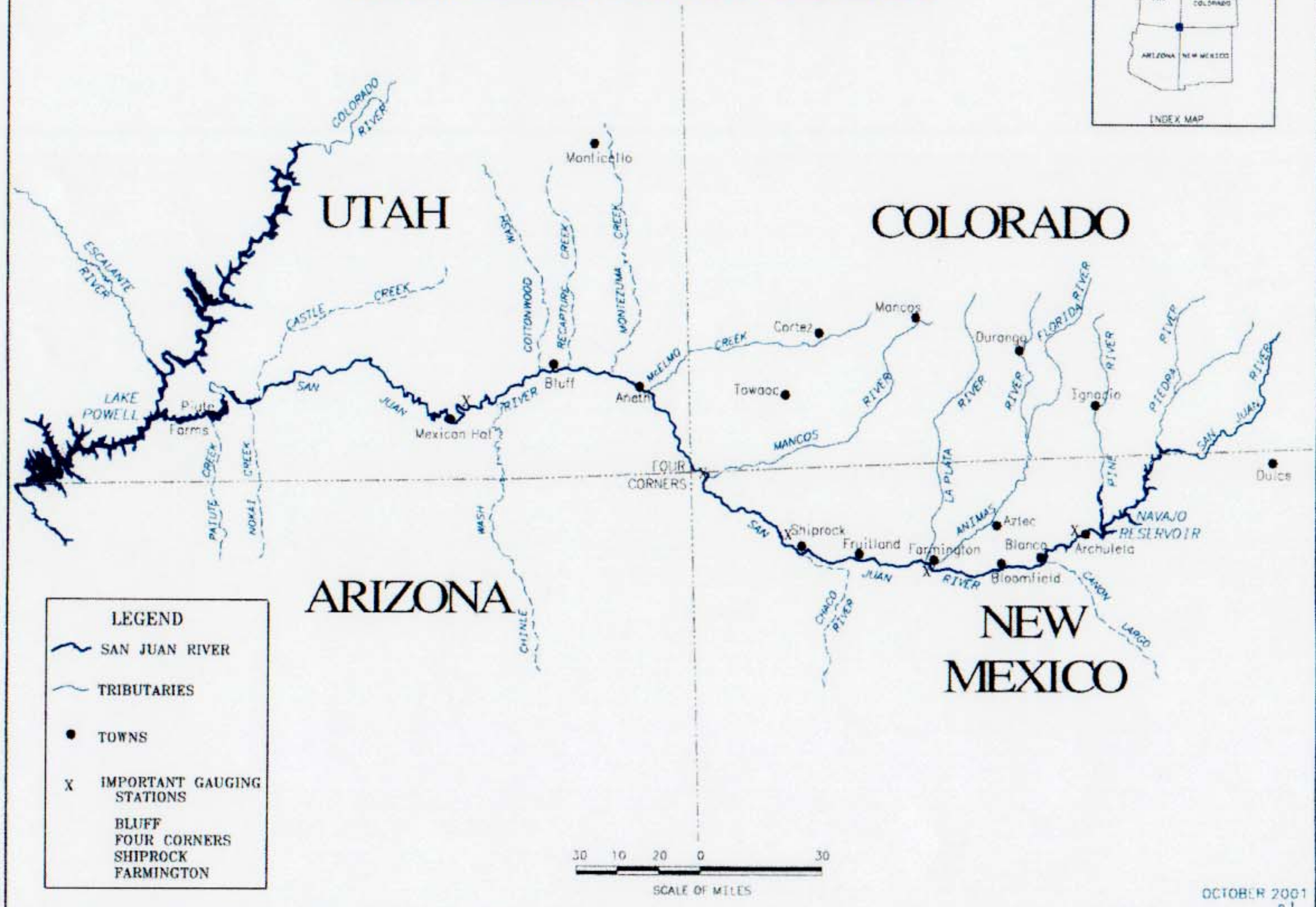
Summer Low Flow Test Report

San Juan River
New Mexico and Utah

U.S. Department of the Interior
Bureau of Reclamation
Upper Colorado Region
Western Colorado Area Office
Grand Junction — Durango

April 2002

SAN JUAN RIVER BASIN



Initial Summary of Findings

Following the July 9–15, 2001, Summer Low Flow Test (Test) on the San Juan River, the Bureau of Reclamation (Reclamation) found that, over the period of the Test, few major negative impacts occurred to the fishery, recreation, diversion structures, or other resources that Reclamation monitored. However, for a number of reasons, these findings may not hold entirely true over the long term for some resources. Accordingly, a full analysis of impacts will be presented in the Navajo Reservoir Operations Environmental Impact Statement (EIS), which will use the Test results as well as other data.

This report presents major findings for the various resources studied and was prepared as a response to public concerns about the effects of low releases (250 cubic feet per second [cfs]) from Navajo Dam, as outlined in the *Flow Recommendations for the San Juan River* (Holden, 1999)[1] (Flow Recommendations).

[1] Under the direction of the San Juan River Basin Recovery Implementation Program's Biology Committee, test releases from Navajo Dam were conducted and evaluated from 1992–98. At the completion of the research period, the committee completed a report, *Flow Recommendations for the San Juan River* (Holden, 1999), which provides recommended flows for the endangered fish in the San Juan River below Farmington and for water development. The recommendations define the conditions for mimicking a natural hydrograph in terms of magnitude, duration, and frequency of flows in the river below Farmington. It is these recommendations that Reclamation is proposing to meet by modifying the operations of Navajo Dam.

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I. Why the Low Flow Test

Introduction

The Test was conducted by Reclamation from July 9–15, 2001. Impacts were studied primarily from Navajo Dam to Farmington, New Mexico, although some effects were assessed further downstream. Releases from Navajo Dam were lowered from approximately 500 cfs to approximately 250 cfs during this time.

The purpose of the Test was to assess the effect of low summer riverflows on various resources. The information obtained will be used to prepare an EIS in 2002 on operating Navajo Dam to meet Flow Recommendations for designated critical habitat of downstream endangered fish while maintaining authorized purposes of the Navajo Unit, which include allowing for current and future water development. The water development would include, but not be limited to, the Animas-La Plata Project near Durango, Colorado, and completion of the Navajo Indian Irrigation Project near Farmington, New Mexico.

Endangered fish (the Colorado pikeminnow and razorback sucker) and their critical habitat are protected under the 1973 Endangered Species Act (ESA), while Navajo Unit authorized purposes are mandated by the 1956 Colorado River Storage Project (CRSP) Act.

Proposed Navajo Dam operational changes represent a degree of departure from past practices which, after the Navajo Unit's completion in 1963, stressed maintaining stable flows and maximizing reservoir storage. For example, operational changes could involve dam releases of 5,000 cfs for peak spring flows followed by lower releases ranging from 250 to more than 500 cfs during the remainder of the year.

Purpose

This Test, along with the results of the l996–97 Winter Low Flow Test (Reclamation, 1998), provides data to be considered when preparing an EIS. Public and agency concerns arose when it became widely known that low flows of 250 cfs could occur in the summer as well as during the winter—in fact, at any time other than the spring peak flow period in May and June.

Generally, as described in the Flow Recommendations, releases from Navajo Dam to the San Juan River comprise a spring peak maximum release of 5,000 cfs and lower releases targeted to maintain year-round flows of 500-1,000 cfs in the critical habitat (downstream of Farmington, New Mexico, to Lake Powell). Releases from the dam could be decreased to as low as 250 cfs when tributary inflows cause the critical habitat reach of the river to approach the upper end of the 500 to 1,000 cfs flow[2]. Also, these reduced releases are necessary to store water in Navajo Reservoir to enable spring peak releases to be made the following year and to store water for development.

[2] The EIS will discuss possible flexibility that may allow higher summer flows.

Public concerns with a 250 cfs release included water quality issues; possible trout stranding; loss of trout habitat; curtailed rafting; flows too low to permit agricultural, municipal, and industrial water diversions; loss of revenue by area businesses; and power generation problems. The Test, held to evaluate these concerns, was preceded by public meetings and the preparation of an Environmental Assessment/Finding of No Significant Impact to analyze impacts of the Test itself.

The Report

This report is not a National Environmental Policy Act (NEPA) document nor is it a technical document—it has not been prepared at an EIS level of detail, nor does it represent compliance with the array of laws and mandates an EIS must satisfy. It is, however, a summary of preliminary data that will help Reclamation and the public understand what low flows in the San Juan River can mean to various resources associated with the river and its uses. The technical data gathered as a result of this Test are included as attachments.

II. How Reclamation Conducted the Test

Methods

Using input from the public, earlier studies, and agency expertise, emphasis for the Test was placed on certain resources: hydrology, water quality, diversion structures and water rights, trout and aquatic habitat, recreation and economics, and hydropower.

The 7-day Test period allowed for physical changes to be observed and extrapolated to approximate long-term conditions. A shorter length of time would not have permitted the river to reach equilibrium after flow changes occurred to conduct testing, and a somewhat lengthier period could have resulted in significant impacts to affected resources.

Termination guidelines were in place during the Test if significant impacts were observed or if public health or safety were compromised.

Potential limitations of the Test included its duration, the unpredictability of river bank storage, sporadic localized rainfall that augmented riverflows, mechanical equipment limitations preventing the release of exactly 250 cfs, and lower rates of water diversion than anticipated. These issues will be addressed in the subsequent EIS.

Monitoring

Monitoring activities conducted during the Test included the following.

- ☆ Aerial photos from the dam to the Animas River confluence
- ☆ Water temperatures (pre-Test, during, and post-Test) and other water quality parameters at several locations from the dam downstream to the Animas River confluence
- ☆ New Mexico Department of Game and Fish (NMDGF) and Fish and Wildlife Service (Service) documentation of trout and trout fishing
- ☆ Visual assessment of flow, habitat conditions, and impacts to water diversion structures and recreation at several locations between the dam and Shiprock, New Mexico
- ☆ Flow data from existing gauge stations and other locations along the river and canal systems
- ☆ Stage (elevation) readings at several locations along the river
- ☆ Observations of resource specialists in the field during the Test

III. Public Input

Public involvement was important to Reclamation in determining which resources were of particular concern in the Test area. Reclamation involved various publics in planning and conducting the Test. Cooperators included Federal, State, and local governmental agencies, American Indian (Indian) Tribes and Nations, nonprofit organizations, area businesses, water users, and recreationists. Reclamation representatives attended meetings of various organizations and held two public meetings on the Test on April 4, 2001, in Farmington, New Mexico, and April 5, in Bluff, Utah. In total, about 65 people attended. Thirty-five written comments also were submitted to Reclamation.

Concerns cited and addressed during the Test included:

- ☆ Water quality degradation
- ☆ Difficulty diverting water

Anglers below Navajo Dam during the Test.

- ☆ Harm to the trout fishery below Navajo Dam

- ☆ River rafting problems from lower flows near Bluff, Utah

- ☆ Loss of revenue by area businesses

- ☆ Power generation problems

The San Juan River below Navajo Dam during the Test.

IV. What Reclamation Learned

Introduction

The following discussion represents an initial summary of findings. These findings may be modified upon further analysis in the EIS.

HYDROLOGY

Outcome

In spite of the rainfall events, the Test indicated that dam releases of 250 cfs will provide sufficient water in the river to meet water rights between the dam and the confluence with the Animas River. Though three diversion structures encountered problems diverting water during the Test, these problems resulted from inadequate diversion facilities, not insufficient water supply. (See the "Diversion Structures and Water Rights" section for more details.)

Table 1 summarizes San Juan River flows measured during the Test between the dam and Farmington. The maximum riverflow was 272 cfs measured at Archuleta (approximately 7 miles downstream from the dam). The minimum flow was about 60 cfs measured below the Hammond Diversion Dam. Since the remainder of the river gains water from irrigation return flow and canal wastewater, the riverflow above the Animas River confluence increased to 218 cfs, with significant contribution from thunderstorm runoff.

Table 1.—Flow measurements during test

Location	River mile	Average flows (cfs)
San Juan River at Archuleta	218.50	[1]272.00
San Juan River at Soaring Eagle Lodge	216.40	132.70
San Juan River above Turley Inlet Channel	214.40	131.40
San Juan River below Hammond Diversion	209.10	63.00
San Juan River below Blanco Bridge	207.00	87.70
San Juan River above Bloomfield Bridge	195.80	130.00
San Juan River below Bloomfield Sewer Effluent	194.80	131.10
San Juan River below Lee Acres Bridge	188.50	185.70
San Juan River 1/4 mile above Animas River confluence	181.40	218.70

[1] Due to mechanical limitation, releases from the dam did not provide an exact 250 cfs release.

Method

During the Test, the river, canal diversions, and canal flows at various points and wasteways were measured. When necessary, flow data were collected through interviews with water users. Attachment A provides a detailed description of flow measurements, analysis, and results.

Outcome

Test results found that most water quality parameters did not exceed State standards. For example, no exceedences were noted for irrigation, livestock, and wildlife habitat standards, and no parameters exceeded short-term fishery standards. Municipal and industrial water supply and secondary contact uses do not have any associated standards.

However, several parameters exceeded the chronic fishery and river segment standards. For example, the high-quality coldwater fishery standard from Navajo Dam to the Highway 64 bridge at Blanco, New Mexico, was exceeded for total organic carbon and conductivity. In addition, fecal coliform samples exceeded the standard at the sites above the Highway 44 bridge in Bloomfield and at the Geological Survey (GS) gauge in Farmington below the confluence of the San Juan and Animas Rivers.

In general, Reclamation projects that during long-term flows of 250 cfs in the irrigation season some exceedence of State standards for the San Juan River between Navajo Dam and the Animas River confluence could occur.

The NMDGF is continuing analysis of the water quality from samples it collected during the Test, and Reclamation will include that information, as appropriate, in the EIS. In addition, the New Mexico Environmental Department/ Surface Water Quality Bureau is beginning studies in the San Juan River Basin to address water quality concerns.

Attachment B lists the sampling site locations and provides a detailed description of observations and results.

Method

Samples were taken and analyzed using New Mexico State standards for uses including irrigation, livestock, and wildlife habitat, and warmwater, marginal coldwater, and high-quality coldwater fisheries. Water quality sampling was conducted using standard GS and Environmental Protection Agency methodologies.

DIVERSION STRUCTURES AND WATER RIGHTS

Outcome

At 250 cfs, existing water uses would be satisfied; however, the Test indicated that at low flows inadequate diversion structures could, in a few instances, make it difficult to take water from the river. Impacts to San Juan River flows could have been more severe than those measured; for example, diversions may have been affected by sporadic localized rainfall. In addition, some area farmers were not irrigating because they were preparing to harvest their alfalfa.

The lowest flow measurement in the San Juan River was 63 cfs measured below the Hammond Diversion. The Citizens Ditch diverted about 140 cfs, slightly less than their water right of 160 cfs, but up to 100 cfs less than previously measured diversions and considerably less than had been anticipated.

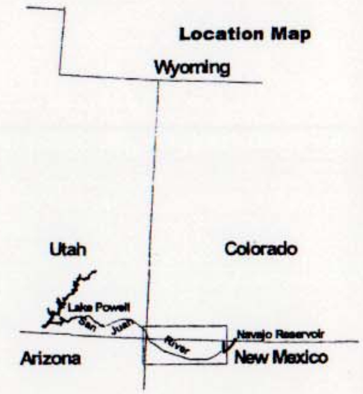
Three of the diversions were noticeably (defined as requiring river channel or diversion alterations) impacted during the Test. Some of the diversion structures were designed for flows greater than 250 cfs and experienced difficulty diverting the lower flow. The channel to the Giant Refinery was able to convey only a minimal amount of water and did not meet refinery requirements for water diversion. (The refinery is on the southern edge of Bloomfield across the San Juan River.) The Turley-Manzanares Ditch was able to divert only a portion of normal usage and required some intake channel modification during the Test. A well at the New Mexico State Parks Cottonwood Campground experienced reduced water production. The remaining 16 diversions between Navajo Dam and Farmington experienced few if any problems during the Test.

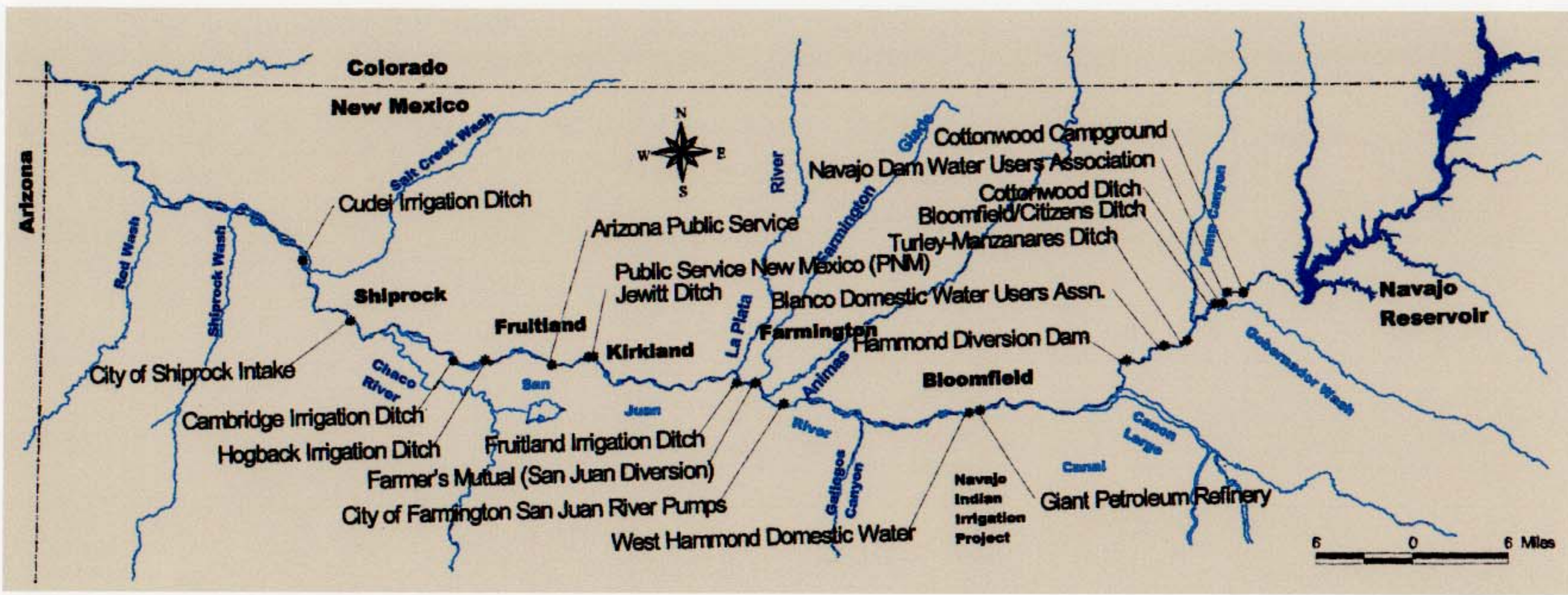
Releases of 250 cfs for long-term periods of time could result in adverse impacts due to some diverters' inability to divert their water right during part of the year, depending on riverflows and weather conditions.

Method

Flows were measured and water diversions monitored along the river during the Test. Towns, utilities, and irrigation companies were contacted in person or by telephone for additional flow data and water diversion impact information. The primary water diversion locations are noted on figure 1.

PRIMARY WATER DIVERSIONS DOWNSTREAM FROM NAVAJO RESERVOIR





Outcome

The Test had minimal short-term effects on the aquatic ecosystem of the San Juan River. Decreases in river stage, wetted perimeter,[3] and average habitat depth did not result in direct mortality of fish. However, habitat of fish was clearly reduced, in all likelihood forcing fish to use the deeper runs and pools for resting and escape cover; this could result in crowding and possible stress of fish over an extended period of time. Reductions in wetted perimeter would decrease aquatic insect and other fish food production, but an adequate food supply would remain because of existing insect density and the moderate degree of reduction in wetted area.

Over a longer period, the reduction of habitat and an associated decrease in water quality could have adverse effects on the trout fishery. According to the New Mexico State Engineer's Office, the Bloomfield Irrigation District is entitled to divert into the Citizens Ditch approximately 160 cfs; if this occurred, impacts would increase downstream. During the Test, habitat was clearly reduced in this area, possibly resulting in overcrowding in addition to causing stress to the fish over an extended period. Reduction in depth of riffles could limit available secure feeding areas for such drift feeders as trout and such bottom scrapers as native suckers.

In general, prolonged low flows or frequent low-flow periods could reduce fish populations as a result of

[3] Length of wetted channel is the horizontal distance of the river between two points perpendicular to flow.

diminished habitat area, reduced habitat depth, higher water temperatures, and water quality changes.

