Ute Mountain Ute Tribe

Nonpoint Source Assessment
for the
Ute Mountain Ute Reservation of Colorado, New Mexico and Utah

2005 Revision

Prepared by Scott Clow, Water Quality Specialist, Ute Mountain Ute Tribe
And *Daniel B. Stephens and Associates, Inc.*

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Overview

The Ute Mountain Ute Tribe retained Daniel B. Stephens & Associates, Inc. to conduct a nonpoint source assessment to delineate nonpoint source pollution problems on Ute Mountain Ute land. The results of their work, more recent information, and subsequent revisions made by the Ute Mountain Ute Tribe's Water Quality Specialist and Nonpoint Source Task Force are presented in this document. This report presents the assessment of nonpoint source pollution on the Ute Mountain Ute Reservation, including the methodology used in the assessment, a summary of land use and water quality data in relation to Tribal water quality standards, and the process of selecting best management practices. The results of the assessment were used to develop the *Ute Mountain Ute Nonpoint Source Pollution Management Program Plan*.

The basic characteristics of nonpoint source pollution are:

- Pollution is diffuse.
- Discharge occurs by dispersed pathways.
- Discharge is generally associated with precipitation and runoff.

The primary nonpoint source pollutants on the Ute Mountain Ute Reservation are sediments, salinity, selenium, sulfates, bacteria, and, in Utah, radionuclides. This pollution is caused by a variety of sources, including runoff from areas that have naturally high salinity and selenium (primarily the Mancos Shale and, in the southeastern corner of the Reservation, the Nacimiento Formation) or from irrigation return flow and erosion and sedimentation that may be accelerated by forest fires, grazing, construction activities, oil and gas development, and related road-building activities. Mining activities in Utah caused the elevated radionuclide levels there. A nonpoint source pollution control program is necessary to reduce the impact of these activities on Ute Mountain Ute waters. These general findings were based on both ambient water quality monitoring data and evaluation of other existing researched information.

For the purposes of this report, three categories of water body impairment are described; ***non-impaired***, or waters meeting water quality standards and supporting designated uses;

moderately impaired, those waters that have limitations on meeting water quality standards and supporting uses, but that are likely to recover from impairments through changes in management activities; and ***severely impaired*** waters, those waters that will require significant, long-term changes in management activities *and* significant on-the-ground projects to minimize or mitigate nonpoint source pollution. The level of impairment of the 2595 miles of perennial and ephemeral streams on the Ute Mountain Ute Reservation for various parameters is generally as follows (see Figures i-1 and i-2 for geographic reference):

In Colorado:

- Navajo Wash (approximately 16 miles on Reservation) is severely impaired for chemical, physical and biological parameters.

- Mancos River (approximately 67 miles on Reservation) is moderately impaired along the lowest 16-17 mile segment, downstream of Hwy 491/666 for chemical, physical and biological parameters.

- McElmo Creek (2 ½-mile segments on Reservation) is moderately impaired for chemical and physical parameters.

- San Juan River (4 mile segment on Reservation; "lower" San Juan) is moderately impaired for bacteria and biological parameters.

In Utah:

- Cottonwood Wash (approximately 18 miles on Reservation) is severely impaired for chemical (radiological) parameters and moderately impaired for related biological parameters.

Reservation-wide, including Colorado, New Mexico and Utah:

- Approximately 50% of ephemeral streams (2506 miles) are moderately impaired for physical parameters, due to incising and loss of lateral mobility. Most streams have some degree of invasive riparian plant infestation; either tamarisk, Russian olive or both; extreme in some cases.

- 50% (2 of 4) of larger, lake-sized reservoirs and natural wetlands that support fish are moderately physically and biologically impaired by water containment and management issues that also affect the biota.

1. Introduction

The goal of this assessment report is to provide baseline information for future efforts to effectively and efficiently address nonpoint sources of water pollution on the Ute Mountain Ute Reservation and to establish a Clean Water Act Section 319 program for the Ute Mountain Ute Indian Tribe. The Clean Water Act is very specific in describing what needs to be included in Indian tribe nonpoint source assessment reports.

In order to meet the requirements Clean Water Act Section 319(a), this report identifies (1) waters on the Ute Mountain Ute Reservation that, due to pollution from nonpoint sources, cannot or will not meet water quality standards, are not supporting designated uses, and will not support these uses without implementing alternative management practices, (2) the types of activities or specific sources that cause these problems, and (3) the Tribal process for identifying BMPs. The programs and sources of funding for controlling nonpoint sources of pollution will be discussed as part of the nonpoint source management plan.

2. Methodology

The methodology relied upon in this assessment involved the use of existing sources of information to identify nonpoint sources and affected waters. This assessment drew upon the experience and expertise of many agencies, individuals, and programs; as a result, many different levels of information have been used in the preparation of the report.

In its guidance for preparing the nonpoint source assessment report (U.S. EPA, 1997), the U.S. Environmental Protection Agency (EPA) recognizes two levels of assessment:

> . . . two levels of assessment reflecting conclusions based on ambient monitoring data and conclusions based on other information. One level is "monitored" waters in which the assessment is based on current site-specific ambient data. The other level is "evaluated" waters in which the assessment is based on information other than current site-specific ambient data, such as data on sources of pollution, predictive modeling, fishery surveys, and ambient data which is older than five years. In the nonpoint source area, best professional judgment and various technical evaluation techniques will play an important role.

Accordingly, this assessment has relied as much as possible on monitored data, and where monitored data were not available, best professional judgment and evaluation techniques were used. The sources of data used in this report included Tribal government reports, consultant reports, data and reports from the federal agencies (i.e., Bureau of Indian Affairs [BIA] and United States Geological Survey [USGS]), and individuals knowledgeable about local water quality conditions. Monitored and evaluated assessments are presented in Section 5.

Three of the perennial streams/rivers on the Reservation had comprehensive data (>5 years, multi-parameter) at the time of *Daniel B. Stephens and Associates*' undertaking of this report—Mancos River, Navajo Wash, and the San Juan River. Since then, data have been collected on Tribal waters in Utah and New Mexico, and in Colorado on McElmo Creek. The status of the impairment of these recently studied water bodies has been added to this report during this current revision (2004-05). In addition, ground water data and limited data on ephemeral streams has also been incorporated into this report. Historical data including water quality, water quantity, biological data, and land use data from U.S. Geological Survey, U.S. Bureau of

Reclamation, Bureau of Indian Affairs, and the U.S. Fish and Wildlife Service was used in this assessment.

Tribal water quality data is managed and evaluated using Microsoft Excel and Arcview GIS. GPS data are collected using a Trimble TSCI Asset Surveyor. Water quality analyses are performed at the Ute Mountain Ute water quality lab or contracted to laboratories that meet the requirements of the Tribe's EPA-approved Quality Assurance Project Plan.

Monitoring data for most Utah streams and most ephemeral streams in Colorado and New Mexico is limited. Much of the evaluation of nonpoint source impacts to these is relative to surrounding land use practices and historical data sources. The off-Reservation ranches are assessed based on land use activities, related nonpoint source affects, and limited water quality monitoring data.

3. Background

The Ute Mountain Ute Reservation encompasses approximately 933 square miles (597,288 acres) of the Four Corners region of the southwest (Figure 1). The reservation is located primarily in the southwestern corner of Colorado, with small portions of the reservation extending into northwestern New Mexico. The reservation shares borders with the Navajo Reservation in New Mexico, Arizona, and Utah to the south and west, the Southern Ute Reservation to the east, and Mesa Verde National Park, BLM-managed land, and private land to the north. The Reservation covers land in Montezuma and La Plata Counties in Colorado, San Juan County in New Mexico, and San Juan County in Utah.

In addition to the land in Colorado and New Mexico, a small number of Ute Mountain Tribal members reside in southeastern Utah, on allotted trust land. These lands, or allotments, cover 2,597 acres (UMU, 1999a) and are located at Allen Canyon and the greater Cottonwood Wash area as well as on White Mesa and in Cross Canyon. Some of the allotments in White Mesa and Allen Canyon are individually owned and some are owned by the Tribe as a whole. The Allen Canyon allotments are located 12 miles west of Blanding, Utah and adjacent to the Manti-La Sal National Forest. The White Mesa allotments are located 9 miles south of Blanding, Utah. The Tribe also holds fee patent title to 41,112 acres of land in Utah and Colorado (Section 3.3).

As of 1999, the membership of the Ute Mountain Ute Tribe was 1960, with a majority of the population in their twenties and younger. Of the total Tribal membership, approximately 1400 live on the Ute Mountain Ute Reservation, along with an additional 212 non-Tribal residents (UMU, 1999a). Most of the Tribe resides in Towaoc, Colorado and White Mesa, Utah. The employment rate among members of the Ute Mountain Ute Tribe is approximately 70 percent, split approximately evenly between the public and private sector. The opportunities for employment on the reservation have increased in the past 10 years with the addition of many Tribally-owned enterprises, such as the Weeminuche Construction Authority, Ute Mountain Casino, the White Mesa and Ute Mountain Travel Centers, Ute Mountain Pottery, the Ute Mountain Tribal Park, and the Farm and Ranch Enterprise. A new hotel and conference center at the Casino/Resort has also recently opened and provides more employment opportunities for the community.

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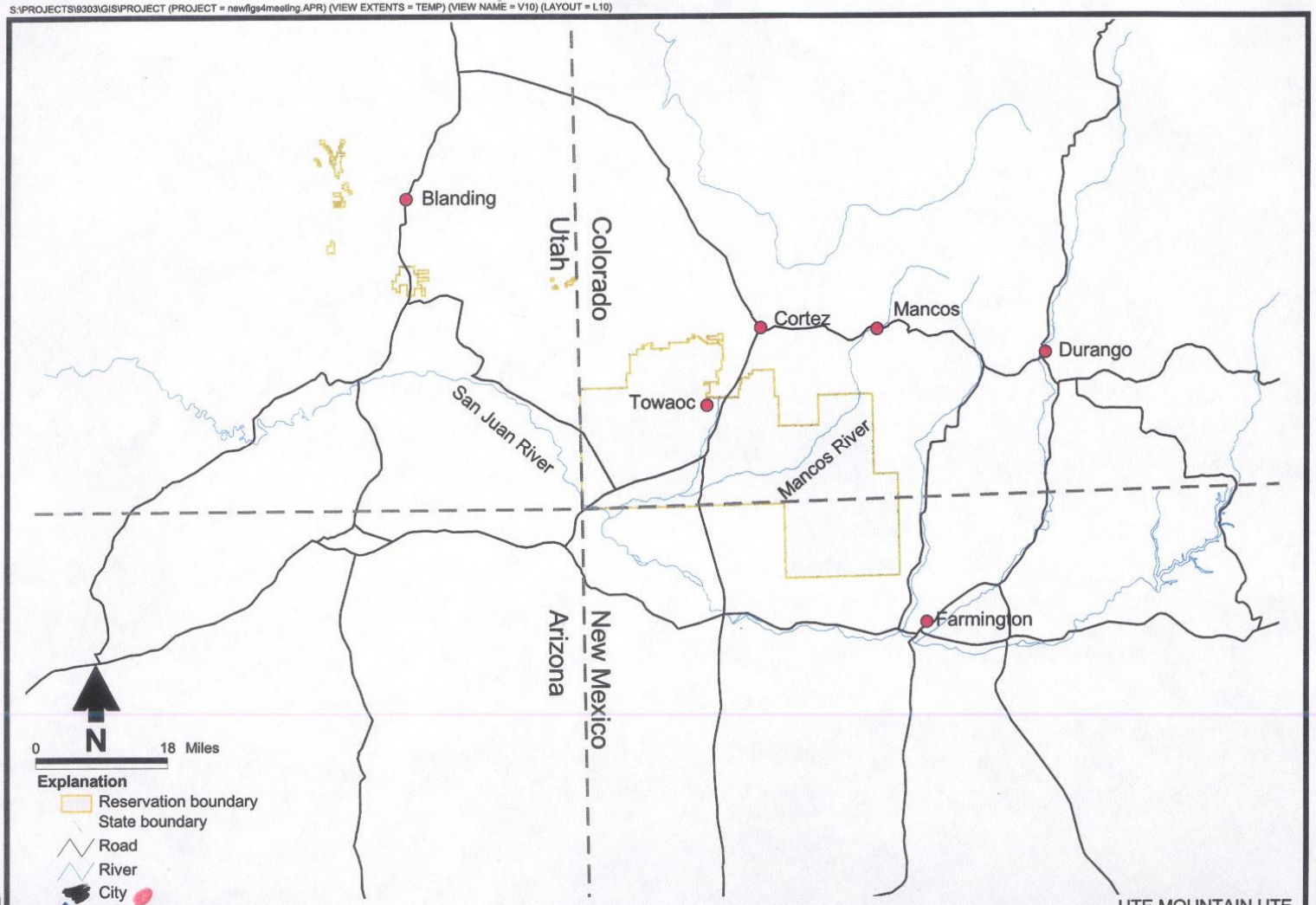

UTE MOUNTAIN UTE
Area Map

Figure 1

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The governing body of the Ute Mountain Ute Tribe is the Tribal Council. The Council consists of seven members, elected by the Ute Mountain Tribal membership. The Tribe operates under an approved Constitution and By-Laws. The administrative leader of the Tribe is the Chairman of the Tribal Council, who is elected for a 3-year term (UMU, 1999a). The position of the Vice-Chairman is held by a Councilman who is selected every year by the Chairman. The Tribal Council, subject to any restrictions in the Constitution and By-Laws and the U.S. Code of Federal Regulations, has the rights and powers to enact and enforce ordinances to promote public peace, safety, and welfare and to manage Tribal and personal property, among others. (UMU, 1976).

3.1 Physical Setting

Topographically, the reservation is characterized as a high desert plateau, with the elevation ranging from 4,600 feet along the San Juan River to 9,977 on Ute Peak. Vegetation ranges from sagebrush shrubs in the lower elevations to ponderosa pine forests in the higher elevations (UMU, 1999a). The reservation includes six vegetation zones (EMI, 2000) including semi-desert grassland, sagebrush savanna, pinyon-juniper woodland, pinyon-juniper woodland/mountain browse, chaparral, and ponderosa pine-fir-spruce-aspen. Approximately 3,800 acres of noncommercial timber forests are represented in the pinyon-juniper woodland/mountain browse, chaparral, and fir-spruce-aspen. The reservation contains verified or potential habitat for several federally listed species of plants and animals.

Early reports indicate that the Ute Mountain Ute land, as late as the 1870s, contained grasses, mowable as hay in nonwooded areas, with sagebrush sparse or absent. This condition was changed by heavy grazing, in part due to encroachment from non-Indian livestock (BIA, 1966). Overgrazing resulted in serious range depletion, with invasion or increase of sagebrush and other undesirable species, the cutting of gullies and arroyos in the lowlands, and severe erosion in the uplands. Later reductions in livestock numbers have resulted in partial recovery of some reservation and surrounding rangelands (BIA, 1966). The Livestock Grazing Program within the Natural Resources Department was established to assist Tribal member cattlemen in developing and maintaining the best possible herds for their families and profit (UMU, 1999a).

The climate of Four Corners region is classified as semiarid and is characterized by low humidity, cold winters, and wide variations in seasonal and diurnal temperatures. Temperature varies with elevation. Average monthly maximum temperature ranges from 39°F to 86°F, and the average monthly minimum temperature ranges from 18°F to 57°F. The highest and lowest temperatures occur in July and January, respectively.

Precipitation also varies with elevation, with average annual precipitation amounts of 8 to 10 inches in the lower elevations of the Ute Mountain Ute Reservation and about 13 inches at Cortez (Butler et al., 1995). The 50-year (1948 through 1997) annual precipitation minimum was approximately 5.2 inches at Cortez (1989) and the 50-year maximum was 30.8 inches at Mesa Verde National Park (1957) (Earthinfo, Inc., 2000). Average monthly precipitation varies from 0.65 inch in June to 2.00 inches in August. At the higher elevations, the monthly precipitation totals are relatively constant throughout the year with the exception of the dry season, which occurs in April, May, and June. At lower elevations, a relatively drier season occurs from April through June and a relatively wetter season occurs from August through October. Summer precipitation is characterized by brief and heavy thunderstorms. The snowfall season lasts for 7 to 8 months with the heaviest snowfall occurring in December.

3.2 Land Use Summary

In the Four Corners region, rangeland and forest account for roughly 85 percent of the entire area, and they cover large areas of the Ute Mountain Ute Reservation as well (Figure 2). Most of the Ute Mountain Ute land is either non-commercial timber land (forest) or rangeland used for open grazing (Table 1). The Weeminuche Construction Authority uses several acres as an equipment yard for storage and maintenance of equipment and construction materials. Other uses include recreational use (e.g., Tribal Park), resource extraction activities, and irrigated agriculture. Outside of Towaoc, urban land use is essentially non-existent.

Accordingly, primary land uses on the Ute Mountain Ute Reservation include housing for tribal members, oil, natural gas, and sand and gravel extraction, grazing for Tribal livestock, and the Farm and Ranch Enterprise south of Sleeping Ute Mountain. In addition, the Ute Mountain Utes operate several tourism facilities, including the 125,000-acre Ute Mountain Tribal Park, the Ute

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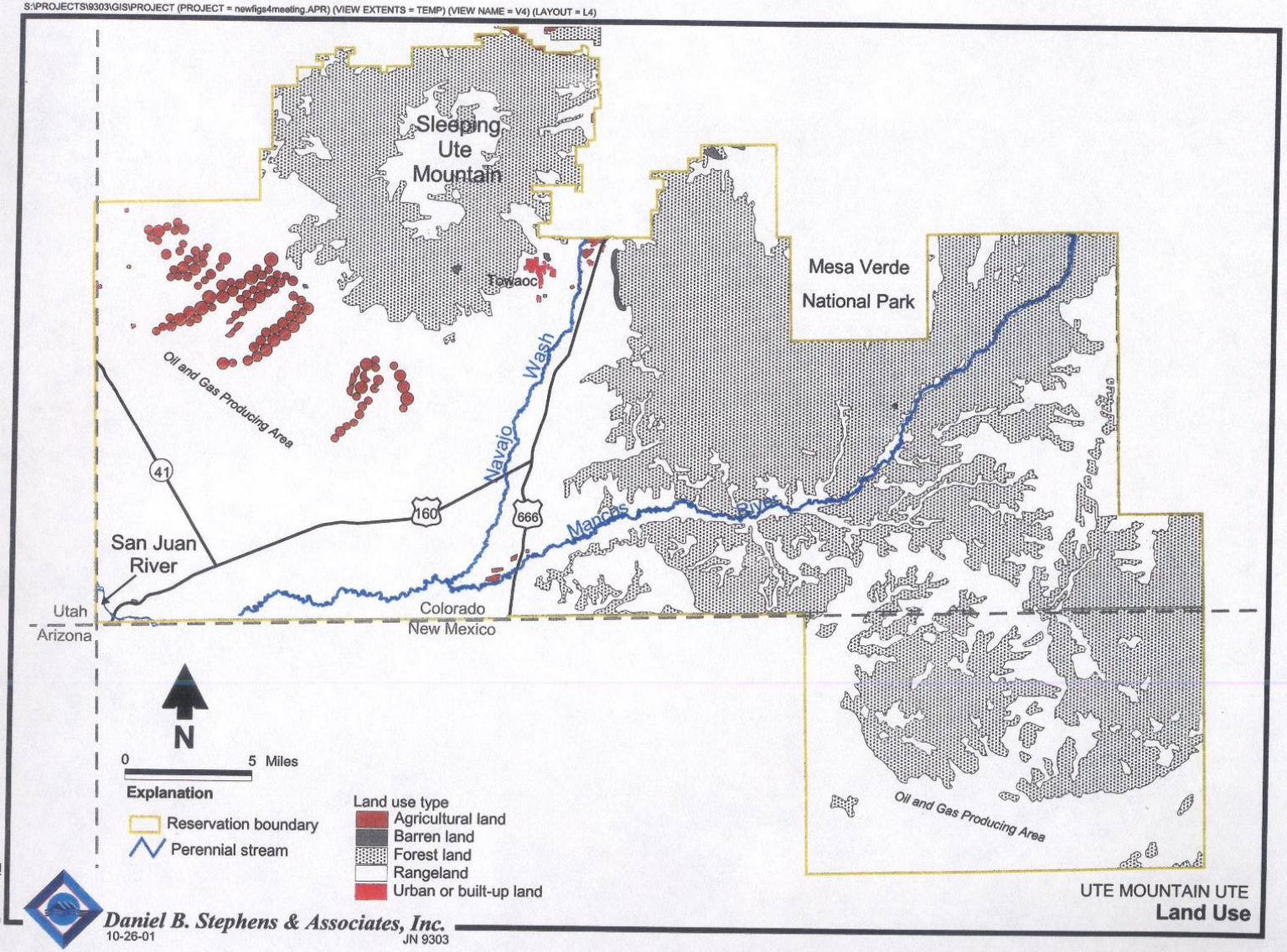

Figure 2

Mountain Casino Hotel/Resort, the Sleeping Ute RV park, and Ute Mountain Pottery. Table 1 summarizes the current land use on the reservation; Figure 2 shows the areas in which these uses take place.

Table 1. Current Land Use

Use		Area (acres)
Irrigated farm land:	Farm and Ranch Enterprise	7,127
	Mancos Creek Farm	157
Timber land:	Commercial	0
	Non-commercial	163,767
Livestock Range		401,433
Other uses (non-agricultural)		1,614

Source: Tribal Land Use Commission, as cited in Ute Mountain Ute Tribe, 1999a.

The Ute Mountain Ute Tribe Farm and Ranch Enterprise is an irrigated agricultural project designed for 7,634 acres of Ute Mountain Reservation land in southwest Colorado (UMU, 1999b). In addition, the Ute Mountain Ute Resources Department operates the smaller Mancos River Farm, which irrigates a few hundred acres. The Farm and Ranch Enterprise grows triticale and alfalfa hay and small grains including corn, wheat, and barley. The Mancos River farm grows hay and provides irrigated rangeland.

The Farm and Ranch Enterprise primarily grows crops, but also owns ~1,200 head of cattle. The purpose of the project is to operate a profitable agricultural enterprise, in addition to providing skilled year-round employment to Tribal members. The enterprise was established, in part, following a dispute in the 1950s over the completion by the Bureau of Reclamation (BOR) of a project that diverted water away from the reservation to non-Indian ranches. Settlement of the water rights issues raised by this project eventually led to the creation of the Dolores Project and Ute Mountain Ute Farm and Ranch Enterprise.

The Farm and Ranch Enterprise uses water entitled to the Ute Mountain Utes by the Colorado Ute Water Settlement Act of 1988, which facilitated the importation of water for irrigation, municipal and industrial, recreation, and wildlife uses. The Dolores Project is a water storage and delivery project that resulted, in part, from the water rights settlement. Water is stored in

McPhee Reservoir, located 10 miles north of Cortez, Colorado and 20 miles from the Ute Mountain Ute Reservation. Water for irrigation, wildlife and recreation is transported from the reservoir through the Towaoc Highline Canal, and municipal water is transported by pipeline from Cortez to Towaoc. The Farm and Ranch Enterprise is designed to encompass roughly 7,600 acres of irrigated cropland, primarily south of Sleeping Ute Mountain, and to use on the order of 23,000 acre-feet per year of water.

Oil and gas leases cover 61,745 acres in the south and east part of the reservation, 54,195 acres of which are actively producing (UMU, 1999a). An additional 290,000 acres of reservation is available for oil and gas exploration and development.

The lands in Utah consist mainly of residential use and livestock use. Traditional plant gathering and limited gardening is practiced in Allen Canyon, the historical home of the Tribal Members who now live in White Mesa.

Traditional plant gathering activities and ceremonial land and water uses also occur throughout the Reservation.

3.3 Off-Reservation Ranches

The Ute Mountain Ute Tribe holds fee patent title to several ranches in Utah and Colorado, outside of Reservation land. The locations, areas, resources, and land uses of those ranches are summarized in Table 2.

Table 2. Summary of Off-Reservation Ranches
Page 1 of 2

Ranch	Location	Acreage		Range Carrying Capacity [c] (# head)	Resources				Land Use
					Water [d]		Forestry [c]		
		Total [a]	Est. Irrigated [b]		Surface (ac-ft)	Ground (gpm)	Quantity (bd-ft)	Type [e]	
Pine Crest	2 miles south of U.S. Hwy 50 between Montrose and Gunnison, CO in Gunnison County	18,749	800	1,250	788	15	1,000M	PP	Livestock range Forestry Hunting Recreation
Neilson's	South of U.S. Hwy 160 near Hesperus, CO, east of the La Plata River	1,717	600	237	962.3	0	1,000M	PP	Livestock range Forestry Hunting Recreation
Dunn/ Henderson	In La Plata County, CO, off U.S. Hwy 140 between Hesperus and Durango, CO	4,423	500	75	494.5	5	Minimal	PJ	Livestock range Hunting Recreation
Adams	North of U.S. Hwy 160 and east of CO Route 184, near Summit Reservoir, north of Mancos, CO	1,628	150-200	428.6	5	213	NA	NA	Livestock range Hunting Recreation
Perkins	Southwest of Blanding, UT, near Bluff, UT	1,630	160	NA	NA	600	None	---	Livestock range Hunting Recreation
Minerich	13.5 miles south of U.S. Hwy 50 between Montrose and Gunnison, CO in Gunnison County	160	0 [f]	NA	NA	NA	NA	NA	Livestock range Hunting Recreation

[a] Source: Summary letter to BIA Superintendent, Towaoc, dated July 28, 1993.

