

Office of Environmental Management – Grand Junction



**Final Report
2006 Biota Monitoring
Moab, Utah**

January 2007



**U.S. Department
of Energy**

Office of Environmental Management

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Moab, Utah, UMTRA Project Site

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1.0 Introduction

The Moab UMTRA Project Site (Moab Site) is a former uranium-ore processing facility located approximately 3 miles northwest of the city of Moab in Grand County, Utah. The plant was constructed in 1956 by the Uranium Reduction Company, which operated the mill until 1962 when the assets were sold to the Atlas Minerals Corporation (Atlas). Operations continued under Atlas until 1984. When the processing operations ceased in 1984, the mill had accumulated an estimated 16 million tons of uranium mill tailings in an unlined impoundment in the floodplain of the Colorado River. The tailings pile covers approximately 130 acres, is about 0.5 mile in diameter, averages about 94 feet in height above the surface of the Colorado River terrace, and is located about 750 feet west of the Colorado River. Atlas placed an interim cover over the tailings pile as part of decommissioning activities ongoing between 1988 and 1995. In October 2001, the title of the property and responsibility for remediation of the tailings pile and contaminated ground water beneath the site were transferred to the U.S. Department of Energy (DOE).

Results of a number of investigations conducted since the early 1970s, including the most recent one completed by DOE (DOE 2003), indicate that contaminants have leached from the tailings pile into the ground water. Several site-related contaminants have been identified, but the most pervasive and highest concentration constituent is ammonia. DOE's studies have identified two plumes of ammonia associated with the site—a deep plume beneath the tailings pile and a shallower plume emanating from the toe of the tailings pile to the Colorado River. Ground water from the shallow plume has been demonstrated to discharge to the Colorado River and to have a localized impact on surface water quality. Degradation of surface water quality is of concern because of potential effects on aquatic species in the area—particularly endangered fish. In its final Biological Opinion issued as part of the DOE's final environmental impact statement (FEIS) for the site (DOE 2005a), the U.S. Fish and Wildlife Service (USFWS) identified several actions required by DOE to address concerns regarding endangered fish. Biota monitoring is one of those actions.

DOE has initiated an Interim Action to pump contaminated ground water from the shallow plume to an evaporation pond on top of the tailings pile. Another Interim Action includes the injection of diverted Colorado River water into the alluvial aquifer. This is accomplished by wells (and since September 2006, an infiltration trench) near the west bank of the river. The goal of the action is to reduce contaminant mass in the aquifer and be protective of potential endangered fish habitat in backwater areas of the river until a long-term remediation system can be designed and installed. The initial portion of the Interim Action has been in place since summer 2003. In its FEIS for remediation of the Moab Site (DOE 2005a), DOE has proposed to intercept ground water and control discharge of contaminants to the river until concentrations in the alluvial system are reduced to levels that permit unrestricted discharge to the river. This proposed action could involve scaling up of the existing Interim Action system or augmenting it in some other way.

The biota monitoring plan for the Moab Site was designed to evaluate potential effects of site-related contamination on endangered fish in the Colorado River, in particular, the Colorado pikeminnow. The purpose of the biota monitoring was to identify suitable fish habitat areas within the backwaters on the western bank of the Colorado River and to observe the habitat areas during fluctuating river levels adjacent to the Moab Site. The biota monitoring commenced on

July 5, 2006, and was completed September 28, 2006. This report contains a summary of observations, field parameters, and analyte results of surface water locations upstream and downstream, but mostly adjacent to the Moab Site. Section 2.0 contains a map of the backwater area and the sample locations, and Appendix A has a collection of observations and field parameters.

2.0 Background

Suitable habitat for the Colorado pikeminnow is slow-moving, relatively shallow backwaters. The best habitat are backwaters connected to the river on the downstream end, though the most critical factor for potential habitat is that waters have very low velocities. Based on previous field observations, it was determined that suitable habitats form adjacent to the Moab Site only when the Colorado River discharge is less than 7,000 cubic feet (ft) per second (cfs) (DOE 2006) (as measured at the Cisco Gaging Station). Therefore, monitoring was generally conducted when river discharge was less than 7,000 cfs. Monitoring was conducted according to methods and timing described in the Biota Monitoring Plan (DOE 2006).

The objectives of the tasks described in this plan are to identify, collect, and preserve for subsequent identification any injured, stressed, or dead fish along the banks of the Colorado River adjacent to the site for purposes of estimating “take” as a result of site-related contamination. It is anticipated that several years of biota monitoring may be needed to accomplish this due to natural variations in river conditions. Results of this first year of monitoring will help guide any necessary revisions and refinements to the plan. Any modifications will be made in consultation with the USFWS.

The main constituent of concern, because of its toxicity to fish, is ammonia. Observations made in this report are often described in relationship to locations of the Interim Action ground water remediation system. The Interim Action consists of segments referred to as Configurations 1 through 4. The locations of the segments of the Interim Action well field are shown in Figure 1. Configuration 4 is located to the south of Configuration 1. It is not shown in Figure 1, as it did not become operational until September 2006. A Baseline Area with several monitoring wells is located to the north of the Interim Action well field.

