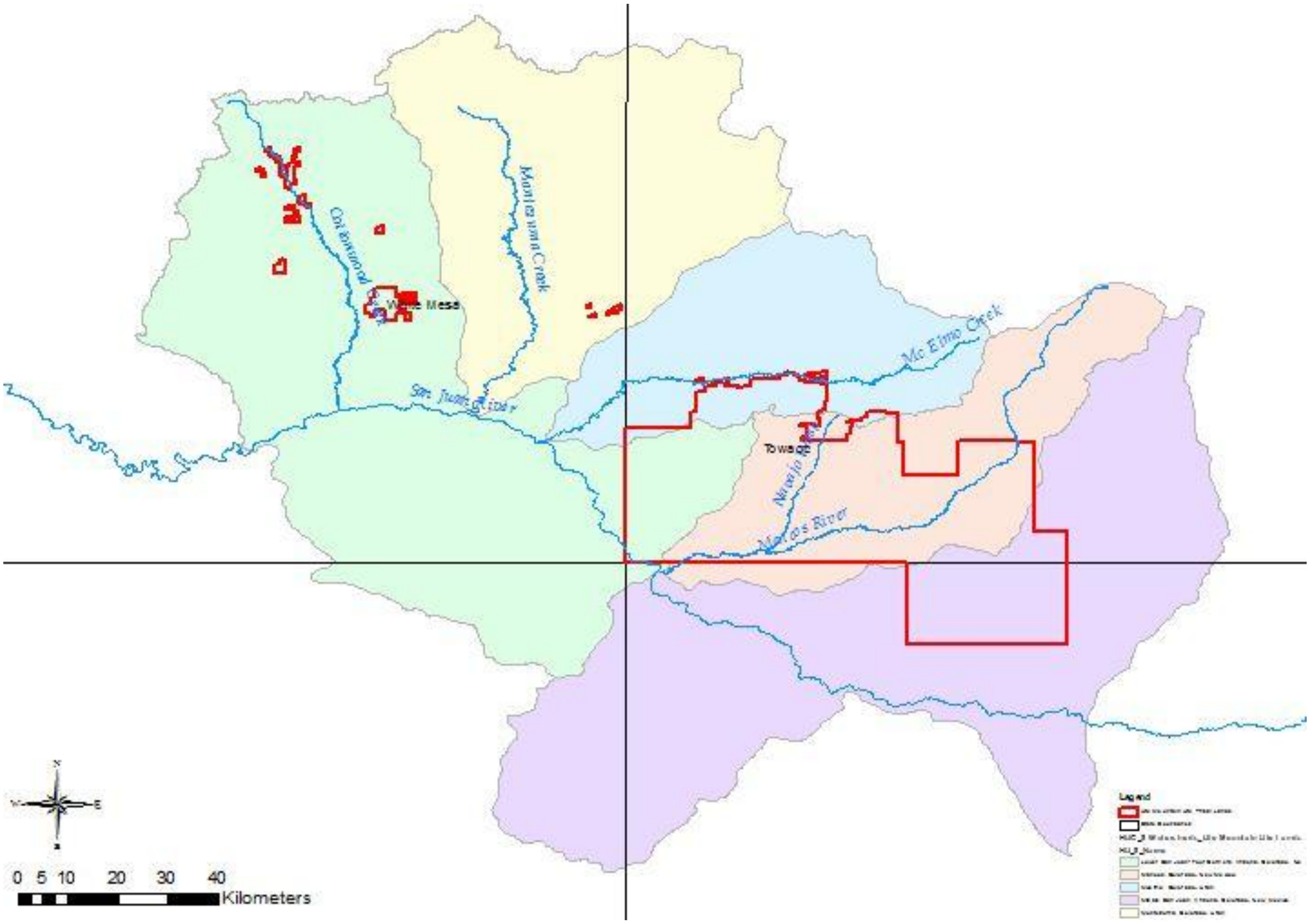
Mancos River Water Quality and Trends Assessment:

2011 – 2012



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Ute Mountain Ute Tribe

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1.0 INTRODUCTION

This Tribal Assessment Report, "Mancos River Water Quality and Trends Assessment, 2011 – 2012" consists of a description of the Ute Mountain Ute Tribe's Section 106 funded Water Pollution Prevention Program monitoring strategy, a water quality assessment for historical and current (2011 – 2012) water quality data and a report of the Ute Mountain Tribe's WQX submitted data for Fiscal Year 2012.

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 2011, the Ute Mountain Tribal Council adopted 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. 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. The standards were recently under triennial revision and were approved by Tribal Council on January 20th of 2011 (Council Resolution # 2011-010) to incorporate significant modifications. The triennial revision contained two significant changes: first, an anti-degradation implementation policy describing procedures for discharge permitting, the relationship to the nonpoint source program, and enforcement of violations of the standards; second, the revision designated three "Outstanding Tribal Resource Waters," for the highest level of protection in the standards. Various numeric criteria were also updated to reflect best current water quality science policy. Our current standards may be found here:
http://www.utemountainuteenvironmental.org/umep/assets/File/Water/Surface%20Water%20Standards/UMU_WQS_2011Revision_042011_supplimental.pdf

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.

1.1 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 temperature ranges from 39°F to 86°F, and the average monthly minimum temperature ranges from 18°F to 57°F. The highest and lowest temperatures occur in July and January, respectively. Precipitation also varies with elevation, with average annual precipitation amounts of 8 to 10 inches in the lower elevations of the Ute Mountain Ute Reservation and about 13 inches at Cortez (Butler et al., 1995). The 50-year (1948 through 1997) annual precipitation minimum was approximately 5.2 inches at Cortez (1989) and the 50-year maximum was 30.8 inches at Mesa Verde National Park (1957) (Earthinfo, Inc., 2000). Average monthly precipitation varies from 0.65 inch in June to 2.00 inches in August. At the higher elevations, the monthly precipitation totals are relatively constant throughout the year with the exception of the dry season, which occurs in April, May, and June. At lower elevations, a relatively drier season occurs from April through June and a relatively wetter season occurs from August through October. Summer precipitation is characterized by brief and heavy thunderstorms. The snowfall season lasts for 7 to 8 months with the heaviest snowfall typically occurring in December.

1.2 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) drains the northern portion of the Sleeping Ute Mountains via small tributaries, flowing west from Cortez across two parcels of Reservation land 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. The Mancos River the focus of FY2012 monitoring and this assessment report is described in Section 1 and 2011 – 2012 monitoring results are analyzed in Section 3.

1.3 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, and sand and gravel extraction, grazing for Tribal livestock, and the Farm and Ranch Enterprise south of Sleeping Ute Mountain. In addition, the Ute Mountain Utes operate several tourism facilities, including the 125,000-acre Ute Mountain Tribal Park, the Ute Mountain Casino Hotel/Resort, the Sleeping Ute RV park, and Ute Mountain Pottery. Table 1 summarizes the current land use on the reservation; Figure 2 shows the areas in which these uses take place.

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

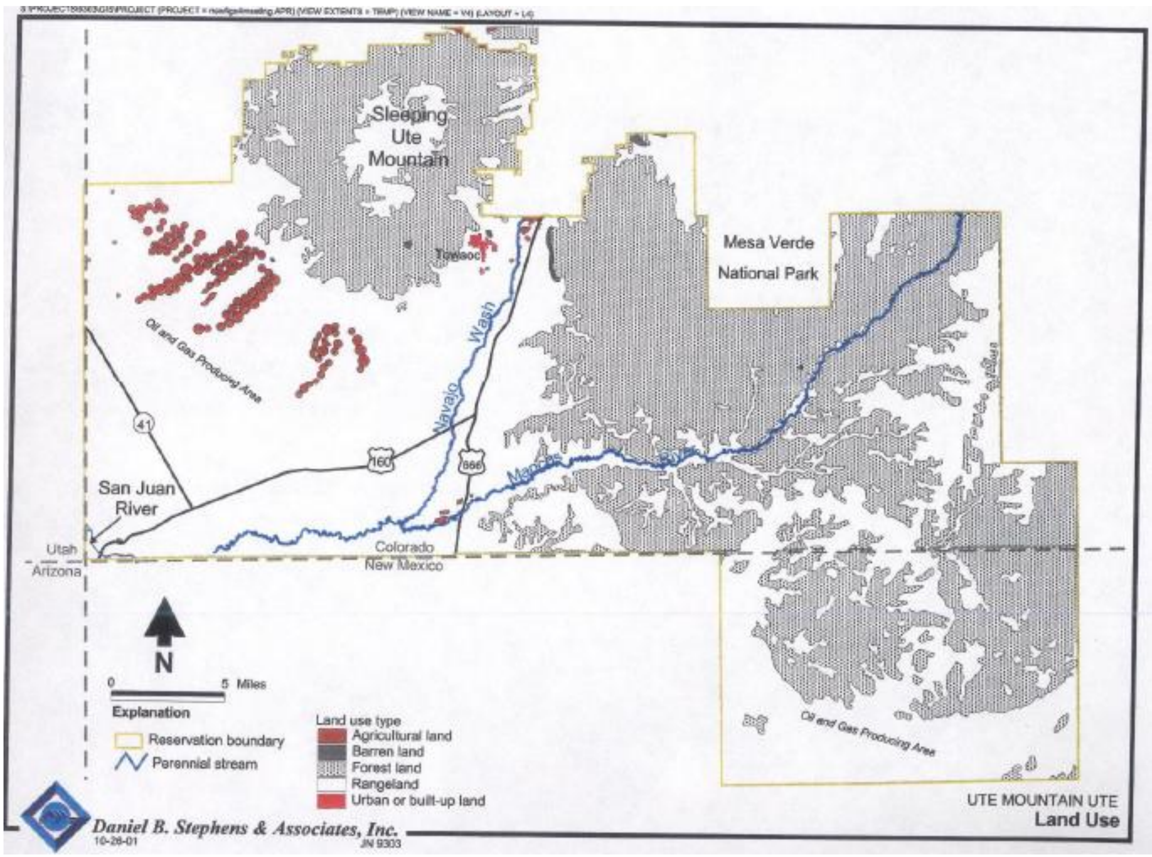
Source: Tribal Land Use Commission, as cited in Ute Mountain Ute Tribe, 1999

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

The Farm and Ranch Enterprise primarily grows crops, but 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 is practiced in Allen Canyon, the historical home of the Tribal Members who now live in White Mesa.

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

1.4 MANCOS RIVER

The main surface water body on the Ute Mountain Ute Reservation is the Mancos River (Map 1). The Mancos River drains approximately 795 square miles. From its headwaters in the La Plata Mountains to the northeast of Mancos, Colorado, the Mancos River flows southwest to south through the Ute Mountain Ute Reservation and joins the San Juan River just south of the Colorado-New Mexico state line (Butler et al., 1995). There are five main tributaries to the Mancos River. Chicken Creek, and the East, Middle and West Forks originate in the peaks of the upper watershed (the two highest peaks are Hesperus Mountain and Lavendar Peak, 13,232 ft. and 13,240 ft. respectively) and the fifth tributary, Mud Creek drains the lower elevations in the northwestern portion of the upper watershed. Numerous canyons and ephemeral washes enter the River as it moves through Mancos Canyon in the lower portions of the watershed and the River then flows through relatively flat desert country until it enters the San Juan River in the Navajo Nation.

Like many western streams, the flow of the Mancos River is dominated by precipitation falling in the higher elevations (La Plata Mountains) in the northeast portion of the watershed. Precipitation in the overall watershed ranges from over 40 inches in the mountains to less than eight inches where the Mancos enters the San Juan River. Perennial stream flows on the Reservation vary widely. The Mancos River has a range of annual mean stream flow, based on 87 years of USGS data, from 4.28 cf/s (1959 drought conditions) to 138.4 cf/s (1973). Due to upstream irrigation diversions, the lower Mancos typically dries up during late June to July until late summer rains restore flow. Minimum flows at the stream gauge on the Mancos have been zero flow, and maximum flow has reached 5,300 cf/s (1941). On September 23, 2013 a huge storm caused a flow over 4,000 cf/s. Off-Reservation, the Mancos River's flow is regulated by Jackson Lake in the La Plata Mountains near its headwaters. During the April/May-September/October irrigation season, much of the flow in the Mancos on the Reservation is irrigation return water.

The Mancos River was listed by the State of Colorado in its 2000 303(d) list for copper. 75% of samples in the upper basin where the State monitors exceeded the chronic copper standard for aquatic life. In the late 1990's as part of the Clean Water Action Plan, the Mancos was identified as impaired by sediment due to erosion. Tribal data have also indicated exceedances of chronic aquatic life selenium criteria. Selenium has been identified as originating from Mancos Shale and shale- related soils that are irrigated in the Mancos Valley.

The Mancos River flows through many of the major ecosystems found on the Colorado Plateau region including Alpine Tundra, Sub-Alpine Coniferous Forests, Spruce-fir Forests, mixed conifer forests, plains-mesa grasslands, savannah and desert scrublands consequently the biological diversity of aquatic and terrestrial communities across the entire watershed is high. Hydrogeomorphic conditions are wide ranging as well including small, straight, narrow and high gradient streams in the mountains (generally above 9,500 feet). The banks and channel bottoms of these high gradient streams are commonly comprised of bedrock.

Between 7,500 and 9,500 feet the Mancos River and its major tributaries form deep canyons as they cut through relatively flat plateaus. The canyons progressively widen downstream. Cobbles and larger rock material that is washed down from the upper mountain reaches comprises the banks and bottom of the channels.

As the River flows through Mancos Valley (6,500 – 7,500 ft) the gradient flattens and the flood plain widens. Urban and agricultural developments have restricted the Rivers movement through this reach resulting in channelization. Remnant fluvial landforms in the flood plain indicate that numerous meanders existed prior to development. The bottom of the channel consists of cobble in portions, which has protected certain reaches from downcutting. The stream bottom rests on bedrock in other portions of the Valley, consisting of the Mancos Shale geologic formation- a Cretaceous aged Marine shale deposit high in salts and certain metals (selenium, arsenic). Land use in the Valley is primarily tied to agricultural use although a large amount of aggregate mining is performed and the number of residences (along with filings for water rights) are increasing.

Between 5,300 and 6,500 feet the River travels through Mancos Canyon. Numerous side canyons contribute ephemeral flows to the river. The gradient through the canyon is low and there is considerable meandering of the channel. Riverbanks and bottom are primarily fine and medium sediments with small amounts of cobble. After Mancos Canyon the river gradually decends to it's lowest elevation (~4,600 ft) where it enters the San Juan River. The river has a low gradient with a wide and shallow channel through this reach. Most of the banks consist of exposed bedrock (Mancos Shale) and fine sediments.

Roundtail chub, Flannelmouth Suckers and Bluehead Suckers, all native fish, are present in the Mancos River and a partnership to protect and restore breeding populations has been implemented with the Colorado Division of Parks and Wildlife (CPW), the Tribe's Brunot Wildlife Department and Environmental Programs Departments, and Mesa Verde National Park. This program has provided a significant ecological benefit to the Mancos River Watershed. The combination of massive, severe-intensity forest fires in the watershed in 2000 and a 5-year drought caused the demise of most of the Mancos River fish. This stream segment is unique because it is populated by almost entirely native fish because of a barricade to migration of San Juan River fish upstream of the Tribe's irrigation diversion dam near Highway 491/666 in Colorado. An effort was made in 2002 to salvage some of the last Mancos River roundtail chubs—a fish species of "special concern" in Colorado, and listed as threatened in New Mexico. Through a successful captivebreeding program, thousands of these fish were returned to the Mancos in September 2003. Also, in April 2004, two other native Mancos River fish species were reintroduced to the river, the flannel mouth sucker and the blue head sucker. Restocking efforts have been carried out annually since, with the Tribe stocking an average of 12,000 native fish each year.