[b] Source: Bureau of Indian Affairs. 1990. *Existing water use inventory map(s).*

[c] Source: Unknown author. *1950's Carrying capacities and forestry resources.* Because origin of this document is unknown, these numbers should be considered estimates.

[d] Source: Keller-Bliesner Engineering. 1987. *Ute Mountain Ute historical claims data base, fee lands.* Prepared for Bureau of Indian Affairs, Albuquerque, New Mexico. July 1987.

[e] PP = Ponderosa pine
PJ = Piñon juniper

ac-ft = Acre feet
gpm = Gallons per minute
bd-ft = Board feet
NA = No information available

Table 2. Summary of Off-Reservation Ranches
Page 2 of 2

Ranch	Location	Acreage		Range Carrying Capacity [c] (# head)	Resources				Land Use
					Water [d]		Forestry [c]		
		Total [a]	Est. Irrigated [b]		Surface (ac-ft)	Ground (gpm)	Quantity (bd-ft)	Type [e]	
Covey	South of U.S. Hwy 160 between Hesperus and Mancos, CO	200	170	NA	NA	NA	NA	NA	Livestock range Hunting Recreation
Pyle	South of U.S. Hwy 160 between Hesperus and Mancos, CO	2,880	190	NA	NA	NA	NA	NA	Livestock range Hunting Recreation
Safley	South of U.S. Hwy 160 between Hesperus and Mancos, CO	236	113	NA	NA	NA	NA	NA	Livestock range Hunting Recreation
Gravel Park	Contiguous with the Ute Mountain Ute Reservation	2,000	NA	NA	NA	NA	NA	NA	Livestock range Hunting Recreation
Burns Cattle	East of Hwy 160/666 north of Commercial Center	180	NA	NA	NA	NA	NA	NA	Livestock range Hunting Recreation
Zwicker	Far west of County Road A in Montezuma County	190	NA	NA	NA	NA	NA	NA	Livestock range Hunting Recreation

[a] Source: Summary letter to BIA Superintendent, Towaoc, dated July 28, 1993.

[b] Source: Bureau of Indian Affairs. 1990. *Existing water use inventory map(s).*

[c] Source: Unknown author. *1950's Carrying capacities and forestry resources.* Because origin of this document is unknown, these numbers should be considered estimates.

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[e] PP = Ponderosa pine
PJ = Piñon juniper

[f] Personal communication with Scott Clow, July 30, 2001

ac-ft = Acre feet
gpm = Gallons per minute
bd-ft = Board feet
NA = No information available

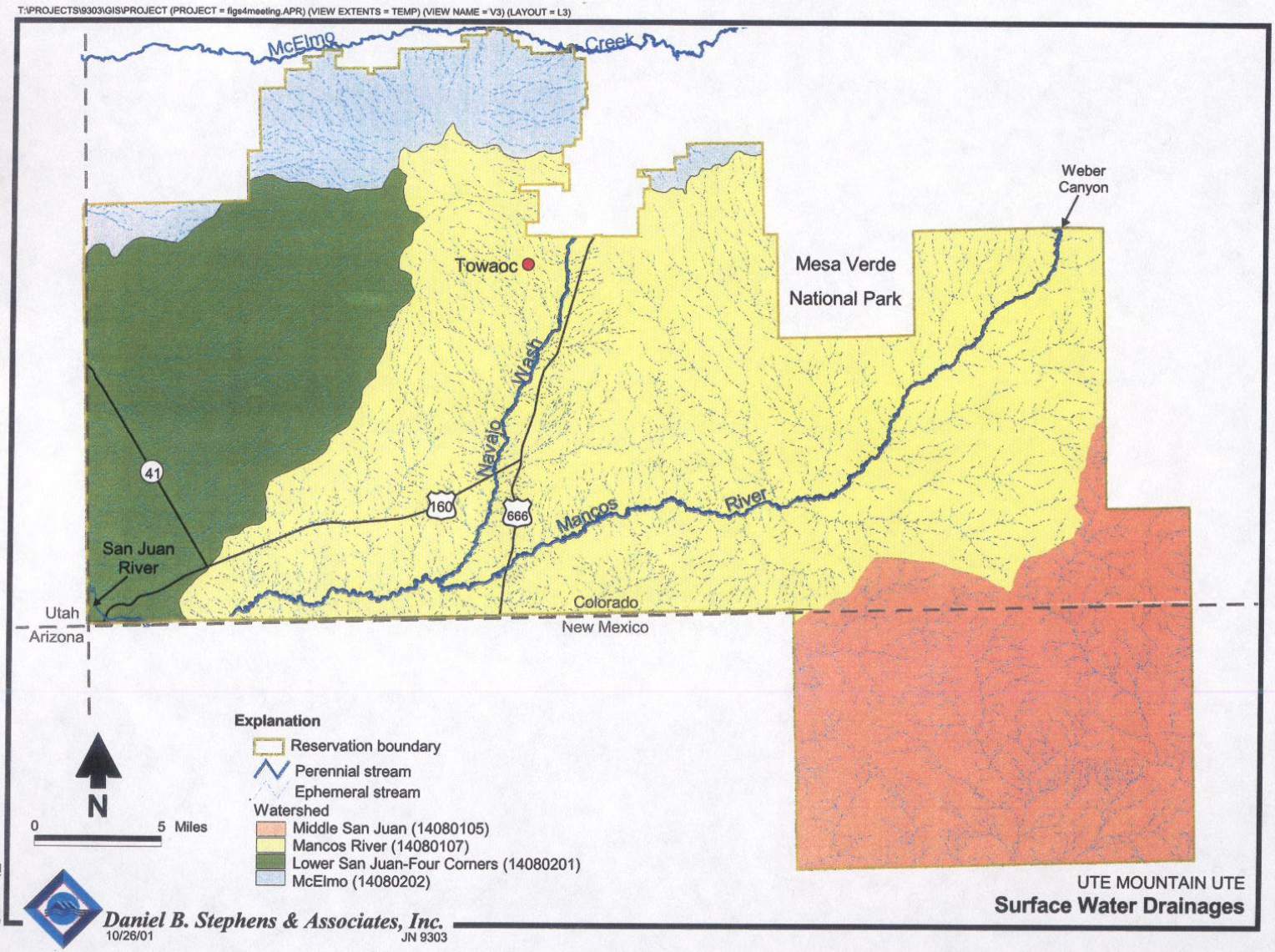
4. Surface Water and Groundwater Summary

This section describes the existing conditions of Ute Mountain Ute surface water and groundwater. Surface water and groundwater quality data are presented in Section 5.

4.1 Surface Water Description

The main surface water body on the Ute Mountain Ute Reservation is the Mancos River (See Figure 3). The Mancos River drains approximately 795 square miles. From its headwaters in the La Plata Mountains to the northeast of Mancos, Colorado, the Mancos River flows southwest to south through the Ute Mountain Ute Reservation and joins the San Juan River just south of the Colorado-New Mexico state line (Butler et al., 1995). The Mancos River was listed by the State of Colorado in its 2000 303(d) list for copper. 75% of samples in the upper basin where the State monitors exceeded the chronic copper standard for aquatic life. In the late 1990's as part of the *Clean Water Action Plan*, the Mancos was identified as impaired by sediment due to erosion. Tribal data have also indicated exceedances of chronic aquatic life selenium criteria from ten sampling events, although not enough events have detected selenium to show a trend in the Mancos River at this time. Selenium is most likely coming from Mancos Shale and shale- related soils that are irrigated in the Mancos Valley. The Mancos River riparian zone is heavily infested with tamarisk (salt cedar), and efforts have been undertaken to address the issue on a small scale (see discussion of tamarisk impacts regarding San Juan River below).

The San Juan River flows across approximately 4 miles of the Reservation near 4 Corners. Water quality in the San Juan is generally good. Bacteria analyses upstream in the Middle San Juan River segment in 2002 and 2003 (from Navajo Dam to Fruitland, NM) have shown high levels of *E. Coli* bacteria, and these may reach the Ute Mountain Ute Reservation after dilution by tributaries like the Mancos River. Bacteria concentrations at Four Corners are of concern for swimmers and boaters. The San Juan River has some riparian health issues because of invasive species of riparian plants—tamarisk (or *salt cedar*), and russian olive have out-competed the native riparian plants in many areas, lowering the ground water table and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McElmo Creek
Weber Canyon
Towaoc
Mesa Verde National Park
Navajo Wash
41
160
666
Mancos River
San Juan River
Utah
Arizona
Colorado
New Mexico
Explanation
Reservation boundary
Perennial stream
Ephemeral stream
Watershed
Middle San Juan (14080105)
Mancos River (14080107)
Lower San Juan-Four Corners (14080201)
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Surface Water Drainages

Figure 3

reducing backwater habitat for fish and other wildlife. Management of Navajo Reservoir is also critical to the physical and biological state of the San Juan River. The San Juan River is home to two of the endangered species on the Ute Mountain Ute Reservation, the Colorado pikeminnow and the razorback sucker.

Another semi-perennial stream with a significant presence on the Ute Mountain Ute Reservation is Navajo Wash, which is a tributary of the Mancos River Watershed. It is described here as "semi-perennial" because it was probably originally ephemeral a century ago, but upstream irrigation has caused the groundwater table to become saturated and the stream flows unnaturally throughout most years. Drought conditions during 2001-2004 limited irrigation in the basin and reduced ground water return flow and it did not flow year-round. Navajo Wash, as noted above, has a variety of impairments from multiple sources. Chemical impairments include exceedances of selenium, arsenic, salinity (TDS/EC) standards, as well as high levels of sulfates and nitrates. Selenium exceeds the U.S. Fish and Wildlife recommended criterion for aquatic life at the Reservation boundary where it flows onto Ute lands. Salinity exceeds livestock watering standards in the winter (low flow) and during dry summers, and also exceeds irrigation standards year-round. Bacteria levels in Navajo Wash have exceeded the standards for primary contact recreation use that is applied due to its proximity to residences in and around Towaoc. Sources of pollutants include: upstream and on-reservation irrigation effects through groundwater return flows across Mancos shale, (non-discharging) wastewater treatment systems on the Reservation, grazing effects, and storm water run-off. Physical impairment is caused by: 1) deep channel incising from erosion of unstable stream banks that lack sufficient vegetation; 2) prohibition of lateral meandering; 3) fine sediment deposition from upstream irrigation; and 4) storm water discharge impacts from Towaoc. Biological impairment is related to all of the chemical and physical impairments—macroinvertebrate populations are limited in diversity of species because of chemical stressors and physical habitat limitations. Riparian health is also impacted by tamarisk infestation.

McElmo Creek is moderately physically impaired by fine sediment deposition from adjacent irrigation return water. It also is deeply incised and has stream bank erosion and channel modifications that have degraded the integrity of the riparian corridor along some segments of the creek. Chemically, McElmo is similar to other small tributaries to the San Juan River,

dominated by alkaline calcium-sulfate salts. High hardness values generally mask the toxicity of waterborne metals, such as arsenic, selenium, copper, chromium and lead, to aquatic life.

In Utah, Cottonwood Wash is the object of an inter-agency watershed clean-up to mitigate the impacts of uranium mining and processing. This stream is listed by the State of Utah on its 2000 303(d) list for gross-alpha radiation. Designated uses impaired by this are wildlife/aquatic life, livestock watering uses, and Tribal ceremonial uses. Gross-alpha radiation data collected by an inter-agency TMDL team show gross- alpha levels in the main stem of Cottonwood Wash ranging from background levels at or slightly above detection limits to a maximum of 76 pCi/L. Brushy Basin Creek, impacted by mines and a mill site, has the highest in-stream levels for a tributary, with two samples indicating gross-alpha levels of 480 and 489 pCi/L. Mine portals that were sampled had levels of gross-alpha radiation one order of magnitude higher than Brushy Basin Creek, and two orders of magnitude higher than in Cottonwood Wash itself, with the highest level being 8860 pCi/L., with a flow of 0.1 cf/s. Physically and biologically, Cottonwood Wash has several road crossings and many historic uranium mines that liberate sediments that may impact aquatic life habitat. Data in this regard are skewed by the radiological impairment that influences aquatic life as much as the physical impacts. Cottonwood Wash and its tributaries are heavily infested with tamarisk, although large cottonwood and willow stands have not been out-competed. The adjacent and tributary Allen Canyon Creek is relatively unimpaired, and it is used as a reference for gross-alpha radiation and chemical and biological assessment purposes. Beavers have created step-pool habitat for a diverse macroinvertebrate population and small fish population. Tamarisk infestation is an issue in Allen Canyon, but the riparian corridor provides habitat for a diverse population of aquatic and terrestrial wildlife.

Water quality on the fee-land ranches has not been fully investigated. The Tribe's Pine Crest ranch, near Gunnison, CO, has two high quality, mountain streams, Pine Creek and Willow Creek. These creeks are in the headwaters of the Gunnison River at >8,000 ft. elevation. They are high gradient, cold-water mountain streams with diverse macroinvertebrate populations and trout. Two sampling events of these have indicated that they meet all State standards and support their designated uses of agriculture, cold water aquatic life, and recreation. Closer to the Reservation lands, the Tribe's Neilson's Ranch on the La Plata River near Heserus, CO also provides excellent aquatic life habitat in a cold-water mountain stream. The La Plata River

supports its agricultural and aquatic life uses, and meets all applicable State standards, including bacteria standards for primary contact recreation. Other fee-land ranches will be investigated for water resource use attainments in the future.

Flow Regimes for Lotic Waters

Perennial stream flows on the Reservation vary widely. The Mancos River has a range of annual mean stream flow, based on 76 years of USGS data, from 3.35 cf/s (2002 drought conditions) to 125 cf/s (1979). Due to upstream irrigation diversions, the lower Mancos typically dries up during late June to July until late summer rains restore flow. Minimum flows at the stream gauge on the Mancos have been zero flow, and maximum flow has reached 5,500 cf/s. On September 10, 2003 a huge storm caused a flow of 1,810 cf/s. Navajo Wash has a range of instantaneous flow measurements from 0 to 20 cf/s based on 9 years of data collected by the Tribe and the US Bureau of Reclamation from 1992-2001. Storm event flows in Navajo Wash have been observed, but not measured, at much higher bank-full levels. McElmo Creek has an annual mean flow range from 16.7 cf/s (2002) to 80.0 cf/s (1997), based on 9 recent years of USGS data, with a peak flow of 1080 cf/s in March of 1995. The San Juan River has had a stream gauge operated by USGS near 4 Corners for approximately 24 years. Data from the gauge have indicated an annual mean flow range from 1,255 cf/s (1891) to 4,081 cf/s (1979). Daily mean flows for the period of record range from 424 cf/s to 7810 cf/s. Maximum flows have reached 12,600 (1997). Navajo Dam in northern New Mexico regulates much of the flow in the San Juan River. A comprehensive operations plan is being completed for the San Juan River by various stakeholders and federal agencies with the aim being to balance between water users needs and mimicking natural flow for the benefit of aquatic species that includes endangered fish.

Off-Reservation, The McElmo watershed contains two large reservoirs—Narraguinnup Reservoir and Totten Reservoir. These reservoirs receive water from the Dolores Project and are used to regulate and manage irrigation and wildlife/recreation water. Narraguinnup Reservoir is listed as impaired for fish consumption due to methyl-mercury. The Mancos River's flow is regulated by Jackson Lake in the La Plata Mountains near its headwaters. During the

April/May-September/October irrigation season, much of the flow in the Mancos on the Reservation is irrigation return water.

Lentic Waters on the Reservation include four reservoirs that do or have supported fisheries, in three different watersheds. Navajo Wash watershed has a reservoir—Hayfield Reservoir—with water supplied from the Dolores Project that is used for irrigation and wildlife/recreation. In the higher elevations, Cottonwood Wash (tributary to Navajo Wash) has a reservoir that is commonly called "First Lake." There is also Horseshoe Reservoir or "Last Lake," and an unnamed wetland lake – both in the Pine Creek watershed (tributary to McElmo). Many small livestock impoundments exist that stop some or all of the flow in their respective ephemeral streams.

Canal Water

The Towoac Highline Canal provides water for irrigation (and some wildlife enhancement) to the Farm and Ranch Enterprise. The canal water is very high quality and comes from the Dolores Project via a trans-basin diversion. Once it leaves its original basin, it is relatively unaffected by nonpoint sources of pollution except evaporation and atmospheric deposition.

4.2 Groundwater Description

The Ute Mountain Ute Reservation lies within the Four Corners Platform, a structural bench between local uplifts and the adjacent San Juan River and Blanding Basins. The rocks are gently folded into a shallow syncline that plunges to the south. This structure is flanked on the east by Barker Dome, on the west by Sleeping Ute Mountain Uplift, and on the north by the Dolores Plateau. Moderately to highly incised topography has developed on the southward-tilted Upper Cretaceous strata, consisting of (in ascending order) the Dakota Sandstone, the Mancos Shale, and the Mesa Verde Group, which consists of the Point Lookout, Meneffee, and Cliff House Sandstones.

Near Sleeping Ute Mountain, the Morrison, Burro Canyon, and Dakota Sandstone Formations are near the surface (Figure 4). The Mancos Shale crops out between the igneous intrusions

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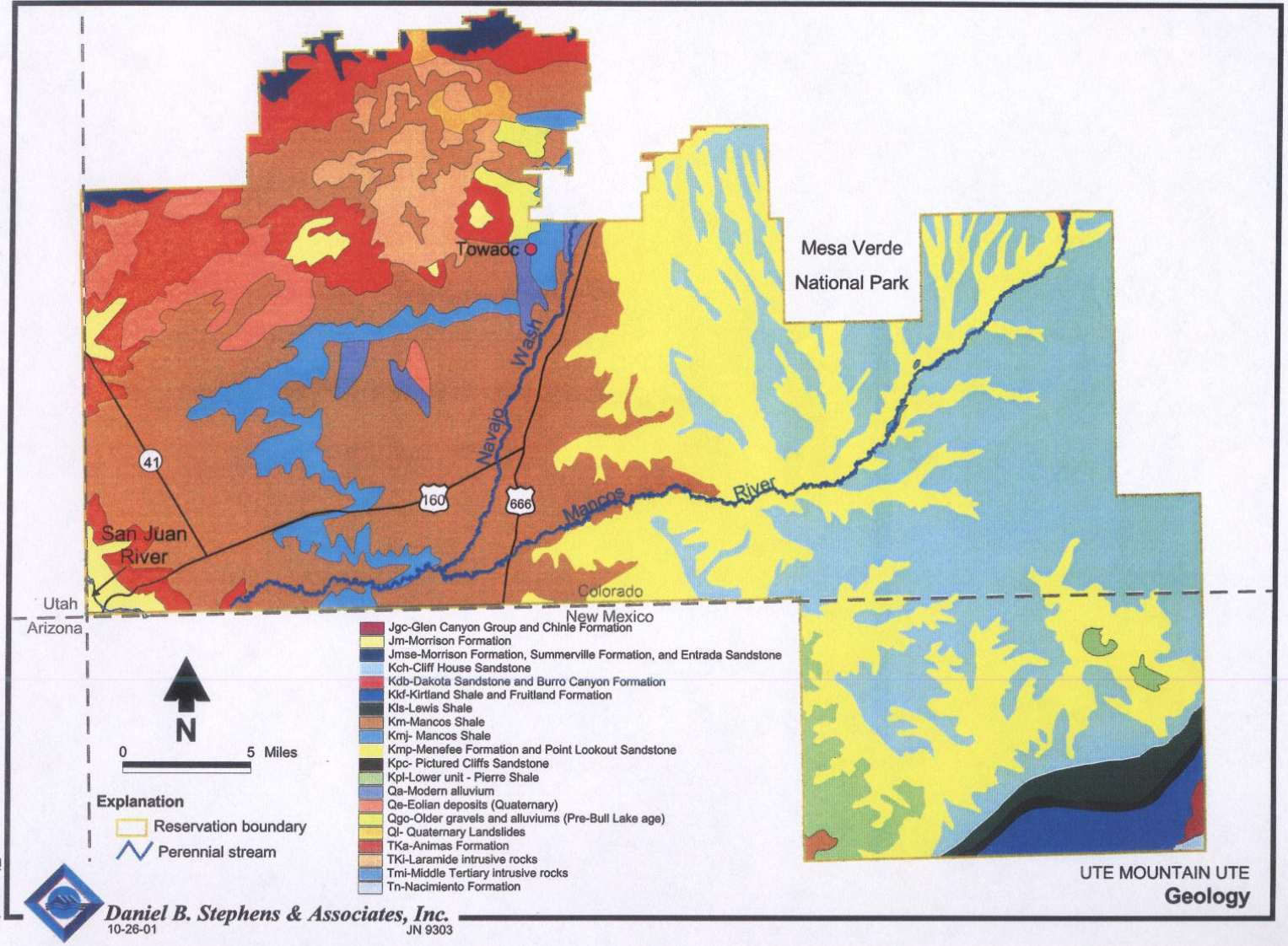

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Figure 4

forming the mountain and underlies the pediment alluvium flanking the mountain. Isolated Quaternary deposits (Figure 4) consist of talus, block rubble, colluvium, stream-channel alluvium, and pediment alluvium. The overlying soils reflect the composition of the underlying geologic formations.

- Groundwater is available from several unconsolidated surficial deposits and from confined bedrock aquifers:

- Alluvium, talus deposits, and pediment deposits may provide small quantities of shallow groundwater. Springs issuing from near-surface talus, block rubble, and colluvium in the Sleeping Ute Mountain area may yield more than 100 gallons per minute (gpm) seasonally (Geldon, 1985). During most of the year, channel alluvium and older pediment alluvium contain water only near the bases of these units, where downward percolation is restricted by the Mancos Shale. Groundwater in the alluvium generally flows toward canyons and tributaries of the San Juan River (Whitfield et al., 1983, cited in Butler et al., 1995).

- Groundwater is also obtained from three primary bedrock aquifers on the Ute Mountain Ute Reservation: the Dakota Sandstone, two sandstone units of the Mesa Verde Group, and in Utah, the Navajo/Entrada sandstone.

  - The Dakota Sandstone is the main aquifer for livestock water on the Ute Mountain Ute Reservation. The gray, resistant Dakota Sandstone ranges from 100 to 160 feet in thickness and lies below the gray Cretaceous Mancos Shale and above the Burro Canyon Sandstone. Wells in the Dakota Sandstone in Colorado and New Mexico are used primarily to supply water to livestock because they are generally 200 to 1,000 feet deep and do not yield much water (Ecosphere Environmental Services, 2000). Groundwater flow is generally toward the San Juan River (Whitfield et al., 1983, cited in Butler et al., 1995).

- Small amounts of groundwater are also obtained from the sandstone units of the Mesa Verde Group, especially the Cliff House Sandstone and the upper sandstone member of the Point Lookout Sandstone. The Cliff House Sandstone is a sequence of sandstone and shale that is not uniform throughout in thickness or lithologic characteristics (Ecosphere Environmental Services, 2000). The sandstone is characterized as grayish-orange to pale yellowish-brown, very fine- to fine-grained, immature to submature, subarkose, thick-bedded sandstone units with large-scale cross-bedding. Groundwater in the Cliff House and Point Lookout Sandstones generally occurs in the southeast part of the reservation. The development of this aquifer is limited by (1) the lack of recharge and infiltration because of highly impermeable materials overlying the aquifer, (2) the Mancos River and its tributaries, which dissect and drain the Mesa Verde Group, and (3) the belief that the sandstones do not hold much water (Ecosphere Environmental Services, 2000).

- To the west, Navajo/Entrada sandstone occurs 1200 to 1800 feet below the surface. It is the first (stratigraphically) dominant useable aquifer in southeastern Utah, providing artesian pressure and 150- to 225 gallons per minute of water.

Given the limited and/or seasonal nature of the alluvial and bedrock aquifers described above, the use of groundwater on the Ute Mountain Ute Reservation in Colorado and New Mexico to fulfill municipal and agricultural demands is small. Municipal and agricultural irrigation water is obtained largely from the Dolores Project (Section 3.2), while local groundwater is primarily used for livestock watering.

