D. AFFECTED ENVIRONMENT

This section identifies the affected environment and focuses on the existing resources and uses that could be affected by the alternatives described in Sections C.1 and C.2. This EA includes a comprehensive approach to describing the human environment, the natural and physical resources, and people's relationship to those resources. Study area boundaries were developed for each resource and are described in the respective resource sections. Study areas for each environmental resource are based on the predicted extent of direct and indirect impacts associated with the alternatives. Relevant current environmental conditions and human uses within the Kayenta Mine permit area have been identified and described using geographic information system (GIS) data, literature searches, electronic information and data searches, personal interviews, and detailed field surveys. The information presented in this section is derived from past studies and site-specific field data collected by or for PWCC.

The following resources are not analyzed further in this EA because they are not present within the study area (i.e., not directly affected) or would not be indirectly affected by continued mine operations: Wilderness, Wild and Scenic Rivers, and Wild Horses and Burros.

D.1 GENERAL SETTING

The 44,073 acre Kayenta Mine permit area, including coal resource areas N-9, J-19, and J-21, is located within the boundaries of the Hopi and Navajo Indian reservations near Kayenta in Navajo County, Arizona (see Map A-1 and Map A-2 and Appendix A, Section B for details on the mining operation). The Federal government holds these reservations in trust for the tribes. The PWCC lease area comprises approximately 24,858 acres of land where the surface and mineral interests are held exclusively by the Navajo Nation (Navajo Exclusive Lease Area, Lease 14-20-0603-8580), and approximately 40,000 acres of land are located in the Hopi and Navajo Joint Minerals Ownership Lease Area (Joint Lease Area, Leases 14-20-0603-9910 and 14-20-0450-5743).

The Kayenta Mine permit area is located within the Colorado Plateau physiographic province, which is a region of low relief, punctuated by erosional plateaus; steep-sided, river-cut canyons; and isolated volcanic landforms. To the west and southwest, the Colorado Plateau gives way to the Basin and Range province, characterized by lower elevations and steeper relief. The topography of the Colorado Plateau province in northern Arizona is the result of relatively gentle structural folding and contains coal-bearing formations on Black Mesa (see Figures D-1 and D-2). The Black Mesa Basin is a broad synformal geologic structure defined by major uplifts (e.g., Defiance uplift) and massive folds (e.g., Organ Rock Monocline). These large geologic structures control the regional attitudes of the rock formations and affect the types of landforms developed (Cooley 1969). The geographic feature known as Black Mesa sits high in elevation relative to the surrounding areas of Arizona (see Map A-1) (Arizona Geologic Survey 1979).

D.2 AFFECTED RESOURCES, INCLUDING SPECIAL AREAS OF CONSIDERATION

D.2.1 Cultural Resources

The cultural environment includes 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 (King and Rafuse 1994). The Kayenta Mine permit renewal could affect two aspects of the cultural environment: (1) archaeological and historical resources, and (2) traditional cultural life ways and resources. These potential impacts were considered pursuant to Federal, Hopi Tribe, and Navajo Nation laws protecting cultural resources.

Section 106 of the National Historic Preservation Act requires Federal agencies to consider the effects of their undertakings on properties eligible for the National Register of Historic Places (National Register). To be considered for inclusion in the National Register, properties must be at least 50 years old (unless they have exceptional significance) and possess integrity of location, design, setting, feeling, materials, workmanship, and association. To be eligible, properties must meet one or more of the following criteria to demonstrate their significance in American history, architecture, archaeology, engineering, or culture:

Criterion A	Be associated with significant historical events or trends
Criterion B	Be associated with historically significant people
Criterion C	Have distinctive characteristics of style or type, or have artistic value, or represent a significant entity whose components may lack individual distinction.
Criterion D	Have yielded, or may be likely to yield, important information (36 CFR 60.4)

The area of potential effects (or region of influence) is the geographic area within which a project may affect resources. Traditional cultural resources can include places where ceremonies or rituals have been conducted; blessed locations such as hogans, houses, sweathouses, game corrals, springs, eagle collecting areas; trail shrines; places for gathering plants, minerals, and other materials for ceremonial and other traditional uses; places associated with traditional stories; rock art; marked and unmarked graves; and ancestral archaeological sites. The area of potential effects can vary for different types of potential impacts on the cultural environment. The impacts of the permit renewal would stem from ground disturbance related to continued mining operations within coal resource areas N-9 (1,019 acres), J-19 (502 acres), and J-21 (1,558 acres). Associated haul roads, coal-handing areas, conveyors, coal load out silo facilities, storage areas, shops, offices, and other structures and facilities would continue to be used as they have been, and such use is not expected to result in any additional effects on cultural resources. Ongoing mining in coal resource areas N-9, J-19, and J-21 will be limited to those areas if the permit is renewed. The ongoing mining in these three coal resource areas does not result in any potential for additional indirect impacts on cultural resources due to visual intrusions and increased noise outside those coal resource areas. Therefore, the area of potential effects for the permit renewal was defined as the coal resource areas N-9, J-19, and J -21 (a total of about 4.8 square miles).

From 1967 to 1986, the 20-year Black Mesa Archaeological Project conducted research to mitigate the impacts of mining coal within the PWCC mine lease area. The investigations recorded a total of 2,710 archaeological sites (1,671 pre-ceramic and Puebloan and 1,039 historic Navajo), excavated 215 of those sites, and archaeologically tested, mapped, and collected artifacts from 887 other sites (Powell et al. 2002). The Black Mesa Archaeological Project inventory includes 36 prehistoric sites and 20 historic Navajo sites within the area of potential effects defined for the permit renewal, including 12 sites (5 prehistoric and 7 historic) in the J-19 coal resource area, 22 sites (15 prehistoric and 7 historic) in the J-21 coal resource area, and 22 sites (16 prehistoric and 6 historic) in the N-9 coal resource area. The artifacts and project records of the Black Mesa Archaeological Project are curated at Southern Illinois University.

Through the Black Mesa Archaeological Project, OSM completed Section 106 requirements for the entire Kayenta Mine permit area. Therefore, the proposed permit renewal does not require additional Section 106 consultations to address the effects of coal mining on recorded properties eligible for the National Register. However, OSM continues to consider cultural resources pursuant to other laws through standard conditions and terms attached to mining permit renewals issued for continuing coal mining operations pursuant to the National Historic Preservation Act and other laws. Those terms were initially incorporated into the Mining Permit AZ-0001C issued on July 6, 1990 and were subsequently incorporated into Mining Permit AZ-0001D that was renewed on July 6, 2005 and would be incorporated into the permit renewal, if approved. Pursuant to those terms, PWCC continues to:

- Report the discovery of any previously unrecorded cultural resources to OSM and to suspend work near discoveries until OSM determines appropriate disposition
- Take into account any sacred and ceremonial sites brought to the attention of PWCC by local residents, clans, or tribal government representatives of the Hopi Tribe and Navajo Nation
- Identify and respectfully treat any human remains associated with archaeological sites pursuant to the 1990 Native American Graves Protection and Repatriation Act

Since the permit conditions were initially stipulated in 1990, PWCC has made three cultural resource discoveries in the J-19 and J-21 coal resource areas—two inadvertent discoveries of human bones, and one discovery of three possible historic gravesites. Those discoveries were treated in accordance with the permit terms which would continue to be effective under a renewed mining permit.

Traditional Hopis and Navajos consider all of Black Mesa (known as *Nayavuwaltsa* to the Hopi and *Dzilijiin* to the Navajo) to be a significant traditional cultural resource due to its role in traditional stories and ceremonial and clan traditions. Other mountains in the region, such as the San Francisco Peaks, also are considered sacred. Although Hopis and Navajos living anywhere might regard continued mining as an impact on their cultural traditions, the traditional life ways of the four Navajo households in the J-21 coal resource area could be most affected because they are required to move to accommodate the continued mining (SWCA Environmental Consultants 2005). No specific sacred or ceremonial sites have been identified in coal resource area J-19, but PWCC has been notified about five specific sacred and

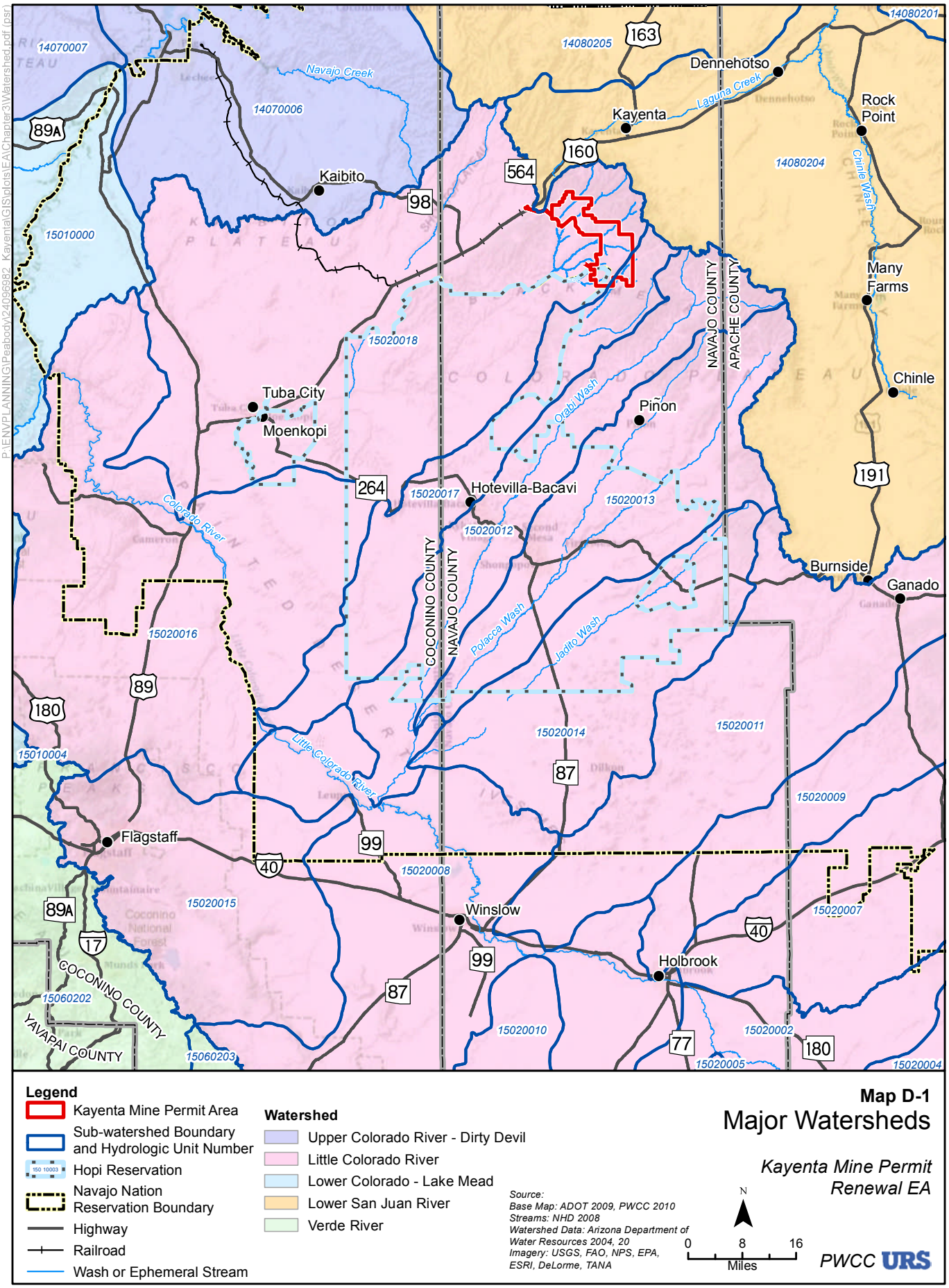
ceremonial sites within the N-9 coal resource area. Pursuant to permit AZ-0001D, PWCC previously considered those five sites and agreed to avoid mining at those locations (PWCC 2005b). Recently, PWCC has been notified of two additional potential sacred and ceremonial sites within the J-21 coal resource area, and is continuing to investigate and consider those sites in accordance with the approved permit.

Although the Black Mesa Archaeological Project excavated many burials, only a representative sample of the archaeological sites were excavated and additional burials could be present at unexcavated sites. In response to the permit terms, PWCC established and continues to implement an archaeological testing program at sites identified with potential for human remains. To date, PWCC has identified, documented, and reburied 74 burials found within 25 sites in accordance with the Native American Graves Protection and Repatriation Act, and the Navajo Nation policy for the Protection of Jishchaá: Gravesites, Human Remains, and Funerary Items before mining was initiated at those locations. Sixteen of those prehistoric burials were found at two archaeological sites within the J-19 coal resource area, and four prehistoric burials and one historic burial were found within the N-9 coal resource area. No additional archaeology sites with the potential for human remains have been identified within the areas that would be mined within the permit renewal period in coal resource areas J-21 and N-9. Two prehistoric archaeological sites within the part of coal resource area J-19 that may be mined within the permit renewal period have been identified as having potential for human remains.

D.2.2 Hydrology

Black Mesa, where the Kayenta Mine permit area is located, is a major geographic feature of the Colorado Plateau (see Map A-1). The Colorado Plateau is a region of low relief, punctuated by erosional plateaus; steep-sided, river-cut canyons; and isolated volcanic landforms. The area stands high in elevation relative to surrounding parts of Arizona. Drainage is controlled by the perennial Colorado River flowing from the northeast to the west, and by the Little Colorado River running from the south near the White Mountains to its junction with the Colorado River downstream from Page, Arizona. Major watersheds are shown on Map D-1.The Little Colorado River is intermittent and flows at certain times of the year from Holbrook, Arizona, to the Colorado River.

The study area for hydrologic resources in this EA underlies the Black Mesa and adjacent areas where the N aquifer discharges. Water resources on Black Mesa and in the vicinity have been studied and monitored for decades (e.g., McGavock et al. 1966; Macy 2010). PWCC has conducted extensive surface water and groundwater studies and monitoring in support of its permit applications and associated regulatory requirements (GeoTrans Inc. 2005; PWCC 2010a). These studies and monitoring include surface water quality, sedimentation and streamflow measurements, groundwater levels and quality, and groundwater modeling of the N and D aquifers. Discharges from sediment ponds, although infrequent, are also monitored in accordance with PWCC's NPDES Permit No. NN0022179. Details of the OSM-approved hydrologic monitoring conducted by PWCC at the Kayenta Complex are contained in Chapter 16, "Hydrologic Monitoring Program," in the AZ-0001D permit application package for the Kayenta mining


P:\ENVPLANNING\Peabody\24096982_Kayenta\GIS\plots\EA\Chapter2\Watershed.pdf (psr)
14070007
14070006
14080205
14080201
14080204
15010000
15020018
15020017
15020013
15020012
15020016
15020014
15020011
15020009
15020008
15020015
15020007
15020010
15020002
15020005
15020004
15010004
15060202
15060203
Navajo Creek
Laguna Creek
Chinle Wash
Orabi Wash
Polacca Wash
Jadito Wash
Little Colorado River
Colorado River
Dennehotso
Kayenta
Rock Point
Kaibito
Many Farms
Chinle
Tuba City
Moenkopi
Pinon
Hotevilla-Bacavi
Burnside
Ganado
Flagstaff
Winslow
Holbrook
NAVAJO COUNTY
APACHE COUNTY
COCONINO COUNTY
YAVAPAI COUNTY
163
160
564
98
89A
264
191
89
180
87
99
40
17
77
Legend
Kayenta Mine Permit Area
Sub-watershed Boundary and Hydrologic Unit Number
Hopi Reservation
Navajo Nation Reservation Boundary
Highway
Railroad
Wash or Ephemeral Stream
Watershed
Upper Colorado River - Dirty Devil
Little Colorado River
Lower Colorado - Lake Mead
Lower San Juan River
Verde River
Source:
Base Map: ADOT 2009, PWCC 2010
Streams: NHD 2008
Watershed Data: Arizona Department of Water Resources 2004, 20
Imagery: USGS, FAO, NPS, EPA, ESRI, DeLorme, TANA
N
0
8
16
Miles
Map D-1
Major Watersheds
Kayenta Mine Permit Renewal EA
PWCC URS

operations. PWCC also collects samples from the water-distribution system to comply with the Navajo Nation's Safe Drinking Water Act requirements.

OSM prepared a Cumulative Hydrologic Impact Analysis (CHIA) to evaluate the potential for damage to the hydrologic balance outside the Kayenta Mine permit area (USDI 1989). The hydrologic balance is the relationship between the quality and quantity of water inflow to, and water outflow from, a hydrologic unit such as a drainage basin or aquifer. The 2008 updated CHIA (USDI 2008), which was approved by OSM in 2010 to update the Permit Application Package (AZ-0001-D-J-77), includes additional water resource information and determines potential mining-related hydrologic impact on the existing and foreseeable water uses (USDI 2008).

D.2.2.1 Surface Water

Surface water, including Moenkopi, Dinnebito, Oraibi, Wepo, Polacca, and Jeddito washes, drain Black Mesa to the southwest and join the Little Colorado River, as shown on Map D-2. Laguna Creek and Chinle Wash drain to the north and join the San Juan River. All of the washes draining Black Mesa are ephemeral with discontinuous and relatively short intermittent reaches. Springs also discharge into the washes and limited stream segments in the lower portions of these washes may be perennial due to groundwater discharge. Moenkopi Wash and Dinnebito Wash and their five main tributaries convey runoff and spring discharges from the PWCC lease area (see Map D-2). Segments of these washes, and tributaries including Moenkopi, Dinnebito, Wepo, Oraibi, Coal Mine, and Yellow Water Canyon washes and Laguna Creek are fed by springs (refer to Map D-2). None of the tributaries or washes in or near the mine permit area are a reliable source of water for irrigation, livestock, or potable use.

The washes within Black Mesa exhibit a parallel drainage pattern suggesting slope and structural control on drainage development. Within the PWCC lease area and in the upper reaches of the washes, channel gradients are higher and channel meandering is less compared with downstream reaches. Watersheds associated with upper reaches typically feature narrow valley profiles and deeply entrenched drainage channels with minimal meandering. In the lower reaches, channel gradients lessen, meandering is more pronounced, and valley bottoms and flood plains are wider. Drainage densities range from about 4 to 16 miles of stream channel per square mile. High densities such as these are common in semi-arid watersheds due to the sandier and less developed soils, higher basin elevation differences, lower vegetative cover, and the erosive power of flash flooding that typically occurs during high-intensity storm events (PWCC 2005b).

Surface flows within the Kayenta Mine permit area are highly variable and primarily consist of storm runoff. Typical of the area, runoff from storm events range from a few cubic feet per second (cfs) to more than 10,000 cfs, depending on the location, intensity, and duration of a storm. Intermittent reaches are the result of saturated rock units at the surface and the discharge of alluvial aquifers holding stormwater bank storage. This flow is referred to as base flow and is generally synonymous with the low flow of the stream. Not all stream reaches within the permit area have periods of base flow. Based on data collected in 1985 and in 2009, the base flow is generally low at stream sites located along the major washes and

tributaries (PWCC 2010b, PWCC 2005b). Table D-1 shows that base flow varies from 0.09 to 1.12 cfs. Water quality standards established by the Navajo Nation EPA (Navajo Nation 2008) and Hopi Tribe (Hopi Tribe 2008) have been used to assess the historical and potential uses of various surface water sources in the vicinity of the Kayenta Mine. In addition, recommended livestock standards for both TDS (NAS 1972) and sulfate (Botz and Pederson 1976) have also been used (PWCC 2005b). Comparisons with water quality standards established by the Hopi Tribe are limited to sources within the boundary of the Hopi Reservation on PWCC's leasehold. Water quality standards associated with livestock drinking water and aquatic and wildlife habitat apply to surface waters that support livestock grazing and wildlife habitat, both of which are primary post-mining land uses at the Kayenta Mine. Comparisons of shallow groundwater quality are limited to livestock drinking water standards established by the Navajo Nation (2008) and Hopi Tribe (2008) where applicable. Comparisons of base flow water quality monitored in 2009 with livestock standards and aquatic and wildlife habitat standards established by the Navajo Nation (2008), and Hopi Tribe (2008) where applicable indicate most base flow meets these standards (PWCC 2010b).

Table D-1 Base Flow in Major Washes and Tributaries

Wash	Low Base Flow (cfs)	High Base Flow (cfs)
Lower Coal Mine Wash	0.13	1.12
Middle Coal Mine Wash	0.09	0.12
Middle Moenkopi Wash	0.12	0.30
Lower Red Peak Valley Wash	0.11	0.18

SOURCE: Peabody Western Coal Company 2010b

PWCC categorizes surface-water quality data based on sources of surface water monitored for permit requirements, including rainfall (stormwater). Stormwater generally has less contact time with salt-containing materials and TDS concentrations tend to decrease as runoff increases. Water quality analyses indicate a variety of water types, mostly calcium/magnesium sulfate and calcium/magnesium bicarbonate water. Mean concentrations of select chemical parameters in stormwater on streams with monitoring sites are shown in Table D-2. These chemical parameters are indicators of water quality. Comparisons of stormwater runoff water quality monitored in 2009 with livestock standards and aquatic and wildlife habitat standards established by the Navajo Nation (2008), and Hopi Tribe (2008) where applicable indicate 88 percent of the analytical results compared, met livestock standards. Comparisons of the same 2009 water quality data with acute aquatic and wildlife habitat standards indicate 86 percent of analytical results compared, met these standards (PWCC 2010b). Samples collected from stormwater runoff events that are not filtered and are analyzed for trace elements using the total or total recoverable methods often yield high values due to the high-suspended solids concentrations (PWCC 2008). Stormwater runoff typically carries very high concentrations of suspended solids, which are often greater than 10,000 milligrams per liter (mg/L) (PWCC 2005b).

Table D-2 Mean Concentrations of Chemical Parameters in Stormwater, Stream Monitoring Sites by Site Number (1986 to 2008)

Chemical Parameter	Streams with Monitoring Sites												
	Dinnebito Wash		Reed Valley Wash	Yellow Water Wash		Yazzie Wash	Coal Mine Wash			Red Peak Valley Wash		Moenkopi Wash	
	Site Numbers												
	34	78	37[1]	50	15	157	16	18[2]	25	14	155	35	26
pH	8.0	8.0	8.0	8.0	8.0	8.1	8.1	8.0	8.0	8.2	8.3	8.1	8.1
Total Dissolved Solids (TDS)	1,179	1,462	1,485	755	686	229	471	1,335	1,503	271	324	292	924
Alkalinity (Alk)	98	87	121	86	85	112	80	123	130	95	94	68	100
Sulfate (SO_4)	671	919	694	437	398	112	242	809	917	106	135	118	525
Calcium (Ca)	160	194	162	125	127	48	87	165	165	46	44	52	128
Magnesium (Mg)	62	95	105	44	34	8	19	80	92	12	12	11	53
Sodium (Na)	64	96	100	19	16	4	13	104	135	15	33	5	68
Chloride (Cl)	15	22	213	17	10	3	8	27	21	10	11	4	40

SOURCE: Peabody Western Coal Company 2005b

NOTES: 1 Excludes chemical data for two samples that were influenced by magnesium chloride spills upgradient of this monitoring site.

2 Includes chemical data from subsites FLUM18 and CG18.

Sediment control structures (or impoundments) are earthen embankments constructed across ephemeral drainages from materials excavated locally using standard engineering and construction methods. These impoundments (or ponds) are necessary to reduce sediment transport from disturbed areas prior to discharge into receiving streams. In 2010, 156 sediment impoundments provided treatment of disturbed area runoff from mined areas within the PWCC lease area. Ten additional sediment impoundments are planned for construction during the permit period, and 51 sediment impoundments would remain permanently after mining and reclamation (Map D-3).

Comparisons of water quality monitored between 1986 and 2008, and in 2009 at proposed permanent impoundments located within or adjacent to reclaimed areas with livestock-watering standards and aquatic and wildlife habitat standards established by the Navajo Nation (2008), and Hopi Tribe (2008) where applicable indicate more than 95 percent of the analytical results compared met the livestock standards, and more than 98 percent of the analytical results compared met the aquatic and wildlife habitat standards (PWCC 2005a, PWCC 2010b). The quality of water in these impoundments is similar to the water quality of stormwater collected from natural drainages, however TDS, sulfate (SO4), calcium (Ca), magnesium (Mg), sodium (Na), and chloride (Cl) concentrations are typically lower in the impoundments than natural drainages (see Table D-3). Based on the water quality of permanent impoundments located in reclaimed areas, runoff from reclaimed areas that contribute to the impoundments has similar water quality composition (PWCC 2005b). Permanent impoundments must meet performance standards outlined in 30 CFR 816.49(b), and meet applicable State, Federal and Tribal water quality standards. The quality of impounded water must be suitable on a permanent basis to support livestock grazing and wildlife habitat at final bond release.

Table D-3 Mean Concentrations of Chemical Parameters, Permanent Impoundments by Site Number (1986 to 2008)

Chemical Parameter	Permanent Impoundment Site Numbers													
	116	124	118a	N1-RA	122[1]	123[1]	112[1]	113[1]	119[1]	N7-D	N2-RA	N2-RB	N2-RC	N8-RA
pH	8.2	7.8	8.6	9.5	8.0	7.5	7.8	7.9	7.9	8.1	8.6	8.1	8.6	8.0
Total Dissolved Solids (TDS)	459	205	144	440	143	177	281	603	165	939	9509	566	227	133
Alkalinity (Alk)	84	100	105	142	96	102	109	205	116	74	261	113	97	56
Sulfate (SO_4)	225	68	16	197	15	21	98	252	25	595	6557	297	79	34
Calcium (Ca)	63	44	24	35	25	26	24	46	29	155	359	108	44	26
Magnesium (Mg)	25	13	11	24	9	9	12	21	12	56	432	34	12	4
Sodium (Na)	29	4	5	70	4	7	44	117	9	41	1934	12	6	2
Chloride (Cl)	10	3	5	7	5	6	4	8	2	20	45	7	4	4

SOURCE: Peabody Western Coal Company 2005b
NOTES: [1] Pre-law area ponds.