Method

Visual observations were made by fishery biologists using rafts on approximately 35 miles of the San Juan River from Navajo Dam to Salmon Ruin downstream of Bloomfield. Measurements were taken at 71 sample sites of changes in river stage, wetted perimeter, and average depth for pools, riffles, and runs. Measurements were also taken at 77 sites for water quality parameters, including water temperature, dissolved oxygen, conductivity, and salinity.

Attachment C describes in greater detail the effects of the Test on fish populations and the aquatic habitat of the San Juan River below Navajo Dam.

Before the Test, fish shocking was conducted and about 1,200 trout were captured below Citizens Ditch, moved upstream, and maintained for replacement purposes in the event the Test resulted in significant losses downstream. After the Test, NMDGF restocked the river below Citizens Ditch with trout.

RECREATION AND ECONOMICS

Outcome

Reservoir – Negative impacts to reservoir recreation were not observed during the Test. Colorado and New Mexico State Parks do not anticipate long-term adverse impacts.

Fishing – Wade fishing increased during the Test. Some outfitters shifted to wade fishing from dory boat use because they would have had to pull their boats over exposed rocks, gravel, and sand bars at some points because of the low flow levels. Lower water levels kept most dories confined to the Texas Hole about 1.5 miles below Navajo Dam. Fishing was good, as measured by catch rates, although some anglers were concerned about the loss of fish habitat and food, higher water temperatures, and crowding on the river.

Some of the outfitters had cancelled or had not booked trips during the week of the Test because they were concerned about the impacts fishing pressure would add to low-flow impacts on the trout fishery. Therefore, business owners reported fewer rooms reserved and less restaurant traffic.

Table 2 provides a comparison between the angler hours and catch rates during the Test and at other times when releases were higher than 250 cfs. According to the information gathered, the short-term effects would probably not be as detrimental as anticipated during public meetings.

However, long-term projected impacts may include a reduction in licensed outfitters, a shift from dory boat fishing to rubber raft use, and an increase in wade fishing. A decline in current recreation use can be expected with a decline in trout populations.

Rafting – Some private rafters canceled trips on the lower San Juan River in anticipation of the Test; however, commercial rafting trips continued because outfitters told their clients that flows would be adequate. Even though Navajo Dam releases were low, flows below the confluence of the Animas River were adequate for rafting. Flows during the Test did not drop below approximately 800 cfs

Table 2.—Creel census and pressure counts for July 1998–2001 and the 2001 Summer Low Flow Test

	Quality waters		Regular waters		Total	
Date	Angler hours	Catch rate	Angler hours	Catch rate	Angler hours	Catch rate
July 2001	[1]26,164	1.72	3,450	0 .49	29,614	1.11
July 9–15 (Low Flow Test)	4,706	2.16	1,155	0.49	5,861	1.33
July 1–8, 16–31	19,699	1.45	5,166	0.49	24,865	0.97
July 2000	21,949	1.07	7,748	1.6	29,697	1.34
July 1999	21,043	1.24	9,118	0.39	30,161	0.82
July 1998	27,674	1.23	7,459	0.39	35,133	0.81

Provided by Marc Wethington, NMDGF, and Rick Vinton, Reclamation.

Notes: (1) Angler hours for the month of July 2001 are not additive as the result of deriving full-month data based on a formula with actual counts made during the Test. (2) The low flow data were gathered daily during the Test; the previous year's data for the same week were only gathered two times during the week and the weekend, so data comparisons would not be based on the same number of sampling days. (3) Comparison can only be made on the total monthly data and the catch rates. (4) There is no real explanation why July 1998 and July 2001 angler hours are higher than July 1999 and 2000. (5) The high catch rate for the regular waters in July 2000 is due to public knowledge of the stocking date and place and the resulting catch rate (being at the right place at the right time).

at the Bluff gauge, and, in fact, increased during the Test because of thunderstorms upstream and flows from tributary washes between Bluff and Farmington.

Optimum flows for rafting range between 1,000 to 3,000 cfs, and rafters rarely put in below 500 cfs because of safety concerns. Between 500 to 1,000 cfs they generally use smaller boats, which can reduce the efficiency and increase the cost for commercial operators.

Additional review of existing hydrologic data will be used to analyze long-term impacts in the EIS.

Method

Data were collected by interviewing anglers, fishing and rafting outfitters, area business owners, rafters, State and Federal employees, and others. Area business owners and others interviewed were asked to complete questionnaires, few of which were returned.

HYDROPOWER

Outcome

The hydropower generating unit is owned and operated by the City of Farmington. The unit has averaged 15.4 megawatts (MW) daily power generation capacity since it was installed in 1989. It was initially designed to provide optimum power generation at release flows of 1,000-2,000 cfs.

The generating unit at Navajo Dam experiences cavitation at flows below 350 cfs. Cavitation-caused damage noted after

San Juan River approximately 6 miles below Navajo Dam at approximately 500 cfs.

San Juan River at same location at approximately 250 cfs.

the Test was slight “frosting” (erosion) on the leading edge of the turbine blades. No other damage was observed, but it is anticipated further damage would be associated with long-term flows of less than 350 cfs.

During the Test, the minimal variation (low flow) in power production seemed to have a significant effect on noise (caused by cavitation) from the unit. The noise from the turbine runner sounded like gravel passing through the unit, and there appears to be a direct correlation with the wicket gate adjustment on the unit and the noted noise. As the wicket gates are closed to reduce the passing flows to the generating unit, the noise in the generating unit appears to increase.

Attachment D contains the City of Farmington’s impact analysis of the Test. Their assumption is that although no significant damage was detected during the Test, damage is likely to occur at 250 cfs over a longer period of operation. The seriousness of this expected damage is yet to be determined and will require a longer period of low flow to assess.

Method

Before the Test, the unit was opened, inspected, and photographed in detail by the City of Farmington to note existing conditions. The unit was also inspected immediately after the Test to document any damage. During the Test, the generating unit output averaged 6 MW, ranging from 5.7 to 6.4 MW per day. Calculations based on the unit's performance curves indicated the load should be 5.8 MW per day.

OTHER RESOURCES/AREAS OF INTEREST

Prior to the Test, Reclamation determined that the Test would have no potential to impact cultural resources. In addition, observations made during the Test revealed that the Test had no impact on the following resources/areas of interest: special status species, vegetation, wildlife, air quality, noise, soils, limnology, lands, dam operation and maintenance, safety of dams, hazardous materials, or flood control.

Some resources, such as Indian Trust Assets (ITA), could experience long-term effects outside the scope of the Test and were not included in this report; however, these areas will be addressed in the EIS.

Diversion modification on the San Juan River below Navajo Dam.

V. What the Results Mean

Short-term negative results measured during the Test were relatively few (below). Concern, if any, centers on the potential effects of prolonged low flows on key resources. Most importantly, the possible long-term effects projected from limited Test data, combined with other information, will be reflected in the EIS. An informal summary of Test findings and long-term projections for affected resources is as follows:

SUMMARY OF TEST FINDINGS

Test findings	Long-term projections
Hydrology: Sufficient water is available for projected diversions	Sufficient flows are available; however, some diversion structure modifications may be needed
Water quality: Some exceedences of State standards	Some exceedences of State standards
Diversions: Of the 19 diversions monitored, 3 were impacted noticeably, and the remaining experienced few problems	Impacts would occur depending on riverflows and weather conditions
Water rights: No effect	No effect
Trout/aquatic habitat: Essentially no negative effect on trout; some on habitat	Physical habitat reduction would reduce trout populations
Recreation and economics: Decrease in outfitted fishing and private rafting and some decrease in related businesses	Fishing and rafting: Possible business and overall recreation reduction

Test findings	Long-term projections
Hydropower: Slight damage to turbine blades; noise increase at generating unit	Further damage and increase in noise levels would be expected at flows below 350 cfs; lost power revenues.
Other Resources/Areas of Interest (special status species, vegetation, wildlife, air quality, soils, limnology, land, dam operation and maintenance, safety of dams, hazardous materials, and cultural resources): No effect	Generally, no significant adverse effects, although long-term effects on riparian vegetation may occur and will be addressed in the EIS
Indian Trust Assets: Outside the scope of the Test	Will be addressed in the EIS

VI. The Next Step

As noted, Reclamation will use Test information, along with other data, to prepare an analysis in the EIS of the impacts of changes in Navajo Dam releases. The Test and EIS may also provide area recreationists, outfitters, water diverters, business owners, and others with information for future planning.

TIME LINE FOR THE NAVAJO RESERVOIR OPERATIONS EIS

October 1999	Notice of Intent
November 1999	Public scoping meetings
November 1999 – January 2002	Data collection and analysis; EIS preparation
Summer 2002	Release draft EIS
Summer 2002	60-day public comment period begins on the day the draft EIS is released to the public
Summer 2002	Public hearings
Winter 2002	Release final EIS
Winter 2002 – 03	Record of Decision

VII. Attachments

(Support and Technical Data)

Attachment A:	Hydrology
Attachment B:	Water Quality Observations and Sample Results
Attachment C:	Assessment of Aquatic Habitat of the San Juan River
Attachment D:	City of Farmington Hydropower Analysis Memorandum
Attachment E:	Diversion Structure Observations

Attachment A

Hydrology

Attachment A

Hydrology

This analysis was done to evaluate proposed flow recommendations (*Flow Recommendations for the San Juan River* [Flow Recommendations]) (Holden, 1999) of the San Juan River Basin Recovery Implementation Program (SJRBRIP). Operating criteria for Navajo Dam were developed to demonstrate how the dam might be operated to meet the Flow Recommendations. These suggested criteria determine the timing and size of release flows to maximize the ability of the river to meet the Flow Recommendations. These proposed criteria could reduce releases from Navajo Reservoir to 250 cubic feet per second (cfs) for a portion of time during the non-spring runoff period when fish releases or flood control releases are not being made. This analysis addresses hydrologic impacts that may affect water diverters in the San Juan River from Navajo Dam to the Animas River confluence under these low-flow conditions. Impacts to the trout fishery and the riparian environment are addressed in other sections.

In a 6-day test, July 9, 2001 through July 15, 2001 (Summer Low Flow Test [Test]), average releases from Navajo Dam were reduced from a previous rate of approximately 500 cfs to a target minimum of approximately 250 cfs. All releases during the test were made through the Navajo Hydroelectric Plant via the Navajo Dam main outlet works penstock. Release criteria for the Test included flows as low as 250 cfs at Navajo Dam, provided that a minimum flow of 500 cfs was maintained in the San Juan River in the critical habitat area. During the Test, six Geological Survey (GS) river gauging stations were monitored to ensure the 500 cfs minimum flow was not violated. The minimum flow recorded in the recovery area was 609 cfs at Shiprock on July 15. Daily flow data from the six gauging stations are shown in table 1. Flow rates shown are mean daily values and are provisional data only. Figure 1 is a graph of the data in table 1.

To evaluate impacts between the San Juan River GS gauge at Archuleta and the Animas River confluence, flow measurements were collected over a three-day period, July 10-12. The San Juan River, canal diversions from the river, canal flow at various points along the canal, and canal wasteways were measured. When necessary, flow data were collected through interviews with water users. All flow measurements, reported flow, and observed or estimated flows are summarized in table 2. Data types are station number, station name, description, river mile, flow measurements, average of the measured flow, and field personnel (who performed measurements) and are arrayed by rivers, canals, personal contacts and observations, and Hammond Data Sheets. Maps1 and 2 show the location of measurement points and irrigated areas. Table 3 summarizes irrigated acres by canal subset by return flow points that coincide with river measurement locations.

Table 1.—GS provisional mean daily streamflow (cfs)						
Date	San Juan River at Archuleta	San Juan River at Farmington[1]	San Juan River at Shiprock	San Juan River at Four Corners	San Juan River near Bluff	Animas River at Farmington
01-Jul-01	571	1,450	1,140	1,270	1,250	995
02-Jul-01	565	1,440	1,050	1,160	1,190	979
03-Jul-01	562	1,440	1,050	1,120	1,090	974
04-Jul-01	559		1,019	1,130	1,070	940
05-Jul-01	553		959	1,070	1,060	868
06-Jul-01	536		872	977	994	837
07-Jul-01	533		851	916	890	821
08-Jul-01	531		857	916	832	778
09-Jul-01	386		817	892	827	750
10-Jul-01	267		844	913	796	723
11-Jul-01	279	1,010	751	894	869	715
12-Jul-01	270	835	663	842	1,000	661
13-Jul-01	265	793	624	856	836	643
14-Jul-01	262	730	654	1,190	884	631
15-Jul-01	368	750	609	1,620	1,390	647
16-Jul-01	526	1,030	637	1,040	1,380	655
17-Jul-01	507	992	748	1,130	914	564
18-Jul-01	505	832	636	1,100	858	480
19-Jul-01	504	694	533	857	854	405
20-Jul-01	504	620	464	690	720	362
21-Jul-01	504	602	505	622	622	351
22-Jul-01	502	576	487	660	550	351
23-Jul-01	571	512	440	599	581	313
24-Jul-01	620	590	379	485	543	275
25-Jul-01	620	610	408	455	487	271
26-Jul-01	761	648	426	511	437	277
27-Jul-01	854	967	484	475	453	275
28-Jul-01	844	980	595	683	461	283
29-Jul-01	843	898	590	756	528	238
30-Jul-01	846	820	558	691	633	193
31-Jul-01	867	764	566	676	602	191

[1] The Farmington gauge was not functioning from July 4 through July 10.

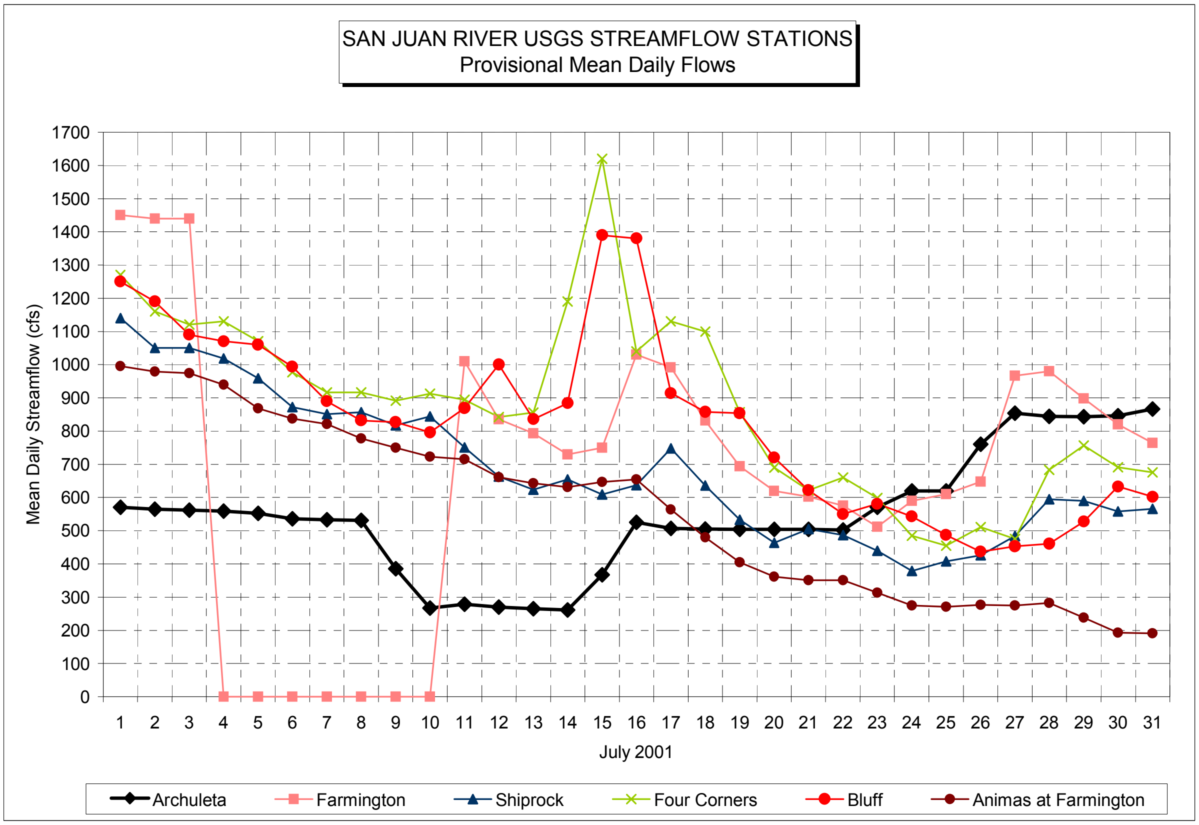


Figure 1.—San Juan River GS streamflow stations during the month of July 2001. Notes: The 2001 Summer Low Flow Test was conducted from July 9 through July 15. The Farmington station had 7 days of missing values, of which 2 days occurred during the Test. The missing values (from July 4 through July 10) are a result of the gauge not working.

Table 2.—Measured, observed, and reported flow data

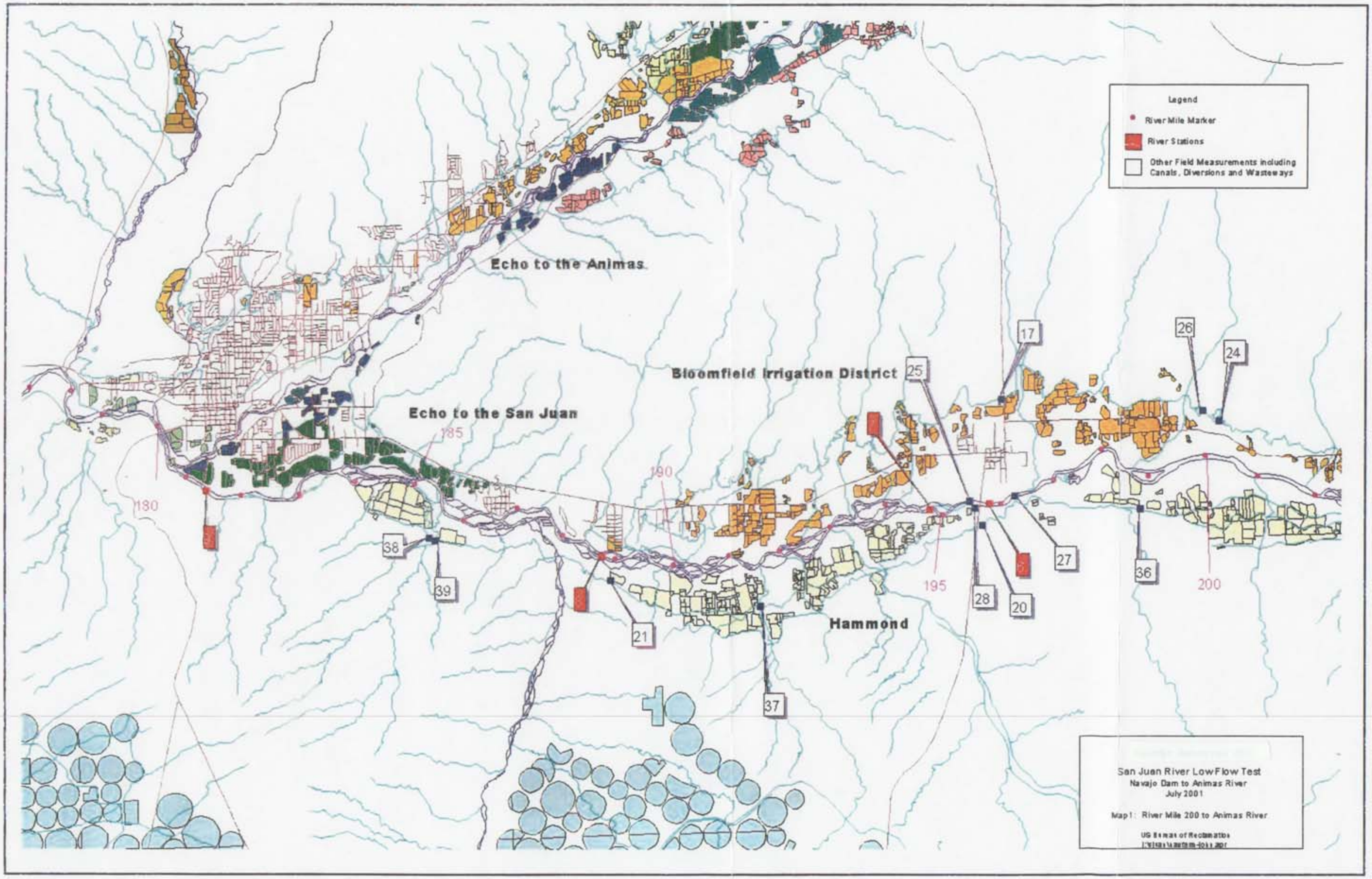
Station	Name	Description	River mile	Flow (cfs)				Who
				10-Jul	11-Jul	12-Jul	Average	
1	San Juan River at Archuleta	GS station-Mean Daily Provisional Values	218.50	267	279	270	272.0	
1	San Juan River at Archuleta	GS station	218.50	285.6	263.3		274.5	Jensen, Alcon
2	San Juan River	At Soaring Eagle Lodge	216.40		123.6	141.8	132.7	Jensen, Alcon
3	San Juan River	Above Turley Inlet Channel	214.40	131.4			131.4	Alcon
4	San Juan River below Hammond Diversion	About 200 yards below Diversion	209.10	65.5		60.5	63.0	Davis, Alcon
5	San Juan River	Below Blanco Bridge	207.00		87.7		87.7	Alcon
6	San Juan River above Bloomfield Bridge	About 1/2 mile above bridge	195.80			130.0	130.0	Alcon
7	San Juan River	Below Bloomfield Sewer effluent	194.80			131.1	131.1	Alcon
8	San Juan River below Lee Acre's Bridge	About 100 yards below bridge	188.50			185.7	185.7	Davis
9	San Juan River 1/4 mile above Animas River confluence	1/4 mile above Animas River confluence	181.40			218.7	218.7	Alcon
		Canals						
10	Citizens Ditch Intake Channel	At river	217.75	179.2		181.1	180.1	Jensen
11	Citizens Ditch Intake Channel	Just above headworks	217.25	143.0			143.0	Simons
12	Citizens Ditch Bypass to river	Confluence with river	217.20	1.1			1.1	Jensen
13	Citizens Ditch near La Pumpa - Rickety Bridge	Above all irrigated lands except about 45.6 acres (1993 GIS)	215.25	125.9			125.9	Davis
14	Pump Ditch below Citizens Ditch	Above all irrigated lands except about 45.6 acres (1993 GIS)	215.25	16.5			16.5	Davis
15	Citizens Ditch	Across from Hammond Diversion	209.10	98.1			98.1	Davis
16	Citizens Ditch at Blanco	Behind Blanco church	206.10		95.3		95.3	Davis
17	Citizens Ditch at Bloomfield	West of highway	195.80		44.5		44.5	Davis
18	Turley Ditch diversion	~1000 yards below river diversion, but above first irrigation delivery	213.60	2.8			2.8	Alcon
19	Hammond Canal diversion	At flume	209.25	82.0			82.0	Alcon
20	Hammond Canal	Near Bloomfield	195.80		33.4		33.4	Simons
21	Hammond	At Lee Acres	188.50		10.9		10.9	Simons