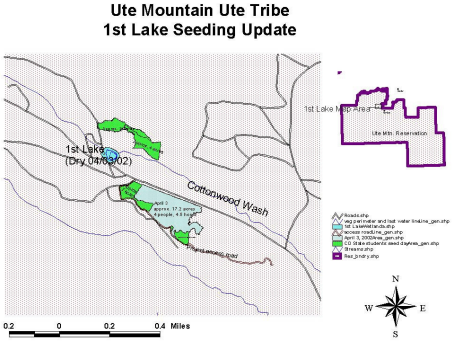
Five domestic groundwater wells exist on the Reservation. In Colorado, 2 private wells in McElmo Canyon and one well at the Farm and Ranch Headquarters west of the Sleeping Ute Mountains provide drinking water. **In Utah, the White Mesa Community relies on 2 deep groundwater wells for its entire municipal supply.** Each of the domestic groundwater wells provides water that meets Safe Drinking Water Act standards, but the White Mesa water has organoleptic effects from iron and manganese.

Chemical water quality reflects the lithologic composition of the aquifers. The concentration of minerals is small in block rubble and talus deposits, which are composed mostly of igneous rock, while water from other aquifers, such as Dakota Sandstone, locally may exceed federal maximum contaminant levels (MCLs) for several constituents, including total dissolved solids (TDS), sulfate, selenium, fluoride, and manganese. In addition, bacteriological contamination from livestock and human activities remains a threat for shallow groundwater resources.

4.3 Past and Ongoing Nonpoint Source Pollution Prevention

Several programs and projects have been undertaken to address nonpoint source impacts to water quality on the Ute Mountain Ute Reservation, and more are currently underway.

One project undertaken in 1999 was to plug an old well that was adding approximately 1 ton of salt per day to the lower San Juan River watershed. The well was plugged using CWA Section 106 Special Studies funding, and the salt load was removed from the system. Another project undertaken in 2002 was to reduce erosion in the greater Towaoc, Colorado area, particularly where a fuels-reduction, forest-thinning project had been undertaken. CWA Section 106 Special Studies funds were used to purchase grass seed in order to seed the disturbed area to stabilize soils and prevent sediment movement. Despite drought conditions, the grasses took hold and the project was successful.



On left, newly planted native grasses (competing with cheat grass) on Special Studies Project—note slash pile to be burned during wetter conditions and steep hill with moderately successful seeding. Previously clear-cut steep hillside was not part of the fuels reduction project, but it was also seeded to prevent erosion. On right, Project map for seeding done with CWA Section 106 Special Studies $ to prevent soil erosion after fuels treatment

Livestock management projects have been undertaken to reduce nonpoint sources of pollution related to grazing issues. A large multi-year project was undertaken by the Tribe and the NRCS to construct water tanks and pipelines throughout some of the southwestern-most portion of the reservation lands in Colorado. This EQUIP-funded project allows better rotation and management of livestock by providing water to range that was previously without water resources for livestock. EQUIP has also funded projects to exclude livestock from windmills and springs on the Reservation in Colorado and New Mexico. Funding from the Bureau of Indian Affairs and the Bureau of Reclamation have been used to improve structures at springs and around water sources—these have included fencing out livestock to prevent disturbance and pollution of those resources. Related ongoing projects include exclusion and cross-fencing for improved livestock rotation and management.

Funding from the Bureau of Reclamation is currently being used to enhance two reservoirs that support sport fisheries. First Lake and Horsheshoe Lake have both leaked severely in the past five years, causing the demise of those fisheries. Dirt work has been completed on each reservoir, and a polymer-based sealant or bentonite clay will be used to prevent further leakage in 2004. If this project is successful, fish will be stocked in each lake in 2005 or 2006.

A partnership with the Colorado Division of Wildlife, the Tribe's Brunot Wildlife Department and Environmental Programs Departments, and Mesa Verde National Park has provided a significant ecological restoration to the Mancos River Watershed. The combination of massive, severe-intensity forest fires in the watershed in 2000 and a 5-year drought caused the demise of most of the Mancos River fish. This stream segment is unique because it is populated by

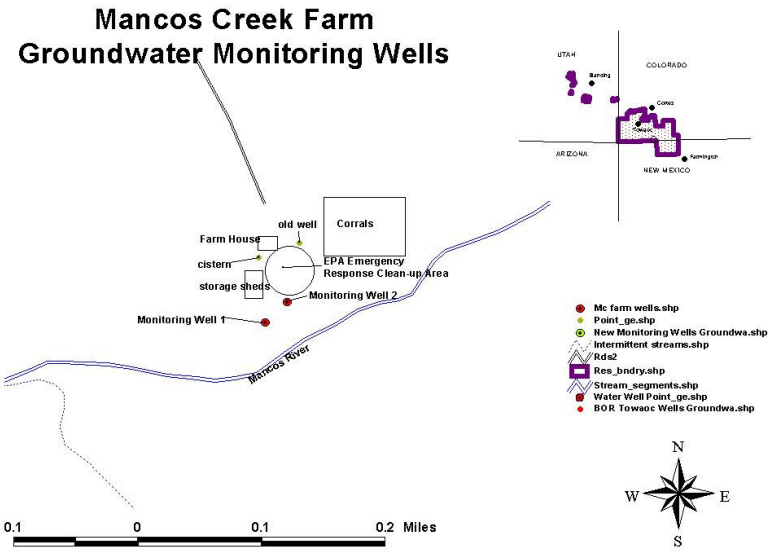
Transferring flannel mouth suckers


Reintroducing fish with Tribal/State team work

almost entirely native fish because of a barricade to migration of San Juan River fish upstream of the Tribe's irrigation diversion dam near Highway 491/666 in Colorado. An effort was made in 2002 to salvage some of the last Mancos River roundtail chubs—a fish species of "special concern" in Colorado, and listed as threatened in New Mexico. Through a successful captive-breeding program, thousands of these fish were returned to the Mancos in September 2003. Also, in April 2004, two other native Mancos River fish species were reintroduced to the river, the flannel mouth sucker and the blue head sucker.

The Tribe's Brownfields Program is currently assisting the Water Pollution Prevention Program to address pesticide pollution at a site where EPA has twice (1995 &1999) conducted emergency response clean-up activities. The site had improperly stored containers of various synthetic organic pesticides that had leaked and contaminated soil. Odors of fumes from the contaminated soils can still be detected at the site. Soil samples collected in 2005 will identify the extent and concentration of the pollutants and how much additional soil needs to be replaced. Groundwater monitoring wells installed at the site have not had measurable quantities of water due to drought. It is the intention of the project to eliminate the risk to the adjacent Mancos River and any potentially affected groundwater resources at the site, and to reduce any risk to the health of the caretakers who live there.

Mancos Creek Farm Pesticide clean-up site map



Another project was undertaken in May of 2004 to prevent further erosion and improve aquatic habitat in Navajo Wash in Towaoc, CO. This project involved grading eroded slopes around the bridge that crosses the stream in Towaoc; seeding the disturbed area; installing matting to hold the sloped banks and seed in place until it is sufficiently vegetated. In 2005, trees will be planted along the stream to create shade and enhance aquatic habitat. Rocks were also placed around the project area to exclude recreational vehicles and trucks from causing further disturbance and erosion.

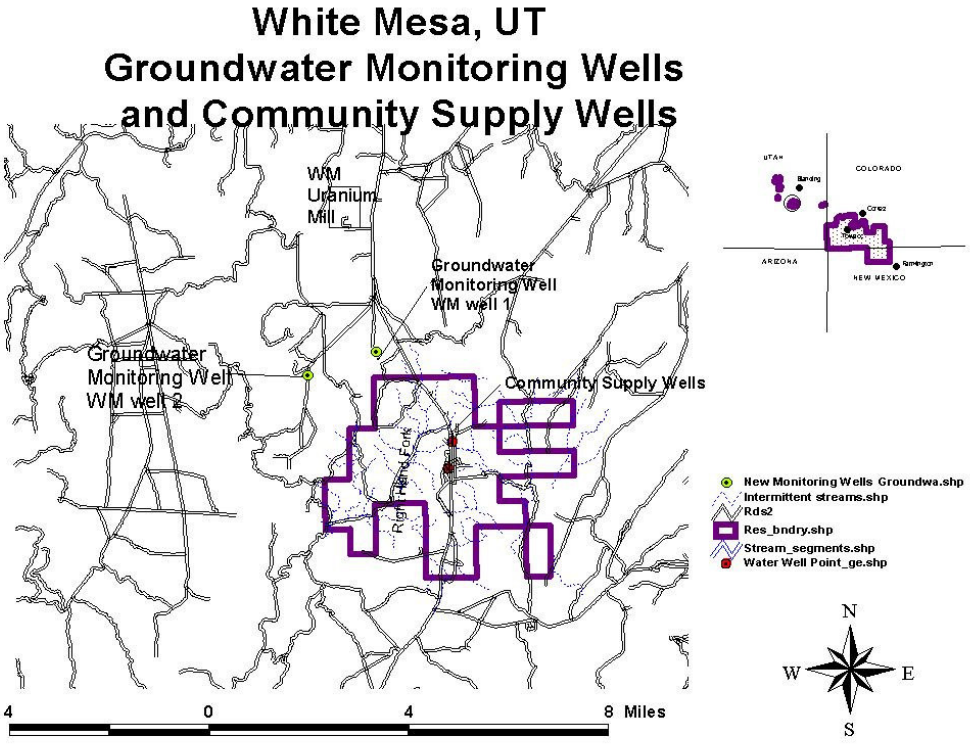
Navajo Wash erosion project

Tamarisk (salt cedar) removal and treatment has been undertaken in the Mancos River Canyon. A small (4-5 acre) project was undertaken in 2003, utilizing Bureau of Indian Affairs weed control funding, to cut and treat tamarisk at the northern boundary of the Reservation. The project was very successful, and another project was funded for 2004-2005. This will cut and treat another 6-10 acres directly adjacent to the first project. A larger, reservation-wide strategy is being developed by the *Environmental Technician*, and EPA wetland grant funds and/or local or state funds will be sought to fund those projects.

Tamarisk (salt cedar) in Mancos Canyon

Various other programs have been and are being developed to address nonpoint source pollution. The Tribe's *Ground Water Protection Plan* was adopted in early 2005, and will be concurred on by EPA soon. The Ground Water Protection Plan addresses various aquifers, the pollutants and/or land use practices that may degrade the quality of the resources, and how the Tribe intends to prevent that from happening. A major component of the Ground Water Protection Plan is a pesticide management plan that describes preventative measures and how to respond to the detection of those chemicals at various levels. Another preventative measure being undertaken for the protection of ground water in Utah is a *sole-source aquifer* designation for the White Mesa, UT community drinking water aquifer. This designation will allow the Tribe to undertake more intensive preventative measures to ensure that the aquifer will meet Safe Drinking Water Act Standards. Two monitoring wells, sponsored by the Bureau of Reclamation, have been drilled into an overlying bedrock aquifer in White Mesa in order to monitor any pollution that may emanate from the White Mesa Uranium Mill, 3 miles north of the White Mesa Community of Utes. These wells will intercept any perched ground water that may be affected by the mill, indicate the level of pollution and allow a substantial time to mitigate the situation before any pollution reaches the sole-source aquifer 800-1000 feet below it.

Tribal Electrical Dept. assisted in wiring pumps on White Mesa ground water monitoring wells. CWA Section 106 Special Studies $ paid for electrical work and generator (in truck at right). Uranium mill is in background of photo on right, between well and mountains.



Proximity of White Mesa, UT community to uranium mill; note community supply wells and new monitoring wells

CWA Section 106 Special Studies funding will be used in the near future to develop a storm water management plan for the town of Towaoc. This plan will identify existing conduits for storm run-off; impermeable surfaces; receiving waters; potential diversions to reduce sedimentation impacts; management practices for construction activities to reduce storm run-off erosion, including pre-project planning concepts; road construction BMP's; etc. When implemented, the storm water management plan would prevent further degradation of local streams by sediment and run-off chemicals. This will be particularly helpful for Navajo Wash, the stream that receives most of the town's storm water and sediment.

In addition to these programs and projects, other programs indirectly benefit the prevention of nonpoint sources of water pollution. These include: oil field environmental compliance; environmental education activities; underground storage tank management; wastewater management activities; and threatened and endangered species management. While the primary responsibility for most of these programs does not fall directly on the Tribe's Environmental Programs Department, the Environmental Programs Department does play an active role in assistance and compliance for each.

5. Surface Water Quality Summary

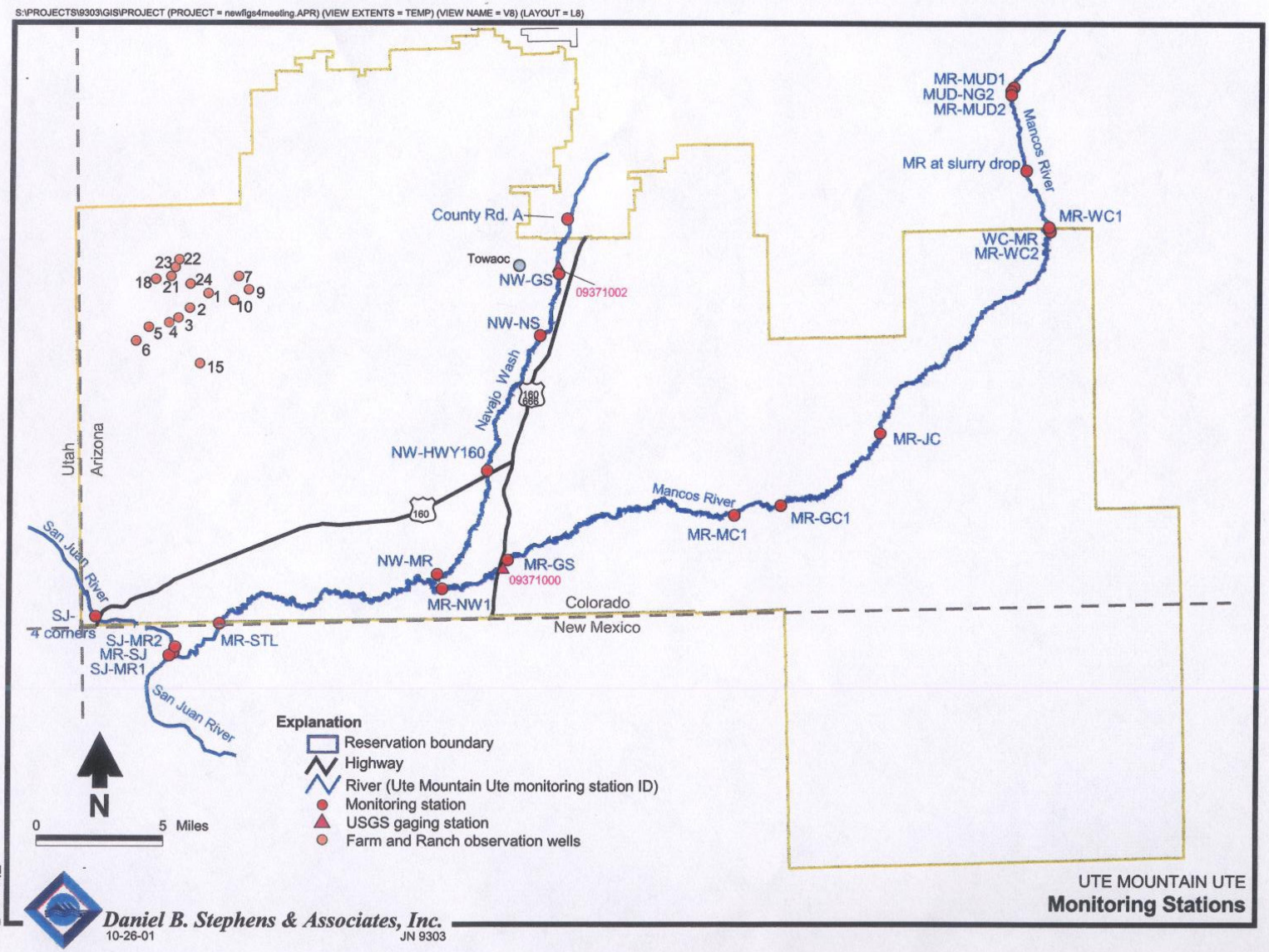
As discussed in Section 2, the methodology used to evaluate the impacts of nonpoint sources included examination of both ambient water quality monitoring data as well as other information that, though not quantitative, would indicate potential water quality impairment. Monitored data are discussed in Section 5.1 and other information is presented in Section 5.2.

5.1 Monitored Assessment

Water quality conditions are assessed in this section based on monitoring data collected by the Ute Mountain Ute Tribe Environmental Programs Department. These data included surface water data and limited groundwater quality data, including water quality data for Navajo Wash, the Mancos River, and other sites in the San Juan River Basin. Additionally, in order to evaluate the effect of the Bircher and Pony fires on water quality, post-fire water quality data from the Mancos River in the northeast portion of the reservation and upstream of the reservation were included. Only quality-assured data collected by the Ute Mountain Ute Tribe were included in the assessment. These data include analysis results for samples from the monitoring station locations shown on Figure 5 and others monitored since the last draft of this document.

The organization of Section 5.1 is basically from three different, but related, ways of communicating information:

- Specific Water Quality Standards exceedances—the regulatory perspective
- General, reservation-wide issues, organized by subject
- Specific, stream-reach issues, organized by watershed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MR at slurry drop
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County Rd. A
Towaoc
NW-GS
09371002
NW-NS
Navajo Wash
160
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NW-HWY160
MR-JC
Mancos River
MR-GC1
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160
NW-MR
MR-GS
09371000
MR-NW1
San Juan River
SJ-
4 corners
SJ-MR2
MR-SJ
SJ-MR1
MR-STL
Colorado
New Mexico
San Juan River
Utah
Arizona
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6
15
Explanation
Reservation boundary
Highway
River (Ute Mountain Ute monitoring station ID)
Monitoring station
USGS gaging station
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Monitoring Stations
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Figure 5

The available water quality data were compared to the *Ute Mountain Ute Water Quality Standards*, adopted November 2002. Water uses that are defined in these standards include:

- Cold water aquatic life (CWAL)
- Warm water aquatic life (WWAL)
- Drinking water source (DW)
- Recreation, primary contact (REC1)
- Recreation, secondary contact (REC2)
- Agriculture, irrigation and/or livestock watering (AG)
- Industrial use (IND)
- Tribal Ceremonial Use (T)
- Fish consumption (FSH)

Tables 3 and 4 summarize the occurrence of water samples that do not meet Ute Mountain Ute water quality standards based on data included in the Ute Mountain Ute water quality database. The analytes in Tables 3 and 4 represent all the constituents or parameters for which the Ute Mountain Ute Tribe has adopted numeric standards.

Prior to querying the database files for regulatory exceedances, a single "most stringent" standard for each sample location was identified. In order to identify the most stringent standard, all applicable designated uses for each waterbody were considered. For example, in the case of selenium, the designated use with the lowest numeric standard (5 ug/L) is warm water aquatic life. Therefore, this number becomes the most stringent standard for all samples with this designated use, and all dissolved selenium concentrations above 5 ug/L were considered to be exceedances. Some of the metals standards are based upon hardness, and ammonia criteria rely on pH, temperature, and the presence or absence of salmonid fish species. In these cases, the appropriate equation was used to determine if the standards were exceeded.

As shown in Tables 3 and 4, the constituents with the greatest number of exceedances of water quality standards or guidelines are sulfate, TDS, and selenium. Other constituents with

exceedances include chloride, nitrate (mostly in Navajo Wash), pH, temperature, dissolved oxygen, and several trace metals, including arsenic, copper, iron, lead, mercury, and silver.

Many of the waterbodies on Ute Mountain Ute land are used primarily for agricultural purposes, which require a less stringent standard. For comparison, therefore, Table 5 summarizes concentrations that exceed agricultural standards for each waterbody.

Another quantitative method of evaluating water quality is to prepare stiff diagrams. Stiff diagrams graphically illustrate the amount of cations and anions present in a sample as well as the relative proportions of the major cations and anions (sodium and potassium, calcium, magnesium, chloride, carbonate and bicarbonate, and sulfate). Stiff diagrams for selected stations from four sampling events are included in Appendix A. These figures illustrate that most of the samples are either sodium sulfate or calcium sulfate water types. In general, sodium and sulfate concentrations (both indicators of nonpoint source pollution) are highest along Navajo Wash.

Reservation-wide Bacteria Concerns:

Bacteria data (fecal coliform data before 2001 or *E. Coli* data thereafter) indicate that Navajo Wash, McElmo Creek, the San Juan River and the Mancos River exceed Tribal standards for those parameters during storm events, and under other conditions. Generally, winter levels do not exceed the standards, but it is very unlikely that primary contact recreation would occur during the winter. Conversely, it is also very unlikely that primary contact recreation would occur during storm events or spring run-off. The main threat to public health as a result of these indications of potential pathogens occurs during summer low-flow periods when people are likely to go swimming. The water quality standard for bacteria still applies at all times to the main stems of each of these streams, so the exceedance is valid even if the use impairment at those times is debatable because the use is not occurring. Whether or not it is a threat to public health, the impairment of use is an indicator that bacteria sources are loading the streams. Likely sources are: grazing cattle (and manure when cattle are no longer present); wildlife—especially birds; sedimentation from bacteria-laden soils—primarily from storm run-off events;

improperly treated or untreated wastewater; pets; and irrigated agriculture—namely tail water from excess water application.

Limited San Juan River data indicate that it may not meet Tribal standards at Four Corners, where it crosses the Reservation, especially during spring run-off. Upstream of there, bacteria loading has been a major concern in the efforts of the San Juan Watershed Group, and several sampling efforts and land use assessments have been undertaken to characterize the bacteria loading in the middle San Juan in New Mexico. The Tribe participates in that watershed group, and plays an active role in this investigation.

Specific bacteria data for each stream are presented in Table 6.

Table 3. Summary of Exceedances of General Chemistry Water Quality Standards on the Ute Mountain Ute Reservation
Page 1 of 3

Sampling Point	Exceedances [a]													
	pH		Temperature		Dissolved Oxygen		Chloride		Sulfate		Nitrate (as N)		Total Dissolved Solids	
	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]
Standard	*6.5-9.0*		*<30°C [c]*		*At least 5.0 mg/L*		*100 mg/L [d]*		*1,000 mg/L [d]*		*10 mg/L*		*1,500/5,000 mg/L [e]*	
Navajo Wash														
County Road A	29	3.5	29	0	5	0	26	11.5	26	50.0	12	33.3	26	61.5
NW-GS	59	1.7	26	0	7	0	59	23.7	59	52.5	32	56.3	58	56.9
NW-NS	12	8.3	12	0	3	0	12	16.7	12	83.3	8	87.5	12	91.7
NW-Hwy 160	15	6.7	15	6.7	4	0	13	7.7	14	85.7	6	100	17	94.1
NW-MR	23	0	23	0	6	0	21	19.1	21	71.4	6	16.7	21	81.0
Mancos River														
MR-MHS	10	20.0	10	0	NS	NS	8	0	10	0	4	0	9	0
WWTP-MR	6	0	6	0	NS	NS	7	0	8	0	4	25.0	8	0
WWTP2	8	0	6	0	NS	NS	8	0	9	0	4	0	9	11.1
MUD1	8	0	6	0	NS	NS	8	0	9	0	3	0	9	0
MUD-NG2	8	12.5	6	0	NS	NS	7	0	8	37.5	3	0	8	50.0
MUD2	10	10	8	0	2	0	9	0	10	20.0	4	0	10	20.0
MR @ slurry drop	2	0	2	0	2	0	2	0	2	100	2	0	2	100
MR-WC1	29	0	21	0	9	0	27	3.7	28	17.9	6	0	27	22.2
WC-MR	24	0	23	0	6	0	23	0	24	37.5	4	0	23	47.8
MR-WC2	31	0	31	0	10	0	32	0	32	18.8	8	0	30	30.0

[a] Any concentration (or temperature) that exceeds the most stringent standard among the applicable designated uses for the waterbody (or, in the case of pH, is outside the specified range).

[b] Percentage of samples exceeding the most stringent standard among the applicable designated uses for the waterbody.

[c] The warmwater aquatic life standard of <30°C applies to all waterbodies except Hayfield Reservoir, which is a coldwater fishery, with a standard of <20°C.

[d] Based on a goal to be included in revised standards.

