

SURFACE WATER RESOURCES

Evaluation of the surface water pathway requires an understanding of where surface water occurs proximal to the AUM sites, as well as the flood potential of a site. Proximity is directly related to the ease with which hazardous substances can migrate to surface water. Surface waters include streams, rivers, and lakes. On the Navajo Nation, where the mean annual precipitation is less than 20 inches, intermittently-flowing waters and ditches also qualify as surface water. Release of a hazardous substance from an AUM to surface water could threaten drinking water supplies, human food chain organisms, and sensitive environments. The distance from an AUM site to surface water can be used as an indicator of the likelihood of release of hazardous substances to surface water. The location of an AUM site with respect to surface water floodplains is another important indicator of the likelihood of release of a hazardous substance, and is also directly related to distance from surface water (EPA, 1991 - S01230301). No floodplain maps for the Navajo Nation were found to be available from either the Federal Emergency Management Agency or the U.S. Army Corps of Engineers.

WATERSHEDS

A watershed is the area of land draining into a river or stream at a given location. The United States is divided and subdivided into successively smaller hydrologic units which are classified into four levels: regions, sub-regions, accounting units, and cataloging units (also referred to as watersheds). The hydrologic units are arranged hierarchically, from the smallest (cataloging units) to the largest (regions). Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to eight digits based on the four levels of classification in the hydrologic unit system (USGS, 2003 - S07290302).

Figure 30 shows the three HUC regions covering the Navajo Nation: Rio Grand (HUC 13), Upper Colorado (HUC 14), and the Lower Colorado (HUC 15). The Navajo Nation is within 5 HUC sub-regions, which are shown in Figure 31. HUCs for the watersheds are listed in the legend of Figure 31. This dataset is provided on the GIS Data DVD (DB/Water/NN_Subbasins.shp).

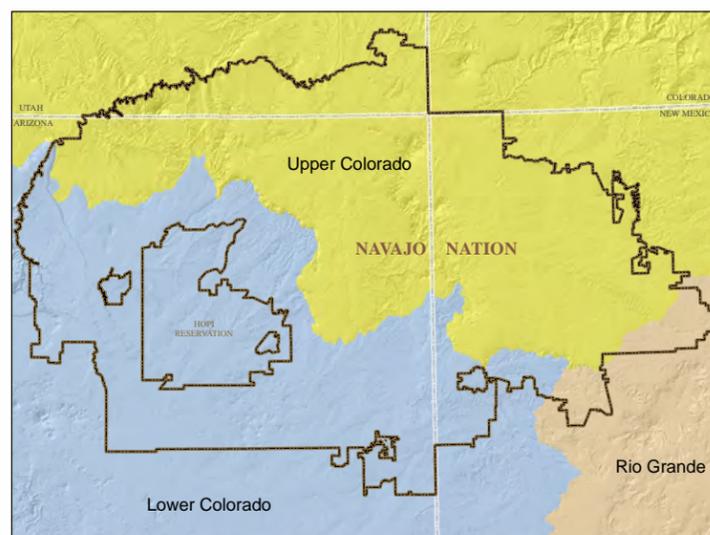


Figure 30. Hydrologic Unit Code Regions (USGS, 2003 - S07290302).

DRAINAGES

Drainages are important to surface water pathway screening assessments. This factor involves assessing whether potential drainage pathways exist for the transport of hazardous substances via surface water, and if so, whether any targets (e.g., intakes supplying drinking water, fisheries, or sensitive environments) are likely to be exposed to contaminants.

Erosion is a concern for AUM sites because of the mine wastes. Major sources of erosion/sediment loadings at mining sites include waste rock and overburden piles, haul and access roads, exploration areas, and reclamation areas. The main factors influencing erosion include rainfall/snowmelt runoff, soil infiltration rate, soil texture and structure, vegetative cover, slope length, and erosion control practices. Erosion may cause loading of sediments to nearby drainages, especially during severe storm events and high snowmelt periods.

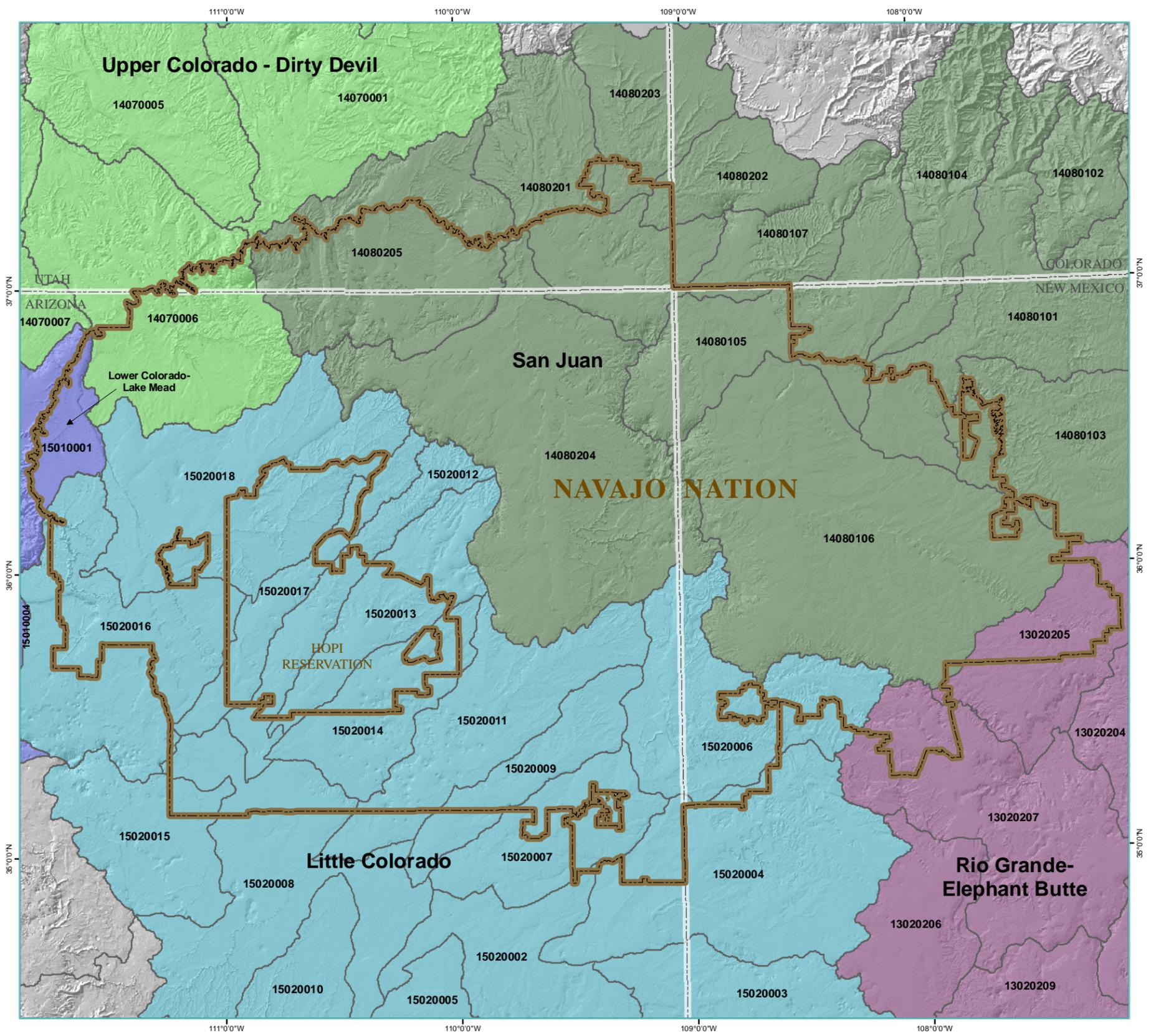
The majority of surface waters flowing within, or originating from, the Navajo Nation are either intermittent or ephemeral. Intermittent streams flow water part of the time in most years and have a defined stream channel. Ephemeral streams flow water in response to heavy rainfall events and do not have a defined stream channel. Stream flow in the intermittent channels is also dependent on storm events. Differences in rainfall patterns cause stream flow to be extremely variable. Perennial streams have visible water flowing above the streambed year-round.

The type of soil and the amount and type of vegetation have a significant effect on the amount of precipitation that becomes surface runoff. Vegetation on the Navajo Nation generally consists of sparse grasses and desert shrubs at lower altitudes, and piñon-juniper forests at higher altitudes. Approximately one-half of the annual precipitation occurs from July through October, generally in the form of localized, short-duration, high-intensity thunderstorms. Due to the torrential character of the much of the rainfall, and the abundance of bare rock surfaces, the consequent runoff means that thunderstorms anywhere in the basin of a drainage may create large flows, which are commonly of limited duration and extent (Cooley et al., 1969 - S10290201).

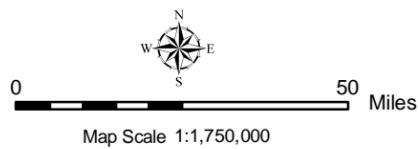
Hazardous constituents (e.g., radionuclides and heavy metals) associated with discharges from uranium mining operations may be found at elevated levels in sediments (EPA, 2000 - S02200302). For example, radioactive elements were released to the Puerco River through mine-water discharge, and by a catastrophic spill of uranium mine tailings and mine water. Several large uranium mines and a processing mill released contaminated mine water to a small tributary of the Puerco River, known as Pipeline Arroyo. Because the ore deposits lie beneath the water table, water draining to mine tunnels was pumped and released to Pipeline Arroyo. Mine dewatering released an estimated total of 510 tons of uranium and 260 trillion pico curies of gross-alpha radioactivity to the Puerco River over a 22 year period. On July 16, 1979, the failure of an earthen dam, holding uranium-mining and milling wastewater and sediment, released about 94 million gallons of highly acidic liquid and 1,100 tons of uranium-mine tailings to the Puerco River through Pipeline Arroyo. However, despite the large size of the spill, more radioactive elements were released gradually by mining over a period of more than two decades. At least 300 times more uranium and six times more total gross-alpha activity were released by day-to-day pumping from the underground mines than was released by the spill (Wirt, 1994 - S03030609).

Surface water features on and near the Navajo Nation were acquired from the USGS National Hydrography Dataset high resolution (NHDH) database (shown on Figure 32). These datasets are available on the GIS Data DVD (DB/Water/NN_WaterBody_NHDH.shp; DB/Water/NN_Points_NHDH.shp; DB/Water/NN_Flowline_NHDH.shp; and DB/Water/NN_Areas_NHDH.shp).

Figure 33 shows drainages that were interpreted as potential downstream surface water pathways on the Navajo Nation. The drainage dataset documents streams within one mile overland and downslope of AUMs for a distance of at least fifteen miles. The primary source for these stream courses was the NHDH, but it was augmented by the addition of streams that were automated from DRGs and DOQQs. These drainage datasets are provided on the GIS Data DVD (DB/Water/NN_Drainage_HR_AUM.shp and DB/Water/NN_Drainage_Poly_HR_AUM.shp).



