



— BUREAU OF —  
RECLAMATION

# Calendar Year 2021 Report to the Rio Grande Compact Commission

**Interior Region 7: Upper Colorado Basin**



## **Mission Statements**

The U.S. Department of the Interior (DOI or Department) protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated Island Communities.

The mission of the Bureau of Reclamation (Reclamation) is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

March 2022

# **Calendar Year 2021 Report to the Rio Grande Compact Commission**

*Prepared by Bureau of Reclamation, Albuquerque Area Office, Albuquerque, New Mexico*

## **For the Rio Grande Compact Commission:**

**Colorado**  
**Kevin Rein**

**New Mexico**  
**Mike Hamman**

**Texas**  
**Robert Skov**

**Federal Chairman**  
**Hal Simpson**

Cover Photo: Rio Grande from east bank just downstream of the Closed Basin Project River Outlet  
(Reclamation, 2020)

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## List of Acronyms and Abbreviations

AAO.....Albuquerque Area Office  
ABCWUA .....Albuquerque Bernalillo County Water Utility Authority  
ac-ft .....acre-feet  
AIS .....Aquatic Invasive Species  
ANWR.....Alamosa National Wildlife Refuge  
AOP .....Annual Operating Plan  
Article VII.....Article VII of the Rio Grande Compact of 1938  
ASI .....Annual Site Inspection  
ASG .....Applied Science Grants  
AWARDS.....Agricultural Water Resources Decision Support  
BCM.....Basin Characterization Model  
BDANWR.....Bosque del Apache National Wildlife Refuge

BIA.....	Bureau of Indian Affairs
BLM.....	Bureau of Land Management
BO.....	Biological Opinion
BWHA.....	Blanca Wildlife Habitat Area
CADSWES .....	Center for Advanced Decision Support for Water and Environmental Systems
CAS .....	Corrective Action Study
CFA.....	Contributed Funds Agreements
cfs .....	cubic feet per second
Compact.....	Rio Grande Compact of 1938
CPUE.....	Catch-Per-Unit-Effort
CPW.....	Colorado Parks and Wildlife
CR.....	Comprehensive Review
cuckoo .....	Western Yellow-billed Cuckoo
CWCD.....	Conejos Water Conservancy District
CWMP.....	Cooperative Watershed Management Program
D.N.M. ....	District Court of New Mexico
DCP .....	Drought Contingency Plan
DMI .....	Data Management Interface
DOI/Department.....	U.S. Department of the Interior
DOMSAT .....	Domestic Communications Satellite
DSS .....	Data Storage System
EBID .....	Elephant Butte Irrigation District
EDW.....	Emergency Drought Water
EIS .....	Environmental Impact Statement
EOM.....	End of Month
EPCWID.....	El Paso County Water Improvement District No. 1
ESA .....	Endangered Species Act
ESARO.....	Evaluation of San Acacia Reach Options
ESP .....	ensemble streamflow prediction
ET .....	Evapotranspiration
flycatcher .....	Southwestern willow flycatcher
FR.....	Federal Register
FRR.....	Facility Reliability Rating
HCCRD.....	Hudspeth County Conservation and Reclamation District No. 1
HDB .....	Bureau of Reclamation's Hydrologic Database
HEC-RAS .....	Hydrologic Engineering Center River Analysis System
IBWC.....	International Boundary and Water Commission
ITS.....	Incidental Take Statement
JPL.....	NASA's Jet Propulsion Laboratory
jumping mouse.....	New Mexico Meadow Jumping Mouse
kWhr .....	kilowatt-hour
LFCC .....	Low Flow Conveyance Channel
MAT.....	Minnow Action Team
MF-OWHM.....	MODFLOW One-Water Hydrologic Flow Model
MODFLOW.....	Modular Three-Dimensional Finite-Difference Groundwater Flow Model
MODIS.....	Moderate Resolution Imaging Spectroradiometer
MRG .....	Middle Rio Grande

MRG BO.....	2016 Middle Rio Grande Biological Opinion
MRG .....	Middle Rio Grande
MRGCD.....	Middle Rio Grande Conservancy District
MRGV.....	Middle Rio Grande Valley
NASA .....	National Aeronautics and Space Administration
NCAR.....	National Center for Atmospheric Research
NEPA .....	National Environmental Policy Act
NMDGF .....	New Mexico Department of Game and Fish
NMISC .....	New Mexico Interstate Stream Commission
NMOSE .....	New Mexico Office of the State Engineer
NMWSC.....	New Mexico Water Science Center
NRCS.....	Natural Resources Conservation Service
NREL .....	National Renewable Energy Laboratory
OA.....	Rio Grande Project Operating Agreement
O&M.....	operations and maintenance
P&P.....	Prior and Paramount
P.L. ....	Public Law
PEST.....	Parameter ESTimation
Reclamation .....	Bureau of Reclamation
RGCC.....	Rio Grande Compact Commission
RGP .....	Rio Grande Project
RGP BO.....	2016 Rio Grande Project Biological Opinion
RGSM.....	Rio Grande silvery minnow
RGTIHM.....	Rio Grande Transboundary Integrated Hydrologic Model
RGWCD .....	Rio Grande Water Conservation District
RM.....	River Mile
ROV.....	Remote Operated Vehicle
RWS .....	Regional Water System
S&T.....	Science and Technology Program
SADD.....	San Acacia Diversion Dam
Secretary .....	Secretary of the U.S. Department of the Interior
SECURE Water Act .....	Science and Engineering to Comprehensively Understand and Responsibly Enhance Water Act
SIR.....	Scientific Investigations Report
SJ-C .....	San Juan-Chama
SLVCBD .....	San Luis Valley Project-Closed Basin Division
SLVCD.....	San Luis Valley Project-Conejos Division
SLVWCD.....	San Luis Valley Water Conservation District
SOD.....	Safety of Dams
SWEP.....	Small-Scale Water Efficiency Project
TDS.....	total dissolved solids
Title XVI.....	Title XVI of P.L. 102-575, Water Reclamation and Reuse Program
TRG .....	Transboundary Rio Grande
TRGWM.....	Transboundary Rio Grande Watershed Model
TSC .....	Technical Service Center
UCB .....	Upper Colorado Basin
URGWOM .....	Upper Rio Grande Water Operations Model
USACE.....	U.S. Army Corps of Engineers
USDS.....	U.S. District Court

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USFWS ..... U.S. Fish and Wildlife Service  
USGS ..... U.S. Geological Survey  
UT ..... Ultrasonic Thickness  
WaterSMART ..... Sustain and Manage America's Resources for Tomorrow; DOI  
program focused on improving water conservation  
WCFSP ..... Water Conservation Field Services Program  
WEEG ..... WaterSMART Water and Energy Efficiency Grant  
WIIN Act ..... Water Infrastructure Improvements for the Nation



# Introduction

The Albuquerque Area Office (AAO) of the Bureau of Reclamation (Reclamation) is responsible for operation, maintenance, and oversight of four projects on the mainstem of the Rio Grande (Figure 1) and its upper basin tributaries. These projects are the San Luis Valley Project, the San Juan-Chama Project, the Middle Rio Grande Project, and the Rio Grande Project.

The San Luis Valley Project consists of the Conejos and Closed Basin Divisions. The Conejos Division, which includes Platoro Dam and Reservoir, supplies water for approximately 86,000 acres within the Conejos Water Conservancy District (CWCD). The Closed Basin Division (CBD) is a groundwater salvage project located near Alamosa, Colorado, which pumps water from the shallow unconfined aquifer primarily to assist Colorado in meeting its commitment under the Rio Grande Compact (Compact).

The San Juan-Chama Project (SJ-C) consists of a system of diversion structures, tunnels, and channels for transbasin movement of water from the San Juan River Basin to the Rio Grande Basin for storage in Heron Reservoir as a component of the Colorado River Storage Project. The Project supplies water for municipal, domestic, industrial, recreation, fish and wildlife purposes, and supplemental water for irrigation. Another part of the project is the Pojoaque Tributary Unit including Nambé Falls Dam. The Pojoaque Tributary Unit supplies water for approximately 2,800 irrigated acres in the Pojoaque Valley.

The Middle Rio Grande Project (MRG) consists of El Vado Dam and Reservoir and irrigation and drainage facilities in the Middle Rio Grande Valley (MRGV). The Project also includes river channel maintenance from Velarde, New Mexico, south to Caballo Reservoir, and the Low Flow Conveyance Channel (LFCC) south of San Acacia, New Mexico. Irrigation water is provided to the Middle Rio Grande Conservancy District (MRGCD) which supplies water to 50,000 – 70,000 acres of land.

The Rio Grande Project (RGP) includes Elephant Butte and Caballo Reservoirs and Percha, Leasburg, and Mesilla Diversion Dams. The Project stretches from the lower Rio Grande Valley of southern New Mexico to Fort Quitman south of El Paso, Texas. The Rio Grande Project provides an agricultural water supply for approximately 178,000 acres of land within the Elephant Butte Irrigation District (EBID) in New Mexico and the El Paso County Water Improvement District No. 1 (EPCWID) in Texas. Water is also supplied for diversion to Mexico by the United States Section of the International Boundary and Water Commission (IBWC), according to the terms of the Convention of 1906 between the United States and Mexico. Drainage waters from the Project lands provide a supplemental supply for approximately 18,000 acres of land within the Hudspeth County Conservation and Reclamation District No. 1 (HCCRD) in Texas. Elephant Butte Dam also generates hydroelectric power that is marketed by the Western Area Power Administration.