[e] Ute Mountain Ute revised standards set a goal of 1,500 mg/L for surface water and an agricultural standard of 5,000 mg/L for springs and wells.

mg/L = Milligrams per liter
NS = No samples analyzed for this parameter

Table 3. Summary of Exceedances of General Chemistry Water Quality Standards on the Ute Mountain Ute Reservation

Sampling Point	Exceedances [a]													
	pH		Temperature		Dissolved Oxygen		Chloride		Sulfate		Nitrate (as N)		Total Dissolved Solids	
	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]
Standard	*6.5-9.0*		*<30°C [c]*		*At least 5.0 mg/L*		*100 mg/L [d]*		*1,000 mg/L [d]*		*10 mg/L*		*1,500/5,000 mg/L [e]*	
MR-JC	5	0	2	0	1	0	5	0	5	40.0	1	0	5	40.0
Mancos River (continued)														
MR-GC1	32	9.4	25	4.0	8	25.0	29	0	31	16.1	4	0	32	25.0
MR-MC1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MR-GS	32	0	29	3.5	6	0	29	0	30	6.7	4	0	29	6.9
MR-NW1	21	4.8	21	0	7	0	21	0	19	15.8	4	0	20	10.0
MR-STL	6	0	6	0	NS	NS	5	0	6	16.7	1	0	6	16.7
MR-SJ	26	0	25	0	7	0	24	0	25	8.0	4	0	26	11.5
Ute Canyon	2	0	1	0	1	0	2	0	2	100	NS	NS	2	100
MR-MC2	13	7.7	9	0	1	0	11	0	12	16.7	2	0	13	15.4
MR-NW2	22	4.6	22	0	6	0	20	0	20	20.0	6	0	20	20.0
San Juan River														
San Juan @ Four Corners	11	0	NS	NS	7	0	10	0	11	0	NS	NS	11	0
SJ-MR2	28	7.1	24	0	1	0	26	0	27	0	NS	NS	28	0
SJ-MR1	28	3.6	28	0	6	0	27	0	25	0	NS	NS	29	0

[a] Any concentration (or temperature) that exceeds the most stringent standard among the applicable designated uses for the waterbody (or, in the case of pH, is outside the specified range).

[b] Percentage of samples exceeding the most stringent standard among the applicable designated uses for the waterbody.

[c] The warmwater aquatic life standard of <30°C applies to all waterbodies except Hayfield Reservoir, which is a coldwater fishery, with a standard of <20°C.

[d] Based on a goal to be included in revised standards.

[e] Ute Mountain Ute revised standards set a goal of 1,500 mg/L for surface water and an agricultural standard of 5,000 mg/L for springs and wells.

mg/L = Milligrams per liter
NS = No samples analyzed for this parameter

Table 3. Summary of Exceedances of General Chemistry Water Quality Standards on the Ute Mountain Ute Reservation
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Sampling Point	Exceedances [a]													
	pH		Temperature		Dissolved Oxygen		Chloride		Sulfate		Nitrate (as N)		Total Dissolved Solids	
	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]
Standard	*6.5-9.0*		*<30°C [c]*		*At least 5.0 mg/L*		*100 mg/L [d]*		*1,000 mg/L [d]*		*10 mg/L*		*1,500/5,000 mg/L [e]*	
Springs, Water Resource Wells, and Monitoring Wells														
East Spring	3	0	NS	NS	NS	NS	2	0	2	0	NS	NS	3	0
East Spring Pond	1	0	1	0	NS	NS	NS	NS	NS	NS	NS	NS	1	0
Springs, Water Resource Wells, and Monitoring Wells (continued)														
West Spring	1	0	NS	NS	NS	NS	1	0	1	0	NS	NS	2	0
AW-HWYS 41/160	2	0	1	0	NS	NS	2	100	1	100	NS	NS	2	0
AW-Hwy 41	2	0	1	0	NS	NS	2	100	2	100	NS	NS	2	50.0
AP-14 (GW MW)	1	0	NS	NS	NS	NS	2	100	2	100	NS	NS	2	50.0
AP-5 (GW MW)	1	0	NS	NS	NS	NS	1	0	1	0	NS	NS	1	0
6000 Pond West	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
6000 Pond East	2	100	2	0	NS	NS	2	0	1	0	NS	NS	2	50.0
Other Waterbodies														
Hayfield Reservoir	2	0	2	0	1	0	2	0	2	0	NS	NS	2	0
MBLW Well-1	13	15.4	5	0	NS	NS	12	58.3	12	58.3	NS	NS	12	16.7
MBLW Well-2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MBLW @ Hwy 41	1	0	NS	NS	NS	NS	1	100	1	0	NS	NS	1	0

[a] Any concentration (or temperature) that exceeds the most stringent standard among the applicable designated uses for the waterbody (or, in the case of pH, is outside the specified range).

[b] Percentage of samples exceeding the most stringent standard among the applicable designated uses for the waterbody.

[c] The warmwater aquatic life standard of <30°C applies to all waterbodies except Hayfield Reservoir, which is a coldwater fishery, with a standard of <20°C.

[d] Based on a goal to be included in revised standards.

[e] Ute Mountain Ute revised standards set a goal of 1,500 mg/L for surface water and an agricultural standard of 5,000 mg/L for springs and wells.

mg/L = Milligrams per liter
NS = No samples analyzed for this parameter

Table 4. Summary of Exceedances of Metals Water Quality Standards on the Ute Mountain Ute Reservation
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Sampling Point	Exceedances [a]																			
	Silver		Arsenic		Cadmium		Chromium III		Copper		Lead		Iron		Mercury		Selenium		Zinc	
	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b] [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]
Standard (µg/L [c])	*HB [d]*		*100 [e]*		*10*		*160 [f]*		*HB [g]*		*HB [h]*		*1.0 mg/L [i]*		*0.012 [j]*		*5*		*HB [k]*	
Navajo Wash																				
County Road A	23	0	15	0	7	0	8	0	19	0	24	0	18	22.2	9	0	22	81.8	15	0
NW-GS	19	0	16	6.25	8	0	8	0	18	0	24	0	15	33.3	8	0	24	87.5	16	0
NW-NS	10	0	9	0	7	0	7	0	11	0	12	0	6	66.7	6	0	12	83.3	7	0
NW-Hwy 160	16	0	10	0	8	0	8	0	14	0	19	0	13	23.1	8	12.5	18	100	12	0
NW-MR	20	0	13	0	16	0	17	0	17	0	21	0	17	47.1	9	0	19	89.5	13	0
Mancos River																				
MR-MHS	9	0	9	0	6	0	6	0	9	11.1	9	0	6	16.7	6	16.7	9	0	9	0
WWTP	8	0	8	0	6	0	6	0	8	12.5	8	0	6	0	5	20.0	8	12.5	8	0
WWTP2	9	0	9	0	7	0	7	0	9	11.1	9	0	7	14.3	7	0	9	11.1	8	0
MUD1	8	0	8	0	6	0	6	0	8	0	8	12.5	6	16.7	6	0	8	0	8	0
MUD-NG2	8	0	8	0	6	0	6	0	8	0	8	12.5	7	14.3	7	0	8	50.0	8	0
MUD2	8	0	8	0	6	0	6	0	8	12.5	8	12.5	7	28.6	6	0	8	12.5	8	0
MR @ slurry drop	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	0	NS	NS	NS	NS	NS	NS
MR-WC1	16	0	19	0	5	0	5	0	19	5.3	19	10.5	12	25	5	0	20	0	10	0
WC-MR	18	0	22	0	8	0	8	0	22	0	22	4.5	15	33.3	9	0	22	0	13	0
MR-WC2	25	0	26	0	12	0	12	0	25	0	26	0	21	23.8	21	14.3	26	0	17	0
MR-GC1	24	0	26	0	11	0	11	0	25	0	26	0	19	26.3	13	23.1	27	3.7	19	0
MR-GS	25	0	31	0	11	0	11	0	31	0	31	0	23	34.8	13	23.1	31	16.1	19	0
Mancos River (continued)																				

[a] Any concentration above the most stringent standard among the applicable designated uses for the waterbody.

[b] Percentage of samples exceeding the most stringent standard.

[c] Unless otherwise noted

[d] Hardness-based, calculated according to the following formula: e^(1.72 [ln(Hardness) - 9.06)]

[e] Total recoverable arsenic (for irrigation).

[f] Hardness-based, calculated according to the following formula: e^(0.819 [ln(Hardness) + 0.6848)]

[g] Hardness-based, calculated according to the following formula: e^(0.8545 [ln(Hardness) - 1.702)]

[h] Hardness-based, calculated according to the following formula: e^(1.273 [ln(Hardness) - 4.705)]

[i] Ute Mountain Ute did not adopt a standard for this parameter. The standard shown here is the Utah level of concern.

[j] Based on revised Ute Mountain Ute standard for aquatic life, wildlife, and fish.

[k] Hardness-based, calculated according to the following formula: e^(0.8473 [ln(Hardness) + 0.884)].

NS = No samples analyzed for this parameter

Table 4. Summary of Exceedances of Metals Water Quality Standards on the Ute Mountain Ute Reservation
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Sampling Point	Exceedances [a]																			
	Silver		Arsenic		Cadmium		Chromium III		Copper		Lead		Iron		Mercury		Selenium		Zinc	
	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b] [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]
Standard (µg/L [c])	*HB [d]*		*100 [e]*		*10*		*160 [f]*		*HB [g]*		*HB [h]*		*1.0 mg/L [i]*		*0.012 [j]*		*5*		*HB [k]*	
MR-NW1	18	0	20	0	8	0	9	0	20	0	20	0	14	28.6	7	0	20	15.0	12	0
MR-STL	6	0	6	0	5	0	5	0	6	0	6	0	4	25.0	4	0	6	50.0	6	0
MR-SJ	22	0	22	0	8	0	8	0	22	0	22	0	19	52.6	18	0	22	27.3	15	0
Ute Canyon	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	100	NS	NS
MR-MC2	13	0	13	0	13	0	13	0	13	0	13	0	13	15.4	13	30.8	13	0	13	0
MR-NW2	19	0	21	0	10	0	14	0	21	0	21	0	14	42.9	9	0	21	47.6	13	0
MR-GC2	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	100	1	0	1	0
San Juan River																				
SJ-MR2	21	0	5	0	7	0	2	0	21	4.8	22	0	14	71.4	8	0	5	40.0	15	0
SJ-MR1	22	0	3	0	8	0	2	0	22	0	23	4.3	15	73.3	9	0	8	0	16	0
Springs, Water Resources, and Monitoring Wells																				
East Spring	NS	NS	1	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	100	1	0
East Spring Pond	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
AW-HWYS 41/160	NS	NS	1	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	0	1	0
AW-Hwy 41	1	0	2	0	1	0	1	0	1	100	1	100	1	100	1	0	2	0	2	0
AP-14 (GW MW)	NS	NS	1	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	0	NS	NS
AP-5 (GW MW)	NS	NS	1	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	0	NS	NS
Springs, Water Resources, and Monitor Wells (Continued)																				
6000 Pond West	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[a] Any concentration above the most stringent standard among the applicable designated uses for the waterbody.

[b] Percentage of samples exceeding the most stringent standard.

[c] Unless otherwise noted

[d] Hardness-based, calculated according to the following formula: e^(1.72 [ln(Hardness) - 9.06)]

[e] Total recoverable arsenic (for irrigation).

[f] Hardness-based, calculated according to the following formula: e^(0.819 [ln(Hardness) + 0.6848)]

[g] Hardness-based, calculated according to the following formula: e^(0.8545 [ln(Hardness) - 1.702)]

[h] Hardness-based, calculated according to the following formula: e^(1.273 [ln(Hardness) - 4.705)]

[i] Ute Mountain Ute did not adopt a standard for this parameter. The standard shown here is the Utah level of concern.

[j] Based on revised Ute Mountain Ute standard for aquatic life, wildlife, and fish.

[k] Hardness-based, calculated according to the following formula: e^(0.8473 [ln(Hardness) + 0.884)].

NS = No samples analyzed for this parameter

Table 4. Summary of Exceedances of Metals Water Quality Standards on the Ute Mountain Ute Reservation
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Sampling Point	Exceedances [a]																			
	Silver		Arsenic		Cadmium		Chromium III		Copper		Lead		Iron		Mercury		Selenium		Zinc	
	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b] [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]
Standard (µg/L [c])	*HB [d]*		*100 [e]*		*10*		*160 [f]*		*HB [g]*		*HB [h]*		*1.0 mg/L [i]*		*0.012 [j]*		*5*		*HB [k]*	
6000 Pond East	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Other Waterbodies																				
Hayfield Reservoir	1	0	1	0	NS	NS	NS	NS	2	0	2	0	NS	NS	1	0	1	0	1	0
MBLW Well-1	3	0	6	0	1	0	1	0	3	0	3	0	NS	NS	NS	NS	7	42.9	3	0
MBLW Well-2	1	0	1	0	1	0	1	0	1	0	1	100	1	100	1	0	1	0	1	0
MBLW @ Hwy 41	1	100	1	0	1	0	1	0	1	0	1	100	1	100	1	0	1	0	1	0
SC-MR	1	0	1	0	NS	NS	NS	NS	1	0	1	0	NS	NS	NS	NS	1	0	1	0

[a] Any concentration above the most stringent standard among the applicable designated uses for the waterbody.

[b] Percentage of samples exceeding the most stringent standard.

[c] Unless otherwise noted

[d] Hardness-based, calculated according to the following formula: e^(1.72 [ln(Hardness) - 9.06)] (Standard is for the WWAL use.)

[e] Total recoverable arsenic (for irrigation).

[f] Hardness-based, calculated according to the following formula: e^(0.819 [ln(Hardness) + 0.6848)]

[g] Hardness-based, calculated according to the following formula: e^(0.8545 [ln(Hardness) - 1.702)]

[h] Hardness-based, calculated according to the following formula: e^(1.273 [ln(Hardness) - 4.705)]

[i] Ute Mountain Ute did not adopt a standard for this parameter. The standard shown here is the Utah level of concern.

[j] Based on revised Ute Mountain Ute standard for aquatic life, wildlife, and fish.

[k] Hardness-based, calculated according to the following formula: e^(0.8473 [ln(Hardness) + 0.884)].

NS = No samples analyzed for this parameter

Table 5. Summary of Exceedances of Water Quality Standards for Agricultural Use on the Ute Mountain Ute Reservation
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Sampling Point	Exceedances [a]																					
	Arsenic		Boron		Cadmium		Chromium III		Copper		Mercury		Nitrate		Lead		Selenium		Total Dissolved Solids		Zinc	
	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]
Standard	*100 µg/L*		*750 µg/L*		*10 µg/L*		*100 µg/L*		*200 µg/L*		*10 µg/L*		*10 mg/L*		*100 µg/L*		*20 µg/L*		*5,000 mg/L*		*2,000 µg/L*	
Navajo Wash																						
County Rd. A	15	0	NS	NS	7	0	8	0	19	0	9	0	12	33.3	24	0	22	36.4	26	11.5	15	0
NW-GS	16	6.3	NS	NS	8	0	8	0	18	0	8	0	32	56.3	24	0	24	33.3	58	27.6	16	0
NW-NS	9	0	NS	NS	7	0	7	0	11	0	6	0	8	87.5	12	0	12	66.7	12	16.7	7	0
NW-Hwy160	10	0	NS	NS	8	0	8	0	14	0	8	0	6	100	19	0	18	72.2	17	5.9	12	0
NW-MR	13	0	NS	NS	16	0	17	0	17	0	9	0	6	16.7	21	0	19	52.6	21	19.1	13	0
Mancos River																						
MR-MHS	9	0	NS	NS	6	0	6	0	9	0	6	0	4	0	9	0	9	0	9	0	9	0
WWTP-MR	8	0	NS	NS	6	0	6	0	8	0	5	0	4	25.0	8	0	8	0	8	0	8	0
WWTP2	9	0	NS	NS	7	0	7	0	9	0	7	0	4	0	9	0	9	0	9	0	8	0
MUD1	8	0	NS	NS	6	0	6	0	8	0	6	0	3	0	8	0	8	0	9	0	8	0
MUD-NG2	8	0	NS	NS	6	0	6	0	8	0	7	0	3	0	8	0	8	12.5	8	0	8	0
MUD2	8	0	NS	NS	6	0	6	0	8	0	6	0	4	0	8	12.5	8	0	10	0	8	0
MR @ slurry drop	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2	0	NS	NS	NS	NS	2	0	NS	NS
MR-WC1	19	0	NS	NS	5	0	5	0	19	0	5	0	6	0	19	5.3	20	0	27	0	10	0
WC-MR	22	0	NS	NS	8	0	8	0	22	0	9	0	4	0	22	4.6	22	0	23	0	13	0
MR-WC2	26	0	NS	NS	12	0	12	0	25	0	21	0	8	0	26	0	26	0	30	0	17	0
MR-JC	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	0	NS	NS	NS	NS	5	0	NS	NS
MR-GC1	26	0	NS	NS	11	0	11	0	25	0	13	0	4	0	26	0	27	0	32	0	19	0
MR-MC1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MR-GS	31	0	NS	NS	11	0	11	0	31	0	13	0	4	0	31	0	31	0	29	0	19	0
MR-NW1	20	0	NS	NS	8	0	9	0	20	0	7	0	4	0	20	0	20	5.0	20	0	12	0
MR-STL	6	0	NS	NS	5	0	5	0	6	0	4	0	1	0	6	0	6	16.7	6	0	6	0
MR-SJ	22	0	NS	NS	8	0	8	0	22	0	18	0	4	0	22	0	22	0	26	0	15	0
MR-GC2	1	0	NS	NS	1	0	1	0	1	0	1	0	NS	NS	1	0	1	0	NS	NS	1	0
Ute Canyon	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	0	2	0	NS	NS

[a] Any concentration that exceeds the agricultural standard for the waterbody. [b] Percentage of samples exceeding the standard. NS = No samples analyzed for this parameter

Table 5. Summary of Exceedances of Water Quality Standards for Agricultural Use on the Ute Mountain Ute Reservation
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Sampling Point	Exceedances [a]																					
	Arsenic		Boron		Cadmium		Chromium III		Copper		Mercury		Nitrate		Lead		Selenium		Total Dissolved Solids		Zinc	
	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]	Total Samples	% [b]
Standard	*100 µg/L*		*750 µg/L*		*10 µg/L*		*100 µg/L*		*200 µg/L*		*10 µg/L*		*10 mg/L*		*100 µg/L*		*20 µg/L*		*5,000 mg/L*		*2,000 µg/L*	
Mancos River (continued)																						
MR-MC2	13	0	NS	NS	13	0	13	0	13	0	13	0	2	0	13	0	13	0	13	0	13	0
MR-NW2	21	0	NS	NS	10	0	14	0	21	0	9	0	6	0	21	0	21	19.1	20	0	13	0
San Juan River																						
San Juan @ Four Corners	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	11	0	NS	NS
SJ-MR2	5	0	NS	NS	7	0	2	0	21	0	8	0	NS	NS	22	0	5	0	28	0	15	0
SJ-MR1	3	0	NS	NS	8	0	2	0	22	0	9	0	NS	NS	23	0	8	0	29	0	16	0
Springs, Water Resource Wells, and Monitoring Wells																						
East Spring	1	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	0	3	0	1	0
East Spring Pond	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	0	NS	NS
West Spring	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2	0	NS	NS
AW-HWYS 41/160	1	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	0	2	0	1	0
AW-HWY-41	2	0	NS	NS	1	0	1	0	1	0	1	0	NS	NS	1	0	2	0	2	50.0	2	0
AP-14 (GW MW)	1	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	0	2	50.0	NS	NS
AP-5 (GW MW)	1	0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	0	1	0	NS	NS
6000 Pond West	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
6000 Pond East	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2	50.0	NS	NS
Other Waterbodies																						
Hayfield Reservoir	1	0	NS	NS	NS	NS	NS	NS	2	0	1	0	NS	NS	2	0	1	0	2	0	1	0
MBLW-Well1	6	0	NS	NS	1	0	1	0	3	0	NS	NS	NS	NS	3	0	7	0	12	16.7	3	0
MBLW-Well2	1	0	NS	NS	1	0	1	0	1	0	1	0	NS	NS	1	0	1	0	NS	NS	1	0
MBLW@Hwy 41	1	0	NS	NS	1	0	1	0	1	0	1	0	NS	NS	1	0	1	0	1	0	1	0
SC-MR	1	0	NS	NS	NS	NS	NS	NS	1	0	NS	NS	NS	NS	1	0	1	0	NS	NS	1	0

[a] Any concentration that exceeds the agricultural standard for the waterbody. [b] Percentage of samples exceeding the standard. NS = No samples analyzed for this parameter

Table 6 Bacteria Data for Ute Mountain Ute Streams

(all units are cfu/100-mL, numbers are rounded to nearest integer)

"Not applicable" indicates that the none of this type of bacteria was analyzed at that site or in that stream or mean does not apply

Mean values are shown, but it should be noted that extreme variation in results skews the mean.

Watershed & Stream Site	**Number of Samples (FC,EC)**	**Range of values (fecal coliform)**	**Mean Value (fc)**	**Range of values (*E. Coli*)**	**Mean Value (ec)**	**condition for maximum**	**Impairment**
McElmo							
Main stem	0,4	not applicable		17 to 1046		storm	NO
Mud Creek	0,4	not applicable		17 to (>or=)2419	333	storm	NO
Mountain tributaries	0,4	not applicable		all non-detect	na	spring run-off 2004	NO
Mountain Springs	1,2	all non-detect	na	all non-detect	na	na	NO
Navajo Wash							
NW-CRA (upstream of Res)	5,5	9 to (>or=)1600	667	77 to (>or=)2419	313	storm	**State jurisdiction**
NW-GS (Towaoc)	2,6	23 to 240	132	<1 to 7,070	1666	summer low-flow	**YES**
NW-NS	3,3	9 to 2400	1170	46 to 1733	609	storm (fc), spring run-off (EC)	**YES**
NW-Hwy 160	2,3	<3 to 460	na	18 to (>or=)2419	910	storm (fc), spring run-off (EC)	**YES**
NW-MR	1,0	9	na	na	na	winter low flow	NO
Mountain Springs	2,4	all non-detect	na	all non-detect	na	na	NO
Mancos River							
MR @ Hwy 160 (upstream of Res)	0,3	not applicable	na	40 to 387	189	storm	**State jurisdiction**
MR-MUD1(upstream of Res)	0,2	not applicable	na	1 to 1674	838	storm	**State jurisdiction**
MR-WC1	5,2	23 to 460	245	1 to 365	183	spring run-off 2001	NO
WC-MR (tributaary)	6,3	43 to 1100	399	5 to 461	162	spring run-off 2000 (fc), 2001 (ec)	NO
MR-WC2 (below Tributary)	5,2	240 to 1100	584	3 to 613	308	storm (fc), spring run-off 2001 (EC)	**YES**
MR-JC	0,1	not applicable	na	18,600	na	storm event 2001	**YES**
MR-GC	0,2	not applicable	na	78 to 51,720	25,899	storm event 2001	**YES**
Ute-MR (tributary)	0,3	not applicable	na	1 to 26,020	8,675	storm event 2001	**YES**
MR-SJ (@San Juan R.)	2,0	4 to 2400	1202	not applicable	na	storm event 2000	**Navajo jurisdiction**
San Juan River							
SJ @ MR	2,0	both 2400	2400	not applicable	na	storm event 2000	**Navajo jurisdiction**
SJ @ 4 corners	0,3	not applicable	na	101 to 687	492	spring run-off 2004	**YES**
Westwater (tributary in NM)	1,2	24,000	na	649 to 19,683	10,256	storm event samples only	**YES**
Shumway (tributary in NM)	1,1	11,000	na	24,192	na	storm event samples only	**YES**
La Plata River @ Neilson's	0,3	not applicable	na	3 to 116	74	storm	**State jurisdiction**
(tributary on off-Res ranch)							

Erosion and Sedimentation:

All surface waters below an elevation of approximately 7,000 feet (and some above) on the Ute Mountain Ute Reservation have impacts from erosion and sedimentation. Channel head-cutting and stream bank instability prevent natural flooding and migration of streams and sediment deposition impacts the aquatic life habitat. Acceleration of flows from channeling for bridges, and culverts, and levying near home sites amplify the natural flashing nature of storm events in this unique geologic area. Inefficient grazing practices also dramatically added to this problem for most of the twentieth century. Once started these erosional phenomena take a monumental effort and expense to correct. When a stream is incised to a certain critical elevation, manual or mechanical restoration is the only viable option.

Total Suspended Solids (TSS) values range widely from stream to stream and depend largely on the intensity of storm events. Light rains and winter snow generally move small amounts of sediment while quick desert storms and monsoon rains often load a stream with a huge, almost instantaneous pile of sediment. The latter type of event accounts for the majority of precipitation on most of the Reservation. For example, from 1996 to 2000, San Juan River TSS levels ranged from 25 mg/L to 10,080 mg/L with a weighted-mean value of 1485 mg/L. Mancos River TSS ranged from 25 mg/L to 38,090 mg/L with a weighted-mean value of 3205 mg/L during the same time period. Navajo Wash TSS, with a much smaller watershed, ranged from 30 mg/L to 2020 mg/L with a weighted-mean of 204 mg/L.