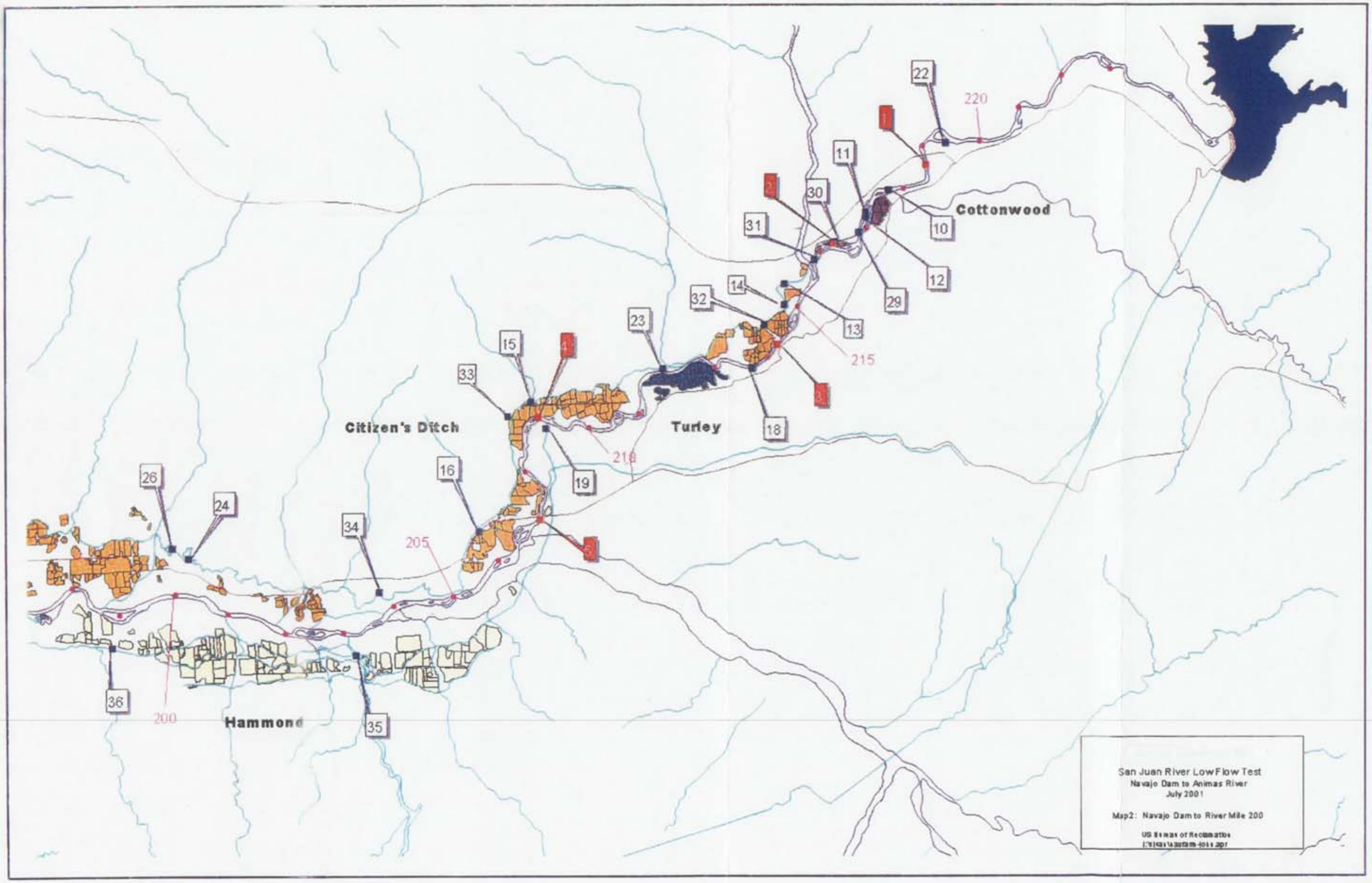
Table 2.—Measured, observed, and reported flow data (continued)

Station	Name	Description	River mile	Flow (cfs)				Who
				10-Jul	11-Jul	12-Jul	Average	
		Personal contacts and observations						
22	Navajo Dam Water Users Association intake	1/2 mile above San Juan River at Archuleta GS gauge	219.50	0.1	0.1	0.1	0.1	Tammy Bodle
23	Blanco Domestic Water Users Assoc. intake	From river above Hammond diversion dam	212.00	0.1	0.1	0.1	0.1	Dean Phillips
24	Bloomfield City Reservoir	Filled from Citizens Ditch at about RM 200	200.00	3.1	3.1	3.1	3.1	Bloomfield
25	Bloomfield Wastewater Treatment Plant discharge	River below Bloomfield bridge	195.40	2.5	2.3	1.9	2.2	Bloomfield
26	Conoco Reservoir	Filled from Citizens Ditch at about RM 200	200.00		9.2		9.2	Davis-Reclamation
27	Giant Refinery Diversion	From river upstream of Bloomfield Bridge	196.30	0.3	0.2	0.6	0.4	Chad King
28	West Hammond Domestic Water Association diversion	From river downstream of Bloomfield Bridge	195.50	0.0	0.0	0.0	0.0	Nick Ashcroft
29	Jaquez Wasteway #1 - Citizens Ditch	Side channel spillway with slide gate	216.80	4.5			4.5	Simons
30	Jaquez Wasteway #2 - Citizens Ditch	Side channel spillway with slide gate	216.30	5.4			5.4	Simons
31	Munoz Wasteway - Citizens Ditch	Side channel spillway with slide gate	215.80		3.5		3.5	Simons-Estimated
32	Wasteway across from Turley Diversion	Side channel spillway with slide gate	214.20	1.9			1.9	Davis-Reclamation
33	Above Blanco - Leaky Flume - Citizens Ditch	Side channel spillway with slide gate	208.70		2.0		2.0	Simons-Estimated
34	Chavez Wasteway	Slide gate - Enters a large wetlands area	203.90		2.3		2.3	Davis
		Hammond Data Sheets						
19	Hammond Canal Diversion	At flume	209.25	87.00	87.00	87.00	87.0	Teresa Lane
35	Armenta Waste	At Hammond canal crossing	203.00	15.05	15.20	16.10	15.4	Teresa Lane
36	Sullivan Spill	At Hammond canal crossing	199.00	12.41	13.41	14.54	13.5	Teresa Lane
37	Horn Canyon Waste	At Hammond canal crossing	191.50	9.88	9.90	10.45	10.1	Teresa Lane
38	Hammond Canal - Delivery to Tommy Bolack (1410+00)	Last user on the Canal	185.50	9.15	10.00	9.70	9.6	Teresa Lane
39	Store Canyon Waste (Stewart Canyon)	At Hammond canal crossing	185.50	7.30	7.60	7.60	7.5	Teresa Lane

Table 3.—Irrigated acres by ditch system subset by return flow location

Reach	Description	Irrigated area	Irrigated acres
1	Between Archuleta Gauge and Soaring Eagle Lodge	Cottonwood	19.8
2	Between Soaring Eagle Lodge and above Turley Diversion	Citizens Ditch	16.7
3	Between above Turley Diversion and below Hammond Diversion Dam	Turley Diversion	168.9
4	Between below Hammond Diversion Dam and above Bloomfield Bridge	Citizens Ditch subtotal	1,228.2
		Hammond Diversion to St. Rose	248.1
		St. Rose to Bloomfield	980.1
		Hammond Conservancy District	1,431.3
5	Between above Bloomfield Bridge and below Lee Acres Bridge	Citizens Ditch	833.9
		Hammond Conservancy District	1,237.5
6	Between below Lee Acres Bridge and Animas confluence	Hammond Conservancy District	573.4
		Echo Ditch (Diversion from Animas River)	449.1
		Total (without Cottonwood)	6,521.2


Legend
River Mile Marker
River Stations
Other Field Measurements including Canals, Diversions and Wasteways
Echo to the Animas
Echo to the San Juan
Bloomfield Irrigation District
Hammond
180
185
190
195
200
17
26
24
25
38
39
21
37
28
20
27
36
San Juan River Low Flow Test
Navajo Dam to Animas River
July 2001
Map 1: River Mile 200 to Animas River



22
220
11
30
31
10
Cottonwood
12
29
14
13
32
23
215
15
33
18
Turley
Citizen's Ditch
210
19
16
26
24
34
205
36
200
Hammond
35
San Juan River Low Flow Test
Navajo Dam to Animas River
July 2001
Map2: Navajo Dam to River Mile 200

The flow of the San Juan River between the GS gauge at Archuleta to the Animas River confluence was measured at nine locations. At seven of these locations, corresponding canal flows were also measured. Figure 4 shows the total measured flow at each of these reaches. A complication of the hydrology evaluation was the occurrence of thunderstorm events during the initial two days of the Test. Analysis of GS instantaneous flows at the upper and lower ends of the study reach illustrates this. Figure 2 shows the flows at the GS Archuleta gauge, which represents the upper reach. The chart compares the GS instantaneous 15-minute reported values versus the GS mean daily streamflow versus two field measurements taken by Reclamation during the Test period. The chart demonstrates that the flow remained relatively constant during the Test through this reach and that the two Reclamation measurements are representative of that flow. The flows in the lower reach are shown in figure 3, which compares the flow of the San Juan River above the Animas River confluence, calculated as the GS San Juan River at Farmington minus the GS Animas River at Farmington. The chart compares the GS instantaneous 15-minute reported values versus the GS mean daily streamflow versus one field measurement taken by Reclamation during the Test. The chart demonstrates that flows leaving the lower end of the study reach were not constant during the Test. Precipitation runoff was significant on July 10, with a calculated instantaneous flow of about 600 cfs and a mean daily flow of 295 cfs. The minimum instantaneous flow was about 75 cfs and the minimum mean daily flow was about 99 cfs. These variations in 15-minute and daily flows illustrate the problem of using instantaneous flow measurements to represent daily flow volumes.

Based on visual observations of the river, it appears that most of the runoff came from Canyon Largo. It is the largest drainage area in this section of the river and enters the river below the Hammond Diversion. Since all irrigation canal diversions are above Canyon Largo, it is unlikely that thunderstorm runoff would have had a significant influence on the divertible water supply. Therefore, in spite of the rainfall events, the Test was an accurate simulation and demonstrated that dam releases of 250 cfs would provide sufficient flows to meet water rights in the San Juan River between Navajo Dam and the confluence with the Animas River. Though shortages were encountered at three locations during the Test, these were the result of inadequate diversion facilities, not insufficient water supply. The lowest riverflow measured approached 60 cfs below the Hammond Diversion Dam. The remainder of the river is a gaining reach from irrigation return flow and canal waste. Riverflow above the Animas River confluence was measured at 218 cfs, probably containing a large portion of thunderstorm runoff.

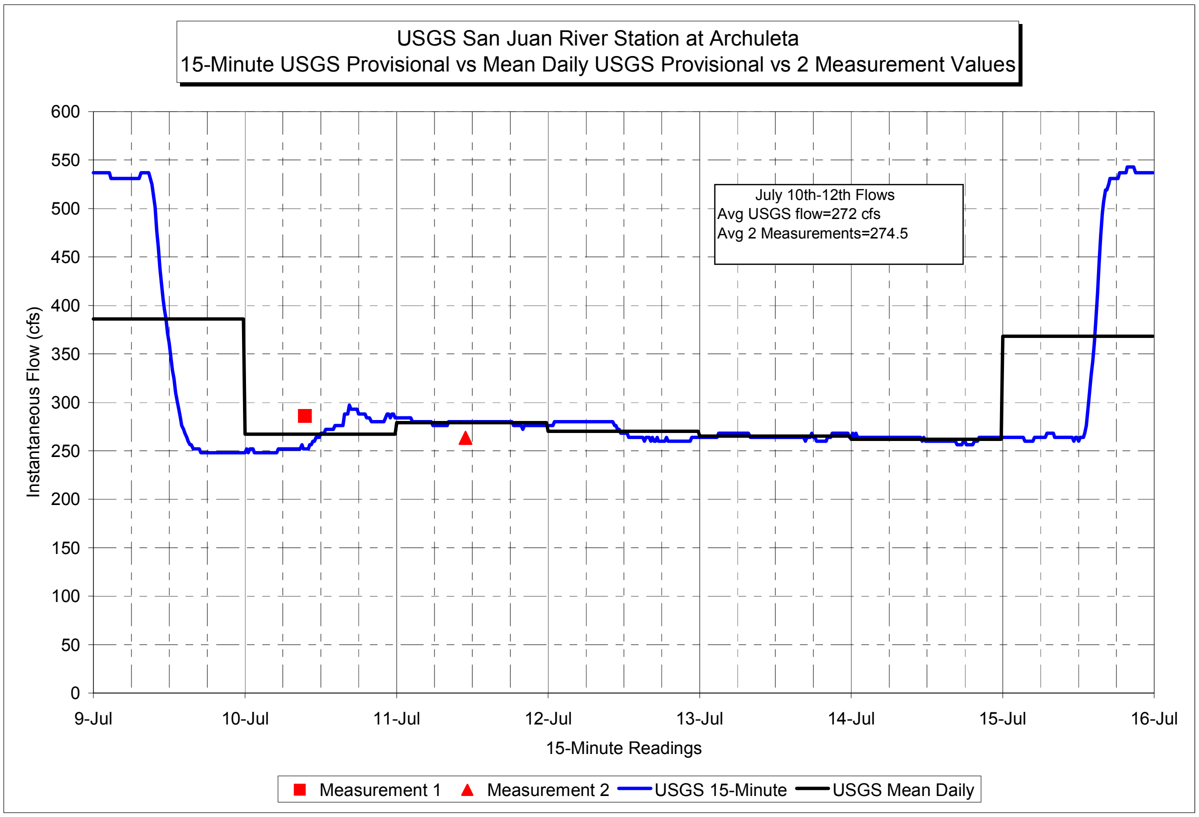


Figure 2.—This graph shows that a relatively constant flow occurs at the upper end of the river section at Archuleta and that the two Reclamation measurements capture that flow.

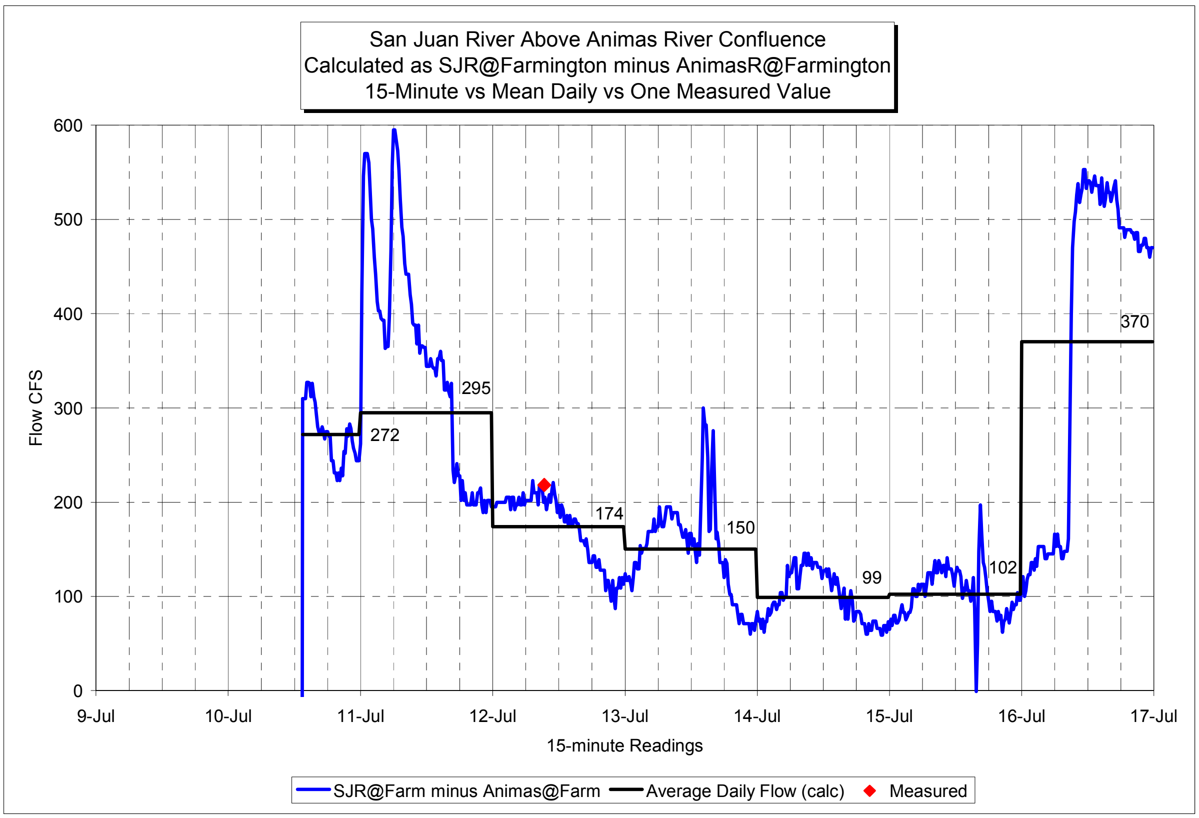


Figure 3.—This graph shows magnitude of runoff at the lower end of the river section near the Animas River confluence. Note: Farmington gauge was not in operation from July 9 through July 10.