**ABANDONED URANIUM MINES AND THE NAVAJO NATION
WATERSHEDS BY SUB-REGION**



Legend

WATERSHED HUCS AND NAMES BY SUB-REGION

- 1302 - RIO GRANDE - ELEPHANT BUTTE**
- 13020204, Rio Puerco
- 13020205, Arroyo Chico
- 13020206, North Plains
- 13020207, Rio San Jose
- 13020209, Rio Saldo

- 1407 - UPPER COLORADO - DIRTY DEVIL**
- 14070001, Upper Lake Powell
- 14070005, Escalante
- 14070006, Lower Lake Powell
- 14070007, Paria

- 1408 - SAN JUAN**
- 14080101, Upper San Juan
- 14080102, Piedra
- 14080103, Blanco Canyon
- 14080104, Animas
- 14080105, Middle San Juan
- 14080106, Chaco
- 14080107, Mancos
- 14080107, Mancos
- 14080201, Lower San Juan-Four Corners
- 14080202, McElmo
- 14080203, Montezuma
- 14080204, Chinle
- 14080205, Lower San Juan

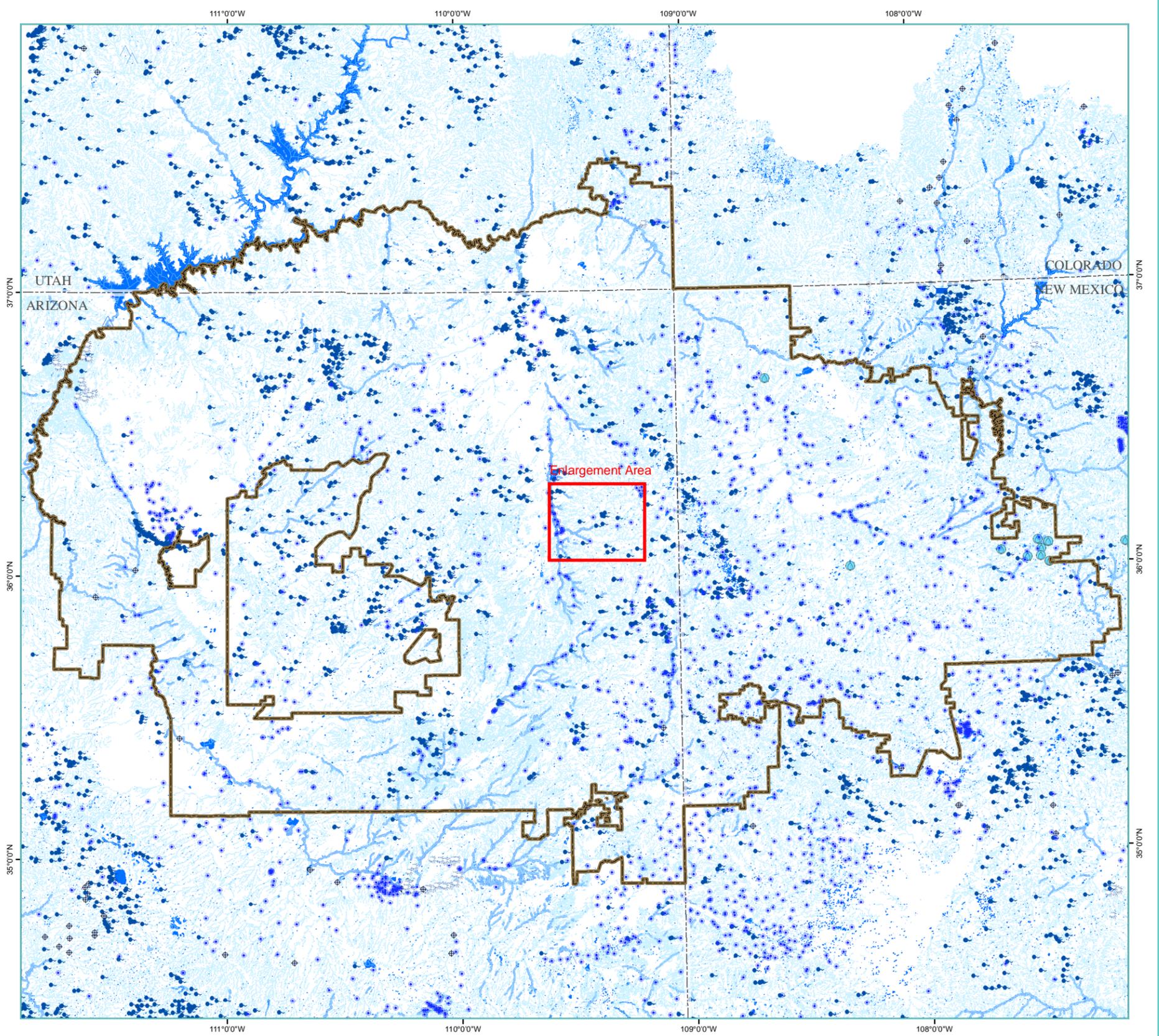
- 1501 - LOWER COLORADO - LAKE MEAD**
- 15010001, Lower Colorado-Marble Canyon
- 15010004, Havasu Canyon

- 1502 - LITTLE COLORADO**
- 15020011, Cottonwood Wash
- 15020012, Corn-Oraibi
- 15020013, Polacca Wash
- 15020014, Jadito Wash
- 15020015, Canyon Diablo
- 15020016, Lower Little Colorado
- 15020017, Dinnebito Wash
- 15020018, Moenkopi Wash
- 15020002, Upper Little Colorado
- 15020003, Carrizo Wash
- 15020004, Zuni, Arizona
- 15020005, Silver
- 15020006, Upper Puerco
- 15020007, Lower Puerco
- 15020008, Middle Little Colorado
- 15020009, Leroux Wash
- 15020010, Chevelon Canyon

Source

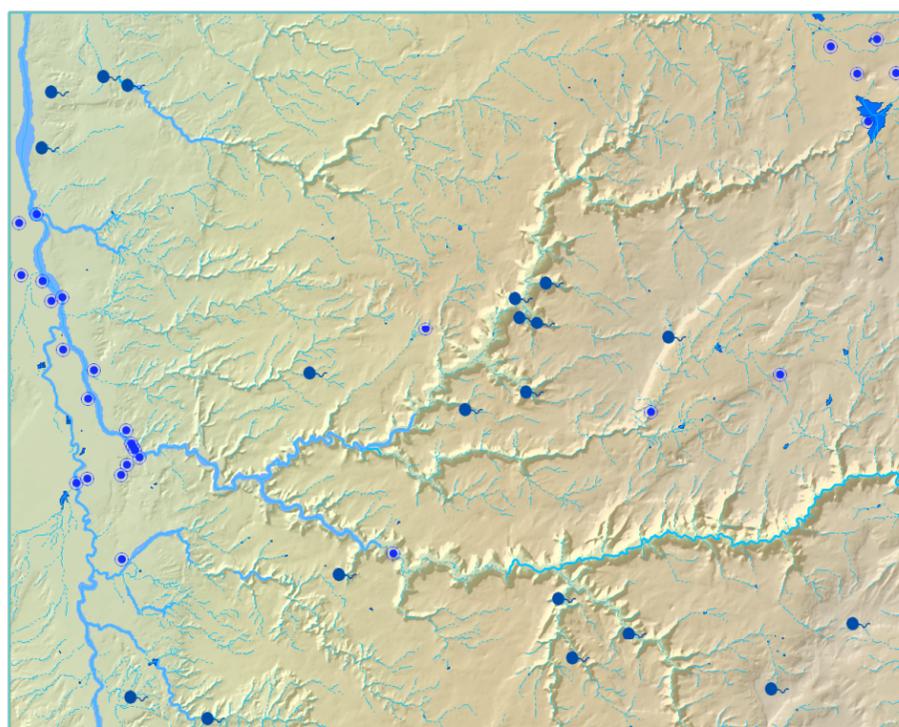
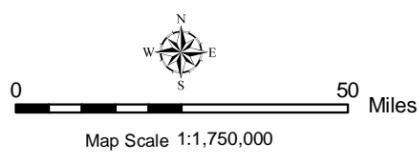
Watershed boundaries are from the U.S. Geological Survey (USGS) National Hydrography Dataset high resolution (NHDH). Filename: DB/Water/NN_Subbasins.shp

Figure 31. Watersheds On and Near the Navajo Nation.



ABANDONED URANIUM MINES AND THE NAVAJO NATION

SURFACE WATER FEATURES



Enlargement of National Hydrography Dataset high-resolution data.

Legend

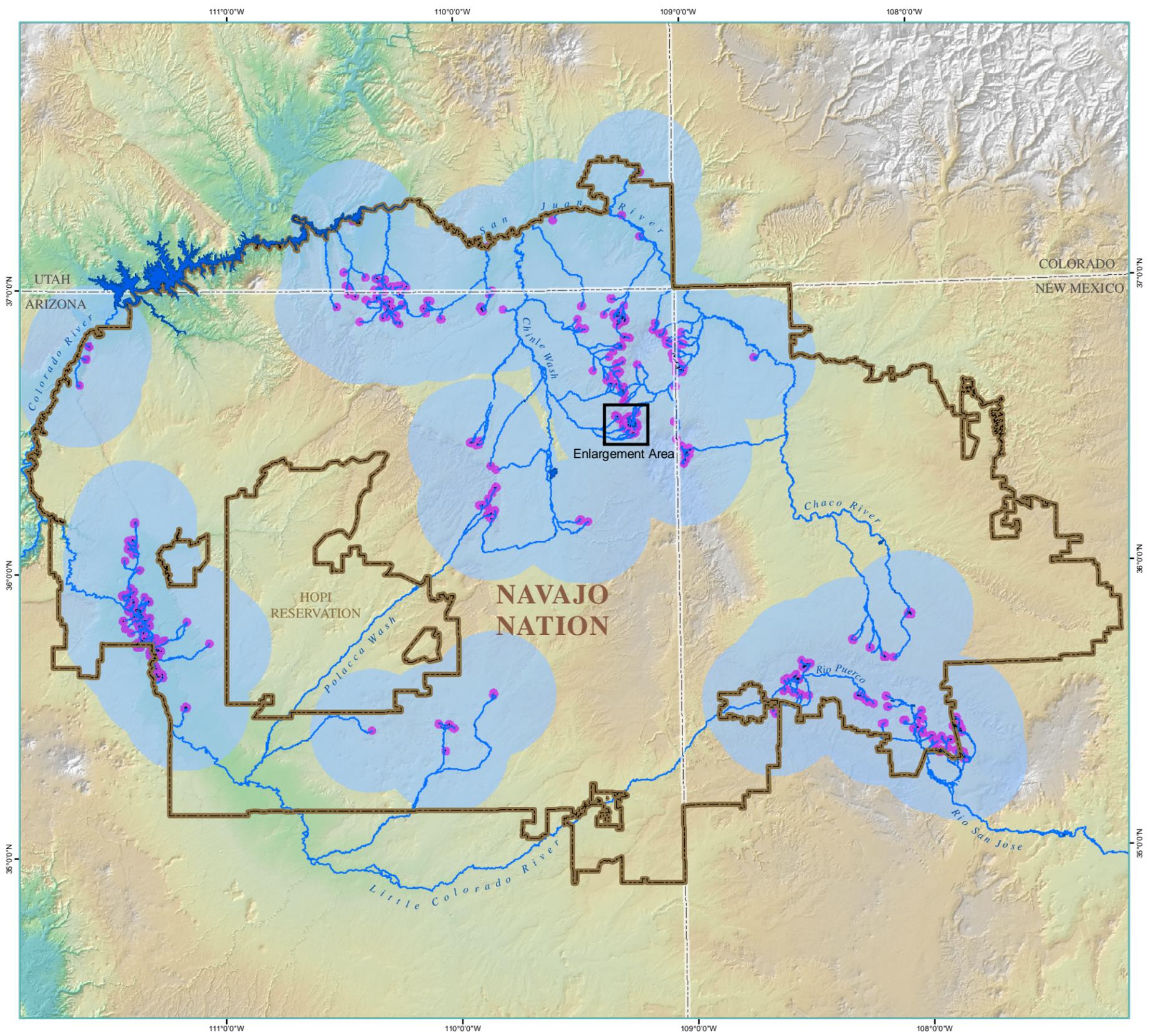
- ⊕ Gaging Station
- ⊗ Gate
- ⊕ Reservoir
- ⊕ Sink/Rise
- ⊕ Spring/Seep
- ⊕ Water Intake/Outflow
- ⊕ Waterfall
- ⊕ Well
- Artificial Path
- Stream/River, Intermittent
- Stream/River, Perennial
- Waterbody
- Areas: Complex Channels, Canal/Ditch, Dam/Weirs, Inundation Areas, Rapids, Streams/Rivers, and Washes

