WATERSHED MANAGEMENT PLANS FOR EIGHT SUB-BASINS OF THE HUALAPAI RESERVATION

Submitted to:

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1.0 INTRODUCTION

There are eight sub-basins on the nearly one-million acre Hualapai Reservation in northwestern Arizona for which Watershed Management Plans have yet to be developed (Figure 1). Watershed Management Plans (Plans) provide for descriptions of existing features and land use practices that may affect water quality of watersheds. Point and non-point sources of pollution are also identified and evaluated in the Plans. Plans also identify management measures that can be implemented to improve watershed water quality. Plans have previously been developed for Spencer Creek Canyon watershed and Mohawk Canyon (a prominent side canyon of the Coconino Plateau watershed) with funding from U.S. EPA and the U.S. Bureau of Reclamation. This document will provide Plans for the remainder of the Colorado Plateau watershed, the Upper Gila watershed, Peach Springs Canyon, Truxton Wash, Granite Gorge, Western Hualapai Plateau (including Quartermaster Canyon) and the Big Sandy watershed (Figure 1).

The northern border of the Hualapai Reservation is 108 miles of the Colorado River in Grand Canyon. Because most of the watersheds (except Truxton Wash and Upper Gila) on the Hualapai Reservation drain into the Colorado River and add to the impairment (mainly sediment and fecal coliform) of that water body, the identification of non-point source pollution sources and associated mitigation actions can directly affect future water quality of the Colorado River. Therefore, most of the management measures identified here are directed at improving water quality of the Colorado River.

In the Hualapai Tribe's Unified Watershed Assessment (Wegner and Duffield,1999) four of the tribe's watersheds (including the Colorado River) were identified as Class I watersheds that are in need of restoration and have a high priority (within the next two years) for remediation. These watersheds are the Peach Springs Watershed, Coconino Plateau Watershed, Truxton Wash Watershed and the Colorado River. The dominant non-point source of water pollution from these watersheds is sediment and fecal coliform (from feral animals and livestock). Three of the watersheds were classified as Class II watersheds with a medium priority for remediation (within the next five years). These watersheds were the Western Hualapai Watershed, the Upper Gila Watershed and the Spencer Creek Watershed (with a previously developed watershed management plan as discussed above and not addressed here). The dominant non-point source pollutants emanating from these watersheds are also sediment and fecal coliform. One watershed was identified as being a Class III watershed; the Granite Gorge Watershed also with a five year horizon for remediation. The dominant non-point sources of pollution emanating from this watershed are sediment, fecal coliform and organic hydrocarbons. The Big Sandy Watershed was not evaluated in the 1999 assessment.

2.0 WATERSHED EVALUATIONS

2.1 Coconino Plateau

2.1.1 Physical Setting

The Coconino Plateau Sub-basin varies greatly in elevation from 1245 feet at the Colorado River to over 7,000 feet in the ponderosa pine forest. This watershed is approximately 620 square miles in size. Much of the basin is vegetated with pine forests and pinyon-juniper vegetation as well. The northern portion of the plateau is canyon-lands of Grand Canyon dominated by desert-scrub vegetation. Three main canyons drain this sub-basin into the Colorado River (National Canyon, Mohawk Canyon and Prospect Valley; Figure 2). Prospect Valley is the largest drainage with a length of nearly 20 miles. The Toroweap Monocline geologically controls Prospect Valley with the drainage bottom composed of a thick sequence of Quaternary era alluvium (Wegner and Duffield 1999). Mohawk Canyon is defined by the Mohawk-Stairway fault and is approximately 9 miles long. It is a deeply eroded canyon that contains little alluvium. National Canyon is the furthest east of the canyons, parallels the Mohawk fault and exhibits deep erosion.

2.1.2 Unique Features

As mentioned above, Prospect Valley, Mohawk Canyon and National Canyon are spectacular canyon features of this watershed (Figure 3) and provide a source for much of the sediment that is eroded into the Colorado River from this sub-basin. In addition, the extensive ponderosa pine forests provide for a successful silviculture program supplying timber products at a profit to the tribe. Silvicultural activities can also add to the impairment of waters draining from this watershed.

2.1.3 Water Sources

Table 1. Water sources in the Coconino Plateau Watershed (Figure 4).

Site Name	Type	Elevation	Non-point Source Pollutants	Water(s) Affected
Wild Horse Spring	Intermittent Spring	4678	fecal coliform, sediment	Colorado River
Cave Spring	Intermittent Spring	5600	fecal coliform, sediment	Colorado River
Peyate Spring	Intermittent Spring	6046	fecal coliform, sediment	Colorado River
Three Springs	Perennial Springs	1625	fecal coliform	Colorado River
Pumpkin Spring	Perennial Spring	1450	fecal coliform, sediment	Colorado River
Warm Springs	Perennial	1810	fecal coliform, sediment	Colorado River
Ridenour Spring	Perennial	1575	fecal coliform	Colorado River
Cement Tank	Intermittent	4680	fecal coliform	Colorado River
Red Spring	Intermittent	3570	fecal coliform, sediment	Colorado River
Moss Spring	Intermittent	3800	fecal coliform, sediment	Colorado River

2.1.4 Water Quality

Several of the springs in the Coconino Plateau Watershed have been fenced to prevent access by feral animals (Figure 4). This has greatly improved the water quality of those springs. To date, Wild Horse Spring, Red Spring, Moss Spring, Peyate Spring and Ridenour Spring have been fenced. Many of these springs were also fitted with water pipes and drinkers outside of the fence to provide water for wildlife. Some of the springs that are currently impaired include Wild Horse Spring, Three Springs, Pumpkin Spring and Warm Springs. Wild Horse Spring is impaired because the fence has been knocked down by feral animals and the animals have damaged the vegetation and

polluted the water such that there are low levels of dissolved oxygen. The three springs along the Colorado River in Grand Canyon (Three Springs, Pumpkin Spring and Warm Springs) are affected by human visitation (stirring up silt, deposition of waste, damage to vegetation). Below, we provide the specific water quality monitoring data from the water sources in the Coconino Plateau Watershed.

SITE NAME: Wild Horse Spring **SITE NO.** S41

G.P.S. LOCATION: LAT N 3607.734 **LON** W 11259.867

SITE DESCRIPTION: Site is located on the western slope of Mohawk Canyon in the upper supai formation. Water issues at an approximate rate of 1/5 gallon a minute, from a 2 inch round hole in the side of a rock mound. In 2004 the site was enhanced with the following modifications. The extent of the wetland was encompassed in a barbed wire fence. A cement trough was constructed around water discharge in order to capture water. The trough is plumbed to a wildlife drinker located outside the fence enclosure.

DATE & SITE CHANGES:

October 3, 1997: On this date a diagram of the site was incorporated into the field notebook, depicting a riparian area at the base of the flow and documented that this spring source has been known to flow all year round.

August 9, 2005: Upon arrival at the site we noted that the southwest corner of the fence was down. Further investigation revealed that the eastern side of the fence was also down. The pipe work from the cement tank to the drinker was damaged, probably the result of wildlife trampling. Bees have made an extensive hive in the soil surrounding the rock wall where water emerges. Elk and deer feces were observed around the area.

Table 2. Wild Horse Spring water quality sampling history and results.

Date	PH	TDS(mg/L)	Conductivity(uS)	Salinity(ppt)	Temp.(°C)	D.O.	Turbidity (NTU)
10/3/97	7.5	409	766	0.4	22.0	1.2mg/L 10%	
08/9/05	8.25	261	544	0.3	19.1	6.01mg/L 103.1%	.66

SITE NAME: Cave Spring ` **SITE NO.** M2

G.P.S. LOCATION: LAT N 3602.965 **LON** W 11302.047

SITE DESCRIPTION: Site is located at the base of a Coconino sandstone cliff. There are several small seeps located along an area about 15 feet long. Small dams have been constructed around the seeps in order to catch water. These dams are about 4 feet wide, 1-foot long, and 4 inches high. Tracks and feces in the area indicate that wild horses and wildlife are frequently using this site as a source of water.

DATE & SITE CHANGES:

August 9, 2005: Upon arrival at the site a strong odor of horse excrement was noticed. Soil surrounding the water source has been trampled and has a muddy consistency. The periphery of both the water and the wetted areas has a blackish coloration. This spring site was discovered in a survey of the Mohawk Canyon Watershed management plan and did not have a name. Through collaboration with a tribal elder (Everett Manakaja Sr.) and elder tribal members in the Department of Natural Resources, Joel Querta and Dudley Manakaja the spring was named in the Hualapai language, Oyalalcava – "Spring in the mouth of the cave" (Cave Spring).

Table 3. Cave Spring water quality sampling history and results.

Date	PH	TDS(mg/L)	Conductivity(uS)	Salinity(ppt)	Temp.(°C)	D.O.	Turbidity(NTU)
08/9/05	8.25	261	544	0.3	19.2	6.01mg/L 103.1%	.66

SITE NAME: Peyate Spring **SITE NO.** M1

G.P.S. LOCATION: LAT N 360215. 807 **LON** W 1130220.042

SITE DESCRIPTION: Site is located at the southernmost end of Mohawk Canyon, on the western slope at an elevation of 6046. The water source is found at the back of approximately 7 feet wide by 8 feet tall cave that is approximately 6 feet in depth. Water drips off the back wall at several different places and is pooled by a cement catchment. A metal pipe fence constructed to keep out wild horses and feral animals surrounds the mouth of the cave. The predominant wetland vegetation at this site consists of grass.

DATE & SITE CHANGES:

August 23, 2005: Site has minimal disturbance with the presence of some elk and coyote feces were noticed inside the fence enclosure.

Table 4. Peyate Spring water quality sampling history and results.

Date	PH	TDS(mg/L)	Conductivity(uS)	Salinity (ppt)	Temp .(°C)	D.O.	Turbidity(NTU)
08/9/05	8.25	261	544	0.3	19.2	6.01mg /L 103.1%	.66

SITE NAME: Pocamote Spring **SITE NO.** S40

G.P.S LOCATION: LAT N 354925. 160 **LON W** 1130941. 072

SITE DESCRIPTION: The spring is located on the eastern side of Prospect Valley in a side canyon. Water issues out from 5 major seeps along a portion of the canyon where the geology changes from white sandstone to a red amorphous sandstone. The highest yielding seep has a 15-foot by 4-foot trough built at the bottom of the flow for containment, there are two other lower yielding seeps from the canyon wall that have small water containments built around them. Historically there was water that flowed in a creek bed in close proximity to these seeps that also had low containment dam built across the creek bed.

DATE & SITE CHANGES:

June 10, 2005: On this site visit there is an abundance of elk feces scattered about the area and in the water catchments. Along the trails accessing this site signs of cattle were observed (tracks and feces). The largest water trough has green algal growth and silt deposits in the bottom. Oak and Pinion trees are located in the vicinity and small grass grows in the wetted areas on the ground.