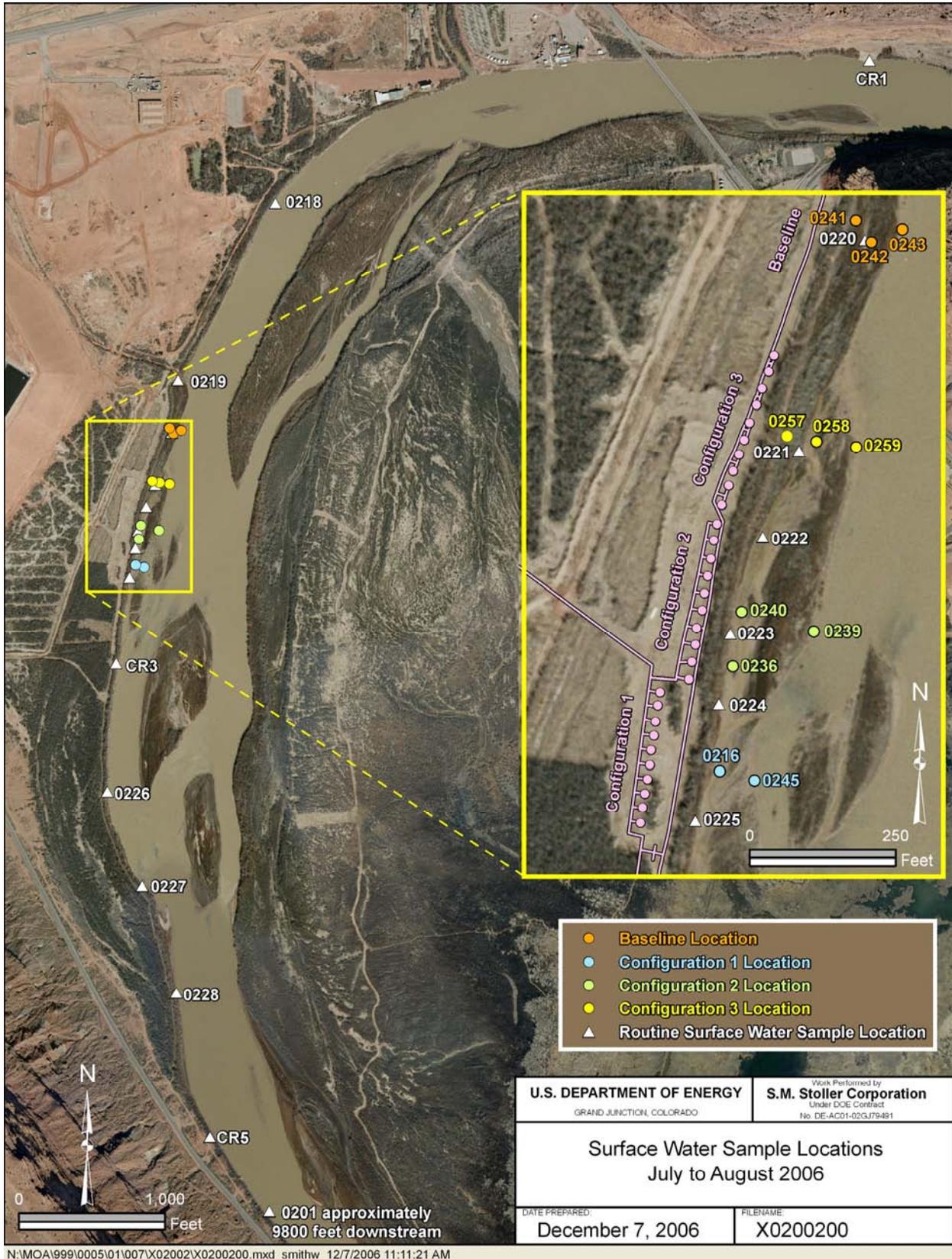


Figure 1. Surface Water Sampling Locations

3.0 Results

3.1 July 2006

When the biota monitoring began on July 5, 2006, the Colorado River (at the Cisco Gaging Station) was flowing at 5,060 cfs. The flow increased in early to mid-July as the result of monsoonal rain to a flow of 8,350 cfs on July 12, 2006, and slowly decreased until early August when the flow reached 5,170 cfs. The morphology of the backwater channels varied considerably depending on river flow.

On July 5, 2006, a main backwater channel was observed flowing openly along the western shoreline adjacent to Configuration 3 southward to Configuration 1. The backwater channel in the Baseline Area north of Configuration 3 was completely dry up to the river edge (main channel) and the Moab Wash area contained less than 1 ft of water with an abundance of wood debris. A few fish were observed in the backwater channels near Configurations 1 and 2. A few patches of salt precipitate were present on ground surface of the mud bars of Configurations 2 and 3.

When the river flow increased in mid-July, the main backwater channel flowed more rapidly and had a high turbidity. Wood debris washed up into the backwater causing areas of more stagnant flow. These were the areas where fish were observed. As the river flow decreased again, the main backwater channel near Configurations 2 and 3 consisted of isolated pockets of water that were shut off from the main river channel. The Configuration 2 area dried up, with the exception of one pocket of water (Location 0236), where a school of small fish (1–2 centimeters) were observed.

Surface water samples were collected from the backwater areas during two different sampling events during the month of July. These include (1) the site-wide routine event and (2) the monthly performance assessment of the ground water Interim Action well field which, with the installation and completion of Configuration 4 wells in August, now consists of 40 extraction and/or injection wells. During the week of July 12, surface water samples were collected both upstream and downstream near the Moab Site, as well as along the backwater areas of Moab Wash, the Baseline Area, and Configurations 1, 2, and 3. This sampling was conducted during the ascending limb of the hydrograph for the month, but overall during the descending limb following the spring runoff. Surface water samples were also collected on July 27, 2006, for the monthly sampling event. Samples were collected throughout the backwater areas of Configurations 1, 2, and 3. This sampling event was conducted during lowest flow values of the hydrograph (Figure 2).

To obtain a comparison of the surface water upstream, downstream, and at the Moab Site, several offsite river locations were sampled. Background Location CR1 is located upstream of the Moab Site, and Locations CR3 and CR5 are located downstream of the site boundary. Location 201 is approximately 2.3 miles downstream from the Moab Site. During the week of July 11, 2006 (river flow > 8,000 cfs), the field parameter and analyte results are comparable for all of the upstream locations, Moab Site backwaters, and downstream locations.

