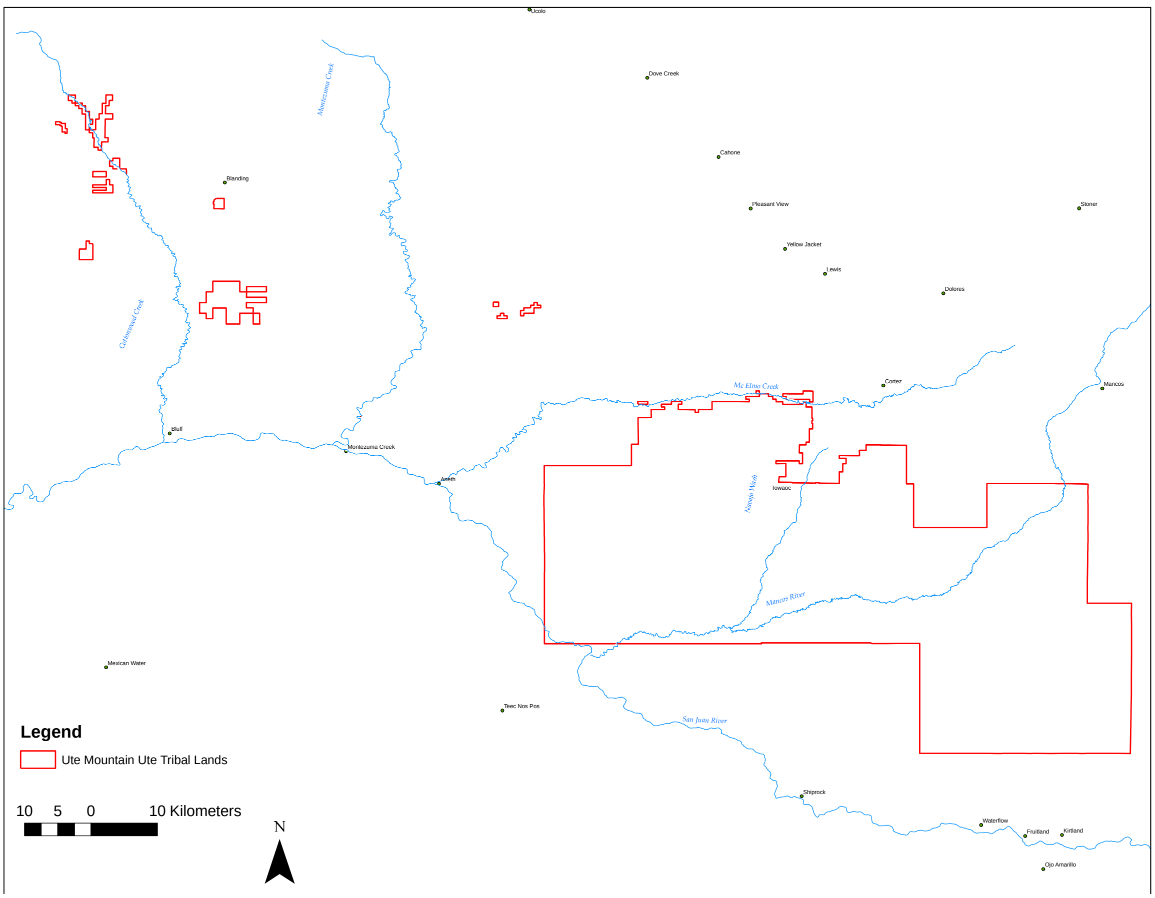
McElmo Creek, Lower San Juan River, Colorado and Cottonwood Wash, Utah Water Quality and Trends Assessment:

2009 – 2010



Prepared by Colin Larrick, Water Quality Specialist

Ute Mountain Ute Tribe

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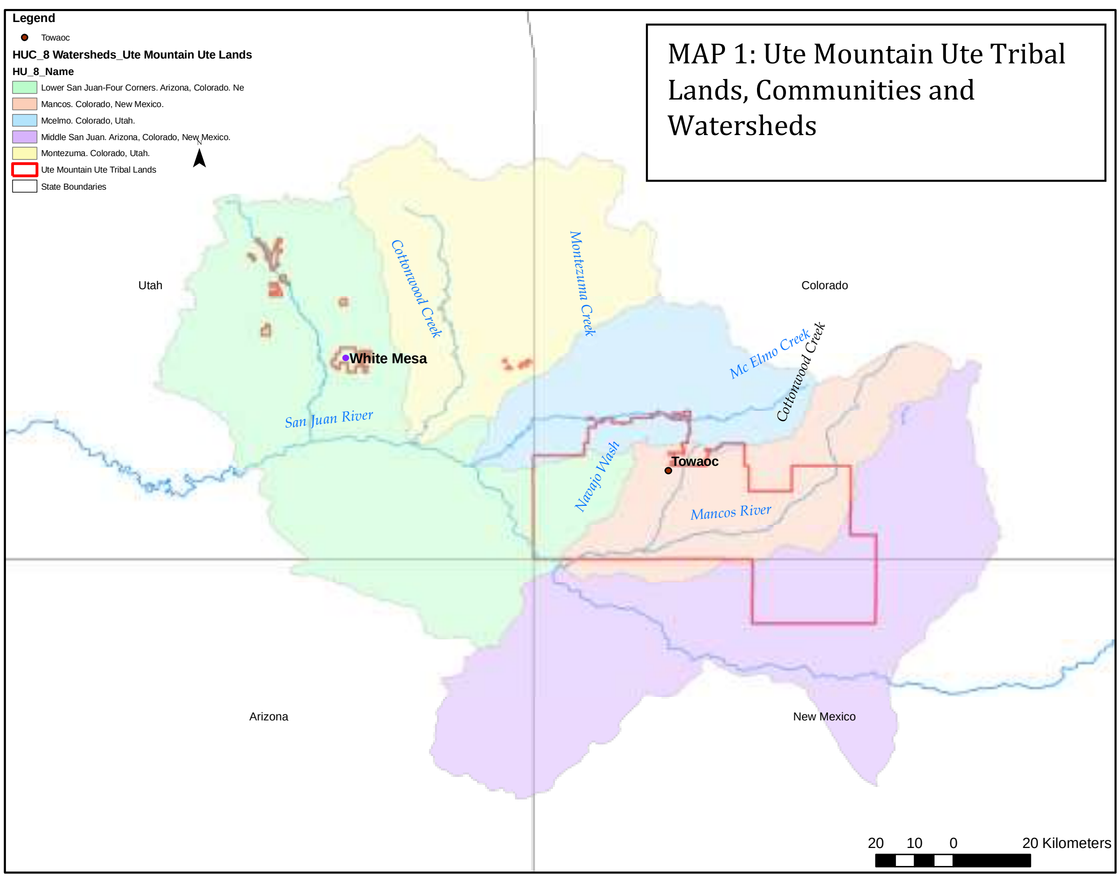
INTRODUCTION

This Tribal Assessment Report, "McElmo Creek, Lower San Juan River, Colorado and Cottonwood Wash, Utah Water Quality and Trends Assessment, 2009 – 2010" consists of a description of the Ute Mountain Ute Tribe's Section 106 funded Water Pollution Prevention Program monitoring strategy, a water quality assessment of historical and current (2009 – 2010) water quality data and a report of the Ute Mountain Tribe's WQX submitted data for Fiscal Year 2010.

Ute Mountain Ute Tribal Lands (Tribal Lands) are located mostly in extreme southwestern Colorado, with portions extending in southeast Utah and northwestern New Mexico (Map 1). The Reservation is 597,288 acres or approximately 933 square miles in total area of trust land, with an additional 27,354 acres of fee land that is used for cattle ranching. It is the homeland for the Weeminuche Band whose population is approximately 2,100 members.

The Tribal seat is located in Towaoc, Colorado (pronounced Toy-uk), and is located at the base of the Sleeping Ute Mountain in Montezuma County, Colorado. This area is commonly known as "The Four Corners Region," describing the intersection of the states of Colorado, Utah, New Mexico, and Arizona. The intersection point of the four states is the most southwestern point in Colorado and also the most southwestern point on the Ute Mountain Ute Indian Reservation.



Water quality regulation on the Reservation exists under a few different programs. In 2005, EPA approved the Tribe's application for "Treatment in the Same Manner as a State," thereby granting jurisdiction for the standards following EPA's technical approval. In 2011, the Ute Mountain Tribal Council adopted revised Water Quality Standards for Surface Waters of the Ute Mountain Ute Reservation. These standards follow the context of the Clean Water Act and guidance produced by U.S. EPA.

Most significantly, the recently adopted revision of the water quality standards include an anti-degradation policy and anti-degradation implementation policy designed to protect uses and maintain highest possible water quality. The antidegradation provisions contain two important components:

- **Antidegradation Review and permitting process for activities that may significantly degrade water quality**
- **Enforcement provisions for permit violations or water quality pollution on the reservation**

Other non-binding water quality regulations are the Nonpoint Source Management Program and the Ground Water Protection Plan. The former is a management plan for control of nonpoint source pollutants on the Reservation and Tribal fee lands. The Tribe has been awarded a small base-grant through Clean Water Act Section 319 funding to assist with implementing nonpoint source management strategies on the Reservation. The Ground Water Protection Plan describes the various aquifers on the Reservation, their vulnerability to various pollutant sources, and what each aquifer is used for. Thresholds are set for taking action to mitigate any pollution; those are mostly based on Safe Drinking Water Act Maximum Contaminant Levels. Both of these "non-binding" regulations do not specifically outline consequences of non-compliance such as the water quality standards, but instead are intended to be pollution prevention measures to protect public health and environment. For more information and to view or download these documents, visit www.utemountainuteenvironmental.org .

The semi-arid climate and limited water resources on and around the Ute Mountain Ute Indian Reservation make the quality of available water resources a key to the survival and prosperity of the Tribe, its enterprises, and the ecosystems on the Reservation. The existing Clean Water Act Section 106 Water Pollution Prevention Program has begun to give the Tribe insight into the present problems and issues surrounding their water resources and the effect that the Tribe and surrounding land owners have on those resources. The San Juan River watershed is important habitat for many threatened and endangered species of fish and wildlife as well as home to the Ute Mountain Ute Tribe and many other people. With the continuing support of the EPA, through the Clean Water Act Section 106 Pollution Prevention Program, the Tribe hopes to research and protect the valuable resources of this watershed.

1. DESCRIPTION OF LAND BASE

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 semi-arid grassland in the lower elevations to mixed conifer forests in the higher elevations (UMU, 1999). The reservation includes six vegetation zones (EMI, 2000) including semidesert 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, 1999).

The climate of Four Corners region is classified as semi-arid and is characterized by low humidity, cold winters, and wide variations in seasonal and diurnal temperatures. Temperature varies with elevation. Average monthly maximum temperatures range from 39°F to 86°F, and the average monthly minimum temperatures range 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 typically occurring in December.

1.1 WATERSHEDS

The Ute Mountain Ute Indian Reservation is part of the San Juan River drainage basin (with the exception of some fee lands), a major tributary to the Colorado River. The San Juan River flows from the mountains of Colorado into Navajo Reservoir and northwestern New Mexico, through the Farmington, New Mexico area- a few miles south of the Ute Mountain Ute Reservation (in New Mexico), then turns northwest- crossing the Navajo Reservation and flows across approximately four miles of the most southwestern part of the Ute Mountain Reservation, near the Four Corners (Map 1).

The Mancos River (HUC 14080107) is the main tributary to the San Juan River from the Reservation. It enters the northeast corner of the Reservation, from Mesa Verde National Park into the Ute Mountain Ute Tribal Park. It joins the San Juan River just outside the southern Reservation boundary, flowing approximately 70 stream miles through the Colorado portion of the Reservation. The Mancos River drains some of the western slope of the La Plata Mountains, all of the south face of Mesa Verde, the southern half of Sleeping Ute Mountain, and areas south of the mountain by way of Navajo Wash, its tributaries and Aztec Wash.

On the Western side of the Ute Mountains, water flows ephemerally and intermittently in Cowboy Wash, Coyote Wash, Marble Wash, and Mariano Wash which are tributary to the lower San Juan River in Colorado and Utah (HUC 14080201).

The Tribe also has lands that are tributary to the San Juan in the Middle San Juan Watershed (HUC 14080105). McElmo Creek (HUC 14080202) flows west from Cortez across two parcels of Reservation land draining the northern portion of the Sleeping Ute Mountains via small tributaries and empties into the San Juan River in Utah. Most lotic surface water bodies on the Reservation are ephemeral and/or intermittent with the exceptions of the San Juan River, the Mancos River, McElmo Creek, and Navajo Wash (Map 1).

The Monitoring Strategy for the Ute Mountain Ute Tribes' Clean Water Act 106 Water Pollution Prevention Program is designed with a triennial rotating basin approach. The monitoring strategy is described in further detail in Section 2. McElmo Creek and the San Juan River in Colorado and Cottonwood Wash in Utah were the focus of FY2010 monitoring and this assessment report. The watersheds of these areas are described in Section 1 and 2009 – 2010 monitoring results are analyzed in Section 3.