Table 5. Pocamote Spring water quality sampling history and results.

Date	PH	TDS(mg/L)	Conductivity(uS)	Salinity(ppt)	Temp .(°C)	D.O.	Turbidity (NTU)
6/10/05	7.88	200	418	0.2	16.1	8.38mg/ L 107.3%	0.52

SITE NAME: Three Springs **SITE NO.** S23

G.P.S LOCATION: LAT N 355294 **LON W** 1131912

SITE DESCRIPTION: Located at river mile 215.6 on river left of the Colorado River in the Grand Canyon. The site is accessible by boat or helicopter. This spring is visited by river running trips and has a well-established trail leading to the spring. This site is 1600 feet in elevation and is 1/8 mile up Three Springs Canyon from the Colorado River. The lower spring is in an open part of the canyon immediately above a short chasm where the creek passes through tapeats sandstone. It is covered with dense vegetation and permanently flows. There is minor disturbance from river runners where a trail crosses the creek at the tip of a low waterfall; otherwise, hikers do not enter the densely vegetated area. The second spring is about 1/3 of a mile up the canyon.

DATE & SITE CHANGES:

March 4, 2002: On this site monitoring visit the Grand Canyon National Park Service accompanied the Water Resources Technician. A representative of the NPS explained that the trail was improved because of hikers causing disturbances to the wetland vegetation as well as slope damage. Lining the trail with rocks made these improvements. This will keep people from taking short cuts down slope. Alkalinity; 255 mg/l (test conducted by Grand Canyon National Park hydrologist).

March 1, 2003: Weather conditions bright and sunny with high storm clouds. Heavy rain storms throughout the night and early morning hours. Extensive wetland vegetation was present with large pools of water.

September 22, 2005: Water was tested approximately 20 feet from the rivers edge. There was sparse vegetation approaching the site, which allowed for easy access.

Table 6. Three Springs water quality sampling history and results.

Date	PH	TDS(mg/L)	Conductivity(uS)	Salinity (ppt)	Temp.(°C)	D.O.	Turbidity (NTU)
10/9/97	8.17	322	605	0.3	23	51% 4.1 mg/L	
4/28/98	8.25	295	617	0.3	20	71% 5.8 mg/L	
12/4/98	8.29	312		0.3	18	63% 5.7 mg/L	
8/2/99	8.02	321	667	0.3	22		
3/4/02		302	636	0.3	12		1.1

9/22/05	8.13	258	537	0.3	27.7	6.36mg/ L 84.5%	11.8

SITE NAME: Pumpkin Spring **SITE NO.** S24

G.P.S LOCATION: LAT N 35502 **LON W** 1131959

SITE DESCRIPTION: Located at river mile 213 on the river left of the Colorado River in the Grand Canyon. This site is accessible by boat or helicopter. This spring is located on the Colorado River and is at the rivers edge. Due to its proximity to the river the spring is under water during high flows. This spring is a primary source of water for wildlife and visited by people on river trips. Alkalinity; 1,815 mg/l (test conducted by Grand Canyon National Park hydrologist).

DATE & SITE CHANGES:

August 2, 1999: There has not been any major physical change to the spring and the surrounding area and there is a noticeable sulfur odor present around the spring source.

March 27, 2001: On this site visit there was a strong sulfur odor and there was a film of green algae floating on the surface of the spring pool. The temperature on this site visit was very warm.

March 1, 2002: On this site visit the spring was accessed by boat and we arrived in the late afternoon. There was no odor of sulfur present and the water was barely flowing over the rock containment formation. In the pool of water, there was visible bubbling indicating spring flow into the pool of water.

March 1, 2003 Cold windy day with heavy rains upon arrival to the site. The color of the water was light green and there were several clumps of brownish gray residue floating on the surface of the pool.

September 22, 2005: The water has a greenish color to it, with yellow green grime along the periphery of the water. The turbidity meter had to be re-adjusted in order to read and record higher values.

Table 7. Pumpkin Spring water quality sampling history and results.

Date	PH	TDS(mg/L)	Conductivity(uS)	Salinity (ppt)	Temp.(°C)	D.O.	Turbidity (NTU)
4/28/98	6.45	7840	1272	8.1	29		
8/2/99	6.42	5955	1094	6.2	34		
3/27/01	6.38	7930	1407	8.2		66% 6.0 mg/L	
3/3/02		6630	1199	6.7	20	61%	22.8
3/1/03	6.94	5910	1057	6.0	21		1. 43.0 2. 25.6 3. 86.6
9/22/05	6.36	1470	2980	1.5	32.7	7.4mg/L 93.0 %	17.2

SITE NAME: Warm Spring
SITE NO. S29

G.P.S LOCATION: LAT N 361148
LON W 1130459

SITE DESCRIPTION: Located at river mile 179.3 on river left of the Colorado River. Discharge begins on the east side of the mouth of Prospect Canyon, and descends north toward the Colorado River, in the Grand Canyon. This spring location is accessed by boat or helicopter. This spring runs year round, has deep pools in the area, and is surrounded with very dense vegetation.

DATE & SITE CHANGES:

March 3.2002: On this site monitoring visit the Water Resource Technician was accompanied by a representative of the Grand Canyon National Park Service. Arrived at the site at approximately 11:00 a.m. field parameter samples were retrieved from a cool shady area. Vegetation in the area consisted of saw grass and a mesquite tree. Flat shaped orange and black water beetles were present in the water. Alkalinity-662 mg/l (test conducted by Grand Canyon National Park hydrologist).

August 8, 2002: On this site-monitoring visit we arrived at 09:00 a.m. The weather conditions are sunny and humid.

February 27, 2003:

The area surrounding the site has become overgrown with saw grass. This vegetation was bent over and laid on in order to expose and access spring flow.

September 22, 2005:

The site is overgrown with sawgrass and no major changes to site. The field water parameters were sampled approximately 5 feet from the river.

Table 8. Warm Springs water quality sampling history and results.

Date	PH	TDS(mg/L)	Conductivity(uS)	Salinity (ppt)	Temp.(°C)	D.O.	Turbidity (NTU)
10/15/97	6.82				24		
11/17/98	6.53	703	1303	0.7	25	54% 4.7 mg/L	
8/2/99	8.51	596	1233	0.6	26	51% 3..0 mg/L	
3/3/02	6.15	629	1287	0.6	24.0		1. 4.0 2. 3.6 3. 0.9
8/8/02	6.5	500	1043	0.5	24.7	6.6mg/L	1. 2.5 2. 4.4 3. 4.9
2/27/03	6.84	583	1213	0.6	22		1. 1.1 2. 1.0 3. 1.0
9/22/05	6.77	427	887	0.4	25.3	6.84mg/L 87.0%	0.48

SITE NAME: Ridenour Spring
SITE NO. S10

G.P.S LOCATION: LAT N 360435
LON W 1131047

SITE DESCRIPTION:

Seep issues from base of Hermit shale, on Esplanade at top of upper member of Supai formation, elevation 5120 feet. The spring seeps out of the ground on the sidewalls of a drainage ditch and collects in several small pools in the lower flats of the drainage ditch. The spring is located to the west of an old copper mine, on the plateau adjacent to Prospect Ridge. The road to the point is approximately 40 miles from Peach Springs,

and another 3 miles down the canyon wall. This spring site has been enhanced to provide a source of water for wildlife and cattle. The site can be accessed by vehicle or helicopter.

DATE & SITE CHANGES:

October 2, 1997:
There was a tiny seep.

November 19, 1998:
The spring was running and had a thin layer of ice covering it.

August 2, 1999: There was no water present. Only a muddy spot remained at the spring area. There was not enough water present to take measurements.

March 27, 2001: On this monitoring date this site was accessed by vehicle and there was no water present, only wet ground around the spring site. The continued lack of water is a direct result of the continued drought.

August 8, 2002: On this monitoring date, the conditions remain the same, with no water present due to the drought.

August 26, 2005: Enhancement efforts were made to this site before this visit. A metal pipe fence has been constructed around the spring enclosing an area roughly 60 by 80 feet. The area below the spring seep has been dug out and a 4-foot by 3-foot pool now exists. A small dam has been constructed around the pool. A smaller spring approximately 15 feet away from the bigger one has been piped to a drinker trough located outside the fence enclosure.

Table 9. Ridenour Spring water quality sampling history and results.

Date	PH	TDS(mg/L)	Conductivity(uS)	Salinity (ppt)	Temp .(°C)	D.O.	Turbidity (NTU)
10/2/97	8.13	310	576	0.3	17	3.4mg/ L 32%	
11/19/98	7.45	408	842	0.4	2	6.0mg/ L 52%	
8/26/05	7.91	404	837	0.4	17.1	5.04m g/L 63.5%	1.92

SITE NAME: Cement Tank Spring **SITE NO.** S31

G.P.S LOCATION: LAT N 360732.750
LON W 113042.188

SITE DESCRIPTION: This spring is located in Prospect Canyon. There is rock and a cement containment wall to keep flooding from washing out the spring source. The wall is about 30 to 40 yards above the cement trough. In 1997 this spring was running and in 1998 the spring was running at a very low trickle. In 1999, the spring was running as it had in 1997. At all three visits to the cement tank, it was full of sediment. Mainly wildlife and birds use it. At one time this location was used by people and may still be used by some individual that know of its location.

DATE & SITE CHANGES:

August 8, 2002: On this site monitoring visit there was not any water present, due to continued drought conditions in the region.

September 2, 2005: The cement water capture is full of sediment. However there was water coming out of the bottom of this trough. The water ran for about 10 feet before it came to a small rock overhang. Field parameters were acquired from a small pool at this point.

Table 10. Cement Tank Spring water quality sampling history and results.

Date	PH	TDS(mg/L)	Conductivity(uS)	Salinity (ppt)	Temp.(°C)	D.O. mg/l	Turbidity (NTU)
10/2/97	11.7	1090	1950	1.1	22	0.8 9%	
11/16/98	7.50	849	1751	0.9	9	5.8 54%	
8/2/99	12.56	768	1575	0.8	20		
8/8/99							
8/8/02							
9/2/05	8.29	348	722	0.3	23.2	6.51 89.1%	7.46

2.1.4.1 Water Quality Goals

The main goal for water quality in the Coconino Plateau Watershed is the reduction of sediment and fecal contaminants in the water that is produced within the watershed and the water that drains the watershed during storm runoffs. In addition, we hope to improve the dissolved oxygen levels in the water sources to support a greater diversity of aquatic biota.