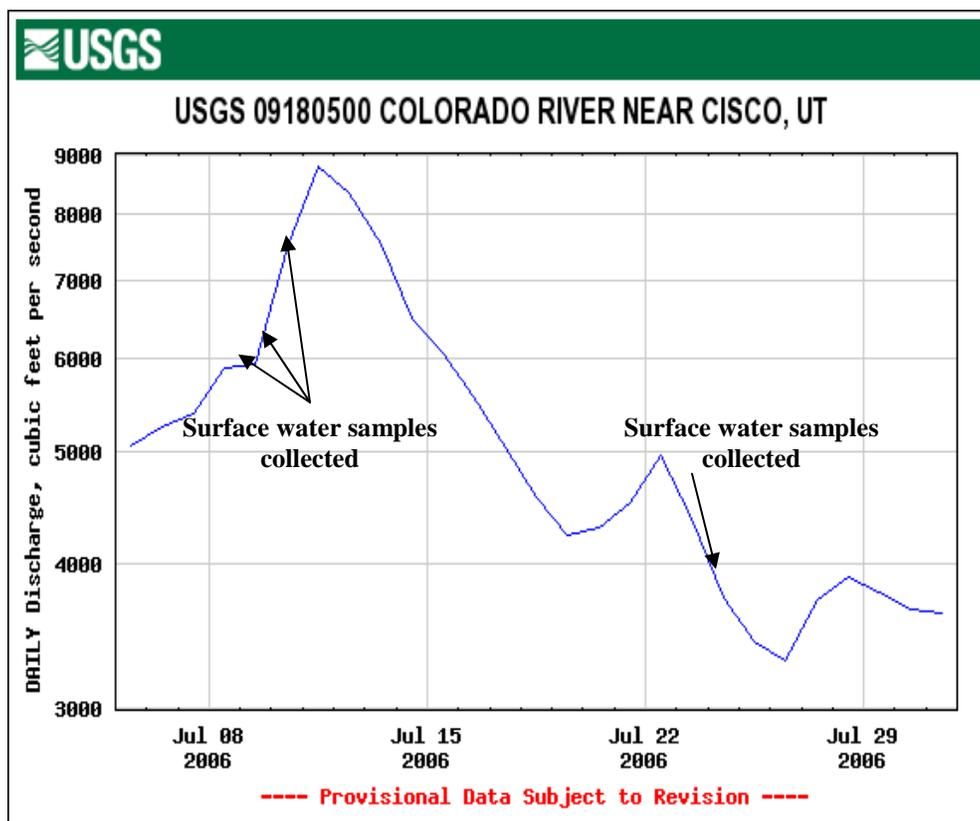


Figure 2. The Colorado River (Cisco Gaging Station) Hydrograph for July 2006

On July 27, 2006, the river flow was 3,720 cfs. The field parameter and analyte values for all the surface water locations were slightly higher, reflecting the lower river flow (Table 1). Location 0240 is located adjacent to Configuration 2. On July 27, 2006, the analyte results for Location 0240 were elevated from the rest of the samples taken that day. At the time of sampling, this backwater location was shallow and isolated from both the river and the backwater channel. It is possible that the analyte and parameter values of this location are representative of a mixture between the ground water and surface water. Fish were rarely observed at Location 0240.

Table 1. Analyte and Parameter Data of Surface Water Locations, July 2006

Date	Location	River Flow (cfs)	Temp. (°C)	Cond. (µmhos/cm)	pH (S.U.)	D.O. (mg/L)	ORP (mV)	U (mg/L)	TDS (mg/L)	Br* (mg/L)	Cl (mg/L)	SO ₄ (mg/L)	NH ₃ -N* (mg/L)
07/11/06	CR 1	8,780	21.68	918	7.71	7.33	120	0.0038	620	0.2	62	220	0.1
07/12/06	CR 3	8,350	23.00	879	7.69	7.58	25.5	0.0041	590	0.2	52	210	0.1
07/11/06	CR 5	8,780	22.64	929	8.00	7.05	72	0.0038	640	0.2	64	230	0.1
07/11/06	0201	8,780	23.60	908	7.87	7.06	87	0.0039	610	0.2	64	220	0.17
07/13/06	0218	7,530	23.29	899	8.12	8.44	-9.1	0.0045	590	0.2	50	240	0.1
07/12/06	0219	8,350	26.56	911	7.58	6.48	103	0.0055	600	0.2	52	230	0.1
07/12/06	0220	8,350	37.10	512	8.75	8.17	18	0.00043	330	0.2	25	140	0.1
07/12/06	0221	8,350	22.98	937	7.84	6.70	34.7	0.0042	650	0.2	51	260	0.1
07/12/06	0222	8,350	24.10	948	7.93	6.79	-6.7	0.0043	650	0.2	51	260	0.1
07/12/06	0223	8,350	23.09	904	7.88	6.20	211	0.0043	670	0.2	52	250	0.15
07/13/06	0224	7,530	22.40	893	7.84	7.95	129	0.0049	630	0.2	49	240	0.1
07/13/06	0225	7,530	21.87	891	7.95	8.07	112	0.0049	610	0.2	49	240	0.11
07/12/06	0226	8,350	22.98	1,277	7.87	7.07	-15	0.0053	590	0.2	54	210	0.11
07/12/06	0227	8,350	22.93	1,087	7.93	7.46	23	0.0039	590	0.2	56	220	0.1
07/11/06	0228	8,780	22.34	993	8.14	7.28	-198	0.004	660	0.2	64	260	0.1
07/27/06	0245	3,720	27.59	1,146	8.22	9.06	54	0.009	810	0.2	81	270	0.1
07/27/06	0216	3,720	29.43	1,151	8.30	9.02	52	0.0092	770	0.2	86	290	0.15
07/27/06	0239	3,720	28.49	1,152	8.31	9.70	53	0.0088	760	0.2	85	280	0.1
07/27/06	0240	3,720	28.88	1,382	8.11	11.97	66	0.071	960	0.4	100	370	0.37
07/27/06	0243	3,720	25.74	1,143	8.08	7.50	121	0.0089	780	0.2	84	280	0.1
07/27/06	0259	3,720	25.49	1,142	8.19	9.23	82	0.009	820	0.2	84	270	0.1