Sources

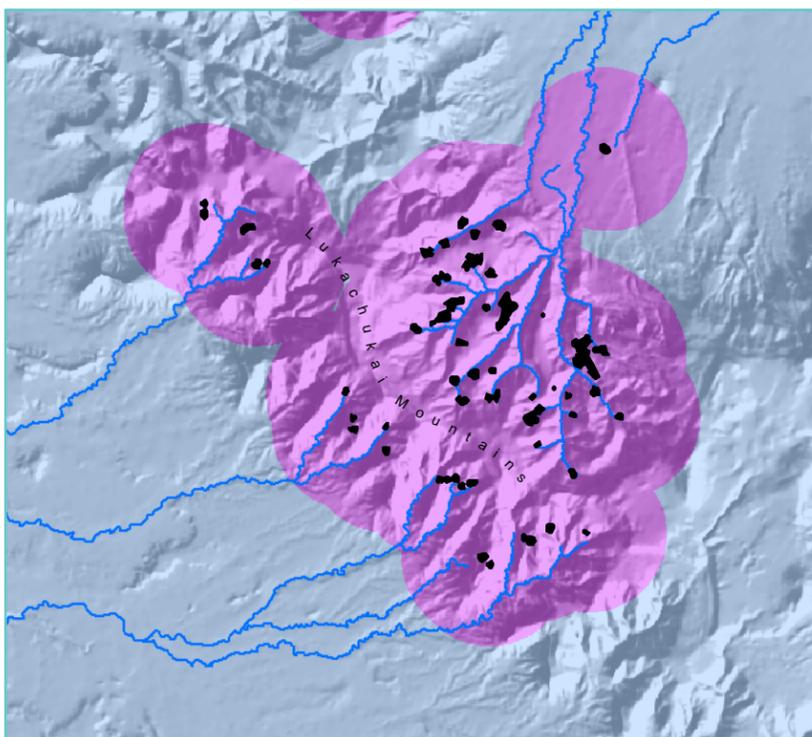
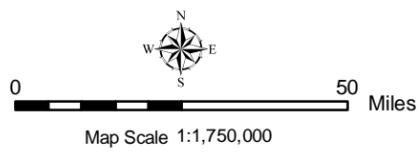
Surface water features are from the U.S. Geological Survey (USGS) National Hydrography Dataset high resolution (NHDH) 1:24,000 scale database.

Filenames:
 DB/Water/NN_WaterBody_NHDH.shp
 DB/Water/NN_Points_NHDH.shp
 DB/Water/NN_Flowline_NHDH.shp
 DB/Water/NN_Areas_NHDH.shp

Figure 32. Surface Water Features On and Near the Navajo Nation.



ABANDONED URANIUM MINES AND THE NAVAJO NATION
DOWNSTREAM DRAINAGES WITHIN ONE MILE OF AN AUM



Legend

■ Abandoned Uranium Mine (AUM)

DRAINAGE FEATURES

— Downstream Water Pathway

■ Downstream Waterbodies

ABANDONED URANIUM MINE BUFFERS

■ 1 Mile

■ 15 Miles

Sources

Drainages downstream and within one (1) mile of an AUM were mapped using the U.S. Geological Survey (USGS) National Hydrography Dataset high resolution (NHDH) 1:24,000 scale database and interpreted using USGS digital orthophotography.

Filenames:
 DB/Water/NN_Drainage_HR_AUM.shp
 DB/Water/NN_Drainage_Poly_HR_AUM.shp

Enlargement of AUMs with a One Mile Buffer and Drainages Extending Downstream.

Figure 33. Downstream Drainages Within One Mile of an AUM.

SOILS

Soils properties, such as infiltration rate, drainage, and texture, can have significant impact on the likelihood of hazardous substances reaching ground water. Course textured, well drained soils with high infiltration rates have a higher potential for movement of water through the soil media to the underlying geologic material than fine textured, poorly drained soils with low infiltration rates. Soil erodibility characteristics are important to assess the soil runoff potential. Soil erodibility is also important when assessing windblown transport potential (EPA, 1991 - S01230301).

SOIL GEOGRAPHIC DATABASES

The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) is responsible for collecting, storing, maintaining, and distributing soil survey information for privately owned lands in the United States. NRCS has established two primary soil geographic databases: the Soil Survey Geographic (SSURGO) database and the State Soil Geographic (STATSGO) database.

SSURGO

The SSURGO database provides the most detailed level of information and was designed primarily for farm and ranch, landowner/user, township or county natural resource planning and management. Maps are made at scales ranging from 1:12,000 to 1:63,360. Data for SSURGO are collected and archived in 7.5-minute topographic quadrangle units. SSURGO data are not yet available for the entire Navajo Nation (see Figure 34.). Soil surveys are being conducted over most of the Navajo Nation, with the exception of the central area.

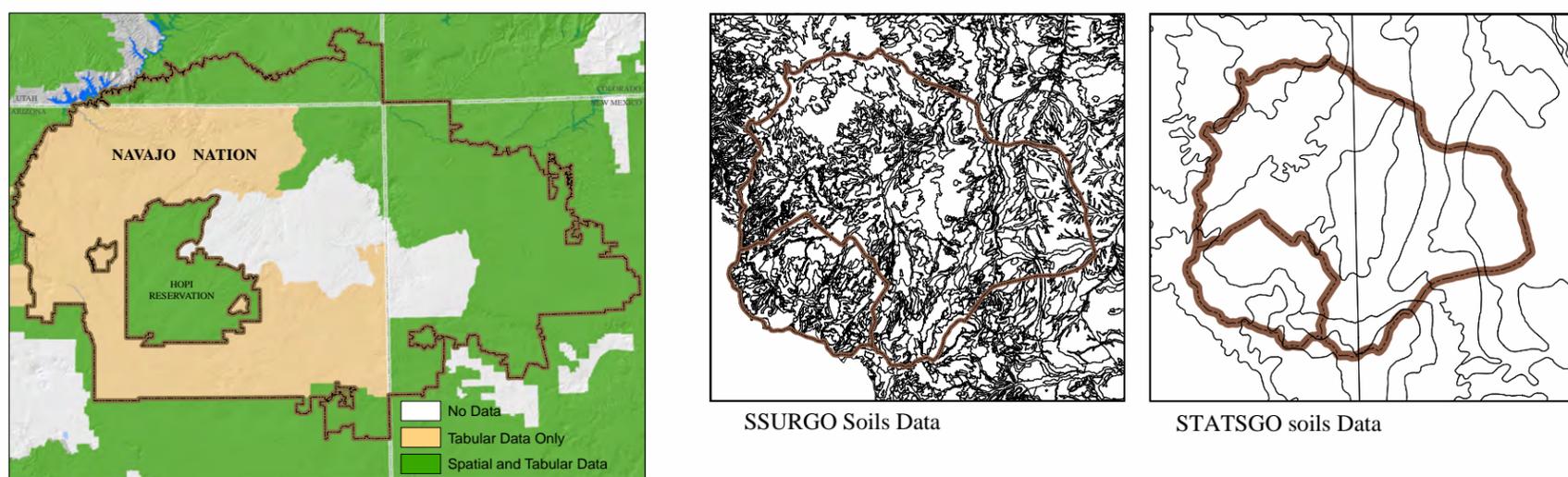


Figure 34. Status of SSURGO Processing as of May 30, 2007 and Comparison of SSURGO and STATSGO data.