2.1.5 Pollutant Sources

The main source of pollutants on the Coconino Plateau Watershed is sediment runoff due to the erosive condition of the soils, silvicultural and road construction activities and from trampling by livestock and feral animals. In addition, wildfires cause an increase in soil erosion and an increase in sediment loads during storm runoffs. Furthermore, feral animals cause fecal and nitrogen contamination of water sources across the watershed. Human activities also act to increase sediment and nitrate levels at water sources along the Colorado River.

2.1.6 Land Use Practices

Cattle grazing, silviculture and recreation are the main land use activities occuring on the Coconino Plateau Watershed. There are 1,665 Animal Unit Months (AUM's) allocated on the Coconino Plateau Watershed, but around one-half of those are actually in operation at any one time. In the past (1950's) pastures on this water shed were severely over-grazed which resulted in the loss of grassland habitats in favor of sage brush which now dominates in many areas. During times of drought, livestock tend to congregate around available water supplies thus causing impaction of the soils and loss of vegetation. This causes an increase in soil erosion resulting in increased sediment levels during storm runoffs.

There are twenty-five timber harvest compartments across the Coconino Plateau Watershed (Figure 5). The use of heavy equipment causes disturbance of the soil surface causing increased sediment levels in storm runoff. In addition, there is often a need to develop new roads to access timber resources. These new roads also result in greater sediment erosion during storms.

Recreational activities across the Coconino Plateau Watershed include big-game hunting, river rafting and hiking. Hunters increase sediment runoff due to the disturbance of the soils surface from their trucks and trailers. River rafters affect spring water quality along the Colorado River as discussed above. Hikers may increase the levels of nitrates in storm water runoff to a slight degree.

2.1.7 Proposed Mitigation Actions

- Install sediment traps at appropriate locations to reduce sediment runoff to the Colorado River
- Limit access to springs along the Colorado River
- Increase water storage and supplies across the plateau to spread concentrations of livestock
- Mitigate activities that disturb the soil surface (e.g. road construction, logging)

- Remove feral livestock from side canyons of the Colorado River
- Fence remaining springs that are being affected by feral animals
- Treat and remove sage brush to promote grassland growth

2.1.8 Recommendations

This watershed was classified as Class I Watershed in need of immediate remediation to reduce sediment, nitrate and *E. coli* contamination. We recommend immediate implementation of the above identified management measures to begin to reduce the impairment of the waters draining from the Coconino Plateau Watershed.

2.2 Upper Gila

2.2.1 Physical Setting

This 120 square mile sub-basin adjoins the Coconino Plateau to the north and drains into the upper Verde Watershed of the Gila River basin (Figure 1). The upper part of the basin is forested and is geologically composed of consolidated sedimentary rocks exposed at the land surface. The lower part of the basin is an alluvial valley formed by down faulting along the Aubrey Cliffs. The drainage flows southeast across the Reservation boundary onto private land in the Aubrey Valley. All streams in this sub-basin are ephemeral. Several shallow wells are located in the alluvial valley near Frazier Wells. These wells produce water for cattle and wildlife. The shallow unconfined water table puts these wells at risk to contamination from surface sources.

2.2.2 Unique Features

The Hualapai Tribe's Endangered Fish Rearing Facility (Facility) is one of the unique feature of the Upper Gila watershed (Figure 6). The Facility is comprised of one, two and one-half acre re-circulation pond and twelve, one-half acre rearing ponds. The Facility uses water from a well drilled on-site. The well produces 40 gallons per minute. Effluent from the Facility is used to water the Native Tree Nursery as discussed below. The Facility is currently rearing the endangered razorback sucker. This species has been reared for the past five years. The tribe is currently working with the U.S. Fish and Wildlife Service and the Arizona Game and Fish Department to obtain endangered humpback chub for future rearing.

The Hualapai Tribe's Native Tree Nursery (Nursery) is also located in the Upper Gila Watershed. The Nursery covers twenty acres of land with 7-10 rows available for growing trees (Figure 7). Native Goodding's willows are currently being grown there to provide material for riparian restoration projects. A portion of the Nursery is also used for the production of vegetables. Squash, watermelon, pumpkins and onions are grown at the Nursery.

2.2.3 Water Sources

As mentioned above, there are several wells located on the Upper Gila Watershed. Wells are located at Blue Mountain and two at Frazier Wells (Figure 2). Upper and Lower Pine Springs are the only natural springs located in this watershed. There are no perennial streams in this sub-basin.

Table 11. Water sources in the Upper Gila watershed.

Site Name	Type	Elevation	Non-point Source Pollutant	Water(s) Affected
Pine Springs (lower)	Well	6410	sediment from erosion, fecal coliform from cattle, wildlife and feral animals	Frazier Wells aquifer
Pine Springs (upper)	Intermittent Spring	6600	sediment from erosion, fecal coliform from cattle, wildlife and feral animals	Frazier Wells aquifer
Fish Facility (Frazier Wells)	Well	5953	sediment from erosion, fecal coliform from cattle, wildlife and the fish facility	Frazier Wells aquifer

2.2.4 Water Quality

Water quality of the well water is generally good and potable. Testing has been done at Frazier Wells, Upper Pine Springs and Lower Pine Springs. In general, water quality is good at all water sources including the wells in this watershed. Below, we provide the water quality testing results for each source.

SITE NAME: Fish Facility Well

SITE NO. G13

G.P.S LOCATION: LAT N 3545.918
LON W 11304.947 **SITE DESCRIPTION:** Well is located at the north east corner of the Hualapai Department of Natural Resources' Endangered Fish Rearing Facility. The depth to water in this well is approximately 74 feet and the submersible pump is set to a depth of 126 feet and pumps at a rate of 75 gallons per minute. The water from this well is used to fill endangered fish rearing stock ponds with water. The effluent from these ponds overflows into a 2-½ acre pond. The effluent water is used at the 20-acre native tree nursery, to irrigate approximately 150 native willows that were propagated from clippings from willows along the Colorado River and other wetlands on the reservation.

DATE & SITE CHANGES:

July 8, 2005:
Water sample was collected from faucet just off primary water line.

Table 12. Fish Facility well water quality sampling history and results.

Date	PH	TDS(mg/L)	Conductivity(uS)	Salinity (ppt)	Temp.(˚C)	D.O.	Turbidity(NTU)
7/8/05	7.02	184	383	0.2	22.7	5.91mg/L 72.4%	1.62

SITE NAME: Pine Springs (Lower)
SITE NO. S37

G.P.S LOCATION: LAT N 3550.165
LON W 11305.622

SITE DESCRIPTION: This site is a groundwater well that was developed by tapping into ground water flow below the actual spring. The depth to water is approximately 30 feet and the pump is powered with solar panels generating electricity. Approximately 10 gallons a minute is pumped to a large earthen reservoir providing a source of water for cattle and wildlife.

DATE & SITE CHANGES:

June 6, 2002:

On this site monitoring visit there was not any water present due to the drought conditions of the region. Since there was not any water present, there is no field parameter sampling to report.

June 17, 2005:

before visit, a ponderosa pine tree was removed in order to allow maximum sunlight on solar panels. Well and solar panels are working properly. Water was taken from the surge tank near the well for testing.

Table 13. Historic water quality data for the Lower Pine Springs water source.

Date	PH	TDS(mg/L)	Conductivity (uS)	Salinity (ppt)	Temp.(˚ C)	D.O.	Turbidity (NTU)
11/13/98	9.06	114	246	0.1	8		
4/23/98	8.62	149	307	0.1	15	13.7	
8/5/99	8.68	110	234	0.1	22	2.8	
6/6/02			no water				
6/17/05	8.25	164	348	0.2	29.2	4.55	0.27

SITE NAME: Pine Springs (Upper)

SITE NO. 44

G.P.S LOCATION: LAT N 3550.585
LON W 11306.984

SITE DESCRIPTION: Site is located approximately 1 mile northwest of lower pine springs well. Spring waters issues from the back of a small cave. The Cave is approximately 20 feet wide, 5 feet tall and approximately 15 feet deep. There are several places where water drips onto cave floor and a small narrow water flow extends for approximately 40 to 50 yards down stream.

DATE & SITE CHANGES:

May 18, 2005:

Moss growing around the water pool has a bluish gray coloration. There is grass growing along the extent of the water flow. Ponderosa pine and oak tress line the perimeter around the site.

Table 14. Upper Pine Springs water quality sampling history and results.

Date	PH	TDS (mg/L)	Conductivity	Salinity (ppt)	Temp.(˚C)	DO	Turbidity(NTU)
5/18/05	7.03	291	605	0.3	18.7	3.36mg/L 49.0%	1.45

2.2.4.1 Water Quality Goals

The goal for water quality in the Upper Gila Basin is to reduce non-point source pollution in the form of sediment and fecal coliform through reductions in sage brush communities (which promote soil erosion) and by enforcement of the tribe's Water Resources Ordinance with regard to septic system installation and operation guidelines. In addition, through appropriate livestock management, it may be possible to reduce inputs from livestock waste.

2.2.5 Pollutant Sources

The main sources of non-point source pollution in the Upper Gila Basin are sediment caused by logging and cattle grazing. In addition, livestock and feral animals are a source of nitrate pollution into runoff waters. Finally, it is not known whether septic systems in this basin contribute to groundwater contamination.

2.2.6 Land Use Practices

Several timber harvest compartments are located within the Upper Gila Basin watershed (Figure 5). While logging has not been recently conducted, timber sales have occurred in the past in these compartments and are likely to occur in the future. Harvest activities contribute to sediment runoff in the watershed.

Cattle grazing also occurs within the Upper Gila Basin watershed. Approximately, 810 Animal Unit Months (AUM's) are alloted within this sub-basin. Currently, there are 623 animals grazing. Waste from these animals contributes to nitrate and coliform pollution to runoff waters.

2.2.7 Proposed Mitigation Actions

- Manage cattle according to grazing association management plans
- Manage logging operations to minimize surface disturbance
- Regulate the installation and maintenance of domestic septic systems
- Rip-rap or otherwise protect drainage banks where there is a danger of

substantial erosion.
- Install sediment traps to reduce erosion into the Gila drainage.
- treat and remove sage brush

2.2.8 Recommendations

This watershed was classified as a Category II watershed with a ranking of “Medium Priority”. The above identified mitigation actions should be implemented within the next two years or sooner.

2.3 Peach Springs Canyon

The Peach Springs Canyon Sub-basin is centrally located on the Hualapai Reservation and begins near Peach Springs and runs to the Colorado River (Figure 1). The only road to the river in lower Grand Canyon runs down Peach Springs Canyon and is known as Diamond Creek Road. There are four perennial water sources in Peach Springs Canyon; Diamond Spring and Creek, Peach Springs, McGee Spring and Mesquite Spring.

Table 15. Water sources in the Peach Springs Canyon watershed.