Seepage through the embankment of impoundments or surrounding geology (e.g., thin coal seams) can react with naturally occurring constituents in the embankment materials or the more permeable geologic formations in the vicinity. These reactions can result in elevated concentrations of water-quality parameters such as pH, nitrate, aluminum, selenium, iron, and other trace elements in the seep water. On occasion, water quality samples collected from seeps below impoundments have exceeded water-quality standards for these parameters within the permit area.

Since mining began, over 220 sediment impoundments have been built, and seeps have been observed at 33 of these impoundments since 1972. At some sediment ponds, impounded water persists in large enough amounts and for sufficient durations to seep through the bottom of the embankment or more permeable underlying geologic formations. The seeps range in size from damp areas less than $1/10^{th}$ acre at the embankment toe to areas with persistent water flow at rates up to several gallons per minute (gpm). The USEPA required PWCC to conduct a comprehensive study of seeps below NPDES ponds in 1995. This study concluded that constituent concentrations in seep water greater than applicable water quality standards are attributable to natural processes, and/or the geologic material within the study area (Brogan-Johnson 1996). PWCC developed a Seepage Management Plan (PWCC 2005a) to manage seeps below NPDES-permitted sediment-control structures. The plan was approved by USEPA and subsequently incorporated in the Mine's NPDES permit.

During 2009, 12 of the 25 NPDES impoundments had seeps with sufficient water for water quality sampling. The water quality samples were measured in the field for electrical conductivity, pH, temperature, and salinity and analyzed in the laboratory for cadmium, nitrate/nitrite, selenium, aluminum and copper. The analytical results were compared to standards established for livestock drinking water and aquatic and wildlife habitat set by the Navajo Nation (2008), and Hopi Tribe (2008) where applicable (PWCC 2010c). The comparisons indicated that five of the 12 seeps sampled had one or more constituent concentrations greater than the standards. Table D-4 summarizes the seep water quality parameters and

results that were higher than the corresponding water quality standards during the 2009 seep monitoring program.

Table D-4 2009 Seep-Water Samples not Meeting Water Quality Standards

Seep Monitoring Site	Water-Quality Parameter(s)	Water Quality Standard	Result
BM-A1-SP1	Total recoverable cadmium	A&WHbt[1] – Acute[2]	8.0 µg/l
BM-A1-SP2	Nitrate/Nitrite Total recoverable selenium	LW[3] (132 mg/L) A&WHbt[1] (33 µg/l)	260 mg/L 36 µg/l
J3-E-S2	Total aluminum	A&WHbt[1] – 0.75 mg/l	2.18 mg/l
J7-JR-S1	Total recoverable copper	A&WHbt[1] – Acute[2]	60 µg/l
N6-F-S1	Total aluminum Field pH	A&WHbt[1] – 0.75 mg/l LW[3] (6.5 to 9.0 S.U.)	172 mg/l 3.62 to 4.12 S.U.

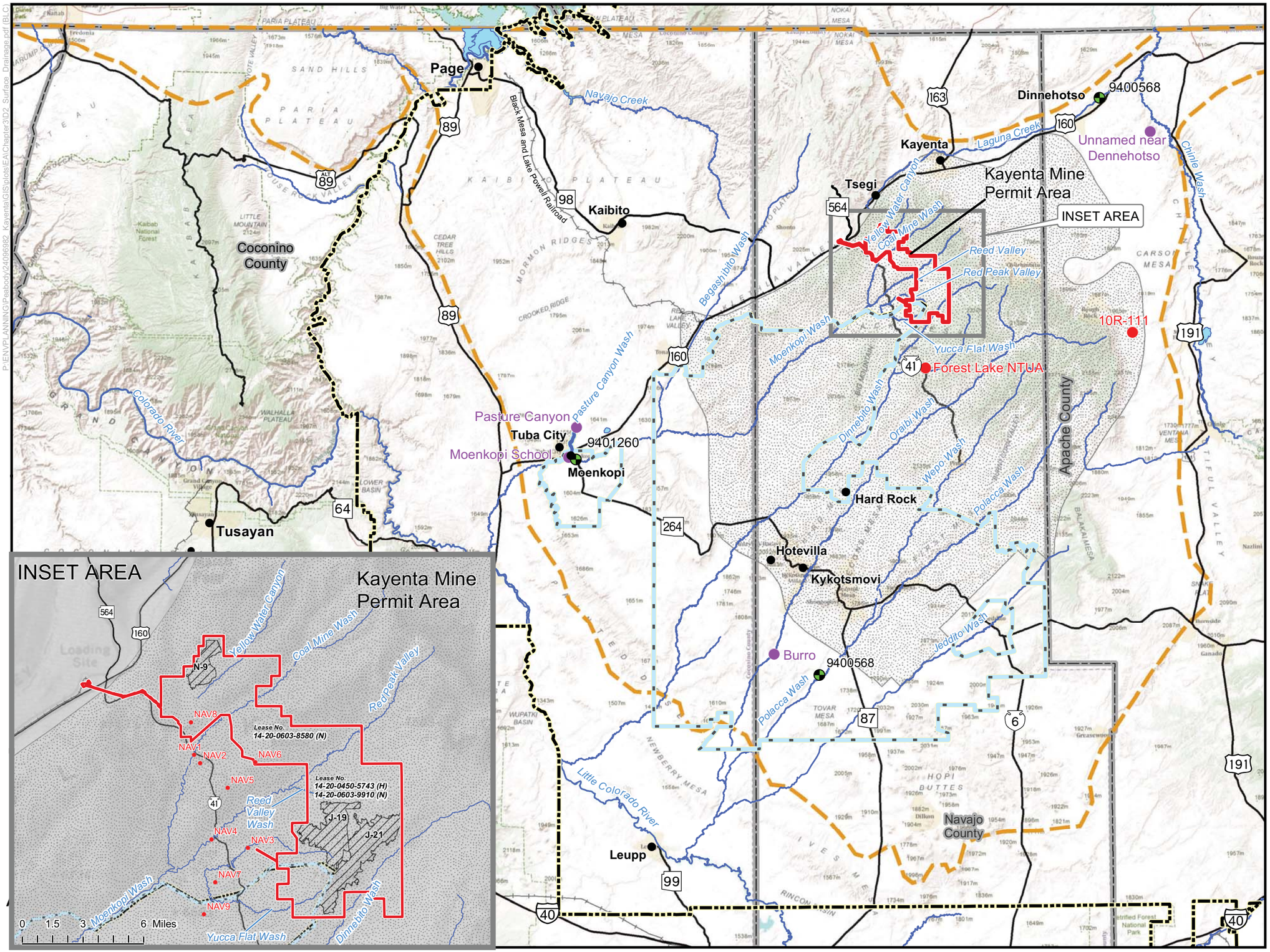
SOURCE: Peabody Western Coal Company 2010c

NOTES: [1]Aquatic and Wildlife Habitat; [2]Hardness based; [3]Livestock Watering
pH = measure of acidity or alkalinity of a solution, S.U. = standard units,
mg/L = milligrams per liter, µg/l = micrograms per liter

The cadmium value measured at BM-A1-SP1 was qualified as being between the method detection limit and the practical quantitation limit, and is therefore not considered to be a statistically valid analytical result. Local geologic materials may have contributed to the cadmium detection, or the lab result may be anomalous. Sheep and other livestock waste in the vicinity likely influence nitrate levels at BM-A1-SP2, and the selenium value (36 µg/l) was only slightly higher than the standard (33 µg/l). The aluminum value measured at J3-E-S2 was the first value that exceeded the standard, and is the only exceedance at the two seeps monitored below Pond J3-E since monitoring began, and may be anomalous. The copper value measured at J7-JR-S1 was qualified as being between the method detection limit and the practical quantification limit, and is therefore not considered to be a statistically valid analytical result. Local geologic materials may have contributed to the copper detection, or the lab result may be anomalous. Finally, the aluminum value that exceeded the standard at Seep N6-F-S1 and the low pH measurements are similar to historical measurements at this site. Reclamation in the fall of 2009 removed the sediment control structure at Pond N6-F, which removed Seep N6-F-S1 permanently. At the remaining eight NPDES sediment ponds, seeps met all standards established for livestock drinking water and aquatic and wildlife habitat established by the Navajo Nation (2008), and Hopi Tribe (2008) where applicable (PWCC 2010c).

Flow rates of the seeps monitored in 2009 were within the historical range of seep flows (ranging from pooled water [no flow] to 9.5 gpm). During 2009, there were fewer NPDES ponds exhibiting poor seep-water quality than in prior years. The constituent results that exceeded water-quality standards were comparable to historical ranges.

P:\ENVPLANNING\Peabody\24096982 Kayenta\GIS\plots\EA\Chapter3\D2 Surface Drainage.pdf (BLC)



Map D-2

Location of Surface Drainages on Black Mesa and Key N Aquifer Features

Kayenta Mine Permit Renewal EA

Legend

- Kayenta Mine Permit Area
- Coal Resource Area

Surface Drainage Feature

- Wash or Ephemeral Stream
- Well
- Spring
- Stream Gage

Aquifer

- N Aquifer
- Confined Area of N-Aquifer (Southeast edge is limit of the model)

General Feature

- Hopi Reservation Boundary
- Navajo Nation Reservation Boundary
- County Boundary
- Lake
- Interstate/U.S. Highway/State Route
- Railroad

Source:
Base Map: USGS 2005, PWCC 2010
Stream: USGS Water Resources 2006
Political Boundary: Bureau of Reclamation 2005
Imagery: USGS, FAO, NPS, EPA, ESRI, DeLorme, TANA

N

0 5 10 20
Miles

PWCC URS

P:\ENVPLANNING\Peabody\24096982_Kayenta\GIS\plots\EA\Chapter3\D3_Impoundments.pdf (psr)

Map D-3

Temporary and Permanent Impoundments

Kayenta Mine Permit Renewal EA

Legend

- Kayenta Mine Permit Area
- Coal Resource Area

Impoundment

- Permanent
- Temporary

General Feature

- Hopi Reservation Boundary
- Navajo Nation Reservation Chapter Boundary
- Railroad
- Highway
- PWCC Mine Road

Source:
Base Map: ADOT 2009, PWCC 2011
Impoundments: PWCC 2010
Imagery: USGS, FAO, NPS, EPA, ESRI, DeLorme, TANA

N

0 0.5 1 2

Miles

PWCC URS

D.2.2.2 Groundwater

Within Black Mesa, groundwater in the region can be found in the alluvium, Mesa Verde Group, D, N, and C regional aquifer systems. The groundwater sources within each of these aquifer systems have varying water quality, and water-yielding capacity. Figure D-1 identifies the significant water-bearing units in the study area. Significant water-bearing formations and associated local and regional aquifers include the following, in descending stratigraphic order:

- The alluvial aquifer, composed of gravel, sand, and silt, is associated with stream channels that occur within the Black Mesa area (PWCC 2005b). This local aquifer system varies greatly in size, extent, and degree of saturation depending on the nature of the stream channels.
- Water-bearing formations of the Mesa Verde Group aquifer, specifically the Wepo Formation containing siltstone, mudstone, sandstone, and coal beds. There are no developed Wepo Formation water-use locations on the leasehold (GeoTrans Inc. 2005). The Wepo aquifer is discontinuous across the leasehold and does not constitute a regional aquifer.
- The D aquifer, which includes the Dakota Sandstone, portions of the Morrison Formation, and the Cow Springs Sandstone (Arizona Department of Water Resources [ADWR] 1989); the overlying Mancos Shale confines the D aquifer.
- The N aquifer includes the Navajo Sandstone, the Kayenta Formation, and the Lukachukai member of the Wingate Sandstone; the overlying Carmel Formation confines the N aquifer.
- The C aquifer includes the Kaibab Formation, the Coconino Sandstone, and the upper part of the Supai Group; beneath Black Mesa, the overlying Moenkopi and Chinle Formations confine the C aquifer.

The D, N, and C regional aquifers extend over large areas and are controlled by the regional northern dip of the rocks and the basin structure beneath Black Mesa (see Figure D-2). The relationships among these water-bearing units and the Kayenta Mine permit area are shown on Figure D-1 and Figure D-2. The extent of the regional aquifers is shown on Map D-4. Although the C aquifer is exposed at the surface south of the Little Colorado River it is buried beneath more than 5,000 feet of sedimentary rock beneath the Kayenta Mine permit area.

The N aquifer is a sandstone aquifer with a hydraulic conductivity (0.2 to 1.3 feet per day) that is confined beneath Black Mesa, and unconfined around the periphery of the basin where rocks of the N aquifer are exposed. Discharge from the N aquifer occurs where the aquifer is unconfined and near the boundary between the confined and unconfined portions. Examples include areas along Moenkopi Wash downstream of its confluence with Begashibito Wash, and the washes near the Hopi communities near Dinnebito, Oraibi, Wepo, Polacca, and Jeddito washes. Discharge also occurs where the Navajo sandstone is incised near recharge areas such as Tsegi Canyon northwest of Kayenta, and at Pasture Canyon near Tuba City and Moenkopi (see Map D-4). Navajo Creek is separated from the N aquifer underlying Black

Mesa, which isolates Navajo Creek from any pumping effects in the aquifer beneath Black Mesa (see Map D-2 and Figure D-2).

The alluvial-aquifer system represents alluvium (stream deposits) and colluvium (original rocks and debris) that occur within and along principal washes in the study area. These washes include Dinnebito, Reed Valley, lower Coal Mine, and lower Moenkopi. The saturated portions of these washes in the mine leasehold range from 900 to 40,000 square feet in area (Peabody 2005b). Transmissivity values are reported to range from 325 gallons per day per foot (gpd/ft) upwards to 63,800 gpd/ft (Peabody 2005b). The alluvial aquifer is recharged from infiltration of surface-water runoff, and from the intersection of the alluvial channels with saturated portions of the Mesa Verde Group, including the Toreva and Wepo Formations.

Alluvial-aquifer water quality is highly variable and dependent upon the water quality and quantity of the contributing source. The TDS concentrations range from 628 mg/L (Coal Mine Wash) to 62,000 mg/L (Moenkopi Wash) and nitrate concentrations (a concern for livestock) are in the alluvium, ranging up to a maximum of 540 mg/L in some samples. Water quality in alluvial wells upgradient of all mining activities (i.e., groundwater flow before reaching the mine area) has a median TDS concentration ranging from 540 mg/L (Coal Mine Wash) to 4,276 mg/L (Dinnebito Wash). Sulfate concentrations in upgradient background alluvial-monitoring wells have a median concentration ranging from 220 mg/L (Coal Mine Wash) to 2,774 mg/L (Dinnebito Wash). Of the 32 wells sampled in 2005, 5 wells potentially were suitable for livestock use (PWCC 2005b). In 2009, 29 of 30 alluvial wells within the Kayenta Mine permit area sampled were considered suitable for livestock use based on water quality standards established by the Navajo Nation (2008) and Hopi Tribe (2008) where applicable. Of note, more parameters were analyzed and compared against standards in 2009 than in 2005 (PWCC 2010a).). A difference in precipitation amounts from year to year is the likely cause of variable alluvial water quality.

The Mesa Verde Group, including the Wepo Formation, yields small amounts of water to wells and springs on Black Mesa. This group is a source of water for springs located on the Hopi Reservation and is of local significance as a shallow source of water supply. The relatively impermeable Mancos Shale (see Figure D-1) separates the Wepo Formation aquifer from the underlying D aquifer. Water levels in the Wepo Formation aquifer range from 0 (i.e., seep or spring) to 212 feet below ground surface (bgs) across the Kayenta Mine permit area (GeoTrans Inc. 2005). Groundwater within the Wepo aquifer occurs under both confined and unconfined conditions. The aquifer is not present continuously across the permit area. Recharge occurs in the unconfined formation and exposed surface areas of broken and burned coal-clinker material. Groundwater flow is generally southwest across the PWCC lease area. Unless the more permeable parts of the Wepo Formation (likely to be sandstones) are widespread and continuous, groundwater inflow into the mine pits is likely to be limited in volume and duration.

Groundwater modeling of both the Wepo and alluvial aquifers was performed to estimate groundwater flow to open mine pits at the Kayenta Mine (GeoTrans Inc. 2005). Simulated maximum inflow from the Wepo Formation into Pit N-14 were estimated to be about 23 gpm. The computer-predicted impact on Wepo aquifer water levels was as much as 65 feet. However, actual observations of both pit-water inflow

and water-level change in Wepo wells suggests that groundwater modeling overestimated both these values (GeoTrans Inc. 2005). The actual volume of Wepo Formation inflow was too low to measure reliably.

Groundwater from the Wepo aquifer is highly variable in chemical quality. Water from sandstone units generally contains calcium bicarbonate while water from coal units contains calcium/magnesium sulfate, and water from shale units contains sodium/potassium sulfate. Comparisons of water quality collected at Wepo aquifer wells with livestock drinking water standards as applicable established by the Navajo Nation (2008) and Hopi Tribe (2008) indicate that most Wepo wells remain suitable for use as a livestock drinking water source (PWCC 2010b).

To date, two Wepo windmill wells have been removed by mining, and one additional windmill well is identified for future removal. PWCC has committed to replacing all three windmill wells once reclamation is complete and a grazing unit is established at the relocated sites and prior to final bond release or termination of jurisdiction. PWCC has installed two water stands that provide free potable (N aquifer) water to the public on a 24-hour, 7-day-a-week basis.

Springs emanating from the Mesa Verde Group within the PWCC lease area have been monitored for several years. Ten spring sites were monitored during 2009. Flow rates at these springs were low ranging from zero (pooled water) to 7.9 gpm, consistent with historical flow measurements. TDS concentrations range from 1,350 mg/L to 13,500 mg/L. Comparison of spring water quality data collected in 2009 with Navajo Nation (2008) and Hopi Tribe (2008) as applicable, and recommended standards for TDS and sulfate livestock standards indicate that five of the springs are suitable for livestock use, and the other five springs are either marginally suitable or unsuitable for livestock use (PWCC 2010b). Comparison of 2009 spring water quality data with aquatic and wildlife habitat standards established by the Navajo Nation (2008), and Hopi Tribe (2008) as applicable, indicate four of the ten springs are suitable for aquatic and wildlife habitat, and the remaining six are either marginally suitable or unsuitable for aquatic and wildlife habitat (PWCC 2010b).

D.2.2.3 Water Supply

N and D Aquifers

The N aquifer is the major source of potable water for municipal use and the current source of water supply for the Kayenta coal mining operation. The average thickness of the aquifer is approximately 400 feet (Eychaner 1983). Regionally, groundwater in the N aquifer flows to the south and west or north and west, but is locally influenced by pumping at the mine and communities.

Most of the N aquifer is confined in the center of the basin. Recharge generally occurs in the north-central part of the N aquifer, northwest of Kayenta, where aquifer formations are exposed at the land surface and precipitation is relatively high. Recharge occurs primarily from precipitation falling on outcrops of the Navajo sandstone, and estimated recharge rates range between 2,500 to 3,500 af/yr (for the outcrop area north of Black Mesa) to 20,248 af/yr with a median recharge rate of 13,000 af/yr (Brown and Eychaner

1998, Eychaner 1983, GeoTrans 1987, Lopes and Hoffman 1997, and Zhu 2000). As recharge is largely limited to the margins, water levels in the N aquifer throughout most of the basin do not respond to short-term changes in recharge. However, water levels in the recharge areas can respond to precipitation events.

The USGS has monitored N aquifer water levels since 1972 and currently uses a groundwater-monitoring network of 34 wells to track annual water-level changes. Six non-pumping observation wells evaluate the regional hydrologic condition of the N aquifer. The largest measured regional drawdown since 1965 is associated with observation well BM-6 with a water-level decline of 155 feet by 2004 (USGS 1985-2005). The USGS groundwater monitoring also indicated that although drawdown has occurred in the N aquifer, measured water levels have not dropped below the top of the N aquifer within the confined basin (see Map D-2). The saturated thickness of the confined portion of the N aquifer is unchanged at the monitored locations because water levels remain above the top of the aquifer.

The PWCC well field is located in the confined area of the N aquifer, which is shown on Map D-2. PWCC's usage of groundwater from the N aquifer for Kayenta mining operations since December 2005 has averaged about 1,240 af/yr. At the end of 2005, pumping by PWCC was greatly reduced because use of the coal-slurry pipeline was discontinued, and water levels in the confined N aquifer began to recover (i.e., rise). The greatest recovery has been at BM-6, which is the USGS observation well that had experienced the greatest historical drawdown.

Considered to be of good to excellent quality, groundwater from the N aquifer is suitable for most uses. Generally, the groundwater contains less than 500 mg/L of TDS and rarely exceeds 1,000 mg/L TDS. Fluoride concentrations are generally less than the 4 mg/L maximum contaminant level (MCL) for drinking water.

There is little or no leakage of groundwater from the N aquifer into the underlying C aquifer because approximately 1,000 feet of relatively impermeable Chinle and Moenkopi Formations occur between the two aquifer systems (ADWR 1989).

The D aquifer overlies and is separated from the N aquifer by the relatively impermeable Carmel Formation. The D aquifer provides limited water supply to the mine and local communities. The potential for leakage from the D aquifer because of groundwater pumping in the N aquifer is less in the area where the N aquifer is confined by the Carmel Formation than in areas where the Carmel Formation is thin or sandy (refer to Figure D-2). The thickness and lithology of the Carmel Formation are factors influencing groundwater leakage between the two aquifers. Areas where the Carmel Formation is less than 120 feet thick coincide with areas where water from the overlying D aquifer has over thousands of years mixed with underlying N aquifer water (Truini, Macy and Porter 2005).

P:\ENVPLANNING\Peabody\24096982_Kayenta\GIS\plots\EA\Chapter3\D4_Regional_Aquifers.pdf (c)

Map D-4

Extent of Regional Aquifers

Kayenta Mine Permit Renewal EA

Legend

- Kayenta Mine Permit Area

Aquifer

- C Aquifer (Saturated)
- D Aquifer
- N Aquifer

General Feature

- Hopi Reservation Boundary
- Navajo Nation Reservation Boundary
- State Boundary
- County Boundary
- Lake
- Interstate/U.S. Highway/State Route
- Railroad
- Wash or Ephemeral Stream

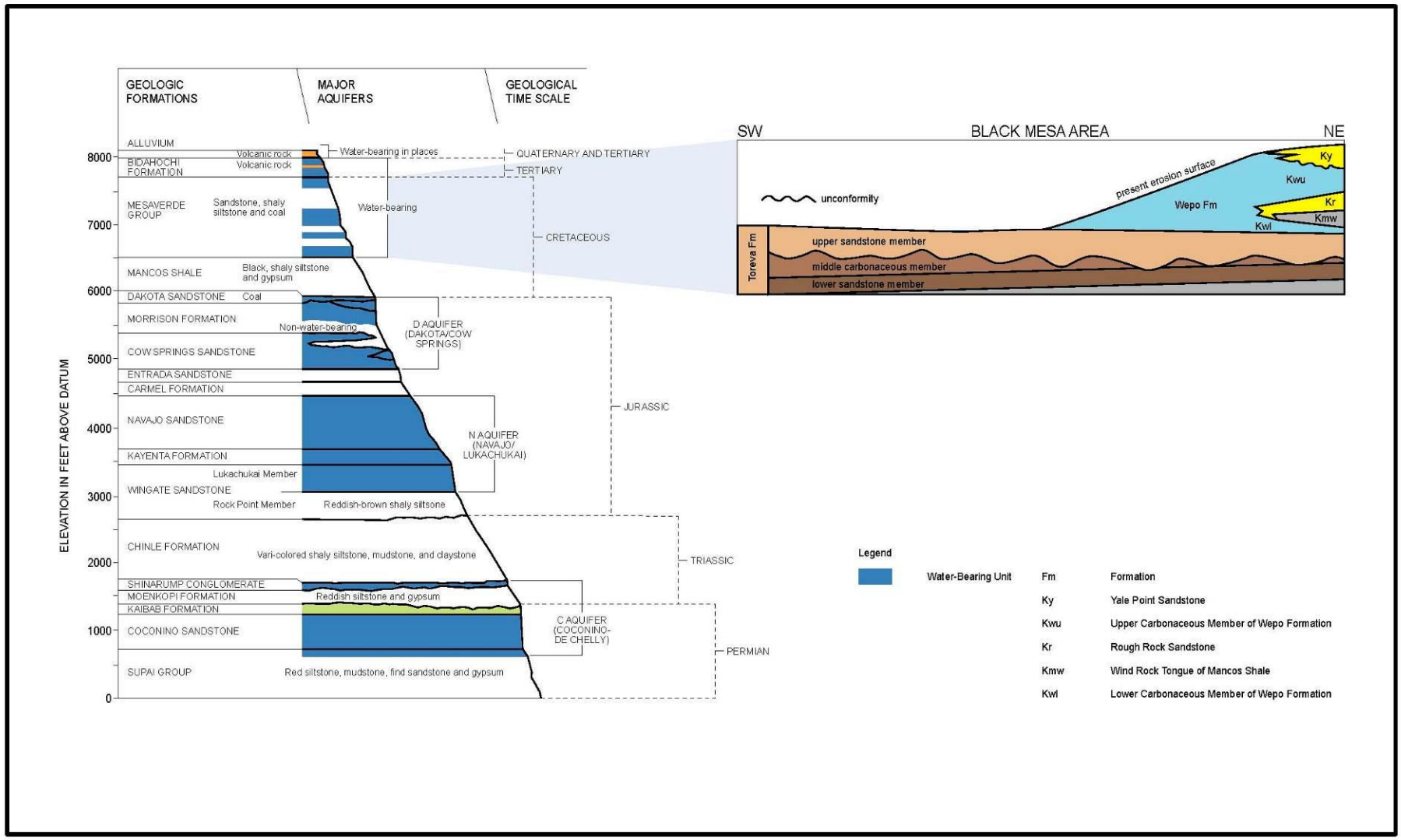
Source:
Base Map: Peabody Energy 2006
Stream: NHD 2008
C Aquifer: Bureau of Reclamation 2005
Aquifer: URS Corporation 2005, 2006
Imagery: USGS, FAO, NPS, EPA, ESRI, DeLorme, TANA

