2 DELINEATION OF CUMULATIVE IMPACT AREA

A CIA is defined in 30 CFR 701.5 as the area, including the permit area, within which impacts resulting from the proposed operation may interact with impacts of all anticipated mining on the surface and groundwater system. CIA delineation for the Navajo Mine consists of both surface and ground water delineations, with specific impact areas delineated for both surface and ground waters based upon the resource extent and potential use impacts.

2.1 Surface Water Cumulative Impact Area

The Navajo Mine lease covers all or part of the drainage areas of the Bitsui, Chinde, Hosteen, No Name, and Barber Washes, and the Neck, Lowe, Cottonwood, and Pinabete Arroyos (Figure 6).

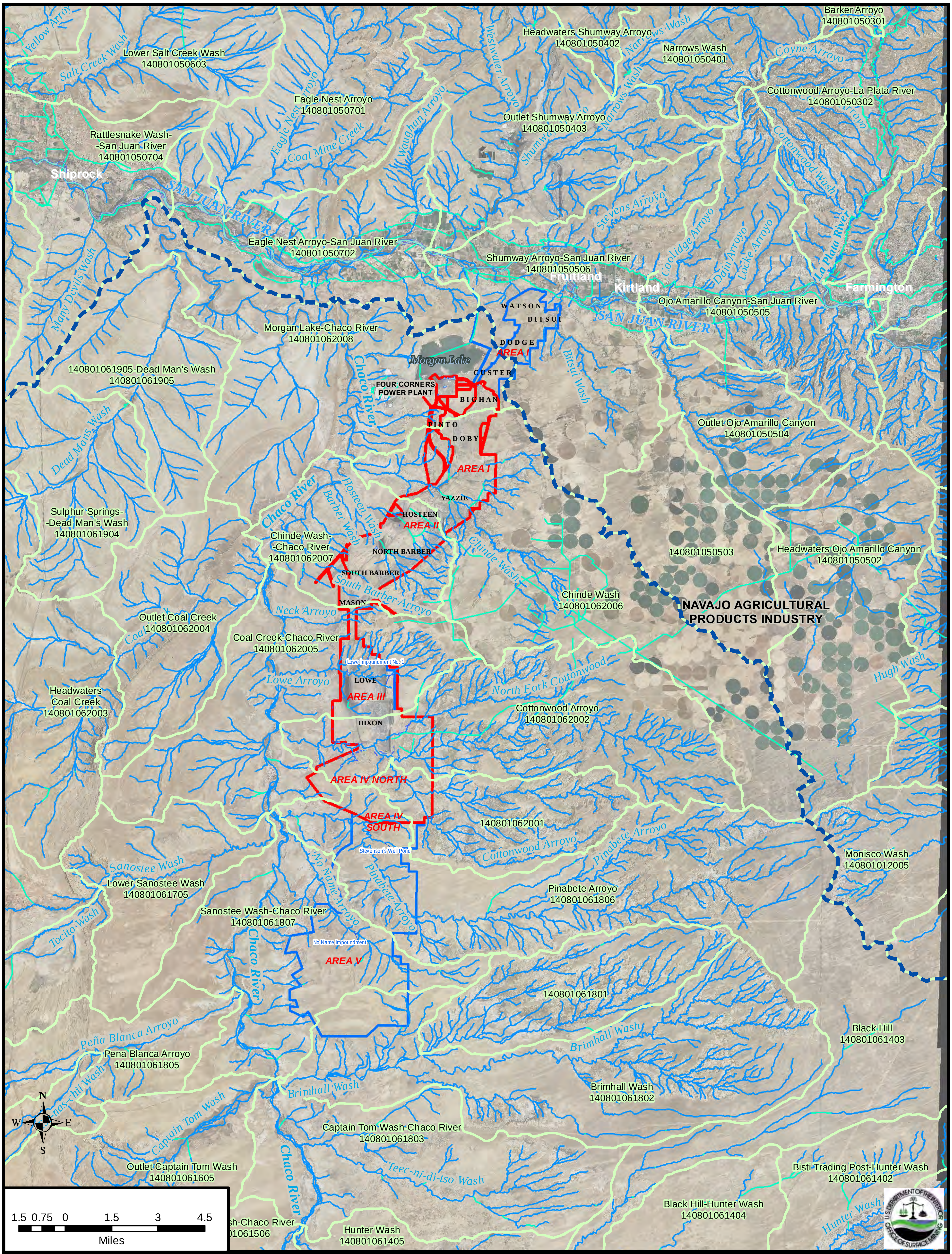
Since mining operations at the Navajo Mine are the only SMCRA regulated operations in the above mentioned drainage basins, surface water impacts cannot be cumulative with other SMCRA operations unless the impacts extend farther downstream. Bitsui Wash discharges directly to the San Juan River, all other washes and arroyos discharge to the Chaco River, which in turn discharges to the San Juan River. The San Juan River and Chaco River channels and flood plains will not be directly impacted by active mining activities. Therefore, potential coal mining impact on these rivers would be through the discharge of surface or groundwater from the mine area or from reclaimed surface and backfill (BNCC 2011, Section 11.6). OSM will assess (1) the cumulative surface water impact potential of all SMCRA mining operations on the Chaco and San Juan watersheds, and (2) the potential for cumulative surface water quality and quantity impacts of the Navajo Mine on either the Chaco or San Juan Rivers.

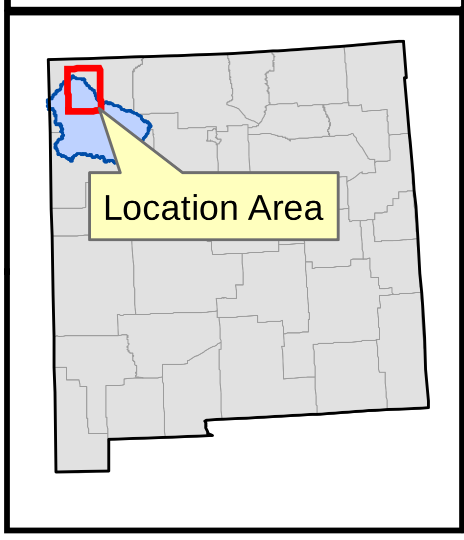
2.1.1 Cumulative Surface Water Impact Potential

Surface coal mining and reclamation activities are required to minimize disturbance to the hydrologic balance within the permit and adjacent areas, prevent material damage to the hydrologic balance outside the permit area, to assure the protection or replacement of water rights, and to support approved post-mining land uses and conditions (30 CFR 816.41(a)). Surface water quality protection of the hydrologic balance is accomplished, to the extent possible, by using the best technology currently available to minimize acidic or toxic drainage and additional contribution of suspended solids to streamflow outside the permit area (30 CFR 816.41(d)(l)).

The 1984 Navajo Mine CHIA (with addendum in 1989) was prepared considering the entire San Juan Watershed as the CIA (Kaman Temp 1984) (OSMRE 1989). Therefore, this delineation considers the cumulative surface water impact potential of all SMCRA regulated activities in the San Juan Watershed. The San Juan Watershed contains the following historical or existing coal mines: Chimney Rock Mine, Coal Gulch Mine, Carbon Junction Mine, Peacock Mine, National King Coal Mine, La Plata No. 1 Mine, Blue Flame Mine, La Plata Mine, Black Diamond Mine, San Juan Mine, Navajo Mine, Burnham Mine, De-Na-Zin Mine, Gateway Mine, and El Segundo Mine (Figure 7). Lee Ranch Mine, which began surface coal operations in 1984, is identified on Figure 7 for illustration purposes only. Existing and planned operations boarder but are not within the San Juan Watershed; therefore, Lee Ranch Mine will not be included in the potential cumulative impacts discussion at this time.