cfs - cubic feet per second

°C - degrees Celsius

Cond. - conductivity

DO - dissolved oxygen

µmhos/cm - micromhos per centimeter

mg/L - milligrams per liter

mV - millivolts

TDS - total dissolved solids

ORP - oxidation reduction potential

*The detection limit for Br is 0.2, and the detection limit for NH₃-N is 0.1

3.2 August 2006

The Colorado River flow did not vary much during the month of August. During the beginning of the month, the river flow was 4,210 cfs, and all of the backwater areas were separated from the main river channel (Figure 3; Photos 11 and 12 in Appendix A). The former backwater channels near the Baseline Area and Configuration 3 were dry, and patches of salt precipitate covered the surface. The main backwater channel through Configuration 2 was dry; however, the isolated pocket of water near Configuration 2 (Location 0236) was approximately 4 inches deep and contained a small school of fish.

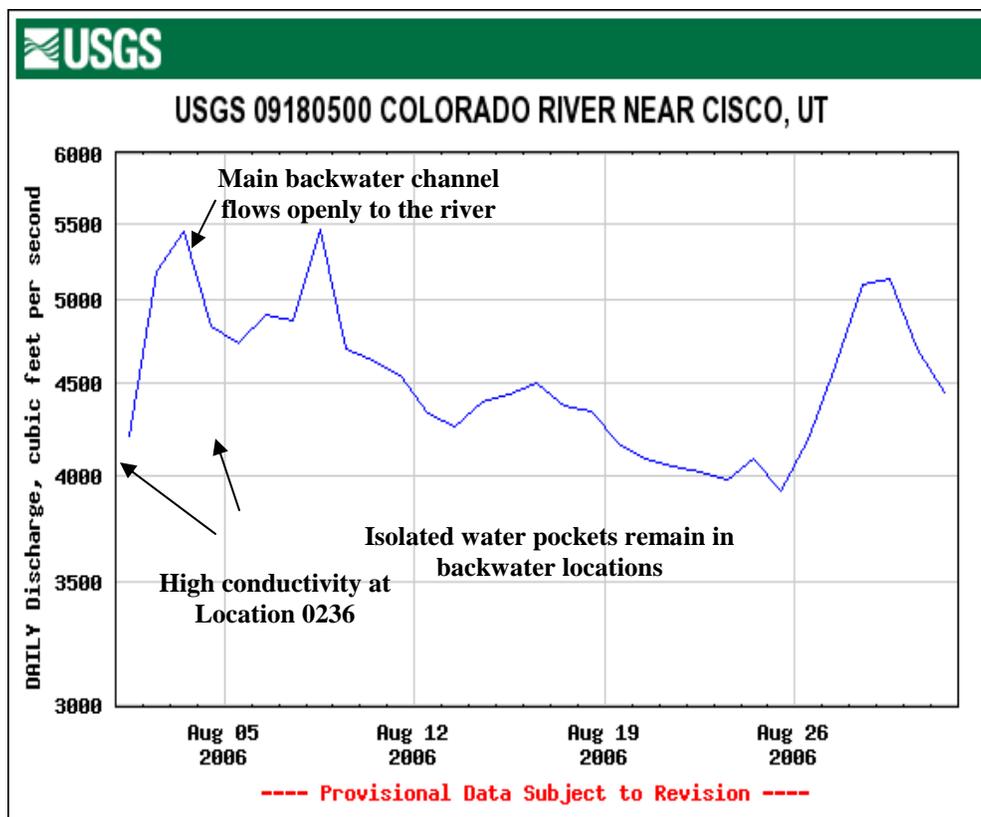


Figure 3. The Colorado River (Cisco Gaging Station) Hydrograph for August 2006

As a result of the minor river flow fluctuations, short-lived, isolated pockets of water frequently occurred adjacent to Configurations 2 and 3. Occasionally, fish were observed within these isolated water pockets. In order to monitor the water quality, parameters were collected from each individual pocket during the month of August. Since the Configuration 1 area adjoined to the main river channel, parameters were collected from this location to obtain a comparison of the flowing versus stagnant water.

On July 31, 2006 the isolated backwater pocket near Configuration 2 (Location 0236) had a conductivity of 3,153 micromhos per centimeter ($\mu\text{mhos/cm}$) when the river flow was 3,630 cfs. Two days later, on August 2, 2006, the conductivity of Location 0236 increased to 3,820 $\mu\text{mhos/cm}$ when the river flow was 5,170 cfs (see Photo 13 in Appendix A). On August 8, 2006, the river flow was at 5,460 cfs, and the main backwater channel flowed through

Configuration 2 (see Photo 15 in Appendix A). As a result, the conductivity of Location 0236 dropped to 1,063 $\mu\text{mhos/cm}$. Schools of small fish (1–2 cm) were observed in this water pocket during both high and low conductivity.

Surface water samples were not collected in the month of August. On August 8, 2006, the river level peaked for the month at 5,460 cfs, and the backwater area consisted of a continuous channel from Configuration 3 to Configuration 1 that was open to the river on both ends. Refer to Appendix A for details on August observations and parameter values.

3.3 September 2006

The Colorado River flow slowly increased during the month of September and peaked at 7,330 cfs on September 23, then rapidly decreased towards the end of the month (Figure 4). The flow through the main backwater channel from the river resumed by mid-month and continued until September 27, when the river flow dropped to 4,680 cfs.