1.2 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. 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, 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 Mountain Casino Hotel/Resort, the Sleeping Ute RV park, and Ute Mountain Pottery. Table 1 summarizes the current land use on the reservation; Figure 1 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

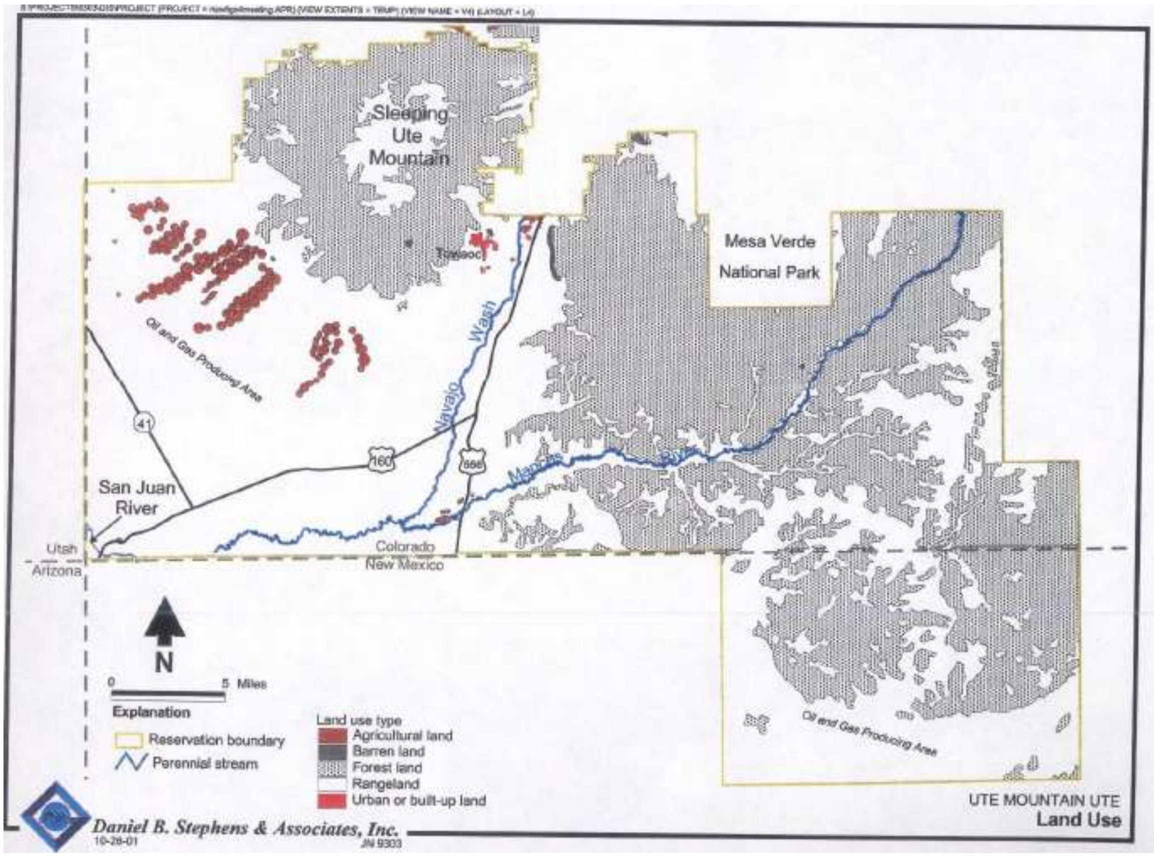
Source: Tribal Land Use Commission, as cited in Ute Mountain Ute Tribe, 1999

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, sunflowers and barley. The Mancos River farm grows hay and provides irrigated rangeland.

The Farm and Ranch Enterprise primarily grows crops and also owns approximately 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.

Figure 1



Source: 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.

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, 1999). 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 are 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.

1.3 LOWER SAN JUAN, CO

The San Juan River's headwaters are among the 14,000 foot peaks of the San Juan mountains in southwestern Colorado. The river travels south and the surface geology changes from areas of crystalline, igneous and metamorphic lithology to fine-grained sedimentary strata. The San Juan River flows across approximately four miles of the Reservation near Four Corners and is home to two of the endangered species on the Ute Mountain Ute Reservation, the Colorado Pikeminnow and the Razorback Sucker. Flow in the San Juan River has been regulated by Navajo Dam since 1962. This significant hydrologic modification of the river has altered historical flow regimes and water quality and has also contributed to habitat fragmentation. These changes have altered species composition in the river and the entire riparian corridor. Invasive species are now dominant organisms in the river ecosystem from Navajo Dam through Ute Mountain Ute Tribal Lands continuing to the river's terminus at Lake Powell, Utah.

Irrigation, grazing and mineral extraction, processing and use are the major categories of contaminant sources in the San Juan Basin watershed. Selenium and salinity are the major contaminants associated with irrigation return flows and sediment from infrastructure development such as roads and well pads. Pesticides, nutrients and polycyclic aromatic hydrocarbons are also associated with these sources in addition to mercury. Disturbed soils generally impact water quality most during storm events as eroded soils carry sediment and related pollutants into the waterways.

The San Juan has been listed as impaired on the State of New Mexico's 303(d) list for both sedimentation/stream bottom deposits and e.coli bacteria/human pathogens upstream of the Tribe's land.

1.4 MCELMO CREEK, CO

McElmo Creek is in the southwest corner of Colorado within Montezuma County. The City of Cortez which is centrally located in the project area is at an elevation of 6200 feet above sea level. The watershed originates in the lower foothills of the LaPlata Mountains to the East. It is bounded by the Dolores River Canyon Rim to the North and to the South by Mesa Verde and the Ute Mountain to the Southwest. McElmo Creek is a tributary to the San Juan River.

The McElmo Creek basin is relatively dry under natural conditions. Montezuma Valley Irrigation Company (MVIC), the major user and distributor of irrigation water, diverts approximately 116,000 acre feet of Dolores River water annually (1957-1973 data) into the Montezuma Valley. Diverting water from McPhee reservoir on the Dolores River through a tunnel and extensive canal system, MVIC presently distributes water to approximately 29,000 acres. Return flows from irrigation and municipal discharges constitute most of the continuous channel flow in McElmo creek.

Mancos Shale underlies much of the Montezuma Valley. This shale is of Cretaceous aged and marine in origin with a high salt content, and provides the main salt source for the return flow into McElmo Creek. Excessive irrigation and seepage from delivery systems cause deep percolation. This water dissolves salts, which move downward until they reach McElmo Creek, the San Juan River and finally the Colorado River.

The farmland elevation ranges from 5,800 to 7,000 feet. The annual precipitation is nearly 12 inches, including snowfall. (NRCS, 2009)

Mud Creek, an intermittent tributary, flows from its headwaters on the northeast flank and foothills of the Sleeping Ute Mountains, goes underground for approximately four miles and emerges approximately one half mile from McElmo Creek. It picks up minerals and metals from the geologic formations it passes and contributes significantly to the salinity load in McElmo Creek. Mud Creek has also been added to the State of Colorado's monitoring and evaluation list to evaluate if it should be listed as impaired due to elevated selenium concentrations.

Mountain snow melt and springs that are tributary to McElmo Creek are generally 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 (Last Lake, elbow wetland) capture water in the upper reaches of Pine Creek, a tributary to McElmo. Besides adverse physical effects of these 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.

1.5 COTTONWOOD WASH, UT

In Utah, Cottonwood Wash has elevated uranium and radiation levels stemming from uranium mining within 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 the Tribal numeric criteria for uranium of 30 ug/L which has been set to protect livestock health. Narrative criteria exist in the Tribe's water quality standards as well to protect against negative effects of toxic substances such as radionuclides, the narrative citeria are expressed as follows:

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

The Tribe also has a narrative biological criterion:

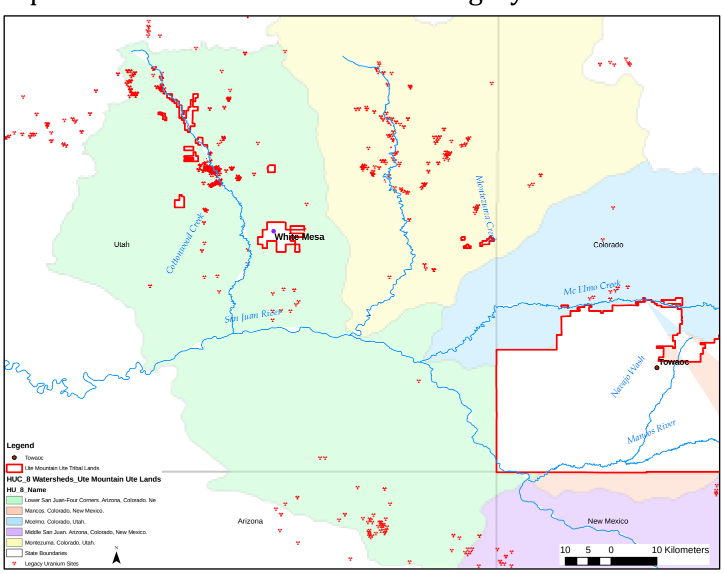
"*The overall biological criterion of the Tribe is to maintain and support conditions similar to reference sites or reference conditions that are determined by the Tribe. Assessment of biological conditions will include monitoring of the benthic macroinvertebrates, fish, and/or plant communities as appropriate. 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 Tribe Surface Water Quality Standards, Section 6)

Both Allen Canyon and Cottonwood Wash have a warm water aquatic life designated use assigned to them. This includes benthic macroinvertebrates; macroinvertebrate sampling conducted in the past has confirmed there are very few species of benthic macroinvertebrates that can tolerate the conditions in Cottonwood Wash (Ute Mountain Ute Tribe Nonpoint Source Assessment Report, 2005). 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. Gross Alpha 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.

An archeologically rich area inhabited for three thousand years and extensively mined for vanadium and uranium in the 20th century, the watershed was littered with radioactive waste and open mines that threatened public safety after mining booms began when ore-bearing minerals were discovered in the watershed in 1931 and lasted through the early 1970's. Cottonwood Wash has been listed by the State of Utah on its 2000 303(d) list as impaired for gross-alpha radiation. A multi-agency watershed clean-up effort was implemented to mitigate the impacts of uranium and vanadium mining and processing. The clean-up effort has been moderately successful although serious impacts and radioactive legacy remain. At Cottonwood Wash, cooperative partnering between agencies reclaimed 264 acres to date. Seventy-three miles of mine exploration roads have been reclaimed, 213 adits have been sealed and 66 shafts are now safeguarded. (http://www.blm.gov/ut/st/en/prog/more/Abandoned_Mine_Lands/projects/Cottonwood_Wash_Watershed.html).

Designated uses impaired due to gross alpha and uranium contamination include wildlife/aquatic life, livestock watering and Tribal Ceremonial.

Map 2: Cottonwood Wash Area and Legacy Uranium Sites



Physically and biologically, Cottonwood Wash has several road crossings and many remaining legacy mines and associated tailings spoils that liberate sediments with storms and other flow events (spring runoff, baseflows) that may be impacting aquatic life in ways unrelated to their potentially associated radiological impacts. Sediments can negatively impact aquatic life by smothering available habitat and thereby eliminating food sources as well as places for aquatic life to dwell and procreate.

Cottonwood Wash and its tributaries are heavily infested by Tamarisk, although large Cottonwood and Willow stands have not been outcompeted. San Juan County has also released *Diorhabda Elongata*, the Tamarisk Beetle, a bio-control agent that has defoliated Tamarisk across the watershed and will likely result in significant Tamarisk mortality over the next decade.

The adjacent and tributary Allen Canyon Creek is relatively unimpaired biologically and physically. There are no road crossings or mine tailings contributing to sediment loading and beavers have created step-pool habitat that create 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.

To adequately assess and quantify the physical and biological status and trends in the watershed the Rapid Stream Riparian Assessment Protocol (RSRA) will be implemented during the next monitoring period for the watershed (2013). This protocol has been designed to efficiently assess the health and functional condition of streams and their associated floodplains. This method, which has been used throughout the southwest, takes a holistic approach and considers: water quality, fluvial geomorphology, condition of the aquatic habitat for fish and invertebrates, structure and productivity of terrestrial vegetation, and quality of wildlife habitat. The Tribes' water quality staff (Technician Jamie Ashmore and Specialist Colin Larrick) attended a training workshop for RSRA methodology in 2010 and are currently implementing the protocol for Navajo Wash (2011 monitoring) and the Mancos River (2012 monitoring).

2. DESCRIPTION OF MONITORING STRATEGY

The document, "Ute Mountain Ute Environmental Programs Department Water Pollution Prevention Program Monitoring Strategy, revised July, 2009" (Appendix 1) includes a description of watersheds on the Reservation along with a general water quality summary for each watershed area. Monitoring objectives, monitoring design and parameters, frequency of sampling, data management, quality assurance, project effectiveness, data analysis and assessment, reporting and general support and infrastructure of the Water Pollution Prevention Program are all described in detail in the document. A summary of the monitoring strategy is presented below to facilitate interpretation of the 2009 monitoring results.

2.1 MONITORING OBJECTIVES

Monitoring objectives for the Ute Mountain Ute Clean Water Act Section 106 Water Pollution Prevention Program Monitoring Program have been developed in order to effectively assess the overall quality of Tribal waters in relation to the Tribes Water Quality Standards, the extent that water quality is changing over time, the identification of potential problem areas, areas needing protection and restoration, and the evaluation of the effectiveness of the Tribes' clean water program and projects.

2.2 MONITORING DESIGN AND PARAMETERS

The surface water monitoring program has used a rotating basin strategy to accomplish monitoring in each watershed within a three year period, as in the schedule table below. Specific sample sites chosen for the determination of surface water quality are chosen based on the following factors:

- Reservation boundaries
- Pollution sources
- Potentially impaired stream segments
- Tributaries
- Historical data collected by the U.S.G.S. and the B.O.R.
- Public interest and concern
- Accessibility

There are currently 101 sample locations in the Ute Mountain Ute Water Quality Database. The number of actual locations sampled each year is dependent on funding, available staff, site access and weather conditions. Sample locations are reviewed annually to assess if changes, additions, or deletions of sites are appropriate.