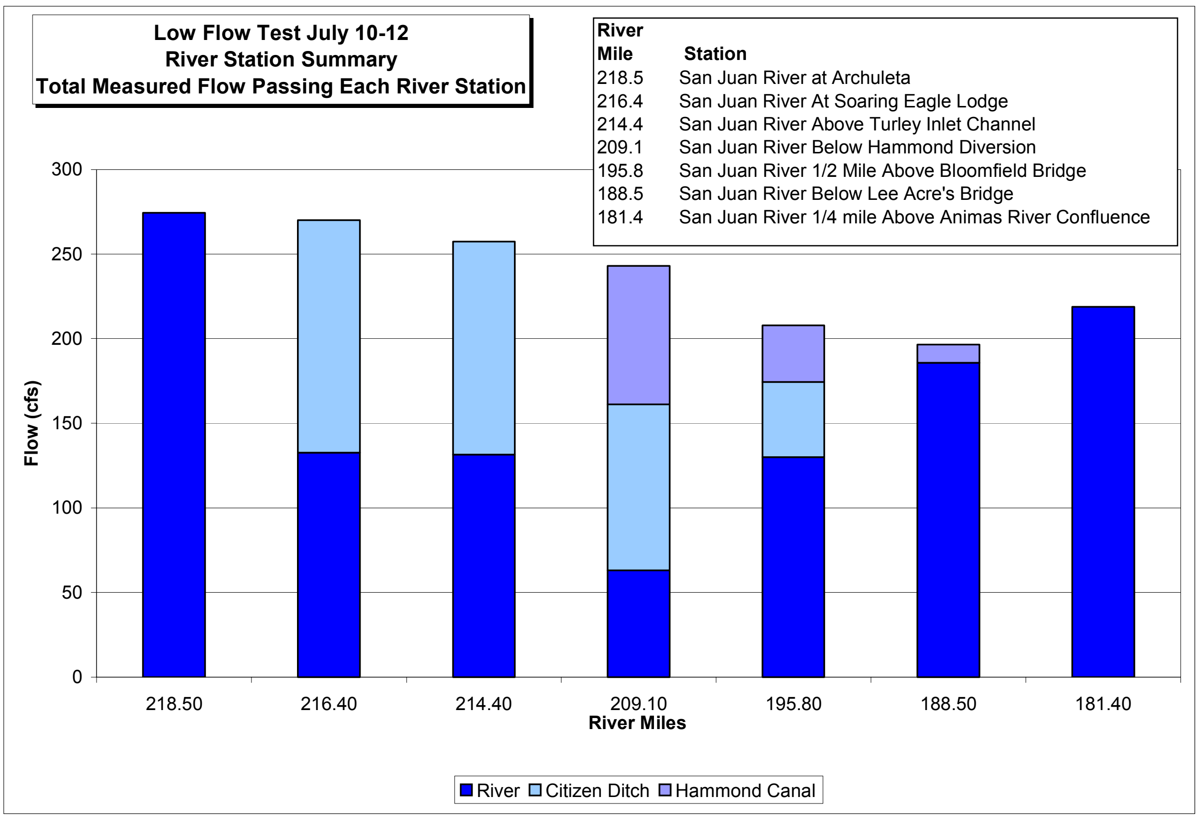


Figure 4.—Reclamation measurement of San Juan River flows at the seven mass-balance stations and the corresponding canal locations. Each bar represents the total measured flow passing each mass balance station.

Attachment B

Water Quality Observations and Sample Results

Attachment B

Water Quality Observations and Sample Results During the San Juan River Low Flow Test July 9 through 15, 2001

(Date of Report - November 23, 2001)

Background

Water quality sampling sites were selected based on previous test sample sites (Archuleta, Blanco, Bloomfield, and Farmington), discussions with New Mexico Environment Department (NMED) (added site below Bloomfield wastewater treatment plant), and field observations (added site below Citizens Ditch diversion) during the Summer Low Flow Test (Test). Because flows were within the historical range at the gauging stations, no sampling was done below the Animas River confluence (flows between Navajo Dam and the Animas River confluence were also within the historical range).

During discussions with the NMED, the Bureau of Reclamation (Reclamation) committed to take samples and analyze for all State standards for the given water use of the river segments. These water uses and associated standards include those from irrigation, livestock, wildlife habitat, and marginal and high-quality coldwater and warmwater fishery. Municipal and industrial water supply and secondary contact uses do not have any associated standards.

Constituents analyzed include: Major cations and anions, dissolved and total trace elements, some radiometrics, some organic compounds (DDT, PCB, Total Chlordane), fecal coliform, E. coli, and physical properties.

Sample Methods

For all samples except the coliform samples, water was collected using the standard GS method of obtaining a depth-integrated sample. A water sample was collected with a D-81 sampler at 30 to 50 locations on a cross-section across the river. The sample was deposited in a churn bucket and transported to the sample truck. Samples were filtered, preserved, bottled, and labeled in the sample truck. All samples were kept in an ice cooler with ice during transportation. Some samples were delivered to labs (radiometrics and coliform) on July 13, and others were held in a refrigerator until shipment on July 16. Coliform samples were collected by sweeping the bottle on the surface at the sample collection points and were delivered to the lab within the 6-hour holding time.

Water samples for major cations and anions and total and dissolved trace metals were sent to the Sangre De Cristo Laboratory, Inc., in Alamosa, Colorado. Samples were analyzed using current Environmental Protection Agency (EPA) methodology. The water samples for radiometrics and dissolved trace metals were sent to Acculabs, Inc in Durango, Colorado. Samples were analyzed using EPA and other methodologies. Water samples for organics, such as DDT and PCBs, were sent to the Reclamation's lab in Denver, Colorado, where they were sent to contract labs for analysis. The fecal coliform samples were delivered and analyzed by the Colorado Department of Public Health and Environment Laboratory, San Juan Basin Health Unit in Durango, Colorado.

Sample Site Locations

Samples for major cations and anions, dissolved and total trace elements, radiometrics, and organics were collected at: (1) Archuleta GS gauge, (2) Highway 64 bridge at Blanco, New Mexico, (3) above Highway 44 bridge at Bloomfield, New Mexico, (4) below Bloomfield wastewater treatment plant, and (5) above the Animas River confluence in Farmington, New Mexico. A partial sample for major cations and anions and dissolved and total trace elements was taken below Citizens Ditch diversion to see what, if any effects, this first major diversion had on the San Juan River water quality. Table B-1 has additional information on the sample sites.

Sample sites for total coliform, fecal coliform, and E. coli were taken at five locations along the San Juan River. The sample sites were at: (1) Archuleta GS gauge, (2) Highway 64 bridge at Blanco, New Mexico, (3) above Highway 44 bridge at Bloomfield, New Mexico, (4) County Road 5500 bridge at Lee Acres, New Mexico, and (5) below the Animas River confluence at the GS gauge in Farmington, New Mexico.

Sample Results

The coliform sample results are noted in table B-2. The results are comparable with previous data collected during low flow tests in that fecal coliform exceeds the standard of

Table B-1.—Water quality sample sites

Sample number	Date/time	Location	Latitude	Longitude	River mile
1	July 12, 2001 09:51	San Juan River upstream of Animas River confluence	36°42'30.6"	108°12'48.7"	181.4
2	July 12, 2001 14:00	San Juan River 0.6 mile downstream of Bloomfield Wastewater Treatment Plant	36°41'57.7"	108°00'05.5"	194.8
3	July 12, 2001 12:00	San Juan River 0.3 mile upstream of Bloomfield Wastewater Treatment Plant	36°41'58.9"	107°59'00.5"	195.4
4	July 11, 2001 09:00	San Juan River at Highway 64 bridge at Blanco	36°43'27.0"	107°48'48.7"	207.0
5	July 11, 2001 13:30	San Juan River at Soaring Eagle Lodge	36°46'57.8"	107°43'23.6"	216.4
6	July 11, 2001 11:00	San Juan River at GS gauge in Archuleta	36°48'07.6"	107°41'54.5"	218.5

400 colonies/100 mL (single sample) in river segment 20.6.4.401[1] at Farmington GS gauge and Bloomfield Highway 44 bridge. This segment of the San Juan River is listed in the State's draft 2000-2002 §303(d) list of water quality limited waters requiring Total Maximum Daily Loads (TMDLs). The 303(d) lists probable causes of the pollutant as agriculture and urban runoff. The TMDL for fecal coliform is due December 31, 2004.

Table B-3 includes the New Mexico State standards for the different water uses and the results of the water quality samples. Red shaded boxes indicate parameters that exceed the standards for that water use. Yellow shaded boxes indicate the detection limit was above the standard and therefore it is unknown if the standard was exceeded.

[1] River segment numbers are assigned by State of New Mexico identifying sections of the San Juan River.

Table B-2.—Fecal coliform results

Sample location	Latitude	Longitude	River mile	Total coliform (colonies/ 100 mL)	Fecal coliform (colonies/ 100 mL)	E. coli (colonies/ 100 mL)
San Juan River at Farmington GS gauge NM State river segment 20.6.4.401	36°43'22.8"	108°13'32.6"	180.7	>2,400	460	214
San Juan River at Lee Acres Bridge - County Road 5500 NM State river segment 20.6.4.401	36°41'23.6"	108°05'44.4"	188.5	>2,400	93	365
San Juan River upstream of Highway 44 bridge at Bloomfield NM State river segment 20.6.4.401	36°41'59.0"	107°59'04.7"	195.4	>2,400	1,100	291
San Juan River at Highway 64 bridge at Blanco border between NM State river segments 20.6.4.401 and 20.6.4.405	36°43'27.0"	107°48'48.7"	207.0	>2,400	240	38
San Juan River at GS gauge in Archuleta NM State river segment 20.6.4.405	36°48'07.6"	107°41'54.5"	218.5	153	4	1

Note: Grab samples from bank where flow was visible. Precipitation events occurred on the afternoons of July 9, 10, and possibly 11 with fine sediment deposition in the river downstream of Highway 64 bridge at Blanco, New Mexico.

Short-Term Impacts Noted During Test

The preliminary results noted no exceedences for the irrigation, livestock, and wildlife habitat standards. No parameters exceeded the acute fishery standards. Several parameters exceeded the chronic fishery and river segment standards.

Also, several parameters had detection limits above the standard, which hinders evaluation of possible exceedences of the standards. Total DDT, total PCB, and total mercury all had detection limits above the standard, but the results received indicated the parameters were not detected. When the laboratory reports this, it usually just means that the parameter was not detected by instrumentation. The parameter may be detected, but due to small amounts, it is reported as less than the detection limit. This was the case for total chlorine residual and one sample of total ammonia. Exceedences of the standard may have occurred, but since the detection is not low enough, it is unknown if it was.

Table B-3.—Water sample results

New Mexico State Standards	Sample results for San Juan River during Low Flow Test					
Irrigation standards	Archuleta	Below Citizens Diversion	Blanco	Above Bloomfield	Below Bloomfield	Above Animas River
Sample number	DRSJ060#1	SE-1	DRSJ033A	DRSJ036A	SJRBBS01	SJFAA1
Fecal coliform 2,000 counts/mL[1] single sample	4	NA	240	1,100	93 (Lee Acres)	460 (below Animas confluence)
Diss. aluminum 5.0 mg/L[2]	<0.010	<0.010	0.0327	0.169	0.0284	<0.010
Diss. arsenic 0.10 mg/L	ND	0.0026	0.0039	0.0034	0.0043	0.0061
Diss. boron 0.75 mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	ND
Diss. cadmium 0.01 mg/L	ND	ND	0.0001	ND	ND	<0.0001
Diss. chromium 0.1 mg/L	<0.001	0.0013	<0.001	<0.001	<0.001	<0.001
Diss. cobalt 0.05 mg/L	<0.005	Not taken	<0.005	<0.005	<0.005	<0.005
Diss. copper 0.2 mg/L	0.001	ND	0.001	0.0016	0.0016	0.0012
Diss. lead 5.0 mg/L	<0.001	<0.001	0.0012	ND	0.0023	<0.001
Diss. molybdenum 1.0 mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Diss. selenium 0.13 mg/L	ND	<0.001	<0.001	ND	<0.001	ND
Diss. selenium (>500 mg/L SO4) 0.25 mg/L	NA	NA	NA	NA	NA	NA
Diss. vanadium 0.1 mg/L	<0.010	Not taken	<0.010	<0.010	<0.010	<0.010
Diss. zinc 2.0 mg/L	0.0052	0.0101	0.0035	0.0024	0.0089	0.0026
Livestock standards						
Diss. aluminum 5.0 mg/L	<0.010	<0.010	0.0327	0.169	0.0284	<0.010
Diss. arsenic 0.2 mg/L	ND	0.0026	0.0039	0.0034	0.0043	0.0061
Diss. boron 5.0 mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	ND
Diss. cadmium 0.05 mg/L	ND	ND	0.0001	ND	ND	<0.0001
Diss. chromium 1.0 mg/L	<0.001	0.0013	<0.001	<0.001	<0.001	<0.001
Diss. cobalt 1.0 mg/L	<0.005	Not taken	<0.005	<0.005	<0.005	<0.005

Table B-3.—Water sample results

New Mexico State Standards	Sample results for San Juan River during Low Flow Test					
Irrigation standards	Archuleta	Below Citizens Diversion	Blanco	Above Bloomfield	Below Bloomfield	Above Animas River
Diss. copper 0.5 mg/L	0.001	ND	0.001	0.0016	0.0016	0.0012
Diss. lead 0.1 mg/L	<0.001	<0.001	0.0012	ND	0.0023	<0.001
Total mercury 0.01 mg/L	ND	ND	ND	ND	ND	ND
Diss. selenium 0.05 mg/L	ND	<0.001	<0.001	ND	<0.001	ND
Diss. vanadium 0.1 mg/L	<0.010	Not taken	<0.010	<0.010	<0.010	<0.010
Diss. zinc 25.0 mg/L	0.0052	0.0101	0.0035	0.0024	0.0089	0.0026
Radium-226+radium-228 30.0 pCi/L[3]	1.0±0.5	Not taken	0.1±0.6	0.9±0.4	1.0±0.6	0.9±0.5
Tritium 20,000 pCi/L	Not taken	Not taken	Not taken	Not taken	140±750	Not taken
Total gross alpha 15 pCi/L	0.54±0.97	Not taken	0.8±1.3	5.3±3.60	3.5±3.10	13.1±7.20
Wildlife habitat standards						
Total mercury 0.77 µg/L[4]	ND	ND	ND	ND	ND	ND
Total recoverable selenium 5.0 µg/L	ND	<1	<1	ND	<1	ND
Cyanide, weak acid dissociable 5.2 µg/L	ND	ND	ND	ND	ND	ND
Total chlorine residual 11 µg/L	<1000	<1000	<1000	<1000	<1000	<1000
Total DDT and metabolites 0.001 µg/L (sample detection limit = 0.1 µg/L)	ND	Not taken	ND	ND	ND	ND
Total PCBs 0.014 µg/L (sample detection limit = 1.0 µg/L)	ND	Not taken	ND	ND	ND	ND
Fishery standards						
High-quality coldwater fishery						

Table B-3.—Water sample results

New Mexico State Standards	Sample results for San Juan River during Low Flow Test					
Irrigation standards	Archuleta	Below Citizens Diversion	Blanco	Above Bloomfield	Below Bloomfield	Above Animas River
Dissolved oxygen (DO) shall not be less than 6.0 mg/L	8.45	8.7	8.95	NA	NA	NA
pH between 6.6-8.8	8.0	8.08	7.58	NA	NA	NA
Temperature shall not exceed 20 °C (68 °F)	12.8°C	16.5°C	17.3°C	NA	NA	NA
Total organic carbon shall not exceed 7 mg/L	20	6	12	NA	NA	NA
Turbidity shall not exceed 10 NTU[5]	1.39	4.87	3.62	NA	NA	NA
Conductivity between 300 and 1,500 umhos/cm[6]	306	258	318	NA	NA	NA
Total ammonia standards per subsection N (standard ranged from 1.1 to 1.7 mg/L depending on pH and temperature)	<0.4	<0.4	<0.4	NA	NA	NA
Marginal coldwater fishery						
DO shall not be less than 6 mg/L	NA	NA	8.95	6.4	6.8	Not taken
pH between 6.6-9.0	NA	NA	7.58	7.85	8.16	7.82
Temperature shall not exceed 25 °C on a case-by-case basis	NA	NA	17.3 °C	23.3 °C	25.6 °C	22.4 °C
Total ammonia standards per subsection N (standard ranged from 0.35 to 1.8 mg/L depending on pH and temp.)	NA	NA	<0.4	<0.4	<0.4 Standard from table 0.35 mg/L	<0.4
Warmwater fishery						
DO shall not be less than 5 mg/L	NA	NA	8.95	6.4	6.8	Not taken
pH between 6.6-9.0	NA	NA	7.58	7.85	8.16	7.82

Table B-3.—Water sample results

New Mexico State Standards	Sample results for San Juan River during Low Flow Test					
Irrigation standards	Archuleta	Below Citizens Diversion	Blanco	Above Bloomfield	Below Bloomfield	Above Animas River
Temperature shall not exceed 32.2 °C (90 °F)	NA	NA	17.3 °C	23.3 °C	25.6 °C	22.4 °C
Total ammonia standards per subsection N (standard ranged from 0.5 to 2.1 mg/L depending on pH and temperature)	NA	NA	<0.4	<0.4	<0.4	<0.4
Chronic fishery standards						
Hardness - calculated mg/L	106	104	122	172	170	184
Diss. aluminum 87 µg/L	<10	<10	32.7	169	28.4	<10
Diss. arsenic 150 µg/L	ND	2.6	3.9	3.4	4.3	6.1
Diss. beryllium 5.3 µg/L	<5.0	Not taken	<5.0	<5.0	<5.0	<5.0
Diss. cadmium hardness dependent µg/L (standard ranges from 2.3 to 3.5 based on hardness of samples)	ND	ND	0.1	ND	ND	<0.1
Diss. chromium hardness dependent µg/L (standard ranges from 76.5 to 122.1 based on hardness of samples)	<1.0	1.3	<1.0	<1.0	<1.0	<1.0
Diss. copper hardness dependent µg/L (standard ranges from 9.3 to 15.1 based on hardness of samples)	1.0	ND	1.0	1.6	1.6	1.2
Diss. lead hardness dependent µg/L (standard ranges from 2.6 to 4.9 based on hardness of samples)	<1.0	<1.0	1.2	ND	2.3	<1.0
Total mercury 0.012 µg/L	ND	ND	ND	ND	ND	ND
Total recoverable selenium 5 µg/L	ND	<1.0	<1.0	ND	<1.0	ND

Table B-3.—Water sample results

New Mexico State Standards	Sample results for San Juan River during Low Flow Test					
Irrigation standards	Archuleta	Below Citizens Diversion	Blanco	Above Bloomfield	Below Bloomfield	Above Animas River
Cyanide, weak acid dissociable 5.2 µg/L	ND	ND	ND	ND	ND	ND
Total chlordane 0.0043 µg/L (sample detection limit = 0.5 µg/L)	ND	Not taken	ND	ND	ND	ND
Diss. nickel hardness dependent µg/L (standard ranges from 53.8 to 87.1 based on hardness of samples)	ND	<1.0	ND	ND	ND	ND
Diss. zinc hardness dependent µg/L (standard ranges from 122.1 to 198.0 based on hardness of samples)	5.2	10.1	3.5	2.4	8.9	2.6
Total chlorine residual 11 µg/L	<1000	<1000	<1000	<1000	<1000	<1000
Acute fishery standards						
Diss. silver hardness dependent µg/L (standard ranges from 3.7 to 9.8 based on hardness of samples)	ND	ND	<0.15	ND	ND	ND
Physical standards for river section 20.6.4.401						
pH single sample 6.6-9.0	NA	NA	7.58	7.85	8.16	7.82
Temperature shall not exceed 32.2 °C (90 °F)	NA	NA	17.3 °C	23.3 °C	25.6 °C	22.4 °C
Fecal coliform (single sample) shall not exceed 400/100 mL	NA	NA	240	1,100	93	460
Physical standards for river section 20.6.4.405						
pH (single sample) 6.6-8.8	8.0	8.08	7.58	NA	NA	NA
Conductivity (single sample) shall not exceed 400 umhos/cm	306	258	318	NA	NA	NA

Table B-3.—Water sample results

New Mexico State Standards	Sample results for San Juan River during Low Flow Test					
Irrigation standards	Archuleta	Below Citizens Diversion	Blanco	Above Bloomfield	Below Bloomfield	Above Animas River
Temperature shall not exceed 20 °C (68 °F)	12.8 °C	16.5 °C	17.3 °C	NA	NA	NA
Turbidity shall not exceed 10 NTU	1.4	4.9	3.6	NA	NA	NA
Fecal coliform (single sample) shall not exceed 200/100 mL	4	Not taken	240	NA	NA	NA

ND - reported as not detected
NA - does not apply

Note: The Blanco sample site is located on the boundary between river segments 20.6.4.401 and 20.6.4.405 and the results are included in both segments.

[1] Counts per milliliter.
[2] Milligrams per liter.
[3] Picocuries per liter.
[4] Micrograms per liter.
[5] Microsiemans per centimeter.
[6] Nephelometric Turbidity Unit.

River Segment 20.6.4.405 (From Navajo Dam to the Highway 64 Bridge at Blanco, New Mexico)

The high quality coldwater fishery standard in river segment 20.6.4.405 was exceeded for the parameters total organic carbon and conductivity. Total organic carbon ranged from 6 to 20 mg/L in this segment, with the standard being 7 mg/L. The conductivity readings ranged from 258 to 318 umhos/cm with the standard stating that conductivity must be between 300 and 1,500 umhos/cm.