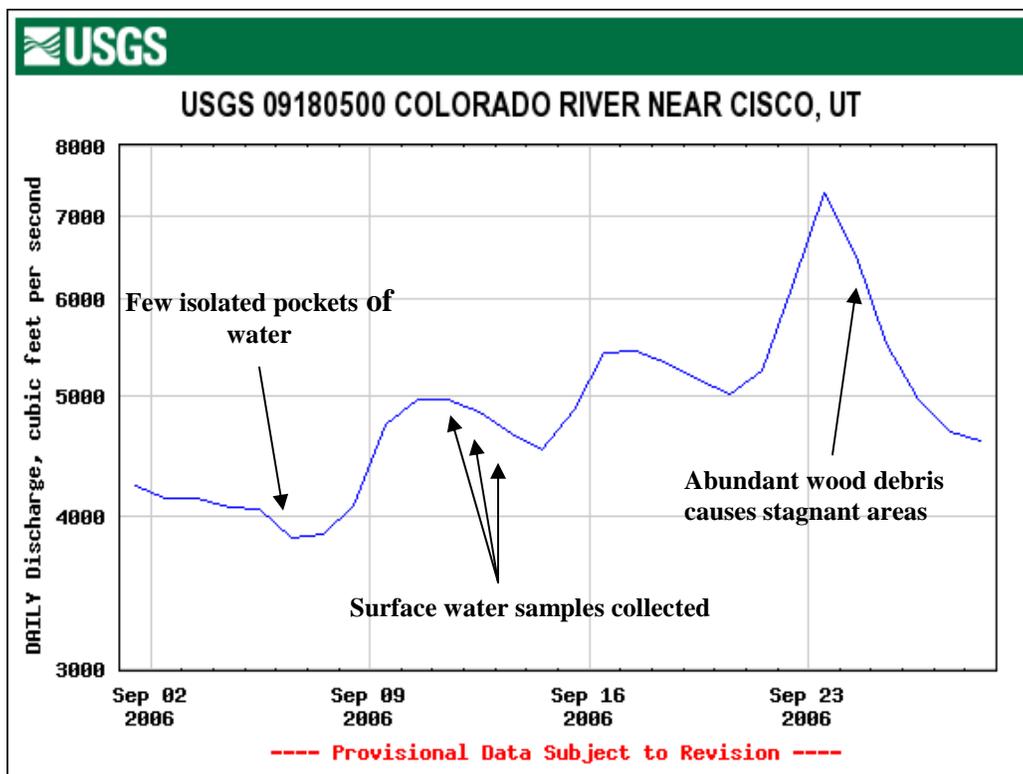


Figure 4. The Colorado River (Cisco Gaging Station) Hydrograph for September 2006

In order to monitor the water quality, field parameters were collected from individual surface water pockets during the month. Based on observations from July and August, the frequency of the monitoring was decreased to once or twice a week, depending on river flow conditions.

In early September, the Colorado River flow was near 4,000 cfs. The backwater channel areas consisted of a few isolated pockets of stagnant water. By September 12, the river flow had increased to 4,860 cfs, and water flow resumed in the main backwater channel (Photos 24 and 25

in Appendix A). The river flow peaked on September 23 at 7,330 cfs, as the result of a local rainfall event. By the end of September the river flow was around 5,000 cfs, and the backwater channel was open to the river. Surface water samples were collected during the September Interim Action performance assessment monthly sampling event on September 12–14, 2006, when the river flow was between 4,860 and 4,530 cfs (Table 2). The parameter and analyte values were similar for each of the surface water locations.

Table 2. Analyte and Parameter Data of Surface Water Locations, September 2006

Date	Location	River Flow (cfs)	Temp. (°C)	Cond. (µmhos/cm)	pH (su)	DO (mg/L)	ORP (mV)	U (mg/L)	TDS (mg/L)	Br* (mg/L)	Cl (mg/L)	SO ₄ (mg/L)	NH ₃ -N* (mg/L)
09/14/06	0216	4,530	19.27	1,033	8.21	7.25	203	0.0069	680	0.2	73	260	0.1
09/13/06	0236	4,660	24.10	1,011	8.66	11.56	63	0.0062	670	0.2	76	270	0.1
09/13/06	0239	4,660	23.63	1,121	8.20	7.28	67	0.0073	690	0.2	74	270	0.1
09/12/06	0240	4,860	27.30	1,015	8.37	10.45	115	0.0062	710	0.2	74	260	0.1
09/13/06	0243	4,660	23.23	1,083	8.19	7.52	69	0.0073	740	0.2	71	260	0.1
09/12/06	0258	4,860	25.44	1,121	8.15	8.68	114	0.0062	690	0.2	75	260	0.1
09/12/06	0259	4,860	23.51	1,046	8.12	8.29	114	0.0062	730	0.2	74	260	0.1

cfs – cubic feet per second

°C - degrees Celsius

Cond. - conductivity

DO - dissolved oxygen

µmhos/cm - micromhos per centimeter

mg/L - milligrams per liter

mV - millivolts

TDS - total dissolved solids

ORP - oxidation reduction potential

* The detection limit for Br is 0.2, and the detection limit for NH₃-N is 0.1

End of current text

4.0 Conclusions and Recommendations

Throughout the biota monitoring event, the configuration of the Colorado River backwater channels changed drastically through the fluctuating river levels. Small schools of fish were observed in the main backwater channel in times of high river flow. During lower river flow, the schools of fish were observed in isolated pockets of water, mostly at Location 0236, between Configuration 1 and Configuration 2. Throughout the biota monitoring event, no dead or distressed fish were observed. The fish were observed at Location 0236 at various conductivity levels. It should be noted that when the isolated pockets of water containing fish became increasingly shallow, the fish were no longer present. It is apparent from tracks in the mud that large birds were visiting the backwater area.