N

0 10 20 40

Miles

PWCC URS



SOURCE: Modified from ADWR, 1989; Nations et. al., 2000

Figure D-1 Stratigraphic Column of Black Mesa Area

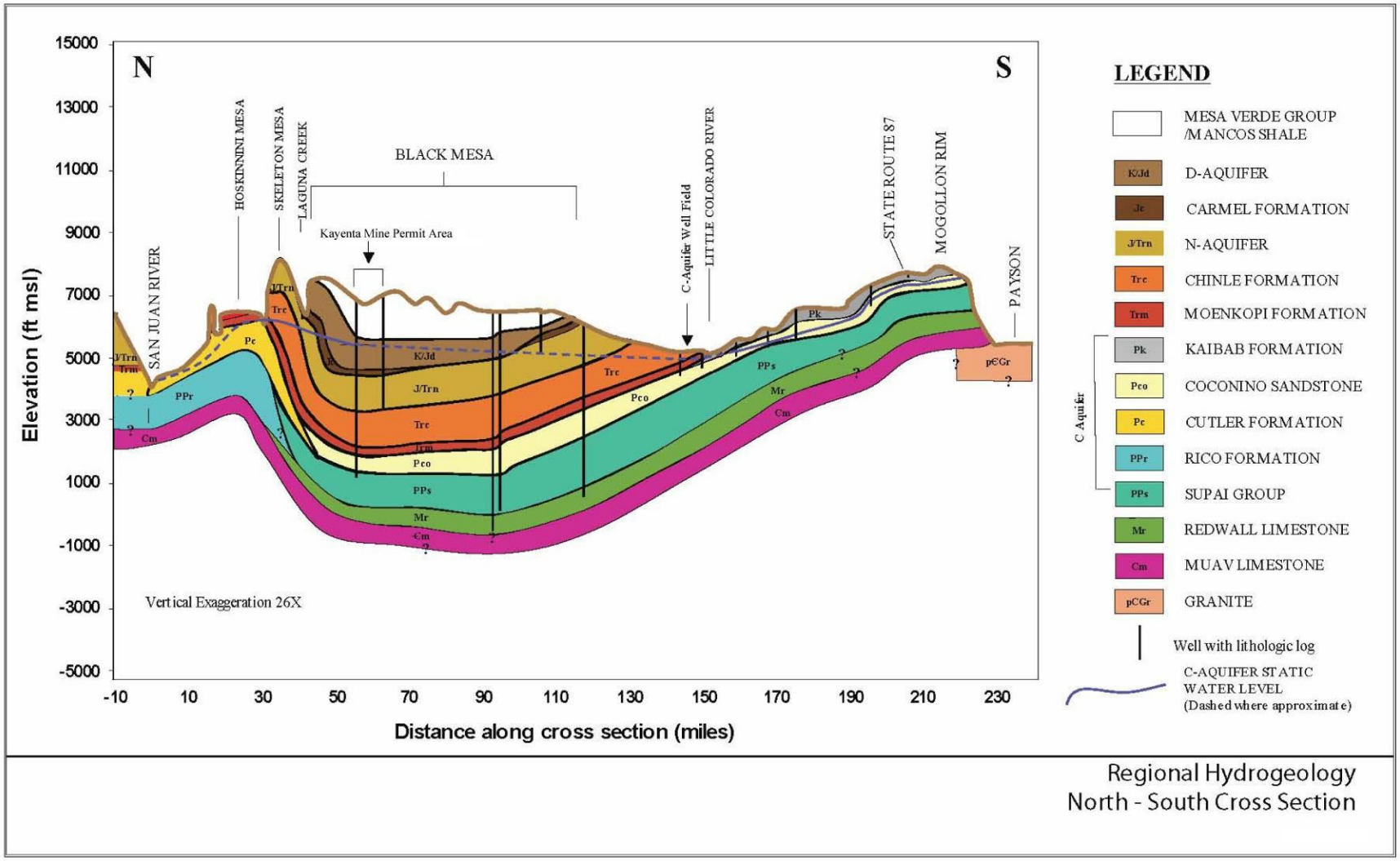


Figure D-2 Regional Hydrogeology

The D aquifer includes the Dakota Sandstone, the water-bearing portions of the Morrison Formation, and the Cow Springs Sandstone (see Figure D-1). Recharge generally occurs from precipitation along the eastern boundary of the D aquifer (see Map D-4). Groundwater flows south, west, and north and discharges as springs on the eastern and northern edges of the aquifer and into the alluvium of Polacca, Oraibi, and Dinnebito Washes along the southwest aquifer boundary, and Moenkopi Wash to the west. This discharge is consumed (i.e., transpired) by plants or lost to evaporation and is generally not seen as surface flow. The estimated saturated thickness of the D aquifer is roughly 500 feet; however, this also may include some variably saturated units within the Dakota and Morrison Formations.

Groundwater quality in the D aquifer is marginal to unsuitable for domestic use, although it may be acceptable for other uses. TDS concentrations range from 190 to 4,410 mg/L, generally exceeding the recommended limit of 500 mg/L for drinking water. Fluoride concentrations range from 0.2 to 9.0 mg/L and often exceed the MCL concentration of 4 mg/L. Water quality improves slightly in the southern portion of the D aquifer (ADWR 1989).

Infrastructure

PWCC Well Field

The N aquifer currently supplies the water for the mining operations in the Kayenta Mine permit area and the local communities. Used primarily for mining operations, the PWCC well field consists of eight wells that are located on the PWCC lease area (refer to Map D-2). The depth of these wells ranges from 3,417 feet to 3,733 feet bgs. Static (non-pumping) water levels in 2005 ranged from 945 to 1,374 feet bgs. These static well levels have recovered (risen and range from 932 to 1,264 feet bgs) due to the reduction in mine-related pumping over the past five years (2006-2010; PWCC 2010b). The reduction in pumping primarily occurred when use of the coal-slurry pipeline was discontinued in 2005.

Community Well Fields

The Bureau of Indian Affairs (BIA), Navajo Tribal Utility Authority (NTUA), and Hopi Tribe operate about 70 N aquifer wells combined into 28 well systems that supply water to several communities on Black Mesa. The closest communities to the PWCC well field are Forest Lake, Kitsillie, Chilchinbito, and Kayenta. The largest water users are Tuba City, Kayenta, and Shonto (Truini, Macy and Porter 2005). Well depths range from 475 feet bgs in the unconfined N aquifer near Tuba City to 2,600 feet bgs near Forest Lakes and Kitsillie in the confined N aquifer. Depth to water in 2009 ranged from 29 feet bgs (Tuba City) to 1,332 feet bgs (Kitsillie) (USGS 2010).

Water Withdrawal

The N aquifer currently supplies the majority of the water for the mining operations at the Kayenta Mine permit area. It also is used extensively by the Navajo Nation and Hopi Tribe as a public drinking supply. Total withdrawals from the N aquifer increased from about 70 to 8,000 af/yr from 1965 to 2002, with the major increase due to industrial pumping at the eight wells used for mining operations and the previously used coal-slurry pipeline. About 270 windmills produce about 65 af/yr of N aquifer water, primarily for

watering livestock. In 2003, 5,800 af of water were withdrawn from the confined N aquifer, of which 4,450 af were attributed to operations at the Black Mesa and Kayenta Mines (USGS 1985-2005). The communities use the remaining water withdrawn. When use of the coal-slurry pipeline was discontinued in December 2005, PWCC's pumping declined. PWCC pumped approximately 1,171 af of water in 2010, a 3,279 af reduction in annual water use compared to 2003.

Groundwater pumping has occurred historically in the D aquifer. PWCC withdraws a minor amount of water from the D aquifer through its production wells, which are screened in both the N aquifer and D aquifer. Community pumping of the confined D aquifer accounts for an annual withdrawal of approximately 100 af.

D.2.3 Vegetation

The Kayenta Mine permit area and Black Mesa are located within the Great Basin conifer woodland biotic province and the Colorado Plateau physiographic province (AGFD 2006; Brown 1994; Reichenbacher et al. 1998). Detailed vegetation data, including baseline vegetation sampling of the coal-resource areas, were collected between 1979 and 1983, and supplemental baseline sampling has been performed at various times thereafter (BIOME 2003 and ESCO Associates 2000a, 2000b, 2003, 2010). The study area for vegetation includes the area that overlays the Black Mesa coal field (see Map A-1 for the extent of the coal field). This area contains canyons, mesas, and plains with precipitation ranging from 5 to 30 inches per year. Most precipitation falls as snow during the winter season. Elevation, temperature extremes, landforms, and local precipitation patterns influence the development of the various plant communities within the study area (AGFD 2006). Table D-5 provides the acres of the vegetation communities and land cover types within the study area. These acres were estimated based on GIS calculations derived from the Southwest ReGAP landcover data (USGS National Gap Analysis Program 2004) and Brown et al. (2007).The Kayenta Mine permit area and nearby vicinity include five plant communities: mixed-conifer, piñon/juniper woodland, sagebrush shrubland, saltbush and greasewood shrubland, and tamarisk dominated riparian and disturbed areas (Map D-5). A reclaimed plant community occurs where previously mined areas have been backfilled, graded, topsoil added to the surface, and revegetated.

Table D-5 Vegetation Communities and Landcover in the Study Area

Vegetation Community	Acres	Percent
Riparian[1]	20	<1
Water	130	<1
Mixed Conifer	12,500	1
Disturbed[2]	19,500	1
Sparse Vegetation[3]	144,200	8
Saltbush and Greasewood Shrubland	258,500	14
Sagebrush Shrubland	464,700	25
Piñon-juniper Woodland	950,400	51
Total	1,849,950	100

SOURCE: USGS SWReGAP 2004

NOTES: [1] Includes riparian areas dominated by tamarisk

[2] Includes developed areas, agricultural areas and previously mined or quarried reclaimed areas

[3] Includes cliff and canyon areas, sand dunes and other areas where vegetation cover is low.

Mixed Conifer. The mixed conifer vegetation community is mostly evergreen needle-leafed forest with patches of broadleaf deciduous trees. Tree cover varies from 50 percent to 80 percent cover, with the cover by understory shrubs decreasing relative to increasing shade from the tree canopy. Within the study area, mixed conifer vegetation occupies approximately 12,500 acres (1 percent of the total acres). Mixed conifer vegetation occurs north and east of but not within the Kayenta Mine permit area.

Common tree species include Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*), with lesser numbers of white fir (*Abies concolor*), spruce (*Picea* spp.), and aspen (*Populus tremuloides*). Important understory trees and shrubs in mature stands include Gambel's oak (*Quercus gambelii*), New Mexico locust (*Robinia neomexicana*), Rocky Mountain maple (*Acer glabrum*), Bigtooth maple (*A. grandidentatum*), and Saskatoon serviceberry (*Amelanchier alnifolia*).

Piñon-juniper Woodland. Within the Kayenta Mine permit area, piñon-juniper woodland is the most common plant community and occupies approximately two-thirds of the undisturbed land in the Kayenta Mine permit area(Map D-5) and about 51 percent of the land in the larger study area (Table D-5). Piñon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) are the common over-story tree species. Common under-story shrubs include big sagebrush (*Artemisia tridentata*), four-wing saltbush (*Atriplex canescens*), Mexican cliffrose (*Cowania mexicana*), Douglas rabbitbrush (*Chrysothamnus viscidiflorus*), and rubber rabbitbrush (E*ricameria nauseosa*) (Brown 1994). Grasses and forbs provide a small amount of cover, with the most common of these being bottlebrush squirreltail (*Sitanion hystrix*), Indian ricegrass (*Oryzopsis hymenoides*), and muttongrass (*Poa fendleriana*) (Brown 1994).

Total vegetation cover is low, often less than 22 percent. Some piñon-juniper stands appear to have very little understory vegetation, while others have a lesser presence of shrubs (Jacobs 2008). Piñon-juniper woodland has extensive areas of bare soil, rock, and litter below trees (Brown 1994). This vegetation

community occurs at an elevation range of 6,300 feet (1,920 m) to over 7,200 feet (2,195 m) in the mine area.

Sagebrush Shrubland. Sagebrush shrubland is the second most common vegetation type in the Kayenta Mine permit area, covering close to a third of the undisturbed land (Map D-5) and about 25 percent of the land area in the larger study area (Table D-5). This community occurs on deeper soils that develop in flatter areas and in valley bottoms. Total vegetation cover is often less than 20 percent with low rock cover and sparse understory vegetation (Brown 1994). Sagebrush shrubland usually occurs up to 7,000 feet (2,134 m) in elevation on Black Mesa. Above that elevation, it often is interspersed with piñon-juniper woodland. Within the study area, sagebrush shrubland occupies approximately 464,700 acres (21 percent of the total acres).

Sagebrush shrubland is dominated by big sagebrush and blue grama (*Bouteloua gracilis*) (Brown 1994). Other common shrub species include four-wing saltbush, Douglas rabbitbrush, Greene's rabbitbrush (*Chrysothamnus greenei*), and rubber rabbitbrush (Brown 1994). Blue grama and galleta (*Hilaria jamesii*) are the common warm-season grasses in this plant community. Cool-season grasses are less common and include big squirreltail (*Sitanion jubatum*), bottlebrush squirreltail, needle and thread (*Stipa comata*), Indian ricegrass, and western wheatgrass (*Agropyron smithii*).

Saltbush and Greasewood Shrublands. Saltbush and greasewood shrublands are two additional upland shrub communities that occupy relatively small, linear areas along washes in the study area and Kayenta Mine permit area (Map D-5). These shrublands grow on the margins of terraces associated with the higher order drainages. The terraces typically lie 5 to 20 feet (1.5 to 6 m) above a wash channel where saline-alluvial soil has accumulated. Four-wing saltbush dominates the saltbush community, and greasewood (*Sarcobatus vermiculatus*) dominates the greasewood community (Brown 1994). Annual forbs and grasses form sparse to dense understories (Brown 1994). Within the study area, saltbush and greasewood shrubland occupy approximately 258,506 acres (14 percent of the total acres).

Disturbed Lands. Within the study area, the disturbed landcover occupies approximately 19,500 acres, including the 11,670 acres of reclaimed land within the Kayenta Mine permit area (see Map D-5). Vegetation cover in reclaimed lands is usually higher than in native vegetation types and other disturbed lands, averaging 23 percent (BIOME 2003 and ESCO Associates 2000a, 2000b, 2003). Rock cover is low, but litter cover is high (BIOME 2003 and ESCO Associates 2000a, 2000b, 2003).

Native and introduced grasses and native shrubs dominate reclaimed lands in the Kayenta Mine permit area. Cool-season native grass species include western wheatgrass, thickspike wheatgrass (*Agropyron dasystachyum*), Indian ricegrass, needle and thread, big squirreltail, and bottlebrush squirreltail; and common warm-season native grass species include blue grama, galleta, and alkali sacaton (*Sporobolus airoides*). The most abundant introduced perennial grass species is Russian wildrye (*Elymus junceus*). Crested wheatgrass (*Agropyron desertorum*) and intermediate wheatgrass (*Agropyron intermedium*) also are present. Four-wing saltbush is the dominant shrub species, but several other species are common. Fourwing saltbush is long-lived, spreads primarily by seed dispersal, and could slowly spread into

reclamation areas from adjoining plant communities (USDA 2011). Several weedy annuals occur primarily in newer reclamation areas; these include kochia (*Kochia scoparia*), Russian thistle (*Salsola iberica*), and cheatgrass (*Bromus tectorum*).

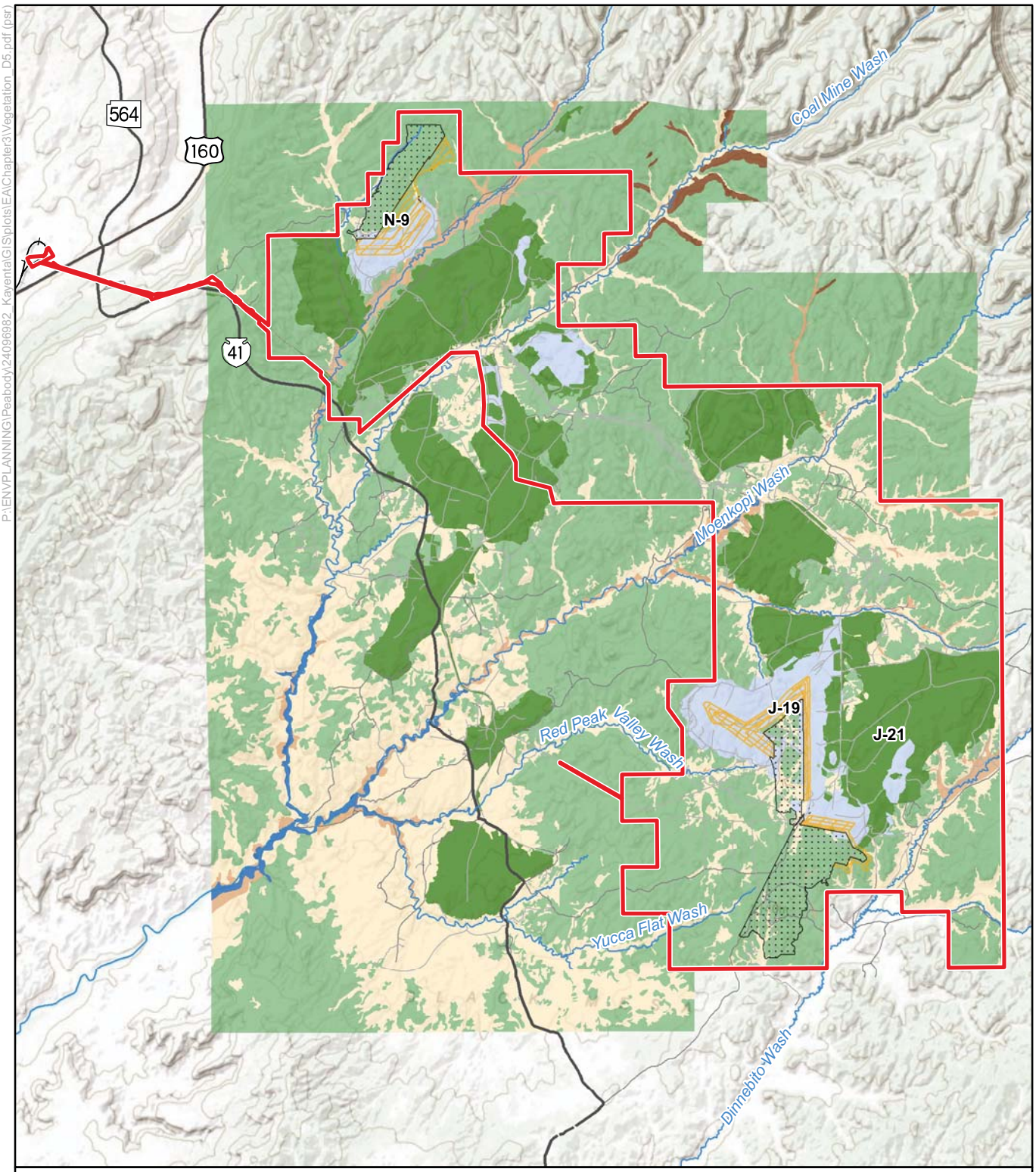
Riparian Vegetation and Aquatic Plants. Riparian vegetation occurs along major drainage ways, forming linear bands of vegetation within the study area. These form patches that are typically between 10 feet and 20 feet (3 meters and 6 meters) wide and from a few yards (meters) to more than 0.5 mile (800 meters) long. This vegetation occurs on the bottoms of the washes and typically occupies the depositional side of a channel. In the study area, surface water in riparian areas usually is ephemeral but short reaches of intermittent streams are sometimes present.

Tamarisk (*Tamarix* sp.) dominates in riparian vegetation within the Study Area. Small amounts of greasewood and four-wing saltbush associate with tamarisk in drier areas. Coyote willow (*Salix exigua*) occurs with tamarisk in wetter areas. Herbaceous understory vegetation is limited and is often composed of cheatgrass, European alkali grass (*Puccinellia distans*), stickseed (*Lappula occidentalis*), and desert seepweed (*Suaeda torreyana*). The largest areas of riparian vegetation occur in Yellow Water Canyon, Moenkopi Wash, and Dinnebito Wash south of the Kayenta Mine permit area (Map D-5). Riparian vegetation occupies only about 20 acres in the study area.

In the Kayenta Mine permit area, aquatic plants are limited to some impoundments, which include freshwater ponds, sediment ponds, and internally draining ponds in reclaimed areas. Some of the larger impoundments have emergent wetland plants along the margin, including tamarisk, coyote willow, bulrush (*Scirpus acutus*) and cattail (*Typha latifolia*). Submergent aquatic plants include common poolmat (*Zanichellia palustris*), pondweeds (*Potamogeton filiformis* and *P. pectinata*), and holly-leafed water nymph (*Najas marina*). The only non-microscopic alga that is found in most ponds is a type of green algae (*Chara sp*.).

D.2.3.1 Noxious Weeds and Invasive Plant Species

A number of noxious weed or invasive plant species are known or expected to occur in the Kayenta Mine permit area. Potential noxious weeds include common purslane (*Portulaca oleracea*), diffuse knapweed (*Centaurea diffusa*), field bindweed (*Convolvulus arvensis*), puncture vine (*Tribulus terrestris*), Russian knapweed (*Acroptilon repens*), and Scotch thistle (*Onopordum acanthium*). Common purslane and bull thistle are reported from the mine permit area (BIOME 2003). Weedy invasives occurring or potentially occurring in the Kayenta Mine permit area include tamarisk, bull thistle (*Cirsium vulgare*), musk thistle (*Carduus nutans*), kochia, Russian thistle, and cheatgrass (California Information Node 2010; ESCO Associates 2003; USGS 2004). At the Kayenta mine, these species, with the exception of tamarisk, are ubiquitous, early successional weedy species found in newly reclaimed and disturbed areas that diminish as perennial vegetation develops and out-competes these species. The vegetation management program monitors and treats annual weeds (see Appendix A). The other areas with noxious weeds and invasive plants are mostly found along U.S. Highway 160 and Indian Route 41 and could potentially spread into the Kayenta Mine permit area (California Information Node 2010; USGS 2007).



P:\ENVPLANNING\Peabody\24096982_Kayenta\GIS\plots\EA\Chapter3\Vegetation_D5.pdf (psr)

Legend

- Kayenta Mine Permit Area
- Permit Renewal Period Mine Area
- Future Mine Area
- Highway
- PWCC Mine Road
- Railroad
- Wash or Ephemeral Stream

Vegetation Type

- Mixed Conifer
- Piñon-Juniper Woodland
- Sagebrush Shrubland
- Saltbush and Greasewood Shrubland
- Tamarisk Riparian Shrubland
- Reclaimed Lands
- Disturbed

Source:
Base Map: ADOT 2009, PWCC 2010
Streams: NHD 2008
Vegetation: PWCC 2011
Imagery: USGS, FAO, NPS, EPA, ESRI, DeLorme, TANA

N

0 1 2
Miles

Map D-5

Vegetation Communities

Kayenta Mine Permit Renewal EA

PWCC URS

D.2.3.2 Special Status Plant Species

Special status plant species considered for analysis included federally listed species under the Endangered Species Act, endangered species listed by the Navajo Nation, and plants listed under the Arizona Native Plant Laws. The analysis of threatened, endangered, and special status species included review of U.S. Fish and Wildlife Service (USFWS) county lists (USFWS 2010), the Navajo Nation endangered species list (Navajo Nation Department of Fish and Wildlife [NNDFW] 2008), Navajo Natural Heritage Program (NNHP) endangered species accounts (2008), Arizona Natural Heritage Program lists (Arizona Game and Fish Department [AGFD] 2010), and evaluation of habitats and ranges of the species. Special status plants and animals considered for analysis are presented in Appendix C.

There are no federally listed, proposed, or candidate plant species known or expected to occur within the Kayenta Mine permit area. No plants listed as endangered by the Navajo Nation occur in the Kayenta Mine permit area. Traditional Navajo and Hopi collect numerous species of plants for food, materials for making craft items, and for use in rituals and ceremonies. No populations of highly restricted plant species used for traditional purposes have been identified within the permit area.

Navajo Sedge. The Navajo sedge (Carex specuicola) is a perennial plant found in springs and seeps associated with hanging gardens, on vertical sandstone cliffs and alcoves comprised of Navajo sandstone (NNHP 2008). The species is confined to higher elevations that generally support Great Basin conifer forests and woodlands (NNHP 2008). The Navajo sedge was federally listed as threatened with critical habitat in 1985.

Navajo sedge has limited distribution in the region surrounding the Kayenta Mine permit area. The species does not occur, nor does any potential habitat exist, within the Kayenta Mine permit area. The only known populations potentially affected by the proposed action include the Tsegi Canyon population, about 12 miles north of the N-9 coal resource area, and the population where Moenkopi Wash and Ho No Geh Canyon overlap the unconfined portion of the N aquifer.

Alcove bog-orchid. The alcove bog-orchid (Platanthera zothecina) also is a perennial plant found in the same types of habitats as the Navajo sedge (NNHP 2008). The Navajo Nation lists the alcove bog orchid as a Group 3 (G3) endangered species (NNHP 2008). Group 3 designates a species or subspecies whose prospects of survival or recruitment are likely to be in jeopardy in the foreseeable future. The alcove bog-orchid sedge has limited distribution in the region surrounding the Kayenta Mine permit area. The species does not occur, nor does any potential habitat exist, within the Kayenta Mine permit area. The closest population is approximately 12 miles north of the Kayenta Mine permit area in Tsegi Canyon and is associated with seeps and springs originating from the unconfined portion of the N aquifer.