Sediment deposits from a tributary at confluence with the San Juan River, New Mexico, upstream of Ute Mountain Ute Reservation

Specific Watershed Concerns:

Cottonwood Wash, UT:

In Utah, Cottonwood Wash has elevated uranium and radiation levels because of uranium mining in the watershed. Allen Canyon, a tributary, is used in comparison as a reference stream that is relatively unaffected by uranium mining, with only "natural" background levels of alpha radiation and uranium. Cottonwood Wash exceeds Tribal standards for radionuclides, which are expressed in the narrative standard as follows:

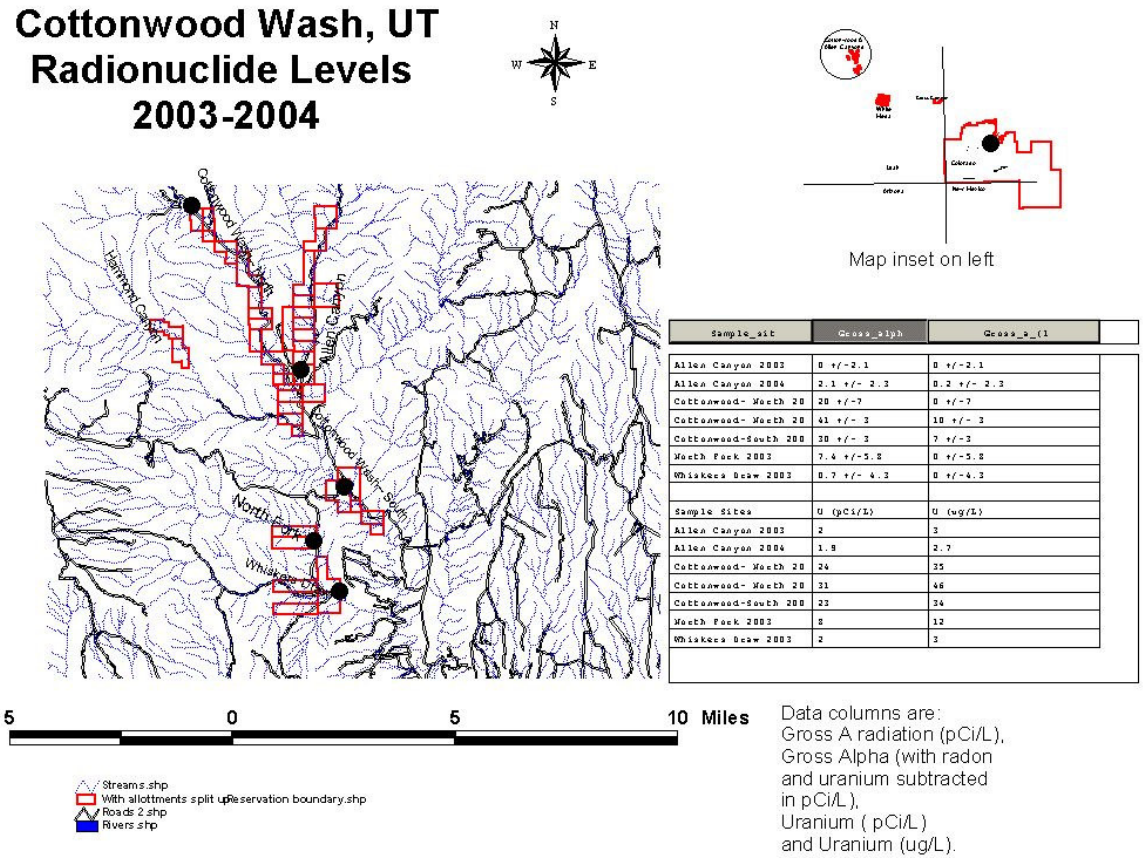
> "All waters … shall be free from substances, from any pollution source, that… Cause injury to, or are toxic to, or produce adverse physiological responses in humans, animals, or plants…" (Ute Mountain Ute Tribe Surface Water Quality Standards, Section 5 (a)(4)).

The Tribe also has a narrative biological criterion:

> "The overall biological criterion of the Tribe is to maintain and support conditions similar to reference sites or reference conditions that are determined by the Tribe.
>
> Assessment of biological conditions will include monitoring of the benthic macroinvertebrates, fish, and/or plant communities, as appropriate. Community metrics will be determined by the Tribe, relative to reference sites. A reference condition may be assigned as a goal for the biological community if there is an insufficient number of reference sites or if those sites become impaired. Data for a reference condition will be treated in the same manner as if it were a reference site" (Ute Mountain Ute Tribe Surface Water Quality Standards, Section 6).

Allen Canyon and Cottonwood Wash have a warm water aquatic life designated use assigned to them. This includes benthic macroinvertebrates; currently there are very few species of benthic macroinvertebrates that can tolerate the conditions in Cottonwood Wash. Allen Canyon, on the other hand, has a tremendous variety of benthic macroinvertebrates. Because of the alarming difference in biota diversity at relatively similar elevations and habitat type, Cottonwood Wash must still have a substantial impairment that limits its diversity. The radionuclide data present that difference. Both gross-alpha radiation and uranium levels were approximately 20 times higher at the northern Cottonwood Wash sample site than they were on the same day in Allen Canyon in 2003 and in 2004. See Figure 6 below.

Figure 6: Utah Radionuclides

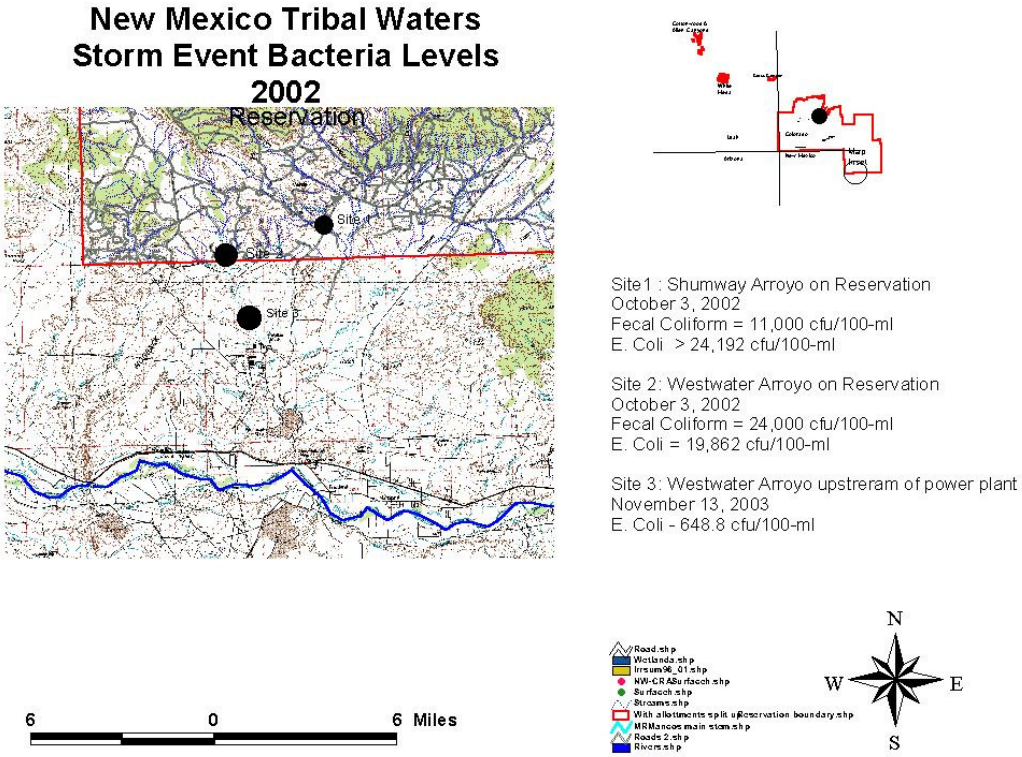


Sample_sit	Gross_alph	Gross_a_(1
Allen Canyon 2003	0 +/-2.1	0 +/-2.1
Allen Canyon 2004	2.1 +/- 2.3	0.2 +/- 2.3
Cottonwood- North 20	20 +/-7	0 +/-7
Cottonwood- North 20	41 +/- 3	10 +/- 3
Cottonwood-South 200	30 +/- 3	7 +/-3
North Fork 2003	7.4 +/-5.8	0 +/-5.8
Whiskers Draw 2003	0.7 +/- 4.3	0 +/-4.3
Sample Sites	U (pCi/L)	U (ug/L)
Allen Canyon 2003	2	3
Allen Canyon 2004	1.8	2.7
Cottonwood- North 20	24	35
Cottonwood- North 20	31	46
Cottonwood-South 200	23	34
North Fork 2003	8	12
Whiskers Draw 2003	2	3

Data columns are:
Gross A radiation (pCi/L),
Gross Alpha (with radon and uranium subtracted in pCi/L),
Uranium (pCi/L)
and Uranium (ug/L).

In New Mexico, erosion and sedimentation and bacteria loading are the primary water quality impacts. Oil and gas development and related road building influence the mobility of these pollutants—running in roadside gullies, along roads themselves and into ephemeral streams at road crossings during storm events. Direct oil field impacts from spills of products or on-site chemicals are addressed through off-site soil removal, and do not generally affect water resources. Undocumented spills of product, chemicals, or saline produced water may affect water resources following storm events. One problematic area in New Mexico will have a permitted soil remediation land farm, but current storm water management does not allow off-site migration of pollutants. Grazing management in New Mexico, the primary land use there, has impacts to water quality due to erosion, sedimentation, and related transportation of pollutants during storm events. Bacteria data from storm-sampling events demonstrate the run-off issues in New Mexico.

Figure 7:



For Tribal surface waters in Colorado, the following descriptions, data, and figures define nonpoint source pollution issues in the Mancos River, Navajo Wash, and McElmo Creek watersheds—within the lower San Juan watershed.

Mancos River Nonpoint Source Pollution Issues:

Forest Fires Impacts in the Mancos River:

Impacts from extreme forest fires resulting from long-term fire suppression had temporary impacts to the system following the 2000 Bircher/Pony Fires. Primarily, the ashy sediment flowing from post-fire storm events suffocated cobble macroinvertebrate habitat and filled in pools that provide fish habitat. Chemical effects were minimal with detectable increases in potassium levels, slightly increased salinity and total nitrogen levels and elevated total organic carbon levels. A small fish kill was caused in Mesa Verde National Park by fire retardant being dropped in the stream, but monitoring at the site did not show detectable amounts of cyanide or ammonia, the fish toxins.

Figure 8 Forest Fire Impacts :The photograph on the left shows the site where fire retardant was dropped in the Mancos River, the photo on the right shows ashy sediment in the river following a storm event.

Macroinvertebrate data were the best indicators of the natural restoration of the ecology following the forest fires. While overall abundance of benthic macroinvertebrates was lower following the fires (total abundance decreased 75% and 95% at two sites, respectively), and sensitive species were subdued (post-fire EPT ratios at two sites were 14% and 10% compared to pre-fire means of 48% and 49% at two sites, respectively). Still, the total number of taxa, representing the overall species diversity, was consistent (7 families and 3 families post-fire compared with 7 and 5 pre-fire, respectively). It should be noted that the impact of drought on the system during the monitoring period following the fires was also a factor on the numbers. Following a rain event in September of 2003 that scoured the streambed down to cobble that had not been exposed since 1999, a huge resurgence of insects was observed—insects whose eggs had been buried for 4 years.

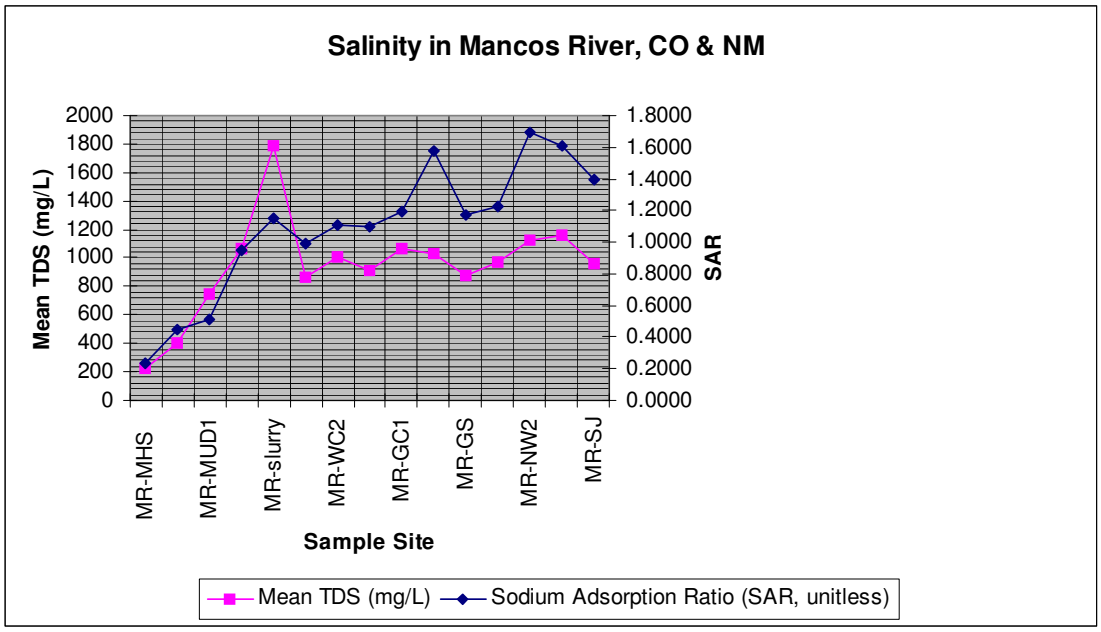
Salinity in the Mancos River:

Tribal Standards for salinity specify that for Livestock consumption: TDS<or= 5,000 mg/L; and for Irrigation: <2250 mg/L when SAR is <or= 4.00, <1500 when SAR is 4.01-10.00; 750 mg/L if SAR> 10.00. For the Mancos River, SAR is always < 4.00 and TDS < 2250, so it meets its designated use for irrigation (at Mancos Creek Farm). As water moves downstream in the Mancos watershed from just downstream of the mountain tributaries across irrigated lands and the Reservation, salinity increases approximately 5-fold (See Table 7 and Figure 9).

In Table 7, Total Dissolved Solids and Sodium Adsorption ratio data are presented for Sample Sites in the Mancos watershed (listed upstream to downstream, sites starting with “MR” are main stem sample sites, others are tributaries, as noted):

Table 7 Salinity in Mancos River					
Site (descriptor)	TDS Mean Value	TDS Std Dev	SAR Mean Value	SAR Std Dev	Period of Record
Upstream of Reservation:					
MR-MHS	229	93.4	0.2360	0.1904	July, 1995-Oct.,1999
WWTP-MR (Mancos wastewater effluent)	292	56.9	1.3781	0.5961	July, 1995-Sept.,1997
MR-WWTP2	408	471	0.4487	0.4324	July, 1995-Sept.,1997
MR-MUD1	744	320	0.5061	0.2702	March, 1995- Sept. 1997,
					& August 2001
MUD-NG2 (tributary)	1575	770	1.8029	1.1854	July, 1995-Sept., 1997
MR-MUD2	1070	508	0.9475	0.5174	July 1995-Sept., 1997 & August 2000-August 2001
MR-slurry drop	1786	188	1.1545	0.5713	August 2000-July 2001
On Reservation:					
MR-WC1	860	609	0.9955	0.5355	July, 1995- May, 2001
WC-MR (tributary)	1659	489	1.7199	0.3691	July, 1995- May, 2001
MR-WC2	1006	623	1.1124	0.5043	May, 1994- May, 2001
MR-JC	906	613	1.0942	0.7279	June, 1993 & June, 1999- August 2001
MR-GC1	1061	565	1.1887	0.6029	May, 1994- August, 2001
Ute-MR (tributary)	1718	752	2.0003	1.7283	May, 1999- Nov., 2001
MR-MC2	1030	518	1.5808	0.6741	May, 1994-Nov., 1995
MR-GS	872	479	1.1675	0.4862	June, 1993- May, 2001
MR-NW1	972	489	1.2300	0.3869	Dec., 1995- June, 2001
NW-MR (tributary)	2798	1669	4.7197	2.4086	Dec., 1995- June, 2001
MR-NW2	1126	606	1.6910	0.7055	Dec., 1995- June, 2001
MR-STL (boundary)	1160	496	1.6074	0.3263	July, 1996- June, 1997
Downstream of Reservation:					
MR-SJ	964	444	1.3963	0.5145	Sept., 1996- October, 2000

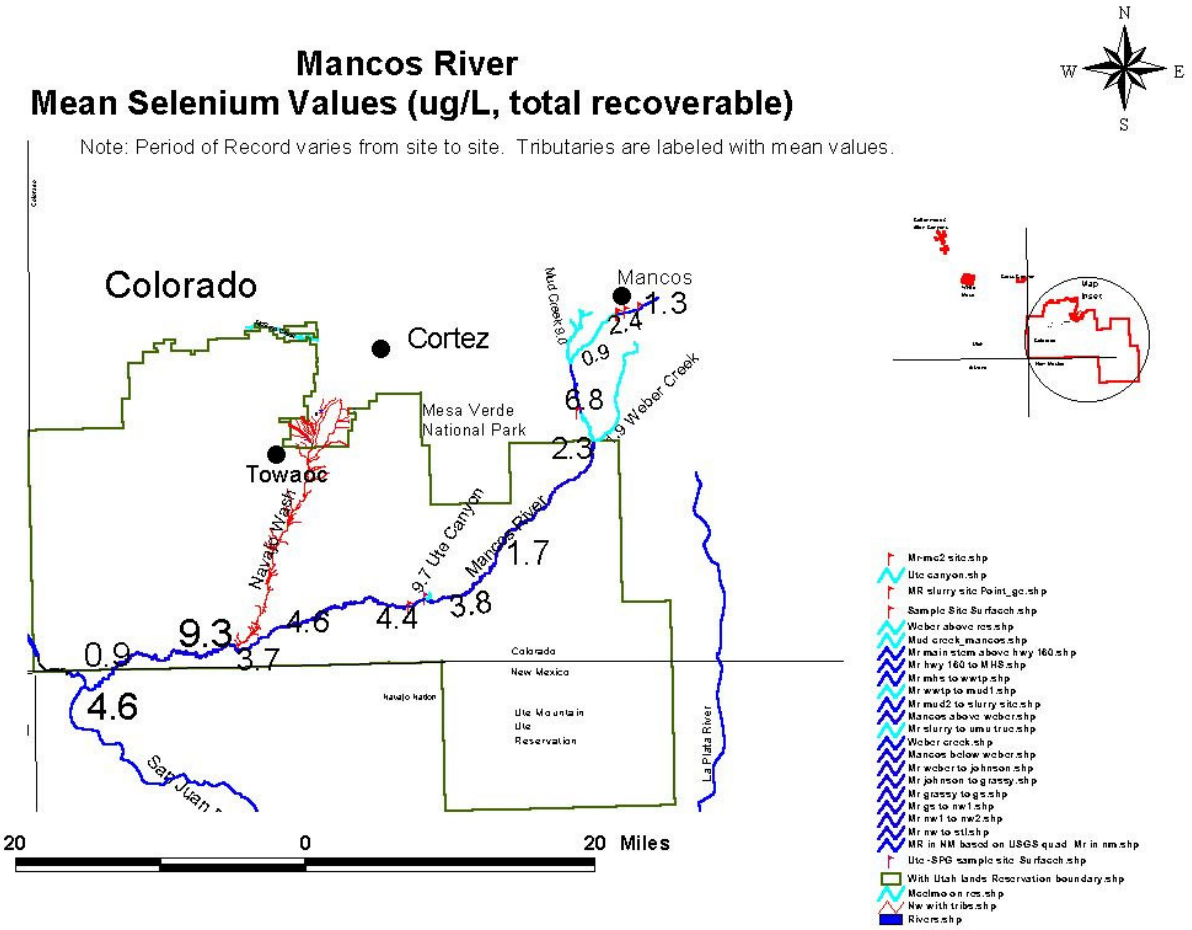
FIGURE 9: Mancos River Salinity (without tributaries)



Selenium in the Mancos River:

Selenium levels in the Mancos River have exceeded the current Tribally-adopted aquatic life criterion of 5 ug/L chronic total recoverable selenium, and occasionally have exceeded the acute criterion of 20 ug/L. Figure 10 shows mean values of total recoverable selenium data for sample sites on the Mancos River and some tributaries. As is evident in Figure 10, tributaries load the main stem of the river with selenium and increase the mean levels downstream of them. Navajo Wash has the highest selenium levels in Montezuma County (Butler, et al. 1995), and this is described in further detail in the next section. Other tributaries that have been monitored for selenium include Mud Creek, Weber Creek, and Ute Creek, as indicated on Figure 10. Each contributes to the selenium load to the Mancos River.

Figure 10:



Navajo Wash Nonpoint Source Pollution Issues:

Salinity in Navajo Wash:

Navajo Wash does not meet the salinity criteria for irrigation. Because of its proximity to the Mancos Creek Farm (see map in Figure 11), it would be beneficial to the Tribe to have that water meet irrigation standards, but-- as it is-- Navajo Wash is impaired for that use. Standards indicate that irrigation water must have a TDS <1500 mg/L if SAR is > 4.0. See Table 8 for mean data values at various sites. Livestock consumption of Navajo Wash water is suspect.

During winter months (when livestock are likely present), TDS can exceed 5,000 mg/L, the Tribe's livestock consumption standard.

Table 8: Salinity in Navajo Wash					
Site (descriptor)	TDS Mean Value	TDS Std Dev	SAR Mean Value	SAR Std Dev	Period of Record
Upstream of Reservation:					
NW-CRA	2691	2065	4.3135	2.7631	Nov. 1993-March 2003
On Reservation:					
NW-GS	3112	2365	3.9651	2.7548	Feb. 1992-Feb. 2004
NW-NS	3723	2386	5.3629	2.2933	Nov. 1995-Feb.2004
NW-Hwy160	2812	1429	3.7503	2.2964	Nov. 1995-July 2001
NW-MR	2798	1669	4.7197	2.4086	Dec. 1995- June 2001

Figure 11:

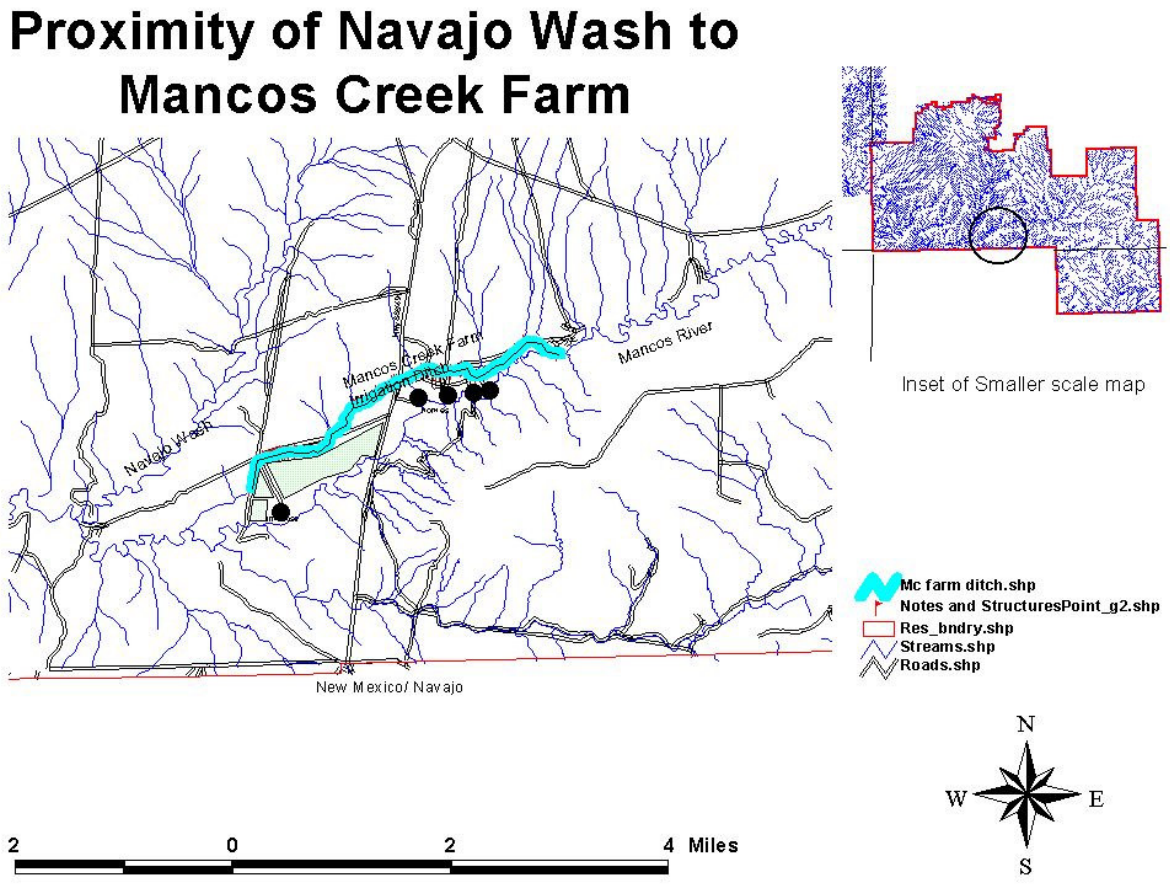
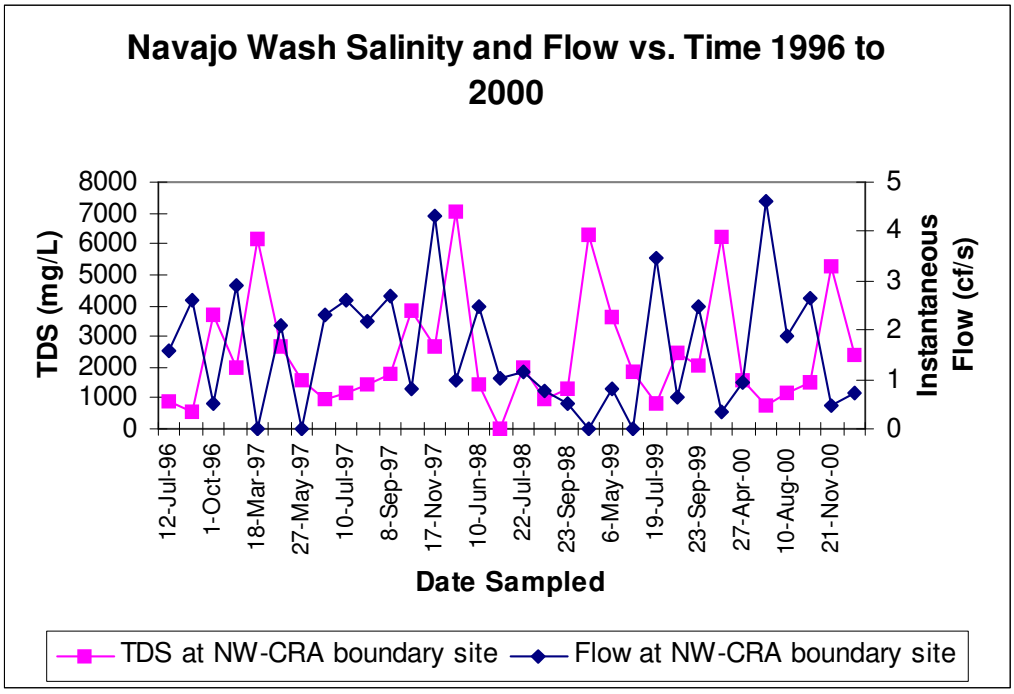


Figure 12:



Selenium in Navajo Wash :

Selenium in Navajo Wash is one of the more prominent nonpoint source concerns on the Reservation. The lower Montezuma Valley has been irrigated for about 100 years, since the construction of the Dolores Tunnel brought irrigation water to the valley. The surface geology of the valley is mostly Mancos shale and shale-related soils. These rocks and soils are very high in nitrogen, arsenic, and selenium, as well as overall minerals capable of being dissolved. The phenomenon that results when irrigation occurs is that during the summer growing season, irrigation returns dilute in-stream ambient conditions, while contributing slight levels of selenium and salts. During the winter, the saturated ground water table causes flows laterally along the confining shale, leaching arsenic, selenium, and salts, including nitrates. See salinity vs. flow in Figure 12 and Se vs. flow in Figure 13 for this inverse relationship. The effect on aquatic life is understandably grim. Livestock uses also become threatened.

