostatic precipitators or baghouses and secondarily by wet scrubber systems.
- Bottom ash is composed of agglomerated coal ash particles that are too large to be carried in the flue gas. Bottom ash is formed in pulverized coal furnaces and is collected by impinging on the furnace walls or falling through open grates to an ash hopper at the bottom of the furnace.
- Flue gas desulfurization (FGD) material is produced through a process used to reduce sulfur dioxide emissions from the exhaust gas system of a coal-fired boiler. The physical nature of these materials varies from a wet sludge to a dry powdered material, depending on the process.

The EPA published the Disposal of Coal Combustion Residuals from Electric Utilities final rule on December 19, 2014. The final rule regulates CCR as a RCRA Subtitle D solid waste. FCPP is required to comply with EPA's Final Rule, which provides specific deadlines for compliance. A lined ash impoundment (LAI) and lined decant water pond (LDWP) are the only active CCR impoundments (ponds) being used by FCPP. In addition to the impounded LAI and LDWP, a dry fly ash disposal area (DFADA) is also active. The DFADA is a lined landfill facility that was constructed in 2007 and is used for disposal of dry fly ash from Units 4 and 5, as well as small amounts of construction debris. FGD waste produced by FCPP Units 4 and 5 FGD is dewatered and placed in the DFADA. The current DFADA is projected to reach capacity by 2016; after 2016 CCR would be placed in a newly constructed DFADA located adjacent to the existing DFADA.

3.2 Water Resources

3.2.1 Definition of Resource

For this analysis, water resources include surface water, including waters of the U.S. and groundwater

whose use, quality, or quantity may be affected by the proposed Project. Water resources are limited in the arid environment in which the Navajo Mine is located, which receives about 5 inches of precipitation per year. Existing conditions for some of the water resources discussed in this section include the effects of past and current mining operations.

The water resources considered in this EA have been defined broadly to include the water resources that could be affected directly or indirectly by the proposed Project and alternatives. The groundwater resources include the Fruitland Formation that contains the coal seams to be mined, the PCS Formation that underlies the Fruitland Formation, and the unconsolidated alluvial deposits in the valleys of the San Juan River, Chaco River, and the Chaco tributaries, including Cottonwood Arroyo. The surface water resources include the San Juan River, the Chaco River, the named tributaries to the Chaco River, primarily Cottonwood and Lowe Arroyos, and unnamed ephemeral headwater and tributary channels that are located within the proposed Project Area.

Existing conditions in the Project Area reflect the comprehensive regulatory standards and requirements implemented for many years by operations at Navajo Mine under a variety of Federal authorities. The CWA is the primary Federal regulation that protects the nation's waters including surface waters and wetlands. The USACE regulates fill in waters of the U.S. under Section 404 of the CWA. The EPA regulates discharge of stormwater and pollutants into waters of the U.S. under the National Pollutant Discharge Elimination System (NPDES) program under Section 402 of the CWA. The Navajo Nation establishes and certifies compliance with water quality standards under Section 401 of the CWA. In addition, OSMRE, which regulates mining on tribal lands, sets requirements for characterizing water resources, for assessing the probable hydrologic consequences (PHCs) of mining, and for hydrologic monitoring. In addition, OSMRE requires the restoration or replacement of any water supply that has been contaminated, polluted, diminished, or interrupted by mining operations. The updated PHC analysis provides additional detail regarding the water resources in the Project Area (BNCC 2011 § 11.6).

3.2.2 Affected Environment

3.2.2.1 Groundwater

As described in Section 4.5 of the FCPP/NMEP EIS and depicted in Figure 4.5-1 of the EIS, the Project Area (including the entire Navajo Mine Lease Area and FCPP Lease Area) is within the San Juan hydrologic basin. 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.

The geologic units bearing groundwater within and adjacent to the Project Area, and which could be affected by the Proposed Action, include:

- The alluvial groundwater of the Chaco River and Cottonwood Arroyo
- The coal seams of the Fruitland Formation
- The overburden of the Kirtland Shale and Fruitland Formations
- The PCS, located below the Fruitland Formation

Additional information on the hydrogeology of these units is provided in Section 4.5 of the FCPP/NMEP EIS, Sections 6 and 11 of the mine permit application package (BNCC 2011), and in various technical reports and papers, including Thorn (1993), Stone et al. (1983), and Myers and Villanueva (1986). A summary of the alluvial system is provided in Section 4.5 of the FCPP/NMEP EIS. This description is incorporated by reference below:

> *Baseline alluvium monitoring has been conducted within the Navajo Mine Lease Area at alluvial monitoring wells in the Cottonwood Arroyo, No Name Arroyo, and Pinabete Arroyo. In addition, 44 alluvial monitoring wells are present 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 in the Pinabete Arroyo alluvium monitoring wells ranged from approximately 8-12 feet below ground surface between 1998 and 2009….Water levels in the Cottonwood Arroyo alluvium monitoring wells ranged from approximately 8-21 feet below ground surface between 1974 and 2004. All wells were dry during tests from 2005 to 2008 (the most recent data provided)…..*
>
> *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. ….A review of monitoring data over the period 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.*

3.2.2.1.1 Groundwater Use

Groundwater use in and surrounding the Project Area is extremely limited in extent and is derived from a few stock wells completed within the alluvium of Cottonwood Arroyo, Pinabete Arroyo, and the Chaco River. A regional study of the San Juan Basin by Stone et al. (1983) identified no water supply wells completed in the Fruitland Formation or the underlying PCS within several miles of the Navajo Mine Lease Area boundary. This regional study included a conclusion that the Fruitland and Kirtland Formations and the underlying PCS are not important water supply aquifers in the San Juan Basin because they are both reservoirs for natural gas—generally have low yield—and have relatively high salinity. Nevertheless, both the Kirtland-Fruitland Formation and the PCS supply water to a few stock wells located near outcrops within portions of the San Jan Basin where recharge dilutes salinity (Stone et al. 1983).

An inventory of wells within and adjacent to the NTEC coal lease is included in Appendix 6.E of the mine permit application package (BNCC 2011). There are no identified water wells within the area proposed for mining and reclamation activities. The inventory identifies two water wells, W-0644 and W-0618, along Cottonwood Arroyo approximately 0.2 mile and 1.4 miles, respectively, down valley from the Navajo Mine permit boundary (Figure 3.2-1). The inventory also identifies three wells along the Chaco River, W-0654, W-0342, and W-0519, approximately 0.75 mile, 3.3 miles, and 3.4 miles, respectively, down valley from the confluence with the Cottonwood Arroyo (Figure 3.2-1).

Figure 3.2-1. Inventory of Water Wells and Springs

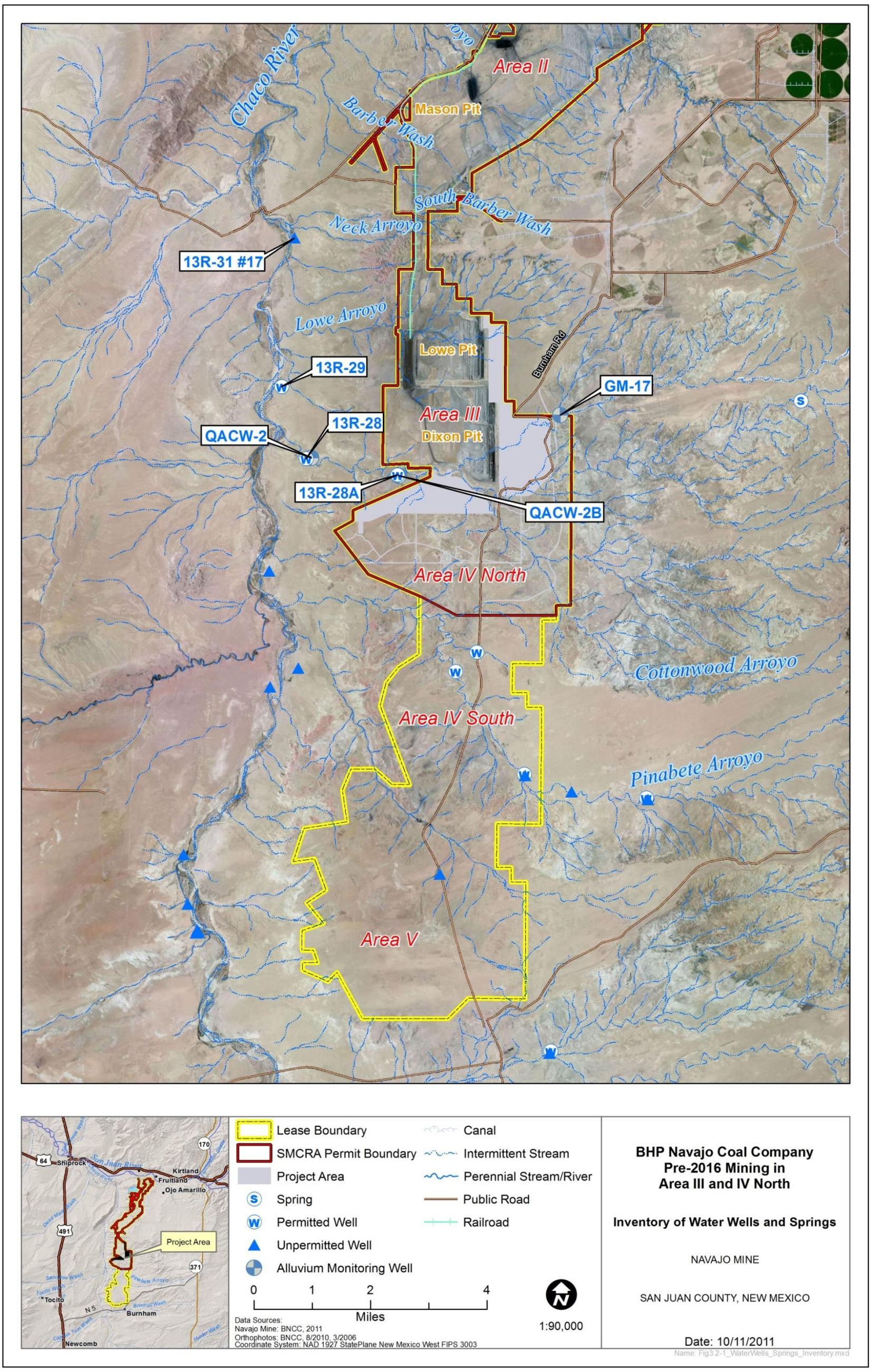

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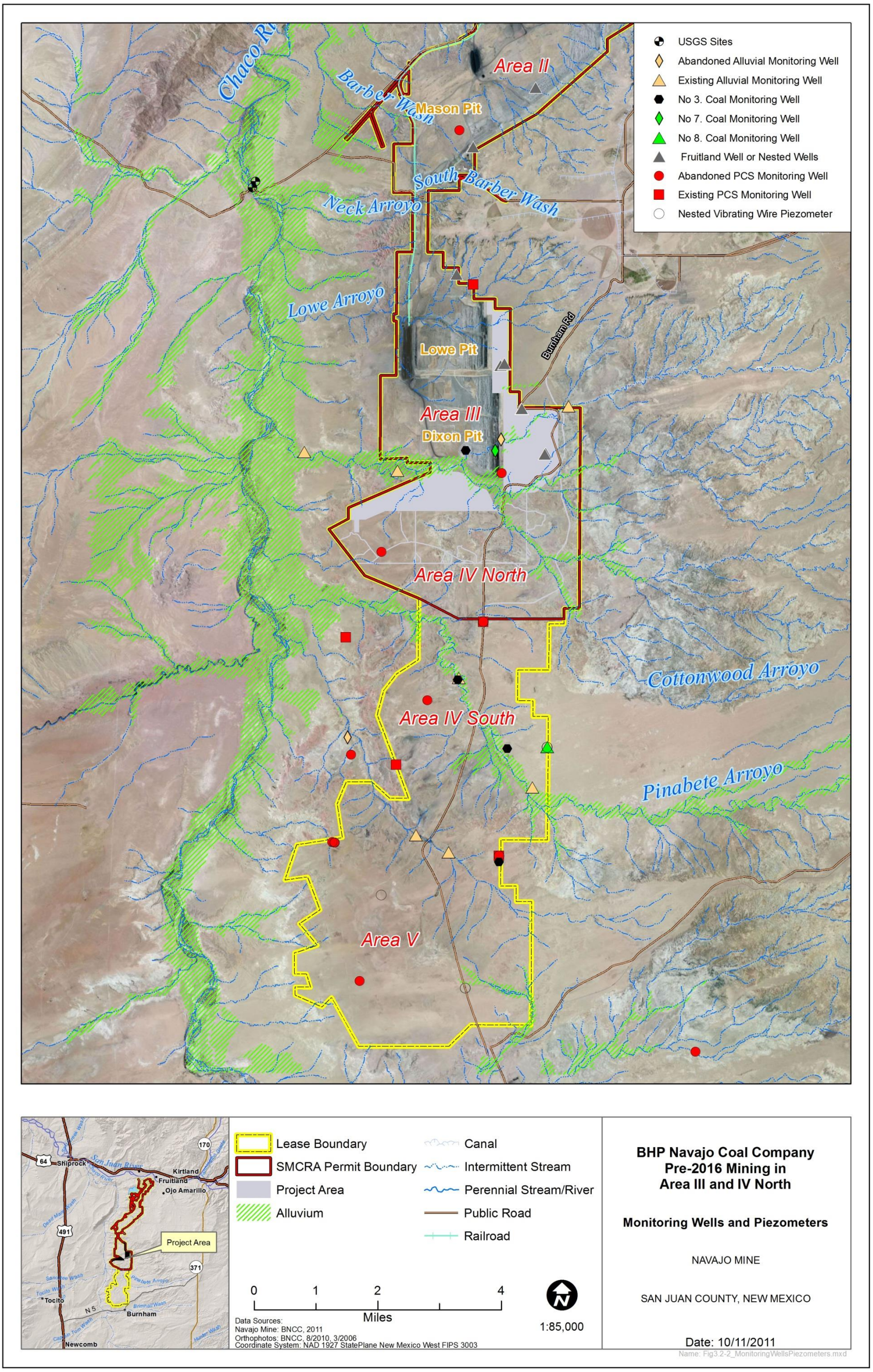
Figure 3.2-2. Monitoring Wells and Piezometers



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Wells W-0654 and W-0519 are dug livestock wells completed in the Chaco River alluvium. The aquifer tapped by W-0342 is unknown, and Metric Corporation (1991) was unable to locate the well during its 1991 survey.

The other wells and springs identified in the inventory are upgradient of the SMCRA permit revision area. Almost all of these wells are stock wells completed in the alluvium of the Chaco River or in main tributaries. No drinking water supply wells exist in the Project Area or the area that may be affected by the proposed Project.

3.2.2.1.2 Groundwater Quantity and Flow

Groundwater availability in the Fruitland coals and the PCS near the Navajo Mine Lease Area is limited by the relatively low hydraulic conductivity of the coals and the PCS and by the low rates of recharge (BNCC 2011 § 11.6). Based on the previous mining experience at the Navajo Mine, the coals, the overburden, and the interburden in the Fruitland Formation do not yield much water during mining. The existing mining pits have generally remained dry except on rare occasions when surface flows are captured following precipitation events. Groundwater seeps are rarely observed within the mine pits as any groundwater in the Fruitland overburden and coals is typically consumed by evaporation along the highwall.

No springs or seeps have been observed during hydrologic investigations conducted within and adjacent to the proposed Project Area. Alluvial groundwater occurs within the valley bottom of Cottonwood and Pinabete Arroyos within the Navajo Mine Lease Area and along the Chaco River several miles west of the lease boundary. The alluvium provides limited stock water supply at several dug wells, although many of the wells are often dry. The background monitoring of Cottonwood Arroyo alluvial wells found that the alluvium is variably saturated and often does not yield sufficient water for sampling.

3.2.2.1.3 Groundwater Quality

Baseline water quality monitoring has been conducted by BNCC (and subsequently, NTEC) at three monitoring locations in the alluvium of Cottonwood Arroyo as shown in Figure 3.2-2. The baseline water quality monitoring results for the three Cottonwood alluvial wells are summarized in Appendix 6.G, Table 6.G-1 of the Mine Plan Revision (BNCC 2011). The water quality results show the alluvium of Cottonwood Arroyo to be a sodium sulfate type with variable TDS concentrations. Water within the Cottonwood alluvium is unsuitable for drinking water use because of naturally occurring high TDS, sulfate, iron, and manganese levels. The water in the alluvium of the mainstem of Cottonwood Arroyo has been used for stock watering when available. Water availability for livestock watering is often limited by the low saturated thickness in the aquifer. TDS and sulfate concentrations are also often above livestock use suitability criteria (Lardy et al. 2008).

Information on baseline water quality for the Chaco River alluvium is provided in the reports by Myers and Villanueva (1986) and by Thorn (1993). Myers and Villanueva (1986) provide analysis results for 12 observation wells completed in the alluvium along the Chaco River and five observation wells completed in the alluvium of tributary washes or arroyos east and northeast of the Chaco River. This study found a general increase in TDS and sulfate concentrations in the downstream direction. Thorn (1993) reports water quality results for three wells completed in the alluvium of Chaco River. These results show the water quality to be a sodium-sulfate type. The results also show that the water quality is quite variable and unsuitable for drinking water use based on the EPA secondary drinking water standards due to elevated

levels of TDS and sulfate. Water quality was generally within a suitable range for livestock watering, however, occasional exceedance of livestock use suitability criteria occurred with respect to TDS, sulfate, and chloride.

Information on the baseline water quality in the San Juan River alluvium is provided in the well inventory included in Appendix 6.E of the Area IV North SMCRA permit revision application (BNCC 2011). The available water quality information obtained from these wells and from other San Juan River alluvial wells in the vicinity as reported by Thorn (1993) show that water quality in San Juan River alluvium is also quite variable. The TDS and sulfate concentrations in all wells sampled are above the EPA drinking water use criterion. Water quality was generally within a suitable range for livestock watering, however, occasional exceedance of livestock use suitability criteria occurred with respect to TDS, sulfate, and chloride.

Water quality monitoring data from Fruitland Formation coal wells at the NTEC monitoring locations show that baseline groundwater in the coals is very saline. Baseline water quality measurements were obtained from 10 coal wells located within Areas II, III, and IV of the Navajo Mine Lease Area (BNCC 2011, Appendix 6.G). The TDS concentrations in the coal water for baseline monitoring exceed the Navajo Nation and EPA water quality criteria for drinking water use. The TDS concentrations also indicate that the coal water is a poor source for livestock use (Lardy et al. 2008).

Information on background groundwater quality has also been obtained for the PCS at six locations within the Navajo Mine lease boundary. Locations of monitoring wells, including the monitoring wells that have been abandoned, are shown in Figure 3.2-2. Water quality data for these PCS monitoring wells indicate a sodium-sulfate type with high TDS concentrations. The groundwater in the PCS within Areas IV North and South and V of the Navajo Mine lease boundary is generally unsuitable for either domestic or livestock use due to poor water quality and low well yields (BNCC 2011, Appendix 6.G). This is a common characteristic of water quality in the PCS.

3.2.2.2 Surface Water

The Navajo Mine is located in the San Juan River Watershed. The San Juan River basin is within New Mexico, Arizona, Colorado, and Utah, and comprises drainage of 24,908 square miles within U.S. Geological Survey (USGS) Hydrologic Unit Code (HUC) 1408. Most of the lease area drains from east to west into the Chaco River—a tributary of the San Juan River. The Chaco River watershed comprises drainage of 4,563 square miles within the USGS HUC 14080106. BBNMC holds New Mexico Office of the State Engineer (NMOSE) Permit Number 2838 and associated groundwater Permit Number SJ-2917, which provides NTEC a total diversionary right of 51,600 acre-feet annually, with a consumptive right of 39,000 acre-feet annually, for waters drawn from the San Juan River. The diversions under the water right are the source of water for Morgan Lake and for the water supplies used by NTEC for mining, coal processing, 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 on the Chaco River downstream of the discharge point in the lower, northern reaches of the watershed near its confluence with the San Juan River.

A description of regional surface water resources in the vicinity of the Navajo Mine and FCPP (both hydrology and water quality conditions) is provided in the FCPP/NMEP EIS. This description is incorporated by reference below:

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... 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 2012b]. Recent drought conditions in the Southwest have further decreased flow rates in the San Juan River.

The New Mexico Environment Department (NMED) set a standard for temperature of 32.2 degrees Celsius (°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). Total maximum daily loads (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 2010].

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 milligrams per liter (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 Wastewater Treatment Facility (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 2013).*

In addition to the summary of surface water quality provided above, the August 5, 2015, release of tailings water from the Gold King Mine into the Animas River temporarily affected water quality of the river. On September 2, 2015, US EPA released data indicating that water quality had returned to pre-event levels (EPA 2015b). However, as of late September 2015, the King Mine continues to release contaminated discharge at a rate of 550 gallons per minute. US EPA intends to install a temporary water treatment facility at the mine to remove any metals and solids from the discharged water mid-October 2015 (EPA 2015c).

3.2.2.2.1 Project Area Surface Water Resources

The surface water drainages within and adjacent to the Project Area include eight named ephemeral streams that drain from east to west across the mine permit area and into the Chaco River, located west of the Navajo Mine. From south to north, the drainages include Pinabete Arroyo in Area IV South, Cottonwood Arroyo in Area IV North, Lowe Arroyo in Area III, Neck and South Barber Arroyos, Barber Wash, Hosteen Wash and Chinde Wash in Area II as shown in Figure 3.2-3. Bitsui Wash drains to the north into the San Juan River. Bitsui receives drainage from pre-SMCRA jurisdictional lands on the northern area of the mine lease but no drainage from the reclaimed areas or from sediment ponds within the Navajo Mine SMCRA permit area. Cottonwood Arroyo, Pinabete Arroyo, and Chinde Wash have the largest drainages of the Chaco River tributaries at 80.1, 55.5, and 46.3 square miles, respectively. The proposed Project Area includes Cottonwood Arroyo, its tributaries, and Lowe Arroyo.

Within and adjacent to the proposed Project Area, surface water use is limited to stock watering at ponds located outside of active mining areas. Stock water ponds were constructed to catch surface flows from some tributary drainage. One structure, the "Gilmore" pond, is located upstream of the Lowe Pit. There are no other private water rights in or near the Project Area. Comments received during the public workshops indicated concern about stock ponds being affected by coal dust.

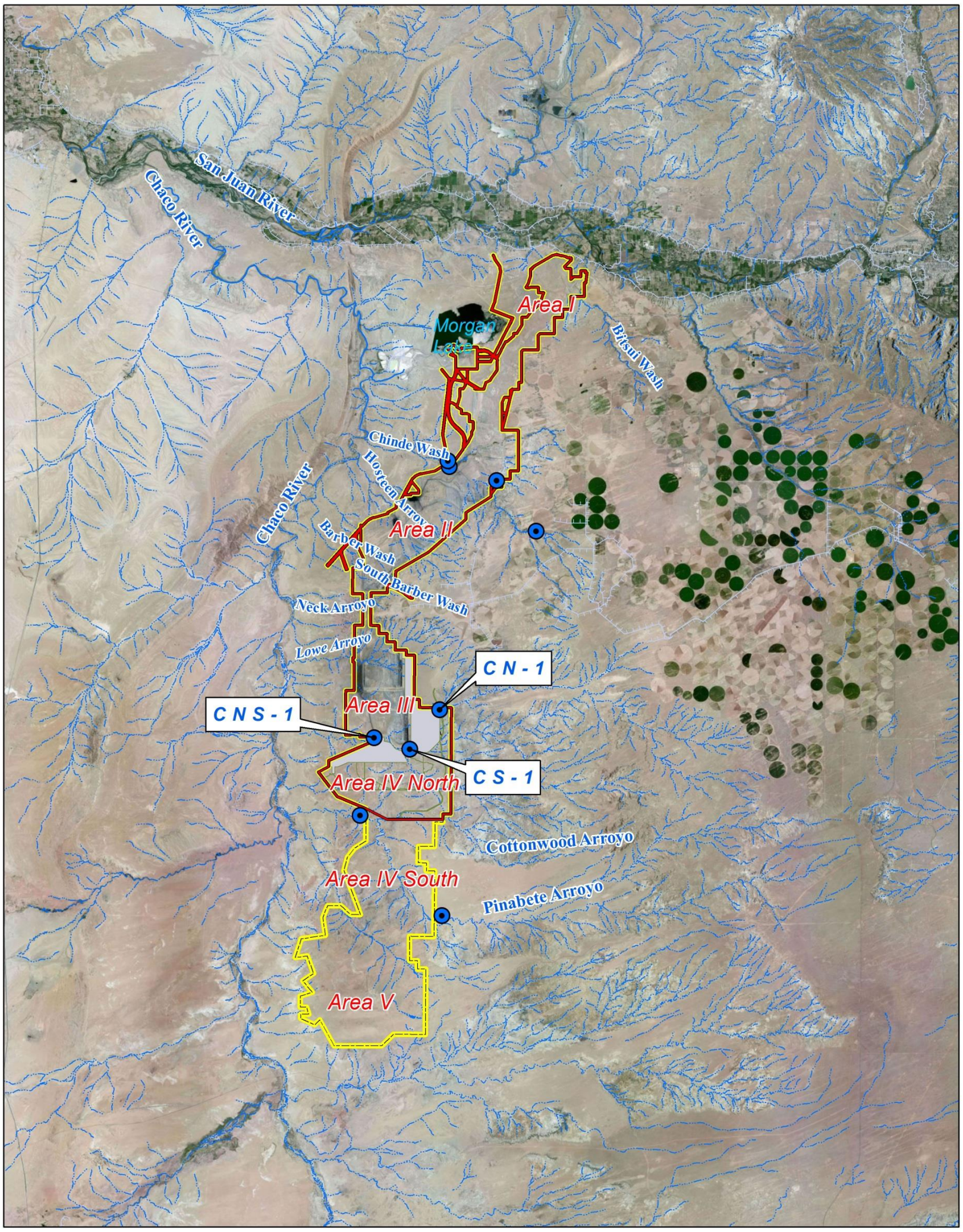
Cottonwood and Lowe Arroyos

The primary surface water drainages that intermittently flow through the proposed Project Area are the Cottonwood and Lowe Arroyos. Cottonwood Arroyo is one of the largest of the Chaco River tributaries with a drainage area of approximately 80.1 square miles. Flow events in these drainages are primarily driven by localized precipitation events (e.g., snowmelt, thunderstorms). Cottonwood Arroyo is also seasonally influenced by irrigation activities in the NAPI lands just east of the mine lease area.

Cottonwood Arroyo is located between active mining in Area III and proposed mining in Area IV North. The arroyo exhibits flashy hydrology, typical of arid southwest environments, is characterized by wide variation in flow ranging from no discharge (dry channel) under typical conditions to peak discharge during and after storm events, followed by a recession to a low discharge over several hours. These rapidly varying flows can transport large amounts of sediment and cause extensive change in the shape of the channels. About 48 percent of the Cottonwood Arroyo watershed is occupied by sparsely vegetated badlands, which accounts for the high discharge and flow intensities observed in this stream (BNCC 2011 § 11.6). Peak flows along Cottonwood Arroyo from a 10-year, 6-hour event are predicted to be about 2,879 cfs. The Cottonwood Arroyo channel near its mouth with the Chaco River has a uniform flat gradient, yielding lower downcutting downgradient of the mine.

Lowe Arroyo lies immediately north of Cottonwood Arroyo and flows through Area III to the Chaco River. Lowe Arroyo has a drainage area of approximately 12.3 square miles, of which approximately 41 percent is located within Area III. Peak flows from a 10-year, 6-hour event near the outlet would have been about 919 cfs prior to mining (BNCC 2011). Lower flood flows currently occur due to interception of portions of the Lowe drainage by the Area III mine operations. The channel only flows in response to flow events. The Lowe Arroyo channel exhibits a relatively steep gradient where it encounters sandstone bedrock outcrops downstream of mining within Area III.

Figure 3.2-3. Regional Surface Water Features and Monitoring Locations



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Ephemeral Tributaries

The Project Area also includes several ephemeral tributaries to Cottonwood Arroyo and Lowe Arroyo that are variable in width and depth. In addition, three small drainages along the southern portion of Area IV North drain into the Pinabete Arroyo, which flows into the Chaco River. These drainages typically have narrow, shallow channels that drain small watersheds with no adjacent riparian vegetation. The USACE's 404(b)(1) Alternatives Analysis prepared in support of the Clean Water Act permitting for the project describes the hydrologic and ecological functions of these intermittent and ephemeral systems.

Badlands, with sparse to no vegetation, are the dominant land type in the eastern portion of the proposed mining area. The tributaries that drain these badland formations are narrow and typically have deep, incised channels with little to no vegetation. After large precipitation events, these channels contain high sediment loads.

Water Quality

The NNEPA (2008) has identified designated uses of Cottonwood Arroyo as 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 2011 § 11.6). 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 are reworked by the larger flood events. A summary of the surface water monitoring data collected from Cottonwood Arroyo is included in Table 7.7 of the mine permit application package (BNCC 2011).

During mining operations, water from disturbed areas is routed to NPDES sediment ponds where it is impounded and evaporated. In general, the NPDES sediment ponds discharge only in response to extreme precipitation events.

Waters of the United States

Under Section 404 of the CWA, the USACE has jurisdiction over all waters of the U.S. within the Project Area that contain a distinct channel (bed-and-bank) and ordinary high water mark (OHWM) as defined by the USACE (2008). In the Project Area, Cottonwood Arroyo, Lowe Arroyo, and several unnamed ephemeral channels are waters of the U.S. In 2009 and 2011, all streams within the Project Area were evaluated to determine if the channel contained a defined bed-and-bank and OHWM. Depths and widths of channels were measured using features such as the top elevation of lateral and point bars, changes in particle size, and the presence/absence of vegetation. The results identified approximately 18 miles and 25 acres of ephemeral stream channels within the proposed Project Area as waters of the U.S. Ephemeral streams are those that flow only during or immediately after storm events and receive no flow from alluvium or springs. The USACE's 404(b)(1) Alternatives Analysis provides a detailed methodology and comprehensive analysis of waters of the U.S. within the Project Area and describes the hydrologic and ecological functions of these intermittent and ephemeral systems (OSMRE 2012a). No wetlands or other special aquatic sites, as defined by the USACE are present within the Project Area. In March 2012, the USACE authorized under Section 404 of the CWA approximately 1.7 acres of fill in waters of the U.S. associated with mining to meet BNCC (and subsequently NTEC's) contractual coal sales obligations to FCPP through July 6, 2016

and the relocation of the Burnham Road in order to maintain safe and reliable public access to the Navajo Nation's Burnham Chapter area.

3.3 Noise and Vibration

3.3.1 Definition of Resource

3.3.1.1 Noise

This section addresses the existing conditions in the affected environment with respect to noise and vibration. People define noise as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound can be caused by its pitch or its loudness. Pitch is the height or depth of a tone or sound, depending on the relative rapidity (i.e., frequency) of the vibrations by which it is produced. Higher pitched signals typically sound louder to humans than sounds with a lower pitch, because the human ear is more sensitive to higher pitched sounds. Loudness is the amplitude of sound waves combined with the reception characteristics of the ear. Amplitude may be compared with the height of an ocean wave.

In addition to the concepts of pitch and loudness, there are several noise measurement scales, which are used to describe noise in a particular location. A decibel (dB) is a unit of measurement that indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 dB represents a ten-fold increase in acoustic energy, while a 20 dB increase is 100 times more acoustic energy; a 30 dB increase is 1,000 times more acoustic energy, etc. There is a relationship between the subjective noisiness or loudness of a sound and its decibel level. Each 10 dB increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities (Bies and Hansen 2009). Technical terms for noise are defined in Table 3.3-1.

Table 3.3-1. Definition of Acoustical Terms

Term	Definitions
Decibel (dB)	A unit describing the amplitude, or loudness, of sound by comparing it to a given reference level on a logarithmic scale. The reference level in air is 20 micropascals (µPa), corresponding to 0 decibels.
Sound pressure level	Sound pressure is the sound force per unit area, usually expressed in micropascals (micronewtons per square meter), where 1 pascal is the pressure resulting from a force of 1 newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels. Sound pressure level is measured by a sound level meter.
Frequency (Hz)	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hertz (Hz) and 20,000 Hz. Infrasonic sound are below 20 Hz and ultrasonic sounds are above 20,000 Hz.
A-weighted sound level (dBA)	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.

Term	Definitions
Equivalent noise level (L_{eq})	The average A-weighted noise level during a given measurement period. The hourly L_{eq} is denoted as L_{eq} [h].
Day/Night Noise Level (L_{dn})	The average A-weighted noise level during a 24-hour day, obtained after the addition of a 10 dBA penalty for nighttime noise from 10:00 p.m. and 7:00 a.m.
L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 10%, 50%, or 90% of the time during the measurement period.
Ambient noise level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, time of occurrence, the tonal or informational content, as well as the prevailing ambient noise level.

There are several methods of characterizing sound. The most common is the A-weighted sound level (dBA). All sound levels discussed in this section utilize the A-weighting scale. This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table 3.3-2. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This energy-equivalent sound/noise descriptor is termed equivalent noise level (L_{eq}). The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration (Bies and Hansen 2009).

Table 3.3-2. Typical Noise Levels in the Environment

Common Outdoor Noise Source	Noise Level (dBA-L_{eq})	Common Indoor Noise Source
	120	
Jet flyover at 1,000 feet		Rock concert
	110	
Pile driver at 60 feet	100	
		Night club with live music
	90	
Large truck pass by at 50 feet		
	80	Noisy restaurant
		Garbage disposal at 3 feet
Gas lawn mower at 100 feet	70	Vacuum cleaner at 10 feet
Commercial/Urban area daytime		Normal speech at 3 feet
Suburban expressway at 300 feet	60	

Common Outdoor Noise Source	Noise Level (dBA-L_{eq})	Common Indoor Noise Source
Suburban daytime		Active office environment
	50	
Urban area nighttime		Quiet office environment
	40	
Suburban nighttime		
Quiet rural areas	30	Library
		Quiet bedroom at night
Wilderness area	20	
	10	Quiet recording studio
Threshold of human hearing	0	Threshold of human hearing

The scientific instrument used to measure noise is the sound level meter. Type 1 sound level meters—the most common type used for environmental noise measurements—can accurately measure noise levels to approximately 1 dBA. Various computer models are used to predict environmental noise levels from sources, such as roadways, airports, and rail lines. The accuracy of the predicted models is greater for receptors close to the noise source. The models are accurate to within approximately 3 dBA for receptors within about 500 feet from the noise source, but are less accurate at greater distances, primarily because of the unpredictable influences of atmospheric and terrain effects (International Organization for Standardization [ISO] 1996).

Since the sensitivity to noise increases at night because excessive noise interferes with the ability to sleep, 24-hour descriptors were developed that incorporate artificial noise penalties added to quiet-time noise events. The most common of these is the Day-Night Average Sound Level, or L_{dn}, which is a measure of the cumulative 24-hour noise exposure, with a 10-dB penalty added to nighttime (10:00 p.m. – 7:00 a.m.) noise levels (Bies and Hansen 2009).

3.3.1.2 Vibration

Several methods are typically used to quantify the amplitude of vibration including peak particle velocity (PPV) and root mean square (RMS) velocity. PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. RMS velocity is defined as the average of the squared amplitude of the signal. PPV is typically used to evaluate vibration effects on buildings, while RMS is typically used to evaluate human response to vibration (Federal Transit Administration [FTA] 2006).

The reaction of humans and effects on buildings from continuous levels of vibration is shown on Table 3.3-3. As discussed previously, annoyance is a subjective measure and vibrations may be found to be annoying at much lower levels than those shown, depending on the level of activity or the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying.

Table 3.3-3. Reaction of People and Damage to Buildings Resources from Continuous Vibration Levels

Vibration Level, PPV (inches per second)	Human Reaction	Effect on Buildings
0.006 to 0.019	Threshold of perception: Possibility of intrusion	Vibration unlikely to cause damage of any type
0.08	Vibrations readily perceptible	Recommended upper level of vibration to which ruins and ancient monuments should be subjected
0.10	Level at which continuous vibrations begin to annoy people	Virtually no risk of "architectural" damage to normal buildings
0.20	Vibrations annoying to people in buildings	Threshold at which there is a risk of "architectural" damage to normal dwellings such as plastered walls or ceilings.
0.40 to 0.60	Vibrations considered unpleasant by people subjected to continuous vibrations	Vibration at this level would cause "architectural" damage and possibly minor structural damage.

Source: California Department of Transportation (Caltrans) 2002.

Low-level vibrations frequently cause irritating secondary vibration, such as a slight rattling of windows, doors, or stacked dishes. The rattling sound can give rise to exaggerated vibration complaints, even though there is very little risk of actual structural damage. In high noise environments, which are more prevalent where ground-borne vibration approaches perceptible levels, this rattling phenomenon may also be produced by loud airborne environmental noise causing induced vibration in exterior doors and windows.

Construction and mining activities can cause vibration that varies in intensity depending on several factors. The use of pile driving, vibratory compaction equipment, and blasting typically generates the highest construction- and mining-related ground-borne vibration levels. Because of the impulsive nature of such activities, the use of PPV has been routinely used to measure and assess ground-borne vibration from construction and mining activities (Caltrans 2002).

The two primary concerns with project-induced vibration—the potential to damage a structure and the potential to annoy people—are evaluated against different vibration limits. Studies have shown that the threshold of perception for the average person is a PPV in the range of 0.2 to 0.3 millimeters per second (0.008 to 0.012 inches per second). Human perception to vibration varies with the individual and is a function of physical setting and the type of vibration. Persons exposed to elevated ambient vibration levels, such as people in an urban environment, may tolerate a higher vibration level.

Vibration damage to buildings can be classified as cosmetic only, such as minor cracking of building elements, or may increase to the level of structural damage, which could threaten the integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary whether the vibrations are short-duration single events, such as from blasting, or continuous or repeated vibration events, such as from railroads or rail transit. The safe vibration limit from blasting is typically in the range of 2-inches per second, while the safe limit from continuous vibrations is typically 0.2-inch per

second to prevent architectural damage to buildings (Caltrans 2002). Construction-induced vibration that can be detrimental to a building is very rare and has only been observed in instances where the structure is at a high state of disrepair and the construction activity occurs immediately adjacent to the structure.

3.3.1.3 Applicable Noise Regulations

Federal, tribal, state, and local regulations and policies are established to limit noise exposure at noise sensitive land uses. Regulations vary widely among different jurisdictions throughout the country, with some states and counties having very restrictive noise ordinances, and others having no regulations on noise. Noise regulations from all levels of government that may apply to the project are described below.

3.3.1.3.1 Federal Regulations

U.S. Environmental Protection Agency

The EPA, pursuant to the Noise Control Act of 1972, established guidelines for acceptable noise levels for sensitive receivers such as residential areas, schools, and hospitals. The levels set forth are 55 dBA L_{dn} for outdoor use areas, and 45 dBA L_{dn} for indoor use areas and a maximum level of 70 dBA L_{dn} is identified for all areas in order to prevent hearing loss (EPA 1974). These provide guidance for local jurisdictions, but do not have regulatory enforceability. In the absence of applicable noise limits, the EPA levels can be used to assess the acceptability of project-related noise.

U.S. Department of Housing and Urban Development

The U.S. Department of Housing and Urban Development (HUD) has also established guidelines for acceptable noise levels for sensitive receivers such as residential areas, schools, and hospitals (24 CFR 51). The HUD noise levels include a two-pronged guidance, one for the desirable noise level and the other for the maximum acceptable noise level. The desirable noise level established by HUD conforms to the EPA guidance of 55 dBA L_{dn} for outdoor use areas of residential land uses and 45 dBA L_{dn} for indoor areas of residential land uses. The secondary HUD standard establishes a maximum acceptable noise level of 65 dBA L_{dn} for outdoor use areas of residential areas.

Mine Safety and Health Administration

Mine Safety and Health Administration (MSHA) regulates noise levels in mining environments (30 CFR 62), similar to Occupational Safety and Health Administration's (OSHA's) regulation of noise levels in industrial environments. Both agencies are under the U.S. Department of Labor. MSHA regulations require that the time-averaged noise level of any work environment be limited to 90 dBA for any 8-hour period. Hearing protection can be used to bring the miner's noise exposure down to the permissible exposure level. Work environments exceeding 85 dBA for an 8-hour period require a hearing conservation program for workers. At no time shall a miner be exposed to a noise level exceeding 115 dBA (MSHA 2000).

3.3.1.3.2 Navajo Tribal Regulations

The Navajo Nation does not have any noise regulations or requirements that would be applicable to noise or vibration generated by the Project.

3.3.1.3.3 New Mexico State Regulations

The State of New Mexico does not have jurisdiction on the Navajo Nation, so any state-wide noise or vibration regulations would not apply to the Project.

3.3.1.3.4 Local Regulations

San Juan County does not have any noise regulations or ordinances that would be applicable to noise or vibration generated by the Project.

3.3.1.4 Applicable Vibration Regulations

OSMRE regulates ground-borne vibrations and air blasts from blasting activities at mining operations (30 CFR 816.67), including requirements for seismographic recording during each blast. Maximum allowable airblasts and ground-borne vibrations are specified for nearby vibration-sensitive buildings, including dwellings, public buildings, schools, churches, community buildings, and institutional buildings. Allowable airblasts are limited to a maximum of 129 flat-response or linear decibels (dBL) at 6 Hertz (Hz) or lower and 133 dBL at 2 Hz or lower. Allowable ground-borne vibration levels are weighted based on distance from the blasting site, with maximum PPV of 1.25 inches per second PPV_{max} at distances of 0 feet to 300 feet, 1.00 inches per second PPV_{max} at distances of 301 feet to 5,000 feet, and 0.75 inches per second PPV_{max} at distances of 5,001 feet and beyond. An alternative blasting level criterion (Blasting Level Chart) uses the ground-vibration limits to determine maximum allowable ground vibration if seismograph records include both particle velocity and vibration-frequency levels.

3.3.2 Affected Environment

3.3.2.1 Existing Noise-Sensitive Land Uses

Some land uses are more sensitive to noise levels than others, due to the amount of noise exposure (in terms of both time and insulation from noise) and the types of activities typically involved. Residences, motels and hotels, schools, libraries, churches, hospitals, nursing homes, auditoriums, and parks and outdoor recreation areas are more sensitive to noise than are commercial and industrial land uses. Workers at industrial and mining facilities are generally not included in discussions of noise-sensitive receptors, but are covered under worker protection programs, such as OSHA or MSHA regulations for noise exposure.

There are several isolated single-family residences within the vicinity of the proposed mining disturbance of Area IV North, the closest residence is 4,500 feet away (refer to Figure 3.3-1). Three of the residences are within 1 mile of the edge of the disturbance area. There are four additional residences within 1 mile of the mining disturbance of Area III. The nearest structure is approximately 3,880 feet north of Area III.

A comment received at the public workshops indicated concern of nearby residents with noise and vibration from mining activities at night.

The FCPP generating units are located more than 1/2-mile from any sensitive land uses such as schools, hospitals, and convalescent homes. The nearest sensitive receptors are homes located greater than 1 mile from the FCPP. Noise from the FCPP is not detectable at this distance (OSMRE 2015).

3.3.2.2 Ambient Noise

At the Navajo Mine, a series of noise measurements was conducted on February 23 and 24, 2011, to characterize typical noise levels generated by various mining activities, as well as to document ambient noise levels at nearby residences and in the areas surrounding the active mining area. Noise measurements were conducted in accordance with American National Standards Institute (ANSI) S12.9-1993(R2008), the standard for environmental noise measurements (ANSI 2008). Fourteen separate noise measurements were collected, which ranged in duration from 10 minutes to 70 minutes. Table 3.3-4 presents the results of the noise measurements. Average noise levels ranged from 33 dBA L_{eq} at a residence 4,500 feet from mining activities to 72 dBA L_{eq} at 75 feet from a fully loaded haul truck. Measurements were taken at three residences adjacent to local roads surrounding the mining area. At two of these residences (ID 1 and ID 11), mining vehicle pass-by's accounted for the major source of noise. Noise levels at these residences were 44 and 46 dBA L_{eq}. At the third residence (ID 13), the only source of noise was mining activity, which resulted in a noise level of 33 dBA L_{eq}. Highest noise generating activities from mining are usually associated with heavy machinery and earthmoving equipment movements, such as scrapers, excavators, bulldozers, or front-end loaders. The background ambient noise level, without mining noise, vehicle travel noise, or other sources is approximately 35 dBA.

Primary noise sources in the area of the FCPP include the coal plant generating units, rail line, pump house, ash storage and processing equipment and appurtenances, and other associated facilities. Previous long-term noise levels measured approximately 700 feet from the coal plant, corresponding to the edge of the facility boundary, (Site LT-1) averaged 54-dBA L_{eq} with a maximum noise level (L_{max}) of 78-dBA, while a short-term noise measurement approximately 300 feet from the coal plant (Site 10) averaged 61-dBA L_{eq} with an L_{max} of 64-dBA (OSMRE 2015).

3.3.2.3 Vibration Measurements

As required by OSMRE blasting regulations, vibration levels are routinely measured by NTEC (and previously BNCC) during blasting operations to ensure that airblasts and ground-borne vibrations are within allowable levels. A chart from a typical blast is provided in Figure 3.3-2 (BNCC 2010a). Blasts are typically audible for about 2 seconds. The blast shown in Figure 3.3-2 occurred on July 26, 2010, along Strip 61 in the Lowe Pit and represents an average blast routinely occurring at the mine. The seismograph was located at the nearest residence, approximately 5,539 feet from the blasting area. As shown in the chart, the maximum airblast was measured at 112 dBL and the maximum ground-borne vibration was measured at 0.18 inches per second PPV_{max}. Both of these measurements were within OSMRE-allowable levels.

Figure 3.3-1. Noise Sampling Locations and Area Residences

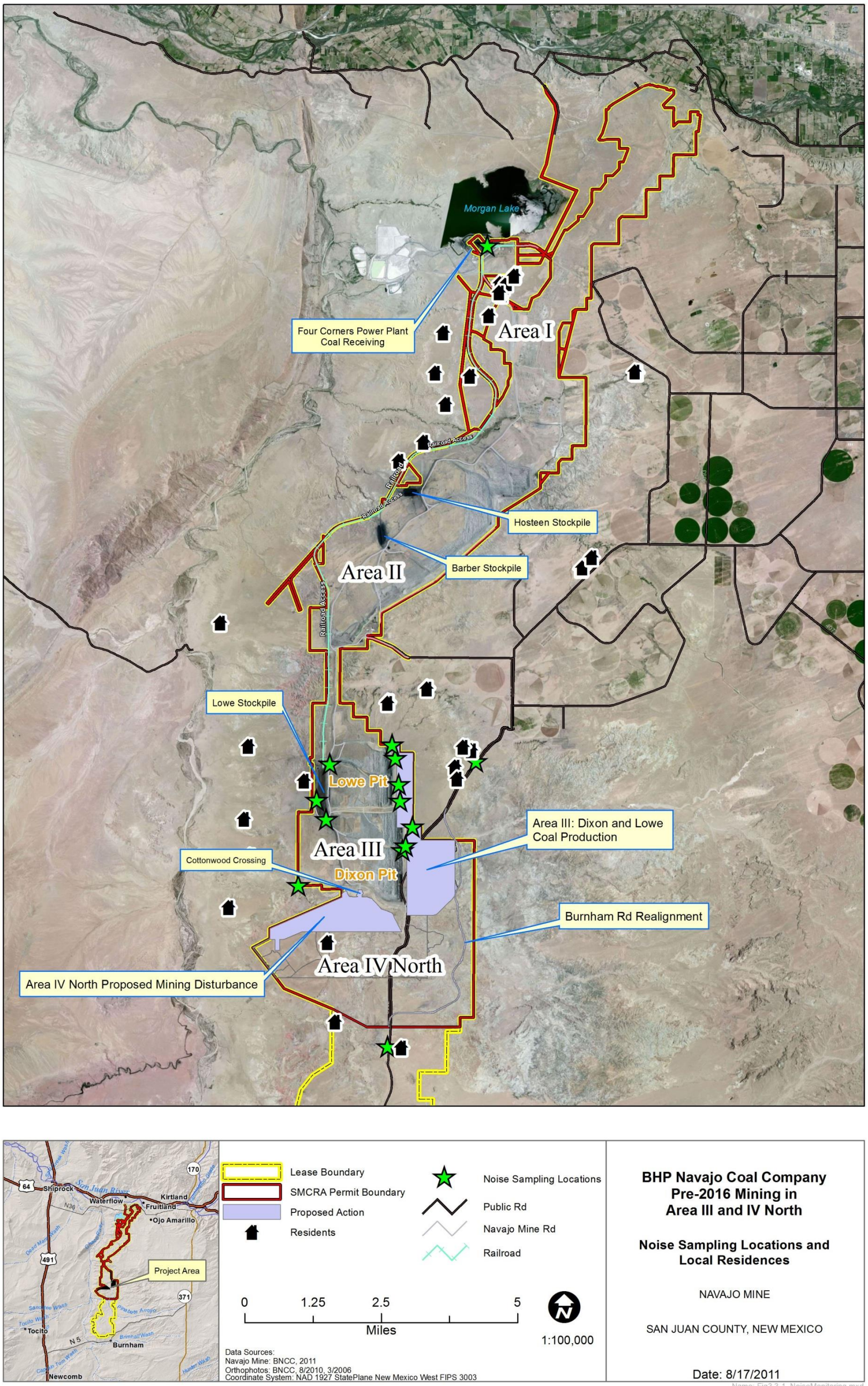

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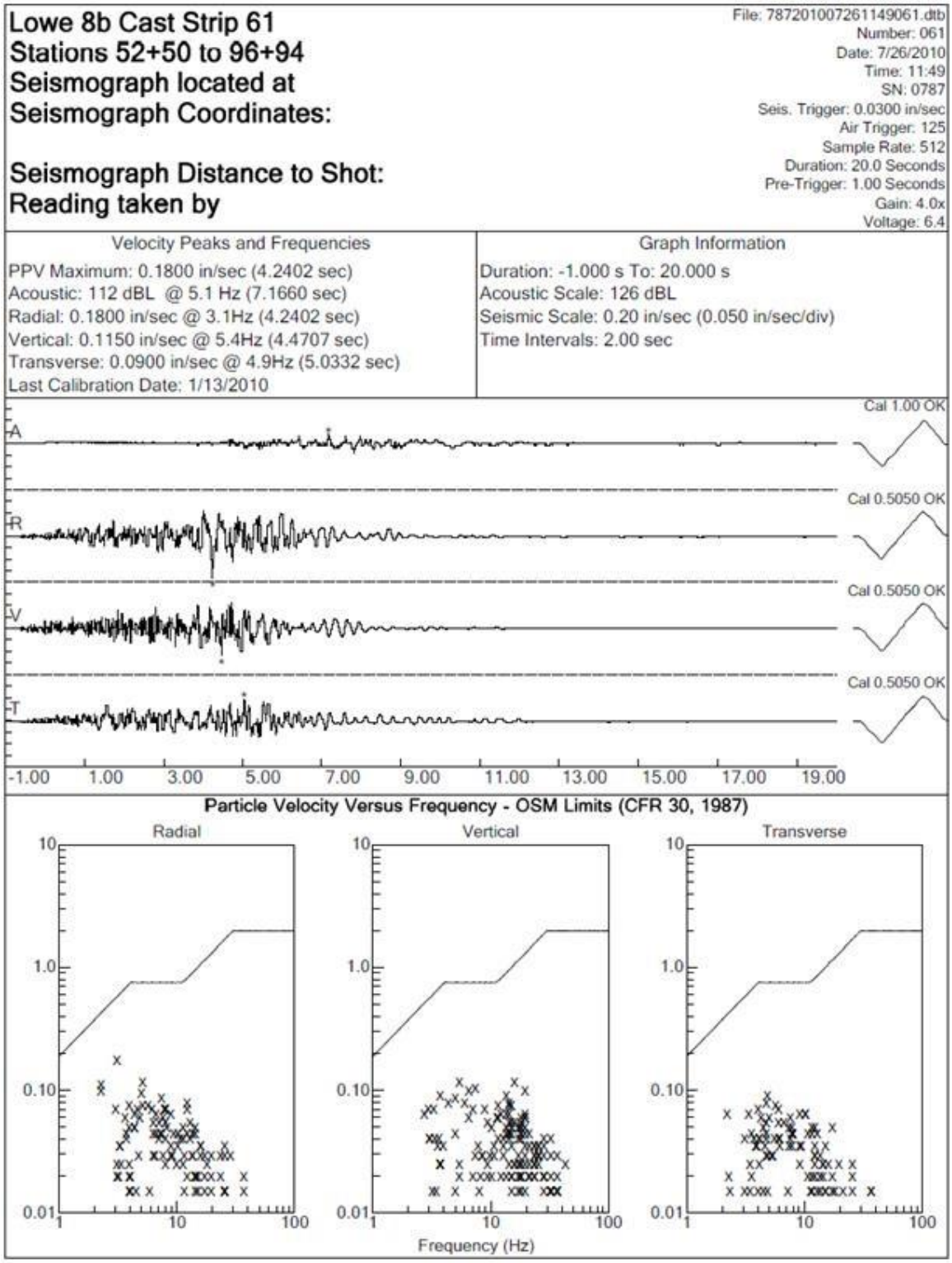
Table 3.3-4. Ambient Noise Measurements in Project Area

ID Number	Description of Location and Predominant Noise Source	Approximate Distance to Noise Source (feet)	Average Noise Level (dBA L_{eq})	Peak Noise Level (dBA L_{max})
1	Residence south of Area IV North (peak noise is vehicle pass-by)	14,000	46	72
2	Dozers on coal stockpile	350	46	56
3	Lowe Ramp 1 - water trucks, haul trucks, and bottom dump trucks	100	66	77
4	Dragline #1 with D11 dozer in distance	770	56	63
5	Scrapers, water trucks on stockpile	45	69	74
6	Dixon Ramp 2 - D11 dozers (2)	370	66	74
7	In Dixon Pit – dragline with D11 dozer	730	62	69
8	Pre-strip 63 – East – haul trucks – empty	75	67	79
8	Pre-strip 63 – East – haul trucks – fully loaded	200	67	80
9	Pre-strip 63 – West – haul trucks – fully loaded	75	72	84
9	Pre-strip 63 – West – haul trucks – empty	200	72	77
10	Coal plant with power plant in distance	300	61	64
11	Near residence to east of Area 3 (peak noise is mining vehicle pass-by)	8,000	44	65
12	High wall by Lowe Pit – dozers and dragline	770	62	72
13	Near residence west of Area 3 – no audible noise sources	4,500	33	36
14	Near blasting area in Lowe Pit, Strip 59 – warning sirens	300	54	67
14	Near blasting area in Lowe Pit, Strip 59 – blast	300	66	94



Source: BNCC 2010a

Figure 3.3-2. Typical Vibration Measurement at Residence 5,539 Feet from Blasting Area during Blasting Activities

3.4 Visual Resources

3.4.1 Definition of Resource

The BLM's visual resource methodology was used to characterize the visual environment. This methodology (BLM Manual H-8410-1) is a common methodology for conducting visual resource inventory and determining visual contrast ratings (BLM Manual 8431) for projects with a BLM Federal action. The area of analysis for visual resources consists of the project viewshed or areas from which the project activities and equipment may be visible in the long term (greater than 5 years). The viewshed, which extends outside of the proposed Project Area, was defined using a computerized 30-meter grid size Digital Elevation Model (DEM) program. The program considered the areas that would be located within topographic line-of-sight of the project's tallest components. Overburden piles as tall as 153 feet are likely the most visible components of the Proposed Action and the draglines, the tallest of which is 190 feet, are the tallest component of the Proposed Action. To ensure a conservative approach to estimating visual resources impacts, 190 feet was used. The information from the modeling is presented in Figures 3.4-1 and 3.4-2.

The DEM viewshed program analyzed whether each cell in the DEM grid would be in the line-of-sight of the Project. In the program, the tallest proposed project component was given a height offset of 190 feet from the ground elevation of the location on the DEM; this represents the general overall height of the tallest dragline. All other cells were given a 6-foot offset to simulate the view from a standing adult. The viewshed modeling performed for this project also considered the line-of-sight of the proposed mining actions to all lands located within 20 miles of the Project Area. Twenty miles was used since beyond that distance few, if any, mine features or activities would be discernible. The model took into account the existing topography between the active Project Area and selected viewpoints as well as the curvature of the earth. It did not include vegetative or atmospheric screening. Additional local factors such as vegetation height (which is minimal in the Project Area), micro-topographic features not represented in the DEM, time of day, atmospheric conditions, and distance from the Project Area ultimately determines how visible project activities and equipment would be from locations within the modeled line-of-sight.