It is recommended that the next season of biota monitoring include a collection of parameters in the isolated backwater areas when there is little or no flow on the upstream side in order to monitor the water quality conditions of the habitat areas. The frequency of observations and parameters will be dependent upon river flow conditions. An initial monitoring period will take place in early summer to determine the upper and lower brackets of river flow through the backwater area. At times of high river flow, when the backwater area is connected to the main river channel both up and down stream, any ground water that is introduced into the channel becomes diluted. The analytical results indicate that the site contaminants have little impact on the adjacent backwaters. At times of low river flow (near 4,800 cfs for summer 2006), when the backwater area is closed off upstream the isolated water pockets may contain fish, and if ground water is introduced, the water quality could be jeopardized. However, this was not observed this year.

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Appendix A

Field Observations

July 2006

Date	River flow (cfs)	Configuration 3 (CF3)	Configuration 2 (CF2)	Configuration 1 (CF1)	Baseline
07/05/2006	5,060	Main backwater channel present, open on the upstream side flows into CF3, no fish observed, abundant wood debris, few foamy bubbles on water surface, between 6–12 inches deep, moderate turbidity, slow water flow. Temperature 19.34 °C. Photo 2	School of fish observed in channel (1-2 cm), most are downstream of the debris in channel, water is 6 inches deep, light green water, moderate flow, slow-stagnant flow downstream. Temperature 21.47 °C. Photo 2	Backwater channel snakes over to CF2 bank, 12 inches wide, 1 ft deep, stagnant, high turbidity, few fish present. Temperature 19.21 °C. Photo 3	Dry backwater channel along the bank Photo 1
07/06/2006	5,250	The backwater channel is still flowing through, moderate flow and velocity. Temperature 19.23 °C.	Stagnant deep water, few isolated water pockets shut off by debris, no fish observed, bottom of channel is covered in algae and the top has bubbles, salt crystals have formed on the flats. Temperature 23.14 °C.	Same as 07/05/06. Temperature 22.13 °C.	Dry
07/10/2006	7,500	Few isolated ponds of water in the mud bar adjacent to the backwater channel, the channel is 2 ft deep and 4 ft wide, stagnant, very turbid, few fish 1–2 cm in length, slight film on the surface. Temperature 20.8 °C.	Same backwater channel flowing from CF3, few bubble patches, fish present, still open upstream, 2 ft deep, 8 ft wide, very turbid. Temperature 21.77 °C.	Same as 07/05/06. Temperature 20.43 °C.	Dry
07/12/2006	8,350	Small secondary backwater channel between bank and intermediate area is now flowing, wood debris from the rain storm, water depth 3–4 ft, 10 ft wide, moderate flow, extremely turbid, mud bar has pockets of water. Temperature 21.39 °C. Photo 4	Wood debris from storm, water 3–4 ft deep, 20 ft wide; slow to moderate flow, very turbid. Temperature 23.56 °C. Photos 5 and 6	Not accessible. Photo 6	Dry
07/13/2006	7,530	The backwater channel is still present, the mudflats contain less water, some isolated water patches are present on the mudflats, very turbid, stagnant, no fish observed, many bubbles on the surface, 3.5 ft deep, 7 ft wide, moderate flow, very turbid. Temperature 21.35 °C.	Wide backwater channel is very turbid, wood debris, levels down 1.5 ft from yesterday, bubbles on the surface, no fish observed, 4 inches deep, 25 ft wide, slow flow, no fish observed. Temperature 22.70 °C.	Moderate flow over a rocky substrate.	Dry
07/17/2006	5,030	Main backwater channel is still present, all backwater pockets on the mudflats have dried out, the mouth is still open, bubbles and wood on surface, bird prints are abundant from the lower water levels, 1.5 ft deep, 5 ft wide, slow flow, very turbid. Temperature 24.76 °C.	Many mudbars have formed in the backwater, lots of wood debris, bubble patches, channel near bank is dry, 1 ft deep, 7 ft wide, slow flow, very turbid. Temperature 24.81 °C.	Same as 07/13/06. Temperature 21.28 °C.	Dry

July 2006 (continued)

Date	River flow (cfs)	Configuration 3 (CF3)	Configuration 2 (CF2)	Configuration 1 (CF1)	Baseline
07/18/2006	4,570	Main backwater channel levels are lower, low flow, still open at mouth, 8 inches deep, 3.5 ft wide, moderately turbid, few bubbles on water surface. Temperature 26.41 °C.	Backwater channel is really close to being shut off from CF3, 6 inches deep, 2 ft wide, CF2 is almost shut off from CF1. Temperature 28.49 °C.	CF1 is almost shut off from CF2, 8 inches deep, rocky substrate. Temperature 25.51 °C.	Dry
07/19/2006	4,230	Main backwater channel is now separate from CF2, few stagnant puddles in between, green-brown water, bubbles, film on surface, 10 inches deep, 1–2 ft wide, very turbid. Temperature 38.8 °C.	Small main backwater channel is now in two separate sections, algae, no fish observed. Temperature 37.4 °C.	CF1 is shut off from CF2, moderate flow, 8 inches deep, rocky. Temperature 29 °C.	Dry
07/24/2006	3,740	Main backwater channel is now closed off upstream, moderate turbidity, stagnant water, few live fish, 3 ft wide, 5 inches deep, closed off by wood debris. Temperature 26.15 °C.	Isolated ponds, no fish observed, 3 ft wide, 4 inches deep, moderate turbidity. Temperature 28.03 °C.	Moderate flow, high turbidity, shallower, 6 inches deep. Temperature 28.02 °C.	Dry
07/26/2006	3,300	One stagnant pond, few desiccation cracks, slight green algal growth, 3 inches deep, 3 ft wide, moderate turbidity. Temperature 28.04 °C.	Completely dry. Photo 10	Isolated ponds are present, slight algal growth, rocky substrate, 3 inches deep, 4 ft wide, moderate turbidity. Temperature 27.49 °C. Photo 10	Dry
07/31/2006	3,630	Desiccation cracks present, completely dried up, few salt crystals on mud flats.	Deep stagnant pond, two fish relocated to main channel, green, iridescent sheen, moss, 5 inches deep, 15 ft long, 3 ft wide. Temperature 25.78 °C. Conductivity 3,153 µmhos/cm. pH 7.36.	Milky appearance, stagnant water, 6 inches deep. Temperature 26.10 °C. Conductivity 1,230 µmhos/cm. pH 8.00.	Dry