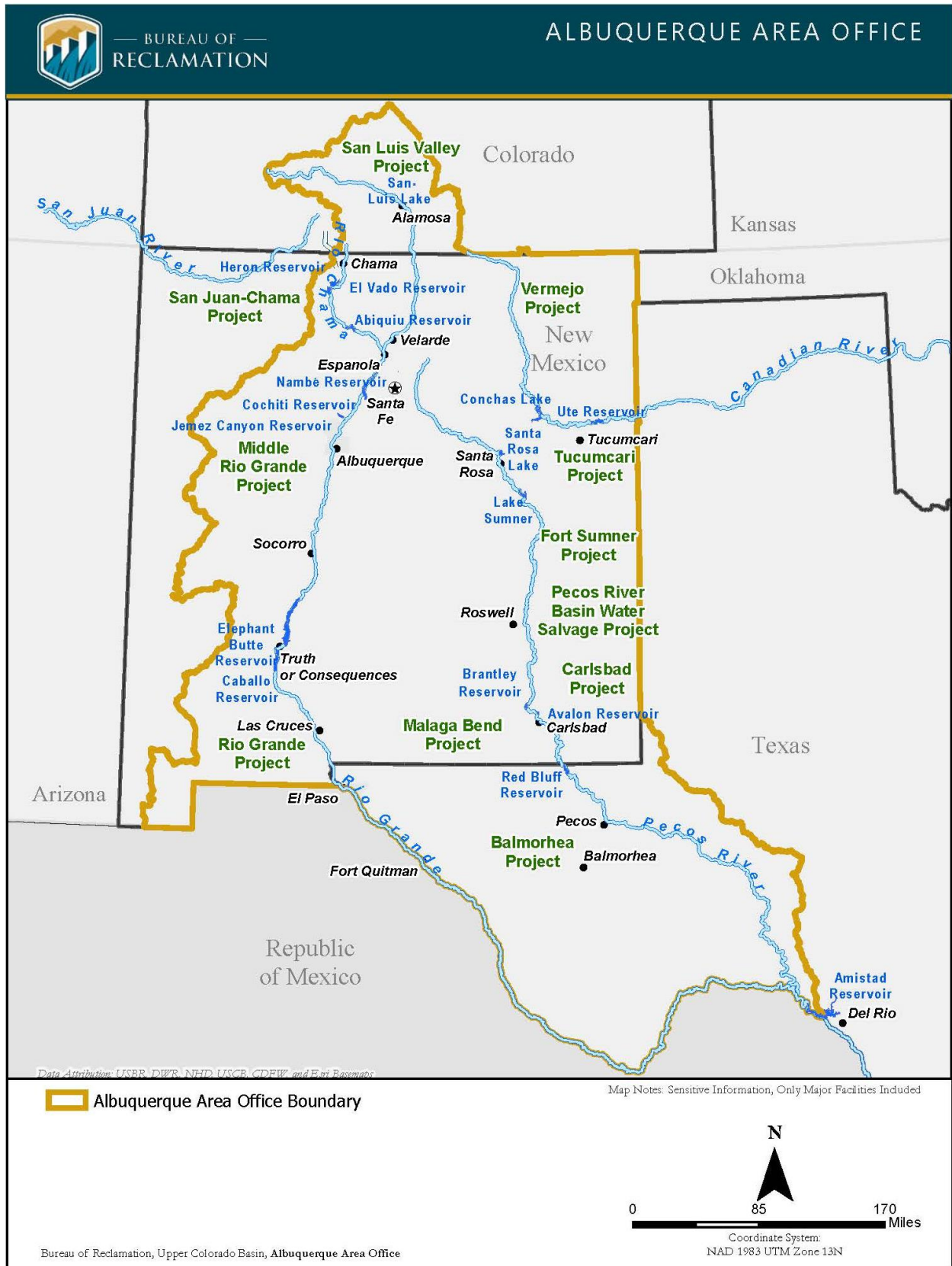


Figure 1: Map of Reclamation's Albuquerque Area Office Projects

# San Luis Valley Project, Colorado

## Conejos Division, Platoro Reservoir

The CWCD, located in Manassas, CO, operates Platoro Reservoir, which provides storage for approximately 86,000 acres associated with the San Luis Valley Project Conejos Division (SLVCD) (Figure 2).

### Operations

Platoro Reservoir started 2021 with a midnight water surface elevation of 9,972.08 feet and a storage volume of 14,235 acre-feet (ac-ft), on January 1. Article VII<sup>1</sup> restrictions were in effect on January 1, 2021, and remained in effect for the rest of calendar year 2021. The December 31, 2021, reservoir elevation was 9,972.19 feet, with a storage volume of 14,292 ac-ft. The minimum storage during calendar year 2021 was on May 21, 2021, at 13,847 ac-ft (9971.28 feet). The maximum storage was on June 12, 2021, when the reservoir peaked at 9,986.88 feet, with a storage volume of 22,323 ac-ft.

### 2022 Platoro Reservoir Outlook

The March Natural Resources Conservation Service (NRCS) most probable forecast for Platoro Reservoir inflow is for 51,000 ac-ft or 100 percent of the 30-year median<sup>2</sup>. Article VII Compact restrictions on storage in Platoro are projected to be in effect for the entirety of 2022.

## Platoro Dam Facility Review and Safety of Dams Program

There are no significant dam safety related operation and maintenance (O&M) issues with Platoro Dam and Dike.

Comprehensive Reviews (CR) are regularly scheduled examinations conducted every eight years and consist of civil and mechanical examinations. The scheduled CRs were completed in 2021 and resulted in seven new Category 2 O&M recommendations.

At the end of the 2020 irrigation season, the dam tender planned to recoat the interior of the conduit pipe where two locations adjacent to the conduit pipe bifurcation are exhibiting areas of coating degradation stemming from high velocity discharges. The coating surface defects were first observed in 2017. It was recommended that the outlet pipe coating be repaired before the next peak discharge to prevent further damage. The scheduled recoating work was not completed in 2021 due to weather concerns and downstream water demands. It is scheduled to be completed in 2022.

The Facility Reliability Rating (FRR) was completed in September 2021 with Platoro Dam receiving a score of 92 which equates to an overall rating of “Good.”

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<sup>1</sup> See the Article VII section under Rio Grande Project

<sup>2</sup> In 2022, the NRCS updated the 30-year period from 1981-2010 to 1991-2020 and also changed from the average to the median for their comparison metric.