The Chimney Rock, Coal Gulch, Gateway, De-Na-Zin, and Black Diamond Mines were surface coal mines (Table 2). Mining was completed at each of these mines, as well as final bond release. The Blue Flame and La Plata No. 1 Mines were underground mines, which began operation in 1950 and 1905 respectively. Mining was completed at each in 1991 and 1988 respectively; final bond release occurred in 2008 and 2004 respectively. The Peacock Mine was on underground coal mine, which began mining in 1905, and reclamation was completed in 1996.





Legend

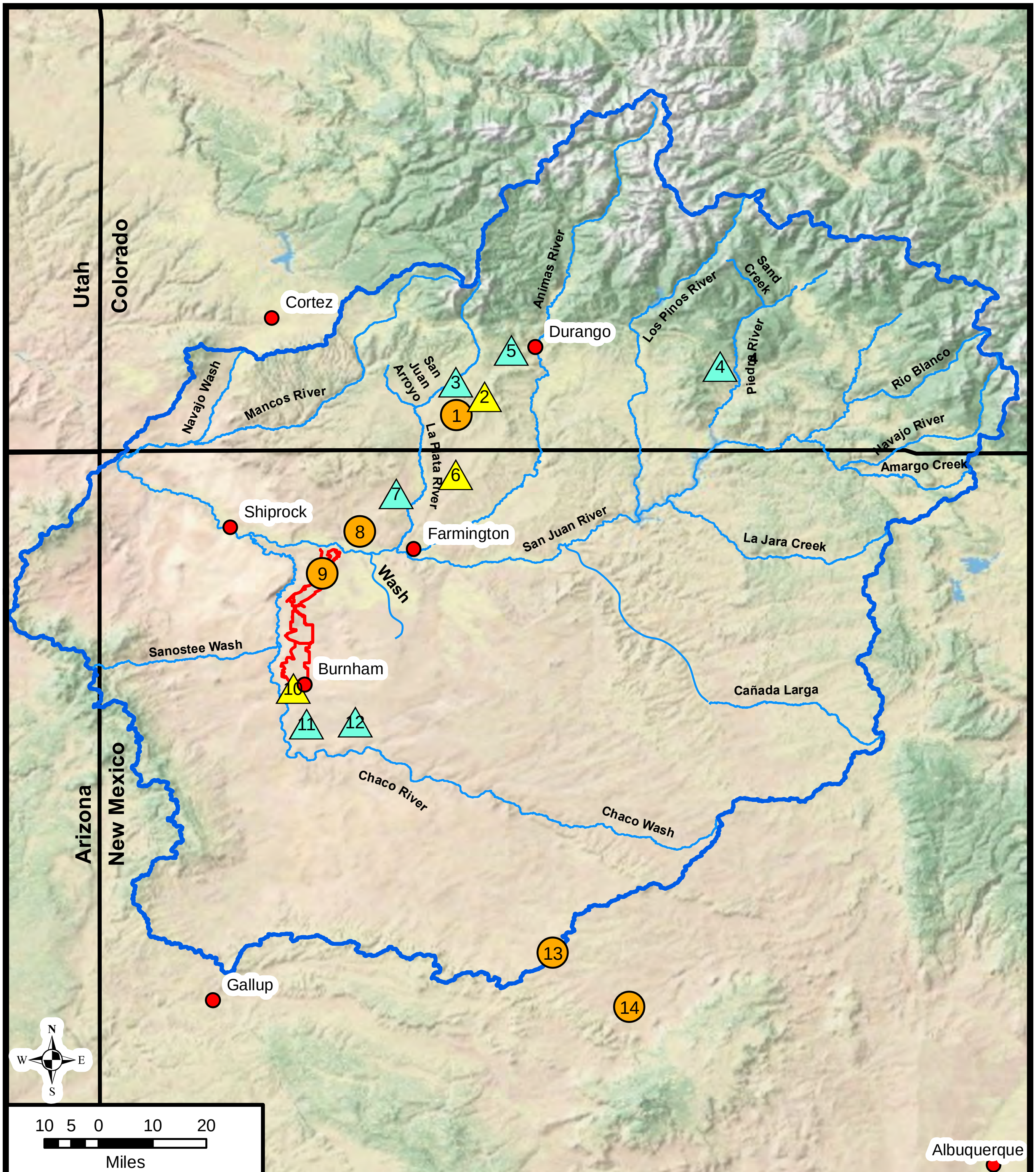
- HUC12 Watersheds[1]
- Ponds
- Natural Stream[1]
- Artificial Canal/Ditch[1]
- Surface Water CIA
- Coal Lease Area
- Permit Area
- PIT NAMES

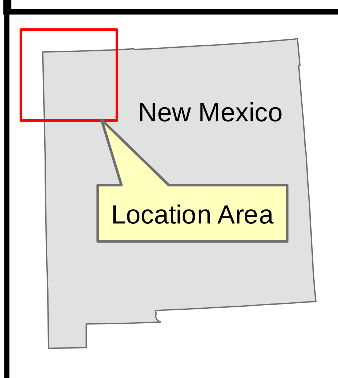
Data Sources:
Aerial Photography (San Juan County) 2009
[1] USGS National Hydrography Dataset

Navajo Mine CHIA

HUC12 Watersheds

Figure 6





Legend

	Mine_Name
1	National King Coal
2	Carbon Junction
3	Peacock
4	Chimney Rock
5	Coal Gulch
6	La Plata
7	Black Diamond
8	San Juan
9	Navajo
10	Burnham
11	De-Na-Zin
12	Gateway
13	El Segundo
14	Lee Ranch

Historical and Existing Coal Mines, San Juan Basin

Figure 7

The Carbon Junction, La Plata and Burnham mines are surface mines, which have not achieved final bond released. The Carbon Junction Mine achieved final reclamation in 2008. Phase II bond release was achieved for the entire La Plata Mine site, and the location is now in final reclamation. The Burnham Mine was conditionally approved for the initial seven years of operation; however, was never issued a permit under the Permanent Program, and the location is currently under reclamation. The King Coal Mine is an underground operation, which began in 1941, and is currently active. The San Juan Mine is both a surface and underground mine operation, which began in 1973 and 2000 respectively. Both the San Juan surface and underground mines are currently active. El Segundo Mine is a surface mine, which began in 2008, and is currently active. The Navajo Mine has operated since 1963, and is the subject of this assessment.

Table 2: Mining History in the San Juan Watershed

Mine	Type	Start of Mining	End of Mining	Status
Chimney Rock	Surface	1976	1985	Final Bond Release 2005
Coal Gulch	Surface	1978	1998	Final Bond Release 2010
Gateway	Surface	1982	1990	Final Bond Release 2004
De-Na-zin	Surface	1980	1992	Final Bond Release 2003
Black Diamond	Surface	1983	1993	Final Bond Release 2007
Blue Flame	Underground	1950	1991	Final Bond Release 2008
La Plata No. 1	Underground	1905	1988	Final Bond Release 2004
Peacock	Underground	1905	1981	Reclamation Completed 1996
Carbon Junction	Surface	1983	1990	Reclamation Completed 2008
La Plata	Surface	1986	2003	In Final Reclamation
Burnham	Surface	1980	1984	Under Reclamation
King Coal Mine	Underground	1941	NA	Active
San Juan Mine	Surface/Underground	1973/2000	NA	Active
El Segundo	Surface	2008	NA	Active
Navajo	Surface	1963	NA	Active

Generally, Phase I bond release requires submission and approval of all documentation for permanent drainage control structures. Phase II bond release generally requires documentation that the permittee or the landowner has provided for sound future maintenance of all approved permanent impoundments in accordance with 30 CFR 800.40(c)(2). Phase III bond release requires a demonstration in accordance to 30 CFR 816.41 that all surface mining and reclamation activities have been conducted to minimize disturbance of the hydrologic balance within the permit and adjacent areas, to prevent material damage to the hydrologic balance outside the lease area, to assure quantity and quality are suitable to support approved postmining land uses, the water rights of other users have been protected or replaced, and in accordance with terms and conditions of the approved permit.