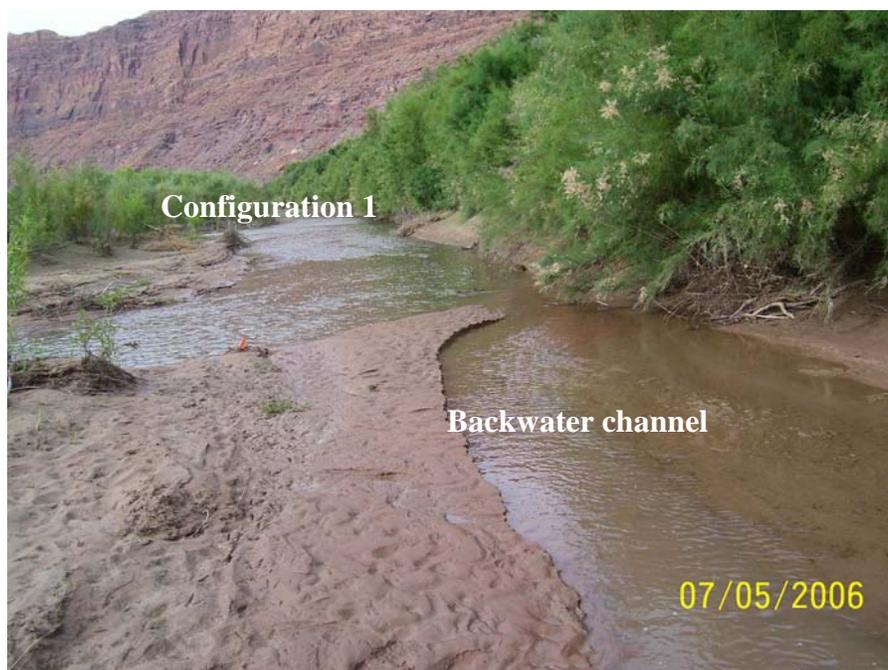
July Figures
July 5, 2006
River Flow 5,060 cfs



Photo 1. This former/potential backwater channel adjacent to the Baseline Area was dry throughout the biota monitoring event. View is to the north.



Photo 2. Configurations 3 and 2 backwater areas part of the "main backwater area" on July 5, 2006. The main backwater channel flowed freely near all of the well field configuration areas. View is to the south.



*Photo 3. The confluence of main backwater channel near the Configuration 1 area.
View is to the south.*

**July 12, 2006
River Flow 8,350 cfs**



*Photo 4. The main backwater channel through the Configuration 3 area.
View is to the north.*



*Photo 5. The main backwater channel as it flows through the Configuration 2 area.
View is to the south.*



*Photo 6. The confluence of backwater channels near Configurations 1 and 2.
Compare with Photo 3 dated July, 5, 2006. View is to the south.*

July 27, 2006
River Flow 3,720 cfs



Photo 7. The backwater channel near Configuration 3 is dry at this lower river flow. Compare with Photo 4. View is to the north.



Photo 8. Configuration 2 "backwater" consisted of isolated pockets of water. The water in the foreground is surface water sample Location 0240. Compare with Photo 5. View is to the south.



Photo 9. Surface Water Location 0236. Fish were frequently observed in this pocket of water. View is to the north.



Photo 10. Backwater area near Configurations 1 and 2. View is to the north.

August 2006

Date	River flow (cfs)	Configuration 3 (CF3)	Configuration 2 (CF2)	Configuration 1 (CF1)	Baseline
08/01/2006	4,210	Still dry, less salt present.	Same pond is present, 4 inches deep, 2.5 ft long, mud cracks present on bank, salt casts in two locations.	Water is red, no rocks visible, extremely turbid, moderate flow.	Dry
08/02/2006	5,170	2 inches of water in main backwater channel, lots of bubbles on the surface, green algae, stagnant water. Temperature 30.13 °C. Conductivity 2,088 µmhos/cm. pH 8.00. Photo 11	Dry, Location 0236 has 3 inches of water. Temperature 28.46 °C. Conductivity 3,820 µmhos/cm. pH 7.90. Photos 12 and 13	Moderate flow, very turbid, 6 inches deep, flowing through. Temperature 26.00 °C. Conductivity 1,040 µmhos/cm. pH 7.98.	Dry
08/08/2006	5,460	Water flowing through main backwater channel, very turbid, slow-mod flow, 6 inches deep, secondary backwater channel is still dry. Temperature 26.50 C. Conductivity 988 µmhos/cm. pH 7.55. Photo 14	Same backwater channel flowing through. Temperature 26.57 °C. Conductivity 932 µmhos/cm. pH 7.65. Location 0236 is stagnant, filmy, no fish. Temperature 34.35 °C. Conductivity 1,063 µmhos/cm. pH 8.31. Photos 15 and 16	Moderate flow, high turbidity. Temperature 27.22 °C. Conductivity 978 µmhos/cm. pH 8.22. Photo 16	Dry
08/09/2006	4,690	Same as 08/08/06, water level 4 inches, slow flow, still open upstream. Temperature 24.60 °C. Conductivity 652 µmhos/cm pH 7.84.	Water levels down, 5 inches deep, slow flow. Temperature 26.59 °C. Conductivity 1,044 µmhos/cm. pH 7.42. Location 0236 Temperature 26.56 °C. Conductivity 999 µmhos/cm. pH 8.27.	Same as 8/8/06.	Dry
08/10/2006	4,630	Open to the river, stagnant, red color, 3 inches deep. Temperature 23.97 °C. Conductivity 1,080 µmhos/cm. pH 7.65.	Isolated pockets of water between CF2 and CF3. Location 0236 is ~2 inches deep, few fish observed. Temperature 21.57 °C. Conductivity 1,072 µmhos/cm. pH 8.31.	Moderate flow, red color, ~6 inches deep. Temperature 23.56 °C. Conductivity 1,051 µmhos/cm. pH 7.94.	Dry
08/14/2006	4,390	Dry.	Location 0236 is filmy, ~1 ft deep, small fish observed. Temperature 21.32 °C. Conductivity 977 µmhos/cm. pH- 8.32	Moderate flow, very turbid.	Dry