New Mexico Department of Game and Fish personnel verbally indicated dissolved oxygen (DO) varied from approximately 9.0 to 6.4 during the day, with the low readings occurring during the early morning hours before sunrise. Data submitted for the low flow test report indicated temperature averaged 14.4 °C with 26 readings (out of 292) above 20 °C (standard for high quality coldwater fishery). DO averaged 9.0 mg/L with 12 readings (out of 291) below 6.0 mg/L (standard for high quality coldwater fishery) and pH averaged 7.9 standard units with 35 readings (out of 287) less than 6.6 or greater than 8.8 standard units (standard for high quality coldwater fishery).

The Reclamation biology team took water quality readings at 77 locations between Navajo Dam (approximate river mile 225) and Salmon Ruin (approximate river mile 187), which includes most of both river segments 20.6.4.401 and 20.6.4.405. The readings included conductivity, temperature, and DO. The following paragraph is taken from the *Executive Summary of the Assessment of Aquatic Habitat of the San Juan River.*

> "Readings were taken at approximately 250 cfs releases and a week later at approximately 500 cfs releases. Average water temperature for all sites changed from 17.18 °C at 500 cfs to 21.53 °C at 250 cfs, for an increase of 25.3 percent. Average dissolved oxygen changed very little from 7.80 mg/L at 500 cfs to 7.61 mg/L at 250 cfs, for an decrease of 2.4 percent. Average conductivity changed from 257 µS/cm at 500 cfs to 366 µS/cm at 250 cfs, for an increase of 42.4 percent."

River Segment 20.6.4.401 (From Highway 64 Bridge at Blanco, New Mexico to Confluence of the San Juan and Animas Rivers at Farmington, New Mexico)

The marginal coldwater fishery standard for ammonia was possibly exceeded. The detection limit for the sample was 0.4 mg/L and the standard, based on temperature and pH at the time the sample is collected, is approximately 0.35 mg/L (temperature and pH numbers were rounded up to the table values which results in a conservative interpretation of the standard).

The water temperature at one site exceeded the marginal coldwater fishery standard, but was below the warmwater fishery temperature standard.

The dissolved aluminum (169 micrograms per liter [µg/L]) from the site upstream of the Highway 44 bridge in Bloomfield, NM exceeded the chronic fishery standard (87 µg/L), but was less than the acute fishery standard (750 µg/L). The results of dissolved aluminum samples upstream and downstream were much less and the cause of the exceedence is not known. The laboratory has been notified to check their records.

The fecal coliform results have been discussed previously. The fecal coliform sample at the Highway 64 bridge at Blanco, NM is located on the boundary between river segments 20.6.4.401 and 20.6.4.405. The fecal coliform standard for segment 20.6.4.401 is 400 colonies per 100 mL and the fecal coliform standard for river segment 20.6.4.405 is 200 colonies per 100 mL. The sample result was 240 colonies/100 mL which for the river segment 20.6.4.405 is an exceedence of the standard. Precipitation events did occur in the watershed area on the afternoons of July 9, 10, and 11, which contributed runoff and may have resulted in higher-than-normal results.

Fecal coliform samples exceeded the standard at the sites above the Highway 44 bridge in Bloomfield and at the GS gauge in Farmington below the confluence of the San Juan and Animas Rivers. Fecal coliform is noted in New Mexico State's 303(d) listing as being out of compliance in stream segment 20.6.4.401. TMDL studies will begin in 2002 for fecal coliform and bottom sediments.

Projection of Potential Long-Term Impacts

General Impacts

Some parameters could exceed the State standards between Navajo Dam and the confluence of the Animas River with long-term 250 cfs flows during the irrigation season. If a parameter exceeds the standard more than once in three years, then the NMED would place the parameter on the 303(d) list of impaired streams. The State would then perform a TMDL study on the parameter in the stream segment.

River segments 20.6.4.401 and 20.6.4.405 have several parameters that are exceeded at the present time and would continue to be exceeded at low flows. Segment 20.6.4.401 is out of compliance with fecal coliform and bottom sediments. TMDLs are planned to be developed by the end of 2004 for both of these parameters. Segment 20.6.4.405 is out of compliance with turbidity and bottom sediments and TMDLs are also planned to be developed by the end of 2004.

Table B-4 shows the results from the low flow samples and compares them to the historical data at 250 cfs and 500 cfs for the sample site at the GS gauge at Archuleta, Colorado in river segment 20.6.4.405.

Most parameters monitored are within the historical ranges with increases in water temperature, conductivity, bicarbonate ion, and dissolved calcium. DO shows a decrease from the 500 cfs average and is lower than the bottom end of the historical range. Only nine samples for DO were reported in the STORET data for this site.

Table B-5 shows the results from the low flow samples and compares them to the historical data at 250 cfs and 500 cfs for the sample site at the San Juan River above the confluence of the Animas River in river segment 20.6.4.401.

As table B-5 illustrates, very little data (as shown in column blanks) have been collected at the sample site historically. It also illustrates that temperature, conductivity, and bicarbonate ion continue to be above the 500 cfs average, but within the historical range of data.

Table B-4.—Comparison of water quality data at GS gauge at Archuleta, New Mexico

Parameters	Archuleta - Low Flow Test July 9-15, 2001	Archuleta - Historical Winter Low Flow Tests (winter 1996-97)	Archuleta - Historical data for average 500 cfs flows (range from 450 to 551 cfs)	Archuleta - Historical max/min data for 500 cfs flows
Average streamflow (cfs)	264	280 (n=11)	503 (n=45)	551/450
Conductivity (umhos/cm)	306	252 (n=11)	279 (n=43)	480/199
Water temperature degrees Centigrade	12.8	4.6 (n=11)	7.3 (n=45)	14/2
Turbidity	1.4	6.3 (n=8)	4 (n=34)	10/1
DO	8.45	10.9 (n=11)	10.9(n=9)	14.13/9.43
pH	8.0	8.0 (n=11)	8.2 (n=43)	8.9/7.2
HCO3 ion (mg/L)	103	75.5 (n=8)	96 (n=23)	112/67
NO3-N diss (mg/L)	No Data	0.1 (n=4)	0.085 (n=8)	1.01/0.04
Calcium diss (mg/L)	33	30 (n=10)	32 (n=38)	38/25.1
Magnesium diss (mg/L)	5.6	5.7 (n=10)	6.0 (n=38)	7.6/4.8
Sodium diss (mg/L)	14.7	13.6 (n=6)	15 (n=37)	23/11
Potassium diss (mg/L)	1.9	1.7 (n=6)	1.9 (n=36)	2.6/1.5
Chloride total (mg/L)	1.9	2.3 (n=2)	3 (n=36)	11/1
Sulfate SO4 total (mg/L)	42.5	44.5 (n=2)	53 (n=35)	79/33
Arsenic diss (µg/L)	ND	4.7 (n=9)	2 (n=14)	5/0.5
Barium diss (µg/L)	No Data	64 (n=4)	74 (n=5)	100/50
Boron diss (µg/L)	<5	No Data	29 (n=24)	220/10
Cadmium diss (µg/L)	ND	No Data	0.6 (n=7)	2/0
Chromium diss (µg/L)	<1	No Data	4.3 (n=7)	10/0
Cobalt diss (µg/L)	<5	No Data	ND (n=7)	<3/0
Copper diss (µg/L)	1	6.1 (n=8)	4.1 (n=9)	10/1
Lead diss (µg/L)	<1	1.2 (n=9)	1.3 (n=12)	6/0

Parameters	Archuleta - Low Flow Test July 9-15, 2001	Archuleta - Historical Winter Low Flow Tests (winter 1996-97)	Archuleta - Historical data for average 500 cfs flows (range from 450 to 551 cfs)	Archuleta - Historical max/min data for 500 cfs flows
Manganese diss (µg/L)	ND	12.8 (n=4)	7.3 (n=8)	20/5
Nickel diss (µg/L)	ND	7.5 (n=8)	7.5 (n=2)	10/5
Silver diss (µg/L)	ND	No Data	ND	0
Zinc diss (µg/L)	5.2	8.3 (n=9)	10.8 (n=14)	50/0
Aluminum diss (µg/L)	<10	53 (n=8)	22.5 (n=2)	30/15
Selenium diss (µg/L)	ND	0.7 (n=9)	1.1 (n=14)	4/0.5
Selenium total (µg/L)	ND	0.9 (n=9)	1.1 (n=7)	2/0
Hardness (mg/L)	106	100 (n=8)	105 (n=26)	126/84
Nitrate diss NO_3 (mg/L)	<0.1	0.1 (n=4)	0.37 (n=7)	0.5/0.2
Mercury diss (µg/L)	ND	0.16 (n=9)	0.27 (n=13)	1.3/0.05

Table B-4.—Comparison of water quality data at GS gauge at Archuleta, New Mexico (continued)

Notes: For data that were below detection levels, the value used to calculate the average value was ½ the detection limit. Historical data from STORET retrieval, most samples taken during 1970's and 1990's. "ND" is not detected as reported by the laboratory doing the analysis. "n" is the number of analysis. "diss" is dissolved.

Both tables (B-4 and B-5) confirm analysis that shows total dissolved solids (TDS) and associated ions are expected to increase with a decrease in flow and metal trace elements show no correlation to flow. The same relationship was found by the San Juan River Basin Recovery Implementation Program (SJRBRIP) in their water quality analysis of the San Juan River.

The standards for water uses like irrigation, livestock, and wildlife habitat would most likely not be exceeded during long-term low flows. Data from the 2001 Summer Low Flow Test (Test) show parameters well below the standards.

The warmwater fishery standards (water temperature, DO, pH, and total ammonia) would most likely not be exceeded based on the data from the Test sampling. The total ammonia parameter is closest to the standard and additional monitoring may be necessary during low-flow periods.

Table B-5.—Comparison of water quality data at San Juan River above the confluence of the Animas River

Parameters	San Juan River above confluence of Animas River - Low Flow Test July 9-15, 2001	San Juan River - Historical low flow data (range from 112 to 257 cfs)	San Juan River - Historical data for average 500 cfs flows (range from 460 to 554 cfs)	San Juan River - Historical max/min data for 500 cfs flows
Average streamflow (cfs)	219	199 (n=15)	502 (n=19)	554/460
Conductivity (umhos/cm)	557	617 (n=15)	638 (n=18)	1800/464
Water temperature degrees Centigrade	22.4	14.6 (n=13)	14.4 (n=17)	24.5/3
Turbidity	40.5			
pH	7.82	7.9 (n=13)	7.9 (n=16)	8.4/7.2
HCO3 ion (mg/L)	151	132 (n=12)	143 (n=14)	275/118
NO3-N diss (mg/L)	0.3		0.4 (n=2)	0.7/0.1
Calcium diss (mg/L)	62.5	56 (n=8)	63 (n=14)	120/52
Magnesium diss (mg/L)	6.6	8.6 (n=8)	8.6 (n=14)	12/5.4
Sodium diss (mg/L)	44.6	44 (n=8)	65 (n=14)	270/35
Potassium diss (mg/L)	2.2	2.3 (n=8)	2.9 (n=10)	6.3/2
Chloride total (mg/L)	5.0	6.5 (n=14)	5.9 (n=16)	15/3
Sulfate SO4 total (mg/L)	162.2	159 (n=8)	204 (n=13)	700/130
Arsenic diss (µg/L)	6.1			
Barium diss (µg/L)				
Boron diss (µg/L)	ND	43 (n=7)	57.5 (n=8)	130/30
Cadmium diss (µg/L)	<0.1			
Chromium diss (µg/L)	<1.0			
Cobalt diss (µg/L)				
Copper diss (µg/L)	1.2			
Lead diss (µg/L)	<1.0			
Manganese diss (µg/L)	8			

Table B-5.—Comparison of water quality data at San Juan River above the confluence of the Animas River (continued)

Parameters	San Juan River above confluence of Animas River - Low Flow Test July 9-15, 2001	San Juan River - Historical low flow data (range from 112 to 257 cfs)	San Juan River - Historical data for average 500 cfs flows (range from 460 to 554 cfs)	San Juan River - Historical max/min data for 500 cfs flows
Nickel diss (µg/L)	ND			
Silver diss (µg/L)	ND			
Zinc diss (µg/L)	2.6			
Aluminum diss (µg/L)	<10			
Selenium diss (µg/L)	ND			
Selenium total (µg/L)	ND			
Hardness (mg/L)	184			
Nitrate diss NO3 (mg/L)	0.3		1.6 (n=3)	3.1/0.4
Mercury diss (µg/L)	ND			
Iron diss (µg/L)	ND	15 (n=7)	60 (n=5)	210/10

Notes: For data that were below detection levels, the value used to calculate the average value was ½ the detection limit. "ND" is not detected as reported by the laboratory doing the analysis. "n" is the number of samples analyzed. "diss" is dissolved. Historical data taken from EPA STORET retrieval for this sample site. Data for 250 cfs flow from after construction of Navajo Dam in 1960's and 1970's, mostly late summer, but also several May and June sample dates. Majority of data for 500 cfs period dated during or post-construction of Navajo Dam. Most data from 1970's.

The water temperature standard (25°C) for marginal coldwater fishery within segment 20.6.4.401 would be exceeded during the summer. The parameter would probably have to be added to the 303(d) list and TMDLs developed. If the marginal cold water use was dropped from this segment, then the water temperature standard of 32.2°C would probably not be exceeded.

The standards for the different coldwater fishery uses—high quality coldwater and marginal coldwater—would be the most restrictive. Based on historical data, the State's latest 303(d) listing and 305(b) report, and the Test sample results, no acute fishery standards are expected to be exceeded over long-term 250 cfs releases from Navajo Reservoir. Of the chronic fishery standards, it appears dissolved aluminum may be exceeded over the long term. One sample site (above Highway 44 bridge at Bloomfield, New Mexico) had a dissolved aluminum result two times higher than the standard. The sample results from sites upstream and downstream were about one-third of the standard.

The most likely standards to be exceeded over the long term between Navajo Dam and the Animas River confluence are water temperature, conductivity, total ammonia, DO, and total organic carbon.

In initial discussions with the State on the Test, the State feels the antidegradation policy (section 20.6.4.8) in the Standards for Interstate and Intrastate Surface Waters would protect present stream segment water quality from further degradation due to flow releases from Navajo Reservoir. This section could provide the legal authority for the State to enforce the standards through court proceedings. The NMED realizes that Reclamation is attempting to return the San Juan River to a more natural hydrograph and generally supports that effort. Further talks are needed with the State to clarify issues on the long-term effects of 250 cfs flows.

The NMED expressed concerns about effects on National Pollution Discharge Elimination System (NPDES) permit holders if 250 cfs occurred during most of the year. These permits would be primarily for wastewater treatment plants and power plants along the river. The change in flows could affect the discharge limits on the permits, which may require the permit holders to make changes in their operations, upgrade equipment, or take other measures. Reclamation may conduct preliminary studies (from the dam to the confluence of the Animas River) to determine if permitted constituents change significantly at the wastewater treatment plants.

In an earlier low flow test, the Four Corners Power Plant expressed concerns about managing Morgan Lake during low flows due to increases in TDS in the San Juan River.   These low flows occurred during the 4-month flow test (1996-97) in which flows between Farmington and Shiprock were around 200 to 300 cfs. According to the *Flow Recommendations for the San Juan River* (Flow Recommendations) (Holden, 1999) developed by the SJRBRIP, 500 cfs would be maintained in the San Juan River between Farmington and Lake Powell. This flow would be higher than the critical low flows of the wastewater treatment plants in Farmington and Shiprock and the two power plants in this reach, so the NPDES permits would not be affected.

Long-term impacts to salinity should not be significant. Overall water volume delivered downstream of New Mexico would not change—just the timing. The large spring runoff period would have lower TDS, while the lower flows would have higher values. Results from previous low flow tests and historical data show TDS increase during low flows. Reclamation continues to look for ways to reduce salinity under the Colorado River Basin Salinity Control Program. Additional salinity control measures, like the lining of the canal system for Hammond Irrigation System, have reduced salt input to the river. Other irrigation districts in the watershed may be potential candidates for additional salinity control projects.

Soil erosion is another potential source of salts that could be transported to the river. Much of the middle and lower San Juan River watershed has little natural vegetation coverage, which leads to rapid soil erosion and transportation to the river during precipitation events. The Bureau of Land Management is conducting studies in the Canyon Largo watershed to reduce soil erosion and arroyo runoff. When the NMED completes their TMDL studies for bottom sediments in the San Juan River segments in 2004, additional salinity improvements are likely through control of bank erosion, agricultural runoff, and arroyo runoff.

Attachment C

Assessment of Aquatic Habitat of the San Juan River

Attachment C

Navajo Dam Low Flow Test

Assessment of Aquatic Habitat of the San Juan River

by

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EXECUTIVE SUMMARY

Visual observations were made of the San Juan River and measurements were taken during and after the Summer Low Flow Test (Test) of July 9–15, 2001, to assess changes to the aquatic habitat. Observations were made by fishery biologists rafting approximately 35 miles of the San Juan River from Navajo Dam downstream to Salmon Ruin (downstream of Bloomfield, New Mexico). Measurements were taken of changes in river stage, wetted perimeter,[1] and average depth for pools, riffles, and runs at a total of 77 sample sites, spaced 0.25-0.50 mile apart. Measurements were also taken at each site of water quality parameters, including water temperature, dissolved oxygen (DO), conductivity, and salinity[2].

Visual observations revealed few acute detrimental effects on fish populations. Stranding was observed for 10 young-of-year trout (rainbow trout and brown trout mixed) in a small isolated pool near Texas Hole (approximately 1 mile downstream of Navajo Dam), and 12 adults were found stranded in a small pool immediately upstream of Soaring Eagle Lodge (approximately 9 miles downstream of Navajo Dam). Water temperature in the small pool near Texas Hole was well above river temperature and observers surmise that all 10 young trout died. The pool near Soaring Eagle Lodge was receiving some flow and no deaths or stress of these fish were observed during the Test. No other incidents of stranding were observed by the team of fishery biologists. The low level of stranding that likely occurred does not represent a significant or even detectable reduction in fish populations. No evidence of stress or deaths of fish attributed to changes in flow was observed during or after the Test.

Measurements of river stage, wetted perimeter, and average depth of pools, riffles, and runs were taken during (at 250 cubic feet per second [cfs]) and after (at 500 cfs dam release) the Test beginning immediately below the Citizen's Ditch diversion (approximately 8 miles downstream of Navajo Dam). Change in river stage (i.e., vertical change in water elevation) was consistent for pools, riffles, and runs. For all 77 sample sites, the river dropped an

[1] The horizontal distance of the river between two points generally taken perpendicular to flow.

[2] Salinity readings were read with a Yellow Springs Instrument (YSI) that provided readings to the nearest 0.1 parts per thousand (ppt). The readings, therefore, were not as accurate as those taken by more sophisticated methods employed by the Geological Survey (GS). Because salinity is affected by a suite of ions, GS measures individual ionic concentrations as well as the sum of dissolved solids in milligrams per liter (mg/L). The salinity readings obtained, although not as accurate, are valuable in terms of determining whether there were salinity levels that were potentially harmful to aquatic life. They should not be used in determining very specific salinity levels within the river nor should they be compared to more accurate GS readings. Most freshwater aquatic life lives in less than 400 mg/L salinity (0.4 ppt); readings on the San Juan River during the Test ranged from 0.1 to 0.2 ppt (100-200 mg/L). Specific conductivity in uS/cm (at 20 C) can be converted to an approximate measure of salinity in mg/L by a multiplier of about 0.55-0.58; this conversion is only an approximation without specific measures of ionic concentrations.

average of 0.51 feet (range, 0.29-0.77 feet). Changes in wetted perimeter were greatest for riffles and least for runs. Wetted perimeter of riffles decreased by 14.7 percent (151 to 129 feet) when dam releases were decreased from 500 cfs to 250 cfs. Change in wetted perimeter for pools was 7.8 percent (109 to 101 feet) and for runs was 3.2 percent (143 to 138 feet). Average depth of pools decreased from 3.81 to 3.42 feet (13.4 percent); riffles decreased from 1.42 to 0.94 feet (36.6 percent); and runs decreased from 2.17 to 1.58 feet (23.5 percent).

Water quality parameters were also measured during and after the Test for all 77 sites. Average water temperature for all sites changed from 17.18 °C at 500 cfs to 21.53 °C at 250 cfs, for an increase of 4.35 °C (25.3 percent). Average DO changed very little from 7.80 mg/L at 500 cfs to 7.61 mg/L at 250 cfs, for a decrease of 0.19 mg/L (2.4 percent). No evidence of oxygen sag was observed indicating that oxygen levels did not differ dramatically with time of day. Average conductivity changed from 257 microsiemans per centimeter (µS/cm) at 500 cfs to 366 µS/cm at 250 cfs, for an increase of 109 µS/cm (42.4 percent). Average salinity also increased from 0.12 ppt at 500 cfs to 0.18 ppt at 250 cfs, for an increase of 0.06 ppt (50 percent).