3.4.2 Affected Environment

Existing visual conditions in the Project Area and the potential visual impact area include views of existing coal-mining operations. Open, undulating, low shrubland-dominated arid landscapes lie east, west, south, and north of the proposed Project Area with distant views of the La Plata, Chuska and Lukachukai, and Carrizo mountain ranges to the northeast, west, and northwest of the site, respectively. Views in the area include panoramic landscapes or views with a limited number of obstructions within a 360-degree field of vision. Foreground and middleground views throughout most of the Project Area include the reddish-brown dragline and black coal stockpiles and light brown to gray overburden piles of existing coal mining operations, and light brown or gray-green shadscale or greasewood-dominated scrublands to the east, west, south, and north of the active mining areas. No large trees are generally visible in this landscape, although some patches of tamarisk and coyote willow are found along the Cottonwood Arroyo that runs along the approximate boundary between Area III and Area IV North. The Hogback geologic feature lies northwest of the Project Area and is both a major geographic landmark as well as a cultural landmark to the Navajo people.

Burnham Road runs through the eastern portion of the existing mine lease area southward to the Burnham Chapter. Other travel routes in the area include a variety of two-track access roads to local residences and corrals, and abandoned stone buildings and hogans, and a west-running public roadway along the Cottonwood Arroyo. Vegetation is minimal in the region and signs of sheep, horse, and cattle grazing are evident.

No residences are located within the Project Area; however, 11 active residences were found within 2 miles northeast, south, and northwest of the Project Area (see Figure 3.4-2). Viewers in the immediate Project Area are primarily NTEC employees, livestock managers, and local residents. Existing visitation in the area is low and is expected to continue to be low.

Night lights used in existing mining operation areas are currently visible from select locations along Highway 491, from Burnham Road, and from at least two area residences.

The FCPP is located on the flat top of a mesa with Morgan Lake located directly north of the FCPP. The landscape has a very industrial appearance because it has been extensively modified by construction of the FCPP facilities, an electrical substation, and multiple transmission lines. The FCPP is visible from a limited number of locations along U.S. Highway 491 and from the mesa north of U.S. Highway 64 near the San Juan Generating Station. From along New Mexico Highway 371, it is seen on the horizon from a far distance. The FCPP facilities are prominent from secondary highways BIA Highway N-36 and Navajo Nation 3005. The plumes from the stacks and the brown haze from the plant emissions are visible for short periods of time from U.S. Highway 491 and U.S. Highway 64 and from a limited number of locations along New Mexico Highway 371. The stacks and plumes are very prominent from secondary highways BIA Highway N-36 and Navajo Nation 3005.

Although no formal visual classifications have been identified for the Project Area, the *San Juan River Coal Region Environmental Impact Statement* (BLM 1984) classifies lands west and south of the Project Area between the communities of Gallup and Crownpoint, north to the Bisti area, as BLM Visual Resource Management (VRM) Classes III and IV. Under VRM Class III objectives, visual changes are limited to relatively moderate levels, and activities may attract attention, but should not dominate the view and should partially retain the existing character of the landscape. VRM Class IV objectives provide for management activities that require major modifications to the existing character of the landscape. These BLM classifications are used by the BLM for areas under their surface management and do not necessarily apply to the Project Area other than to provide a regional context of surface management.

To assist in identifying existing visual conditions near the Project Area, important view locations were identified through review of the viewshed analysis mapping generated for the project, consideration of the cultural landscape, and discussions with agency representatives, residents, and archeologists. The rationale used in picking these locations is summarized on Table 3.4-1 and are mapped on Figures 3.4-1 and 3.4-2. These important view locations included several residences located within 2 miles of the Project Area, and locations near culturally sensitive landscape features, such as the Hogback geologic feature. Key observation points (KOPs) were chosen from among the important view locations identified for the Project Area to conduct impact analyses.

Table 3.4-1. Key Observation Locations Used for Identifying Existing Conditions in the Project Region

KOP	Location	Datum/ Zone	Easting	Northing	KOP View Compass Bearing Angles	Approximate Bearing at Center Point Towards Project Area	Observer Position	General Type of Viewer	Amount of Use	Duration of Visibility	Distance Zone in Relation to Project Area Boundaries	Surrounding Land Ownership
KOP 1	Burnham Road; 200 feet east of active residence and meeting shelter	NAD 27 Zone 12	725582	4047706	180-360	240	Vehicle on roadway	Residents, livestock managers	Low	Approximately 1-2 minutes in car; greater than 5 minutes at residence or shelter	Middleground (1-5 miles)	Navajo Nation
KOP 2	Burnham Road temporary reroute #2	NAD 27 Zone 12	724646	4045807	90-240	190	Vehicle on roadway	Residents, livestock managers	Low	Approximately 1-2 minutes	Foreground (less than 1 mile)	Navajo Nation
KOP 3	Intersection of Burnham Road and public roadway along Cottonwood Arroyo	NAD 27 Zone 12	723861	4043717	180-360	240	Vehicle on roadway	Residents, livestock managers	Low	Approximately 1-2 minutes	Foreground (less than 1 mile)	Navajo Nation
KOP 4	Burnham Road; west of active residence and southwest of red ochre mine site	NAD 27 Zone 12	723425	4039716	240-90	360	Vehicle on roadway or resident	Residents, livestock managers	Low	Approximately 1-2 minutes in car; greater than 5 minutes at residence	Foreground (less than 1 mile)	Navajo Nation
KOP 5	Active residence approximately 1 mile west of Burnham Road	NAD 27 Zone 12	720002	4032751	240-90	180	Resident	Residents, livestock managers	Low	Varies - typically greater than 5 minutes	Middleground (1-5 miles) to background	Navajo Nation
KOP 6	Active residence east of Chaco Wash and west of Project Area	NAD 27 Zone 12	719237	4044971	360-180	90	Resident	Residents, livestock managers	Low	Varies - typically greater than 5 minutes	Middleground (1-5 miles)	Navajo Nation

KOP	Location	Datum/ Zone	Easting	Northing	KOP View Compass Bearing Angles	Approximate Bearing at Center Point Towards Project Area	Observer Position	General Type of Viewer	Amount of Use	Duration of Visibility	Distance Zone in Relation to Project Area Boundaries	Surrounding Land Ownership
KOP 7	Access road to radio towers on Hogback geologic feature northwest of Project Area	NAD 27 Zone 12	714354	4052457	360-180	90	Vehicle on roadway	Local residents, recreators, livestock managers	Low	Varies - typically greater than 5 minutes	Background (5-10 miles)	Navajo Nation
KOP 8	Highway 491; south of Shiprock geologic feature	NAD 27 Zone 12	705180	4050848	360-180	90	Vehicle on highway	Tourists, residents, general public	High	Approximately 1-2 minutes in vehicle	Seldom seen (>10 miles)	Navajo Nation

Figure 3.4-1. 20 Mile Vicinity Viewshed and Key Observation Points Map

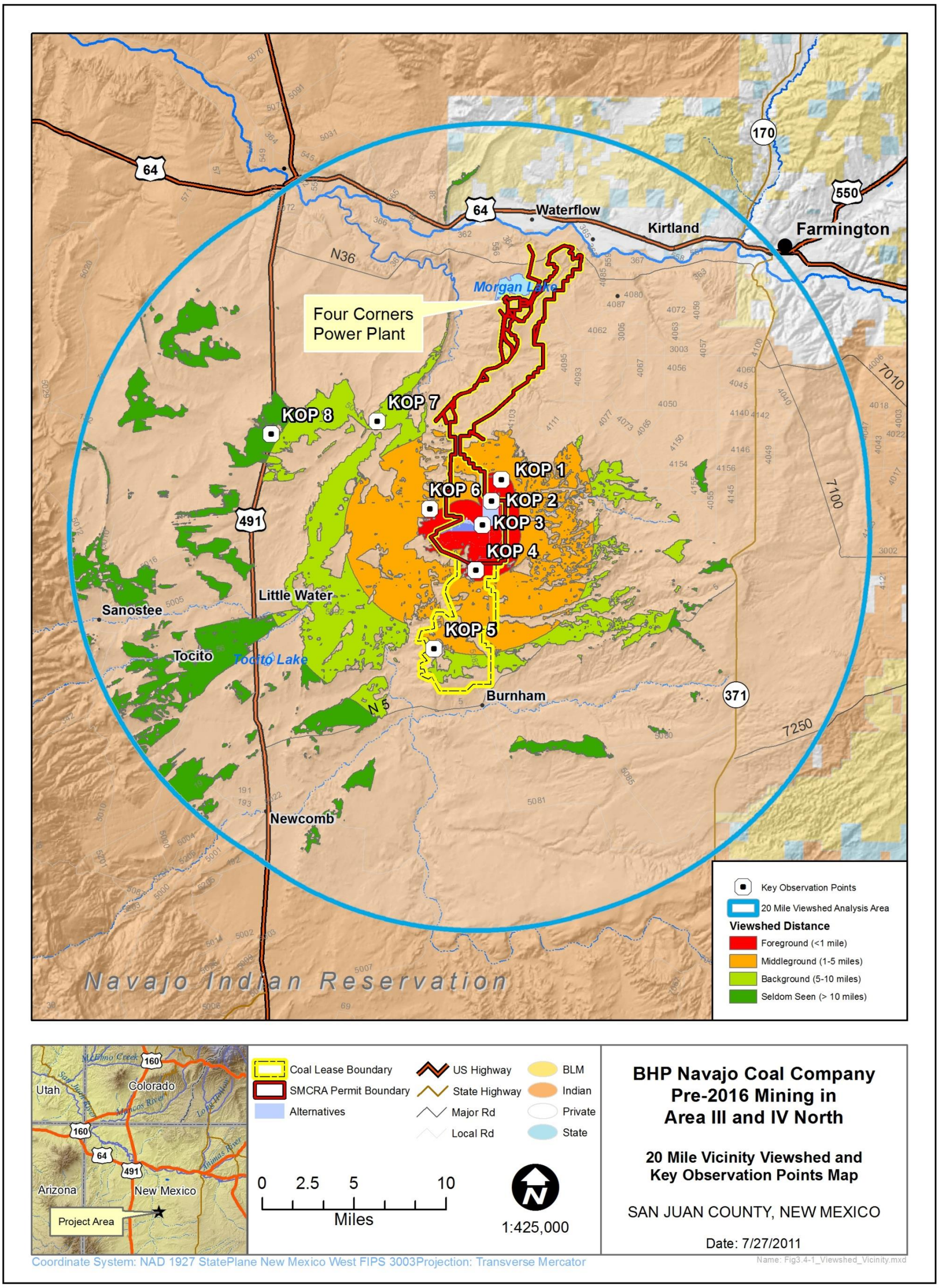


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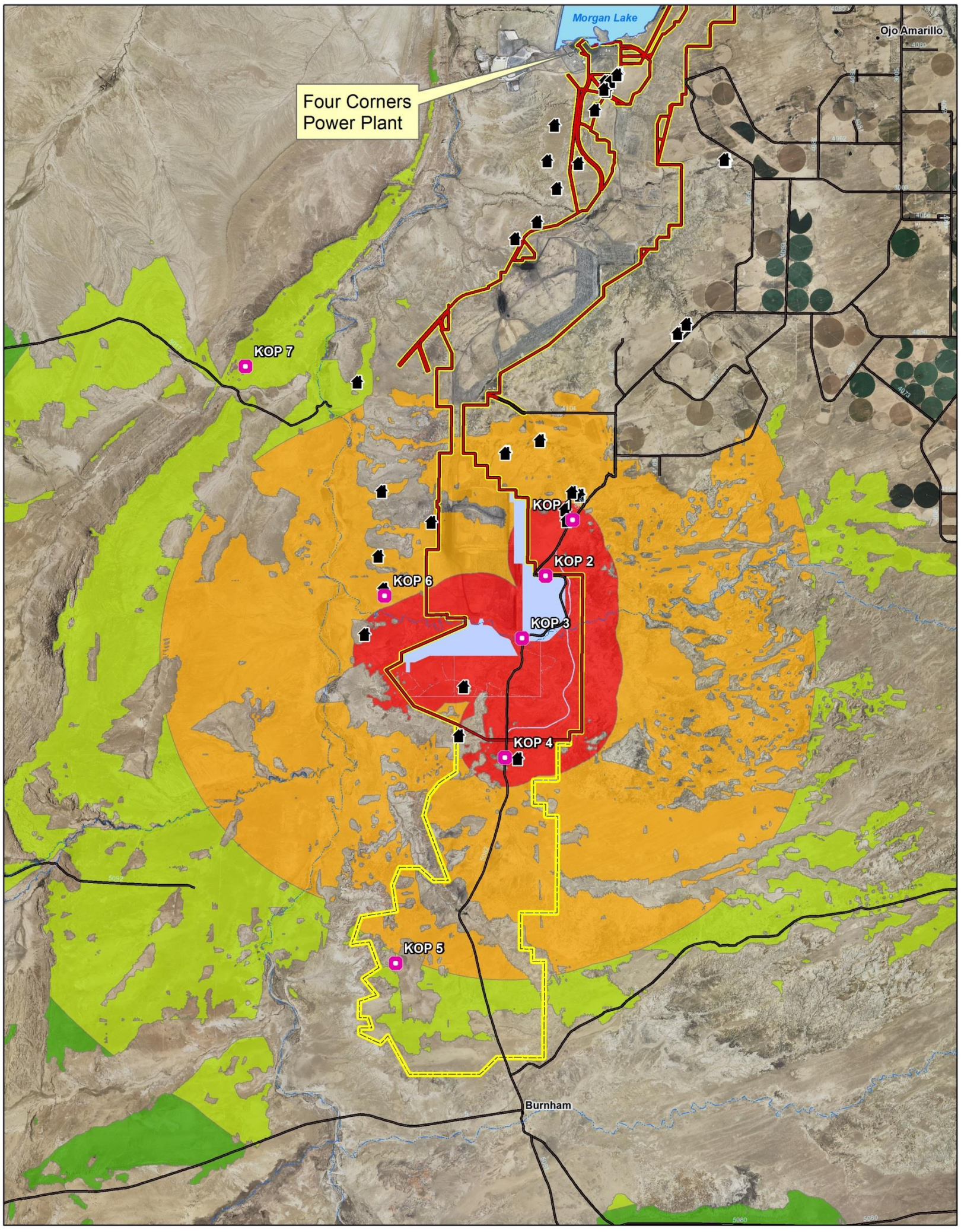
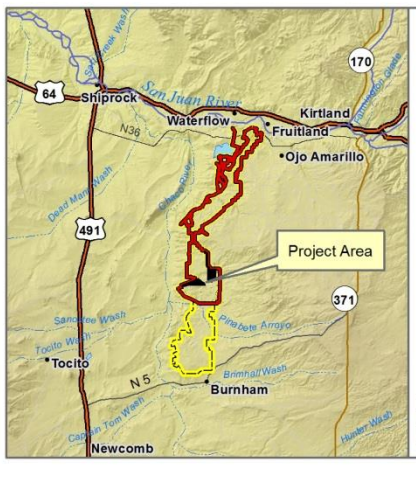
Figure 3.4-2. Viewshed Detail and Key Observation Points Map





Residents
Key Observation Points

Viewshed Distance
Foreground (<1 mile)
Middleground (1-5 miles)
Background (5-10 miles)
Seldom Seen (> 10 miles)

Lease Boundary
SMCRA Permit Boundary
Alternatives
Public Rd
Intermittent Stream

0 1.25 2.5 5
Miles

1:125,000

Data Sources:
Navajo Mine: BNCC, 2011
Orthophotos: BNCC, 8/2010, 3/2006
Coordinate System: NAD 1927 StatePlane New Mexico West FIPS 3003

BHP Navajo Coal Company
Pre-2016 Mining in
Area III and IV North

Viewshed Detail and Key Observation Points Map

NAVAJO MINE

SAN JUAN COUNTY, NEW MEXICO

Date: 7/27/2011

Name: Fig3.4-2_Viewshed_Detail.mxd

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The existing conditions of form, line, color, and texture at each important view location were documented. Appendix C contains information on the existing visual setting at each of these locations. In total, eight important view locations were identified and evaluated during the field reconnaissance session for existing visual conditions. Distance zones utilized in this project for the purposes of classifying relative visibility based on distance, were confirmed in the field for each of the sensitive view locations in relation to the Proposed Action. All locations were assigned distance zone designations as described below:

- Foreground – This zone is located within 1 mile from the Project Area boundaries. Existing coal mine infrastructure is readily visible in this zone.
- Middleground – The area that is located more than 1 mile but less than 5 miles away from the Project Area boundary. The outer boundary of this distance zone is defined as the point where the texture and form of individual plants are no longer apparent in the landscape.
- Background – This zone includes the area greater than approximately 5 miles away, but less than 10 miles that can be seen from travel routes or KOPs. It does not include areas in the background that are so far distant that the only thing discernible is the form or outline. In order to be included within this distance zone, vegetation must be visible at least as patterns of light and dark.
- Seldom Seen – This zone includes areas greater than 10 miles away where views of the Project Area may still be faintly visible under excellent atmospheric conditions.

Overall, existing conditions in the Project Area are predominately natural to the east, west, and south, with minimal visual disturbance beyond improved travel corridors. Existing coal mining operations are currently visible in portions of the Project Area.

3.5 Air Quality

3.5.1 Definition of Resources

"Air quality" is a generic term that refers to the relative levels of air pollution in ambient air (i.e., outside air to which the general population may be exposed). Air quality for a specific air pollutant is quantitatively expressed in terms of the concentration of that pollutant in ambient air (e.g., micrograms per cubic meter of air, or $\mu g/m^3$). In general, local air quality for a given pollutant is heavily influenced by emissions of that pollutant from stationary and mobile sources in the surrounding area. Once emitted into the atmosphere, the pollutant disperses into the ambient air.

The affected environment for air quality is typically the existing ambient concentrations of relevant pollutants in the Air Quality Resource Area (AQRA) prior to the Proposed Action. The sources of emissions that likely cause or contribute to those air quality levels are identified as well.

The principal pollutant emitted from a surface coal mine is PM; therefore, the ambient air concentration of PM is the air quality element of most interest for emissions from mining operations. Ambient air concentration of PM is regulated for two different forms of particulate matter: particulate matter less than or equal to 10 microns in diameter (PM_{10})—particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers, and particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$)—particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.

The ambient air generally affected by particulate emissions from a surface coal mine is highly local in nature (i.e., the geographic area in proximity to the mine's boundary). Nevertheless, consistent with the minimum geographic scope commonly used for an air quality analysis to support the preconstruction review of major emission sources, the AQRA for this study is the geographic area extending out to 50 kilometers from the mine's boundary, as shown in Figure 3.5-1. An AQRA with that broader expanse will allow identification of those emission sources in the surrounding area and their air quality impacts, which may overlap with those from Navajo Mine. The identification of aggregate emissions and air quality impacts in the AQRA, with and without contributions from the Proposed Action, will allow assessment of ambient levels of air pollutants that are representative of what the population and environment in that area experience now and may experience in the future as a result of the Proposed Action.

Air emissions from coal burning at FCPP include additional pollutants of concern. Discussion related to coal burning at FCPP draws heavily from the FCPP/NMEP EIS (OSMRE 2015), incorporating relevant text within the section and referring to additional detail that can be found in the EIS. Federal and tribal law defines criteria pollutants to include the following: reactive or volatile organic compounds (ROCs or VOCs), nitrogen oxides (NO_x as nitric oxide [NO] and nitrogen dioxide [NO_2]), ozone (O_3), carbon monoxide (CO), SO_2, respirable particulate matter (PM_{10}), and fine particulate matter ($PM_{2.5}$). Of these, VOCs and NO_x are precursors of ground-level photochemical O_3, which can result in decreased visibility and haze. The Navajo Mine and FCPP are located in the Four Corners region of northwestern New Mexico within the San Juan Air Basin, comprised of northwest New Mexico, southwest Colorado, southeast Utah, and northeast Arizona. San Juan Basin air quality is generally good and meets EPA ambient air quality standards. Primary issues of concern in this region include regional haze and visibility issues, as well as the potential deposition of metals from air to soil and water as a result of industrial air emissions. The AQRA for emissions from FCPP encompasses a 300-kilometer (186-mile) radius from FCPP, which includes the Navajo and Hopi tribal trust lands, consistent with EPA's area of evaluation for the FIP for FCPP. The EPA published a Final Ruling regarding the Source Specific FIP to implement BART at the FCPP in August 2012, which provides requirements for future operation of the plant.

3.5.1.1 Air Quality Regulatory Framework

The Clean Air Act (CAA), (42 USC 7401 et seq.) and EPA-established CAA implementing regulations (40 CFR 50-99), establish a comprehensive framework for the evaluation and regulation of both air quality and air quality impacts via National Ambient Air Quality Standards (NAAQS). NAAQS set the maximum allowable concentration of pollutants in ambient air. The overall approach of the CAA is based on the linkage between emission sources of air pollutants and the ambient concentrations of those pollutants.

Figure 3.5-1. Air Quality Resource Area

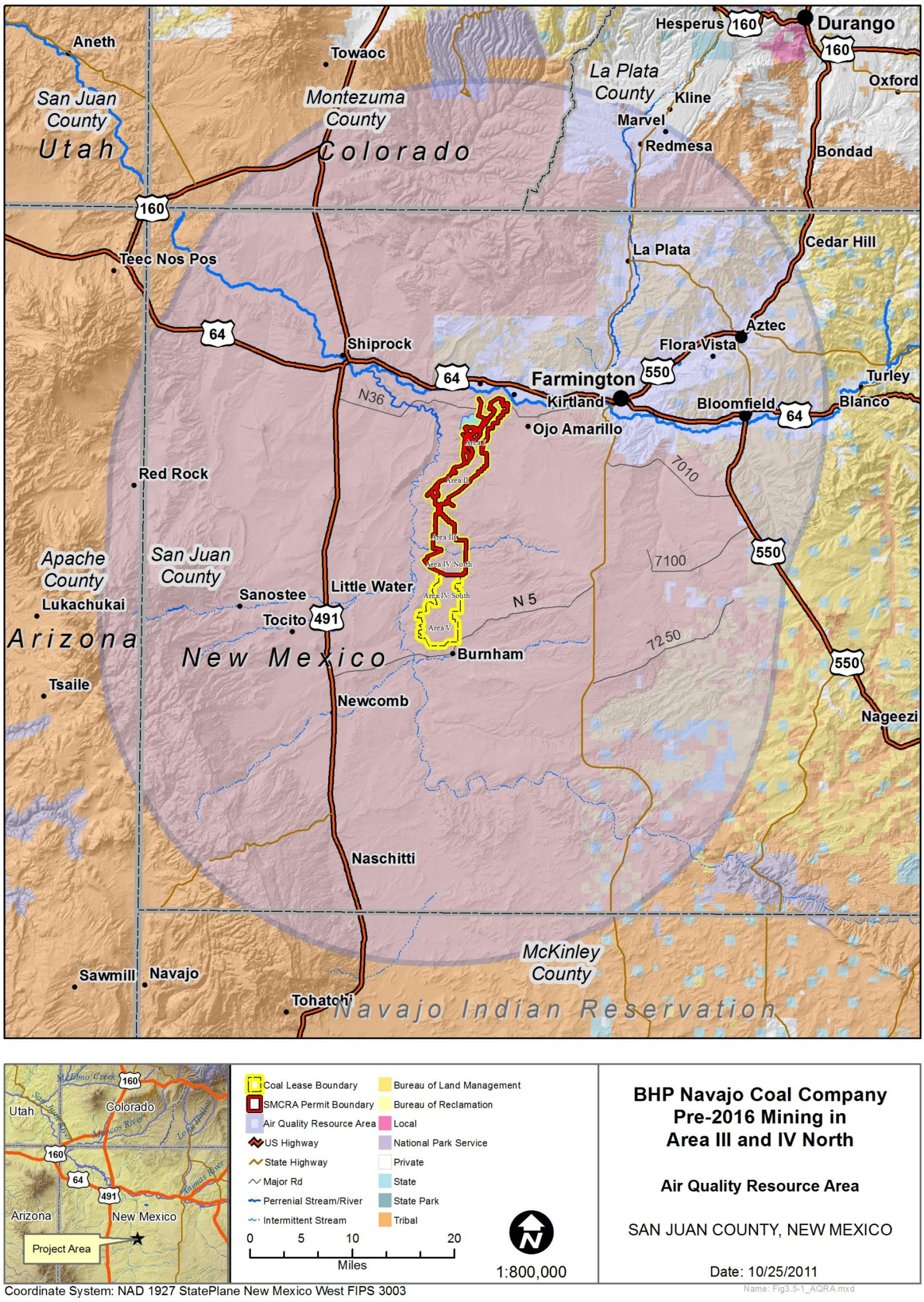

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Table 3.5-1. Summary of National Ambient Air Quality Standards (NAAQS) as of October 2011

Pollutant	Primary Standards Concentration	Primary Standards Averaging Time(1)	Secondary Standards Concentration	Secondary Standards Averaging Time(1)
Carbon Monoxide	9 parts per million (ppm) (10 mg/m^3)	8-hour	None	None
	35 ppm (40 mg/m^3)	1-hour	None	None
Lead	0.15 µg/m^3 (2)	Rolling 3-month Average	Same as Primary	Same as Primary
Nitrogen Dioxide	0.053 ppm	Annual (Arithmetic Mean)	Same as Primary	Same as Primary
	0.100 ppm	1-hour	None	None
Particulate Matter (PM_{10})	150 µg/m^3	24-hour	Same as Primary	Same as Primary
Particulate Matter ($PM_{2.5}$)	12.0 µg/m^3	Annual (Arithmetic Mean)	15.0 µg/m^3	15.0 µg/m^3
	35 µg/m^3	24-hour	Same as Primary	Same as Primary
Ozone(2)	0.075 (0.070) ppm	8-hour	Same as Primary	Same as Primary
Sulfur Dioxide(3)	0.075 ppm	1-hour	0.5 ppm	3-hour (1)

1 Averaging periods for a numerical standard are qualified in a variety of ways, e.g., 3-year average of 98th percentile, 3-year average of the fourth-highest daily maximum, not to be exceeded more than once per year, etc. Complete details of averaging period for each pollutant are provided at 40 CFR Part 50 (http://www.epa.gov/air/criteria.html).

2 On October 1, 2015, the EPA lowered the 8-hour NAAQS for ground-level ozone from 0.075 to 0.070 parts per million (ppm) based on extensive scientific evidence about the effects of ozone on public health and welfare (Federal Register 65292).

3 For mining purposes, SO_2 emissions are limited to tailpipe emissions from vehicles and equipment and small quantities associated with blasting. The precise quantities have not been measured from tailpipe emissions but are estimated to be about 2 – 3 orders of magnitude smaller than NO_x factors, due to prevalence of low-sulfur fuels. SO_2 emissions from blasting activities are included in the Appendix E tables.

In the CAA Amendments of 1990, Congress authorized EPA to treat a qualifying Indian tribe in the same manner as a state for the regulation of air resources within the exterior boundaries of the reservation or other areas within the tribe's jurisdiction. Subject to EPA approval, an eligible tribe may develop,

administer, and enforce its tribal implementation plan (TIP). CAA requires EPA to designate existing air quality in all of the planning areas identified by each state relative to the NAAQS for each pollutant as:

- "Attainment," if the area meets a NAAQS for the pollutant.
- "Nonattainment," if the area does not meet a NAAQS for the pollutant (or if the area contributes to air quality in a nearby area that does not meet a NAAQS for the pollutant).
- "Unclassifiable," if the area cannot be classified on the basis of available information.

3.5.1.1.1 National Ambient Air Quality Standards

The NAAQS are the principal parameters for evaluating air quality. EPA has promulgated NAAQS for six different criteria pollutants that apply throughout the U.S.: sulfur oxides, measured as SO_2, CO, O_3, NO_2, lead (Pb), and particulate matter. Table 3.5-1 identifies the value of each NAAQS for each applicable averaging time, including the new 8-hour O_3 standard adopted on October 1, 2015. In the context of NEPA, a NAAQS defines an appropriate threshold of air quality for those pollutants beyond which adverse change would cause significant degradation of the air quality resource. The EPA proposed developing new secondary standards for SO_2 and NO_x aimed at reducing the impacts of atmospheric deposition on surface waters (Government Accountability Office [GAO] 2013). Individual states have the option to adopt more stringent standards and to include other pollution sources; however, all states in the Four Corners region – New Mexico, Arizona, Utah, and Colorado – have adopted NAAQS in lieu of adopting more stringent state standards.

3.5.1.1.2 Navajo Nation Regulatory Program

Just as individual states may implement air quality statutes, in 2004 the Navajo Nation Council enacted the Navajo Nation Air Pollution Prevention and Control Act (Act). The Act is structured in many respects like the Federal CAA in that it authorizes the NNEPA to create and implement a variety of air quality programs such as Prevention of Significant Deterioration (PSD), Visibility Protection, Operating Permits, Hazardous Air Pollutants (HAPs), New Source Performance Standards (NSPS), Acid Deposition, etc. To date, the NNEPA has only promulgated its Navajo Nation Operating Permit Regulations (NNOPR) that apply to major sources of criteria pollutants. NNEPA intends to seek EPA approval of the NNOPR as part of a TIP, after which NNEPA would then implement a tribal "Title V" operating permit program that would conform to Federal specifications contained in 40 CFR Part 70.

In October 2004, the EPA delegated full authority to NNEPA to administer the Federal Title V operating permit program for major stationary sources located within the exterior boundaries of the Navajo Reservation. The permit program is administered by NNEPA in accordance with a delegation agreement with EPA Region IX. "Major" sources on the Reservation are generally ones that have the potential to emit 100 tons per year (tpy) or more of any criteria pollutant, more than 10 tpy of a single HAP, or more than 25 tpy of aggregated HAPs. It is noteworthy that Federal permitting regulations exclude fugitive emission sources from certain source categories, such as surface coal mining, when determining the potential to emit for major source applicability. Consequently, the Navajo Mine is currently not subject to the Federal or NNEPA major source permit program.

In 2005, the Navajo Nation and owners of the FCPP entered into a voluntary compliance agreement under which FCPP agreed to apply for and obtain a CAA Title V operating permit from NNEPA provided, among

other things, that permit requirements would be no more stringent than Federal requirements unless FCPP agreed to more stringent requirements and the administration and enforcement of the permit would be no more stringent than what EPA would do and that would be required under Federal court decisions.

3.5.1.1.3 Attainment Status

Descriptions of applicable monitoring projects referenced in the Air Quality Section of this EA are provided in Appendix A of the FCPP/NMEP EIS (OSMRE 2015), which is incorporated by reference.

States and county or regional air districts are required to monitor air pollutant levels to ensure that NAAQS are met and, in the event that they are not, to develop strategies to meet these standards. Sovereign nations (e.g., Navajo, Southern Ute) also monitor air pollutant levels as required. Depending on whether the standards are met or exceeded, the local air basin or air quality control region is classified as being in "attainment" or "nonattainment." Where insufficient data exist to make a determination, an area is deemed "unclassified." A General Conformity determination is required for Federally-sponsored, permitted, or funded actions in NAAQS nonattainment areas or in certain maintenance areas when the total direct and indirect net emissions of nonattainment pollutants (or their precursors) exceed specified thresholds (CAA Amendments of 1990 Section 176[c]).

On December 17, 2014, EPA published a proposal to revise the NAAQS standard for O_3 from 75 parts per billion by volume (ppbv) to 65 to 70 ppbv (Federal Register 75234). The purpose of publishing the draft proposal was to solicit comments from the public, other Federal agencies, state and local governments, and industry. After consideration of comments and making revisions, EPA promulgated the final rule on October 1, 2015 which lowered the 8-hour NAAQS for ground-level O_3 from 75 to 70 ppbv. The new standard is based on extensive scientific evidence about the effects of ozone on public health and welfare. The updated standard will improve public health protection, particularly for at-risk groups including children, older adults, people of all ages who have lung diseases such as asthma, and people who are active outdoors, especially outdoor workers. The new standard will improve the health of trees, plants, and ecosystems, including food crops (Federal Register 65292). However, consistent with both the prior and new NAAQS standards for O_3, the FIP for BART at FCPP addressed O_3 emission reductions. The EPA addressed NO_x emissions from the FCPP, the primary O_3 precursor compound emitted from the boiler stacks. In this final action, EPA required FCPP to reduce NO_x emissions. Because reducing NO_x emissions from FCPP would not be the sole cause of any change in regional O_3 concentrations, whether upward or downward, under the new standard, the new rule would not lead to a change in the assessment of significance. Furthermore, the change to the NAAQS would not require a General Conformity determination, as explained in the FCPP/NMEP EIS (OSMRE 2015). As such, the new 8-hour O_3 standard comprises a new significance criterion for the Proposed Action.

3.5.1.1.4 Hazardous Air Pollutants

HAPs, also known as toxic air pollutants or air toxics, are those pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. Title III of the CAA Amendments of 1990 currently identifies 187 pollutants as HAPs, the Federal term for air toxics. In 2001, the EPA identified 21 HAPs as mobile source air toxics, 6 of which are designated priority pollutants (66 Federal Register 17235): acetaldehyde, acrolein, benzene-1, 3-butadiene, diesel exhaust (PM and organic gases), and formaldehyde. Diesel particulate matter (DPM, as PM10) is

considered a carcinogenic air toxic. An EPA assessment "examined information regarding the possible health hazards associated with exposure to diesel engine exhaust (DE), which is a mixture of gases and particles. The assessment concludes that long-term (i.e., chronic) inhalation exposure is likely to pose a lung cancer hazard to humans, as well as damage the lung in other ways depending on exposure. Short-term (i.e., acute) exposures can cause irritation and inflammatory symptoms of a transient nature, these being highly variable across the population" (EPA 2002). However, no EPA standard exists for DPM.

In addition to DPM from mining equipment and heavy trucks, coal combustion in power plant boilers emits a wide range of inorganic and organic HAPs from stacks, according to the EPA (EPA 2011a, 40 CFR 63 Subpart UUUUU). Inorganic metals include: antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, Pb, manganese, mercury, nickel, and selenium. Organics and nonmetallic inorganics include: acetaldehyde, acetophenone, acrolein, benzene, benzyl chloride, bis(2-ethylhexyl)phthalate (DEHP), carbon disulfide, chlorobenzene, chloroform, cyanide, 2,4-dinitrotoluene, ethyl benzene, ethyl chloride, formaldehyde, hexane, hydrogen chloride, hydrogen fluoride, isophorone, methyl bromide, methyl chloride, methyl ethyl ketone, methylene chloride, polycyclic aromatic hydrocarbons (PAHs), phenol, propionaldehyde, tetrachloroethylene, toluene, styrene, and xylenes (ortho-, meta-, para- isomers).

Mercury and Air Toxics Standards

Coal-fired power plants are the largest source of mercury and acid gas emissions in the U.S. and are responsible for about 50 percent of mercury emissions and about 77 percent of acid gas emissions. Most mercury deposited in the western U.S., however, originates in Asia (Strode et al. 2008). Peer-reviewed scientific literature shows that mercury emissions from Electric Generating Units in the U.S. enhance mercury deposition and the response of ecosystems in the U.S. (77 Federal Register 9339). Other toxic metals emitted from power plants include arsenic, chromium, hexavalent chromium, nickel, and selenium (EPA 2013a).

When elemental mercury from the air reaches surface waters via direct and indirect deposition, microorganisms can convert it into methylmercury, a highly toxic form that bio-accumulates in fish. Humans are primarily exposed to mercury by eating contaminated fish. Methylmercury exposure is a particular concern for women of childbearing age, fetuses, and young children because studies have linked high levels of methylmercury to damage to the developing nervous system, which can impair children's' ability to think and learn. Mercury and other power plant emissions also damage the ecological environment (EPA 2013a).

On December 16, 2011, the EPA issued the final Mercury and Air Toxics Standards (MATS) and Utility NSPS rulemakings which were published in the Federal Register on February 16, 2012 (77 Federal Register 9304). Promulgated as 40 CFR 63 Subpart UUUUU – National Emission Standards for Hazardous Air Pollutants (NESHAPS) for Coal- and Oil-Fired Electric Utility Steam Generating Units, the MATS rule establishes emission limitations and work practice standards for HAPs emitted from coal- and oil-fired electric utility steam generating units along with requirements to demonstrate initial and continuing compliance with the HAP emission limits.

The EPA estimates there are about 1,400 existing generating units affected by the MATS rule – 1,100 coal-fired units and 300 oil-fired units – at about 600 power plants nationwide. As an existing coal-fired generating facility, FCPP must comply with specific HAP emissions limits for the following pollutants:

- Filterable PM or total nonmercury HAP metals or individual HAP metals (antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium)
- Hydrogen chloride or SO_2
- Mercury

The MATS emissions limits are based on existing control technologies that are widely available and commonly used in the electric utility industry such as electrostatic precipitators, fabric filters (baghouses), flue gas desulfurization (scrubbers), or dry sorbent injection. For existing controlled units such as FCPP Units 4 and 5, which are equipped with baghouses and scrubbers, compliance can be achieved by April 16, 2015, and maintained as described in detail in the FCPP/NMEP EIS (OSMRE 2015).

On March 28, 2013, the EPA finalized updates to certain emission limits for new power plants under the MATS rule, including mercury, PM, SO_2, acid gases, and certain individual metals. Additionally, certain testing and monitoring requirements that apply to new sources were adjusted. The new standards affect only new coal- and oil-fired units that will be built in the future (78 Federal Register 24073). The update does not change the final emission limits or other requirements for such existing power plants as FCPP.

3.5.1.1.5 Federal Visibility Protection and Atmospheric Deposition Control Programs

Visibility and haze are regulated under the Regional Haze Rule of the CAA (40 CFR 51 Subpart P). Under the CAA, Class I areas are those in which visibility is protected more stringently than under NAAQS. Class I areas include national parks and monuments, wilderness areas, and other areas of special national and cultural significance. Section 169A (42 USC Part 7491) of the CAA sets forth a national goal for visibility which is the ‘‘prevention of any future, and the remedying of any existing, impairment of visibility in Class I areas which impairment results from manmade air pollution’’ (64 Federal Register 35714).

There are 156 Class I areas in the U.S., 49 of which are national parks and monuments. The Regional Haze Rule, enacted in 1999, requires states to establish goals and emission reduction strategies for improving visibility in all Class I areas as part of State Implementation Plans (SIPs) as geographically applicable. In addition, the EPA encourages states to work together in regional partnerships to develop and implement multistate strategies to reduce emissions of visibility-impairing fine particle ($PM_{2.5}$) pollution (64 Federal Register 35714).

Due to long range transport of visibility-impairing fine particles, all 50 states are required to participate in planning, analysis, and in many cases, emission control programs. Each state must develop coordinated strategies and implement programs to make reasonable progress toward the goal of no “man-made impairment” in Class I areas by reducing emissions that contribute to haze. The Regional Haze Rule requires states to establish goals for each affected Class I area which improve visibility on the haziest days (20 percent most-impaired days) and ensure no degradation occurs on the clearest days (20 percent least-impaired days). The reasonable progress goals are designed to reach natural conditions by 2060. States are required to conduct certain analyses, including analyses of improvement rates, to ensure that they set reasonable progress goals (64 Federal Register 35714, Colorado State University [CSU] 2013a).

National Ambient Air Quality Standards

On December 14, 2012, the EPA established the current primary NAAQS standards to protect the public health, in accordance with CAA Section 109A and secondary NAAQS standards to protect the public welfare, in accordance with CAA Section 109B for $PM_{2.5}$ (see Table 3.5-1). On October 1, 2015, the EPA lowered the 8-hour NAAQS for ground-level ozone from 0.075 to 0.070 ppbv based on extensive scientific evidence about the effects of ozone on public health and welfare (Federal Register 65292). However, consistent with the purposes of Section 169A of the CAA, the EPA recognizes that uniform NAAQS cannot eliminate visibility impairment in all parts of the country. The regional haze program contributes to improvement of local visibility impacts outside of Class I areas that may persist after attainment of the secondary standard (64 Federal Register 35714).

Federal Implementation Plan for Implementing Best Available Retrofit Technology

The Regional Haze Rule (40 CFR 51 Subpart P) requires the use of BART at older coal-fired power plants to reduce haze and improve visibility. The BART provision in Section 169A(b)(2)(A) addresses the pollution from a specific set of existing sources, such as coal-fired power plants near Class I areas (e.g., FCPP, SJGS, Navajo Generating Station). The BART provision requires EPA to promulgate regulations requiring states to revise their SIPs to contain measures to make reasonable progress toward the national visibility goal, including a requirement that certain existing stationary sources procure, install, and operate BART (64 Federal Register 35714).

The CAA defines the sources potentially subject to BART as major stationary sources, including reconstructed sources, from 1 of 26 identified source categories which have the potential to emit 250 tpy or more of any air pollutant, and which were placed into operation between August 1962 and August 1977. This set of sources potentially subject to BART was defined in the 1977 amendments to the CAA and the 2012 Regional Haze Rule is consistent with these amendments, 35 years later. Chief among the 26 source categories are fossil-fuel fired steam electric plants of more than 250 million British thermal units per hour (mmBTU/hr) heat input such as FCPP.

Consistent with the Regional Haze Rule, the *Source Specific Federal Implementation Plan for Implementing Best Available Retrofit Technology for Four Corners Power Plant: Navajo Nation* (40 CFR 49) requires FCPP to reduce emissions of NO_x and defines emission limits for PM based on emission rates currently achieved at FCPP. The FIP requires that Units 4 and 5 meet a BART emission limit of 0.015 pounds per million BTU (lb/mmBTU) within 60 days after restart following the scheduled major outages for Units 4 and 5 in 2013 and 2014, suggesting that the emission limit is achievable through the proper operation of the existing baghouses. FCPP must continue to meet the existing 20 percent opacity limit on Units 4 and 5 and is required to comply with a 20 percent opacity limit on its material handling operations, including coal handling.

NO_x and PM pollutants contribute to visibility impairment in the mandatory Class I Federal areas surrounding FCPP. These pollutants contribute to visibility impairment in the mandatory Class I Federal areas surrounding FCPP, of which there are 16 within the 300-kilometer radius as shown in the FCPP/NMEP EIS, Appendix A, Section A3. For NO_x emissions, APS has opted to close Units 1, 2, and 3 (completed on December 30, 2013)

and install SCR controls on Units 4 and 5 to meet an emission limit of 0.098 pound NO_x per million BTU[1] (lbs/mmBTU) heat input each (30-day rolling average), which is an 80 percent reduction from 0.49 lb/mmBTU. For PM, Units 4 and 5 must meet an emission limit of 0.015 lb/mmBTU, while retaining the existing 20 percent opacity limit, through the proper operation of the existing baghouses. EPA is also requiring FCPP to comply with a 20 percent opacity limit on its coal and material handling operations (77 Federal Register 51620).

Atmospheric Deposition

Since the 1970s, implementation of CAA regulations has reduced emissions of NO_x, SO_2, and mercury and reduced the impact of atmospheric deposition on water quality and aquatic ecosystems. However, in spite of progress, atmospheric deposition continues to affect water quality and harm aquatic ecosystems (GAO 2013).

According to EPA's 2008 National Emissions Inventory, domestic emissions of NO_x declined from about 26 million tons in 1990 to about 17 million tons in 2008. About 74 percent of this reduction came from reduced emissions from power plants and vehicles. Also according to the inventory, emissions of SO_2 declined from 23 million tons in 1990 to 10 million tons in 2008, and about 64 percent of this reduction came from reduced emissions from power plants (EPA 2011b, GAO 2013).

Three key regulations or programs have contributed to reductions in acid rain precursors:

a. Title II emission standards for mobile sources (motor vehicles),

b. Actions designed to meet primary NAAQS, and

c. The Acid Rain Program.

Although neither vehicle emissions standards nor actions to meet primary NAAQS are designed to address the deposition effects of NO_x and SO_2 emissions on surface waters, these standards have contributed to overall reductions in these criteria pollutants. In contrast, the Acid Rain Program was designed, in part, to address the effect of NO_x and SO_2 on surface waters (GAO 2013).

New Environmental Regulations and Changing Market Conditions

Recent developments could affect future NO_x and SO_2 emissions from power plants:

- Title IV of the CAA Amendments of 1990 set the goal of reducing annual SO_2 emissions by 10 Mtpy below 1980 levels. To achieve these reductions, the Act required a two-phase approach to reducing SO_2 and NO_x emissions from fossil fuel power plants. Phase I began in 1995 and affected 445 generating units, mainly at coal-fired electric utility plants located in eastern and mid-western states. Phase II began in 2000 and lowered annual emissions limits imposed on large, higher emitting plants and also set limits on smaller, cleaner plants fired by coal, oil, and gas, encompassing over 2,000 generating units rated 25 megawatts or greater nationwide. The Act (1990) also required a 2 Mtpy reduction in NO_x emissions by 2000 using technology such as low-NO_x burners in coal-fired units.

[1] One BTU is the amount of heat required to raise the temperature of one pound (453.6 grams) of pure water from 39 to 40°F (3.9 to 4.4°C).

- The Cross-State Air Pollution Rule promulgated by EPA on July 6, 2011, was challenged in the District of Columbia Circuit Court of Appeals (Case No. 11-1302, August 21, 2012) on the grounds that the Cross-State Air Pollution Rule exceeds the EPA's statutory authority in two independent respects. For each of those two independent reasons, the Court ruled that the Cross-State Air Pollution Rule violates Federal law and therefore must be vacated. On October 5, 2012, the EPA filed a petition with the Court seeking en banc rehearing of the case, and on January 24, 2013, the Court denied EPA's petition. On March 29, 2013 the U.S. Solicitor General petitioned the Supreme Court to review the District of Columbia Circuit Court's decision. The Supreme Court granted certiorari and heard arguments for the case on December 11, 2013. The Supreme Court reversed the District of Columbia Circuit Court of Appeals in *EPA v. EME Homer City Generation*, 134 S. Ct. 1584 (2014), upholding EPA's Cross-State Air Pollution Rule (EPA 2013b).
- Contemporaneous (occurring at the same time) changes in energy market conditions have been weighing on the future viability of coal-fired power plants. Key among these has been the decline in the price of natural gas due to increased supply, which has made it more attractive to electric power providers in lieu of burning coal. Natural gas emits far less NO_x and SO_2 than coal, and about half as much GHGs for the same level of generating efficiency, and even less in new high-efficiency (i.e., combined-cycle) generating units. Thus, as more new power plants opt for natural gas in lieu of coal, acid deposition would be expected to continue to decrease overall (GAO 2013).

Acid Rain Program

FCPP is subject to the Acid Rain Program, as administered by NNEPA and EPA. To achieve this goal in a cost-effective manner, the program employs both traditional command-and-control and innovative market-based approaches for controlling air pollution. The program also encourages energy efficiency and pollution prevention. The Acid Rain Program was developed with consultation from various stakeholders including electric utilities, energy companies, pollution control equipment vendors, labor, academia, public utility commissions, state environmental agencies, and conservation groups. As an affected source, FCPP is a participant in the Acid Rain Program.

The Acid Rain program implements requirements for significant decreases in the emissions of NO_x and SO_2 from power plants to improve air quality and protect ecosystems that have been damaged by acid rain, including aquatic ecosystems. According to the 2011 National Acid Rain Precipitation Assessment Program report, the Acid Rain Program has been successful in reducing NO_x and SO_2 emissions from electric power generation to below levels set by Congress in 1990. By 2009, SO_2 emissions from power plants were 3.25 million tons lower than the final 2010 cap level of 8.95 million tons, and NO_x emissions were 6.1 million tons less than the levels projected for 2000. As a result of these reductions, air quality has improved and acid deposition has decreased to the extent that some acid-sensitive areas are beginning to show signs of recovery. However, current emission reductions pursuant to rules finalized in 2005 are not sufficient to allow full recovery of acid-sensitive ecosystems. Estimates from modeling presented in the National Acid Rain Precipitation Assessment Program report show that additional emission reductions are necessary to protect and recover acid-sensitive ecosystems. However, since the mandated emission reductions have been achieved, no additional reductions in emissions can reasonably be expected from the Acid Rain Program as currently designed (National Science and Technology Council [NSTC] 2011).

FCPP is subject to the principal provisions of the Acid Rain Program, under the authority of the NNEPA and EPA Region IX, respectively. This includes appointing a Designated Representative, filing an Acid Rain

permit application and compliance plan, and monitoring and recording emissions. FCPP is also able to take part in allowance trading, and is required to hold sufficient SO_2 allowances to cover annual emissions (EPA 2013b). These provisions are described in detail in the FCPP/NMEP EIS, Appendix A.

3.5.1.1.6 Federal Prevention of Significant Deterioration Program

PSD (40 CFR 51.166 and 40 CFR 52.21) provides the overall regulatory framework for the permitted operation of FCPP. The PSD Program is designed to:

- Protect public health and welfare;
- Preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreational, scenic, or historic value;
- Ensure that economic growth will occur in a manner consistent with the preservation of existing clean air resources; and,
- Ensure that any decision to permit increased air pollution in any area to which this section applies is made only after careful evaluation of all the consequences of such a decision and after adequate procedural opportunities for informed public participation in the decision making process.

PSD does not prohibit new or existing stationary sources, such as oil refineries, factories, or power plants, from increasing emissions; rather, PSD is designed to ensure that emissions increases would have no significant effect on regional air quality (EPA 2013c).

PSD permitting applies to new major sources or major modifications at existing sources (e.g., FCPP) located in NAAQS attainment or unclassified areas for applicable pollutants. Since FCPP is located in an NAAQS attainment area for all criteria pollutants (see Table 3.5-4), PSD applies to emissions of NO_x, VOC, CO, SO_2, PM_{10}, $PM_{2.5}$, and Pb (EPA 2013c). Details of the requirements of PSD permitting are provided in the FCPP/NMEP EIS, Appendix A.

A recent District of Columbia Circuit Court decision on PSD rules related to $PM_{2.5}$ increments and baselines could affect FCPP in the future. On January 22, 2013, the U.S. Court of Appeals for the District of Columbia Circuit granted a request from the EPA to vacate and remand portions of two PSD $PM_{2.5}$ rules which addressed the Significant Impact Levels so that the EPA could correct errors in the rules. The Court also vacated parts of rules establishing $PM_{2.5}$ Significant Monitoring Concentrations due to regulatory errors. The Court's decision became final on March 15, 2013, and the affected provisions of 40 CFR 51.166 and 52.21 were vacated. The EPA will develop replacement PSD $PM_{2.5}$ rules to correct errors and address the Court's decision (EPA 2013c). On November 26, 2013, EPA issued a good cause final rule to remove elements of the CAA PSD program for fine particle pollution. These elements address air quality modeling and monitoring provisions for fine particle pollution in areas protected by the PSD program.

A PSD permit was required for the major modification at FCPP to meet FIP for BART requirements. APS plans to install SCR NO_x control equipment on FCPP Units 4 and 5 in compliance with 40 CFR 49 BART requirements. However, this part of the BART implementation is beyond the timeframe of this EA, but is addressed in the FCPP/NMEP Final EIS (OSMRE 2015).

3.5.1.1.7 Federal Stationary Source Regulations

The Regional Haze Rule requires the use of BART at older coal-fired power plants to reduce haze and improve visibility. In August 2012, EPA issued its final rule for BART compliance at FCPP. The final rule allows APS the choice in either complying with the EPA's 2010 draft rule or the APS counter-proposal to meet stated NO_x and PM emissions limits. In compliance with the first of the options provided by EPA, APS shut down Units 1, 2, and 3 on December 30, 2013 and plans to install SCR devices on Units 4 and 5 by July 31, 2018.

FCPP Source Specific FIP for Implementing BART

APS notified EPA that it preferred the alternative FIP emissions control strategy. As such, Units 1, 2, and 3 were shut down on December 30, 2013. Thus, emissions from Units 1, 2, and 3 permanently ceased. In addition, APS will install SCR devices on Units 4 and 5 by July 31, 2018; however, this part of the BART implementation is beyond the timeframe of this EA, but is addressed in the FCPP/NMEP EIS (OSMRE 2015).

Title V Operating Permits

Parts 70 and 71 implement Title V of the CAA, 42 USC 7661, et seq. Title V operating permits are legally enforceable documents that permitting authorities issue to major stationary sources of air pollution regulating their emissions. Title V major source thresholds are defined by the NAAQS attainment status of the jurisdiction, with progressively lower (more stringent) thresholds in moderate, serious, severe, and extreme nonattainment areas. Part 70 permits are issued by state and local (county or district) permitting authorities. Part 71 permits are issued either directly by the EPA or through tribal EPAs on sovereign tribal lands. The Part 71 permit for FCPP is issued by the NNEPA.

The current Part 71 permit for FCPP (NN-ROP-05-07) expired August 1, 2013; however, FCPP submitted a permit renewal application on January 25, 2013. FCPP may operate according to their present permit terms and conditions until NNEPA either issues a new permit or denies their renewal application. Section II.A.2 of the permit contains the following enforceable limitations on SO_2, NO_x, PM, and opacity emissions (40 CFR 49.23):

- Minimum 88 percent SO_2 control efficiency (reduction) on a plantwide weighted annual average basis, calculated daily using heat input data (this is stated as a maximum 12 percent post-control residual SO_2 emissions compared to pre-control uncontrolled emissions).
- Maximum 17,900 pounds per hour SO_2 emissions on a plantwide 3-hour rolling average basis.
- Maximum 0.050 lb/mmBTU PM emission rate from any unit, determined by source testing.
- Maximum plume opacity of 20 percent from Units 4 and 5, except for brief periods of not more than 27 percent opacity lasting not more than 6 minutes in an hour.
- Maximum 0.85 lb/mmBTU NO_x emission rate from Units 1 and 2 on a 30-day rolling average basis.
- Maximum 0.65 lb/mmBTU NO_x emission rate from Units 3, 4, and 5 on a 30-day rolling average basis.
- Maximum 335,000 pounds per day NO_x emissions on a plantwide 24-hour basis, discounted by 1,542 pounds per hour for any of Units 1, 2, or 3 not operating and discounted by 4,667 pounds per hour for any of Units 4 or 5 not operating.

Section II.A.3 of the Part 71 permit contains testing and monitoring requirements to quantify the above emissions limitations, and Section II.A.4 contains emissions recordkeeping and reporting requirements. Section II.B incorporates by reference provisions of the Phase II Acid Rain permit (40 CFR Parts 72 and 75). Section II.C defines Compliance Assurance Monitoring (40 CFR Part 64) requirements for monitoring PM emissions from Units 1, 2, 3, 4, and 5 per the above limitation.

Continuous Emissions Monitoring

The FCPP is subject to Part 75 requirements for the monitoring, recordkeeping, and reporting of SO_2, NO_x, CO_2 emissions, volumetric flow, and opacity data from affected units under the Acid Rain Program pursuant to Sections 412 of the CAA, 42 USC 7401-7671, et seq. Part 75 and the GHG Reporting Rule, 40 CFR Part 98 also sets forth provisions for the monitoring, recordkeeping, and reporting of NO_x mass emissions, which are required to be controlled to demonstrate compliance with a NO_x mass emission reduction program. For FCPP, this is consistent with the *Source Specific Federal Implementation Plan for Implementing Best Available Retrofit Technology for Four Corners Power Plant: Navajo Nation.* Under Part 75, operating and emissions records must be retained for a minimum of 5 years.

3.5.1.1.8 Mobile Source Regulations

The EPA regulates mobile sources of air pollution in the state of New Mexico and Navajo Nation via Federal mobile source standards. In most jurisdictions, self-propelled nonroad mining and construction equipment is considered a vehicle, as defined by vehicle codes. Operations at both the FCPP and Navajo Mine are subject to mobile source emissions standards.

A vehicle may have an engine that both propels the vehicle and powers equipment mounted on the vehicle, typically via hydraulics. As such, single-engine vehicles are generally exempt from direct regulation by states, air districts, or sovereign tribes. However, not included in most exemption provisions is any nondriveline engine-powered equipment mounted on a vehicle that would otherwise require a permit under state, air district, or tribal regulations. An example of this dual-engine configuration would be a vacuum street sweeper where an auxiliary engine drives the vacuum blower. Another example would be a mobile crane or drilling rig with an independent hoist or draw-works engine, respectively.

Federal Tier 1 standards for off-road diesel engines were adopted in 1995. Federal Tier 2 and Tier 3 standards were adopted in 2000 and selectively apply to the full range of diesel off-road engine power categories. Both Tier 2 and Tier 3 standards include durability requirements to ensure compliance with the standards throughout the useful life of the engine (40 CFR 89.112).

On May 11, 2004, the EPA signed the final rule implementing Tier 4 emission standards which are to be phased-in over the period of 2008-2015 (69 Federal Register 38957-39273, June 29, 2004). The Tier 4 standards require that emissions of PM and NO_x be further reduced by about 90 percent. Such emission reductions can be achieved through the use of advanced control technologies – including advanced exhaust gas after treatment similar to those required by the 2007-2010 standards for highway diesel engines.