Restocking) efforts had been effective in boosting numbers of native fish in the River until the summer of 2012 (Paul Jones CPW, 2012 Mancos Fish Sampling Report). Over ten thousand acres of terrain in close proximity to the Mancos River and a significant tributary, Weber Creek, burned in July of 2012. This event was named the Weber Fire and it had a profound impact on water quality, fish and biological communities, and physical characteristics of the River. These impacts are discussed in detail in the assessment portion of this report (Section 4).

The riparian vegetation community along the Mancos River within Tribal lands is impacted by invasive species. Although healthy populations of native species such as cottonwood (*Populus spp.*), willow (*Salix spp.*), sumac (*Rhus spp.*), buffaloberry (*Shepherdia spp.*), box elder (*Acer negundo*) and New Mexico privet (*Forestiera pubescens*) are present and common in the upper reaches of the canyon, invasive species including Tamarisk (*Tamarix spp.*), white top (*Lepidium draba*) and Russian knapweed (ACROPTILON REPENS) have crowded out and replaced native species along much of the river. The Mancos River riparian zone is heavily infested with Tamarisk, and significant efforts have been undertaken to address the issue.

The Tamarisk removal project was started in 2008 using combination of three methods, mechanical (stump cutting using chain-saws), chemical (spraying the freshly-cut stumps with herbicide), and biological (releasing and monitoring of diorhabda elongata, "Tamarisk Beetle"). The Tamarisk Crew, a team of five men led by one Environmental Programs Department (EPD) staff, implements the cut-and-spray operation two days a week year-round. Annually a team of four EPD staff monitors the movement of the insects and the extent of defoliation implement twice a year at established plots. These efforts are also collaborative and coordinated with the regional Tamarisk control effort; the Tamarisk Crew with the NRCS and biological control with Palisade Insectary, beetle monitoring work with San Juan Watershed Woody-Invasive Initiative and Tamarisk Coalition. Approximately, 200 acres of Tamarisk has been cut and sprayed manually and 4,000 acres of Tamarisk in the Tribal lands have been defoliated biologically to date.

The Tribe completed a Nonpoint Source Assessment Report in 2005. This report analyzed water quality data collected through 2001 and presented a summary of the condition of streams and water resources on the Reservation. Three categories of water body impairment are described in the Tribes Nonpoint Source Assessment Report (UMU, 2005); ***nonimpaired***, or waters meeting water quality standards and supporting designated uses; ***moderately impaired***, those waters that have limitations on meeting water quality standards and supporting uses, but that are likely to recover from impairments through changes in management activities; and ***severely impaired*** waters, those waters that will require significant, long-term changes in management activities *and* significant on-the-ground projects to minimize or mitigate nonpoint source pollution

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

Sources of pollutants include: Mining legacy impacts from abandoned mines located near the headwaters in the upper basin (La Plata Mountains), upstream irrigation effects through groundwater return flows through Mancos Shale (Cretaceous-aged marine derived material naturally high in mobile selenium, arsenic and salt compounds), wastewater treatment systems upstream of the Reservation, and grazing effects. Physical impairment is caused by: 1) fine sediment deposition from upstream irrigation and upstream and on reservation grazing. Biological impairment is related to all of the chemical and physical impairments—macroinvertebrate populations are limited in diversity of species because of chemical stressors and physical habitat limitations. Riparian health is also impacted by tamarisk infestation. The town of Mancos has a wastewater treatment plant adjacent to the river that has as a post-treatment effluent discharge into the river. There is significant cattle grazing in and downstream from the town of

Mancos, which is upstream from the Reservation. At the same location as one of the cattle ranches, Mud Creek flows into the Mancos River. Just above this confluence, on Mud Creek, is a gravel mining operation. Once the Mancos River enters the Reservation, it is affected by occasional cattle grazing in the canyon north of Highway 491. A small population of feral horses also cause grazing impacts to the river as it crosses the Reservation. The Mancos is partially diverted for the Tribe's Farm next to the gauging station and sample site MR-GS. Below that point, the only potential impacts are from occasional grazing and road/pipeline building for oil and gas interests. There are no point source discharges to any surface water body on the Reservation.

2.0 DESCRIPTION OF MONITORING STRATEGY

The document, "Ute Mountain Ute Environmental Programs Department Water Pollution Prevention Program Monitoring Strategy, revised September, 2013" (Appendix A) 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 2011 - 2012 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 154 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.

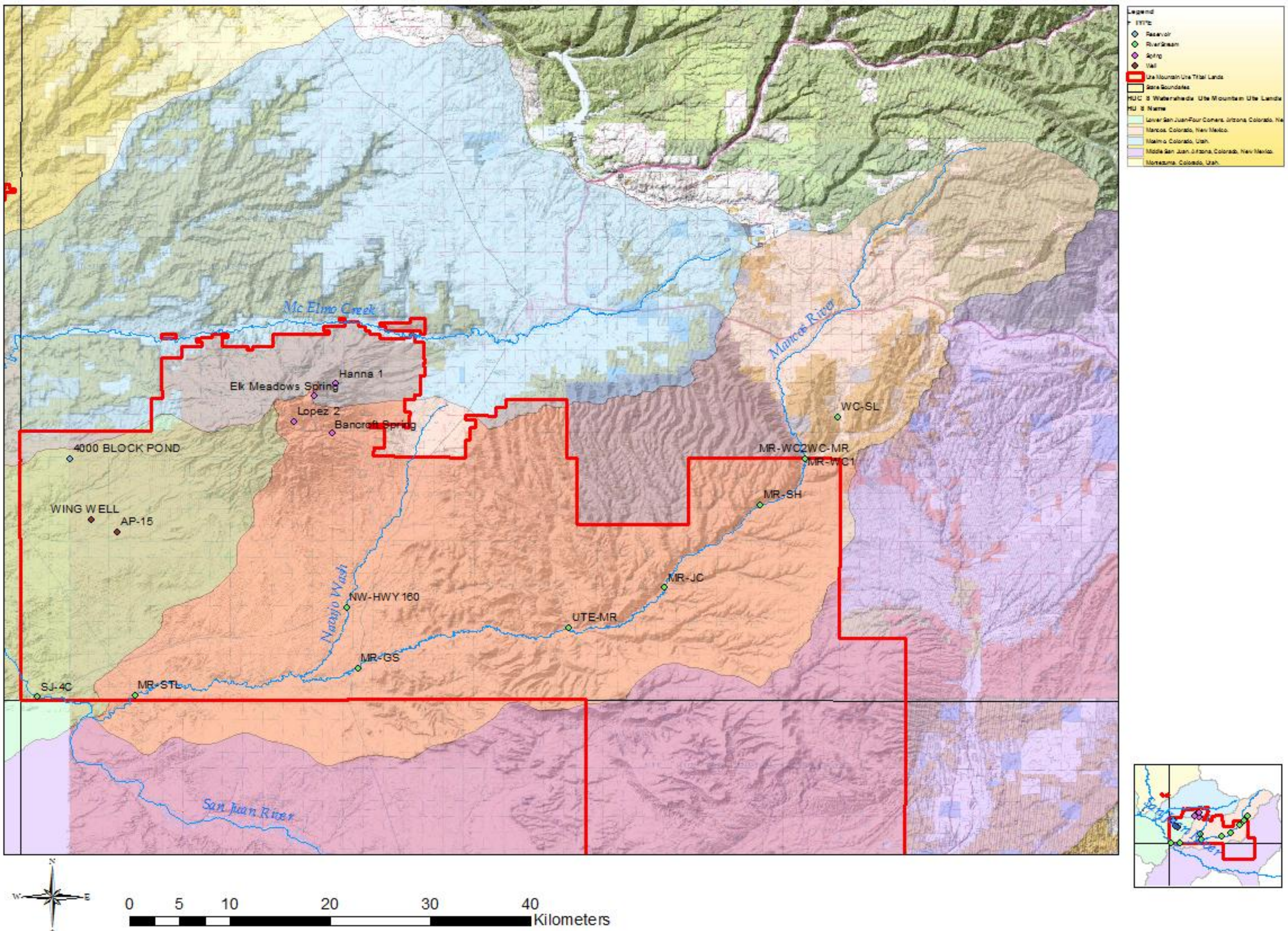
YEAR (Oct-Sept)	BASIN(S)
FY 2013	Mid/Lower San Juan, incl. McElmo Creek, Cottonwood Wash, UT
FY 2014	Navajo Wash
FY 2015	Mancos River
FY 2016	Mid/Lower San Juan, incl. McElmo Creek, Cottonwood Wash, UT
FY 2017	Navajo Wash
FY 2018	Mancos River

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 A).

2.3 WATER QUALITY MONITORING SITE DESCRIPTIONS

Monitoring locations have been established on the Mancos River to assess water quality trends and protect designated uses. Map 2, below, shows the geographical locations of monitoring locations on the Mancos River. A justification of the monitoring locations is included as well.

MAP 2: Fiscal Year 2012 Water Quality Sample Locations



Surface water sample site location justification:

Mancos River Basin:

MR-WC1: this site indicates what flows onto the Reservation in the Mancos River upstream of tributary influences

WC-MR: this site indicates what flows onto the Reservation in Weber Creek

MR-WC2: this site indicates what cumulative impact Weber Creek has on pollutant concentrations in the Mancos River

MR-JC1: this site indicates what water quality changes occur in the 10+ miles of remote canyon with geological changes and tributaries (lots of fire activity in the past 10 years)

MR-GC1: this site indicates what influences Johnson Canyon, Navajo Canyon and the traffic on the improved gravel road along here may have on water quality (lots of fire activity in the past 10 years)

Ute-MR: this is unique perennial spring-fed stream segment with tribal ceremonial use designation—heavily used by horses, and the feral horses—soon to be removed—hopefully this will provide water quality improvements

MR-GS: This is at the mouth of the canyon where geology changes significantly. Site of USGS gauge cost-shared with Tribe; long period of historic flow and water quality data

MR-STL: this site is at the downstream end of the Mancos River near the discharge into the San Juan; popular breeding ground for endangered fish; represents cumulative nonpoint source impacts from the landscape to the river

AP-15: Groundwater well on Farm and Ranch Enterprise irrigation project. Baseline Data Collection Farm and Ranch Enterprise area: Assess NPS impacts from agricultural operations

4000 Block Pond: Baseline Data Collection Farm and Ranch Enterprise area: Assess NPS impacts from agricultural operations and use attainment for livestock drinking

Wing Well: Baseline Data Collection Farm and Ranch Enterprise area: Assess NPS impacts from agricultural operations and use attainment for livestock drinking

SJ-4C: Baseline data collection, assess upstream NPS

Elk Meadows Spring, Hanna Spring, Lopez Spring, Bancroft Spring: Baseline Data Collection shallow aquifer, assess use attainment for Tribal Ceremonial Use

2.4 LOCATIONS SAMPLED AND DATA COLLECTED

Nineteen distinct locations were sampled. These locations are shown geographically on Map 2 and are described in Table 2 below. Data collected at each location varied slightly due to data collection objectives and generally included data collection for the following categories: field parameters, major ions, nutrients, bacteria, trace metals, pesticides, radionuclides and macroinvertebrates. Table 2, below includes detail for analytes collected for each sample location.

3. 2012 WATER QUALITY EXCHANGE (WQX) SUBMITTED DATA

Each distinct water quality sampling event in the Mancos River Watershed for FY2012 was submitted to the Regional WQX database following QC measures (described in Section 3.1), this data is analyzed in the following sections. Table 2 below summarizes sample locations, dates and data types collected for each sample. Complete analytical results for each sample event are included with this report as Table 3 at the end of Section 3.

Table 2

Ute Mountain Ute Water Pollution Prevention Program

Sampling Locations, Dates and Data Types for the Mancos River FY12

Station ID	Location Description	Latitude	Longitude	Elevation *ft*	Sample Date	Data Type

4000 BLOCK POND	Livestock pond north end of farm and ranch on the west side of 4000 block	37.214872	-109.00002	5179	8/15/2012	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5],Physical parameters[6] ,Pestecides[7],
AP-15	Farm and ranch monitoring well located at the south end of 2000 block	37.149655	-108.95784	5041	6/18/2013	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5], Physical parameters[6],Pestecides7,
Bancroft Spring	Spring located on north side of Indian Route 257 just past first lake	37.23851611	-108.7651325	6820	6/18/2013	Field Parameters[1], Bacteria[4]
Elk Meadows Spring	Located just south of Ute Peak	37.27134111	-108.7808164	8130	6/18/2013	Field Parameters[1], Bacteria[4]
Hanna 1	Mountain spring lots of human use.	37.282368	-108.761172	7520	5/9/13, 6/18/13	Field Parameters[1], Bacteria[4]
Lopez 2	Spring near Sun Dance grounds highest human consumption use tested for bacteria annually before Sun Dance; restoration project undertaken here.	37.24828875	-108.7986625	7800	5/9/2012	Field Parameters[1], Bacteria[4]
MR-CC	Mancos river just upstream of the diversion damn for	37.04130194	-108.7112183	5100	10/13/2011	Field Parameters[1],Macroinvertebrates[9]

	Mancos creek farm					
MR-CG	Mancos river at the north end of the campground	37.08907694	-108.4725017	5620	10/13/2011	Field Parameters[1],Macroinvertebrates[9]
MR-GS	Mancos river at USGS gauge 09371000 MANCOS RIVER NEAR TOWAOC, CO.	37.027271	-108.74191	5048	10/12/2011, 1/11/2012, 2/23/2012, 5/16/2012, 8/8/2012	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5], Physical parameters[6],Pestecides7, Radionuclide[8,] Macroinvertebrates[9]
MR-JC	Mancos River at confluence with Johnson Canyon	37.099391	-108.46609	5648	1/11/2012, 2/23/2012, 5/14/2012, 7/10/2012, 8/6/2012, 9/26/2012	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5], Physical parameters[6], Macroinvertebrates[9]
MR-SH	Mancos River at Sandal house Ruin	37.17343306	-108.3807672		10/12/2011	Field Parameters[1],Macroinvertebrates[9]
MR-STL	Mancose river just above the state line where the Mancos enters New Mexico	37.002499	-108.94202	4720	10/11/2011, 1/11/2012, 2/23/2012, 5/16/2012, 8/8/2012	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5], Physical parameters[6],Pestecides7, Radionuclide[8,] Macroinvertebrates[9]
MR-WC1	Mancos river above webber creek-site is upstream from confluence with creek flowing from weber Canyon, below riffle area, directly above confluence and	37.215363	-108.34028	6153	10/18/2011, 12/12/2011, 1/11/2012, 4/10/2012, 4/17/2012, 5/14/2012, 6/19/2012, 8/6/2012, 9/6/2012, 9/26/2012	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5], Physical parameters[6],Pestecides7, Radionuclide[8,] Macroinvertebrates[9]

	road crossing.					
MR-WC2	Mancos river below webber creek-site is downstream from confluence with creek flowing from weber Canyon, below where water enters from the adjecent wetland oxbow	37.214906	-108.34022	6153	10/18/2011, 12/12/2011, 1/11/2012, 4/10/2012, 4/17/2012, 5/14/2012, 6/19/2012, 8/6/2012, 9/6/2012, 9/26/2012	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5], Physical parameters[6]
NW-HWY 160	Navajo Wash at Highway 160 is located just up river of the bridge	37.08166	-108.75212	5127	1/11/2012, 2/23/2012, 5/16/2012	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5], Physical parameters[6],Pestecides7, Radionuclide[8,] Macroinvertebrates[9]
SJ-4C	San Juan River near four corners. USGS gauge at site with historical data record for flow and water quality. Jurisdictional hotspot.	37.001113	-109.029585	4440	8/8/2012	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5], Physical parameters[6], Macroinvertebrates[9]
UTE-MR	Ute spring discharges into the Mancos River	37.063297	-108.55221	5445	1/11/2012, 2/23/2012, 5/16/2012	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5], Physical parameters[6]