All mines approved for final bond release are eliminated from the potential impact discussion since a determination has been made that material damage to the hydrologic balance has been prevented. Peacock mine is also excluded from the potential impact discussion, since reclamation has been completed to the satisfaction of the Colorado Department of Mining and Safety. Inactive operations, and permit areas currently under reclamation, especially those further along in the bond release process, will most likely not have a cumulative impact; however, they are considered in the potential impacts discussion. All currently active mines are also considered in the potential impact discussion. Therefore, mines which are considered in the potential impact discussion are Carbon Junction, La Plata, Burnham, King Coal, San Juan, El Segundo, and Navajo Mine.

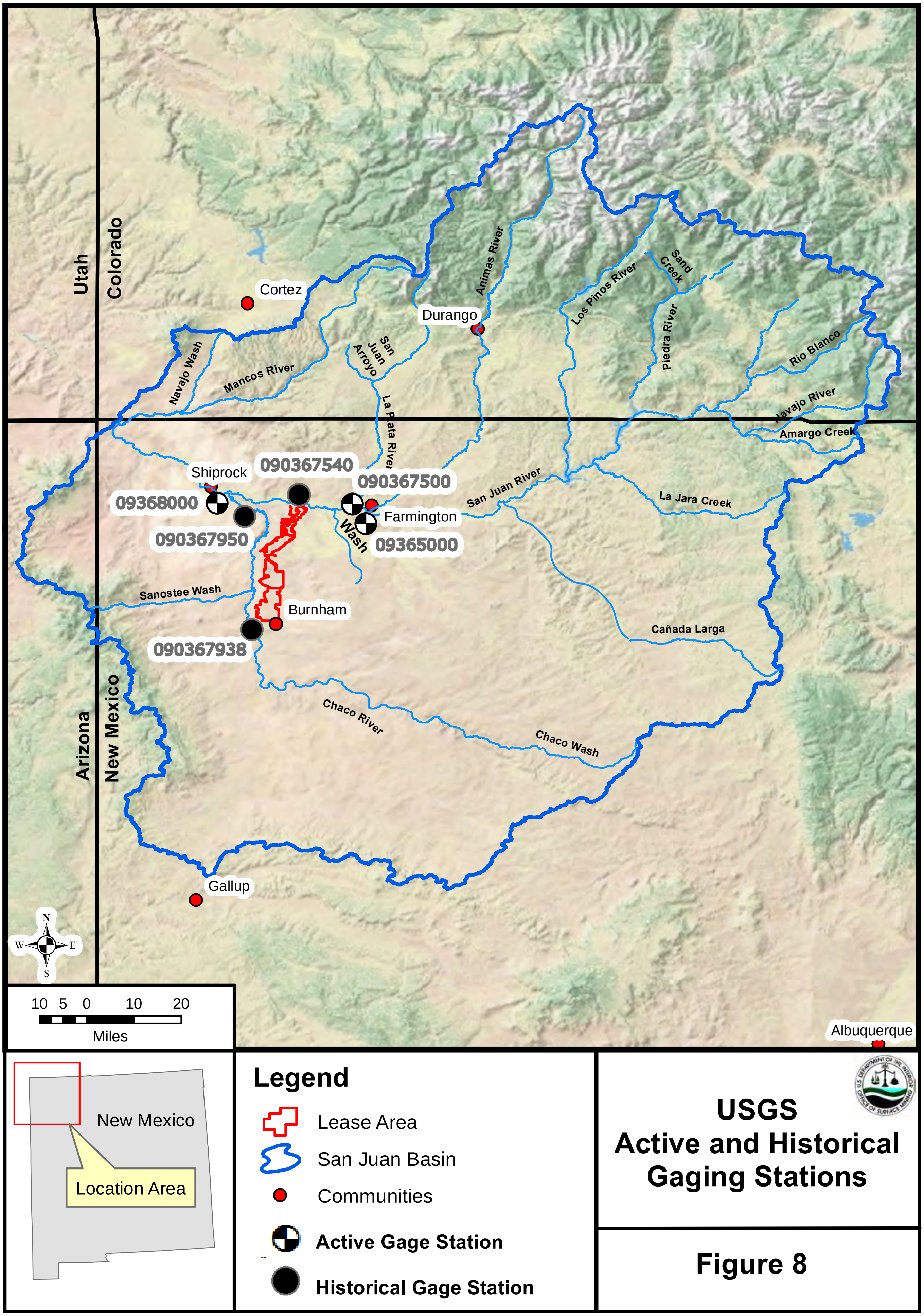
2.1.2 **Impact Potential to the San Juan River**

The San Juan River is a major tributary to the Colorado River, with a drainage area of 24,900 square miles. The San Juan River Watershed is within New Mexico, Arizona, Colorado, and Utah. Originating on the western slope of the Continental Divide in southwestern Colorado, the San Juan River flows perennially from the San Juan Mountains north of Pagosa Springs, Colorado, and enters northwestern New Mexico through the Navajo Reservoir in Rio Arriba County, west of the Jicarilla Apache Reservation and the Carson National Forest. The course of the San Juan River turns westward for approximately 140 miles through New Mexico and southern Utah to its confluence with the Colorado River.

The United States Geologic Survey (USGS) located three stream gaging stations along the San Juan River within the general area of the Navajo Mine (Figure 8). These stations were assigned the following site numbers by the USGS; 09368000, 09367540, and 09365000. Station 09368000 is active and located on the San Juan River approximately 0.9 miles south of Shiprock New Mexico, and 2 miles west of the Chaco River confluence. Station 09367540 is not active, and located approximately 0.4 miles west of Fruitland New Mexico, 13.8 miles east of the Chaco River confluence, and 8.3 miles west of the La Plata confluence. Station 09365000 is active, and located approximately 0.9 miles southwest of Farmington New Mexico, 1.7 miles southeast of the La Plata River confluence, and 0.7 miles northwest of the confluence with the Animas River (Figure 8).

The San Juan River is perennial, and part of its flow originates from groundwater discharge. The historic average mean annual flow at USGS station 09368000 near Shiprock is 2024 ft^3/sec, with a historical low of 657 ft3/sec in 2002. BNCC holds Surface Water Permit Number 2838, issued by the New Mexico Office of the State Engineer in October 1958, and supplies water to the Four Corners Generating Station, the San Juan Generating Station, and the Navajo Mine under this permit. Permit number 2838 provides BNCC a total diversionary right of 51,600 acre-feet annually (~71 ft3/second), with a consumptive right of 39,000 acre-feet annually (~54 ft3/second), for waters drawn from the San Juan River. BNCC typically diverts 825 acre feet per year (~1.14 ft3/second) for use at the Navajo Mine (United States of America 2011, Table L-1), or less than 0.2% of the San Juan River historic low flow rate from 2002. Therefore, diversion from the San Juan River for use at Navajo Mine is not expected to result in material damage to the surface water quantity of the San Juan River given the ratio of the diversion to the total flow of the San Juan River.

