San Juan River Annual Habitat Monitoring

Fiscal Year 2021 Scope of Work

Submitted to

Bureau of Reclamation

From

Ecosystems Research Institute

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1 October 2020 to 30 September 2021

Introduction

In 1998, flow recommendations were developed by the SJRIP for the San Juan River below the confluence with the Animas River (River Mile 180). The details of the flow recommendations were heavily based upon river channel and habitat response to flows determined from a 7-year research study of channel morphology and habitat. In 1999, long-term monitoring was established to monitor channel and habitat response to flows. The protocols were continuations of those established during the 7-year research period and continued through 2004. From 1992 to 2007, the river-wide habitat mapping was conducted by ERI staff.

During the data integration process of 2004–2005, it became evident that backwater habitat types during base flow periods (800-1500 cfs) had been reduced in number and surface area beginning in September, 1995. Backwater surface areas between River miles 2 to 180 had decreased from 140,000 m^2 in September 1995 to less than 20,000 m^2, river wide by October 2003. From 2005 to 2015, backwater surface areas have stabilized at approximately 30,000 to 40,000 m^2. However, during 2016, the area of backwaters increased to over 90,000 m^2. It was hypothesized that the characteristics of the 2016 San Juan River spring runoff (magnitude, duration, etc.) were instrumental in the increase in low velocity habitats. These habitats persisted in 2017 with another high spring flow. However, in 2018, there was no spring release from Navajo Reservoir and the San Juan River experienced significant periods with summer baseflows less than 500 cfs. These resultant low flows reduced backwater surface areas to levels near their lows in 2004. In 2019, two monitoring data points were collected because of additional available water from Navajo Reservoir. The first was at an elevated baseflow of 1,500 cfs and the second at a lower baseflow of 690 cfs. The antecedent conditions prior to data collections, were considered high spring runoff conditions. All high flow metrics were met by the spring runoff. The resultant low velocity habitat surface areas were the largest since the 1995 high measurements

The 2020-21 habitat monitoring will document the impacts of the 2020 hydrograph, which is anticipated to be a lower than average flow year. We are hypothesizing that the backwater habitat areas created in 2019 will be reduced.

Within the major goals of the SJRIP monitoring program, the results of this proposed project will in part meet goal number (2) “Track changes in abiotic parameters, including water quality, channel morphology, and habitat, important to the fish community in particular and the aquatic community in general”. Specifically, the major tasks to be undertaken are:

> Task 1) Arrange the acquisition of high- resolution digital imagery from Rm 180 to Rm -10, (confluence with Lake Powel) and prepare maps for field verifications. Areal imagery will be obtained from a consultant contracted by ERI. The ortho corrected photography will be acquired for the post run-off summer baseflows as soon as possible given the instability of flows due to the summer monsoonal season.
>
> Task 2) Field habitat mapping will be conducted to verify flowing secondary channel types, backwaters, embayments, islands and total wetted areas under summer baseflow conditions in critical complex areas of the San Juan River that are problematic in interpreting conditions on the aerial images (channels with minimal inflow through cobble at the inflow area)

Task 3) Post-process the planform geometry into ARC GIS and determine density and area for each habitat type.

Task 4) Analysis data and prepare a final report describing the effects of the 2019 high flow hydrograph on the habitats and secondary channel types found in 2018 and compare them to the habitats created in 2016 and 2017.

The scope of work time frame is from September 1, 2020 to September 31, 2021.

Project Justification

The SJRIP has, as one of its two primary goals, the conservation of populations of Colorado pikeminnow and razorback sucker in the San Juan River basin. To aid in the evaluation of achievement of these program goals, the following monitoring plan goals were developed (San Juan Draft Monitoring Protocols, 2010):

1) Track the status and trends of endangered and other fish populations in the San Juan River;
2) Track changes in abiotic parameters, including water quality, channel morphology, and habitat, important to the fish community in particular and the aquatic community in general;
3) Utilize data collected under Goals 1 and 2 to help assess progress towards recovery of endangered fish species; and,
4) Assess effectiveness of management actions, implemented flows, and intra- and inter-annual variability in flows on recovery of Colorado pikeminnow, razorback sucker and population status of other fish species.