August Figures
August 2, 2006
River Flow 5,170 cfs



Photo 11. The main backwater channel near Configuration 3, note the desiccation cracks. Compare with Photos 4 and 7. View is to the north.



Photo 12. Backwater channel near Configuration 2 is dry, with the exception of isolated pocket at Surface Water Location 0236. View is to the south.



Photo 13. Surface Water Location 0236 on August 2, 2006. The conductivity of this location was abnormally high on this day (3,820 $\mu\text{mhos/cm}$).

August 8, 2006
River Flow 5,460 cfs



Photo 14. Main backwater channel near Configuration 3. Colorado River is in background. View is to the north.



Photo 15. With slight increase in river flow, water returns to main backwater channel near Configuration 2. View is to the south.



Photo 16. Confluence near Configurations 1 and 2. View is to the southeast.

August 17, 2006
River Flow 4,370 cfs



Photo 17. At this river flow, the main backwater channel is cut off from the river near Configuration 3. Compare with Photo 14. View is to the north.



Photo 18. Isolated pockets of water near Configuration 2. View is to the north.



Photo 19. Surface Water Location 0236.



Photo 20. Backwater channels confluence near Configurations 1 and 2. Configuration 2 is almost shut off from channel flowing near Configuration 1 and farther south. View is to the south.

September 2006

Date	River flow (cfs)	Configuration 3 (CF3)	Configuration 2 (CF2)	Configuration 1 (CF1)	Baseline
09/05/2006	4,050	Dry, desiccation cracks and abundant salt precipitate on ground surface.	Location 0236 contains 0.5 inch of water, no fish observed.	Approximately 4 inches deep, low turbidity, slow flow. Temperature 20.17 °C. Conductivity 1,190 µmhos/cm. pH 8.66.	Dry
09/07/2006	3,860	Dry, salt present on ground surface. Photo 21	Dry; 0.5 inch of water at Location 0236. Photos 22 and 23	4–6 inches deep, low turbidity, slow to moderate flow. Temperature 22.16 °C. Conductivity 1,185 µmhos/cm. pH 8.75. Photo 23	Dry
09/19/2006	5,160	Main backwater channel is present flowing through to CF1, 5 inches deep, 6 ft wide, slow flow, extremely turbid. Temperature 19.14 °C. Conductivity 1,112 µmhos/cm. pH 8.43.	Main backwater channel is 3 inches deep and very narrow (~1 ft wide), slow flow, extremely turbid. Temperature 21.04 °C. Conductivity 1,200 µmhos/cm. pH 8.47.	Moderate flow, turbid, 6 inches deep. Temperature 20.00 °C. Conductivity 1,005 µmhos/cm. pH 8.50.	Dry
09/26/2006	4,980	Filmy surface on water, stagnant from debris blockage. Temperature 16.27 °C. Conductivity 1,035 µmhos/cm. pH 8.27. Photos 27 and 28	Location 0236 is stagnant and barely connected to the main backwater channel, school of fish observed. Temperature 20.03 °C. Conductivity 1,100 µmhos/cm. pH 7.78. Photos 28, 29, 30	Moderate flow, 6–8 inches deep, extremely turbid. Temperature 15.21 °C. Conductivity 1,114 µmhos/cm. pH 7.93. Photo 30	Dry
09/28/2006	4,610	Separate from CF2, 1 inch of water present.	Many fish observed at Location 0236. Temperature 22.11 °C. Conductivity 1,125 µmhos/cm. pH 8.27.	4–6 inches deep, moderate flow and turbidity. Temperature 17.28 °C. Conductivity 1,095 µmhos/cm. pH 8.29.	Dry

September Figures

September 7, 2006
River Flow 3,860 cfs



Photo 21. The area between Configurations 2 and 3 contained very few isolated pockets of water. View is to the north.



Photo 22. Surface Water Location 0236 is nearly dry at this low river flow.



Photo 23. Channel near Configuration 2 is dry when the river is at this low stage. Compare with Photo 16 and note vegetation growth. View is to the south.

September 12–13, 2006
River Flow 4,860–4,660 cfs



Photo 24. The backwater area near Configuration 3 is connected to the main river channel upstream.



Photo 25. The main backwater channel flows through the Configuration 2 area.



Photo 26. Surface Water Location 0236.

September 26, 2006
River Flow 4,980 cfs



Photo 27. The backwater channel near Configuration 3 is connected to the river. View is to the north.



Photo 28. Abundant wood debris present between Configurations 2 and 3 following rain events earlier in the month.



Photo 29. The backwater channel near Configuration 2. View is to the south.



Photo 30. Channel confluence near Configurations 1 and 2. View is to the south.

End of current text