The Test had little acute effect on the aquatic ecosystem of the San Juan River for the 6 days in which the test was conducted. Decreases in river stage, wetted perimeter, and average habitat depth did not result in direct mortality of fish. However, habitat of fish was clearly reduced, in all likelihood forcing fish to use the deeper runs and pools for resting and escape cover; this could result in crowding and possibly stress of fish over an extended period of time. Reductions in wetted perimeter will decrease macroinvertebrate production, but food for fish is not expected to be limited even at lower flows. However, reductions in depth of riffles could limit available secure feeding areas for drift feeders, such as trout, and for bottom scrapers, such as native suckers.

The chronic effects of a prolonged low flow cannot be assessed at this time. In all likelihood, fish populations could be reduced from prolonged low flows as a result of reduced habitat area, reduced habitat depth, and higher water temperatures; on the other hand, higher conductivity and salinity resulting from low flows are not expected to be detrimental to fish populations. DO is also not likely to drop to detrimental levels unless prolonged low flows promote high algal production that would induce high night-time consumption of oxygen and high production of carbon dioxide, resulting in an oxygen sag condition.

It is concluded that a Test of short duration is not likely to detrimentally affect fish populations and the aquatic ecosystem of the San Juan River. However, prolonged low flows, or frequent low flow periods could have detrimental chronic effects.

Introduction

Reclamation reduced releases from Navajo Dam from 500 cubic feet per second (cfs) to 250 cfs from July 9 to 15, 2001, in order to assess effects of lowered flows on various stakeholders. The Summer Low Flow Test (Test) began at 7 a.m. on Monday, July 9 and ended at 7 a.m. on Sunday, July 15. Flows were ramped from 500 cfs, the usual base release at the dam, to approximately 250 cfs.

This report describes effects of this Test on fish populations and the aquatic habitat of the San Juan River downstream of Navajo Dam. Observations and measurements were designed to address concerns expressed about the potential effect of the low flow on fish populations and the aquatic riverine habitat.

Methods

Visual observations were made of the San Juan River and measurements were taken during and after the Test to assess changes in the aquatic habitat. Observations were made by fishery biologists rafting approximately 35 miles of the San Juan River from Navajo Dam downstream to Salmon Ruin (downstream of Bloomfield, New Mexico) (figure C-1). Measurements were taken to assess changes in river stage, wetted perimeter, and average depth for pools, riffles, and runs at a total of 77 sample sites, spaced 0.25-0.50 mile apart, from the Citizen's Ditch diversion downstream to Salmon Ruin. Sample sites were placed at randomly-selected representative pools, riffles, and runs. Measurements were also taken at each site of water quality parameters, including water temperature, dissolved oxygen (DO), conductivity, and salinity. Observations were made and measurements were taken during the Test (at 250 cfs, July 9-13) and following the test (at 500 cfs, July 19-22). Photographs were taken at each site, one each facing upstream, across the channel, and downstream. Small inflatable rafts were used to float most of the 35-mile reach downstream of Navajo Dam.

Measurements of river stage were taken by placing temporary rebar stakes near the bank at each sample site. A 2-foot length of rebar was partially driven into the river bed and the distance from the top of the rebar to the water surface was measured with both a 250 cfs and a 500 cfs dam release (the rebar stakes were removed following the second measurement). No attempt was made to measure flow at the specific sample site locations. The location of each rebar stake was recorded as a way-point with a Global Positioning System (GPS) unit, which recorded specific locations to about 5 feet; these locations were used to relocate each rebar marking specific sample sites, allowing for the same point on the river to be reevaluated associated with a change in dam releases.

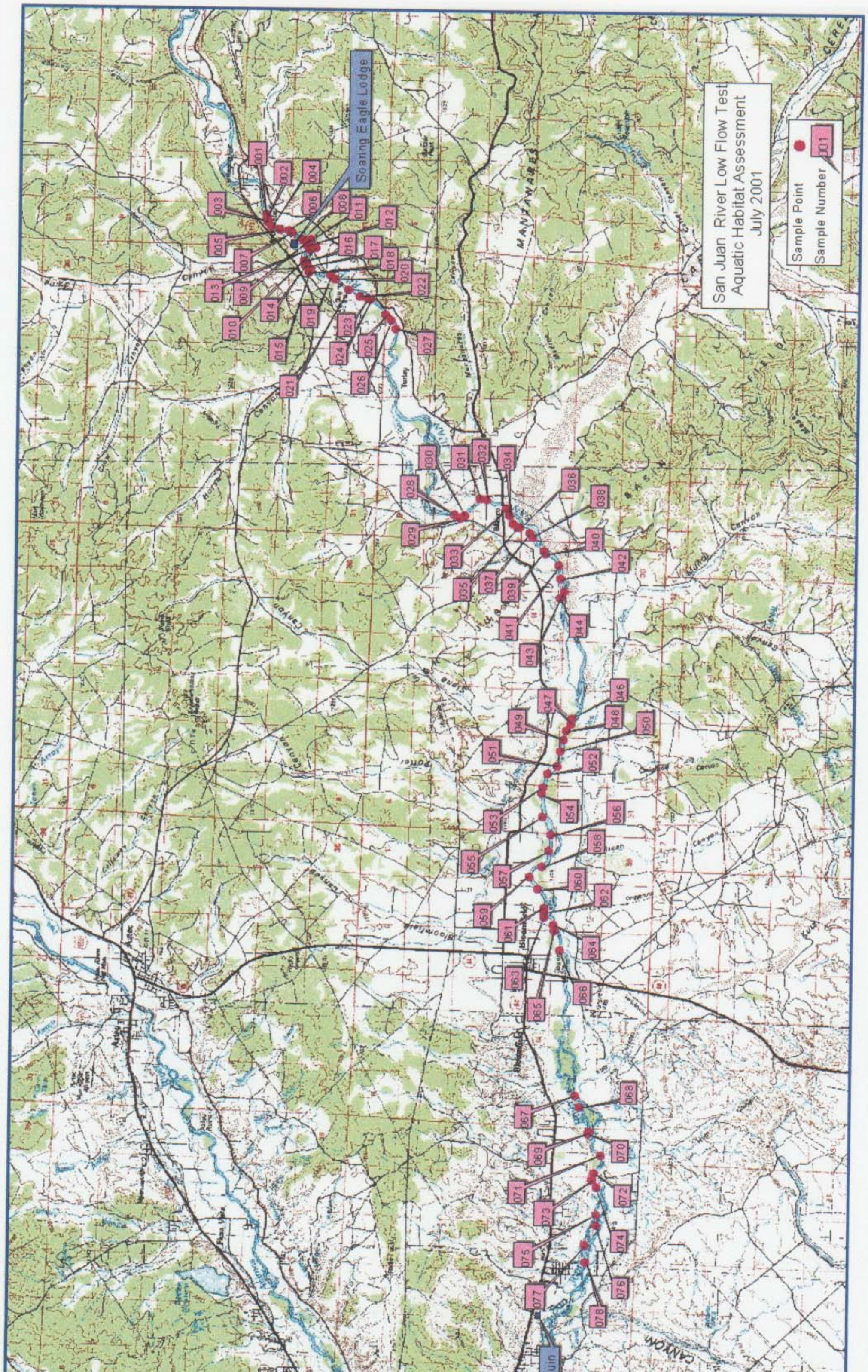

Figure C-1.—Sampling site locations.

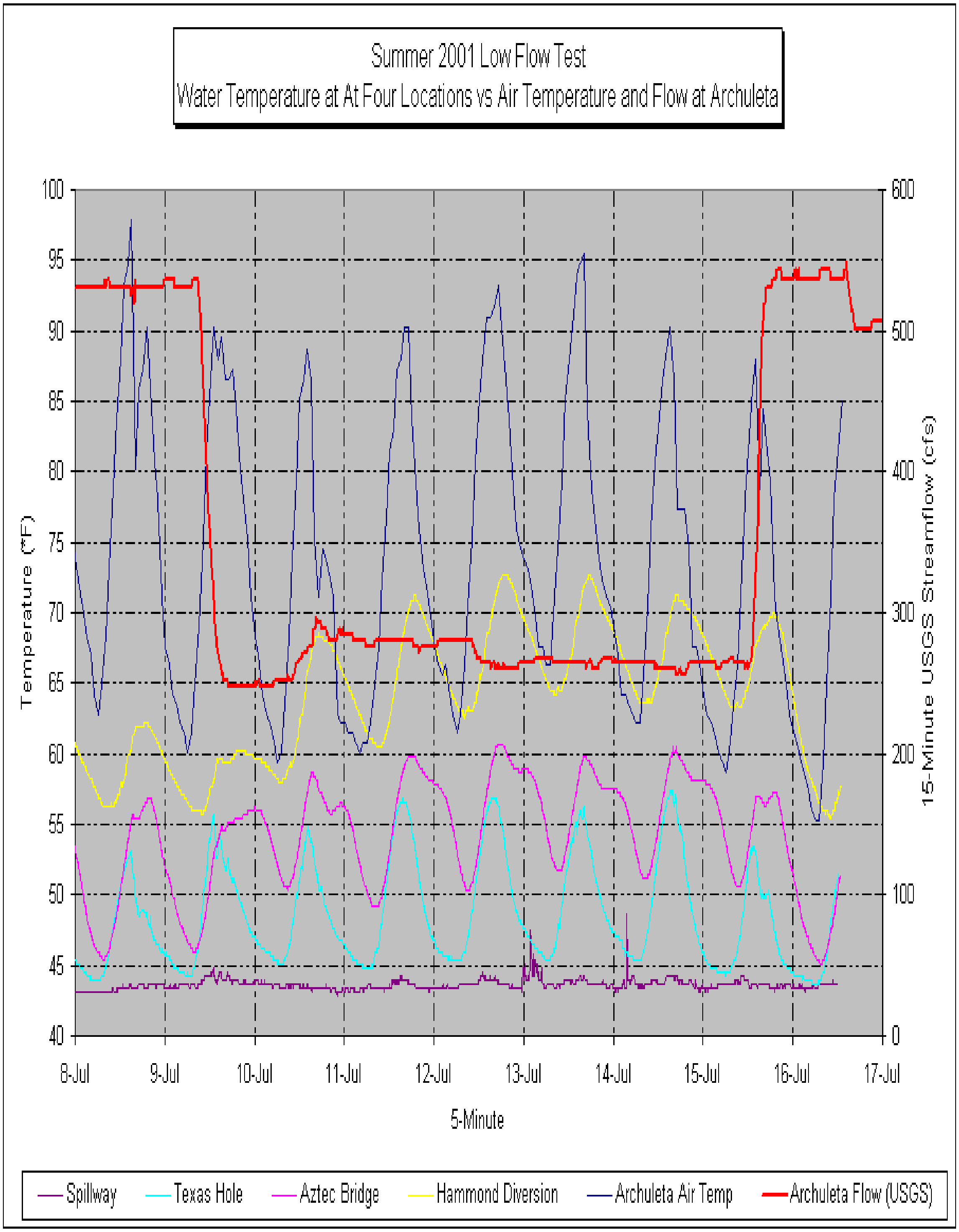

Figure C-2.—This graph shows a direct correlation between an increase in ambient air temperature and reduction in dam release and a resulting increase in river water temperature. As shown by the graph, water temperatures at the dam remain constant while an approximate 10 degree increase in daily temperature occurs at the Hammond Diversion Dam.

Wetted perimeter was measured perpendicular to the river flow at each sample site at an angle recorded as a compass bearing from the rebar stake. This compass bearing ensured that the same cross-section was measured at each flow. Wetted perimeter was measured as the distance across the channel which was wetted, using an electronic range finder; a second observer standing on the opposite shore was used as the target for the range finder. Three readings were taken at each site to ensure an accurate reading. Five representative water depths across the channel were recorded to assess average depths of pools, riffles, and runs. Depths were recorded with extendable stadia rods, delineated in tenths of a foot.

Water quality was measured at each sample site, using a Yellow Springs Instruments (YSI) multi-parameter meter. Air temperature, water temperature, DO, percent oxygen saturation, conductivity, and salinity were recorded. These data sheets are available at Reclamation's Durango Projects Office from Kirk Lashmett.

Results

Of the 77 sample sites established during the Test (at 250 cfs, July 9-13), all were generally relocated using a GPS instrument, but the rebar stake was not found for 6 sites following the test (at 500 cfs, July 19-22). Hence, measurements of stage change, wetted perimeter, and average habitat depth were recorded for 71 sites, but water quality parameters were recorded for all 77 sites. Of the 77 sites, 18 were at pools, 22 were at riffles, and 37 were at runs. Rebar stakes were relocated at 14 pools, 20 riffles, and 37 runs.

Visual Observations

Visual observations revealed few acute detrimental effects on fish populations. Stranding was observed for 10 young-of-year trout (rainbow trout and brown trout mixed) in a small isolated pool near Texas Hole (approximately 1 mile downstream of Navajo Dam), and 12 adults were found stranded in a small pool immediately upstream of Soaring Eagle Lodge (approximately 9 miles downstream of Navajo Dam). Water temperature in the small pool near Texas Hole was well above river temperature and observers surmise that all 10 young trout died. The pool near Soaring Eagle Lodge was receiving some flow and no deaths or stress of these fish were observed during the Test. No other incidents of stranding were observed by the team of fishery biologists. The low level of stranding that likely occurred as a result of ramping down from 500 cfs to 250 cfs does not represent a significant or even detectable reduction in fish populations. No evidence of stress or deaths of fish attributed to changes in flow was observed during or after the Test.

River Stage, Wetted Perimeter, Habitat Depth

Measurements of river stage, wetted perimeter, and average depth of pools, riffles, and runs were taken during (at 250 cfs) and after (at 500 cfs) the Test beginning immediately below the Citizen's Ditch diversion (approximately 8 miles downstream of Navajo Dam) and extending approximately 30 miles downstream to Salmon Ruin. Change in river stage (i.e., vertical change in water elevation) was consistent for pools, riffles, and runs (table C-1). For the 71 sample sites resampled, the river dropped an average of 0.51-0.52 feet (range, 0.29-0.77 feet).

As was expected, changes in wetted perimeter were greatest for riffles and least for pools (table C-1, figure C-3). Wetted perimeter of riffles decreased by 14.7 percent (151 to 129 feet) when dam releases were decreased from 500 cfs to 250 cfs. Change in wetted perimeter for pools was 7.8 percent (109 to 101 feet) and for runs was 3.2 percent (143 to 138 feet). Average depth of pools decreased from 3.81 to 3.42 feet (13.4 percent); riffles decreased from 1.42 to 0.94 feet (36.6 percent); and runs decreased from 2.17 to 1.58 feet (23.5 percent) (table C-1, figure C-3).

Table C-1.—Changes in river stage, wetted perimeter, and average habitat depth for the San Juan River during the Test (i.e., change in releases from Navajo Dam from 500 cfs to 250 cfs)

Habitat (number)	Change in river stage (feet)	Wetted perimeter (feet)			Average depth (feet)		
		At 500 cfs	At 250 cfs	Change	At 500 cfs	At 250 cfs	Change
Pools (14)	-0.51	99.88	93.24	6.64 (6.6%)	3.81	3.42	0.51 (13.4%)
Riffles (20)	-0.52	151.25	128.94	22.31 (14.7%)	1.42	0.94	0.52 (36.6%)
Runs (37)	-0.51	143.05	125.71	17.34 (8.8%)	2.17	1.58	0.51 (23.5%)

Water Quality

Water quality parameters were measured during and after the Test for all 77 sites (table C-2). Average water temperature for all sites changed from 17.18 °C at 500 cfs to 21.53 °C at 250 cfs, for an increase of 4.35 °C (25.3 percent). Average DO changed very little from 7.80 mg/L at 500 cfs to 7.61 mg/L at 250 cfs, for a decrease of 0.19 mg/L (2.4 percent). No evidence of oxygen sag was observed indicating that oxygen levels did not differ dramatically

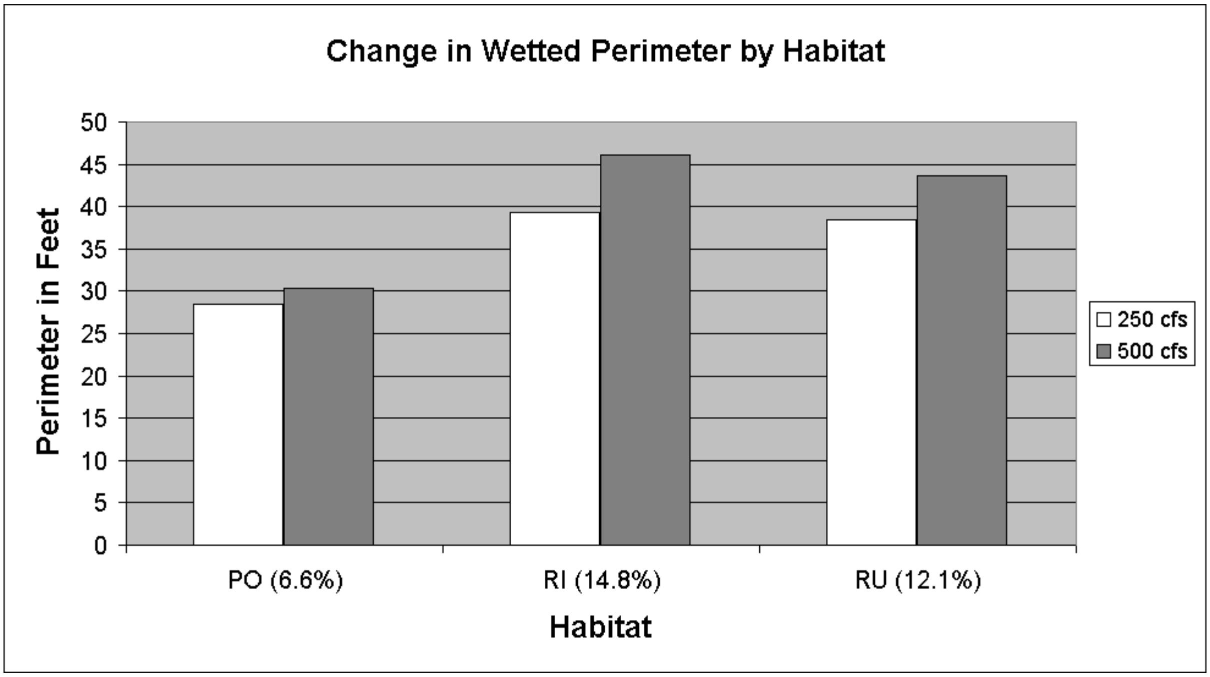

Figure C-3.—Changes in wetted perimeter by pools, riffles, and runs, comparing 500 cfs with the Test of 250 cfs on the San Juan River. Percentage change is indicated on the x-axis.

Table C-2.—Changes in average water temperature, DO, conductivity, and salinity for the San Juan River during the Test (i.e., change in releases from Navajo Dam from 500 cfs to 250 cfs). Range in values is shown in parentheses

Dam release	Water temperature (°C)	DO (mg/L)	Conductivity (µS)	Salinity (ppt)
500 cfs	17.18 (10.0-22.3)	7.82 (4.8-10.5)	257 (148-590)	0.12 (1-2)
250 cfs	21.53 (12.0-27.5)	7.61 (4.6-9.6)	366 (149-700)	0.18 (1-3)
Change	+4.35 (25.3%)	-0.19 (2.4%)	+109 (42.4%)	+0.06 (50%)

with time of day. Average conductivity changed from 257 µS/cm at 500 cfs to 366 µS/cm at 250 cfs, for an increase of 109 µS/cm (42.4 percent). Average salinity also increased from 0.12 ppt at 500 cfs to 0.18 ppt at 250 cfs, for an increase of 0.06 ppt (50 percent).