WC-MR	Webber Canyon Creek at Mancos River-site is directly above road crossing and confluence with Mancos River, in straight segment just above road.	37.215379	-108.34008	6153	10/18/2011, 12/12/2011, 1/11/2012, 4/10/2012, 4/17/2012, 5/14/2012, 6/19/2012, 8/6/2012, 9/6/2012, 9/26/2012	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5], Physical parameters[6]
WC-SL	Webber Canyon Creek on State Land above Tribal land	37.25246556	-108.3103344	6500	9/26/2012	Field Parameters[1], Major Ion Data[2], Nutrient Data[3], Bacteria[4], Metals[5], Physical parameters[6]

[1] Field parameters include: Water temp, Air temp, pH, Conductivity, Dissolved Oxygen, Flow, Barometric Pressure

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

[3] Nutrient Data includes Nitrite-Nitrate, Total Kjeldhal Nitrogen, and Total Phosphorus

[4]Bacteria includes: e.Coli and Total Coliforms

[5] Metals Data includes Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silicon, Silver, Thallium, Uranium, Vanadium and Zinc

[6] Physical parameters include Total Dissolved Solids, Total Suspended Solids

[7] Pesticide Data; EPA Method 8141A and 525.2 include: Alachlor, Aldrin, Atazine, Azinphos-methyl, Benzo[a]pyrene, Butachlor, Chlorpyrifos, Coumaphos, Demeton-O, Demeton-S, Di(2-ethylhexyl) adipate, Di(2-ethylhexyl) phthalate, Diazinon, Dichlorvos, Dieldrin, Dimethoate, Disulfoton, Endrin, Ethoprop, Fensulfothion, Fenthion, Glyphosate, Heptachlor, Heptachlor epoxide, Hexachlorobenzene, Hexachlorocyclopentadiene, Lindane, Malathion, Merphos, Methoxychlor, Methyl parathion, Metolachlor, Metribuzin, Mevinphos, Naled,O-Ethyl O-(p-nitrophenyl) phenylphosphonothioate, Parathion, Phorate, Propachlor, Prothiofos, Ronnel, Simazine, Sulfotep, Sulprofos, Tetrachlorvinphos and Trichloronate

[8]Radionuclide Data include: Beta particle, Gross alpha radioactivity, Uranium-234, Uranium-235, Uranium-238, Uranium-234/235/238

[9] Macroinvertebrates

Table 3 includes complete sample results for each sample collected

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 all analytes from duplicate samples were within 20% relative percent difference (RPD). Table 4, attached, contains duplicate sample results and RPD calculations. Seventeen duplicate pairs were analyzed during the sampling period. Typically small differences in lower concentrations can result in relatively high RPD percentages. The majority of RPD calculations greater than 20% include parameters that tested near their respective detection limits.

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.

3.2 GROUNDWATER MONITORING ASSESSMENT 2012

Management and protection of the Tribes' groundwater resources are summarized in, "Ute Mountain Ute Tribe Ground Water Protection Plan, March 2004" (Mountaintop Associate and Ute Mountain Ute Tribe, 2004).

The Environmental Programs Department monitors groundwater conditions during FY12 in the following areas (results and discussion for this years' monitoring results are included below as well):

Farm and Ranch Enterprises: Groundwater monitoring in the Farm and Ranch area involves the measurement and sampling of a series of shallow wells down gradient of irrigation center pivots. The purpose of this monitoring effort is to gain a more complete understanding of irrigation related seeps, the types of pesticides or nutrients that may be escaping the irrigated fields (Atrazine is the largest concern), and to prevent shallow ground water contamination. The purpose of the monitoring effort is to provide information that can be used to refine farm management through reuse and more controlled application, reducing both risk to the environment and lower operational costs.

Pre Irrigation groundwater monitoring for 23 groundwater wells installed in the Farm and Ranch Enterprise area was conducted to determine presence of water. Seven of the 23 wells had water and the location of these wells was compared to the Farms cropping plan for 2012. Two groundwater wells were selected for sampling in August. These samples were analyzed for a suite of pesticides, with Atrazine being the primary concern. The two wells selected were in proximity to fields that corn was grown in, as Atrazine is used as a pre-emergent herbicide on these fields. If any samples tested positive for Atrazine, the wells would immediately be retested, if another positive result incurred- management practices at the Farm could be modified to mitigate any potential impact to the Tribes' surface or groundwater resources.

Two groundwater samples and one sample from a surface water impoundment in the Farm and Ranch Enterprise area were collected on August 15, 2012 and tested below the detection limit for all pesticides.

Sleeping Ute Mountain Springs: Four springs in the Sleeping Ute Mountains were sampled 5/18/2012 and 6/18/2012. A total of fifteen samples were collected for these four locations and were analyzed for e.coli and total coliform (Table 3, Bacteria Results).

3.3 MANCOS RIVER ASSESSMENT 2012

The Mancos River Basin is part of the Mancos River Watershed (HUC 14080107) which drains into the San Juan River and ultimately the Colorado River at Lake Powell. The condition of the Mancos River including parameters of concern (Selenium, Salinity and Bacteria) is discussed in detail in Section 1 of this report along with the causes/sources of pollution which from human and natural sources and are non-point source in nature.

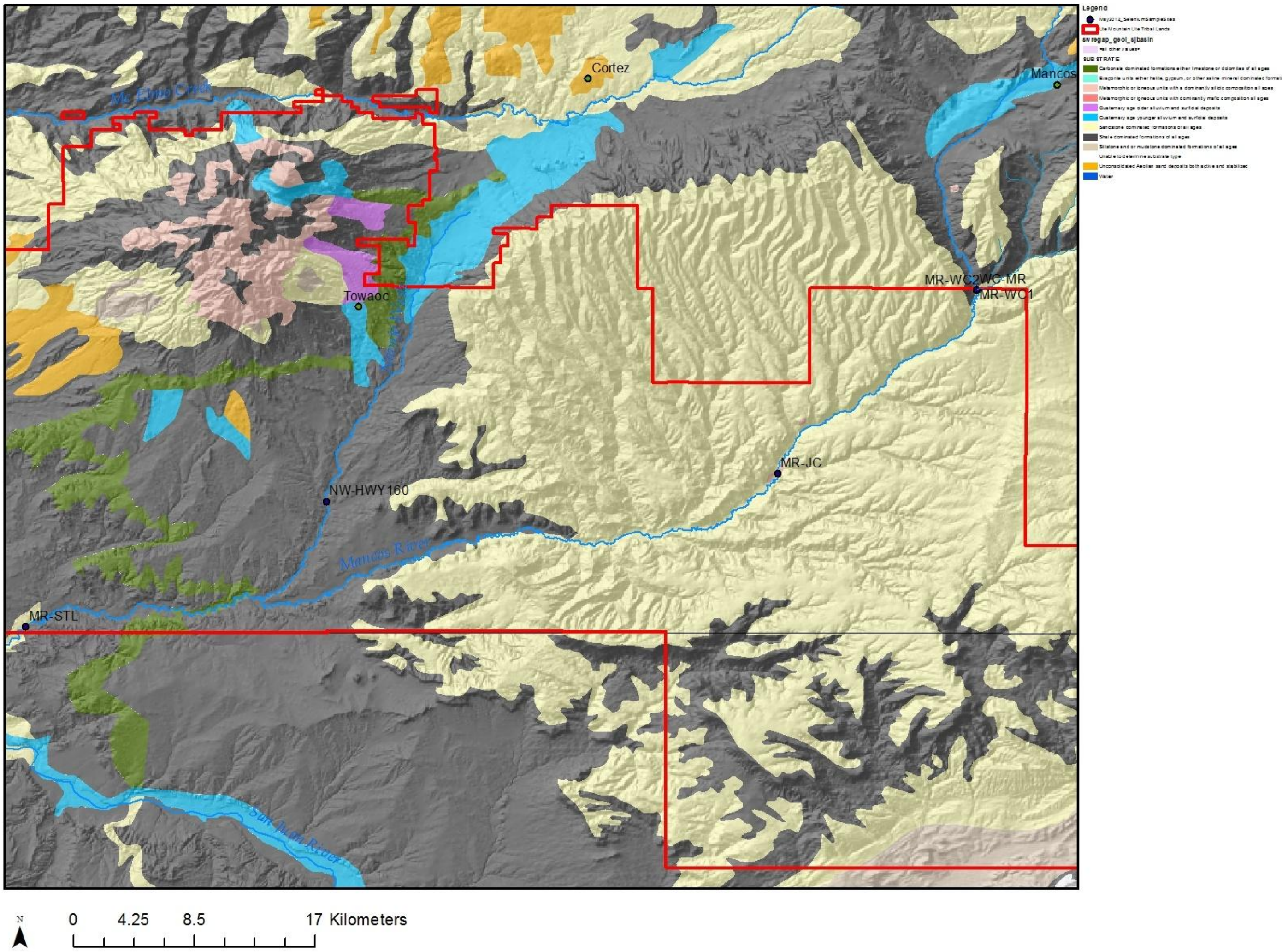
Sampling conducted in 2012 confirmed historic, longstanding (presumably since irrigation and grazing were initiated in the area circa 1880) trends in water quality impairment for selenium, salinity and bacteria persist. Post-fire water quality impacts to the River from the Weber Fire were significant and resulted in the complete elimination of what had been a healthy and recovering (since the last major fires in the watershed in 2002) population of native fish. High organic content and resulting low dissolved oxygen levels, along with the high levels of several metals at toxic concentrations (copper, zinc, manganese, iron, aluminum).

A discussion of recommended improvements for monitoring for the next sampling round on the Mancos River (scheduled for fiscal year 2015) is included at the end of Section 3.

3.3.1 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) exist through much of the Mancos River watershed (Map 3, following page).

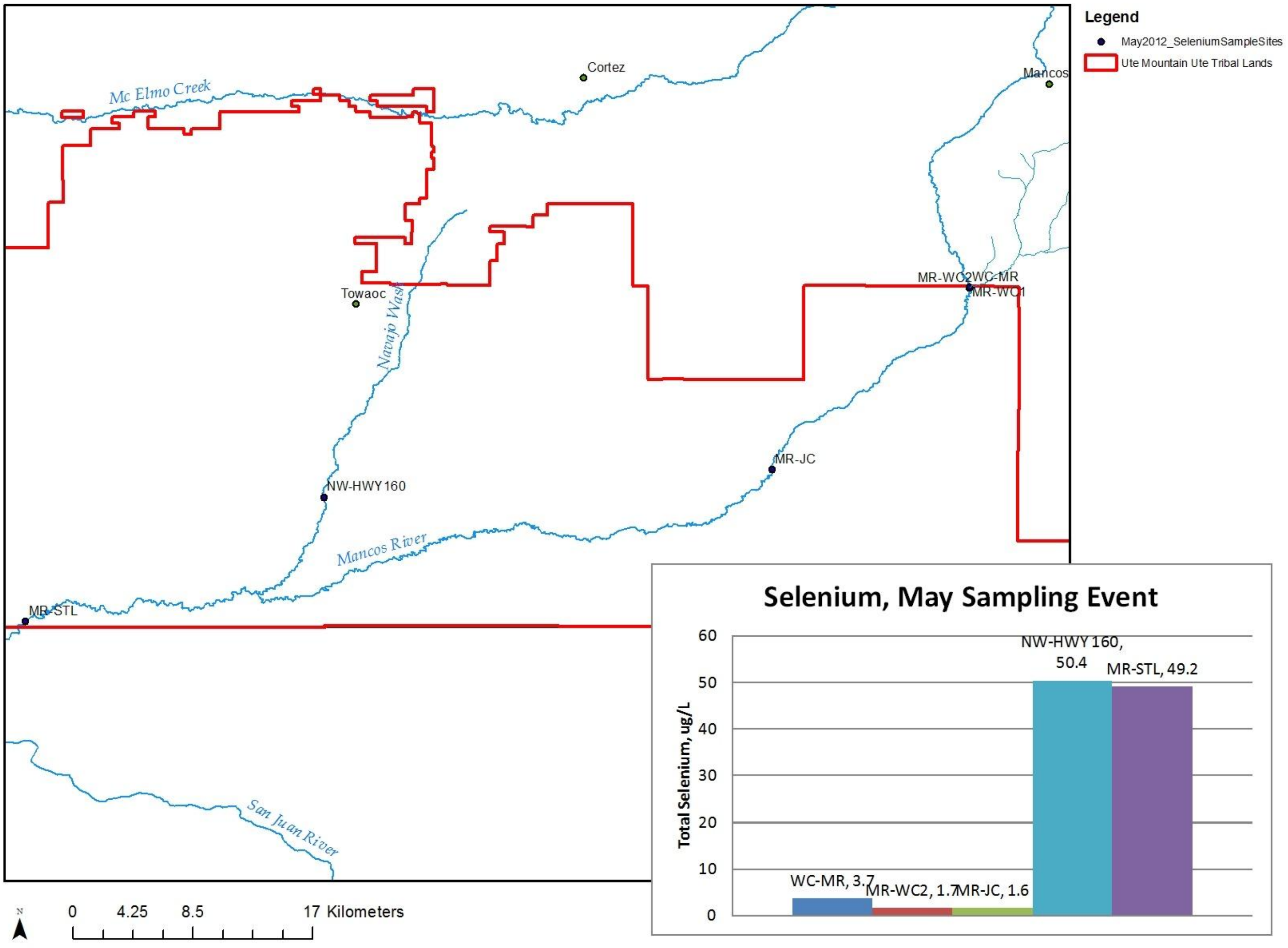
Map: Cretaceous aged Shale formations comprise the surface geology of the Mancos Valley upstream of Tribal Lands and on the Reservation in the region of Navajo Wash. These soils are heavily irrigated and produce return flows carrying elevated levels of Selenium which puts aquatic life at risk. (Note: Grey areas are Cretaceous Shale on map)



Selenium levels in the Mancos River have exceeded the current Tribally-adopted aquatic life criterion of 5 ug/L chronic total recoverable selenium twice during the years' monitoring, once exceeding the acute criterion of 20 ug/L. Two samples exceeded the chronic water quality standard to protect aquatic life (5 ug/L) with a maximum level of 49.2 ug/L, a level which also exceeds the agricultural standard of 20 ug/L. Both of these samples (8.9 ug/L on 1/11/2012 and 49.2 ug/L on 5/16/2012) were collected at the monitoring location MR-STL at the downstream end of the River not far from its' confluence with the San Juan.

