

**Cumulative Hydrologic Impact Assessment
Material Damage Determination Statement
BHP Navajo Coal Company
Navajo Mine**

Prepared By



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Western Region Office – Denver, Colorado
March 2012**

The Office of Surface Mining Reclamation and Enforcement (OSM) is the regulatory authority for coal mining operations on Indian Lands under the Surface Mining Reclamation and Control Act of 1977 (SMCRA). As such, OSM is responsible for the review and decisions on all permit applications to conduct surface coal mining operations within the boundaries of the Navajo Nation Indian Reservation. BHP Navajo Coal Company's (BNCC's) Navajo Mine permit area is located on the Navajo Nation lands. By regulation, OSM must prepare a Cumulative Hydrologic Impact Assessment (CHIA) for this permit area. The CHIA determines whether the proposed operation has been designed to prevent material damage to the hydrologic balance outside the permit area (30 Code of Federal Regulations (CFR) § 780.21(g)). This Material Damage Determination Statement is a summary of OSM's material damage findings for the 2012 Navajo Mine CHIA. For detailed discussion and analysis, please refer to the 2012 Navajo Mine CHIA document.

The 2012 Navajo Mine CHIA supersedes the previous CHIA written in 1984 and the addendum from 1989. The 2012 Navajo Mine CHIA has been peer reviewed by the Bureau of Indian Affairs (BIA), Navajo Nation Environmental Protection Agency (NNEPA), Navajo Nation Minerals Department (NNMD), U.S. Army Corps of Engineers (USACE), and OSM technical staff. Additionally, separate face-to-face discussions were conducted with the aforementioned organizations to review the assessment approach, and to identify any potential major concerns prior to finalization of the assessment. BIA, NNMD, and USACE concurred that the assessment approach for the 2012 Navajo Mine CHIA was reasonable, and the conclusions were appropriate. NNEPA found that the process used to determine water quantity impact was appropriate and that comparison between baseline and post-mining results was acceptable.

OSM developed a use impact assessment approach, specific to the evaluation of potential impacts from Navajo Mine. This approach developed by OSM in part referenced and used NNEPA water quality standards for comparison and also considered Baseline (background) water quality as well as research supported water quality criteria for livestock. OSM did not use NNEPA guidance for assessing the quality of Navajo Nation surface waters to determine impairment because OSM has no authority to implement 303d impaired stream listing protocols. For this reason NNEPA cannot concur with OSM's conclusions without first assessing water quality impairment using NNEPA guidance. NNEPA has expressed future plans to conduct analysis on the available data set using NNEPA guidance.

The 2012 Navajo Mine CHIA:

- Provides a definition for "Material Damage to the Hydrologic Balance",
- Identifies material damage limits and hydrologic balance thresholds,
- Updates hydrologic monitoring data sets through 2010,
- Includes background baseline information for Mine Areas IV and V,
- Considers NNEPA 2007 surface water use designations and water quality standards,
- Evaluates the effects of Morgan Lake,
- Considers the effect of the Navajo Agricultural Product Industry (NAPI),
- Evaluates the impact of Coal Combustion By-product (CCB) placement within the permit area,
- Updates the methodology for impact assessment,
- Refines the surface water Cumulative Impact Area (CIA), and
- Expands the groundwater CIA.

This CHIA delineates a surface water CIA and a groundwater CIA to assess impacts associated with these distinct hydrologic resources. The surface water CIA for assessing cumulative impacts of the Navajo and El Segundo Mines is the entire Chaco River watershed (Figure 1). However, to ensure adequate protection of water uses adjacent to the Navajo Mine, impacts were also assessed using smaller evaluation

areas. Impact to surface water quality was assessed for the Chaco River within the immediate vicinity of the Navajo Mine and the primary washes and arroyos traversing this mine. Impacts on surface water quantity were analyzed using 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) (Figure 2). A single groundwater CIA was delineated to encompass all three groundwater resources (Figure 3a and 3b); Fruitland Formation, Picture Cliffs Sandstone (PCS) and alluvium. Surface and ground water within the CIA's were evaluated for the following existing and reasonably foreseeable designated uses within the permit and adjacent areas:

- Direct human use (including domestic and municipal water supply),
- Industrial water supply,
- Irrigation supply water,
- Livestock watering, and
- Aquatic and wildlife habitat

The 2012 Navajo Mine CHIA considers available quantity and quality information related to surface water and groundwater potentially affected by the Navajo Mine as well as the El Segundo Mine operations. The impact assessment approach used for each resource is summarized in Table 1. Impact assessment relied upon analysis of monitoring data, analytical and numerical surface water and groundwater models, relevant published and unpublished reports and papers, and observation and experience of past mining and reclamation activities on the Navajo Mine and other mines located along the western rim of the San Juan Watershed. Impacts are designated as negligible, minor, moderate or major as defined in Table 1. Table 1 also identifies current impact minimization techniques and updates to the Navajo Mine monitoring program.