The San Juan alluvial aquifer is estimated to have an average flow of approximately 30,000 ft^3/day (BNCC 2011, Section 11.6), or approximately 0.02% of the historic average flow within the San Juan River. Approximately 1% of the alluvial aquifer flow, or 300 ft^3/day, is estimated to discharge from the backfilled mining areas to the San Juan River (BNCC 2011, Section 11.6). Leaching studies from overburden and spoil sample analysis indicate that the chemical quality expected from backfill leachate would be similar to baseline quality in coal seams. Therefore, groundwater discharge from the mine area will have a negligible effect on the water quantity or quality of the San Juan River due to low discharge estimates and water quality analysis comparison.



USGS
Active and Historical Gaging Stations

Figure 8

Figure 9 illustrates discharge data collected by the USGS at three stations San Juan River gaging stations from 1931 to 2010. The data demonstrates there has been consistent flow variability along the San Juan, with a general decreasing flow trend for the period of record. Although flows initially increased upstream to downstream along the San Juan during the monitoring period, this trend reversed, such that downstream flows were less than upstream flows. Based on linear trend lines, the tipping point at which this occurred was around 1972. However, the general trend of decreasing flows, and the difference in the rate of decrease between the downstream and upstream stations, was apparent before mining, and appears unrelated to the changing mining activity in the San Juan Watershed.

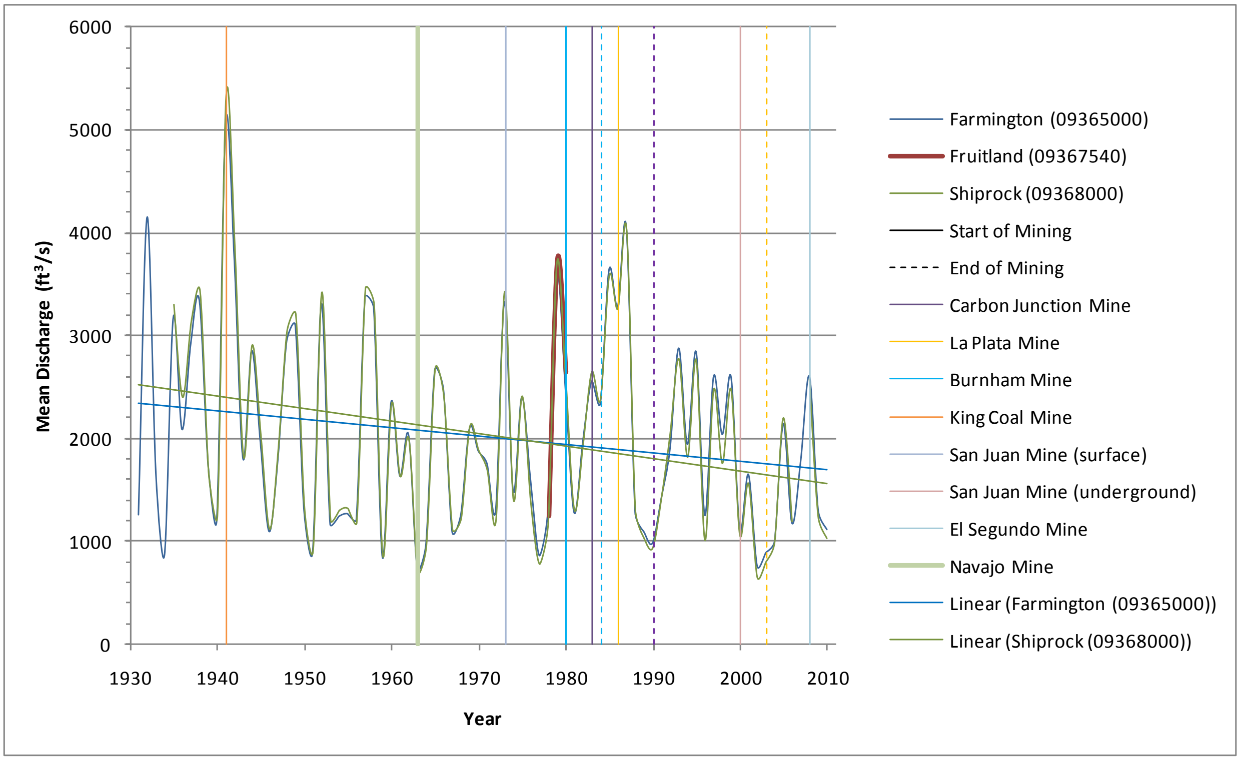


Figure 9: San Juan River Discharge and Mine Operational Period Comparison (1931-2010)

Historic data was analyzed for over 20 constituents collected by the USGS along the San Juan River at the three stations from 1958 to 2010 (Appendix A). Analysis indicates high variability, generally increasing pH, and generally decreasing or relatively unchanged concentrations in constituents of interest over time. Additionally, changes in data trends do not show correlation with mining activities.

For instance, the measured Total Dissolved Solids (TDS) concentrations indicate variability in concentrations along the San Juan River, with a general trend of decreasing concentration throughout the duration of monitoring. TDS increases from upstream to downstream along the San Juan River, and is consistently higher at downstream monitoring stations. Based on linear trend lines, TDS concentrations are decreasing at downstream locations, and the general trend appears to be unrelated to the changing mining activity in the San Juan Watershed (Figure 10).

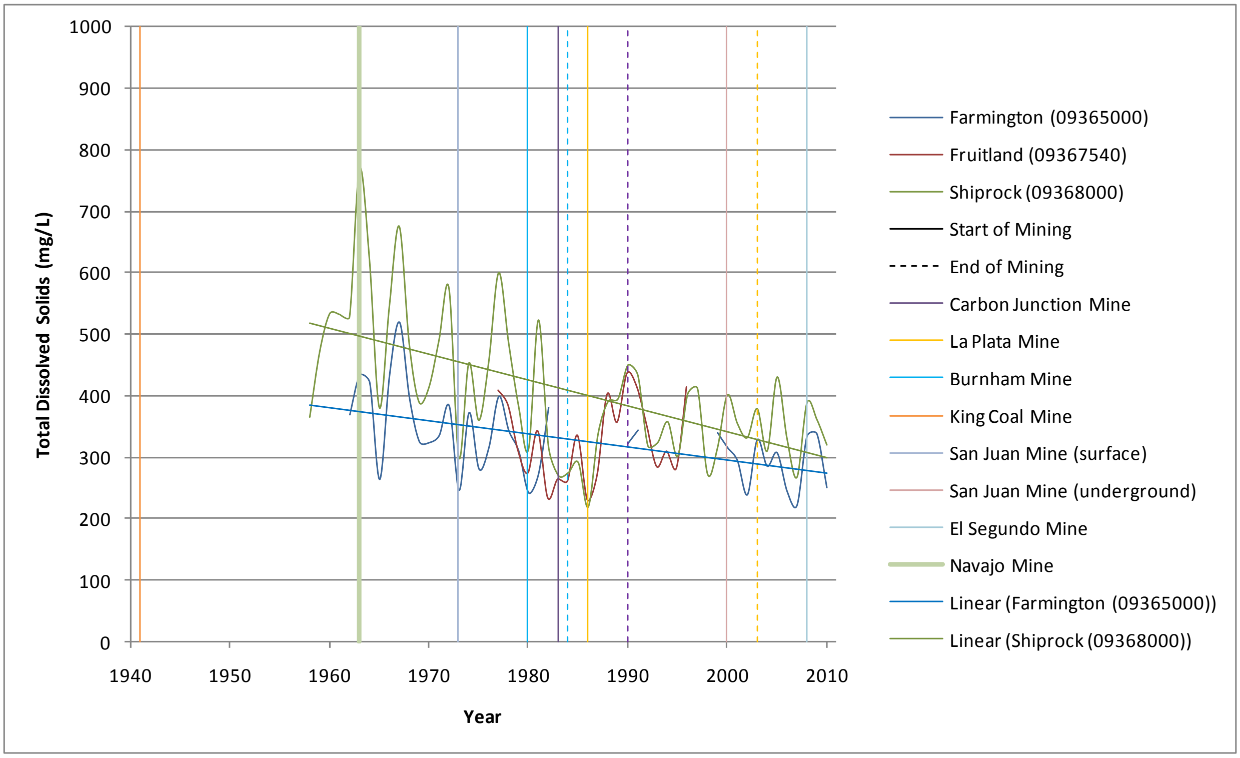


Figure 10: San Juan River TDS and Mine Operational Period Comparison (1957-2010)