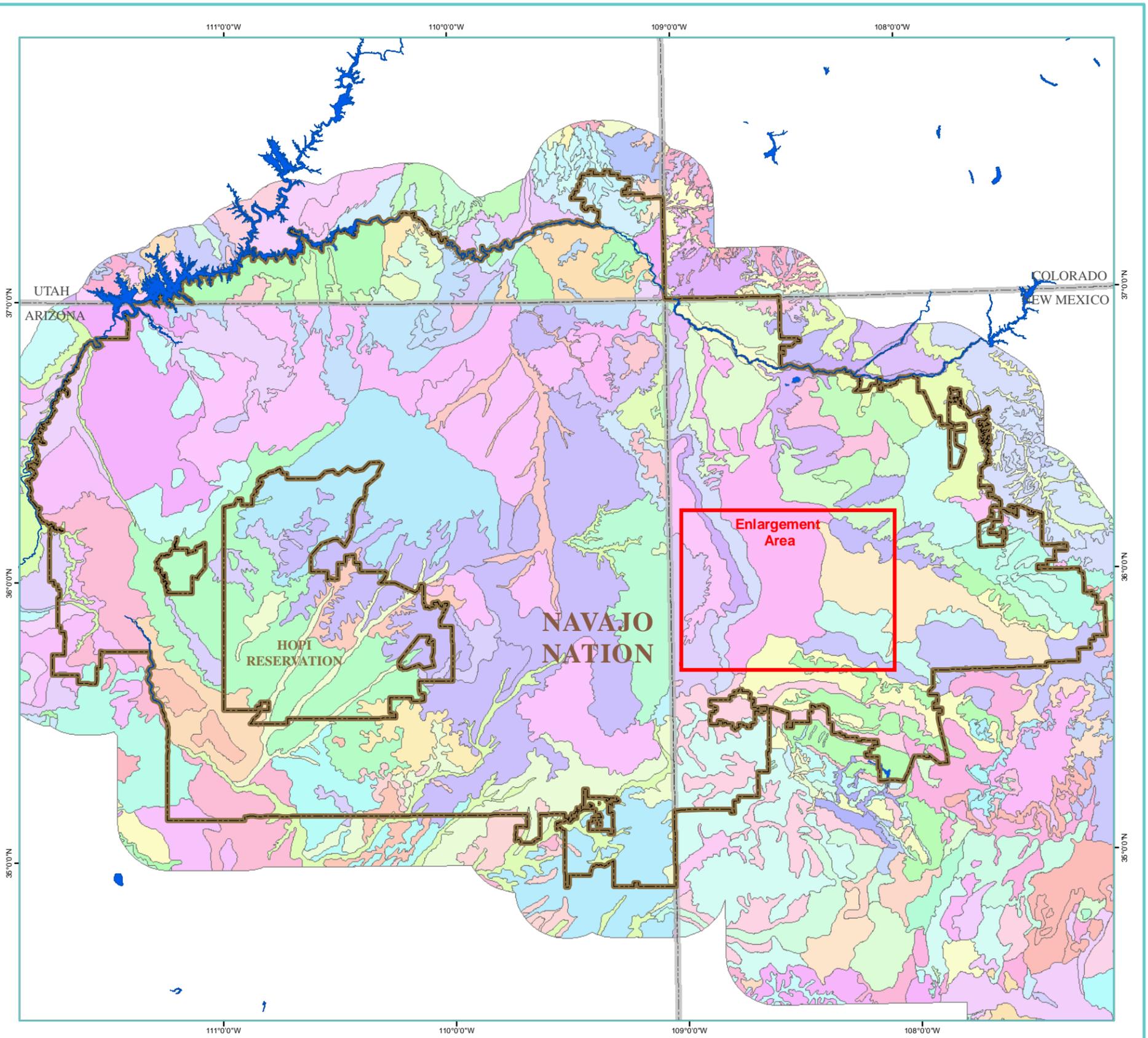
STATSGO

STATSGO was developed by the National Cooperative Soil Survey and was published in 1994. This dataset contains general soil association polygon units and has been compiled over the entire Navajo Nation. It consists of a broad based inventory of soils and non-soil areas that occur in a repeatable pattern on the landscape. These data are intended for geographic display and analysis at the state, regional, and national level. The data should be displayed and analyzed at scales appropriate for 1:250,000-scale data. Figure 34 illustrates the difference in mapping detail between the SSURGO and STATSGO databases.

The soil map units in the STATSGO dataset are linked to attributes in the National Soil Information System database, which gives the proportionate extent of the component soils and their properties. These raw STATSGO spatial data were subsequently clipped to an area that included and extended 20 kilometers beyond the Navajo Nation boundary. Key parameters were extracted: soil map unit, hydrologic group, permeability, K factor erodibility, and wind erodibility index (Table 4). Results for these parameters are presented in Figures 35 thru Figure 39, respectively. Datasets used for these maps are provided on the GIS Data DVD (DB/Soils/NN_STATSGO.shp and DB/Soils/nnstsgob_all).

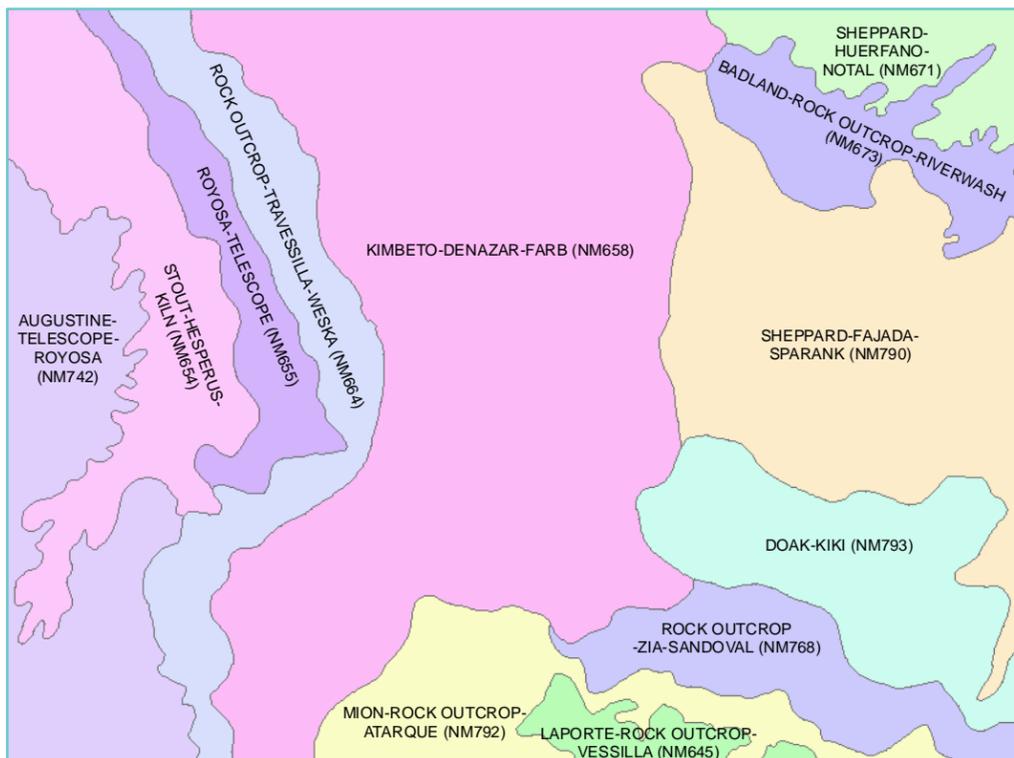
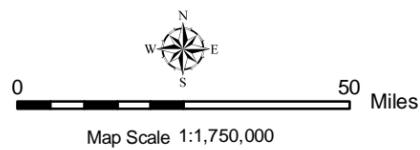
Field	Type	Description
HYDGRP	Hydrologic Group	A code identifying the hydrologic characteristics of the soil. The coding transformations are: A = 1 (high infiltration, deep soils, well drained to excessively drained sands and gravels), B = 2 (moderate infiltration rates, deep and moderately deep, moderately well and well drained soils with moderately coarse textures), C = 3 (slow infiltration rates, soils with layers impeding downward movement of water, or soils with moderately fine or fine textures), D = 4 (very slow infiltration rates, soils are clayey, have a high water table, or are shallow to an impervious layer).
WEI	Wind Erodibility Index (in tons/acre/year)	A code for Wind Erodibility Index (WEI in tons/acre/year), developed from the STATSGO layer file two character code for WEG (Wind Erodibility Group) converted to numeric codes. The coding transformations are:WEG 1 = 310, WEG 2 = 134, WEG 3 = 86, WEG 4 = 86, WEG 4L = 86, WEG 5 = 56, WEG 6 = 48, WEG 7 = 38, WEG 8 = 0. WEG 1, Surface texture - VFVS,FS,S,COS, percent aggregates = 1, WEI = 310 t/a/y. WEG 2, Surface texture - LVFSL,LFS,LCOS,Sapric material, percent aggregates = 10, WEI = 134 t/a/y. WEG 3, Surface texture - VFSL,FSL,SL,COSL, percent aggregates = 25, WEI = 86 t/a/y. WEG 4, Surface Texture - C,SIC,noncalcareous CL,SICL(>35% clay), percent aggregates = 25, WEI = 86 t/a/y. WEG 4L, Surface texture - calcareous L/SIL/CL,SICL, percent aggregates = 25, WEI = 86 t/a/y. WEG 5, Surface textue - noncalcareous L/SIL(<20% clay),SCL,SC, percent aggregates = 40, WEI = 56 t/a/y. WEG 6, Surface texture - noncalcareous L/SIL(>20% clay),CL(<35% clay), percent aggregates = 45, WEI = 48 t/a/y. WEG 7, Surface texture - SI, noncalcareous SICL(<35% clay), percent aggregates = 50, WEI = 38 t/a/y. WEG 8, Erosion not a problem - 0 t/a/y.
KFACT	Soil Erodibility Factor	An erodibility factor which quantifies the susceptibility of soil particles to detachment and movement by water. Actual k factor used in the Revised Universal Soil Loss Equation adjusted for rock fragments to calculate soil loss by water. Computed as a layer thickness weighted average, across soil layers, of the variable kfact contained in the STATSGO layer file. Missing value indicator = -1.0.
PERM	Permeability of the soil (in inches per hour)	Permeability of the soil (in inches per hour). Computed as a layer thickness weighted average, across soil layers, of a simple average of permh and perm1 contained in the STATSGO layer file.

Table 4. STATSGO Codes Used for Key Parameters.



ABANDONED URANIUM MINES AND THE NAVAJO NATION

SOIL MAP UNITS



Enlarged view showing STATSGO mapunit soil names and mapunit ID (MUID).

Sources

Data used to develop this map were derived from the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) Cooperative Soil Survey known as the State Soil Geographic (STATSGO) data set, published in 1994.

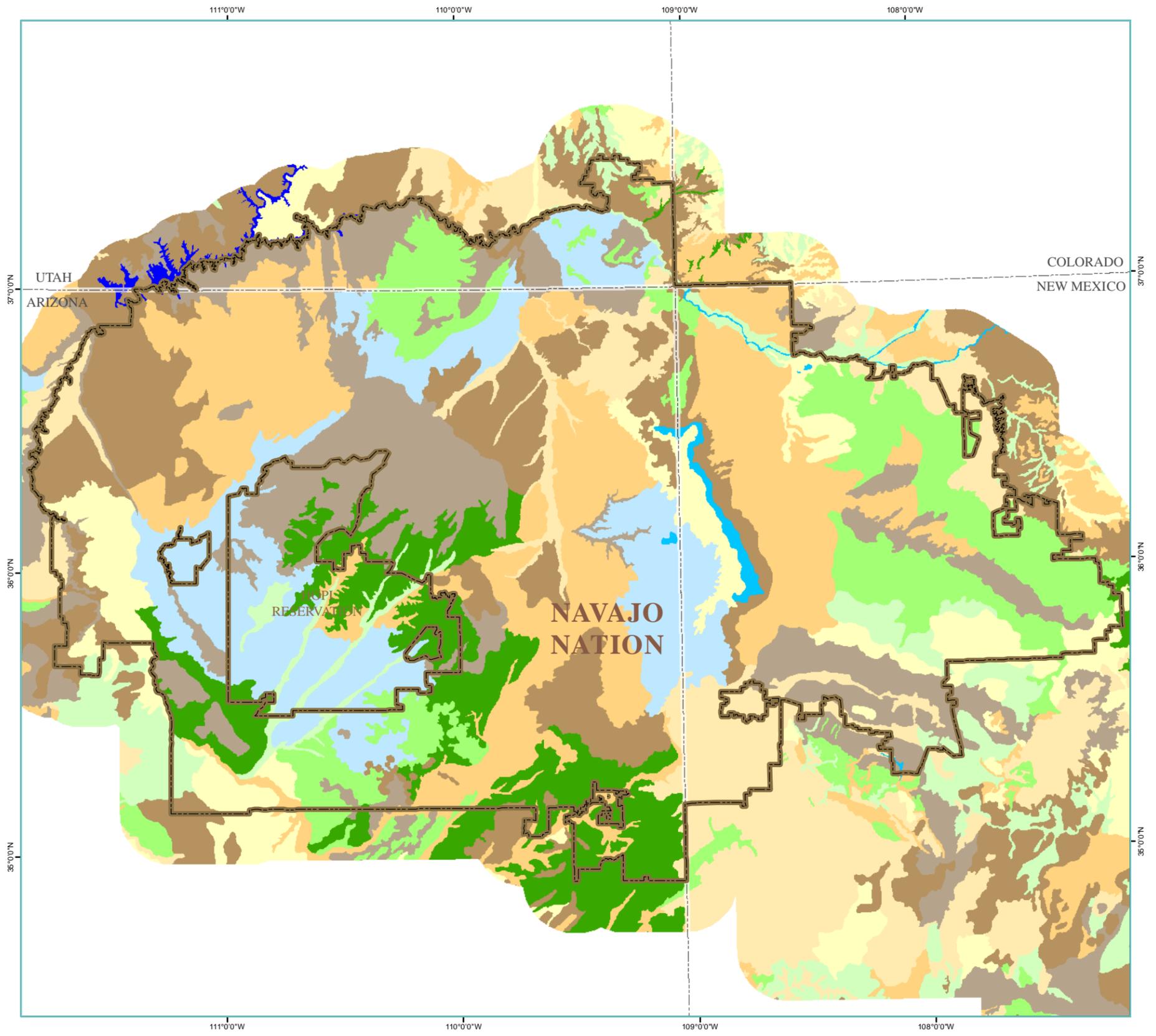
These data provide information about soil features on or near the surface of the Earth. Data were collected as part of the National Cooperative Soil Survey. There are over 100 different soil mapunits across the Navajo Nation, each having distinctive patterns of soils, topography and drainage.