“Material damage to the hydrologic balance” is not defined in SMCRA or at 30 CFR § 701.5. The intent of not developing a programmatic definition for “material damage to the hydrologic balance” was to provide the regulatory authority the ability to develop a definition based on regional environmental and regulatory conditions. Therefore, for the purpose of this CHIA;

Material damage to the hydrologic balance outside the permit area means any quantifiable permanent adverse impact from surface coal mining and reclamation operations on the quality or quantity of surface water or groundwater that exceeds the identified material damage limits and that would preclude any existing or reasonably foreseeable use of surface water or groundwater outside the permit area.

The 2012 Navajo Mine CHIA material damage definition is tied to the protection of existing or reasonably foreseeable uses. The CHIA considers existing water quality standards for designated uses to determine if a surface water or groundwater use has been precluded. The material damage assessment determines, for the purpose of permit eligibility, if material damage to the hydrologic balance has occurred due to the mining operation.

OSM has identified both **hydrologic balance thresholds** and **material damage limits** for the Navajo Mine (Table 2).

- A **material damage limit** is a long-term coal mining effect on the hydrologic balance by the mining operation that permanently precludes an existing or reasonably foreseeable designated use outside of the permit boundary, and specifically pertains to the designated post-mining land use within the permit area. Such an effect cannot be effectively mitigated or replaced by the coal operator.

- A **hydrologic balance threshold** constitutes changes to the hydrologic balance caused by the mining operation that are short-term and can be effectively mitigated by reclamation or by water supply replacement, or changes to the hydrologic balance that do NOT preclude existing or reasonably foreseeable uses. The intent of determining a hydrologic balance threshold is to alert BNCC and OSM of potential water resource impacts of concern, such that BNCC may take appropriate actions to prevent material damage.

For the purpose of this material damage assessment, short-term impacts are defined as impacts that occur to the hydrologic balance during mining, but are not projected to persist after the reclamation liability period¹. Long-term impacts are defined as impacts that are projected to persist after the reclamation liability period.

Determination of impacts for the Navajo Mine relative to the adequacy of the monitoring program, impact minimization techniques, and hydrologic balance thresholds and material damage limits, are summarized in Table 3.

¹ The reclamation liability period ends after the permittee has met all of the requirements at 30 CFR 750, including those at 30 CFR 800.13. At a minimum an application for final (Phase III) reclamation liability release would not be considered by the regulatory authority until the reclaimed (back filled, re-graded and top soiled) lands have been revegetated for ten years.