Longitudinal patterns in water temperature, DO, conductivity, and salinity demonstrate differences in these water chemistry parameters at 500 cfs and 250 cfs (figures C-5 through C-8). Inflections in the temperature patterns reflect time of day that temperature was

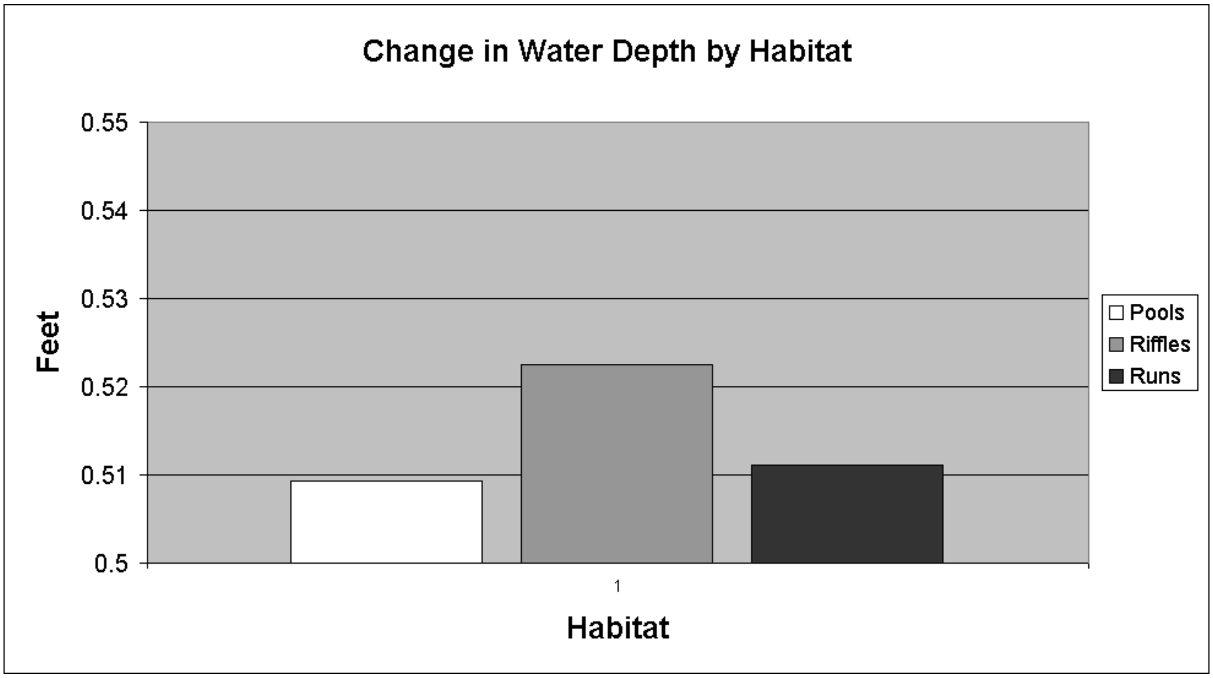

Figure C-4.—Changes in average water depth of pools, riffles, and runs, comparing 500 cfs with the Test of 250 cfs on the San Juan River.

recorded. Temperatures recorded early in the day were consistently cooler than temperatures recorded later in the day; e.g., temperatures starting at sample site 44 were recorded at the beginning of the day on both trips and are lower than temperatures recorded in the afternoon of the previous day. This variation demonstrates the limitations of these data, and confirms that Hobo constant recording temperature monitors best reflect water temperature changes during the Test. Nevertheless, the magnitude of change in temperature between 500 cfs and 250 cfs is well illustrated by this longitudinal analysis.

Longitudinal patterns in DO show similar oxygen levels at both 500 cfs and 250 cfs. There was no apparent oxygen response to the change in river flow. Longitudinal patterns in conductivity and salinity, however, were markedly different between 500 cfs and 250 cfs. Both conductivity and salinity increased at a greater rate at 250 cfs with distance downstream.

Conclusions

The Test had little acute effect on the aquatic ecosystem of the San Juan River for the 6 days in which the test was conducted. Decreases in river stage, wetted perimeter, and average habitat depth did not result in direct mortality of fish. However, fish habitat was clearly reduced, in all likelihood forcing fish to use the deeper runs and pools for resting and escape

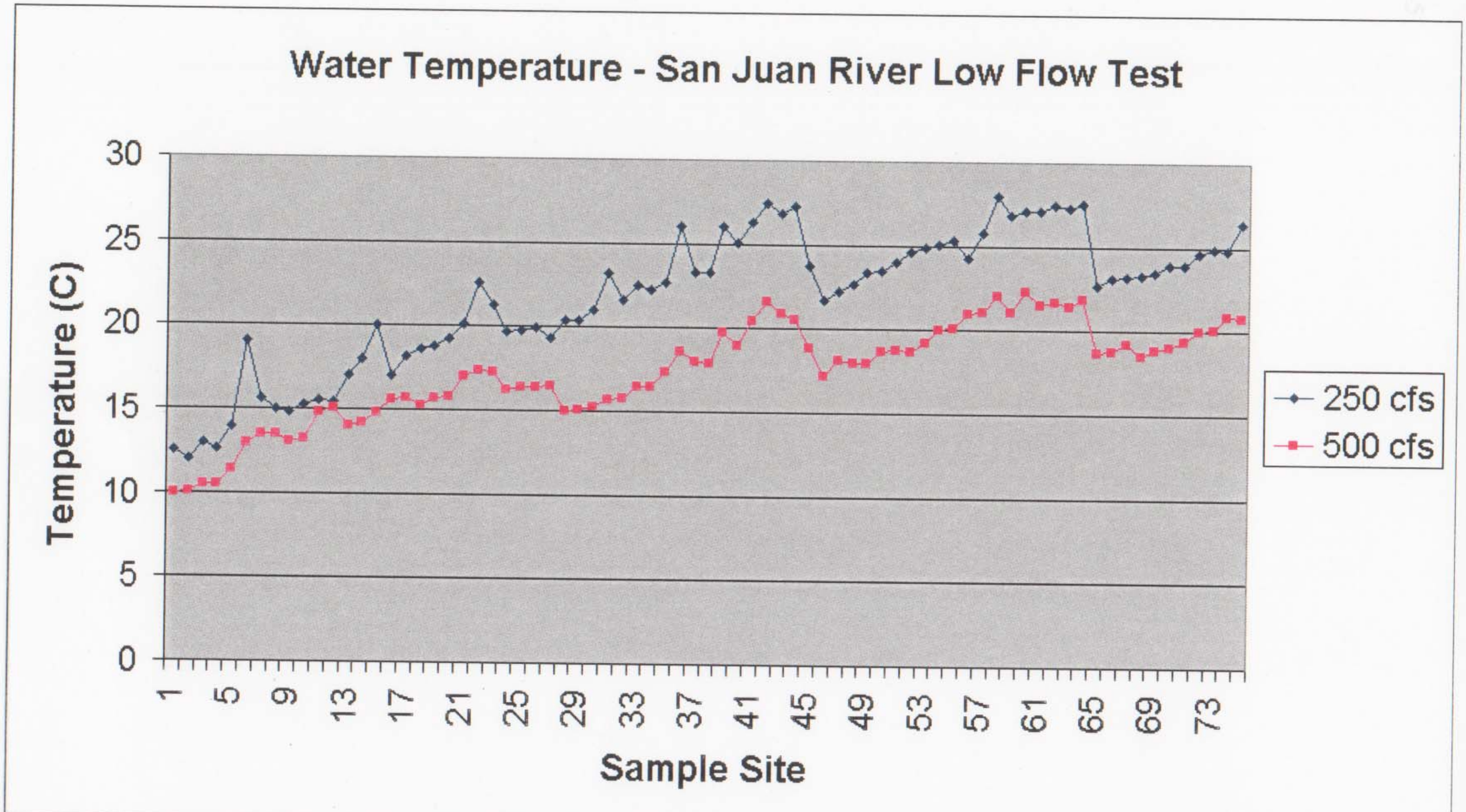

Figure C-5.—Longitudinal patterns in water temperature for the San Juan River at 500 cfs and during the Test at 250 cfs. Sample sites are spaced 0.25-0.50 mile apart for approximately 30 miles from Citizens Ditch diversion downstream to Salmon Ruin.

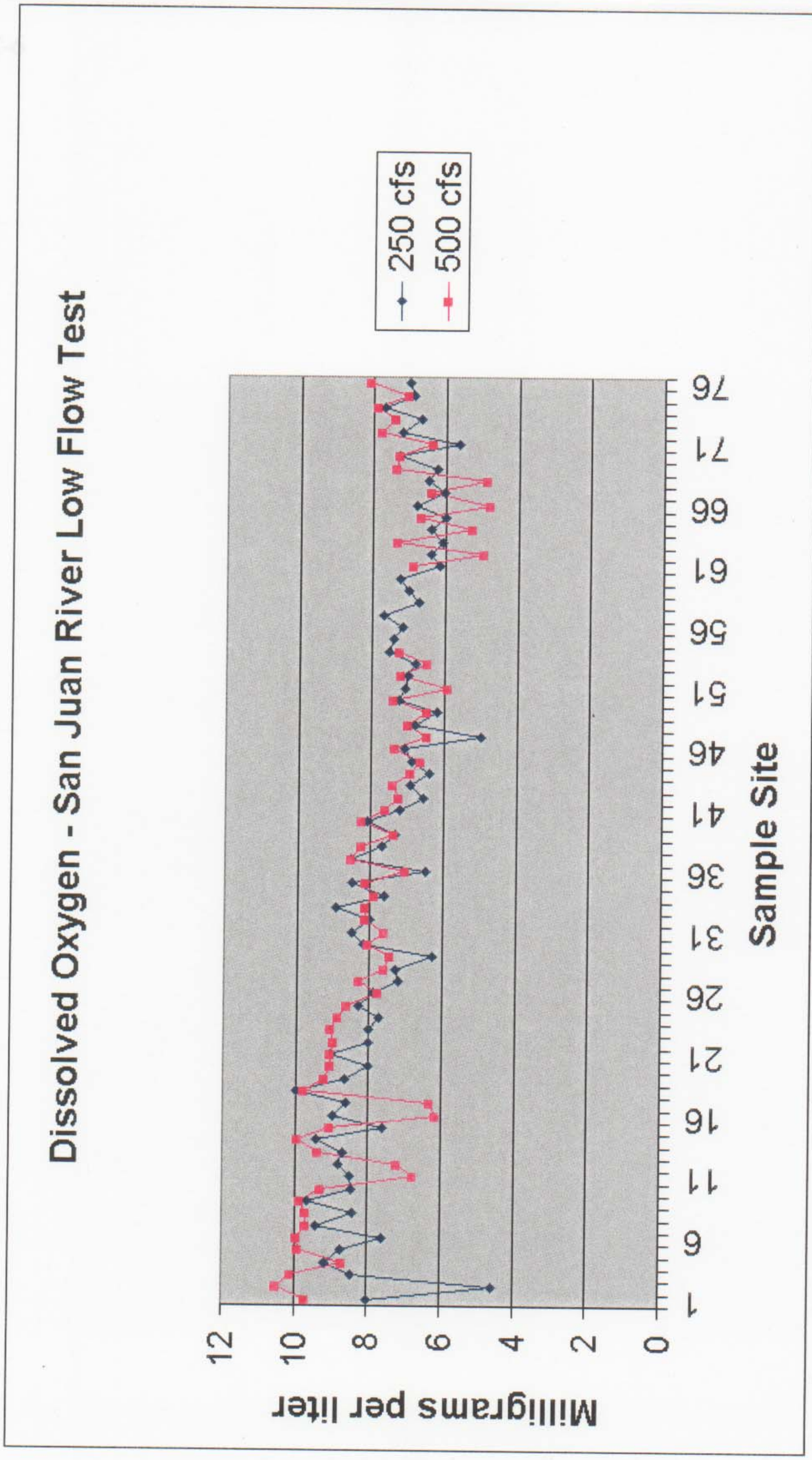

Figure C-6.—Longitudinal patterns in DO for the San Juan River at 500 cfs and during the Test at 250 cfs. Sample sites are spaced 0.25-0.50 mile apart for approximately 30 miles from Citizens Ditch diversion downstream to Salmon Ruin.

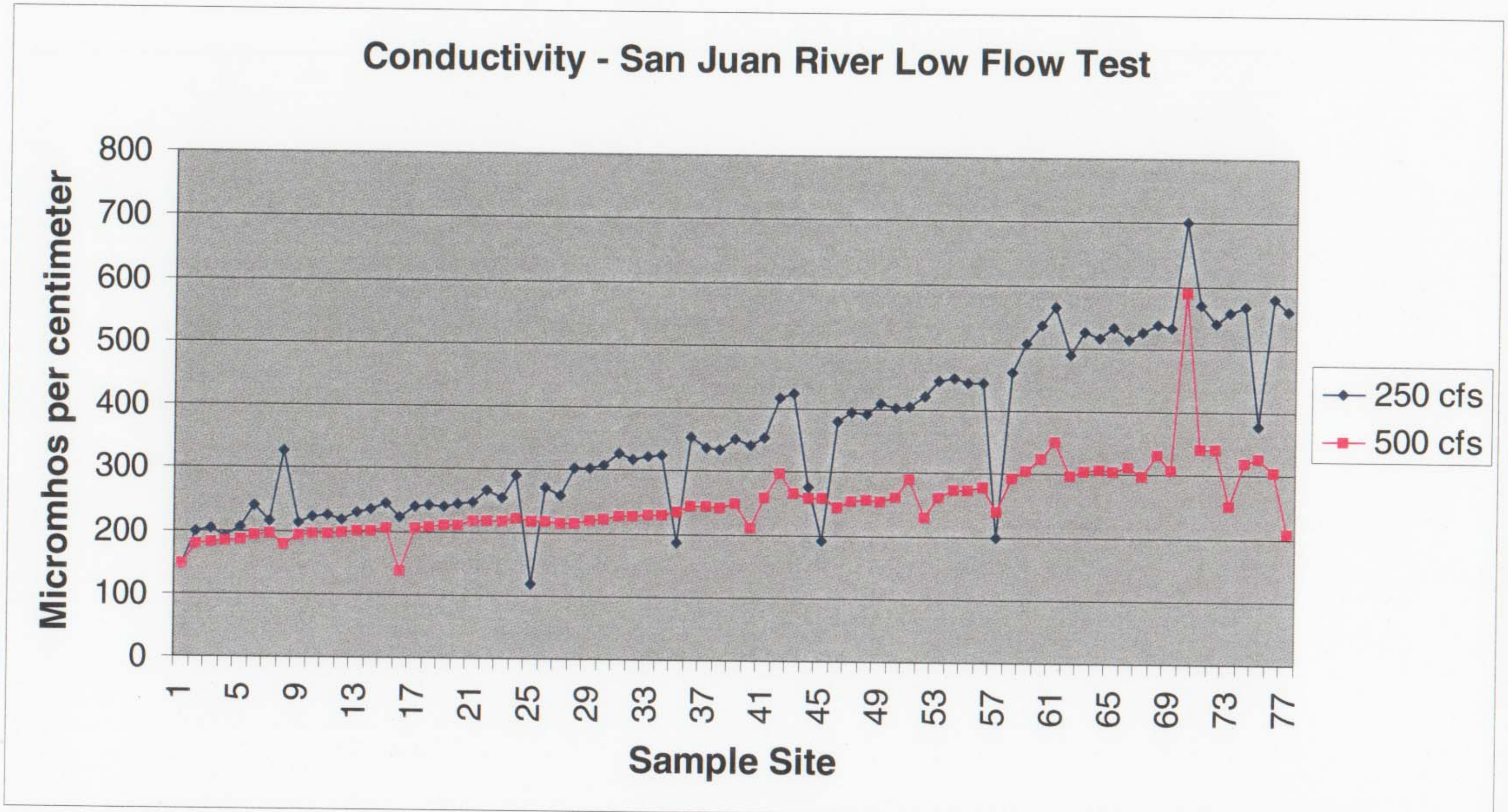

Figure C-7.—Longitudinal patterns in specific conductivity for the San Juan River at 500 cfs and during the Test at 250 cfs. Sample sites are spaced 0.25-0.50 mile apart for approximately 30 miles from Citizens Ditch diversion downstream to Salmon Ruin.

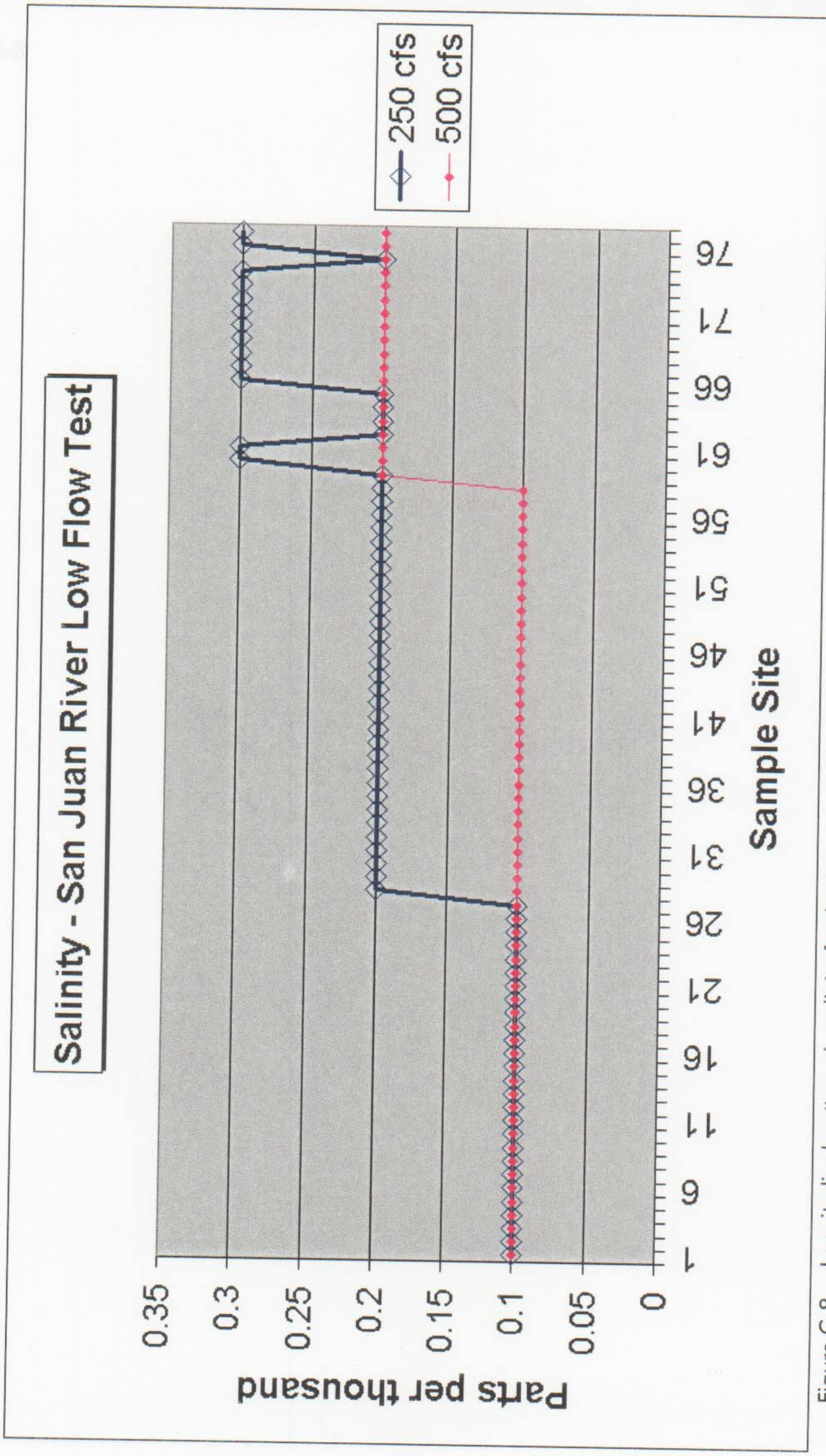

Figure C-8.—Longitudinal patterns in salinity for the San Juan River at 500 cfs and during the Test at 250 cfs. Sample sites are spaced 0.25-0.50 mile apart for approximately 30 miles from Citizens Ditch diversion downstream to Salmon Ruin.

cover; this could result in crowding and possibly stress of fish over an extended period of time. Reductions in wetted perimeter decrease macroinvertebrate production, but fish food is not expected to be limited, even at lower flows. However, reductions in depth of riffles could limit available secure feeding areas for drift feeders, such as trout, and bottom scrapers, such as native suckers.

The chronic effects of a prolonged low flow cannot be assessed at this time. In all likelihood, fish populations could be reduced from prolonged low flows as a result of reduced habitat area, reduced habitat depth, and higher water temperatures; higher conductivity and salinity resulting from low flows are not expected to be detrimental to fish populations. DO is also not likely to drop to detrimental levels, unless prolonged low flows promote high algal production that would induce high night-time consumption of oxygen and high production of carbon dioxide, resulting in an oxygen sag condition.

Reclamation concludes that a low-flow test of short duration is not likely to detrimentally affect fish populations and the aquatic ecosystem of the San Juan River. However, prolonged low flows, or frequent low flow periods, could have detrimental chronic effects.