Each STATSGO mapunit is identified by an alphanumeric mapunit ID (MUID) consisting of the two-letter postal abbreviation for the state, followed by a three-digit number (e.g., AZ001 is the first mapunit for Arizona). There are names for the dominant soil in the unit. In the enlarged view, soil mapunits are shown for a small portion of the eastern Navajo Nation, in northwest New Mexico. The mapunit polygons are labelled using data in the "MUNAME" field of the GIS dataset. This field includes the dominant soil names and MUID.

These data are intended for geographic display and analysis at the state, regional, and national level. The data should be displayed and analyzed at scales appropriate for 1:250,000-scale data.

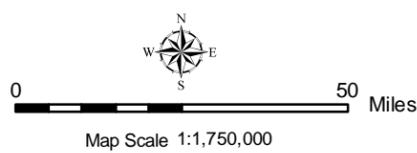
Filename: DB/Water/NN_STATSGO.shp (MUID)

Figure 35. Soil Map Units.



ABANDONED URANIUM MINES AND THE NAVAJO NATION

HYDROLOGIC GROUP



Sources

Data are from the Natural Resources Conservation Service (NRCS) State Soil Geographic (STATSGO) data set. A code identifying the hydrologic characteristics of the soil was extracted from the STATSGO data. The character codes defined in the STATSGO component file are converted into numeric codes according to Schwartz and Alexander, 1995. The coding transformations are:

A = 1 (high infiltration, deep soils, well drained to excessively drained sands and gravels),

B = 2 (moderate infiltration rates, deep and moderately deep, moderately well and well drained soils with moderately coarse textures),

C = 3 (slow infiltration rates, soils with layers impeding downward movement of water, or soils with moderately fine or fine textures),

D = 4 (very slow infiltration rates, soils are clayey, have a high water table, or are shallow to an impervious layer).

The transformed data are averaged across components using the component percentage as the area-weighting factor, then reapportioned into hydrologic group intergrades.

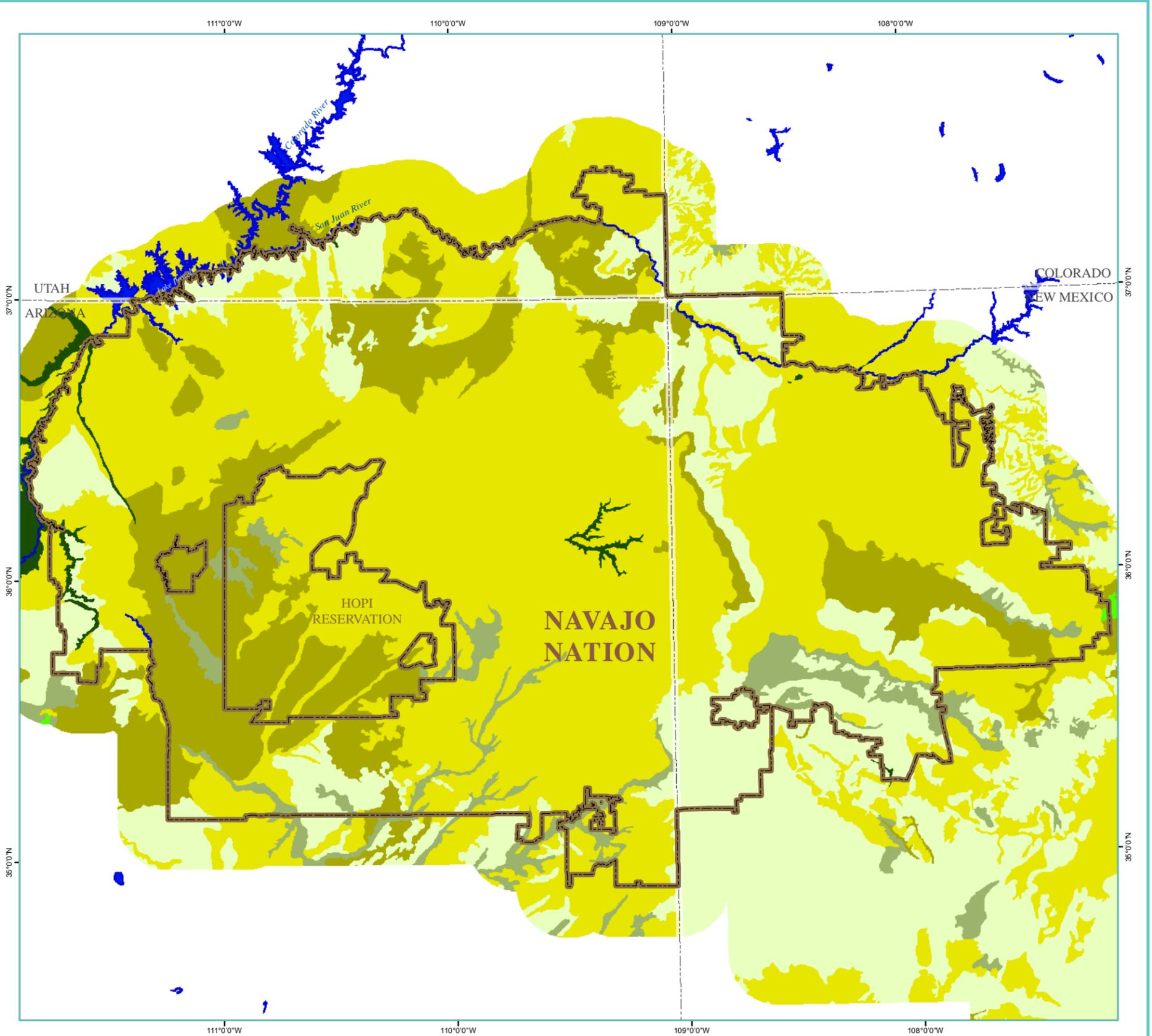
Hydrologic groups are based on the relationship between soil properties and hydrologic properties. These properties include depth to a seasonally high water table, intake rate and permeability after prolonged wetting, depth to a very slowly permeable layer, and wetness characteristics.

Filename: DB/Water/NN_STATSGO.shp (HYDGRPWTAV)

Legend

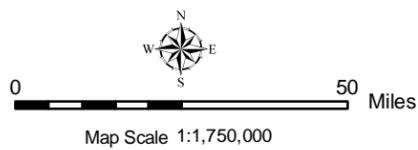
- Water
- HYDROLOGIC GROUP INTERGRADES, Weighted Average**
- A High infiltration, deep soils, well drained to excessively drained sands and gravels
- A-
- B+ Moderate infiltration rates, deep and moderately deep, moderately well and well drained soils with moderately coarse textures
- B
- B-
- C+ Slow infiltration rates, soils with layers impeding downward movement of water, or soils with moderately fine or fine textures
- C
- C-
- D+ Very slow infiltration rates, soils are clayey, have a high water table, or are shallow to an impervious layer.
- D

Figure 36. Hydrologic Group.



ABANDONED URANIUM MINES AND THE NAVAJO NATION

PERMEABILITY



Sources

Data from the Natural Resources Conservation Service (NRCS) State Soil Geographic (STATSGO) data set.

Soil permeability is the quality of the soil that enables water or air to move through it. STATSGO weighted average soil permeability rate is expressed as inches per hour.

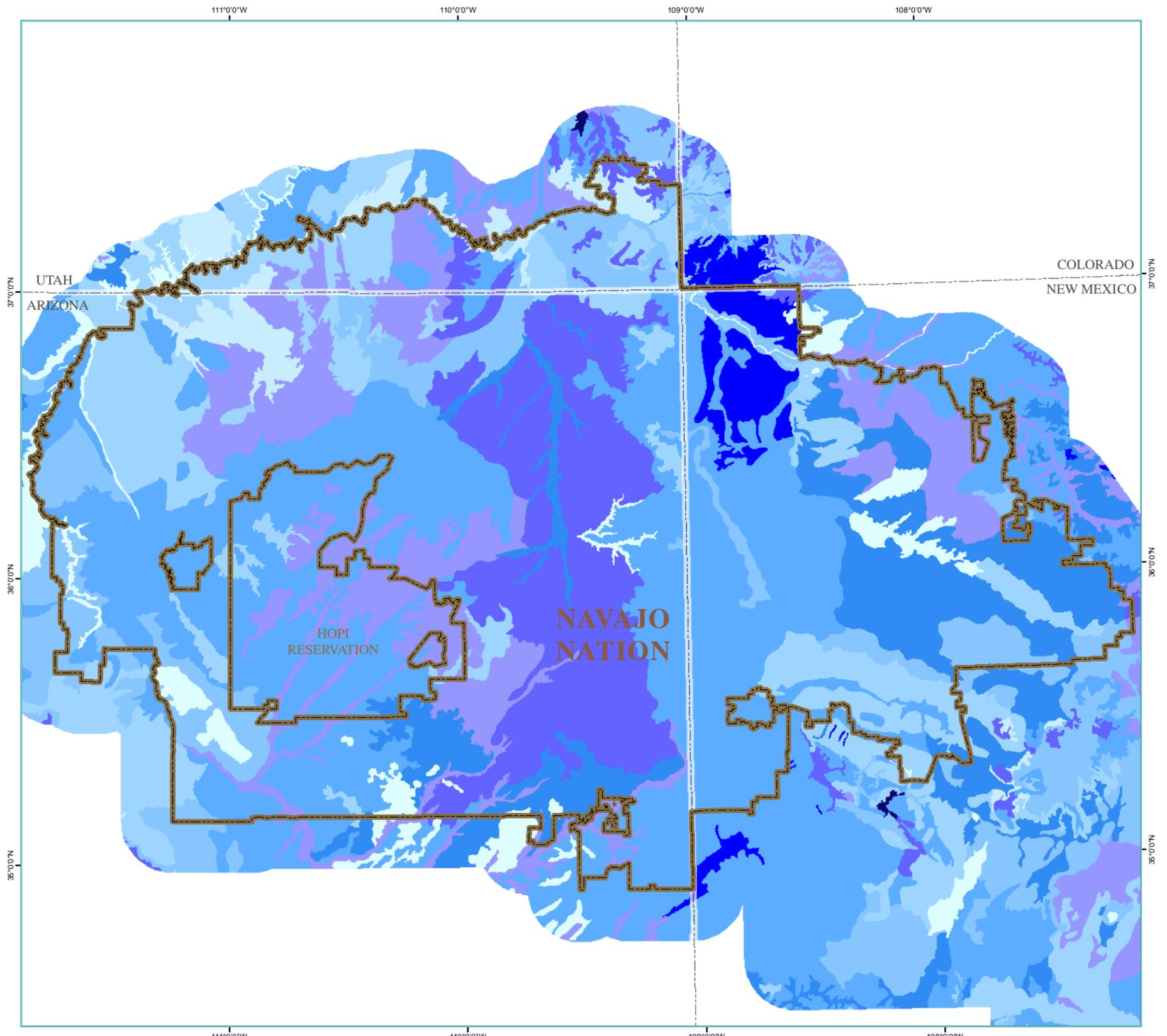
The STATSGO layer file "permh" and "perml" values were averaged across layers (by layer thickness) and components (by component percentage) as the depth- and area-weighting factors.