D.2.4 Fish and Wildlife

The study area for fish and wildlife includes Black Mesa and the Kayenta Mine permit area containing the four vegetation communities described in Section D.2.3. This area of northern Black Mesa is approximately 2 million acres (Brown et al. 2007, LaRue 1994).

D.2.4.1 Fish and Wildlife Resources

Wildlife populations on Black Mesa and within the Kayenta Mine permit area reflect the diversity of available vegetation and landscape habitat features. Landscape features such as washes, rock formations, the hillside slope and aspect, alcoves and cave entrances, and ponds produce a variety of habitats and in turn, influence the natural and reclaimed land communities that contribute to the available habitats. Combined, these features and the vegetation communities support a diverse mix of wildlife in the area by providing a complex of micro and macro habitats for which species are adapted to or dependent on. Piñon-juniper habitat predominates in the Kayenta Mine permit area (>50 percent), with the remaining somewhat evenly split between sagebrush shrubland and reclaimed lands.

Wildlife baseline studies were conducted in 1979 through 1983 (PWCC 1992) and updated in 2003 (BIOME 2003). Annual wildlife monitoring is conducted in the Kayenta Mine permit area and supports baseline studies, documents wildlife population characteristics, and monitors for special status species.

Twenty-six mammal species were recorded in the PWCC lease area, which encompasses the Kayenta Mine permit area, during the 1979 to 1983 and 2003 wildlife studies. Two additional mammal species were observed during monitoring in 2008 (EMI 2009). Big game species, while present are not abundant. A 1979-1980 census for game species recorded two observations of mule deer (*Odocoileus hemionus*), both north of the PWCC lease area. In 2003, ten mule deer and numerous pellet groups of mule deer and elk (*Cervus elaphus*) were observed during biological surveys for birds and threatened and endangered species (BIOME 2003). More recent monitoring has documented the presence of elk, mule deer, white-tailed deer (*Odocoileus virginianus*), bobcat (*Lynx rufus*), red fox (*Vulpes vulpes*), and coyote (*Canis latrans*) within the Kayenta Mine permit area (EMI 2009, EMI 2010). Increased elk presence has coincided with the increased reclaimed land vegetation.

Sagebrush shrublands and piñon-juniper woodlands support the largest variety of mammal species. Deer mice (*Peromyscus maniculatus*) are one of the most common species observed in the Kayenta Mine permit area, both in native and reclaimed lands. Also common are ground squirrels (*Ammospermophilus spp.*). Piñon-juniper woodland supports piñon-mice (*Peromyscus truei*), brush mice (*Peromyscus boylii*), Ord's kangaroo rat (*Dipodomys ordii*), Stephen's woodrat (*Neotoma stephensi*), and Colorado chipmunk (*Tamias quadrivittatus*). Gunnison's prairie dogs (*Cynomys gunnisoni*) occur in low statured, sparse cover shrubland habitats adjacent to the Kayenta Mine permit area. Black-tailed jackrabbits (*Lepus californicus*) and desert cottontails (*Sylvilagus audubonii*) occur in all habitats within the Kayenta Mine permit area, as do coyotes, red foxes, and gray foxes.

Bat studies were conducted in 1999 in reclaimed lands and piñon-juniper within and adjacent to the Kayenta Mine permit area (SWCA Environmental Consultants 2000). Nine bat species were identified including the big brown bat (*Eptesicus fuscus*), long-legged myotis (*Myotis volans*), silver haired bat (*Lasionyctris noctivagans*), pallid bat (*Antrozous pallidas*), fringed myotis (*Myotis thysanodes*), Mexican free-tailed bat (*Tadarida brasiliensis*), big free-tailed bat (*Nyctinomops macrotis*), canyon bat (*Parastrellus hesperus*), and an unknown myotis species. Only the first six species were found in the piñon-juniper habitat, but all nine species were found in the reclaimed lands.

Bird surveys have recorded 235 bird species in the PWCC lease area, more than half of which are known to or potentially nest in the area (LaRue 1994). The highest number of birds and the greatest diversity of species have been observed in summer, partly due to fledged offspring and species that are breeding residents only (LaRue 1994 and BIOME 2003). Ongoing monitoring continues to document these trends (EMI 2009).

Raptor studies in the 1980s recorded a total of 22 raptor species with nine of those likely to nest in the Kayenta Mine permit area. Red-tailed hawks (*Buteo jamaicensis*) were the most abundant raptor species; Cooper's hawks (*Accipiter cooperii*) and sharp-shinned hawks (*Accipiter striatus*) were relatively common in coniferous woodland habitats. Later raptor surveys in 2003 recorded American kestrel (*Falco sparverius*) and Cooper's hawk. A historic red-tailed hawk nest remained inactive in 2003 (BIOME 2003). Two active red-tailed hawk nests were documented in the Kayenta Mine permit area in 2009 (EMI 2010). Other less common species that may breed include northern goshawk (*Accipiter gentilis*), prairie falcon (*Falco mexicanus*), western screech owl (*Otus kennicottii*), great horned owl (*Bubo virginianus*), northern pygmy owl (*Glaucidium gnoma*), and long-eared owl (*Asio otus*). Comprehensive raptor studies have been conducted on and adjacent to the Kayenta Mine permit area for red-tailed hawk, peregrine falcon (*Falco peregrinus*), and Mexican spotted owl (*Strix occidentalis lucida*). The results have been documented and reported to OSM.

A high diversity of migratory waterfowl and shorebirds utilize many of the larger impoundment ponds in the Kayenta Mine permit area. Mallards (*Anas platyrhynchos*) are likely the only nesting species, though redheads (*Aythya americana*), ruddy ducks (*Oxyura jamaicensis*), and American coots (*Fulica americana*) also may nest in the vicinity (Corman and Wise-Gervais 2005). Many other species may utilize the ponds during migration such as the eared grebe (*Podiceps nigricollis*), great blue heron (*Ardea herodias*), blue-winged teal (*Anas discors*), green-winged teal (*Anas crecca*), cinnamon teal (*Anas cyanoptera*), northern shoveler (*Anas clypeata*), gadwall (*Anas strepera*), American wigeon (*Anas americana*), and lesser scaup (*Aythya affinis*) (Corman and Wise-Gervais 2005). Killdeer (*Charadrius vociferous*) is the only shorebird that may nest in the Kayenta Mine permit area (Corman and Wise-Gervais 2005). All of these species have been observed in baseline studies and annual wildlife monitoring for the Kayenta Mine permit area.

Reptile and amphibian species observed during baseline studies from 1979 to 1983 and during the 2003 field reconnaissance include whiptail lizard (*Aspidoscelis* spp.), collared lizard (*Crotaphytus collaris*), sagebrush lizard (*Sceloporus graciosus*), fence lizard (*Sceloporus undulatus*), short-horned lizard

(*Phyrnosoma douglassi)*, side-blotched lizard (*Uta stansburiana*), gopher snake (*Pituophis melanoleucus)*, western rattlesnake (*Crotalus viridis*), western spadefoot toad (*Scaphiopus hammondi*), Woodhouse's toad (*Bufo woodhousei)*, and red-spotted toad (*B. graciosus*) (BIOME 2003 and PWCC 1992).

D.2.4.2 Special Status Animal Species

Special status species considered for analysis included federally listed species under the Endangered Species Act, endangered species listed by the Navajo Nation, and wildlife species of concern tracked by AGFD. The analysis of special status species included reviews of USFWS county lists (USFWS 2010), the Navajo Nation endangered species list (NNDFW 2008), Navajo Nation Natural Heritage Program Endangered Species Accounts (NNHP 2008), Arizona Natural Heritage Program lists (AGFD 2010), and evaluation of habitats and ranges of the species. As described in the following species and habitat descriptions, there are no federally listed, proposed, or candidate animal species known or expected to occur within the PWCC mine lease area due to the lack of suitable habitats.

California Condor. The California condor (*Gymnogyps californianus*) is federally listed as an endangered species, and the reintroduced population in Arizona is managed as a threatened species outside the reintroduction area. It is listed as a Group 4 endangered species by the Navajo Nation (Group 4: lacks information to list as Group 2 or Group 3 endangered species, but the NNDFW has reason to consider listing).

The California condor is a species that utilizes canyon country and mountainous habitats for nesting and roosting, and can forage widely in a variety of habitats around these areas (NNHP 2008). The reintroduced population in Arizona has been expanding its foraging range to the north and northeast of its release site near the Grand Canyon and has not utilized areas south of the Grand Canyon since around 2000 (URS personal communication April 2010). This may represent a natural pattern related to the scarcity of carrion from big game. It is unlikely that California condors will utilize the Kayenta Mine permit area as a foraging site, but livestock and big game in the area could provide a limited carrion source.

Mexican Spotted-Owl. The Mexican spotted-owl (MSO) (*Strix occidentalis lucida*) is federally listed as a threatened species. It also is listed as a G3 endangered species by the Navajo Nation. MSOs occupy a variety of habitats for breeding and foraging. Breeding habitat includes dense old-growth mixed conifer forests along steep slopes and ravines (AGFD 2005). Within this habitat, the trees are dense, and form a closed canopy with a high basal area. The ground often is littered with numerous downed logs and snags. The large trees provide suitable nest cavities; whereas, the numerous smaller trees in combination with large trees provide roosting and foraging habitat (AGFD 2005).

The MSO is a year-round resident of the northeastern part of Black Mesa (BIOME 2003). As part of the Kayenta Mine permit, PWCC conducts ongoing monitoring surveys for the species whenever mining activities will occur within two miles of potential habitat for the owl pursuant to OSM and NNDFW requirements. Initial surveys were conducted between 1982 and 2000 and upon discovery of the species

by PWCC, subsequent intensive surveys were conducted between 1994 and 2000 as required in the Kayenta Mine permit. Suspension of the annual surveys occurred in conjunction with completion of mining in the northern part of the Kayenta Mine permit area within the buffer zone. Consistent with OSM and NNDFW requirements and using USFWS survey protocols, monitoring for MSOs resumed in spring 2011 in advance of mining in the N-9 coal resource area because mining will soon advance into the established 2-mile sensitivity area. As per the OSM permit requirements, PWCC contracts professional biologists that are certified in USFWS monitoring protocols to conduct monitoring in the areas within a 2-mile radius north and east of the N-9 coal resource area.

The results of the annual surveys indicated that nesting occurs in mixed-conifer habitats, and active protected activity centers (PACs) are within the two-mile buffer around the northeastern portion of the Kayenta Mine permit area (BIOME 2003). Survey results have shown that the closest MSO detections to actively mined areas have been within two miles northeast of the Kayenta Mine area in upper Yellow Water Canyon, the side canyons of Coal Mine Wash, and upper Moenkopi Wash (BIOME 2003). No records or habitat of MSOs occur elsewhere in the vicinity of the Kayenta Mine permit area.

There have been no previous data to suggest that MSOs use the reclaimed mine areas or adjacent undisturbed piñon-juniper woodlands in the Kayenta Mine permit area. Development of the N-9 mining area will be within about 2 to 4 miles of known PACs in Yellow Water Canyon.

Southwestern Willow Flycatcher. The southwestern willow flycatcher (*Empidonax traillii extimus*) is federally listed as an endangered species and is listed by the Navajo Nation as a Group 2 endangered species. Group 2 designates a species or subspecies whose prospects of survival or recruitment are in jeopardy.

The southwestern willow flycatcher is a Neotropical migrant that nests in the United States, typically from April to August (NNHP 2008). It utilizes dense stands of riparian vegetation that have a layered canopy and are next to or are flooded by perennial sources of water (NNHP 2008). The primary vegetation can either be native blocks of cottonwood and willow or non-native stands of tamarisk or Russian olive (*Elaeagnus angustifolia*) that are taller than 3 meters (10 feet) (NNHP 2008).

Willow flycatchers have been documented on Black Mesa during migration, but the subspecies has not been definitely identified (BIOME 2003). Potential migration habitat is present in the Kayenta Mine permit area where larger blocks of tamarisk occur in Yellow Water Canyon Wash, Moenkopi Wash, and Dinnebito Wash (BIOME 2003). No critical habitat occurs within or adjacent to the Kayenta Mine permit area.

Black-Footed Ferret. The black-footed ferret (*Mustela nigripes*) is listed as an endangered species and was considered extinct in the wild after the last known population was removed from the wild in 1987 near Meeteetse, Wyoming. It has since been reintroduced to numerous sites in the western United States, Canada, and Mexico following a successful captive breeding program. Two release sites are in Arizona—

one north of Williams and one near Seligman. These are categorized as non-essential experimental populations. It is listed as a G2 species by the Navajo Nation.

Black-footed ferrets are highly specialized predators that depend on prairie dogs for food and shelter. More than 90 percent of the ferrets' diet is made up of prairie dogs. Ferrets live in prairie dog towns, nest in prairie dog burrows, and usually forage in the tunnel complexes of prairie dogs. Although Gunnison's prairie dogs occur near the Kayenta Mine permit area, the colonies remain too small to support a population of black-footed ferrets (BIOME 2003).

Prairie dog colonies within and adjacent to the Kayenta Mine permit area are censused and reported on annually. There has been no indication of the presence of black-footed ferrets, and habitat conditions remain unsuitable for ferrets within this area (EMI 2010).

Sora. The sora (*Porzana carolina*) is listed as a G4 endangered species by the Navajo Nation. It also receives protection under the Migratory Bird Treaty Act. The sora inhabits a variety of natural and man-made wetland habitats (Corman and Wise-Gervais 2005). Suitable habitat has dense emergent vegetation, and shallows are needed for adequate foraging (Corman and Wise-Gervais 2005).

The closest breeding site to the Kayenta Mine permit area is about 70 miles southwest near Tuba City (Corman and Wise-Gervais 2005). However, potential habitat exists at impoundments within the Kayenta Mine permit area. LaRue (1994) described the location of seven records of soras at various impoundments within the PWCC lease area. These likely are limited as stop-over habitat during migration (LaRue 1994).

Bald Eagle. The bald eagle (*Haliaeetus leucocephalus*) is listed by the Navajo Nation as a G2 species. It has been de-listed as a federally threatened species but remains protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. In Arizona, bald eagles typically nest in riparian areas with mature trees, particularly large mature cottonwoods that are adjacent to large bodies of water (major rivers, lakes, or reservoirs) with abundant prey (large fish and waterfowl) (NNHP 2008). Winter roost sites occur in the same type of large mature trees, but can include mature pine forests as well as riparian river bottoms, or canyon rims (NNHP 2008). Winter roost areas are typically used by a congregation of bald eagles and are usually within a few miles of a foraging site – a large lake or river with adequate prey (NNHP 2008).

The Kayenta Mine permit area lacks adequate breeding and winter roosting habitat because fish bearing ponds and impoundments are limited in the mine complex and offer a limited foraging resource (BIOME 2003). It is speculated that bald eagles also could forage on the occasional livestock or game carrion in the area (BIOME 2003). Bald eagles have been observed infrequently as early winter transients near the Kayenta Mine permit area. Individuals have been seen at temporary perch sites located in Coal Mine Wash, Moenkopi Wash, lower Yellow Water Canyon Wash, and in the vicinity of the J7-R and N1-RA permanent impoundments (see Map D-3) (BIOME 2003).

Golden Eagle. The golden eagle (*Aquila chrysaetos*) is listed as a G3 endangered species by the Navajo Nation. The species also receives protection under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. The golden eagle typically inhabits mountainous terrain and canyon country where it nests on steep cliffs, typically more than 30 meters (98 feet) in height (NNHP 2008). Nesting cliffs are normally directly adjacent to foraging habitat that provides the primary prey of cottontails and jackrabbits (NNHP 2008). Perch sites can occur in tall trees or on structures that occur in habitat otherwise only suitable for foraging. The species has been documented from the north end of Black Mesa at Lolomai Point and Kayenta Point, and golden eagles occasionally utilize the Kayenta Mine permit area for foraging (EMI 2010). The most recent record was on April 12, 2009 of an individual seen following a northern harrier (*Circus cyaneus*) along the main drainage in the J-16 coal resource area (EMI 2010).

Ferruginous Hawk. The ferruginous hawk (*Buteo regalis*) is listed as a G3 species by the Navajo Nation. It also receives protection under the Migratory Bird Treaty Act. The ferruginous hawk is an open-country inhabitant in western North America. The species occurs in grasslands, sagebrush scrub, saltbush-greasewood shrubland, and the periphery of piñon-juniper and other western forests (Bechard and Schmutz 1995). The ferruginous hawk usually avoids dense montane forests, aspen parkland, and habitats recently altered by agricultural cultivation (Bechard and Schmutz 1995). It typically forages on rabbits (*Lepus* spp.), ground squirrels (*Spermophilus* spp.), and prairie dogs (*Cynomys* sp.) (Bechard and Schmutz 1995). It nests on a variety of elevated sites and structures in the landscape that are typically less than 30 meters (98 feet) above the ground.

The ferruginous hawk is an occasional visitor to the Kayenta Mine permit area (BIOME 2003). Potential foraging habitat occurs in and adjacent to revegetated areas and in prairie dog colonies in this area.

Northern Goshawk. The northern goshawk (*Accipter gentilis*) is listed as a G4 endangered species by the Navajo Nation. It also receives protection under the Migratory Bird Treaty Act. The northern goshawk inhabits a variety of mature forest types in North America (Kennedy 2003). In the West, it typically nests in mature ponderosa or mixed-conifer forests with high canopy closure and moderately steep slopes (Kennedy 2003). Adjacent foraging habitat has a similar structure but may require a less dense understory (Kennedy 2003). Wintering and post-fledgling habitats are more variable, less dependent on tree density, and more dependent on the availability of prey (Kennedy 2003).

The northern goshawk has been documented at several sites on the northeastern end of Black Mesa (BIOME 2003). One nesting record has been reported from this area, but the northern goshawk seems to be more common on Black Mesa during the winter months (BIOME 2003). The nearest sighting of a northern goshawk to the Kayenta Mine permit area has been a possible breeding female located about 2 miles north of the site (BIOME 2003). Potential habitat for the species occurs in the N-9 mining area (BIOME 2003).

Peregrine Falcon. The peregrine falcon (*Falco peregrinus*) is listed as a G4 endangered species by the Navajo Nation. The species also receives protection under the Migratory Bird Treaty Act. The peregrine falcon nests in a variety of habitats, with steep cliffs typically more than 45 meters (148 feet) tall (NNHP

2008). Suitable habitat requires an abundance of prey (birds of various species) near nest and roost sites (NNHP 2008). These areas typically occur along wetlands, riparian forests, and other forest habitats.

Peregrine falcons have been documented from the northeastern part of Black Mesa (BIOME 2003). Suitable breeding habitat occurs along the mesa escarpment and many of the taller, steeper canyons (BIOME 2003). Peregrine falcons occasionally forage in the Kayenta Mine permit area, and the species could be expected in the N-9 mining area and other places with piñon-juniper woodlands (BIOME 2003).

Northern Saw-Whet Owl. The northern saw-whet owl (*Aeoglius acadicus*) is listed as a G4 endangered species by the Navajo Nation. The species also receives protection under the Migratory Bird Treaty Act. The northern saw-whet owl typically utilizes relatively open ponderosa pine, Douglas-fir, or mixed conifer forests for foraging and nesting activities (NNHP 2008). The species also may occur in old-growth riparian woodlands (NNHP 2008). It nests in tree cavities in these habitats (NNHP 2008).

The species has been documented from the northeastern part of Black Mesa, but its breeding status there is unconfirmed (BIOME 2003). Suitable habitat for the species is absent from within the Kayenta Mine permit area (BIOME 2003).

Northern Pygmy Owl. The northern pygmy owl (*Glaucidium gnoma*) is listed as a G4 endangered species by the Navajo Nation. The species also receives protection under the Migratory Bird Treaty Act. The northern pygmy owl nests in tree cavities and uses habitats often near forest openings (e.g., meadows, lakes and ponds) (NNHP 2008). The species occurs in a variety of montane forest habitats, and possibly wooded canyons that include coniferous forest (spruce, fir, and ponderosa pine), mixed conifer-hardwood with oak and aspen, hardwood bottomlands, and occasionally aspen stands (NNHP 2008).

The northern pygmy owl has been documented on the northern part of Black Mesa (BIOME 2003). It occurs in Coal Mine Wash and Yellow Water Canyon outside of a two-mile buffer zone adjacent to the Kayenta Mine permit area (BIOME 2003). No suitable habitat occurs within the Kayenta Mine permit lease area.

Flammulated Owl. The flammulated owl (*Otus flammeolus*) is listed as a G4 endangered species by the Navajo Nation. The species also receives protection under the Migratory Bird Treaty Act. The flammulated owl nests in tree cavities in open conifer (usually ponderosa pine) or aspen forests, often with brushy understory of dense saplings or oak shrubs and clearings (NNHP 2008). It usually prefers to use old-growth stands with dense cover and large-diameter trees as roosting habitat (NNHP 2008).

The flammulated owl has been documented on the northeastern part of Black Mesa (BIOME 2003). It occurs in Yellow Water Canyon outside of a two-mile buffer zone adjacent to the PWCC lease area (BIOME 2003). No suitable habitat occurs within the Kayenta Mine permit area.

Burrowing Owl. The burrowing owl (*Athene cunicularia*) is listed as a G4 endangered species by the Navajo Nation. It also receives protection under the Migratory Bird Treaty Act. The burrowing owl inhabits flat, open areas with short-grass grasslands, sparse desert scrub, agricultural lands, and other

areas with human disturbance (NNHP 2008). The species relies on areas with prairie dogs and other digging mammals in order to provide burrows for nesting (NNHP 2008). Suitable habitat also includes perch sites with unobstructed views (NNHP 2008). This species occurs both east and south of Black Mesa, and potential habitat occurs in prairie-dog towns in reclamation areas in the Kayenta Mine permit area. LaRue (1994) stated that potential habitat could be used by transient burrowing owls during migration.

Navajo Mountain Vole. The Navajo mountain vole (*Microtus mogollonensis*) is listed as a G4 endangered species by the Navajo Nation. It has no further designations. The Navajo mountain vole typically inhabits dry grassy vegetation in conifer forests and forest openings (BIOME 2003). The species also inhabits patches of sagebrush, greasewood, desert-olive (*Forestiera neomexicana*), and tamarisk with a heavy cover of grasses (NNHP 2008). The species has been documented in the Kayenta Mine permit area in places with rocky substrates, in continuous stands of sagebrush, near permanent impoundments on mine reclamation, and along drainage bottoms (BIOME 2003). Its abundance varies from rare to common and can vary with the annual precipitation and habitat (BIOME 2003).

Townsend's Big-eared Bat. Townsend's big-eared bat (*Corynorhinus townsendii*) is listed as a G4 endangered species by the Navajo Nation. It has no further designations. Townsend's big eared bat forages in a variety of habitats that include coniferous forests, piñon-juniper woodlands, deciduous riparian woodlands, and desert scrub habitats (NNHP 2008). It roosts, hibernates, and raises its young in caves, mine tunnels, and man-made structures (NNHP 2008). Townsend's big-eared bat has not been documented in the Kayenta Mine permit area, but suitable foraging habitat occurs in the mine complex, and suitable foraging and roost habitat occurs in the surrounding habitats on Black Mesa (BIOME 2003).

D.2.5 Soil Resources

Soil resources are the result of soil-forming processes on materials deposited or accumulated by geological processes. The development of diagnostic soil features are influenced over time by climate, parent material, biological activity and topography (Natural Resource Conservation Service [NRCS] 2009). The study area for soil resources is the Kayenta Mine permit area (see Map A-2). The Kayenta Mine permit area falls within the Colorado Plateau, as described in Section D.1. The soils on the plateaus, mesas, hillsides, and fan terraces of the Colorado Plateau range from a few inches to more than 5 feet deep and generally are well drained. Soils in many portions of the Colorado Plateau are subject to high wind and water erosion due to sparse vegetation cover, steep slopes, and soil type (AGFD 2006).

Soils within the coal resource areas N-9, J-19, and J-21 are derived from the Cretaceous Mesaverde Group, a series of sedimentary sandstones, siltstones, and mudstones (Figure D-1). In 1979, 1983, 1985, 2000, and 2003 SMCRA required that private contractors conduct site-specific soil surveys in the Kayenta Mine permit area and surrounding areas, to provide detailed soil taxonomy and determine thickness of suitable topsoil, subsoil, and unconsolidated material for reclamation use. The surveys identified 14 soils in and surrounding the area. These soils were predominantly very fine- to fine-grained sandy loams with minor smectitic clayey soils. The smectite clays, also referred to as "swelling clays,"

can undergo as much as a 30 percent volume change due to wetting and drying. Soils in the area are characterized generally as well drained with moderate shrink-swell potential (with the exception of the smectitic clayey soils) and as slightly susceptible to wind erosion.

Topsoil is essential for reestablishing native vegetation and forage on reclaimed surface mines. Subsoil and weathered rock overburden beneath the topsoil supply additional nutrients and moisture for plant growth. The removal and replacement of all topsoil is required by SMCRA unless it is demonstrated that selected subsoil, weathered overburden, or spoil is better suited for growing plants. Topsoil is removed as a separate layer before mining and is either spread directly on nearby regraded areas or, if necessary, temporarily stockpiled. Topsoil is spread to the appropriate depths for the approved post-mining land use.