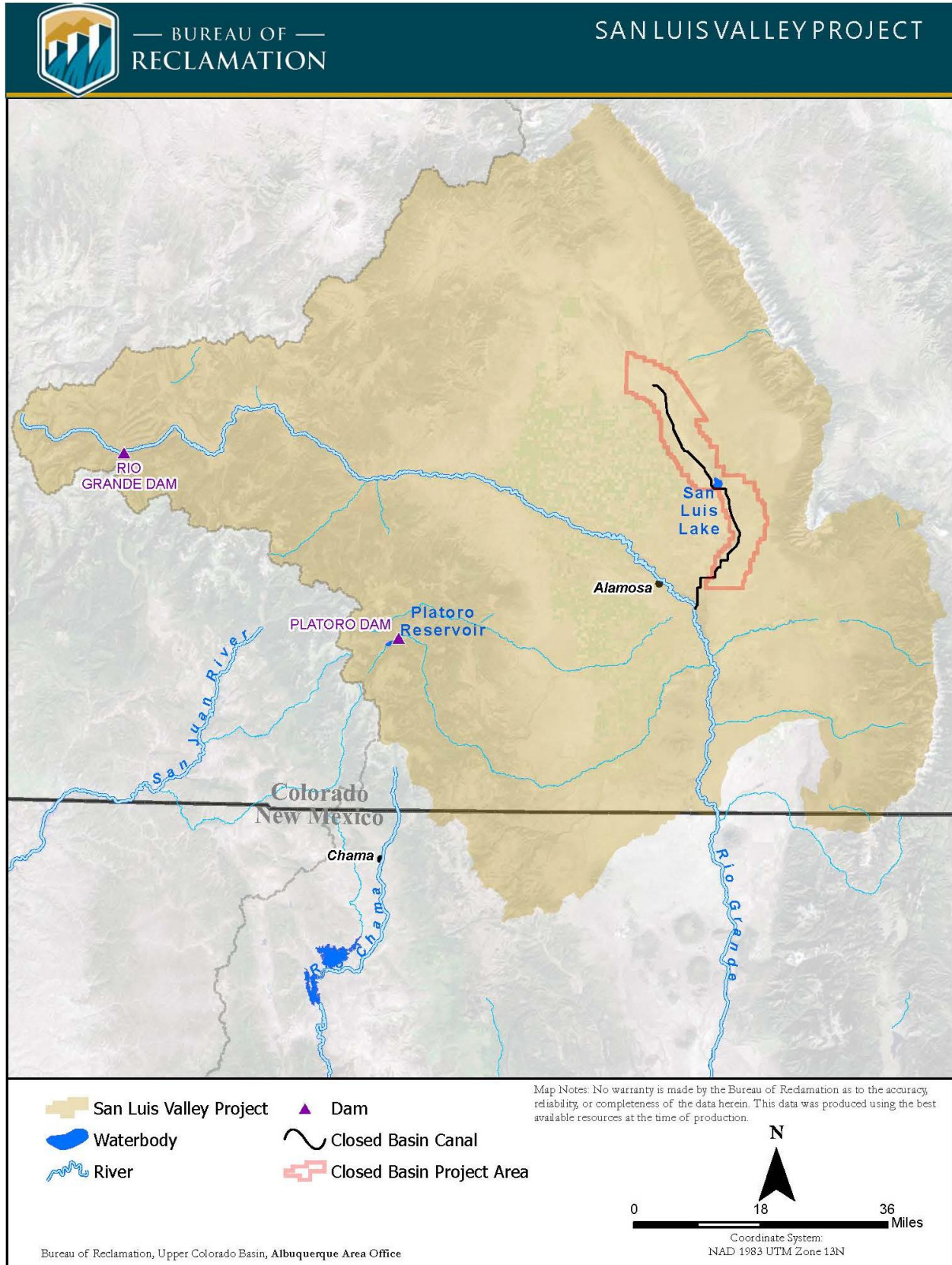


Figure 2: Area Map of San Luis Valley Project

## Closed Basin Division

The San Luis Valley-Closed Basin Division (SLVCBD) is a water salvage project in Colorado (Figure 2). The SLVCBD purpose is to salvage unconfined groundwater from the Closed Basin that would otherwise be lost to evaporation and evapotranspiration. The salvaged water is pumped from up to 170 salvage wells and delivered through a conveyance channel to the Rio Grande to assist Colorado in meeting its scheduled delivery under the Rio Grande Compact. The SLVCBD also delivers mitigation water to the Alamosa National Wildlife Refuge (ANWR) and Blanca Wildlife Habitat Area (BWHA). Reclamation operates the Project under the guidance of the SLVCBD Operating Committee.

### Operations

The SLVCBD continues to supply Priority 1 (Compact) and Priority 2 (mitigation) water deliveries. The San Luis Valley is still in a long-term drought. Since 2002, the water table in the unconfined aquifer has dropped significantly in some areas. SLVCBD salvage wells are operated to minimize aquifer impacts outside the Project area and to insure sustainability of the Closed Basin aquifer. Salvage wells turned off at the recommendation of the SLVCBD Operating Committee remain off while nearby water levels are monitored.

Deliveries by the SLVCBD in 2021 included deliveries to the Rio Grande, BWHA, ANWR, and San Luis Lakes State Wildlife Area (SWA). In 2021, the Project delivered 11,600 ac-ft. Of that, total creditable Compact water delivered to the Rio Grande was 8,239 ac-ft. This included 7,777 ac-ft delivered at the SLVCBD canal outlet, plus 24 ac-ft delivered to the BWHA and 438 ac-ft delivered to the San Luis Lakes SWA in exchanges with BLM and Colorado Parks and Wildlife (CPW). The Compact specifies that creditable water delivered to the Rio Grande cannot exceed 350 parts per million total dissolved solids (TDS) based on a 10-day average. All water deliveries to the Rio Grande met these water quality standards in 2021. Table 1 compares total production and Compact deliveries in 2021 to the five preceding calendar years.

Table 1: SLVCBD Deliveries 2016-2021<sup>1</sup>

Year	Total SLVCBD Production	Delivered to Rio Grande @ SLVCBD Canal Outlet	Delivered to Rio Grande by Exchange <sup>2</sup>	Total Creditable Delivery to Rio Grande
2021	11,600	7,777	462	8,239
2020	9,911	6,188	310	6,498
2019	12,334	8,567	400	8,967
2018	10,209	6,558	250	6,808
2017	11,789	8,003	378	8,381
2016	12,095	8,469	242	8,711

<sup>1</sup> Units are ac-ft

<sup>2</sup> SLVCBD water delivered to BWHA or San Luis Lakes SWA in exchange for other water sources delivered upstream to the Rio Grande.

Table 2 shows total water deliveries to the Bureau of Land Management’s (BLM) BWA were 1,274 ac-ft, composed of 800 ac-ft for annual mitigation, 24 ac-ft from an exchange with BLM, and 450 ac-ft transfer from the ANWR. Deliveries to ANWR were 2,111 ac-ft for SLVCBD Project mitigation – 2,561 ac-ft less the 450 ac-ft transfer to the BWA.

Table 2: SLVCBD Water Accounting<sup>1</sup>

San Luis Valley - Closed Basin Division	BWA CH03 STA. 730 + 00	BWA CH04 STA. 798 + 60	BWA Month Totals <sup>2</sup>	Parshall Flume Total Passing Flume	Parshall Flume Creditable Amount at Flume	ANWR CH01 Chicago Turn-Out	ANWR CH02 Mum. Turn-Out	ANWR Pumping Plant	ANWR Month Totals	Delivery to the Rio Grande Total at Flume Minus Del. @ ANWR	Delivery to the Rio Grande Credit Amt. (Del. to R.G. & not used by ANWR) <sup>3</sup>	Delivery to the Rio Grande Non-Creditable at Lobatos	SLVCBD Totals
January	0	0	0	949	949	0	0	0	0	949	949	0	949
February	0	0	0	952	952	0	0	0	0	952	952	0	952
March	91	90	181	986	986	307	307	0	614	372	372	0	1,167
April	5	5	10	897	897	0	0	0	0	897	897	0	907
May	0	0	0	1,025	1,025	0	0	0	0	1,025	1,025	0	1,025
June	101	75	176	734	734	0	0	0	0	734	734	0	910
July	128	139	267	488	488	0	0	0	0	488	488	0	755
August	151	275	426	249	249	41	33	0	74	175	175	0	675
September	113	101	214	815	815	318	290	0	608	207	207	0	1,029
October	0	0	0	855	855	398	401	0	799	56	56	0	855
November	0	0	0	883	883	8	8	0	16	867	867	0	883
December	0	0	0	1,055	1,055	0	0	0	0	1,055	1,055	0	1,055
Annual	589	685	1,274	9,888	9,888	1,072	1,039	0	2,111	7,777	7,777 <sup>4</sup>	0	11,162 <sup>5</sup>

<sup>1</sup> Units are ac-ft

<sup>2</sup> Delivery to BWA includes: 24 ac-ft transferred via exchange by the BLM and 450 ac-ft transfer of mitigation water from the ANWR to the BWA

<sup>3</sup> The San Luis Lakes SWA received 438 ac-ft which was delivered to the North Head Lake Playa in an exchange with CPW

<sup>4</sup> Total creditable to Rio Grande from delivery and exchange = 7,777 + 24 + 438 = 8,239 ac-ft

<sup>5</sup> Total SLVCBD production for 2021 was 11,162 + 438 = 11,600 ac-ft

## **Maintenance**

Routine preventive maintenance and repair activities continue at all observation and salvage wells, lateral line valves, canal structures, pumping plants, and canal and lateral access roads. Several miles of lateral roadways were upgraded and rehabilitated with added road base material. All vehicles and heavy equipment were serviced according to their recommended maintenance schedule.

Redrilling and rehabilitation of salvage wells is ongoing. In 2021, two salvage wells were redrilled, 19 wells were rehabilitated, and 10 new pumps were installed.

## **Water Quality**

Reclamation continues to monitor the water quality of SLVCBD salvage wells, the Rio Grande, San Luis Lake, Head Lake, and the conveyance channel with 1,308 samples collected during 2021.

Reclamation's Water Quality Laboratory continues to support the O&M groups with their salvage well rehabilitation and bio-fouling mitigation efforts.

## **Rio Grande Water Conservation District**

The Rio Grande Water Conservation District (RGWCD) assists Reclamation with SLVCBD maintenance through a cooperative agreement. RGWCD assisted with salvage well maintenance, rehabilitation, and drilling activities. Other work included blading and mowing of all canal berms and lateral access roads, removal of aquatic weeds and sediment from the canal and associated structures, repair and maintenance of right-of-way fences, and repair of erosion along the canal berms. RGWCD also assisted in vehicle and heavy equipment maintenance.

# **San Juan-Chama Project, Colorado – New Mexico**

Water is diverted from the San Juan River Basin in Colorado through the San Juan-Chama Project (SJ-C) (Figure 3), authorized by Congress in 1962 through Public Law (P.L.) 87-483. This introduces special circumstances for water use and management in the Middle Rio Grande Valley. Imported SJ-C water must be accounted for separately from native Rio Grande flow.

## **San Juan-Chama Project Accounting**

Reclamation is responsible for water contracts and water accounting for the SJ-C. Accounting reports are generated with Crystal Reports, which mines accounting data from Reclamation's hydrologic database (HDB). HDB is Reclamation's database of record. The data are computed in RiverWare and sent to HDB via a Data Management Interface (DMI). Crystal Reports has been used since 2013 to generate the SJ-C accounting report. SJ-C accounting for 2021 is provided in the separate *2021 Water Accounting Report*.