Table 1: Impact Assessment and Designation Methodology

Water Resource	Fruitland & PCS Quantity	Alluvial Quantity	Surface Water Quantity	Fruitland & PCS Quality	Alluvial Quality	Surface Water Quality
Assessment Approach	Evaluation of potentiometric surface contour maps	Comparison of water levels at individual wells over-time	SEDCAD modeling- pre- and post-mining; Percent of HUC12 Watersheds controlled with impoundments	Comparison of baseline water quality to potentially impacted or non-baseline wells, including spoil and CCB wells	Comparison baseline (upstream/pre-mining) water quality to non-baseline (during and post-mining/downstream) water quality and comparison to applicable Water Quality Standards	
Impact Designation	Major	Changes in water level contours that are significantly less than baseline levels	Changes in water levels that are consistently (>60% of the time) below baseline fluctuations as Characterized by the Median minus 2 MAD ²	Impounded areas relative to HUC 12 watersheds or change in peak flows relative to baseline are >60%	Changes in water quality that consistently (>60%) exceed baseline fluctuations as Characterized by the Median plus 2 MAD	
	Moderate	Changes in water level contours that are moderately less than baseline levels	Changes in water levels that are regularly (30%-60%) below baseline fluctuations as Characterized by the Median minus 2 MAD	Impounded areas relative to HUC 12 watersheds or change in peak flows relative to baseline are between 30% and 60%	Changes in water quality that regularly (30-60%) exceed baseline fluctuations as Characterized by the Median plus 2 MAD	
	Minor	Changes in water level contours that are slightly less than baseline levels	Changes in water levels that are occasionally (10%-30%) below baseline fluctuations as Characterized by the Median minus 2 MAD	Impounded areas relative to HUC 12 watersheds or change in peak flows relative to baseline are between 10% and 30%	Changes in water quality that occasionally (10%-30%) exceed baseline fluctuations as Characterized by the Median plus 2 MAD	
	Negligible	Impacts to Groundwater that is not capable of providing a sustainable water supply for use or that are similar to baseline fluctuations		Impounded areas relative to HUC 12 watersheds or change in peak flows are <10% (considered within baseline)	Impacts to water quality that are within baseline fluctuations (<10%) as Characterized by the Median plus 2 MAD or Impacts to Groundwater that is not capable of providing a sustainable water supply for use or that are similar to baseline fluctuations	
Measures to Minimize Impact	Contemporaneous Reclamation	Contemporaneous Reclamation; reclamation of approximate original contour (AOC); mining limited to ephemeral channels; stream buffer zones		Contemporaneous Reclamation; mixing of overburden/ backfill materials; material classification and handling procedures	Contemporaneous Reclamation; mining limited to ephemeral channels; stream buffer zones	Contemporaneous Reclamation; mining limited to ephemeral channels; stream buffer zones; Sedimentation Ponds
Monitoring Program Updates	Submittal of 5 yr Potentiometric Surface Contour Maps	Addition of new monitoring stations	Addition of new monitoring stations	Additional coal seam well in area IV north	Addition of new monitoring stations	Addition of new monitoring stations

² Median Absolute Deviation

Table 2: Material Damage Limits and Hydrologic Balance Thresholds

Category		Definition	
General	Quantity	Limit	Irretrievable loss of the water resource to support existing or reasonably foreseeable uses outside of the permit area that cannot be mitigated by reclamation or provided by alternate water supplies or water treatment
		Threshold	Long- term loss of the water resource that does not preclude the current or potential future use potential of the resource or short term loss of the water resource to support existing uses that can be mitigated by reclamation or by provision of alternate water supplies or water treatment
	Quality	Limit	Long-term changes in water quality outside the permit area that preclude existing or reasonably foreseeable uses that cannot be mitigated by reclamation or provided by alternate water supplies or water treatment
		Threshold	Long- term changes in water quality that occasionally exceed the baseline but do not preclude the current or future use potential of the resource, or short term changes in water quality that consistently exceed the baseline water quality condition but that do not preclude the current use or can be mitigated by reclamation or by provision of alternate water supplies or water treatment
Criteria Applied to the Navajo Mine	Limit	Long-term Impact Designation of Major as defined in Table 1, and which Preclude Existing or Reasonably Foreseeable Uses Outside of the permit area that Cannot be Mitigated by Reclamation or Provision of Alternate Water Supplies	
	Threshold	Long-term Impact Designation of Moderate or Major as defined in Table 1 Outside of the permit area that Does NOT Preclude Existing or Reasonably Foreseeable Uses OR Short-term Impact Designation of Major as defined in Table 1, which may Preclude Existing or Reasonably Foreseeable Uses Outside of the permit area that Can be Mitigated by Reclamation or Provision of Alternate Water Supplies	

Table 3: Assessment of Material Damage for the Waters of the Navajo Mine

Water Resource	Assessment Approach	Hydrologic balance threshold Reached	Material Damage Limit Reached	Measures to Minimize Impact	Adequate Monitoring Program
Fruitland & PCS Quantity	Evaluation of potentiometric surface contour maps	No	No	Contemporaneous Reclamation	Yes
Alluvial Quantity	Comparison of water levels at individual wells over-time	No	No	Contemporaneous Reclamation; reclamation of approximate original contour (AOC); mining limited to ephemeral channels; stream buffer zones	Yes
Surface Water Quantity	SEDCAD modeling-assessment of pre- and post-mining impacts; Percent of HUC12 Watersheds controlled with impoundments	Yes	No		Yes
Fruitland & PCS Quality	Comparison of baseline water quality to potentially impacted or non-baseline wells, including spoil and CCB wells	No	No	Contemporaneous Reclamation; mixing of overburden/backfill materials; material classification and handling procedures	Yes
Alluvial Quality	Comparison baseline (upstream/pre-mining) water quality to non-baseline (post-mining/downstream) water quality	Yes	No	Contemporaneous Reclamation; mining limited to ephemeral channels; stream buffer zones	Yes
Surface Water Quality		No	No	Contemporaneous Reclamation; mining limited to ephemeral channels; stream buffer zones; Sedimentation Ponds	Yes