3.5.1.1.9 Subtitle D of the Resource Conservation and Recovery Act

EPA published the *Disposal of Coal Combustion Residuals from Electric Utilities* final rule on December 19, 2014. The final rule regulates CCR as a RCRA Subtitle D solid waste. FCPP is required to comply with EPA's Final Rule, which provides specific deadlines for compliance. EPA issued minimum national criteria,

including requirements for composite liners, groundwater monitoring, structural stability requirements, corrective action, and closure/post closure care. The final rule includes air criteria to address the pollution caused by windblown dust from CCR units and requires owners and operators to minimize CCR from becoming airborne at the facility. The CCR rule (257.80) requires that operators adopt measures that will effectively minimize CCR from becoming airborne at the facility, including CCR fugitive dust originating from CCR units, roads, and other CCR management and material handling activities.

3.5.2 Affected Environment

3.5.2.1 Existing Navajo Mine Sources of Emissions

This section identifies and quantifies baseline air pollutant emissions from permitted activities associated with mining currently taking place at the Navajo Mine and emissions resulting from operations at the FCPP.

Sources of particulate emissions from Area III prior to the Proposed Action have been sub-divided into the categories listed in Table 3.5-2.

Table 3.5-2. Categories of Area III Emission Sources

Categories of Area III Emission Sources
Overburden Drilling and Blasting
Coal Seam Drilling and Blasting
Overburden Dragline Stripping
Mine Extraction Operations and Loading
Coal Haul Truck to Stockpiles
Unloading at Stockpile and Railcar Loading
Plant Vehicle Travel
Wind Erosion – Soil/Overburden Spoil Pile
Wind Erosion – Coal Stockpile
Reclamation – Mine Pit Backfilling, Grading, and Topdressing
Preparation Plant

For each of those categories, the dust-generating nature of each pollutant-emitting activity has been identified and levels of each activity's baseline emissions of PM_{10} and $PM_{2.5}$ have been estimated.

The general equation for emission estimation is:

$$E = A \times EF \times (1-ER/100)$$

where: E = emissions
A = activity rate
EF = emission factor
ER = overall emission reduction efficiency, percent

This general approach (EPA 1995) has been used to calculate estimated PM_{10} and $PM_{2.5}$ emissions from each of the individual pollutant-emitting activities within each of the categories of Area III Emission Sources identified above. The specific emission factor and estimating equation applied for each of the pollutant-emitting activities in Area III of Navajo Mine is identified in Table 3.5-3.

Annual emissions of PM_{10} or $PM_{2.5}$ from a particular pollutant-emitting activity (and NO_x from blasting) are estimated by multiplying the specific PM_{10} or $PM_{2.5}$ (or NO_x) emission factor or equation shown above for that activity times the "rate" at which that particular activity operates. For example, the "rate" for blasting is the number of blasts per year; the "rate" for haul trucks is the annual vehicles miles traveled; the "rate" for unloading and loading is the tons handled per year, etc. The basis for establishing each pollutant-emitting activity's "rate" is detailed in Appendix E along with the emission factor and emission reduction efficiency applied to estimate that activity's emissions.

Table 3.5-3. Emission Factors and Estimating Equations for Pollutant-Emitting Activities

Emission Factor/Equation for Each Pollutant-Emitting Activity
Drilling – overburden (AP-42, § 11.9, Table 11.9-4) TSP, lb/hole = 1.3
Drilling – coal (AP-42, § 11.9, Table 11.9-4) TSP, lb/hole = 0.22
Blasting – coal or overburden (AP-42, § 11.9, Table 11.9-1) PM_{10}, lb/blast = $0.52[0.000014(A)^{1.5}]$, where A = horizontal area (ft^2) $PM_{2.5}$, lb/blast = $0.03[0.000014(A)^{1.5}]$
Blasting – coal or overburden (AP-42, § 13.3, Table 13.3-1 for ANFO) NO_x, lb/ton = 17
Dragline – overburden (AP-42, § 11.9, Table 11.9-1) PM_{10}, lb/yd^3 = $0.75[0.0021(d)^{0.7} / M^{0.3}]$, where d = drop height (ft), M = material moisture content (%) $PM_{2.5}$, lb/yd^3 = $0.017[0.0021(d)^{1.1} / M^{0.3}]$
Haul Trucks – unpaved roads (AP-42, § 13.2.2, Eq'n 1(a)) PM_{10}, lb/VMT = $1.5[(s/12)^{0.9} (W/3)^{0.45}]$, where s = surface material silt content, (%), W = mean vehicle weight (tons) $PM_{2.5}$, lb/VMT = $0.15[(s/12)^{0.9} (W/3)^{0.45}]$
Unloading to Stockpile (AP-42, § 13.2.4, Eq'n 1) PM_{10}, lb/ton = $0.35(0.0032) [(U/5)^{1.3}/(M/2)^{1.4}]$, where U = mean wind speed (mph), M = material moisture content (%) $PM_{2.5}$, lb/ton = $0.053(0.0032) [(U/5)^{1.3} /(M/2)^{1.4}]$
Loading to Railcar (AP-42, § 13.2.4, Eq'n 1) PM_{10}, lb/ton = $0.35(0.0032) [(U/5)^{1.3} / (M/2)^{1.4}]$, where U = mean wind speed (mph), M = material moisture content (%) $PM_{2.5}$, lb/ton = $0.053(0.0032) [(U/5)^{1.3} / (M/2)^{1.4}]$
Wind Erosion (AP-42, § 13.2.5.2, "Emissions and Correction Parameters")

Emission Factor/Equation for Each Pollutant-Emitting Activity
Railcar Unloading (AP-42, § 13.2.4, Eq'n 1) PM_{10}, lb/ton = 0.35(0.0032) $[(U/5)^{1.3} / (M/2)^{1.4}]$, where U = mean wind speed (mph), M = material moisture content (%) $PM_{2.5}$, lb/ton = 0.053(0.0032) $[(U/5)^{1.3} / (M/2)^{1.4}]$
Coal Crushing (AP-42, § 11.19.2) PM_{10}, lb/ton = $PM_{2.5}$, lb/ton = 0.0024
Transfer Points (AP-42, § 13.2.4, Eq'n 1) PM_{10}, lb/ton = 0.35(0.0032) $[(U/5)^{1.3} / (M/2)^{1.4}]$, where U = mean wind speed (mph), M = material moisture content (%) $PM_{2.5}$, lb/ton = 0.053(0.0032) $[(U/5)^{1.3} / (M/2)^{1.4}]$

Note:

SO2 emissions are limited to tailpipe emissions from vehicles and equipment and small quantities associated with blasting. The precise quantities have not been measured from tailpipe emissions but are estimated to be about 2-3 orders of magnitude smaller than NO_x factors, due to prevalence of low-sulfur fuels. SO2 emissions from blasting activities are included in the Appendix E tables.

Diesel engines power most of the mining equipment as well as the coal haul trucks. Those non-road mobile sources emit NO_x, CO, and VOCs. Medium-duty and light-duty gasoline-powered vehicles are used for transportation purposes. Emissions from the diesel-powered and gasoline-powered engines at the mine have been calculated using comprehensive equipment-specific emission factors updated in 2008 for the "1993 CEQA Air Quality Handbook" of the South Coast Air Quality Management District (SCAQMD). Emission calculations based on the particular emission factors applied to the different engines are documented in Appendix E.

The overall amount of PM emitted from a surface coal mine is a function of the quantity of coal the mine produces. During the past several years, Navajo Mine has produced coal from Area III at a nominal annual rate of 8.5 million tons, which declined by about 30 percent after the reduction in mining activity due to reduced coal demand by the FCPP shut-down of Units 1, 2, and 3 at the end of 2013.

Table 3.5-4 provides estimates of annual baseline emissions of PM_{10} and $PM_{2.5}$ from current and recent mining, reclamation, processing, and erosion.

The emissions summaries in Table 3.5-4 include an estimate of the mine's NO_x emissions from its blasting operations as well as estimates of NO_x, CO, and VOCs from the various diesel- and gasoline-powered engines in use at the mine site.

Table 3.5-4. Estimated Annual Baseline Emissions from Area III

Emission Source Category[1]	PM_{10} tons/yr	$PM_{2.5}$ tons/yr	NO_x tons/yr	CO tons/yr	VOC tons/yr
Overburden Drilling and Blasting	3.33	0.96	5.49	21.64	--
Coal Seam Drilling and Blasting	4.82	1.40	62.64	246.9	--
Overburden Dragline Stripping	62.96	5.56	--	--	--

Mine Extraction Operations and Loading	142.6	17.12	133.07	60.86	14.46
Coal Haul Truck to Stockpiles	265.2	26.52	125.54	68.15	14.17
Plant Vehicle Travel	214.6	21.46	35.72	10.44	3.56
Unloading at Stockpile and Railcar Loading	0.71	0.11	--	--	--
Reclamation	128.5	25.70	--	--	--
Preparation Plant (ex. storage piles)	13.89	4.05	--	--	--
Wind Erosion	69.67	25.39	--	--	--
TOTAL - Area III Baseline Emissions	906.3	128.3	362.5	408.0	32.2

Notes:

[1] Listing of the individual emission sources and equipment within each category is shown in Appendix E tables. Equipment roster and "rate" of a particular activity reflect BNCC representative baseline year level for equipment working in Area III. Applicable emission factors or emission equations have been addressed in previous sub-section. All estimates incorporate the control measures outlined in the preceding sub-section. Calculations for each pollutant and category are provided in Appendix E.

[2] Although the magnitude of CO emissions is the same as those for PM_{10}, $PM_{2.5}$ and NO_x, the magnitude of the NAAQS for CO is a hundred times or more greater than the NAAQS for other criteria pollutants. Consequently, compliance with the CO NAAQS for the aggregate level of CO emissions from Navajo Mine and other sources in the AQRA is not an issue.

Note: SO_2 emissions are limited to tailpipe emissions from vehicles and equipment and small quantities associated with blasting. The precise quantities have not been measured from tailpipe emissions but are estimated to be about 2-3 orders of magnitude smaller than NO_x factors, due to prevalence of low-sulfur fuels. SO_2 emissions from blasting activities are included in the Appendix E tables.

3.5.2.2 Existing FCPP Sources of Emissions

Turbine-generator nameplate capacities at FCPP are 170 MW each for Units 1 and 2, 220 MW for Unit 3, and 770 MW each for Units 4 and 5. The boilers are rated at 2,551 mmBTU[1]/hr each for Units 1 and 2, 3,387 mmBTU/hr for Unit 3, and 8,612 mmBTU/hr each for Units 4 and 5. Total installed generator capacity is 2,100 MW and combined boiler ratings are 25,713 mmBTU/hr.

Air pollution control equipment installed on FCPP Units 4 and 5 consists of baghouses (fabric filters) for PM (fly ash) control, low-NO_x burners designed to reduce NO_x emissions, and caustic wet scrubbers (i.e., FGD) which use hydrated lime (calcium hydroxide) in solution to control SO_2 and acid gases via absorption. Unit 4 and 5 FGD absorber systems went into service in 1985 and in 2004-2005 APS undertook a voluntary trial to increase SO_2 removal. The FGD system consists of 10 100-foot tall absorber towers for reduction of SO_2 and acid gases to base salts (e.g., calcium sulfate, calcium chloride). Mercury is incidentally captured by the baghouses and FGD. During operation, boiler exhaust (flue gas) passes through the baghouses and then FGD before being released to the atmosphere via the auxiliary stacks, bypassing the original Units 4 and 5 stacks. The Units 4 and 5 baghouses trap over 99 percent of PM and FGD removes approximately 90 percent of SO_2 from the flue gas.

The following summarizes stationary sources of emissions from the FCPP. For the representative 12-year[2] period 2000 to 2011, Table 3.5-5 shows historic plantwide generation (MW-hrs per year), SO_2 and NO_x emissions (short tpy), and emission rates (kilograms per megawatt hour [kg/MW-hr], same as grams per

[1] British Thermal Unit (BTU): the amount of heat required to raise the temperature of 1 pound of water 1°F, from 39 to 40°F

[2] The Title V recordkeeping requirement is 5 years.

kilowatt hour) from FCPP Units 1, 2, 3, 4, and 5, as reported to EPA pursuant to the CAA. Emissions of PM are estimated by applying EPA emission factors as noted.

Table 3.5-5. Historic Aggregated Part 75 Emissions - ORISPL 2442 Units 1, 2, 3, 4, and 5

Year	Generation MW-hrs/yr	Sulfur Dioxide tons/yr	Sulfur Dioxide kg/MW-hr	Nitrogen Oxides tons/yr	Nitrogen Oxides kg/MW-hr	Particulate Matter tons/yr	Particulate Matter kg/MW-hr
2000	16,109,134	38,332	2.16	46,513	2.62	2,107	0.12
2001	16,472,108	39,564	2.18	47,300	2.60	2,170	0.12
2002	14,768,989	32,847	2.02	41,577	2.55	1,972	0.12
2003	16,857,882	35,094	1.89	45,197	2.43	1,998	0.11
2004	16,134,118	20,943	1.18	40,742	2.29	1,964	0.11
2005	16,829,089	12,653	0.68	41,743	2.25	2,051	0.11
2006	17,162,615	15,192	0.80	44,649	2.36	2,040	0.11
2007	15,700,442	10,239	0.59	41,083	2.37	1,979	0.11
2008	15,821,299	10,398	0.60	40,311	2.31	1,969	0.11
2009	16,804,764	12,450	0.67	42,511	2.29	2,030	0.11
2010	14,955,046	11,043	0.67	38,837	2.36	1,908	0.12
2011	15,066,283	11,822	0.71	38,712	2.33	1,852	0.11
Historic Baseline	16,048,505	11,971	0.68	41,121	2.32	1,976	0.11
Plantwide Share	100%	100%	—	100%	—	100%	—

Source: EPA 2012b.

Notes:

PM calculated per AP-42 Chapter 1.1 support document Tables 4-7 and A-3; Title V permit condition (Units 1, 2, and 3); 40 CFR 49 final rule (Units 4 and 5).

Baseline period is 2005-11 (flue gas desulfurization, FGD, installed on Units 4 and 5).

Projected future emissions from FCPP and regional plants are estimated in Section 4.5.2.5 referencing the 7-year historic baseline period of 2005 to 2011 when FGD became active on Units 4 and 5. It is necessary to define this historic baseline period because FGD affects boiler performance by a small amount, mainly due to increased exhaust back-pressure. In turn, this affects turbine-generator output by a small amount.

Mobile sources associated with FCPP include materials handling equipment, maintenance equipment, and support vehicles, as well as employee personal vehicles. Similar to the Navajo Mine, the dominant fuel used for mobile sources is diesel fuel and some gasoline. Emissions of fugitive dust occur through earthmoving activities and unpaved road travel within the FCPP lease area. Table 3.5-6 below displays estimated criteria emissions from mobile sources at FCPP.

Table 3.5-6. Estimated Criteria Emissions from FCPP Mobile Sources

Mobile Sources	VOC tons/yr	CO tons/yr	NO_X tons/yr	SO_X tons/yr	PM_{10} tons/yr	$PM_{2.5}$ tons/yr
Power Plant Off-road Equipment	0.31	3.69	2.05	0.004	0.13	0.11
Power Plant On-road Vehicles	0.11	0.76	0.86	0.002	0.04	0.03

Mobile Sources	VOC tons/yr	CO tons/yr	NO_X tons/yr	SO_X tons/yr	PM_{10} tons/yr	$PM_{2.5}$ tons/yr
Annual Totals	**0.42**	**4.46**	**2.90**	**0.006**	**0.16**	**0.14**

Sources: APS 2012, EPA 2011a, SCAQMD 2008.

Notes:

PM_{10} and $PM_{2.5}$ for exhaust only, fugitive dust accounted for in BNCC FONSI.

CO = carbon monoxide

NO_X = nitric oxide

PM_{10} = particulate matter having an aerodynamic diameter of 10 microns or less

$PM_{2.5}$ = particulate matter having an aerodynamic diameter of 2.5 microns or less

SO_X = sulfur oxide

tons/yr = tons per year

VOC = volatile organic compound

In addition to criteria pollutants, HAP emissions from coal combustion are estimated based on historic operating data for Units 1, 2, 3, 4, and 5 and projected future utilization of Units 4 and 5 using EPA emission factors (EPA 2011a, 40 CFR 63 Subpart UUUUU). Coal combustion in power plant boilers emits a wide variety of inorganic and organic HAPs. Tables 3.5-7 and 3.5-8 show estimated average annual HAP emissions from FCPP based on historic (pre-Project) operating data prior to implementation of 40 CFR 63 Subpart UUUUU for Units 1, 2, 3, 4, and 5.

Table 3.5-7. Estimated Historic HAP Metals Emissions - ORISPL 2442

HAP (Metals)	2000-11 Units 1 – 5 Average lbs/yr
Antimony (Sb)	156
Arsenic (As)	3,552
Beryllium (Be)	182
Cadmium (Cd)	442
Chromium (Cr)	2,252
Cobalt (Co)	866
Copper (Cu)	4,938
Lead (Pb)	3,639
Manganese (Mn)	4,245
Mercury (Hg)	719
Nickel (Ni)	2,426
Selenium (Se)	11,262
Average FCPP Generation (MW-hrs/yr)	**16,056,814**

Table 3.5-8. Estimated Historic HAP Nonmetals Emissions - ORISPL 2442

HAP (Organics and Inorganics)	2000-11 Units 1 – 5 Average lbs/yr
Acetaldehyde	4,938
Acetophenone	130
Acrolein	2,512
Benzene	11,262
Benzyl chloride	6,064
Bis (2-ethylhexyl)phthalate (DEHP)	632
Carbon disulfide	1,126
Chlorobenzene	191
Chloroform	511
Cyanide	21,659
2,4-Dinitrotoluene	2
Ethyl benzene	814
Ethyl chloride	364
Formaldehyde	2,079
Hexane	580
Hydrogen chloride	10,396,140
Hydrogen fluoride	1,299,518
Isophorone	5,025
Methyl bromide	1,386
Methyl chloride	4,592
Methyl ethyl ketone	3,379
Methylene chloride	2,512
PAHs (composite total)	180
Phenol	139
Propionaldehyde	3,292
Tetrachloroethylene	373
Toluene	2,079
Styrene	217
Xylenes (o,m,p)	321
Average Generation (MW-hrs/yr)	16,056,814

3.5.2.3 Other Existing Sources within the AQRA

Navajo Mine is located in the north central portion of San Juan County. Such large stationary sources as FCPP and SJGS emit substantial amounts of NO_x and SO_2, along with PM_{10} and $PM_{2.5}$. The remaining stationary sources in the region are predominantly oil and gas development and production facilities, which emit mainly NO_x and VOCs along with some SO_2, PM_{10}, and $PM_{2.5}$. Such mobile sources as light motor vehicles, diesel powered construction equipment, and commercial trucks used in the region are another source of these pollutants. Non-combustion sources of PM_{10} and $PM_{2.5}$ include fugitive dust from roads, construction, demolition, and earthmoving, as well as wind-blown dust and forest fires. Finally, commercial and general aviation aircraft operating at nearby airports generate emissions that affect air quality.

Point source emissions of NO_x in San Juan County are dominated by the contributions from FCPP (45,000 tpy) and SJGS (21,000 tpy) (76 Federal Register 10,536; 76 Federal Register 500-01). However, area sources of NO_x emissions, especially from oil and gas production, are also significant in San Juan County. In 2006, San Juan County alone, exclusive of tribal lands, contained almost 8,300 conventional gas wells, over 3,100 coal-bed-methane wells, and 451 conventional oil wells. Another 300+ wells, mostly conventional oil and gas, were located on tribal lands within San Juan County (Environ 2009). Emissions from those extensive oil and gas operations are estimated to be 27,500 tpy NO_x and 32,700 tpy VOCs. NO_x emissions from FCPP, SJGS and oil and gas operations in San Juan County dwarf the nominal 360-tpy annual NO_x emissions from Navajo Mine.

3.5.2.4 Ambient Air Quality Related to Navajo Mine Emissions

OSMRE regulations (30 CFR 780.15) require NTEC to perform air quality monitoring to evaluate the effectiveness of the fugitive dust control measures that the mine implements. NTEC currently operates an air quality monitoring network consisting of five PM_{10} monitoring stations located in the vicinity of existing mining activities and field stockpiles. Quarterly data summary reports are submitted to OSMRE's Indian and Federal Programs Team and to NNEPA.

Quarterly summaries of calendar year 2010 results from the mine's PM_{10} monitoring network are shown in Table 3.5-10. By their nature, monitoring data reflect a contribution of particulate matter from multiple sources within and near the AQRA. By design, the PM_{10} monitoring results at Navajo Mine primarily reflect fugitive dust from mining operations, wind erosion of disturbed areas including stockpiles, and haul road traffic.

Table 3.5-10. Navajo Mine PM_{10} Monitoring Data

Navajo Mine Ambient Air Monitoring Sampler	1st Quarter 2010 Max 24-hr PM_{10} (µg/m³)	1st Quarter 2010 Avg 24-hr PM_{10} (µg/m³)[1]	2nd Quarter 2010 Max 24-hr PM_{10} (µg/m³)	2nd Quarter 2010 Avg 24-hr PM_{10} (µg/m³)[1]	3rd Quarter 2010 Max 24-hr PM_{10} (µg/m³)	3rd Quarter 2010 Avg 24-hr PM_{10} (µg/m³)[1]	4th Quarter 2010 Max 24-hr PM_{10} (µg/m³)	4th Quarter 2010 Avg 24-hr PM_{10} (µg/m³)[1]
NM-01	21	10.9	129	27.3	27	15.0	20	10.0
NM03-1	74	20.4	140	58.7	129	65.5	91	29.8
NM04-B NM04/4C	267 [2]	39.9	118	63.9	388 [3]	94.1	75	26.7
NM06	45	19.7	164 [2]	66.6	93	32.7	149	32.2
NM07	38	11.1	90	30.7	94	36.2	19	9.7

Source: BNCC 2010b.

Notes:
[1] Reported average is the arithmetic mean concentration of the all valid samples.
[2] The listed maximum 24-hour value represents the single sample that exceeded NAAQS during the quarter.
[3] The NAAQS was exceeded for two samples during the quarter; the second highest sample was 187 µg/m³.

Measured concentrations of PM_{10} near the mine's boundary are consistently lower than the applicable NAAQS. A small number of elevated concentrations noted in Table 3.5-10 are attributable to coinciding high wind events and/or movement of large equipment in close proximity to monitoring stations.

In accordance with CAA, the State of New Mexico operates a network of air quality monitoring stations designated as State and Local Air Monitoring Stations or "SLAMS," which measure ambient concentrations of pollutants for which a NAAQS has been promulgated. In the geographic area surrounding the AQRA there are relatively few monitoring stations to characterize the local air quality. The NMED operates four SLAMS monitoring sites in San Juan County. Table 3.5-11 indicates the location of each SLAMS site, its approximate distance and direction from Navajo Mine's Area III boundary, and the criteria pollutants monitored at each site (NMED 2008).

Table 3.5-11. NMED Ambient Air Monitoring Stations in San Juan County

Station ID	Location Relative to Area III Boundary	Pollutants Monitored
Farmington	20 km ENE (12.4 mi.)	PM_{10}, $PM_{2.5}$
Shiprock	28 km NNE (17.4 mi.)	SO_2, NO, NO_2, O_3
Bloomfield	41 km ENE (25.4 mi.)	SO_2, NO, NO_2, O_3
Navajo Lake	89 km ENE (55.5 mi.)	$PM_{2.5}$, NO, NO_2, O_3

Table 3.5-11 shows that ambient levels of PM near the AQRA are monitored only at two of the four SLAMS sites. Consequently, the regional air quality with respect to particulate concentrations is sparsely monitored. Based on the most recent ambient PM_{10} and $PM_{2.5}$ monitoring data from the Farmington station that are reported on EPA's AirData website, Table 3.5-12 and Table 3.5-13 compare the second-highest short-term and highest annual observed concentrations to the applicable NAAQS for three recent representative years (EPA 2011c).

Table 3.5-12. Measured PM_{10} (µg/m^3), NMED Farmington SLAMS

Year	24-Hour Values 2nd Highest	24-Hour Values NAAQS	Annual Values Mean	Annual Values NAAQS
2008	37	150	18	50
2007	29	150	15	50
2006	29	150	16	50

Table 3.5-13. Measured $PM_{2.5}$ (µg/m^3), NMED Farmington SLAMS

Year	24-Hour Values 2nd Highest	24-Hours Values NAAQS	Annual Values Mean	Annual Values NAAQS
2008	14.4	35	5.91	15.0
2007	15.5	35	5.96	15.0
2006	12.0	35	6.06	15.0

The state's monitoring data indicate that actual ambient levels of PM_{10} and $PM_{2.5}$ in the Farmington area consistently remain well below the applicable NAAQS on both a short-term and long-term basis. EPA has previously concluded that measurements from the Farmington monitors are "regionally representative" of air quality throughout the general Four Corners area (EPA undated). However, as indicators of regional background concentrations, measurements from the Farmington SLAMS site are not expected to be representative of ambient levels of PM_{10} and $PM_{2.5}$ closer to sources of particulate matter emissions in the AQRA.

The SLAMS monitoring station closest to Navajo Mine is the San Juan Substation site in Shiprock, approximately 17 miles northeast of Navajo Mine. Table 3.5-14 summarizes ambient concentrations of SO_2, NO_2, and O_3 observed at that site during 2008-2010. This station does not include particulate monitoring. In general, measured ambient levels of SO_2 and NO_2 from the station have confirmed consistent satisfaction of the NAAQS for those pollutants.

Table 3.5-14. Monitored Ambient Air Data – NMED San Juan Substation

Pollutant and Basis	NAAQS[1]	2008	2009	2010
SO_2 ppm, Max 24-hr Avg.	0.14	0.0038	0.0050	0.0029
SO_2ppm, Annual Avg.	0.03	0.00047	0.00055	0.00035
NO_2 ppm, Max 1-hr Avg.	0.100	0.043	0.045	0.051
NO_2 ppm, Annual Avg.	0.053	0.019	0.018	0.020
Ozone ppm, Max 8-hr Avg. [2]	0.075 (0.070)	0.071	0.063	0.069

Source: NMED 2011a.

Notes:

[1] All NAAQS values are listed in units of ppm to facilitate their comparisons to NMED results, as reported.

[2] Compliance with the O_3 NAAQS is determined using the 3-year average of the fourth-highest daily maximum 8-hour average O_3 concentration measured at each monitor within an area over each year. On October 1, 2015, the EPA lowered the 8-hour NAAQS for ground-level ozone from 0.075 to 0.070 ppbv based on extensive scientific evidence about the effects of ozone on public health and welfare (Federal Register 65292).

Over the last several years, measured levels of ambient O_3 at all three SLAMS sites in San Juan County have been increasing. Although the state has recommended to EPA that San Juan County be designated as attainment for the revised 2008 O_3 NAAQS, trends in measured O_3 levels in the county will be closely watched in the future (NMED 2008), now with regard to the new 0.070 ppbv 8-hour federal ozone standard.

3.5.2.5 Ambient Air Quality Related to FCPP Emissions

Air quality is affected by a variety of sources in the Project Area. Large stationary sources such as FCPP and SJGS emit substantial amounts of NO_x and SO_2, along with PM_{10} and $PM_{2.5}$. Oil and gas production facilities in the region emit mainly NO_x and VOCs along with some SO_2, PM_{10}, and $PM_{2.5}$. Light motor vehicles, diesel-powered construction equipment, and commercial trucks used in the region are another source of these pollutants. Non-combustion sources of PM_{10} and $PM_{2.5}$ include fugitive dust from roads, construction, demolition, and earthmoving, as well as wind-blown dust and forest fires. Finally, commercial and general aviation aircraft operating at nearby airports generate emissions that affect air quality.

Ozone is a secondary pollutant that is not emitted directly by sources, but rather is formed by a reaction between NO_x and VOCs in the presence of sunlight. Reductions in O_3 concentrations are dependent upon reducing emissions of these precursors. Principal sources of O_3 precursors are motor vehicles and other mobile equipment (including agricultural equipment), solvent use, petroleum industry activities, nonelectric agricultural water pumping, and electric utilities operation such as power plant boilers. Another secondary pollutant is condensable $PM_{2.5,}$ which is formed by precursors SO_2, NO_x, VOCs, and ammonia (California Air Resources Board [CARB] 2005). Condensable $PM_{2.5}$ is a principal driver of regional haze (visibility degradation); therefore, reductions in regional levels of NO_x and SO_2 would also reduce the amount of haze.

The NMED, Navajo Nation, Southern Ute Indian Tribe, Colorado Department of Public Health and Environment, U.S. Forest Service (USFS), and National Park Service (NPS) in combination operate an extensive regional air monitoring network composed of 17 stations that collectively measure the ambient concentrations of six criteria air pollutants: O_3, NO_2, SO_2, CO, PM_{10}, and $PM_{2.5}$. Not all monitoring stations are fully instrumented for these pollutants, while some sites have not been operating for adequate periods of time to provide representative data for determination of attainment status. In addition, one site measures Pb

and sulfate (SO_4) within total suspended particulate matter (TSP). Each site listed in Table 3.5-15 and shown on Figure 4.1-2 is categorized by the monitoring program it operates under (EPA 2012c):

- SLAMS (New Mexico, Colorado)
- Tribal Monitors (Navajo Nation, Southern Ute Indian Tribe)
- Non-EPA Federal Monitors (USFS, NPS)
- Special Purpose Monitors (Colorado)
- Interagency Monitoring of Protected Visual Environments (IMPROVE) (NPS)

Data collected by the various monitoring programs is ultimately reported to the EPA, which oversees the programs and provides technical support, quality assurance, data processing, and public access (EPA 2012c). Ambient air monitoring data summaries are presented in Table 3.5-15.

3.5.2.6 Regional Haze

Regional haze has been an air quality issue in Class I areas throughout the southwestern U.S., including those closest to the AQRA. In the 1977 Amendments to the CAA, Congress established a national goal of having no man-made visibility impairment in any mandatory Class I Federal area. Sixteen mandatory Federal Class I areas are within roughly 300 kilometers of Navajo Mine. The nearest such area, Mesa Verde National Park, is located in southwestern Colorado approximately 62 kilometers from the mine. The next two Class I areas closest to Navajo Mine are the Weminuche Wilderness Area in Colorado (137 kilometers) and the San Pedro Parks Wilderness Area in New Mexico (160 kilometers) (75 Federal Register 64, 229-30). Regional haze conditions in the closest Class I areas can be affected by emission from the coal-fired power plants nearest to the AQRA, more so than the operation of the ground-level particulate sources operated at the Navajo Mine.

Under the Federal regional haze rule (30 CFR 51.308), each state was required to submit its initial regional haze SIP to EPA by December 17, 2007. The compliance-planning period for those first SIPs extends through July 2018. The Navajo Nation has not elected to develop a regional haze TIP. Therefore, EPA has decided to implement the regional haze program on the Navajo Reservation for the first regional haze planning period by proposing source-specific requirements. EPA has proposed to implement the BART requirement for FCPP by obtaining major NO_x emission reductions from all five electric generating units at that source. In addition, NMED adopted a regional haze SIP for the SJGS, including a NO_x BART requirement for each unit (NMED 2011b).

Because the majority of particulate emissions from surface coal mines are larger particles emitted at or near ground level with little or no buoyancy, surface coal mines are not the typical contributors to visibility impairment at distant locations. Surface coal mines were not one of the stationary source categories for which Congress specifically required BART. Nevertheless, during one of the future planning periods for regional haze, EPA may elect to evaluate Navajo Mine's particulate emissions to assess whether they contribute to visibility impairment in any mandatory Federal Class I area.

Table 3.5-15. Ambient Monitoring Site Descriptions and Parameters – Four Corners Region

Site ID Code	State	County	Location	North Latitude	West Longitude	Type of Site	Reporting Agency	Criteria Pollutants Monitored O_3	Criteria Pollutants Monitored NO_2	Criteria Pollutants Monitored SO_2	Criteria Pollutants Monitored CO	Criteria Pollutants Monitored PM_{10}	Criteria Pollutants Monitored $PM_{2.5}$	Criteria Pollutants Monitored Other
35-45-0006	New Mexico	San Juan	Farmington	36.727500	-108.220833	SLAMS	NMED				X	X	X	
35-45-0008	New Mexico	San Juan	Farmington	36.735833	-108.238333	SLAMS	NMED			X				
35-45-0009	New Mexico	San Juan	Bloomfield	36.742222	-107.976944	SLAMS	NMED	X	X	X				
35-45-0014	New Mexico	San Juan	Kirtland (near FCPP)	36.708333	-108.500278	SLAMS	NMED		X	X				
35-45-0017	New Mexico	San Juan	Shiprock	36.752778	-108.716667	SLAMS	NMED			X		X		
35-45-0018	New Mexico	San Juan	Navajo Dam	36.809730	-107.651580	SLAMS	NMED	X	X				X	
35-45-0019	New Mexico	San Juan	Farmington	36.774162	-108.165034	SLAMS	NMED					X	X	
35-45-1005	New Mexico	San Juan	Farmington	36.796667	-108.472500	SLAMS	NMED	X	X	X				
35-45-1223	New Mexico	San Juan	Shiprock (Diné College)	36.807100	-108.695230	Tribal	Navajo	X	X	X		X		
08-67-1004	Colorado	La Plata	Weminuche Wilderness	37.303890	-107.484167	Federal	USFS	X	X					
08-67-7001	Colorado	La Plata	Pine River Valley	37.136780	-107.628630	Tribal	S. Ute	X	X		X	X	X	
08-67-7002	Colorado	La Plata	La Plata River Plateau	37.096389	-108.183333	Tribal	S. Ute	X	X					
08-67-7003	Colorado	La Plata	Animas River Valley Rim	37.102580	-107.870219	Tribal	S. Ute	X	X			X	X	
08-83-0005	Colorado	Montezuma	Mesa Verde NP	37.203611	-108.491944	SLAMS	CDPHE							X

Site ID Code	State	County	Location	North Latitude	West Longitude	Type of Site	Reporting Agency	Criteria Pollutants Monitored O_3	Criteria Pollutants Monitored NO_2	Criteria Pollutants Monitored SO_2	Criteria Pollutants Monitored CO	Criteria Pollutants Monitored PM_{10}	Criteria Pollutants Monitored $PM_{2.5}$	Criteria Pollutants Monitored Other
08-83-0006	Colorado	Montezuma	Cortez	37.350054	-108.592334	Special	CDPHE	X					X	
08-83-0101	Colorado	Montezuma	Mesa Verde NP	37.198333	-108.490278	Federal	NPS	X						
08-83-9000	Colorado	Montezuma	Mesa Verde NP	37.198413	-108.491357	IMPROVE	NPS					X	X	

Source: EPA 2012c.

Notes:

CDPHE = Colorado Department of Public Health and Environment
CO = carbon monoxide
Federal = Non-EPA Federal Monitors (USFS, NPS)
IMPROVE = Interagency Monitoring of Protected Visual Environments (NPS)
NMED = New Mexico Environment Department
NO_2 = nitrogen dioxide
NPS = National Park Service
O_3 = ozone
PM_{10} = particulate matter having an aerodynamic diameter of 10 microns or less
$PM_{2.5}$ = particulate matter having an aerodynamic diameter of 2.5 microns or less
SLAMS = EPA State and Local Air Monitoring Stations (New Mexico, Colorado)
SO_2 = sulfur dioxide
Special = Special Purpose Monitors (Colorado)
Tribal = Tribal Monitors (Navajo Nation, Southern Ute Indian Tribe)
USFS = U.S. Forest Service

Site 08-83-0005 monitored Total Suspended Particulate, Lead, and Sulfate in 1996 (as Other)

The role of regional transport of fine particles and aerosols which contribute to elevated PM levels and regional haze impairment has been well-documented through decades of research. Data from the IMPROVE network (described below) shows that chronic visibility impairment occurs at most national park, national monument, and wilderness area monitoring sites in the west. Average visual range in many Class I areas in the west is 60 to 90 miles (100 to 150 kilometers) equivalent to 13.6 to 9.6 deciviews[1], or about 50 to 70 percent of the visual range that would exist without anthropogenic air pollution from stationary and mobile sources (64 Federal Register 35714). Tables 3.5-16 through 3.5-22 provide historic O_3 and O_3 precursor levels in the Four Corners Region. Table 3.5-23a shows trends in regional visibility over the same time period.

Visibility conditions are presented by individual park or wilderness areas in Table 3.5-23b to show how conditions vary geographically. Deciviews have steadily decreased; thus, regional visibility has improved during the 11-year period (Figure 3.5-2), apparently due to improved control of air pollution from sources such as power plants. Thus, progress is being achieved toward the future goal of the Regional Haze Rule; i.e., achieving natural conditions by 2060.

3.5.2.7 Atmospheric Deposition / Acid Rain

Atmospheric deposition transfers air pollutants such as NO_x, SO_2, and mercury from the air to the earth's surface and affects water quality due to precipitation runoff into waterbodies. Nitrogen compounds such as ammonia contribute to nutrient over-enrichment (i.e., algae blooms) which can result in oxygen depleted areas known as "dead zones," where fish and other organisms cannot survive. Once in water, mercury becomes concentrated in fish and can harm the health of individuals who consume these fish, particularly children. Further, acid rain threatens certain aquatic ecosystems, especially in high-altitude mountain lakes and streams with limited buffering capacity (EPA 2013d, GAO 2013).

Nitrogen oxides react with moisture and oxygen in the atmosphere to form nitric acid, nitrates, and nitrites, while SO_2 reacts to form H_2SO_4, sulfates, and sulfites. Other inorganic pollutants include ammonium ion, chloride ion, light metals such as beryllium, calcium, magnesium, potassium, and sodium, and heavy metals such as antimony, arsenic, cadmium, chromium, cobalt, copper, Pb, manganese, mercury, nickel, and selenium. Organic pollutants can include polychlorinated biphenyls (PCBs) and PAHs, both of which are carcinogenic, along with some metals listed above.

[1] One deciview represents the minimal perceptible change in visibility to the human eye and is proportional to the logarithm of the light extinction coefficient. As such, it is linear with respect to perceived visual changes over its entire range, analogous to the decibel scale for sound. A 1 dv change represents about a 10 percent change in the extinction coefficient. The higher the deciview value, the poorer the visibility.

Table 3.5-16. Historic Ozone Trends

Site ID Code	Averaging Time	Standard (ppbv)	MVP ppbv 1990s	MVP ppbv 2000	MVP ppbv 2001	MVP ppbv 2002	MVP ppbv 2003	MVP ppbv 2004	MVP ppbv 2005	MVP ppbv 2006	MVP ppbv 2007	MVP ppbv 2008	MVP ppbv 2009	MVP ppbv 2010	MVP ppbv 2011	3-Year Trend	Meet Std.
35-45-0009	8-hour 4th max	75	—	79	74	76	73	68	75	63	69	63	52	65	66	61	Yes
35-45-0009	1-hour 1st max	—	—	96	94	91	89	78	87	79	80	76	60	77	77	77	—
35-45-0018	8-hour 4th max	75	—	—	—	—	—	—	—	79	79	69	62	69	74	68	Yes
35-45-0018	1-hour 1st max	—	—	—	—	—	—	—	—	104	94	83	75	80	90	90	—
35-45-1005	8-hour 4th max	75	—	80	74	75	75	69	72	71	73	69	59	63	68	63	Yes
35-45-1005	1-hour 1st max	—	—	93	87	87	91	80	88	93	86	82	69	80	75	80	—
35-45-1233	8-hour 4th max	75	—	—	—	—	—	—	—	—	—	—	—	185	63	—	—
35-45-1233	1-hour 1st max	—	—	—	—	—	—	—	—	—	—	—	—	422	79	—	—
08-67-1004	8-hour 4th max	75	—	—	—	—	—	67	75	74	69	69	71	74	77	74	Yes*
08-67-1004	1-hour 1st max	—	—	—	—	—	—	86	91	92	79	81	93	83	86	93	—
08-67-7001	8-hour 4th max	75	—	63	52	60	62	63	—	—	58	67	65	68	72	68	Yes
08-67-7001	1-hour 1st max	—	—	77	68	69	75	77	—	—	77	78	76	77	90	90	—
08-67-7002	8-hour 4th max	75	69	—	—	—	—	—	—	—	—	—	—	—	—	—	—
08-67-7002	1-hour 1st max	—	82	—	—	—	—	—	—	—	—	—	—	—	—	—	—
08-67-7003	8-hour 4th max	75	—	61	51	55	60	60	66	63	71	67	66	67	69	67	Yes
08-67-7003	1-hour 1st max	—	—	85	66	75	70	68	77	92	86	80	78	83	88	88	—
08-83-0006	8-hour 4th max	75	—	—	—	—	—	—	—	—	—	64	64	64	71	66	Yes
08-83-0006	1-hour 1st max	—	—	—	—	—	—	—	—	—	—	78	77	88	86	88	—
08-83-0101	8-hour 4th max	75	—	73	65	70	67	69	76	74	70	69	69	66	70	68	Yes
08-83-0101	1-hour 1st max	—	—	96	77	80	88	80	88	94	77	75	81	87	81	87	—

Sources: EPA 2012c, d.

Notes: Standards are 2012 NAAQS, including ozone (75 ppbv); 1990s data are 1994 (08-67-7002); 8-hour trend is 3-year average of most recent data (4th highest daily maximum); 1-hour trend is 3-year maximum of most recent data (1st highest daily maximum); Site 35-45-1233 certification is not required, or the state [or tribe] has not certified to the EPA that the underlying raw data are complete and accurate.
MVY = Measured Values by Year ppbv = parts per billion by volume (cc/10^3 m^3) * notwithstanding historic timeframe, new (2015) 70 ppbv ozone standard exceeded.

Table 3.5-17. Historic Nitrogen Dioxide Trends

Site ID Code	Averaging Time	Standard (ppbv)	MVY ppbv 1990s	MVY ppbv 2000	MVY ppbv 2001	MVY ppbv 2002	MVY ppbv 2003	MVY ppbv 2004	MVY ppbv 2005	MVY ppbv 2006	MVY ppbv 2007	MVY ppbv 2008	MVY ppbv 2009	MVY ppbv 2010	MVY ppbv 2011	3-Year Trend	Meet Std.
35-45-0009	1-hour	100	—	39	41	45	44	41	39	43	45	44	36	41	44	40	Yes
35-45-0009	Annual Mean	53	—	24	25	29	26	25	25	28	30	27	27	27	26	27	Yes
35-45-0014	1-hour	100	49	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35-45-0014	Annual Mean	53	20	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35-45-0018	1-hour	100	—	—	—	—	—	—	49	45	47	37	40	37	40	39	Yes
35-45-0018	Annual Mean	53	—	—	—	—	—	—	34	25	23	21	20	21	20	20	Yes
35-45-1005	1-hour	100	—	44	42	41	55	40	39	59	44	35	35	40	36	37	Yes
35-45-1005	Annual Mean	53	—	22	22	22	25	21	22	27	24	19	18	20	19	19	Yes
35-45-1233	1-hour	100	—	—	—	—	—	—	—	—	—	—	—	32	34	—	—
35-45-1233	Annual Mean	53	—	—	—	—	—	—	—	—	—	—	—	16	18	—	—
08-67-1004	1-hour	100	—	—	—	—	—	14	18	17	19	13	16	16	21	18	Yes
08-67-1004	Annual Mean	53	—	—	—	—	—	5	5	5	5	5	5	5	5	5	Yes
08-67-7001	1-hour	100	—	27	30	19	30	14	29	26	35	30	47	35	33	38	Yes
08-67-7001	Annual Mean	53	—	22	22	22	25	21	22	27	24	19	18	20	19	19	Yes
08-67-7002	1-hour	100	23	—	—	—	—	—	—	—	—	—	—	—	—	—	—
08-67-7002	Annual Mean	53	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—
08-67-7003	1-hour	100	—	38	45	39	42	37	41	40	42	37	37	39	38	38	Yes
08-67-7003	Annual Mean	53	—	18	18	18	19	19	19	18	17	16	16	14	15	15	Yes

Sources: EPA 2012c, d.

Notes:

Standards are 2012 NAAQS; 1990s data are 1994 (35-45-0014) (08-67-7002); 1-hour trend is 3-year average of most recent data (98th percentile); Annual trend is 3-year average of most recent data (annual mean)

MVY = Measured Values by Year

ppbv = parts per billion by volume (cc/103 m3)

Table 3.5-18. Historic Sulfur Dioxide Trends

Site ID Code	Averaging Time	Standard (ppbv)	MVY ppbv 1990s	MVY ppbv 2000	MVY ppbv 2001	MVY ppbv 2002	MVY ppbv 2003	MVY ppbv 2004	MVY ppbv 2005	MVY ppbv 2006	MVY ppbv 2007	MVY ppbv 2008	MVY ppbv 2009	MVY ppbv 2010	MVY ppbv 2011	3-Year Trend	Meet Std.
35-45-0008	1-hour	75	—	37	30	28	31	—	—	—	—	—	—	—	—	30	Yes
35-45-0008	3-hour	500	—	26	31	56	21	—	—	—	—	—	—	—	—	56	Yes
35-45-0009	1-hour	75	—	23	30	20	18	22	18	15	5	4	5	6	9	7	Yes
35-45-0009	3-hour	500	—	19	24	36	17	26	20	13	4	4	5	4	8	8	Yes
35-45-0014	1-hour	75	141	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35-45-0014	3-hour	500	130	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35-45-0017	1-hour	75	78	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35-45-0017	3-hour	500	32	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35-45-1005	1-hour	75	—	182	86	73	96	78	82	74	75	20	25	14	20	20	Yes
35-45-1005	3-hour	500	—	144	58	61	90	58	124	45	83	16	20	10	37	37	Yes
35-45-1233	1-hour	75	—	—	—	—	—	—	—	—	—	—	—	163	136	—	—
35-45-1233	3-hour	500	—	—	—	—	—	—	—	—	—	—	—	175	54	—	—

Sources: EPA 2012c, d.

Notes:

Standards are 2012 NAAQS.

1990s data are 1994 (35-45-0014) and 1998 (35-45-0017).

1-hour trend is 3-year average of most recent data (99th percentile).

3-hour trend is 3-year maximum of most recent data (not to be exceeded).

Site 35-45-1233 certification is not required, or the state [or tribe] has not certified to the EPA that the underlying raw data are complete and accurate.

MVY = Measured Values by Year

ppbv = parts per billion by volume ($cc/10^3\ m^3$)

Table 3.5-19. Historic Carbon Monoxide Trends

Site ID Code	Averaging Time	Standard (ppmv)	MVY ppmv 1990s	MVY ppmv 2000	MVY ppmv 2001	MVY ppmv 2002	MVY ppmv 2003	MVY ppmv 2004	MVY ppmv 2005	MVY ppmv 2006	MVY ppmv 2007	MVY ppmv 2008	MVY ppmv 2009	MVY ppmv 2010	MVY ppmv 2011	3-Year Trend	Meet Std.
35-45-0006	1-hour	35	—	5.4	—	—	—	—	—	—	—	—	—	—	—	—	—
35-45-0006	8-hour	9	—	1.9	—	—	—	—	—	—	—	—	—	—	—	—	—
08-67-7001	1-hour	35	—	—	—	—	—	2.5	1.8	1.2	1.7	1.5	1.4	1.2	1.4	1.4	Yes
08-67-7001	8-hour	9	—	—	—	—	—	1.6	1.6	0.8	1.3	1.0	0.9	0.7	0.7	0.9	Yes

Sources: EPA 2012c, d.

Notes: Standards are 2012 NAAQS; 1-hour trend is 3-year maximum of most recent data (not to be exceeded); 8-hour trend is 3-year maximum of most recent data (not to be exceeded).

MVY = Measured Values by Year

ppbv = parts per billion by volume (cc/103 m3)

ppmv = parts per million by volume (cc/m^3)

Table 3.5-20. Historic Respirable Particulate (PM_{10}) Trends

Site ID Code	Averaging Time	Standard (µg/m³)	MVY µg/m³ 1990s	MVY µg/m³ 2000	MVY µg/m³ 2001	MVY µg/m³ 2002	MVY µg/m³ 2003	MVY µg/m³ 2004	MVY µg/m³ 2005	MVY µg/m³ 2006	MVY µg/m³ 2007	MVY µg/m³ 2008	MVY µg/m³ 2009	MVY µg/m³ 2010	MVY µg/m³ 2011	3-Year Trend	Meet Std.
35-45-0006	24-hour bulk average	150	—	27	30	41	57	28	42	41	30	116	—	—	—	116	Yes
35-45-0006	24-hour composite	150	—	24	26	34	49	23	39	37	27	102	—	—	—	102	Yes
35-45-0017	24-hour bulk average	150	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35-45-0017	24-hour composite	150	14	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35-45-0019	24-hour bulk average	150	—	—	—	—	—	—	—	—	—	22	73	22	38	73	Yes
35-45-0019	24-hour composite	150	—	—	—	—	—	—	—	—	—	19	61	18	32	61	Yes
35-45-1233	24-hour bulk average	150	—	—	—	—	—	—	—	—	—	—	—	56	61	—	—
35-45-1233	24-hour composite	150	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
08-67-7001	24-hour bulk average	150	—	—	—	18	94	31	37	24	—	—	—	—	—	37	Yes
08-67-7001	24-hour composite	150	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
08-67-7003	24-hour bulk average	150	—	—	—	109	88	26	40	24	—	—	—	—	—	40	Yes
08-67-7003	24-hour composite	150	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
08-83-9000	24-hour bulk average	150	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
08-83-9000	24-hour composite	150	29	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Sources: EPA 2012c, d.
Notes: Standards are 2012 NAAQS; 1990s data are 1998 (35-45-0017); 24-hour trend is 3-year maximum of most recent data (not to be exceeded).
MVY = Measured Values by Year µg/m³ = micrograms per cubic meter (10^{-6} g/m³)

Table 3.5-21. Historic Fine Particulate ($PM_{2.5}$) Trends

Site ID Code	Averaging Time	Standard (µg/m³)	MVY µg/m³ 1990s	MVY µg/m³ 2000	MVY µg/m³ 2001	MVY µg/m³ 2002	MVY µg/m³ 2003	MVY µg/m³ 2004	MVY µg/m³ 2005	MVY µg/m³ 2006	MVY µg/m³ 2007	MVY µg/m³ 2008	MVY µg/m³ 2009	MVY µg/m³ 2010	MVY µg/m³ 2011	3-Year Trend	Meet Std.
35-45-0006	24-hour composite	35	—	12.9	14.3	16.8	13.4	13.2	11.3	11.5	14.9	14.4	—	—	—	13.6	Yes
35-45-0006	Annual Mean	12	—	6.0	6.0	6.9	6.7	6.1	5.5	6.1	6.0	5.9	—	—	—	6.0	Yes
35-45-0018	24-hour composite	35	—	—	—	—	—	—	4.4	6.3	9.0	7.3	7.6	12.0	10.6	10.1	Yes
35-45-0018	Annual Mean	12	—	—	—	—	—	—	2.1	2.4	4.5	3.3	2.5	3.0	2.7	2.7	Yes
35-45-0019	24-hour composite	35	—	—	—	—	—	—	—	—	—	9.7	10.4	18.0	12.0	13.5	Yes
35-45-0019	Annual Mean	12	—	—	—	—	—	—	—	—	—	4.3	4.4	4.8	4.2	4.5	Yes
08-67-7001	24-hour composite	35	—	—	—	—	—	—	—	—	—	—	8.6	7.6	10.0	8.7	Yes
08-67-7001	Annual Mean	12	—	—	—	—	—	—	—	—	—	—	4.4	4.1	4.3	4.3	Yes
08-67-7003	24-hour composite	35	—	—	—	—	—	—	—	—	—	—	11.8	11.1	12.1	11.7	Yes
08-67-7003	Annual Mean	12	—	—	—	—	—	—	—	—	—	—	4.2	4.3	4.6	4.4	Yes
08-83-0006	24-hour composite	35	—	—	—	—	—	—	—	—	—	25.3	15.0	13.3	14.8	14.4	Yes
08-83-0006	Annual Mean	12	—	—	—	—	—	—	—	—	—	6.1	6.8	5.9	6.1	6.3	Yes
08-83-9000	24-hour composite	35	10.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
08-83-9000	Annual Mean	12	3.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Sources: EPA 2012c, d.

Notes: Standards are 2012 NAAQS; 1990s data are 1995 (08-83-9000); 24-hour trend is 3-year average of most recent data (98th percentile); Annual trend is 3-year average of most recent data (annual mean).

MVY = Measured Values by Year µg/m³ = micrograms per cubic meter (10^{-6} g/m³)

Table 3.5-22. TSP / Lead / Sulfate

Site ID Code	Averaging Time	TSP µg/m³	Pb µg/m³	SO_4 µg/m³
08-83-0005	24-hour average	45	0.02	7.3
08-83-0005	Standard	150	0.15	—
08-83-0005	Meet Standard	Yes	Yes	—

Sources: EPA 2012c, d.

Notes:

Standards are 2012 NAAQS.

Data are 1996 (08-83-0005).

µg/m³ = microgram(s) per cubic meter

Table 3.5-23a. Historic Composite Visibility - 10 IMPROVE Sites

Year	Lowest 20% of Days Mean dV	Lowest 20% of Days Median dV	Highest 20% of Days Mean dV	Highest 20% of Days Median dV	Average of all Days Mean dV	Average of all Days Median dV
2000	3.46	3.45	11.88	11.21	7.39	7.03
2001	3.46	3.62	10.67	10.90	7.02	7.07
2002	3.47	3.73	12.25	11.95	7.47	7.34
2003	3.36	3.22	12.67	12.25	7.44	6.80
2004	3.27	3.72	10.35	10.40	6.70	6.68
2005	2.60	2.59	11.66	11.93	6.85	6.85
2006	3.11	2.89	10.73	10.88	6.77	6.77
2007	2.95	3.09	11.18	11.20	6.92	7.09
2008	2.48	2.60	10.88	11.07	6.59	6.65
2009	2.63	2.86	11.01	10.91	6.40	6.55
2010	2.31	2.27	9.89	9.68	5.93	5.92
11-Year Trend Change	**-1.18**	**-1.22**	**-1.40**	**-1.08**	**-1.22**	**-0.82**
Relative Improvement	**33%**	**33%**	**12%**	**9%**	**16%**	**11%**

Source: CSU 2013b.

Notes: Aggregated data for 10 sites: BAND1, CANY1, CAPI1, GRCA2, GRSA1, MEVE1, PEFO1, SAPE1, WEMI1, WHPE1; Missing data substituted by interpolation (11 of 110 sets); Change and improvement calculated on linear trend basis.

dV = deciview

Table 3.5-23b. Historic Visibility - 10 IMPROVE Sites

National Park or Wilderness (NPS code)	dV Lowest 20% of Days	dV Highest 20% of Days	dV Average of all Days
Bandelier National Monument (BAND1)	4.45	11.82	7.87
Canyonlands National Park (CANY1)	3.21	11.08	6.82
Capitol Reef National Park (CAPI1	2.88	10.66	6.57
Grand Canyon National Park (GRCA2)	2.12	11.62	6.54
Great Sand Dunes National Park (GRSA1)	3.97	11.90	7.71
Mesa Verde National Park (MEVE1)	3.66	12.11	7.44
Petrified Forest National Park (PEFO1)	4.76	12.96	8.52
San Pedro Parks Wilderness (SAPE1)	1.17	9.86	5.50
Weminuche Wilderness (WEMI1)	2.63	10.10	6.16
Wheeler Peak Wilderness (WHPE1)	1.03	9.68	5.31

Source: CSU 2013b.
dV = deciview

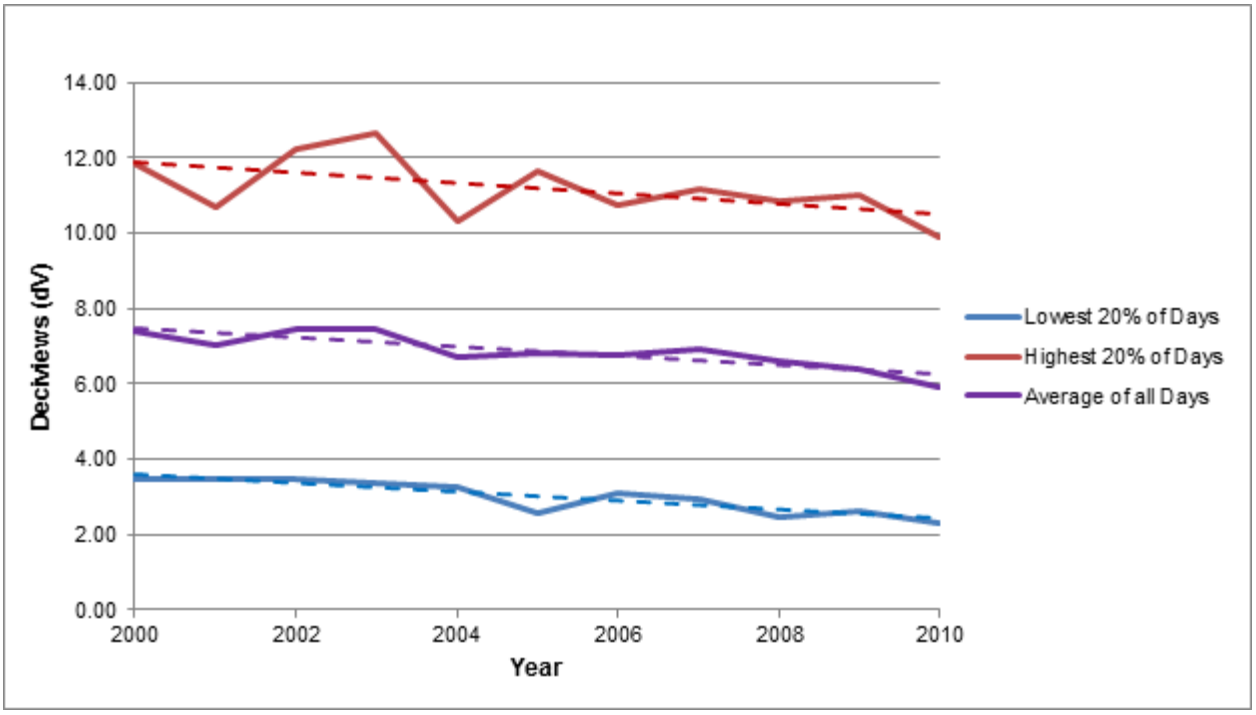

Figure 3.5-2. Historic Composite Visibility Trend

The term "acid rain" is a broad reference to mixtures of wet and dry deposition containing higher than normal amounts of sulfuric and nitric acids. The main anthropogenic precursors of acid rain are SO_2 and NO_x emissions from fossil fuel combustion. In the U.S., about 67 percent of all SO_2 and about 25 percent all NO_x is emitted from fossil fuel electric power generation, in particular, coal-fired power plants. Acid rain occurs when these gases react (hydrolyze) in the atmosphere with water, oxygen, and other chemicals to form a weak solution of sulfuric and nitric acids, typically pH[1] 3 to 5. When SO_2 and NO_x are released from power plant stacks and other sources, prevailing winds transport these compounds across state and national borders, sometimes over hundreds of miles, resulting in environmental impacts far away from the pollution source. Acid rain causes acidification of lakes and streams and contributes to damage to trees and many sensitive forest soils. It also accelerates the decay of building materials and paints, including irreplaceable buildings, statues, and sculptures which are part of the national cultural heritage (EPA 2013d).