Site Name	Type	Elevation (ft)	Non-point Source Pollutants	Water(s) Possibly Impacting
Diamond Spring/Creek	Perennial	1775-1300	sediment from vehicle traffic, nitrates from feral animals	Colorado River Blue Mountain Spring
McGee	Perennial	4000	nitrates from feral animals	Colorado River
Pocamate Spring	Perennial Spring	2110	nitrates from feral animals	Colorado River
Mesquite Spring	Perennial Spring	2417	nitrates from feral animals and cattle	Colorado River

2.3.1 Physical Setting

The Peach Springs Sub-basin lies west of the Upper Gila Watershed and includes the town of Peach Springs (Figure 8). The sub-basin encompasses approximately 300 square miles of mostly desert scrub habitats dominated by canyon formations. The canyon begins just north of Peach Springs and runs into Grand

Canyon to the Colorado River. The perennial springs flow from the Muav limestone formation. Diamond Creek runs for approximately five miles to the Colorado River (Figure 8) with an average discharge of 5 cubic feet per second. During monsoon storms, however, the Diamond Creek drainage and the Peach Springs Canyon drainage can experience severe flooding. In fact, Diamond Creek Road is routinely washed out by these storms.

2.3.2 Unique Features

Peach Springs, McGee Springs, Mesquite Spring, Diamond Springs and Diamond Creek are the most spectacular aquatic features of the Peach Springs sub-basin (Figure 9). The canyon formations are also breathtaking and thousands of tourists each year come to travel down Diamond Creek Road to see the spectacular geological formations (including Diamond Peak) and the Colorado River itself. Even Mesquite Spring is visited by many tourists who come to hear the stories of what the unique spring wetland resources meant to Hualapai Tribal members for hundreds of years.

2.3.3 Water Sources

As mentioned above, Diamond Spring, Peach Springs, McGee Spring and Mesquite Spring are perennial water sources in the Peach Springs Canyon watershed. Photographs of these sources can be found in Figures 10-13.

2.3.4 Water Quality

SITE NAME: Diamond Creek (Source)
SITE NO. S9

G.P.S. LOCATION: LAT N 355602
LON W 1131032

SITE DESCRIPTION: Site is located at the head of Diamond Creek canyon in a small side canyon. Spring can be accessed by hiking or helicopter. Riparian vegetation is abundant throughout this side canyon and mostly consists of cottonwood trees. Water emerges from approximately 30 feet above the creek bed and is surrounded by dense hanging gardens. Water is dispersed from three major discharges that combine into one flow at the base of the creek bed. The combined flow measurement of the major discharges is approximately 100 gallons per minute. The site is very isolated and remote and appears that wildlife only access the site on occasion.

DATE & SITE CHANGES:

April 22, 2005:

On this visit nitrate, nitrite and reactive phosphorous content of the water was assessed and macroinvertebrate samples were collected. There were no tracks, feces or disturbed vegetation to indicate frequent use of the site by wildlife. The creek bed gravels are very hard and are possibly the result travertine deposits.

Table 16. Historic water quality data for Diamond Creek Spring.

Date	PH	TDS (mg/l)	Conductivity (uS)	Salinity (ppt)	Temp (C)	D.O. mg/l	Turbidity (NTU)
4/22/05	7.97	206	422	0.2	22.7	7.25	0.55

SITE NAME: McGee Spring

SITE NO. S42

G.P.S LOCATION: LAT N 353540.373
LON W 1132611.491

SITE DESCRIPTION: Site is located approximately 7 miles south on diamond creek road. On the right side of road, there is a small side canyon where water emerges from a small cave. A small earthen dam about 6 inches high contains water. Willow trees and other wetland vegetation are abundant in the area.

DATE & SITE CHANGES:

July 7, 2005:

Cattle and wildlife frequently use the spring flow as a source of water, evident by the presence of several trails that lead to the spring. The pool of water has dense green algal growth. In the future there may be plans to enclose the spring and wetland areas and the development of a cattle and wildlife water trough outside of the enclosure.

Table 17. Historic water quality for McGee Sprjngs.

Date	PH	TDS(mg/L)	Conductivity (uS)	Salinity (ppt)	Temp. (˚C)	D.O.	Turbidity(NTU)
7/7/05	7.35	241	503	0.2	16.3	4.35mg/L 51.2%	0.25

SITE NAME: Peach Spring

SITE NO. S20

G.P.S LOCATION: LAT N 353530
LON W 11326

SITE DESCRIPTION: Site is located along the floor of Peach Spring Wash about 5 miles north of the community of Peach Springs (Figure 11). The main spring area is fenced off from livestock, and water feeds into an old concrete trough. Cattails grow in the trough and desert wetland species grow below trough in outflow. A saline seep is recognized on the wall of the canyon upstream from the trough. A continuous flow of water discharges from the old concrete trough. Cutting down non-native Tamarisk trees and planting native Goodings Willows and Peach trees have enhanced the spring site. Water flows down Peach Springs Canyon and collects in a dam approximately ¼ of a mile north of the spring. The dam has substantial wetland vegetation around the water and is utilized for swimming and picnics in the summer.

DATE & SITE CHANGES:

September 29, 1997:
Arrived on site at approximately 2:00 p.m. and departed at 3:00 p.m.

August 5, 1999:
On this site visit the spring flow was extremely slow and the depth of water was too shallow to collect any water samples.

March 7, 2000:
Arrived at approximately 4:00 p.m. the weather is clear and cool with a slight breeze. At the spring site there was brown moss build up and dead tree limbs at the edge of water pool. Recent grading of the dirt road has created dirt build up on the shoulder of the road. This has caused the spring source to pool up and seep through the dirt berm. Three water samples were taken and preserved with nitric acid.

August 18, 2003:
Recent flash floods have cleared away most of the small vegetation along the perimeter of the spring flow. Clear waters are present.

June 16, 2004:
This site has undergone some drastic changes as the result of a project to renovate this water system. One of the changes made directly affected the water channel as it no longer fed by the pipe work it used to come from. The new water flow comes from a man made channel about 15 feet from the old source.

Table 18. Historic water quality data from Peach Springs.

Date	PH	TDS(mg/L)	Conductivity (uS)	Salinity (ppt)	Temp. (°C)	D.O.	Turbidity (NTU)
9/29/97	7.62	299	55	0.3	23		
8/5/99	7.48	216	442	0.2	22		
3/7/00	7.53	61	129.4	0.1	15		
8/18/03	7.38	289	598	0.3	22.0	117.5% 8.50 mg/L	2.1

SITE NAME: Mesquite Spring **SITE NO.**

G.P.S. LOCATION:
LAT N

SITE DESCRIPTION: Site is located about 11 miles north of the community of Peach Springs (Figure 13). The spring discharge is captured in a concrete box. The soil saturation below this structure has a surface area of approximately 20 feet by 10 feet. The dominant vegetation around this spring site is mesquite bosque and covers an area of about 100 feet by 200 feet.

DATE & SITE CHANGES:
October 8, 2003:

Burros and coyotes seem to be frequently visiting the site as evident for tracks and fecal matter. Also, there are a lot of quail feathers around the area indicating a fresh kill. There is approximately 8 inches of water in the catchment. However, about 3 inches of the surface is plant debris. There was a slight stagnant odor.

June 16, 2004:

Arrived at site a many birds flew away. Eight birds were actually seen and counted. A rattle snake was seen at the site near the water. The water had an odor of sewage to it. Green algal growth with pinkish periphery was observed.

Table 19. Historic water quality data for Mesquite Spring.

Date	PH	TDS(mg/L)	Conductivity (uS)	Salinity (ppt)	Temp. (°C)	D.O.	Turbidity (NTU)
10/8/03	7.48	476	585	0.5	16.1	.25mg/L 3.1 %	32.3
6/16/04	7.93	459	950	0.5	23.8	3.41mg/L 45.8%	5.76

2.3.4.1 Water Quality Goals

The main goal for water quality in the Peach Springs Canyon Watershed is the reduction of sediment and fecal contaminants in the water that is produced within the watershed and the water that drains the watershed during storm runoffs. In addition, we hope to conserve the integrity of the wetland resources that maintain the good water quality at water sources in this sub-basin.

2.3.5 Pollutant Sources

The majority of non-point source pollution in the Peach Springs Canyon Watershed is sediment carried by runoff waters during monsoon storms. This sediment is deposited into the Colorado River adding to its impairment. In addition, feral animals and livestock have polluted McGee Spring and Peach Springs with fecal waste adding to the nitrate levels. This pollution is reflected by the low dissolved oxygen levels seen at McGee and Mesquite springs. Ultimately much of this nitrogenous waste is washed into the Colorado River as well.

Vehicles traveling down Diamond Creek Road also cause sediment erosion into Diamond Creek as they cross and drive down the creek to access the Colorado River. It is unknown how much sediment is released into the creek and Colorado River from this pollutant source.

2.3.6 Land Use Practices

Land use practices that occur in the Peach Springs Canyon sub-basin include cattle grazing, transportation and recreation. The Peach Springs Livestock Association grazes an average of 487 Animal Unit Months (AUM'S) in this watershed throughout the year. Diamond Creek Road is the main thoroughfare for river running take outs from Grand Canyon river rafting activities. In addition, Hualapai River Running accesses the Colorado River for their river rafting expeditions from April through October.

A total of 24,657 river rafters are permitted to raft the Colorado River in Grand Canyon in each year under the new Colorado River Management Plan (CRMP) of Grand Canyon National Park. Approximately 60 percent of these passengers exit at Diamond Creek. Under the CRMP, Hualapai River Runners are permitted to transport up to 90 passengers per day (April to October) down the river as accessed by Diamond Creek Road.

2.3.7 Proposed Mitigation Actions

- Fence McGee Springs to prevent access by livestock and feral animals
- Improve fencing at Mesquite Spring
- Channel Diamond Creek so that vehicle traffic does not pollute the waters
- Remove feral animals from Peach Springs Canyon
- Fence the Peach Springs wetlands
- Remove tamarisk in Peach Springs Canyon to reduce evapotranspiration
- Manage livestock in Peach Springs Canyon to reduce impacts to water quality

2.3.8 Recommendations

In the 1999 Unified Watershed Assessment (Wegner and Duffield 1999) Peach Springs Canyon was identified as a Category I watershed with a High Priority for remediation. Fencing of McGee Springs is the first activity that should be engaged. An assessment of the feasibility of protecting the Peach Springs wetlands is also a number one priority. Channelization of Diamond Creek near the confluence with the Colorado River should also be immediately evaluated and designed. Removal of feral animals should be considered within one to two years. Management of cattle and removal of tamarisk should be ongoing activities.

2.4 Truxton Valley

Table 20. Water sources in the Truxton Valley watershed.