YEAR (Oct-Sept)	**BASIN(S)**
FY 2007	Mid/Lower San Juan, incl. McElmo Creek, Cottonwood Wash, UT
FY 2008	Navajo Wash
FY 2009	Mancos River
FY 2010	Mid/Lower San Juan, incl. McElmo Creek, Cottonwood Wash, UT

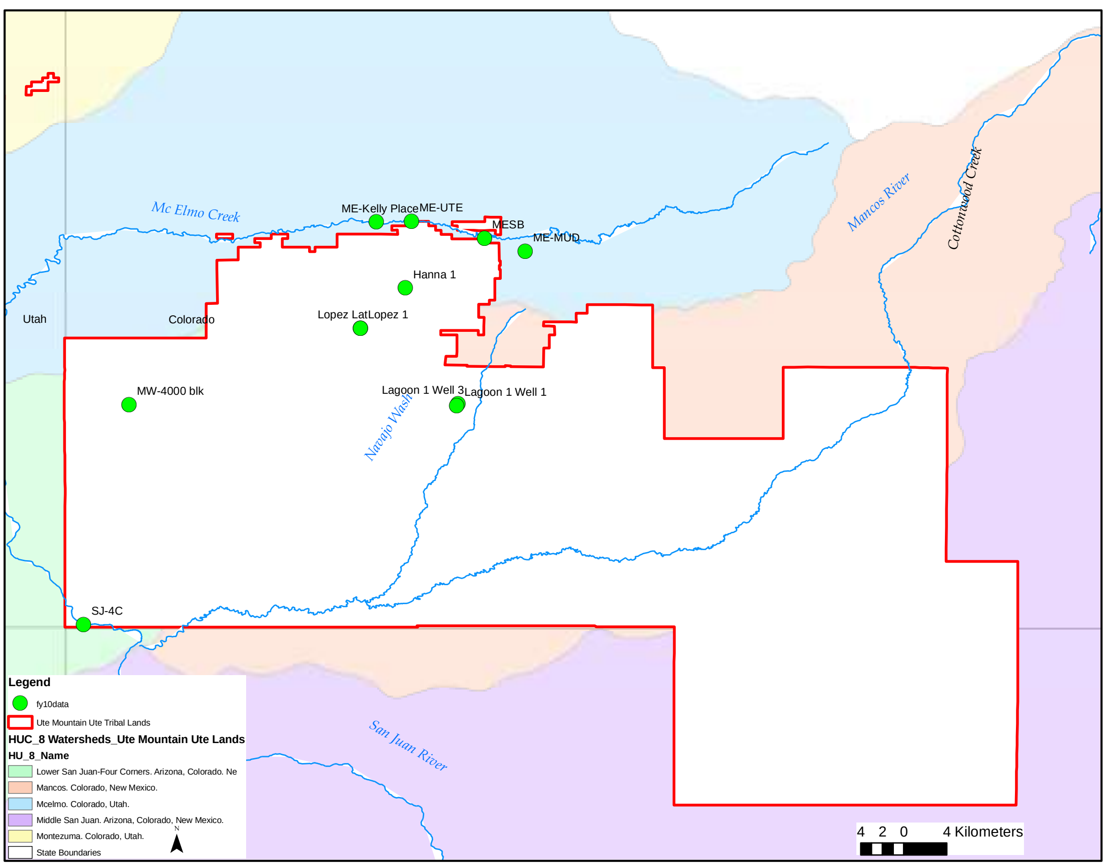
FY 2011	Navajo Wash
FY 2012	Mancos River
FY 2013	Mid/Lower San Juan, incl. McElmo Creek, Cottonwood Wash, UT

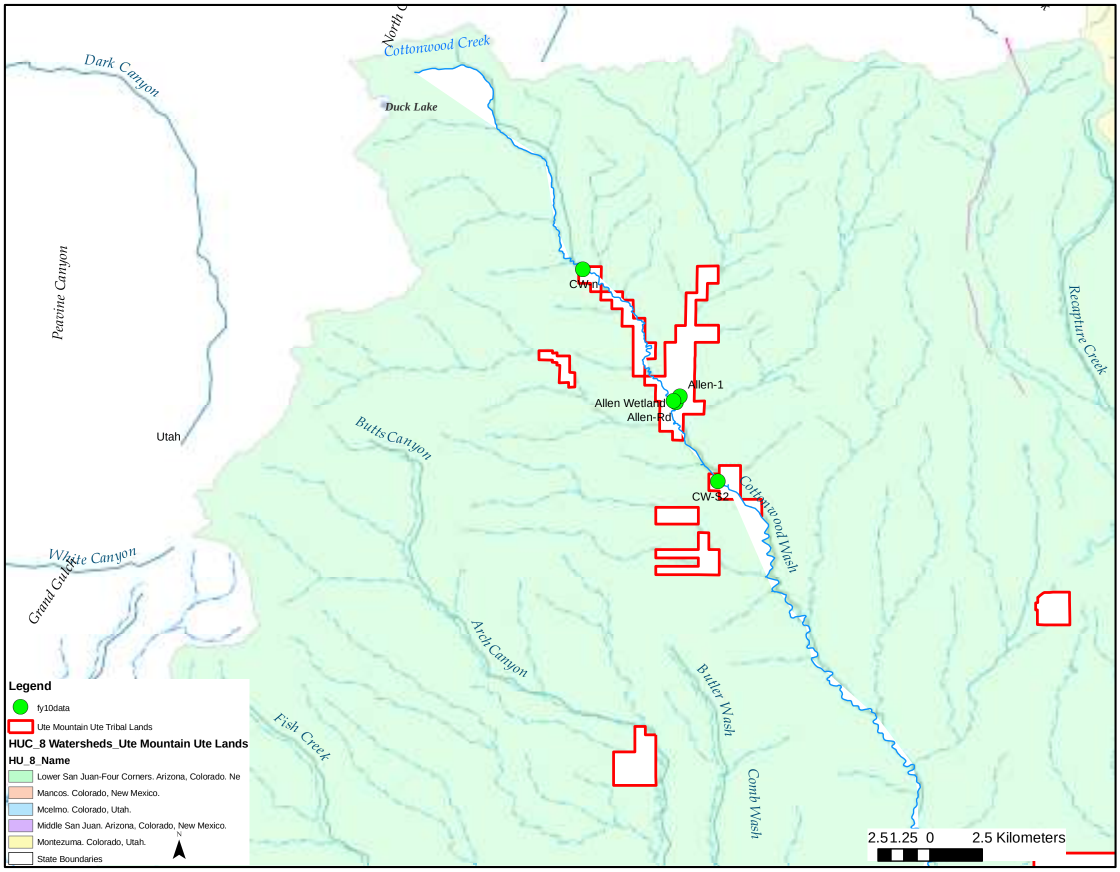
Each of the basins in the table above has some baseline data. Each has specific data gaps that will need to be addressed to meet the monitoring objectives described in Section II of the Monitoring Strategy (Appendix 1).

2.3 WATER QUALITY MONITORING SITE DESCRIPTIONS

Monitoring locations have been established on the San Juan River, McElmo Creek, Cottonwood Wash watershed in Utah, and around the community of Towaoc and Sleeping Ute Mountain in Colorado to assess water quality trends and protect designated uses. Map 3, below, shows the geographical locations of monitoring locations for Mid/Lower San Juan, including McElmo Creek and Cottonwood Wash, UT. A justification of the monitoring locations is included as well.

MAP 3: FY-10 Sampling Locations:





<u>Surface water sample site location justification</u>:

ME-MUD: Perennial tributary to McElmo Creek. Headwaters on Reservation. Influenced by irrigation returns. Parameters of concern include selenium, salinity.

ME-UTE: Site is at confluence of McElmo Creek and Ute Creek, an ephemeral/intermittent stream channel originating near Ute Peak on Reservation.

ME-SB: Monitoring location is on one of the few parcels of Tribal land that include access to McElmo Creek. Downstream of significant acerage of irrigated land.

ME-Kelly Place: Sample location is directly upstream of Tribal land on McElmo Creek.

SJ-4C: Sample location at USGS gauge on Tribal Land on the San Juan. One of the only sample locations on the relatively small portion of San Juan River (~4 miles) that flows through the Reservation.

CW-N: Site is at Tribal Boundary downstream of Forest Service land with significant legacy mine issues.

CW-S2: Site is on Tribal Land in Cottonwood Wash watershed, an area with significant legacy mining issues.

Allen-Rd: Site in on Tribal land in relatively unimpacted portion of Cottonwood Wash, useful as a reference site to Cottonwood Wash. Also designated as an Outstanding Tribal Resource Water and afforded the greatest level of protection under Tribal Law/Tribal Water Quality Standards. Allen-Rd was established after historically used monitoring location, Allen 1 was unexpectedly found to be dewatered in FY10 on multiple locations, investigations into the cause of this continue. . ..

Allen 1: Site in on Tribal land in relatively unimpacted portion of Cottonwood Wash, useful as a reference site to Cottonwood Wash. Also designated as an Outstanding Tribal Resource Water and afforded the greatest level of protection under Tribal Law/Tribal Water Quality Standards.

Allen Wetland: Wetland area at Allen Canyon/Cottonwood Wash confluence. Important water resource for all types of biological life in the watershed.

MW-4000blk: Irrigation runoff comprises much of the flow in Marble Wash. Concerns with quality of this water resource, also heavily used by livestock.

Lagoon 1 Well 3: Downstream of wastewater lagoon 1 system. Evaporative lagoons serving Towaoc municipality, not completely lined. Concerns with potential nutrient, bacteria, trace metal, salinity impacts to groundwater and potentially Navajo Wash.

Lagoon 1 Well 1: Downstream of wastewater lagoon 1 system. Evaporative lagoons serving Towaoc municipality, not completely lined. Concerns with potential nutrient, bacteria, trace metal, salinity impacts to groundwater and potentially Navajo Wash.

Lopez: Spring near sundance grounds on Ute Mountain. Ceremonially important. Pristine Resouce.

Hanna: Spring on Ute Mountain. Ceremonially important. Pristine Resouce.

2.4 MONITORING GOALS, LOCATIONS SAMPLED AND DATA COLLECTED

Data collection efforts for the Lower San Juan, McElmo Creek and Cottonwood Wash systems during the course of fiscal year 2010 monitoring were designed to assess the quality of water in these locations for compliance with the Tribes water quality standards to determine the current state of the Tribes water resources and to identify trends and potential sources of impairment. Table 2 below summarizes sample locations, dates and data types collected for each sample.

Table 2				
Sampling Locations, Dates and Data Types for FY 10 Data **Ute Mountain Ute Water Polution Prevention Program**				
Location Description	Station ID	Latitude / Longitude	Sample Date	Data Type
At USGS Guaging Station 09371492. South side of highway 32 Upstream of confluence with McElmo Creek. Mud Creek is a spring fed creek that flows intermittently on the reservation before proceding to McElmo.Some small diversions upstream from station for irrigation. Most of flow is from diversion of water from Dolores River through Dolores Project and Montezuma Valley Irrigation Company.	ME-MUD	37.313 / 108.661	2/18/2010 5/6/2010 7/21/2010 7/29/2010 9/8/2010 9/29/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],
McElmo Creek approximately 1.2 miles downstream of the confluence of McElmo Creek and Mud Creek, located on a parcel of Tribal Land between Alkali and Trail Canyon. Site is located on a deeply incised meander of creek adjacent to a salt encrusted soil-bank.	MESB	37.324 / 108.695	2/18/2010 5/6/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],
At the confluence of Ute creek and McElmo creek	ME-UTE	37.338 / 108.756	2/18/2010 7/21/2010 7/29/2010 9/8/2010 9/29/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],
Directly up stream of the Ute Mountain Ute land	ME-Kelly Place	37.337301 / 108.785407	2/18/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],
San Juan River near four corners. USGS guage at site with historical data record for flow and water quality. Jurisdictional hotspot.	SJ-4C	37.001113/-109.029585	2/18/2010 7/21/2010 7/29/2010 9/8/2010 9/29/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],

Cottonwood Wash, north end of Tribal lands there. The ephemeral wash flows onto and off from the Tribal lands a few times on its journey to the San Juan River. Highly impacted by uranium mining.	CW-N	37.742 / 109.689	5/5/2010 7/22/2010 9/9/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],
Cottonwood wash @ Kigalia Point road crossing. Site is approximately 75 yards upstream of road crossing.	CW-S2	37.650 / 109.630	5/5/2010 9/9/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],
Downstream end of Allen Canyon 10-15 yards off road, up stream, tributary to Cottonwood Wash. Because of the absence of uranium mining on Tribal Lands, Allen Canyon Creek is used as a reference condition for radiation levels and ecology in comparison to Cottonwood Wash.	Allen-Rd	37.684 / 109.6485	5/5/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],
Downstream end of Allen Canyon, tributary to Cottonwood Wash. Because of the absence of uranium mining on Tribal Lands, Allen Canyon Creek is used as a reference condition for radiation levels and ecology in comparison to Cottonwood Wash.	Allen 1	37.687 / 109.647	7/22/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],
Wetland in between Cottonwood wash and Allen canyon creek just upstream of confluence.	Allen Wetland	37.685 / 109.649	9/9/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],
Ground water well down gradient of Lagoon 1 sewer system	LAGOON 1 WELL 3	37.186 / 108.717	9/15/2010 9/28/2010 9/29/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],
Groundwater well down-gradient of Lagoon 1 sewer system	LAGOON 1 WELL 1	37.184 / 108.718	9/15/2010 9/28/2010 9/29/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],

Spring near Sun Dance grounds, highest human consumption use, tested for bacteria annually before Sun Dance; restoration project undertaken here.	Lopez 1	37.249 / 108.798	5/26/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],
Spring near Sun Dance grounds, highest human consumption use, tested for bacteria annually before Sun Dance; restoration project undertaken here.	Lopez Lat	37.249 / 108.799	5/26/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],
Mountain spring, lots of human use.	Hanna 1	37.282 / 108.761	5/26/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],
Marble wash below farm and ranch 4000 block. sampled for the determination of herbicides in surface water.	MW-4000 blk	37.185 / 108.992	7/8/2010	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],

[1] Field parameters: Water temp, Air temp, pH, Conductivity, Disolved Oxygen, Flow, Barametric Presure

[2] Major Ion Data: Calcium, Chloride, Magnesium, Potassium, Sodium, Sulfate, Hardness, Alkalinity

[3] Nutrient Data: Nitrite-Nitrate, Organic Nitrogen, Ammonia, and Phosphorus

[4] Metals Data: Arsenic, Barium, Boron, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Nickel, Selenium, Silver and Zinc

[5] Physical parameters: Total Dissolved Solids, Total Suspended Solids

Note: Complete parameters listed for each of the five data types were not collected for every sample

Table 3 includes complete sample results for each sample collected

3. 2010 WQX SUBMITTED DATA

1,547 distinct rows of data were successfully migrated to the WQX warehouse for FY10 water quality sampling events in the Lower San Juan, McElmo and Cottonwood Wash Watersheds for FY2010 were submitted to the Regional WQX database, this data is analyzed and interpreted in the following sections. Complete analytical results for each sample event are included with this report as Table 3 in Appendix A.

3.1 QA/QC SUMMARY

Samples were collected, analyzed and stored electronically according to procedures outlined in the programs EPA approved QAPP ("Ute Mountain Ute Indian Tribe Water Pollution Prevention Program Quality Assurance Project Plan for the Monitoring of Surface and Ground Waters Revision No. 6, March 2007").

Duplicate samples were collected and concentrations of nearly all analytes from duplicate samples were within 20% relative percent difference (RPD). Table 4, attached in Appendix A, contains duplicate sample results and RPD calculations. The majority of RPD calculations greater than 20% include parameters that tested near their respective detection limits.

Two duplicate samples were reclassified as distinct samples after examining the RPD calculations and analytical results. The 9/15/2010 duplicate sample for Lagoon 1 Well 3 and the 7/22/2010 duplicate sample at CW-N each captured sediments that were not present in the original samples and will be considered as unique samples.

The 9/15/2010 sample at Lagoon 1 Well 3 was collected in accordance with departmental groundwater standard operating procedures. Three casing volumes were purged and field parameters (temperature, conductivity, pH) had stabilized from the well before sample and duplicate sample collection, however periodic grayish sediment slugs were still discharging and some of this material was captured in the "duplicate" sample. This sediment is evident in the analytical results by the elevated aluminum and iron results (geochemistry of these trace elements is discussed below in Section 3, they are each tied to sediments in the region) along with elevated total suspended solids, elevated ions (Ca, K, Mg) and elevated metals (Mn, Ni, Zn, Pb).