The EPA and National Acid Deposition Program (NADP) operate nationwide networks of deposition-oriented monitoring sites. Sites in the vicinity of the Project area are shown on Figure 3.5-3 and listed on Table 3.5-24. Descriptions of applicable monitoring projects are provided in the FCPP/NMEP EIS, Appendix A.

[1] pH is defined as the negative (base 10) logarithm of the hydrogen ion concentration (moles per liter). For example, if $[H^+]$ = 0.0001 moles/liter, then pH = 4.

Figure 3.5-3. Location of Atmospheric Deposition Monitoring Sites

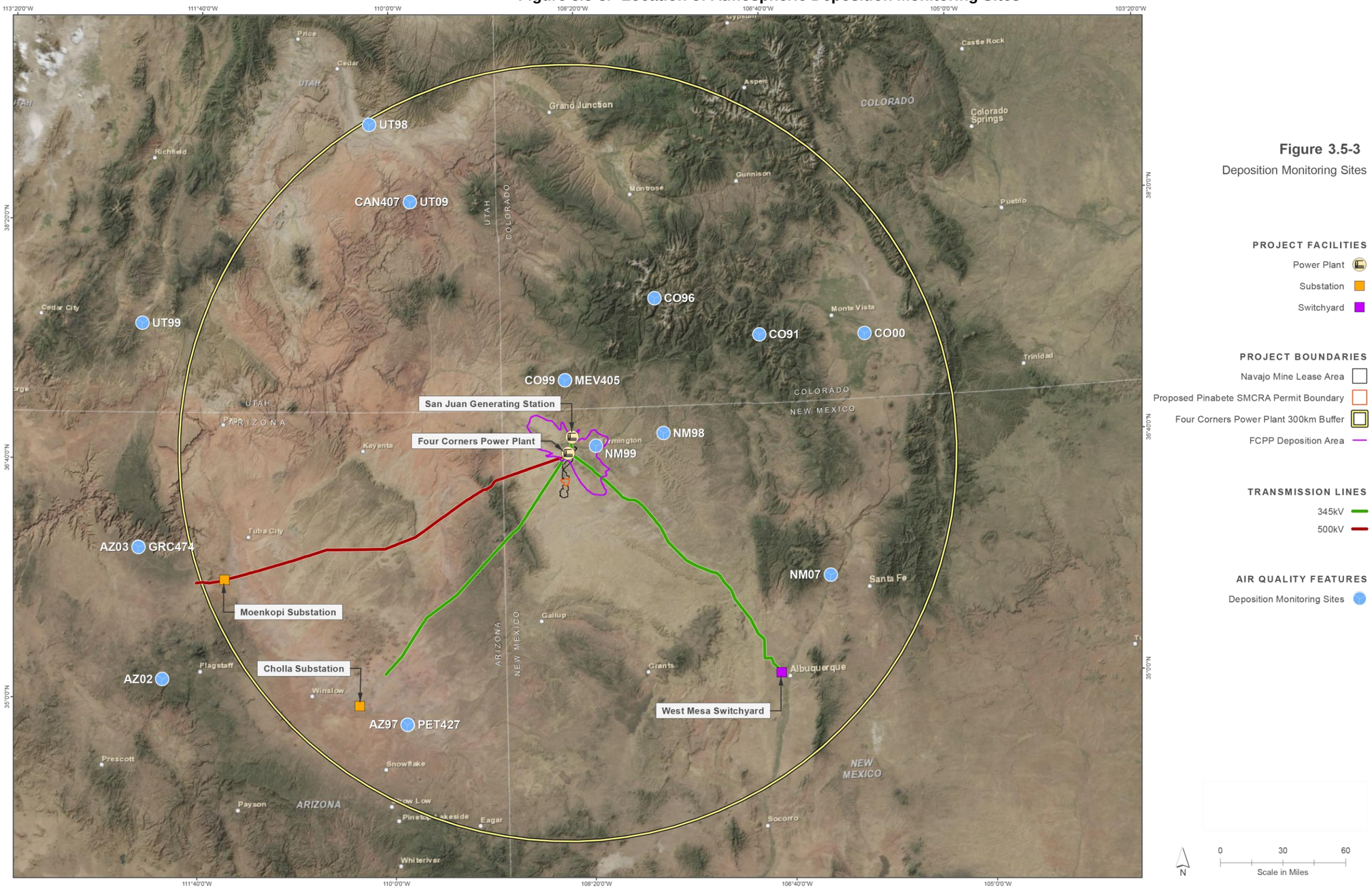

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Table 3.5-24. Deposition Monitoring Sites - Four Corners Region and Vicinity

Site ID Code	Network	State	Location / Site Name	Elevation MSL meters	Elevation MSL feet	North Latitude	West Longitude	Monitoring Start Date
GRC474	CASTNET	Arizona	Grand Canyon National Park	2,073	6,801	36.0597	-112.1822	5/16/1989
PET427	CASTNET	Arizona	Petrified Forest National Park	1,723	5,653	34.8225	-109.8919	9/12/2002
MEV405	CASTNET	Colorado	Mesa Verde National Park	2,165	7,103	37.1983	-108.4903	1/1/1995
CAN407	CASTNET	Utah	Canyonlands National Park	1,809	5,935	38.4586	-109.8211	1/1/1995
AZ03	NTN	Arizona	Grand Canyon National Park	2,071	6,795	36.0586	-112.1840	8/11/1981
AZ97	NTN	Arizona	Petrified Forest National Park	1,707	5,600	34.8224	-109.8925	12/3/2002
CO00	NTN	Colorado	Alamosa	2,285	7,497	37.4421	-105.8680	4/22/1980
CO91	NTN	Colorado	Wolf Creek Pass[1]	3,287	10,784	37.4686	-106.7870	5/26/1992
CO96	NTN	Colorado	Molas Pass[1]	3,248	10,656	37.7500	-107.6890	7/29/1986
CO99	NTN	Colorado	Mesa Verde National Park	2,162	7,093	37.1979	-108.4910	4/28/1981
NM07	NTN	New Mexico	Bandelier National Monument	1,997	6,552	35.7788	-106.2660	6/22/1982
UT09	NTN	Utah	Canyonlands National Park	1,797	5,896	38.4584	-109.8210	11/11/1997
UT98	NTN	Utah	Green River	1,256	4,121	39.0010	-110.1740	4/25/1985
UT99	NTN	Utah	Bryce Canyon National Park[2]	2,477	8,127	37.6186	-112.1728	1/29/1985
AZ02	MDN	Arizona	Sycamore Canyon Wilderness[3]	2,046	6,713	35.1406	-111.9692	2/28/2006
CO96	MDN	Colorado	Molas Pass[4]	3,248	10,656	37.7500	-107.6890	6/30/2009
CO99	MDN	Colorado	Mesa Verde National Park	2,162	7,093	37.1979	-108.4910	12/26/2001
NM98	MDN	New Mexico	Navajo Lake	1,972	6,470	36.8097	-107.6515	4/21/2009

Site ID Code	Network	State	Location / Site Name	Elevation MSL meters	Elevation MSL feet	North Latitude	West Longitude	Monitoring Start Date
NM98	AMoN	New Mexico	Navajo Lake	1,972	6,470	36.8097	-107.6515	1/11/2008
NM99	AMoN	New Mexico	Farmington	1,634	5,361	36.7358	-108.2380	1/9/2008

Sources: EPA 2013e, NADP 2013.

Notes:

[1] Indicates location is nondesert characteristic (mountains), data not used due to sufficient characteristic sites.

[2] Indicates location is outside 300-km radius of FCPP, data not used due to sufficient characteristic sites.

[3] Indicates location is outside 300-km radius of FCPP, data used due to insufficient characteristic sites.

[4] Indicates location is nondesert characteristic (mountains), data used due to insufficient characteristic sites.

AMoN = Ammonia Monitoring Network (NADP)

CASTNET = Clean Air Status and Trends Network (EPA)

MDN = Mercury Deposition Network (NADP). MDN Site NM98 Navajo Lake closed 9/25/12; remains active as AMoN site NM98

NTN = National Trends Network (NADP)

3.5.2.7.1 Clean Air Status and Trends Network (CASTNET) Data

For the historic 12-year period from 2000 through 2011, Tables 3.5-25a (metric units) and 3.5-25b (English units) show measured precipitation, wet and dry ammonium, wet and dry nitrate, wet and dry sulfate, dry nitric acid, and dry SO_2 as reported by CASTNET for cumulative annual periods (EPA 2013e). Precipitation units are depth in centimeters and inches; deposition units are mass per unit area in kilograms per hectare (kg/ha) and pounds per acre (lb/acre).

Table 3.5-26 shows total nitrogen compounds and total sulfur compounds deposition rates versus annual precipitation amounts. Total deposition is expressed two ways, absolute in units of kg/ha and normalized in units of kilograms per hectare per decimeter precipitation (kg/ha-dm).

Deposition is normalized in units of kg/ha-dm to eliminate the variability of precipitation amounts and discern the actual deposition contents of precipitation (i.e., concentrations).

Figures 3.5-4 and 3.5-5 illustrate historic deposition trends as measured by the CASTNET monitoring program. Figure 3.5-4 shows absolute amounts of precipitation, total nitrogen compounds, and total sulfur compounds over the 12-year period. Since the amount of deposition is proportional to the amount of precipitation received, Figure 3.5-5 shows normalized total nitrogen compounds and total sulfur compounds where normalized precipitation is expressed as unity.

As shown in Table 3.5-26 and Figure 3.5-5, the data suggests the average rate of nitrogen and sulfur deposition in the Four Corners region has been trending downward over the 12-year period. The data also suggests that total nitrogen compound deposition has decreased by about 30 percent and total sulfur compound deposition has decreased by about 24 percent, as measured by CASTNET from 2000 to 2011. These apparent downward trends suggest that regional emissions of NO_x and SO_2 from stationary and mobile sources may have decreased overall due to improved emission controls, lower-polluting fuels, and changes in economic activity, among other factors.

3.5.2.7.2 National Trends Network

Annual summary data from seven National Trends Network (NTN) sites located at Canyonlands, Grand Canyon, Mesa Verde, Petrified Forest, Alamosa, Bandelier, and Green River is aggregated to provide a general estimate of historic deposition in the Four Corners region. Deposition is calculated by NADP based on the NTN wet bucket method and measured precipitation (NADP 2013).

For the historic 12-year period from 2000 through 2011, Tables 3.5-27a (metric units, kg/ha) and 3.5-27b (English units, lb/acre) show measured precipitation, free acidity (H^+ as pH), calcium, magnesium, sodium, potassium, sulfate, nitrate, chloride, and ammonium ions, also total inorganic nitrogen as reported by NTN for cumulative annual periods (NADP 2013).

Table 3.5-28 shows absolute and normalized acid/base ion deposition rates in metric units for sulfate, nitrate, chloride, and ammonium. Table 3.5-29 shows absolute and normalized light metal ion deposition rates in metric units for calcium, magnesium, potassium, and sodium.

Table 3.5-25a. Historic Speciated Deposition - 4 CASTNET Sites (metric units)

Year	Precip cm	Wet NH_4 kg/ha	Wet NO_3 kg/ha	Dry HNO_3 kg/ha	Dry NO_3 kg/ha	Dry NH_4 kg/ha	Wet SO_4 kg/ha	Dry SO_2 kg/ha	Dry SO_4 kg/ha
2000	23.6	0.34	0.68	0.89	0.03	0.12	0.58	0.12	0.14
2001	27.0	0.40	0.71	0.85	0.03	0.12	0.64	0.12	0.15
2002	19.2	0.48	0.53	0.89	0.04	0.11	0.50	0.11	0.13
2003	21.8	0.39	0.53	0.97	0.03	0.11	0.41	0.22	0.13
2004	31.1	0.68	0.78	0.91	0.04	0.11	0.79	0.21	0.14
2005	36.4	0.58	0.70	0.92	0.03	0.12	0.73	0.21	0.15
2006	28.9	0.64	0.77	0.92	0.03	0.10	0.68	0.21	0.13
2007	29.8	0.49	0.70	0.96	0.04	0.12	0.57	0.24	0.14
2008	30.2	0.42	0.59	0.78	0.03	0.11	0.48	0.15	0.14
2009	22.1	0.50	0.54	0.68	0.03	0.10	0.66	0.11	0.12
2010	44.5	0.83	0.90	0.64	0.03	0.09	0.75	0.11	0.11
2011	32.4	0.67	0.76	0.63	0.03	0.10	0.69	0.10	0.12
Mean	28.9	0.54	0.68	0.84	0.03	0.11	0.62	0.16	0.13
Median	29.3	0.49	0.70	0.89	0.03	0.11	0.65	0.13	0.14
Cumulative	347.0	6.42	8.20	10.03	0.40	1.31	7.49	1.89	1.60

Source: EPA 2013e.

Notes:

Aggregated data for 4 sites: CAN407, GRC474, MEV405, PET427.

Missing data compensated by aggregation (25 of 384 points = 6.5%).

cm = centimeter

kg/ha = kilogram(s) per hectare

Table 3.5-25b. Historic Speciated Deposition - 4 CASTNET Sites (English units)

Year	Precip in	Wet NH_4 lb/acre	Wet NO_3 lb/acre	Dry HNO_3 lb/acre	Dry NO_3 lb/acre	Dry NH_4 lb/acre	Wet SO_4 lb/acre	Dry SO_2 lb/acre	Dry SO_4 lb/acre
2000	9.3	0.30	0.61	0.80	0.03	0.10	0.52	0.10	0.13
2001	10.6	0.36	0.63	0.76	0.03	0.11	0.57	0.10	0.13
2002	7.6	0.43	0.48	0.79	0.04	0.10	0.44	0.09	0.12
2003	8.6	0.34	0.48	0.87	0.03	0.10	0.37	0.19	0.12
2004	12.3	0.61	0.70	0.81	0.03	0.10	0.71	0.19	0.12
2005	14.3	0.52	0.62	0.82	0.02	0.11	0.65	0.19	0.13
2006	11.4	0.57	0.69	0.82	0.03	0.09	0.60	0.18	0.11
2007	11.7	0.44	0.62	0.85	0.03	0.10	0.51	0.21	0.13
2008	11.9	0.38	0.52	0.69	0.03	0.10	0.43	0.13	0.12
2009	8.7	0.44	0.48	0.60	0.03	0.09	0.59	0.09	0.11
2010	17.5	0.74	0.80	0.57	0.03	0.08	0.67	0.10	0.10
2011	12.8	0.60	0.68	0.56	0.03	0.09	0.62	0.09	0.11
Mean	11.4	0.48	0.61	0.75	0.03	0.10	0.56	0.14	0.12
Median	11.5	0.44	0.62	0.79	0.03	0.10	0.58	0.12	0.12
Cumulative	136.6	5.73	7.31	8.94	0.36	1.17	6.68	1.68	1.43

Source: EPA 2013e.

Notes:

Aggregated data for 4 sites: CAN407, GRC474, MEV405, PET427.

Missing data compensated by aggregation (25 of 384 points = 6.5%).

in = inches

lb/acre = pound per acre

Table 3.5-26. Historic Composite Deposition Rates - 4 CASTNET Sites

Year	Precipitation cm	Precipitation dm	Nitrogen Compounds kg/ha	Nitrogen Compounds kg/ha-dm	Sulfur Compounds kg/ha	Sulfur Compounds kg/ha-dm
2000	23.6	2.36	2.06	0.87	0.84	0.36
2001	27.0	2.70	2.11	0.78	0.91	0.34
2002	19.2	1.92	2.06	1.07	0.74	0.38
2003	21.8	2.18	2.04	0.93	0.76	0.35
2004	31.1	3.11	2.52	0.81	1.14	0.37
2005	36.4	3.64	2.34	0.64	1.09	0.30
2006	28.9	2.89	2.46	0.85	1.01	0.35
2007	29.8	2.98	2.30	0.77	0.95	0.32
2008	30.2	3.02	1.93	0.64	0.77	0.25
2009	22.1	2.21	1.84	0.83	0.88	0.40
2010	44.5	4.45	2.50	0.56	0.97	0.22
2011	32.4	3.24	2.19	0.68	0.91	0.28
Trend	—	—	—	-0.28	—	-0.09
Change	—	—	—	-30%	—	-24%

Source: EPA 2013e.

Notes:

Aggregated data for 4 sites: CAN407, GRC474, MEV405, PET427.

Missing data compensated by aggregation (25 of 384 points = 6.5%).

Change and improvement calculated on normalized linear trend basis (see Figure 4.1-6).

cm = centimeter

dm = decimeter

kg/ha = kilogram(s) per hectare

kg/ha-dm = kilogram(s) per hectare per decimeter

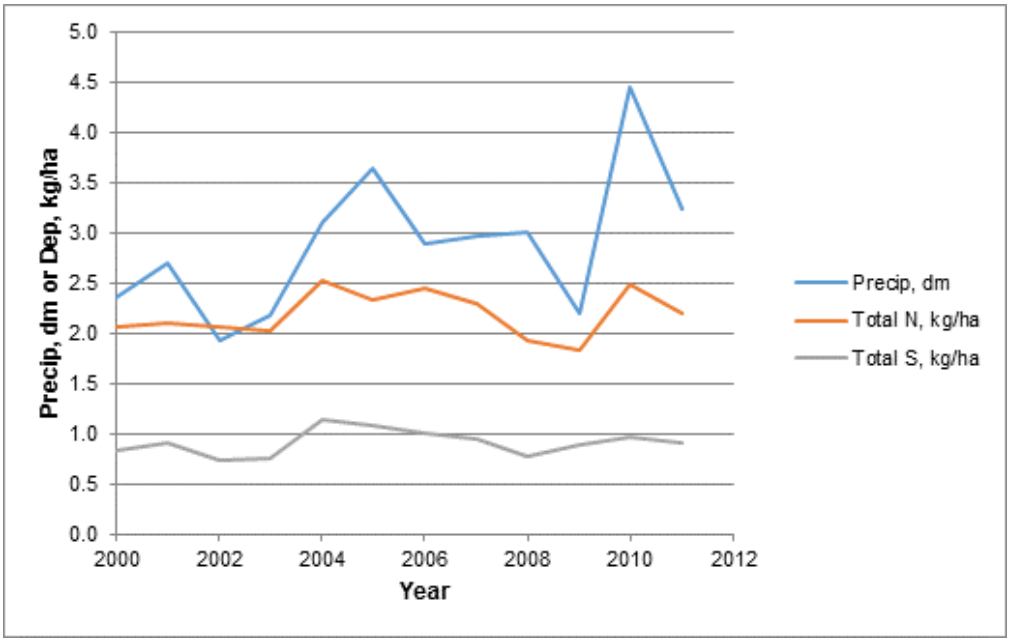


Figure 3.5-4. Historic CASTNET Precipitation and Deposition

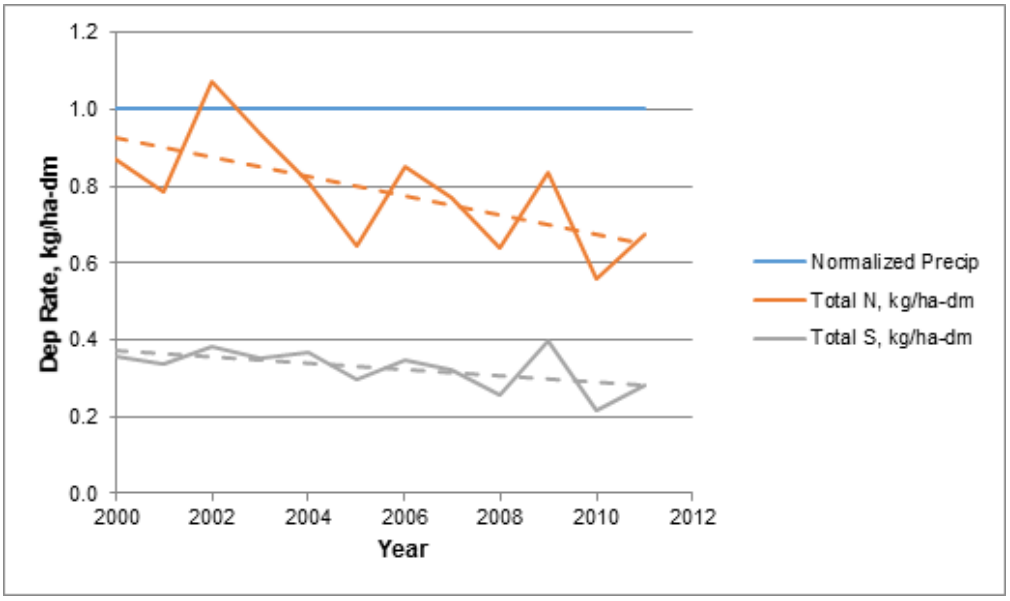


Figure 3.5-5. Historic CASTNET Deposition Rates - Normalized

Table 3.5-27a. Historic Speciated Deposition - 7 NTN Sites (metric units)

Year	Precip cm	Ca kg/ha	Mg kg/ha	K kg/ha	Na kg/ha	NH_4 kg/ha	NO_3 kg/ha	Inorg N kg/ha	Cl kg/ha	SO_4 kg/ha	H^+ kg/ha
2000	23.7	1.96	0.19	0.16	0.33	1.30	7.99	2.82	0.52	4.52	0.06
2001	25.9	2.34	0.25	0.14	0.42	1.64	8.59	3.22	0.60	5.10	0.05
2002	16.3	1.76	0.15	0.08	0.21	0.98	3.53	1.56	0.30	2.26	0.01
2003	18.7	1.56	0.15	0.10	0.17	1.04	4.37	1.80	0.27	2.41	0.02
2004	28.1	3.38	0.33	0.23	0.58	2.47	10.58	4.32	0.91	6.45	0.06
2005	33.6	3.30	0.30	0.23	0.52	2.66	10.43	4.42	0.72	7.65	0.09
2006	26.8	3.18	0.32	0.18	0.41	2.01	8.33	3.45	0.61	4.85	0.04
2007	26.6	3.49	0.31	0.20	0.50	1.99	8.32	3.43	0.77	5.10	0.05
2008	25.9	3.05	0.30	0.18	0.43	1.58	7.02	2.81	0.65	4.09	0.04
2009	21.1	5.87	0.34	0.29	0.48	1.35	5.10	2.20	0.61	4.19	0.02
2010	34.7	6.12	0.73	0.37	0.93	3.77	13.89	6.07	1.46	7.70	0.07
2011	25.0	3.79	0.38	0.21	0.52	2.05	7.80	3.36	0.72	4.76	0.03
Mean	25.5	3.32	0.31	0.20	0.46	1.91	8.00	3.29	0.68	4.92	0.05
Median	25.9	3.24	0.31	0.19	0.46	1.82	8.15	3.29	0.63	4.81	0.04
Cumulative	306.4	39.80	3.75	2.37	5.51	22.86	95.96	39.45	8.12	59.07	0.54

Source: NADP 2013.

Notes: Aggregated data for 7 sites: AZ03, AZ97, CO00, CO99, NM07, UT09, UT98; Site AZ97 commenced operation 2003 (no data for 2000, 2001, 2002).

Ca = calcium
CI = chloride
cm = centimeter(s)
H* = free acidity
K = potassium
kg/ha = kilogram(s) per hectare
Mg = magnesium
Na = sodium
NH_4 = ammonium
NO_3 = nitrate
precip = precipitation
SO_4 = sulfate

Table 3.5-27b. Historic Speciated Deposition - 7 NTN Sites (English Units)

Year	Precip in	Ca lb/acre	Mg lb/acre	K lb/acre	Na lb/acre	NH_4 lb/acre	NO_3 lb/acre	Inorg N lb/acre	Cl lb/acre	SO_4 lb/acre	H^+ lb/acre
2000	9.3	1.75	0.17	0.14	0.30	1.16	7.13	2.52	0.46	4.03	0.06
2001	10.2	2.09	0.22	0.12	0.38	1.46	7.67	2.87	0.54	4.55	0.05
2002	6.4	1.57	0.14	0.07	0.19	0.87	3.15	1.39	0.27	2.01	0.01
2003	7.4	1.39	0.13	0.09	0.15	0.93	3.90	1.61	0.24	2.15	0.02
2004	11.0	3.02	0.30	0.20	0.52	2.21	9.44	3.85	0.81	5.75	0.05
2005	13.2	2.94	0.27	0.20	0.46	2.38	9.30	3.94	0.64	6.83	0.08
2006	10.6	2.84	0.29	0.16	0.36	1.79	7.44	3.07	0.55	4.33	0.04
2007	10.5	3.11	0.27	0.18	0.45	1.78	7.42	3.06	0.69	4.55	0.04
2008	10.2	2.72	0.27	0.16	0.38	1.41	6.27	2.51	0.58	3.65	0.04
2009	8.3	5.23	0.31	0.26	0.43	1.21	4.55	1.97	0.55	3.74	0.02
2010	13.7	5.46	0.65	0.33	0.83	3.36	12.40	5.42	1.30	6.87	0.06
2011	9.9	3.38	0.34	0.19	0.46	1.83	6.96	2.99	0.64	4.25	0.03
Mean	10.1	2.96	0.28	0.18	0.41	1.70	7.13	2.93	0.60	4.39	0.04
Median	10.2	2.89	0.27	0.17	0.41	1.62	7.28	2.93	0.56	4.29	0.04
Cumulative	120.6	35.50	3.34	2.11	4.91	20.40	85.62	35.20	7.25	52.70	0.49

Source: NADP 2013.

Notes: Aggregated data for 7 sites: AZ03, AZ97, CO00, CO99, NM07, UT09, UT98. Site AZ97 commenced operation 2003 (no data for 2000, 2001, 2002).

Ca = calcium
CI = chloride
H* = free acidity
in = inch(es)
K = potassium
lb/acre = pound per acre
Mg = magnesium
Na = sodium
NH_4 = ammonium
NO_3 = nitrate
precip = precipitation
SO_4 = sulfate

Table 3.5-28. Historic Acid/Base Ion Deposition Rates - 7 NTN Sites

Year	Precip cm	Precip dm	SO_4 Comp kg/ha	SO_4 Comp kg/ha-dm	NO_3 Comp kg/ha	NO_3 Comp kg/ha-dm	Cl Comp kg/ha	Cl Comp kg/ha-dm	NH_4 Comp kg/ha	NH_4 Comp kg/ha-dm
2000	23.7	2.37	4.52	1.90	7.99	3.37	0.52	0.22	1.30	0.55
2001	25.9	2.59	5.10	1.97	8.59	3.32	0.60	0.23	1.64	0.63
2002	16.3	1.63	2.26	1.39	3.53	2.17	0.30	0.18	0.98	0.60
2003	18.7	1.87	2.41	1.29	4.37	2.33	0.27	0.14	1.04	0.56
2004	28.1	2.81	6.45	2.30	10.58	3.77	0.91	0.32	2.47	0.88
2005	33.6	3.36	7.65	2.28	10.43	3.10	0.72	0.21	2.66	0.79
2006	26.8	2.68	4.85	1.81	8.33	3.11	0.61	0.23	2.01	0.75
2007	26.6	2.66	5.10	1.92	8.32	3.13	0.77	0.29	1.99	0.75
2008	25.9	2.59	4.09	1.58	7.02	2.72	0.65	0.25	1.58	0.61
2009	21.1	2.11	4.19	1.98	5.10	2.41	0.61	0.29	1.35	0.64
2010	34.7	3.47	7.70	2.22	13.89	4.00	1.46	0.42	3.77	1.09
2011	25.0	2.50	4.76	1.90	7.80	3.12	0.72	0.29	2.05	0.82
Trend	—	—	—	0.24	—	0.19	—	0.14	—	0.27
Change	—	—	—	14%	—	7%	—	75%	—	47%

Source: NADP 2013.

Notes: Aggregated data for 7 sites: AZ03, AZ97, CO00, CO99, NM07, UT09, UT98; Site AZ97 commenced operation 2003 (no data for 2000, 2001, 2002).

CI = chloride
cm = centimeter(s)
dm = decimeter
kg/ha = kilogram(s) per hectare
kg/ha-dm = kilogram(s) per hectare per decimeter
NH_4 = ammonium
NO_3 = nitrate
precip = precipitation
SO_4 = sulfate

Table 3.5-29. Historic Light Metal Ion Deposition Rates - 7 NTN Sites

Year	Precip cm	Precip dm	Ca Comp kg/ha	Ca Comp kg/ha-dm	Mg Comp kg/ha	Mg Comp kg/ha-dm	K Comp kg/ha	K Comp kg/ha-dm	Na Comp kg/ha	Na Comp kg/ha-dm
2000	23.7	2.37	1.96	0.83	0.19	0.08	0.16	0.07	0.33	0.14
2001	25.9	2.59	2.34	0.90	0.25	0.09	0.14	0.05	0.42	0.16
2002	16.3	1.63	1.76	1.08	0.15	0.09	0.08	0.05	0.21	0.13
2003	18.7	1.87	1.56	0.83	0.15	0.08	0.10	0.05	0.17	0.09
2004	28.1	2.81	3.38	1.21	0.33	0.12	0.23	0.08	0.58	0.21
2005	33.6	3.36	3.30	0.98	0.30	0.09	0.23	0.07	0.52	0.15
2006	26.8	2.68	3.18	1.19	0.32	0.12	0.18	0.07	0.41	0.15
2007	26.6	2.66	3.49	1.31	0.31	0.12	0.20	0.08	0.50	0.19
2008	25.9	2.59	3.05	1.18	0.30	0.12	0.18	0.07	0.43	0.17
2009	21.1	2.11	5.87	2.77	0.34	0.16	0.29	0.14	0.48	0.23
2010	34.7	3.47	6.12	1.76	0.73	0.21	0.37	0.11	0.93	0.27
2011	25.0	2.50	3.79	1.51	0.38	0.15	0.21	0.09	0.52	0.21
Trend	—	—	—	1.13	—	0.10	—	0.05	—	0.10
Change	—	—	—	155%	—	139%	—	108%	—	84%

Source: NADP 2013.

Notes: Aggregated data for 7 sites: AZ03, AZ97, CO00, CO99, NM07, UT09, UT98; Site AZ97 commenced operation 2003 (no data for 2000, 2001, 2002).

Ca = calcium
dm = decimeter
K = potassium
kg/ha = kilogram(s) per hectare
kg/ha-dm = kilogram(s) per hectare per decimeter
Mg = magnesium
Na = sodium
precip = precipitation

Figures 3.5-6a, 3.5-6b, and 3.5-6c illustrate the normalized rates shown in Tables 3.5-28 and 3.5-29 using compatible Y-axis scales (i.e., 0-1, 0-2, 0-4). Figure 3.5-6a shows normalized magnesium, potassium, sodium, chloride, and acidity. Figure 3.5-6b shows ammonium and total inorganic nitrogen. Figure 3.5-6c shows calcium, nitrate, and sulfate. In each of these normalized figures, precipitation is expressed as unity.

As shown in Tables 3.5-28 and 3.5-29 and Figures 3.5-6a, 3.5-6b, and 3.5-6c, NTN data suggests the average rate of deposition for all analytes in the Four Corners region has been trending upward over the 12-year period. The data also suggests that sulfate, nitrate, chloride, and ammonium deposition has increased by about 14 percent, 7 percent, 75 percent, and 47 percent, respectively, over the 12-year period. Further, calcium, magnesium, potassium, and sodium deposition has increased by an average of about 120 percent, as measured by NTN from 2000 to 2011.

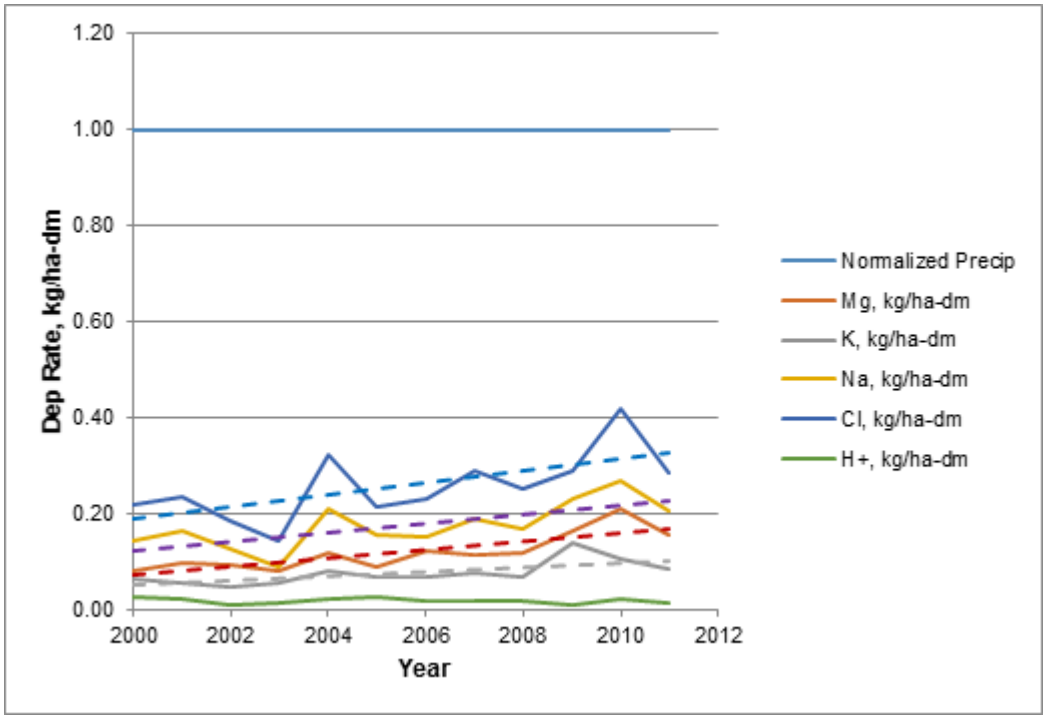


Figure 3.5-6a. Historic NTN Deposition Rates – Normalized (Mg, K, Na, Cl, H+)

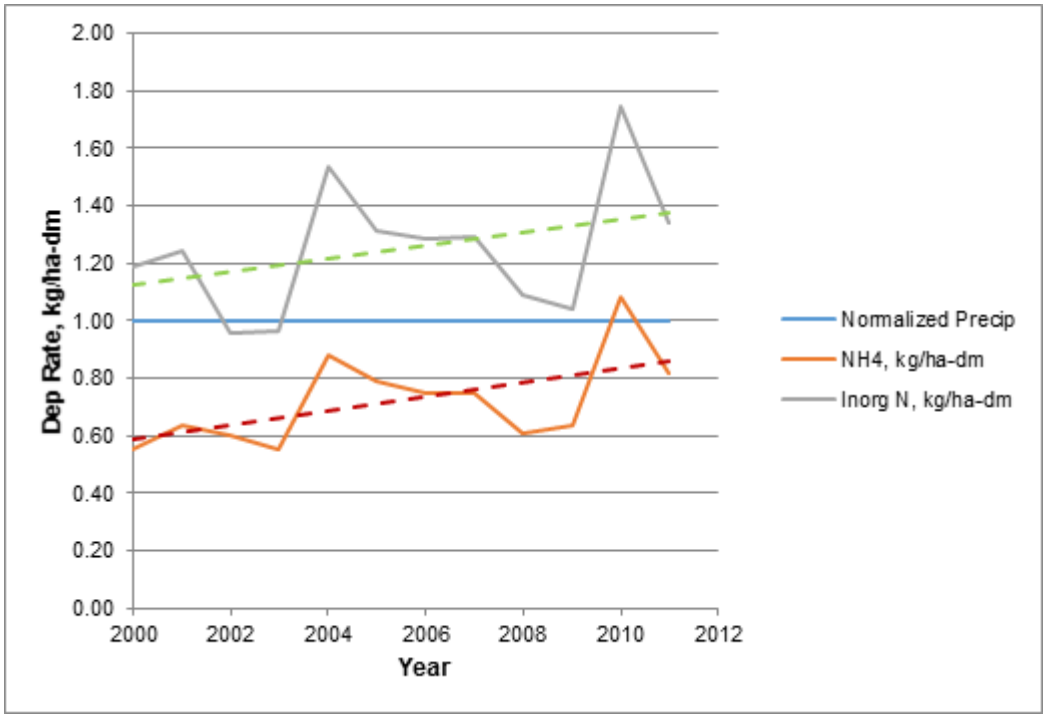


Figure 3.5-6b. Historic NTN Deposition Rates – Normalized (Ammonia)

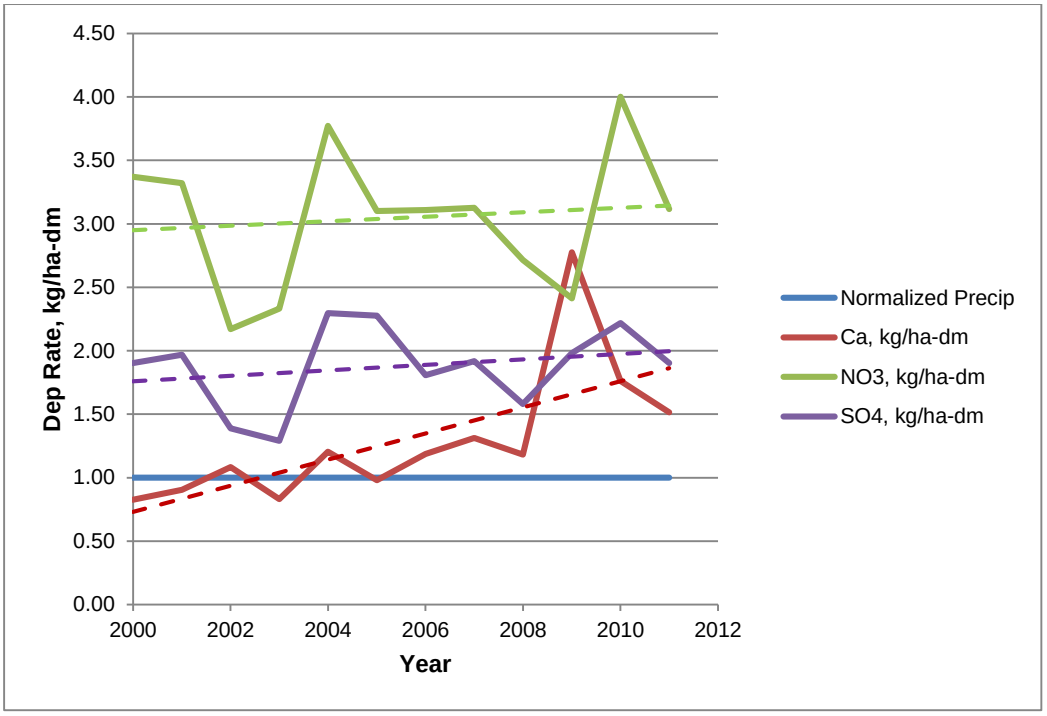


Figure 3.5-6c. Historic NTN Deposition Rates – Normalized (Ca, NO_3, SO_4)

The lower rates of increase for sulfate and nitrate suggests that regional emissions of NO_x and SO_2 from stationary and mobile sources may not be increasing as rapidly overall due to improved emission controls and lower-polluting fuels; however, these factors could be offset by use of agricultural chemicals such as fertilizers which can contain these compounds. The higher rate of increase for the metallic analytes (calcium, magnesium, potassium, sodium) suggests that drought conditions in the region could be responsible for increased airborne soil dusts which can contain these minerals. For the remaining analytes chloride and ammonium, increases are moderate, which suggests that while chloride could be attributable to soil dust, ammonium could be attributable to fertilizer application, animal husbandry, or NO_x emissions controls on stationary sources.

Because CASTNET and NTN employ very different measurement principles, results from the two networks are not directly comparable and differences in results and trends cannot be strictly viewed as inconsistent or contradictory. Rather, the two different methods should be considered complimentary as they each provide insight into the complexities of atmospheric deposition.

3.5.2.7.3 Mercury Deposition Network

Annual sampling data from four Mercury Deposition Network (MDN) sites located at Sycamore Canyon, Molas Pass, Mesa Verde, and Navajo Lake is compared and aggregated to provide a general estimate of historic mercury deposition in the Four Corners region. Total mercury deposition (organic + elemental) is calculated by NADP in units of nanograms per square meter (ng/m^2) based on the amount of sample collected in the wet bottle in equivalent millimeters (mm) times its mercury concentration in nanograms per liter (ng/l). In contrast to NTN, precipitation gage data are not used for data reduction since the bottle quantity is a more precise measurement for trace quantities (NADP 2013).

For the historic 10-year period from 2002 through 2011, individual site results are shown in Table 3.5-30 comprising absolute units of ng/m^2 and kg/ha, and normalized units of ng/m^2-mm as reported by MDN on a discrete sample basis (NADP 2013). Since the number of sites and samples is not large, absolute percent difference (variation) about the weighted arithmetic mean is shown to assess measurement variability (consistency) from year-to-year.

Table 3.5-31 aggregates the results shown in Table 3.5-30 to provide a general estimate of region-wide mercury deposition rates over the 10-year period. Figure 3.5-7 illustrates these normalized mercury deposition rates in units of ng/m^2-mm. For consistency with NTN precipitation data from multiple (7) rain gages over 12 years, Table 3.5-31 correlates MDN trending results against NTN precipitation amounts to obtain estimated mercury deposition as if it were an NTN parameter, as illustrated on Figure 3.5-8.

The normalized MDN results shown in Table 3.5-31 and Figure 3.5-7 suggest an upward trend in the rate of mercury deposition in the region over a decade. As shown in Table 3.5-31, from 2000 to 2011, the estimated average trending deposition rate increased by about 6 ng/m^2-mm or about 40 percent overall with an average annual variability of less than 20 percent, which indicates that results are reasonably consistent overall. The trending analysis suggests that mercury deposition in the Western region has been increasing.

While increases are due in part to trans-Pacific transport of mercury from sources in Asia (refer to Section 4.8, Special-Status Species for a more detailed discussion), coal-fired power plants are the largest source of mercury emissions in the U.S. Mercury is emitted from EGUs in three forms; each of which has specific physical and chemical properties that determine how far it travels in the atmosphere before depositing to the landscape. Although gaseous oxidized mercury and particle-bound mercury are generally local/regional mercury deposition concerns, all forms of mercury may deposit to local or regional watersheds. U.S. coal-fired power plants account for over half of the U.S. controllable emissions of the quickly depositing forms of mercury (Federal Register 2012). According to the EPRI baseline scenario modeling results, the maximum contribution of FCPP mercury emissions to mercury total deposition is about 28 percent in San Juan County near the FCPP and contributions from FCPP range from 2 to 28 percent in the vicinity of the plant; however, the contributions from FCPP are less than 2 percent over the remainder of the San Juan basin (EPRI 2013).

Table 3.5-30. Historic Mercury Deposition - 4 MDN Sites

Site ID Code	Year	Months Operation	Valid Samples	Precipitation Collected mm	Precipitation Collected cm	Measured Mercury Deposition ng/m^2	Measured Mercury Deposition kg/ha	Measured Mercury Deposition ng/m^2-mm	Measured Mercury Deposition variation
AZ02*	2006	10	29	429	42.9	8,678	8.68E-05	20.2	13%
AZ02*	2007	12	21	401	40.1	10,358	1.04E-04	25.8	10%
AZ02*	2008	12	22	459	45.9	8,567	8.57E-05	18.7	20%
AZ02*	2009	12	25	178	17.8	5,384	5.38E-05	30.3	30%
AZ02*	2010	12	23	313	31.3	7,859	7.86E-05	25.1	8%
AZ02*	2011	12	28	287	28.7	7,436	7.44E-05	25.9	11%
		AZ02 Cumulative	*148*	*2067*	*206.7*	*48,282*	*4.83E-04*	*23.4*	*14%*
NM98	2009	8	18	151	15.1	3,762	3.76E-05	24.9	5%
NM98	2010	12	20	241	24.1	7,126	7.13E-05	29.6	25%
NM98	2011	12	24	231	23.1	4,294	4.29E-05	18.6	22%
NM98	2012	9	18	152	15.2	3,179	3.18E-05	20.9	12%
		NM98 Cumulative	*80*	*775*	*77.5*	*18,360*	*1.84E-04*	*23.7*	*16%*
CO96**	2009	6	22	331	33.1	4,928	4.93E-05	14.9	14%
CO96**	2010	12	39	614	61.4	8,475	8.47E-05	13.8	5%
CO96**	2011	12	44	790	79.0	9,307	9.31E-05	11.8	10%
		CO96 Cumulative	*105*	*1735*	*173.5*	*22,709*	*2.27E-04*	*13.1*	*9%*
CO99	2002	11	23	190	19.0	3,471	3.47E-05	18.3	3%
CO99	2003	12	29	301	30.1	4,914	4.91E-05	16.3	8%
CO99	2004	12	27	327	32.7	3,161	3.16E-05	9.7	45%
CO99	2005	12	30	481	48.1	5,433	5.43E-05	11.3	36%
CO99	2006	12	30	310	31.0	4,963	4.96E-05	16.0	9%

Site ID Code	Year	Months Operation	Valid Samples	Precipitation Collected mm	Precipitation Collected cm	Measured Mercury Deposition ng/m^2	Measured Mercury Deposition kg/ha	Measured Mercury Deposition ng/m^2-mm	Measured Mercury Deposition variation
CO99	2007	12	33	380	38.0	6,708	6.71E-05	17.6	0%
CO99	2008	12	28	404	40.4	6,021	6.02E-05	14.9	16%
CO99	2009	12	25	321	32.1	10,100	1.01E-04	31.5	79%
CO99	2010	12	30	458	45.8	10,583	1.06E-04	23.1	31%
CO99	2011	12	28	373	37.3	7,203	7.20E-05	19.3	9%
		CO99 Cumulative	*283*	*3545*	*354.5*	*62,558*	*6.26E-04*	*17.6*	*24%*

Source: NADP 2013.

Notes:

* Indicates location is outside 300 km radius of FCPP.

**Indicates location is nondesert characteristic (mountains).

Site NM98 ceased operation September 2012.

Variation is absolute difference between annual value and cumulative mean of annual values.

cm = centimeter

kg/ha = kilogram(s) per hectare

mm = millimeter

ng/m^2 = nanogram(s) per square meter

ng/m^2-mm = nanogram(s) per square meter- millimeter

Table 3.5-31. Historic Annual Mercury Deposition - 4 MDN Sites

Year	Sites Operating	Valid Samples	Precipitation Collected mm	Precipitation Collected cm	Deposition Rate ng/m^2-mm	Deposition Rate variation
2002	1	23	190	19.0	18.3	2%
2003	1	29	301	30.1	16.3	13%
2004	1	27	327	32.7	9.7	48%
2005	1	30	481	48.1	11.3	39%
2006	2	59	739	73.9	18.5	1%
2007	2	54	782	78.2	21.8	17%
2008	2	50	863	86.3	16.9	9%
2009	4	90	980	98.0	24.7	32%
2010	4	112	1,626	162.6	20.9	12%
2011	4	124	1,681	168.1	16.8	10%
Cumulative	**—**	**598**	**7,969**	**796.9**	**18.7**	**18%**
Trend	**—**	**—**	**—**	**—**	**6.2**	**—**
Change	**—**	**—**	**—**	**—**	**43%**	**—**

Source: NADP 2013.

Notes: Aggregated data for 4 sites: AZ02, NM98, CO96, CO99; Site NM98 ceased operation September 2012. Variation is absolute difference between annual value and cumulative mean of annual values

cm = centimeter

mm = millimeter

ng/m^2-mm = nanogram(s) per square meter- millimeter

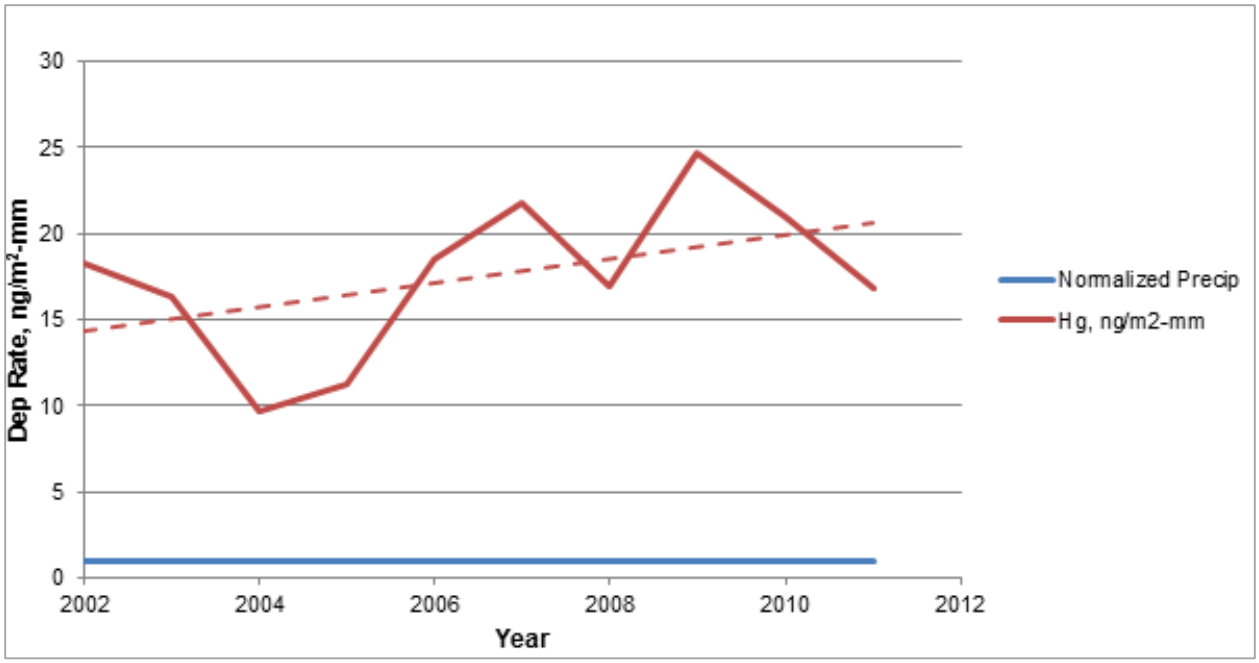


Figure 3.5-7. Historic MDN Deposition Rates – Normalized

Table 3.5-32. Estimated NTN-Correlated Annual Mercury Deposition

Year	NTN Precipitation cm	NTN Precipitation mm	Average Deposition ng/m^2-mm	Average Deposition ng/m^2	Average Deposition kg/ha
2000	23.7	237	13.0	3,086	3.09E-05
2001	25.9	259	13.7	3,546	3.55E-05
2002	16.3	163	14.4	2,341	2.34E-05
2003	18.7	187	15.1	2,827	2.83E-05
2004	28.1	281	15.8	4,430	4.43E-05
2005	33.6	336	16.5	5,540	5.54E-05
2006	26.8	268	17.2	4,604	4.60E-05
2007	26.6	266	17.9	4,751	4.75E-05
2008	25.9	259	18.6	4,798	4.80E-05
2009	21.1	211	19.2	4,070	4.07E-05
2010	34.7	347	19.9	6,923	6.92E-05
2011	25.0	250	20.6	5,165	5.16E-05
Mean	**25.5**	**255**	**—**	**4,340**	**4.34E-05**
Median	**25.9**	**259**	**—**	**4,517**	**4.52E-05**
Cumulative	**306.4**	**3064**	**—**	**52,080**	**5.21E-04**

Source: NADP 2013.

Notes: Aggregated precip data for 7 NTN sites: AZ03, AZ97, CO00, CO99, NM07, UT09, UT98; Aggregated Hg dep data for 4 MDN sites: AZ02, NM98, CO96, CO99; Average deposition rate determined from 10-year trend line.

cm = centimeter

kg/ha = kilogram(s) per hectare

mm = millimeter

ng/m^2 = nanogram(s) per square meter

ng/m^2-mm = nanogram(s) per square meter- millimeter

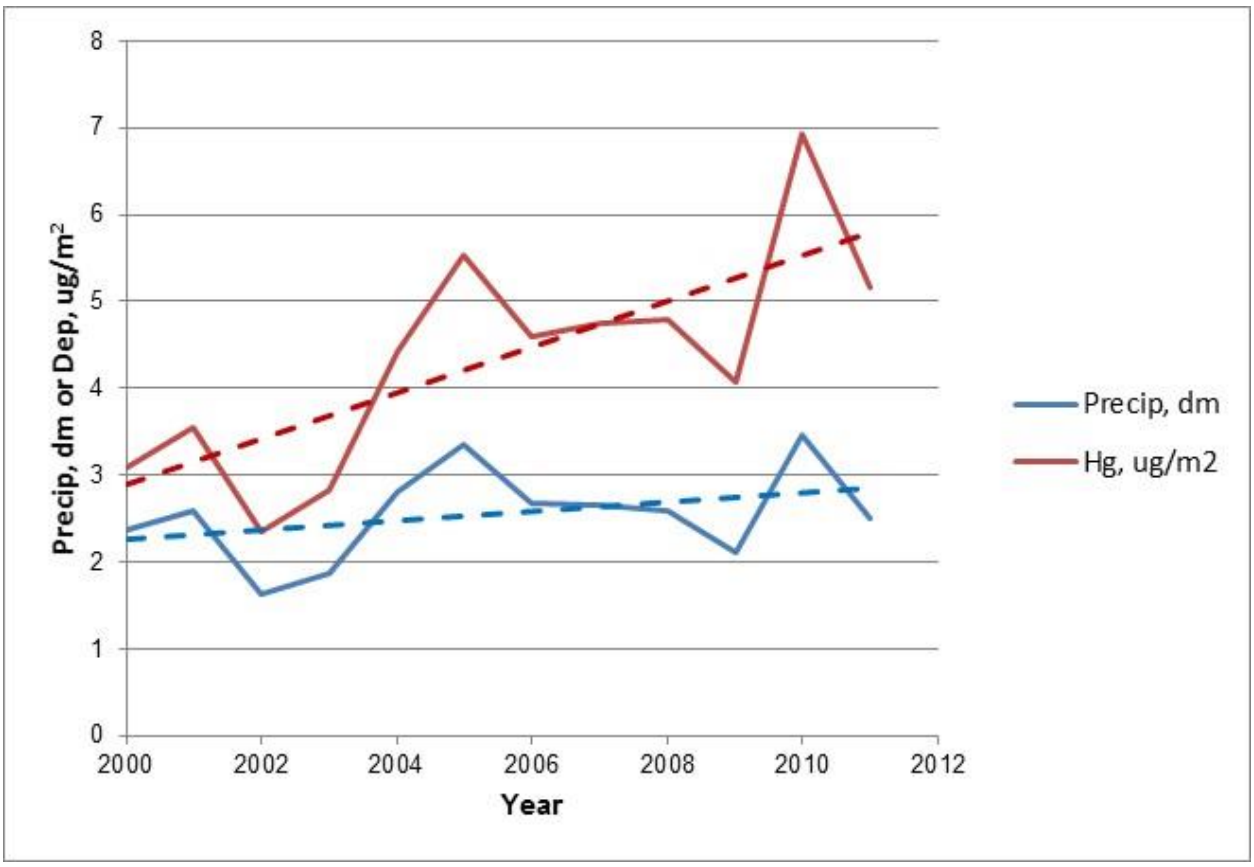


Figure 3.5-8. Estimated NTN-Correlated Annual Mercury Deposition

3.5.2.7.4 Ammonia Monitoring Network

Annual sampling data from two Ammonia Monitoring Network (AMoN) sites located in Navajo Lake and Farmington are compared and aggregated to provide a general estimate of historic ambient ammonia concentrations in the Four Corners region. Concentrations are calculated by NADP based on the AMoN diffusion filter method and measured air flow rates (NADP 2013).