By definition, topsoil means the A and E soil horizon layers of the four master soil horizons (30 CFR 701.5). The soils of the Kayenta Mine permit area have A horizons that range in thickness between 0 to 1 inch and 0 to 4 inches, depending on the soil. The topsoil is of insufficient quantity to salvage as a separate layer and must be salvaged together with suitable subsoil and suitable unconsolidated material below the subsoil to provide an average two feet thick topsoil mixture suitable for reclamation. Overall, a four foot thick suitable root zone is created per SMCRA requirements and the reclamation plan using a combination of this topsoil mixture underlain with suitable spoil. When a more rocky topsoil material is needed to support the reclamation plan, PWCC salvages the suitable residual soils unless their depth makes salvage impractical. The soil surveys assessed residual soils' suitability for restoration based on seven conditions: selenium concentration, sodic zones, pH, saline strata, texture, rock fragment percentage, and acid-forming spoils.

Soils developed in the Kayenta Mine permit area have the potential for higher than normal selenium concentrations. Native vegetation that bioaccumulates selenium on these soils can create a level of toxicity in the forage high enough to affect cattle.

PWCC's geobotanical studies demonstrated that selenium-accumulating plant populations are locally common. The selenium accumulators occurred on the shallow soils associated with wooded ridges and disturbed areas, and were absent from the broad sagebrush valleys and wash terraces where the deeper soils occur. Overburden material, which could be used to provide soil in reclamation areas, also was evaluated for selenium. Initial results indicated the probability of suspect concentrations of plant-available selenium occurring in regraded spoils. Based upon the results of selenium analysis in plants and soils at a representative cross section of sites where accumulator plants were found, the soils in which they were growing are not seleniferous. No selenium poisoning of livestock has been reported in or surrounding the Kayenta Mine permit area. Selenium supplements are often added to salt blocks used by the local ranchers.

Analysis of selenium levels of regraded spoil in comparison to selenium blood levels in cattle grazing on reclaimed areas indicate that the selenium levels present in the regraded spoil do not pose a threat to livestock and in fact are at or slightly below levels desired for cattle.

Sodium adsorption ratios (SAR) greater than 18 or 22, depending on soil texture, are indicative of elevated sodium in soil.

Overburden materials having elevated SAR also may have unsuitable pH values: either alkaline pH values greater than 8.8, or acidic pH values less than 5.5. However, acidic soils may not be a significant issue because of excess alkalinity measured in many core samples. Acidic or acid-forming spoils are not anticipated in most areas.

Negative acid-base account potential values indicate a potential for acid-forming zones that make spoil unsuitable for use as replacement soil in reclamation areas. Negative acid-base accounting has been detected at unsuitable levels in about 10 percent of the total samples of spoil collected and analyzed.

D.2.5.1 Prime Farmland Determination

The soils that occur are predominantly in the Natural Resource Conservation Service (NRCS) land capability Classes VI and VII. Soils in Classes VI and VII have severe to very severe limitations that make them unsuitable for cultivation and limit or restrict their use largely to pasture, range, woodland, or wildlife habitat. Soils in these groupings are used primarily for livestock grazing. The land in the study area has received a negative determination as prime or unique farmland from the NRCS (NRCS 2005).

D.2.6 Recreation

The Kayenta Mine is located atop the Black Mesa, a major geographic feature of the Colorado Plateau, where geological and archaeological features provide opportunities for recreation and tourism. The study area for recreation is Black Mesa, and within the study area, all areas are closed to non-tribal members without a permit or authorization. The Moenkopi Wash area southwest of the study area also may be a prominent location for game hunting, commercial trapping, bird watching, and photography. Hiking may occur to a limited extent north of the study area near the rim of Black Mesa.

There are no developed recreation resources within the Kayenta Mine permit area and no specific data are available on the use of the study area for recreation. Residents report that the area is sparsely used for sightseeing (OSM 1990). Possible recreational activities may include hiking and game and bird hunting; however, the area north of the Kayenta Mine permit area is closed to all big game hunting (PWCC 2005b).

D.2.7 Air Quality

Under the Clean Air Act, national ambient air quality standards (NAAQS) establish the maximum allowable levels of certain pollutants in the ambient air in order to protect public health and welfare. Those "criteria pollutants" consist of particulate matter (PM), sulfur oxides (SO_x), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3) and lead (Pb). However, because emissions from surface coal mining are predominantly particulate matter, current and projected ambient levels of PM are the primary focus of this analysis.

Ambient concentrations of particulate matter are currently expressed both in terms of PM_{10}, i.e., particles that are 10 microns or less in size, and in terms of $PM_{2.5}$, i.e., particles that are 2.5 microns or less in size. The particulate matter emissions from surface coal mining activities are predominantly PM_{10} (which includes all $PM_{2.5}$), and this analysis focuses upon current and projected ambient concentrations of PM_{10}.

Sources of PM_{10} emissions from surface coal mining include blasting, overburden removal, coal extraction, coal preparation/handling/storage and fugitive road dust from haul trucks. The vast majority of such emissions are fugitive in nature. Tailpipe emissions from vehicles and mining equipment include particulate matter and also CO, SO_2, NO_x, and volatile organic compounds (VOC).

Existing ambient concentrations of a pollutant are most accurately characterized by actual measurements, as opposed to the alternative of predicting ambient concentrations with dispersion models. This principle is particularly true for characterizing ambient levels of PM_{10} that are due primarily to fugitive PM_{10} emissions from coal mining activities. When the ambient concentration of a pollutant is lower than its maximum allowable level, i.e., the standard, that pollutant's concentration is said to be in "attainment." In determining the attainment status of a given criteria pollutant in a particular geographic area, EPA policy focuses on evaluation of the most recent three years of ambient monitoring data that are considered to be representative of concentrations in that area.

In keeping with a requirement under SMCRA, Peabody has operated a network of PM_{10} ambient air monitors at the Kayenta Mine permit area for just under two decades (see Map D-6). The purpose of the monitoring program is to facilitate assessment of the effectiveness of existing fugitive dust control measures at the Kayenta Mine permit area in order to ensure continued satisfaction of the NAAQS for PM_{10}. In consultation with OSM, the Navajo Nation EPA (NNEPA) and the U.S. EPA, the network configuration has been modified on several occasions either to add additional monitors and/or to relocate existing monitors. Revisions to the monitoring network design represent continuing attempts to accurately characterize ambient PM_{10} impacts caused by some of the larger mining sources of fugitive PM_{10} emissions while distinguishing those impacts from ambient PM_{10} concentrations resulting from on- or off-site non-mining activities and/or uncontrollable meteorological events.

Currently, the Kayenta Mine permit area monitoring network includes twelve PM_{10} samplers, four meteorological monitoring stations and numerous precipitation gauges (Map D-6). PWCC generally operates its PM_{10} monitoring network in accordance with applicable EPA requirements, including a quality assurance program, although the network is designed primarily for the purpose of providing data OSM can use to evaluate the effectiveness of the fugitive dust control plan. Quarterly monitoring reports are submitted to OSM and NNEPA. In the event that a PM_{10} concentration is measured that exceeds the level of the PM_{10} standard, PWCC submits an assessment of the probable cause of that exceedance to OSM. PWCC's monitoring sites were very reliable in the three-year period from 2007 to 2009, collecting more than 98 percent of the required samples. For purposes of this EA, the results of the air quality monitoring conducted at the mine are conservatively assumed to be representative of the larger region assessed to determine the impacts of the Kayenta Mine within and surrounding the permit area, including

proximate Class I areas designated by USEPA and locations considered sensitive by the tribes (see Section E.1.7).

Short-term (24-hour) Ambient Air Concentrations

Table D-6 shows the highest and second highest PM_{10} concentrations at each sampler for the three-year period. There were a total of twelve sample results that exceeded the PM_{10} 24-hour standard of 150 µg/m^3 applicable during the three-year period. These twelve elevated measurements account for 0.6 percent of 2,143 valid measurements taken during this period. The exceedances occurred on only six separate days. The dates of the exceedances are indicated in the footnotes to the table.

Table D-6 Kayenta Mine Permit Area PM_{10} 24-Hour Ambient Air Concentrations, 2007-2009 (in µg/m^3)

Monitor Site	2007		2008		2009	
	First High	Second High	First High	Second High	First High	Second High
1	84.6	29.9	106.0	70.3	161.7[c]	102.2
2R	112.7	56.7	116.5	76.8	355.6[c]	218.1[d]
3R	104.3	49.0	140.8	92.4	186.4[e]	174.9[f]
4R	101.8	100.0	65.5	52.7	86.7	81.5
5R	105.0	102.1	93.4	69.1	125.9	86.0
6R	83.5	35.0	81.9	44.7	166.7[c]	101.2
7R	220.9[a]	41.0	112.5	89.1	195.8[c]	115.2
8R	126.0	54.2	143.6	129.0	142.7	95.9
12	72.7	38.6	263.2[b]	119.1	129.9	128.6
200	83.3	44.8	90.2	46.2	105.1	89.0
201	97.7	57.9	107.8	72.9	193.9[c]	104.9
202	62.7	32.3	70.9	65.6	208.9[c]	78.6

NOTES: [a] April 14, 2007: Cause was regional dust storm.

[b] October 27, 2008: Cause was temperature inversion with calm wind and negligible precipitation.

[c] October 4, 2009: Cause was regional dust storm.

[d] April 25, 2009: Cause was regional dust storm.

[e] December 27, 2009: Cause was temperature inversion with calm wind.

[f] June 30, 2009: Cause was temperature inversion with calm wind and negligible precipitation.

When an exceedance of the ambient PM_{10} standard has been measured at one of the samplers, PWCC follows up with a report to OSM. That report documents related on-site sampling and meteorological data for the day of interest as well as that day's operations with respect to both mining activities and fugitive dust control actions. The footnotes to Table D-6 summarize PWCC's assessment of each reported exceedance of the 24-hour PM_{10} NAAQS.

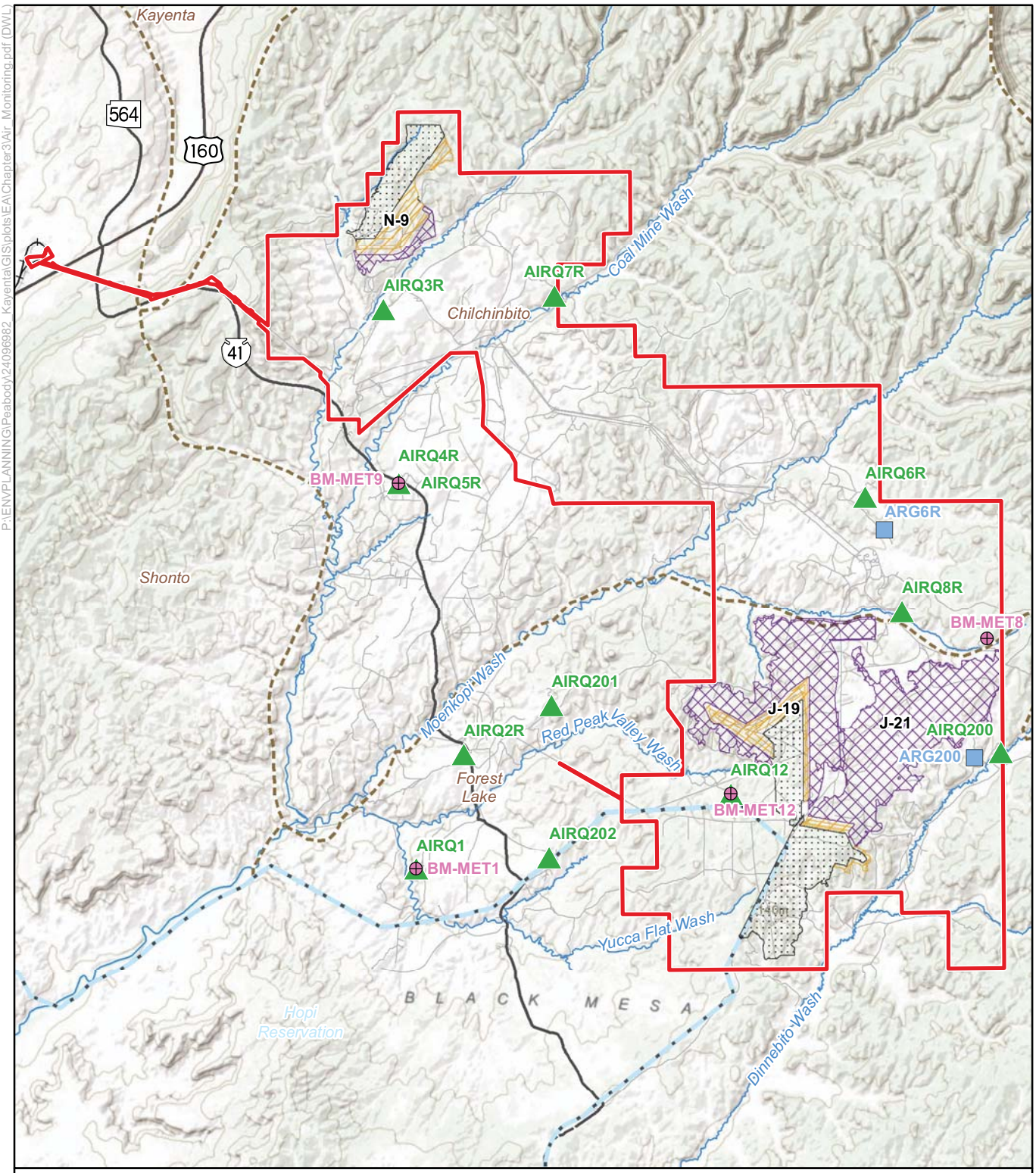
A thorough examination of the related on-site meteorological data and documentation of on-going mining activities during the six days of exceedances shown above reveals that the exceedances were likely caused by non-mining activities and climatic conditions leading to off-site generation of wind-blown particulates. Given the dry, arid conditions which prevail throughout the area for long periods of time, wind erosion can generate significant amounts of fugitive PM_{10} emissions. Despite the fact that PWCC operates its fugitive dust control plan to suppress mining-generated emissions of PM_{10} throughout the Kayenta Mine permit area, climatic conditions may frequently be ripe for the transport of off-site fugitive PM_{10} emissions into the permit area where their resultant impacts are monitored.

In summary, recorded short-term (24-hour) concentrations of PM_{10} have exceeded the NAAQS on only six days in the past three years. Evaluations of sampler, meteorological and operating data from the mine indicates that Peabody's mining activities have seldom been the cause of these exceedances of the short-term ambient PM_{10} NAAQS. Instead, long-term dryness, high winds, PM from off-site sources, and the generation of fugitive road dust by non-mining activities near the mine are recognized as significant contributors to or causes of the recorded exceedances.

Additionally, the atmospheric deposition of mercury (Hg) and selenium (Se) was identified as a specific concern relative to the use and handling of coal in the Four Corners region of New Mexico. Mercury and selenium have been recognized as chemicals of potential ecological concern that may cause adverse effects in certain invertebrates, fish, bird and mammal populations by exposure through cycling and bioaccumulation. In northern Arizona, ENVIRON International Corporation conducted a screening analysis of the impact of mercury and selenium emitted from the Salt River Project's Navajo Generating Station on local aquatic life (ENVIRON 2011). (See Appendix E for a summary of the ENVIRON report).

Reported evidence from laboratory and field studies indicates that methylmercury can lead to direct mortality in some fish at high tissue concentrations and suggests that mercury and selenium can cause toxicity and reproductive failure at lower concentrations. Exposure to these chemicals occurs throughout the food web in a complex chemical and biological cycle, including the deposition and transportation of the chemicals to a waterbody, organic and inorganic uptake, plant absorption, exposure to aquatic and sediment dwelling invertebrates, and consumption by fish and wildlife populations throughout the food chain.

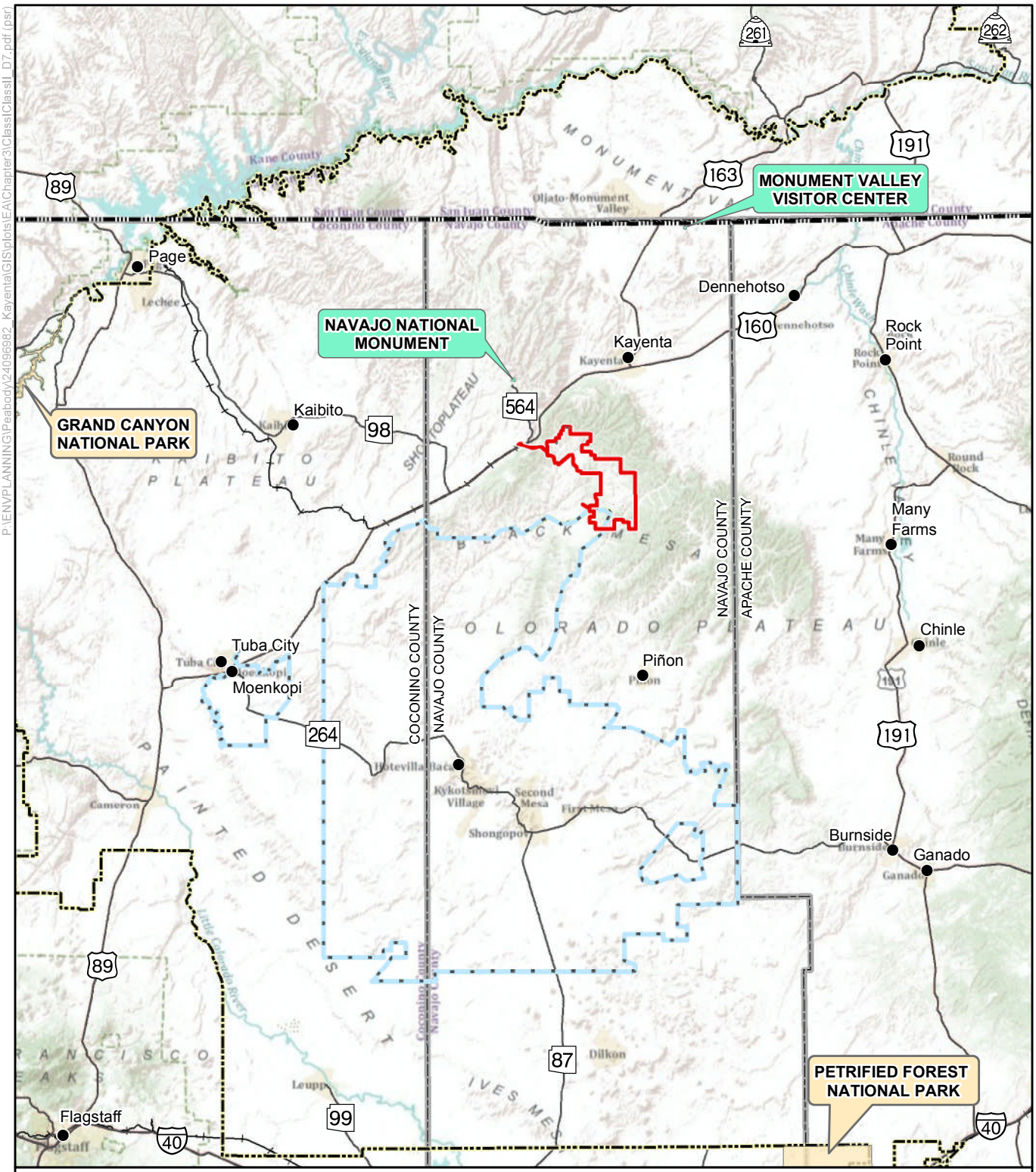
Mercury occurs naturally in the environment as several different chemical compounds. Most mercury in the atmosphere (95–97 percent) is present in a neutral, elemental state, Hg0. In water, sediments, and soils, most mercury is found in the oxidized, divalent state, Hg2+ (ENVIRON 2011). A small fraction of



Map D-6

Air Quality Monitoring and Meteorological Sites

Kayenta Mine Permit Renewal EA



Legend

- Kayenta Mine Permit Area
- Hopi Reservation
- Navajo Nation Reservation Boundary
- Highway
- Railroad

Air Quality Feature

- Federal Class I Area
- Sensitive Class II Area

Map D-7

Class I and Sensitive Class II Areas

Kayenta Mine Permit Renewal EA

N

0 8 16 Miles

Source:
Base Map: ADOT 2009, PWCC 2010, ESRI 2010
Imagery: USGS, FAO, NPS, EPA, ESRI, DeLorme, TANA

PWCC URS

this pool of divalent mercury is transformed by microbes into methylmercury (CH3Hg2+ [abbreviated MeHg]) (ENVIRON 2011). Methylmercury is retained in fish tissue and is the only form of Hg that biomagnifies in aquatic food webs (ENVIRON 2011). Selenium in sediments is particularly important to long-term habitat quality because mechanisms present in most aquatic systems effectively mobilize such selenium into food chains and thereby cause long-term dietary exposure of fish and wildlife (ENVIRON 2011).

Appendix E discusses the process of measuring or estimating the magnitude, frequency, and duration of receptor exposure to mercury and selenium; the assessment of the potential for these chemicals to cause adverse effects; and the risk characterization to evaluate the likelihood, severity, and spatial distribution of predicted or observed effects. The effects assessment in the report evaluates the potential for mercury and selenium to cause adverse effects in certain receptors and estimates the relationship between the extent of exposure and severity of effects. The effects assessment utilizes several metrics and ecological screening benchmarks, including literature-derived concentrations or doses, USEPA's Criterion Continuous Concentration, sediment concentrations from the National Atmospheric and Oceanic Administration (NOAA), and literature-derived critical body residues.

D.2.8 Noise and Vibration

Noise is defined as any sound that is undesired or interferes with a person's ability to hear something. The basic measure of sound is the sound pressure level, commonly expressed as a logarithm in units called decibels (dB). Vibration consists of rapidly fluctuating motions that can be described in terms of displacement, velocity, or acceleration.

The study area for noise and vibration are the noise-sensitive receptors including residences within the Kayenta Mine permit area and up to three miles from the permit renewal areas. The three-mile distance was selected based on attenuation of a 100 dBA noise source to approximately 50 dBA. A sound level of 50 dBA is generally considered to be quiet (Table D-7). Based on information from previous noise studies (see Table D-8) the loudest single mining and excavation equipment noise source is the rock drill at 95 dBA (Federal Transit Authority [FTA] 2006). Sensitive receptors in the study area including the Kayenta Mine permit area are residences clustered near the intersection of U.S. Highway 160 and Navajo Route 41, and along Moenkopi and Dinnebito washes.

The ambient conditions encountered in the study area consist of an assortment of sounds at varying frequencies (FTA 2006). Sound level measurements are often adjusted or weighted and the resulting value is called an "A-weighted" sound level. A-weighted sound measurements (dBA) are standardized at a reference value of zero decibels (0 dBA), which corresponds to the average threshold of human hearing. The A-rated scale is logarithmic, that is, a sound that is 10 decibels louder is perceived by people as twice as loud (FTA 2006). Table D-7 lists measured values of common noise sources to provide context.

Table D-7 Sound Levels of Typical Noise Sources and Noise Environments

Noise Source or Environment	A-Weighted Sound Level (decibels)	Subjective Evaluation
Shotgun blast in close range Jackhammer in close range	130	Deafening
Commercial jet take-off (200 feet away)	120	
Motorcycle (25 feet) Propeller plane fly-over (1,000 feet) Diesel truck, 40 miles per hour (50 feet)	90	Very Loud
Passenger car, 65 miles per hour (25 feet) Vacuum cleaner (3 feet)	70	Loud
Normal conversation (5 feet)	60	Moderate
Average office	50	Quiet
Average residence without radio playing	30	Faint
Soft whisper (5 feet)	20	
Normal breathing (0 feet) Rustle of leaves in the wind	10	Very faint
Normal breathing (5 feet)	5	
Average threshold of human hearing	0	

SOURCES: Housing and Urban Development 1991, and United States Environmental Protection Agency 1971

The existing noise environment near the coal resource areas is dominated by noise associated with mining operations, including coal processing, blasting, and hauling. No noise measurements or detailed field reconnaissance were conducted to measure existing noise sources or noise levels in sensitive areas for this EA. Precise data on existing noise sources (type, number, locations, and operating times) were not generally available at the time of this study. Therefore, noise levels expected by sensitive receptors within and adjacent to the Kayenta Mine permit area were estimated from typical mining equipment noise levels, as listed in Table D-8. The noise levels presented in Table D-8 offer reasonable expected sound decibels consistent with mining activities.

Based on the noise sources described in Table D-8, existing sound levels at 50 feet from equipment are likely to range from 50 dBA to 95 dBA for typical daytime noise levels, depending on the level of intensity of mining activities, and less depending upon distance from the noise source. For comparison, 40 dBA is relatively quiet and can be equated to the noise level of a residence at night, while 60 dBA is comparable to a normal conversation and is considered a comfortable noise level. Noise from a point source, such as mining equipment decreases approximately 6 dB per doubling of the distance to a sensitive noise receptor. For example, a source that emits 85 dBA at 50 feet decreases to 79 dBA at 100 feet (OSHA 1999).

Table D-8 Source Noise Used for Estimating Existing Noise Levels[1]

Noise Source		Source-to-Receiver Distance (feet)	Noise Exposure Estimates[1] (decibels)	Source-to-Receiver Distance (feet)	Noise Exposure Estimates[1] (decibels)
Mining and excavation related noise sources	Bucket loader	50	89	200	65
	Haul trucks (100 tons)	50	88	200	64
	Ore trucks (tractor-trailer)	50	88	200	64
	Water truck	50	91	200	67
	Front end loader	50	80	300	70
	Fork lift	50	73	200	49
	Dozer	50	92	300	77
	Rock drill	50	95	300	79
	Dragline crane	50	88	300	73
	Scraper	50	92	300	77
	Pumps	50	71	200	47
	Generators	50	83	200	59
	Compressors	50	86	200	62
Traffic-related noise sources	Roadways[2]	50	70	200	60
	Electric railroad[3]	50	70	240	60

SOURCES: Mining sources – Minor, Michael & Associates 2000, Transportation sources – FTA 2006

NOTES: 1 All noise exposure estimates are based upon typical highway or vehicle operation. Railroad noise levels are described in day-night average sound level; all others are in equivalent noise level daytime.