## **Heron Dam and Reservoir Operations**

Diversions into the Azotea Tunnel began on March 8, 2021, and continued until September 7 during 2021. The total volume diverted was 60,129 ac-ft. The running 10-year average of Azotea Tunnel diversions decreased significantly this year, from 82,959 ac-ft for the period 2011 through 2020, to 79,145 ac-ft for the period 2012 through 2021 (Table 3).



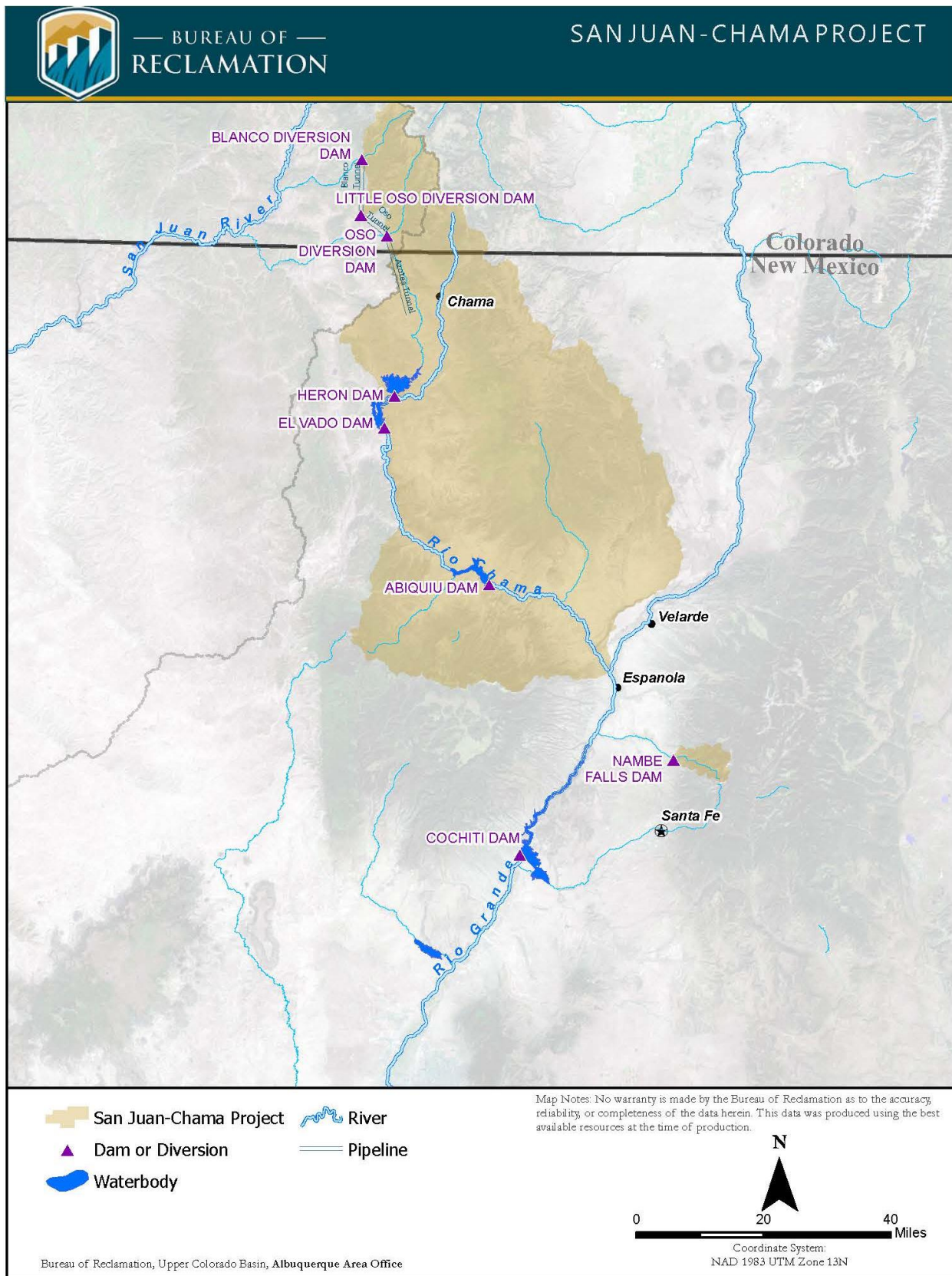


Figure 3: Area Map of the San Juan-Chama Project

Table 3: SJ-C Diversions through Azotea Tunnel<sup>1</sup>

Azotea Tunnel	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	10-Year Total
Month											
January	0	0	0	28	109	0	0	0	0	0	137
February	0	0	227	974	1,917	1,488	0	0	9	0	4,615
March	7,014	1,036	1,984	6,890	6,489	16,839	1,598	1,036	1,644	816	45,346
April	18,133	7,068	13,808	8,163	13,687	32,628	12,869	24,049	10,605	13,446	154,456
May	17,032	16,844	20,251	24,470	27,940	45,326	15,616	33,926	26,972	24,778	253,155
June	4,037	8,387	18,851	38,438	35,427	46,227	2,636	56,925	7,866	17,907	236,701
July	670	511	1,550	8,581	3,535	10,617	152	26,285	876	2,439	55,216
August	260	3,115	788	889	3,681	4,809	7	5,841	159	627	20,176
September	76	4,930	902	126	1,271	1,806	0	208	83	116	9,518
October	0	2,761	1,334	811	253	2,413	1,216	0	0	0	8,788
November	0	1,049	335	862	0	279	283	0	0	0	2,808
December	52	0	59	0	334	0	90	0	0	0	535
Annual	47,274	45,760	60,030	90,566	94,309	162,522	34,377	148,270	48,214	60,129	791,451

Heron Reservoir began the year at elevation 7,088.42 feet (53,271 ac-ft). The maximum elevation/storage was reached on June 15 at 7,113.85 feet (99,258 ac-ft). Heron Reservoir ended the year at elevation 7,077.69 feet (40,239 ac-ft), close to the low point of 7077.49 feet (40,022 ac-ft), which occurred on December 23.

There was insufficient storage in the project pool on January 1 to make an initial allocation to the SJ-C contractors. The first allocation of 8,000 ac-ft was made in April, and subsequent allocations were made in, May, June, July, and August. The total volume allocated was 63,000 ac-ft, or 65 percent of a full allocation.

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<sup>1</sup> Units are ac-ft

The SJ-C contractors’ 2021 and waived 2020 allocations were delivered as shown in Table 4, for a total delivery of 68,097 ac-ft. The remaining 2021 allocations are being held in Heron according to waivers, which grant an extension of the delivery date into 2022. It should be noted that many contractors lease their allocation to Reclamation which shows up as an internal transfer within Heron and not a release from the individual contractor’s account. Table 5 presents actual monthly Heron water operations in 2021.

Table 4: SJ-C Water 2021 Releases from Heron Reservoir<sup>1</sup>

SJ-C Heron Release	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Release
MRGCD	0	0	0	0	0	9,342	0	0	0	0	0	0	9,342
Santa Fe	0	0	0	0	0	0	0	0	4,740	0	0	0	4,740
Santa Fe County	0	0	0	0	0	0	304	0	0	0	0	246	550
Cochiti	0	0	0	0	0	0	0	0	381	0	1,904	388	2,673
City of Albuquerque	0	0	0	0	0	3,370	9143	12,335	14,233	0	0	0	39,081
Pojoaque Unit	0	0	0	0	0	0	0	0	784	0	0	0	784
Taos	0	0	0	0	0	0	0	0	0	0	53	0	53
County of Los Alamos	0	0	0	0	0	0	0	0	0	0	4	781	785
City of Española	0	0	0	0	0	0	0	0	0	0	0	17	17
Taos Ski Valley	0	0	0	0	0	0	0	0	0	0	10	0	10
Village of Los Lunas	0	0	0	0	0	100	0	0	0	0	108	0	208
Town of Bernalillo	0	0	0	0	0	100	0	0	224	0	0	0	324
Belen	0	0	0	0	0	200	0	0	0	0	51	0	251
Red River	0	0	0	0	0	0	0	0	0	0	0	0	0
Jicarilla Apache	0	0	0	0	0	0	0	0	0	0	0	0	0
Ohkay Owingeh	0	0	0	0	0	0	0	0	0	0	0	0	0
Reclamation	0	0	0	0	0	1,589	2,164	2,668	2,858	0	0	0	9,279
El Prado	0	0	0	0	0	0	0	0	0	0	0	0	0
Taos Pueblo	0	0	0	0	0	0	0	0	0	0	0	0	0
Aamodt Settlement	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>14,701</b>	<b>11,611</b>	<b>15,003</b>	<b>23,220</b>	<b>0</b>	<b>2,130</b>	<b>1,432</b>	<b>68,097</b>