Assessment of historic USGS data suggests that cumulative surface water quality impacts from mining are not distinguishable from baseline surface water quality for the San Juan River. All surface water drainages that traverse the Navajo Mine discharge into the Chaco River, which in turn discharges into the San Juan River, except Bitsui Wash. Bitsui Wash is located near the northernmost portion of the lease area, flows intermittently, and discharges directly to the San Juan River (Figure 6). Bitsui Wash drains an area of 7,835 acres. Approximately 17.5% of the Bitsui watershed, or 1,371 acres, were disturbed by historical mining at Navajo Mine. All mining disturbance within the Bitsui watershed predates the establishment of SMCRA in 1977, and is consider pre-law (BNCC 2011, Ch.7). Bitsui receives drainage from pre-law jurisdictional lands on the northern area of the mine lease, but receives no drainage from the reclaimed areas from the Navajo Mine permanent program permit area (BNCC 2011, Section 11.6). Historically, Bitsui Wash would flow ephemerally in response to precipitation; however, the development of NAPI causes Bitsui Wash to flow intermittently. Surface water monitoring was conducted along the Bitsui Wash from 1986-1992. Comparison of median water quality monitoring data to the 2007 NNEPA numeric standards for designated uses indicated exceedances of the aquatic and wildlife standards for cadmium, chromium, and selenium. However, median concentrations are only slightly elevated, and impact to the hydrologic balance is not expected to be significant. The San Juan River is the closest surface water body which could be impacted by Bitsui Wash outside the lease area. Analysis of USGS data indicates concentrations of cadmium, chromium, and selenium have all been decreasing with time in the San Juan River. Therefore, material damage to the San Juan River uses is not expected. Since discharge from Bitsui Wash is not expected to result in material damage to the hydrologic balance, and since the Bitsui Wash area was mined and reclaimed prior to the jurisdiction of SMCRA, it is excluded from the surface water CIA.

Additionally, the Mining and Minerals Division of the New Mexico Energy, Minerals and Natural Resource Division (NMEMNRD) completed CHIAs for both the La Plata and San Juan Mines. La Plata CIA, as determined in the 1999 La Plata CHIA, was found to be entirely contained within the La Plata

Watershed, and potential impacts from the La Plata Mine were not found to extend to the San Juan River. The northern boundary of the La Plata mine CIA is the Colorado-New Mexico border, which is downstream of the King Coal Mine, indicating impacts were not found to be cumulative between the King Coal and La Plata mines along the La Plata River (NMEMNRD 1999). The 1999 San Juan Mine CIA includes the Shumway Arroyo and Stevens Arroyo, which are both tributaries to the San Juan River, but does not extend to the San Juan River (NMEMNRD 1999). Considered in conjunction with hydrologic assessments completed by the NMEMNRD, impacts from the King Coal, La Plata and San Juan mines will have a negligible cumulative potential with the Navajo Mine impacts.

Based on historical quantity and quality data along the San Juan River and CHIA analysis completed by the NMEMNRD, the San Juan River will not be included in the Navajo Mine surface water CIA.

2.1.3 **Impact Potential to the Chaco River**

The Chaco River has a watershed area of approximately 4,350 square miles, of which, the Navajo Mine lease area occupies approximately 0.6-percent. The Chaco River lies to the west of the lease area, and flows north to the San Juan River, downstream of the Navajo Mine. Flow in the Chaco River is ephemeral except for the last 12.5 miles near the confluence of the Chaco and San Juan rivers. The surface expression of the Chaco River is approximately 0.1 mile wide. The Chaco River is subject to high sediment loadings. The Bureau of Land Management (BLM) Farmington Field Office estimated an average sediment yield from the Chaco watershed at 5.8 tons per acre per year (URS 2009). The only coal mining activities in the Chaco Watershed that have not achieved final bond release, other than Navajo Mine, are the Burnham Mine and the El Segundo Mine.

The Burnham Mine is located in Burnham, New Mexico approximately 15 miles east of U.S. Highway 491 on BIA Road 5 in San Juan County, New Mexico (Golder Associates Inc. 2008). In 1978, Consol proposed mining 6,831 acres at Burnham Mine. OSM conditionally approved Burnham Mine for 7 years, and mining operations commenced in 1980. However, the mine only produced coal for 4 years, and production ceased in 1984. Consol submitted an application under the permanent program as a result of the approval of the Federal Program for Indian Lands (30 CFR § 750) in 1984. However, prior to OSM completing review of the application, lease negotiations between Consol and the Navajo Nation failed resulting in lease termination in 1990. For this reason in 1991 OSM rejected the Permanent Program application, returned the application, and requested Consol reclaim the disturbed lands of about 140 acres. Consol submitted the "Plan for the Reclamation of the Burnham Mine" to OSM and it was approved in 1994 (Blake 1994).

The existing Burnham Mine site encompasses approximately 203 acres; containing a former pit area, reclamation areas, and the main facility. The main facility area contains an office building, abandoned guard house, abandoned trailer, and two 500 gallon above ground storage tanks (ASTs). In 1992 a release of diesel fuel was confirmed from an AST system that provided fuel to a generator. The product lines from two 8,000 gallon ASTs to the generator leaked an unknown volume of diesel fuel, and the site is currently under reclamation. The release affected the subsurface soil and shallow groundwater. The majority of soil contamination present at the site is present at the air-water interface between 16 and 26 feet below ground surface not exceeding four feet in thickness. The extent of soil contamination roughly mirrors the extent of non-aqueous phase liquid (NAPL) and is present south of the former ASTs and extends south to the office building. There is approximately 6,500 total cubic yards of diesel contaminated soil at the Burnham Mine. Results of groundwater monitoring indicate that dissolved phase contamination has not migrated extensively ahead of the NAPL contamination. The nearest major surface water is the Chaco River located approximately seven miles west of the site, with the Brimhall Wash a tributary feature to the Chaco River located 0.5 miles south of the site (Golder Associates Inc. 2008).

A draft reclamation plan was prepared by Golder Associates and submitted by Consol to the NNEPA in 2008; it was approved without changes and became the final reclamation plan in 2009 with cleanup standards for diesel contaminates of 500 mg/kg for soil and 100 mg/L for groundwater. The plan currently under action identifies the need for excavation and land farming of contaminated soils, and control and treatment of groundwater from the excavated area. Reclamation on the site is was completed by the end of 2011. This contamination is not expected to affect surface water quantity or quality in the area since the contamination is well below the surface and is not expected to extend laterally to the nearest surface water features before completion of reclamation. For these reasons, the impacts associated with Burnham mine will not be considered further in this surface water CIA.