2 Roads with traffic at 55 miles per hour, but without trucks.

3 Typical for Black Mesa and Lake Powell electric-railroad operations.

Surface blasting is conducted an average of twice daily during weekdays, from sunrise to sunset and is conducted at least 0.5 mile from any residence or occupied dwelling. Warning and all-clear signals audible for at least 0.5 mile are sounded before and after blasting. Except for emergencies, blasting occurs according to a schedule that is published annually in a newspaper with general circulation in the mining area. Additionally, blasting schedules are delivered to all individuals living within the Kayenta Mine permit area and within 0.5 mile outside the permit area.

Low-frequency vibrations are normally felt rather than heard. Existing sources of vibrations within the study area may occur as heavy equipment or trucks travel through Kayenta mining areas or from blasting. Blasting is used as part of the mining operations to fragment material for excavation and transport. Energy liberated from the blast is converted into vibrations as either ground motion or air overpressure (air blast). Ground motion is the principal vibration that could result from blasting, though air blast may be more noticeable because of the accompanying noise effects. Like other noises, air blast is measured in decibels; however, the overpressure is normally at low frequencies, an air blast may be felt more than heard. Ground motion is a wave motion spreading outwards from the blast, like ripples spreading

outwards after a stone is dropped into water. This ground motion is measured as peak particle velocity and is used as an indicator of possible blast damage.

In support of mining activities carried out at the Kayenta Mine permit area and compliance with the Blasting Guidance Manual, PWCC issues monthly blasting reports to OSM that contain seismographic data, including all ground-motion and air-overpressure records. Monitoring levels for ground movement and air overpressure from the mining operation have not exceeded established OSM limits.

Flyrock is rock that is ejected into the air or along the ground from a blast. Flyrock is controlled by the blasting design and by limiting access near the blast. The Federal regulation in 30 CFR 816.67(c) prohibits flyrock from being cast more than one-half the distance to the nearest dwelling, beyond the area of control [required under 30 CFR 816.66(c)], or beyond the permit boundary.

D.2.9 Landforms and Topography

The project study area is Black Mesa which is a geographic feature located within the Colorado Plateau physiographic province. The Colorado Plateau is defined by an abrupt change in elevation, coincident with uplifted and gently folded sedimentary layers internal to the plateau, and steep-sided valleys that incise the plateau's perimeter. The Colorado Plateau province is higher in elevation than surrounding provinces, with elevations generally between 5,000 and 7,000 feet above mean sea level (MSL). Elevations within the project study area generally range from 6,500 to 7,000 feet above MSL.

The topography of the Kayenta Mine permit area is characterized by gently rolling hills on a relatively flat mesa. Through 2009, approximately 20,756 acres have been disturbed in the Kayenta Mine permit area and 11,670 acres have been graded, topsoiled, and seeded per the approved reclamation plan. Restoration of mining sites to the approximate original contour is required by SMCRA. Mined areas are backfilled and graded to approximate the original topographic relief. The approximate original contour restoration is designed to reestablish the drainage patterns to blend in with the surrounding undisturbed areas. Restored areas generally have smoother contours with less topographic relief than the original topography, and no pronounced landforms (e.g., no cliffs, steep buttes, or narrow canyons).

D.2.10 Geology and Mineral Resources

The study area for geology and mineral resources is the Black Mesa coal field (see Map A-1 for the extent of the coal field). The Colorado Plateau physiographic province is characterized by relatively flat-lying and laterally continuous Paleozoic and Mesozoic sedimentary formations. Coal resource areas N-9, J-19, and J-21 fall within Black Mesa, which contains coal-bearing rocks deposited within the basin that supply the Kayenta Mine operation (Figure D-2).

Black Mesa is a broad upward fold in rock layers trending northwest to southeast. It is bounded by uplifts on the eastern, southeastern, western and northern sides and folds define the southwestern and northeastern sides. These folds have very gentle dips even though they extend for miles. The folds along the north and northwest dip down to the southeast and create a hydrologic barrier within the N aquifer.

Faulting is less extensive than folding in the study area. Normal faulting associated with fold axes is the most common type found. None of these faults are considered significantly active, and there is no indication that any recent volcanism ever extended to Black Mesa. Several recorded earthquakes have measured between 5 and 6 magnitude on the Richter scale.

D.2.10.1 Geologic Environment

Geologic formations are illustrated in Figure D-1 and Figure D-2. Relatively level sedimentary rocks dominate the geology of the Kayenta Mine permit area with minor structural deformation by local folding and faulting. The rock units of Black Mesa are primarily undeformed and oriented in roughly horizontal beds. The Oljeto Syncline is a prominent fold that cuts north-south across the area, and lesser folds, such as the Maloney Syncline, are roughly parallel to it. Most faults are oriented east-west and are displaced less than 40 feet. The coal seams that are mined at the Kayenta Mine are contained within the Wepo Formation. The Yale Point Sandstone is a medium- to coarse-grained quartz sandstone. It is interbedded with the underlying Wepo Formation and can exceed 200 feet of thickness in the outcrop on the northeastern edge of Black Mesa.

D.2.10.2 Mineral Resources

The 90,000-square-mile Colorado Plateau, is rich in coal, uranium, and oil shale, all of which produce energy. Past mining activity in this area included uranium, gravel, and coal mines (NEMO 2010). Black Mesa, which includes the Kayenta Mine permit area, has proven coal reserves that have been mined for use by local communities as well as commercial enterprises. Mining in coal resource areas N-9, J-19, and J-21 is within the economically viable coal reserves of the Wepo Formation. In 2010, more than 7.7 million tons of coal were extracted by the Kayenta Mine operation. Through 2009, 259 million tons of coal had been mined at Kayenta Mine and 153 million tons at the neighboring Black Mesa Mine. The USGS' inferred total coal resource in the Wepo Formation exceeds 4.8 billion tons (Nations, Swift and Haven 2000).

Coal from the Black Mesa area has been analyzed for rare earths and germanium, but only trace amounts (less than 0.01 percent) are present. Such trace concentrations are currently not recoverable economically. Only secondary uranium mineralization occurs in the Toreva Formation on Black Mesa (Bureau of Indian Affairs [BIA] 1987). Minor quantities of the mineral material scoria are present. Scoria is used for road maintenance and in reclamation activities.

D.2.10.3 Paleontological Resources

Paleontological resources (fossils) are the remains, imprints, and traces of once-living organisms preserved in rock layers. Fossils can be bones and teeth, shells, leaf impressions, footprints, or burrows. Fossils are nonrenewable resources with scientific, educational, commercial, and recreational values. The Cretaceous coal-bearing strata in Black Mesa contain abundant plant and animal fossils and have high potential for yielding fossils. The fossils contained in these rocks are common throughout the Kayenta Mine permit area. Field surveys in N-9, J-19, and J-21 coal resource areas will be conducted to document

any important fossils, and PWCC will recover important fossils that are discovered during mining operations.

D.2.11 Climate

The Colorado Plateau region in northeastern Arizona has a semiarid climate, characterized by wide variations in diurnal and annual temperature. This region defines the study area for purposes of the discussion of climate. Black Mesa receives much of its precipitation during the summer months, when afternoon showers form due to moist air from the Gulf of Mexico moving over the area. Rainfall as high as 1.26 inch for 1 hour and 2.35 inches for 24 hours have been recorded. Most snowfall on Black Mesa is light and evaporates within a few days. Topographic features and changes in altitude influence the total amount of precipitation received at various locations on Black Mesa.

Due to the elevation (ranging from 6,000 to 8,200 feet above MSL), Black Mesa has mild summers and cold winter temperatures. The average annual temperature is about 50 degrees Fahrenheit (ºF). Summer temperatures generally range from the mid-50s to the low 80s. Temperatures over 100ºF are rare.

Within the PWCC mine lease area an extensive climatological monitoring program has been operating since the early 1980s (Map D-6). Temperature, wind speed, and precipitation data recorded at site BM-MET9 from January 2005 through December 2009 are summarized by season in Table D-9. This meteorological data describes the recent climate variables important to atmospheric transport and dispersion across the Kayenta Mine permit area.

Table D-9 Seasonal Meteorological Conditions at the Kayenta Mine Permit Area (2005-2009)

Parameter	Winter	Spring	Summer	Fall	Annual Average
Average daily mean temperature (°F)	30.8	48.6	70.0	51.1	50.6
Maximum daily temperature (°F)	59.4	84.9	94.5	82.2	92.1
Minimum daily temperature (°F)	-3.4	7.8	35.8	8.0	2.9
Average wind speed (miles per hour)	6.6	8.3	7.0	7.3	7.3
Hourly maximum wind speed (miles per hour)	34.5	38.0	32.0	36.5	35.6
Precipitation (liquid inches)	2.36	1.70	2.28	1.72	8.05

NOTE: ºF = degrees Fahrenheit

The dominant wind directions recorded from January 2005 through December 2009 are from the north and north-northeast. The other primary wind directions are from the south through southwest. The direction associated with the highest hourly average wind speed was southwest at 10.5 miles per hour (mph) (4.7 meters per second [m/s]) while the lowest average wind speeds occur under east-northeasterly and southeasterly winds at 4.7 mph (2.1 m/s). The overall average wind speed for the period at this site was 7.3 mph (3.3 m/s). A wind rose for the five-year period is provided in Figure D-3.

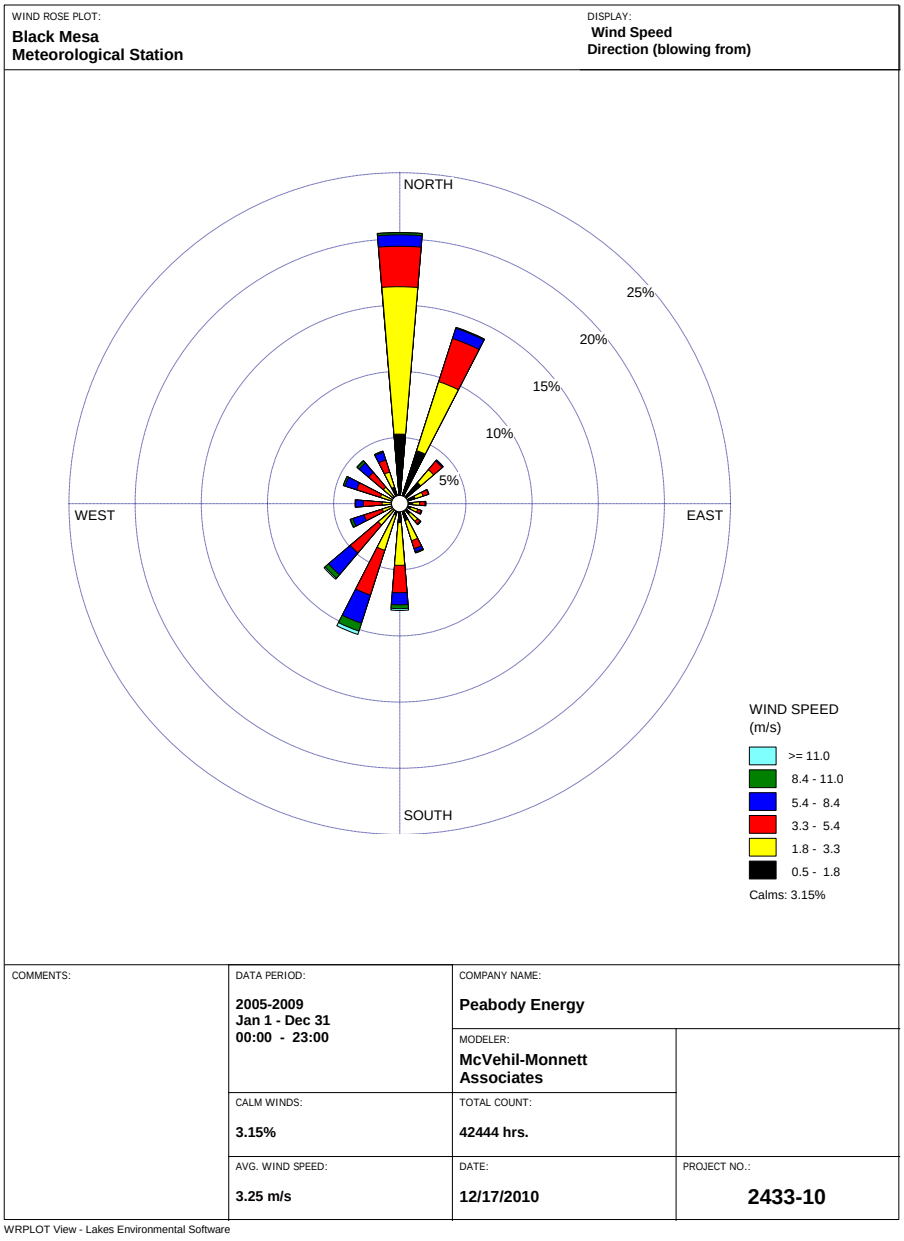


Figure D-3 Site BM-MET9 Wind Rose

D.2.11.1 Climate Change

Based on recent reports, there is concern about changes that may occur in the global climate. The U.S. Environmental Protection Agency (EPA) recently found that human greenhouse gas (GHG) emissions cause or contribute to air pollution that may reasonably be anticipated to endanger the public health or welfare (EPA 2009a).This section discusses the issues relevant to global climate change and summarizes the scientific uncertainties that make predictions about foreseeable changes in weather, localized effects and attribution to individual sources indeterminate and unreliable. Ultimately, under any scenario about whether and how climate might be changing, greenhouse gas emissions from the proposed action are too small to allow calculation of any measurable change on global climate.

Reports of observed temperature measurements over the last 150 years indicate the occurrence of periods of global temperature increases, such as the period from 1910 to 1945 and a period from 1977 to 1998 (U.S. EPA 2009b, National Oceanic and Atmospheric Administration 2010).[3]

Between 1998 and 2010, there has been a twelve-year period of less or no warming (NOAA 2010, Easterling and Wehner, 2009, EPA 2009c). Uncertainty exists over whether the temperature increases during the last several decades of the 20th century have been unprecedented over the past 1,000 to 2,000 years (EPA 2009b, National Research Council 2006).

Relying on the work of the International Panel on Climate Change, EPA concluded that the warming that occurred during the 20th century is evidence that GHG emissions affect global climate change (EPA 2009a, Intergovernmental Panel on Climate Change 2007). EPA, however, also emphasized the uncertainties involved in attempting to attribute specific amounts of warming to human GHG emissions EPA (2009b).[4]

Additional research is being conducted to better understand current scientific views on mechanisms with the potential to affect climate change. For example, recent scientific studies are raising new questions about the physics of GHG emission pathways and how water vapor variations in the lower stratosphere play a role in the variability of global temperature trends (Soloman et al. 2010).

With regard to the warming potential of greenhouse gases, water vapor is the most abundant greenhouse gas (Congressional Budget Office [CBO] 2003). Several other trace gases, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), and several fluorine- and chlorine-containing gases, also have been identified as potential greenhouse gases. Scientists have attempted to compare the global warming potential of each of these compounds.[5] Because of this potential variability, these compounds are expressed in this EA in terms of CO_2 equivalent (CO_2e).

Most greenhouse gases have both natural and anthropogenic sources (EPA 2011a). For example, natural sources of carbon dioxide are more than 20 times greater than sources due to human activity.[6] The

[3] These data rely upon a combination of land-based meteorological measurements, water temperature recordings from ships at sea prior to 1982 and satellite measurements of the troposphere since 1982, which may introduce error into the trends. Also, the long-term instrumental record is incomplete and the data include systematic problems due to sampling errors and variability concerns (Hegerl et al. 2001, Kalnay and Cai 2003).

[4] A number of scientists also stress that insufficiencies in our understanding of key aspects of the climate system, such as the role of water vapor and clouds (Spencer and Braswell 2010), limitations in climate model performance (Fildes and Kourentzes 2011), and uncertainties in future emissions pathways (Intergovernmental Panel on Climate Change 2007), make specific forecasts unreliable (see also: Spencer et al. 2007, Pielke et al. 2007, McKitrick and Michaels 2007).

[5] Atmospheric greenhouse gases (except water vapor) are adjusted for heat retention characteristics, relative to CO2.

[6] http://www.newworldencyclopedia.org/entry/Greenhouse_gas#cite_ref-13 (citing United Nations Environmental Programme, at http://www.grida.no/publications/vg/climate/).

primary natural processes that release CO_2 into the atmosphere (sources) and that remove CO_2 from the atmosphere (sinks) are (EPA 2011a):

- Animal and plant respiration, by which oxygen and nutrients are converted into CO_2 and energy;
- Plant photosynthesis, by which CO_2 is removed from the atmosphere and stored as carbon in plant biomass;
- Ocean-atmosphere exchange, in which the oceans absorb and release CO_2 at the sea surface; and,
- Volcanic eruptions, which release carbon from rocks deep in the Earth's crust.

With regard to anthropogenic GHG emissions, EPA reports that global CO_2 emissions from fossil fuel use (including power generation, transportation, and all other human uses of fossil fuel) account for 56.6% of the anthropogenic sources (EPA 2011b. Deforestation and the decay of biomass account for the second largest source (17.3%) of anthropogenic greenhouse gases (EPA 2011b). The Food and Agriculture Organization of the United Nations estimates the percentage of greenhouse gases released into the atmosphere each year from deforestation to be much higher in the range of 25 to 30 percent of all anthropogenic sources (Food and Agriculture Organization of the United Nations [FAO] 2006).

Substantially greater uncertainty exists when trying to disaggregate, or spatially downscale, the global models into regional or local predictions, even among those who believe some climate change is likely (Bureau of Reclamation 2011). Although it warns about the uncertainties from spatial downscaling, the Bureau of Reclamation has attempted to forecast future changes in climate and hydrology in the Colorado River Basin.

The Bureau of Reclamation's findings apply to an area approximately 250,000 square miles with varying terrain and habitat; therefore, the general predictions cannot be extrapolated to the Kayenta Mine Permit Area. However, according to Reclamation's climate modeling, the Colorado River Basin overall could face the following:

- On average, the Colorado River Basin temperature is projected to increase by 5-6 degrees Fahrenheit during the 21st century, with slightly larger increases projected in the upper Colorado Basin.
- Precipitation is projected to increase by 2.1 percent in the upper basin while declining by 1.6 percent in the lower basin by 2050.
- Mean annual runoff is projected to decrease by 8.5 percent by 2050.
- Warmer conditions are projected to transition snowfall to rainfall, producing more December-March runoff and less April-July runoff.

- Warmer conditions might result in increased stress on fisheries, shifts in species geographic ranges, increased water demands for instream ecosystems and thermoelectric power production, increased power demands for municipal uses – including cooling – and increased likelihood of invasive species infestations.

The U.S. Department of the Interior Task Force on Climate Change warns that "[t]here are large uncertainties in the projections of how fast these changes are occurring, what the full extent of the changes will be, and how our ecosystems will be permanently altered" (Department of the Interior 2008a).

Most sources acknowledge that current climate models are not able to predict with sufficient precision the localized climate impacts resulting from global climate changes, particularly in an area as small as the Kayenta Mine, nor can they accurately and reliably identify global impacts caused by individual projects. Based on a review of data from USGS, the Department of the Interior concluded that "[g]iven the nature of the complex and independent processes active in the atmosphere and the ocean acting on [greenhouse gases], the causal link simply cannot be made between emissions from a proposed action and specific effects on a listed species or its critical habitat. [A]ny observed climate change effect on a member of a particular listed species or its critical habitat cannot be attributed to the emissions from any particular source" (U.S. Department of the Interior, Office of the Solicitor 2008).

In the United States, the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* reports U.S. anthropogenic sources of CO_2 by use category to the United Nations (EPA 2011c). According to the most recent U.S. inventory, the main fossil-fuel CO_2 emission-source categories include electric-power generation (41 percent of total anthropogenic CO_2 emissions), transportation (33 percent), other industrial uses (14 percent), and residential and commercial uses (10 percent) (EPA 2011c).

The *Final Arizona Greenhouse Gas Inventory and Reference Case Projections for 1990-2020*, taking into account all human emission sources within the state, reports that Arizonans emit about 14 tons of CO_2e per capita, 36 percent less than the national average (Arizona Department of Environmental Quality 2006 [p. D-7]). The Arizona GHG inventory specifically addressed methane emissions from coal mining in the state, with Kayenta Mine accounting for most of the coal production. According to the inventory, these emissions are less than 0.1 million metric tons (MMt) CO_2e and have remained relatively constant from 1990 to 2002 (Arizona Department of Environmental Quality 2006). The inventory also anticipated that coal production and resulting methane emission would remain at 2002 levels through 2020. By comparison, total GHG emissions from all industrial processes in the state were projected to grow from 1.9 MMt CO_2e in 1990 to more than 9.0 MMt CO_2e in 2020 (Arizona Department of Environmental Quality 2006).

Net CO_2e emissions from all anthropogenic emission sources in Arizona was estimated to be approximately 80 MMt in 2000 and projected to be more than 100 MMt by 2010 (Arizona Department of Environmental Quality 2006).

Globally, CO_2 emissions in 2008 from all human sources were estimated to be 29,000 MMt (International Energy Agency 2010). PWCC estimated its GHG emissions from all emission sources at Kayenta Mine to be 163,000 metric tons total CO2e (PWCC 2011a).

D.2.12 Land Use

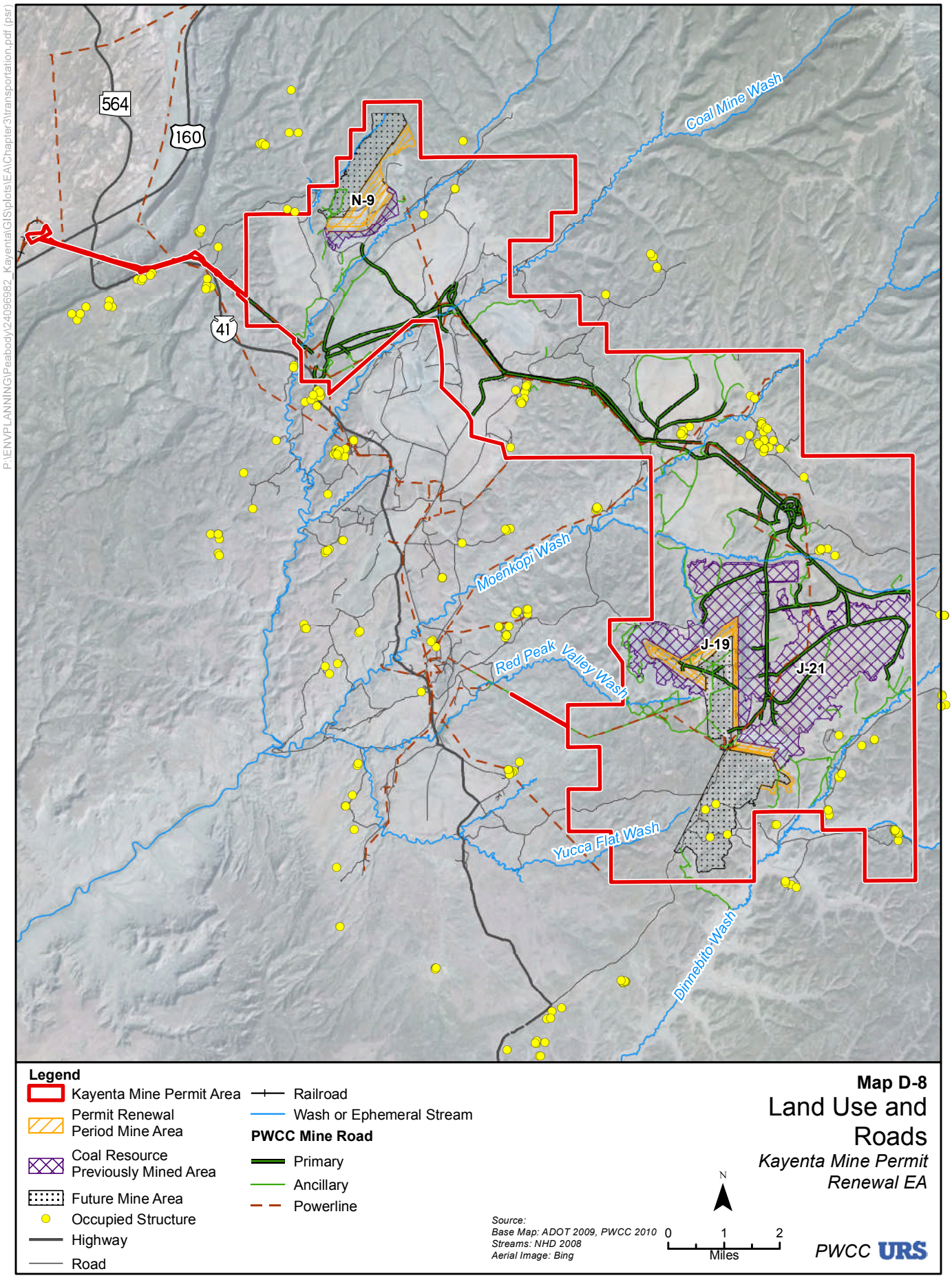
The study area for land use is Black Mesa. Land uses within and adjacent to the Kayenta Mine permit area include mineral exploration and development, dispersed residential uses, livestock grazing, and traditional uses (such as hunting, gathering, and ceremonial (Map D-8). PWCC's Kayenta Mine operation, including transportation and support facilities, is the only industry currently within or adjacent to the Kayenta Mine permit area (PWCC 2005b).

There is little commercial development on or within 5 miles of the Kayenta Mine permit area. A gas station and convenience store are located north of the mine at the intersection of U.S. Highway 160 and Navajo Route 41. The closest commercial area with food and lodging is in Tsegi on U.S. Highway 160 about six miles north of the study area. The next closest commercial area is Kayenta, approximately 15 miles northeast of the study area.