Surface Water

Surface water quantity impacts are assessed as a relative percentage of the watershed controlled through the use of sediment impoundments compared to the corresponding Hydrologic Unit Code (HUC) 12 watershed delineation. Hydrologic balance **thresholds**³ and material damage **limits** have not been reached for any of the assessed HUC 12 watersheds, since all impact designations are *negligible*⁴ or *minor*.

³ **Bold** terms are defined in Table 2.

⁴ *Italicized* terms are defined in Table 1.

When modeled pre-mining peak flows are compared to-post-mining peak flows, the comparison indicates that hydrologic balance **thresholds** and material damage **limits** have not been reached for the Chinde Wash Watershed, Coal Creek-Chaco River Watershed, or Cottonwood Arroyo Watershed.

In the Chinde-Chaco River Watershed a long-term impact designation of *moderate* has been determined for the area outside of the permit boundary. This *moderate* impact designation is due to a reduction in post-mining peak flow. Therefore, the hydrologic balance **threshold** has been reached for this watershed. The material damage **limit** has not been reached since the impact designation has not been determined to be *major* and current designated water uses are not expected to be precluded. BNCC and OSM are currently discussing modifications to the reclamation plan that may be needed for this area to ensure material damage to the hydrologic balance is prevented outside of the permit area over the long-term.

Relative to the Chaco River surface water quality, the hydrologic balance **threshold** and material damage **limit** have not been reached, and are not anticipated to be reached, since impacts are not long-term and will not preclude designated water uses. Relative to Chinde Wash surface water quality, the hydrologic balance **threshold** and material damage **limit** have not been reached, since impacts are not long-term, not determined to be *major*, and will not preclude designated water uses.

Alluvium

The material damage assessment for alluvial water quantity confirms that hydrologic balance **thresholds** and material damage **limits** have not been reached, since all impact designations are *negligible*.

It has also been determined that the alluvial water quality hydrologic balance **threshold** has been reached in the Chinde Wash alluvium, since a short-term *major* impact designation has been assigned, which may preclude designated water use. The material damage **limit** has not been reached since impacts are not considered long-term. BNCC is enhancing the existing alluvial monitoring plan in this area to further assess and verify the duration of coal mining impacts in the Chinde Wash alluvium outside the permit area.

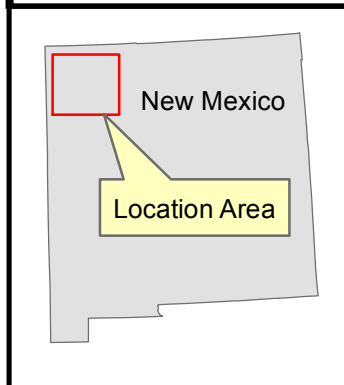
Relative to Cottonwood alluvial water quality, the hydrologic balance **thresholds** and material damage **limits** have not been reached since all impact designations are *negligible*.

Fruitland Formation and PCS

Relative to Fruitland formation and PCS quantity and quality, hydrologic balance **thresholds** and material damage **limits** have not been reached since impact designation is *negligible* and designated water use is not expected to be precluded. OSM's assessment has concluded that potential impacts, outside of the permit area, from historic CCB disposal, are *negligible*.

Conclusion

OSM finds that the Navajo Mine operation monitoring program has supplied sufficient information for this CHIA and finding. OSM finds that the Navajo Mine operation has been designed to minimize impacts within the permit area and to prevent material damage to the hydrologic balance outside of the permit area.