For the historic 4-year 8-month period from January 2008 through August 2012, individual and aggregated site results are shown in Table 3.5-33 comprising units of nanograms per cubic meter (ng/m^3) and parts per billion by volume (ppbv) as reported by AMoN on a discrete sample basis (NADP 2013). Since the number of sites and samples is not large, absolute percent difference (variation) about the weighted arithmetic means are shown to assess measurement variability (consistency) from year-to-year. Figure 3.5-9 illustrates the results shown in Table 3.5-33 and contrasts them against the overall mean value obtained by averaging all samples overall years at both sites.

The trending results shown in Table 3.5-33 and Figure 3.5-9 indicate an apparent rise in mean ambient ammonia concentration of about 240 µg/m^3 or about 0.3 ppbv, which is about a 40 percent increase, with an average annual variability of 15 percent over the course of the active monitoring period. This suggests that changes in ambient ammonia concentrations could be attributable to changes in fertilizer application, animal husbandry, or NO_x emissions controls on stationary sources. Another possible explanation for these changes

is overall improvement in the relatively new measurement technique over time, from field procedures to laboratory analysis. This could have resulted in better sensitivity and data capture as the program progressed, which would tend to detect an analyte, which may have previously been under-detected or undetected; i.e., a lowering of the method detection limit (MDL).

Table 3.5-33. Historic Ambient Ammonia Concentration - 2 AMoN Sites

Site ID Code	Year	Months Operation	Valid Samples	Days of Data	Measured Ammonia ng/m^3	Measured Ammonia ppbv	Measured Ammonia variation
NM98	2008	12	18	246	331	0.48	14%
NM98	2009	12	26	356	354	0.51	8%
NM98	2010	10	20	270	463	0.67	20%
NM98	2011	12	26	348	330	0.47	14%
NM98	2012	8	17	236	483	0.70	25%
		NM98 Weighted Average	**107**	**1456**	**385**	**0.55**	**17%**
		Trend	**—**	**—**	**112**	**0.16**	**—**
		Change	**—**	**—**	**33%**	**33%**	**—**
NM99	2008	12	18	253	844	1.21	22%
NM99	2009	12	24	309	1,008	1.45	7%
NM99	2010	12	26	354	1,213	1.75	12%
NM99	2011	12	26	356	1,054	1.52	3%
NM99	2012	8	14	195	1,341	1.93	24%
		NM99 Weighted Average	**108**	**1467**	**1,084**	**1.56**	**14%**
		Trend	**—**	**—**	**416**	**0.60**	**—**
		Change	**—**	**—**	**47%**	**47%**	**—**
NM98/99	2008	24	36	499	592	0.85	20%
NM98/99	2009	24	50	665	658	0.95	11%
NM98/99	2010	22	46	624	887	1.28	21%
NM98/99	2011	24	52	704	696	1.00	5%
NM98/99	2012	16	31	431	870	1.25	18%
		NM98/99 Composite Average	**215**	**2923**	**736**	**1.06**	**15%**
		Trend	**—**	**—**	**238**	**0.34**	**—**
		Change	**—**	**—**	**38%**	**38%**	**—**

Source: NADP 2013.
Note: Variation is absolute difference between annual value and cumulative mean of annual values.
ng/m^3 = nanogram(s) per cubic meter; ppbv = part(s) per billion (by volume)

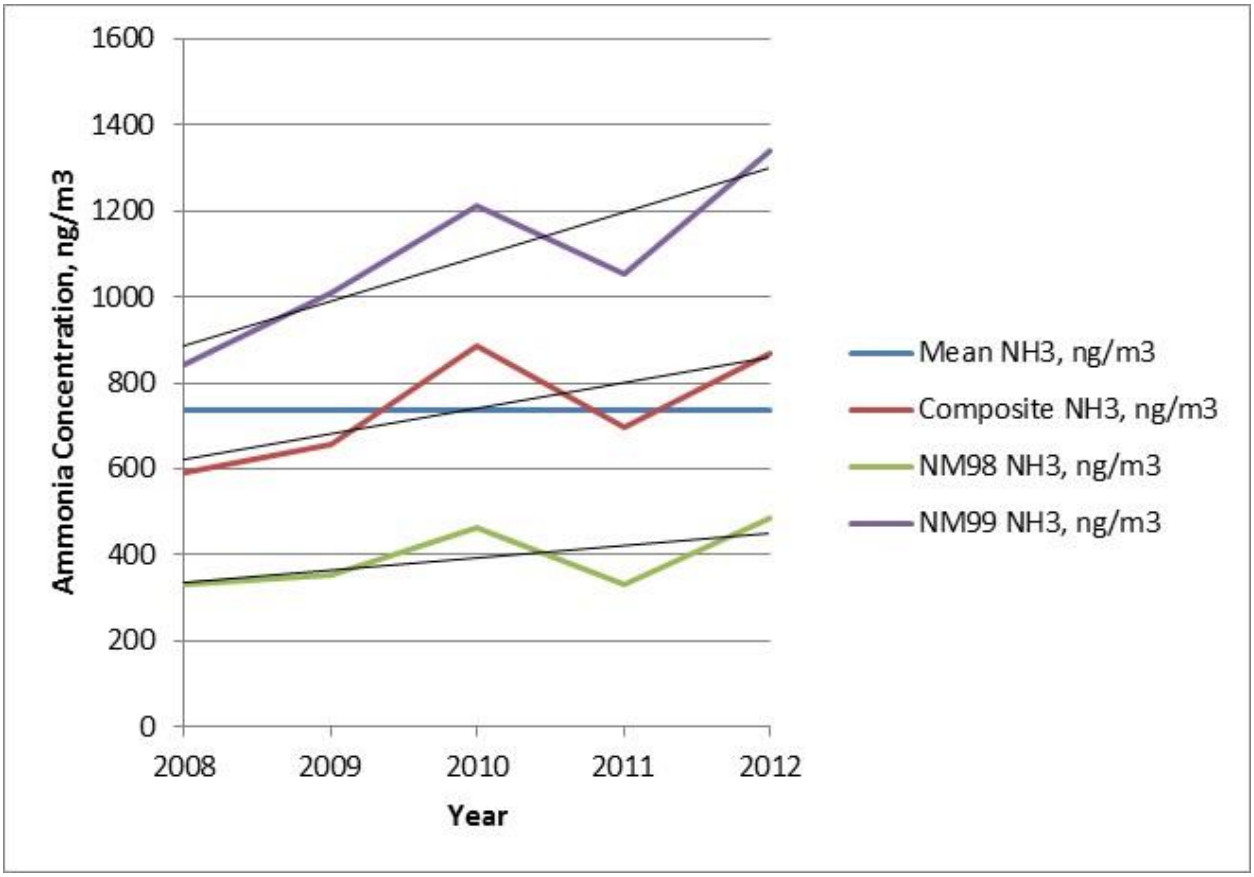


Figure 3.5-9. Historic Ambient Ammonia – Northwest New Mexico

3.5.2.8 Sensitive Receptors

Certain population groups are considered more sensitive to air pollution and odors than others; those that are particularly sensitive include children, elderly, and acutely ill and chronically ill persons, especially those with cardio respiratory diseases such as asthma and bronchitis. Sensitive receptors (land uses) indicate locations where such individuals are typically found, namely schools, daycare centers, hospitals, senior citizen centers, residences of sensitive persons, and parks with active recreational uses, such as youth sports.

Persons engaged in strenuous work or physical exercise also have increased sensitivity to poor air quality. Residential areas are considered more sensitive to air quality conditions than commercial and industrial areas, because people generally spend longer periods of time at their residences, resulting in greater exposure to ambient air quality conditions. Recreational uses such as parks are also considered sensitive, due to the greater exposure to ambient air quality conditions and because the presence of pollution detracts from the recreational experience.

The FCPP generating units are located more than 1/2 mile from any sensitive land uses such as schools, hospitals, and senior citizen centers. The nearest sensitive receptors are homes located greater than 1 mile from the FCPP (Figure 3.3-1).

Several isolated single-family residences are in the vicinity of the proposed mining disturbance zone of Area IV North, the nearest of which is about 4,500 feet (1,370 meters) away. Three residences are within 1 mile (1,600 meters) of the edge of the disturbance area. Four additional residences lie within 1 mile (1,600 meters) of the mining disturbance zone of Area III within the Navajo Mine SMCRA Permit Area. The nearest structure is approximately 3,900 feet (1,190 meters) north of Area III (Figure 3.3-1).

3.5.2.9 Climate and Meteorology

The climatic region for Navajo Mine is arid to semi-arid, sparsely vegetated high desert. The region has warm summers and cold, relatively dry winters. Average monthly temperatures are listed for long-term periods at several monitoring stations in Table 3.5-11. The summer climate in San Juan County displays typical southwestern high desert characteristics. This region is at high elevation, so there is usually a wide diurnal temperature swing between daily low and high levels. The summer heat is tempered somewhat by the extremely low relative humidity. However, humidity can increase markedly for the months of July through October in association with a moist "monsoonal flow" from the south. Winters are generally moderate with monthly average temperatures just below freezing.

Overall annual precipitation is low. As shown in Table 3.5-34 the recorded average annual total precipitation for three stations in the region are between 6 and 7.5 inches per year. Pacific storms may produce winter snow or rainfall in northwestern New Mexico, but snow accumulation is unusual. The highest monthly precipitation totals occur during the warmer months. In this area, moist winds from the south and east support the development of thunderstorms associated with significant flash flooding and/or strong downburst winds. Strong wind episodes in the warmer summer and early fall months are usually connected with thunderstorms and are thus isolated and localized (WRCC 2011a, 2011b).

The Navajo Mine operates three meteorological stations within the mine property. In addition, data is also available for three stations in San Juan County nearest to the mine: Newcomb, Fruitland, and Shiprock, New Mexico (WRCC 2011c). Representative data from each of these stations are listed in Table 3.5-34 for average monthly temperatures and precipitation. The monthly average temperatures at the mine site tend to be slightly higher than for other monitoring stations in the region.

Located in the center of Area IV North, the mine's Meteorological Station No. 3 monitors meteorological parameters at an accepted standard height of 10 meters above ground level that are representative of Areas III and IV North.

Figure 3.5-10 presents an annual wind rose that summarizes Station No. 3 measurements of wind speed and direction during 2009.

As shown in Figure 3.5-10, with 13 percent of total measurements, the prevailing wind direction during 2009 was from the Northwest. Those NW winds were mostly in the wind speed range of >5 – 9 m/s, with the next most frequent component in the >3 to 5 m/s range. In addition, almost 9 percent of the winds were from the North-Northwest. The second most frequent wind direction during 2009 was from the South, with slightly less than 11 percent of the total winds. Most of those winds were in the wind speed range of >1 to 3 m/s. In addition, winds from the South-Southeast made up a little more than 10 percent of the total winds during 2009. The greatest frequency of higher-speed winds was from the Northwest. Measured wind patterns in Area IV North during 2009 indicate that the mine's particulate emissions likely dispersed in the

Southeast and South-Southeast directions for roughly 22 percent of the time and in the North and North-Northwest directions approximately 21 percent of the time.

Table 3.5-34. Climatology Summary: Mean Temperature and Precipitation in the Region

Monthly Average Dry Bulb Temperature (Degrees Fahrenheit)

Month	Navajo Mine[1] (2010)	Newcomb[2]	Fruitland[3]	Shiprock[4]
Jan	27.9°F	28.3°F	29.6°F	29.4°F
Feb	35.4°F	35.2°F	35.7°F	36.0°F
Mar	43.5°F	42.2°F	43.3°F	43.7°F
Apr	53.2°F	51.7°F	51.2°F	52.4°F
May	61.3°F	61.7°F	60.0°F	61.8°F
June	75.7°F	71.2°F	69.2°F	70.7°F
July	78.0°F	76.5°F	75.2°F	76.6°F
Aug	73.9°F	73.2°F	73.2°F	74.6°F
Sept	70.6°F	65.8°F	64.9°F	66.5°F
Oct	60.9°F	54.0°F	53.1°F	54.2°F
Nov	39.1°F	39.5°F	40.1°F	40.7°F
Dec	39.0°F	28.7°F	30.6°F	30.5°F
Annual Mean	54.9°F	52.3°F	52.2°F	53.1°F

Average Monthly Total Precipitation (inches)

Month	Navajo Mine[1] (2010)	Newcomb[2]	Fruitland[3]	Shiprock[4]
Jan	1.10 in	0.22 in	0.58 in	0.46 in
Feb	0.70 in	0.16 in	0.52 in	0.46 in
Mar	0.52 in	0.31 in	0.58 in	0.54 in
Apr	0.20 in	0.26 in	0.54 in	0.41 in
May	0.10 in	0.34 in	0.44 in	0.51 in
June	0.02 in	0.29 in	0.27 in	0.29 in
July	0.53 in	0.92 in	0.80 in	0.66 in
Aug	1.30 in	1.13 in	0.93 in	1.00 in
Sept	0.67 in	0.72 in	0.82 in	0.80 in
Oct	1.56 in	0.81 in	0.84 in	0.78 in
Nov	0.09 in	0.36 in	0.57 in	0.52 in
Dec	0.41 in	0.44 in	0.60 in	0.57 in
Annual Total	7.18 in	5.96 in	7.49 in	7.00 in

Source: WRCC 2011c.

Notes:

[1] Navajo Mine operates three on-site meteorological stations at different locations within the mine property. The average of the monthly mean values for the three stations is tabulated for 2010.

[2] Newcomb is a small tribal community 16 miles southwest of the Navajo Mine. Period of Record of Newcomb Climate Summary 6/6/1948 to 4/30/1971

[3] The Town of Fruitland is a rural agricultural/residential community on U.S. 64 approximately 10 miles northeast of the Navajo Mine. Period of Record of Fruitland Climate Summary 1/1/1893 to 8/31/2010

[4] The Town of Shiprock is an agricultural and tribal community, with a large number of traveler services, approximately 8 miles northwest of the Navajo Mine. Period of Record of Shiprock Climate Summary 7/1/1926 to 10/31/2007

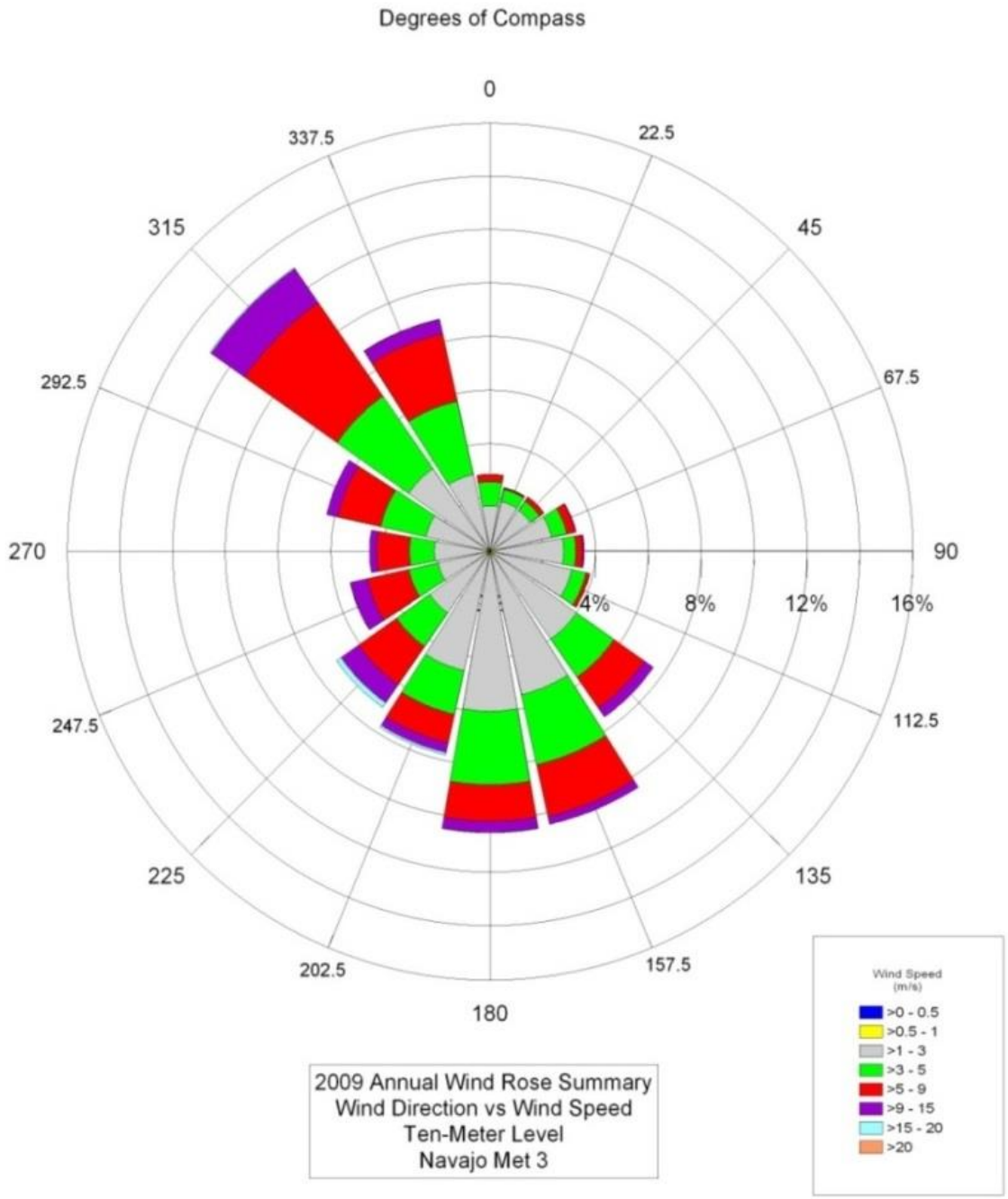


Figure 3.5-10. Measured Wind Speed and Direction Wind Rose for Area IV North

Atmospheric stability is a meteorological factor that also affects the dispersion of air pollutants. When the atmosphere is stable, emitted pollutants tend not to rise much, instead diffusing horizontally within a few hundred feet of the surface. Conversely, when the atmosphere is unstable, air pollutant emissions mix vertically within the atmosphere and tend to be carried away by prevailing winds.

In northwestern New Mexico, stable and unstable conditions of the atmosphere occur for roughly the same duration during the warmer months. Periods of atmospheric instability are typically manifested in monsoon rain events and wind storms that may occur almost daily from approximately early July through mid-October. Wind speeds tend to be highest during the monsoon months of July through October.

3.6 Climate Change

The FCPP/NMEP EIS, Section 4.2, includes a detailed description of the regulatory framework surrounding climate change as well as the existing environment as it relates to the FCPP and Navajo Mine. This entire section is incorporated by reference and specific pertinent sections have been summarized here (rather than verbatim quoted directly).

Climate change refers to any measurable alteration of climate lasting for an extended period of time –several decades or longer –and includes recordable changes in temperature, precipitation, or wind patterns. Additionally, United Nations Framework Convention on Climate Change (United Nations 1992) defines 'Climate change' as "A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."

During the 20th century, the Earth's average temperature increased about 0.7 to 1.5°F (0.4 to 0.8°C) and is projected to rise another 2 to 11.5°F (1.1 to 6.4°C) over the next 100 years (Intergovernmental Panel on Climate Control [IPCC] 2001, EPA 2012e). Seemingly, small changes in the average temperature of the planet can translate to large and potentially hazardous shifts in climate and weather. Climate change is suspected as the cause of changes in rainfall amounts and distribution that can result in flooding, droughts, or more frequent and severe heat waves. Also, oceans are warming and becoming more acidic, polar ice caps are melting, glaciers are receding, and sea levels are rising due to thermal expansion and ice loss. Long-term studies indicate that ocean surface temperatures have been rising at an average rate of 0.13°F (0.07°C) per decade and, since 1901, average sea level has increased by about 8 inches (20 centimeters). Average pH has decreased (acidified) by about 0.05 pH units since the mid-1980s. Late summer Arctic Ocean sea ice coverage has decreased by half since 1979, and glaciers have receded and lost significant mass since the 1970s (EPA 2012e). As climate change progresses in the coming decades, it will likely present challenges to society and the environment.

Over the past century, human activities have released large amounts of carbon dioxide (CO_2) and other GHGs into the atmosphere. The majority of GHGs are the by-product of burning fossil fuels to release energy in the form of heat, although deforestation, industrial processes, and some agricultural practices also emit GHGs into the atmosphere. GHGs trap solar energy in the atmosphere and cause it to warm. This phenomenon is called the greenhouse effect and is necessary to support life on Earth; however, excessive buildup of GHGs can change Earth's climate and result in undesirable effects on ecosystems, which affects human health and welfare (EPA 2012e).

In its *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2013* (EPA 2015a), the EPA provides summary information on GHG emissions by sources and removals by sinks in accordance with commitments under the United Nations Framework Convention on Climate Change (2009) and the United Nations IPCC (IPCC 1990-2007); key information from that report is summarized below.

The United Nations Framework Convention on Climate Change (2009) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." In its *Second Assessment Report* of the science of climate change, the IPCC concluded, "human activities are changing the atmospheric concentrations and distributions of greenhouse gases and aerosols" (IPCC 1995). These changes can produce a radiative forcing by changing either the reflection or absorption of solar radiation, or the emission and absorption of terrestrial radiation. Building on this conclusion, the IPCC *Third Assessment Report* asserted, "concentrations of atmospheric greenhouse gases and their radiative forcing have continued to increase as a result of human activities" (IPCC 2001).

The IPCC reports the Earth's global average surface temperature has increased by 1.1 ± 0.4°F (0.6 ± 0.2°C) over the 20th century. This value is about 0.27°F (0.15°C) larger than that estimated by the *Second Assessment Report*, which reported for the period up to 1994, "owing to the relatively high temperatures of the additional years (1995 to 2000) and improved methods of processing the data" (IPCC 2001). While the *Second Assessment Report* concluded "the balance of evidence suggests there is a discernible human influence on global climate" (IPCC 1995), the *Third Assessment Report* more directly connects the influence of human activities on climate. IPCC concluded, "In light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations" (IPCC 2001).

In the *Fourth Assessment Report*, IPCC stated warming of Earth's climate is unequivocal, and that warming is very likely attributable to increases in atmospheric GHGs caused by human activities (IPCC 2007). IPCC further stated changes in many physical and biological systems, such as increases in global temperatures, more frequent heat waves, rising sea levels, coastal flooding, loss of wildlife habitat, spread of infectious disease, and other potential environmental impacts, are linked to changes in the climate system, and some changes might be irreversible (IPCC 2007).

In the most-recent *Fifth Assessment Report*, IPCC reinforced evidence for the warming of the climate system since the 1950s based on observed changes over decades to millennia (IPCC 2013). The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of GHGs have increased. Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. In the Northern Hemisphere, 1983 to 2012 was likely the warmest 30-year period of the last 1,400 years (IPCC 2013).

The IPCC *Fifth Assessment Report* (IPCC 2013) further concludes that:

- The atmospheric concentrations of CO2, methane (CH4), and nitrous oxide (N2O) have all increased since 1750 due to human activity. In 2011, average concentrations of CO2, CH4, and N2O were 390 parts per million (ppm), 1.8 ppm, and 0.3 ppm, respectively, which are higher than pre-industrial levels by about 40 percent, 150 percent, and 20 percent, respectively.

- The globally-averaged combined land and ocean surface temperature data, as calculated by a linear trend, showed an average warming of 0.85°C (1.5°F) over the period 1880 to 2012. The average total increase between the 1850 to 1900 period and the 2003 to 2012 period was 0.78°C (1.4°F).
- Ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90 percent of the energy accumulated between 1971 and 2010. The rate of sea level rise since the mid-19th century has been larger than the mean rate during the previous two millennia. Over the period 1901 to 2010, global mean sea level rose by 0.19 meter (0.62 feet).
- Over the last two decades, the Greenland and Antarctic ice sheets have been losing mass, glaciers have continued to shrink almost worldwide, and Arctic sea ice and Northern Hemisphere spring snow cover have continued to decrease in extent.

This section presents the regulatory framework for monitoring GHG emissions, as well as a detailed description of national and regional emission sources and trends. In addition, detailed accounts of GHG emissions from stationary and mobile sources at the FCPP and Navajo Mine are provided in the environmental setting. The environmental consequences of the Proposed Action and alternatives with regard to climate change are presented in comparison to the relative contribution of the subject facilities to GHG emissions overall.

3.6.1 Regulatory Compliance Framework

No Federal, tribal, or state rules or regulations currently limit or curtail GHG emissions from FCPP, Navajo Mine, or other sources in the state of New Mexico or Navajo Nation. Federal and tribal stationary source regulations require monitoring, record keeping, and reporting of GHG emissions from FCPP; however, they do not apply to Navajo Mine since it does not meet the definition of a stationary source (i.e., consists of mobile source equipment only). These regulations are briefly described below.

3.6.1.1 Federal Regulations

3.6.1.1.1 Mandatory Reporting of Greenhouse Gases Rule (40 CFR Part 98)

On October 30, 2009, the EPA issued the Mandatory Reporting of Greenhouse Gases rule (74 Federal Register 56260, 40 CFR 98, effective December 29, 2009), which requires reporting of GHG data and other relevant information from large sources and suppliers in the U.S. pursuant to Fiscal Year (FY) 2008 Consolidated Appropriations Act (HR 2764; PL 110-161).

The rule facilitates collection of accurate and comprehensive emissions data to provide a basis for future EPA policy decisions and regulatory initiatives. The rule requires specified industrial source categories and facilities with an aggregated heat input capacity of 30 mmBTU or more per hour or that emit 25,000 metric tons or more per year (MT/yr) of CO_2 equivalent (CO_2e) GHGs to submit annual reports to the EPA. The gases covered by the rule are CO_2, CH_4, N_2O, and hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride (SF_6), and other fluorinated gases including nitrogen trifluoride and hydrofluorinated ethers.

As a Title V Operating Permit (40 CFR Part 71) source and Title IV Acid Rain Permit (40 CFR Part 72) source, FCPP is also required to report GHG emissions to the tribal and Federal EPA under Part 98 Subpart D for privately and publicly owned fossil-fuel fired electric generating units, including units located on sovereign tribal lands. Federal GHG regulations and reporting requirements do not apply to surface coal

mining operations. The Navajo Mine is not a "major" source of stationary emissions as defined under the Title V and PSD regulatory programs.

3.6.1.1.2 Continuous Emissions Monitoring (40 CFR Part 75)

FCPP is subject to Part 75 requirements for the monitoring, record keeping, and reporting of SO_2, NO_x, and CO_2 emissions, volumetric flow, and opacity data from affected units under the Acid Rain Program pursuant to Sections 412 of the CAA, 42 USC 7401-7671 et seq. Part 75 and the GHG Reporting Rule, 40 CFR Part 98 also sets forth provisions for the monitoring, record keeping, and reporting of NO_x mass emissions, control of which is required to demonstrate compliance with a NO_x mass emission reduction program. For FCPP, this control is consistent with 40 CFR Part 49 – *Source Specific Federal Implementation Plan for Implementing Best Available Retrofit Technology for Four Corners Power Plant: Navajo Nation,* described in detail in Section 3.5, Air Quality.

3.6.1.1.3 EPA Proposed Clean Power Plan

In June 2014, EPA issued the "Clean Power Plan" proposal to cut carbon pollution from existing power plants. The proposal establishes state-by-state goals to reduce GHGs by 2030. The focus is on power plants, but states have discretion to meet goals with a combination of industries. The proposed regulation is subject to comment and finalization. Additionally, tribal lands are not given goals at this time. A proposed timetable is suggested for moving into the process with tribes, with July 2017 being when EPA would have a proposed goal for tribal lands. States are given a year to establish programs, with a provision for a 2-year extension; therefore, 2020 is when states are required to have a program in place. Programs for compliance by tribes will likely happen a year or two later, with the compliance timeframe adjusted accordingly. Proposed requirements in the plan were not analyzed in the EA because of the uncertainties associated with whether the plan will be adopted or modified, and how it would be implemented on the Navajo Nation. Although EPA's Federal Implementation Plan for Best Available Control Technology for the FCPP did not explicitly include GHG reductions, the option selected by APS would reduce GHG emissions from FCPP by 26 percent compared to levels in 2005 (the baseline for the Clean Power Plan).

3.6.1.2 State Rules

Since FCPP and Navajo Mine are located on Navajo Nation sovereign tribal lands, they are not subject to state GHG reduction policies contained in or developed through Executive Orders. Similarly, state rules and regulations do not apply to FCPP or Navajo Mine due to tribal sovereignty. However, they do apply to other sources of GHG in the region, which are described in Section3.5.2. As such, the state regulatory framework is described in the following.

3.6.1.2.1 Executive Order 2009-047

On December 7, 2009, the Governor of New Mexico signed Executive Order 2009-047 *Establishing New Mexico as a Leader in Addressing Climate Change* that directed new emission reduction strategies to address climate change in New Mexico. This order built on actions taken in 2006 pursuant to Executive Order 2006-069 *New Mexico Climate Change Action*, in which the Governor directed state agencies to follow several recommendations of the Climate Change Advisory Group (New Mexico Climate Change Advisory Group 2006). The 2009 Order maintains a state government implementation team that is tasked with ensuring policies from the order are carried out. Those policies include:

- Continuing to participate in the Western Climate Initiative to develop a regional GHG emission reduction program that addresses the unique characteristics of New Mexico;
- Working with the State's electrical utilities and stakeholders to develop recommendations for reducing GHG emissions from existing coal-fired power plants within the State's jurisdiction;
- Developing recommendations for establishing an emission performance standard for new fossil-fueled generating facilities and new long-term power purchase agreements;
- Developing recommendations for offset protocols that are consistent with the Western Climate Initiative;
- Evaluating mechanisms for quantifying and awarding GHG emission allowances for emission reductions that occur before mandatory state or Federal cap-and-trade programs require such reductions;
- Convening a Resilience Advisory Group to develop a plan for adapting to climate changes; and,
- Strengthening state government efforts to reduce emissions associated with energy use and transportation in state government operations.

The 2009 and 2006 Executive Orders updated an initial 2005 Executive Order (05-33) establishing the New Mexico Climate Change Advisory Group and GHG emission reduction goals originally targeted to meet year 2000 levels by 2012, 10 percent below 2000 levels by 2020, and 75 percent below 2000 levels by 2050 (New Mexico Climate Change Advisory Group 2006).

3.6.1.2.2 GHG Reporting, Verification, Cap-and-Trade

On February 6, 2012, the New Mexico Environmental Improvement Board approved the repeal of 20.2.300 New Mexico Administrative Code (Reporting of Greenhouse Gas Emissions), 20.2.301 New Mexico Administrative Code (Greenhouse Gas Reporting Verification Requirements), and 20.2.350 New Mexico Administrative Code (Greenhouse Gas Cap-and-Trade Provisions). The effective date of these repeals was March 14, 2012. Due to the repeals, applicable stationary emissions sources are required to follow 20.2.73 New Mexico Administrative Code in reporting GHG emissions (NMED 2012a).

3.6.1.2.3 NMED Title V GHG Reporting Requirements

Pursuant to 20.2.73 New Mexico Administrative Code – Notice of Intent and Emissions Inventory Requirements, GHG emissions data are required to be submitted to NMED from Title V sources subject to permit requirements under 20.2.70 New Mexico Administrative Code (NMED 2012a).

For Title V sources that are not oil and gas facilities, the existing rule requires CO_2 and CH_4 emissions to be quantified and reported in accordance with 40 CFR Part 98. In accordance with NMED GHG reporting and quantification procedures, Title V sources that are not oil and gas facilities shall quantify and report CO_2 and CH_4 emissions using EPA GHG reports; EPA methods applied to facilities not subject to EPA reporting; NMED procedures; or Best Available Data only for sources lacking quantification methods under EPA methods or NMED procedures. The rule also requires applying EPA methods to facilities not subject to EPA reporting; NMED procedures; or Best Available Data only for sources lacking quantification methods under EPA methods or NMED procedures. The NMED procedures specify or reference acceptable EPA calculation methods and emission factors that Title V source owners must use when preparing GHG

emissions data reports for submission to NMED, as specified in 20.2.73 New Mexico Administrative Code (NMED 2012a).

Further, NMED accepts GHG emission reports submitted to EPA pursuant to 40 CFR Part 98 as a method of complying with 20.2.73 New Mexico Administrative Code GHG emissions reporting requirements. Part 98 Subpart D – Electricity Generation, applies to power plants.

3.6.2 Affected Environment

Descriptions of applicable monitoring projects referenced in the Climate Change Section of this EA are provided in Appendix A of the FCPP/NMEP EIS (OSMRE 2015), which is incorporated by reference.

3.6.2.1 Atmospheric Composition

Air is a mixture of constituent gases and its composition varies slightly with location and altitude. For 20th century scientific and engineering purposes, it became necessary to define a standard composition known as the U.S. Standard Atmosphere. In addition to the common gases (nitrogen, oxygen, CO_2, CH_4, hydrogen, N_2O), the atmosphere contains noble or inert gases (argon, neon, helium, krypton, xenon). Radon is also present in low concentrations near ground level in limited geographic areas where it is naturally emitted from certain types of rock and soil. Table 3.6-1 shows the typical composition of dry standard air, which is over 99 percent nitrogen and oxygen (Universal Industrial Gases, Inc. [UIG] 2008, EPA 2012f).

Table 3.6-1. Standard Composition of Dry Air

Principal Gas	Concentration in Air ppmv	Fraction percent
Nitrogen	780,805.00	78.080500
Oxygen	209,440.00	20.944000
Argon	9,340.00	0.934000
Carbon Dioxide	387.69	0.038769
Neon	18.21	0.001821
Helium	5.24	0.000524
Methane	1.81	0.000181
Krypton	1.14	0.000114
Hydrogen	0.50	0.000050
Nitrous Oxide	0.32	0.000032
Xenon	0.09	0.000009
Totals	**1,000,000.00**	**100.000**

The atmosphere consists of five basic altitude zones: troposphere (sea level to 8 miles above the Earth's surface); stratosphere (8 to 32 miles); mesosphere (32 to 50 miles); thermosphere (50 to 350 miles); and exosphere (350 to 500 miles). Within the stratosphere is the O_3 layer (9 to 22 miles), which absorbs ultraviolet wavelengths; and within the mesosphere is the ionosphere (62 to 190 miles), which reflects

shortwave radio signals and produces auroras. These approximate altitude ranges vary with latitude, season, solar activity, and turbulence. GHGs persist mainly in the troposphere and stratosphere (some in the mesosphere) for different lengths of time, ranging from less than 5 years to over 50,000 years, which is long enough to become well-mixed, meaning that atmospheric concentrations are about the same all over the world, regardless of source locations (EPA 2012g). Thus, the homogeneous composition of the lower atmosphere is the global setting for climate change.

3.6.2.2 Greenhouse Gases

Principal GHGs include CO_2, CH_4, N_2O, hydrofluorocarbons, perfluorocarbons, SF_6, and other fluorinated gases, including nitrogen trifluoride and hydrofluorinated ethers. GHGs occur naturally because of volcanoes, forest fires, and biological processes such as enteric fermentation and aerobic decomposition. They are also produced by combustion of fuels, industrial processes, agricultural operations, waste management, and land use changes such as loss of farmland to urbanization. The most common GHG from human activity (fuel combustion) is CO_2, followed by CH_4 and N_2O (EPA 2012g).

Larger GHG emissions lead to higher concentrations of GHGs in the atmosphere. GHG concentrations are measured in units of ppm, ppb, and parts per trillion (ppt). One ppm is equivalent to 1 cubic centimeter (cc) of pure gas diluted in 1 cubic meter of air. Similarly, 1 ppb is one cc diluted in 1,000 cubic meters, and 1 ppt is one cc diluted in 1,000,000 cubic meters (EPA 2012g).

3.6.2.2.1 Carbon Dioxide

CO_2 enters the atmosphere through burning fossil fuels (coal, natural gas, and petroleum products), decomposition of solid waste, trees and wood products, fermentation, and also as a result of certain chemical reactions, such as manufacture of cement. CO_2 is removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biologic carbon cycle. In the carbon cycle, carbon in various molecular forms is cycled among atmospheric, oceanic, land and marine biotic, and mineral reservoirs. Atmospheric CO_2 is part of this global carbon cycle. CO_2 concentrations in the atmosphere have increased from about 280 ppm in pre-industrial times to about 390 ppm, a 39 percent increase. The IPCC notes that "this concentration has not been exceeded during the past 420,000 years, and likely not during the past 20 million years. The rate of increase over the past century is unprecedented, at least during the past 20,000 years." The IPCC definitively states that "the present atmospheric CO_2 increase is caused by anthropogenic emissions of CO_2" (EPA 2012g, IPCC 2007).

Global Warming Potential (GWP) is a quantified measure of the globally averaged relative radiative forcing impacts of a particular GHG. It is defined as the cumulative radiative forcing both direct and indirect effects integrated over a period of time from the emission of a unit mass of gas relative to a reference gas. CO_2 is the reference gas with a GWP of unity (1). CO_2e are calculated by multiplying the mass emissions of each GHG species times its EPA official GWP coefficient, then adding the resultant products together to obtain a single value for CO_2e. The persistence of CO_2 in the atmosphere is estimated to be in the range of 50 to 200 years, depending on variations in the carbon cycle (EPA 2012f, g).

3.6.2.2.2 Methane

CH_4 is primarily produced through anaerobic decomposition of organic matter in biological systems. Agricultural processes such as wetland rice cultivation, enteric fermentation in ruminant animals (e.g., cows),

and the decomposition of animal wastes emit CH_4, as does the decomposition of municipal solid wastes. CH_4 is also fugitively emitted during the production and distribution of natural gas and petroleum, and is released as a by-product of coal mining and incomplete fossil fuel combustion. Pipeline-quality natural gas is over 90 percent CH_4 by volume and is considered a "clean fuel" by industry with CO_2 and water vapor as its main combustion by-products. Atmospheric CH_4 concentrations have increased by about 160 percent since pre-industrial times, although the rate of increase has been declining. It has been estimated that slightly more than half of the current CH_4 flux to the atmosphere is anthropogenic, from human activities such as agriculture, fossil fuel use, and waste disposal. Until 2015, the EPA's official GWP coefficient of CH_4 was 21, and its persistence in the atmosphere was estimated to be about 9 to 15 years (EPA 2012f, g). In 2015, the EPA updated its official GWP coefficient for CH_4 to the IPCC *Fifth Assessment Report* value of 25 (EPA 2015a, IPCC 2013). As discussed in Section 3.6.3 below, this change would have no substantive effect on estimated CO_2e emissions associated with the Proposed Action.

3.6.2.2.3 Nitrous Oxide

N_2O is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste. Anthropogenic sources of N_2O emissions include agricultural soils, especially the use of synthetic and manure fertilizers; fossil fuel combustion, especially from mobile combustion; adipic (nylon) and nitric acid production; wastewater treatment and waste combustion; and biomass burning. N_2O's atmospheric concentration has increased by about 19 percent since 1750, from a pre-industrial value of about 270 ppb to about 320 ppb today, a concentration that has not been exceeded during the last thousand years. Until 2015, the EPA's official GWP coefficient of N_2O was 310, and its persistence in the atmosphere was estimated to be about 110 to 120 years (EPA 2012f, g). In 2015, the EPA updated its official GWP coefficient for N_2O to the IPCC *Fifth Assessment Report* value of 298 (EPA 2015a, IPCC 2013). As discussed in Section 3.6.3 below, this change would have no substantive effect on estimated CO_2e emissions associated with the Proposed Action.

3.6.2.2.4 Fluorinated Gases

Hydrofluorocarbons, perfluorocarbons, and SF_6 are synthetic, powerful GHGs that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for O_3-depleting substances (e.g., chlorofluorocarbons, hydrochlorofluorocarbons, and halons). In the electric utility industry, SF_6 is used as a dielectric gas in high-voltage equipment, such as switchgear and circuit breakers. As a man-made gas, SF_6 in the atmosphere has increased from 0 to about 7 ppt in modern times. Due to their expense, all of these fluorinated gases are typically emitted (lost) in small quantities relative to combustion by-products, but because they are potent GHGs, they are sometimes referred to as "High GWP gases" with estimated persistence in the atmosphere ranging from 1.5 to 50,000 years. Of these, SF_6 is the most potent, with an EPA official GWP of 23,900 and an estimated persistence of about 3,200 years (EPA 2012f, g).

3.6.2.3 Emission Sources

The EPA tracks GHG emissions in the U.S. and publishes the *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, which is updated annually (EPA 2015a, 2012f, 2014a). This detailed report contains estimates of the total national GHG emissions and removals associated with human activities in all 50 states. From the current report, the main sources of GHG emissions in the U.S. are described below (EPA 2014a):

- Electric power generation accounts for 32 percent of GHG emissions nationwide. Over 70 percent of electric power is generated by burning fossil fuels, mainly coal and natural gas. GHG emissions from electric power generation in the U.S. have increased by about 24 percent since 1990 as demand for electric power has grown, and fossil fuels have remained the dominant energy source for generation due to their low cost and high reliability.
- Transportation accounts for 28 percent of GHG emissions nationwide. GHG emissions from transportation result from burning fossil fuels in automobiles, trucks, trains, ships, and aircraft. About 90 percent of the fuel used for transportation is petroleum-based, which includes gasoline, diesel, and jet fuel.
- Industry accounts for 20 percent of GHG emissions nationwide. GHG emissions from industry are associated mainly with burning fossil fuels (coal, natural gas) for heat energy as well as emissions from certain chemical reactions necessary to produce goods from raw materials.
- Commercial and Residential uses account for 10 percent of GHG emissions nationwide. GHG emissions from businesses and homes result primarily from fossil fuels burned for heat, the use of certain products that contain GHGs, and the handling and disposal of domestic wastes.
- Agriculture accounts for 10 percent of GHG emissions nationwide. GHG emissions from agriculture are primarily caused by livestock such as cows (enteric fermentation), soil management practices, and rice farming.
- Land Use and Forestry offsets (absorbs or sequesters) about 15 percent of GHG emissions nationwide. Land areas can act as GHG sinks (absorbing CO_2 from the atmosphere) or GHG sources. Since 1990, well-managed forests and other lands have absorbed more CO_2 from the atmosphere than they emit.

3.6.2.4 Emission Trends

Since 1990, GHG emissions in the U.S. have increased by about 4.7 percent. However, from year-to-year emissions can increase or decrease due to changes in the economy, the price of fuel, weather, and other factors. In 2010, overall GHG emissions increased about 3 percent from 2009 levels. This increase was attributed to the improving economy, which increased energy consumption across all sectors. In addition, a hot summer caused an increase in electric power demand for air conditioning that was generated mainly by burning coal and natural gas in existing power plants (EPA 2014a).

3.6.2.5 Electric Power Generation

The electric utility sector involves the generation, transmission, and distribution of electricity. CO_2 comprises the vast majority (over 99 percent) of GHG emissions from this sector, but small amounts of CH_4 and N_2O are also emitted. These gases are released during the combustion of fossil fuels, such as coal, oil, and natural gas, to generate electricity. Less than 1 percent of GHGs from this sector is in the form of SF_6, a dielectric (insulating) gas used in high-voltage transmission and distribution equipment, such as circuit breakers and switches (EPA 2012f, g).

Coal combustion is much more carbon-intensive than burning natural gas or petroleum to generate electricity. In 2012, consumption of energy generated by coal decreased by 12.3 percent; thus coal generated

about 33 percent of electric power in the U.S. and in 2012 accounted for about 40 percent of CO_2 emissions from the power sector (EPA 2014a). In 2011, coal generated about 45 percent of electric power in the U.S., and accounts for 81 percent of CO_2 emissions from this sector. About 25 percent of electricity generated in 2010 was generated using natural gas, and this percentage has grown in recent years due to its reputation as a "clean" fuel and increased supply, which has driven down prices. Petroleum accounts for less than 1 percent of electricity generation, down significantly from the past. The remaining generation comes from nuclear plants (about 20 percent) and renewable sources (about 10 percent), which includes hydroelectric, geothermal, biomass (wood and agricultural wastes), wind, and solar (photovoltaic and thermal). Geothermal and biomass sources typically release fewer GHGs than fossil fuel combustion; and hydroelectric, wind, and solar emit no GHGs directly (EPA 2012g).

Table 3.6-2 presents a comparison of the GHG contents of various fuels used for electric power generation in units of kilograms per million BTU[1] (kg/mmBTU). Table 3.6-3 summarizes GHG emission rates for various generating resources in units of kg/MW-hr and pounds per megawatt-hour. The Interim Standard referenced in Table 3.6-3 is per the California Public Utilities Commission (PUC) Decision No. 07-01-039, January 25, 2007 (SB 1368).

Table 3.6-2. Comparison of Fuel GHG Contents - Thermal Electric Power Generation

Fuel / Heat Source	Generator Drive	GHG Emissions CO_2	GHG Emissions CH_4	GHG Emissions N_2O	GHG Emissions CO_2e
Bituminous Coal (electric utility)	ST	95.52 kg/mmBTU	0.0011 kg/mmBTU	0.0016 kg/mmBTU	96.03 kg/mmBTU
Biomass (wood waste cogeneration)	ST	88.45 kg/mmBTU	0.0316 kg/mmBTU	0.0042 kg/mmBTU	90.42 kg/mmBTU
Residual Fuel Oil No. 6	ST	75.09 kg/mmBTU	0.0032 kg/mmBTU	0.0006 kg/mmBTU	75.36 kg/mmBTU
Diesel Fuel No. 2	ICE, CT	73.96 kg/mmBTU	0.0032 kg/mmBTU	0.0006 kg/mmBTU	74.22 kg/mmBTU
Pipeline Natural Gas	ICE, CT, ST	53.02 kg/mmBTU	0.0011 kg/mmBTU	0.0001 kg/mmBTU	53.07 kg/mmBTU
Geothermal	ST	7.52 kg/mmBTU	0.0000 kg/mmBTU	0.0000 kg/mmBTU	7.52 kg/mmBTU
Solar Thermal	ST	0.00 kg/mmBTU	0.0000 kg/mmBTU	0.0000 kg/mmBTU	0.00 kg/mmBTU
Nuclear	ST	0.00 kg/mmBTU	0.0000 kg/mmBTU	0.0000 kg/mmBTU	0.00 kg/mmBTU

Sources: EPA 2012f, 2011a.

BTU = the amount of energy (heat) required to raise 1 pound of liquid water 1 degree Fahrenheit in temperature (39 to 40°F)
CT = combustion turbine (simple cycle or combined cycle), also referred to as gas turbine
ICE = internal combustion engine (diesel compression ignition or gas spark ignition), also referred to as reciprocating engine
kg/mmBTU = kilogram(s) per million British Thermal Units
ST = steam turbine (multistage), requires boiler

[1] BTU – British Thermal Unit, the amount of heat required to raise the temperature of 1 pound of water 1°F, from 39 to 40°F.

Table 3.6-3. Comparison of Electric Power Generation GHG Rates

Generating Units	CO_2e Rates kg/MW-hr	CO_2e Rates lb/MW-hr	Percent of Standard
Conventional Gas-Fired Turbine[1]	533	1,175	107%
Interim Standard[2]	499	1,100	100%
Combined Cycle Gas-Fired[3]	377	832	76%
Geothermal[4]	107	236	21%
Solar Thermal or Nuclear	0	0	0%

Sources: EPA 2012b, f.

Notes:

[1] Conventional gas-fired is steam turbine or simple-cycle gas turbine, 34% efficiency.

[2] California PUC Decision No. 07-01-039, January 25, 2007 (SB 1368).

[3] Combined cycle is gas turbine with steam turbine, 48% composite efficiency.

[4] Saturated steam, 24% efficiency (no superheat).

kg/MW-hr = kilogram(s) per megawatt-hour (same as grams per kilowatt-hour)

lb/MW-hr = pound(s) per megawatt-hour

3.6.2.6 Mobile Sources

While stationary sources such as power plants and oil refineries emit large quantities of GHGs due to their sheer numbers nationwide, mobile sources also emit substantial amounts. Mobile sources include on-road vehicles (e.g., automobiles, trucks, motorcycles), off-road equipment (e.g., earthmovers, cranes, portable pumps and generators), trains (e.g., freight, passenger, light rail), vessels (e.g., boats, ships, watercraft), and aircraft (e.g., general aviation, commercial, military). Mobile source fuels include gasoline, diesel, heavy fuel oil, and jet fuel, all of which emit GHGs when combusted.

Mobile sources associated with Navajo Mine include diesel-powered draglines, loaders, coal haul trucks, support vehicles, and explosives detonation. Mobile sources associated with FCPP include materials handling equipment, maintenance equipment, and support vehicles used at the plant and for transmission line upkeep. The dominant fuel used for mobile sources at Navajo Mine and FCPP is diesel fuel, also referred to as distillate fuel oil no. 2, with a calculated GHG content of 22.4 pounds per gallon CO_2e.

3.6.2.7 Regional and State GHG Emissions

There are 17 electric power-generating facilities in the Four Corners region (northeastern Arizona, southwestern Colorado, Navajo Nation, and northwestern New Mexico) including FCPP that report to U.S. and tribal EPAs pursuant to Part 75 (Table 3.6-4). No generating facilities in southeastern Utah are within an equivalent distance of 400 kilometers (248 miles). These sources are identified in order to provide context regarding regional GHG emissions and their portion of national GHG emissions resulting from electric power generation. Table 3.6-5 summarizes historic GHG emissions reported to, and published by, EPA for the most recent 6-year period (2005 to 2010) from electric power generation on national, regional (17 plants, including FCPP), and local (FCPP only) levels. At the New Mexico state level, Table 3.6-6

shows reported statewide industrial GHG emissions from all sources for 2008, 2009, and 2010 with FCPP Part 75 data included for geographic context.

Table 3.6-4. Regional Part 75 Sources - 17 Electric Power Generating Facilities

State	Facility Name	Facility Label	ORISPL	Fuel	County
Arizona	Cholla	Generating Station	113	Coal	Navajo
Arizona	Coronado	Generating Station	6177	Coal	Apache
Navajo Nation	Navajo	Generating Station	4941	Coal	Coconino
Arizona	Springerville	Generating Station	8223	Coal	Apache
Colorado	Comanche	Generating Station	470	Coal	Pueblo
Colorado	Fountain Valley	Power Plant	55453	Gas	El Paso
Colorado	Front Range	Power Plant	55283	Gas	El Paso
Colorado	Martin Drake	Generating Station	492	Coal	El Paso
Colorado	Nucla	Generating Station	527	Coal	Montrose
Navajo Nation	FCPP	Steam Electric Station	2442	Coal	San Juan
New Mexico	Bluffview	Power Plant	55977	Gas	San Juan
New Mexico	Escalante	Generating Station	87	Coal	McKinley
New Mexico	Milagro	Cogeneration and Gas Plant	54814	Gas	San Juan
New Mexico	Person	Generating Project	55039	Gas	Bernalillo
New Mexico	Reeves	Generating Station	2450	Gas	Bernalillo
New Mexico	San Juan	Generating Station	2451	Coal	San Juan
New Mexico	Valencia	Power Plant	55802	Gas	Valencia

Table 3.6-5. Historic GHG Emissions from Electric Power Generation

Summary Year	U.S. Total[1] MMT CO_2e	National Plants MMT CO_2e	Regional Plants MMT CO_2e	FCPP MMT CO_2e	FCPP Percent of National Emissions	FCPP Percent of Regional Emissions
2005	7,204	2,419	75.67	14.61	0.60%	19.3%
2006	7,159	2,363	76.79	14.96	0.63%	19.5%
2007	7,253	2,430	76.75	13.76	0.57%	17.9%
2008	7,048	2,378	76.67	13.70	0.58%	17.9%
2009	6,608	2,164	77.06	14.67	0.68%	19.0%
2010	6,822	2,277	76.78	13.14	0.58%	17.1%
6-Year Average	**7,016**	**2,339**	**76.62**	**14.14**	**0.60%**	**18.5%**
Annual Variation	**2.9%**	**3.4%**	**0.4%**	**4.3%**	**—**	**—**
Percent of Total US GHG Emissions	**100.0%**	**33.3%**	**1.1%**	**0.2%**	**—**	**—**

Sources: EPA 2012b, f.

Notes:

[1]all emissions sources

Percentages represents the percent of electrical power generation emissions

1 metric ton = 1,000 kilograms or 2,204.6 pounds

CO_2e = carbon dioxide equivalents

MMT = million metric tons

Table 3.6-6. Reported Statewide Industrial GHG Emissions - New Mexico[1]

Standard Industrial Classification	2008 MMT CO_2e	2009 MMT CO_2e	2010 MMT CO_2e	3-Year Average MMT CO_2e	3-Year Average percent
Electricity Generation - FCPP[2]	13.697	14.671	13.135	13.834	34.8%
Electricity Generation - San Juan[3]	10.797	12.167	10.731	11.232	28.2%
Electricity Generation - Other Plants[3]	4.899	5.632	5.665	5.398	13.6%
Electricity Generation - Subtotals	*29.393*	*32.470*	*29.531*	*30.465*	*76.6%*
Oil and Gas Extraction	1.001	1.220	1.043	1.088	2.7%
Oil and Gas Field Services	2.100	2.404	2.042	2.182	5.5%
Natural Gas Liquids	3.048	3.352	3.430	3.277	8.2%
Natural Gas Transmission	0.818	1.332	1.147	1.099	2.8%
Oil and Gas – Subtotals	*6.967*	*8.308*	*7.662*	*7.646*	*19.2%*
Petroleum Refining	1.086	0.995	1.190	1.090	2.7%
Petroleum Pipelines	0.066	0.069	0.059	0.065	0.2%
Refining and Pipelines - Subtotals	*1.152*	*1.064*	*1.249*	*1.155*	*2.9%*
Potash Mining	0.150	0.104	0.115	0.123	0.31%
Copper Mining	0.088	0.000	0.0002	0.029	0.07%
Gypsum Products	0.037	0.019	0.067	0.041	0.10%
Mining and Minerals - Subtotals	*0.275*	*0.123*	*0.182*	*0.193*	*0.5%*
Dry Dairy Products	0.051	0.037	0.030	0.039	0.10%
National Security	0.032	0.064	0.000	0.032	0.08%
Universities	0.027	0.032	0.036	0.032	0.08%
Landfills	0.006	0.248	0.398	0.217	0.55%
Plastic Foam Products	0.001	0.0004	0.0005	0.001	0.002%
Other Sources – Subtotals	*0.117*	*0.381*	*0.465*	*0.321*	*0.8%*
Annual Totals	**37.904**	**42.346**	**39.089**	**39.780**	**100.00%**

Source: NMED 2012b; EPA 2012f, g.

Notes:

[1] Most recent state data available (June 2012).

[2] Navajo Nation, does not appear on state inventory (EPA data).

[3] Included in state inventory.

CO_2e = carbon dioxide equivalents

MMT = million metric tons (1 metric ton = 1,000 kilograms or 2,204.6 pounds)

As shown in Table 3.6-4, electric power generation, including FCPP, comprised 76 percent of GHG emissions in geographic New Mexico during the 2008 to 2010 reporting period. Of electrical power generation emissions, FCPP contributed 45 percent, the SJGS contributed 37 percent, and other plants contributed 18 percent. Thus, FCPP was the largest emitter of GHGs in the geographic state during the reporting period.

3.6.2.8 FCPP Stationary Source GHG Emissions

For the representative 12-year[1] period 2000 to 2011, Table 3.6-7 shows historic plantwide generation (MW-hrs/yr), GHG emissions (MT/yr), and GHG rates (kg/MW-hr) from FCPP Units 1, 2, 3, 4, and 5, as reported to EPA pursuant to Part 75[2]. Similarly, Table 3.6-8 sums Units 1, 2, and 3 for the same period, and Table 3.6-9 sums Units 4 and 5. These split GHG data illustrate the relative contributions of the older, less-efficient generating units (1, 2, and 3) and the newer, more-efficient generating units (4 and 5). Table 3.6-10 displays the relative contribution of FCPP to regional electrical generation and GHG emissions.

As shown in Tables 3.6-8 and 3.6-9, historically, Units 1, 2, and 3 generated 29 percent of electric power at FCPP and emitted 33 percent of GHGs, while Units 4 and 5 generated 71 percent of electric power and emitted 67 percent of GHGs. This result demonstrates that Units 4 and 5 are more efficient and have lower GHG emission rates in units of kg/MW-hr. Tables 3.6-8 and 3.6-9 represent total values per year.