The 7/22/2010 sample at CW-N was collected after an overnight precipitation event and analytical results exhibit suspended sediment present in the water column was captured in the "duplicate" yet not in the original sample. This is apparent by the absence of suspended sediment in the original sample and the presence of 228 mg/L TSS in the "duplicate" along with corresponding elevated concentrations of aluminum and iron (presence of high total Al and Fe is strongly tied to sediments, discussed in further detail in Section 3 below). Copper, lead, chloride, potassium, sodium, sulfate and total phosphorus were significantly different in this sample as well.

Field Blanks (Field Blank data is attached as Table 5) indicated that potential contamination in sample bottles, preservatives, shipping or sampling methodology was minimal to none. The Field blank for 9/15/2010 sampling event contained a trace amount of zinc (0.007 ug/L, detection limit is 0.001 ug/L), all other chemical parameters tested below or at their respective detection limits.

3.2 SAN JUAN RIVER, MCELMO CREEK AND COTTONWOOD WASH ASSESSMENT 2010

McElmo Creek and Cottonwood Wash are both tributaries to the San Juan River and ultimately the Colorado River at Lake Powell. The geographic setting and historical condition of each of these waterbodies is discussed in detail in Section 1 of this report.

Analytical data collected through the Tribes CWA 106 program during FY2010 is interpreted and discussed below and causes and sources of pollution are identified to the best practical extent.

Sampling conducted in 2010 confirmed historic, longstanding (presumably since irrigation and grazing were initiated in the area circa 1880) elevated trends in water quality as salinity, nutrients and bacteria persist at high concentrations in the lower San Juan River Watershed. Aluminum and iron were also identified as constituents of concern during FY10 monitoring.

Surface water analytical results are categorized into the following groups for discussion: Temperature, pH, Dissolved Oxygen, Major Ions (Alkalinity, Sulfate, Chloride, Potassium, Calcium, Magnesium, Sodium), Salinity, Nutrients (ammonia, nitrate-nitrite, TKN, and total phosphorus) and Trace Metals (Arsenic, Barium, Boron, Cadmium, Chromium, Copper, Iron, Lead, Mercury, Nickel, Selenium, Silver and Zinc).

Groundwater analytical results from wastewater evaporative lagoon monitoring wells and the 7/08/2010 surface water sampling event at Marble Wash are discussed separately in this section.

Recommended changes in monitoring frequency for the next sampling round on for the San Juan River, McElmo Creek and Cottonwood Wash, Ut (scheduled for fiscal year 2013) is included at the end of Section 3.

3.2.1 WATER QUALITY DATA ASSESSMENT

TEMPERATURE

The affects of water temperature in a stream has a direct correlation with the physical and chemical properties within its system. Most aquatic organisms are poikilothermic meaning their metabolic rates are controlled by the temperature of the water they live in. If the ranges of temperature are too far outside the limits for certain aquatic organisms the habitat may become unlivable. A rise in temperature will also have a direct affect on the amount of dissolved oxygen the water can hold. An increased growth rate of bacteria and algae is also a direct effect of a rise in water temperature.

The Tribe's water quality standard for temperature requires temperatures of less than 30 degrees celcius (86 degrees farenheight) and is designed to protect warm water aquatic life. The San Juan River, McElmo Creek and Cottonwood Wash each exhibited normal seasonal variations in temperature ranging from a low of 0 degrees celcius in Mud Creek on 02/18/2010 when the creek was iced over to a high of 25.6 degrees celcius in Marble Wash (tributary to San Juan River) on 07/08/2010.

PH

Hydrogen ion concentration (pH) is the measure of the acidity of water. A range in pH between 6.5 and 8.5 is required for aquatic life in the Tribe's water quality standards, where pH ranges above and below can have detrimental effects on growth and reproduction in aquatic organisms and can lead to death. Water with a high pH or "Basic" concentrations can be caused by algal blooms and from the release of basic compounds from industrial wastes. Acidic concentrations can be the result of combustion engines, the release of acidic compounds from industrial wastes, oxidation of sulfide containing sediments and the decomposition of organic materials.

Twenty-nine measurements for pH during FY10 monitoring averaged 8.08 standard units with a high of 8.39 at the San Juan River on 7/21/2010 and a low of 7.42 at Allen Wetland in the Cottonwood Wash watershed in Utah on 9/09/2010.

DISSOLVED OXYGEN

Dissolved oxygen (DO) is the amount of oxygen gas that is dissolved in water. It is important for respiration of most aquatic life. Favorable (higher) DO concentrations depend on low water temperature, low altitude and low conductivity. Decreases in DO may be caused by the decomposition of organic matter, increased nutrients, and respiration of microorganisms. DO may be increased by turbulent waters (waterfalls and rapids), and by photosynthesis of aquatic plants. The Tribe's water quality standards to protect aquatic life require DO levels above five mg/L. Seasonal variations in DO is apparent in the 29 DO samples recorded during FY10 monitoring with generally higher DO levels in the cold winter season and lower in the hot summer months (average of 12.44 mg/L during February at ME-Mud, ME-SB and SJ-4C and 6.45 mg/L at the same locations in July), however the highest DO level recorded was 16.9 on 7/08/2010 at Marble Wash. This elevated number reflects oxygen production from algae in the stream. The DO was supersaturated at 200% of the "saturation level". 100% represents the maximum concentration of dissolved oxygen that would be present in water at a specific temperature "supersaturation" occurs at levels above 100% and is most likely tied to oxygen production from respiration by algae in the stream in this case. The lowest DO level was 6.04 on 7/21/2010 in Mud Creek.

MAJOR IONS

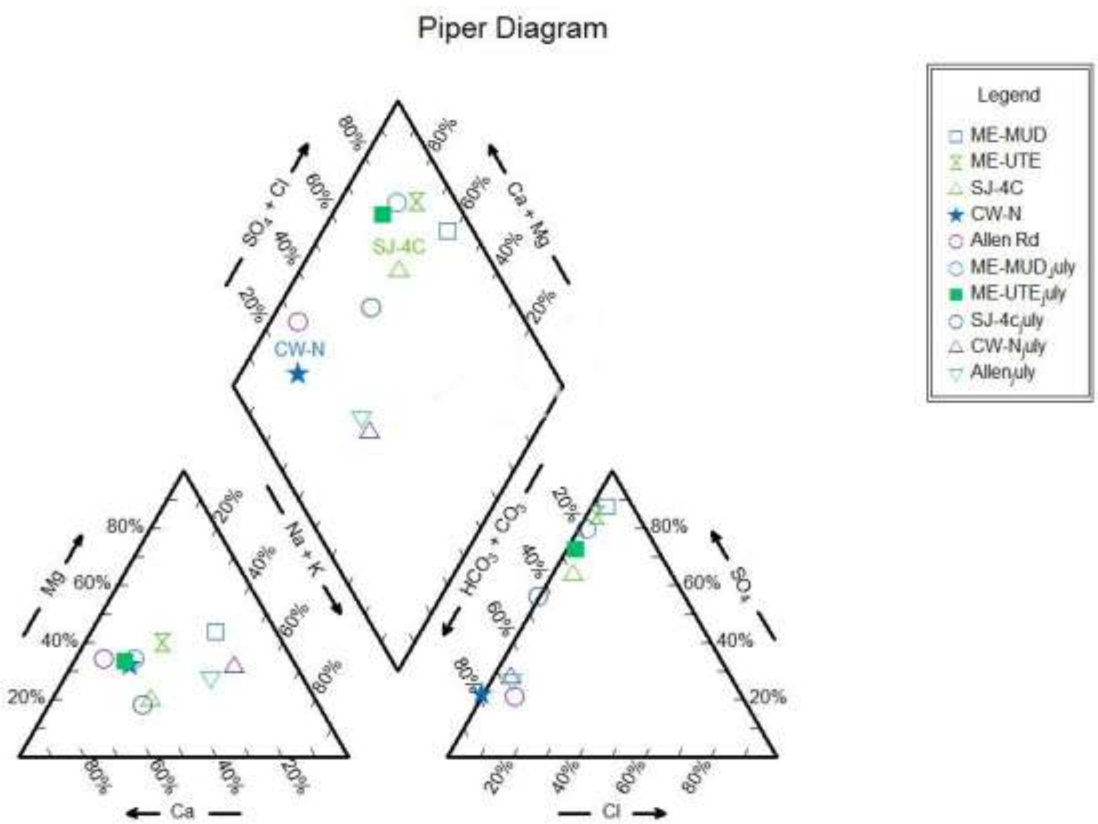
Water dissolves many chemical species as it passes through the air and through and over the land. Water simply traveling through the atmosphere for example dissolves gases which constitute ambient air, including nitrogen, oxygen and carbon dioxide. The dissolution and incorporation of carbon dioxide into water molecules from the air is important because when carbon dioxide is present in water it forms carbonic acid, lowering the pH of the water and enhances the water's ability to dissolve many other chemical species like salts and metals contained in rocks and soil. In passing through a polluted atmosphere it is also possible for the water to dissolve gases associated with pollution such as sulphur and nitrogen oxides. Some of these gases can also make the water acidic, further lowering the pH.

By the time this rain water has passed over and through land to become groundwater and surface water it has normally acquired many dissolved chemical species. The precise chemical composition of the water will depend upon the types of rock and soils with which the water has been in contact and this can be used to characterize a particular water by determining its ion composition.

The major constituents often comprising 1.0 to 1000 mg/L of a water sample include: Sodium, Calcium, Magnesium, Potassium, Bicarbonate and Carbonate, Sulfate and Chloride.

Secondary Constituents typically making up 0.01 to 10.0 mg/L include: Iron, Strontium, Nitrate, Fluoride, Silica, Boron

Water samples collected in Colorado can be characterized as sulfate-type water while samples collected in Utah are Bicarbonate-type.



Besides the fundamental difference (Sulfate verses Bicarbonate water types) in water samples between the watersheds, each sample exhibited seasonal differences as well.

In general for Colorado, samples collected during irrigation season with the higher flows and trans-basin water (Dolores Project, Dolores River) import influence exhibited lower sulfate concentrations and increased calcium and bicarbonate equivalent concentrations. The increased calcium equivalent concentrations is due to a reduction of magnesium and potassium concentrations in the irrigation season water samples as opposed to an actual concentration in calcium, calcium concentrations remained relatively stable through the year.

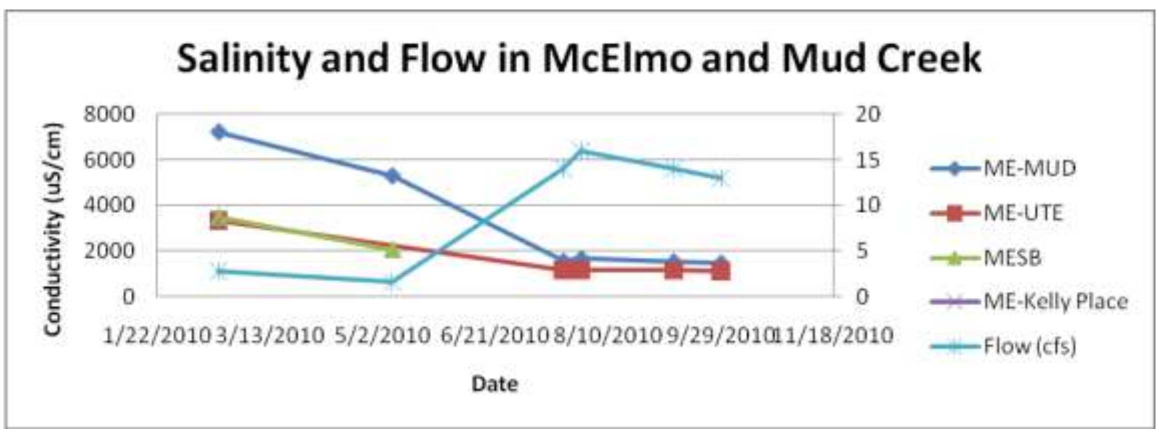
Utah samples remained dominated by the bicarbonate ion through the year, however the summer samples exhibited higher concentrations of magnesium and potassium.

The San Juan river is characterized by calcium-sulfate type water through the year, however the July sample had lower concentrations of each of these ions and a higher bicarbonate level.

SALINITY

Total Dissolved Solids, also referred to as filterable residue or salinity, are comprised of organic salts and matter and dissolved ions. Principal inorganic cations include carbonates, chlorides, sulfates and nitrates and principal cations include sodium, potassium, calcium and magnesium. The USGS has developed a classification system for waters based on their salinity in milligrams per liter. Water with a concentration of 0 – 1000 is considered fresh; 1,000 – 3,000 is slightly saline; 3,000 – 10,000 is moderately saline; 10,000 – 35,000 is very saline and concentrations greater than 35,000 is considered briney (Spangler 1992). The EPA (1986) reports that water systems with TDS concentrations exceeding 15,000 mg/L are unsuitable for most freshwater fish.

TDS levels collected during FY10 monitoring ranged from a minimum of 240 mg/L for the July 21, 2010 sample to a maximum of 7,260 mg/L at ME-Mud on February 18, 2010 for flowing water samples. The September sample for Lagoon 1 Well 1 was 20,000 mg/L a high result that is a potential risk in contributing to salt loading to Navajo Wash due to it's proximity. In general, the San Juan river and Cottonwood Wash and Allen Canyon had much lower TDS concentrations than McElmo and Mud Creek in Colorado. The Colorado samples averaged approximately 4,000 mg/L for the February and May sampling events and 1,442 mg/L during the irrigation season. Utah samples averaged approximately 300 mg/L for May and approximately 400 mg/L through the summer. The San Juan River showed seasonal variation as well with 405 mg/L in February and lower levels of 240 and 280 mg/L in July and September respectively. Typically, lower flows in this geographic region result in higher salinity as there is less water diluting the ion concentrations. The relationship between flow, and salinity (TDS) is examined below.



Note: Flow volume included in graph is data from Mud Creek. McElmo Creek flow exhibited identical pattern (low flow through winter until May with an order of magnitude increase corresponding with the start of the irrigation season) however McElmo flow was not incorporated into the graph due to scaling issues- flow data for McElmo is included in Table 3 Field Parameters.

A high salinity content can reach a concentration to impair water used for irrigation purposes. A high salt concentration present in the water and soil will negatively affect the crop yields, ruin soil structure, limit nutrient availability to biota and pollute groundwater.

Tribal Standards for salinity specify that for Livestock consumption: TDS<or= 5,000 mg/L

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.