Relative to this scope of work, SJRIP goal (2) and (4) above will be met in part. Specifically, achievement of this goal will occur through the tracking of species important low velocity habitats (numbers and areas), as well as channel complexity necessary for all life stages of the two rare fish in the San Juan River. Updating the existing database and comparing the current information will provide a status and trends.

Project Objectives

The specific objectives of this work-plan correspond to the overall objectives of the monitoring protocols (2012). Specifically the direct linkage of objectives between this study and protocol objectives (by number) that are in common include:

Objective 1) Annually, following spring runoff, document abundance and distribution of key habitats and geomorphic features (backwaters, embayments, islands and total wetted area) that indicate the response of the river channel and habitat to antecedent runoff conditions and specific management actions… (*Specifically, determine the impact of the 2020 water hydrograph conditions on habitat planform).*

Objective 8) Develop relationships between habitat availability and antecedent flow conditions. Use key habitats for this analysis. (*For example*, t*he hydrograph for 2019 produced more days above 10,000, 8,000 and 5,000 cfs since the high flows of 2008 and produced the most backwater area since 1995.Conversely, flows in 2018 were well below those in 2019 and backwater habitat was*

reduced to the second lowest level since 2004). The project will evaluate if the existing relationships between habitat densities and antecedent conditions are still valid for the habitat densities that will be found after the 2020 spring runoff).

Objective 9) Track long-term trends of habitat availability

Task 1. Develop high-resolution Digital Imagery for Rm -10 to Rm 180.

The San Juan River will be flown and digital images captured at a resolution of 10 centimeters. Images will be printed with a 20% overlap between images and placed in plastic overlays.

Task 2 Field Habitat Mapping

If necessary, field-verify selected problematic marginally flowing secondary channels during the summer base-flow period (2020) captured in the aerial images. This will be dependent upon flow at image capture. All secondary channels, main channel splits, island splits and cobble/sand bar splits will be noted on base-maps and compared to the newest images.

Task 3) Post-process the planform geometry into ARC GIS and determine density and area for each habitat type.

Once the digital frames have been registered, ArcGIS will be used to digitize the boundaries of the wetted secondary channels. In addition backwaters, embayments islands and in-stream sand/cobble bars will be mapped. The data will be processed and summarized by river-mile to match existing datasets.

Task 4) Prepare a final report describing the effects of the 2020 spring flow hydrograph on the habitats and secondary channel types compared to 2016 to 2019 habitat data

A final report will examine the relationships between hydrology (especially recent antecedent hydrology conditions prior to image capture and mapping) and habitat conditions (density and area) throughout the river. Trend analysis will be performed on all habitat types mapped to assess trend with time and flow at mapping. Trends with time will be analyzed with raw data (habitat count and area by river-mile with time) and with data normalized for flow at mapping where flow is a covariate. Antecedent conditions will be calculated and relationships to habitat abundance compared to previously developed relationships.

One of the following hypothesizes will be addressed for the 2020 data depending upon the hydrologic conditions prior to mapping.

H_{O1} : If the spring runoff is greater than the average runoff, TWA, Island Count and Backwater Type area will be equal to or greater than the areas from the 2019 habitat characteristics (density and area)

H_{O2} : If the spring runoff is equal to the average runoff, TWA, Island Count and Backwater Type area will remain the same compared to the 2019 habitat characteristics (density and area)

H_{O3} : If the spring runoff is less than the average runoff, TWA, Island Count and Backwater Type area will be less than the 2019 habitat characteristics (density and area)

As part of the habitat post processing analysis, backwater and embayments will be divided into several types. These types of backwaters include those associated with main channel point bars and point bars on islands. In addition, backwaters associated with dry secondary channels and dry island split channels will be defined and quantified by river mile (count and area). Recent analysis has resulted in all historical backwater data being reclassified into these categories.

Schedule

Base photography will be acquired in September, 2020 (flow permitting). Frame capture, rectification, and photo-interpretation will be completed by December 2020. Field mapping (verification) will occur as soon as possible following image capture and be completed by the end of September 2020. ARC GIS data transfer will be completed by December 31, 2020. The draft annual report will be completed by March 31, 2021 with the final report due June 1, 2021.