Figure 13:

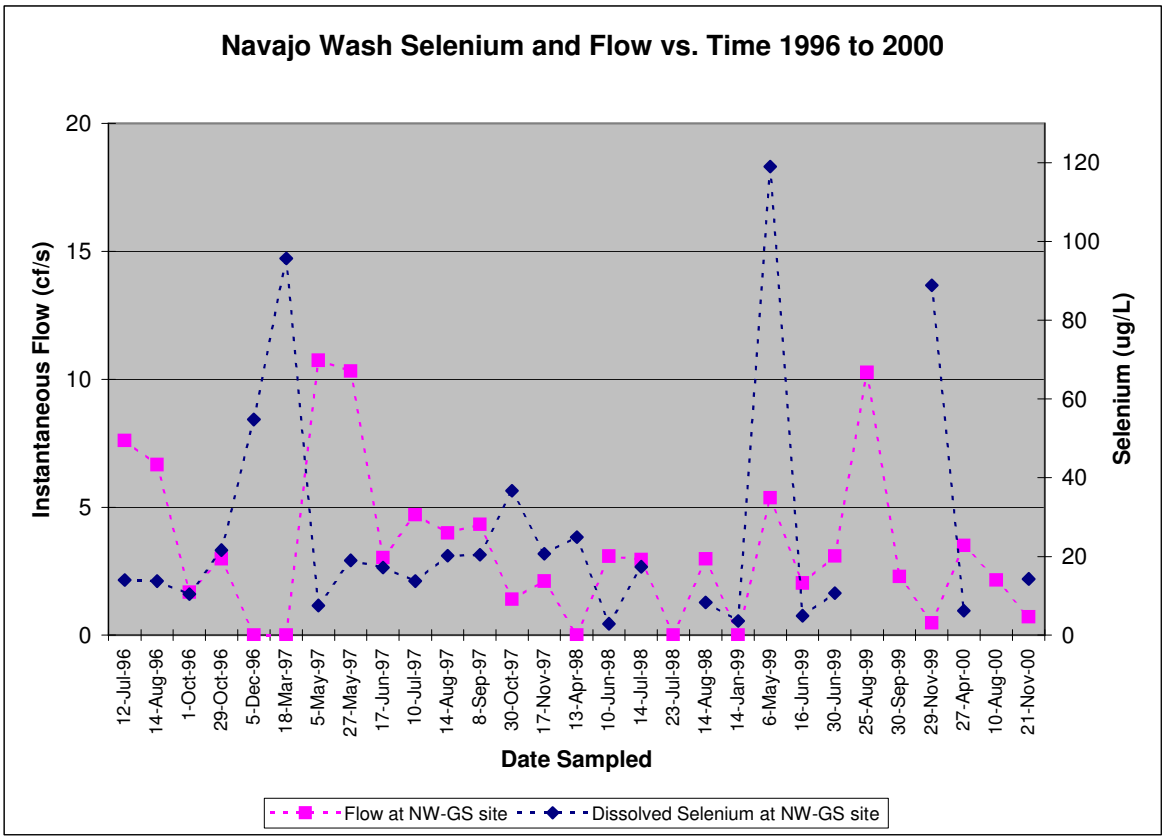
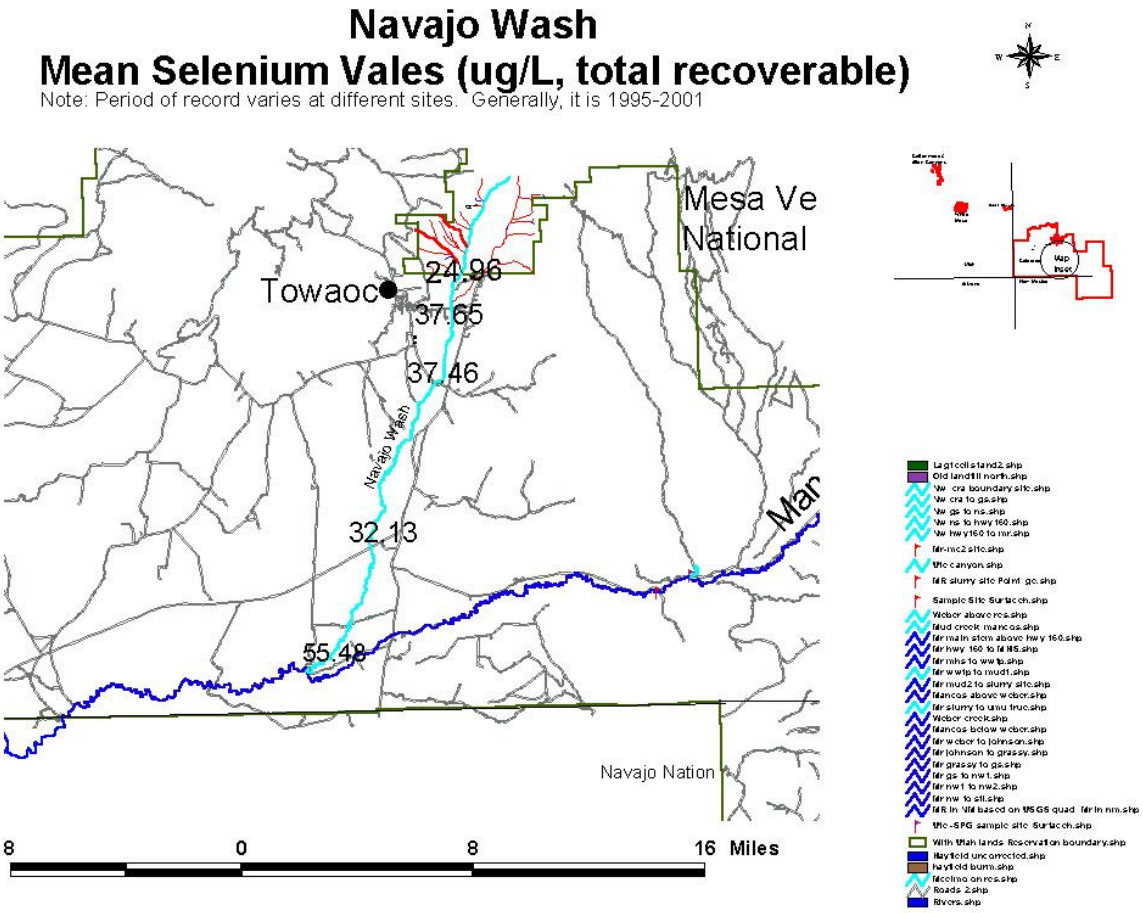


Figure 14 shows the mean selenium levels in Navajo Wash at sampling sites. Because of the downstream increasing trend indicated in Figure 14, the water quality standards for Navajo Wash have a site-specific standard, variance from table value aquatic life standard for selenium, a goal of no net gain of selenium on the Reservation, and the description of the site specific standard indicates that the Tribe's nonpoint source program will implement the changes to achieve that goal.

Figure 14:



McElmo Creek watershed issues:

One year of monitoring on McElmo Creek has indicated that the main stem generally has detectable levels of lead, iron, and nickel, but not at hazardous levels. One sampling event indicated very high levels of several metals and minerals, but it was an anomaly due to drought—the stream flow was 1.2 cf/s in May 2003 on a day when the daily average stream flow over 50 years was 48 cf/s. Even at those high levels, the hardness-dependent metals standards were not exceeded because the water was buffered by hardness that averages close

to 2,000 mg/L. One intermittent tributary, Mud Creek, flows from its headwaters on the northeast flank and foothills of the Sleeping Ute Mountains, goes underground for 3-4 miles, and emerges approximately ½ mile from McElmo Creek. It picks up minerals and metals from the geologic formations it passes through, and adds significant arsenic, barium, chromium, copper, iron lead, nickel, and manganese to the watershed. It is also buffered by its hardness to reduce the toxicity to aquatic life, and is twice as saline as McElmo itself. Mountain snow melt and springs that are tributary to McElmo Creek are very high quality with low dissolved solids and only traces of nutrients and metals. McElmo Creek is relatively unaffected by on-Reservation activities that may contribute to water pollution. Two small reservoirs capture water in the upper reaches of Pine Creek, a tributary to McElmo. Besides the adverse physical affects of those impoundments, and some potential sediment from oil and gas production roads, virtually no pollution emanates from the Reservation into McElmo Creek. Its anthropogenic water quality issues mainly result from irrigated agriculture in the canyon, and wastewater discharges in and around the City of Cortez upstream.

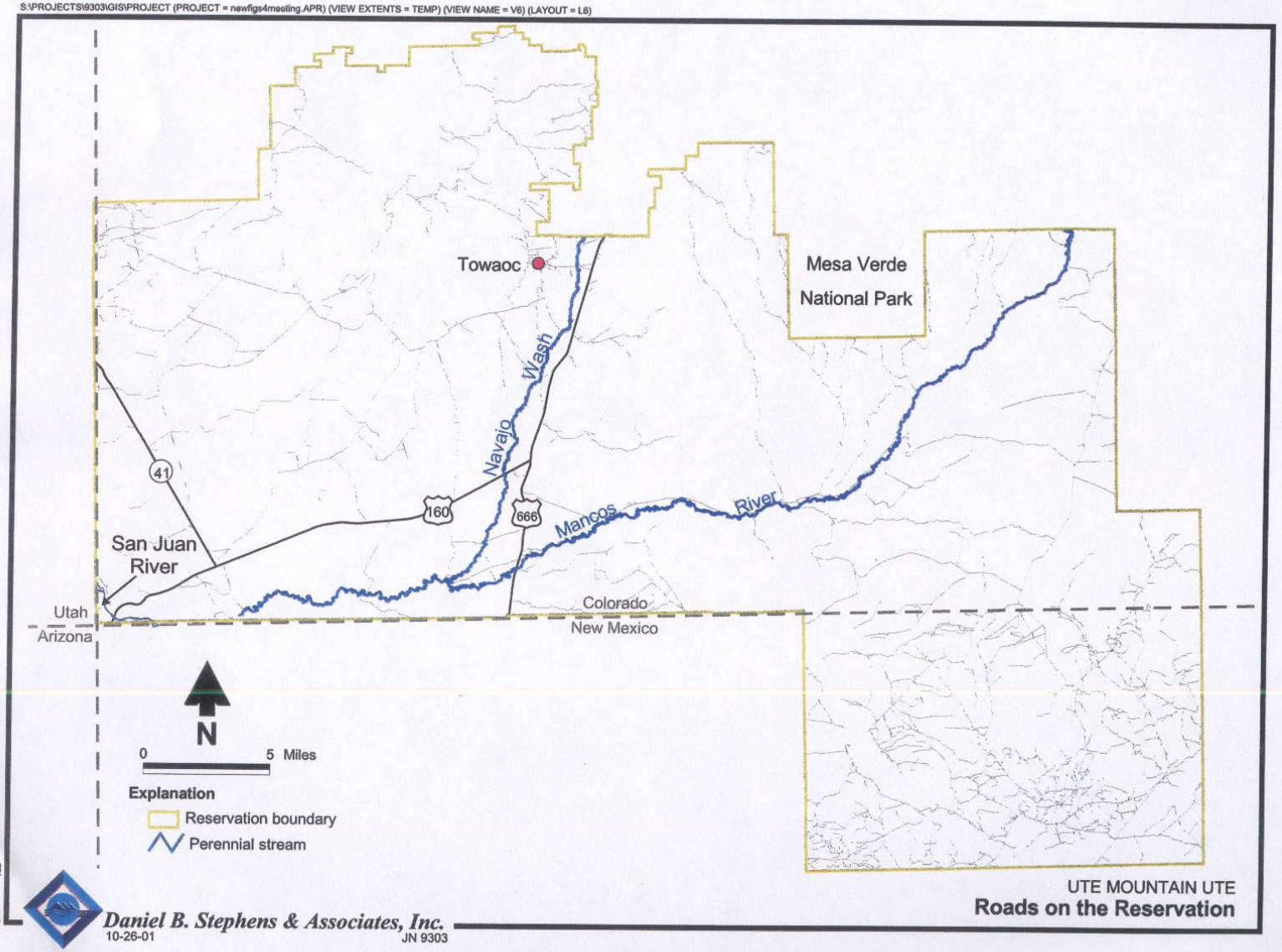


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Figure 15

Figure 6

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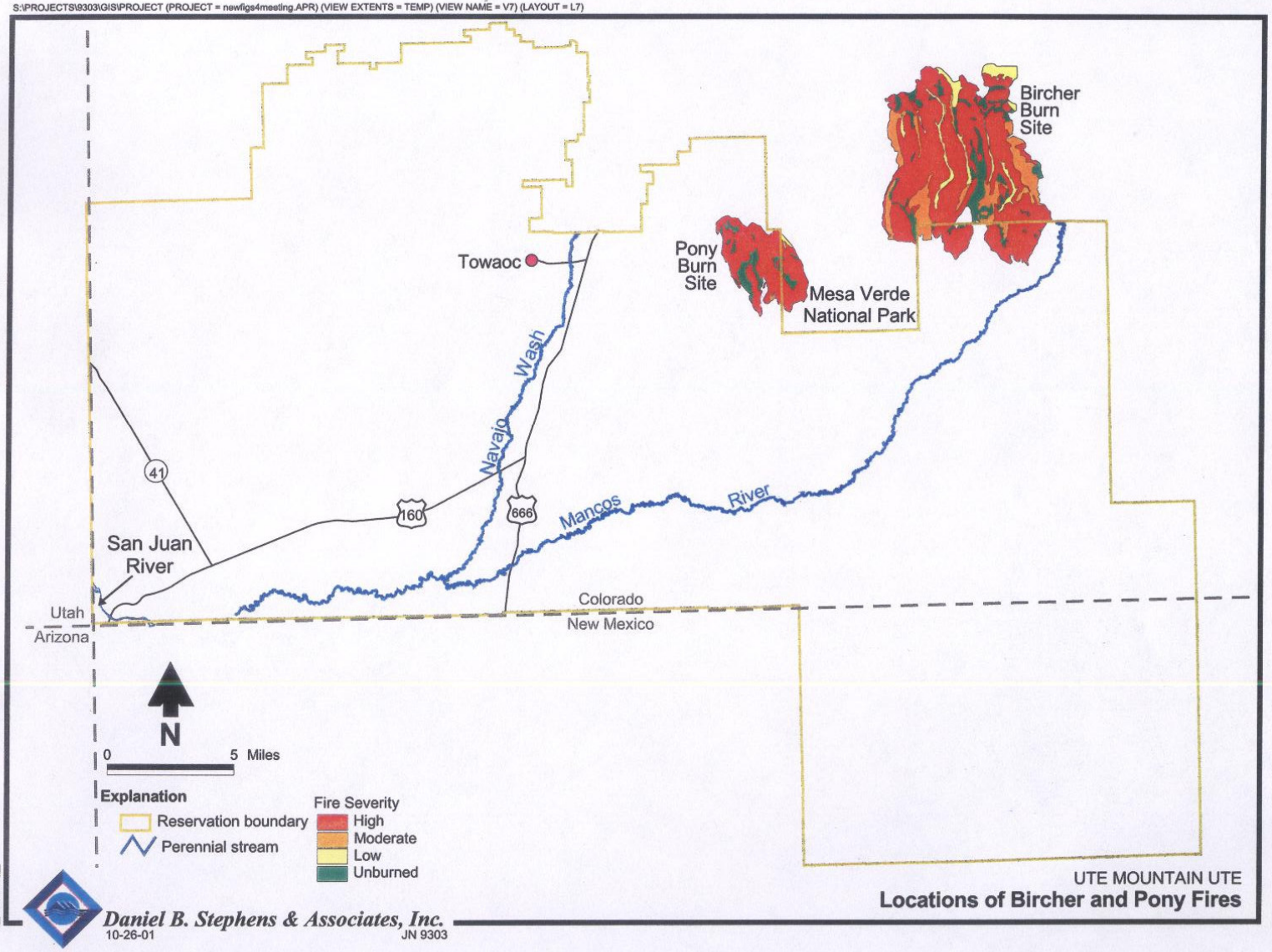

UTE MOUNTAIN UTE

Locations of Bircher and Pony Fires

Daniel B. Stephens & Associates, Inc.

10-26-01 JN 9303

Figure 16

Figure 7

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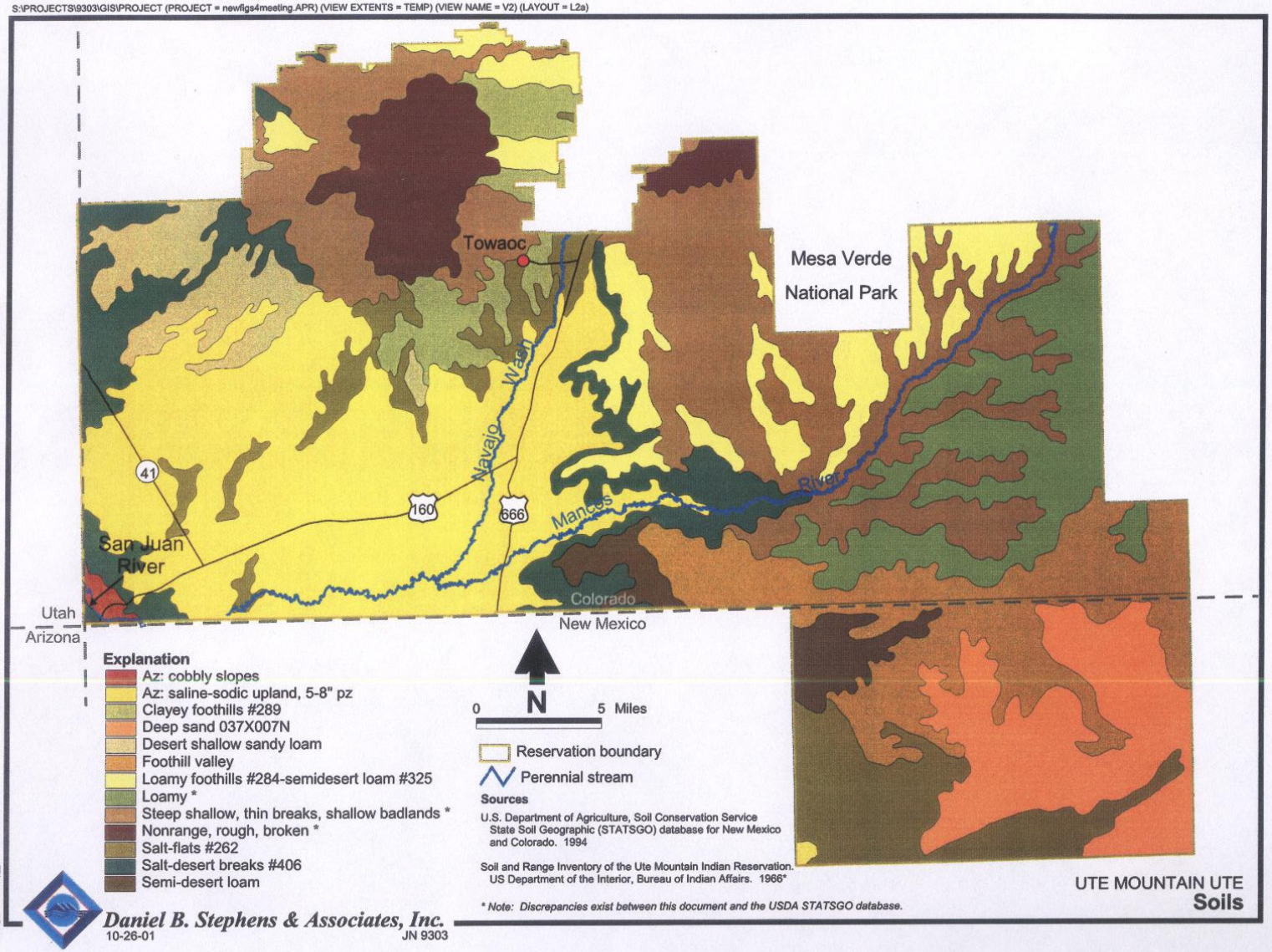

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Figure 17

5.2 Evaluated Assessment

Since the data available do not cover all potential constituents or sources of concern, other existing information that could indicate potential nonpoint sources was compiled and reviewed. This information included existing reports on water quality and management practices on the Ute Mountain Ute Reservation (Appendix B), geographic information system (GIS) coverages of soils, geology, and roads, and other information that could contribute to an understanding of potential nonpoint sources. Based on this "evaluated" assessment, several nonpoint source concerns for the Ute Mountain Ute Reservation were identified, as discussed in Sections 5.2.1 through 5.2.6.

5.2.1 Erosion and Sedimentation

The watersheds of the San Juan River Basin produce some of the highest sediment yields in the western U.S., making sediment a major component of basin waters and potentially a concern for the health of native fishes (Abell, 1994). The *State of Colorado Unified Watershed Assessment* (Colorado DPHE and USDA, 1998) lists the Mancos watershed as a top priority (Category 1) for funding during fiscal year 1999/2000, in part because of a Section 303(d) listing for sediment yield above Highway 160 (Upstream of the Ute Mountain Ute Reservation).

A potential contributor to erosion and sedimentation is the presence of roads, particularly where they intersect drainages. A map illustrating road locations on the Ute Mountain Ute Reservation is included as Figure 15. Stream bank erosion due to hydrologic modifications and storm events along creeks and their tributaries also contributes sediments. In addition, erosion and sedimentation can be accelerated by improper grazing activities and natural events such as forest fires (locations of the recent Bircher and Pony fires are shown on Figure 16).

The *State of Colorado Nonpoint Source Assessment* (Colorado WQCD, 1989) lists the Mancos River as severely affected by sediment. The document also indicates that erosion related to shale soils, grazing, and surface disturbances contribute salts and sediment to the Mancos

River. Critical erosion areas have been designated around the Town of Mancos, including Mud Creek and Weber Canyon, and near the New Mexico state line in Mancos Canyon, including Aztec and Navajo Washes.