<sup>1</sup> Units are ac-ft

Table 5: SJ-C Monthly Water Operations in Heron Reservoir<sup>1</sup>

Heron Reservoir	Rio Grande Inflow	San Juan Chama Inflow	Rio Grande Outflow	San Juan Chama Outflow	San Juan Chama Loss	Rio Grande End of Month (EOM) Content	San Juan Chama EOM Content	Total	Elevation (feet)
Dec. 2020	-	-	-	-	-	350	52921	53271	7,088.42
January	168	0	32	0	0	136	53271	53407	7,088.52
February	179	0	29	0	0	286	53271	53557	7,088.63
March	1169	816	707	0	0	748	54087	54835	7,089.56
April	1877	13419	2293	0	2122	331	65385	65716	7,096.81
May	51	24728	51	0	1052	331	89061	89392	7,109.49
June	61	17871	61	14701	217	331	92014	92345	7,110.84
July	698	2439	937	11611	64	93	82778	82871	7,106.35
August	157	627	51	15003	683	199	67720	67919	7,098.15
September	32	116	32	23220	586	199	44030	44229	7,081.23
October	22	0	22	0	210	199	43820	44019	7,081.05
November	20	0	20	2130	317	199	41373	41572	7,078.90
December	117	0	18	1432	0	298	39941	40239	7,077.69
Sub-Total	4,551	60,016	4,253	68,097	-	-	-	-	-
Adjustment <sup>2</sup>	-	-	-	-	-	-350	-	-	-
Annual	64,567		72,350		5,251	-52	40,291	40,239	-

<sup>1</sup> Units are ac-ft (except as noted)

<sup>2</sup> 350 ac-ft of native Rio Grande water is annually retained in Heron to cover water use by New Mexico State Parks' facilities under a water rights file No. 1545

## **Pojoaque Tributary Unit – Nambé Falls Dam and Reservoir**

Operations at Nambé Falls Reservoir consist of non-irrigation and irrigation season activities. During non-irrigation season (November – April), all inflow in excess of the bypass requirement of 0.5 cfs is typically stored until an elevation of 6,825.60 feet is reached. Once that elevation is attained, the outlet gates are regulated weekly to stabilize the reservoir at 6,825.60 feet, or the elevation it is at when it reaches 100 percent ice cover. An uncontrolled spill begins at elevation 6,826.60 feet, which is the top of the spillway crest. During irrigation season (May – October), water is stored and released on demand to meet downstream requirements.

Nambé Falls Reservoir began 2021 at an elevation of 6,813.69 feet (1,097 ac-ft). The reservoir filled on April 16 and remained full and spilling until May 1 when irrigation releases began. The maximum elevation was 6,826.65 feet (1,731 ac-ft) which occurred on April 17. There were three 9-day releases made at approximately 30 cfs throughout the summer, the last ending on September 4. A flow of 5 cfs was maintained for Nambé Pueblo between block releases. The minimum elevation of 6,813.08 feet (1,071 ac-ft) was reached on July 17. The reservoir ended 2021 at elevation 6,823.57 feet (1,566 ac-ft).

The Nambé Falls depletion for the year was 1,467 ac-ft. A release of 1,493 ac-ft from Heron Reservoir was required to account for losses from Heron to Otowi. Due to the higher than normal depletion and a less-than-full allocation made at Heron, only 784 ac-ft of the required amount was released. The model calculated a shortfall of 711 ac-ft, which will be released in 2022 or subsequent years as available.

Table 6 shows all SJ-C water at Otowi, and includes a summary of Nambé Falls use above Otowi and the Pojoaque Unit return flow credit used to calculate depletions during 2021. A summary of 2021 Nambé Falls Reservoir operations is provided in Table 7.

Table 6: SJ-C Water at Otowi<sup>1</sup>

SJ-C at Otowi	Release from Heron	Heron Release Stored in El Vado	Release from El Vado	Total Below El Vado	Release from or Storage in Abiquiu	Trans. Losses	Nambé Falls Use Above Otowi	Return Flow Credit - Pojoaque Unit	San Juan Water at Otowi
January	0	0	5,226	5,226	-2,669	81	138	22	2,361
February	0	0	5,591	5,591	-4,462	72	124	24	957
March	0	0	5,609	5,609	-3,310	82	207	20	2,029
April	0	0	0	0	5,281	48	214	18	5,037
May	0	0	0	0	2,929	26	136	17	2,784
June	14,701	2,481	0	12,221	1,094	254	46	56	13,071
July	11,611	2,958	0	8,653	-5,745	121	212	72	2,646
August	15,003	4,632	0	10,371	-3,361	177	337	27	6,523
September	23,220	10,682	0	12,539	-5,573	201	59	42	6,748
October	0	0	1,662	1,662	150	35	120	49	1,707
November	2,130	0	1,533	3,663	-2,056	55	149	30	1,434
December	1,432	0	1,443	2,875	-409	54	124	24	2,312
Annual	68,097	20,753	21,064	68,410	-18,131	1,206	1,866	401	47,609

<sup>1</sup> Units are ac-ft

Table 7: SJ-C Monthly Water Operations at Nambé Falls Reservoir<sup>1</sup>

Nambé Falls	Inflow	Outflow Bypassed	Outflow Storage Release Operational	Outflow Storage Release Irrigation	Reservoir Losses	Total Outflow + Losses	EOM Content	EOM Elevation (feet)
Dec. 2020	-	-	-	-	-	-	1,091	6,813.56
January	195	58	0	0	0	57	1,229	6,816.70
February	169	44	3	0	3	50	1,348	6,819.23
March	241	34	0	0	10	44	1,544	6,823.16
April	385	165	0	10	25	201	1,729	6,826.60
May	591	452	0	337	11	799	1,521	6,822.70
June	337	281	0	449	13	744	1,114	6,814.09
July	496	283	0	53	-2	334	1,276	6,817.71
August	716	376	0	205	7	588	1,403	6,820.37
September	285	212	0	227	20	459	1,229	6,816.70
October	244	123	0	42	5	170	1,303	6,818.29
November	197	48	0	0	7	56	1,444	6,821.20
December	185	61	1	0	3	64	1,566	6,823.57
Annual	4,041	2,137	4	1,323	102	3,566	-	-

## 2022 San Juan-Chama Project Outlook

On January 1, 2022, the allocable SJ-C water in Heron Reservoir was zero (0) ac-ft. Allocations must leave sufficient water in SJ-C storage to cover both the dead pool and anticipated reservoir evaporation from January 1 until runoff begins in the spring. Therefore, contractors were notified on January 15, 2022, of the zero ac-ft initial allocation.

Water scarcity was contemplated in the San Juan-Chama Project Authorization (P.L. 87-483), and all SJ-C water contracts state that “when the actual available water supply may be less than the estimated firm yield, [Contractors] shall share in the available water supply in the ratio that the above allocation bears to the firm yield.” Subsequent allocations will be made monthly beginning in April. They will continue until December 15, unless a full allocation is made earlier. The March NRCS most probable forecast for the Rio Blanco and the Navajo River at the diversions are for 40,000 and 48,000 ac-ft respectively. That may translate to an inflow into Heron of 70,000 to 80,000 ac-ft. Median annual project inflow for the period of 1971 to 2021 is 89,180 ac-ft, therefore a full allocation is unlikely in 2022.

## Facility Review and Safety of Dams Program

### Heron Dam

There are no significant dam safety related O&M issues associated with Heron Dam and Dike. An Emergency Management Functional Exercise was conducted in September 2021. The Annual Site

<sup>1</sup> Units are ac-ft except as noted

Inspection (ASI) was completed in July 2021. Comprehensive Reviews (CR) are regularly scheduled examinations conducted every eight years and consist of civil and mechanical examinations. The civil exam portion of the Heron Dam CR was conducted in 2020, and the mechanical exam portion in May 2021. As a result of the civil exam portion, a new Safety of Dams (SOD) recommendation was initiated, 2020-SOD-A, “Abandon the hydraulic piezometer terminal well at Heron Dam by backfilling with ASTM C33<sup>1</sup> concrete sand.” The piezometer well was backfilled in the fall of 2021 and the final report is pending.

The FRR was completed in September 2021 with Heron Dam receiving a score of 96, which equates to an overall rating of “Good.”

### **Nambé Falls Dam**

There are no significant dam safety-related issues associated with Nambé Falls Dam.

The mechanical exam portion of the CR was completed in May 2021 and the Civil exam portion was completed in September 2021. The result of the mechanical exam portion resulted in two Category 2 O&M recommendations, one to repair the generator and one to repair the automatic operation of the gates. In September 2021, Chama Field Division personnel repaired the generator and the gates. The Mechanical Inspector subsequently removed these two O&M recommendations from the final CR report. The Civil exam portion of the CR resulted in four Category 2 O&M recommendations and two Category 3 O&M recommendations. To date, there is one incomplete Safety of Dams recommendation and three incomplete Category 2 O&M recommendations.

Work continues on Category 2 O&M recommendation 2007-2-A: Review and update the dam break analyses for the earth embankment and the arch dam, including the effects of the small reservoir storage, and revise the downstream inundation maps. The inundation map revisions were completed in 2021.

In the fall of 2021, the dam tender resigned, and a replacement dam tender was hired in late December 2021.

The FRR was completed in September 2021 with Nambé Falls Dam receiving a score of 82, which equates to an overall rating of “Good.”