There are two historic United States Geologic Survey (USGS) stream reach stations along the Chaco River. These stations were assigned the following site numbers by the USGS; 09367950 and 09367938. Station 09367950 is located on the Chaco River approximately 6 miles southwest of Waterflow New Mexico and 4.6 miles southeast of the San Juan River confluence. Station 09367938 is located on the Chaco River approximately 15 miles southwest of Burnham New Mexico and 0.7 miles north of the Brimhall Wash confluence. Discharge data was collected from 1977 to 1994, and water quality data was collected from 1969 to 1989. The period of record does not sufficiently cover the more recent mining activity in the watershed, and therefore cannot be used to rule out cumulative SMCRA related surface water impacts along the Chaco.

In addition to the USGS data, the Mining and Minerals Division of the NMEMNRD has completed a CHIA assessment for the El Segundo Mine. El Segundo coal mine is located in the eastern end of the Standing Rock Cleary Coal area which is located in the southern part of the San Juan Watershed in an area known as the Chaco Slope. The Chaco Slope is a broad, gently dipping part of the San Juan Watershed extending from the edge of the Zuni uplift on the south, northward to the central area of the basin. The proposed lease area straddles the continental divide at elevations approximating 7,000 feet above mean sea level (MSL) in an area that is crossed by several unnamed ephemeral, arroyos. The continental divide separates the lease area into two surface watersheds; only the western section is included as part of the Chaco watershed. There are no named drainages to the west of the continental divide within the proposed lease area. The main drainage through the western mine area has the National Hydrologic Database (NHD) reach code of (14080106000944) and is identified as ephemeral as it leaves the lease area. The drainage area for the main western drainage as it leaves the lease area is approximately 24.7 square miles of which about 6.1 square miles (25%) of the total watershed are proposed to be disturbed by mining (NMEMNRD 2005).

Cumulative surface water quantity and quality impacts from the Navajo Mine with other mining operations in the Chaco River Watershed cannot be ruled out based solely on historical quantity and quality data along the Chaco River and analysis from the Mining and Minerals Division of the NMEMNRD.

2.1.4 Surface Water Impact Area

The Surface water CIA for assessing cumulative impacts of the Navajo and El Segundo mines will be the entire Chaco River watershed (Figure 11). However, the BNCC lease area covers a relatively small percentage of the entire Chaco Watershed. Therefore to insure adequate protection of water uses adjacent to the lease impacts will also be assessed using smaller evaluation areas. Impact of surface water quality will be assessed for the Chaco River within the immediate vicinity of BNCC and the primary washes and arroyos traversing the lease area; Pinabete Arroyo, No Name Wash, Cottonwood Arroyo, and Chinde Wash, as these washes are representative of the water quality conditions of the lease area. Impacts on surface water quantity are analyzed using Hydrologic Unit Code (HUC) 12 watersheds. The USGS has divided and sub-divided the United States into successively smaller hydrologic units and assigned each a HUC number. HUC 12 watersheds are among the smallest of these hydrologic units and represent 6 levels of divisions (USGS 2012). HUC 12 watersheds are used rather than individual drainage basins in order to standardize the analysis as flow is heavily impacted by watershed size which varies significantly between drainages. The Navajo Mine lies primarily within five HUC12 watersheds that either intersect or contain portions of the lease area (Figure 6). Impacts on surface water quantity were analyzed using the following HUC 12 watersheds; Morgan Lake-Chaco River (140801062008), Chinde Wash (140801062006), Chinde Wash-Chaco River (140801062007), Coal Creek-Chaco River (140801062005), and Cottonwood Arroyo (140801062002)

2.2 Ground Water Cumulative Impact Area

Based on drilling and excavation activities, the Quaternary Alluvium, the coal seams and inter-bedded lithologic units of the Fruitland Formation, and the Pictured Cliffs Sandstone (PCS) bear appreciable amounts of water within the mine area. All coal seams at Navajo Mine are within the Fruitland Formation, and the majority of water within the Fruitland Formation is concentrated within these lenticular coal strata, therefore the Fruitland Formation will be assessed in this CHIA with an emphasis on the coal strata. The Kirtland Shale is relatively impermeable, contains no coal seams and was not found to contain appreciable amounts of water within the mine area; it will therefore not be considered for impact assessment in this CHIA (BNCC 2011, Ch. 6). The potentiometric gradients in Fruitland Coal and in the PCS trend north to northwest towards the San Juan River (BNCC 2011, Appendix 6.D), with localized gradients toward the topographic lows along the Chaco tributaries. Ground water in the Fruitland coals and Pictured Cliffs Sandstone may discharge at a very low rate at some locations within the topographic lows along arroyos, where it is removed by evapotranspiration. These discharges are insufficient to sustain baseflow, although they may be sufficient to enhance localized vegetation growth (URS 2009). Alluvial groundwater will also be included in this groundwater CIA. Ground water recharge of the bedrock is thought to be enhanced along the select channels and at existing pond locations where water is available for recharge from storm runoff and pond storage. Recharge water, although limited, is thought to move predominantly downward through the overburden and coal units of the Fruitland Formation and into the PCS. For this reason the PCS will also be assessed in this CHIA. The Lewis Shale underlies the PCS; however, the Lewis Shale is relatively impermeable and does not receive significant discharge from the PCS and will not be considered for impact assessment in this CHIA. Therefore, potential groundwater quality and quantity affects on the Fruitland and Picture Cliffs Sandstone (PCS) Formations and valley alluvium in the permit and adjacent area will be evaluated in this CHIA.

2.2.1 Ground Water Impact Area

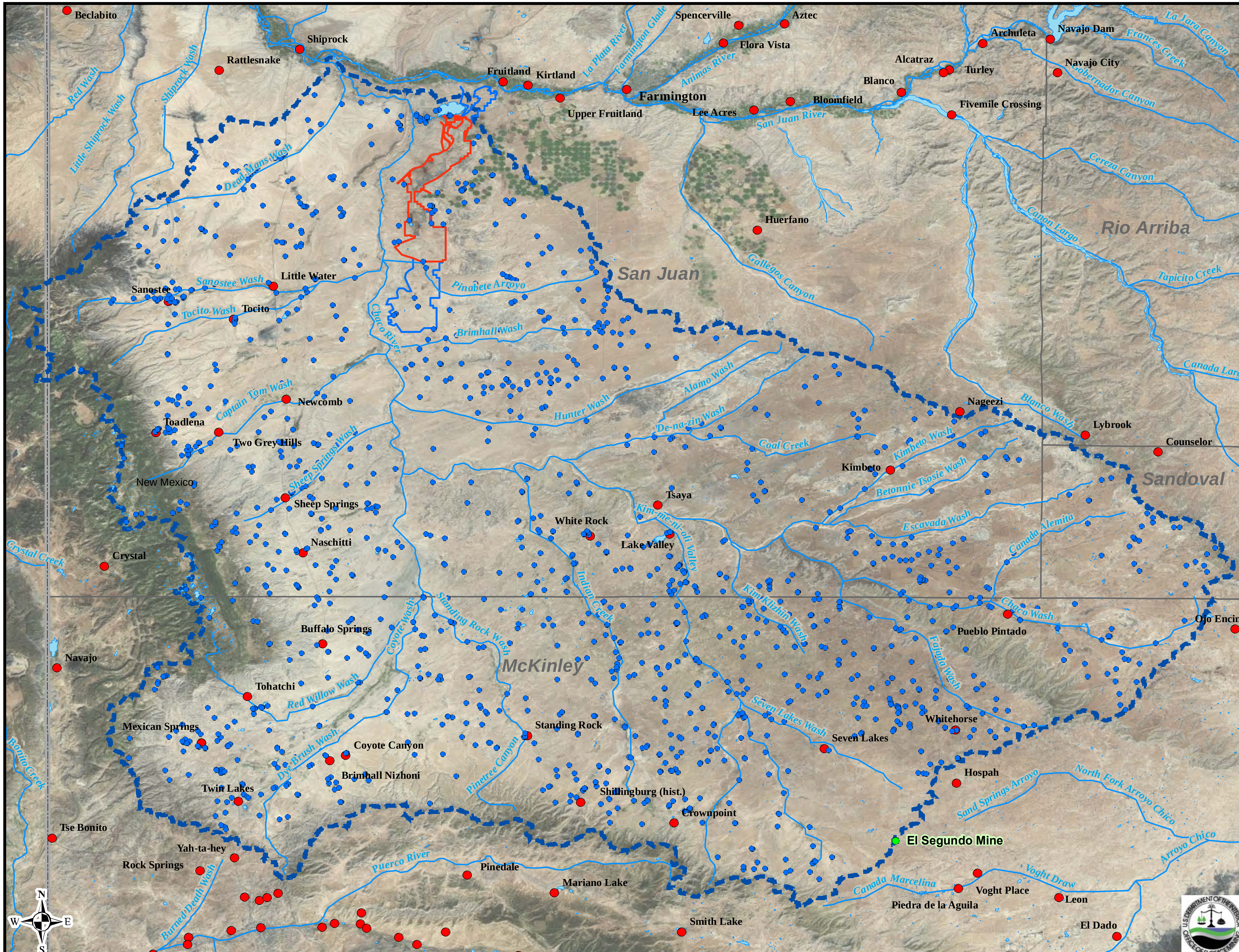
A single groundwater CIA will be used to encompass all three groundwater resources (Figure 12); Fruitland Formation, PCS and alluvium. The CIA will be bounded on the north by the San Juan River. Both the PCS and the Fruitland outcrop in the vicinity of the San Juan River, and given that the San Juan is perennial and receives groundwater baseflow, it is expected that the groundwater potentiometric elevation is close to the elevation of the San Juan River channel bottom. The San Juan River can therefore be assumed to act as a hydrologic barrier.