There are 83 Navajo households within the Kayenta Mine permit area, four of which are located in the J-21 coal resource area. Regulations require a minimum distance between mining activities and residential properties. Residences consist of individual family dwellings or extended family camps with several dwellings. PWCC, in cooperation with the Navajo Nation and according to approved procedures, relocates households to an agreed location, as needed, to accommodate surface coal mining activities. Relocated residents are compensated for the replacement of all structures, including homes, corrals, and sheds, and for lost grazing acreage if the resident can establish a customary use area claim (PWCC 2005b; OSM 1990). PWCC, through its relocation program would attempt to relocate residents within their customary use areas (i.e., where ranching activities take place or where sociocultural ties exist). Long-term residents would be able to return to their original home sites after reclamation is completed and the land is returned to tribal control after 20 to 25 years.

Historically, individual land ownership by Native American tribes did not exist. This perspective persists today within the Navajo and Hopi tribes, in that they consider themselves caretakers of the land and its resources. Land, a part of the universe, belongs to all, and all are entitled to the fruits of nature. Users' rights are protected and specified in various traditions, but there is no such thing as land "ownership".

Livestock grazing is a traditional and predominant land use on Black Mesa. Grazing in the Kayenta Mine permit area and vicinity occurs throughout the year and includes all classes of livestock. There are three range management districts, two Navajo and one Hopi, that overlap with the Kayenta Mine permit area. A small percentage of the permitted sheep units for the districts are grazed within the Kayenta Mine permit area. Residents may graze sheep, cattle and/or horses under a livestock grazing permit. Range condition on all native grazing lands is generally low due to heavy year-round livestock grazing. Extensive vegetation monitoring of reclaimed areas in 2009 (ESCO 2010) continues to document that as areas are reclaimed to meet post-mining land uses, the reclaimed areas contain the best developed grazing lands.


564
160
41
N-9
Coal Mine Wash
Moenkopi Wash
Red Peak Valley Wash
J-19
J-21
Yucca Flat Wash
Dinnebito Wash
Legend
Kayenta Mine Permit Area
Permit Renewal Period Mine Area
Coal Resource Previously Mined Area
Future Mine Area
Occupied Structure
Highway
Road
Railroad
Wash or Ephemeral Stream
PWCC Mine Road
Primary
Ancillary
Powerline
Source:
Base Map: ADOT 2009, PWCC 2010
Streams: NHD 2008
Aerial Image: Bing
N
0
1
2
Miles
Map D-8
Land Use and Roads
Kayenta Mine Permit Renewal EA
PWCC
URS

Traditional family gardens associated with residences occur within the Kayenta Mine permit area. These small fields are used or have been used for the production of adapted crops, particularly corn for domestic use. The size of individual plots averages approximately 4.5 acres (OSM 1990).

Numerous plant species have cultural significance to the Hopi and Navajo people on Black Mesa. Plants are used for construction, heating, medicine, ceremonies, and food. Hundreds of culturally important plants to the Hopi and Navajo have been documented by a number of authors (Rainey and Adams 2004), and one of the missions of the Navajo Nation Natural Heritage Program is to document cultural information on plants and animals important to the Navajo. Unknown quantities of piñon pine, Utah juniper, and one-seed juniper trees are harvested for firewood, fence posts, and construction materials (OSM 1990). No specific collection areas have been identified in the Kayenta Mine permit area, and many of the species are widely distributed within their habitats, including the Kayenta Mine permit area. Culturally important plants also are present in reclaimed areas where cultural plant sites have been established and where natural recolonization has occurred.

Coal from Kayenta Mine is provided to the Navajo and Hopi people on Black Mesa for home heating. Other natural resources that may be used for traditional purposes include minerals or clay deposits and sources of surface water or shallow groundwater.

The presence of wildlife habitat and associated species encourages recreational activities, such as hunting, and provides a means of supplementing the dietary needs of the residents. Hunting is regulated by the Navajo and Hopi tribal governments.

D.2.13 Social and Economic Conditions

In accordance with the NEPA, the analysis of social and economic conditions addresses the relationships between the proposed project and the communities it may affect. The following characterization of current social and economic conditions describes demographics, employment, income, fiscal and budgetary information, and community facilities in the region that could potentially be affected by the Kayenta Mine operations during the permit period.

The social and economic conditions study area includes areas that could be affected economically and socially by the proposed project due to their proximity to project facilities. For the regional analysis, data were collected for Navajo, Coconino, and Apache Counties, the Hopi and Navajo Reservations, and local villages and chapters of government on the Hopi and Navajo Reservations. Data also were collected for the State of Arizona, to use for comparison purposes.

The Kayenta Mine permit area is located entirely within Navajo County, Arizona and is located within a portion of the Hopi Reservation and the Navajo chapters of Chilchinbito, Forest Lake, Kayenta, and Shonto. A village is the Hopi unit of local government; a chapter is the Navajo unit of local government. Generally, 2000 census data are provided for tribal areas and chapters. The U.S. Census Bureau defines portions of some chapters or other areas densely populated unincorporated communities as census-designated places. Certain information in Census 2000, such as the unemployment rate, is shown for

census-designated places. Tribal and county-level data used in this analysis overlap in places where these geographic units overlap. A summary of the proportion of each county's population in each of the two reservations, as well as living off-reservation, is shown in Appendix F, Table F-1, which indicates the extent to which this data may be duplicative.

Regional Overview of Demographics and Economics

Table D-10 presents an overview of demographic characteristics for the Hopi Reservation, Navajo Nation, Apache, Coconino, and Navajo Counties, and the State of Arizona. Arizona was one of the fastest growing states in the nation in the 1990s. Rapid growth continued between 2000 and 2004 at the State, county, and tribal levels.

Table D-10 Key Population Characteristics – Regional

	Counties			Tribal Areas		
	Apache	**Coconino**	**Navajo**	**Hopi Reservation [1]**	**Navajo Nation**	**State of Arizona**
Total Population						
Census 1990	61,591	96,591	77,658	7,360	148,451	3,665,228
Census 2000	69,423	116,320	97,470	6,946	180,462	5,130,632
Census 2010[2]	N/A	N/A	N/A	N/A	N/A	6,392,017
Percent Change, 1990-2000	12.7	20.4	25.5	-5.6	21.6	
Percent Change, 2000-2010	N/A	N/A	N/A	N/A	N/A	24.6
Median age, 2000	27	29.6	30.2	29.1	24.0	34.2
Median age, 2010						35.9
Dependency ratio, 2000 [3]	67.1	44.2	64.6	68.9	69.7	54.9
Dependency ratio, 2010 [3]						53.9
Persons per household, 2000	3.41	2.80	3.17	3.49	3.77	2.64
Persons per household, 2010[2]						2.63

SOURCE: U.S. Census Bureau 1990, 2000, 2010; Hopi Tribe 2001, Navajo Nation 2005

NOTES: [1] Surveys completed for the Hopi Strategic Land Use and Development Plan indicated a year 2000 population of 10,571, rather than the 6,946 reported in Census 2000.

[2] Detailed 2010 census data is currently only available at the state level and 2000 Census data was used as the best available data. State of Arizona numbers reflect calculations from 2000 to 2010 and all calculations for other entities are based upon comparisons of 1990 and 2000 data.

[3] The dependency ratio is the proportion of dependents in relation to a working-age adult.

According to the 2000 U.S. Census, the median age of the population in the region is similar to that of the State of Arizona. However, the Hopi Reservation, Navajo Nation, Apache, Coconino, and Navajo County have lower median ages than relative to the State of Arizona. The region also has a larger number of persons per household in comparison to the State of Arizona (see Table D-10).

The dependency ratio is a statistic that compares the size of the economically dependent population age groups to the size of the working-age population expressed as a percentage. The dependency ratio is the sum of the under 15 and over 65 population divided by the population aged 15 through 64. Areas with dependency ratios over 60 tend to have a proportionately small number of employed persons supporting the remainder of the residents. While the State of Arizona and Coconino County have dependency ratios less than 60, the remaining areas of the region have dependency ratios over 60, and both tribes' dependency ratios are higher than any of the counties in the study area. The dependency ratio reported in the 2010 U.S. Census for the State of Arizona is similar to that reported in the 2000 U.S. Census for the State of Arizona. At this time, no data is available for the dependency ratio at the County and Tribal level.

Recently, unemployment rates in the study area generally have been higher than those for Arizona as a whole (Appendix F, Table F-2). In 2004, while Arizona's statewide unemployment rate was 4.8 percent, Coconino County had a rate slightly higher than the state (6.1 percent). Navajo County, which contains the Kayenta Mine operations, had a rate of 10.6 percent, and Apache County had a rate of 13.3 percent.

In 2004, the unemployment rates of the Hopi Reservation (18.2 percent) and the Navajo Nation (20.6 percent, Arizona portion) were highest in Arizona, according to the Arizona Department of Economic Security. Arizona Department of Economic Security data consider neither the unemployed whose unemployment benefits have run out nor those who are a part of the informal economy. The informal reservation economy focuses on non-business-related social, traditional, and avocational activity and reflects the production of traditional goods required to reciprocate in clan and family social obligations. A 1999 survey for the Hopi Strategic Land Use and Development Plan documented an unemployment rate of about 64 percent for the reservation. The Navajo Nation Department of Economic Development conducted surveys that indicated an unemployment rate of about 47.6 percent for 2003 (SWCA Environmental Consultants 2005).

Employment status data for the years 2005-2009 is available for the Hopi Reservation and Navajo Nation from the U.S. Census Bureau, 2005-2009 American Community Survey. During that time period, unemployment rates for the Hopi Reservation and Navajo Nation (Arizona, New Mexico, and Utah) dropped to 12.4 percent and 14.3 percent, respectively. Employment data for the State of Arizona from 2005 through 2009 were only available from the U.S. Bureau of Labor Statistics website (www.bls.gov). The trend from 2003 through 2007 showed a decrease in the unemployment rate percentage at a state level. The percentages for the region from 2003 through 2004 correlated with the state level decrease. However, from 2007 through 2009, the trend in unemployment rate percentages showed a significant increase. The data for years 2005 through 2009 are not available at a regional level; however, based on data at the state level, it can be assumed that a similar increase in the unemployment rate percentage occurred at a regional level.

The distribution of employment by industry sector in the study area appears in Table D-11. In the year 2000, the services and information sector dominated employment to a similar extent in Apache, Coconino, and Navajo County, the Hopi Reservation and Navajo Nation, and the State of Arizona. Retail and wholesale trade and manufacturing were the next largest sectors of Arizona's employment, although

they were generally smaller proportions of total employment on the reservations. Mining employs a much higher proportion of workers on the Navajo Nation than statewide. Public administration employs a higher proportion of workers on both reservations than statewide.

Table D-11 Regional Employment, Percent Share by Industry Sector, 2000

Area	Total Employment	Industry as Percent (%) of Total Employment								
		Agriculture, Forestry, Fishing, and Hunting	Mining	Construction	Manufacturing	Retail and Wholesale Trade	Transportation, Warehousing, and Utilities	Services and Information	FIRE and Rental/Leasing	Public Administration
Counties										
Apache	16,469	1.9	1.2	10.9	2.6	9.1	7.2	51.7	2.8	12.6
Coconino	55,510	1.3	0.4	7.7	5.2	14.8	5.4	54.5	3.9	6.8
Navajo	29575	2.3	1.4	11.1	5.4	14.7	7.0	45.1	3.8	9.2
Tribal Areas										
Hopi Reservation	1,869	0.3	0.7	10.5	5.5	8.6	1.4	45.2	1.8	26.0
Navajo Nation (Arizona portion)	21,907	1.0	2.7	12.9	3.3	8.4	6.0	52.7	2.2	10.8
State of Arizona	2,233,004	1.0	0.5	8.7	10.2	15.6	5.0	45.8	7.9	5.4

SOURCE: U.S. Census Bureau 2000
NOTE: FIRE = Finance, Insurance, and Real Estate

Kayenta Mine

The Kayenta Mine permit area is within the jurisdiction of the Hopi Reservation and Navajo Nation, and is located entirely within Navajo County. The area of influence for social and economic conditions is defined as the areas where the socioeconomic effects of Kayenta Mine mining operations are most keenly felt. The population in this area includes the residents of the Hopi Reservation and 14 Navajo chapters. The Coconino County communities of Page and Flagstaff also are included because these provide some mine-support services, trade activities, and some mine-related employment. There are 83 occupied structures within the Kayenta Mine permit area, including four households located in the J-21 coal resource area.

Population in the Study Area

Population in the study area has generally grown over the past 20 years. The Navajo Nation population has grown from 148,451 in 1990 to 155,214 in 2000 (Appendix F, Table F-3). There were 40,933 households documented in the Navajo Nation in 2000. On the Hopi reservation, population decreased from 7,360 in 1990 to 6,815 in 2000. The Hopi reservation reports 1,938 households. Population growth has increased from 1990 to 2000 in both of these agencies. The Chinle agency increased from 5,221

people in 1990 to 6,212 in 2000, and there were 1,589 households reported in 2000. The Western agency population has also grown, increasing from 23,787 people in 1990 to 28,434 in 2000. There were 7,143 households reported among the members of the Western agency in 2000. Specific population data can be found in Appendix F, Table F-3.

The two largest communities within the study area are Kayenta Township (within Kayenta Chapter) and Tuba City (a census-designated place within Tuba City Chapter), both designated by the Navajo Nation as "primary growth centers" for economic development. Kayenta Township is the closest urban community to the Kayenta Mine operation; the township is the only government structured as a municipality on the Navajo Reservation, with taxing authority and a sales tax of 5 percent.

The Navajo Nation and the BIA each distribute a variety of services through the agency system, and residents tend to identify with their agency. The Western Navajo Agency and the Chinle Agency are two of five administrative jurisdictions of the BIA, providing services to the Navajo Indian people within the central and western region of the Navajo Nation. These services include natural resource, real estate, transportation, and safety programs. Tuba City is the headquarters of the Western Navajo Agency, and Chinle is the headquarters of the Chinle Agency. While most of the chapters in the local area of influence belong to the Western Navajo Agency, a few belong to the Chinle Agency.

Unemployment

Unemployment is a persistent problem in communities within the study area, particularly on the reservations. The overall unemployment rates for the Hopi Reservation and Navajo Nation appear in Appendix F, Table F-2 as reported by the Arizona Department of Economic Security and the tribes. The rates are significantly higher than the unemployment rates for the State of Arizona and for Apache, Coconino, and Navajo County. The Kayenta and Tuba City areas of the reservation have unemployment rates that are lower than those in the other parts of the reservation. Of the two areas, the Kayenta area's 2004 unemployment rate was lowest, at 9.6 percent, less than half the overall Navajo Nation rate.

Employment and Income

The major employment sectors on the Hopi Reservation, according to the 2000 Census, appear on Table D-11. Information from the Hopi Tribe (Hopi Office of Community Planning and Economic Development 2001) indicates that manufacturing employment is at 40 percent of the labor force, compared with the Census' figure of 5.5 percent. The difference is partly explained by some differences in the definition of employment. The Hopi Tribe count as manufacturing employees, people who produce crafts—some for market and some for ceremonial purposes and exchange within extended families. The Hopi Tribe's information indicates that services employ 37 percent of the labor force. The Hopi definition includes all jobs that the Census defines as public administration, plus a small number of the jobs that the Census defines as service jobs, so the figures from the Hopi Tribe and Census 2000 are consistent. The most numerous public administration jobs are with the Hopi tribal government, schools, and the Indian Health Services.

The five largest employers on the Navajo Nation in 2002 were government entities: the Navajo Nation, the State of Arizona (including school districts), the Indian Health Services, the BIA's Office of Indian Education Program, and the State of New Mexico (SWCA Environmental Consultants 2005). That ranking of largest employers was consistent, in general, with Census 2000 figures, which indicated that public administration and the services and information sectors accounted for over 60 percent of employment on the Arizona portion of the Navajo Reservation. Private industries, including mining, manufacturing, agriculture, and tourism are a few in comparison. After the five government entities listed above, PWCC is the sixth largest employer.

According to the 2000 Census, the median family income for residents of the Hopi Tribe and Navajo Nation were $23,496 and $23,209, respectively; these data were below the median family income for residents in the Kayenta census-designated place ($32,500), Navajo County ($32,409), and the State of Arizona ($46,723).

The mining sector provides many jobs in the local area of influence. The Kayenta Mine currently employees 422 people, the majority of whom reside in the local area; only 13 people live in an area outside of Arizona. Of the 409 miners residing in Arizona, 369 live on the Hopi Reservation or Navajo Nation. In 2010, employees of the Kayenta Mine are expected to earn $51.5 million through payroll and fringe benefits. Table D-12 shows the estimated Kayenta employees and payroll and benefits for the years through 2015.

Table D-12 PWCC Employment Data

Year	Kayenta Mine Employees [1]	Kayenta Mine Payroll ($ million) [1, 2]	Kayenta Mine Benefits ($ million) [1]	Total Payroll and Benefits ($ million) [1]
Actuals				
2009	426	31.6	14.1	46.2
Projected				
2010	422	31.0	20.5	51.5
2015	432	29.6	20.6	50.2
SOURCE: URS personal communication, December 2010				

NOTES: [1] Totals include both hourly and salaried employees.
[2] Above dollars are not escalated; to escalate salaries a 2.5% annual increase is used.

Mining's share of local employment is higher than its share of regional employment. While mining employed more than 5 percent of workers in the local communities in the year 2000, mining employed less than 3 percent of workers in the Arizona portion of the Navajo Reservation. In Chilchinbito and Kayenta, the employment in the mining sector is second to the services and information sector (Appendix F, Table F-4).

Mine employees support many young and elderly persons. The ratio of the dependent aged population to the working age population is higher overall for the Tribal Areas than the ratios for Apache, Coconino,

and Navajo Counties and these are significantly higher than the ratio for the State of Arizona (Table D-10).

Residents of the area around the Kayenta Mine permit area generally enjoy greater prosperity than residents of the Hopi and Navajo Reservations. Incomes are highest for mining workers and for those employed in tourism or government. Typically, wages are low in other sectors, and those seeking work exceed the number of jobs available.

A 2004 study of the area including the communities of Kayenta, Chilchinbito, and Oljato identified the mining operations as the driving force behind the local economy (Arizona State University [ASU] Center for Business Research 2004). Jobs that exist due to a mine worker's household spending, or the spending of a business that supplies the mines, represent indirect jobs attributable to current mining operations. Similarly, income and spending that support the increase in household spending and supplier spending attributable to the mining operation represent indirect economic impacts.

Fiscal Conditions

PWCC pays property and sales taxes, and makes special payments to federal agencies, the Navajo Nation, and Hopi Tribe. The following sections describe these payments and include the entity receiving the payments.

Property Valuation and Taxation

PWCC pays property and sales taxes to the State of Arizona (Appendix F, Table F-5). Property taxes are based on the assessed value, not the current market value. In addition, cities and counties, schools, water districts, community colleges, and bond issues all affect the amount paid in property taxes. The tax rate of each property is the sum of the state, county, municipal, school, and special district rates. The property taxes for the mines are paid to Navajo County. It is estimated that about 85 percent of the property tax paid by PWCC is distributed back to Kayenta Unified School District. State sales tax is paid on coal sales, outside services, and materials and supplies. The revenue from the State sales tax is retained by the State and distributed through a number of funds based upon the approved State budget. Various State services are provided to residents within the area of influence, most notably through distributions back to local school districts. PWCC compensates local area residents for acreage removed from customary grazing areas as a result of the mining activities. On average, these payments amount to about $487,000 distributed on an annual basis to those residents whose grazing area has been reduced due to mining and reclamation activities (see Appendix F, Table F-5).

Federal Payments

OSM is responsible for collecting fees related to the SMCRA, which provides for the restoration of land mined and abandoned or left inadequately restored before August 3, 1977. Under this program, production fees (based on a per/ton basis) are collected from coal producers at all active coal mining operations. The fees are deposited in the Abandoned Mine Land (AML) Reclamation Fund, which is used to pay the reclamation costs of abandoned mine land projects. The Hopi Tribe and Navajo Nation receive

grants on an annual basis awarded under Title IV of SMCRA to fund reclamation of eligible mines (SWCA Environmental Consultants 2005). A variety of projects have been funded by these grants for reclamation work on tribal or Indian lands, including abandoned coal and uranium mine reclamation and assorted community development projects. Another Federal tax paid by PWCC is the Black Lung Excise Tax, the proceeds of which are provided to the United Mine Workers of America Combined Benefit Fund.

Since 2001, annual payments have been made by PWCC under the AML Reclamation Fund, as well as the amounts paid through the Black Lung Excise Tax for 2001 through 2009 (Appendix F, Table F-6). The 2010 estimated payments for both the AML Reclamation Fund was $2.5 million and the Black Lung Excise Tax was $4.3 million.

Payments to Tribes

The coal produced from the mining operations also is subject to three coal-mining leases approved by the Hopi Tribe, Navajo Nation, and Secretary of the Interior. The lease agreements provide for payment of royalties and bonuses to the tribes. The royalty rates were adjusted in 1987 and were again adjusted for the Hopi lease in 1997. Since 1987, the total coal royalties paid to the tribes is $797.4 million; $235.3 million to the Hopi and $562.1 million to the Navajo. The yearly average of coal royalties paid to the tribes by PWCC is $34.7 million; $10.2 million to the Hopi and $24.4 million to the Navajo. Table F-7 in Appendix F includes historical and current revenues to the tribes for royalties and bonuses related to coal extraction.

The lease agreements with the tribes provide for royalty payments for use of the N aquifer water. The fees paid are based on the amount of water withdrawn from the aquifer. Table F-8 (Appendix F) summarizes the historical and current annual payments for water-use royalties to both tribes. Since 1987, the total water use fees paid to the tribes is $73 million; $36.5 million to the Hopi and $36.5 million to the Navajo. The yearly average of water use fees paid to the Hopi and Navajo by PWCC is $3.2 million; $1.6 million to each Tribe. The years 2005 to 2009 show an overall reduction of $0.5 million in the yearly average paid to each Tribe. It is estimated that in 2010, $543,300 would be paid to both the Hopi Tribe and Navajo Nation for water use fees associated with Kayenta Mine operations.

In some recent years, mining operations have been the single largest source of revenue in the Hopi and Navajo Nation tribal budgets. Funds received by the tribes are distributed broadly to a number of tribal agencies, Hopi villages, and Navajo chapters. Historically, coal revenues fund the bulk of the Hopi Government's annual operating budget and have funded the majority of more than 500 jobs provided by the Hopi Tribe. According to the Navajo Nation Division of Economic Development's *2009-2010 Comprehensive Economic Development Strategy – The Navajo Nation* report, of the fiscal year 2009 Navajo Nation General Fund budget of $150.5 million, total mining revenues contributed $54.9 million, or 36.5 percent (Navajo Nation 2009). According to March 2010 written comments made by the Hopi Tribe in response to the Environmental Protection Agency's Advanced Notice of Proposed Rulemaking Regarding Best Available Retrofit Technology for Nitrogen Oxide Emissions at the Navajo Generating

Station Docket Number EPA-R09-OAR-2009-0598, "[t]he Hopi Tribe derives almost all of its revenues directly or indirectly from coal mining activities. In 2009, the Hopi Tribe's coal-based revenues were $14 million, representing approximately 88 percent of the Tribe's annual governmental budget."

Electric

The Navajo Tribal Utility Authority (NTUA) is an enterprise of the Navajo Nation, providing electric, natural gas, water, wastewater treatment, and solar energy to residents and businesses of the Navajo Nation and limited areas of service to the Hopi Reservation. The NTUA purchases electrical power from off the Navajo Nation reservation and transmits that power to homes across northeastern Arizona, northwestern New Mexico, and southeastern Utah. Arizona Public Service provides electrical service to part of the study area, particularly on the Hopi Reservation. There is no service provided to the mine by Arizona Public Service.

There are two 69 kilovolt feeder lines servicing the mines; NTUA has an agreement with PWCC by which PWCC operates the substation to serve the mine. As Kayenta Mine is a major user of power provided by NTUA, payments for electric service represent approximately 16 percent of NTUA's electric revenue and about 10 percent of the total revenue for the NTUA for the years 1987 through 2004 (see Appendix F, Table F-10). The data for total electric revenue and total revenue are not available from the NTUA for the years 2005 to 2010. The average payment for electric service at the Kayenta Mine between 2005-2010 is approximately $8.01 million dollars per year. A summary of these payments can be found in Appendix F, Table F-10.

Education

The educational institutions at the kindergarten through high-school levels in the local area comprise four categories of schools: Arizona unified school districts, BIA schools, BIA contract schools (funded by BIA but managed by the tribes), and Arizona charter schools (see Table D-13).

Table D-13 Schools (Grades K-12) in the Local Area

Name of District or School	Category	Grade Levels
Kayenta Unified District	Arizona Unified District	K-12
Tuba City School District	Arizona Unified District	K-12
Piñon Unified District	Arizona Unified District	K-12
Shonto Preparatory School	BIA contract and Arizona charter	K-12
Kayenta Community School	BIA	K-8
Chilchinbito Community School	BIA contract	K-8
Greyhills Academy (Tuba City)	BIA contract	9-12
Moenkopi Day School	BIA	K-8
Dennehotso Boarding School	BIA	K-8
Kaibito Boarding School	BIA	K-8
Tonalea Day School	BIA	K-8
Tuba City Boarding School	BIA	K-8
Rough Rock Community School	BIA contract	K-12

SOURCES: Arizona Department of Education 2005, SWCA Environmental Consultants 2005
NOTES: K = kindergarten; K-12 = kindergarten through the twelfth grade

Arizona schools' five-year graduation rate in 2003 averaged 73 percent, compared to rates ranging from 51 percent to 87 percent for the schools in the local area near the Kayenta Mine permit area for which the rate was available (Arizona Department of Education 2005). In 2008, the statewide four-year graduation rate was 75 percent, compared to 60 percent for those students who classified themselves as Native American; the percentage for Native Americans is up from 55 percent in 2007 (Arizona Department of Education State Report Card 2008-2009, 2010 www.ade.state.az.us).