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<sup>1</sup> American Society for Testing and Materials – Concrete Aggregates (fine and coarse)



# Middle Rio Grande Project, New Mexico

The Middle Rio Grande Project (MRG) is operated by the Albuquerque Area Office, with support from the Chama Field Division for operations and maintenance of MRG and SJ-C facilities. The Socorro Field Division performs construction throughout the area. The MRG includes El Vado Dam and Reservoir and the River Maintenance Program from Velarde, NM to Caballo Reservoir (Figure 4). MRGCD acts as Reclamation's agent with the transferred O&M authority and responsibility for the MRG diversion dams and irrigation distribution system.

## El Vado Dam and Reservoir Operations

A new area and capacity table was implemented at El Vado Reservoir on January 1, 2021, so volumes will reflect the new values. El Vado Reservoir began 2021 at an elevation of 6,813.07 feet (18,813 ac-ft) and ended the year at 6,809.75 feet (16,101 ac-ft). The low point of the year occurred on March 19, just prior to the beginning of spring runoff, with the reservoir hitting an elevation of 6,802.32 feet (10,849 ac-ft). The peak was on September 30 at an elevation of 6,829.35 feet (35,154 ac-ft).

MRGCD started 2021 with 169 ac-ft of SJ-C water in El Vado Reservoir from the previous year's allocation. As part of the initial 2021 SJ-C allocation, MRGCD received no initial allocation in Heron Reservoir on January 1. By the end of the year, they had received 13,687 ac-ft of their full allocation of 20,900 ac-ft. MRGCD took delivery of and released all of their 2021 allocation. A total of 9,342 was released from Heron in June. In July, MRGCD borrowed 4,297 ac-ft from the City of Santa Fe's Abiquiu account to release to meet irrigation demand prior to the July 15 SJ-C allocation. This was paid back to Santa Fe in Heron in September when it was clear no further SJ-C allocations would be made for the year. A transfer of 4,345 ac-ft was made from MRGCD to Santa Fe's Heron account, which includes a transportation loss factor.

MRGCD began the year with no native Rio Grande water in storage in El Vado for Middle Valley irrigation. At the beginning of 2021, Article VII<sup>1</sup> Compact restrictions on storage of native water were in effect and remained so for the entire year. The only native water stored during the year was 15,428 ac-ft for potential Prior and Paramount (P&P) needs.

El Vado was used as a re-regulating reservoir for water moving between Heron and Abiquiu for efficient operations and multi-purpose water availability. The Albuquerque Bernalillo County Water Utility Authority (ABCWUA) and the City of Santa Fe moved some of their 2019 SJ-C allocation out of Heron and into El Vado late in 2020. This SJ-C water (11,284 ac-ft – ABCWUA and 5,144 ac-ft – Santa Fe) was used to maintain winter flows between El Vado and Abiquiu in early 2021 while allowing native inflows to be stored in El Vado. Reclamation moved its own leased water from Heron to El Vado during June and July to help provide weekend rafting flows. In August and September, ABCWUA provided the flows for weekend rafting while Reclamation's leased water provided the 100 cfs minimum base flows on weekdays.

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<sup>1</sup> See Article VII Section under Rio Grande Project

Total storage in the reservoir at the end of the year was 16,101 ac-ft, all SJ-C water: 15,004 ac-ft – ABCWUA, 311 ac-ft – City of Santa Fe, and 786 ac-ft – Los Alamos. Table 8 provides a summary of monthly operations and water accounting for El Vado Reservoir.

Table 8: Reservoir Operations for El Vado Dam<sup>1</sup>

El Vado Reservoir Operations	Rio Grande Inflow	San Juan - Chama Inflow	Rio Grande Outflow	San Juan - Chama Outflow	Rio Grande Losses	San Juan - Chama Losses	Rio Grande EOM Content	San Juan - Chama EOM Content	Total EOM Content
Dec. 2020	2929	559	2814	3576	127	-14	3437	16668	20105
January	1668	0	2238	5226	0	0	2867	11371	14238
February	3028	0	0	5591	0	0	5895	5780	11675
March	6234	0	444	5609	53	2	11632	169	11801
April	39444	0	35349	0	128	2	15599	167	15766
May	58678	0	58875	0	56	2	15346	165	15511
June	12705	14701	13114	12221	63	17	14874	2628	17502
July	5679	11611	5417	8653	211	1	14926	5585	20511
August	2426	15003	2791	10371	-82	67	14643	10150	24793
September	718	23220	1012	12471	0	95	14349	20805	35154
October	2268	0	2072	1662	61	37	14485	19105	33590
November	1952	2130	10140	3667	76	39	6221	17529	23750
December	2769	1432	8896	3656	94	-795	0	16101	16101
Annual	137569	68097	140348	69127	660	-533	-	-	-

All daily operations decisions were made using provisional data available at the time of the decision. Because of that, reservoir storage in the final accounting model, which uses final Compact-approved data, may differ from reservoir storage used to make daily operational decisions. Hence, the dates mentioned above may differ from those found using final 2021 data.

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<sup>1</sup> Units are ac-ft

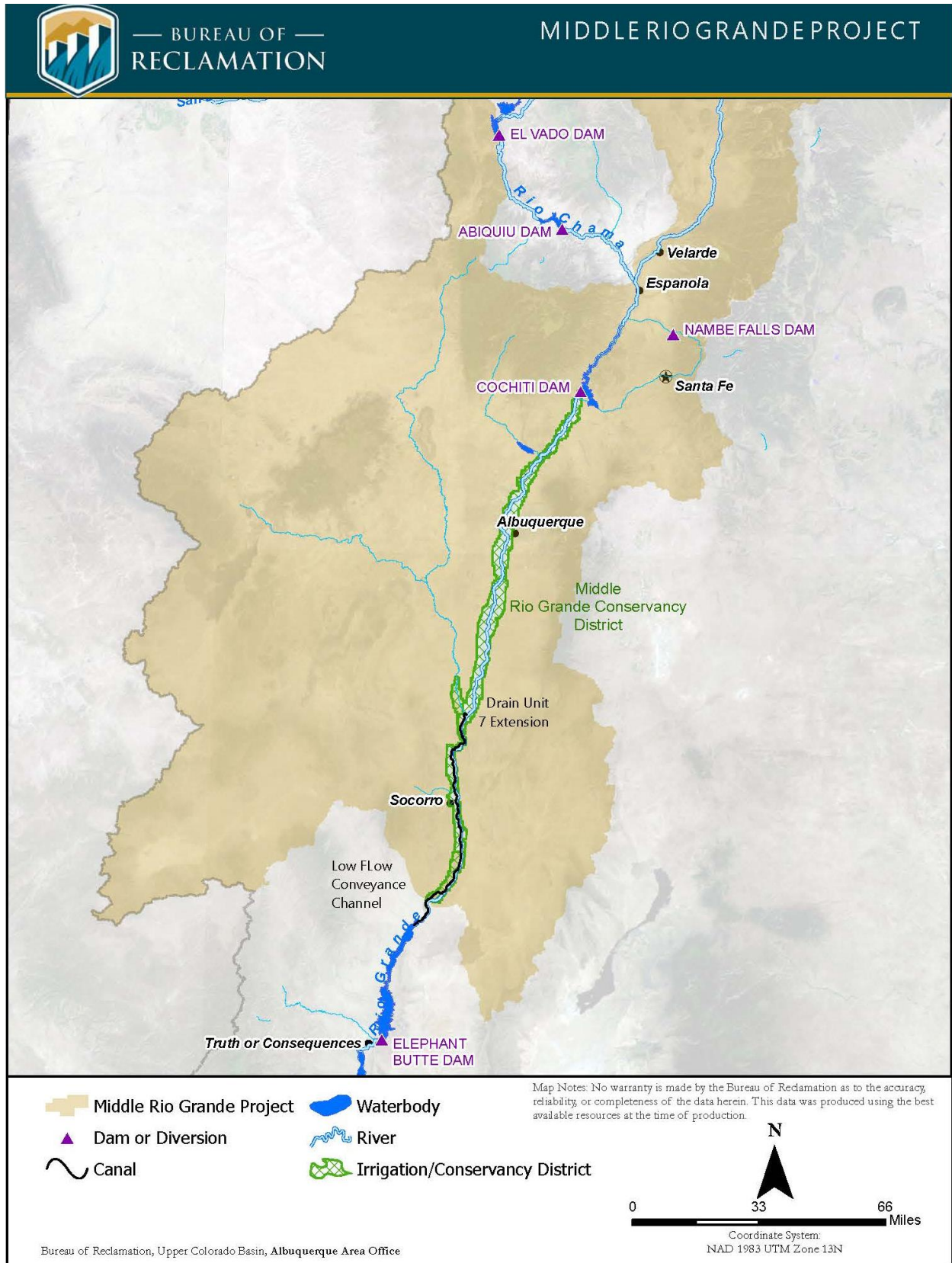


Figure 4: Area Map of the Middle Rio Grande Project

### **Prior and Paramount Operations**

Reclamation stores native water in El Vado Reservoir for use on the P&P acreage of the six MRG Pueblos when natural Rio Grande flows are not sufficient to meet irrigation demand. The Bureau of Indian Affairs' (BIA) call for P&P storage in 2021 was 15,428 ac-ft. That volume was transferred to P&P storage in El Vado on April 30 from the native water stored since January 1. There was no call for any release to be made from storage over the course of the irrigation season. A total of 14,176 ac-ft was released to Elephant Butte Reservoir between November 29 and December 8. The release was done as a spike flow of 2,400 cfs for one day with a ramp up and a ramp down on the days before and after. Losses from April 30 to December 8 were 1,252 ac-ft.