Site Name	Type	Elevation	Non-point Source	Water(s) Possibly Impacting
HDNR Well	Perennial	4791	hydrocarbons	Truxton Wash Aquifer
Surprise Spring	Perennial	5200	nitrates from wildlife	Truxton Wash

2.4.1 Physical Setting

The seventy-five square mile Truxton Valley sub-basin adjoins the Peach Springs Canyon sub-basin and includes the community of Peach Springs (Figure 1). The terrain is flat terraces interspersed with rolling hills. The dominant vegetation type is juniper/grasslands. A limestone mine is located up gradient from Peach Springs, and the reservation water supply is located down gradient in Truxton where several wells are located. A small, 1.5 square mile satellite of the reservation is located approximately 10 miles west of Peach Springs in Valentine, AZ. A short section of the Truxton Wash flows perennially (except in extreme drought) near Valentine. Groundwater occurs from the Tertiary lacustrian, gravel and volcanic deposits which supply the municipal wells for Peach Springs.

2.4.2 Unique Features

The town of Peach Springs, Truxton Wash and the Burlington-Northern Santa Fe Railroad are the dominant features of the Truxton Wash sub-basin (Figure 14). The wash carries stormwater runoff nearly fifty miles to Red Lake in the Hualapai Valley. Red Lake is normally dry except for during unusual periods of above-normal precipitation. Peach Springs is the center of the Hualapai population, and the tribal administration is located there. Approximately 2,000 individuals reside in Peach Springs. The Burlington-Northern Santa Fe Railroad bisects the center of Peach Springs. Over 100 trains per day travel along the railway through Peach Springs.

2.4.3 Water Sources

The Truxton Well, Mud Tank Well and Surprise Spring are the main water supplies within the Truxton Wash sub-basin. Water quality of the wells are good and monitored bi-weekly by the Hualapai Department of Public Works. The Surprise Spring water quality is also good and provides water for wildlife. Water pollution occurs from storm run-off into Truxton Wash containing sediment, nitrates and organic hydrocarbons.

2.4.4 Water Quality

SITE NAME: Hualapai DNR Well

SITE NO. G1

G.P.S LOCATION: LAT N 353137.392
LON W 1132521.958

SITE DESCRIPTION: Well is located in the Hualapai Department of Natural Resources compound. A 10,000-gallon surge tank is located at the site. The water from the well serves as a primary component of water distribution for the southeastern side of the reservation from Peach Springs with distribution lines and laterals extending a distance of 14 miles to a large water storage tank at Blue Mountain. The water tank gravity feeds to lateral pipelines that fill water troughs in the area.

DATE & SITE CHANGES:

July 13, 2005:
Well is functioning properly and surge tank is full. Water sample was collected from the access panel on the surge tank.

Table 21. Historic water quality data for the HDNR well.

Date	PH	TDS (mg/L)	Conductivity (uS)	Salinity (ppt)	Temp.(˚C)	D.O.	Turbidity(NTU)
7/16/05	7.08	330	686	0.3	23.9	4.64mg/L 64.7%	0.17

SITE NAME: Truxton Wash
SITE NO.

G.P.S. LOCATION: LAT N 352307
LON W 1133925

SITE DESCRIPTION: This site located on Hualapai Indian lands about 20 miles west of the main reservation near the town of Valentine. The water flow fluctuates seasonally but is perennial. The United States Geological Survey has chosen the site to monitor discharge and has set up a gaging station at this location.

DATE & SITE CHANGES:

June 30, 2004:
On this visit the sky is partly cloudy with winds coming out of the west. Vegetation consists of Cottonwood Trees, shrubs and Grasses. Numerous Jack rabbit and cottontail rabbits inhabit the area. No field parameters or macroinvertebrate sampling was done at the site due to there being no water. This maybe caused by drought or the pumping of water for municipal uses, but we cannot be certain.

Table 22. Historic water quality data for Truxton Wash.

Date	PH	TDS(mg/L)	Conductivity (uS)	Salinity (ppt)	Temp.(˚C)	D.O. mg/l	Turbidity(NTU)
5/25/06	7.65	292	606	0.3	17.8	5.95	0.30
8/24/06	7.91	293	261	0.1	26.8	5.85	5.89

SITE NAME: Surprise Spring
SITE NO.

G.P.S. LOCATION: LAT N 353108
LON W 1132404

SITE DESCRIPTION: This site is located about 2 miles south east of Peach Springs on the western slope of a small ravine. The emergence of water comes from a small seep at the back of a 40 foot long cave. The bottom of the cave is filled with water and the depth decreases as water approaches the entrance. The walls of this cave have been reinforced by support beams to prevent subsidence and potential loss of this water source. The water here has been utilized to provide livestock with drinking water. This was accomplished by tapping water from the cave to a 3000 gallon storage tank at the bottom of this ravine using pvc pipe. This tank in turn feeds a concrete water trough. Presently, this system is no longer in use as the amount of water needed to run this system is not available, most likely due to drought.

DATE & SITE CHANGES:

October 7, 2003:

At this time there is not enough water flow to see any movement in the stream. However, Water trickling at the back of the cave was heard. A brownish brush like vegetation was noticed at the bottom of the pool. The depth of water at the entrance is approximately 1 foot and about 4 feet wide.

May 18, 2004:

Site has not changed significantly since last visit. Although the water seems to have a light green suspension to it. Green algal growth in the bottom of the pool was noted. Also there is very little vegetation growing on the side of the stream flow consisting of grasses and weeds.

Table 23. Historic water quality data for Surprise Spring.

Date	PH	TDS(mg/L)	Conductivity (uS)	Salinity (ppt)	Temp. (°C)	D.O.	Turbidity (NTU)
10/7/03	7.97	712	844	0.3	17.4	3.26mg/ L 42.4%	6.86
5/18/04	8.25	328	678	0.3	14.1	4.79mg/ L 58.17%	9.16

SITE NAME: Horse Trough

SITE NO.

GPS LOCATION: LAT N 35330

LONG W 1133705

SITE DESCRIPTION

This spring site is located approximately 11 west of Peach Springs at the foot of the Music Mountains. The spring has been enhanced by digging out the spring source

from the hillside and shoring up the hillside around the spring source with timber braces; similar in structure to hillside mine entrances. Tapped into the water source is a piping system that siphons water from the spring source and gravity flows down hill to a water storage tank and trough; approximately 50 yards away. The hillside spring source is fenced to prevent livestock and wildlife from contaminating the source.

DATE AND SITE CHANGES:

October 1, 1997

There was not enough water present to take any field parameters.

August 3, 1999

The spring was very shallow and had just enough water present to conduct measurements

May 5, 2002 Due to a continued drought, on this site visit there was no water present and no field parameter sampling was conducted.

July 22, 2004

No water present on this monitoring visit. No field parameters taken.

Table 24. Historic water quality data for Horse Trough spring.

Date	PH	TDS(mg/L)	Conductivity (uS)	Salinity (ppt)	Temp. (°C)	D.O. mg/l	Turbidity (NTU)
10/1/97	8.34	391	728	0.4	19.0		
4/22/98	9.86	428	890	0.4	12.0	4.1	
8/3/99	8.05	295	626	0.3	21.0	2.1	

2.4.4.1 Water Quality Goals

The water quality goal for the Truxton Valley sub-basin is to reduce nitrates in the Truxton aquifer through livestock management practices and through a septic system monitoring program. We also propose to implement an emergency response plan for spills resulting from activities of the Burlington-Northern Santa Fe Railroad. Finally, we propose to maintain the fence at Surprise and Horse Trough Springs to prevent access by livestock and feral animals thereby maintaining good water quality.

2.4.5 Pollutant Sources

Pollutant sources in the Truxton Valley watershed include stormwater runoff, livestock waste, hazardous material spills from the railroad, septic systems, open dumping and other municipal activities.

2.4.6 Land Use Practices

Cattle grazing, municipal activities, railroad trains, automobile traffic and surface mining of limestone are the main land use practices affecting the Truxton Valley watershed. Other mining activities also occur down gradient from the Hualapai Reservation.

2.4.7 Proposed Mitigation Actions

- Maintain fences at Surprise and Horse Trough Springs
- Implement storm-water runoff management plan
- Implement Source Water Protection Plan for the Truxton and Valentine aquifers
- Work with Burlington-Northern/Santa Fe Railroad regarding pollutant discharge containment and prevention
- Maintain monitoring program of all water sources

2.4.8 Recommendations

Because of the populus of Peach Springs, the Truxton Valley watershed was identified as having the most non-point source pollution on the Hualapai Reservation (Wegner and Duffield 1999). It is therefore recommended that this sub-basin be given the highest priority for implementation of mitigation actions to reduce the effects of non-point source pollution on water quality.

2.5 Granite Gorge

2.5.1 Physical Setting

The Granite Gorge sub-basin consists entirely of incised canyons within Grand Canyon (Figure 1). There are perennial water sources that flow into Bridge Canyon, Travertine that flows to the Colorado River. All storm runoff in this watershed flows to the Colorado River. This watershed is probably the most pristine of all watersheds on the Hualapai Reservation as it is quite remote and rarely visited (except by river runners along the river).

2.5.2 Unique Features

The main unique features of the Granite Gorge Watershed are associated with the perennial water sources that feed into Bridge Canyon, Travertine Canyon and Travertine Falls. River running recreationists regularly visit the waterfall at Travertine Canyon including Hualapai River-Running Clients.

2.5.3 Water Sources

As mentioned above, the three water sources that occur in the Granite Gorge watershed are Bridge Canyon Spring, Travertine Spring and Travertine Falls Spring. The water quality of these springs is generally good.

2.5.4 Water Quality

SITE NAME: Travertine Canyon 57 **SITE NO.** S7

G.P.S LOCATION: LAT N 354503
LON W 1132526

SITE DESCRIPTION: SITE DESCRIPTION: Located on the Colorado River at river mile 229.This site is accessed by motor boat that is put in at Diamond Creek (river mile 225.5) traveling down the river. This site is used frequently by recreational white water raft tours as a designated destination stop. This site has a travertine cavern where the spring flows into from the top of the cavern and cascades down as a 30-foot water fall, which empties into the Colorado River. To access this cavern it is required to hike about 50 feet from the beach area and climb up the rock face with the assistance of a rope. Boaters also hike about five miles back into the canyon along a trail that runs on the left side of the spring and up over the cavern. The field parameter sampling site is also in this general area, approximately a 25 minute hike behind the cavern.

DATE & SITE CHANGES:

December 6, 2001:

On this site monitoring visit the weather conditions are cool with moderate winds.

March 27, 2001:

On this site monitoring visit the weather conditions were sunny and hot with a strong breeze.

March 4, 2002:

On this site monitoring visit arrived at approximately 1:00 p.m. the weather was sunny and warm, on the trail to the sampling site there were recent droppings of desert Big Horn Sheep.