5.2.2 Salinity

Most of the salt that is naturally contributed from the San Juan River Basin is contributed by surface runoff and groundwater discharge from the Nacimiento Formation and the Mancos Shale (Abell, 1994). Soils derived from the Mancos Shale and Nacimiento Formation perpetually continue to absorb salt rather than ultimately reaching a salt balance. The Mancos Shale is also a major source of saline springs and groundwater, which eventually drain into the surface waters. Locations of the Mancos Shale and Nacimiento Formation are shown on the geologic map of the reservation (Figure 4), and a map of surficial soils is presented as Figure 17.

The *State of Colorado Nonpoint Source Assessment* (Colorado WQCD, 1989) lists McElmo Creek west of Cortez and the Mancos River as severely affected by salinity. As shown on Figure 3, the drainages on the northeastern part of the reservation flow into McElmo Creek. The USGS also classifies water in the Mancos River as having a high salinity hazard as judged by the relationship between the sodium absorption ratio and specific conductance (Leavesley, 1975). The U.S. EPA has estimated that salinity in the Upper Colorado River Basin results from two-thirds natural causes and one-third anthropogenic causes, with nonpoint sources contributing to 84 percent of the salinity and point sources contributing the rest (Abell, 1994). These studies illustrate the importance of addressing nonpoint sources of salinity on the Ute Mountain Ute Reservation.

5.2.3 Oil and Gas Development

The Four Corners area lies between two major oil- and gas-producing basins: the Paradox Basin to the west and the San Juan River Basin to the south. In addition, east of Cortez a series of shallow Dakota Sandstone oil and gas pools have been developed in the Mancos River Valley. Waste brines and hydrocarbons can potentially migrate into surface water and

groundwater bodies if not properly controlled. Locations of oil and gas development are shown on Figure 2. Water quality monitoring data for oil fields does not exist at this time; most are not far from ephemeral streams, but timing of storm event sampling and travel limitations at those times has prevented sampling those streams.

5.2.4 Mining Activities

Coal deposits underlie a large part of Montezuma and La Plata Counties, but thickness, mining cost, and transportation have restricted their economic development. If developed, salinity of the shale spoils in proximity to the San Juan River will require control. Mapped strippable coal deposits extend onto the Ute Mountain Ute Reservation (Abell, 1994).

The *State of Colorado Nonpoint Source Assessment* (Colorado WQCD, 1989) lists the East Fork of the Mancos River as being impacted by inactive mining. This location upstream of the Ute Mountain Ute Reservation could potentially contribute nonpoint source pollution through leaching from small mine operations and natural deposits of uranium, vanadium, copper, and other minerals. Monitoring data for the Mancos at the Reservation boundary have indicated small quantities of copper and silver in excess of Tribal water quality standards for aquatic life. The Copper and silver probably originated in the La Plata mining district (Colorado WQCD, 1989, p. 125). Uranium mining impacts to Utah lands of the Ute Mountain Ute Tribe are described in Section 5.1, Monitored Assessment. The Tribe's Dunn ranch (at Hay Gulch) in Colorado is adjacent to a small operating National King Coal Co. mine, but water quality impacts have been minimal. The Tribe is pursuing an operating agreement to allow King Coal to expand the mine onto the ranch. If the mine were to expand, best management practices would be required of the mine operators to minimize impacts to surface and ground water in the area.

5.2.5 Selenium

Selenium is the major contaminant associated with irrigation return flows in the San Juan River Basin (Abell, 1994). A reconnaissance survey conducted by the USGS indicated that selenium concentrations exceeded the chronic aquatic-life criterion for selenium in most water samples from newly irrigated areas and from McElmo Creek, Navajo Wash, and the Mancos River

(Butler et al., 1995). The largest selenium concentration seen in fish samples from the Montezuma Valley was in a sample from Navajo Wash, and the maximum selenium concentration on the reservation was from a site draining the Mancos Shale in Navajo Wash. The USGS study also indicated that irrigation drainage may be the primary source of selenium to McElmo Creek.

Butler et al. (1997) indicated that there were high concentrations of selenium in Navajo Wash and Mud Creek, a tributary to McElmo Creek, and selenium was also detected in bottom sediments and biota samples in the Mancos River Basin. Selenium that has been detected in springs on Sleeping Ute Mountain (Geldon, 1985) could potentially contribute to the selenium levels in Navajo Wash. See Section 5.1, Monitored Assessment for more information about selenium.

Because of the proximity in the San Juan Basin to the Colorado River endangered fish, the Colorado pikeminnow and the razorback sucker, selenium is particularly important. The Ute Mountain Ute Tribe's Water Quality Standards for Surface Waters, adopted in 2002, address the Navajo Wash selenium issue by setting a "no net gain" goal for the stream from the Reservation boundary to its confluence with the Mancos River. This will be accomplished through the future nonpoint source program, as identified in the standards, because there are no point sources of that pollutant in the watershed.

5.2.6 Other Pollution

The presence of phosphorus and mercury in water samples from the reservation indicates other potential nonpoint sources of pollution in Ute Mountain Ute waters:

- High levels of phosphorous are found below the Town of Mancos, possibly from treated sewage effluent from the Town of Mancos (Colorado WQCD, 1989, p. 125).

- In 1971, mercury concentrations in surface water samples from the Mancos River exceeded the U.S. EPA standard for aquatic life (0.05 μg/L). Mercury-bearing sedimentary rock is probably the main source of this metal in the waters. The two coal-

fired power plants in northwestern New Mexico may also add mercury to the system, and mercury-containing manometers used to measure pressure at natural gas wells may also be sources of contamination in the basin.

5.3 Recommendations for Continuing Assessment

The Ute Mountain Ute Tribe's Water Pollution Prevention Program will continue to monitor water quality for further refining the issues put forth in this assessment and to identify other issues not yet on the Tribe's radar screen. Until additional quantitative data are available, the Ute Mountain Ute Tribe may rely on other sources of information to assess nonpoint source pollution. These include:

- Water quality studies discussed in Section 5.2
- Field observations of such factors as headcutting, streambank undercutting, and other indicators of ongoing erosion and sediment deposition, and riparian habitat degradation
- Evaluation of land use practices in comparison to BMPs that are known to control nonpoint source pollution

Management practices that will be used to address these nonpoint sources of pollution are discussed in Section 6 and in the *Ute Mountain Ute Nonpoint Source Pollution Management Program Plan.*

5.4 Impairment Determination and Ranking

The level of impairment of a stream, lake, wetland or groundwater resource is relative to its designated use or a use that is practical. For surface waters, these are mostly identified in the Tribe's Water Quality Standards for Surface Waters. For groundwater resources, the Tribe's Ground Water Protection Plan describes the various aquifers, their uses and quality issues where data are available. For the purposes of this assessment, an impaired water body is one that is not attaining all of its designated uses. This may be implied by an exceedance of water

quality standards, but an exceedance of a standard does not necessarily imply an impairment. Physical and biological conditions also cause impairments that are not recognized by numeric or even narrative standards. The following rankings, either "moderate" or "severe," are qualitatively based upon the level of ecological risk to the riparian ecosystem of each stream, lake, or reservoir, respectively. For example, in the Mancos River watershed, the riparian ecosystem is not at risk of catastrophic dysfunction due to erosion and sedimentation—in fact it is more a part of that ecosystem than in many other western streams, thus it is rated as "moderate." Infestation by non-native plants in the riparian ecosystem of the Mancos River, on the other hand, changes a base food source of the riparian ecosystem and it is getting worse at a very alarming rate—biomass of tamarisk in the watershed has increased rapidly in the past decade, especially in former stream channels where the root systems of native riparian plants are shallower than those of tamarisk. The situation continuously compounds itself because the areas that would have only large, well-established cottonwood trees now have stands of tamarisk that lower the ground water table and increase their competitive edge across the entire floodplain. The ecological ramifications of this problem are huge and compounding quickly, thus it is a "severe" impairment, and one that deserves highest priority.

Table 9: Impairment and Ranking

Water Body(s)	Pollutant	Assessment Technique	Potential Source	Rank
Mancos River	Sediment	Biological and physical, document review	Gravel mines, forest fires, Road construction and maintenance	MODERATE
Mancos River	Metals—Ag, Cu	WQ standards and monitoring	Historic mining	MODERATE
San Juan River, Mancos River,	Bacteria	WQ standards and	Grazing, wildlife, off-reservation sources,	MODERATE

Navajo Wash		monitoring	wastewater treatment	
Navajo Wash (Mancos River)	Selenium, salinity, nutrient enrichment	WQ standards and monitoring	Local geology and irrigation, wastewater management	**SEVERE** (Mancos MODERATE)
Navajo Wash	Erosion and Sediment	Biological and physical, document review	Local geology, grazing, roads, urbanization	MODERATE
McElmo Creek	Erosion and sediment; nutrients	Biological and physical, document review	Roads, grazing, off-reservation irrigation practices, wastewater treatment	MODERATE
Cottonwood Wash, UT	Radionuclide contamination	Monitoring and TMDL review; bioassessment	Historic uranium mining and processing	**SEVERE**
50% ephemeral streams, reservation-wide	Erosion and sedimentation, physical impairment	Monitoring, observation, document review, history	Grazing, roads, channelization, local geology	MODERATE
All water bodies <8,000 feet elevation	Invasive riparian vegetation—tamarisk	Survey data, photography	Historic infestation	**SEVERE**

6. Selection of Best Management Practices

Based on existing data and these sources of information, nonpoint source pollution control efforts on the Ute Mountain Ute Reservation should focus on:

- Managing sediment and salinity from background sources, particularly where the Mancos Shale is present

- Minimizing erosion and sedimentation along the perennial streams and ephemeral drainages located throughout the reservation due to grazing, road construction, forestry, and other activities such as oil and gas development

- Conducting additional monitoring programs to assess and/or address nonpoint source pollution from selenium, mercury, or other trace metals.

Best management practices (BMP's) for the control of nonpoint sources of pollution will be selected based on various factors:

1) Information provided by the Non Point Source Task Force; decisions made by the Task Force;

2) Availability of funding to implement BMP's;

3) Buy-in by individuals and administrators responsible for implementation of BMP's;

4) Incorporation of BMP's in project proposals and grants; project scope;

5) Compliance with existing Tribal environmental statutes, specifically the *Ute Mountain Ute Tribe Water Quality Standards for Surface Waters of the Ute Mountain Ute Reservation of Colorado, New Mexico and Utah* and the *Ute Mountain Ute Tribe Ground Water Protection Plan* ;

6) Implementation of existing formal and informal management strategies that compliment the Nonpoint Source Management Program Plan, such as the Farm and Ranch Enterprise's Water Management Plan, various solid waste management strategies, the Tribe's Brownfields Program, environmental education strategies, wildlife management strategies, the Bureau of Indian Affairs' Endangered Species Management Plan, any supplemental environmental penalties, and other such programs.

The Non-Point Source Task Force consists of representatives from the following Tribal departments and enterprises and government: Environmental Programs Department, Farm and Ranch Enterprise, Energy Department, Weeminuche Construction Authority, Tribal Park, Planning Department, Natural Resources Department, Tribal Council and Executive Director's Office. Non-tribal agencies represented periodically at the Non-point Source Task Force meetings include: Bureau of Indian Affairs, USDA-Natural Resources Conservation Service, U.S. Bureau of Reclamation, and the Indian Health Service.

Existing Best Management Practices

Currently the Tribe uses BMP's of various types to minimize water pollution and other adverse impacts of day to day operations. The list below is a sample of these BMP's, but some are implemented without the knowledge of the Environmental Programs Department and are not contained in this document.

Agriculture

- Compliance with the Farm and Ranch *Water Management Plan*

- Education regarding safety, chemical storage and use

- Comprehensive GPS/GIS-based data collection and management of soil data and source water data, as well as fertilizer, pesticide, herbicide, rodenticide, fungicide applications, crop yields and moisture content; application schedules derived from the data above

- Conservation practices to reduce erosion (wind and water) and water use-- no till corn, etc.

- Sprinkler irrigation—mostly telemetry-controlled center-pivot, high efficiency nozzles

- Monitoring around agricultural areas for fertilizers and pesticides, communication of results with farm managers

- Wildlife habitat enhancement projects

- Wellhead protection

- State pesticide inspections (although not required in Indian Country, these were requested by management to assess any potential shortfalls in their methods); EPA pesticide inspections

- Compliance with environmental regulations—both federal and Tribal, including National Environmental Policy Act (NEPA)

Grazing

- Riparian fencing, cross fencing

- Seasonal rotation of livestock from Reservation to summer range; periodic rotations within these areas

- Ecologically friendly reservoir design

- Minimization of road construction

- Renewable energy use for livestock well pumps—solar and wind-powered

- USDA/NRCS—EQUIP Program, cattle rotation and alternative water sources

- Compliance with environmental regulations—both federal and Tribal, including National Environmental Policy Act (NEPA)

Silviculture

- Compliance with Bureau of Indian Affairs' Forestry Management Plans and silvicultural prescriptions from Colorado State Foresters

- Minimization of road construction

- Selective forestry management with emphasis on removal of dead and dying trees to reduce fire risk (and adverse water pollution related to it)

- Compliance with environmental regulations—both federal and Tribal, including National Environmental Policy Act (NEPA)

Oil and Gas

- Compliance with lease and contract stipulations—these always include provisions that require the leasee and all operators to NOT POLLUTE water or soil

- Minimization of road construction

- Annual Underground Injection Control inspections (with EPA)

- Mandatory off-site removal of contaminated soils (no land farming)

- Storm Water Pollution Prevention Plans

- Compliance with environmental regulations—both federal and Tribal, including National Environmental Policy Act (NEPA)

Construction/Development

- Storm Water Pollution Prevention Plans
- Wastewater planning and infrastructure
- Minimization of road construction
- Compliance with environmental regulations—both federal and Tribal, including National Environmental Policy Act (NEPA)

General Operations

- Compliance with lease and contract stipulations when overseeing contracted services
- Conservative fuel storage and Underground Storage Tank compliance and inspections
- Correspondence with and recommendations to departments that may have an adverse impact on water resources or the environment in general
- Compliance with environmental regulations—both federal and Tribal, including National Environmental Policy Act (NEPA)

In addition to these BMP's, see ***Section 4.3, Past and Ongoing Nonpoint Source Pollution Prevention*** for on-the-ground projects and other programs that are currently being used to prevent nonpoint source pollution.

Implementation of BMPs will be accomplished through a number of nonpoint source pollution programs, funding mechanisms, and educational programs conducted by the Tribe in conjunction with federal and state agencies. Some of the federal government agencies that can contribute to a nonpoint source pollution control program include:

- U.S. Department of Agriculture
- Bureau of Indian Affairs, Department of Interior
- Bureau of Reclamation, Department of Interior
- U.S. Environmental Protection Agency
- Indian Health Service

Additional discussion of funding sources and program requirements of each of these agencies is included in the *Ute Mountain Ute Nonpoint Source Pollution Management Program Plan.*

Nonpoint Source Control Programs

The following list of programs is meant to be a foundation from which to expand this program's knowledge of the availability of assistance to the Tribe for the implementation of nonpoint source controls. It is not meant to limit the scope or potential to only what is here, for there will inevitably be many opportunities not understood at this time. EPA programs are not listed here.

Agriculture

- USDA/NRCS—EQIP Program

- Agricultural Conservation Reserve Program

- USDA/NRCS --Wildlife Habitat Incentive Program

- Emergency Conservation Program

Silviculture

- Bureau of Indian Affairs-- Forestry on Indian Lands
- USDA/Forest Service—Cooperative Forestry Assistance Programs

Construction

- U.S. Dept. of Housing and Urban Development—Indian Community Development Block Grant Program
- USDA—Rural Utilities Service Water and Wastewater Disposal Programs
- ACOE—Challenge 21
- ACOE-- Section 203 grants for reconnaissance prior to implementation/construction

Oil and Gas

- Bureau of Land Management—Oil and Gas Field Inspectors Program

General Operations

- Bureau of Indian Affairs—Water Resources on Indian Lands
- U.S. Dept. of Commerce/ Economic Development Administration—Public Works Development Facilities Program

Other Nonpoint Source-Related Programs

- Greater Outdoors Colorado
- Southwest Wetlands Focus Area Grants
- U.S. Bureau of Reclamation—Native American Affairs Program
- U.S. Bureau of Reclamation -- Central Utah Project Upper Colorado Basin Programs
- U.S. Fish and Wildlife Service—Endangered Species Management Grants
- State (CO, NM, UT) Nonpoint Source Programs (State CWA Section 319 and other Programs)

7. Conclusions

As described in this assessment, various watersheds on the Ute Mountain Ute Reservation have nonpoint source pollution issues. These include erosion and sedimentation, bacteria loading, nutrient enrichment, salinity leaching and loading, selenium enrichment, and radionuclide contamination. Sources and causes of these problems vary from overgrazing and road building to historic mining activities and irrigation of marine shale soils. Each issue will be addressed in the long term using existing regulatory and management programs, a CWA Section 319 Nonpoint Source Management Program, and on-the-ground projects funded by various sources including, but not limited to, CWA Section 319(h) funding. Working with the Nonpoint Source Task Force to identify new problems not identified in this assessment and solutions to them and the issues herein, management changes will be incorporated into day to day operations to minimize and mitigate nonpoint source pollution. Implementation of a CWA Section 319(b) Nonpoint Source Management Program Plan will provide the framework for selection and implementation of best management practices and nonpoint source pollution mitigation strategies.

8. Abbreviations and Acronyms Used in this Assessment

BIA Bureau of Indian Affairs

BLM Bureau of Land Management

BMP Best Management Practice

CWA Clean Water Act

EPA U.S. Environmental Protection Agency

EQIP Environmental Quality Incentives Program

NPS Nonpoint Source

NRCS Natural Resource Conservation Service

SDWA Safe Drinking Water Act

UMU or UMUT Ute Mountain Ute [Tribe]

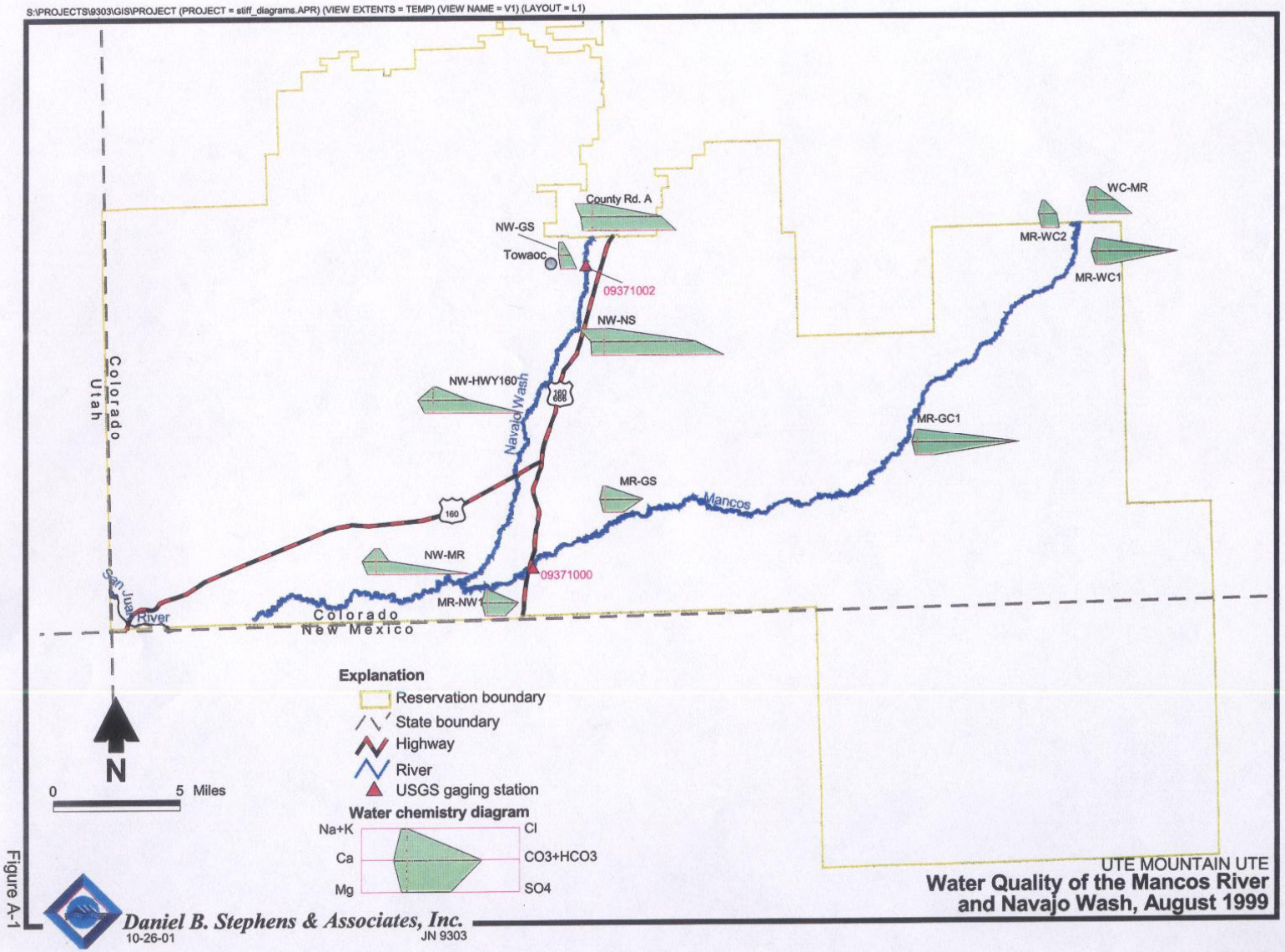
USBR or BOR U.S. Bureau of Reclamation

USDA U.S. Dept. of Agriculture

USGS U.S. Geologic Survey

Appendix A Water Chemistry Diagrams

(*Prepared by Daniel B. Stephens and Associates, Inc.*)



UTE MOUNTAIN UTE

Water Quality of the Mancos River and Navajo Wash, August 1999

Figure A-1

Daniel B. Stephens & Associates, Inc.