The February 2, 2010 and May 6, 2010 samples collected at ME-MUD on Mud Creek exceeded both the livestock watering standard and the irrigation standard:

ME-MUD	SAR	TDS (mg/L)
2/18/2010	6.6	7260
5/6/2010	4.7	5840

This site and sample location are not located on Tribal Land, however, Mud Creek is an important tributary to McElmo Creek, which the Tribe does own property on and Mud Creek is contributing a significant salinity load to McElmo Creek during the non-irrigation season. July and September samples at the same site exhibited drastically lower salinity and SAR figures with SAR of approximately 1.2 and TDS approximately 200 mg/L.

The San Juan River, McElmo along with Cottonwood Wash and Allen Canyon all comfortably met both livestock watering and irrigation criteria.

Groundwater samples collected on September 15, 2010 from the Lagoon 1 wastewater system near Towaoc possess extremely high SAR and TDS values:

Site ID	SAR	TDS (mg/L)
Lagoon 1 Well 1	34.4	20000
Lagoon 1 Well 3	27.5	3250

The affects of the extreme SAR and salinity values on soil structure and vegetation in the Lagoon 1 area is readily apparent where the shallow groundwater is near the surface (0.8 feet deep at Well 3, shown). The white area in the photo is a thick salt crust, the soil structure is very poor and not many plants are able to grow in this area.

TRACE METALS

Table 3 includes complete results for trace metals for FY10 water quality samples. Out of the 15 trace metals sampled for during the FY10 monitoring period, aluminum and iron consistently exceeded water quality standards to the greatest degree. They are each discussed in further detail below.

Antimony was detected only once out of seventeen samples. Antimony can be associated with both mineral mining and refining as well as with petroleum extraction and refining. The detection of antimony at 5.5 ug/L on July 8, 2010 at MW-4000blk near the Tribes Farm and Ranch Enterprises was just under the 5.6 ug/L water quality standard the Tribe has adopted to protect traditional and drinking water uses. The antimony in this sample could represent influence from the geologic composition of the area, perhaps association with the igneous rocks of Sleeping Ute Mountains.

Arsenic was present in twenty three of twenty four samples. The three highest levels (CW-S2 51.7 ug/L 9/9/2010, Allen-Wetland 71.4 ug/L 9/9/2010, MW-4000-blk 66 ug/L

7/8/2010) were all well below the Warm Water Aquatic Life (WWAL) chronic criterion of 150 ug/L.

The arsenic results from the Cottonwood Wash watershed in Utah: 51.7 ug/L in Cottonwood Wash, 14.2 ug/L on 5/5/2010 in Allen Canyon, and 71.4 ug/L from Allen Wetland do exceed the Tribal use criterion standard of 18 ug/L and should be monitored more intensively next monitoring period.

Cadmium was present in ten of twenty nine samples with a maximum level of 0.32 ug/L detected in the 9/9/2010 sample at CW-S2 on Cottonwood Wash, Ut. This level is far below the most stringent Tribal criterion of 5 ug/L to protect tribal ceremonial and drinking water uses.

Chromium was included as an analyte only with the lagoon well samples. The highest measurement was 23 ug/L for the 9/15/2010 sample at Lagoon 1 Well 3. Chromium may be present in the environment in primarily two valance states, Chromium 3 and Chromium 6 with Chromium 6 being more toxic to life. FY10 samples were analyzed for total chromium which does not differentiate between the different compounds. The Tribes criteria for Chromium 6 are 50 ug/L for traditional and drinking water uses and 11 ug/L to protect warm water aquatic life. Lagoon 1 system samples ranged from 1 to 23 ug/L with an average of 11.7 ug/L for six samples.

Copper averaged 4.5 ug/L for twenty two samples which is well below concentrations which would promote concern. The Tribes water quality criteria to protect aquatic life from toxic effects from copper are based on equations that factor in the hardness (calcium and magnesium ions) present in the water sample as well as the dissolved fraction of copper (FY10 samples were all for total recoverable metals).

Lead averaged a concentration of 2.96 ug/L for twenty nine samples with a maximum concentration of 36.2 ug/L at Cottonwood Wash, UT on the 9/9/2010 sample at CW-S2 which is below the Tribes most stringent criteria of 50 ug/L for lead to protect traditional and drinking water uses.

Manganese was analyzed for the wastewater lagoon monitoring well samples, the highest level recorded was 158 ug/L for the 9/15/2010 sample at Lagoon 1 Well 3. This level is above the EPA secondary drinking water standard of 50 ug/L however it is well below the 500 ug/L level recommended to protect human life from toxic effects of manganese (WHO, 2011).

Mercury was not detected in twenty nine samples at the laboratory detection limit of 0.0002 ug/L, which is a lower limit far below the most stringent criteria of 0.012 ug/L to protect the use for warm water aquatic life.

Nickel was sampled for and found in minute concentrations in the monitoring wells downgradient of the Lagoon 1 system. A maximum of 18.5 ug/L was present in the 9/15/2010 sample from Well 3 uses. Tribal standards to protect agricultural and tribal ceremonial and drinking water uses are 100 and 400 ug/L respectively.

Zinc was analyzed for in twenty eight samples. A maximum of 79 ug/L was present in the 9/9/2010 sample from Allen Wetland. Zinc water quality criteria to protect aquatic life are based on hardness results, hardness dependent criteria are based on hardness expressed as mg/L $CaCO_3$. For waters with a hardness value greater than 400 mg/L as CaCo3, the criterion is calculated using a hardness value of 400 mg/L. For Zinc, this leads to a warm water aquatic life criterion of 312 ug/L.

ALUMINUM

Aluminum is the third most abundant element in the Earth's outer crust due to it's occurrence in many silicate igneous rock minerals such as the feldspars and clays, which are sedimentary aluminum enriched minerals. Clay minerals have a layered "sheet" structure of alternating aluminum based and silica based layers bound by Si-O-Al bonds. Clays are present in most natural-water environments and comprise a large percentage of sedimentary strata and their derived soils in the southwest.

The cation Al^{3+} dominates in solutions in which the pH is less than 4 and high concentrations of aluminum can thus be indicative of low pH stemming from acid mine drainage or from acid rain in the geographic area.

At a pH between 6.5 to 9.0 in fresh water, aluminum occurs in a variety of hydroxide forms as well as in complexes with humic acids, phosphates, sulfates, and other less common anions. (EPA 1988).

Due to the challenges of researching the toxicity of the variety of forms of aluminum that may be present in ambient water there remains a lack of definitive information to develop effective aquatic life criterion.

The Tribes aluminum criteria are expressed as total recoverable metal in the water column. The 87 ug/l chronic criterion for aluminum is based on information showing chronic effects on brook trout and striped bass. The studies underlying the 87 ug/l chronic value, however, were conducted at low pH (6.5 – 6.6) and low hardness (< 10 ppm $CaCO_3$), conditions uncommon in Reservation surface waters.

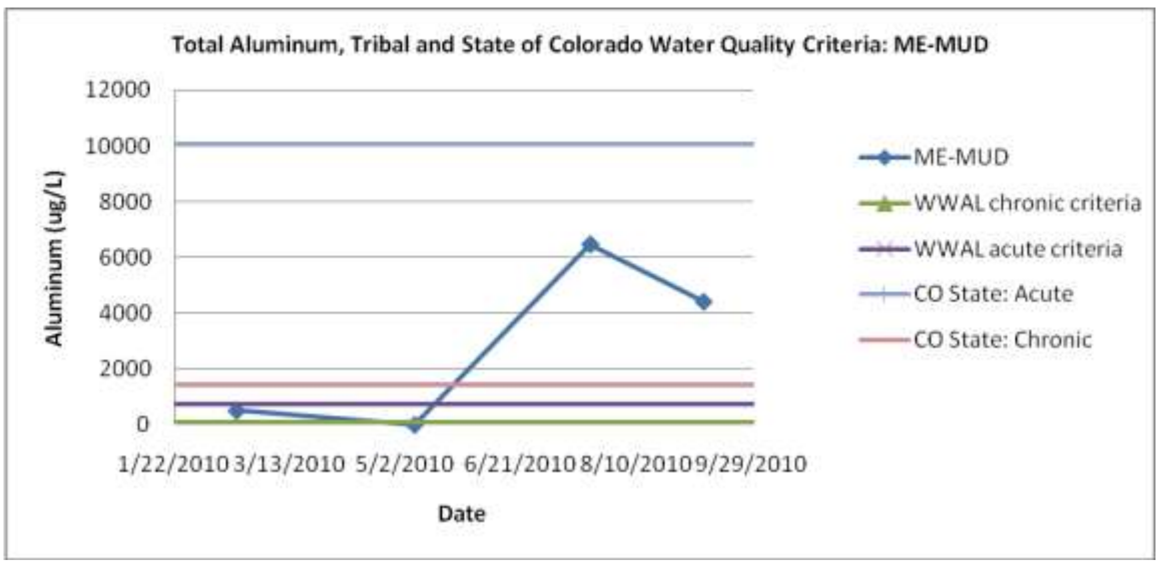
A formal presentation of updated aluminum criteria information was given to the Colorado Department of Public Health and Environment (CDPHE) indicating that the State's total recoverable aluminum water quality standard of 750 μg/L acute and 87 μg/L chronic, should be revised. The technical basis for the existing State, as well as Ute Mountain Ute Tribal aluminum standards is the 1988 EPA Aluminum Document which had become outdated. The State of Colorado's revisions to the acute and chronic aluminum standards used the EPA criteria derivation and recalculation procedures and also incorporated the results from the Arid West Water Quality Research Project (2006), which analyzed potential updates to aluminum standards based on more complete literature reviews.

The Arid West work was primarily based on an overall evaluation of the EPA recalculation procedure for Arid West effluent-dependent water users and provided information that was unavailable when the 1988 Aluminum Document was prepared. Specifically, the Arid West recalculation procedure analysis discovered an inverse aluminum toxicity and hardness relationship. A hardness-based aluminum standard is more representative of the concentration levels that harm aquatic life and so provides a better measurement of potential toxicity. The total recoverable aluminum acute criteria range from 512 µg/L to 10,071 µg/L at hardness concentrations of 25 mg/L and 220 mg/L, respectively. (CDPHE, January 2011)

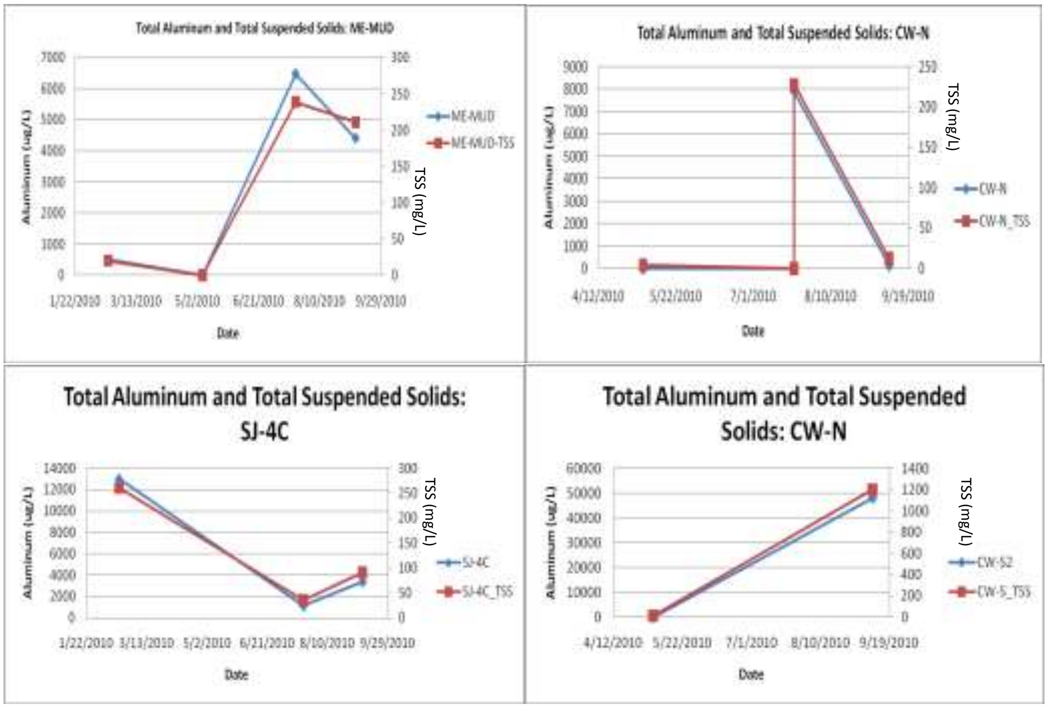
CDPHE also adopted a modified version of the original chronic criteria proposal to reflect certain species' chronic sensitivity, specifically Daphnia magna. Using the modified criteria equation, the total recoverable aluminum chronic criteria ranged from 73 µg/L to 1,438 µg/L at hardness concentrations of 25 mg/L to 220 mg/L.

Given the available data, it was recommended that the upper bound of hardness calculations be 220 mg/L, rather than the standard 400 mg/L for other metals equations. CDPHE also noted some evidence indicating that rainbow trout may exhibit increased sensitivity to aluminum within the upper range of the pH standard and intend to revisit the standard if new data and information become available indicating that the current standard is not protective of rainbow trout. (CDPHE, January 2011).

Based on this recent information and the Tribes water quality data it is likely that the aquatic life standards for total aluminum will be revised with the next triennial revision which is scheduled for 2014. The graph below illustrates aluminum concentrations recorded at ME-Mud along with the Tribe's current standards and the recently adopted State of Colorado standards.



It is apparent from aluminum and suspended solids data (illustrated below in graphical form) that the majority of aluminum in the water column for FY10 samples is coming from suspended soil sediments, which are primarily alumino-silicate clays in the region. It is currently unclear how toxic aluminum in this form may or may not be to aquatic life (Arid Water Quality Research Project, 2006).