August 3, 2004:

The pool at the bottom of the fall has substrate that consists mainly of course gravel. The pool itself is 18 feet at its widest point. The stream flow from that point is approximately 4 feet wide on average.

Table 25. Historic water quality data for Travertine Canyon.

Date	PH	TDS	Conductivity	Salinity	Temp	D.O.	Turbidity
12/06/01	8.71	364	754	0.4	12		
3/27/01	8.79				22		
3/4/02		352	782	0.4	17.8		0.3
8/03/04	8.77		616	0.3	29.7	7.2 mg/l	1.46

SITE NAME: Travertine Falls
SITE NO. S6 59

G.P.S LOCATION: LAT N 354522
LON W 1132648

SITE DESCRIPTION: Located at river mile 230.5 on the south shore of the Colorado River in the Grand Canyon, accessed by boat or helicopter. This spring is visited by river running trips and has a well established trail leading to the spring.

DATE & SITE CHANGES:

March 4, 2002:

On this site monitoring visit we arrived in the late afternoon, shadows present in the canyon and the sky is clear.

July 28, 2004:

The pool where field parameters were taken measured about 9 feet at its widest. Substrate in the pool consists mostly of sand and silt. This substrate is consolidated which is most likely the result of travertine deposits. In the immediate area about 15 salt cedar trees are present.

Table 26. Historic water quality data for Travertine Falls.

Date	PH	TDS(mg/L)	Conductivity (uS)	Salinity (ppt)	Temp. (˚C)	D.O.	Turbidity(NTU)
3/4/02		612	276	0.6	9.7		3.4
7/28/04	8.75	483	992	0.5	21.7	116% 9.84mg/L	0.6

2.5.4.1 Water Quality Goals

The goals for water quality in the Granite Gorge watershed is to maintain the good water quality that is currently present at Bridge Canyon, Travertine Canyon and Travertine Falls. Potential contaminants are primarily derived from recreational visitation at Travertine Canyon and Travertine Falls. If contamination of these water sources increases in the future due to increased visitation, limits may have to be imposed on access to these sites.

2.5.5 Pollutant Sources

As mentioned above, the primary sources of pollutants to the water sources within the Granite Gorge watershed result from human visitation. Walking in the water to . access the waterfall at Travertine Canyon results in soil erosion thereby increasing turbidity toward the confluence with the Colorado River.

2.5.6 Land Use Practices

Recreational visitation by rafters on the Colorodo River dominates the land use of the Granite Gorge watershed.

2.5.7 Proposed Mitigation Actions

- Monitor boater visitation at Travertine Canyon and Travertine Falls
- Implement Lower Grand Canyon Management Plan in association with Grand Canyon National Park and the Glen Canyon Dam Adaptive Management Program
- Maintain composting restroom at Spencer Beach
- Monitor vegetation transects at Diamond Creek and Bridge Canyon

2.5.8 Recommendations

The Granite Gorge watershed is a low priority, Category III watershed according to Wegner and Duffield (1999) because of the lack of non-point source pollution threats. Implementation of the identified mitigation actions should occur as mitigation in other, high-priority watersheds is accomplished.

2.6 Western Hualapai Plateau

2.6.1 Physical Setting

The Western Hualapai Plateau watershed covers approximately 190 square miles of plateau and canyon lands. The southern portion of the watershed is

dominated by pinyon-juniper woodlands and high desert scrub habitats. The incised canyon lands in the north funnel to the Colorado River in Grand Canyon. The canyon lands are dominated by Mohave desert vegetation of prickly pear cactus, yucca, ocotillo and cholla. Two springs in Quartermaster Canyon create perennial flow of water to the Colorado River (Figure 15). The springs that feed Lost Creek also create perennial flow to the river. Boundary Spring and Clay Springs are also sources of water in this watershed.

2.6.2 Unique Features

Grand Canyon West and Quartermaster Canyon helipads are tourist destinations within the Western Hualapai Plateau watershed (Figures 16 and 17). Hundreds of tourists are bussed or flown into these destinations to enjoy the spectacular scenery of western Grand Canyon. At the helipad landing sites adjacent to the Colorado River in Western Grand Canyon, pontoon boat rides on the Colorado are also available. Water for Grand Canyon West is hauled in by truck.

2.6.3 Water Sources

Two springs (upper and lower) in Quartermaster Canyon issue water from the Muav limestone aquifer toward the Colorado River. Springs in Clay Tank Canyon create Lost Creek. Boundary Spring and Clay Springs are the other sources of water in the Western Hualapai Plateau watershed (Figure 15). A deep well (>2,000 ft.) was drilled in the late 1990's near Grand Canyon West to provide a water source there. Unfortunately, the water that was discovered was contaminated with Radium at a level unacceptable to U.S. EPA.

2.6.4 Water Quality

Table 27. Water sources in the Western Hualapai Plateau watershed.

Site Name	**Type**	**Elevation**	**Non-point Source**	**Water(s) Possibly Impacting**
Clay Springs	Perennial	1390	nitrates, fecal coliform	Hualapai Aquifer
Upper Quartermaster	Perennial	1600	fecal coliform	Colorado River
Lower Quartermaster	Perennial	1400	fecal coliform	Colorado River
Boundary Spring	Perennial	1800	nitrates, sediment	Colorado River

SITE NAME: Clay Springs

SITE NO. S43

G.P.S LOCATION: LAT N 3543.855
LON W 11352.103

SITE DESCRIPTION: Site is located off the reservation and is parcels of Tribal allotted lands adjacent to the Hualapai Reservation and within BLM (Figure 15). The site is located by Clay Springs road, which connects the Buck and Doe road to Anteras road. A Wooden house structure and a 10,000 gal water storage tank are located below the spring. The spring is located about 400 yards from the water storage tank, which is empty. The spring emerges from the back of a cave bolstered with support beams and resembles a mineshaft.

DATE & SITE CHANGES:

September 27, 2005:
Cattail and tamarisk trees were located at the site. There were 15-20 birds heard at the site. Frogs and a dead scorpion were observed.

Table 28. Historic water quality at Clay Springs.

Date	PH	TDS	Conductivity	Salinity	Temp (C)	D.O. mg/l	Turbidity
9/7/05	6.96	303	631	0.3	19.7	4.49	0.22

SITE NAME: Boundary Spring **SITE NO.** S14

G.P.S LOCATION: LAT N 360312 **LON W** 1135234

SITE DESCRIPTION:
The spring area is located at river mile 270.7 and is on the east wall of this side canyon about 2.5 miles from the western boundary of the Hualapai reservation (Figure 15). The spring source is at the muave limestone-bright angel shale contact, elevation 1250 feet. Dense vegetation on the slopes and velvet ash trees on the canyon floor exist, due to the continuous water flow.

DATE & SITE CHANGES:
December 4, 2002: On this site-monitoring visit the spring was accessed by helicopter. Arrived at approximately 12:45 p.m., the weather is cool and breezy with clear skies

and sunshine. The spring flow is heavily vegetated with monkey flower and ferns in and around the sides of the waterfall.

February 2, 2005: Hanging gardens are present around the waterfall. The waterfall itself is approximately 12 feet high and has a flow rate of approximately 30 gallons per minute. There is a pool of water at the bottom of the waterfall that measures 11 feet wide, 9 feet long at its widest point and approximately 3 foot deep. Water samples were taken for analysis of radium content levels because of its close proximity to the deep well at Grand Canyon West that has slightly elevated levels of radium 226 and 228. The purpose of the analysis was to assess the water quality for potential future development of the water source for domestic use. The laboratory analysis for radium 226 and 228 reported that the levels were within safe drinking water limits.

Table 29. Historic water quality at Boundary Spring.

Date	PH	TDS	Conductivity	Salinity	Temp (C)	D.O. mg/l	Turbidity
12/4/02	6.89	251	579	0.3	24.8	9.78	
2/2/05	7.91	234	493	0.2	24.7	6.78	0.19

SITE NAME: Lower Quartermaster **SITE NO.** S1B

G.P.S. LOCATION: LAT N 365757 **LON** W 1134596

SITE DESCIPTION: This site is located at the bottom of 60 foot rock wall just below Upper Quartermaster Spring (Figure 15). There are several places where water emerges from the side of the channel and wetland vegetation grows throughout the expanse of the spring flow (Figure 18). Site is located in a small side canyon of the Grand Canyon that is about 250 yards long and 75 yards wide. The first 100 yards of vegetation going south is primarily reeds. The rest of the growth consists of a mix of willow and dense mesquite tree growth. Thus most of the canyon is covered with wetland vegetation.

DATE AND SITE CHANGES:

June 29, 2004: During this sampling trip water resources established macroinvertebrate sampling stations and took field parameters. We took samples at a spot where water emerges fromthe ground at about 5 gallons a minute. Also, there are several places where water emerges from the side of the channel. Helicopter pilot could not land into the canyon as vegetation was too high. We hiked down from the top of the rock wall along the southern part of the canyon.

February 2, 2005: Hanging gardens are present around the waterfall. The waterfall itself is approximately 12 feet high and has a flow rate of approximately 30 gallons per minute. There is a pool of water at the bottom of the waterfall that measures 11 feet wide, 9 feet long at its widest point and approximately 3 foot deep. Water samples were taken for analysis of radium content levels because of its close proximity to the deep well at Grand Canyon West that has slightly elevated levels of radium 226 and 228. The purpose of the analysis was to assess the water quality for potential future development of the water source for domestic use. The laboratory analysis for radium 226 and 228 reported that the levels were within safe drinking water limits.

Table 30. Historic water quality data for lower Quartermaster Spring.

Date	PH	TDS	Conductivity	Salinity	Temp (C)	D.O. mg/l	Turbidity
6/29/04	7.28	362	754	0.4	24.1	7.01	1.22
8/30/04	7.45	348	722	0.3	24.6		5.77

SITE NAME: Upper Quartermaster Canyon Spring SITE NO. S17

G.P.S LOCATION: LAT N 355732 **LON W** 1134555

SITE DESCRIPTION: This site is located at an elevation of 1600 feet, at the base of a large travertine deposit (Figure 19). It is also approximately ½ mile south of Lake Mead. Vegetation consists of dense crimson monkey flower and large mesquite trees. The spring empties into the floor of Quartermaster Canyon.

DATE & SITE CHANGES:
April 3, 2001: On this site monitoring visit we arrived at noon the weather conditions were sunny and bright. The spring flow was very low on this day and it took 35 seconds to fill a small water sample bottle.

December 4, 2002: On this site monitoring visit we arrived at 10:00 a.m. The weather was warm breezy and clear an abundance of birds around the wetland and the spring flow is thickly vegetated with reed growth.

September 26, 2003: Heavy vegetation has enveloped the spring flow. The size of the stream is approximately 3 feet wide and 5 inches in depth.