Filename: DB/Water/NN_STATSGO.shp (PERMWTAVG)

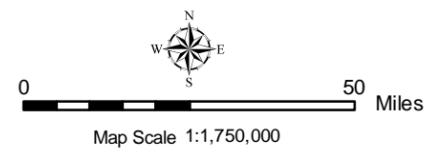
Legend

- Major Waters
- PERMEABILITY RATE (Inches/Hour)
- 6.01 - 16.53; Rapid
- 2.01 - 6.00; Moderately Rapid
- 0.61 - 2.00; Moderate
- 0.21 - 0.60; Moderately Slow
- 0.07 - 0.20; Slow
- 0.01 - 0.06; Very Slow
- 0.00; Impermeable

Figure 37. Soil Permeability.



ABANDONED URANIUM MINES AND THE NAVAJO NATION
SOIL ERODIBILITY BY WATER (K-FACTOR)



Sources

Data are from the Natural Resources Conservation Service (NRCS) State Soil Geographic (STATSGO) data set.

K-Factor is an erodibility factor that quantifies the susceptibility of soil particles to detachment and movement by water. K-Factor is often used in the Revised Universal Soil Loss Equation to estimate soil loss by water in soils with high quantities of rock fragments. The STATSGO layer file "kfact" value for the surface layer was averaged across components using the component percentage as the area-weighting factor.

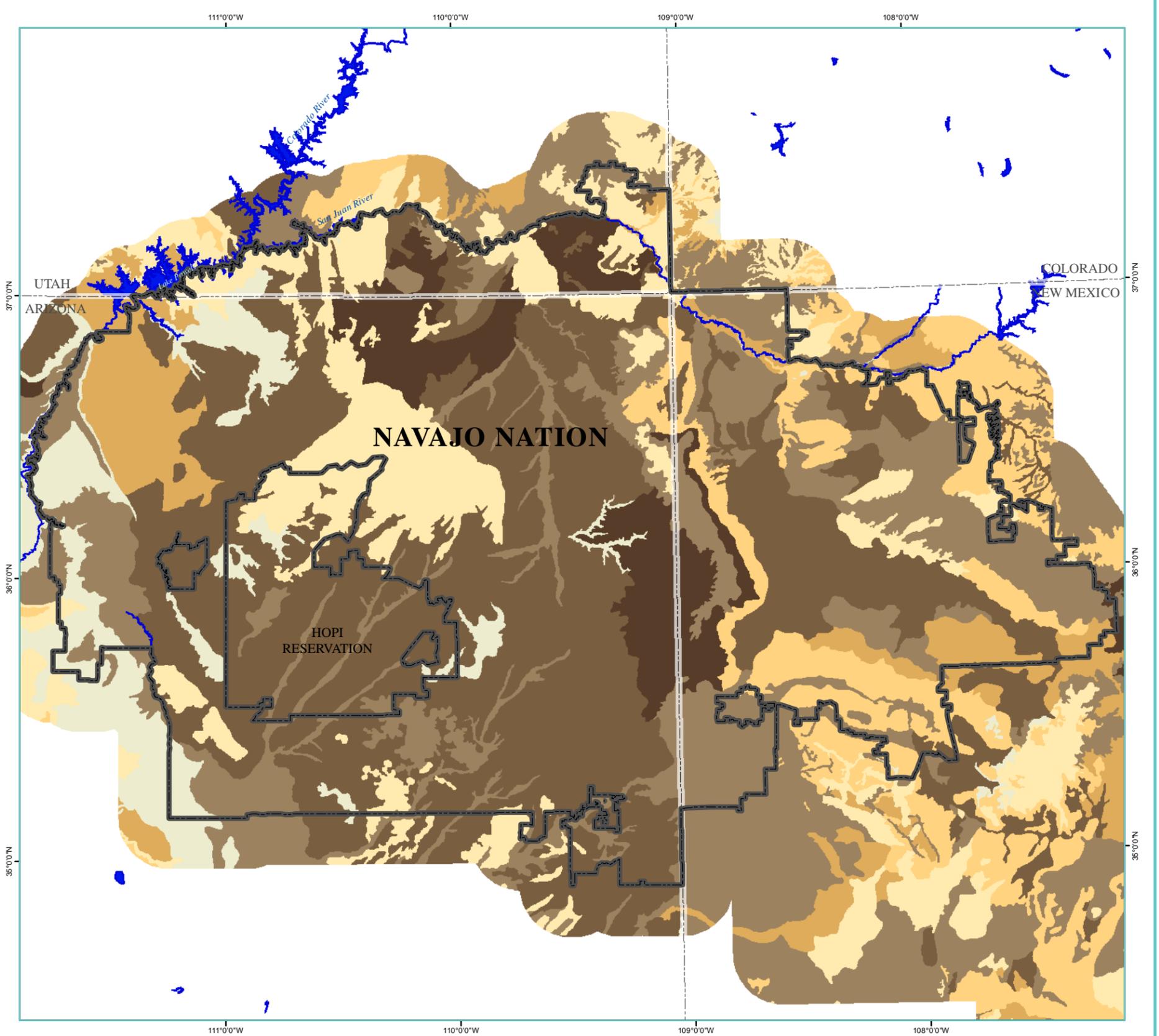
Filename: DB/Water/NN_STATSGO.shp (KFAC1WTAVG)

Legend

SOIL ERODIBILITY FACTOR

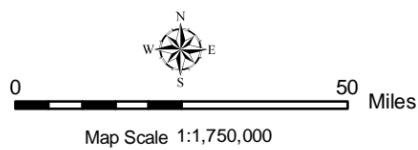
	0.00 - 0.05; Less susceptible to soil loss by water
	0.06 - 0.10
	0.11 - 0.14
	0.15 - 0.19
	0.20 - 0.24
	0.25 - 0.29
	0.30 - 0.34
	0.35 - 0.38
	0.39 - 0.43
	0.44 - 0.48; More susceptible to soil loss by water

Figure 38. Soil Erodibility by Water (K-Factor).



ABANDONED URANIUM MINES AND THE NAVAJO NATION

SOIL ERODIBILITY BY WIND



Sources

Data are from the Natural Resources Conservation Service (NRCS) State Soil Geographic (STATSGO) data set.

STATSGO weighted-average soil surface wind erodibility index is expressed in tons per acre per year, developed from the STATSGO layer file 2-character code for WEG (wind erodibility group) converted to numeric codes. The coding transformations were WEG 1 = 310, WEG 2 = 134, WEG 3 = 86, WEG 4 = 86, WEG 4L = 86, WEG 5 = 56, WEG 6 = 48, WEG 7 = 38, WEG 8 = 0. The transformed data were then averaged across components using the component percentage as the area-weighting factor.

- WEG 1, Surface texture - VFS,FS,S,COS,percent aggregates = 1, WEI = 310 t/a/y;
- WEG 2, Surface texture - LVFS,LFS,LCOS,Sapric material, percent aggregates = 10, WEI = 134 t/a/y;
- WEG 3, Surface texture - VFSL,FSL,SL,COSL, percent aggregates = 25, WEI = 86 t/a/y;
- WEG 4, Surface Texture - C, SIC, noncalcareous CL,SICL (>35% clay), percent aggregates = 25, WEI = 86 t/a/y;
- WEG 4L, Surface texture - calcareous L/SIL/CL,SICL, percent aggregates = 25, WEI = 86 t/a/y;
- WEG 5, Surface textue - noncalcareous L/SIL(<20% clay), SCL,SC, percent aggregates = 40, WEI = 56 t/a/y;
- WEG 6, Surface texture - noncalcareous L/SIL(>20% clay),CL(<35% clay), percent aggregates = 45, WEI = 48 t/a/y;
- WEG 7, Surface texture - SI, noncalcareous SICL (<35% clay), percent aggregates = 50, WEI = 38 t/a/y;
- WEG 8, Erosion not a problem - 0 t/a/y

Filename: DB/Water/NN_STATSGO.shp (WEI1WTAVG)

Legend

- Major Waters
- WIND ERODIBILITY INDEX (Tons/Acre/Year)
- WEI 8 - (0 t/a/y)
- WEI 7 - (38 t/a/y)
- WEI 6 - (48 t/a/y)
- WEI 5 - (56 t/a/y)
- WEI 4, WEI 4L and WEI 3 - (86 t/a/y)
- WEI 2 - (134 a/t/y)
- WEI 1 - (310 a/t/y)

Figure 39. Soil Erodibility by Wind (WED).

SENSITIVE ENVIRONMENTS

Sensitive environments are terrestrial or aquatic resources, fragile natural settings, or other areas with unique or highly-valued environmental or cultural features. Typically, areas that fall within the definition of sensitive environments are established and/or protected by State or Federal Law, and include National Parks, National Monuments, habitats of species of concern, and wildlife refuges (EPA, 1991 - S01230301).

FISHERIES

Fisheries are an area of a surface water body from which food chain organisms are taken or could be taken for human consumption on a subsistence, sporting, or commercial basis. Food chain species include fish, shellfish, crustaceans, amphibians, and amphibious reptiles. Fisheries on the Navajo Nation are shown in Figure 40 (Navajo Nation Fish and Wildlife, 2007 - S05310702).