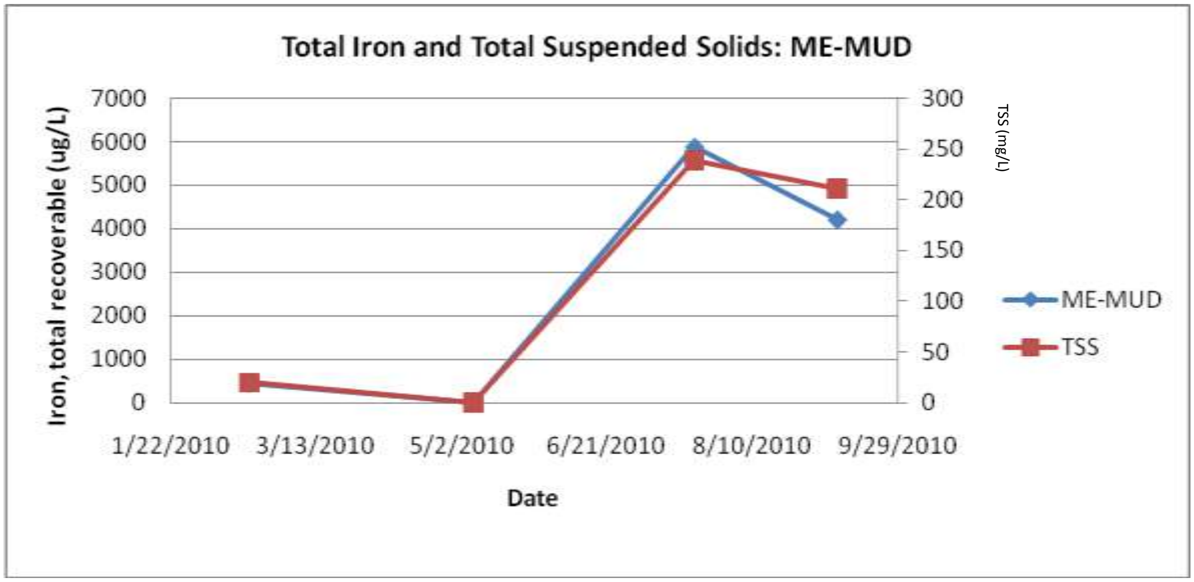
As discussed above, the most recent research into the relationship between aluminum and aquatic life will be investigated in depth for the next revision of the Tribe's water quality standards in order to promulgate revised aluminum standards that will incorporate region-specific data.

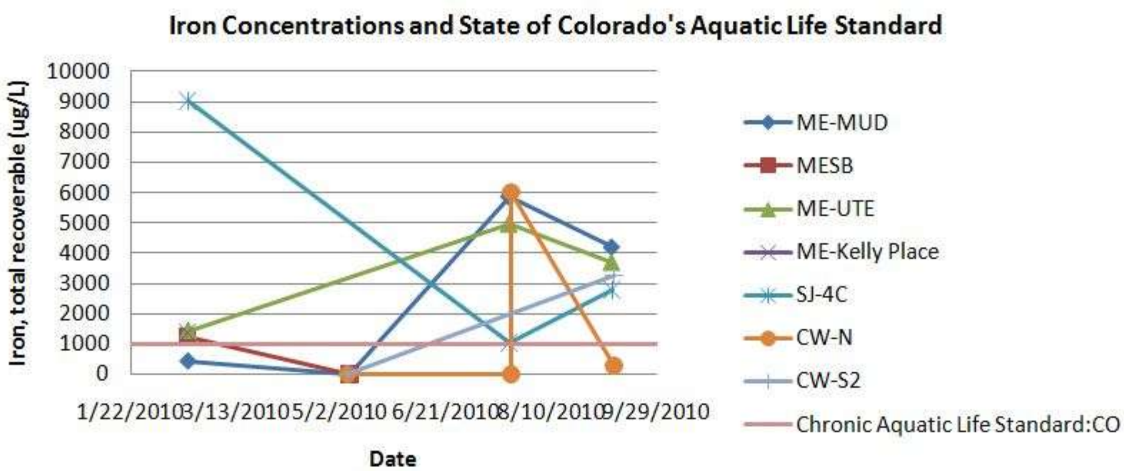
IRON

Iron is the second most abundant element in the Earth's crust and it is an essential element in the metabolism of animals and plants. Organic compounds containing iron are essential for metabolic proceses such as photosynthesis and as a component of hemoglobin and some micro-organisms use iron as an energy source through oxidation-reduction processes. It is present in both organic wastes and plant debris in soils. It's abundance in water is usually small, however when present in excessive amounts it forms red oxyhydroxide precipitates that stain laundry and plumbing fixtures and is generally an objectionable impurity for domestic and industrial water supplies. Iron is also a common constituent of sulfide ores and coal seams and the presence of iron precipitates can indicate influence from these sources.

Water flowing in surface streams is generally well aerated and would not typically contain more than a few micrograms of dissolved iron between pH of 6.5 to 9.5. Metals samples collected for FY10 were not filtered and metals concentrations represent the total fraction of metals in the water column, including suspended sediments which can explain the source of elevated iron concentrations represented in many of the samples.

In oxidizing environments sedimentary species of iron will be represented such as ferric oxides or oxyhydroxides like hematite, Fe_2O_3, goethite, FeOOH or other similar minerals. Natural weathering and erosion of Cretaceous aged sedimentary strata which is widespread in the watershed and is also rich in hematite and similar iron abundant mineral species can account for the elevated Iron concentrations in these unfiltered samples.





The graph above illustrates iron concentrations in relation to Colorado's Chronic Aquatic Life Standard for Iron. The Tribe currently does not have a standard to protect aquatic life uses. However this subject will be investigated for the next triennial revision of the Tribes' standards which is scheduled for 2014 and it is likely that an aquatic life standard will be proposed and adopted at this time. As seen above twelve out of twenty three surface water samples for FY10 data exceeded the state of Colorado's criteria. These twenty three samples averaged 2,119.5 ug/L, factoring in seven non detects (half of the detection limit was used in the calculation for non-detects).

The relationship between iron concentrations and suspended solids is also evident in the graph above for CW-N, two samples were taken on 7/22/2010 one had a non detect for iron and suspended solids, the other had 6,020 ug/L iron and 228 mg/L suspended solids.

SELENIUM

Selenium is a non-metallic trace element and a micronutrient required by animals in small amounts (Hunn et al. 1987). Selenium bio-accumulates in the food chain, increasing in concentration and detrimental effects (reproductive failure and damage to eggs, mortality and deformation, etc.) with each successive tropic level. The two major sources of anthropogenic selenium mobilization into aquatic systems are the extraction, refinement and combustion of fossil fuels and associated disposal of produced ash (flyash) and the irrigation of seleniferous soil which produce selenium-laden return flows. Cretaceous aged sedimentary geologic formations (Mancos Shale).

The current Tribally-adopted aquatic life criterion for selenium is 5 ug/L chronic total recoverable selenium, and acute criterion of 20 ug/L. The only stream to exceed the selenium criteria is Mud Creek which exhibited a level 0f 46 ug/L on 2/18/2010 and 24 ug/L on 5/06/2010 these levels also exceed the agricultural standard of 20 ug/L. With the influx of Dolores Project irrigation water which had arrived by the July sampling event in which Mud Creek had approximately nine times the flow, selenium levels had been diluted, leading to an average of 35 ug/L of selenium during the low flow non-irrigation season samples (February and early May) and an average of 2.5 ug/L selenium during the irrigation season samples (July and early September).

The State of Colorado has appropriately added Mud Creek to their Monitoring and Evaluation List in order to conduct their own characterization for making the determination to list Mud Creek on their 303(d) list as impaired for Selenium.

URANIUN AND GROSS ALPHA

Uranium and gross alpha radiation were included for two sampling events in the Cottonwood Wash, UT watershed due to concern relating to radiological impairment of the water from legacy mining issues. The Tribe has adopted a water quality standard of 30 ug/L for uranium to protect livestock drinking and aquatic life, uranium, besides being a radionuclide emitter and a source of mutagenic and carcinogenic effects, is also acutely toxic to the kidney.

Alpha particles are identical to a helium nucleus having two protons and two neutrons. It is a relatively heavy, high-energy particle, with a positive charge of +2 from its two protons. Alpha particles have a velocity in air of approximately one-twentieth the speed of light, depending upon the individual particle's energy. They are given off by uranium-238, radium-226, and other members of the uranium decay series and are present in varying amounts in nearly all rocks, soils, and water.

The opportunity for environmental and human exposure increase greatly when soils and rock formations are disturbed by the extraction of minerals.

- Uranium mining wastes, (uranium mill tailings), have high concentrations of uranium and radium. Once brought to the surface, they could become airborne or enter surface water as runoff.

- The health effects of alpha particles depend heavily upon how exposure takes place. External exposure (external to the body) is of far less concern than internal exposure, because alpha particles lack the energy to penetrate the outer dead layer of skin.

- However, if alpha emitters have been inhaled, ingested (swallowed), or absorbed into the blood stream, sensitive living tissue can be exposed to alpha radiation. The resulting biological damage increases the risk of cancer; in particular, alpha radiation is known to cause lung cancer in humans when alpha emitters are inhaled.

The CW-N site exceeded the Tribes uranium standard of 30 ug/L on 9/9/2010 with a result of 31 ug/L. The 5/5/2010 sample at this location was lower at 14 ug/L. A sample downstream at CW-S2 on 9/9/2010 was also below the standard with a result of 8.1 ug/L uranium. Allen canyon exhibited markedly lower uranium results with levels of 1.9 ug/L on 5/5/2010 and 2 ug/L on 7/22/2010.

Radium-226/-228 levels need to be included along with uranium and gross alpha in the next monitoring round for this watershed. Adjusted Gross Alpha results are alpha radiation with radon and uranium radiation subtracted out. An elevated adjusted gross alpha result and a low uranium result indicates that the alpha radiation is coming from a source besides uranium. The relatively high adjusted gross alpha results in Cottonwood Wash: CW-S2 45 pCi/L Adjusted Gross Alpha in tandem with the low uranium results: CW-S2 4.1 pCi/L for this location indicate that the gross alpha radiation is originating from a source besides uranium isotopes. It is likely that radium is the culprit for these emissions. Some of the original ore samples used by Madame Curie in her radium experiments came from Cottonwood Wash and water with high radium levels tend to have low uranium levels and vice versa, even though uranium-238 is the parent of radium-226.

NUTRIENTS

Nitrogen and phosphorus are two essential nutrients for plant growth. The presence of these elements in aqueous environments in excess amounts can spur algae dense algal blooms that can lead to a host of problems ranging from negative aesthetic impacts to the depletion of oxygen and the smothering of other aquatic life in the system (eutrophication). Phosphorus availability is generally considered the crucial factor in fueling eutrophic conditions as it is most often the nutrient in the shortest (most limited) supply in natural systems unaffected by anthropogenic inputs.

In 1997 the EPA initiated a nationwide effort to address eutrophication of the nation's surface waters resulting from excess nutrient enrichment. The goal of this effort is the development and adoption of water quality nutrient criteria for total nitrogen (TN) and total phosphorus (TP). In 2001 EPA recommended that states and tribes prepare plans and schedules for the development and adoption of nutrient criteria as water quality standards. The Tribe has not currently formalized a plan and is focusing on data collection and participating in and staying abreast of current research and dialogue on the national level as well as with neighboring states and tribes. It is expected that the adoption of nutrient standards will result in a greater regulatory emphasis on the control of non-point sources of nutrients such as soil erosion and urban runoff in addition to the modification of permits and effluent limits for wastewater facilities.

The primary factor that complicates the development of nutrient criteria is the fact that nutrients are not directly toxic to aquatic life. Nutrient excess in the water column can fuel surplus growth of algae and plants that affects the suitability and can result in the impairment of water for municipal, recreation and aquatic life uses. However, nutrients are not solely responsible for this type of excessive growth. Physical factors such as sunlight, water velocity, temperature, drought, suspended sediment, substrate, zooplankton as well as other biological factors all play a role making the process of determining appropriate nutrient standards technically complex and challenging for rivers and streams.

Currently neighboring states are seeking to develop TN and TP criteria for rivers and streams based on levels necessary to protect aquatic life using macroinvertebrate communities as a surrogate for the aquatic life use and are working to establish criteria based on the relationship between macroinvertebrate metic scores and TN and TP levels using quantile regression statistics.

Nitrogen and phosphorus are discussed in greater detail below and the analytical results for each of these parameters for FY10 sampling are assessed and interpreted.

NITROGEN

Nitrogen comprises the majority of our atmosphere on Earth and is also a vital biological component for plant and animal life. Since nitrogen is crucial for biological processes it is continuously cycled through the environment (the “Nitrogen Cycle”) as chemical and biological processes reprocess nitrogen from the lithosphere, atmosphere, hydrosphere and biosphere.

Nitrogen gas, N_2 makes up around 78 percent of our atmosphere. It is generally un-reactive and is not available to biological organisms. A substantial energy input is required to change its oxidation state and convert N_2 gas to chemical compounds containing nitrogen (NH_3, ammonia). This process is called “nitrogen fixation”. A variety of microorganisms including blue green algae and other bacteria (some of which have a symbiotic relationship with plants, i.e. legumes) have the capacity to perform this transformation. Some inorganic fixation takes place in the atmosphere with lightning discharges. Anthropogenic nitrogen fixation is common in our culture with the production and use of synthetic fertilizers and the combustion of fossil fuels. Coal and petroleum, derived from organic sources, generally contain around one percent nitrogen and as these fuels are combusted a part of the nitrogen is converted to nitrogen oxides and escapes to the atmosphere. Nitrogen oxides in the atmosphere undergo chemical processes that produce H+ ions and eventually leave the nitrogen as nitrate. This process can substantially lower the pH of rain (sulfur oxides, also fossil fuel based, undergo a similar reaction).

Soil bacteria convert ammonia into nitrite NO_{2-} and nitrate NO_{3-} in a process called "nitrification". Nitrate is the form of nitrogen that plants are able to metabolize and use. Other bacteria strains that live in anaerobic environments work to reduce these oxidized forms of nitrogen through a process called "denitrification" where they produce nitrous oxide or nitrogen gas.

In water nitrogen is present as nitrite or nitrate ions, in cationic form as ammonium and in intermediate oxidation states as components of organic molecules. Ammonium cations are strongly attracted to mineral surfaces and commonly adsorb onto particles. Anionic nitrate is stable and readily transported in aquatic environments often traveling great distances. Nitrite and other organic species of nitrogen are unstable in aerated water and can be considered indicators of organic pollution such as sewage if they are found in high concentrations. Elevated nitrate or ammonium may also be indicative of such pollution at a greater distance from the source.

The application of large amounts of nitrogen based fertilizers on agricultural land can also result in large increases in nitrate concentrations in both ground water and streams and rivers.