Tuba City, Kayenta, and Moenkopi have a higher proportion of high-school graduates among residents aged 25 and over than the overall rates for the Hopi (67 percent) or Navajo (57 percent). The State of Arizona's rate of high-school graduates is 80.9 percent. The greater percentage of college graduates reside in Tuba City and Kayenta than overall Navajo Nation's 8 percent college graduates rate. The other local communities have lower educational attainment among adults than is the case for the Hopi Tribe or Navajo Nation overall. PWCC contributes about $0.4 million annually to Hopi Tribe and Navajo Nation scholarship funds. Through 2010, PWCC has contributed about $8.1 million to these scholarship funds.

D.2.14 Environmental Justice

In accordance with Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, it is the responsibility of Federal agencies to identify and address "disproportionately high and adverse human health or environmental effects of its activities on minority populations and low-income populations." The general purposes of the Executive Order are to (1) focus attention of Federal agencies on the human health and environmental conditions in minority and low-income communities with the goal of achieving environmental health; (2) foster nondiscrimination in Federal programs that substantially affect human health or environment; and (3) give minority communities and low-income communities greater opportunities for public participation in, and access to public information on, matters relating to human health and the environment.

An environmental justice population can be defined by one of two criteria: (1) the number of minority and/or low-income persons within a defined area exceeds 50 percent of the population, or (2) the number of minority and/or low-income persons within a defined area exceeds the number of minority and low income persons in a larger community of which it is a part (e.g., State, county, or other division) (Council on Environmental Quality [CEQ] 1997). The study area for Environmental Justice includes the Hopi Reservation and two Navajo Nation chapters (Chilchinbeto and Forest Lake).

The most recent available census data (Census 2000) on race and ethnicity were used to identify minority populations that might be disproportionately larger than the general population. The Hopi and Navajo reservations are predominantly American Indian (93.4 percent and 95.6 percent, respectively). The study area overlaps two Navajo Nation Chapters, Chilchinbeto and Forest Lake, which are about 98 percent American Indian. The Moenkopi Administrative Area in the Hopi Reservation is about 96 percent American Indian (Table D-14 and Table D-15). The percentage of American Indian residents in Navajo County (47 percent), as well as in the Navajo Nation Chapters and Moenkopi Village, significantly exceed the proportion of American Indians in the overall Arizona population (5 percent), but is similar to the proportion of American Indians within the Navajo Nation and Hopi Reservation (refer to Table D-15).

The economies of minority and low-income communities often are less resilient than economies of other communities because these populations generally are dependent upon their surrounding environment (e.g., subsistence living), more susceptible to pollution and environmental degradation (e.g., reduced access to health care), and often less mobile or transient than other populations (e.g., unable to relocate to avoid potential impacts). Census data also were used to identify low-income populations, using thresholds for poverty as defined by the CEQ guidance. On average, low-income populations of the Navajo and Hopi reservations exceed low-income populations in the surrounding county and in the state of Arizona. Navajo and Hopi reservations have disproportionately high low-income populations with 42.1 percent and 41.0 percent below the poverty line, respectively, compared to 13 percent for Arizona overall. Navajo County, at 29.5 percent, also exceeds the statewide proportion of persons below the poverty level (Table D-16). Poverty data from the Census 2000 also were analyzed for both Navajo Chapters and the Moenkopi Administrative Area of the Hopi Reservation that overlap the study area. Both the Chilchinbeto (47.3 percent) and Forest Lake (62.3 percent) chapters have a significantly higher percentage of individuals below the poverty level than the statewide average. While the percentage of individuals below the poverty line on the Hopi Reservation is 41.0 percent, exceeding the statewide percentage, the percentage of individuals below the poverty line living in the Moenkopi Administrative Area appears as zero (Census 2000).

Table D-14 Race and Ethnicity – Regional Level[1,2]

	Arizona (2000 U.S. Census)	**Arizona** (2010 U.S. Census)	**Navajo County**	**Navajo Reservation**	**Hopi Reservation**
Total population	5,130,632	6,392,017	97,470	155,214	6,815
Race (alone)					
White	3,274,258	3,695,647	41,196	3,566	240
Percent of total population	*63.8*	*57.8*	*42.3*	*2.3*	*3.5*
Black or African American	149,941	239,101	794	122	14
Percent of total population	*2.9*	*3.7*	*0.8*	*0.08*	*0.2*
American Indian and Alaska Native	233,370	257,426	45,846	148,423	6,365
Percent of total population	*4.5*	*4.0*	*47.0*	*95.6*	*93.4*
Asian	89,315	170,509	315	100	4
Percent of total population	*1.7*	*2.7*	*0.3*	*0.06*	*0.06*
Native Hawaiian/Other Pacific Islander	5,639	10,959	39	28	1
Percent of total population	*0.1*	*0.2*	*0.04*	*0.02*	*0.01*
Some other race	6,120	8,595	29	7	2
Percent of total population	*0.1*	*0.1*	*0.03*	*0.005*	*0.03*
Two or More Races	76,372	114,631	1,240	1,054	58
Percent of total population	*1.5*	*1.8*	*1.3*	*0.7*	*0.9*
Ethnicity					
Hispanic or Latino origin	1,295,617	1,895,149	8,011	1,914	131
Percent of total population	*25.3*	*29.6*	*8.2*	*1.2*	*1.9*

SOURCE: U.S. Census Bureau 2000, SF1, P4; 2010, DP-1 (Demographic Profile Data)

NOTES: [1] Includes population on Hopi Reservation and off-reservation land in Arizona.

[2] Includes population on Navajo Reservation and off-reservation land in Arizona, New Mexico, and Utah.

Table D-15 Race and Ethnicity – Relevant Navajo Chapters and Hopi District

	Navajo Chapters		Hopi
	Chilchinbeto	**Forest Lake**	**Moenkopi District**
Total population	1,325	573	901
White	13	1	13
Percent of total population	*1.0*	*0.2*	*1.4*
Black or African American	0	0	0
Percent of total population	*0*	*0*	*0*
American Indian or Alaska Native	1,296	566	869
Percent of total population	*97.8*	*98.8*	*96.4*
Asian	0	0	0
Percent of total population	*0*	*0*	*0*
Native Hawaiian/Other Pacific Islander	0	0	0
Percent of total population	*0*	*0*	*0*
Other	0	0	0
Percent of total population	*0*	*0*	*0*
Two or more races	0	2	12
Percent of total population	*0*	*0.3*	*1.3*
Hispanic or Latino origin	16	4	7
Percent of total population	*1.2*	*0.7*	*0.8*

SOURCE: U.S. Census Bureau 2000, SF1, P4

Table D-16 Regional Income Characteristics

				Navajo Chapters		Hopi	
	Arizona	**Navajo County**	**Navajo Reservation**	**Chilchinbeto Chapter**	**Forest Lake Chapter**	**Hopi Reservation**	**Moenkopi**
Total population	5,021,238	95,084	154,496	1,367	424	6,595	15
Per capita income	$20,275	$11,609	$7,486	$5,745	$3,638	$8,637	$11,800
Median Family Income	$46,723	$32,409	$23,209	$26,029	$9,479	$23,496	$41,250
Persons below poverty level	698,669	28,054	65,001	647	264	2,702	0
Percentage of persons below poverty level	13.1	29.5	42.1	47.3	62.3	41.0	0

SOURCE: U.S. Census Bureau 2000, SF3, P77; SF3, P82; SF3, P87

OSM's responsibilities for administering the Indian lands program, Federal program, and Federal lands program established under SMCRA and the implementing regulations for these programs specifically address public notification and participation, and availability of documents to the general public. As part of the public outreach with environmental justice populations in the study area and as part of the permit renewal application, announcements were published in the Navajo-Hopi Observer and the Navajo Times once a week in March and April of 2010. These announcements provided information to residents on the permit renewal application and the request for public comments. During the comment period that ended June 4, 2010, two requests were made for informal public conferences to be held in accordance with 30 CFR 773.6 (c).

Informal public hearings were held on May 26, 2010 in the town of Second Mesa and on May 27, 2010 in the town of Kayenta. These informal public hearings on PWCC's application to renew the permit provided residents with information related to the project and meeting attendees were provided the opportunity to voice their questions and concerns related to the permit renewal. Information provided during the meeting was a description of the Kayenta Mine permit area, which coal resources areas were proposed for renewal, and the regulatory criteria associated with the renewal application. The residents were notified by public announcements in local newspapers and by radio stations. Approximately 26 people provided comments during the informal hearings (OSM 2010a and OSM 2010b).

In addition to this public outreach regarding the Kayenta Mine permit renewal, the Black Mesa Review Board, whose mission is to advocate for the best interest of the local families within the leased area of Peabody Western Coal Company (PWCC), has also been informed of the PWCC permit renewal application. PWCC collaborates with the Black Mesa Review Board to address local issues and provides technical assistance, data and field research (Black Mesa Review Board 2011).

D.2.15 Indian Trust Assets

The United States has a responsibility to protect and maintain rights reserved by or granted to American Indian tribes by treaty, statutes, and executive orders. This responsibility requires Federal agencies to take actions necessary to protect Indian trust assets. The Secretary of the Interior's Order Number 3215, dated April 28, 2000, addresses "Principles for the Discharge of the Secretary's Trust Responsibility." That Secretarial Order cited the American Indian Trust Fund Management Reform Act of 1994 (Public Law 103-412, 108 Statute 4239) as the most comprehensive and informative legislative statement of Secretarial duties in regard to the trust responsibility of the United States. A key section of that law indicates that the Secretary's proper discharge of the trust responsibilities of the United States shall include, but are not limited to, appropriately managing the natural resources located within the boundaries of Indian reservations and trust lands (25 U.S. Code 162a(d), cited in Babbitt 2000).

D.2.15.1 Indian Trust Assets Definition and Characteristics

The Federal Government defines Indian trust assets as legal interests in assets that are held in trust or restricted status for federally recognized American Indian tribes or individual American Indians. Based on Department Manual 303, Indian Trust Assets [are] lands, natural resources, money, or other assets held by the federal government in trust or that are restricted against alienation for Indian tribes and individual Indians (USDI 2000). Examples of Indian trust assets include minerals, water rights, lands, hunting and gathering rights, other natural resources, or money. Examples of property interests, other than exclusive ownership, are leases or rights of use. Indian trust assets can be real property, physical assets, or intangible property rights. Indian trust assets do not include things in which a tribe has no legal interest. For example, off-reservation sacred sites in which a tribe has no legal property interest generally are not considered Indian trust assets. Important characteristics of the trust relationship between American Indian tribes and the United States include the following:

- A trust has three components—the trustee, the beneficiary, and the trust asset(s). In the case of Indian trust assets, title to Indian trust assets is held by the United States (trustee) for the benefit of a tribe or individual American Indian.
- Legal interest means there is a property interest for which a legal remedy may be obtained.
- Indian trust assets cannot be sold, leased, or otherwise alienated without the United States' approval. While most Indian trust assets are located on Indian reservations, they also can be located off reservation.

Indian Trust Assets are property interests held in trust by the United States for the benefit of Indian tribes or individuals, Indian reservations, rancherias, and public domain allotments. The Indian Trust Assets for the Navajo Nation and Hopi Tribe within the study area are minerals, water rights, lands, hunting and gathering rights, and other natural resources.

D.2.15.2 Indian Trust Assets within the Affected Environment

Minerals

The primary statutes governing the leasing of Indian coal assets for the benefit of an Indian tribe or nation are the Indian Mineral Leasing Act of 1938 and the Indian Mineral Development Act of 1982. An American Indian Coal Lease is obtained by direct negotiation with Indian tribal authorities, but is subject to approval and administration by the United States Department of the Interior (USDI). The authority by which coal reserves that are Indian trust assets are leased is described in 25 U.S. Code 396a and concerns leases of unallotted lands for mining purposes. It states the following:

> On or after May 11, 1938, unallotted lands within any Indian reservation or lands owned by any tribe, group, or band of Indians under Federal jurisdiction, except those specifically excepted from the provisions of Sections 396a and 396g of this title, may, with the approval of the Secretary of the Interior, be leased for mining purposes, by authority of the tribal council or other authorized spokesmen for such Indians, for terms not to exceed ten years and as long thereafter as minerals are produced in paying quantities.

The coal resource areas (N-9, J-19, and J-21) are located on leased land within the boundaries of the Navajo Nation near Kayenta in Navajo County. All of the coal produced from these areas is an Indian trust asset and is produced subject to one of three coal-mining leases, which designates land rental rates, royalty rates for the coal, other fees, and additional terms. One lease covers the 24,858 acres of the northern portion of the Kayenta and Black Mesa mining operations, where the Navajo Nation holds both surface and mineral land ownership. In 1964, that lease No. 14-20-0603-8580, was approved by the Navajo Nation Tribal Council, executed by the Navajo Nation, and approved by the Secretary of the Interior. Coal resource area N-9 is within this area.

The other two leases, approved by the Hopi Tribe and Navajo Nation in 1966, cover the southern portion of the mining operations, where the tribes have joint and equal interests in the minerals that underlie the former Joint Use Area. Lease No. 14-20-0603-9910 was approved by the Navajo Nation Tribal Council, executed by the Navajo Nation, and approved by the Secretary of the Interior. Lease No. 14-20-0450-5743 was executed by the Hopi Tribe and approved by the BIA. The surface of the southern portion of the leasehold has been partitioned. Approximately 33,863 acres are in Navajo Nation ownership, while 6,137 surface acres are in Hopi Tribe ownership (PWCC 2002). Coal resource areas J-19 and J-21 are within the area owned by the Navajo Nation.

Land

Infrastructure for the existing coal resource areas N-9, J-19, and J-21, within the Kayenta Mine permit area, occupies land that is an Indian tribal asset. PWCC holds leases, rights-of-way, and easements for the associated facilities such as haul roads, coal-handing areas, conveyors, the Black Mesa and Lake Powell Railroad loading site, storage areas, shops, offices, and other structures and facilities.

Water

Rights to the surface water and groundwater associated with the Navajo Nation and Hopi Tribe are Indian trust assets of the tribes. The Little Colorado River watershed comprises all of the existing project components. The Navajo Nation claims water as an Indian Trust asset as a party to the Little Colorado River water rights litigation entitled, "In re: The General Adjudication of all Right to use water in the Little Colorado River System and Source (Nos. 6417-033-9055 and 6417-033-9066, Consolidated)." A settlement agreement has been proposed. The Navajo Nation Tribal Council approved the proposed settlement agreement and it was signed by the Navajo Nation President in November, 2010. Agreement among other parties to the case remains pending. The proposed agreement will not be final until all parties have agreed. Water from the N aquifer would be used in mining operations, principally dust suppression as required by Federal regulations, and to provide water to local residents. PWCC's existing leases with the tribes require N aquifer wells to be transferred to the tribes in operating condition for their use once PWCC successfully completes reclamation and relinquishes the leases.

Hunting and Gathering and Other Natural Resources

The tribes have rights to continue hunting, gathering, grazing, and their traditional uses on the reservations. Ongoing activities of hunting and gathering, grazing, and traditional uses are described in Section D.2.12 of this EA.

D.2.16 Visual Resources

Visual resources are the natural and man-made features that give an area its visual character. The study area for visual resources was defined as 5 miles beyond the edge of the permit renewal area, which is limited to the mining areas of N-9, J-19, and J-21. The 5 miles represent a middleground to background viewing threshold as defined by the Bureau of Land Management's Visual Resource Management system (USDI Bureau of Land Management 1984). Visual conditions are described in terms of landscape

character, viewer sensitivity, and visibility. The Kayenta Mine permit area is on Navajo Nation and Hopi Tribe land; neither tribe classifies lands for scenic resources nor are areas specifically designated for the protection of visual resources.

The study area landscape is characterized using physiographic provinces, or geomorphic regions that are broadscale subdivisions based on terrain texture, rock type, and geologic structure and history. The study area is contained within the Navajo Section of the Colorado Plateau physiographic province, which exhibits several unique landscape settings and viewing conditions. The Colorado Plateau's major distinguishing features are landforms cut by wind and water erosion from the largely horizontal strata and the relatively high elevations of this province (Fenneman 1931).

Scenic integrity indicates the degree of intactness and wholeness of the landscape character (U.S. Department of Agriculture, Forest Service 1995). Human alterations can sometimes raise, maintain, or lower scenic integrity. In general, the landscapes are vast and expansive, permitting extensive views of undisturbed landscapes with rolling piñon-juniper woodlands and rock outcroppings. Often, these same views contain evidence of existing man-made structures or existing coal mining activity. Areas with existing disturbance include active coal mine operations, reclaimed areas with a grassland-shrubland vegetation community, agricultural and rural housing along the Moenkopi and Dinnebito washes, grazing or livestock facilities, transmission lines, and airstrips.

The extent to which new development contrasts with the existing scenic integrity is one of the factors used to analyze potential impacts to visual resources. Visual resource elements consist of form, line, color, texture, and motion. The current PWCC mining areas and associated facilities are notable visual features that contrast with the surrounding natural and reclaimed landscapes. Changes in form and line range from the gently rolling rounded hills to the horizontal and parallel ridges and troughs. Changes in color range from the dark, olive, and silver greens of the piñon-juniper woodland and sagebrush shrubland, and the reds, tans, and grays of the soil to the blacks and dark grays of the exposed overburden ridges. Changes in texture range from the scattered-medium to course patterns of vegetation to the random to linear relatively fine-textured overburden ridges.

Viewer sensitivity is defined by the type of viewer and circumstance of their activity in a landscape. Residents in a residential neighborhood or natural setting who have continuous potential views of the mining area are considered highly sensitive. Residents surrounded by an agricultural area are considered moderately sensitive. Routine travelers along major roads who have transitory and directed views are considered to be moderately sensitive. Daily mine employees are considered to have low sensitivity. Within the 5 mile radius of the study area, the occupied structures are usually in clusters of approximately two to 30 structures (see Map D-8). The major roads include U.S. 160 and Arizona Route 564. Navajo Route 41 is used by the local residents and mine employees. It is reported that this area is sparsely used for sightseeing (OSM 1990). Visibility of the mining operations depends upon distance, topography, and screening by vegetation and structures.

Once mining operations end, the disturbed areas are reclaimed to meet pre-mine conditions as per the permit. Reclamation includes re-grading the land to its approximate original contours, replacing topsoil, and replanting vegetation according to the approved post-mining land uses of livestock grazing, wildlife habitat, and cultural plant use (see Appendix A, Section D). Compared to the natural landscape, reclaimed land in the Kayenta Mine permit area consists of large patches of darker colored soil/rock and various ages of vegetation. The topography is less steep and coarser patterned. The lack of trees in most of the reclaimed areas could widen and extend views. However, as the vegetation matures, reclaimed areas blend into surrounding landscapes and appears to be undisturbed.

D.2.17 Transportation

The transportation study area is the Kayenta Mine permit area roads, Navajo Route 41, State Highway 98, and US Highway 160, that are used to support mine related vehicle traffic. Regionally the transportation network provides access to neighboring communities and the surrounding project area. U.S. Highway 160 lies north of the project boundary and extends from the southwest to the northeast as shown on Map A-1. State Route 98 is located west of the project, extending northwest from U.S. Highway 160 toward Page, Arizona. Navajo Route 41 is also located west of the Kayenta Mine permit area, extending south from U.S. Highway 160 to the town of Piñon.

Primary roads within the mine area are used by major haul vehicles and general access vehicles. Ancillary roads support the primary road system. The Kayenta Mine operation uses approximately 194 miles of primary and ancillary mine roads. Primary and ancillary roads are located, designed, constructed, used, maintained, and reclaimed in accordance with Federal regulations and performance standards. PWCC has constructed or upgraded both primary and ancillary roads within the Kayenta mining area. The primary roads include coal-haul and mine-vehicle roads a minimum of 50 feet wide, and coal-haul, mine-vehicle, and dragline deadheading roads approximately 150 feet wide (OSM 1990). To gain access to mine facilities in remote sites, on-highway vehicles most frequently use ancillary roads. There are two types of ancillary roads: two-lane roads a minimum of 24 feet wide, and single-lane roads with a minimum width of a bulldozer blade or a motor-grader blade. The single-lane roads usually follow the natural topography and were established by area residents prior to mining activities (OSM 1990).

Unless these have been approved by the regulatory authority as a part of the post-mining land use plan, all roads used or built by PWCC on or after December 16, 1977 are to be reclaimed. There are about 57 miles of primary roads and 109 miles of ancillary roads that willd be totally reclaimed, and 28 miles of primary haulage roads that will be narrowed as permanent roads for public use. Due to the extent of PWCC's mining activities, very few of the primary haulage roads are reclaimed until mining activities are completed. However, roads in the immediate vicinity of pits and ramps, which are created in the spoil, are reclaimed as the general reclamation activities progress within a specific coal resource area.

D.2.18 Health and Safety

The affected environment for public health and safety includes the mine operations and individuals who could be exposed to dust, noise, heat stress, and chemicals from the Kayenta Mine operations in coal

resource areas N-9, J-19, and J-21. Many activities conducted during mining operations carry inherent health and safety risks. Typical risks encountered include exposure to dust, noise, heat stress, and chemicals, as well as the opportunity for accidents due to working directly with or in proximity to large equipment. Procedures used during operation and maintenance activities associated with the project, such as blasting or construction, also pose health and safety risks. However, the establishment of appropriate policies and procedures, and the monitoring of those procedures to verify that they are properly observed, helps to reduce the risk involved. The Federal Mine Safety and Health Act of 1977 regulate health and safety associated with the Kayenta Mine operations. During Kayenta Mine operation, permits will be required along with safety inspections to minimize the frequency of accidents and maximize worker safety.

D.2.18.1 Safety Practices and Procedures

Safety practices at the Kayenta Mine and all associated facilities were determined by review of the policies and procedures established by the Mine Safety and Health Act of 1977 (MSHA). MSHA implemented regulation 30 CFR 1-199 and outlined the policy and procedures for safety at mining operations. In addition to complying with the regulations of MSHA, the Kayenta Mine operation is consistent with all Federal, State, and Tribal regulations related to mining operations.

D.2.18.2 Contaminants and Solid Waste

All mining operations are required to be in compliance with regulations promulgated under the Resource Conservation and Recovery Act, Federal Water Pollution Control Act (Clean Water Act), Safe Drinking Water Act, Toxic Substances Control Act, Mine Safety and Health Act, Department of Transportation, and the Federal Clean Air Act. In addition, the Kayenta mining operations comply with all attendant federal and tribal rules and regulations relating to hazardous material reporting, transportation, management, and disposal. Wastes produced by current mining activities at the Kayenta Mine are handled according to the procedures, as described in the approved mine permit (PWCC 2005b). The procedures and requirements for handling hazardous and solid wastes comply with NNEPA and USEPA-approved waste disposal plans. Potential sources of hazardous or solid waste would include spilled, leaked, or dumped hazardous substances, petroleum products, and/or solid waste associated with mine operation or maintenance activities. No hazardous or solid wastes are known to be present on the proposed development area at this time.

A contractor removes non-hazardous waste for disposal in a regulated landfill, which is similar to the disposal of domestic or municipal solid waste from the mine site. At the Kayenta Mine, hazardous materials and materials that could be classified as hazardous include greases, solvents, paints, flammable liquids, and other combustible materials determined to be hazardous by the USEPA under the Resource Conservation and Recovery Act. These types of wastes are recycled where practicable or disposed of by licensed contractors at an off-site USEPA-permitted hazardous waste facility.

Several products are recycled at the mining operation area, including scrap metal, tires, batteries, computer equipment, fluorescent lamps (4-foot and 8-foot lengths), high-pressure sodium light bulbs, and

mercury-vapor light bulbs. Per waste stream analysis, used oil, parts washer fluid, spent solvent, grease, and antifreeze are recycled. Ranging from monthly to annually, materials are removed from the Kayenta Mine by contractors on an as-needed basis.

D.2.18.3 Hazards

The main hazards associated with mining and the use of explosives are the handling of explosives by workers and the proximity to the blast site. Blasting operations at the Kayenta Mine are conducted according to Federal law, applicable regulations, and the approved permit application. Under OSM's permitting requirements, a resident or owner of a dwelling or structure within 0.5 mile of any part of the permit area may request that a pre-blasting survey be conducted on their dwelling or structure. Upon receipt of this request, Peabody conducts the survey by analyzing the conditions of the dwelling or structure prior to blasting activities and documenting any pre-blasting damage and other physical factors that could be affected by the blasting. A written report is prepared and a signed copy provided to the regulatory authority and the person requesting the survey (OSM 1983).

According to the regulations, no blasting is conducted within 0.5 mile of an occupied dwelling. Therefore, residents in or nearby the blasting area are evacuated prior to proceeding with any blasting actions. Residents are notified well in advance of the blasting schedule, and notices are posted in public locations. Federal law and regulations both allow mining to within 300 feet of such a structure. The permit requirements are more stringent than the typical Federal limits. Blasts are monitored for air blast and ground vibration by five seismographs located throughout the Kayenta Mine permit area. The OSM reviews Kayenta Mine's blasting records monthly during field inspections and quarterly through reports submitted by PWCC and their blasting contractor.

Along Navajo Route 41, PWCC assists with maintenance of the road surface and slopes and coordinates maintenance with the Navajo Nation Department of Transportation for repaving, seal coating the road or through their own roadway maintenance contract to maintain roadway shoulders and drainage. To ensure public safety along the mine roads, public traffic is excluded from active mine areas by security gates. All roads are signed and maintained by grading and dust suppression, and school buses and deliveries are escorted by PWCC security vehicles.

This page deliberately left blank.