Figure 2, following page, shows mean values of total recoverable selenium data for sample sites on the Mancos River and Navajo Wash during our spring sampling event (May 16, 2012). Navajo Wash has the highest selenium levels in Montezuma County (Butler, et al. 1995) and is obviously loading the Mancos River with significant levels of selenium from the confluence downstream. The maximum selenium value recorded during this sampling period was 482 ug/L from Navajo Wash at location NW-Hwy160 on 1/11/2012. Additional detail on selenium levels in Navajo Wash may be found in the Navajo Wash Assessment Report, http://www.utemountainuteenvironmental.org

Figure: Selenium levels in the Mancos River, loading from Navajo Wash



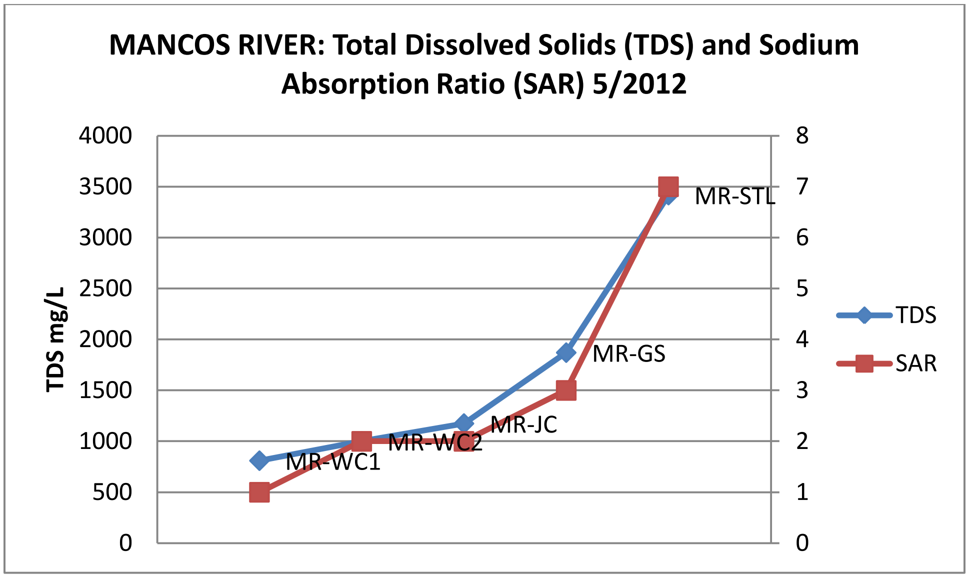
3.3.2 SALINITY

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. 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). US EPA (1986) reports that water systems with TDS concentrations exceeding 15,000 mg/L are unsuitable for most freshwater fish, TDS levels in the Mancos have never approached these levels, however the excess of salts content could conceivably 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, degrade the land and pollute groundwater.

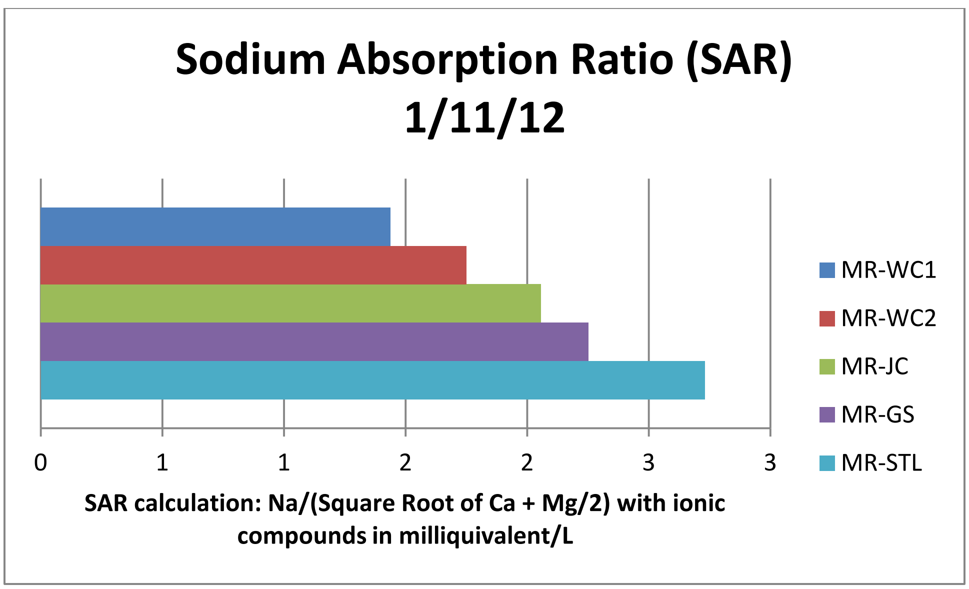
Salinity in the Mancos River:

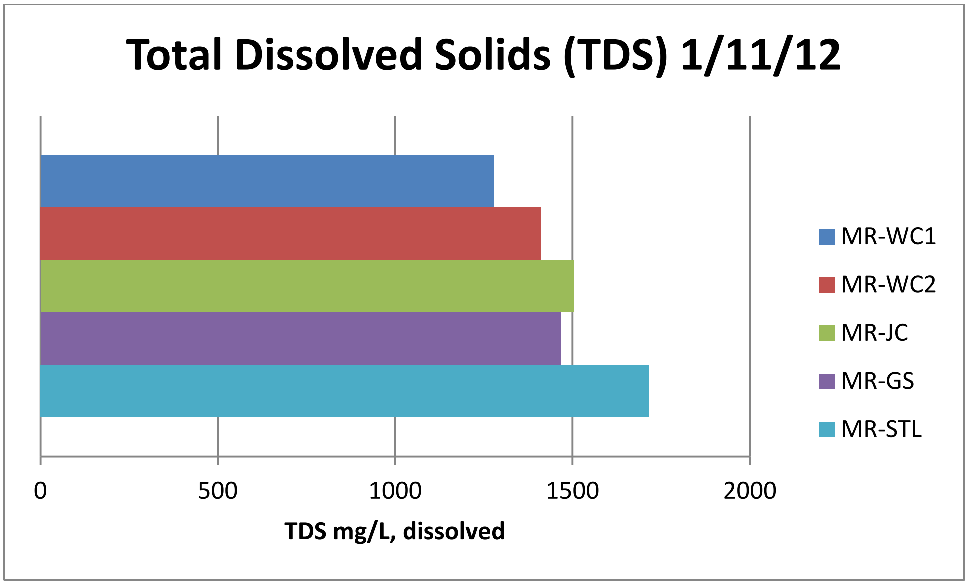
Tribal Standards for salinity specify that for Livestock consumption: TDS<or= 5,000 mg/L; and for Irrigation: <2250 mg/L when SAR is <or= 4.00, <1500 when SAR is 4.01-10.00; 750 mg/L if SAR> 10.00. For the Mancos River, SAR has historically been < 4.00 and TDS < 2250, so it meets its designated use for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

SAR calculations based on 2012 sampling results, below, are in line with historic data.



TDS and SAR for the May, 2012 (above) and January, 2012 sampling (below) events are displayed graphically showing increasing concentrations of ions from the upstream monitoring location, MR-WC1 to the downstream monitoring location, MR-STL.





TDS concentration in Weber Creek averaged approximately twice as high compared to the Mancos River at MR-WC1 (upstream of the confluence with Weber Creek).WC-MR (Weber Creek) averaged 2,090 mg/L and the Mancos River at MR-WC1 averaged 1,079 mg/L TDS during the sampling year (eleven measurements at each location).

For the Mancos River TDS values ranged from a maximum of 3,418 mg/L for the 5/16/2012 sample at MR-STL(furthest downstream site) to a minimum of 292 mg/L for the 4/10/2012 sample at MR-WC1 (furthest upstream site)

Several additional samples collected in the Farm and Ranch Enterprise area exhibited elevateded salinity values, these results were summarized in an internal memo (Reserved).

3.3.3 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.

E.Coli bacteria are currently used exclusively as an indicator of potential human pathogen pollution and the Tribe’s standard is 126/100mL (geometric mean) and 235/100mL (single sample maximum) to protect primary contact recreation (a use which the Mancos River is designated for).

Thirty eight bacteria samples were collected from river and stream sampling events during FY12.

TABLE 3: MANCOS RIVER BACTERIA RESULTS					
Monitoring Location ID	Activity ID	Date	Time	Escherichia coli cfu/100ml - Total	E.Coli Geometric Mean
MR-WC1	MR 1518	4/10/2012	10:40:00 AM	85.7	53
	MR 1524	4/17/2012	11:20:00 AM	20.3	
	MR 1528	5/14/2012	11:10:00 AM	88	
	MR 1537	6/19/2012	12:20:00 PM	2	
	MR 1549	9/6/2012	11:50:00 AM	*2419*	
	MR-1554	9/26/2012	12:05:00 PM	29.5	
WC-MR	MR1517	4/10/2012	10:30:00 AM	1	69
	MR 1523	4/17/2012	11:10:00 AM	22.8	
	MR 1527	5/14/2012	10:55:00 AM	8.5	
	MR 1535	6/19/2012	12:00:00 PM	65.7	
	MR 1541	8/6/2012	11:50:00 AM	2419	
	MR 1548	9/6/2012	10:45:00 AM	2419	
	MR 1536	9/19/2012	12:05:00 PM	119.8	
	MR-1553	9/26/2012	11:45:00 AM	58.3	
MR-WC2	MR 1520	4/10/2012	11:30:00 AM	101.4	112

	MR 1521	4/17/2012	10:45:00 AM	52	
	MR 1522	4/17/2012	10:55:00 AM	34.5	
	MR 1525	5/14/2012	10:40:00 AM	122.3	
	MR 1526	5/14/2012	10:45:00 AM	76.3	
	MR 1534	6/19/2012	11:30:00 AM	18.7	
	MR 1540	8/6/2012	11:20:00 AM	*2419*	
	MR 1547	9/6/2012	10:10:00 AM	*2419*	
	MR-1555	9/26/2012	12:30:00 PM	14.6	
MR-JC	MR1511	2/23/2012	10:30:00 AM	0.05	16
	MR 1529	5/14/2012	12:35:00 PM	34.5	
	MR 1543	8/6/2012	1:55:00 AM	*2419*	
	MR-1557	9/26/2012	2:10:00 PM	14.6	
UTE-MR	MR1512	2/23/2012	11:15:00 AM	12.2	3
	MR 1530	5/16/2012	10:35:00 AM	1	
MR-GS	MR1514	2/23/2012	12:10:00 PM	3.1	159
	MR 1531	5/16/2012	11:40:00 AM	829.7	
	MR 1545	8/8/2012	10:40:00 AM	1553.1	
NW-HWY 160	MR1515	2/23/2012	12:55:00 PM	1	27
	MR 1532	5/16/2012	1:00:00 PM	755.6	

MR-STL	MR1516	2/26/2012	2:00:00 PM	1	10
	MR 1533	5/16/2012	1:50:00 PM	105.8	
	MR 1546	8/8/2012	12:05:00 PM	8.4	
SJ-4C	SJ 1093	8/8/2012	1:15:00 PM	920.8	N/A

Exceed single sample e.coli criteria for primary contact recreation of 235 colony forming units per 100mL

Sample set exceeds geometric mean e.coli criteria for primary contact recreation of 126 colony forming units per 100mL

2419 Values in italics represent a result of "Too Numerous to Count" at greater than 2,419 colonies per 100 mL. 2,419 is used for geometric mean calculations.

Two of three samples collected at MR-GS were well above the singe sample maximum criteria of 235 cfu/100 mL. Cattle intensively use the area in and around MR-GS. Samples collected from the San Juan (920.8 cfu/100mL on 8/8/2012) and Navajo Wash (755.6 cfu/100 mL on 5/16/2012) were also above the criteria along with "Too Numerous to Count" (TNTC) values (more than 2,419 colonies/100mL) measured for the 8/6 and 9/6/2012 events.

3.3.4 NUTRIENTS

Nitrogen and phosphorus are two essential nutrients for plant growth. However, an excess of these nutrients in the aquatic environment can spur dense algal blooms that can lead to a host of problems ranging from negative aesthetic impacts (slimy, yucky stuff) 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.

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.

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.

Due to modern culture's dependence on synthetic fertilizers and combustion engines using fossil fuels, anthropogenic nitrogen fixation is common in our culture. 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.

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 10 mg/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.

The State of Colorado recently adopted table values for any form of nitrogen to protect aquatic life uses and has based the development of TN criteria for rivers and streams based on levels necessary to protect aquatic life, the warm water aquatic life standard is 2.01 mg/L total nitrogen (for Colorado this numeric criteria becomes effective in 2017, Regulation 31).

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

Total nitrogen is calculated as the sum of nitrate/nitrite and total kjeldahl nitrogen. FY12 results are presented at the end of this section in table format and graphical form.

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 metric scores and TN and TP levels. The State of Colorado has adopted an interim value of 0.17 mg/L (Regulation 31) for Total Phosphorus

NUTRIENTS: RESULTS AND DISCUSSION

TABLE 3: NUTRIENTS

Monitoring Location ID	Activity ID	Sample Date	Sample Time	Inorganic nitrogen (nitrate and nitrite)	Kjeldahl nitrogen	Total Nitrogen	Phosphorus
				mg/l - Total	mg/l - Total	mg/L Total	mg/l - Total
MR-WC1	MR 1496	10/18/2011	10:30:00 AM	*0.0005*	0.642	n/a	0.087
	MR1498	12/12/2011	11:30:00 AM	0.132	*0.0125*	n/a	*0.0021875*
	MR1504	1/11/2012	10:35:00 AM	0.124	*0.0125*	n/a	*0.0021875*
	MR 1518	4/10/2012	10:40:00 AM	0.02	*0.0125*	n/a	0.225
	MR 1524	4/17/2012	11:20:00 AM	*0.0005*	*0.0125*	n/a	0.095
	MR 1528	5/14/2012	11:10:00 AM	*0.0005*	*0.0125*	n/a	*0.0021875*
	MR 1537	6/19/2012	12:20:00 PM	0.028	*0.0125*	n/a	0.195

	MR 1542	8/6/2012	12:00:00 PM	0.091	2.52	2.611	0.46
	MR 1549	9/6/2012	11:00:00 AM	0.025	*0.0125*	n/a	0.136
	MR-1554	9/26/2012	12:05:00 PM	*0.0005*	*0.0125*	n/a	0.119
WC-MR	MR 1497	10/18/2011	10:45:00 AM	0.336	0.541	0.877	0.097
	MR1499	12/12/2011	11:15:00 AM	0.507	*0.0125*	n/a	0.09
	MR1503	1/11/2012	10:20:00 AM	0.597	*0.0125*	n/a	0.063
	MR1517	4/10/2012	10:30:00 AM	0.422	*0.0125*	n/a	*0.0021875*
	MR 1523	4/17/2012	11:10:00 AM	0.335	*0.0125*	n/a	0.139
	MR 1527	5/14/2012	10:55:00 AM	0.366	*0.0125*	n/a	0.2
	MR 1535	6/19/2012	12:00:00 PM	0.271	*0.0125*	n/a	0.184
	MR 1541	8/6/2012	11:50:00 AM	1.08	72.1	73.18	1.85
	MR 1548	9/6/2012	10:45:00 AM	0.063	0.559	0.622	0.273
	MR-1553	9/26/2012	11:45:00 AM	0.162	*0.0125*	n/a	0.128
MR-WC2	MR	10/18/2011	10:00:00	0.071	*0.0125*	n/a	0.053

	1494		AM				
	MR1500	12/12/2011	10:55:00 AM	0.266	*0.0125*	n/a	0.065
	MR1502	1/11/2012	9:45:00 AM	0.356	*0.0125*	n/a	0.065
	MR 1520	4/10/2012	11:30:00 AM	0.023	*0.0125*	n/a	0.347
	MR 1521	4/17/2012	10:45:00 AM	0.044	*0.0125*	n/a	0.138
	MR 1525	5/14/2012	10:40:00 AM	0.046	*0.0125*	n/a	0.005
	MR 1534	6/19/2012	11:30:00 AM	0.051	*0.0125*	n/a	0.193
	MR 1540	8/6/2012	11:20:00 AM	0.732	53.4	54.132	0.23
	MR 1547	9/6/2012	10:10:00 AM	0.031	*0.0125*	n/a	0.184
	MR-1555	9/26/2012	12:30:00 PM	0.034	*0.0125*	n/a	0.149
MR-JC	MR1505	1/11/2012	11:55:00 AM	0.268	*0.0125*	n/a	*0.0021875*
	MR 1529	5/14/2012	12:35:00 PM	*0.0005*	*0.0125*	n/a	*0.0021875*
	MR1538	7/10/2012	11:45:00 AM	0.636	70.6	71.236	4.26
	MR	8/6/2012	1:55:00	0.189	12.5	12.689	0.726