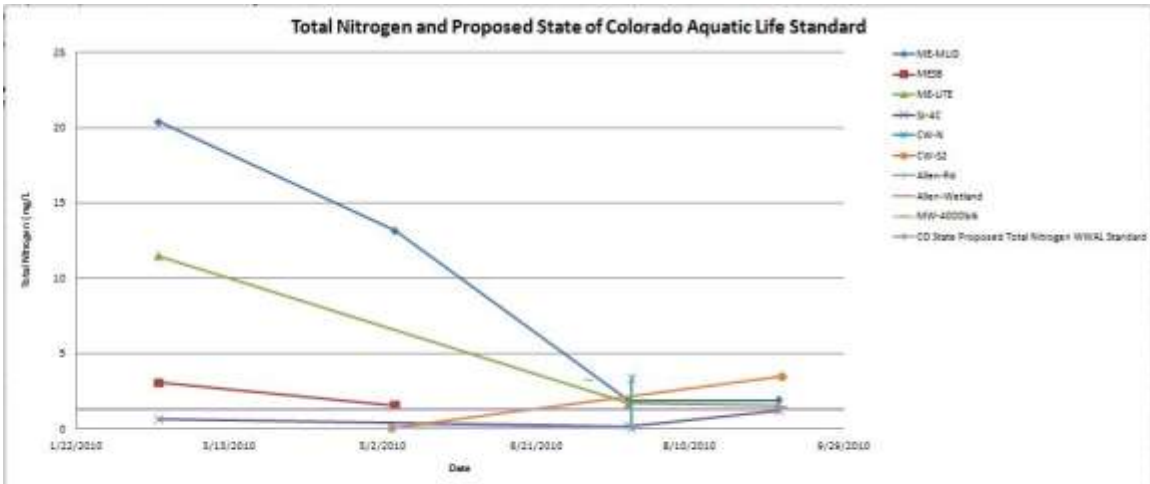
The drinking water standard of 10mg/L for nitrate is designed to protect small children who are vulnerable to methemoglobinemia, "blue baby syndrome", wherein nitrates limit the oxygen carrying capacity of hemoglobin in the blood resulting in an oxygen deficiency.

Current Tribal water quality standards to protect aquatic life from nitrogen in the water column include a calculation using nitrite and chloride concentrations which were adopted based on 1997 State of Colorado water quality regulations which the State of Colorado has since revised. They are no longer considered the best available technology to protect water uses from nitrogen impairment.

Currently, the State of Colorado does not have table values for any form of nitrogen to protect aquatic life uses and has been working on the development of TN criteria for rivers and streams based on levels necessary to protect aquatic life using macroinvertebrate communities as a surrogate for the aquatic life use and have used quantile regression statistics with macroinvertebrate metic scores and TN and TP levels. Colorado proposed TN and TP standards to the State's Water Quality Control Board during 2011,however they were not adopted. Colorado will make another formal rulemaking proposal for nutrient controls following another period of stakeholder input however total nitrogen criteria will not be adopted until after 2017.

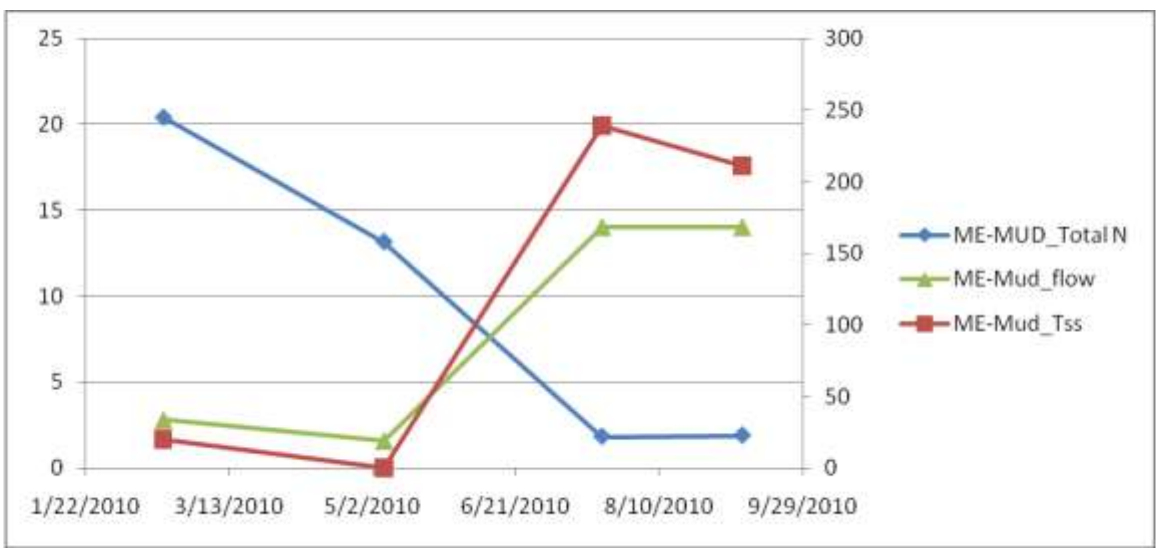
The Tribe is monitoring nutrient criteria development in neighboring states closely and is working to collect the necessary data (TN, TP, Chlorophyll-a and macroinvertebrate metrics) to monitor and evaluate nitrogen and phosphorus impacts. Nutrient criteria using the best available science and technology will be evaluated and incorporated into the Tribes next triennial water quality standards revision.

Total nitrogen is calculated as the sum of nitrate/nitrite and total kjeldahl nitrogen. FY10 results are presented below in graphical form compared to the most recent proposed standard for the State of Colorado to protect warm water aquatic life.



Fourteen of twenty three samples collected during FY 10 exceed the proposed total nitrogen standard. The maximum level was 20.39 mg/L collected 2/18/2010 from Mud Creek at ME-MUD. The minimum level of 0.035 mg/L was recorded for the 5/5/2010 sample collected from Cottonwood Wash at CW-N. Overall, the average of the twenty three total nitrogen samples is 3.187 mg/L.

The most influential response variable for total nitrogen concentrations for FY10 data appears to be flow. As shown in the graph for ME-Mud below, total nitrogen concentrations are at their highest with the lowest flow volume.

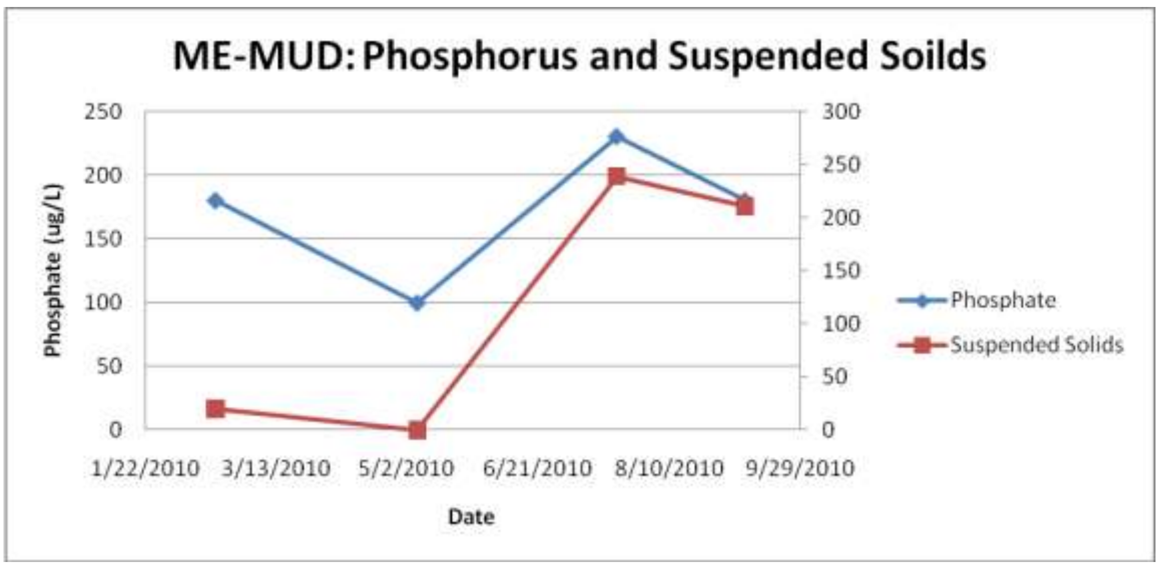


PHOSPHORUS

Phosphorus is an essential element for biologic life forms. It is also a common element in many igneous rocks and is therefore abundant in sediments. Inorganic forms of phosphorus are not very soluble and concentrations of phosphorus present in solution in natural water are relatively low. Phosphorus is in the same group in the periodic table as nitrogen. The fully oxidized state, phosphate, P_5 is the only form of phosphorus of significance in most natural water systems although it may occur in oxidation states ranging from P_{3-} to P_5.

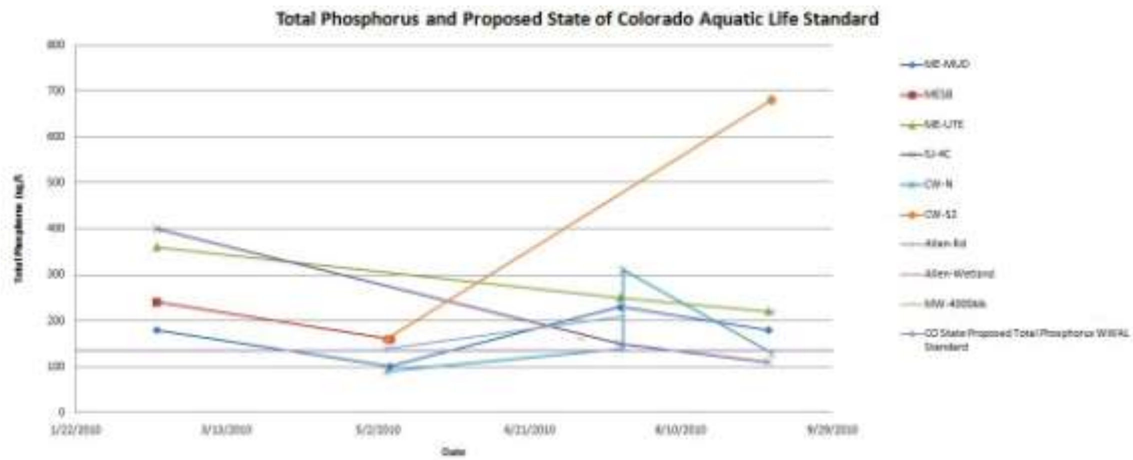
The use of phosphate fertilizers in our region has the potential to increase phosphorus concentrations in area streams and soil erosion from chemically fertilized agricultural fields may play a large role in this process as mobilized soils and sediments can add considerable amounts of suspended phosphate to streams. Phosphorus is always a component of animal metabolic wastes and is always present in sewage. Phosphorus has historically been a component in detergents and although regulations have reduced the amount of phosphorus in consumer and industrial detergents both domestic and industrial waste streams remain important sources of phosphorus in water.

As discussed in the nitrogen section above criteria development for phosphorus is currently ongoing by neighboring states and the Tribe is monitoring this progress closely and collecting data in anticipation of incorporating phosphorus criteria to protect aquatic life into the next triennial revision of the Tribe's water quality standards. Development of TP criteria for rivers and streams is being based on levels necessary to protect aquatic life using macroinvertebrate communities as a surrogate for the aquatic life use and have used quantile regression statistics with macroinvertebrate metic scores and TN and TP levels.



The graph above illustrates that while phosphorus levels appear correlated to suspended solids as expected due to the chemical nature of phosphorus, it appears that a percentage of phosphorus species are present in the water column unbound to sediment particles. On dates with no, or low suspeneded sediment results (2/18/2010: 20 mg/L TSS, 5/6/2010: 0 mg/L TSS) phosphate levels are equal to and above 100 ug/L.

The graph below shows FY10 phosphorus data compared to the TP criteria levels proposed to the State of Colorado's water quality control board in 2011.



Twenty two of twenty six samples analyzed for phosphorus are above the State of Colorado's proposed criteria of 135 ug/L to protect warm water aquatic life. The average of the Tribe's twenty six samples is 216 ug/L.

This data may indicate that the proposed standard is far too stringent and needs to be revised to a higher number, this is in fact the perspective of some dischargers in the state who oppose the proposed standard and the potentially costly treatment upgrades they could entail (Evaluation of Nutrient Criteria Adoption on Colorado Municipal and Commercial Interests, 2010). This data may also indicate that additional pollution control measures for phosphorus do need to be implemented by discharges (municipal, industrial, agricultural) if the proposed standard is in fact scientifically sound and protective of aquatic life. Research is ongoing for this parameter.

BACTERIA

Total coliform bacteria are a collection of relatively harmless microorganisms that live in large numbers in the intestines of man and warm- and cold-blooded animals, aiding in the digestion of food. A specific subgroup of this collection is the fecal coliform bacteria, the most common member being *Escherichia coli*. These organisms may be separated from the total coliform group by their ability to grow at elevated temperatures and are associated only with the fecal material of warm-blooded animals.

The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of man or other animals. At the time this occurred, the source water may have been contaminated by pathogens or disease producing bacteria or viruses which can also exist in fecal material. Some waterborne pathogenic diseases include typhoid fever, viral and bacterial gastroenteritis and hepatitis A. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Fecal coliform bacteria may occur in ambient water as a result of the overflow of domestic sewage or nonpoint sources of human and animal waste.

Table 3 Bacteria			
Site I.D.	date	E. Coli	T. Col.
Standards		235/100mL	
Lopez 1[1]	5/26/2010	ND	ND
	5/26/2010	ND	ND
Lopez Lat[1]	5/26/2010	ND	11
	5/26/2010	ND	6.3
Hanna 1[1]	5/26/2010	ND	ND
	5/26/2010	ND	ND
ME-MUD	7/29/2010	1553.07	
	9/29/2010	307.6	>2419.2
	9/29/2010	290.9	>2419.2
ME-UTE	7/29/2010	2419.2	2419.2
	9/29/2010	290.9	>2419.2
	9/29/2010	365.4	>2419.2
SJ-4C	7/29/2010	1553.07	>2419.2
	7/29/2010	>2419.2	>2419.2
	9/29/2010	224.7	>2419.2
	9/29/2010	222.4	>2419.2
LAGOON 1 WELL 3	9/29/2010	ND	1
	9/29/2010	ND	ND

1.Standards for T=0 (human Health and consumption)

2. Blank cells means samples were not analyzed for analyte.

3. ND = analyte was less than the detection limit

The Ute Mountain Ute Tribe has adopted the most stringent of standards for E.coli on two springs found on Sleeping Ute Mountain. Lopez Spring and Hanna Spring are two historic sites that are used by the Tribe for ceremonial and cultural purposes therefore, its water quality standard is zero for E.coli. Both Lopez Spring and Hanna Spring have revealed no signs of E.coli since the beginning of our sampling in 1993.

Within McElmo canyon there are four known sources of bacteria above tribal lands. Cortez Sanitation District has 3 waste water treatment plants and a private subdivision Vista Verde

Village has another. Besides these known sources, the canyon is occupied by numerous land owners raising Cows, Horses, and Bison to name a few. Other sources of bacteria within McElmo canyon could be due to outdated septic systems as well as Elk, Deer, and other wild animals that may use the stream as a water source. Mud Creek a tributary to McElmo was also sampled for bacteria. This sampling location is directly down stream of a property that has been highly over grazed by horses which is most likely the source of bacteria that our results show. Our results have shown that all of our samples within the McElmo water shed were above Ute Mountain Ute tribe's water quality standards at 235/100ml.