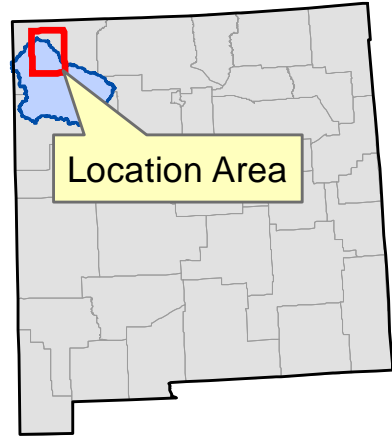
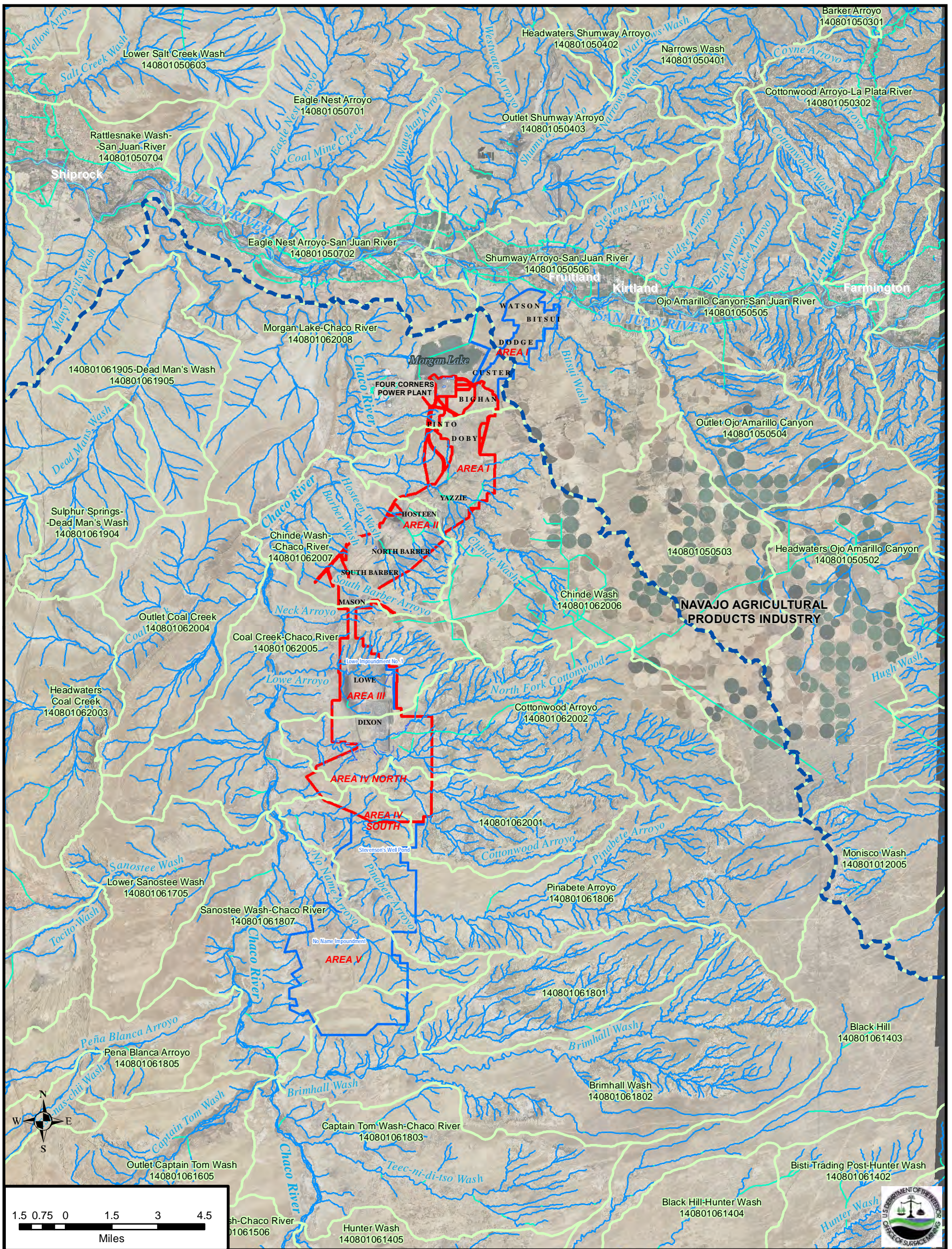