The San Juan alluvial aquifer is estimated to have an average flow of approximately 30,000 ft^3/day, of which 1% or 300 ft^3/day is estimated to be discharged from the backfilled mining areas (BNCC 2011, Section 11.6). Leaching studies of overburden and spoils indicate that the chemical quality expected from backfill leachate would be very similar to baseline quality in coal seams (BNCC 2011, Section 6.5). Consequently, groundwater discharge from the mine area will have a negligible effect on the water quantity or quality of the San Juan River alluvium.

Both the PCS and Lewis Shale outcrop to the west of the Lease area, serving as a physical barrier to groundwater impact for the PCS. In this area the PCS potentiometric surface is above the base of the coal layers and should therefore also serve as in impact boundary for the Fruitland formation. However, in order to address all potential impact to the alluvial system the western boundary of the CIA will be extended beyond the outcrop of the PCS/Lewis shale stratigraphic interface to the western boundary of the Chaco River alluvium.

Both the southern and eastern CIA boundaries are based on groundwater model boundaries developed by Norwest Corporation for BNCC, and presented in the PHC. Two distinct models were developed by Norwest one for the southern mine area (Areas IV and V) and one for the northern mine area (Area I). The southern CIA boundary is the southern boundary developed for the model of Areas IV and V. The eastern CIA boundary is a composite of the eastern boundaries of both models extended correspondingly north and south to their natural intersection. Current and historic water level monitoring data from wells, drainage and outcrop locations, and previously conducted studies in the area, were used to generate a potentiometric surface for the PCS. This potentiometric surface was then used to establish boundaries at a sufficient distance to the east and south of the coal lease where the required assumptions about hydrogeologic conditions at the boundary were expected to have minimal influence on the predicted changes in the groundwater system. The models represent the most comprehensive compilation and evaluation of geologic and hydrologic data in the area, and are therefore appropriate tools for assessing BNCC hydrologic impacts. Figure 12 illustrates the boundaries of the groundwater CIA for this CHIA.

It should be noted that this groundwater CIA extends south of the Burnham Mine. The depth to groundwater at Burnham Mine ranges from approximately 16 to 30 feet below ground surface. Hydrologic monitoring at Burnham Mine indicates groundwater is moving to the southeast away from the Navajo Mine site. Additionally, the area has a low hydraulic gradient and reclamation is expected to be complete before degraded water quality has significantly migrated (Golder Associates Inc. 2008). Therefore, the groundwater contamination at Burnham is not expected to result in cumulative groundwater affects with the Navajo Mine, and the groundwater impacts associated with Burnham mine will not be considered further in this CHIA.

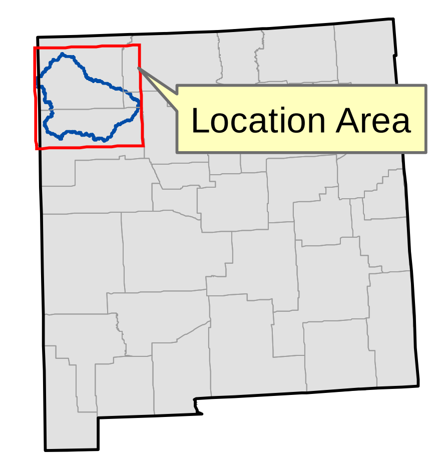


Legend

- Impoundments [1]
- Water Body [2]
- Streams [3]
- Permit Area
- Coal Lease Area
- Surface Water CIA
- Counties
- El Segundo Mine
- Population Centers

Data Sources:
Aerial Photography (Bing Mapping Service)
[1] Navajo Nation Hydrographic Survey (2010)
[2] USGS National Hydrography Dataset
[3] ESRI USA Base Data (2010)