[1] The Title V record-keeping requirement is 5 years.

[2] Part 75 CO_2 emissions corrected to CO_2e by multiplying by 1.0055 (average) to account for CH_4 and N_2O emissions with EPA official GWPs applied (21 and 310, respectively).

Table 3.6-7. Historic Aggregated GHG Emissions - FCPP Units 1, 2, 3, 4, and 5

Year	Generation MW-hrs/yr	CO_2e MT/yr	CO_2e kg/MW-hr
2000	16,109,134	15,452,300	959
2001	16,472,108	15,708,085	954
2002	14,768,989	13,619,193	922
2003	16,857,882	14,862,974	882
2004	16,134,118	13,779,824	854
2005	16,829,089	14,609,268	868
2006	17,162,615	14,956,107	871
2007	15,700,442	13,760,220	876
2008	15,821,299	13,697,313	866
2009	16,804,764	14,670,764	873
2010	14,955,046	13,135,014	878
2011	15,066,283	13,215,996	877
Historic Baseline	16,048,505	14,006,383	873
Plantwide Share	100%	100%	–

Source: EPA 2012b, f.

Notes:

CO_2e = carbon dioxide equivalents

Historic baseline period is 2005-11 (FGD installed on Units 4 and 5)

kg/MW-hr = kilograms per megawatt-hour (same as grams per kilowatt-hour)

MT = metric ton, 1,000 kg or 2,204.6 lbs

MT/yr = metric tons per year

MW-hrs/yr = megawatt-hours per year

Table 3.6-8. Historic GHG Emissions - FCPP Units 1, 2, and 3

Year	Generation MW-hrs/yr	CO_2e MT/yr	CO_2e kg/MW-hr
2000	4,550,595	4,643,060	1020
2001	4,642,272	4,860,698	1047
2002	4,664,651	4,700,023	1008
2003	4,503,798	4,311,611	957
2004	4,799,830	4,588,422	956
2005	4,936,157	4,691,541	950
2006	4,683,715	4,500,030	961
2007	4,851,740	4,686,109	966
2008	4,823,075	4,661,488	966
2009	4,780,246	4,566,395	955
2010	4,646,445	4,571,064	984
2011	4,258,209	4,239,444	996
Historic Baseline	4,711,369	4,559,439	968
Plantwide Share	29%	33%	–

Source: EPA 2012b, f.

Notes:

CO_2e = carbon dioxide equivalents

Historic baseline period is 2005-11 (FGD installed on Units 4 and 5)

kg/MW-hr = kilograms per megawatt-hour (same as grams per kilowatt-hour)

MT = metric ton, 1,000 kg or 2,204.6 lbs

MT/yr = metric tons per year

MW-hrs/yr = megawatt-hours per year

Table 3.6-9. Historic GHG Emissions - FCPP Units 4 and 5

Year	Generation MW-hrs/yr	CO_2e MT/yr	CO_2e kg/MW-hr
2000	11,558,538	10,809,239	935
2001	11,829,836	10,847,388	917
2002	10,104,338	8,919,170	883
2003	12,354,084	10,551,363	854
2004	11,334,289	9,191,403	811
2005	11,892,933	9,917,727	834
2006	12,478,900	10,456,077	838
2007	10,848,702	9,074,111	836
2008	10,998,224	9,035,825	822
2009	12,024,518	10,104,369	840
2010	10,308,601	8,563,950	831
2011	10,808,075	8,976,552	831
Historic Baseline	11,337,136	9,446,944	833
Plantwide Share	71%	67%	–

Source: EPA 2012b, f.

Notes:

CO_2e = carbon dioxide equivalents

Historic baseline period is 2005-11 (FGD installed on Units 4 and 5)

kg/MW-hr = kilograms per megawatt-hour (same as grams per kilowatt-hour)

MT = metric ton, 1,000 kg or 2,204.6 lbs

MT/yr = metric tons per year

MW-hrs/yr = megawatt-hours per year

Table 3.6-10. Historic Contribution of FCPP to Regional Electrical Generation and GHG Emissions

Year	Percent of Regional Generation	Percent of Regional| CO_2e Emissions
2000	20.2%	20.3%
2001	20.8%	20.6%
2002	18.9%	18.2%
2003	21.1%	20.1%
2004	19.6%	18.6%
2005	20.0%	19.3%
2006	19.9%	19.5%
2007	18.1%	17.9%
2008	18.7%	17.9%
2009	20.0%	19.0%
2010	17.3%	17.1%
2011	17.1%	16.7%

Sources: EPA 2012a, f, g.

Notes: For 17 regional electric power producers in Arizona, Colorado, Navajo Nation, and New Mexico, 2000-11 historic data.

CO_2e = carbon dioxide equivalents

3.6.2.9 FCPP and Navajo Mine Mobile Source GHG Emissions

Mobile GHG emissions from the Navajo Mine and FCPP result from support vehicles and equipment in the form of fugitive CH_4 and engine exhaust. Table 3.6-11 summarizes these emissions. In comparison to stationary source GHG emissions from FCPP, unadjusted (i.e., full production) mobile and fugitive source GHG emissions comprise a small fraction of total Project GHG emissions, only 0.7 percent of total Project GHG emissions, and is very small compared to regional and global emissions.

Mobile and fugitive sources GHG emissions from the Navajo Mine shown in Table 3.6-11 summarize data from the Area IV North Mine Plan Revision EA (OSMRE 2011). GHG emissions are conservative, because they were based on a full production rate of approximately 8.5 Mtpy; however, coal production rates in years 2014, 2015, and 2016 are approximately 5.8 Mtpy based on compliance with the FIP for BART, a 30 percent reduction in mining activity. Thus, the adjusted (i.e., reduced production) contribution to total Project GHG emissions would be only 0.5 percent of total Project GHG emissions.

Table 3.6-11. Estimated GHG Emissions from Navajo Mine and FCPP Mobile and Fugitive Sources

Mobile and Fugitive Sources	CO_2 MT/yr	CH_4 MT/yr	N_2O MT/yr	CO_2e MT/yr
Mine Extraction Operations and Loading	7,557	5.18	2.32	8,385
Coal Hauling Trucks to Stockpiles	2,010	0.11	0.05	2,028
Mining Support Vehicle Travel	2,134	0.11	0.04	2,150
Mine Fugitive Methane Emissions	—	2,747	—	57,687
Power Plant Off-road Equipment	149	0.01	0.00	151
Power Plant On-road Vehicles	160	0.01	0.01	162
Annual Totals (full production, rounded)	12,010	2,750	2	70,560
Annual Totals (reduced production, rounded)	8,410	1,930	1.4	49,390

Sources: OSMRE 2011; APS 2012; EPA 2012f, 2011d; SCAQMD 2008.

Notes:

CH_4 = methane
CO_2 = carbon dioxide
CO_2e = carbon dioxide equivalents
MT = metric ton, 1,000 kg or 2,204.6 lbs
MT/yr = metric tons per year
N_2O = nitrous oxide

A September 2014 study based on data collected by a new satellite-based CH_4 monitoring system found relatively higher levels of CH_4 in the atmosphere over the Four Corners region than elsewhere in the Southwest (referred to as a "methane hot spot"). A period of validating the observations is necessary; however, limited ground-based measurements appear to corroborate the space-based findings. The study primarily attributed the CH_4 levels to natural gas production, processing, and distribution, noting that "[oil and gas] Operators in Four Corners report higher emissions than any other basin in the new EPA greenhouse gas reporting program (GHGRP) subpart W [EPA 2013]." Although the study notes other sources of CH_4, such as coal mining and ruminant animals, the study focuses on oil and gas extraction and proposed increases in shale gas production in the area as the source of elevated CH_4 levels. The study does not change the regional baseline information, which is based on 12 years of historic data; therefore, the CH_4 analysis presented in the EA is the most relevant background data for the impact analysis. Additionally, the Navajo Mine CH_4 emissions total less than 1 percent of the total CH_4 emissions in the Four Corners area, which is consistent with the findings of the recent study that oil and gas production, primarily coal-bed methane extraction, is the likely cause of the anomaly noted in the study.

3.6.3 Affected Environment 2014 - 2016

3.6.3.1 FCPP Stationary Source Emissions

In order to comply with EPA's FIP specifying BART for the FCPP, APS has selected to implement the following actions:

- Shut down Units 1, 2, and 3. This shutdown occurred December 30, 2013.
- Continue to operate Units 4 and 5 through 2016 for the duration of the coal supply agreement.

These actions will produce a substantial reduction in the GHG emissions from FCPP. The expected timing of the reduction is at the beginning of 2014. Compared to the baseline conditions, GHG emissions from the FCPP are reduced by 26 percent (Table 3.6-12). Tables 3.6-10, 3.6-11, and Tables 4.6-1 through 4.6-3 show that as a result of the annual GHG emission reductions from BART compliance, the percentage contribution of FCPP to regional GHG emissions will decrease from 16.7 percent to a little over 12 percent.

Table 3.6-12. Annual Reduction in GHG Emissions as a Result of BART Compliance

	CO_2e MT/yr	CO_2e kg/MW-hr
Units 1, 2, 3, 4, 5	14,006,383	873
Units 4 and 5[1]	10,339,030	833
Total Reduction (years 2014, 2015, and 2016)	3,667,353	40
Percent Reduction	26%	5%

Notes:

CO_2e = carbon dioxide equivalents

kg/MW-hr = kilograms per megawatt-hour (same as grams per kilowatt-hour)

MT = metric ton, 1,000 kg or 2,204.6 lbs

MT/yr = metric tons per year

[1] Note that APS will install "hot side/high dust" SCRs in 2018 between the boiler economizer and secondary air preheater on Units 4 and 5; however, this change will not affect GHG emissions during the EA analysis period. Additionally, 99.9 percent of the experienced GHG reduction is through shutdown of Units 1, 2, 3. Installation of SCRs on Units 4 and 5 will reduce nitrous oxide along with nitric oxide and nitrogen dioxide; however, the resulting reduction in GHG emissions from SCR operation is negligible by comparison since over 99 percent of CO_2e emissions from coal combustion comprise carbon dioxide.

As discussed in Section 3.6.2.2 above, the EPA has adopted the IPCC *Fifth Assessment Report* GWP coefficients of 25 and 298 for CH_4 and N_2O, respectively. This represents a 19 percent increase in GWP for CH_4 and a 4 percent decrease for N_2O compared to the previous values of 21 and 310, respectively. Since CO_2 comprises over 99 percent of CO_2e from coal combustion, these changes are not substantive for this analysis, as determined below.

For the pre-2015 GWP coefficients in effect during the historical analysis period, the CO_2e emission factor for coal combustion can be calculated in units of grams per gigajoule (g/GJ) as follows (EPA 2012f):

$$(88{,}200 \text{ g/GJ } CO_2 \times 1) + (1 \text{ g/GJ } CH_4 \times 21) + (1.5 \text{ g/GJ } N_2O \times 310) = 88{,}686 \text{ g/GJ } CO_2e$$

For the current GWP coefficients, the CO_2e emission factor for coal combustion can be calculated as follows (EPA 2015a):

$$(88{,}200 \text{ g/GJ } CO_2 \times 1) + (1 \text{ g/GJ } CH_4 \times 25) + (1.5 \text{ g/GJ } N_2O \times 298) = 88{,}672 \text{ g/GJ } CO_2e$$

As shown above, the decrease from the pre-2015 to the current GWP values is very small and therefore negligible:

$$(88{,}672 / 88{,}686) - 1 = -0.016 \text{ percent}$$

This difference is well within the EPA range of uncertainty for fossil fuel combustion, which is −2 percent to +5 percent per Annex 7 of the *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, which is updated annually (EPA 2015a). Therefore, notwithstanding recent changes in GWP coefficients for CH_4 and N_2O, there would be no substantive differences in estimated CO_2e emissions from FCPP Units 4 and 5 under the Proposed Action, and the CO_2e values shown in Table 3.6-12 are representative of future operations.

3.6.3.2 FCPP and Navajo Mine Mobile Source GHG Emissions

Mobile source GHG emissions are anticipated to change slightly downward as a result of compliance with the FIP for BART. Mobile source GHG emissions associated with mining will be about 30 percent less based on the reduced coal production rates in years 2014, 2015, and 2016.

Mining-related emissions of CO_2e, including fugitive methane, would be a very small fraction of total CO_2e from FCPP Units 4 and 5 — less than 1 percent — which is within the EPA range of uncertainty for fossil fuel combustion of −2 percent to +5 percent (EPA 2015a):

$$70{,}250 \text{ MT/yr} \times (1 - 0.3) = 49{,}200 \text{ MT/yr } CO_2e \text{ from all coal mining activities}$$

$$49{,}200 \text{ MT/yr} / 10{,}339{,}000 \text{ MT/yr} = 0.5 \text{ percent of coal combustion emissions}$$

Therefore, notwithstanding recent changes in GWP coefficients for methane, there would be no substantive differences in estimated CO_2e emissions from coal mining relative to coal combustion under the Proposed Action.

3.7 Vegetation

3.7.1 Definition of Resource

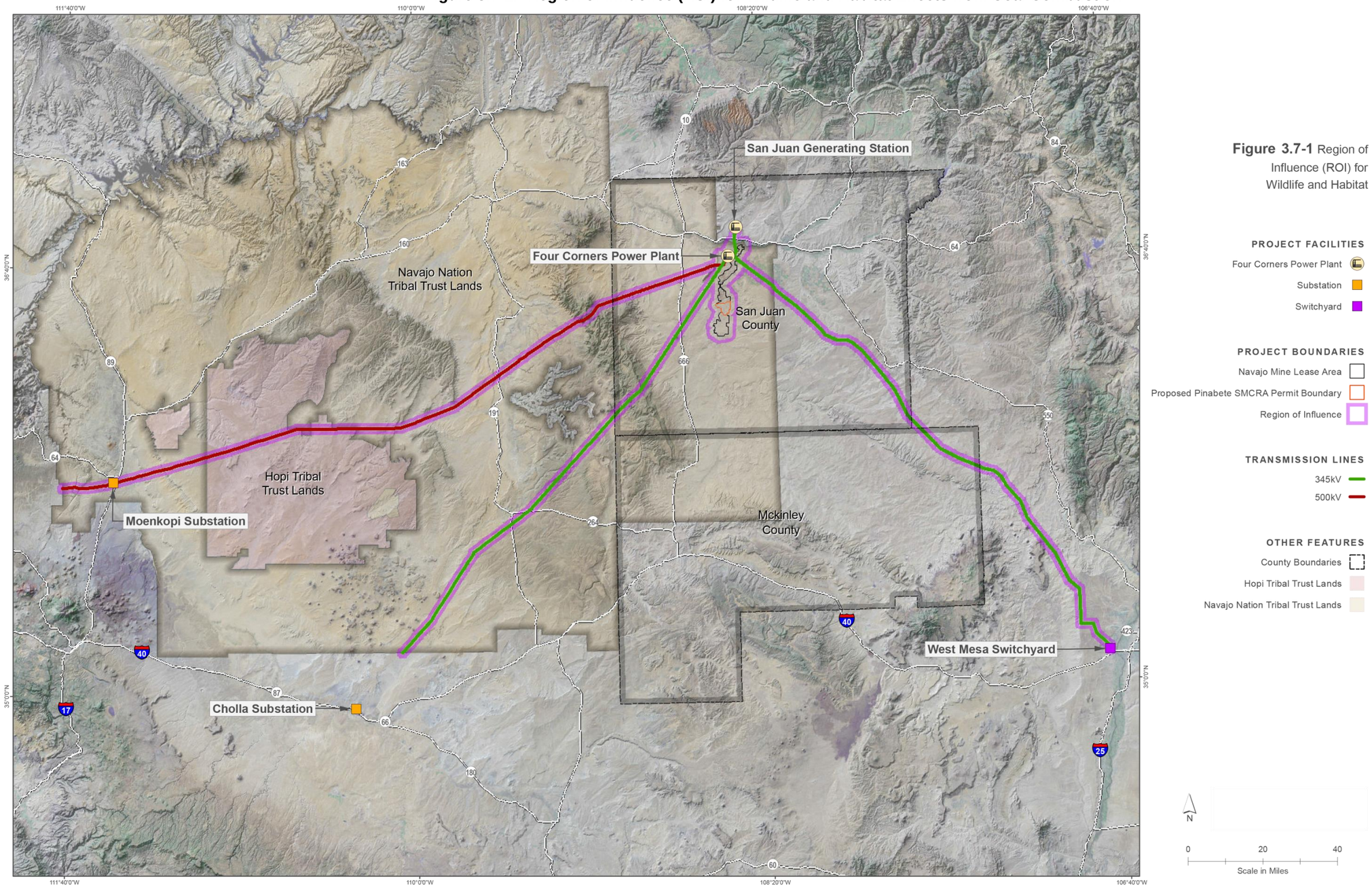
Vegetation resources include the plant communities and the species that comprise them. The vegetation resources assessment area includes the areas of existing mining in Area III, proposed mining in Area IV North, and the Burnham Road realignment.

Under SMCRA, NTEC is required to provide an adequate description of the existing pre-mining environmental resources within the proposed disturbance area(s). This information is used by OSMRE to determine whether the applicant can comply with the performance standards of the regulations for surface coal mining and whether reclamation of these areas is feasible (30 CFR 779.10). NTEC is required to map and delineate existing vegetative types and provide description of the plant communities within the

proposed permit area (30 CFR 779.19). Plant species protected by Federal or tribal regulations are addressed in the discussion of Threatened and Endangered and Protected Species, Section 3.8 of this document.

The combustion of the coal mined at Navajo Mine at FCPP would result in emission of chemicals of potential concern (COPECs) into the atmosphere. These COPECs would be dispersed by the wind and be deposited over land and water surfaces over an area extending beyond the area of potential effects described previously. This deposition was modeled using CALPUFF and AERMOD to describe the area over which deposition of COPECs would occur (AECOM 2013a, 2013b), and used to complete the effects analysis in the FCPP/NMEP EIS (OSMRE 2015). This analysis is incorporated into this EA by reference. The region of influence (ROI) for coal combustion includes the area within which the cumulative future air emissions from FCPP over the next 25 years is anticipated to increase baseline concentrations of COPECs by more than 1 percent (as described in the FCPP/NMEP EIS Section 4.6.2.5). It also includes the San Juan River from the upstream boundary of the Deposition Area downstream to, and including, the San Juan arm of Lake Powell, as this area may be affected by deposition and runoff of COPECs within this area (Figure 3.7-1).

Figure 3.7-1. Region of Influence (ROI) for Wildlife and Habitat Effects from Coal Combustion



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3.7.2 Affected Environment

3.7.2.1 Regional Setting

Within the defined ROI, land cover was classified per the National Vegetation Classification System nomenclature (Table 3.7-1). The cover classes are described in the FCPP/NMEP EIS Section 4.6.2.1 (OSMRE 2015).

Table 3.7-1. Land Cover Classes Occurring within 1 Mile of Navajo Mine Lease Area, 1 Mile of FCPP Lease Area, and 0.5 Mile of Transmission Line ROWs

Cover Class	Acres*	Percent of ROI
Agricultural Vegetation	6,544.5	1.6
Developed and Other Human Use	9,209.6	2.3
Forest and Woodland	75,668.9	18.7
Introduced and Semi-Natural Vegetation	1,269.1	0.3
Nonvascular and Sparse Vascular Rock Vegetation	22,707.4	5.6
Open Water	2,826.3	0.7
Semi-Desert	262,371.4	64.9
Shrubland and Grassland	23,391.6	5.8
Grand Total	403,988.9	100.0

Source: USGS 2005, OSMRE 2015.

Note:

*The acreage included in this table includes four transmission lines serving FCPP (FCCP to Moenkopi, FCPP to Cholla, FCPP to SJGS, FCPP to West Mesa)

3.7.2.2 Navajo Mine

The natural vegetation community within the area is referred to as Great Basin Desertscrub (Dick-Peddie 1993, Brown 1994). This type of vegetation is known as “cold desert,” a name assigned due to the climatic combination of cold winters, low precipitation, and wide fluctuations in both daily and seasonal temperature extremes. The Great Basin Desertscrub is characteristically dominated by salt tolerant plants and has few cacti (Brown 1994). As a whole, the plant species diversity of Great Basin Desertscrub is typically less than other types of desert scrublands. However, within the Great Basin Desertscrub there is considerable variation in plant species diversity between different plant communities.

In 1987, BNCC conducted vegetation studies within the Great Basin Desertscrub community and delineated the community into range sites for SMCRA planning. Range sites are defined as vegetation communities found on rangelands that contain unique associations of plant species composition and productivity; and have distinctive soils, hydrology, and topography (BNCC 2009a, NRCS 2011). The original 1987 characterization delineated eight community types in the vegetation resource assessment area as Alkali Wash, Arroyo Shrub, Badlands, Dunes, Thinbreaks, Calcareous Sands, Saline Sands, and Sands. The three sands sites were later combined into a single vegetation community type “Sands” to simplify analysis and reporting. These range sites were delineated by interpretation of aerial photography followed by ground-

truthing along with site-specific data on soils, geology, and topography. Subsequent studies used ground-truthing to confirm range sites as community types based on vegetative attributes (Ecosphere 2004a).

In undisturbed areas throughout the vegetation resource assessment area, forbs are the most dominant vegetative life form, followed by shrubs and then grasses. The most common plant species overall is Russian thistle (*Salsola tragus*), an introduced weed, followed by scorpion weed (*Phacelia crenulata*) and cryptantha (*Cryptantha crassisepala*). The current vegetation type distribution in the vegetation resource assessment area is shown in Figure 3.7-2. The acreages of vegetation types/range sites and corresponding percentage of the total vegetation within the assessment area are shown in Table 3.7-2 along with average cover and shrub densities for each range site. Disturbed vegetation associated with the existing mining area in Area III and previously disturbed areas in Area IV North accounts for 16 percent of total vegetation within the assessment area. Six vegetation range sites are present in the undisturbed areas associated with Area IV North. Area III has been disturbed by ongoing mining activities and is either reclaimed or un-vegetated. Species composition and density have been altered in this area from its natural state.

Table 3.7-2. Characterization of Vegetation in the Project Area

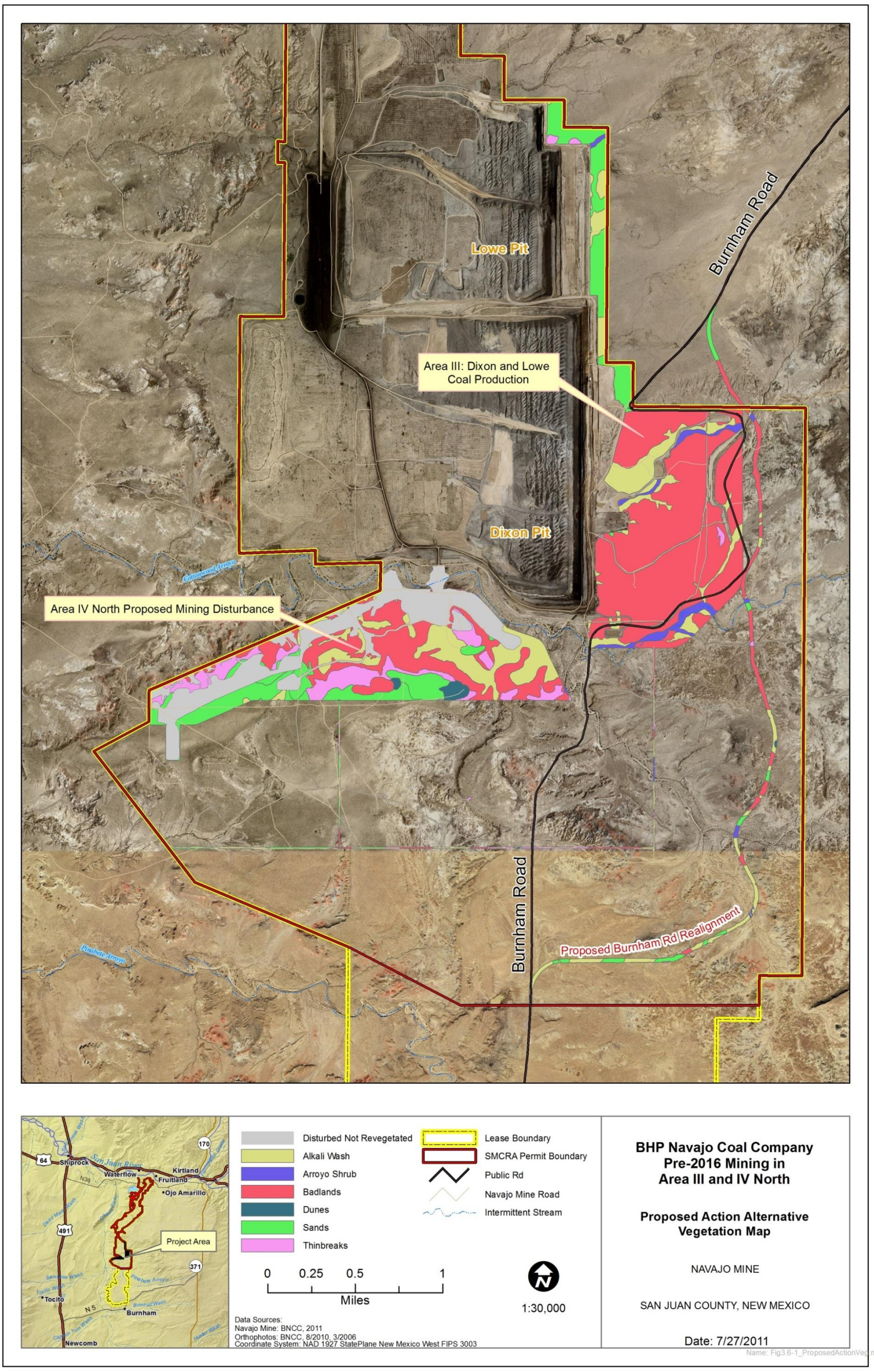
Vegetation Type	Project Area Acres	Project Area Percent	Areas I, II, III[1] Average Cover (%)	Areas I, II, III[1] Average Shrub Density (shrubs/m^2)	Area IV North[2] Average Cover (%)	Area IV North[2] Average Shrub Density (shrubs/m^2)
Alkali Wash	238	12	0.85	0.10	3.20	0.24
Arroyo Shrub	32	2	2.05	0.33	5.71	0.34
Badlands	689	36	0.35	0.05	1.08	0.10
Dunes	10	1	2.55	0.48	6.23	0.94
Sands	206	11	2.26	0.39	8.35	0.16
Thin Breaks	89	5	1.4	0.33	2.11	0.01
Disturbed	626	33	n/a	n/a	n/a	n/a

Sources:

[1] BNCC 2009.

[2] Ecosphere 2004a.

Figure 3.7-2. Vegetation Distribution in Project Area



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3.7.2.2.1 Alkali Wash

Alkali Wash is associated with minor waterways. Terrain is nearly level to moderately sloping and ranges from 0 to 3 percent. These community areas are typically broad and level with occasional small, dense patches of galleta grass (*Pleuraphis jamesii*) and alkali sacaton (*Sporobolus airoides*). Alkali Wash is typically located in washes and drainages as well as at the base of Badlands. The soils are shallow, often with heavy clays and high sodic levels. These conditions contribute to the lack of productivity in the community type.

3.7.2.2.2 Arroyo Shrub

Arroyo Shrub is found on level or nearly level terrain (0-2 percent slopes) located next to streambeds in major drainages, such as Cottonwood Arroyo and Pinabete Arroyo. The soils are stratified sands and often have a high sodium adsorption ratio value, which generally means soils are compacted, dry with only trace vegetation present. Production is still high because of the deep, well-drained soil and proximity to water. Shrubs and perennials characteristic of this community include greasewood (*Sarcobatus vermiculatus*), burroweed (*Isocoma azteca*), lemon scurf-pea (*Psoralidium lanceolatum*), and saltgrass (*Distichlis spicata*).

3.7.2.2.3 Badlands

Badlands have the least vegetation of any community type in the Project Area. Badlands consists of exposed, weathered shale with moderately undulating to steep topography (10-60 percent slopes). The vegetation community common to Badlands generally occurs between plateau edges and major drainages. Plants, where they occur, are often located along the small relief channels of these barren areas. Species typical of Badlands are Gardner's saltbush (*Atriplex gardneri*), Powell's saltbush (*Atriplex powellii*), yellow beeplant (*Cleome lutea*), and poverty weed (*Monolepis nuttalliana*). This community can abruptly shift to another community type or gradually transition to Alkali Wash or Thinbreaks.

3.7.2.2.4 Dunes

Dunes form gently rolling terrain (0 to 5 percent slopes) located on the leeward side of ridges, bluffs, and plateaus. Dunes soils are deep and composed of well-drained sands. The soil depth in Dunes offers deep, but more consistent water availability. Since only deep-rooted perennial plants can exploit this water, Dunes often harbor unique plant species such as San Juan milkweed (*Asclepias sanjuanensis*). The Dunes community type is one of the more productive found in the area.

3.7.2.2.5 Sands

As with Dunes, the deeper penetration of rainwater into sandy soils allows for greater water availability and increases plant species diversity. The types of sand in this vegetation community can vary from saline to calcareous. Sands often transition to, and can be mixed with the Thinbreaks community. In years with high amounts of spring rainfall, sandy soils display an abundance of annuals, especially scorpion weed, annual Townsend daisy *(Townsendia annua*), and cryptantha.

3.7.2.2.6 Thinbreaks

Thinbreaks are typically located in upland habitats with surface rock as a unifying feature. These are rocky areas, usually characterized by shale, and may contain loose rock or large pieces of rock firmly embedded

in the ground. Slopes vary from 2 to 9 percent. These sites usually occur along ridges and rock outcrops that are in between plateaus and major drainages or plateaus and Badlands, but can also occur on butte and mesa tops. Thinbreaks can abruptly shift to another community type or gradually shift to Badlands or Sands. Typical soils are shallow sandy deposits overlaying sandstone. Thinbreaks plant species that occur in fissures between rocks include Bigelow sagebrush (*Artemisia bigelovii*), Mojave brickellbush (*Brickellia oblongifolia*), Fendler's spurge (*Euphorbia fendleri*), and basin daisy (*Platyschkuhria integrifolia*).

3.7.2.2.7 Disturbed

This category refers to areas where native vegetation has been removed or disturbed from ongoing mining activities in Area III and from previous disturbances in Area IV North. Mining strips, stockpiles, roads and other areas subject to frequent use are unvegetated. Those areas that are in the process of reclamation are vegetated with varying densities of shrubs and forbs including saltbush (*Atriplex* sp.), Indian ricegrass (*Achnatherum hymenoides*), galleta grass (*Pleuraphis jamesii*) and alkali sacaton (*Sporobolus airoides*).

3.8 Wildlife

3.8.1 Definition of Resource

The ROI for wildlife species would be the same as that described for vegetation in Section 3.7 and shown in Figure 3.7-1. Specific to the Navajo Mine, the ROI for Area IV North is those terrestrial and aquatic animal species previously documented or having potential to occur in the proposed areas of mining and Burnham Road realignment, and within a 1-mile area around the existing Navajo Mine Permit Area. This assessment area pertains to the general area that OSMRE requires NTEC to monitor annually for wildlife utilization. The NNDFW are responsible for the stewardship and conservation of wildlife within the Navajo Nation including the Navajo Mine. The wildlife resources assessment area is part of the larger New Mexico Department of Game and Fish Game Management Unit 1, which covers the entire Navajo Nation exclusive of checkerboard areas and is managed by the NNDFW. Wildlife species protected by Federal or tribal regulations are addressed in the discussion of Threatened and Endangered and Protected Species, Section 3.9 of this document.

In addition, as described in Section 3.7, the combustion of the coal mined at Navajo Mine at FCPP would result in emission of COPECs into the atmosphere. These COPECs would be dispersed by the wind and be deposited over land and water surfaces over an area extending beyond the area of potential effects described previously. This deposition was modeled using CALPUFF and AERMOD to describe the area over which deposition of COPECs would occur (AECOM 2013a, 2013b), and used to complete the effects analysis in the FCPP/NMEP EIS (OSMRE 2015). This analysis is incorporated into this EA by reference. The ROI for coal combustion includes the area within which the cumulative future air emissions from FCPP over the next 25 years is anticipated to increase baseline concentrations of COPECs by more than 1 percent (as described in the FCPP/NMEP EIS Section 4.6.2.5). It also includes the San Juan River from the upstream boundary of the Deposition Area downstream to, and including, the San Juan arm of Lake Powell, as this area may be affected by deposition and runoff of COPECs within this area (see Figure 3.7-1).

3.8.2 Affected Environment

3.8.2.1 Regional Setting

The species that may be present in this area were described in the FCPP/NMEP EIS (OSMRE 2015) and is summarized here. These species include raptors (Table 3.8-1), nonraptor avian species (Table 3.8-2, small mammals (Table 3.8-3), bats (Table 3.8-4), carnivores (Table 3.8-5), amphibians and reptiles (Table 3.8-6), and fish (Table 3.8-7). In addition to these species, rabbits and hares (lagomorphs) and big game species occur. Two species of lagomorphs have been documented in the ROI: desert cottontail (*Sylvilagus audubonii*) and black-tailed jackrabbit (*Lepus californicus*) (BNCC 2012; Ecosphere 2012; Marron and Associates 2012a, b, 2013). Big game documented, or expected to occur, in the ROI include mule deer, elk, and pronghorn antelope.

Table 3.8-1. Raptor Species Expected to Occur in the ROI

Species	Expected to Occur
American kestrel (*Falco sparverius*)	Year-round
bald eagle (*Haliaeetus leucocephalus*)	Winter Nonbreeding, Year-round
barn owl (*Tyto alba*)	Year-round
burrowing owl (*Athene cunicularia*)	Summer Breeding, Year-round
California condor (*Gymnogyps californianus*)	Year-round
Cooper's hawk (*Accipiter cooperii*)	Year-round
ferruginous hawk (*Buteo regalis*)	Summer Breeding, Year-round
golden eagle (*Aquila chrysaetos*)	Year-round
goshawk (*Accipiter gentilis*)	Year-round
great-horned owl (*Bubo virginianus*)	Year-round
Harris' hawk (*Parabuteo unicinctus*)	Year-round
Mexican spotted owl (*Strix occidentalis lucida*)	Year-round
northern harrier (*Circus cyaneus*)	Winter Nonbreeding, Year-round
osprey (*Pandion haliaetus*)	Migration
peregrine falcon (*Falco peregrinus*)	Year-round
prairie falcon (*Falco mexicanus*)	Year-round
red-tailed hawk (*Buteo jamaicensis*)	Year-round
rough-legged hawk (*Buteo lagopus*)	Winter Nonbreeding
sharp-shinned hawk (*Accipiter striatus*)	Year-round
Swainson's hawk (*Buteo swainsoni*)	Summer Breeding
turkey vulture (*Cathartes aura*)	Summer Breeding, Year-round

Table 3.8-2. Nonraptor Avian Species Expected to Occur in the ROI

Species	Expected to Occur
American avocet (*Recurvirostra americana*)	Summer Breeding, Migration
American coot (*Fulica americana*)	Year-round, Summer Breeding
American crow (*Corvus brachyrhynchos*)	Year-round
American redstart (*Setophaga ruticilla*)	Migration
American robin (*Turdus migratorius*)	Year-round
American widgeon (*Mareca Americana*)	Year-round
ash-throated flycatcher (*Myiarchus cinerascens*)	Summer Breeding
Audubon's warbler (*Setophaga coronata*)	Summer Breeding
Baird's sparrow (*Ammodramus bairdii*)	Winter Migrant, nonbreeding
barn swallow (*Hirundo rustica*)	Summer Breeding, Migration
Bewick's wren (*Thryomanes bewickii*)	Year-round
black-chinned hummingbird (*Archilochus alexandri*)	Summer Breeding
black-crowned night heron (*Nycticorax nycticorax*)	Year-round
black-headed grosbeak (*Pheucticus melanocephalus*)	Summer Breeding
black-throated sparrow (*Amphispiza bilineata*)	Summer Breeding
blue grosbeak (*Pheucticus melanocephalus*)	Year-round
blue-gray gnatcatcher (*Polioptila caerulea*)	Summer Breeding
blue-winged teal (*Anas discors*)	Summer Breeding
black tern (*Chlidonias niger*)	Migration
black-chinned hummingbird (*Archilochus alexandri*)	Summer Breeding
black-throated sparrow (*Amphispiza bilineata*)	Summer Breeding
blue grosbeak (*Passerina caerulea*)	Summer Breeding
Bonaparte's gull (*Larus philadelphia*)	Migration
Brewer's sparrow (*Spizella breweri*)	Year-round
broad-tailed hummingbird (*Selasphorus platycercus*)	Summer Breeding
brown-headed cowbird (*Molothrus ater*)	Year-round
Bullock's oriole (*Icterus bullockii*)	Summer Breeding
bushtit (*Psaltriparus minimus*)	Year-round
cactus wren (*Campylorhynchus brunneicapillus*)	Year-round
Canada goose (*Branta canadensis*)	Year-round
canyon towee (*Melozone fusca*)	Year-round
Cassin's finch (*Carpodacus cassinii*)	Year—round
Cassin's kingbird (*Tyrannus vociferans*)	Summer Breeding

Species	Expected to Occur
cedar waxwing (*Bombycilla cedrorum*)	Winter Nonbreeding
chipping sparrow (*Spizella passerine*)	Summer Breeding
cinnamon teal (*Anas cyanoptera*)	Summer Breeding
cliff swallow (*Petrochelidon pyrrhonota*)	Summer Breeding
common merganser (*Mergus merganser*)	Winter Nonbreeding
common nighthawk (*Chordeiles minor*)	Summer Breeding
common raven (*Corvus corax*)	Year-round
common yellowthroat (*Geothlypis tricha*)	Summer Breeding
curve-billed thrasher (*Toxostoma curvirostre*)	Year-round
dark-eyed junco (*Junco hyemalis*)	Year-round
Eared grebe (*Podiceps caspicus*)	Year-round
Eurasian collared-dove (*Streptopelia decaocto*)	Year-round
Eurasian widgeon (*Anas penelope*)	Migration
gadwall (*Anas strepera*)	Year-round, Winter Nonbreeding
Gamble's quail (*Callipepla gambelii*)	Year-round
gray flycatcher (*Empidonax wrightii*)	Summer Breeding
gray vireo (*Vireo vicinior*)	Summer Breeding
great blue heron (*Ardea Herodias*)	Year-round
greater yellowlegs (*Totanus melanoleucus*)	Migration
green-tailed towhee (*Chlorura chlorura*)	Year-round
green-winged teal (*Anas carolinensis*)	Year-round
horned lark (*Eremophila alpestris*)	Year-round
house finch (*Carpodacus mexicanus*)	Year-round
house sparrow (*Passer domesticus*)	Year-round
indigo bunting (*Passerina cyanea*)	Summer Breeding
killdeer (*Setophaga coronata*)	Year-Round
lark sparrow (*Chondestes grammacus*)	Summer Breeding
lesser goldfinch (*Spinus psaltria*)	Summer Breeding
loggerhead shrike (*Lanius ludovicianus*)	Year-round
MacGillivray's warbler (*Oporonis tolmiei*)	Migration
mallard (*Anas platyrhyncho*)	Year-round
mountain bluebird (*Sialia currucoides*)	Year-round
Mountain plover (*Chiadrius montanus*)	Summer breeding
mourning dove (*Zenaida macroura*)	Year-round

Species	Expected to Occur
northern flicker (*Colaptes auratus*)	Year-round
northern mockingbird (*Mimus polyglottos*)	Year-round
northern shoveler (*Anas clypeata*)	Year-round
pintail (*Anas acuta*)	Year-round, Winter Nonbreeding
pied-billed grebe (*Podilymbus podiceps*)	Year-round
pinyon jay (*Gymnorhinus cyanocephalus*)	Year-round
plumbeous vireo (*Vireo plumbeus*)	Summer Breeding
red-winged blackbird (*Agelaius phoeniceus*)	Year-round
ring-billed gull (*Larus delawarensis*)	Winter Nonbreeding, Migration
rock dove (*Columba livia*)	Year-round
rock wren (*Salpinctes obsoletus*)	Year-round
ruddy duck (*Oxyura jamaicensis*)	Year-round
sage sparrow (*Amphispiza belli*)	Year-round
sage thrasher (*Oreoscoptes montanus*)	Year-round
savannah sparrow (*Passerculus sandwichensis*)	Year-round
Say’s phoebe (*Sayornis saya*)	Year-round
scaled quail (*Callipepla squamata*)	Year-round
snowy egret (*Leucophoyx thula*)	Summer Breeding, Winter Nonbreeding
Scott's oriole (*Icterus parisorum*)	Summer Breeding
song sparrow (*Melospiza melodia*)	Year-round
southwestern willow flycatcher (*Empidonax traillii extimus*)	Summer Breeding
spotted sandpiper (*Actitis macularius*)	Summer Breeding
spotted towhee (*Pipilo maculatus*)	Year-round
vesper sparrow (*Pooecetes gramineus*)	Year-round
violet-green swallow (*Hirundo rustica*)	Summer Breeding
Virginia warbler (*Oreothlypis virginiae*)	Migration
western flycatcher (*Empidonax difficilis*)	Migration
western grebe (*Aechmophorus occidentalis*)	Summer Breeding
western kingbird (*Tyrannus verticalis*)	Summer Breeding
western meadowlark (*Sturnella neglecta*)	Year-round
western mockingbird (*Mimus polyglottos leucopterus*)	Year-round
western sandpiper (*Ereunetes mauri*)	Winter Nonbreeding
western tanager (*Piranga ludoviciana*)	Summer Breeding
western wood-pewee (*Contopus sordidulus*)	Summer Breeding

Species	Expected to Occur
white-crowned sparrow (*Zonotrichia leucophrys*)	Winter Nonbreeding
white-faced ibis (*Plegadis chihi*)	Migration
white-winged dove (*Zenaida asiatica*)	Summer Breeding
willet (*Tringa semipalmata*)	Summer Breeding, Migration
willow flycatcher (*Empidonax traillii*)	Year-round, Migration
Wilson’s phalarope (*Phalaropus tricolor*)	Migration
Wilson's warbler (*Wilsonia pusilla*)	Migration
yellow-headed blackbird (*Xanthocephalus xanthocephalus*)	Year-round
yellow-billed cuckoo (*Coccyzus americanus*)	Summer Breeding
yellow-breasted chat (*Icteria virens*)	Summer Breeding

Table 3.8-3. Small Mammal Species Expected to Occur in the ROI

Species	Expected to Occur
antelope ground squirrel (*Ammospermophilus nelson*)	Year-round
banner-tailed kangaroo rat (*Dipodomys spetabilis*)	Year-round
Botta's pocket gopher (*Thomomys bottae*)	Year-round
Abert's squirrel (*Sciurus aberti aberti*)	Year-round
Botta's pocket gopher (*Thomomys bottae albatus*)	Year-round
brush mouse (*Peromyscus boylii rowleyi*)	Year-round
canyon mouse (*Peromyscus crinitus*)	Year-round
canyon mouse (*Peromyscus crinitus auripectus*)	Year-round
cliff chipmunk (*Neotamias dorsalis dorsalis*)	Year-round
Colorado chipmunk (*Neotamias quadrivittatus quadrivittatus*)	Year-round
common porcupine (*Erethizon dorsatum couesi*)	Year-round
deer mouse (*Peromyscus maniculatus blandus*)	Year-round
deer mouse (*Peromyscus maniculatus*)	Year-round
dusky shrew (*Sorex monticolus monticolus*)	Year-round
golden-mantled ground squirrel (*Spermophilus lateralis lateralis*)	Year-round
grasshopper mouse (*Onychomys leucogaster*)	Year-round
Gunnison's prairie dog (*Cynomys gunnisoni gunnisoni*)	Year-round
Gunnison's prairie dog (*Cynomys gunnisoni*)	Year-round
house mouse (*Mus musculus*)	Year-round
kangaroo rat (*Dipodomys* sp.)	Year-round
least chipmunk (*Neotamias minimus operarius*)	Year-round
long-tailed vole (*Microtus longicaudus longicaudus*)	Year-round
meadow vole (*Microtus pennsylvanicus modestus*)	Year-round
montane vole (*Microtus montanus fusus*)	Year-round
muskrat (*Ondatra zibethicus*)	Year-round
northern grasshopper mouse (*Onychomys leucogaster arcticeps*)	Year-round
northern pocket gopher (*Thomomys talpoides fossori)*	Year-round
Ord's kangaroo rat (*Dipodomys ordii longipes)*	Year-round
Ord's kangaroo rat (*Dipodomys ordii*)	Year-round
pinyon mouse (*Peromyscus truei truei)*	Year-round
pinyon mouse (*Peromyscus truei*)	Year-round
plains pocket mouse (*Perognathus flavescens copei*)	Year-round
pocket gopher (*Thomomys* spp.)	Year-round

Species	Expected to Occur
pocket mouse (*Perognathus apache*)	Year-round
red squirrel (*Tamiasciurus hudsonicus fremonti*)	Year-round
rock squirrel (*Spermophilus variegatus grammurus*)	Year-round
rock squirrel (Spermophilus variegatus)	Year-round
silky pocket mouse (*Perognathus flavus flavus*)	Year-round
silky pocket mouse (*Perognathus flavus*)	Year-round
spotted ground squirrel (*Spermophilus spilosoma*)	Year-round
spotted ground squirrel (*Spermophilus spilosoma canescens)*	Year-round
western harvest mouse (*Reithrodontomys megalotis megalotis*)	Year-round
western harvest mouse (*Reithrodontomys megalotis*)	Year-round
white-tailed antelope squirrel (*Ammospermophilus leucurus pennipes*)	Year-round
white-tailed antelope squirrel (*Ammospermophilus leucurus*)	Year-round
white-tailed prairie dog (*Cynomys gunnisoni*)	Year-round
white-throated wood rat (*Neotoma albigula albigula*)	Year-round
wood rat (*Neotoma* sp.)	Year-round
yellow-bellied marmot (*Marmota flaviventris*)	Year-round

Table 3.8-4. Bat Species Expected to Occur in the ROI

Species	Expected to Occur
big brown bat (*Eptesicus fuscus*)	Year-round
big-freetail bat (*Nyctinomops macrotis*)	Year-round
Brazilian free-tailed bat (*Tadarida braziliensis*)	Year-round
brown bat (*Myotis lucifugus occultus*)	Year-round
California myotis (*Californicus californicus*)	Year-round
fringed myotis (*Myotis thysanodes*)	Year-round
hoary bat (*Lasiurus cinereus cinereus*)	Year-round
little brown myotis (*Myotis lucifugus carissima*)	Year-round
long-eared myotis (*Myotis evotis evotis*)	Year-round
long-legged myotis *(Myotis volans interior*)	Year-round
pallid bat (*Antrozous pallidus pallidus*)	Year-round
silver-haired bat (*Lasionycteris noctivagans*)	Year-round
small-footed myotis (*Myotis ciliolabrum melanothinus*)	Year-round
spotted bat (*Euderma maculatum)*	Year-round
Townsend's pale big-eared bat (*Corynorhinus townsendii pallescens*)	Year-round
western pipistrelles (*Pipistrellus hesperus*)	Year-round
Yuma myotis (*Myotis yumanensis yumanens*)	Year-round

Table 3.8-5. Carnivore Species Expected to Occur in the ROI

Species	Expected to Occur
badger (*Taxidea taxus*)	Year-round
black bear (*Ursus americanus amblyceps*)	Year-round
Black-footed ferret (*Mustela nigripes*)	Year-round
bobcat (*Lynx rufus*)	Year-round
Canada lynx (*Lynx canadensis*)	Year-round
coyote (*Canis latrans*)	Year-round
gray fox (*Urocyon cinereoargenteus*)	Year-round
kit fox (*Vulpes macrotis*)	Year-round
long-tailed weasel (*Mustela frenata arizonensis*)	Year-round
Mexican gray wolf (*Canis lupus baileyi*)	Year-round
mountain lion (*Puma concolor Azteca*)	Year-round
raccoon (*Procyon lotor*)	Year-round
red fox (*Vulpes vulpes*)	Year-round
ringtail (*Bassariscus astutus arizonensis*)	Year-round
spotted skunk (*Spilogale putoris*)	Year-round
striped skunk (*Mephitis mephitis*)	Year-round

Table 3.8-6. Amphibian and Reptile Species Expected to Occur in the ROI

Species	Expected to Occur
black-necked garter snake (*Thamnophis cyrtopsis*)	Year-round
bull snake (*Pituophis catinifer*)	Year-round
bullfrog (*Rana catesbeiana*)	Year-round
California kingsnake *(Lampropeltis getula)*	Year-round
canyon tree frog (*Hyla arenicolor*)	Year-round
collard lizard (*Crotaphytus collaris*)	Year-round
common lesser earless lizard (*Holybrookia maculata*)	Year-round
desert striped whipsnake *(Masticophis taeniatus)*	Year-round
eastern fence lizard (*Sceloporus undulates*)	Year-round
glossy snake (*Arizona elegans*)	Year-round
gopher snake (*Pituophis melanoeucus*)	Year-round
greater short-horned lizard (*Phrynosoma hernandesi*)	Year-round
hognose snake (*Heterodon nasicus*)	Year-round
little striped whiptail (*Cnemidophorus inoratus*)	Year-round
longnose leopard lizard (*Gambelia wislizenii*)	Year-round
milk snake (*Lampropeltis triangulum*)	Year-round
New Mexico spadefoot (*Spea multiplicata*)	Year-round
New Mexico whiptail lizard (*Aspidoscelis neomexicano)*	Year-round
night snake (*Hypsiglena torquata*)	Year-round
northern leopard frog (*Rana pipiens*)	Year-round
northern tree lizard (*Urosaurus ornatus*)	Year-round
orange headed Spiny Lizard (*Sceloporus magister cephaloflavus*)	Year-round
plains spadefoot (*Spea bombifrons*)	Year-round
plateau striped whiptail (*Aspidoscelis velox*)	Year-round
plateau striped whiptail (*Cnemidophorus velox*)	Year-round
red-spotted toad (*Bufo punctatus*)	Year-round
sagebrush lizard (*Sceloporus graciosus*)	Year-round
short-horned lizard (*Phrynosoma douglasii*)	Year-round
side-blotched lizard (*Uta stansburiana*)	Year-round
southern many-lined skink (*Eumeces multivirgatus epipleurotus*)	Year-round
southwestern lizard (*Scleoporus cowlesi*)	Year-round
spiny desert lizard (*Sceloporus magister*)	Year-round
striped whipsnake (*Masticophis taeniatus*)	Year-round

Species	Expected to Occur
tiger salamander (*Ambystoma tigrinum*)	Year-round
wandering garter snake (*Thamnophis elegans*)	Year-round
western chorus frog (*Pseudacris triseriata*)	Year-round
western painted turtle (*Chrysemys picta bellii*)	Year-round
western rattlesnake (*Crotalus viridis*)	Year-round
plateau tiger or western whiptail (*Aspidoscelis tigris septentrionalis*)	Year-round
western whiptail (*Cnemidophorus tigris*)	Year-round
western yellow-bellied racer *(Coluber constrictor* sub. *mormon*)	Year-round
Woodhouse's toad (*Bufo woodhousii*)	Year-round

Table 3.8-7. Fish Species Occurring in Permanent Water Bodies in the ROI and Vicinity

Species	Origin**	Family	San Juan River (LBF[a]/SBF[b])	Morgan Lake[c,d]	Chaco River[e]	Lake Powell[f]
bluehead sucker (*Catostomus discobolus*)	N	Catostomidae	C/C			
flannelmouth sucker (*Catostomus latipinnis*)	N	Catostomidae	C/U			P
razorback sucker (*Xyrauchen texanus*)	N	Catostomidae	U/-			P
mottled sculpin (*Cottus bairdi*)	N	Cottidae	R/-			
Colorado pikeminnow (*Ptychocheilus lucius*)	N	Cyprinidae	U/U			P
roundtail chub (*Gila robusta*)	N	Cyprinidae	-/R			
speckled dace (*Rhinichthys osculus*)	N	Cyprinidae	C/C			P
white sucker (*Catostomus commersoni*)	I	Catostomidae	U/-			
black crappie (*Pomoxis nigromaculatus*)	I	Centrarchidae				P
bluegill (*Lepomis macrochirus*)	I	Centrarchidae		P		P
green sunfish (*Lepomis cyanellus*)	I	Centrarchidae	R/R			P
largemouth bass (*Micropterus salmoides*)	I	Centrarchidae	R/R	P		P
smallmouth bass (*Micropterus dolomieui*)	I	Centrarchidae	R/-			P
white crappie (*Pomoxis annularis*)	I	Centrarchidae		P		
gizzard shad (*Dorosoma cepedianum*)	I	Clupeidae		P		P
common carp (*Cyprinus carpio*)	I	Cyprinidae	U/U	P		
fathead minnow (*Pimephales promelas*)	I	Cyprinidae	R/U			P
red shiner (*Cyprinella lutrensis*)	I	Cyprinidae	U/C			P
plains killifish (*Fundulus zebrinus*)	I	Cyprinodontidae	R/R			

Species	Origin**	Family	San Juan River (LBF[a]/SBF[b])	Morgan Lake[c,d]	Chaco River[e]	Lake Powell[f]
Northern pike (*Esox lucius*)	I	Esocidae				P
black bullhead (*Ameiurus melas*)	I	Ictaluridae	R/R			P
channel catfish (*Ictalurus punctatus*)	I	Ictaluridae	C/C	P		P
yellow bullhead (*Ameiurus natalis*)	I	Ictaluridae	R/R			
armored catfish (*Plecostomus* sp.)	I	Loricariidae		P		
walleye (*Stizostedion vitreum*)	I	Percidae				P
Western mosquitofish (*Gambusia affinis*)	I	Poeciliidae	-/C			
brown trout (*Salmo trutta*)	I	Salmonidae	U/-			
kokanee (*Oncorhynchus nerka*)	I	Salmonidae				
rainbow trout (*Oncorhynchus mykiss*)	I	Salmonidae	U/-			P
striped bass (*Morone saxitilis*)	I	Percichthyidae				P

Notes:

**N = Native, I = Introduced. C=common, U=uncommon, R=Rare, - =not reported, P=present

a LBF = Large-bodied Fish (Source: Ryden 2012. 2010 SJR Large-bodied Fish Monitoring - based on proportion of catch C>5percent, U>1 percent, R<1 percent)

b SBF= Small-bodied Fish (Source: Gilbert et al. 2012. 2011 SJR Small-bodied Fish Monitoring, based on 2011 proportion of catch in three habitats as above)

c Source: DOE and BIA 2007

d Source: personal communication to M. Calle of OSMRE

e Does not support fish

f Utah = Lake Powell (Source: accessed at www.waterquality.utah.gov/watersheds/lakes/lakepowl.pdf on 7/9/13)

3.8.2.2 Navajo Mine

The dominant vegetation community within the wildlife resources assessment area is Great Basin Desert scrub (see Section 3.7, Vegetation) The assessment area supports a wide diversity of wildlife species due to a variety of landscape features and topography such as rock outcrops, washes, and rolling hills that provide habitat for these species. Overall, annual precipitation is likely a limiting factor for wildlife. Consequently, perennial stock ponds within the assessment area serve as important water sources for wildlife and drainages are often used disproportionately by wildlife. These areas provide important cover as protection from predation, as breeding habitat, and refuge from adverse weather and heat of the summer.

The wildlife resources assessment area has been surveyed numerous times over the years to fulfill the requirements of the SMCRA permit including wildlife, raptor, and threatened and endangered species surveys (Ecosphere 2001, 2004b, 2008, 2009a, 2009b, 2009c; Hawks Aloft 2000-2007). Numerous wildlife, biological resources, and threatened and endangered species surveys have been conducted between 1975 and 2004 (Ecosphere 2001, 2004b). Section 10 of the Navajo Mine SMCRA permit (BNCC 2009a) provides several compiled lists of wildlife species that either have been observed in the assessment area or may occur in northwestern New Mexico.

The area provides foraging and watering habitat for several bat species including pipistrel (*Pipistrellus hesperus*), Yuma bat (*Myotis yumanensis),* fringed myotis (*Myotis thysanodes*), Townsend's big-eared bat (*Corynorhinus townsendii*), spotted bat (*Euderma maculatum*), pallid bat (*Antrozous pallidus*), and big free-tailed bat (*Nyctinomops macrotis*) (Adams 2003). Roosting habitat for bat species are cliff faces and rock crevices. No large populations of bats are expected to roost in the assessment area based on marginal roosting and foraging habitat coupled with limited water resources.