June 29, 2004: The amount of vegetation has not changed since our last visit. However, there is a lot of debris surrounding the spring flow which could be removed as an attempt to foster the growth of more native vegetation. The pool where we sampled from was about one foot wide and one foot deep. Surface film was noticed in

one section of the spring flow, It seemed to be held back by some debris and was allowed to build up.

August 31, 2004: There is an increased amount of debris in the area surrounding the sample site. The area where surface film was present last visit is still there, but seems to be building up.

Table 31. Historic water quality for upper Quartermaster Spring.

Date	PH	TDS	Conductivity	Salinity	Temp (C)	D.O. mg/l	Turbidity
10/13/97	7.2	375	701	0.4	22	1.5	
4/29/98	7.82	371	772	0.4	24	5.5	
8/17/99	7.28	340	708	0.3	24		
4/3/01	8.11	334	674	0.3	21	164.6 %	
12/4/02	7.45	313	653	0.3	23.8	5.1	
9/26/03	7.29	354	737	0.4	24.6	8.42	
6/29/04	7.34	373	776	0.4	24.4	7.64	0.12
8/31/04	7.41	358	745	0.4	24.6	8.57	0.11

2.6.4.1 Water Quality Goals

The water quality goals for the Western Hualapai Plateau watershed include the continued protection and monitoring of water sources in this region of the Hualapai Reservation including maintenance of the Clay Springs fence.

2.6.5 Pollutant Sources

The main pollution sources within the Western Hualapai Plateau include road runoff, fuel storage at Grand Canyon West and the helipad site and nitrates from feral animals and wildlife. The greatest potential for release of pollutants occurs at Grand Canyon West and the Quartermaster helipad sites. In addition, prior to the construction of composting restrooms at Spencer Beach and the helipad areas, substantial deposition of human waste occurred there.

2.6.6 Land Use Practices

Tourism and cattle ranching are the dominant land use practices within the Western Hualapai Plateau watershed. Over one-hundred thousand tourists visited Grand Canyon west each year. The vehicles that transport them there (buses, airplanes, helicopters and vans) have potential to deposit pollutants in the form of gas and oil. Six-hundred seventy -five AUM's are allotted across the Western Hualapai Plateau watershed. Unknown numbers of feral animals roam this portion of the reservation.

2.6.7 Proposed Mitigation Actions

- maintain the fence at Clay Springs
- implement a Stormwater Runoff Plan for Grand Canyon West
- implement a Fuel Storage Management Plan for Grand Canyon West and the Quartermaster helipads and boat dock\
- remove feral animals
- monitor water quality at sources
- prepare Feasibility Study for improving water quality at the deep well near Grand Canyon West

2.6.8 Recommendations

The Western Hualapai Plateau watershed was listed as a Category II watershed with a medium priority for remediation. Fuel management and maintenance of the fence at Clay Springs are the highest priority for this watershed. Due to the potential danger of fuel spills, immediate implementation of a fuel management plan for Grand Canyon West, the Quartermaster helipads and the pontoon boat dock is necessary. Feral animals should be removed if they begin to constitute a problem at any of the water sources.

2.7 Big Sandy

2.7.1 Physical Setting

The Big Sandy watershed is located approximately 60 miles southwest of the main Hualapai Reservation in the Big Sandy Valley (Figure 20). The Big Sandy River flows adjacent to the property. The property is 80 acres in size. The Big Sandy River is a wide, braided and shallow river that runs through gravel soils (Figure 21). The river varies in size according to runoff. During heavy precipitation, the Big Sandy River can experience severe flooding such that it cannot be crossed. In some years, the Big Sandy runs dry at the reservation property due to a lack of precipitation. The habitat at

the Big Sandy property is dominated by Mohave desert vegetation with creosote bush, canotia, prickly pear and palo verde dominating the landscape.

There is a single well that has been drilled on the Big Sandy property. The quality of water of the well is unknown at this time. We hope to monitor water quality of the well in the future. Trout Creek and Night Creek are perennial streams that traverse the property as well. Water quality of these streams is also unknown.

2.7.2 Unique Features

The Big Sandy River, Trout Creek and Night Creeks are the most unique features of the Big Sandy property. Native fish flourish in Trout Creek while the Big Sandy River supports a large riparian component that is used by the endangered Southwestern Willow Flycatcher for nesting (downstream near Wikieup).

2.7.3 Water Sources

The well on the Big Sandy property is the only potable source of water on this portion of the Hualapai Reservation. The Big Sandy River, Trout Creek and Night Creek are also aquatic habitats on the Big Sandy.

2.7.4 Water Quality

No water quality data are currently available.

2.7.4.1 Water Quality Goals

The main goal for water quality of the Big Sandy watershed is to initiate a water quality monitoring program for the well and the perennial streams on this watershed. Once a baseline is established, we can begin to evaluate land use practices as they affect water quality of this watershed.

2.7.5 Pollutant Sources

It is unknown at this time what potential sources of pollution may affect this watershed. It is likely that trespass cattle are causing some impairment of water quality in this watershed. Future studies should investigate potential pollution sources and identify mitigation actions.

2.7.6 Land Use Practices

Currently, trespass cattle roam on this watershed and probably affect water quality. The tribe monitors air quality and meteorological conditions at the Big Sandy as well.

2.7.7 Proposed Mitigation Actions

- Repair the perimeter fence to keep livestock off the property. Also remove any trespass livestock
- initiate a water monitoring program for the well and the perennial streams
- Assess potential sources of pollution
- Develop mitigation actions for pollution sources

2.7.8 Recommendations

This watershed was not evaluated in the Unified Watershed Assessment that was completed in 1999. Given the presence of trespass livestock and the potential affects to perennial streams, we are proposing a designation of Category II for this watershed and recommend assessment and remediation within the next three years.

3.0 COST ESTIMATES FOR IMPLEMENTATION

Below, we provide cost estimates for activities that may occur in each of the watersheds that are evaluated in this document. Following these estimates are specific estimates for the activities that are proposed for each specific watershed.

Construction of Silt Traps (six feet high, two feet thick, twenty-four feet long)

Materials	$ 1,000
Labor	$ 1,000
Miscellaneous	$ 500
Total Cost/Silt Trap	$ 2,500

Removal of Feral Animals

Helicopter Time	$ 1,000/hour
Labor	$ 300/hour
Fuel	$ 100/hour
Miscellaneous	$ 100/hour
Total Cost/Hour	$ 1,500/hour

Estimated that one animal can be captured, handled, transported per hour

Fencing

Materials and Labor	$	2.75/foot

Mitigation Planning

Labor	$	75/hour
Miscellaneous	$	25/hour
Total Cost per hour	$	100/hour

Water Storage Containers and Pipelines

2,600 gallon water tank $ 2,800/tank

Other size water tanks can be purchased for approximately one dollar per gallon of storage capacity.

Water pipeline	$	1.00 per foot
Catchment Materials (liners, pumps, valves etc.)		$10,000/catchment

3.1 Coconino Plateau Watershed

We propose to install ten silt traps within the Coconino Plateau Watershed to reduce sediment runoff to the Colorado River. The locations for the silt traps will be determined through discussions with livestock associations, the tribal government and the NEPA process.

Ten Silt Traps @ $ 2,500/trap	$25,000
Indirect @ 21.98%	$ 5,495
Total Cost	**$30,495**

We propose to install five, 2,600 water tanks with associated troughs and catchments in the Coconino Plateau Watershed.

5 - 2,600 gallon storage tanks		$14,000
5 - catchment materials		$50,000
Labor (5 people X 24 hours X 5 catchments X 15.00/hr		$ 9,000
Vehicle Use (15 days X $100/day)		$ 1,500
Miscellaneous		$ 5,000
	Total Direct	$79,500
	Indirect @21.98%	$17,474
	Total Cost	**$96,974**

We propose to remove feral animals from each of Mohawk Canyon, National Canyon and Prospect Valley. We estimate that 100 animals can be removed.

100 feral animals X $ 1,500/animal **Total Cost $150,000**

We propose to reduce sage brush on the Coconino Plateau Watershed to promote grassland establishment which reduces soil erosion profiles. This is accomplished by the application of the herbicide, *Spike*, which has been very effective in the past at removing sage brush.

Aerial application of herbicide to 2,400 acres (4 lbs/acre) X $41.50 per acre	$ 99,600
Monitoring of trend plots (240 hours X $30/hr)	$ 7,200
Reporting (NEPA compliance and reports; 120 hours @ $100/hr	$ 12,000
Total Direct	$118,800
Indirect @ 21.98%	$ 26,112
Total Cost	**$144,912**

Total Costs for the Coconino Plateau Watershed $422,381

3.2 Upper Gila Watershed

We propose to prepare a comprehensive water quality mitigation plan for the Upper Gila watershed to best manage cattle, wildlife and land use practices (e.g. logging) to minimize impacts to water quality in this watershed.

Mitigation Planning - 240 hours X $100/hr	$24,000
Stakeholder Involvement/Public Outreach	$10,000
Total Direct	$34,000
Indirect @ 21.98%	$ 7,473
Total Cost	**$41,473**

We propose to install five, 2,600 storage tanks on existing water pipelines in the Upper Gila Watershed to disperse cattle and wildlife to reduce trampling and soil erosion thereby improving water quality.

5 - storage tanks @ $ 2,800/tank		$14,000
Labor 100 hours @ $ 20/hr		$ 2,000
Miscellaneous		$ 4,000
	Total Direct	$20,000
	Indirect @ 21.98%	$ 4,396
	Total Cost	**$24,396**

We propose to rip-rap a portion of the Upper Big Chino Wash to prevent erosion and the loss of roadways (as has occurred in the past) thereby improving water quality in the Upper Gila Watershed.

Labor - 480 hours X 5 people X $25/hr		$ 60,000
Materials		$100,000
	Total Direct	$160,000
	Indirect @ 21.98%	$ 35,168
	Total Cost	**$195,168**

Total Costs for the Upper Gila Watershed	**$261,037**

3.3 Peach Springs Canyon Watershed

We propose to fence the McGee Springs wetland to prevent access by feral animals and livestock thereby improving water quality. We also propose to extend a pipeline from the spring to a trough for wildlife and cattle.

Fencing - 3,000 feet of fence @ $2.75/ft		$ 8,250
Labor - 3 people X 272 hours X $15/hr		$ 12,240
Trough		$ 800
Pipe (300 feet X $ 1.00/ft)		$ 300
	Total Direct	$ 21,590
	Indirect @ 21.98%	$ 4,745
	Total Cost	**$ 26,335**

We propose to fence the Peach Springs wetland to prevent access by feral animals and cattle. This will improve water quality and allow the wetland to expand.