	1543		PM				
	MR-1557	9/26/2012	2:10:00 PM	*0.0005*	*0.0125*	n/a	0.099
UTE-MR	MR1506	1/11/2012	12:30:00 PM	0.055	*0.0125*	n/a	0.084
	MR 1530	5/16/2012	10:35:00 AM	*0.0005*	*0.0125*	n/a	0.372
MR-GS	MR1507	1/11/2012	2:05:00 PM	0.2	*0.0125*	n/a	*0.0021875*
	MR 1531	5/16/2012	11:40:00 AM	*0.0005*	*0.0125*	n/a	0.114
	MR 1545	8/8/2012	10:40:00 AM	*0.0005*	2.31	n/a	0.132
NW-HWY 160	MR1508	1/11/2012	2:45:00 PM	54	1.42	55.42	0.052
	MR 1532	5/16/2012	1:00:00 PM	7.31	2.15	9.46	*0.0021875*
MR-STL	MR1509	1/11/2012	3:35:00 PM	1.2	*0.0125*	n/a	
	MR 1533	5/16/2012	1:50:00 PM	4.84	1.02	5.86	*0.0021875*
	MR 1546	8/8/2012	12:05:00 PM	1.61	3	4.61	*0.0021875*
SJ-4C	SJ 1093	8/8/2012	1:15:00 PM	0.561	2.05	2.611	0.745

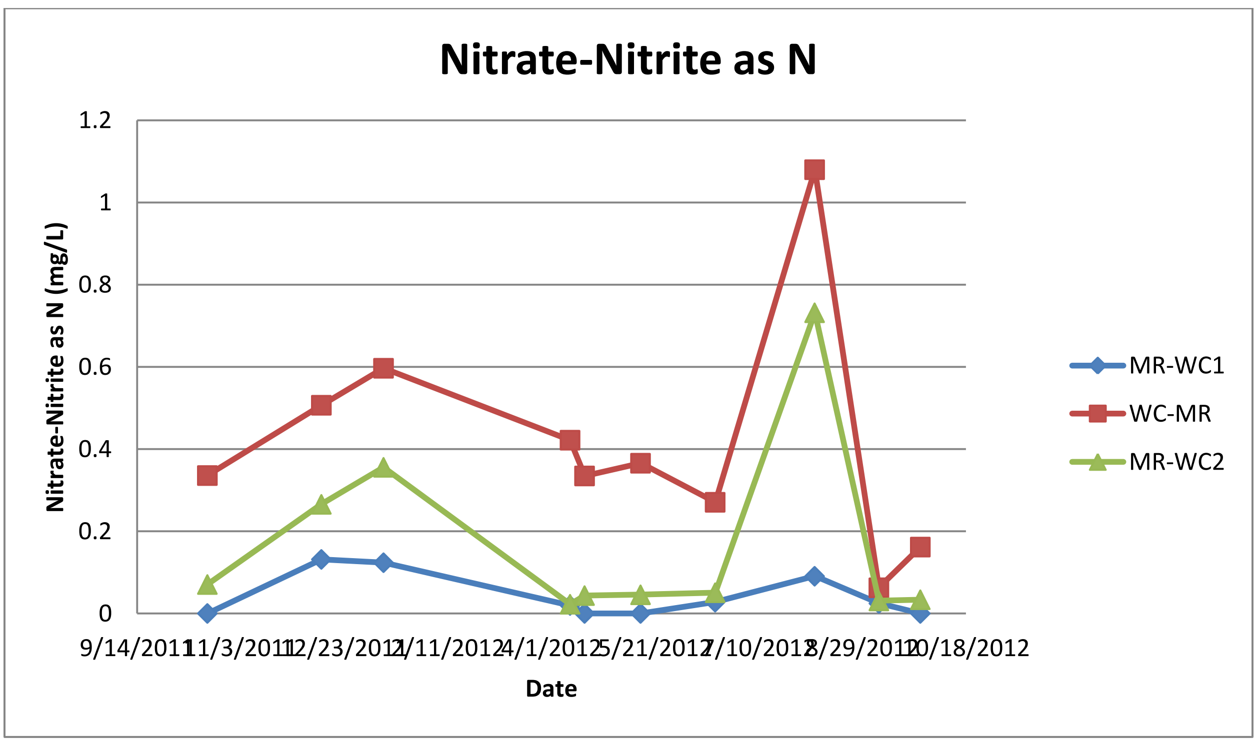
Notes: n/a indicates Total Nitrogen (sum of nitrate-nitrite as N and TKN) was not calculated for this sample since either nitrate-nitrite as N or TKN was non-detect for the sample *italicized values are non-detects and included as 1/2 the detection limit for calculations on this table*

indicates result is above CO Reg. 31 numeric criteria of 2.01 mg/L total nitrogen and/or 0.17 mg/L total phosphorus

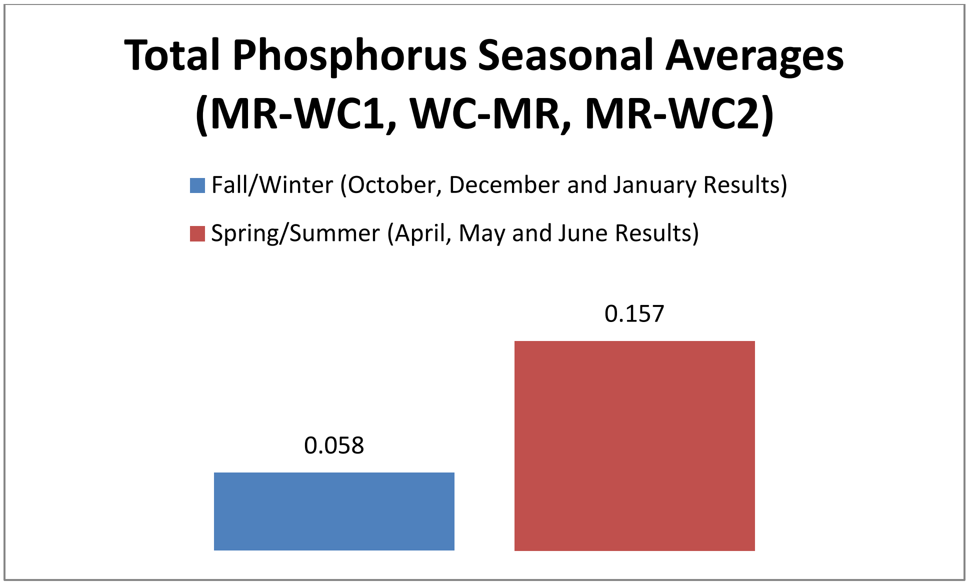
Total nitrogen exceedences in the Mancos River were isolated to post-fire (Weber Fire) events. Water quality impacts from the Weber Fire are discussed separately in Section 4.0. As seen on the graph below, nitrate-nitrite concentrations in Weber Creek (WC-MR) are significantly higher than concentrations in the Mancos River (MR-WC-1) and are resulting in loading of nitrate-nitrite to the Mancos River (MR-WC2).

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.

Field sampling efforts throughout the year indicated that excess algal growth was not a likely problem in the river, based on visual observations of stream conditions, macroinvertebrate and fish abundance and dissolved oxygen measurements. A physical stream assessment using the Rapid Stream Riparian Assessment (RSRA, Stacey et al 2006.) was conducted on September 20, 2012 for a kilometer reach just below the confluence of the Mancos River and Weber Creek and documented that no filamentous algae was present on the stream bottom. RSRA results are comprehensively discussed in Section 3.3.7 Macroinvertebrates.



Total phosphorus results were present at concentrations greater than the Colorado numeric criteria of 0.17 mg/L. A seasonal difference is apparent in the phosphorus results, fall and winter sampling events (October through January) included total phosphorus concentrations at non-detectable levels or levels significantly lower than spring and summer samples (May through September). The Weber Fire also had significant impacts on total phosphorus concentrations in the river (Section 4.0).



Note: post-fire results from the Weber Fire were excluded from this graph and are discussed separately in Section 4.0.

3.3.5 ALUMINUM

Aluminum is the third most abundant element in the Earth's outer crust due to its 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.

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.

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 Table below illustrates aluminum concentrations recorded at several monitoring locations in the Mancos River along with the Tribe's current standards and the recently adopted State of Colorado standards.

<table>
<tr><th colspan="4">Total Recoverable Aluminum: Numeric Criteria Comparison (Al in ug/L)</th></tr>
<tr><td rowspan="10">MR-WC1</td><td>MR 1496</td><td>10/18/2011</td><td>477</td></tr>
<tr><td>MR1498</td><td>12/12/2011</td><td>257</td></tr>
<tr><td>MR1504</td><td>1/11/2012</td><td>223</td></tr>
<tr><td>MR 1518</td><td>4/10/2012</td><td>1790</td></tr>
<tr><td>MR 1524</td><td>4/17/2012</td><td>341</td></tr>
<tr><td>MR 1528</td><td>5/14/2012</td><td>258</td></tr>
<tr><td>MR 1537</td><td>6/19/2012</td><td>179</td></tr>
<tr><td>MR 1542</td><td>8/6/2012</td><td>17100</td></tr>
<tr><td>MR 1549</td><td>9/6/2012</td><td>508</td></tr>
<tr><td>MR-1554</td><td>9/26/2012</td><td>319</td></tr>
<tr><td>WC-MR</td><td>MR 1497</td><td>10/18/2011</td><td>1250</td></tr>
</table>

	MR1499	12/12/2011	1570
	MR1503	1/11/2012	384
	MR1517	4/10/2012	194
	MR 1523	4/17/2012	289
	MR 1527	5/14/2012	268
	MR 1535	6/19/2012	235
	MR 1541	8/6/2012	104000
	MR 1548	9/6/2012	502
	MR-1553	9/26/2012	381
MR-WC2	MR 1494	10/18/2011	620
	MR1500	12/12/2011	522
	MR1502	1/11/2012	270
	MR 1520	4/10/2012	1800
	MR 1521	4/17/2012	313
	MR 1525	5/14/2012	236

	MR 1534	6/19/2012	176
	MR 1540	8/6/2012	156000
	MR 1547	9/6/2012	695
	MR-1555	9/26/2012	346
MR-JC	MR1505	1/11/2012	320
	MR 1529	5/14/2012	230
	MR1538	7/10/2012	170000
	MR 1543	8/6/2012	5340
	MR-1557	9/26/2012	803
UTE-MR	MR1506	1/11/2012	138
	MR 1530	5/16/2012	163
MR-GS	MR1507	1/11/2012	369
	MR 1531	5/16/2012	1020
	MR 1545	8/8/2012	3820
NW-	MR1508	1/11/2012	443

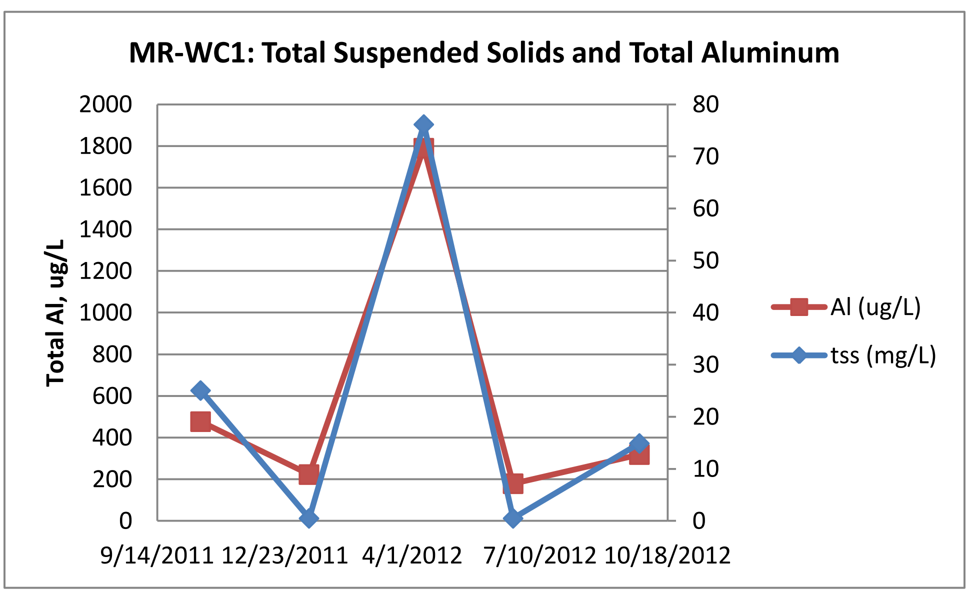
HWY 160	MR 1532	5/16/2012	5560
MR-STL	MR1509	1/11/2012	364
	MR 1533	5/16/2012	321
	MR 1546	8/8/2012	695
SJ-4C	SJ 1093	8/8/2012	34400

(green)	Exceedes CO chronic crteria of 1,438 ug/L at hardnes of 225 mg/L
(pink)	Exceedes CO acute crteria of 10,071 ug/L at hardnes of 225 mg/L

Each of the acute exceedences occurred in post-fire storm event flows. Post-fire impacts to water quality are discussed in Section 4.0. Chronic Aluminum exceedences occurred in December, April and May.

It is apparent from aluminum and suspended solids data (illustrated below in graphical form) that the majority of aluminum in the water column for FY12 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).

TOTAL SUSPENDED SOLIDS AND TOTAL ALUMINUM



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.

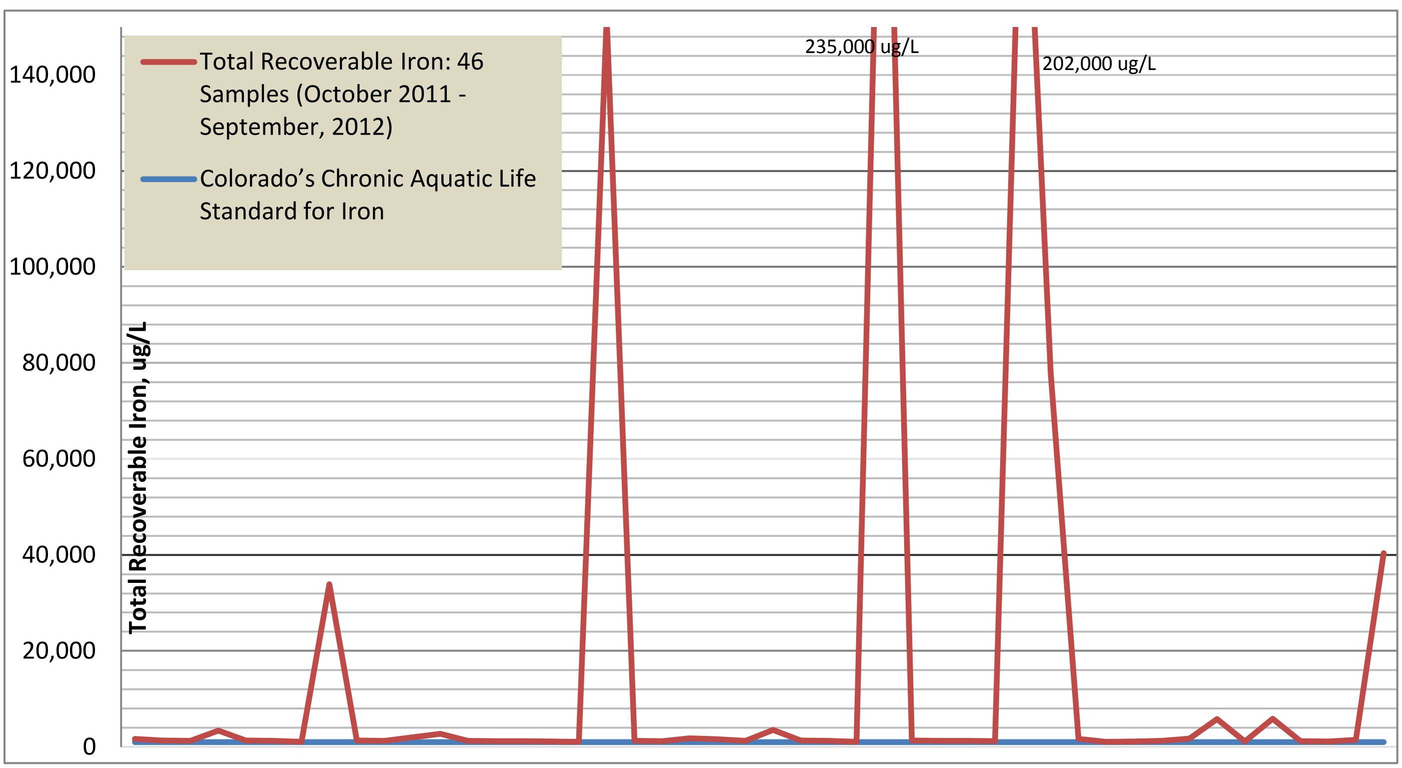
3.3.6 IRON

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 processes 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 FY12 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.