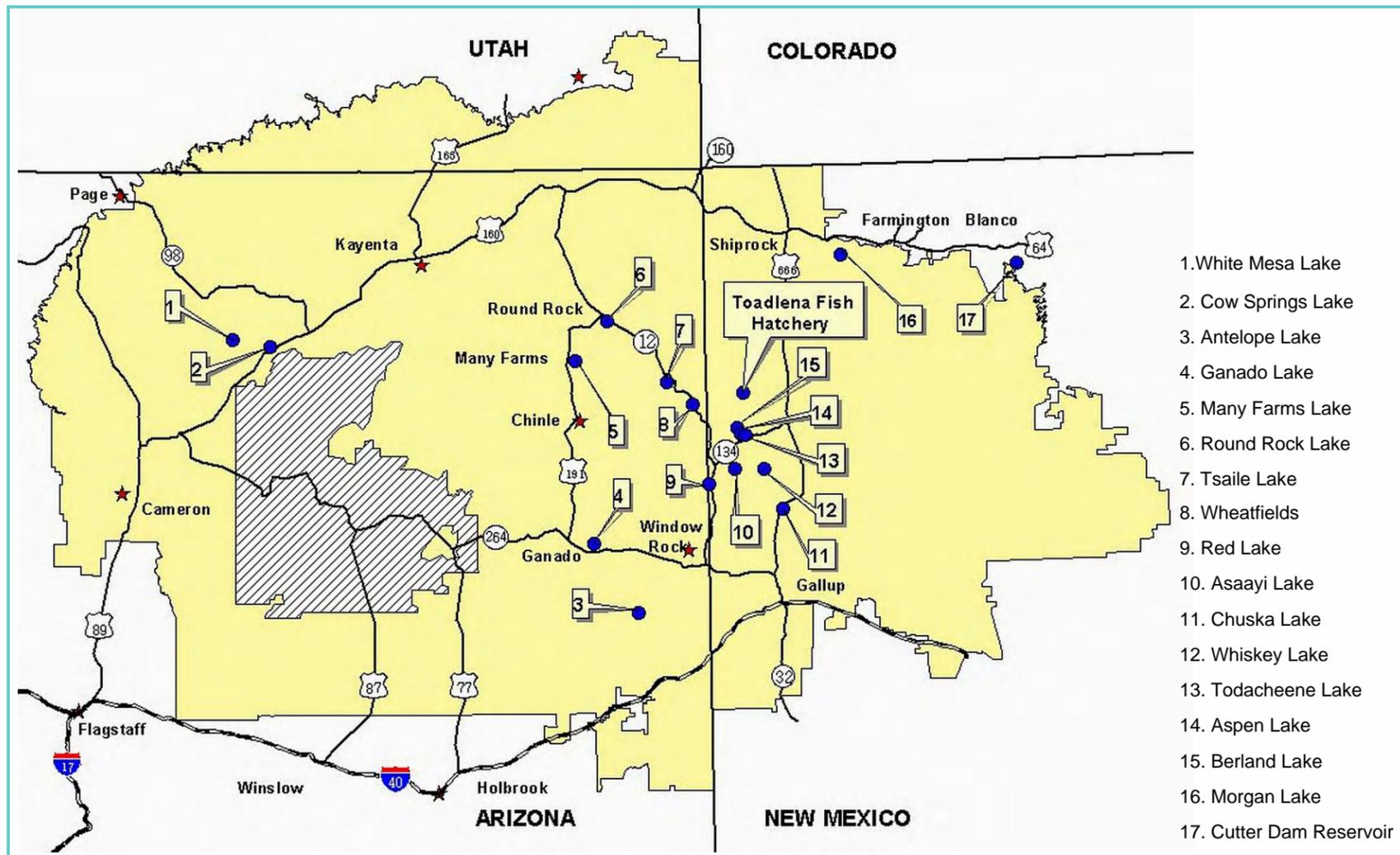


Figure 40. Fisheries on the Navajo Nation.

PROTECTED AREAS

Table 5 lists the protected federal lands that are on or adjacent to the Navajo Nation:

- (1) National Historic Park
- (1) National Historic Site
- (4) National Monuments
- (2) National Parks
- (1) National Recreation Area
- (2) Wilderness Areas
- (1) Wilderness Study Area

These protected federal land areas are shown on Figure 41. The locations for these protected areas are provided on the GIS Data DVD (DB/SEN_Env/NN_NPS.shp and DB/Env_Sens/NN_Wilderness.shp).

Table 5. Protected Federal Lands on and Near the Navajo Nation.

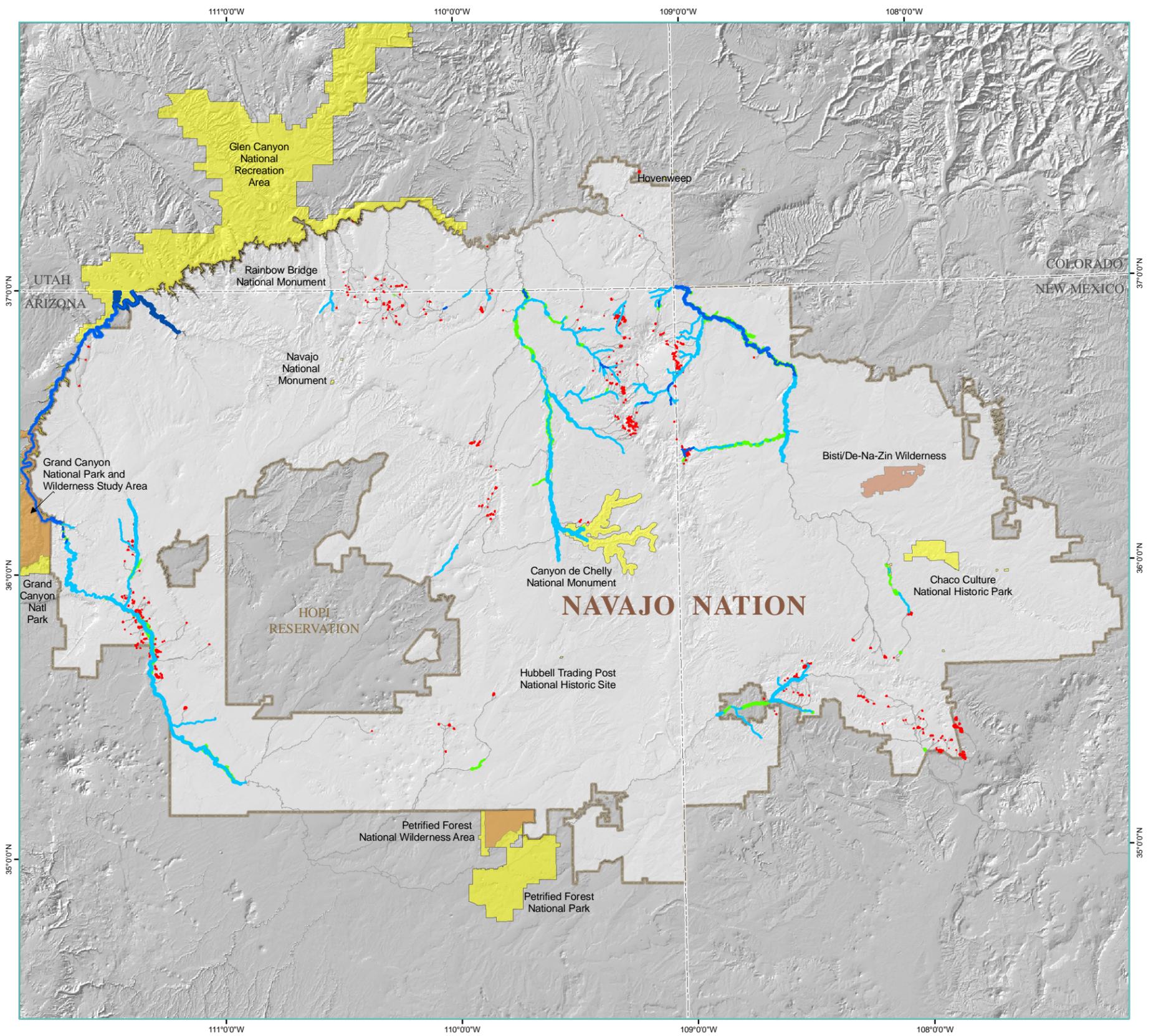
NAME	TYPE
Chaco Culture	National Historic Park
Hubbell Trading Post	National Historic Site
Canyon de Chelly	National Monument
Hovenweep	National Monument
Navajo	National Monument
Rainbow Bridge	National Monument
Grand Canyon	National Park
Petrified Forest	National Park
Glen Canyon	National Recreation Area
Bisti/De-Na-Zin Wilderness	Wilderness BLM
Petrified Forest National Wilderness Area	Wilderness NPS
Grand Canyon National Park Wilderness Study Area	Wilderness Study Area NPS

WETLANDS

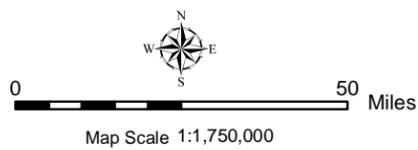
Perhaps the most common type of sensitive environment is wetland areas. Federal Regulation 40 CFR 230.3(t) provides the EPA wetland definition as: “an area that is sufficiently inundated or saturated by surface or ground water to support vegetation adapted for life in saturated soil conditions.” Wetland and riparian vegetation serves as important wildlife habitat. A large percentage of wildlife species depend on these areas for foraging, nesting, or cover during some portion of their life-cycle.

The U.S. Fish and Wildlife Service (USFWS), through the National Wetlands Inventory (NWI), is required to identify, classify, and digitize all wetlands and deepwater habitats in the United States. Figure 41 presents the wetlands data digitized from the 1:100,000-scale maps NWI published in 1983. The NWI wetlands data are not available for the Utah portion of the Navajo Nation.

The USFWS wetland classifications are from 1:120,000-scale black and white aerial photographs taken in 1972 and 1973. The basemaps used are 1:100,000 scale topographic quadrangles or photographic enlargements of 1:250,000-scale topographic quadrangles. The interpretations were prepared primarily by stereoscopic analysis of high-altitude aerial photographs. Wetlands were identified on the photographs based on vegetation, visible hydrology, and geography. The aerial photographs typically reflect conditions during the specific year and season when they were taken. These environments can change significantly from year to year depending upon the



ABANDONED URANIUM MINES AND THE NAVAJO NATION
WETLANDS DOWNSTREAM FROM AUMS AND PROTECTED AREAS



View of Canyon de Chelly from Tseyi Overlook Showing Riparian Vegetation. Photo courtesy NPS (www.nps.gov/cach/photosmultimedia/index.htm)

WETLANDS ALONG DOWNSTREAM DRAINAGES

- Palustrine
- Riverine, Intermittent
- Riverine, Perennial
- Lacustrine
- Palustrine
- Riverine, Intermittent
- Riverine, Perennial

PROTECTED AREAS

- Wilderness and Wilderness Study Areas
- National Park Service

AUM RELATED

- Drainage Downstream From AUM - No Mapped Wetlands
- Abandoned Uranium Mine

Sources

Wetlands are from the U. S. Fish and Wildlife Service National Wetlands Inventory (NWI) 1:100,000-scale maps compiled in 1983 from black and white 1:120,000-scale aerial photography taken in 1972 and 1973.