Attachment D

City of Farmington Hydropower Analysis Memorandum

Attachment D

INTER-OFFICE MEMORANDUM

JUL 30 '01

CLASS	PRJ 13.10		
FOLDER	2305		
PROJECT	- KL		
CONTROL #	100139		
NAME	DATE	INITIAL	C.
visor			
KBeck			
[illegible]			
BDodd			
RWald			
Kl[illegible]			

TO: Dean Chirigos, Asst. Director Energy Resources

FROM: Michael Sims, Power Plant Engineering/O&M Supervisor

DATE: July 25, 2001

SUBJECT: Impact Of San Juan River Low Flow Test

As you are aware, a low flow test was conducted on the San Juan River during the period of July 9 through July 15, 2001. The purpose of the test was to examine impacts in a variety of areas (irrigation, fishery, etc.) in anticipation of permanently altering the San Juan River minimum flow threshold to 250 cfs.

GT
JSimon

Past operating experience has shown that our hydroelectric generating units experience cavitation at flows below 350 cfs. For this reason the operating unit (unit no. 1) was opened and inspected immediately prior to the commencement of the test so that an accurate comparison could be done once the test was complete. Pictures were taken of all internal components.

At 250 cfs, the unit load averaged about 6 MW. The load was not held constant because daily readings taken by the Bureau of Reclamation at the Archuleta Gauge were not consistent from one day to the next. BOR, therefore, required daily changes to maintain their flow reading at 250 cfs. Unit load varied from 5.7 MW to 6.4 MW depending on the day. Calculations based on the unit's performance curves indicated that at 250 cfs, the load should be 5.8 MW.

These relatively small changes seemed to have a significant effect on the amount of noise (caused by cavitation) coming from the unit. In the area around the turbine runner, a constant noise, which sounded much like gravel passing though the unit, was detected during the entire test period. This noise was not very extreme but was clear to those who know the normal operating sound. In the area just downstream of the butterfly valve, a loud rumbling noise and noticeable vibration was detected and appeared to be directly related to the minute flow changes required by the BOR. At 5.7 MW, the noise in this area was almost undetectable but at 6.0 MW, the noise was loud and the vibration could be felt at ground level. Tests were conducted by moving the wicket gates from the 5.7 MW position to the 6.0 MW position (about 1 percent) and back several times which confirmed the relationship between the wicket gate position and the noise. This indicates that even a 1 percent change in wicket gate position <u>could</u> significantly impact the damage caused to the unit.

Immediately after the test, the unit was opened to inspect for damage caused by the test. Inspection revealed only a very slight "frosting" on the leading edge of the turbine blades (this slight frosting does not show up on any pictures). No other damage could be seen.

The assumption can be made that even though no significant damage was detected during this very short test period, damage is likely to occur at 250 cfs over a longer period of operation. The seriousness of this expected damage is yet to be determined and will require a longer period of low flow to assess.

The unit has since been returned to service.

Michael Sims

xc: Maude Grantham-Richards, Electric Utility Director
Ed Warner - USBR
Pat Page - USBR

Attachment E

Diversion Structure Observations

Attachment E

Diversion Structure Observations

The 250 cfs (Summer Low Flow Test [Test]) reservoir releases on the San Juan River were implemented during the period from July 9 through July 15, 2001.

San Juan River and Navajo Reservoir Water User Entity Diversion Structures

This section discusses the observed impacts of the Test to the San Juan River water diversion structures downstream of Navajo Dam and to other diversion structures drawing water from Navajo Reservoir itself, and to the resources and activities of the water user entities that own them. No new diversion structures would be constructed in connection with this action. These observations were made during the week of July 9-15, 2001.

Affected Environment

At the time of the Test, the existing San Juan River water diversion structures downstream of Navajo Dam and other diversion structures drawing water from Navajo Reservoir itself included:

Navajo Reservoir water diversions

(1) Navajo Indian Irrigation Project (NIIP) headgate

(2) Various New Mexico State Parks pump intakes

San Juan River water diversions (downstream of Navajo Dam and upstream of the Animas River - San Juan River confluence)

(1) New Mexico State Parks Cottonwood Campground (Streambed Intake Gallery)

(2) Navajo Dam Water Users Association (Streambed Intake Gallery)

(3) Citizens Ditch – Includes diversions for Bloomfield Irrigation District, Jaquez Ditch, La Acequia de la Pumpa, City of Bloomfield, Lee Acres, El Paso Natural Gas, Conoco, Morningstar, and Plateau. (***Note***: the City of Bloomfield currently diverts water from the Citizens Ditch but is designing a direct diversion from the San Juan River.)

(4) Cottonwood Ditch (temporary/movable pump diversion from the San Juan River)

(5) Turley-Manzanares Ditch

(6) Blanco Domestic Water Users Association (Streambed Intake Gallery)

(7) Hammond Conservancy District Diversion Structure

(8) Giant Refinery (flow-through channel and pump diversion from the San Juan River)

(9) West Hammond Domestic Water Users Association

    (a) Lee Acres Water Users Association (receives water from West Hammond Water Users Association facility)

(10) Williams Field Service (pump diversion from the San Juan River)

(11) City of Farmington (usually diverts from the Animas River but has a pumping plant on the San Juan River for use during droughts)

The diversions listed above represent those diversions directly affected by the Test, since the area from Navajo Dam to the confluence with the Animas River is the area affected by the Test. These diversions were inspected on July 9-12, 2001.

San Juan River water diversions (downstream of the San Juan - Animas Rivers confluence)

(12) Lower Valley Water Users (currently diverts water from the Farmers Mutual Ditch but has the right to divert directly from the San Juan River)

(13) Farmers Mutual Ditch (usually diverts from the Animas River but also has the right to divert from the San Juan River)

(14) Fruitland Irrigation Project (Navajo Nation/BIA)

(15) Public Service Company of New Mexico - San Juan Generating Plant Intake

(16) Jewitt Ditch

(17) Arizona Public Service Company - Four Corners Generating Plant Intake

(18) Hogback Irrigation Project (Navajo Nation/BIA - now includes diversions for both Hogback and Cudei Projects)

(19) Cambridge Ditch (Navajo Nation/BIA)

(20) Shiprock Municipal Water (diverts water via pumps)

(21) Numerous pump intakes in Utah

These diversions were observed on July 12, 2001. The pump intakes located in Utah were not observed during the Test.

Criteria for Determining Significant Impacts

The primary criteria for evaluating impacts included the capability of the individual diversion and intake structures to achieve their full diversion capacity during high and low flows from the San Juan River without significant damage or impairment. Significant impacts are defined as those that require managers of diversion structures that sustain damage during high flows (5,000 cfs or higher) to undertake any kind of repairs. Significant impacts from the low flow (less than 500 cfs) perspective are those that require the managers of diversion structures which are unable to receive water from the San Juan River during those low flows to alter the river channel in the immediate vicinity of the diversion structure in order to receive water to it (if it is allowed under terms of the Clean Water Act, Section 404 or by permit under the same regulation).

General Summary of Significant Impacts

During the 6 days of the Test, it appears generally that water supply was not a problem for most of the diversions. During the first 3 days of the Test, precipitation was noted in the study area. In most cases, the diversions could not provide the full extent of water, as noted during observed 500 cfs flows.

Low flows (250 cfs) in the San Juan River below Navajo Dam for *extended* time durations may cause impacts to some of the river diversion structures for part of the year, depending on seasonal hydrologic conditions, resulting in potentially significant impacts to those diversions. During the Test, only three diversions appeared to be significantly impacted during the 6-day test. The channel to the Giant Refinery was able to convey only a minimal amount of water and did not provide the refinery with their requirements for water diversion. The Turley-Manzanares Ditch was only able to divert a portion of normal usage and required some intake channel modification during the Test. It was also reported that one of the wells associated with the infiltration gallery located at the Cottonwood Campground experienced reduced water production approximately half-way through the Test. Detailed specific impacts are noted below.

San Juan River Water Diversions Field Observations and Related Short-Term Impacts (Downstream of Navajo Dam).—The following are the diversions and their associated performance during the Test (located on the San Juan River downstream of Navajo dam and upstream of the confluence of the San Juan and the Animas rivers).

(1) New Mexico State Parks Cottonwood Campground (Streambed Intake Gallery)

Two systems are located at the campground. These systems divert water through infiltration galleries into cement clear wells. The State Park then pumps from the clear wells through filters to storage tanks. The State Park lower housing system clear well depth dropped 20 inches and remained at that level, and due to this depth did not affect pumping operations. The Cottonwood Campground system clear well depth dropped 20 inches during the Test and it was not possible to pump water through the system without manually operating a portable gasoline powered pump and pumping water from the river into the clear well. This was the only major impact noticed during this Test.

(2) Navajo Dam Water Users Association (Streambed Intake Gallery)

The channel which runs to the intake gallery was flowing at a depth of 4-6 inches during the Test. The gallery appeared to perform adequately during the Test and provided domestic water as needed.

(3) Citizens Ditch – Includes diversions for Bloomfield Irrigation District, Jaquez Ditch, La Acequia de la Pumpa, City of Bloomfield, Lee Acres, El Paso Natural Gas, Conoco, Morningstar, and Plateau. (***Note***: the City of Bloomfield currently diverts water from the Citizens Ditch but is designing a direct diversion from the San Juan River.)

(4) Cottonwood Ditch (temporary/movable pump diversion from the San Juan River)

The ditch has not been operable for several years. The pump was observed in the river, but was not operating at the time of observation. It appeared that there was enough water in the channel to allow full use of the pump.

(5) Turley-Manzanares Ditch

The diversion structure was not able to provide a normal supply of water, as reported by the ditch rider - modifications were made to the diversion during the Test to allow more water to be diverted to the canal. This modification included slight deepening of the intake channel and adding boulders in the river to help channel water to the diversion.

(6) Blanco Domestic Water Users Association (Streambed Intake Gallery)

Observations were not made due to inaccessibility.

(7) Hammond Conservancy District

The diversion structure at this location operated as designed and was able to deliver the water supply needed. The lowest river flow measurement was about 60 cfs below Hammond Diversion Dam.

(8) Giant Refinery – Flow-through channel and pump diversion from the San Juan River

The 500 cfs release rate historically has allowed Giant to divert sufficient water to maintain the Refinery operation. However, the 250 cfs release rate, particularly on July 9 and 10, restricted their ability to draw that water. It is anticipated that a long-term release at that level would require a redesign and revamp of their diversion point. From July 11 through the end of the Test, the flow of water increased past their diversion, probably due to afternoon rains in the area. Water was available beginning July 11, 2001, but pumping activity had to be stopped for up to 24 hours at a time due to high solids loading in that water. This channel is inoperable with low flows.

(9) West Hammond Domestic Water Users Association

(a) Lee Acres Water Users Association (receives water from West Hammond Water Users Association)

This diversion performed as designed during the Test.

(10) Williams Field Service (pump diversion from the San Juan River)

This site was not observed.

(11) City of Farmington (usually diverts from the Animas River but has a pumping plant on the San Juan River for use during droughts)

This diversion was not operated during the Test.

During the first 3 days of the Test, the area received rainfall as noted below, as measured at Navajo Dam:

Date	Inches of precipitation
July 9	0.14
July 10	0.01
July 11	0.42
July 12	0.00

Measured discharges in the San Juan River were noted during the Test in the week of July 9-13, 2001. Riverflows, canal diversions, and canal flows at various points and wasteways were measured. Phone contacts were made with towns, utilities, and irrigation companies for additional flow data.

San Juan River Water Diversions Estimated Long-Term Impacts Associated with a 250 cfs Flow (Downstream of Navajo Dam).—Observations made during the Test represent short-term impacts on the river and associated uses. The Test was completed during a period of summer monsoonal rains and also during a period when many of the farmers in the served area were cutting and drying hay. In the long term, there could be greater demands on water resources for irrigation than those typified during the Test. It is anticipated that the Bloomfield-Citizens Ditch could do minor channel maintenance to improve the efficiency of their existing diversion structure, which could preclude some downstream bypass flows. With reduced flows in the river downstream of this diversion, diversions associated with the Cottonwood Campground and the Navajo Dam Water Users Association could be unable to deliver needed water resources. The Giant Refinery would also be left without sufficient water resources for a majority of the low flow period, as evidenced during the Test.

Cottonwood Diversion and Intake Gallery.

Bloomfield - Citizens Diversion and wasteway.

Navajo Dam Water Users Association intake gallery

Turley-Manzanares Diversion.

Hammond Diversion.

Giant Refinery channel.

West Hammond and Lee Acres intake.

NEW MEXICO ENERGY, MINERALS and NATURAL RESOURCES DEPARTMENT

GARY E. JOHNSON
Governor
Jennifer A. Salisbury
Cabinet Secretary

Thomas P. Trujillo
Director
State Parks Division

Ken Beck
Bureau of Reclamation
835 E. Second avenue
Durango, CO 81301

Dear Ken

As per our discussions here are the impacts for Navajo Lake State Park operations and maintenance during the San Juan River low flow test 7/09/01 – 7/15/01. We have two water systems approximately 4.5 miles downstream from Navajo Dam. These systems divert the water through infiltration galleries into cement clear wells. We then pump from the clear wells through filters to our storage tanks. The State Park lower housing system clear well depth dropped 20 inches, remained at that level, and due to this depth did not affect our pumping operations. The Cottonwood campground system clear well depth dropped 20 inches and we were unable to pump water through the system with out manually operating a gasoline powered pump and pumping water from the river into the clear well. This was the only major impact we noticed during this test. We did not notice any access problems for our visitors. Below is a chart with our visitation figures.

Navajo Lake State Park
Low Flow Test Visitation Figures

Week Before	7/2/01-7/8/01	8103 people
Week of Test	7/9/01-7/15/01	7943 - 2%
Week After	7/16/01-7/22/01	7779 - 3%
Same Week of Test in 2000	7/11/00-7/17/00	6613

We had 21% more visitors this year than last year during the same week of the test.

cc: Larry Federici, Region I Manager
Jim Good, Region I Plant Operation Specialist

State Parks Division * Navajo Lake State Park * 1448 NM 511 #1 * Navajo Dam, New Mexico 87419
Phone: (505) 632-2278 * Fax: (505) 632-8159
Main Office * 1220 St. Francis Drive * P.O. Box 1147 * Santa Fe, New Mexico 87505-1147
Phone: (505) 476-3355 * Fax: (505) 476-3361 * http://www.emnrd.state.nm.us

GI Working File Copy

JUL 10 2000

NW RES 1.1

Navajo Unit

Clarke

Moyer

STATE OF NEW MEXICO
OFFICE OF THE STATE ENGINEER
SANTA FE

THOMAS C. TURNEY
State Engineer

BATAAN MEMORIAL BUILDING, ROOM 101
POST OFFICE BOX 25102
SANTA FE, NEW MEXICO 87504-5102
(505) 827-6175
FAX: (505) 827-6188

July 6, 2000

Ms. Carol DeAngelis, Area Manager
Western Colorado Area Office, USBR
2764 Compass Drive, Ste. 106
Grand Junction, CO 81506

Re: Proposed Low Flow Test Release from Navajo Reservoir – San Juan Basin

Dear Ms. DeAngelis:

Per July 5, 2000 telephone request by Mr. Ed Warner, the attached preliminary table indicates the authorized diversions from the San Juan River below Navajo Dam. The priority dates shown on the table will hopefully help you in determining which diversions are senior and which are junior to the BOR storage right in Navajo Reservoir.

The amounts of diversions shown on the table indicate the amount of the water right, not the normal diversion for each ditch. In some cases, the normal diversion amount exceeds the water right. For example, Citizens' Ditch has a right to 100 cubic feet per second (cfs) but normally divert more than that for efficiency of delivery. Water in excess of their right is returned to the river channel through a wasteway. Another example, Hammond Ditch diverts more than their right because they use the excess flow to help power the pumps required to lift their water right to their distribution system. Excess flows are returned to the river channel.

During our phone conversation this morning, Mr. Warner asked whether a priority call would go up the Animas River or up the San Juan River for those users below the confluence. The answer is that the call would affect junior water users on both systems.

If further discussion would be helpful, please call me at (505) 827-6191.

Sincerely,

Jim L. Sizemore

Jim L. Sizemore, P.E.
Water Rights Division

Cc: B. Enenbach, Aztec Sub-Office

Upstream of the Animas River Confluence		
User	**Priority Dates**	**Water Right, cfs**
Citizens' Ditch	1879, 1881, 1900**, 1907, 1920*, 1951, 1954, 10/24/55, 5/1/56* (A-LP)	100
La Pumpa Ditch	1888	10
Jaquez Ditch	1878	12
Navajo Dam Water Users Association	5/1/56* (A-LP), 1973	2
Turley Ditch	1876	6
Hammond Canal	1944, 1947, 6/17/55 (USBR filing)	90
Giant Refinery	1881, 1907, 1947, 10/24/55, 5/1/56* (A-LP)	2
Lee/Hammond Water Plant	1878*, 1881, 1896*, 1907, 1920*, 1930, 1946, 1947, 1953, 10/24/55, 5/1/56* (A-LP)	3
City of Farmington	1907, 1947, 10/24/55, 5/1/56* (A-LP)	55
	Subtotal	**280**
Downstream of the Animas River Confluence		
User	**Priority Date**	**Water Right, cfs**
Farmers Mutual Ditch	1920*, 2/8/51, 5/1/56* (A-LP)	105
Lower Valley Water Users Association	1879, 1897*, 1907, 1907*, 1947, 10/24/55, 5/1/56* (A-LP)	2
JSH Farms & San Juan Concrete	1877*, 1878*, 1879, 1891*, 1896*, 1920*	1
Jewett Valley Ditch	1879	32
PNM (San Juan Generating Station)	2/28/55 and a permit and USBR contract w/ unknown priority	30
BHP (4 Corners Power Plant)	2/28/55	50
	Subtotal	**220**
	Total Water Rights	**500**
	Indian Diversions below Navajo Dam	
Fruitland		7900 AF/An
Cudai		900 AF/An
Hogback		12100 AF/An
Other		152800 AF/An

All priority dates are for the San Juan River unless otherwise indicated

*	- Animas River priority date
**	- Los Pinos River priority date
A-LP	- Animas La Plata (under a USBR filing)

USBR Filings		
OSE File Nos.	**Quantities (AF/An)**	**Priority Dates**
2847	235,000	6/17/55
2848	23,000	6/17/55
2849	630,000	6/17/55
2873	28,800	1/17/56
2883	40,510	5/1/56
2917	225,000	9/16/57
2847, 2849, 2873 & 2917 Combined		3/6/58
3215	362,080	12/16/68
Total	**1,553,390**	

Note: If Animas-La Plata Project is de-authorized by Congress, USBR would formally release back to the state of New Mexico the water rights under OSE File No. 2883.

Ken Beck
Bureau of Reclamation
835 E 2nd Avenue
Durango, Colorado 81301

Subject: Giant Refinery water diversion during San Juan River low flow test

This letter documents our comments concerning our water diversion point on the San Juan River during the low flow test conducted July 8 through July 15.

The 500 cfs release rate historically has allowed us to divert sufficient water to maintain the Refinery operation. However the 250 cfs release rate, particularly on July 9 and 10, restricted our ability to draw that water. Any long term release at that level would require a redesign and revamp of our diversion point. It is assumed that the engineering and construction costs for this redesign and revamp will be covered by the party responsible for the reduction in Giant's water availibility.

From July 11 through the end of the test, the flow of water increased past our diversion, we assume due to afternoon rains and the upstream washes running. Even though we had water available during that time, our pumping activity had to be stopped for up to 24 hours at a time due to high solids loading in that water.

If you have any questions about this matter please contact Chad King at 632-4145 or Don Wimsatt at 632-4130.

Chad King
Technical Services Manager
Giant Bloomfield Refinery

Acronyms, Abbreviations, Definitions, and References

cfs	cubic feet per second
CRSP	Colorado River Storage Project
EIS	environmental impact statement
ESA	Endangered Species Act
GS	Geological Survey
Indian	American Indian
ITA	Indian Trust Assets
limnology	The study of conditions in fresh waters
MW	megawatts
Navajo Unit	Includes Navajo Dam and Reservoir
NEPA (1969)	National Environmental Policy Act
NMDGF	New Mexico Department of Game and Fish
Reclamation	Bureau of Reclamation
report	Report to the Public on the Low Flow Test
special status species	Include threatened and endangered species and species of concern for which further information is needed to determine their conservation status
Test	Summer Low Flow Test

References

Bureau of Reclamation. 1988. *Summary Report, San Juan River Winter Flow Test*. Upper Colorado Region, Western Colorado Area Office.

Holden, Paul B. 1999. *Flow Recommendations for the San Juan River*. San Juan River Basin Recovery Implementation Program, Fish and Wildlife Service, Albuquerque, New Mexico.