Coyote (*Canis latrans*), as well as red fox (*Vulpes vulpes*) and kit fox (*Vulpes macrotis*), have been well documented in the area. Spotlighting surveys in 2005 documented several individuals, including kit foxes and coyotes (Ecosphere 2008). The occurrence of kit fox, listed as a Group 4 species on the Navajo Endangered Species List, is described in Section 3.9 – Threatened and Endangered Species, Sensitive Species. Bobcat (*Lynx rufus*) may occur in the assessment area in low densities. An individual bobcat was observed north of proposed mining areas in 2008 (Musslewhite 2008, personal communication), and bobcat tracks were identified in Chaco Wash (Ecosphere 2004a) and around Morgan Lake (Ecosphere 2008a). It is unlikely that mountain lion (*Felis concolor*) occur in the assessment area, other than transitory individuals, due to the lack of mule deer (*Odocoileus hemionus)* or other sufficient prey base.

Mule deer are occasional transients wandering into the area from the San Juan River corridor, but are not common residents of Great Basin desertscrub habitat (Hoffmeister 1986). Pronghorn antelope (*Antilocapra americana*) are not known to occur in the assessment area. Desert cottontail (*Sylvilagus audubonii*) and black-tailed jackrabbit (*Lepus californicus*) are well-documented in the area and are commonly observed (Ecosphere 2008, 2010). Both of these species are likely important prey species to carnivores and raptors.

A badger (*Taxidea taxus*) was observed in a prairie dog colony in the wildlife resource assessment area in summer 2004 (Ecosphere 2004b). Badgers (of the Mustelidae family) commonly occur in areas inhabited by prairie dogs (*Cynomys spp.*). Populations of badgers can be correlated to prairie dog populations and the availability of prey, therefore, the assessment area is expected to only support low densities of badger. Other mustelids documented or having potential to occur include skunk (*Mephitis mephitis*) and long-tailed

weasel (*Mustela frenata*) (BNCC 2009a). Gunnison's prairie dog (*Cynomys gunnisoni*) has been documented in almost all surveys conducted by BNCC since 1975 (BNCC 2009a; Ecosphere 2001, 2004b). In 2007, five prairie dog towns ranging in size from 75 to 317 acres were mapped in the adjacent Area IV South and Area V (Ecosphere 2008, 2009a). In February 2011, two prairie dog towns within the proposed mining areas were identified, encompassing 13 and 60 acres, respectively. These towns are in the southern portion of Area IV North, in the vicinity of the existing ancillary roads and outside of proposed ground disturbance areas. Other common squirrel species include white-tailed antelope squirrel (*Ammospermophilus leucurus*), ground squirrel (*Spermophilus sp.*), and rock squirrel (*Spermophilus variegatus*). These species also likely serve as important prey for carnivores and raptors.

Other small mammal species documented include Ord's kangaroo rat (*Dipodomys ordii*) and banner-tailed kangaroo rat (*Dipodomys spectabilis*), both relatively abundant in the assessment area. Other small mammal species documented include silky pocket mouse (*Perognathus flavus*), Apache pocket mouse (*Perognathus apache*), deer mouse (*Peromyscus maniculatus*), western harvest mouse (*Reithrodontomys megalotis*), woodrat (*Neotoma spp.*), northern grasshopper mouse (*Onychomys leucogaster*), and the Botta's pocket gopher (*Thomomys bottae*). These species also comprise an important prey component for carnivores and raptors.

Avian species are also an important wildlife resource and have been well documented in the Project Area. Baseline surveys for breeding birds have been conducted in the Project Area since 1975 as documented in NTEC's existing SMCRA permit (BNCC 2009a), and for adjacent Area IV South and Area V south of the Project Area (Ecosphere 2008). Birds and other highly mobile wildlife species that occur in these adjacent areas may also use the Project Area on a regular or incidental basis. Birds commonly documented in the Project Area include common raven (*Corvus corax*), horned lark (*Eremophila alpestris*), vesper sparrow (*Pooecetes gramineus*), lark sparrow (*Chondestes grammacus*), mourning dove (*Zenaida macroura*), and western meadowlark (*Sturnella neglecta*). Ecosphere Environmental Services also recorded a list of avian species during baseline surveys for Area IV South and Area V (Ecosphere 2008). Waterfowl and shorebird species including American avocet (*Recurvirostra americana*), black-crowned night heron (*Nycticorax nycticorax*), killdeer (*Charadrius vociferus*), Eurasian wigeon (*Anas penelope*), and cinnamon teal (*Anas cyanoptera*), were observed at the temporary pond located along the southern boundary of the Area IV North mine lease boundary within the Project Area (Ecosphere 2008). For a discussion of avian species protected by the Migratory Bird Treaty Act, see Section 3.9.

In addition to those surveys listed above, raptor monitoring was completed annually as part of BNCC's compliance with SMCRA regulations (Ecosphere 2009b, 2010), and continues to be conducted by NTEC. Both nesting and foraging habitat for red-tailed hawk (*Buteo jamaicensis*), great-horned owl (*Bubo virginianus*), golden eagle (*Aquila chrysaetos*), ferruginous hawk (*Buteo regalis*), northern harrier (*Circus cyaneus*), prairie falcon (*Falco mexicanus*), and American kestrel (*Falco sparverius*) have been documented in the Project Area. In 2004, two juvenile bald eagles (*Haliaeetus leucocephalus*) were observed flying over the Project Area during baseline surveys, but they are more likely to utilize the San Juan River and Morgan Lake. Burrowing owls (*Athene cunicularia*) have also been documented in the Project Area, usually associated with prairie dog burrows (Ecosphere 2004b). For more detailed discussion of bald and golden eagle, protected by the Bald and Golden Eagle Act, and burrowing owl and ferruginous hawk, both Group 4 species on the Navajo Endangered Species List, see Section 3.9.

Reptiles and amphibians have typically been documented only as incidental sightings or during cursory pedestrian surveys within the wildlife resources assessment area (BNCC 2009a). Amphibians generally do not occur in the assessment area (BNCC 2009a; Howell 2004, personal communication). Reptiles commonly documented include western whiptail (*Cnemidophorus tigris*), gopher snake (*Pituophis melanoleucus*), bull snake (*Pituophis melanoleucus sub. sayi*), prairie rattlesnake (*Crotalus viridis*), short-horned lizard (*Phrynosoma douglassii*), side-blotched lizard (*Uta stansburiana*), lesser earless lizard (*Holbrookia maculata*), and collared lizard (*Crotaphytus collaris*). The assessment area does not contain streams or ponds that could sustain any species of fish.

Terrestrial invertebrates, namely moths, butterflies, wasps, ants, bees, beetles, and flies common to northwestern New Mexico, have potential to occur throughout the assessment area (DOI and BIA 2007).

3.9 Threatened and Endangered Species, Sensitive Species

3.9.1 Definition of Resource

The ESA of 1973 (PL 93-205, as amended) requires Federal agencies to ensure that no actions that they authorize, fund, or carry out are likely to jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of their critical habitat. The ROI for threatened, endangered, and sensitive species would be the same as that described for vegetation in Section 3.7 and shown in Figure 3.7-1. The combustion of the coal mined at Navajo Mine at FCPP would also result in emission of COPECs into the atmosphere. These COPECs would be dispersed by the wind and be deposited over land and water surfaces over an area extending beyond the area of potential effects described previously. This deposition was modeled using CALPUFF and AERMOD to describe the area over which deposition of COPECs would occur (AECOM 2013a, 2013b), and used to complete the effects analysis in the FCPP/NMEP EIS (OSMRE 2015). This analysis is incorporated into this EA by reference. The ROI for coal combustion includes the area within which the cumulative future air emissions from FCPP over the next 25 years is anticipated to increase baseline concentrations of COPECs by more than 1 percent (as described in the FCPP/NMEP EIS Section 4.6.2.5). It also includes the San Juan River from the upstream boundary of the Deposition Area downstream to, and including, the San Juan arm of Lake Powell, as this area may be affected by deposition and runoff of COPECs within this area (see Figure 3.7-1).

Navajo Nation threatened and endangered species are managed under the NNC requirement for species of concern (17 NNC 507) administered by the Natural Heritage Program of the NNDFW. On the Navajo Nation, all applications for land use are considered by the Resources Committee of the Navajo Nation Council, or their delegate. The NNDFW reviews applications for impacts to biological resources on behalf of the Division of Natural Resources, for recommendation to the Resources Committee pursuant to 2 NNC 164. Pursuant to 17 NNC 507, the Navajo Endangered Species List identifies those native plants and animals in danger of extinction (Group 2) on the Navajo Nation or threatened with endangerment in the near future (Group 3), and protected against take, as defined by ESA. Group 4 species are “candidates” for listing and have no legal protection under Section 507 of the Navajo Code.

The Resources Committee of the Navajo Nation Council is responsible for legislative oversight of the Division of Natural Resources, which includes the NNDFW. The Resources Committee has the responsibility and authority to adopt policies, procedures, and regulations that protect the biological resources of the Navajo Nation. The Resources Committee, by Resolution No. RCMA-34-03, dated March

13, 2003, approved the Biological Resource Land Clearance Policies and Procedures. The entire Navajo Nation has been divided into six types of wildlife areas. These areas provide the framework for planning specific development projects.

Under the Migratory Bird Treaty Act of 1918 (16 USC 703-712; Ch. 128, as amended) and Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds," Federal agencies are required to consider management impacts to migratory non-game birds.

Information used to prepare this section is derived from existing information and data collected during field-based habitat evaluations within the Project Area conducted in February 2011 and are reported in the project BE (Appendix D), from the BA for this proposed action (Appendix G) as well the FCPP/NMEP EIS (OSMRE 2015), BA (OSMRE 2014), and BO (USFWS 2015).. A review of existing data sources was conducted prior to fieldwork. Extensive wildlife baseline data was prepared for the BNCC mine permit and lease area in advance of submittal of the BE. Annual monitoring of raptors and wildlife at Navajo Mine is conducted in accordance with the SMCRA regulations as administered by the OSMRE (BNCC 2009a; Hawks Aloft 2000-2007; Ecosphere 2009a, 2009b, 2010; OSMRE 2015). Additionally, extensive baseline biological surveys of the Project Area were conducted in 2004 (Ecosphere 2004a, 2004b, and 2005). In 2007, baseline surveys were conducted in Area IV South and V located south of the Project Area (Ecosphere 2008, 2009a). Threatened and endangered species surveys for the Burnham Road Realignment (OSMRE 2008a) and the Lowe-Dixon surface addition (Ecosphere 2009c) contribute to the data available for determining impacts and effects.

3.9.2 Affected Environment

3.9.2.1 Regional Setting

Section 4.8.2 of the FCPP/NMEP EIS considers the potential for these species to occur within the ROI. Many species were eliminated because their range does not overlap the ROI or the ROI does not contain suitable habitat for these species. The list of federal, state, or Navajo-designated threatened, endangered, and sensitive species that have potential to occur in the ROI are shown in Table 3.9-1.

3.9.2.2 Navajo Mine

The affected environment or Action Area considered for Federal and Navajo Nation listed species was delineated based on consideration of all direct and indirect effects of the Proposed Action [50 CFR 402.02 and 402.14(h)(2)]. The Action Area analyzed in the project BE (Appendix D) was determined based on maximum distance that a particular impact from mining could reasonably be expected to affect a listed or sensitive species. For example, in the BE the Action Area was largely determined by consideration of spatial factors or impact pathways such as the distance mining noise could be heard over ambient noise; the distance that fugitive dust could reasonably travel and be demonstrated to cause a measurable adverse effect on a listed species; and/or the pathway of water quality or quantity potentially reaching a receiving water.

Table 3.9-1. Threatened, Endangered, and Sensitive Species Potentially Occurring in the ROI

Species	Status[2]	Project Element Area IV North Revised SMCRA Permit Area	FCPP Deposition Area
Mammals			
Pronghorn	NESL G3	Y	Y
Birds			
California Condor	FE-EP, NESL G4	Y	Y
Yellow-billed cuckoo	PFT, NESL G2	N	Y
Southwestern Willow flycatcher	FE, NESL G2, NME	Y	Y
Mexican spotted owl	FT, NESL G3	N	Y
Golden eagle	NESL G3	Y	Y
Ferruginous hawk	NESL G3, BLM	Y	Y
Bald eagle	NESL G2, NME	N	Y
Amphibians			
Leopard frog	NESL G2	N	Y
Fish			
Colorado pikeminnow	FE, NESL G2, NME	N	Y
Razorback sucker	FE, NESL G2, NME	N	Y
Roundtail chub	NESL G2, PFT, BLM, NME	N	Y
Invertebrates			
Nokomis fritillary	NESL G3	N	Y
Plants			
Mancos milk-vetch	FE, NESL G3, NME	N	Y
Mesa Verde Cactus	FT, NESL G2,	N	Y/Y
Gooding's onion	NESL G3	N	Y
Naturita milk-vetch	NESL G4, NMSC	N	Y

[1] Y – Species has potential to occur within that element, N – Species does not have potential to occur within that element, n/a – listing agency does not regulate species within that element

[2] FE-Federal Endangered, FT-Federal Threatened, PFT-Proposed Federal Threatened, NESL – Navajo Nation category, Hopi- Hopi Culturally Sensitive Species, BLM – BLM Sensitive Species, NME-New Mexico Endangered, NMT-New Mexico Threatened, NMSC-New Mexico Species of Concern

Based on the results of the noise, water, and air impact pathway analyses completed in this EA, a one-mile radius around the Navajo Mine lease area is a conservatively large Action Area to assess potential impacts to listed species from the Proposed Action.

3.9.2.2.1 Federally Listed Threatened and Endangered Species

The Action Area for the Section 7 Consultation associated with this EA includes the entire deposition area for the FCPP, as defined for the FCPP/NMEP EIS (OSMRE 2015). USFWS listed species were obtained from a database search of the USFWS Information Planning and Conservation System database for the deposition area on July 1, 2015. According to the USFWS, there are 10 Federally-listed threatened, endangered, proposed threatened, or candidate plant and animal species with potential to occur in the FCPP deposition area, which also includes the entire Navajo Mine Lease Area. In addition to these species, OSMRE also considered two additional species, the California condor and Mexican spotted owl, which were evaluated in the BA for the FCPP/NMEP. Federally-listed species for the deposition area, their habitat associations, and a description of the potential for each to occur in the assessment area is provided in Table 3.9-2.

There is no suitable habitat for any Federally-listed species to reside or breed within the Navajo Mine lease area, including within the areas proposed for mining in Area IV North and Area III and the Burnham Road realignment. It is possible that the southwestern willow flycatcher could land on a native or exotic tree within any of the ephemeral washes that traverse the mine site; however, the potential is low due to the infrequent occurrence of trees on the mine and along ephemeral and intermittent washes.

3.9.2.2.2 Navajo Nation Listed Species of Concern

Area IV North is located within a Moderately Sensitive Wildlife Resources area (Area 2), as identified by the NNDFW and described in the Biological Resources Land Clearance Policies and Procedures, approved September 10, 2008. A list of Navajo Nation species of concern was obtained through coordination with the NNNHP. Species of concern include protected, candidate, and other rare or otherwise sensitive species. The species listed by the Navajo Nation are map quadrangle-specific—rather than project-site specific. The NNNHP listed 11 species of concern (four of which are also Federally-listed) with potential to occur on the USGS 7.5-minute topographic maps that encompass Area IV North. Table 3.9-3 lists these species, their conservation status, habitat associations, and potential to occur in the Project Area. The BE prepared for the Area IV North SMCRA Permit revision included in Appendix D addresses the potential for Navajo Nation listed species to occur in the Action Area and details potential effects to those species.

Based upon evaluation of habitat associations (Table 3.9-3) field surveys, discussions with the NNDFW and the USFWS, five of the 11 (Navajo Natural Heritage Program) species of concern can be eliminated from detailed consideration in the EA and BE. These species include the black-footed ferret, peregrine falcon, mountain plover, Mancos milkvetch, and Mesa Verde cactus—three of which are Federal species described in Section 3.9.2.1.

Six of the Navajo Natural Heritage Program species of concern have potential to occur within the Action Area. These species include the kit fox, southwestern willow flycatcher, golden eagle, ferruginous hawk, western burrowing owl, and San Juan milkweed. The western burrowing owl, ferruginous hawk, and golden eagle are known to occur within 1 mile of the Project Area. Southwestern willow flycatcher is addressed in Section 3.9.2.1.

Table 3.9-2. Species Listed by the U.S. Fish and Wildlife Service as Threatened, Endangered, Proposed Threatened, or Candidate with the Potential to Occur in the Action Area.

Species	Status	Habitat Associations	Potential to Occur
MAMMALS			
Canada lynx (*Lynx Canadensis*)	Candidate	Generally occurs in boreal and montane forests dominated by coniferous or mixed forest with thick undergrowth.	No boreal or montane forests occur within the Action Area.
BIRDS			
California condor (*Gymnogyps californicus)*	Federally Endangered	High desert canyons and plateaus. Ill-defined nest, if any, composed of existing debris within overhung cliff ledges, crevices, potholes, or caves; in northern Arizona, nesting will likely be within walls of major river canyons or tall, steep cliffs within desert scrub and grasslands that allow easy approach from the air, and are inaccessible for terrestrial predators.	Suitable nesting habitat within the Action Area but the Action Area is outside this species' known nesting range. California condors could occur as occasional visitors within the Action Area or use the area for foraging.
Mexican spotted owl (*Strix occidentalis lucida*)	Federally Threatened	Nests in canyons and dense forests with multilayered foliage structure. Generally nest in older forests of mixed conifer or ponderosa pine/gambel oak type. Restricted habitat includes mixed-conifer forest, pine-oak forest, and riparian areas.	Suitable habitat is not found within the Action Area and occurs in scattered patches outside of the Action Area. Mexican spotted owl could occur as an occasional visitor within the Action Area or use the area for foraging.
Southwestern willow flycatcher (*Empidonax traillii extimus*)	Endangered with Critical habitat	Breeds in dense, shrubby riparian habitats, usually in close proximity to surface water or saturated soil.	No suitable nesting habitat within the Navajo Mine permit area. Potential habitat exists along the San Juan River in the Action Area. Potential migratory stopover habitat occurs in an approximate 100 foot stretch of Cottonwood Arroyo, along the lower Chinde Wash, and wherever tamarisk trees occur.
Yellow-billed cuckoo (*Coccyzus americanus*)	Threatened	Breeds in riparian woodlands with dense, understory vegetation.	No suitable nesting habitat within the Navajo Mine permit area. Potential habitat exists along the San Juan River in the Action Area.
Sprague's Pipit (*Anthus spragueii)*	Candidate	Breeds in northern Great Plains. Non-breeding range extends from south-central and southeastern Arizona, occasionally in southern New Mexico. Habitat during migration and in winter consists of pastures and weedy fields, including grasslands with dense herbaceous vegetation or grassy	No. The current range of this species is outside of the Action Area.

Species	Status	Habitat Associations	Potential to Occur
		agricultural fields	
FISH			
Colorado pikeminnow (*Ptychocheilus lucius*)	Endangered with Critical Habitat	Large rivers with strong currents, deep pools, and quiet backwaters.	No suitable habitat within the Navajo Mine permit area. Potential habitat exists along the San Juan River in the Action Area. Critical habitat is also located approximately 16 miles north on the San Juan River.
Razorback sucker (*Xyrauchen texanus*)	Endangered with Critical Habitat	Medium to large rivers with silty to rocky substrates. Prefers strong currents and deep pools.	No suitable habitat within the Navajo Mine permit area. Potential habitat exists along the San Juan River in the Action Area. Critical habitat is also located approximately 16 miles north on the San Juan River.
Zuni bluehead sucker (*Catostomus discobolus yarrowi*)	Endangered	Small streams in low velocity, moderate deep pools, and pool runs with seasonal dense algae. Young prefer quieter shallow areas near shoreline. Limited to possibly one creek in Arizona and to the headwaters of Zuni River drainage in New Mexico.	No suitable habitat within the Navajo Mine permit area. Potential habitat exists along the San Juan River in the Action Area.
PLANTS			
Knowlton's cactus (*Pediocactus knowltonii*)	Endangered	Alluvial deposits that form rolling, gravelly hills in piñon-juniper and sagebrush communities (6,200-6,400 feet.).	No rolling, gravelly alluvial deposits vegetated with piñon-juniper woodland in the Action Area.
Mancos milkvetch (*Astragalus humillimus*)	Endangered	Cracks of Point Lookout Sandstone of the Mesa Verde series (5,000-6,000 feet.).	Point Lookout Sandstone does not occur in the Action Area.
Mesa Verde cactus (*Sclerocactus mesae-verdae*)	Threatened	Highly alkaline soils in sparse shale or adobe clay badlands of the Mancos and Fruitland formations (4,000-5,550 feet.)	The majority of soil substrates in the Action Area are sands. Badlands in the area are capped with sandstone or red cinders and do not provide suitable habitat.

Source: USFWS 2015.

Table 3.9-3. Navajo Nation Listed Species of Concern and the Potential to Occur in the Action Area.

Species Name	Navajo Nation Status	Habitat Associations	Potential to Occur
MAMMALS			
Black-footed ferret (*Mustela nigripes*)	Group 2 ESA	Open grasslands with year-round prairie dog colonies greater than 198 acres in size with greater than 20 burrows per 2.5 acres.	There are no prairie dog colonies of sufficient size to support black-footed ferret in the Action Area.
Kit fox (*Vulpes macrotis*)	Group 4	Desert scrub or desert grassland with soft, alluvial or silty-clay soils, with sparse vegetation cover.	Recorded as occurring in the Action Area.
BIRDS			
Southwestern willow flycatcher (*Empidonax traillii extimus*)	Group 2	Breeds in dense, shrubby riparian habitats, usually in close proximity to surface water or saturated soil.	Has potential to occur in the Action Area.
Ferruginous hawk *Buteo regalis*)	Group 3	Nests in badlands, flat or rolling grasslands and desert scrub.	Known to nest in the Action Area.
Golden Eagle (*Aquila chrysaetos)*	Group 3	Open habitats in mountainous, canyon terrain. Nests primarily on steep cliffs and occasionally large trees.	Known to occur in the Action Area although only 4 nest sites detected within 2 miles of the lease area since raptor monitoring was initiated in 1993.
American peregrine falcon (*Falco peregrinus anatum)*	Group 4	Cliffs that generally exceed 200 feet in height near permanent surface water.	Known to occur in the region, although the Action Area lacks high cliffs suitable for nesting/perching for this species.
Mountain plover (*Charadrius montanus)*	Group 4	Breeds in short sparse vegetation in disturbed-prairies or semi-deserts with less than a two-degree slope.	Suitable habitat has been documented and several individual plovers detected in Areas IV South and V of the Navajo lease area within the Action Area.
Western burrowing owl (*Athene cunicularia hypugea)*	Group 4	Nests in ground burrows (often deserted prairie dog burrows) in dry open grasslands or desert scrub.	This species has been recorded as breeding within the Action Area.

Species Name	Navajo Nation Status	Habitat Associations	Potential to Occur
PLANTS			
Mancos milkvetch (*Astragalus humillimus*)	Group 2	Cracks of Point Lookout Sandstone of the Mesa Verde series (5,000-6,000 ft.).	Has no potential to occur.
Mesa Verde cactus (*Sclerocactus mesae-verdae*)	Group 4	Highly alkaline soils in sparse shale or adobe clay badlands of the Mancos and Fruitland formations (4,000-5,550 ft.)	Has no potential to occur. Refer to Table 2.
San Juan milkweed (*Asclepias sanjuanensis*)	Group 4	Sandy loam soils in juniper savanna and Great Basin desert scrub at 5,000-5,500 ft.	Potential habitat for this species occurs within the Action Area.

Notes:

Navajo Nation Endangered Species List (NESL): Group 2 = species whose prospects of survival or recruitment are in jeopardy; Group 3 = species whose prospects of survival or recruitment are likely to be in jeopardy in the foreseeable future; Group 4 = species for which the NNDFW does not currently have sufficient information to support their being listed in Group 2 or Group 3. The NNDFW will actively seek information on these species to determine if they warrant inclusion in a different group or removal from the list. Group 4 species are “candidates” for listing and have no legal protection under section 507. Sensitive = species for which there may be some concern range-wide; however there is not enough information to support inclusion on the NESL.

3.9.2.2.3 Migratory Birds

While law protects all migratory songbirds, certain species have been determined to be at greater risk. Data collected through breeding bird surveys coordinated by the USFWS as well as other private sector efforts have provided the basis for the New Mexico Partners in Flight (NMPIF) organization to develop bird "Watch Lists" and the USFWS's "Birds of Conservation Concern List." The NMPIF organization has identified priority species of birds for the State of New Mexico by habitat type.

Most of the priority bird species identified by the NMPIF also occur on the USFWS Division of Migratory Bird Management "Birds of Conservation Concern 2008" within Bird Conservation Region 16 – Southern Rockies/Colorado Plateau. Birds included on this list are those "species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the ESA of 1973" (USFWS 2008). The Action Area contains one of the habitat types addressed in these documents—Plains-Mesa Grassland, a subset of the Basin desertscrub. The ferruginous hawk, mountain plover, and long-billed curlew (*Numenius americanus*) are listed as "highest priority" species under the Plains and Mesa Grassland habitat type.

3.10 Socioeconomics

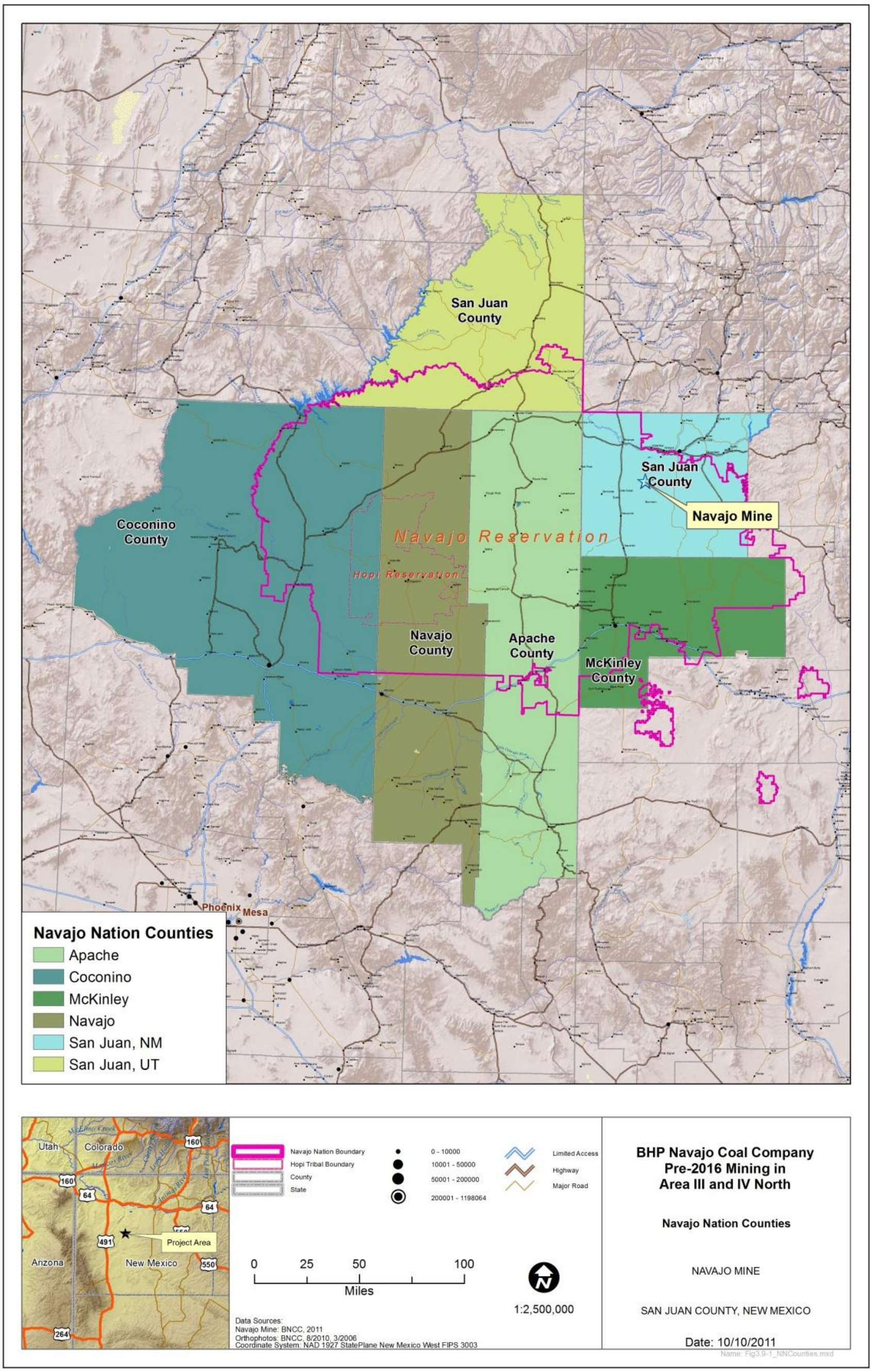
3.10.1 Definition of Resource

For this socioeconomic impact analysis, economic impacts are generally expressed as changes to population, employment, income, government revenue, and related benefits. Social impacts are expressed as changes to community infrastructure—such as access to social and health care services.

3.10.2 Affected Environment

The Project Area for socioeconomics is comprised of the eight counties surrounding the Navajo Mine and FCPP—San Juan County, New Mexico; McKinley County, New Mexico Navajo County, Arizona; Apache County, Arizona; Coconino County, Arizona; San Juan County, Utah; Montezuma County, Colorado; and La Plata County, Colorado. Figure 3.10-1 displays a map of the affected area. The FCPP is included in the baseline for this analysis because it represents the economic end use of the coal supplied from Navajo Mine. This affected area is identified because it includes the majority of the Navajo Nation tribal trust lands; the Navajo Nation receives royalty revenues from coal production and lease payments from both Navajo Mine and FCPP. In addition, the selected Project Area is where the majority of the NTEC employees reside, including the communities where the proceeds and tax revenues generated by Navajo Mine and FCPP are spent. Given the rural nature of this area, the data on employment and income as well as economic models are not available at a scale smaller than by county.

Figure 3.10-1. Navajo Nation Counties



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In addition, the Navajo Reservation as a whole is also considered because tribal tax and royalty revenues from Navajo Mine and FCPP operations flow to the Navajo Nation government. Similarly, local governments including San Juan County, New Mexico and the Navajo Chapters located near the Navajo Mine and FCPP are analyzed to capture the impacts of local government expenditures. NTEC and its sister company, San Juan Coal Company (SJCC) in Waterflow, New Mexico jointly manage those companies' social and community investment funding projects in New Mexico. These community investments are only reported for the combined mine investments. Numerous comments at the public workshops and informal conference indicated that the revenue, income, and jobs provided by the mine are important to the Navajo Nation, tribal and community members, and their families. Opportunities for steady employment and income, skills training, and education for children were particularly noted by commenters.

3.10.2.1 Population

Population estimates from 1990 through 2030 are included in Table 3.10-1. Table 3.10-2 shows population for Navajo Chapters for 2000 through 2020. In 2010, the estimated total population of all eight counties was over 650,000 and the Navajo Nation had a population of about 212,220. With a total land area exceeding 30,300 square miles, the estimated average population density for the affected area is approximately 21 persons per square mile. Despite the small total numbers, population in the affected area has been growing rapidly. San Juan County, NM experienced population growth averaging 25 percent between 1990 and 2000 because of rapid oil and gas investment in the San Juan Basin. Since then, population growth has averaged about 7 percent (San Juan County 2010). The Navajo Nation has been averaging 1.8 percent annual growth since 2000 (Navajo Nation Division of Economic Development [NNDED] 2010).

Table 3.10-1. Population Estimates for Affected Area

County/Year	1990	2000	2010	2020	2030
Apache, Arizona	61,591	69,423	78,230	86,530	93,450
Coconino, Arizona	96,591	116,320	141,460	159,345	173,830
Navajo, Arizona	77,674	97,470	123,170	147,045	166,650
La Plata, Colorado	32,284	44,580	52,530	66,720	80,770
Montezuma, Colorado	18,672	23,845	25,970	31,260	37,500
San Juan, New Mexico	91,605	113,801	133,170	146,815	155,590
McKinley, New Mexico	60,686	74,798	80,750	88,155	92,300
San Juan, Utah	12,621	14,360	15,053	15,320	16,650
Navajo Nation	146,000	180,462	212,220	258,820	n/a
TOTAL Affected Area			650,330		

Sources: Arizona Department of Economic Security 2006, UNM 2008, Utah 2008, Colorado Division of Local Government 2007

Table 3.10-2. Population Data for Navajo Chapters Surrounding Project Area

Chapter	Population 2000	Estimated Population 2010	Estimated Population 2020
Nenahnezad	1,695	1,990	2,430
Tiis Tsoh Sikaad (Burnham)	240	280	340
Fruitland	2,892	3,400	4,150
Tse Daa K'aan (Hogback)	1,386	1,630	1,990
Tsé ałnáozt'ı'í (Sanostee)	1,908	2,240	2,740
Shiprock Gadii'ahi/To'koi (Cudeii)	9,279	10,910	13,310
Sheep Springs	821	970	1,180
Naschitti	1,695	1,990	2,430
White Rock	60	70	90
Crystal	778	910	1,115
Newcomb Toadlena/Two Grey Hills	1,838	2,160	2,640
Teec Nos Pos	1,323	1,560	1,900
Huerfano	2,366	2,780	3,390
Beclabeto	819	960	1,175
Red Valley	1,742	2,050	2,500
Tsaile/Wheatfields	2,044	2,400	2,930
TOTAL Affected Area	**30,886**	**36,300**	**44,310**
TOTAL Navajo Nation	**180,462**	**212,220**	**258,820**

Source: NNDED 2010.

Overall, the population in the affected area has a higher percentage of Native Americans and younger median age than the respective state. For example, in 2008 in San Juan County, New Mexico the median age was 32.6 years as compared to 36 years for the state of New Mexico. In addition, more than one-third of the population of San Juan County, New Mexico was identified as Native American, primarily Navajo, compared to about 10 percent for the state of New Mexico.

3.10.2.2 Royalty, Tax Revenues, and Local Contributions

Coal production from the Navajo Mine has averaged about 8.5 million tons annually between 2008 and 2010. During that same period, BNCC paid an average annual royalty of roughly $8.5 per ton of coal mined in Federal, state, and Navajo Nation taxes and Navajo Nation royalties as shown in Table 3.10-3, Annual Taxes and Royalties Paid by BNCC for Navajo Mine.

Table 3.10-3. Annual Taxes and Royalties Paid by BNCC for Navajo Mine

Category	2010	2009	2008
Coal Mined (tons)	7,809,929	9,178,169	8,897,563
Black Lung Excise Tax (BLET)	$4,327,713	$4,855,014	$4,519,639
Reclamation Act Levy	$2,478,162	$2,780,599	$2,558,620
Property Tax	$2,328,629	$2,241,690	$2,103,764
Severance Tax	$5,332,543	$10,171,600	$7,860,170
Conservation Tax	$333,974	$406,537	$406,196
Resource Excise Tax	$1,321,265	$1,602,753	$1,601,621
Gross Receipts Tax	$8,539,857	$9,732,285	$10,036,430
Tribal Royalties	$26,802,424	$32,202,529	$32,219,881
Navajo Business Activity Tax	$3,940,000	$5,108,425	$4,775,853
Navajo Possessory Interest	$3,799,253	$3,672,030	$4,799,922
Navajo Fuel Excise Tax	-	$964,137	$977,387
Total Payroll Taxes	$3,503,444	$3,431,365	$3,124,692
TOTAL Taxes & Royalties	**$62,687,264**	**$77,168,965**	**$75,014,175**
Total Tax & Roy. per Ton Coal Sold	**$7.94**	**$8.74**	**$9.08**
Navajo Mine Employees	**509**	**498**	**515**
Total Payroll	**$46,817,856**	**$44,651,000**	**$41,373,742**

Source: BNCC 2008, 2009b, 2010b; OSMRE 2015.

3.10.2.2.1 Revenue to Navajo Nation Government

Coal mining has been one of the most important revenue sources for the Navajo Nation. However, recent coal mine closures at Peabody Western Coal Company's Black Mesa Mine (Kayenta, Arizona) and Pittsburgh and Midway Coal and Mining Company's McKinley Mine (Gallup, New Mexico) have substantially reduced these revenues (NNDED 2010). In FY 2005 (year end in September), total Navajo Nation revenues from coal mining were approximately $74.6 million—accounting for almost one-third of gross general fund revenue for the Navajo Nation. In FY 2010, projected revenues from coal mining were $50 million—comprising about one-quarter of gross general fund revenue. Of that $50 million in tax and royalty revenue, approximately $35 million (comprised of royalty and tax payments to the Navajo Nation) was from BNCC's Navajo Mine operations.

The FCPP paid approximately $18.4 million in taxes to the Navajo Nation in 2011 (Arizona State University [ASU] 2013). APS also contributes to community and youth programs on an annual basis.

3.10.2.2.2 State of New Mexico and Local Government Payments

The state of New Mexico charges taxes on coal produced in the state that can amount to an effective tax rate of over 5 percent of the cost depending on the coal source and eligible deductions. The production taxes paid to New Mexico by BNCC (and subsequently, NTEC) from its Navajo Mine operations are severance tax, resource excise tax, and conservation tax. The effective tax rate for these combined production related taxes was $1.20 per ton in 2010 as shown in Table 3.10-3. The severance tax funds New Mexico's Severance Tax Permanent Fund (STPF), which has been used to retire debt from bond issues that have funded various capital projects in the state. The STPF had assets of more than $3.5 billion at the end of 2009. The Resource Excise Tax and Conservation Tax revenues are used in the State General Fund. In 2009, mineral production taxes, including those from oil and gas, comprised less than 10 percent of New Mexico's General Fund revenue (New Mexico 2009).

BNCC also paid sales tax or gross receipts tax to the state and local governments for purchases of equipment, supplies, and services. These tax revenues can be substantial as BNCC and SJCC spent over $164 million in local purchases in 2008 and the tax rate is approximately 7 percent (BNCC 2009b). In 2010, BNCC paid more than $8.5 million in gross receipts tax as shown in Table 3.10-3.

In 2011, the FCPP paid $3.7 million in property taxes, most of which was spent at the state level. FCPP's gross receipt payments and compensating tax totaled $475,000. Taxes paid by FCPP employees amounted to over $7 million (including Federal taxes). The total 2011 state tax impact of the FCPP was approximately $8.7 million (ASU 2013).

3.10.2.2.3 Federal Government Taxes

Like all coal mines in the U.S., BNCC paid (and subsequently, NTEC pays) the Federal Black Lung Excise Tax (BLET) and into the Abandoned Mine Land (AML) fund. In 2010, BNCC paid more than $4 million to the BLET and almost $2.5 million to AML as shown in Table 3.10-3.

3.10.2.2.4 Other Contributions to Local Communities

BNCC (and subsequently, NTEC), SJCC, and their employees have made charitable contributions to local communities in several ways. First, in 2010, BNCC and SJCC jointly invested approximately $1.6 million in the community according to their joint Community Relations Plan (BNCC 2011c). As part of this plan, they established the Community Investment Program, which is focused on "creating sustainable value and contributing to long term benefits based on community needs, balanced with company imperatives and impacts to stakeholders" (BNCC 2010c). Second, BNCC and SJCC employees jointly contributed more than $0.5 million to San Juan County's United Way campaign in 2010 (BNCC 2011). All employee-raised funds were matched dollar for dollar by the companies' matched-giving policy. In total, over $1 million was provided by BNCC and SJCC to San Juan United Way for the 2010 campaign (BNCC 2011). Separate data for NTEC contributions were not available.

3.10.2.3 Mine and Non-Mine Employment

In 2010, BNCC employed 509 people (85 percent Native American) and mined almost eight million tons of coal (BNCC 2010c). Additionally, in 2011, FCPP directly employed 500 people, of which, approximately 75 percent are Native American (OSMRE 2015). The labor force and unemployment rate for the counties in the affected area for 2009 are included in Table 3.10-4. Unemployment rates in the affected area have increased substantially since 2007 because of the economic downturn, as well as reduced oil and gas production in the San Juan Basin. For example, the unemployment rate in San Juan County, New Mexico increased from less than 5 percent in 2007 to 9 percent in October 2009 (San Juan County 2011).

Table 3.10-4. Labor Force, Unemployment Rate, Average Household Income

County	Labor Force 2009	Annual Average Unemployment Rate 2009	Median Annual Household Income 2009
Apache, Arizona	23,000	14.5%	$29,000
Coconino, Arizona	75,500	10%	$50,000
Navajo, Arizona	41,500	16%	$35,000
La Plata, Colorado	30,500	8%	$56,600
Montezuma, Colorado	13,800	10%	$40,900
San Juan, New Mexico	56,000	9%	$46,000
McKinley, New Mexico	27,000	9%	$30,800
San Juan, Utah	5,300	15.5%	$36,000

Source: Bureau of Labor Statistics 2010, U.S. Census Bureau (USCB) 2010.

Focusing on employment on the Navajo Indian Reservation, data from the Navajo Nation found that in 2007 the calculated overall unemployment rate was over 50 percent and much higher for some areas of the Navajo Nation (NNDED 2010). The most recent data available for the Navajo Nation is 2007. The estimated labor force and calculated unemployment for Navajos based on their county of residence is shown in Table 3.10-5. Note that the unemployment rate is estimated by the number of Navajo tribal members aged 16 or older that are not employed, divided by the total Navajo population aged 16 or older. Unlike the Federal unemployment rate, this estimated rate does not account for discouraged workers or workers outside the labor force.

Table 3.10-5. Navajo Labor Force and Unemployment Rate in 2007

County	Navajo Population	Navajo Labor Force	Number of Navajos Employed	Estimated Navajo Unemployment Rate
Apache, Arizona	68,388	20,858	10,754	42%
Coconino, Arizona	26,826	26,826	3,419	49%
Navajo, Arizona	28,367	8,652	3,047	60%
San Juan, New Mexico	30,903	9,425	4,533	42%
McKinley, New Mexico	33,240	10,138	2,758	68%
San Juan, Utah	6,833	2,084	730	55%
Navajo Nation	204,698	62,433	26,306	51%

Source: NNDED 2010.

The sectors of the economy employing the most Navajo tribal members (in order) were Services, Government, Retail Trade, Transportation/Communication, and Mining. BNCC was the 11th largest employer of Navajos in 2007.

3.10.2.4 Mine and Non-Mine Income

3.10.2.4.1 Direct Employment and Income

Total payroll for BNCC was almost $47 million in 2010 (BNCC 2010c). Wages in the mining sector are substantially higher than wages in other sectors of the local economy. For example, in San Juan County, the average annual wage was approximately $43,000 per year in 2009 and the average annual wage in the coal mining sector was $70,600 (IMPLAN 2009). The same can be found in the power generation sector, where FCPP estimates labor income to be approximately $75 million for 500 employees in 2011. Median household income in San Juan County, New Mexico in 2009 was $46,000, which is higher than the median household income for the state of New Mexico of $42,800 (Bureau of Labor Statistics 2010). Median household income levels for the affected area are shown in Table 3.10-4.

3.10.2.4.2 Indirect Employment and Income

In addition to the direct employment and income generated by continued mining operations, indirect employment and income is created by the spending of employees and BNCC (subsequently, NTEC). The multipliers that will be applied to estimate indirect employment and income are from a 2009 IMPLAN model of San Juan County, New Mexico. IMPLAN is a set of data and a computer model for assessing economic conditions and changes on a county level basis. The most recent version of the IMPLAN model (version 3) and datasets (2009) were used in this economic analysis. The multipliers are generated by an input-output model of the economy in San Juan County, New Mexico using 2009 data and are used to estimate indirect impacts of changes in output and employment in a particular industry. For example, in San Juan County, New Mexico:

- Each dollar paid for produced coal supports 0.15 dollars of production elsewhere in the local economy, as represented by an output multiplier of 1.15.
- One dollar of income earned by mine workers supports 0.16 dollars of income elsewhere in the local economy, as represented by an income multiplier of 1.16.
- One coal mining job supports about one additional job elsewhere in the economy as represented by an employment multiplier of 1.8.

These multipliers are used to estimate economic impacts of the alternatives for the entire affected area because San Juan County, New Mexico is representative of the region and includes Navajo Mine jobs in the model.

3.10.2.5 Social Baseline Conditions

Baseline conditions for determining potential social impacts consider quality of life and community indicators such as health and community assets. Recently, San Juan County, New Mexico updated its Community Health Profile that includes a comprehensive overview of social baseline conditions for the communities surrounding the Navajo Mine (San Juan County 2010). Key findings of this study relevant to Navajo Mine Plan alternatives are summarized below.

San Juan County's rapid population growth has leveled off in recent years. Between 1990 and 2000, population grew by 25 percent, but between 2001 and 2008, population grew only by 7 percent. This means that one of the main stressors of social cohesiveness—rate of population growth—has eased in the past decade.

Consistent with New Mexico overall, the Native American and Hispanic populations had higher proportions of individuals under 35, whereas the white population had higher proportions of those 55 and older. This means that youth issues and programs that target 15 to 24 year olds must take into account that Native Americans are 36 percent of the county's population, but are 46 percent of the 15 to 24 year olds in the county.

Poverty affects all areas of life, including health, educational attainment, stress, and general well-being. San Juan County encompasses areas of extreme household and child poverty, coupled with unemployment and transportation challenges. This is especially true for rural areas, poorer neighborhoods in Farmington, and parts of the Navajo Nation where poverty is 30 percent or higher.

The County's Community Health Profile found that San Juan County is not lacking in health or social services. However, awareness and access to these services needs to be improved. Better public transportation and public awareness of services and programs is identified as a critical action area. Public health concerns are discussed in Section 3.15.

Navajo Nation Chapter Houses represent central community gathering places. There are 20 chapters in San Juan County. The Restoring and Celebrating Family Wellness program that meets at the Shiprock Chapter House, offers monthly workshops. Historically, Chapter Houses played a more central role, and many contemporary Navajo residents currently strive to inspire increased interest in community gathering at the chapter level on the Nation. The social impact analysis considers the scale and pace of change to these baseline social conditions.

3.11 Land Use

3.11.1 Definition of Resource

This section addresses the existing conditions in the affected environment with respect to land use. The land use resource assessment area includes the pre-2016 mining areas in Area III and Area IV North, support features, and Burnham Road realignment, and a 1-mile area surrounding these actions. Land use-related comments raised during the public workshops and the informal conference include concerns about contemporaneous reclamation, timing of release of reclaimed lands, and the effect that the Proposed Action may have upon tribal member rights and customary use areas, including relocation of livestock grazing. These comments have been used to develop the discussion of current land use contained herein.

Through the course of operations at the existing Navajo Mine and as proposed, all NTEC mining activities within the land use resource assessment area would be conducted under the guidance of OSMRE as required by SMCRA. NTEC would develop a SMCRA mine permit amendment to the current approved Navajo Mine permit that must show how the company proposes to develop coal resources while protecting and minimizing adverse effects to other resource considerations. Under SMCRA (30 CFR 761.11(a)), BNCC has, and would continue to conduct any proposed mining in consideration of existing (pre-development) land uses, and where coal mining is prohibited, limited, or unsuitable. During active mining operations, NTEC is required by SMCRA to develop contemporaneous reclamation for all surface disturbances—and upon cessation of active operations—to develop final reclamation for bond release and the approved post-mining land use. NTEC is required by OSMRE directive to conduct its operations within the requirements and timeframes established under SMCRA.

3.11.2 Affected Environment

The land use resource assessment area is wholly within lands of the Navajo Nation Indian Reservation. The Tiis Tsoh Sikaad (Burnham) Chapter House, located approximately 5.5 miles south of the Project Area, is the nearest tribal community building.

Active surface coal mining by BNCC (and subsequently, NTEC) has been ongoing since 1957 at the Navajo Mine, when BNCC's predecessor was granted Navajo Tribal Coal Lease 14-20-603-2505 (see Section 1.1). Since 1957, BNCC has developed the Navajo Mine coal lease, associated ROWs, and mine permit area within an approximately 33,600-acres area near Fruitland, New Mexico (see Figure 1.1-1). The approximately 25-mile long coal lease area includes an 13,430-acre mine permit area encompassing an extensive mining infrastructure that include areas of active mining, operational support, and reclamation. Currently, 12,990 acres of the mine permit area are utilized for surface coal mining operations and support, while 7,925 acres of completed mining have been reclaimed.

The surface and mineral rights within NTEC's current coal lease area are held in trust by the U.S. for the benefit of the Navajo Nation. The Navajo Mine coal lease is subdivided into six administrative areas known as Areas I, Area II, Area III, Area IV North, Area IV South, and Area V (see Figure 1.1-1). Mining activities are complete in Area I and is largely reclaimed except for support areas required for mine operation. OSMRE has terminated its jurisdiction over Area I and BNCC is coordinating with the Navajo Nation and BIA regarding status and release of associated lands back to the Navajo Nation. It is anticipated that the release will occur once appropriate coordination is complete. Active mining operations in Area II and III are ongoing and anticipated to be complete in 2011 and 2016, respectively. In Area IV North, mining

preparation activities have been conducted to develop the required infrastructure for surface coal mining, though no mining has been conducted within this area. Area IV South and Area V are undeveloped.

Historically, coal was also mined approximately 7.5 miles south of the land use resource assessment area within the CONSOL coal lease area for the Burnham Mine from 1980 to 1984. One historic coal mine (Figure 3.11-1) and several other smaller mines near the Project Area have been operated over the past 60 years, although none remain active. Cultural resource studies indicate the presence of historic coal mining activities by the general public in the area for more than 200 years.

In addition to surface coal mining activities, the major land use within the land use resource assessment area includes lands used for low-intensity domestic grazing and for wildlife habitat. Limited rainfall within the area produces primarily rangeland plants useful to the tribal livestock grazing. Other potential lands uses within the area are limited by the lack of irrigation and the poor soil conditions that restrict the suitability of lands for agricultural and forestry uses, the lack of forage species and perennial water resources that limit value of fish and wildlife habitat, and the lack of sufficient utility and access infrastructure that constrains residential and industrial land uses. Further information on land productivity is provided in Section 3.1.2.2 – Soils and Section 3.7 – Vegetation. Regional infrastructure information is provided in Section 3.10 – Socioeconomics and Section 3.14 – Traffic and Transportation.

Existing land within the land use resource assessment area is managed and maintained by the BIA and Navajo Nation Land Department and is comprised of eight customary use areas (CUAs), which are broken into 11 different grazing permits (Table 3.11-1). Each CUA is based on traditional (customary) use rights, and grazing permits are primarily used for grazing of sheep, goats, cattle, and horses. Grazing permits have been historically granted to allow for year-long grazing. Grazing permits are typically unfenced, with management relying on topographic features and roads. Sources of water to support livestock include two stock ponds in Area III and in Area IV North. Water resources available to livestock grazing are described in detail in Section 3.2 – Water Resources. As per terms of the Navajo Mine coal lease, the post-mining land use is designated as rangeland for livestock grazing and wildlife habitat (same as current environment). Access to the grazing permit areas and CUAs is supported by the existing Burnham Road (BIA Road N-5082) and an array of unimproved two-track roads (Figure 3.11-1). Roads and access within the land use resource assessment area are further described in Section 3.14 – Traffic and Transportation.

There are no existing ROWs for pipelines, railroads, telephone, and water/sewage conveyances within the land use resource assessment area. BNCC constructed two power lines within Area IV North. One active power line enters Area IV North from the adjacent Navajo Mine Permit area and follows the western permit boundary, crosses east-west midway through Area IV North, and then traverses due north back into the adjacent Navajo Mine area. The second power line, which is inactive and disconnected from the mine power grid, starts halfway in Area IV North and continues south into Area IV South. An active Navajo Tribal Utilities Authority (NTUA) power line enters the southeastern corner of the land use resource assessment area, supplying electricity to Permit Number 13-96/CUA No.0394.

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Figure 3.11-1. Land Use Map

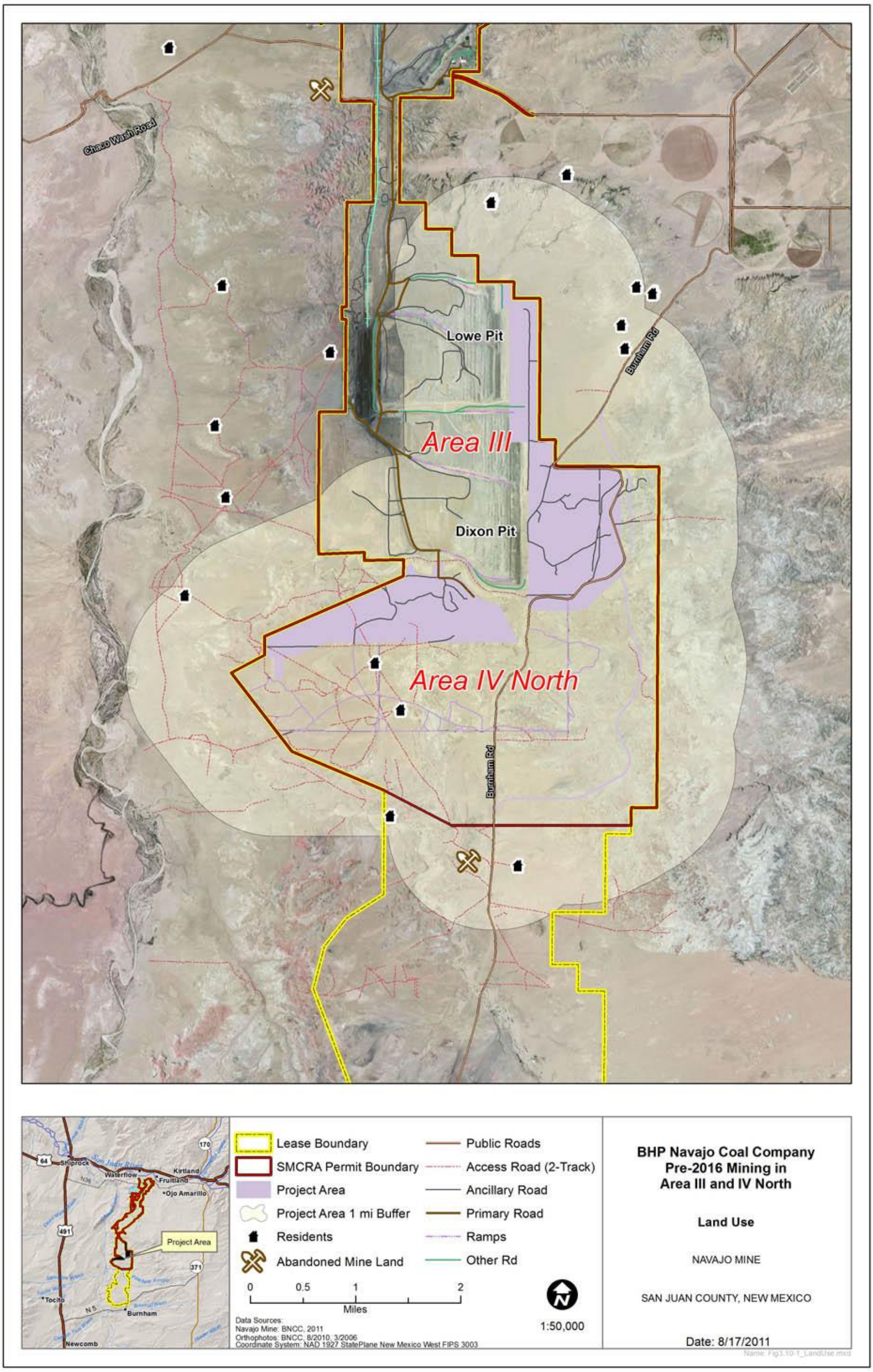

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Table 3.11-1. CUAs within the Land Use Resource Project Area

Permit Number	CUA Number
13-431	.0396
13-296	.0396
13-471	
13-562	.0049
13-629	
13-336	.0362
13-559	
13-500	.0050, .0351, .0366
13-661	.0047
13-565	
13-96	.0394

3.11.2.1 SMCRA Land Use Requirements

As defined by SMCRA for consideration of land use resources, criteria are defined for where coal mining is prohibited, limited, or unsuitable. The following discussion describes these criteria considered in relation to the current land uses within the land use resource assessment area.

Prohibited Lands: This includes lands within the boundaries of national parks, national wildlife refuges, national trails, national wilderness areas, rivers designated or being considered as wild and scenic, or national recreation areas. These land use designations do not occur within the land use resource assessment area. Other prohibited uses include location of mining activities adjacent to public buildings, schools, parks, or cemeteries. No public buildings, schools, parks, or cemeteries are located within the land use resource assessment area. The Burnham Chapter House is located over approximately 5.5 miles to the south.

Limited Lands: These lands include those within the National Forest System, public parks, historic places, public roads, and occupied dwellings. National Forest System land use designations and public parks do not occur within the land use resource assessment area. Although there are no National Register of Historic Places (NRHP) listed historic properties within the land use resource assessment area, four sites, identified during cultural resource and historical resource surveys conducted within the cultural resources assessment area were determined as eligible for inclusion on the NRHP. Under SMCRA, NTEC has developed a plan for protecting any cultural resources, as well as the mitigation and treatment measures to be taken to protect historic places (developed in consultation with OSMRE, the Navajo Nation, and other parties participating in the 2007 Section 106 consultation). Cultural resources surveys and sites that may be eligible for inclusion on the NRHP are discussed in Section 3.13 – Cultural Resources.