The 2005 version of the Wilderness and Wilderness Study Areas are from the 1:2,000,000-Scale National Atlas of the United States.

The 2007 version of Administrative Boundaries of National Park System Units are from the National Park Service.

Filenames:
 DB/Sens_Env/NN_Wetlands_Lines.shp
 DB/Sens_Env/NN_Wetlands_Polys.shp
 DB/Sens_Env/NN_Wilderness.shp
 DB/Sens_Env/NN_NPS.shp

Figure 41. Wetlands Downstream from AUMs and Protected Areas On and Near the Navajo Nation.

SENSITIVE ENVIRONMENTS (continued)

weather conditions. Reliable wetlands mapping usually requires multiple dates of imagery and field verifications. In recognition of the importance of riparian areas in the western states, the USFWS has adopted a standardized riparian definition and developed conventions to guide the mapping of riparian areas (USFWS, 1997 - S08030304).

ENDANGERED AND SENSITIVE SPECIES

The Navajo Natural Heritage Program (NNHP) is the Navajo Nation’s rare, threatened and endangered species office. NNHP collects, manages and disseminates biological and ecological information for land-use planning to promote the conservation of biological diversity on the Navajo Nation. The NNHP maintains a comprehensive database of information on rare and protected plant and animal species and biological communities on the Navajo Nation.

NNHP reviews and updates the Navajo Endangered Species List every two years, pursuant to the Navajo Tribal Code. Information on rare and protected plant and animal species and biological communities on the Navajo Nation is stored in a data system composed of a computerized database, manual files, maps and a library. Information in the NNHP Database include:

- Biological descriptions of plants and animals occurring on the Navajo Nation. Descriptions include details on taxonomic status, identification, habitat preferences, reproductive biology, phenology, etc.
- Information on the status of plants and animals that are rare or protected at the Navajo Nation or federal level.
- Information about specific geographic locations for rare or protected plants and animals on the Navajo Nation.
- Annotated bibliography of publications (reports, articles, books, etc.) relating to biology, ecology and conservation issues, with primary geographic emphasis on the Navajo Nation and Colorado Plateau area.
- A list of species of concern potentially occurring on each U.S. Geological Survey 7.5-minute quadrangle covering the Navajo Nation. “Species of concern” include protected, rare, and certain native species, as well as species of economic or cultural significance.
- Cultural information about plants and animals occurring on the Navajo Nation (e.g., traditional uses and Navajo names). This information is currently limited.

The Endangered Species List for the Navajo Nation adopted under the Navajo Resources Committee Resolution No. RCAU-103-05 on August 9, 2005 are listed below. Sensitive species lists for the Navajo Nation can be found at <http://nnhp.navajofishandwildlife.org>. There are four types of sensitive species, arranged by Group:

GROUP 1: Those species or subspecies that no longer occur on the Navajo Nation.

GROUP 2 (G2) & GROUP 3 (G3): “Endangered” -- Any species or subspecies whose prospects of survival or recruitment within the Navajo Nation are in jeopardy or are likely within the foreseeable future to become so.

G2: A species or subspecies whose prospects of survival or recruitment are in jeopardy.

G3: A species or subspecies whose prospects of survival or recruitment are likely to be in jeopardy in the foreseeable future.

GROUP 4: Any species or subspecies for which the Navajo Nation Department of Fish and Wildlife (NNDFWL) does not currently have sufficient information to support their being listed in G2 or G3 but has reason to consider them. The NNDFWL will actively seek information on these species to determine if they warrant inclusion in a different group or removal from the list.

NAVAJO ENDANGERED SPECIES LIST – August 2005

Scientific name (Common name)

GROUP 1:

- MAMMALS *Canis lupus* (Gray Wolf)
 Lontra canadensis (Northern River Otter)
 Ursus arctos (Grizzly or Brown Bear)

- FISHES *Gila elegans* (Bonytail)

GROUP 2:

- MAMMALS *Mustela nigripes* (Black-footed Ferret)
- BIRDS *Coccyzus americanus* (Yellow-billed Cuckoo)
 Empidonax traillii extimus (Southwestern Willow Flycatcher)
- AMPHIBIANS *Rana pipiens* (Northern Leopard Frog)
- FISHES *Gila cypha* (Humpback Chub)
 Gila robusta (Roundtail Chub)
 Ptychocheilus lucius (Colorado Pikeminnow)
 Xyrauchen texanus (Razorback Sucker)
- PLANTS *Astragalus cutleri* (Cutler’s Milk-vetch)
 Astragalus humillimus (Mancos Milk-vetch)
 Erigeron rhizomatus (Rhizome Fleabane)
 Pediocactus bradyi (Brady Pincushion Cactus)
 Sclerocactus mesae-verdae (Mesa Verde Cactus)

SENSITIVE ENVIRONMENTS (continued)

GROUP 3:

MAMMALS	<i>Antilocapra americana</i> (Pronghorn) ¹ <i>Ovis canadensis</i> (Bighorn Sheep) ²
BIRDS	<i>Aquila chrysaetos</i> (Golden Eagle) <i>Buteo regalis</i> (Ferruginous Hawk) <i>Cinclus mexicanus</i> (American Dipper) <i>Strix occidentalis lucida</i> (Mexican Spotted Owl)
INVERTEBRATES	<i>Speyeria nokomis</i> (Western Seep Fritillary)
PLANTS	<i>Allium gooddingii</i> (Gooding's Onion) <i>Asclepias welshii</i> (Welsh's Milkweed) <i>Astragalus cremnophylax</i> var. <i>hevroni</i> (Marble Canyon Milk-vetch) <i>Carex specuicola</i> (Navajo Sedge) <i>Erigeron acomanus</i> (Acoma Fleabane) <i>Pediocactus peeblesianus</i> var. <i>fickeiseniae</i> (Fickeisen Plains Cactus) <i>Penstemon navajoa</i> (Navajo Penstemon) <i>Platanthera zothecina</i> (Alcove Bog-orchid)

¹ G3 designation excludes NNDFWL Management Unit 16 ('New Lands'), the boundaries of which are: From Sanders, AZ east along Unit 4 boundary to the Zuni boundary; south along the boundary past AZ Hwy 61 to the Navajo Nation/state boundary; west along the boundary past US Hwy 491 to the Navajo Nation/state boundary; north along Rd 2007 to Navajo, AZ; west (to the north and south of Interstate 40) to the state/Petrified Forest National Park boundary; north along the boundary to the Unit 8 boundary; east along the boundary to US Hwy 191; south to Chambers and east to Sanders. For a Unit 16 map, contact NNDFWL, P.O. Box 1480, Window Rock, AZ, 86515, (520) 871-6451.

² Special hunts of *Ovis canadensis* may be conducted in Management Unit 11 for management purposes.

CHAPTER LAND USE PLANNING - WILDLIFE AREAS MAP

The Resources Committee of the Navajo Nation Council passed a Resolution RCMA-34-03 on March 13, 2003 titled "Approving Biological Resource Land Use Clearance Policies and Procedures to Assist the Navajo Nation Government and Chapters Ensure Compliance with Federal and Navajo Laws which Protect Fish, Wildlife, Plant Species and Their Habitat, and Expedite Land Use Approval." To assist the 110 Navajo Nation Chapters in developing Land-Use Plans under the Local Governance Act (LGA), the Navajo Department of Fish and Wildlife identified areas that are sensitive to wildlife across the Navajo Nation. They delineated six types of wildlife areas, covering the entire Navajo Nation, on 1:100,000 scale quadrangle maps. Maps generated from a GIS dataset are posted on the Internet at URL <http://www.navajofishandwildlife.org/clup.htm>.

The six categories of wildlife areas are described as follows:

AREA 1: HIGHLY SENSITIVE WILDLIFE RESOURCES (RED)

This area contains the best habitat for endangered and rare plant, animal and game species, and the highest concentration of these species on the Navajo Nation. The purpose of this area is to protect these valuable and sensitive biological resources to the maximum extent practical.

AREA 2: MODERATELY SENSITIVE WILDLIFE RESOURCES (PURPLE)

This area has a high concentration of rare, endangered, sensitive and game species occurrences or has a high potential for these species to occur throughout the landscape. The purpose of this area is to minimize impacts on these species and their habitats within Area 2, and to ensure the habitats in Area 1 do not become fragmented.

AREA 3: LOW SENSITIVITY WILDLIFE RESOURCES (BLUE)

This area has a low, fragmented concentration of species of concern. Species in this area may be locally abundant on 'islands' of habitat, but islands are relatively small, limited in number and well spaced across the landscape.

AREA 4: COMMUNITY DEVELOPMENT (GRAY)

The Department has determined that areas around certain communities do not support the habitat for species of concern and, therefore, development can proceed without further biological evaluation.

AREA 5: BIOLOGICAL PRESERVE (GREEN)

These areas contain excellent, or potentially excellent, wildlife habitat and are recommended by the Department for protection from most human-related activities, and in some cases are recommended for enhancement.

AREA 6: RECREATIONAL (BROWN)

These areas are used for recreation that involves wildlife, or have potential for development for this purpose. Recreation can involve consumptive and/or non-consumptive uses of wildlife resources, and is often a part of a broader outdoor experience. Examples include fishing lakes, camping and picnic areas and hiking trails.

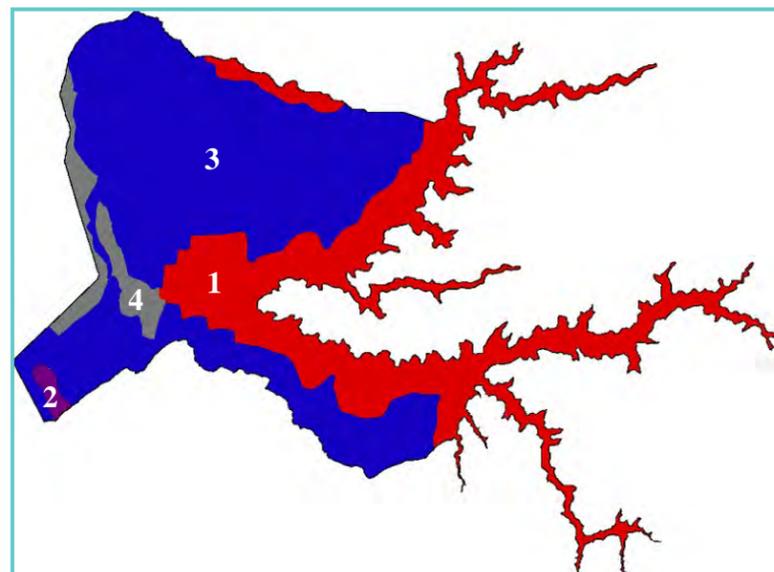


Figure 42. Example Wildlife Areas Map for the Chinle Chapter (from Navajo Department of Fish and Wildlife).