### **Emergency Drought Water**

Allocations of Emergency Drought Water (EDW) made by the New Mexico State Engineer and available for capture and storage during future years are: 19,000 ac-ft by Reclamation, 12,600 ac-ft by NMISC, and 53,767 ac-ft by MRGCD. Reclamation was allocated 19,000 ac-ft of which 5,000 ac-ft were granted to ABCWUA as repayment for water released during the early 2000s under an Agreed Order. Under a 2016 multi-party EDW Agreement, MRGCD agreed to jointly manage Reclamation's allocation for the sole purpose of Endangered Species Act (ESA) compliance. No EDW was stored during 2021.

### **Compact Debit Water**

No Compact Debit water was stored in El Vado during 2021.

## **2022 Middle Rio Grande Project Outlook**

Based on the March NRCS spring runoff forecast for the Rio Grande at Otowi of 390,000 ac-ft (69 percent of median) and March to July El Vado Reservoir inflow of 164,000 ac-ft (88 percent of median), the current La Niña conditions for El Niño-Southern Oscillation activity, and current hydrologic conditions, MRGCD is expected to have a shorter irrigation season than normal. In January 2022, MRGCD announced plans for a staggered start to irrigation season from March 7 to early April 4. Reclamation began retaining water for P&P lands on January 1, 2022.

As detailed in the next two sections, construction on the El Vado Dam embankment should begin after runoff in 2022. From the end of runoff in 2022 to the expected completion of embankment construction in late 2023, El Vado Reservoir will be restricted to 6,785 ft (1,912 ac-ft) to prevent a sediment discharge downstream as well as to protect the facility and the construction crew.

## **Facility Review and Safety of Dams Program – El Vado Dam**

Four additional drill holes were installed on the crest and downstream left abutment of El Vado Dam in the summer of 2020 in support of the final design of the seepage reduction project. Automated piezometers were installed in these drill holes in 2021 and are currently online and collecting data.

Reclamation completed an Ultrasonic Thickness (UT) inspection on 19 panels of the upstream face plate in the spring of 2021. The inspection included five panels which had not been inspected

previously. The UT inspection data does not show an overall substantial material loss of the face plate steel. However, pit depth measurements indicate varying material loss. The average depth of the pits on the dam range from 0.04 inches to 0.08 inches. The maximum depth measured at each UT test location ranged from 0.09 inches to 0.16 inches indicating that up to half of the steel's original thickness (0.25 inches) has been lost in those discrete areas. Pinholes in the steel were also observed which indicate a complete loss of material at those locations. Reclamation noted that moisture may travel through these pinholes and cause corrosion on the back side of the steel plates. The pitting was most severe in the fluctuating zone of the reservoir.

The Corrective Action Study was completed when the Dam Safety Advisory Team moved the Study to final design. The two phases of the construction, embankment and spillway, are discussed separately in this report.

There is currently one incomplete SOD recommendation and eight incomplete Category 2 O&M recommendations for El Vado Dam. Completion of construction and resulting modifications will also complete the outstanding incomplete SOD recommendation and several of the Category 2 O&M recommendations. The outstanding SOD recommendation, 2019-SOD-A, established in FY 2019, refers to preparing final designs for preferred alternatives to address risk associated with the failure of the service spillway, an uncontrolled release via the emergency spillway, and internal erosion through the embankment. An additional SOD recommendation issued in FY 2019, 2019-SOD-B, restricts El Vado Reservoir to an elevation of 6,875 feet to reduce overall risk and has been completed following the change in operations to restrict reservoir elevation.

The contract for the El Vado Dam Seepage Reduction Modification, or embankment construction, was awarded on September 25, 2021. A readiness review meeting and a pre-construction site meeting were held in October 2021.

In the summer of 2021, work began on an Emergency Action Plan supplement for use during the seepage reduction modification construction.

As of September 2021, approximately 95 percent of the El Vado service spillway and crest modification designs have been completed.

The following were completed as part of the final design.

- Prepared drawings and specification sections for the Review C meeting, which marks the end of formal review of the construction specifications and drawings;
- Finalized inundation studies for use in construction and fuse-plug dike risk analyses; and
- Completed flood routings for construction risk analysis.

As a result of the proposed modifications to the service spillway, powerlines currently located near the construction area will need to be relocated. The powerline relocation contract with Northern Rio Arriba County is in progress. Meetings to relocate the powerline prior to the service spillway construction are ongoing.

In 2021, the El Vado Dam mechanical exam was completed for the 2020 CR. No Category 1 O&M or Category 2 O&M recommendations resulted from the CR.

The FY 2021 ASI was completed in July 2021. The 2021 FRR was completed in September 2021 with a score of 51, resulting in an overall rating of “Poor.” The rating is due to SOD recommendation 2019-SOD-A, described above, as well as a 2021 Dam Safety Priority Rating of 2 which denotes an “Urgent Priority.”

## **El Vado Dam Construction Update**

In spring 2020, the primary environmental and cultural compliance aspect of the El Vado Dam construction was completed. The spillway and embankment were recorded by an architectural historian in 2021, and an application for the National Historic register was completed and submitted to the New Mexico State Historic Preservation Office as part of the required cultural mitigation. The final design for the spillway is ongoing and expected to be completed in 2022.

The contract for the embankment construction was awarded in September 2021, and contract mobilization is scheduled for April 2022, with work to commence after spring run-off, approximately mid-May. Work planned for the remainder of 2022 includes grouting behind the steel faceplate. Installation of the geomembrane liner is planned to begin in 2023. During the embankment phase of construction, the reservoir elevation will be restricted to 6,785 ft (1,912 ac-ft) to prevent a sediment discharge downstream as well as to protect the facility and the construction crew. All inflow will be bypassed during this phase of construction. There will also be temporary road closures over the dam on N.M. Highway 112 during embankment construction to allow contractor access.

## **Related Reservoir Operations**

### **Abiquiu Dam and Reservoir**

Abiquiu Dam and Reservoir is a U.S. Army Corps of Engineers’ (USACE) facility. P.L. 97-140 authorizes storage up to 200,000 ac-ft of SJ-C water in Abiquiu Reservoir. SJ-C water in storage in 2021 peaked on November 29 at 75,822 ac-ft. Total storage in the reservoir peaked at 85,126 ac-ft (6,189.88 ft) on December 1 during the spike flow operation from El Vado. There was no flood storage in 2021. Abiquiu ended 2021 with 75,669 ac-ft of SJ-C water in storage. Table 9 provides a summary of monthly operations and water accounting for Abiquiu Reservoir.

Table 9: Reservoir Operations for Abiquiu Dam<sup>1</sup>

Abiquiu Reservoir Operations	Rio Grande Inflow	SJ-C Inflow	Rio Grande Outflow	SJ-C Outflow	Rio Grande Losses	SJ-C Losses	EOM Content Sediment	EOM Content Rio Grande	EOM Content SJ-C	EOM Content Total
Dec. 2020	2594	3090	2610	858	0	-345	2087	7	64341	66435
January	2555	5098	2558	2429	0	109	2087	0	66905	68992
February	779	5534	778	1072	-1	191	2087	2	71176	73265
March	809	5743	813	2433	-2	197	2087	0	74289	76376
April	36308	0	36142	5281	2	795	2115	164	68213	70492
May	62069	0	62101	2929	8	1138	2187	124	64146	66458
June	12063	11311	12217	12405	5	903	2196	-35	62149	64310
July	9534	8516	9126	2770	-4	747	2203	377	67148	69728
August	3789	10515	4168	7154	-4	1153	2207	3	69355	71565
September	859	12220	863	6647	-1	544	2211	0	74384	76596
October	2562	1699	2577	1850	-2	569	2211	-12	73665	75864
November	8433	3454	2367	1398	2	343	2224	6053	75378	83655
December	11759	2908	17804	2500	8	118	2235	0	75669	77904
Annual	151,519	66,998	151,514	48,868	11	6,807	-	-	-	-

<sup>1</sup> Units are ac-ft

### Cochiti Dam and Reservoir

Cochiti Dam and Reservoir is another USACE facility. It is located downstream from the confluence of the Rio Chama and the Rio Grande. Congress authorized a permanent pool of 1,200 surface acres for recreational purposes (recreation pool) and for fish and wildlife. This pool is composed of SJ-C water, and evaporation losses are replaced with more SJ-C water to maintain 1,200 surface acres.

Recreation pool water may be released from Heron Reservoir and temporarily stored in Abiquiu, then released over the winter to provide flows in the Rio Chama between Abiquiu and the confluence with the Rio Grande. In 2021, 1,901 ac-ft was released from Abiquiu Reservoir and 1,878 ac-ft arrived in Cochiti Reservoir to fill the recreation pool and maintain flows on the Rio Chama. The year ended with a deficit of 3,112 ac-ft needed to reach 1,200 surface acres. Table 10 is a summary of monthly operations and water accounting for Cochiti Reservoir.