The Burnham Road runs north to south through the land use resource assessment area (Figure 3.11-1). The Burnham Road, a BIA-managed road with no recorded ROW, is considered a public road under 30 CFR 761.5. Under SMCRA regulations, BNCC was required to protect the affected public road use system, and developed measures to be taken to protect related resources (developed in consultation with OSMRE, BIA, and the Navajo Nation), in accordance with 30 CFR 761.11(d) and 761.14. There are numerous two-track unimproved roads that also traverse the land use resource assessment area (Figure 3.11-1). These unimproved roads do not meet road construction standards for other public roads in the area and are not public roads as defined in 30 CFR 761.5, are not maintained with the use of public funds similar to other public roads in the area, and have not been designated as public roads by the Navajo Nation or any applicable jurisdictional authority. Public use of these roads is infrequent and is primarily utilized by tribal members with customary use rights in the land use resource area. Further discussion on the realignment of the Burnham Road and the traffic associated with the transportation infrastructure within the land use resource assessment area is presented in Section 3.14 – Traffic and Transportation.

SMCRA regulations (30 CFR 761.11) prohibit mining within 300 feet of occupied dwellings unless certain regulatory conditions are met. An occupied dwelling is defined (30 CFR 761.5) as any building that is currently being used on a regular or temporary basis for human habitation. The CUAs are used primarily for grazing purposes, with associated permittees having occupied dwellings within their respective CUAs or within approved home site leases granted by the Navajo Nation Land Department. No dwellings are located within the areas proposed for mining or within the road realignment and none are proposed for relocation. Eight dwellings (five permanent dwellings and three temporary/ancestral dwellings) are found within the 1-mile buffer of the permitted Area III and proposed Area IV North mining activities or the relocated Burnham Road (Table 3.11-2).

Table 3.11-2. Dwellings within the Land Use Resource Assessment Area

Dwelling Location	Status	Approximate Distance to Proposed Activities (Miles)
North of Area III	Permanent	0.75
West of Area III	Permanent	0.90
West of Area III	Permanent	0.75
West of Area III	Permanent	0.75
South of Burnham Road Realignment	Permanent	0.33
South of Area IV North	Temporary/Ancestral	0.50
South of Area IV North	Temporary/Ancestral	0.25
Northwest of Area IV North	Temporary/ Ancestral	0.50

Unsuitable Lands: As defined by SMCRA, no lands considered as unsuitable are located within the land use resource area.

3.11.2.2 Four Corners Power Plant

The FCPP is located 20 miles west of Farmington, New Mexico, on Navajo Nation tribal trust land. It is on the overlapping/disputed lands of the San Juan and Nenahnezad chapters. Its primary components include three power generating units, Morgan Lake - a 1,200-acre human-made reservoir that provides water for FCPP operations - a series of DFADAs, and a coal handling and processing system. Coal is transported from the Navajo Mine to FCPP via an electric rail line that is owned and operated by the Navajo Mine. The FCPP site is used for electricity production, fly ash disposal, and coal transport. No other land uses currently exist in the proposed location.

3.12 Environmental Justice

3.12.1 Definition of Resource

President Clinton's Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," issued on February 11, 1994 declares that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States," including Indian tribes. The Executive Order and CEQ guidance on incorporating environmental justice into NEPA analysis applies where a Proposed Action is likely to have disproportionately high and adverse human health or environmental effects on low-income populations, minority populations, or Indian tribes (CEQ, Environmental Justice Guidance Under the National Environmental Policy Act) (December 10, 1997). Public outreach efforts conducted as part of the NEPA process for this project are described in Section 1.5 of this document. The analysis considers environmental, human health, economic, and social impacts, taking into account mitigation and participation by the affected community (CEQ Environmental Justice Guidance, § III.B).

3.12.2 Affected Environment

In determining the affected environment for analysis of environmental justice, the CEQ advises agencies to use the U.S. Census Bureau (USCB) data to identify potentially affected populations, and to examine geographic distribution by race, ethnicity, and income (CEQ Environmental Justice Guidance, § III.B). Therefore, this analysis provides USCB information for San Juan County, within which the Project Area is located and, to provide context, examines surrounding counties as well. These counties and their minority populations and poverty rates are summarized in Table 3.12-1.

Table 3.12-1. Potential Affected Populations for Environmental Justice Impacts

County	Population (2010)	Minority Population (2009)	Individual Poverty Rate (2008)
Apache, AZ	78,230	61.7%	31.2%
Coconino, AZ	141,460	28.2%	16%
Navajo, AZ	123,170	39.9%	23.1%
La Plata, CO	52,530	7.0%	10.9%
Montezuma, CO	25,970	14.2%	16.3%
McKinley, NM	80,750	61.3%	30.8%
San Juan, NM	133,170	32.6%	14.4%
San Juan, UT	15,053	47.2%	28.1%

Source: USCB 2010.

Based on the census tract data shown in Figures 3.12-1 and 3.12-2, the percentage of Native American population and individual poverty rate are both marginally higher in those tracts closest to the Project Area. However, this pattern is consistent throughout the region; the census tracts located inside Navajo Nation or other Indian Reservation lands have higher minority populations and poverty rates than those outside the Reservation. Given these census tract patterns and CEQ guidance, the impact analysis considers whether there are any disproportionate adverse impacts and any "special" exposures to these vulnerable populations due to cultural or traditional use of resources, such as ceremonial food or medicine gathering. These potential impacts are analyzed in Section 4.12; public health and safety is discussed in Sections 3.15, 4.12, 4.15, and 5.2.14; air quality in Sections 3.5, 4.5, and 5.2.5; cultural resources are discussed in Sections 3.13, 4.13 and 5.2.13; and socioeconomics is discussed in Sections 3.10, 4.10, and 5.2.10. Public outreach is discussed in Section 1.5.

Figure 3.12-1. Map of Census Tracts Shaded to Indicate the Percent of Native American Population

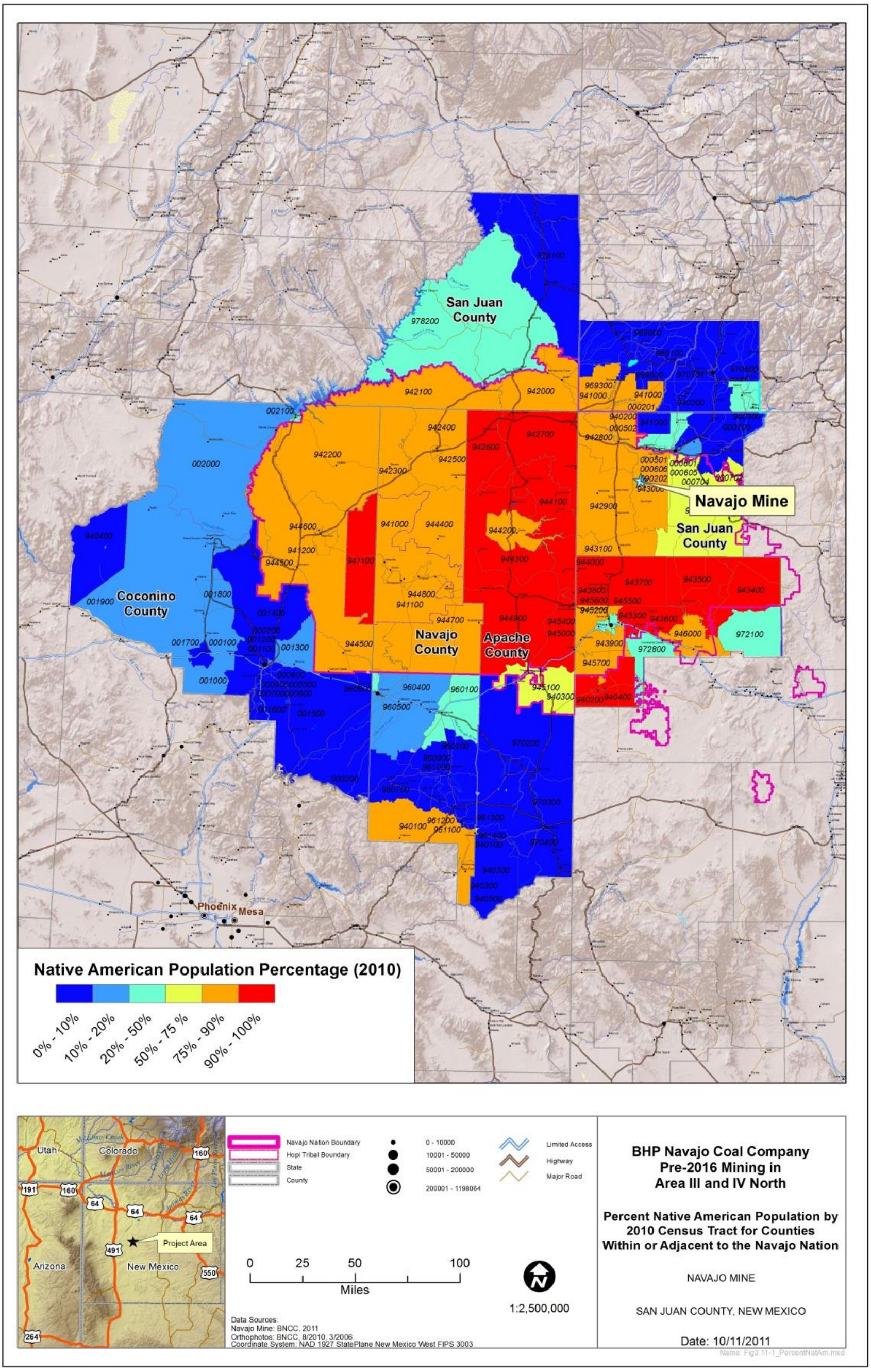

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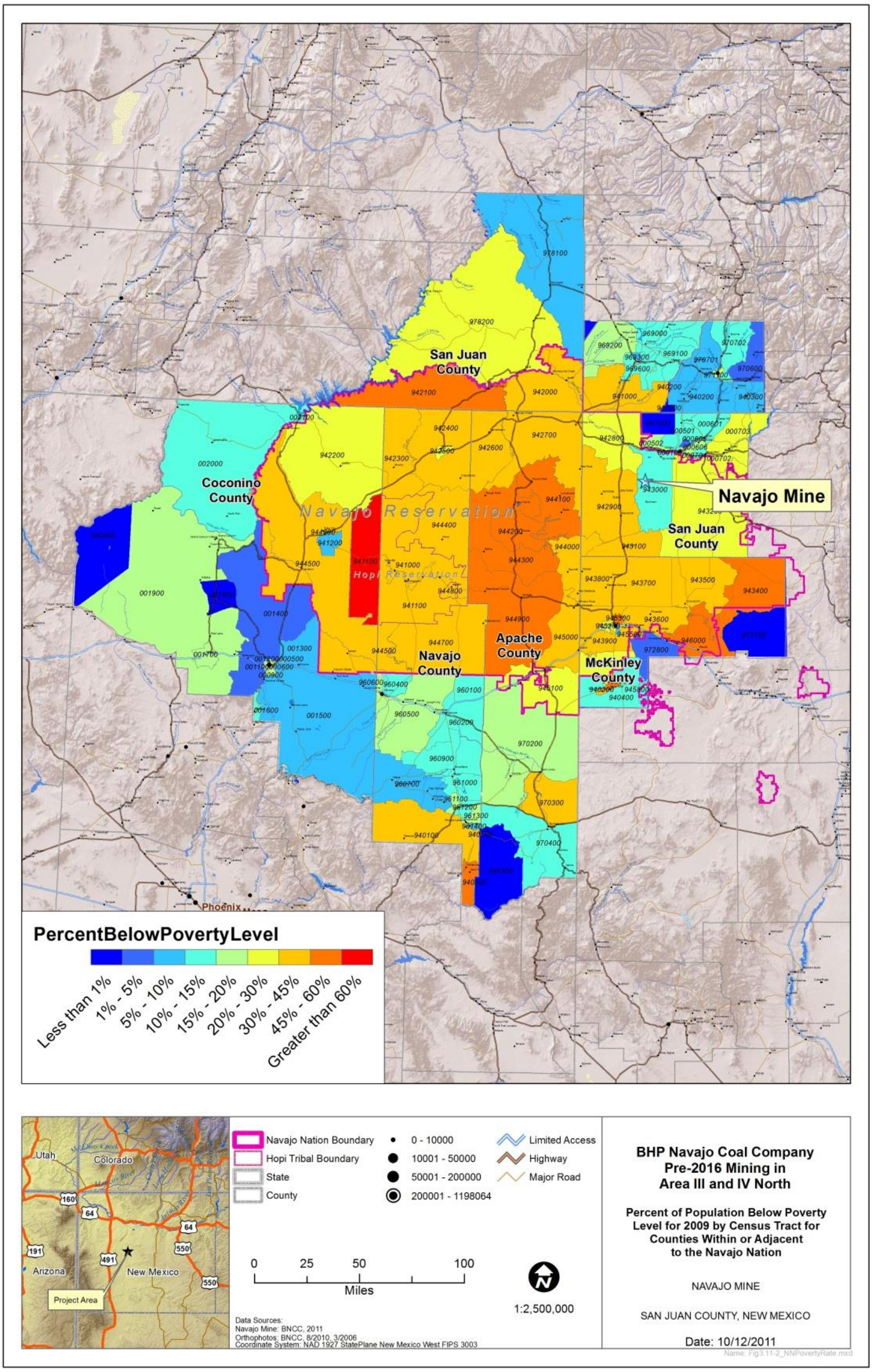
Figure 3.12-2. Map of Census Tracts Shaded to Indicate Percent of Population Below Poverty Level



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3.13 Cultural Resources

3.13.1 Definition of Resource

Archaeological sites and historical properties are physical remnants of societies that have occupied the region. Cultural resources include those aspects of the physical environment that relate to human culture and society, along with the social institutions that form and maintain communities and link them to their surroundings.

For purposes of this EA, the inventory and consideration of cultural resources focuses on historic preservation, data recovery or other mitigation and consultation relating principally to (1) archaeological sites and historic period properties that may or may not be eligible for listing on the NRHP, and including sites that may be considered traditional cultural properties within the Project Area and adjacent lands, and (2) burial sites. While certain compliance work is ongoing, most cultural resources within the Project Area have been inventoried, tested, and subjected to mitigation efforts under the supervision and guidance of OSMRE and the NNHPD. Data regarding traditional cultural properties have been documented through ethnographic efforts. Any further mitigation and compliance work will be performed and incorporated into compliance documentation in accordance with applicable cultural resource management laws and regulations.

The Antiquities Act of 1906 (AA), the NHPA, as subsequently amended, and the Archaeological Resources Protection Act of 1979 (ARPA) are other Federal laws that protect certain cultural resources. In addition, the American Indian Religious Freedom Act of 1978 (AIRFA) requires that all Federal agencies take into account the effects of their actions on traditional Native American religious and cultural values and practices. Finally, NAGPRA expressly provides for the protection of Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony, and gives affiliated Native American groups or individual's priority in the treatment of such human remains and artifacts.

Regulations for Protection of Historic Properties (36 CFR Part 800), which primarily implement Section 106 of the NHPA, define key regulatory requirements beyond those of NEPA. These regulations define a process for Federal agency consultation with state or Tribal Historic Preservation Officers, the Federal Advisory Council on Historic Preservation, and other interested parties to ensure that certain historic properties are duly considered as Federal projects are planned and implemented.

Archaeological work done at Navajo Mine is conducted in accordance with the authorities of the NHPA, NEPA, Executive Order 11593, "Protection and Enhancement of the Cultural Environment," the Archeological and Historic Preservation Act, the Navajo Nation Cultural Resources Protection Act (NNCRPA) (Tribal Council Resolution CMY-19-88), ARPA and NAGPRA, and related statutes and regulations.

Additional relevant Navajo Nation laws and policies include the Policy for the Disposition of Cultural Resources Collection and NNCRPA, Guidelines for the Treatment of Historic, Modern Contemporary Abandoned Sites, Policy to Protect Traditional Cultural Properties, and Policies and Procedures Concerning the Protection of Jishchaa': Cemeteries, Gravesites & Human Remains, and Guidelines for Discovery Situations.

Cultural resources include prehistoric, historic, and TCPs, buildings, structures, districts, objects, as well as associated artifacts, records, and remains related to such properties. Often the importance of cultural resources is determined in consideration of the criteria for listing on the NRHP (36 CFR 60.4 and Bulletin 38). National Register Bulletin 38 provides guidance for evaluating and documenting TCPs. To be eligible for listing on the NRHP, a property must be important in American history, architecture, archaeology, engineering, community, or culture and must possess integrity of location, design, setting, materials, workmanship, feeling, and association. In addition, properties must meet at least one of the following four criteria:

- Criterion A: are associated with events that have made a significant contribution to the broad patterns of our history.
- Criterion B: are associated with the lives of persons significant in our past.
- Criterion C: embody the distinctive characteristics of a type, period, or method of construction, that represent the work of a master, that possess high artistic values, or that represent a significant distinguishable entity whose components may lack individual distinction.
- Criterion D: have yielded, or may be likely to yield, information important in prehistory or history.

The importance of other cultural resources may be determined through consideration of other criteria under applicable statutes, including those listed above. Importantly, NAGPRA, ARPA, and their respective implementing regulations provide criteria and definitions for evaluation, consultation and other regulatory compliance efforts relating to resources subject to the protection of, or consideration under, those statutes including ARPA, Navajo Nation requirements, and SMCRA.

The following discussion of cultural resources is general in nature. Data concerning the location, nature, and descriptions are limited to honor the confidentiality restrictions required by the NHPA and its implementing regulations and related statutes and regulations.

3.13.2 Affected Environment

Archaeological investigations on the Navajo Mine leasehold have taken place in phases corresponding to the sequence of mining activities. Prior to any land disturbance in the start of the FCPP and Navajo Mine, NTEC (and its predecessors, BNCC, BHP Minerals, Utah International Inc., and Utah Construction & Mining Co.) and APS obtained the services of the Laboratory of Anthropology at the University of New Mexico to conduct an archaeological survey of the Area I and Area II. Area I was cleared in June 1961 and the report from this initial survey and excavation was completed in 1962 (Sciscenti and Greminger 1962). Area II was surveyed in 1969. No significant archaeological sites were identified during this survey and an archaeological clearance was granted by the NPS in August 1969.

From September 1973 to December 1974, an archaeological survey was conducted for Area III, Area IV North, Area IV South, and Area V (Reher 1977). In this survey, 718 archaeological sites were identified and 153 were determined eligible for inclusion in the NRHP. Prior to mining, seven archaeological actions were completed to mitigate the impacts of mining on eligible sites identified by Reher (1977).

Extensive archaeological and ethnographic studies, evaluation, consultation, and adverse effects resolution efforts undertaken by BNCC and its predecessors from 1961 through 1992, with oversight from appropriate

Federal agencies and the Navajo Nation, have resulted in the clearance of BNCC lease lands at Navajo Mine, from Area I to the northern third of Area IV North, including most of the Project Area (Hogan and Winter 1983). Artifacts and records from these mitigation and research activities that have not been returned to the Navajo Nation are maintained at one of the approved curatorial facilities located at the Museum of New Mexico, the University of New Mexico, or the San Juan County Museum.

The following more recent consultation, inventory, study, evaluation, and mitigation work was pursued under the direction and guidance of OSMRE and the NNHPD. In 2004, BNCC contracted with the San Juan County Museum Association's Division of Conservation Archaeology (DCA) to perform an updated inventory/evaluation of archaeological and historical properties within the Area IV North portion of the Navajo Mine lease area—including all of the Project Area. In performing this work, DCA reviewed the literature and conducted field inventories to relocate and characterize 57 sites that had been identified within this area during previous archaeological survey work (Hogan and Winter 1983, Reher 1977). In addition, DCA identified 16 new sites of varying potential significance. Seventy-three historic properties were relocated and/or newly identified during the evaluation of the project. A report of their survey and findings are presented in "The Eligibility Evaluation of Cultural Resources Located Within Lease Area IV North of BHP Billiton (sic) Navajo Coal Company's Navajo Mine" (Meininger and Wharton 2004).

Based on the review of the DCA report, and in coordination with OSMRE, the NNHPD issued a Cultural Resources Compliance Form that outlined the "Effects of the Project and Conditions of Compliance." Of the total 73 cultural resource sites located in Area IV North, NNHPD determined that 21 were not NRHP eligible and 52 were NRHP eligible. In addition to the cultural resource sites, one TCP, four burial locations, and two in-use sites were identified; these were all determined not NRHP eligible. In order to mitigate the adverse effects of the proposed mining impact in Area IV North, OSMRE and NNHPD determined that a thorough ethnographic study, a data recovery plan, treatment plan, and additional testing were required.

In 2005, pursuant to OSMRE and NNHPD direction, BNCC contracted with Ecosystem Management, Inc. (EMI) to draft a data recovery and treatment plan, conduct a thorough ethnographic study, conduct additional eligibility testing necessary for the development of Area IV North, and survey the proposed approximately five mile Burnham Road relocation. The data recovery plan provided a framework for the mitigation and testing of 47 sites located within Area IV North (Burelson et al. 2006). This plan, which was approved by OSMRE and NNHPD, provided methodology for formal data recovery at 12 sites and testing at 35 sites to determine whether additional data recovery was warranted.

EMI subcontracted the ethnographic study to Dinétahdóó Cultural Resources Management (DCRM), a Navajo-owned firm with local ethnographic experience. Based on the review of the local literature, field visits to Navajo archaeological sites in Area IV North, and preliminary contacts with members of the two families that were using the Project Area, a plan was made for gathering ethnographic information. This plan was submitted to and approved by NNHPD in 2006. After DCRM obtained a permit, officials of the chapters that encompass the Project Area were consulted—Nenahnezad, Tiis Tsoh Sikaad (Burnham), San Juan, Upper Fruitland, Sanostee, and Newcomb chapters. The chapter officials were informed of the then proposed Area IV mine plan and a formal presentation of the ethnographic study was presented to each chapter at either a general membership or a local planning meeting. Using data from the chapter contacts, historical users of the area, individuals identified in previous ethnographic interviews by Hogan and Winter (1983) and Martin and Wierto (1985), individuals were identified for contact and ethnographic interviews.

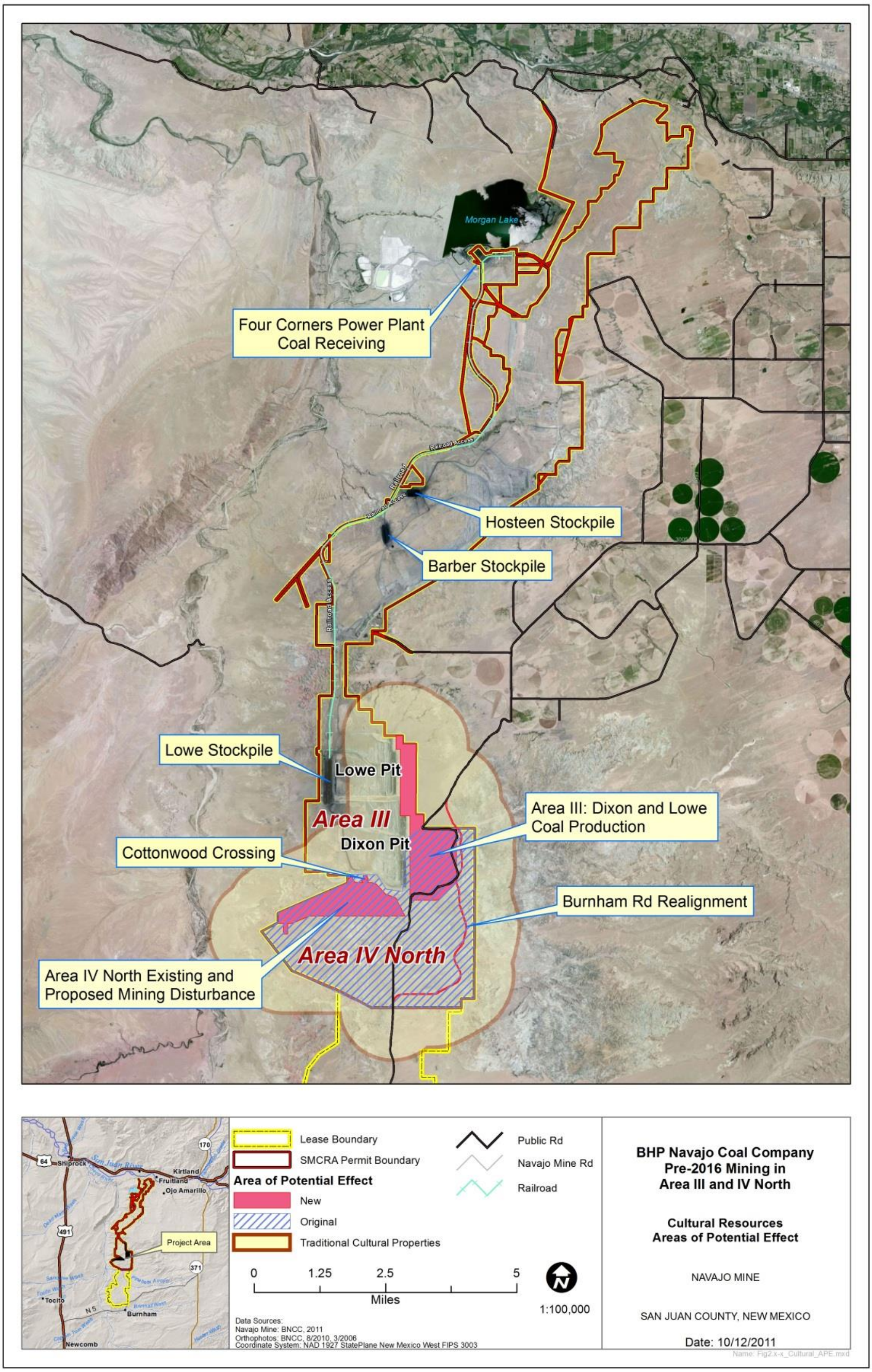
Altogether, 36 people within six chapters were contacted and interviewed. Nineteen individuals were taken on field visits to old family sites and or camps. The results to the ethnographic study were presented in their publication "Each Place Brings Stories" (Kelly et al. 2007) that was submitted to NNHPD and OSMRE in 2007.

Because of the current mining in Area III and proposed Area IV North mine plan revision, it is necessary to relocate a portion of Burnham Road. Since the road relocation is partially outside the mine lease area, EMI conducted a survey of the entire length of the proposed road relocation. In the survey area, four cultural resource sites were located (Burelson 2006). Based on review of EMIs report, NNHPD issued a Cultural Resources Compliance Form that outlined the effects of the project and the Conditions of Compliance. All four sites were determined to be eligible; three of the sites could be avoided by rerouting and one required mitigation. Mitigation work for the one site was completed in 2007 (Honeycutt 2008).

During the spring of 2007, following the earlier work described above, EMI conducted evaluative investigations at 33 sites in Area IV North. Subsurface testing was conducted at 19 sites and detailed mapping and artifact analysis was conducted at the remaining 14 sites. The results of the testing indicated that seven sites should be considered individually as eligible to the NRHP and should be further mitigated according to the data recovery plan. In addition, it was recommended that the sites dating to the Navajo period should be considered as part of an eligible historic landscape and should be mitigated by the development of a cultural landscape study (Johnson et al. 2007). This recommendation was approved by OSMRE and NNHPD and the cultural landscape study was completed by Woods Canyon in 2011 (Tsosie et al. 2011).

Concurrent with EMI's work, was the development and signing of a Cultural Resources PA in 2007 that addressed cultural resources compliance work in Area IV North. The PA detailed the steps and methods for compliance with Section 106 of the NHPA and its implementing regulations. The PA was the agreement between the proponent (BNCC, and now NTEC), the Federal agency (OSMRE), and the NNHPD. OSMRE, in conjunction with NNHPD, amended the 2007 PA to include the BIA, BLM, and the USACE. The Hopi Tribe, Pueblo of Acoma, Pueblo of Laguna, Pueblo of Zuni, and the Ute Mountain Ute Tribe were also invited signatories to the PA. The PA amendments redefined the Area of Potential Effect (APE) by including Area III (see Figure 3.13-1), a reduced Area IV North, and Burnham Road. The PA included procedures for mitigation and reporting, treatment of unanticipated discoveries of archaeological resources, outlined a process for dealing with TCP, and the treatment of human remains.

Figure 3.13-1. Areas of Potential Effect



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In 2007, in accordance with the terms and conditions of the 2007 PA BNCC contracted with Ecosphere Environmental Services to mitigate six sites of the twelve sites initially identified for data recovery. Under subcontract, Woods Canyon Archaeological Consultants, Inc. (Woods Canyon) completed the mitigation work at these sites. As the fieldwork on this project was nearing completion, the results of EMI's testing were finalized. Based on the results of the testing, the contract for mitigation was expanded by 13 more sites to include the 7 additional sites and the remaining 6 sites. Mitigation work was completed in May of 2008 and the technical report was submitted to OSMRE and NNHPD (Fetterman 2011). In 2009, OSMRE and NNHPD determined that BNCC completed all necessary identification and mitigation/data recovery activities for Area IV North (Steele 2009).

In addition to the mitigation work, Woods Canyon was tasked to investigate the location of historic human burials in Area IV North. As a result of the "Each Place Brings Stories" ethnographic study, the locations of 10 human burials were identified in Area IV North. One of these was located in Area III and the remaining nine were located outside the current Project Area. Investigations included surface inspection of locations, metal detector investigations, hand test units in the potential areas of the burial, and in the case of two locations mechanical testing. The investigations located probable evidence of two burials at one location in Area IV North. In accordance with the Navajo Nation Jishchaa' Policy and NAGPRA, the closest lineal descendants were interviewed and it was their desire to leave the graves where they are located. A fence has been built around the location of the burials and proposed mining activities will avoid the location. A written confidential report on the investigations was filed with NNHPD.

In accordance with Section 106 of the NHPA, and as outlined in 36 CFR Part 800.4(b)(2), OSMRE developed two PAs for the FCPP/NMEP EIS (2015). One PA addressed effects to the historic properties within the Navajo Mine APE, and the other PA covered historic properties within the APE for the FCPP and its associated transmission lines. The PAs provide a process for compliance with NHPA pursuant to 36 CFR Part 800.14(b) in parallel with NEPA. Specifically, 36 CFR Part 800.4(b)(2), states that an agency may defer final identification and evaluation of historic properties if it is specifically provided for in a PA or documents used by an agency to comply with NEPA. Accordingly, the identification and evaluation of historic properties within the APE will be completed as specific aspects of that project and related projects are refined pursuant to 36 CFR Part 800.4(b)(1) and 36 CFR Part 800.4(c).

The PAs provide procedures and responsibilities for the ongoing identification, evaluation, and mitigation of historic properties and procedures to minimize impacts to historic properties. The PAs also contain additional information including standards, guidelines, and unanticipated discovery protocols.

3.13.2.1 Archaeological and Historical Resources

Within the Project Area, 13 archaeological or historical resources are located. Two of these resources have unknown age occupations and 1 of these resources have historic Navajo occupations. The type and age of the occupations (Table 3.13-1) suggest limited activity use and habitation during the historic Navajo period.

Table 3.13-1. Archeological and Historic Occupations within the Project Area

Unknown Limited Activity	Historic Navajo Limited Activity	Historic Navajo Habitation
2	10	1

All 13 of the cultural resource sites have been extensively studied. One of the 13 sites has been determined eligible to the NRHP and has been mitigated through excavation; 3 of the sites were determined eligible and were mitigated through ethnographic studies; 2 of the sites have been tested and determined not eligible; and the remaining 7 sites were determined to be not eligible.

3.13.2.2 Traditional Cultural Concerns

The most recent ethnographic investigations on the Navajo Mine Lease Area were initiated as part of the Area IV North cultural resource compliance effort (Kelly et al. 2007). This work builds on the original ethnographic work conducted by York (1983) and Winter (1983), adding a great deal of new information in the process. Extensive interviews were conducted with local informants on all of the Navajo sites previously identified within Area IV North. Information was also collected on sites that may be considered TCPs, gravesites and, as these were provided by consultants, on water sources and miscellaneous resources such as agricultural fields, local coal mines, rock art, and cairns.

In addition, the Navajo Nation Archaeological Department (NNAD) completed an ethnographic assessment for URS Corporation in association with the proposed Desert Rock Energy Project (DREP). This was an ethnographic assessment of Navajo TCPs and burials within the BNCC coal lease Areas IV North, IV South, and V, as well as a 1-mile-wide buffer zone surrounding these tracts in 2006 (Chavez 2006).

Based on this work, no known TCPs are located in the area of direct impact of the Project Area. In addition, based on work conducted in 1979, no known sites of religious or native significance were present in Area III (Hogan and Winter 1983). Commenters at the public workshops noted that the tribal elders collect clay from nearby washes. Comments also indicated that the Hogback feature and the San Juan River are culturally important to the Navajo people, however these sites will not be impacted by the proposed project.

Eight TCPs are located within a mile of the Project Area. Seven of these sites are considered not eligible to the NRHP and one requires additional information before an assessment can be made. In addition to identifying TCPs near the Project Area, a cultural landscape study was undertaken for Area IV North. The study presents an overview of Area IV North from a traditional Navajo perspective (Tsosie et al. 2011). The study examined the origin of the Navajo and the clans of the Navajo that occupied the lease area. It also examined the local landforms as they relate to stories associated with ceremonies.

3.13.2.3 Burial Sites and Related Objects

Ethnographic work identified one historic Navajo burial in Area III and none in the rest of the Project Area. Detailed examination of the location of the burial in Area III failed to produce physical evidence of this burial. Mining in this area should be closely monitored and if human remains are encountered, mining should be suspended in the area, and Navajo Nation Jishchaa' and NAGPRA procedures implemented.

3.13.2.4 Four Corners Power Plant

A total of 20 archaeological resources and 22 isolated occurrences have been identified in the area of potential affect for FCPP, per the surveys and analysis conducted in the FCPP/NMEP EIS (see Section 4.4.2.2 of the EIS). It was determined by OSMRE that 12 sites are eligible for the NRHP, 10 sites are not eligible, and 2 sites are unevaluated for listing in the NRHP. Please see Section 4.4.2 of the FCPP/NMEP EIS for a detailed discussion of the surveys/testing conducted to characterize the FCPP existing environment.

3.14 Traffic and Transportation

3.14.1 Definition of Resource

This section addresses the existing conditions in the affected environment with respect to traffic and transportation. The traffic and transportation resource assessment area is defined as the Proposed Action area, including Area III and Area IV North mining areas and support features, the Burnham Road realignment, and a one-mile area surrounding the Proposed Action. One traffic and transportation related comment was raised during the public workshops and no related comments were received during the informal conference. The public comment addressed improvement of an existing access road located west of Navajo Mine, commonly referred to as the Chaco Wash Road, and concern regarding unfinished improvements. This issue is not associated with the Proposed Action and is outside of the traffic and transportation resource area. Indirectly, land use resource comments in association with effect that the Proposed Action may have upon tribal member rights and customary use areas (as they relate to management and access) have been used to develop this resource discussion.

3.14.2 Affected Environment

Currently, materials and employees access the Navajo Mine from U.S. Highway 64, New Mexico Highway 371, or U.S. Highway 491, via an infrastructure of San Juan County and/or BIA roads (Figure 3.14-1). U.S. Highway 64 is the primary transportation route running east to west between Farmington and Shiprock. The New Mexico Department of Transportation (NMDOT) classifies New Mexico Highway 371 as a rural minor arterial route for travel between Farmington and Interstate 40 at Thoreau. U.S. Highway 491 links Interstate 40 at Gallup with U.S. Highway 191 at Monticello, Utah. From these main artery roads, employees and visitors use the following paved BIA road and San Juan County road routes daily to reach the existing Navajo Mine facilities in Area III (primary point of access for the Proposed Action):

- From South or East (Farmington or Bluffview Navajo Housing Authority Housing) on New Mexico Highway 371, via west on BIA Road 3003 to BIA Road 3005 to BIA Road 4104 to Navajo Mine Area III Facilities.
- From West (Shiprock) or East (Farmington) on U.S. Highway 64, via south on San Juan County Road 6675 to BIA Highway N-36 to BIA Road 3005 to BIA Road 4104 to Navajo Mine Area III Facilities.
- From North or South U.S. Highway 491, via east on BIA Highway N-36 to BIA Road 3005 to BIA Road 4104 to Navajo Mine Area III Facilities.

Traffic counts for the major routes used to access Navajo Mine facilities were taken in 2006 and 2009 (NMDOT 2009). Currently, the traffic levels for all segments of these access routes are well within the design volume for annual average and flow.

Heavy mining equipment over 25 tons is delivered directly to the Navajo Mine North Facilities via U.S. Highway 491 to BIA Highway N-36 to County Road 6675. Equipment weighing less than 25 tons can be delivered directly to Navajo Mine Area III facilities via the described mining area access routes.

Within the traffic and transportation resource area, the Burnham Road (N-5082)—a BIA-managed and maintained gravel road—is one of the main access roads to the Tiis Tsoh Sikaad (Burnham) Chapter. BNCC re-routed the road in 2009 through and immediately adjacent to Area III and Area IV North. BNCC traffic counts conducted April 1, 2011 through June 14, 2011 found that traffic volume averages approximately 50 vehicles per day, with peak daily traffic occurring on Saturday when traffic counts increase to 70 or 80 vehicles per day. Travel on this road can be hazardous due to inclement weather and a 20-mile per hour hairpin curve resulting from the 2009 rerouting of the road to avoid active mining in Area III. Blasting and mining activities in Area III have gradually progressed to within 100 feet of the road. As per SMCRA permit requirements (30 CFR 816.66), NTEC developed blasting plans and standard safety actions to minimize hazards to road users. Currently, traffic can be restricted multiple times per month during active coal mining operations to keep the public at a safe distance from blasting operations. Access restriction on the Burnham Road can result in delays of up to 30 minutes.

Also within the traffic and transportation resource area is a variety of unimproved two-track roads utilized infrequently by tribal members with customary use rights in the area (Figure 3.14-2). These unimproved roads do not meet road construction standards for other public roads in the area and are not public roads as defined in 30 CFR 761.5. These routes are not maintained with the use of public funds similar to other public roads in the area, and have not been designated as public roads by the Navajo Nation or any applicable jurisdictional authority. Considered herein as informal access, approximately 50 miles of these routes primarily serve CUA access and livestock grazing in the resource assessment area.

Access to active mining in Area III and activities developed previously within Area IV North between 2009 and 2010 have resulted in either the improvement, closure or restricted access to several of these access routes. BNCC calculated that approximately five miles of access routes have been either modified (improved, realigned, and/or restricted) or eliminated due to the previous developments within Area IV North. Discussion of CUAs and associated land uses served by existing access routes is included in Section 3.11 – Land Use.

Under SMCRA regulations, NTEC was required to protect the affected public road use system, and developed measures to be taken to protect related resources (developed in consultation with OSMRE, BIA, and the Navajo Nation), in accordance with 30 CFR 761.11(d) and 30 CFR 761.14.

Figure 3.14-1. Regional Transportation Routes

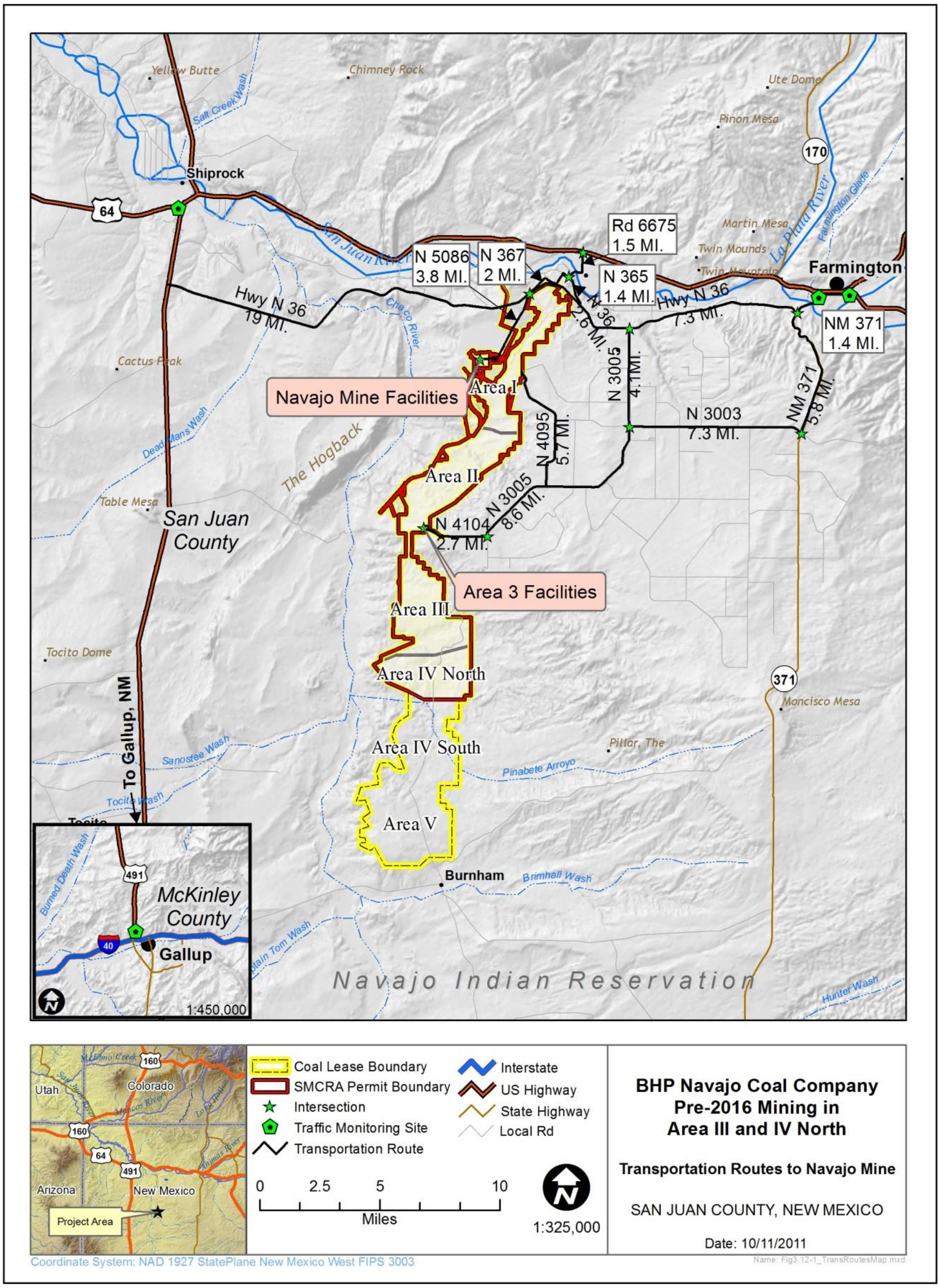

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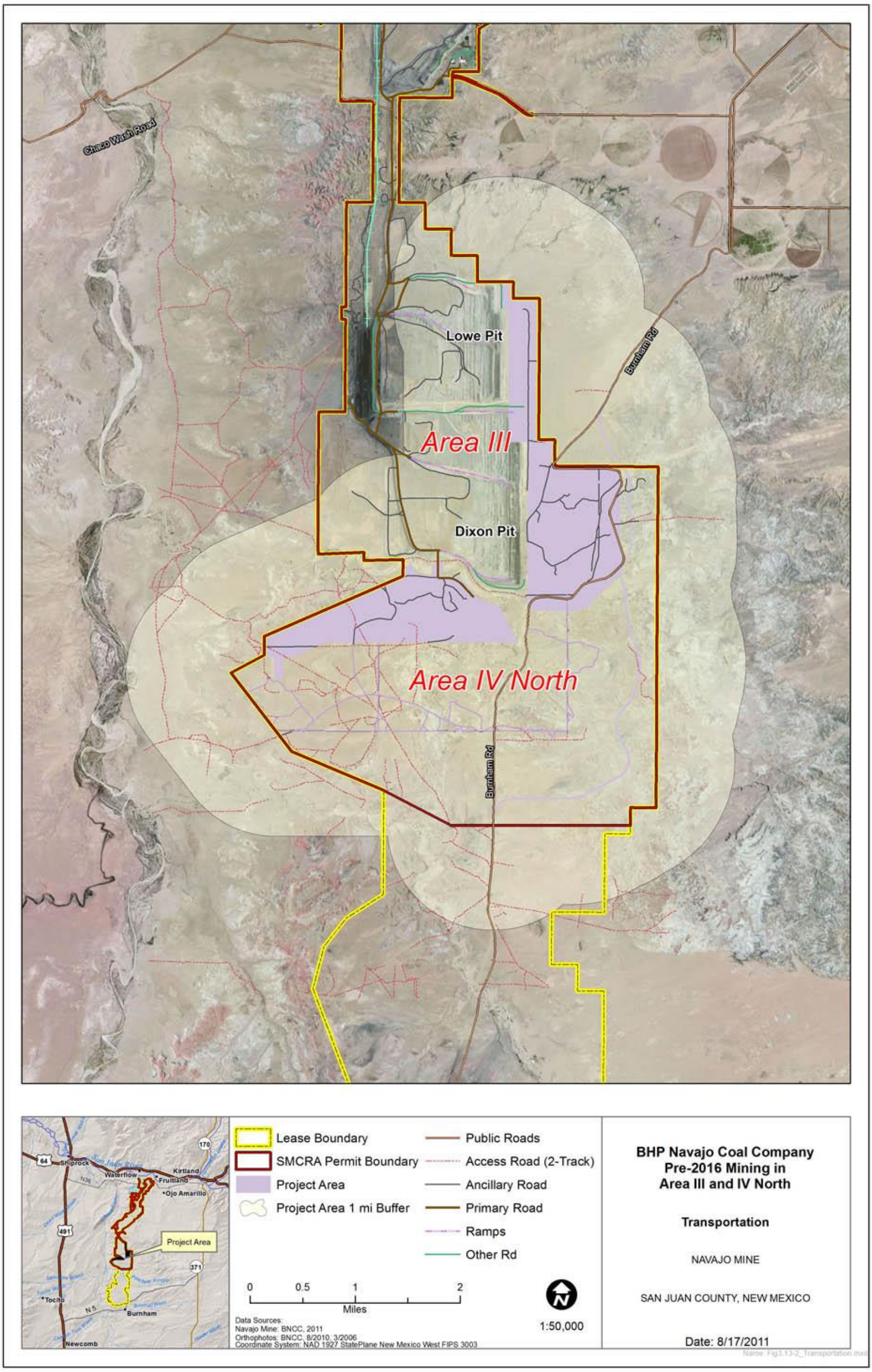
Figure 3.14-2. Transportation System within the Project Area



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3.14.2.1 Four Corners Power Plant Traffic and Transportation

FCPP is primarily accessed from the northeast via Indian Service Route (ISR) 36 to ISR 5086. Project Traffic volumes for the intersection of Highway 371 and ISR 36 are approximately 1,274 average daily vehicles trips; ISR 36 was 1,790 vehicles in 1998 with a future ADT of 2,658 in 2018. FCPP related traffic is primarily worker commuter trips, deliveries, and disposal trips.

3.15 Health and Safety

3.15.1 Definition of Resource

The resource under consideration in this section is the health and safety of the Navajo Mine workers and the public. Generally, health and safety risks would be linked to causes or exposures from activities or emissions at Navajo Mine associated with the mining activities for each of the alternatives including realignment of Burnham Road. This assessment of impacts to health and safety focuses on risks from exposure to air emissions produced by activities at Navajo Mine. Public comment on the proposed project identified dust and air quality as a concern (see Section 1.5). Other health and safety risks are expected to be small in comparison because worker risks are mitigated by safety regulations and operating procedures that are designed to minimize worker exposure to hazards and hazardous conditions. Public health and safety risk is limited to exposure to air and water emissions outside the mine. Those exposures are controlled by CAA and CWA regulations. Background groundwater quality is generally unsuitable for either domestic or livestock use due to poor water quality (sodium sulfate, TDS) and low well yields. Surface water has been designated by the NNEPA as secondary human contact (direct contact to skin associated with recreation or cultural uses), fish consumption, aquatic and wildlife habitat and livestock watering. Water emissions would have minimal risk to public health because local water resources are used for agricultural purposes (see Section 3.2). Public safety is identified in the need for the realignment of Burnham Road. These impacts are assessed in Section 4.14 – Traffic and Transportation.

The potential public health impacts associated with air emissions from activities at Navajo Mine are primarily related to fugitive dust or particulate emissions. PM emissions are regulated under the Federal CAA. Specifically, the NAAQS include standards for PM_{10} and $PM_{2.5}$. In general, particles larger than 10 microns are trapped in a person's mouth, nose, and throat, and do not reach a person's lungs. $PM_{2.5}$ tends to reach the deepest areas of a person's lungs, where illnesses can originate. Generally, the PM emissions from mining and material handling operations are coarse and larger than 10 microns. Emissions from fuel-burning equipment such as combustion engines are generally smaller—less than 2.5 microns.

The ROI for public health with respect to the FCPP is the same as described in Section 3.5 – Air Quality. The public health discussion with regard to the FCPP focuses primarily on the human health risks from exposure to contaminants in air emissions produced by the FCPP. A discussion of baseline levels of contaminants in air that could contribute to human health risks is included in Section 3.5 – Air Quality.

3.15.1.1 Worker Health and Safety

Typical risks encountered at an industrial facility such as Navajo Mine include exposure to dust, noise, heat stress, and chemicals, as well as the increased chance for accidents due to working directly with or in proximity to large equipment. At Navajo Mine, implementation and enforcement of safety policies and procedures reduce risks to mine workers.

Numerous laws and regulations govern the policies and procedures implemented to ensure the health and safety of the mine workers, protect persons living in the surrounding vicinity, and regulate the use and disposal of hazardous materials and wastes. These laws include, but are not limited to, the following:

- The Federal Mine Safety and Health Act of 1977, 30 USC 801 et seq. as amended by PL 91-164, as amended by PL 95-164. Enforced by the MSHA, and administered by the U.S. Department of Labor.
- SMCRA (30 USC 1201 et seq.).
- The CWA, (Federal Water Pollution Control Act [33 USC 1251 to 1387]).
- The CAA of 1970, 42 USC 7401 et seq., as amended 1990.
- The Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 USC 9601 et seq. also known as "Superfund."
- The Superfund Amendments and Reauthorization Act of 1986, Title III, embodying the Emergency Planning and Community Right-to-Know Act, PL 99-499.
- RCRA, as amended (42 USC 6901 et seq.).

Navajo Mine operations are under the jurisdiction of OSMRE. OSMRE conducts regular health and safety inspections. In 2008, for example, there were 41 OSMRE inspections at Navajo Mine (BNCC 2009b). Additional inspections are conducted by MSHA and the Navajo Nation. BHP Billiton has established Health, Safety, Environmental and Community (HSEC) Management Standards for the company. These standards are used to measure the performance of workers at Navajo Mine in minimizing health and safety risks.

3.15.1.2 Public Health and Safety

Some sources of PM emissions associated with activities at Navajo Mine include:

- Mine development and coal extraction activities, primarily from airborne soil and rock fines and equipment exhaust.
- Reclamation activities.
- Roadway dust from travel on paved and unpaved roads.
- Wind erosion from open land.
- Off-road vehicles, primarily trucks, and automobiles.

See Section 3.5 – Air Quality for more detailed information about PM emissions sources. The major public health risk associated with exposure to PM emissions from coal mines is related to increased asthma symptoms in those afflicted with asthma. Asthma is a disease that affects the breathing passages (bronchi) of the lungs. Asthma is caused by chronic inflammation of these passages. The role of outdoor air pollution, in particular O_3 and PM, has not been associated with an increase in asthma incidence. A recent study found that the risk of developing asthma (incidence) was not greater, overall, in children living with high levels of O_3 or particulate air pollution (American Academy of Pediatrics 2004). While the specific causes of asthma are not known, asthmatics share sensitivity to triggers. Common triggers among sensitive persons include exposure to tobacco and wood smoke, inhaling airway irritants such as perfumes and cleaning products, exposure to allergens such as molds and animal dander, exposure to cold, dry weather, an upper respiratory infection such as a cold, emotional stress, stomach acid reflux disease, and sulfites (OSMRE 2008b). A number of studies have been published that demonstrate a positive relationship between PM and increased symptoms of asthma for those people who already have the condition.

The CAA passed by the United States Congress in 1970, and amended in 1990, authorized the EPA to establish NAAQS for pollutants that threaten human health and the environment (40 CFR, Part 50). The CAA established two types of NAAQS:

Primary standards to protect public health, including the health of "sensitive populations" such as individuals with respiratory conditions, children, and elderly, and

Secondary standards which set limits to protect the environment, including protection against "decreased visibility, damage to animals, crops, vegetation, and buildings."

Details regarding the NAAQS are included in Section 3.5 – Air Quality. The current NAAQS require that ambient air levels of PM not exceed 150 $\mu g/m^3$ of PM_{10} and 35 $\mu g/m^3$ for $PM_{2.5}$ average over a 24-hour period. If these levels are exceeded regularly, the area is determined to be "out-of-attainment" and measures must be implemented to reduce PM emissions to protect human health.

3.15.2 Affected Environment

3.15.2.1 Worker Health and Safety

In 2009, there were 326 MSHA inspection days at Navajo and San Juan Mines. A measure of the health and safety performance at Navajo Mine is the average number of citations received per inspection day. In 2009, the average citation per inspection days was 1.11 compared to 1.22 in 2008. In 2009, Navajo Mine also met or exceeded all of BHP Billiton's HSEC targets including improving health and hygiene by identifying and controlling dust and noise exposures as well as reducing total injuries and potential for serious injury or fatality (BNCC 2010c). Commenters at the informal conference noted BNCC's emphasis on safety.

Navajo Mine operates an extensive monitoring program for ambient meteorological data and PM_{10} concentrations with five monitoring stations located near the perimeter of the current mining facility. Refer to Section 3.5 – Air Quality for details on this monitoring system. In 2010, none of the average readings exceeded the annual average NAAQS for PM_{10}. During most monitoring quarters, 24-hour PM_{10} concentration detected at a few monitors exceeded the hourly NAAQS. These are isolated events typically

occurring one or two days per quarter because of elevated winds and dust entrainment, or the transient operation of mobile mining equipment near the monitors.

The FCPP/NMEP EIS (OSMRE 2015) provides a summary of worker and public safety programs at the FCPP in Section 4.17. This discussion is incorporated by reference below.

> *Typical risks encountered at an industrial facility such as the FCPP include exposure to dust, noise, heat stress, falls, electrical shock, and chemicals. Safety policies and procedures in place at the FCPP are designed to reduce these risks…..*
>
> *The Dust Control Plan for Four Corners Steam Electric Station contains procedures and contact information for public complaints regarding fugitive dust. Attachment III, Detailed Plant Areas and Activities, Section 6, Safety and Communications, provides contact information for reporting incidences of fugitive dust emissions from FCPP off-property and potentially affecting the public. The CCR rule (257.80) requires that operators adopt measures that will effectively minimize CCR from becoming airborne at the facility, including CCR fugitive dust originating from CCR units, roads and other CCR management and material handling activities.*

3.15.2.2 Public Health and Safety

San Juan County, New Mexico is designated as attainment or unclassified for all criteria pollutants including PM and precursors to O_3. This means that air quality in the region is considered not to be harmful to human health. However, San Juan County recently updated its Community Health Profile that includes a comprehensive overview of health indicators including respiratory health (San Juan County 2010). This study found that San Juan County has a higher incidence of chronic lower respiratory disease (CLRD) comprised of chronic bronchitis, asthma, and emphysema than New Mexico or the rest of the U.S.. Elevated levels of O_3 in San Juan County have been linked to incidence of asthma-related medical visits. San Juan County residents are 34 percent more likely to have asthma-related medical visits after 20 ppbv increase in local O_3 levels (New Mexico Department of Health 2007).

In considering special exposures for vulnerable populations for Environmental Justice impacts (Section 4.12), a recent study examined the relationship between coal combustion in homes in the Shiprock area and impacts to respiratory health (Bunnell et al. 2010). Shiprock, New Mexico is located on the Navajo Reservation and this census tract (see Figures 3.12-1 and 3.12-2) has a higher percentage of minority population and poverty rate than other surrounding census tracts. This vulnerable population is likely to have the special exposure to the impacts of coal combustion in the home because Shiprock residents have easy access to the low or no-cost coal made available to Navajo tribal members at Navajo Mine. The report found that coal combustion in the home is likely causing poor indoor air quality and increasing risk of CLRD in some Shiprock area residents. The study concludes that, “The presence of two large coal-fired power plants near Shiprock may contribute to that risk, but results from this study suggest that the risk could be reduced by making relatively simple and inexpensive changes to methods of home heating” (Bunnell et al. 2010). Commenters at the public workshops indicated concerns about public health effects of airborne coal dust.