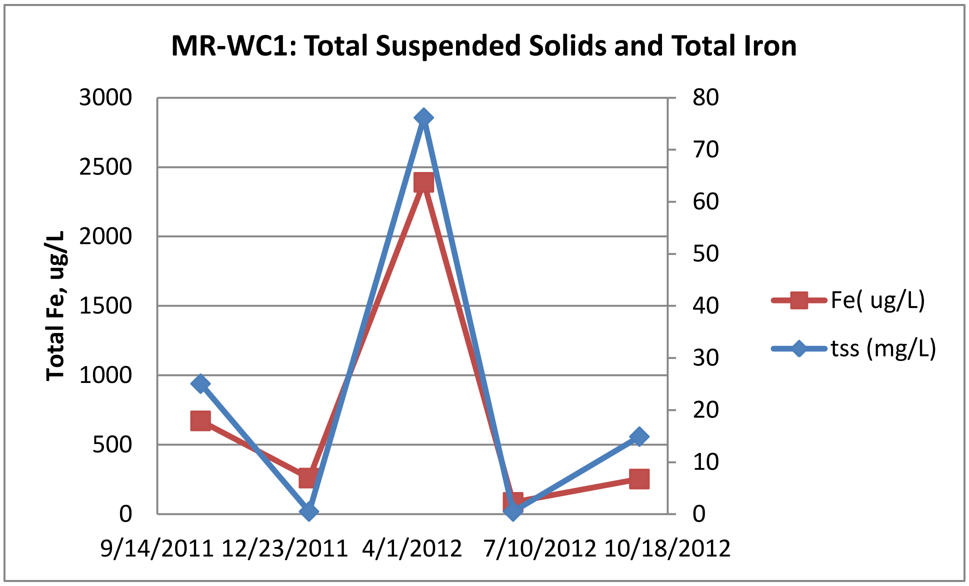
In oxidizing environments sedimentary species of iron will be represented such as ferric oxides or oxyhydroxides like hematite, Fe_2O_3, goethite, FeOOH or other similar minerals. Natural weathering and erosion of Cretaceous aged sedimentary strata which is widespread in the watershed and is also rich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

TOTAL IRON



The graph above illustrates iron concentrations in relation to Colorado's Chronic Aquatic Life Standard for Iron (1,000 ug/L total recoverable). Large peaks (above 20,000 ug/) represent iron concentrations in post-fire flow events, discussed further in Section 4.0. Complete numeric iron results for all samples may be found in Table 3: Metals. 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. Ten out of 43 surface water samples for FY12 data collected at site in the Mancos River exceeded the state of Colorado's criteria.

TOTAL SUSPENDED SOLIDS AND TOTAL IRON

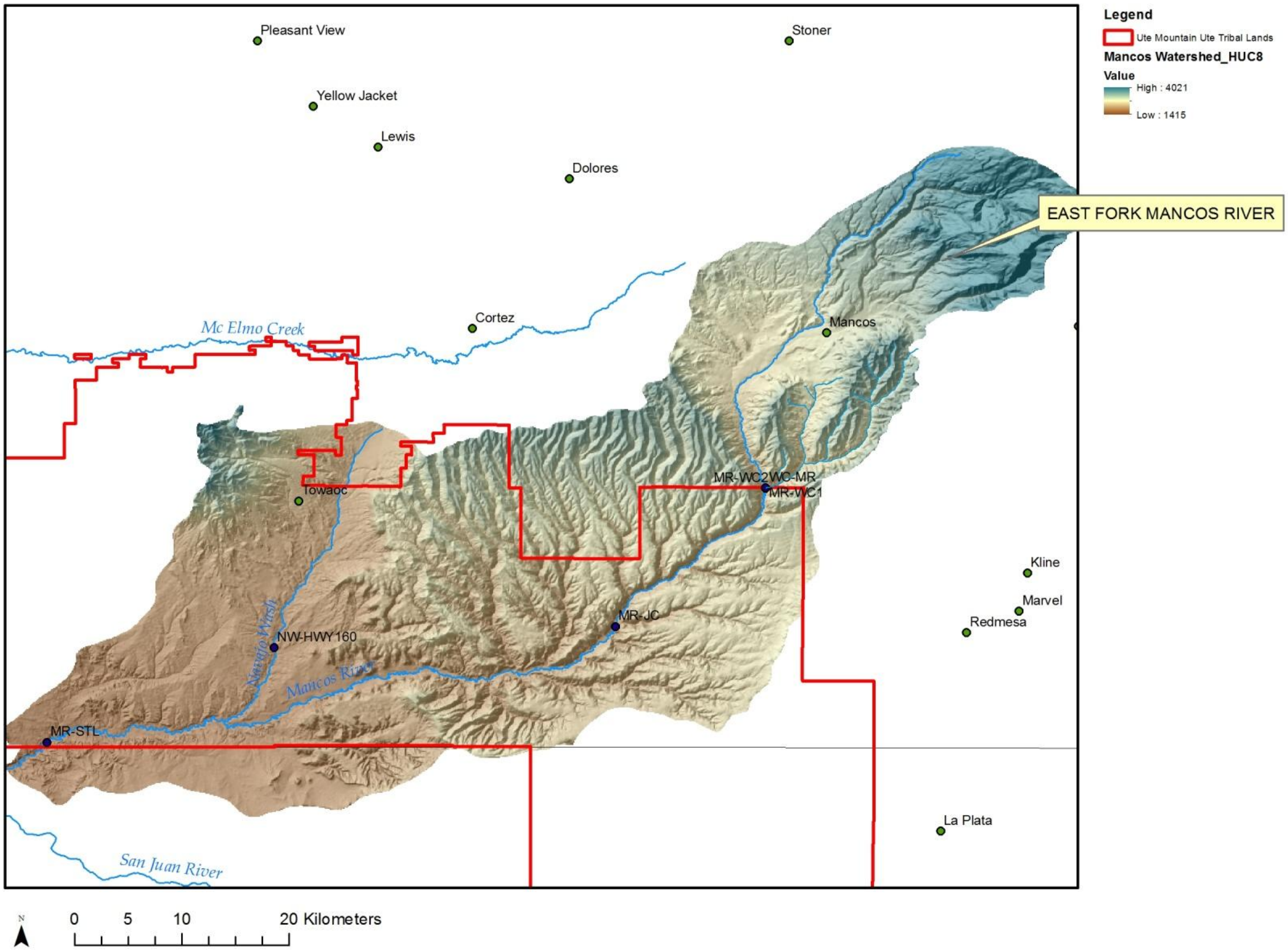


The relationship between iron concentrations and suspended solids is also evident in the graph above for MR-WC1.

3.3.7 COPPER

The Mancos River was listed by the State of Colorado in its 2000 303(d) list for copper. Monitoring data for the Mancos at the Reservation boundary have indicated. The East Fork of the Mancos was initially included on the 2002 Section 303(d) List. This listing was for non-attainment of assigned Table Value Standards for copper. The listing decision was based upon the results of 11 samples with an 85th percentile value of 21.5 ug/L.

More recently, the Division's re-assessment in preparation of the 2010 Section 303(d) List included updated sample results. An ambient (85th%) copper level of 19.5 ug/L was calculated on the basis of 18 samples. These were collected at collected at the Mancos River at Greer Bridge (DOW 404) from 12/11/2003 to 4/30/2003, East Mancos River at 44 Road (WQCD 9720) from 1/20/1999 to 5/25/2005 and West Fork Mancos River at 43 Road (WQCD 9719) from 9/15/2004 to 5/25/2005. The chronic Aquatic Life Use-based standard was calculated to be 11.5 ug/L based upon a hardness of 134 mg/L . (CDPHE letter to Ann Oliver, Mancos Watershed Group Coordinator, February, 2013)



Historically, the water quality data collected by the Tribe has documented small quantities of copper in excess of Tribal water quality standards for aquatic life (Ute Mountain Ute Tribe Nonpoint Source Assessment, 2005). Water quality data collected during this monitoring period (2011 – 2012)

Twelve out of forty five samples collected from the Mancos River on the Reservation and analyzed for copper during 2011 – 2012 monitoring exhibited detectable concentrations (i.e. 33 of 45 copper samples analyzed were less than the detection limit of 1 ug/L). Of these twelve detections, nine were post-fire runoff samples and are related to ashy-sediment from the Weber burned area- discussion on these results are included in Section 4.0.

All three of the detections for copper pre-dating the fire potentially exceeded the Tribes numeric criteria to protect aquatic life (samples were analyzed as total recoverable while numeric criteria are for the dissolved fraction only) and occurred in the spring of 2012. Copper concentrations of 70 ug/L and 72 ug/L were measured for the April 10, 2012 event at MR-WC1 and MR-WC2, respectively, and a value of 63 ug/L was measured for the May 14, 2012 sampling event at MR-WC2.

These elevated copper concentrations in the spring may be related to spring runoff flushing copper down from the East Fork of the Mancos. For future sampling efforts, concentrating a sampling event on the initial peak discharge event and early spring flows is recommended. To evaluate aquatic life standards attainment, copper analysis should be performed for the dissolved fraction of the metal during the next sampling round for the Mancos River.

To protect agricultural use, numeric criteria for copper in the Tribes' water quality standards are set at 200 ug/L (total recoverable) (30-Day). The 8/6/12 sample from MR-WC2 (233 ug/L) and a 8/26/13 sample from MR-GS

(681 ug/L) show that during post-fire storm flow events, that this protective level can be exceeded. Water should not be diverted from the stream channel to the Farm during these types of flow events while fire-related sediment is still being transported through the system.

Complete analytical results for copper may be found in Table 3: Metals.

3.3.8 MACROINVERTEBRATES

Macroinvertebrate samples during the FY 2012 sampling period were taken at MR-WC2 MR-SH MR-CG MR-CC), MR-GS and at MR-STL (See Map 2, Sample Locations). Sampling methodology followed macroinvertebrate protocol detailed in our SOPs (Ute Mountain, 2012). Using a rectangular framed kicknet with 504 micro mesh and dolphin bucket twenty kicks were taken at each site. Each kick was to represent a one meter square so each sample represented a 20 square meter area. A multi-habitat (qualitative) approach and a single-habitat (quantitative) approach were used depending on the reach. If a reach consists of <30% riffle habitat a multi-habitat approached was used and if the reach was >30% riffle habitat a single-habitat approach was used. Multi-habitats and substrates were noted for each kick and ranged from sandy bottoms, small cobbles, clayey-sands, gravely-sands, organic debris, mud, shale floored runs to grasses. Single habitat substrates were also noted as for embeddedness and substrate size. FY 2012 samples were shipped to Absolute Natural Resources, LLC in Arvada, CO to be identified to the lowest possible taxonomic classification.

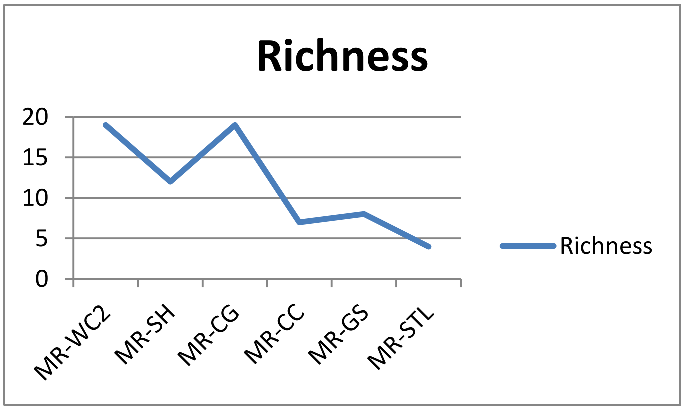
Table: Metrics Values of Macroinvertebrate Communities within the Mancos River FY 2012.

Sample Location	MR-WC2	MR-WC2	MR-SH	MR-CG	MR-CC	MR-GS	MR-STL
Sample ID	MR1494	MR1493	MR1490	MR1492	MR1491	MR1489	MR1488
Total in sample	1098	1216	2080	1819	550	117	19
Richness	16	19	12	19	7	8	4
HBI	5.371585	5.292763	5.4	5.649258	5.905455	5.880342	8.684211
%E	6.557377	9.868421	6.538462	4.562947	0.727273	1.709402	5.263158
%P	6.921676	8.552632	0	4.233095	0	0.854701	0
%T	77.23133	68.09211	88.46154	33.69984	0.363636	0	5.263158
EPT	90.71038	86.51316	95	42.49588	1.090909	2.564103	10.52632
Shannon-Weiver Index	5.219622	6.775638	3.587579	5.179538	1.332869	1.773988	2.453762

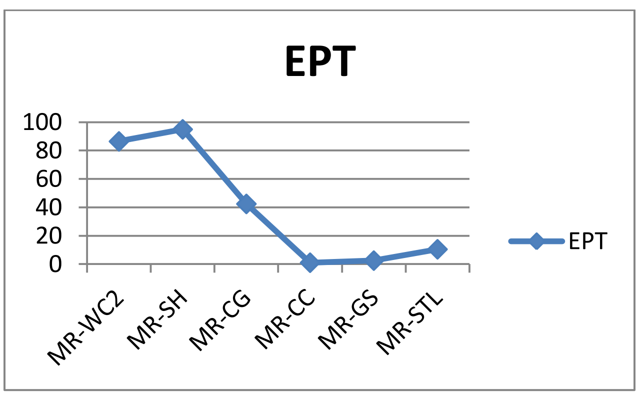
Metrics included in the table are explained below:

Hilsenhof Biotic Index (HBI): HBI is a pollution sensitivity index which takes into account the number (abundance) of organisms present in the sample. By considering the number of each organism the scoring does not skew the index rating due to the presence of a few tolerant or sensitive organisms. Using tolerance values from Mandaville, 2002 an estimation of organic pollution was determined for each site. HBI values are expected to increase with increasing perturbation. HBI numbers for FY 2012 indicate increased perturbation moving downstream ranging from MR-WC2 at5.3 to a value of 8.68 at MR-STL.

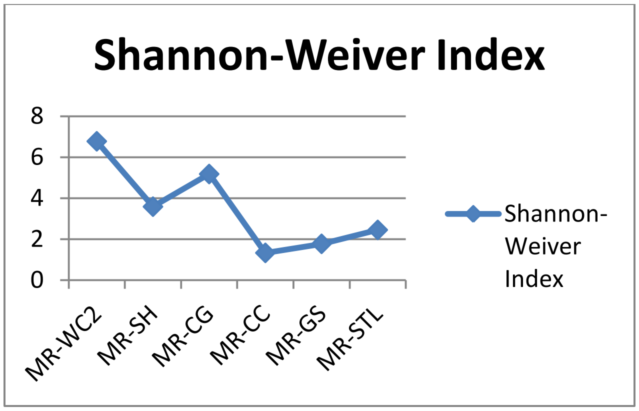
Richness: Richness is the total amount of distinct taxa found at each site and represents the diversity within the sample. An increase in diversity correlates with an increase of a systems health. High diversity suggests that niche space, habitat, and food sources are adequate to support survival and propagation of many species (Barbour et al. 1999) Therefore as water quality and habitat types decrease the distinct number of taxa present would be expected to correspondingly decrease. As seen in the graph bellow, sites sampled for the Mancos River exhibited a decrease in richness downstream signifying that the lower portion of the Mancos River cannot support a diverse abundance of organisms.