Fencing - 5,280 feet of fence @ $2.75/ft		$ 14,520
Labor - 3 people X 480 hours X $15/hr		$ 21,600
	Total Direct	$ 36,120
	Indirect @ 21.98%	$ 7,939
	Total Cost	**$ 44,059**

We propose to remove feral animals from Peach Springs Canyon to improve water quality at springs and in the Colorado River. We estimate that 25 animals can be efficiently removed.

25 animals X $1,500/animal	**$ 37,500**
Total Costs for Peach Springs Canyon	**$107,894**

3.4 Truxton Wash Watershed

Fence maintenance at Surprise and Horse Trough Springs includes replacement of downed fence, replacement of t-posts and stays and shoring of gates and h-guides.

Fence materials - 500 feet of fence @ $2.75/ft	$ 1,375
t-posts and stays - 300 X $4.25	$ 1,275
labor - 2 people X 320 hours X $15/hr	$ 9,600
Other materials	$ 1,000
Total Direct	$ 13,250
Indirect @ 21.98%	$ 2,912
Total Cost	**$ 16,162**

Implementation of the Source Water Protection Plans for the Truxton and Valentine aquifers includes the monitoring of septic systems in Peach Springs, Truxton and Valentine and the development of Best Management Practices (BMP's) for the gas stations, railroad, hazardous materials spills, agricultural practices and industrial waste. These BMP's will also cover storm-water runoff pollution threats.

Septic Monitoring (performed by Indian Health Services) -	$ 12,000
Development of BMP's - 360 hours X $100/hour	$ 36,000
Public Involvement - workshop/training	$ 8,000
Total Direct	$ 56,000
Indirect @ 21.98%	$ 12,309
Total Cost	**$ 68,309**

Total Costs for the Truxton Valley Watershed	**$84,471**

3.5 Granite Gorge Watershed

Monitoring boater visitation of Travertine Falls and Travertine Canyon can be accomplished with weekly visitation to the sites during the summer season to monitor the levels of visitation and impacts to water quality. Following data collection, we will prepare a report detailing recommendations as to whether future restrictions are necessary to maintain good water quality.

River logisitics (1 trip/week X $ 1,000/trip X 20 weeks)		$ 20,000
Labor (two people X 8 hours/day X 2days/wk X 20 weeks X $15/hr)		$ 9,600
Reporting (120 hours X $100/hour)		$ 12,000
	Total Direct	$ 41,600
	Indirect @ 21.98%	$ 9,144
	Total Cost	**$ 50,744**

Maintenance of the composting restroom at Spencer Beach requires three visits during the summer season as accessed by raft.

Three raft trips X $1,000/trip		$ 3,000
Labor (2 people X 8 hours/d X 8 days X $20/hr)		$ 2,560
Supplies		$ 500
	Total Direct	$ 6,060
	Indirect @ 21.98%	$ 1,332
	Total Cost	**$ 7,392**

Monitoring vegetation transects at Diamond Creek and Bridge Canyon requires one, four-day trip via raft in Grand Canyon.

Four day raft trip (4 days X $1,000/day)		$ 4,000
Labor (one staff biologist X 32 hours X $55/hr)		$ 1,760
Logistics		$ 2,000
Consulting botanist (5 days X 300/day)		$ 1,500
Reporting (40 hours X $55/hr)		$ 2,200
	Total Direct	$ 11,460
	Indirect @ 21.98%	$ 2,519
	Total Cost	**$ 13,979**
Total Costs for the Granite Gorge Watershed		**$ 72,115**

3.6 Western Hualapai Plateau Watershed

Maintaining the fence at Clay Springs includes replacement of downed fence, replacement of t-posts and stays and shoring of gates and h-guides.

Fence materials - 400 feet of fence @ $2.75/ft		$ 1,100
t-posts and stays - 300 X $4.25		$ 1,275
labor - 2 people X 320 hours X $15/hr		$ 9,600
Other materials		$ 1,000
	Total Direct	$ 12,975
	Indirect @ 21.98%	$ 2,852
	Total Cost	**$ 15,827**

We propose to remove feral animals from the Western Hualapai Plateau watershed to improve water quality at springs and in the Colorado River. We estimate that 40 animals can be efficiently removed.

40 animals X $1,500/animal **$ 60,000**

Implementation of Source Water Protection and Storm-water Runoff Management Plans includes the development of Best Management Practices (BMP's) for the gas stations, airport, hazardous materials spills, agricultural practices and industrial waste. These BMP's will also cover storm-water runoff pollution threats.

Septic Monitoring (performed by Indian Health Services) -		$ 6,000
Development of BMP's - 360 hours X $100/hour		$ 36,000
Public Involvement - workshop/training		$ 8,000
	Total Direct	$ 50,000
	Indirect @ 21.98%	$ 10,990
	Total Cost	**$ 60,990**

Development of a feasibility study for purifying the water from the Deep Well near Grand Canyon West will require the assistance of an outside hydrology/engineering consultant who will work with staff to prepare the study.

Labor (120 hours X $100/hr)		$12,000
Consultant (360 hours X $150/hr)		$54,000
	Total Direct	$66,000
	Indirect @ 21.98%	$14,507
	Total Cost	**$80,507**

Total Costs for the Western Hualapai Plateau Watershed $217,324

3.7 Big Sandy Watershed

Repair of the perimeter fence at the Big Sandy Watershed to prevent access by trespass livestock involves replacing fencing, t-posts and stays and h-guides.

Fence materials - 6000 feet of fence @ $2.75/ft		$ 16,500
t-posts and stays - 3000 X $4.25		$ 12,750
labor - 3 people X 600 hours X $15/hr		$ 27,000
Other materials		$ 3,000
	Total Direct	$ 59,250
	Indirect @ 21.98%	$ 13,023
	Total Cost	**$ 72,273**

Assessment of pollution sources and development of mitigation plans for those pollution sources can be accomplished by staff of the Hualapai Department of Natural Resources in consultation with U.S. EPA.

Labor (360 hours X $100/hr)		$ 36,000
Gas and Oil		$ 3,000
Travel		$ 2,000
	Total Direct	$ 41,000
	Indirect @ 21.98%	$ 9,012
	Total Cost	**$ 50,012**

Total Cost for the Big Sandy Watershed $122,285

4.0 INFORMATION AND EDUCATION COMPONENT

We propose to prepare an informational pamphlet that discusses sources of non-point pollution on the reservation and ways to reduce its impact on water quality. The pamphlet will also provide Best Management Practices (BMP's) for dealing with non-point pollution sources. We will also hold one public meeting to inform the tribal community about the projects we are implementing on the reservation to reduce non-point source pollution. As mentioned above, we will also work with cattle associations and the Grand Canyon Resort Corporation of the development of BMP's where appropriate.

We will also make the water quality data available to EPA and others through our Challenge and Network Readiness grants that have been implemented over the past several years. In addition, the Hualapai Department of Natural Resources has a web site with a link to all our environmental data. This includes air and water quality data.

The nonpoint source informational pamphlet will be 81/2 X 11", color, trifold, depicting pictures from the reservation. The pamphlet will convey what is nonpoint source pollution. What are the effects of these pollutants on our waters. What causes nonpoint source pollution. What you can do to prevent nonpoint source and a list of best management practices that are specific to our reservation.

One outcome expected is a increased awareness of nonpoint source pollution by Tribal Community Members. This will be measured during a Public meeting presenting the pamphlet to the Community. Following the presentation a brief survey/evaluation of the information will be administered to the participants to gauge their understanding.

5.0 IMPLEMENTATION SCHEDULE

Table 32. Implementation schedule for mitigation activities for each watershed.

Watershed	Work Initiated	Completion of Activites
Coconino Plateau	Spring, 2007	Fall, 2009
Upper Gila	Fall, 2009	Fall, 2011
Peach Springs Canyon	Winter, 2006	Spring, 2007
Truxton Valley	Winter, 2006	Spring, 2007
Granite Gorge	Fall, 2012	Fall, 2014
Western Hualapai Plateau	Spring, 2011	Fall, 2013
Big Sandy	Fall, 2013	Fall, 2015

6.0 INTERIM MILESTONES

For each of the eight watersheds included in this Watershed Management Plan for the Hualapai Reservation, interim milestones include the maintenance of good water quality at each watershed as determined by our monitoring program, the fact that the water quality achievement criteria described below have not been violated and that we have made substantial progress on implementation of the mitigation actions identified in this plan. As long as these criteria have been achieved, we believe that we have reached the interim milestones for remediation of water quality on the Hualapai Reservation.

7.0 WATER QUALITY ACHIEVEMENT CRITERIA

Because the water quality in all of our watersheds is good, we have chosen to set water quality achievement criteria that describe water quality parameters that we do not want to reach. For example, if TDS at a particular water source reaches 1000 mg/l, we will initiate mitigation actions to reduce the TDS level to an acceptable level (e.g. below 500 mg/l). Below, we identify water quality parameters that would trigger mitigation actions.

Dissolved Oxygen below 5.0 mg/l
TDS greater than 1000 mg/l
Salinity greater than 1.0 ppt
Ph less than 7.0 or greater than 9.0

8.0 WATER QUALITY MONITORING PROGRAM

Our water quality monitoring program consists of visitation to each of 52 water sources every other year (i.e. one-half of all the sources each year). In addition, we visit and evaluate water quality and wetland condition at 18 selected wetland sites annually. The water quality parameters that are monitored are listed above in the water quality sections of each watershed. We also characterize the physical environment of each wetland and sample macroinvertebrates. In addition, we monitor bird, small mammal and reptile populations at sites along the Colorado River in the Granite Gorge and Western Hualapai Plateau watersheds, fish in Spencer Creek and the Colorado River and ethnobotanical resources at National Canyon, Granite Park, Diamond Creek, Bridge Canyon and Spencer Beach. Below is a list of wetland habitats that are monitored on an annual basis (Figure 22).

	Watershed
Surprise Spring	Truxton Valley
Truxton Wash	Truxton Valley
Valentine	Truxton Valley
Red Spring	Coconino Plateau
Moss Spring	Coconino Plateau
Matuck Spring	Coconino Plateau
Hockey Puck Spring	Coconino Plateau
Upper Milkweed Spring	Spencer Canyon
Lower Milkweed Spring	Spencer Canyon
Westwater Spring	Spencer Canyon
Spencer Creek	Spencer Canyon
Spencer Creek Mouth	Spencer Canyon
Meriwhitica Wetland	Spencer Canyon
Upper Quartermaster Spring	Western Hualapai Plateau
Lower Quartermaster Spring	Western Hualapai Plateau
Peach Springs	Peach Springs Canyon
Mesquite Spring	Peach Springs Canyon
Bridge Canyon Spring	Granite Gorge

9.0 Literature Cited

Wegner, D.A. and J.R. Duffield. 1999. Unified Watershed Assessment for the Hualapai Reservation. Final Report submitted to U.S. EPA, San Francisco.

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