5 0 5 10 15
Miles

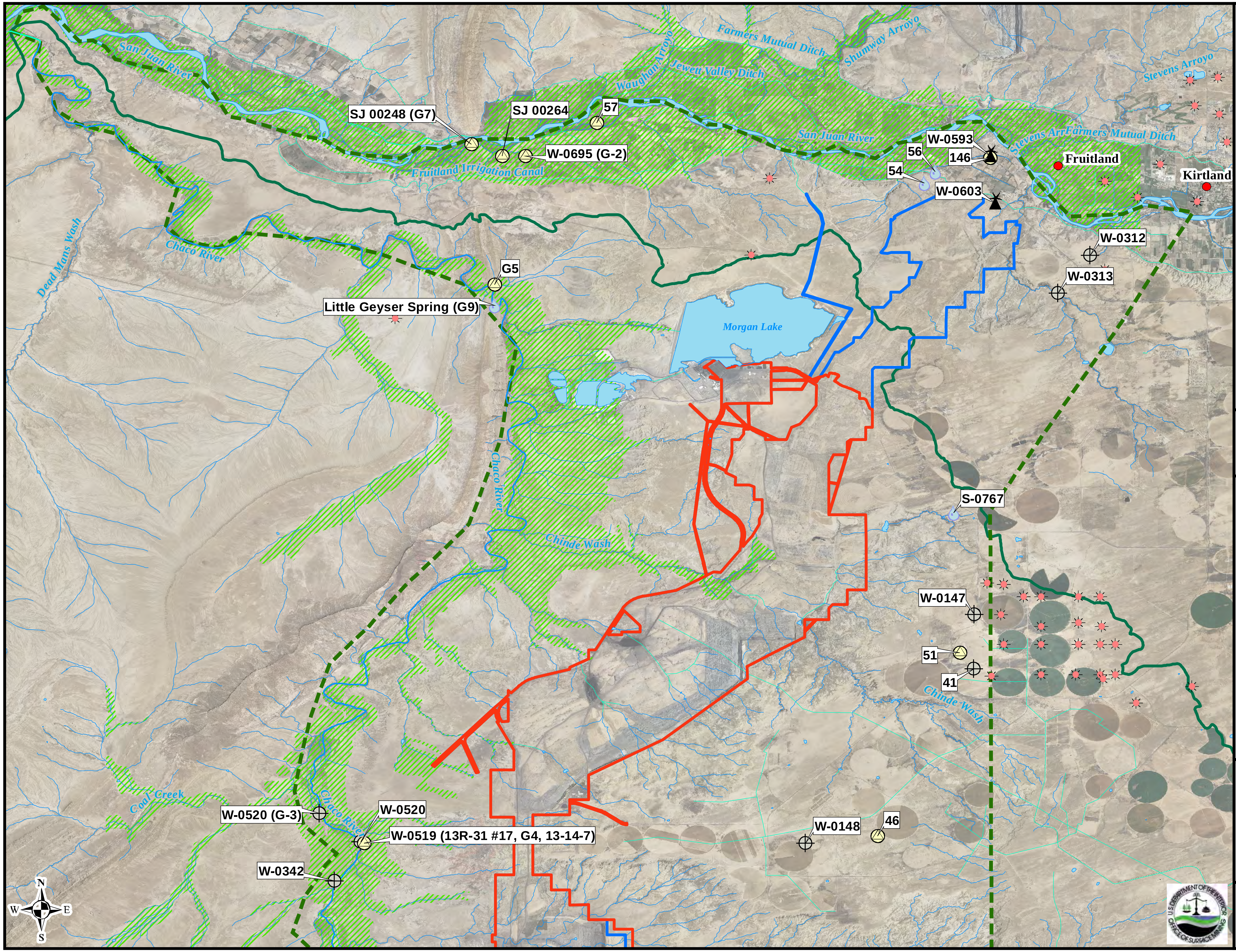


Coordinate System: GCS North American 1983
Datum: North American 1983
Units: Degree

Surface Water

CIA and Non-BNCC Impoundments

Figure 11



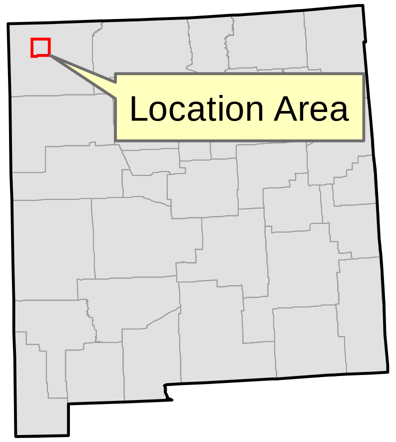
Legend

Water Wells & Springs[1]

- Spring &Seep
- Alluvial Well
- Well
- Windmill
- Gas Wells [4]
- Groundwater CIA
- Permit Area
- Coal Lease Area
- Natural Stream [2]
- Artifical Path/Ditch [2]
- Alluvium [3]
- Population Centers

Data Sources:
Aerial Photography (San Juan County) 2009
[1] Navajo Nation Hydrographic Survey (2010)
[2] USGS National Hydrography Dataset
[3] USGS Geology Maps: MF-1026, MF-1076, MF-1077, MF-1080, MF-1092, MF-1093 & I-1978
[4] NM Oil & Gas wells (GO-TECH website 1/17/12)

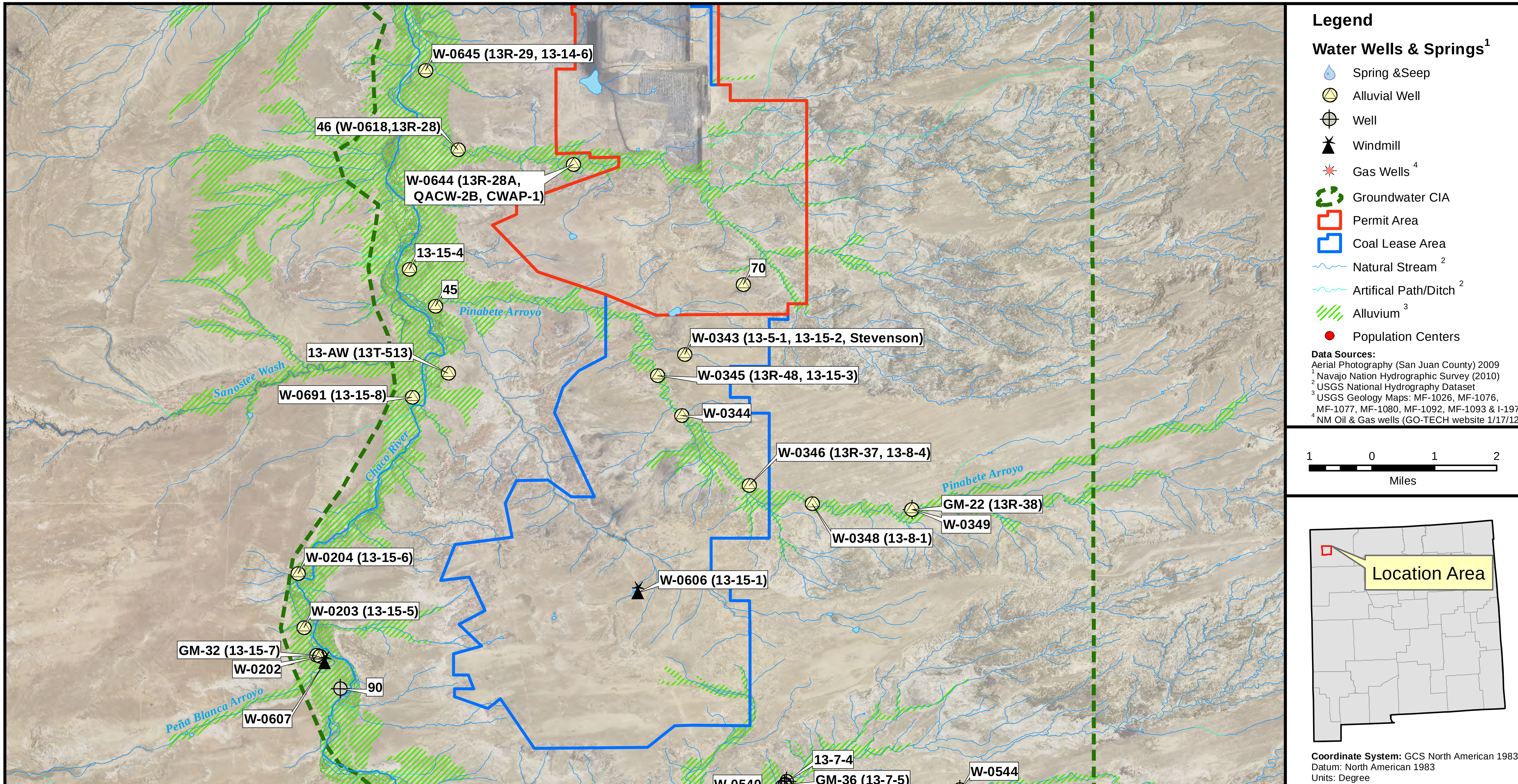
1 0 1 2
Miles



Coordinate System: GCS North American 1983
Datum: North American 1983
Units: Degree

Ground Water Cumulative Impacts Area San Juan County, NM

Figure 12
(pg 1 of 2)



Ground Water Cumulative Impacts Area San Juan County, NM

Figure 12
(pg 2 of 2)