10-26-01

JN 9303

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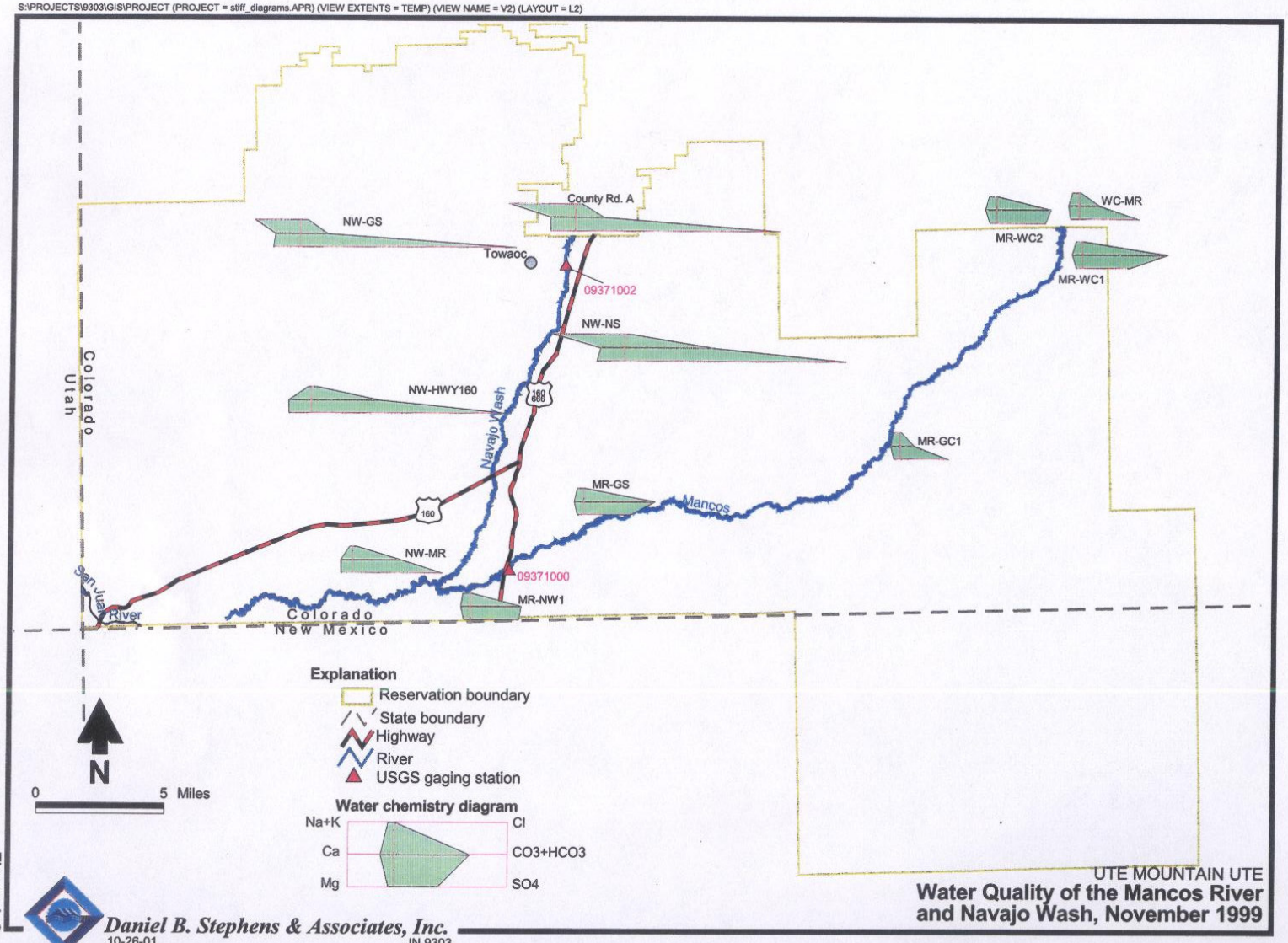

Figure A-2

Daniel B. Stephens & Associates, Inc.
10-26-01
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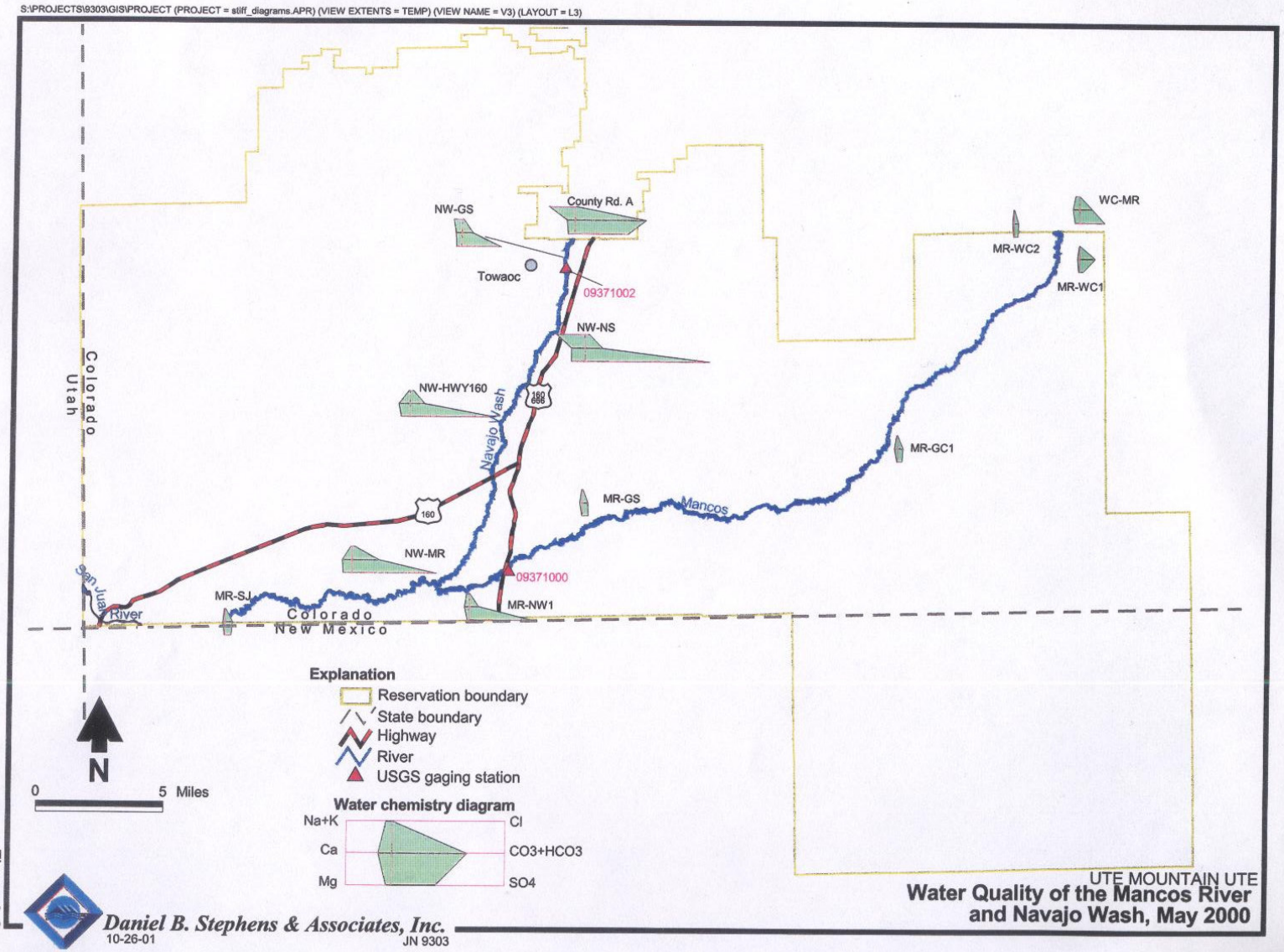
UTE MOUNTAIN UTE
Water Quality of the Mancos River and Navajo Wash, November 1999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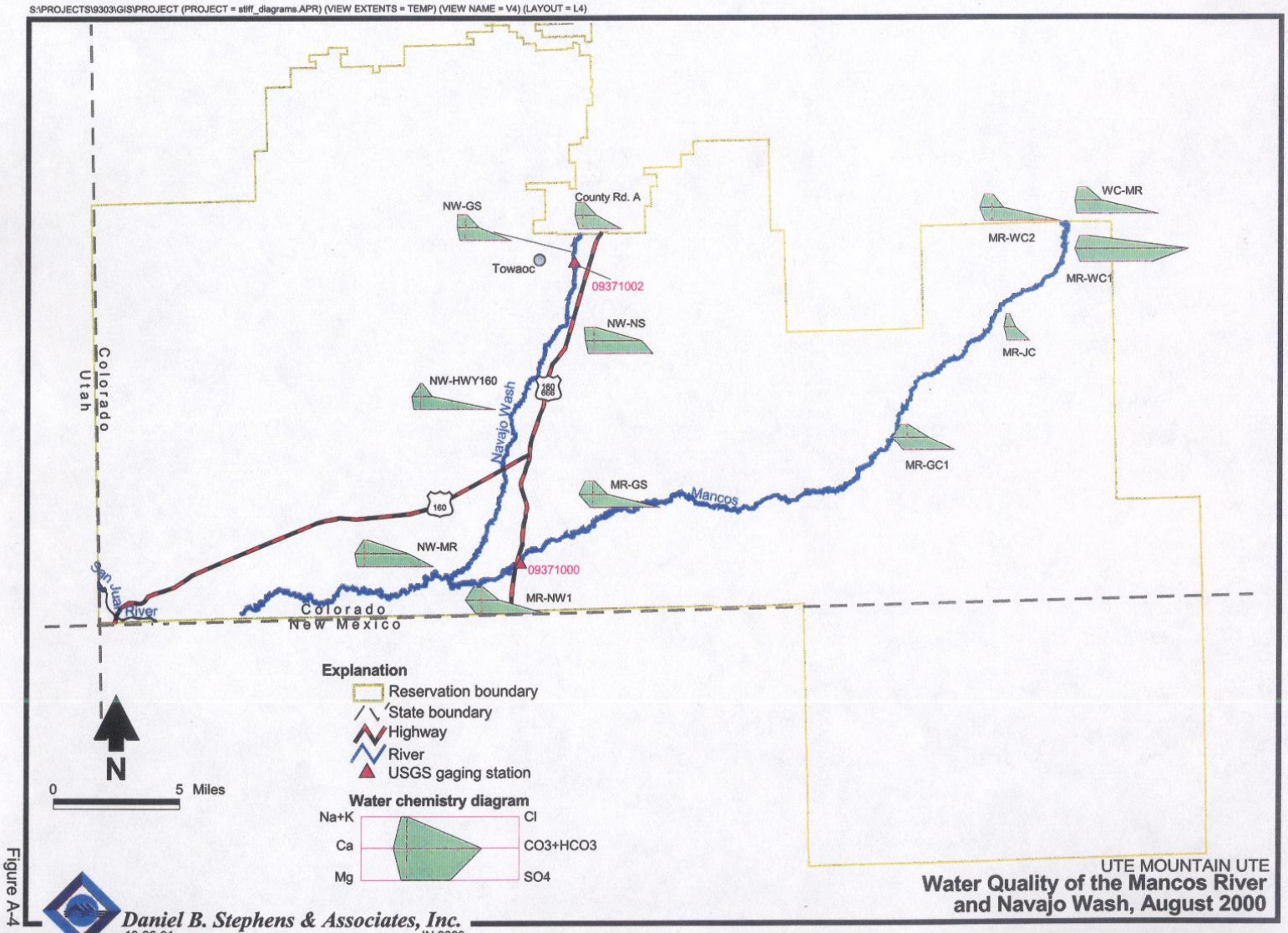
Utah
NW-GS
County Rd. A
Towaoc
09371002
NW-NS
NW-HWY160
160
666
Navajo Wash
MR-GC1
WC-MR
MR-WC2
MR-WC1
MR-GS
Mancos
160
NW-MR
09371000
MR-SJ
San Juan River
MR-NW1
Colorado
New Mexico
Explanation
Reservation boundary
State boundary
Highway
River
USGS gaging station
Water chemistry diagram
Na+K
Ca
Mg
Cl
CO3+HCO3
SO4
N
0
5 Miles
UTE MOUNTAIN UTE
Water Quality of the Mancos River
and Navajo Wash, May 2000
Daniel B. Stephens & Associates, Inc.
10-26-01
JN 9303

Figure A-3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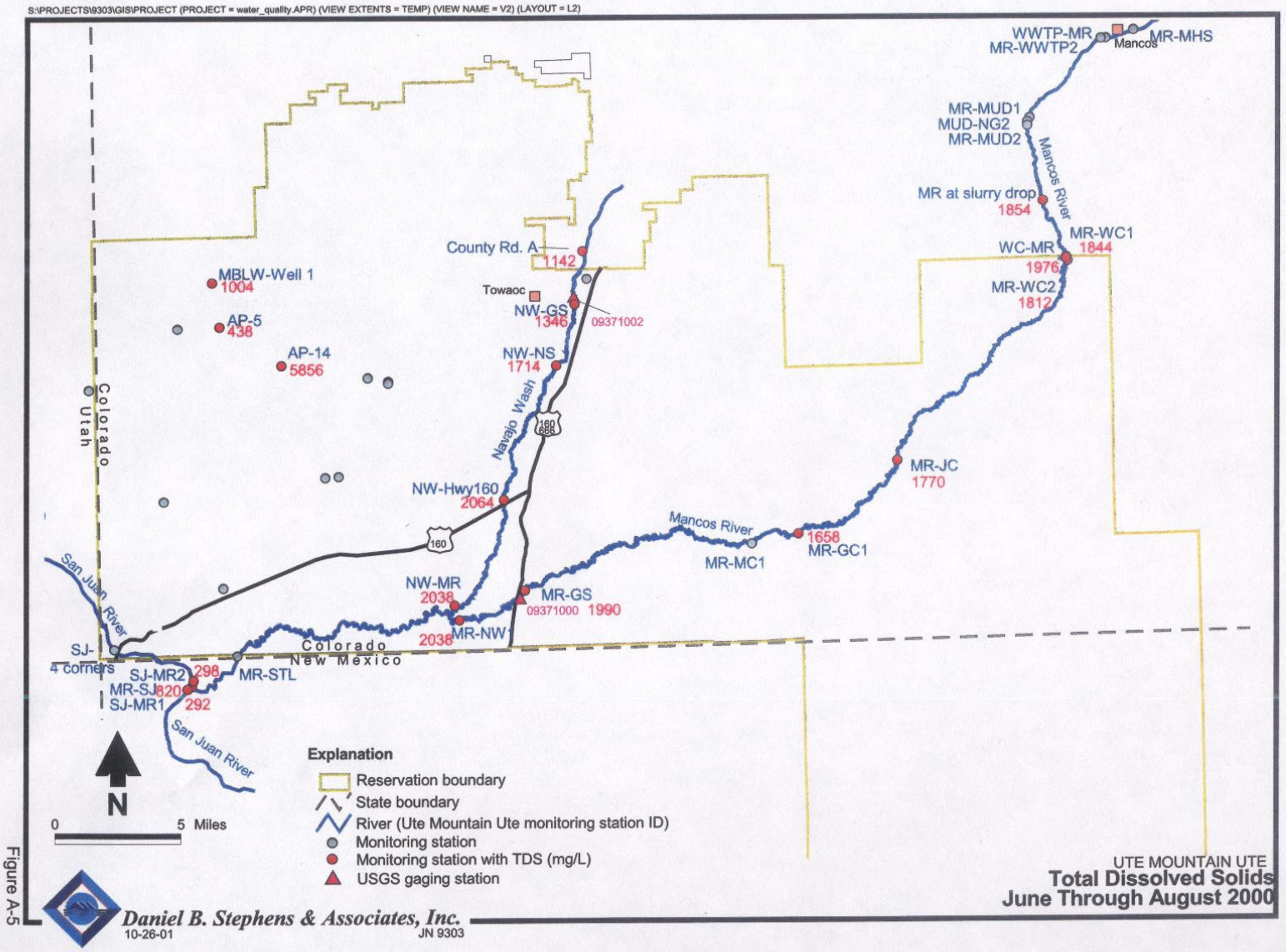
NW-GS
County Rd. A
Towaoc
09371002
NW-NS
NW-HWY160
160
666
Navajo Wash
Colorado
Utah
160
NW-MR
San Juan River
09371000
MR-NW1
Colorado
New Mexico
MR-GS
Mancos
MR-GC1
MR-JC
MR-WC1
MR-WC2
WC-MR
Explanation
Reservation boundary
State boundary
Highway
River
USGS gaging station
Water chemistry diagram
Na+K
Ca
Mg
Cl
CO3+HCO3
SO4
N
0
5 Miles
UTE MOUNTAIN UTE
Water Quality of the Mancos River
and Navajo Wash, August 2000
Daniel B. Stephens & Associates, Inc.
10-26-01
JN 9303

Figure A-4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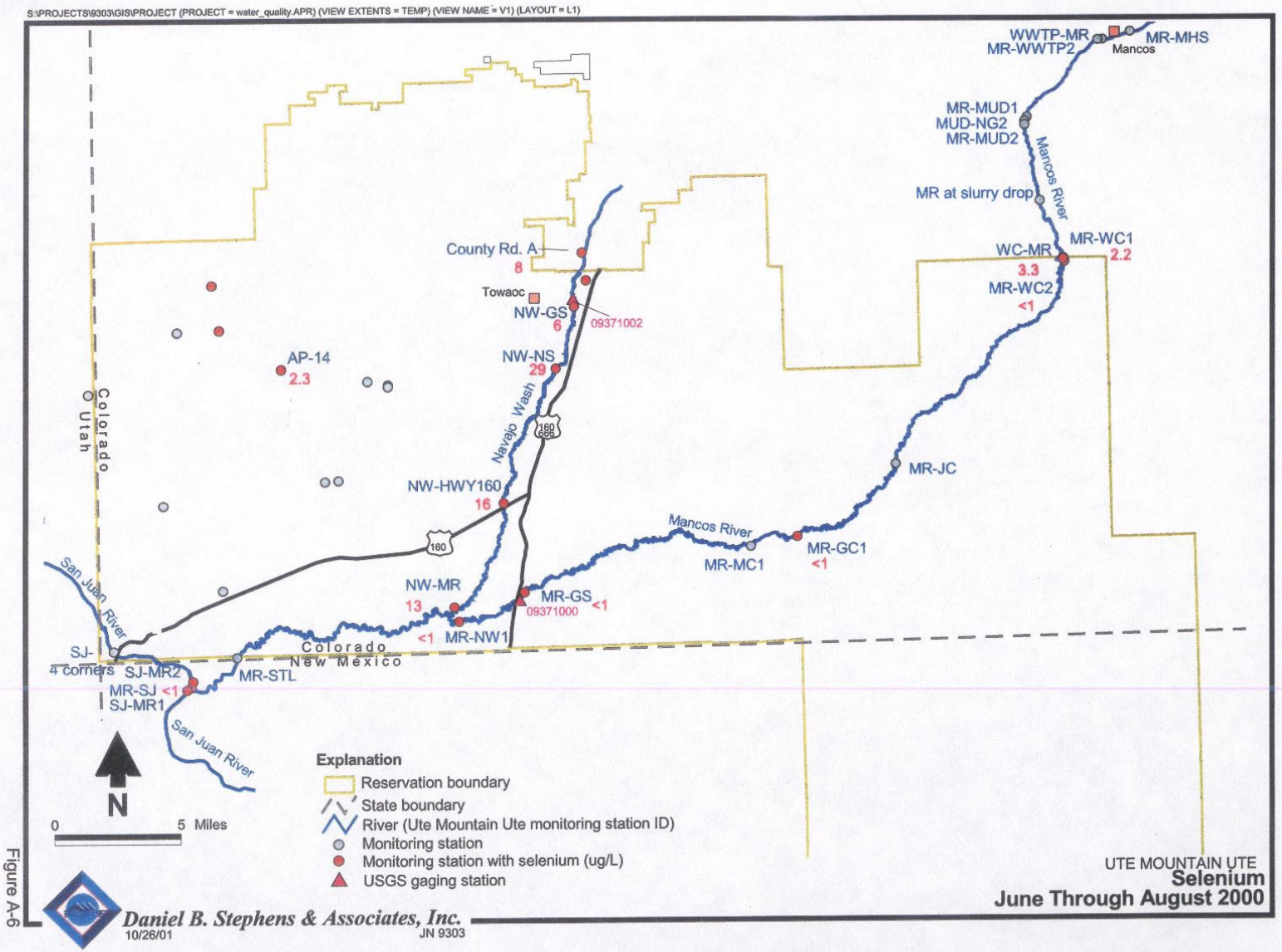
WWTP-MR
MR-WWTP2
Mancos
MR-MHS
MR-MUD1
MUD-NG2
MR-MUD2
Mancos River
MR at slurry drop
1854
MR-WC1
1844
WC-MR
1976
MR-WC2
1812
County Rd. A
1142
MBLW-Well 1
1004
Towaoc
NW-GS
1346
09371002
AP-5
438
AP-14
5856
NW-NS
1714
Navajo Wash
160
666
Colorado
Utah
MR-JC
1770
NW-Hwy160
2064
Mancos River
1658
MR-GC1
MR-MC1
160
San Juan River
NW-MR
2038
MR-GS
09371000
1990
MR-NW
2038
SJ-
4 corners
Colorado
New Mexico
SJ-MR2
298
MR-STL
MR-SJ
820
SJ-MR1
292
San Juan River
N
0
5 Miles
Explanation
Reservation boundary
State boundary
River (Ute Mountain Ute monitoring station ID)
Monitoring station
Monitoring station with TDS (mg/L)
USGS gaging station
UTE MOUNTAIN UTE
Total Dissolved Solids
June Through August 2000
Daniel B. Stephens & Associates, Inc.
10-26-01
JN 9303

Figure A-5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WWTP-MR
MR-WWTP2
MR-MHS
Mancos
MR-MUD1
MUD-NG2
MR-MUD2
Mancos River
MR at slurry drop
WC-MR
3.3
MR-WC1
2.2
MR-WC2
<1
County Rd. A
8
Towaoc
NW-GS
6
09371002
AP-14
2.3
NW-NS
29
Navajo Wash
160
686
Colorado
Utah
MR-JC
NW-HWY160
16
160
Mancos River
MR-GC1
<1
MR-MC1
San Juan River
NW-MR
13
MR-GS
09371000
<1
<1
MR-NW1
SJ-
4 Corners
SJ-MR2
MR-STL
Colorado
New Mexico
MR-SJ <1
SJ-MR1
San Juan River
N
0
5 Miles
Explanation
Reservation boundary
State boundary
River (Ute Mountain Ute monitoring station ID)
Monitoring station
Monitoring station with selenium (ug/L)
USGS gaging station
UTE MOUNTAIN UTE
Selenium
June Through August 2000
Daniel B. Stephens & Associates, Inc.
10/26/01
JN 9303

Figure A-6

Appendix B. References

Abell, R. 1994. *San Juan River Basin water quality and contaminants review*. Museum of Southwestern Biology, Department of Biology, University of New Mexico. April 1994.

Bureau of Indian Affairs, Branch of Land Operations (BIA). 1966. *Summary report: Soil and range inventory of the Ute Mountain Indian Reservation.* U.S. Department of the Interior.

Butler, D.L., R.P. Krueger, and B.C. Osmundson. 1995. *Reconnaissance investigation of water quality, bottom sediment, and biota associated with irrigation drainage in the Dolores Project are, southwestern Colorado and southeastern Utah, 1990-91.* Water-Resources Investigations Report 94-4041. U.S. Geological Survey, Denver, Colorado.

Butler, D.L., B.C. Osmundson, and R.P. Krueger. 1997. Field screening of water, soil, bottom sediment, and biota associated with irrigation drainage in the Dolores Project and the Mancos River Basin, southwestern Colorado, 1994 [abs.]. Water-Resources Investigations Report 97-4008. http://co.water.usgs.gov/publications/abstracts/a97-4008.html, accessed January 18, 2001.

Colorado Department of Public Health and Environment, Water Quality Control Division, and USDA Natural Resources Conservation Service (Colorado DPHE and USDA). 1998. *Colorado unified watershed assessment, Final draft.* October 1, 1998.

Colorado Water Quality Control Division (WQCD). 1989. *1989 Addendum, Colorado nonpoint source assessment report.* November 1989.

Earthinfo, Inc. 2000. *NCDC Summary of the Day, West 1 2000.*

Ecosphere Environmental Services. 2000. *Ute Dome 3D Seismic Project, Ute Mountain Ute Indian Reservation and Bureau of Land Management administered land, San Juan County, New Mexico, La Plata County, Colorado, Environmental Assessment.* Prepared for T.H. Quest, Inc., Dallas, Texas, Bureau of Indian Affairs and Ute

Mountain Ute Indian Tribe, Towaoc, Colorado, and Bureau of Land Management Farmington Field Office, NM-070-00-0706. August 2000.

Ecosystem Management, Inc. 2000. *Environmental assessment, Ute Mountain Ute Fire Management Plan.* Submitted to Bureau of Indian Affairs, Branch of Forestry, Albuquerque. January 26, 2000.

Geldon, A.L. 1985. *Water resources of the Cottonwood Wash watershed, Ute Mountain Ute Indian Reservation, southwestern Colorado.* Water-Resources Investigations Report 85-4027, U.S. Geological Survey, Lakewood, Colorado.

Leavesley, G. 1975. *Quantity and quality of principal rivers entering the southern Ute and Ute Mountain Ute Indian Reservations, Colorado and New Mexico.* Open-File Report 75-90. U.S. Department of the Interior Geological Survey, Lakewood, Colorado.

Titan Environmental Corporation. July 1994. *Hydrogeologic Evaluation of White Mesa Uranium Mill*.

Utah DEQ-- Division of Water Quality, Utah DNR—Division of Oil, Gas, and Mining, United States Forest Service, U.S. Bureau of Land Management. December 2000. *Cottonwood Wash Watershed Abandoned Mine Reclamation Project Environmental Assessment*.

U.S. Environmental Protection Agency (EPA). 1997. *Tribal nonpoint source planning handbook.* EPA-841-B-97-004, Office of Water, Washington, D.C. August 1997.

Ute Mountain Ute Tribe (UMU). 1976. *Overall economic development program.* May 1976.

Ute Mountain Ute Tribe (UMU). 1999a. *Comprehensive economic development strategy.* June 1999.

Ute Mountain Ute Tribe (UMU). 1999b. *Ute Mountain Ute Tribe Farm & Ranch Enterprise water management plan.* Presented to U.S. Bureau of Reclamation. December 1999.

Ute Mountain Ute Tribe (UMU) Environmental Programs Department. 2001. *Water quality standards for surface waters of the Ute Mountain Ute Indian Reservation, Colorado, New Mexico, Utah.* Draft, January 2001.

Ute Mountain Ute Tribe (UMU) Environmental Programs Department. 2001. *Water quality standards for surface waters of the Ute Mountain Ute Indian Reservation, Colorado, New Mexico, Utah*. Final adopted standards, November 2002.

Ute Mountain Ute Tribe (UMU) Environmental Programs Department. August 2004. *Ground Water Protection Plan*.

Whitfield, M.S., Jr., W. Thordarson, W.J. Oatfield, E.A. Zimmerman, and B.F. Rueger. 1983. *Regional hydrology of the Blanding-Durango area, southern Paradox Basin, Utah and Colorado.* Water-Resources Investigations Report 83-4218, U.S. Geological Survey. 88p.