Ephemeroptera, plecoptera and tricoptera (EPT): EPT is a species composition and richness measurement. The three insect groups of Ephemeroptera (Mayfly), Plecoptera (Stonefly), and Tricoptera (Caddisfly) have been categorized as intolerant or sensitive to water quality. A high percentage score for EPT should correlate with good water quality (Mandaville, 2002). EPT numbers on the Mancos trended downward dramatically downstream.



Shannon-Wiener Diversity Index: Shannon-Wiener Diversity Index is commonly used to calculate aquatic and terrestrial biodiversity and is represented by “H”. As the number and distribution of taxa (biotic diversity) within the community increases, so does the value of H. In general the higher the H value the more diversity and healthy a system is. FY12 data shows the Shannon-Weiner diversity index for the Mancos decreases moving downstream.



Macroinvertebrate Summary: The consistent trend of decreased richness, abundance, and diversity in the Mancos in the downstream direction is primarily due to dewatering of the stream channel (See section 3.3.10 Hydrograph of Mancos-dewatering). The stream bed is a dry channel from approximately Johnson Canyon to where it enters the San Juan River after spring runoff and before monsoons return in July or August each year. Dewatering of the stream system leaves less energy in the River to transport sediment. As this sediment falls out of the water column, it is left in the stream channel, filling in spaces between cobbles, pebbles and all of the River channel substrate leaving less space for macroinvertebrates in which to live, shelter, feed, procreate and thrive.

Samples taken at MR-WC2, MR-SH and MR-CG in the upstream reaches of Mancos Canyon exhibited the most biodiversity and are consistent with the stream reaches that contain water throughout the year whereas MR-CC, MR-GS, and MR-STL contain very little diversity and low abundance. This is consistent in the fact that these three sites dry up during the summer.

It is anticipated that the Weber Fire has had a severe impact on macroinvertebrate populations from the confluence of Weber Creek and downstream. Macroinvertebrate samples were collected twice since the summer of 2012 for the Mancos River and analysis of results will be incorporated into the next Mancos Watershed Assessment Report (scheduled for 2016).

3.3.9 HABITAT ASSESSMENT: RAPID STREAM REACH ASSESSMENT

In 2012 a Rapid Stream Riparian Assessment (RSRA) (Stacy et al 2006) was conducted on the Mancos River at sample location MR-WC2. The RSRA Involves a quantitative evaluation using a number of indicators for five different ecological categories: water quality, hydrogeomorphology (stream form), fish and aquatic habitat, riparian vegetation, and terrestrial wildlife habitat

Each variable within the RSRA is rated on a point scale from 1-5 where 1 would represent highly impacted and non-functional conditions and 5 would represent a healthy and functional ecosystem. Each of the five variables and their results are discussed below.

Water quality: Water quality variables include the presence/absence of filamentous algae by percent and the percent of solar shading along the river corridor. The overall score for this reach of the River was 3.5. There were no signs of filamentous algae present which scores highly (filamentous algae presence may be an indicator of nutrient loading), however there was no solar shading of the River due to the absence of an upper canopy throughout much of the reach which significantly lowered the overall score for this category.

Hydrogeomorphology: Hydrogeomorphology had an overall score of 3.4 with floodplain connectivity and inundation having the lowest score of 2 . This is due to the severity of distance between the historic floodplain and the active stream channel where the ratio of bankfull/depth ratio is >1.5-1.7. Vertical bank stability scored the highest at 5 indicating that there were no actively-eroding or vertical cut banks along the river within the study reach. Hydraulic habitat diversity scored well with an overall score of 4 with a healthy number of different stream features represented including: edge water, low velocity riffles, high velocity riffles, high gradient riffles, low gradient riffles, backwater, scour pools and sand floored runs. Riparian area soil integrity scored a 3 indicating that less than 15% of the reach is disturbed from ungulate activity. Beaver activity within the reach was conspicuous with signs consisting of beaver cut stems, tracks and possible burrows, .however there were no signs of dams resulting in a score of 3.

Aquatic habitat: Aquatic habitat in the reach exhibited abundant pool distribution and riffle connectivity scoring a 5. Underbank cover was low with a score of 2 representing that less than 10% of the reach had undercut banks. There was also very little woody debris within the reach which is a key habitat to fish and macroinvertebrates resulting in a score of 2. Cobble embeddedness scored well with less than 20-25% embeddedness providing an increase in nich space and macroinvertebrate habitat. Aquatic invertebrate diversity aslo scored well with more than 3 orders present. and overbank cover all with a score of 4.

The FY12 RSRA score for MR-WC2's aquatic habitat of 3.5 for the RSRA is likely not representative of its current condition due to the Weber Fire that has had a serious impact on the river with increased sediment loads smothering invertebrate habitat. This category today would probably reflect a 2-2.5 or lower due to the impact of the Weber fire. A more comprehensive physical assessment using a level II Rosgen geomorphology methodology be performed at this location in the future to assess the impacts from deposition and filling of pools from sediment caused by the Weber fire.

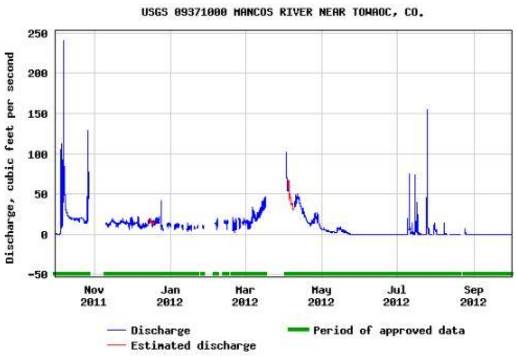
Riparian Vegetation: Riparian vegetation scored 3.4 overall. Lower riparian plant community consisting of mature willows and immature cottonwood recruitment less than 12 feet in height had a score of 3 representing that between 26-50% of the reach had plant cover in the lower riparian corridor. Included in the lower riparian zone there was sparse (<5%) Tamarisk present within the reach. However, non-native herbaceous plant species were the dominant ground cover consisting of knapweed and white top. There was very little upper canopy within the riparian zone plant community and this scored low at 1. Typical native uppercanopy tree populations consist of cottonwood between 30 and 80 feet in stature wich provide habitat and channel shading. Tree demography and recruitment scored 4 with at least three age classes of native seedlings and saplings of cottonwood and coyote willows. Mammalian herbivory for both grazing (Impacts on ground cover) and browsing (impacts on shrubs and small trees) both scored well with a 4 indicating that only between 5 and 10 percent of the plant community was impacted from herbivory. Recently the tribe hired a contractor to round up Ferrell horses in Mancos Canyon and over 400 horses were removed. This should have a positive outcome within Mancos canyon and tree recruitment along the Mancos River.

Terrestrial wildlife habitat: Terrestrial wildlife habitat scored the lowest at 2.25. The low score is indicative of the lack of fluvial habitats including flood-plain ponds, oxbows, side channels, sandbars, wet meadows, marshes, stable cut banks and beaver ponds, this low score is directly related to the score of 2 in hydrogeomorphology for lack of connection to a floodplain. An incised river that is cut off from the floodplain cannot develop diverse fluvial habitat features. In addition patch density for both mid-canopy and upper-canopy exhibited only isolated small patches with low connectivity. The stream reach was dominated by shrub patches with few large open areas between large patches of shrubs.

Summmary: The final overall score for the Rapid Stream Riparian Assessment was 3.21. The lack of mid and upper canopy is a major factor lowering the score. With the lack of overstory there is less channel shading and terrestrial habitat required for the riparian ecosystem to be fully functional. The lack of connection to the historic floodplain and associated loss of fluvial diversity is another major factor influencing the score. A resurvey of this reach using the a more detailed methodology (Rosgen) should be performed during the summer of 2014 to evaluate potential impacts from the recent Weber fire to measure the visually observed increased deposition of sediments, increased embeddedness and decreased hydraulic habitat diversity and bank stability.

3.3.10 HYDROGRAPH OF MANCOS- DEWATERING

As graphically represented on the hydrograph for fiscal year 2012 (October, 2011 through September, 2012), the Mancos River was a dry channel and not flowing for an extended period from late May through mid-July and for shorter durations later in the summer (July/August/September in-between storm events).



The Mancos River runs dry each summer due to upstream agricultural diversions and partly due to widespread tamarisk infestation through the Canyon. Note- brown tamarisk has been defoliated by the tamarisk beetle. Summer, 2013.

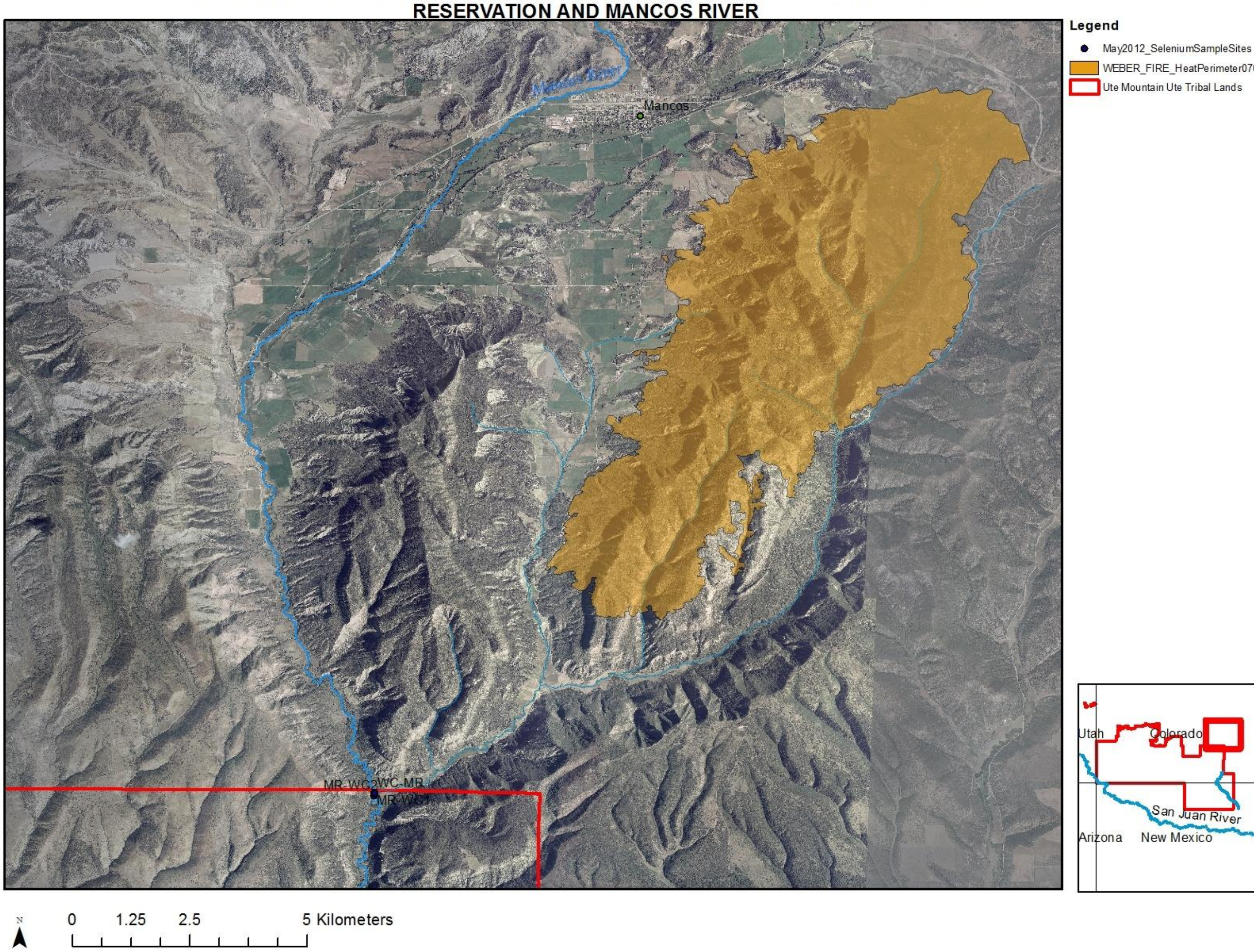
Diversion structures upstream from the Reservation consume the entire flow of the Mancos River during these summer months as agricultural and domestic uses are appropriated by senior water right holders. The Tribe has recently been working towards developing a metered diversion structure for the Mancos Creek Farm. When the project is completed (the diversion structure currently needs to be re-built and a flow-gauge needs to be installed) which would allow the Tribe to exercise their water rights (1986 appropriation date) and make a call on the River to curtail junior users and provide flows to the diversion dam and to the farm. New instream flow appropriations are an additional tool that has been identified as a way to keep water in the channel (Mancos River Basin Instream Flow Report Preliminary Evaluation of Flow Restoration Options, Colorado Water Trust, 2011). Additionally, diversion and delivery system projects to increase efficiency, habitat restoration projects and phreatophyte eradication may help to restore and protect flows.

4.0 WEBER FIRE

The summer of 2012 approximately 10,000 acres of pinyon/juniper woodland burned in a wildfire just north of the Tribal boundary near the town of Mancos, Colorado. This event, known as the Weber Fire, has had a profound impact on the Mancos River and these impacts (post fire sediment and related pollutants, i.e. aluminum, iron, cadmium, copper, manganese, mercury, nitrogen and phosphorus and zinc) are expected to persist for some time into the future (until re-vegetation of the burned area is complete and soils are stabilized). This section of the report summarizes our observations and monitoring activities related to post-fire water quality in the Mancos River.

The map below (following page) features the perimeter of the burned area and the proximity to both the Mancos River and the Reservation boundary.

WEBER FIRE BURNED AREA PERIMETER AND PROXIMITY TO UTE MOUNTAIN UTE RESERVATION AND MANCOS RIVER



Wildfires degrade the water quality of receiving water bodies to varying degrees depending on the extent of area burned, the intensity it burned at, postfire precipitation, watershed composition and topography and local ecology. Potential effects of wildfire on downstream aquatic ecosystems include: changes in magnitude and timing of runoff which influences loading of streams by sediment, nutrients, organic matter (carbon), major ions, and metals.

The table below summarizes dates and description of our monitoring activities along with the start and end dates of the fire.

Table: Weber Fire Water Quality Monitoring Timeline		
Water Quality Pre/Post Fire in the Mancos River and Weber Creek		
Date	Activity	Description
6/19/2012	WQ Sampling event	Bimonthly Series, three sample locations at northern boundary area in canyon

6/22/2012	Weber Fire Starts south of Mancos	
7/6/2012	Weber Fire out (approximate date)	Total of 10,000 acres of burned area in the Mancos Watershed
7/9/2012	Storm Event	Approximate Date of first major precipitation event (post-fire)
7/11/2012	WQ sampling event	Two post-fire WQ samples taken
8/6/2012	WQ Sampling event	Seven summer low-flow samples collected through Mancos canyon and one at San Juan
9/6/2012	WQ Sampling event	Bimonthly Series, three sample locations at northern boundary area in canyon
9/9/2012	Fish Stocking	Approximately 20,000 RTC stocked in Mancos River, Weber and Mud Creeks with CPW
9/20/2012	Rapid Stream Reach Assessment	Physical Habitat Survey conducted at upper end of Mancos Canyon
9/25/2012	Fish Survey	Four locations electro-fish-surveyed on Mancos River with Colorado Parks and Wildlife (CPW) staff
9/26/2012	WQ Sampling Event	Minor storm event flow, near the tail of the hydrograph. Samples collected at three sites

8/26/2013	WQ Sampling event	One post fire WQ sample taken, peak hydrograph- near 900 cfs flow
10/2/2013	Fish Stocking	Approximately 10,000 RTC stocked in Mancos River, Weber and Mud Creeks with CPW
10/28/2013 - 10/29/13	Fish Survey	No fish found. Three sites surveyed with CPW.