Legend

-  Lease Area
-  Chaco Watershed
-  Communities
-  El Segundo Mine

**SurfaceWater
Cumulative
Impact Area**

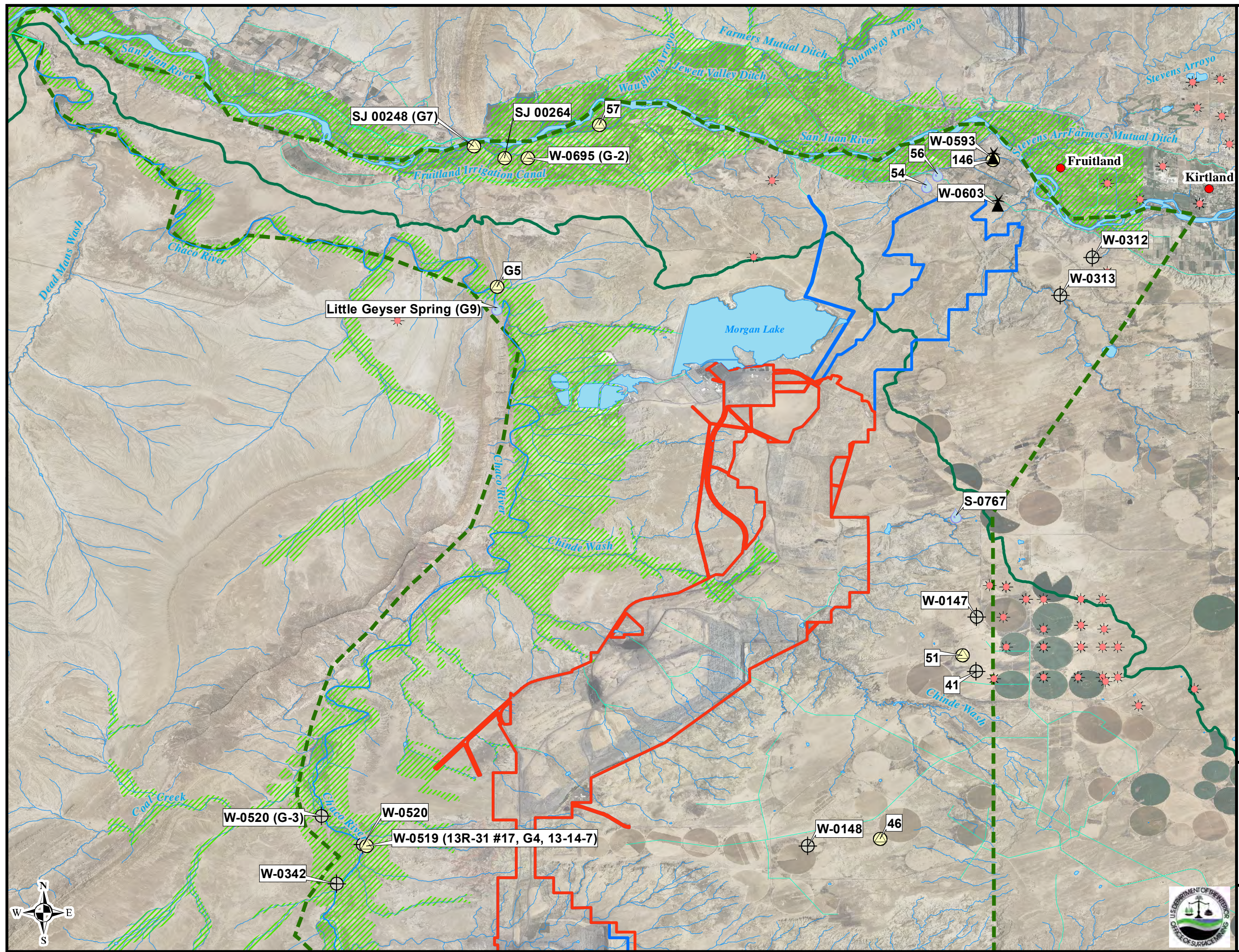
Figure 1



- Legend**
- HUC12 Watersheds¹
 - Ponds
 - Natural Stream¹
 - Artificial Canal/Ditch¹
 - 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 2

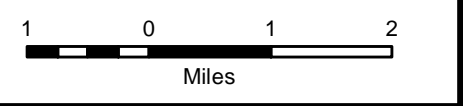


Legend

Water Wells & Springs¹

- Spring & Seep
- Alluvial Well
- Well
- Windmill
- Gas Wells⁴
- Groundwater CIA
- Permit Area
- Coal Lease Area
- Natural Stream²
- Artificial Path/Ditch²
- Alluvium³
- 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)



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

**Ground Water
 Cumulative Impacts
 Area
 San Juan County, NM**

Figure 3
 (pg 1 of 2)