The two sites that were sampled in the McElmo water shed ME-UTE and ME-MUD were sampled in July and then again in September. The July samples had extremely high results with ME- UTE having results that were too numerous to count and ME-MUD showing results over six times that of our standards at 1553/100ml. This is most likely due to increased water temperatures and more runoff shown by the increase in flow due to the seasonal monsoons. The September samples proved to have had much lower bacteria results, however, still above our standards. ME-Ute Samples had results of 290.9/100ml and 365.4/100ml and ME-MUD with results of 290.9/100ml and 307.6/100ml. These results support that during normal flows in McElmo canyons watershed there is a lot of bacteria.

The San Juan watershed above Ute Mountain Ute tribal lands encompasses a large area including Bloomfield, Farmington, Durango, and Ship Rock. All of these areas are highly impacted from cattle and other Agricultural uses. The San Juan River has been listed on New Mexico's 303d list for E.coli.

Our results show that in July there were much higher E.coli numbers than in September. In July our results were 1553.07/100ml and too numerous to count. Where our September samples were within our standard limits with 224.7 and 222.4/100ml. These results support that during higher temperatures and flows there is more E.coli present due to runoff from pastures overall covering a greater surface area.

The Ute Mountain Ute tribe has been a member of the San Juan Watershed Group (SJWG) since its inception. The San Juan Watershed Group (SJWG) has approved the development of a Microbiological Source Tracking (MST) study and to seek Section 319 funding in 2012. A MST study would provide greater clarification on the animal sources of E. coli bacteria in the rivers. This will allow the SJWG better identify bacterial sources for prioritizing BMP efforts.

The MST will be conducted by collecting water samples from the river and then running tests for E. coli bacteria. Bacteria colonies are then sent to a laboratory for gene-typing to classify the animal class source of the bacteria. The genetic analysis can classify the bacterial species origin by fairly broad categories, such as human, canine (dogs and coyotes), feline, equine (horses), bovine (cattle), deer (including elk), avian (geese and ducks), etc. Depending on the prevailing animal origin for the bacteria in a certain stretch of river, the source activities can be classified as urban (human, dog & cat), agricultural (horse, cattle, etc,) or wildlife. This will enable the SJWG to select the most appropriate BMP approaches for those areas.

The watershed group is also currently implementing nonpoint source pollution reduction projects in tandem with the Natural Resource and Conservation Service converting agricultural fields from flood irrigation to side-roll sprinkler irrigation, currently three private landowners enrolled in the project and working to complete their projects. The expected benefit will be a reduction in sediment runoff, fertilizer and fecal coliform (E. coli) bacteria to the San Juan River.

WASTEWATER LAGOON CELL 1

The Tribe operates two evaporative wastewater lagoon systems under National Pollutant Discharge Elimination System (NPDES) non-discharging discharge permits. Historically these systems have been in violation of the Clean Water Act at times due to leakage and loss of excessive amounts of seepage to the groundwater. This seepage has reached the surface and appeared in Navajo Wash at times in the past. Improvements to the system have been made recently. New lined cells have been added and several of the older cells have been lined. As a result the majority of existing cells are lined and the unlined cells (three in Lagoon 2 system and one in Lagoon 1 system) will be holding less volume of effluent. These improvements should result in a significant net reduction in seepage of wastewater effluent to the shallow groundwater system.

Two ground water wells down gradient of Lagoon 1 sewer system, Lagoon 1 Well 3 (Well3) and Lagoon 1 Well 1 (Well 1) were sampled on 9/15/2010 and 9/28/2010. With the evaporative lagoon systems proximity to Navajo Wash there is potential for migration and impact to the stream system of salts, metals and nutrients associated both with the soils and the potential leachate from the contents of the lagoons themselves.

Although Well 1 and Well 3 are in close proximity to each other the ion-chemistry of these wells is drastically different. While both wells are characterized by Sodium-Sulfate type water Well 1 exhibits concentrations of these salts at many times the level of Well 3 (see map with Stiff Diagrams below).

Besides the ion-balance difference Well 1 exhibits a lower ph (7.12 compared to 8.91 at Well 3) as well as drastically lower concentrations of aluminum (250 ug/L Well 1 with 10,400 at Well 3) and iron (290 ug/L Well 1 with 6,210 at Well 3).

Depth to groundwater at the two wells is significantly different. Groundwater at Well 1 is 17.0 feet below the surface while water at Well 3 is only 0.8 feet below the surface. The difference in chemistry and groundwater depths indicates that the wells are intercepting different flowpaths from the Lagoon 1 system. The aerial imagery below exhibits the surficial salt deposits (whitish material originating near upper lagoon cell leading towards Lagoon 1 Well 3) which are concentrating in the soil as evaporation and transpiration processes concentrate the salts present in the shallow groundwater (See Salinity Section 3.2.1 above for presentation of sodium adsorption ratio and soil structure).

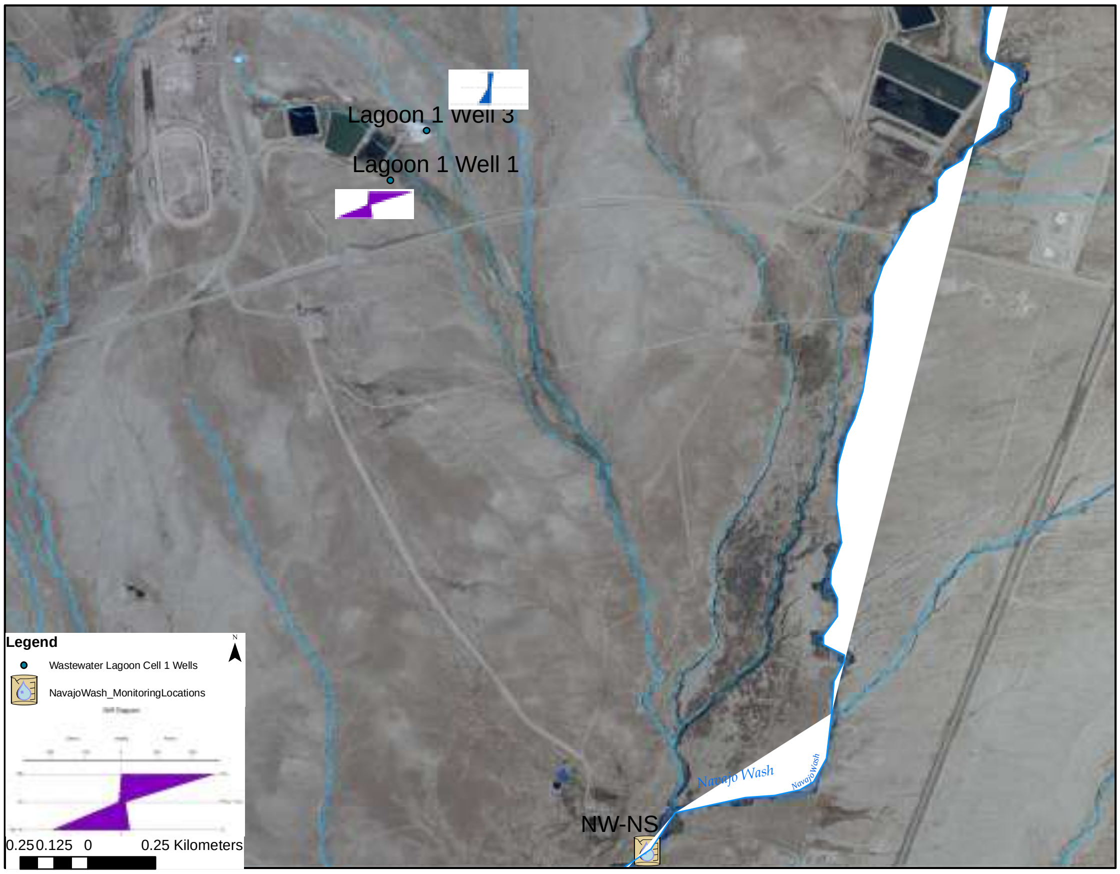
Trace metals analysis did not record concentrations of concern for any of the metals analyzed for at this location: aluminum, arsenic, cadmium, chromium, iron, lead, manganese, mercury, nickel, selenium and zinc.

Nutrient sampling for nitrogen species; ammonia, and nitrate-nitrite were either non-detects or at the detection limit indicating that the shallow groundwater system in this vicinity is not currently impacted by nitrogen from the lagoons. Total phosphorus results of 290 ug/L, 9/15/2010 for Well 3 and 50 ug/L, 9/15/2010 Well 1 do indicate that nutrient loading of phosphorus in the groundwater system is taking place.

Bacteria samples were collected and e.coli were not detected at the reporting limit. This signifies that fecal coliform bacteria are not present in the groundwater downgradient of the Lagoon 1 system.

The Lagoon System 2 wells will be monitored during FY12 to evaluate potential impacts from this system which is in direct proximity to Navajo Wash.

Map 4: Lagoon Well 1 Major Ion Chemistry and Proximity to Navajo Wash



MARBLE WASH LIVESTOCK MORTALITY INVESTIGATION

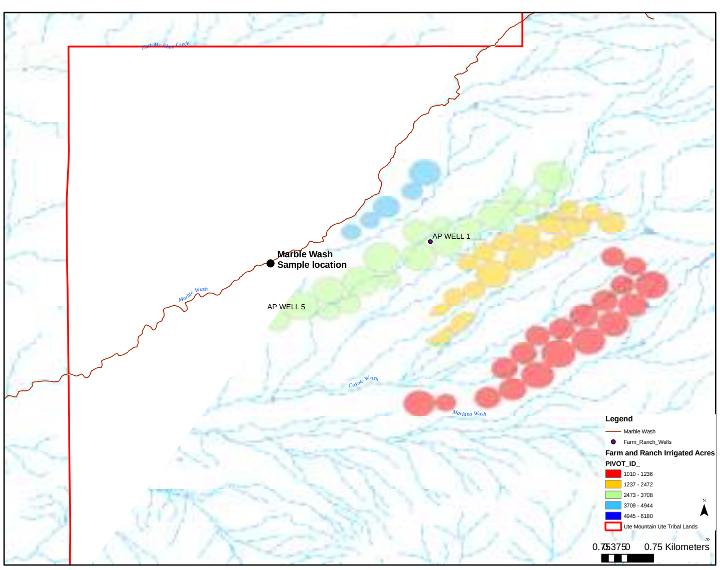
On July 8, 2010 a water sample was collected from Marble Wash, an ephemeral stream originating on the western edge of the Reservation. Marble Wash empties into the San Juan River approximately ten stream kilometers beyond the western border of the Reservation. Most of the flow in the channel stems from irrigation return waters from the Tribe's Farm and Ranch Enterprises. The sample event was conducted in response to concern expressed from a Tribal member who grazes livestock in the area. Several individuals of their herd had recently perished from unknown causes and they suspected that water contamination may have been a factor in the deaths. There are a number of oil and gas pads and related infrastructure in the area. Additionally, the possibility of pesticide contamination from Farm and Ranch Enterprise was identified as a potential concern. Accordingly the sample event was designed to target a suite of metals, Volatile Organic Compounds (VOCs) and pesticides in addition to standard ions and field parameters.

There were no detections of VOC or pesticides in the water and the chemistry of the sample is similar to many of the stream systems in the region. The dominate ions are sodium and sulfate and the conductivity level is relatively high at 2,530 uS/cm, however this level is not near high enough to damage livestock health. The Tribal salinity standard to protect livestock health is 5,000 uS/cm. Selenium was above the acute chronic life criteria to protect aquatic life at a level of 14 ug/L, however this level of selenium is not near a level sufficient to cause mortality.

Arsenic, barium, molybdenum and nitrate have been indentified in literature (Water Quality for Wyoming Livestock and Wildlife, Wyoming Department of Environmental Quality) as potential sources of toxicity to livestock. The arsenic result of 5.5 ug/L is below the threshold of 10 ug/L to protect human health in drinking water and is not at a toxic level. Current research (referenced above) indicates that barium would not be acutely toxic to livestock at concentrations below 23 mg/L, this is a large amount higher than the 0.066 mg/L concentration found in Marble Wash. Similarly, molybdenum may be toxic at concentrations greater than 300 ug/L and the level found in Marble Wash was well below at 3.9 ug/L and Nitrate may be poisonous at levels greater than 100 mg/L and concentrations found in Marble Wash were a small fraction of that at 0.00021 mg/L.

While it appears that water in Marble Wash is an unlikely culprit in the cattle deaths, it remains a possibility that oil and gas infrastructure in the area may have played a role. Concentrations of metals and/or salts in pits or leaking pipes that have been documented in the area may have been toxic sources. Besides ingestion of dissolved constituents in water which was investigated in the Marble Wash sample, animals may be exposed through direct ingestion of oil, inhalation of hydrocarbon vapors, contaminated plant or soil ingestion, or dermal adsorption. Our department did require operators in the area to construct exclusion fencing around potential sources to eliminate potential danger to livestock. The most likely cause of mortality to the cattle is insufficient range resources. Quality forage does not exist to a large degree in the vicinity and a rest and restoration of the range would provide the greatest benefit to livestock operators in the Marble Wash area.

Map 5: Marble Wash Sample Location



3.3 FUTURE SAMPLING RECOMMENDATIONS

The amount of data collected for McElmo Creek, Cottonwood Wash and the San Juan River during FY2010 was sufficient to provide a detailed analysis of current conditions. We are currently working on completing a quality control check and database compilation of historically collected data in order to be able to accurately track trends over time and complete more detailed statistical analysis.

Aluminum, iron, nutrients, selenium, salinity and bacteria need to be monitored regularly into the future along with constituents that are necessary to interpret these parameters: major ions, suspended and dissolved solids, temperature, flow, dissolved oxygen, pH and conductivity.

Future monitoring efforts in the River system should be conducted at a greater frequency and spatial extent. Macroinvertebrate samples need to be collected from each site along with chlorophyll-a. Radium 226 and Radium 228 need to be added to the analysis suite for Utah samples in the Cottonwood Wash watershed.

Bacteria (e.coli) analysis should also be included for Utah locations, due to the remote nature of these sites we were unable to meet hold times for this analysis during FY10. We have recently (FY11) been awarded grant funding to purchase an IDEXX system to conduct these analyses in-house.

The next monitoring round for the McElmo Creek, Cottonwood Wash and the San Juan River is scheduled for FY2013. A Sampling and Analysis plan will be developed and implemented for FY13 to include at least four sampling events for each of the sampling locations included in this report. Each sampling event will include collection and analysis for a comprehensive suite of physical and chemical parameters.

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