Deliverables

1) Aerial images of the San Juan channel at base flows (500 to 1000 cfs).
2) Polygon area, perimeter and geo-referenced location of backwaters, embayments, islands, and channel margins for each flight
3) Flow at mapping (flight date) for each USGS gage. Distribution and abundance (area and density) of backwaters, embayments and total wetted area in response to antecedent runoff condition and other management actions. Channel complexity (e.g. island count and total wetted area per river mile)
4) Date of mapping
5) Antecedent runoff hydrograph
6) Data summarized by river mile, geomorphic reach and full range
    - An annual draft report prepared and submitted by March 31, 2021
    - A final report submitted by June 1, 2021
    - Attendance at the annual report meeting (2021)

APPENDIX A
Qualifications of Investigators

The project team will be made up of staff from Ecosystems Research Institute, Inc (ERI) ERI has extensive experience on the San Juan River and its tributaries having annually mapping aquatic habitats since 1991. In addition, the principal (Dr. Vincent Lamarra, ERI) has a long-standing presence on the Biology Committee of the SJRIP. Mr. Daniel Lamarra of ERI will be responsible for the field and laboratory habitat portion of the work elements. Mr. Daniel Lamarra has mapped the habitats used by the SJRIP for the last five years, including the RERI Phase I and II channels. That same group of scientists at ERI will be used on this project. This will result in a consistent database between the current project and the historical information gathered by the program.

In addition, these scientists have written numerous reports dealing with habitat quality, habitat and fish interactions as well as the effect of physical factors (temperature) on fish distributions in the San Juan River.

For convenience, ERI will manage the Image acquisition contractor (Keystone Aerial Surveys, Inc)) as part of this project.

APPENDIX B
Budget Summary for 2021 Habitat Monitoring

Budget: 2021 (One Flight)

TASK	Labor	Direct Costs	Total by Task
Contractor Image Capture (Keystone Aeriel Survey)	0	$49,545	$49,545
Task 1 Map Preparation			
Image Clipping and Capture	$2,160	$1,275	$3,435
Task 2 Field Verification			
Habitat and Channel determination	$7,560	$1,184	$8,744
Task 3 Post Process			
Image rectification and overlay	$2,160		$2,160
Digitizing Waters Edge	$19,760		$19,760
Back Water/ Embayment Identification	$9,084		$9,084
Task 4 Final Report and Presentation			
Data Analysis	$25,642	$984	$26,626
Reporting	$18,184	$870	$19,054
Total Cost Estimate	$84,550	$53,858	$138,408

APPENDIX C
Keystone Aerial Surveys (Geomni) Bid Summary
2021 Habitat Monitoring

KEYSTONE AERIAL SURVEYS, INC.
Northeast Philadelphia Airport • PO Box 21059 • Philadelphia, PA 19114
PHONE (215) 677-3139 • FAX (215) 464-2889

Quotation / Order form

All quotes are valid for 90 days.
Quotes after 90 days are subject to review and adjustments

TO: Daniel Lamarra
Ecosystems Research Institute
1023 W 800 N, Suite 108
Logan, UT 84321
V: 435-760-3071
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DATE: 3/11/20
QUOTED BY: John Schmitt
KAS REFERENCE #:

email: info@kasurveys.com or Web: www.kasurveys.com
Please Check here if you would like to receive a credit application ☐

ITEM	QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
		Provide New Aerial Survey of client's area using		
		Vexcel UltraCam UCXp Digital Sensor		
	Location:	San Juan River, UT-CO-NM		
	Details:	60 Flight lines and 924 digital images		$ 35,890.00
	GSD:	10 cm		
	Processing:	Lvl.03		
	Bands:	RGBi		
	Bit depth:	8 bit		
	ABGPS:	Yes		
	IMU:	Yes		
		Delivery Items		
	1	Digital imagery sent on hard drive(s)		
	1	Orthorectied dataset (4-band)		$ 13,655.00
		UTM Zone 12, NAD83 meters		
		Accuracny of the final project will be +-6 meters		
		horizontally from the control imagery		
		Flight: 1st week in September		
		TOTAL:		**$ 49,545.00**

If Keystone's product/services has an end use for an engineering or architectural services trade or business, performed in the United States by the taxpayer in the ordinary course of such trade or business with respect to the construction of real property in the United States. (IRS Code Section 199).
The location/description of the construction is as follows: _____