The chemical nature of runoff from the post-Weber Fire area is substantially influenced by the local cretaceous-aged geology which includes economic coal resources which have been explored, exploited (mined) and characterized in the recent past. The Menefee formation (middle formation of the Mesa Verde Group) has deposits of bituminous coal which has was mapped and mined as a fuel source as early as 1906 (Collier, A.J. Coal South of Mancos, Montezuma County, Colo. 1918) and outcrops of this formation comprise a large percentage of the Weber Fire burned area.

Precipitation events post-fire which are significant enough to result in overland flow carrying burned vegetation and surface soils into Weber Creek and the Mancos River have a profound impact on the chemical nature of the River (physical impacts are significant as well, visual observations have noted copious amounts of sediment covering the substrate and a physical survey is planned for the summer of 2014 to officially document this type of impairment).

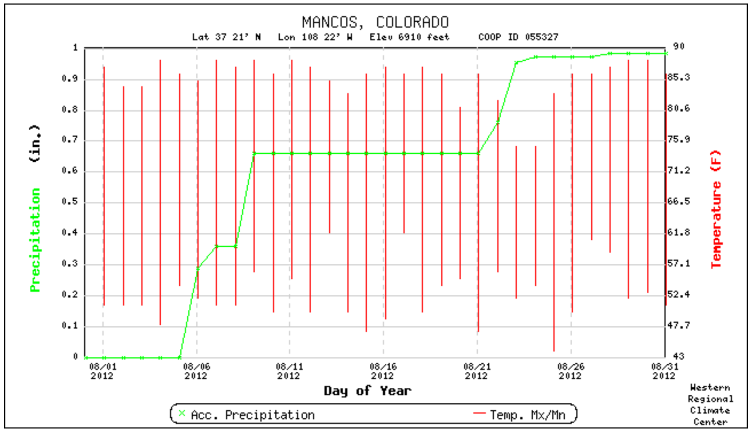
Graphs included on the following two pages present water chemistry data alongside precipitation and flow information for two sample events: August 6th, 2012 which is a sampling event affected by post-fire sediments carried into the river from a recent precipitation event; and September 26, 2012, a sampling event un-affected from post-fire sediment due to a lack of recent precipitation.

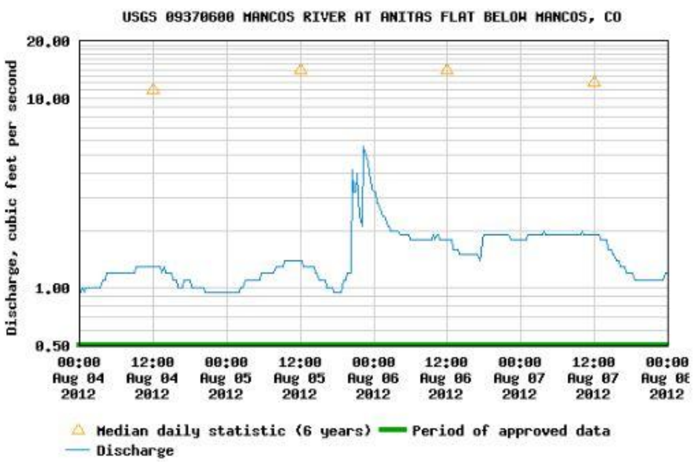
Great alluvial fan of ash in east canyon tributary shot from helicopter after first storm event on July 7th

Photographs courtesy of Tom Rice, BLM

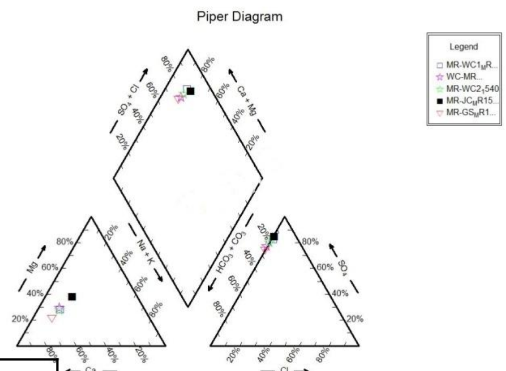
Photographs above, provided by the BLM, illustrate the acceleration of overland flows and the amount of material that are mobilized following precipitation events in the areas burned during the Weber Fire.

Post Fire Storm Flow (Small Precipitation Event, Low Flow)





Confluence, Mancos River, Weber Creek. August 06, 2012



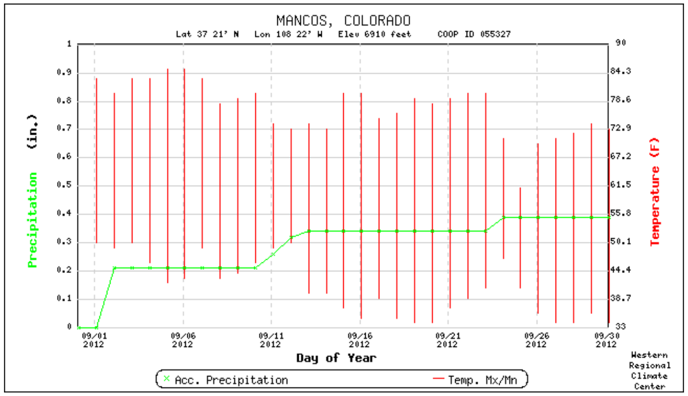
Mancos River Post-Weber Fire Water Chemistry Comparing Storm Event (August 6, 2012) and Base Flow (September 26, 2012)															
Location	Date	TSS	Aluminum	Copper	Iron	Manganese	Zinc	Selenium	Nitrate/Nitrite	TKN	Total Phosphorus	D.O.	Conductivity	Temperature (C°)	pH
MR-WC1	6-Aug-12	4036	17100	27	32900	682	230	0.5	0.091	2.52	0.46	7.69	1769	22.86	8.53
WC-MR		25600	104000	134	151000	8770	1090	2.5	1.08	72.1	72.1	7.54	1414.3	18.51	8.28
MR-WC2		9416	156000	233	235000	7530	1410	2.5	0.732	54.132	54.132	7.38	1576.1	19.88	8.29
MR-WC1	26-Sep-12	15	319	2.3	253	12	2	0.25	0.0005	0.0125	0.119	9.72 [2]	1762.7	13.9	8.1
WC-MR		15	381	2.9	191	39	2	0.25	0.162	0.0125	0.128	10.26 [2]	4382.8	13.48 [2]	7.99
MR-WC2		18	346	2.5	284	18	2	0.25	0.34	0.0125	0.149	10.13 [2]	2067.4	14	8.11

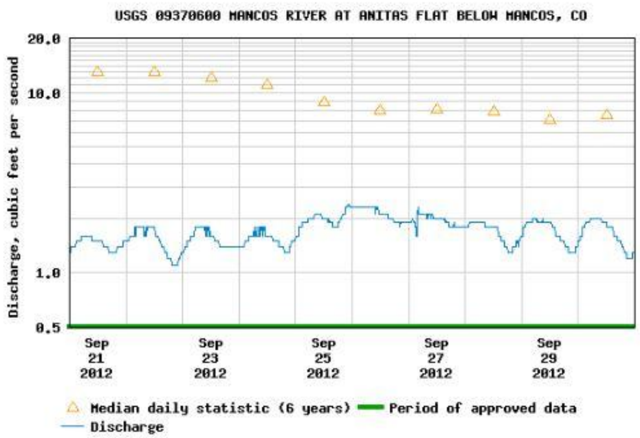
Notes: metals and nutrient concentrations in ug/L

D.O and Temperature measurements were recorded at comparable times of day, approximately 11 am to 12 pm

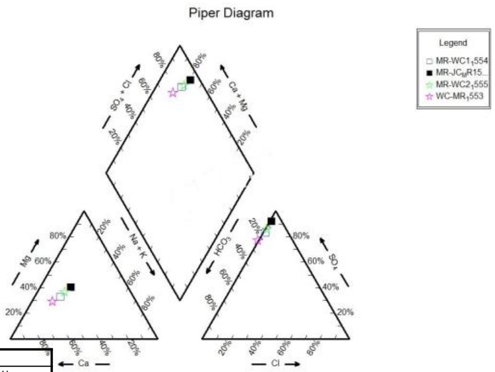
[2] measurements are from 9/6/12 event, meter was unavailable 9/26/12, flow regime and times comparable to 9/26 sampling event

Post Fire Base Flow (No Recent Precipitation Event, Low Flow)





Confluence, Mancos River, Weber Creek. September 26, 2012



Mancos River Post-Weber Fire Water Chemistry Comparing Storm Event (August 6, 2012) and Base Flow (September 26, 2012)

Location	Date	TSS	Aluminum	Copper	Iron	Manganese	Zinc	Selenium	Nitrate/Nitrite	TKN	Total Phosphorus	D.O.	Conductivity	Temperature (C^o)	pH
MR-WC1	6-Aug-12	4036	17100	27	32900	682	230	0.5	0.091	2.52	0.46	7.69	1769	22.86	8.53
WC-MR		25600	104000	134	151000	8770	1090	2.5	1.08	72.1	72.1	7.54	1414.3	18.51	8.28
MR-WC2		9416	156000	233	235000	7530	1410	2.5	0.732	54.132	54.132	7.38	1576.1	19.88	8.29
MR-WC1	26-Sep-12	15	319	2.3	253	12	2	0.25	0.0005	0.0125	0.119	9.72 [2]	1762.7	13.9	8.1
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MR-WC2		18	346	2.5	284	18	2	0.25	0.34	0.0125	0.149	10.13 [2]	2067.4	14	8.11

Notes: metals and nutrient concentrations in ug/L

D.O and Temperature measurements were recorded at comparable times of day, approximately 11 am to 12 pm

[2] measurements are from 9/6/12 event, meter was unavailable 9/26/12, flow regime and times comparable to 9/26 sampling event

Apparent in the information presented in the graphs above, storm event flows from the burned area of the Weber fire carry sediment into the River which corresponds to elevated levels of aluminum and iron along with metals: copper, manganese, zinc, and nutrients: nitrate/nitrite, total kjeldhal nitrogen and total phosphorus.

The prevalence of nitrogen in the organic form (Kjeldahl nitrogen) represents the influx of organic material (burned vegetation and organic material carried by overland flow) into the River. The lower dissolved oxygen numbers from the storm event flow are influenced by both the introduction of increased amounts or organic matter, in which dissolved oxygen in the River is consumed during the decomposition process, along with increased temperatures (colder water is capable of holding greater amounts of dissolved gas). The temperature increase is likely due to the increased solar absorption of the dark-colored water (see photographs of post-fire flows in the slide).

The piper diagram included on the slides graphically represents the ion-composition of the River during flows affected by post-fire sediment and unaffected base flows. Characterizing post-fire affected flows by a unique ion signature does not appear to be a possibility as there is surprisingly little difference and the dominant ions remain calcium and sulfate in each flow regime.

Based on this data, post-fire affected flows are characterized by a dark color, extremely elevated levels of suspended solids, trace metals and nutrients. These sediments may be mobilized by storm events as small as 0.3 inches over two days and less than 2 cfs flow in the River (August 06, 2012 event, 1.8 cfs) however precipitation amount less than 0.1 inch (0.05 inches in the 2 days prior to the 09/26/12 event) may not result in significant sediment transport to the River system.

Post-fire affected water chemistry in the River after large, significant rain events is remarkably similar to the relatively small rain event captured August 06/2012. On August 26, 2013 storm event samples were collected at MR-GS following over an inch of precipitation over the past 2 days to assess potential continuing impacts from the Weber burned area. Flows in the River were recorded over 900 cfs (as opposed to 1.8 cfs measure in the River 8/6/2012) and the results included elevated levels of: Aluminum (501,000 ug/L), Iron (706,000 ug/L), Copper (681 ug/L), Manganese (13,800 ug/L) and Zinc (1,970 ug/L) along with nitrate-nitrite (0.85 mg/L), Total kjeldhal nitrogen (74.8 mg/L) and total phosphorus (23.9 mg/L).

It is anticipated that until vegetation re-establishes and soils are stabilized in the burned area, these impacts to the Mancos River will continue.

FIRE EFFECTS ON FISH POPULATIONS

Roundtail chub, Flannelmouth Suckers and Bluehead Suckers, all native fish, have historically been present in the Mancos River and a partnership to protect and restore breeding populations has been implemented with the Colorado Division of Parks and Wildlife (CPW), the Tribe's Brunot Wildlife Department and Environmental Programs Departments, and Mesa Verde National Park. The combination of massive, severe-intensity forest fires in the watershed in 2000 and a 5-year drought caused the demise of most of the Mancos River fish. An effort was made in 2002 to salvage some of the last Mancos River roundtail chubs—a fish species of "special concern" in Colorado, and listed as threatened in New Mexico. Through a successful captive breeding program, thousands of these fish were returned to the Mancos in September 2003. Also, in April 2004, two other native Mancos River fish species were reintroduced to the river, the flannel mouth sucker and the blue head sucker. Restocking efforts have been carried out annually since, with the Tribe stocking an average of 12,000 native fish each year.

Restocking efforts had been effective in boosting numbers of native fish in the River (Paul Jones CPW, 2012 Mancos Fish Sampling Report) and populations of round tail chub, flannelmouth and bluehead suckers were trending upwards with mixed age groups present indicating breeding populations.

Following the fire, a survey was organized and conducted with CPW staff on September 20, 2012. Four locations were surveyed and zero fish were present. Locations surveyed had historically supported diverse fish populations. The following year, another survey was conducted with CPW staff covering three reaches of the river over two days (10/28/2013 and 10/29/2013), again no chubs or flannelmouths were found (only one small dace was netted).

In the conclusion of the report (CPW, 2012), CPW staff note, "Examining the data over a number of years, it is evident that native fish were recovering in the Mancos River after the drought of 2002. Stocking of RTC appeared to be successful as their numbers increased every year until 2012. The ash flows associated with the Menefee Mountain fire had a dramatic impact on native fish in this reach of the Mancos River. Without stocking it is unlikely that native fish will recover in this reach."

Restocking efforts in cooperation with CPW staff began the summer of 2012 (September 09/2012, approximately 20,000 roundtail chubs) and was repeated in October of 2013 (October 02/2013, approximately 10,000 round tail chubs.

5.0 FUTURE SAMPLING RECOMMENDATIONS

Our rotating basin monitoring strategy covers the extent of the Reservation every three years and the Mancos River is next scheduled for monitoring during fiscal year 2015 (October, 2014 through September, 2015). From our efforts sampling in 2011/2012, analyzing data and preparing this report, the following recommendations will be considered for incorporation into the next monitoring period:

In addition to aluminum, cadmium, copper, iron, mercury and selenium, add additional coal-related trace metals including: nickel, vanadium, cobalt, beryllium, barium, tin, silver, chromium to screen for continuing post-fire related water chemistry impacts.

RSRA and surveys using Rosgen methodology should be performed to further characterize the physical characteristics of the upper and lower Mancos River.

For future sampling efforts, concentrating a sampling event on the initial peak discharge event and early spring flows is recommended.

To evaluate aquatic life standards attainment, copper analysis should be performed for the dissolved fraction of the metal.

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