Table 10: Reservoir Operations for Cochiti Dam<sup>1</sup>

Cochiti Reservoir Operations	EOM SJ-C Pool	Area SJ-C Pool (acres)	EOM SJ-C Pool Losses	Hold Pool (SJ-C + Sed.)	EOM Wetlands Elevation (feet)	EOM Wetlands Area (acres)	Allocated SJ-C Pool Area (acres)	Allocated SJ-C Pool Capacity	Demand for SJ-C Pool	Monthly SJ-C Delivery
Dec. 2020	42,125	1,058	83	42,274	5,354	0	1,200	44,129	1,971	0
January	42,778	1,097	74	42,898	5,354	0	1,200	44,137	1,359	695
February	42,753	1,095	147	42,878	5,354	0	1,200	44,137	1,384	122
March	42,468	1,074	301	42,597	5,354	0	1,200	44,137	1,669	16
April	42,056	1,054	412	42,205	5,354	0	1,200	44,137	2,082	0
May	41,640	1,036	415	41,855	5,354	0	1,200	44,137	2,497	0
June	41,208	1,003	432	41,433	5,354	0	1,200	44,137	2,929	0
July	41,019	983	189	41,260	5,354	0	1,200	44,137	3,119	0
August	41,107	992	332	41,363	5,354	0	1,200	44,137	3,030	421
September	40,765	954	342	41,028	5,354	0	1,200	44,137	3,372	0
October	40,646	941	119	40,911	5,354	0	1,200	44,137	3,491	0
November	40,894	968	171	41,163	5,354	0	1,200	44,137	3,243	418
December	41,025	983	75	41,304	5,354	0	1,200	44,137	3,112	206
Annual	-	-	3,009	-	-	-	-	-	-	1,878

<sup>1</sup> Units are ac-ft noted)



## MRG River Gage Operation and Maintenance

Data from river gages helps Middle Rio Grande water management agencies meet the needs of water users, fulfill the requirements of the Compact, maintain adequate water in the river to support ESA operations, and provide information needed to improve the daily management of the river system from Cochiti Dam to Elephant Butte Reservoir. Data from these gages are available to the public at <http://waterdata.usgs.gov/nm/nwis/current/?type=flow>.

Reclamation continues to fund four gages operated and maintained by the USGS to support ESA operations: Rio Grande near Bosque Farms, NM (08331160); Rio Grande at State Hwy 346 near Bosque, NM (08331510); Rio Grande at bridge near Escondida, NM (08355050); and the Rio Grande above U.S. Hwy 380 near San Antonio, NM (08355490).

MRGCD continues to operate and maintain gages on many of their facilities. These gages show how much water is diverted from and returned to the river and how water is moving through the irrigation system. Funding from Reclamation allowed MRGCD to set up the first set of these gages. Reclamation displays the data from these gages on its Evapotranspiration Toolbox (see ET Toolbox section below).

## River Maintenance

Reclamation has authorization for maintenance of the Rio Grande from Velarde, NM, south to the headwaters of Caballo Reservoir. Responsibilities include maintenance of the river channel, floodplain, project drains, and the 55-mile LFCC. Project purposes include improving water delivery and sediment transport, protecting riverside facilities and property, and preventing flooding. River maintenance consists of any work done in the channel and floodplain, including habitat restoration. Reclamation conducts annual river reviews of conditions of sites and reaches after the spring snowmelt runoff and summer monsoon events.

Maintenance needs are prioritized based on these reviews and assessment of geomorphic trends and conditions, public and infrastructure risk, and water delivery effects for the 260-mile reach of the MRG. Project purposes listed above are joined by newer considerations to enhance ecological function of the system within the Middle Rio Grande Project Authorization (P. L. 81-858 and P. L. 86-645). Maintenance projects involve planning, design, environmental compliance, construction, and adaptive management. Most maintenance projects require adaptive and recurring maintenance over the life cycle of each project's intended design life.

Reclamation is working on a new programmatic approach to Clean Water Act (CWA) compliance for river maintenance projects, using a Letter of Permission. This approach will take time to put in place but should reduce time needed in the future for CWA compliance for individual projects. While this will be helpful, Reclamation anticipates very challenging mitigation requirements for wetland impacts on projects intended to improve water conveyance in river reaches narrowed by vegetation encroachment. Vegetation has colonized new sand bars, changing areas that were open water into wetlands. Restoring the width of the channel in such areas results in very large impacts to those wetlands that will be difficult to mitigate in accordance with CWA requirements from USACE.

## **River Maintenance Sites**

Reclamation is pursuing work at 17 total sites and reaches along the MRG. There are five active sites that require an annual review of channel capacity and possible maintenance due to sediment accumulation.

The 2021 spring runoff was again low (47 percent of average at the Otowi gage), but slightly higher than 2020 (40 percent of average). The Bosque del Apache National Wildlife Refuge (BDANWR) River Mile (RM) 82-79 Pilot Realignment Project, realigning the river to a lower elevation in the eastern floodplain, was completed in March 2021. Due to low spring runoff in 2020 and 2021, the realigned channel has not seen extended high flows to further advance the river slope adjustment from the new downstream connection. Monitoring to evaluate the channel's adjustment and conveyance is underway. At the time of this report, the realignment is functioning as expected with no need for more excavation or further adaptive maintenance with the exception of vegetation management being addressed by the BDANWR.

Reclamation's efforts at all maintenance sites include data collection, geomorphic and sediment investigations, design studies, alternative evaluations, design and development of construction drawings, material supply and development, lands access, environmental compliance, project and construction management, construction maintenance, and adaptive maintenance/monitoring.

In the following sections, the terms "new," "existing," and "adaptive" are used to describe the various river maintenance sites and reach status. "New" sites developed following high flow events on the Rio Grande in the previous year. "Existing" sites are in the process of completion. "Adaptive" sites have been substantially completed and are being monitored for function and performance.

### **San Felipe (Existing Maintenance Sites)**

A total of 10 river maintenance sites have been identified on the Pueblo of San Felipe. Seven sites have been completed, and three are ready for construction. The remaining three sites are RM 211.3, RM 212.8, and RM 214.4. Construction on longitudinal fill stone toe protection at RM 211.3 began in the fall of 2015 and was partially completed by March 2016. The work was put on hold at that time by the Pueblo of San Felipe for a review of impacts to vegetation of traditional or medicinal value. All construction work at the remaining sites is currently pending permission by the Pueblo of San Felipe. During the 2019 spring runoff, the bank eroded towards the levee at the two eastern bends at RMs 212.8 and 214.4. Again, work at these locations is currently on hold. A letter was sent to the Pueblo of San Felipe on October 31, 2019, informing the Pueblo of the potential risk to riverside facilities presented by conditions at these locations.

### **Santa Ana River Mile 205.8 (Adaptive Maintenance Site)**

This site is within the Pueblo of Santa Ana on the east bank of the Rio Grande, across from the Tamaya Resort pavilion. Nine bendway weirs and a low elevation floodplain were designed by a contractor hired by the Pueblo and were constructed by Reclamation in 2014. Through a P.L. 93-638 contract, the Pueblo of Santa Ana planted vegetation at this site in early 2015. During the 2015 spring runoff, erosion at the site washed away the newly planted vegetation and caused bankline scalloping between some of the weirs shortly after completion. An interim adaptive maintenance project was completed in January 2016 to provide additional protection of the levee system while a longer-term solution could be investigated. The site experienced additional bank erosion during the

2016 and 2017 runoff, but the existing weir field and temporary controls placed in 2016 minimized the extent of the lateral bank migration.

An investigation to evaluate the specific geomorphic and hydraulic conditions that led to the unexpected bank erosion during the 2015 runoff was completed in October 2018. Reclamation is currently planning adaptive maintenance work as part of a permanent repair project. These repairs will include the placement of longitudinal stone toe protection between the existing bendway weirs for toe strength, construction of a new side channel on the opposite bankline to relieve hydraulic pressure on the bendway, and the installation of vegetated, mechanically stabilized earth along the hillslope above the stone toe to promote further bank stability. Construction of these channel and bank features is expected to begin in the fall of 2022.



Photo 1: Looking downstream at Santa Ana River Mile 205.8 east bankline bendway weirs and bankline repairs (Reclamation, 2021)

### **Angostura to Montañó Reach Planning (Existing Maintenance Reach)**

In 2014, Reclamation identified the reach of the Rio Grande from RM 201 to Montañó Bridge for hydraulic and geomorphic assessment and project planning. This reach is transitioning, with riverbed incision and migrating bends that have caused problematic erosion at locations such as the Sandia Priority Site, the Bernalillo Priority Site, the Corrales Siphon, Corrales River Mile 199, and private land south of the Highway 550 Bridge. The goal of this reach planning is to analyze the current geomorphic and hydraulic trends and identify potential river projects that both minimize the need

for river maintenance and improve habitat value. Two hydraulic models of this reach were created using 2015 and 2017 hydrographic data. The hydraulic and geomorphic report is complete and located at the following website:

<https://www.usbr.gov/uc/envdocs/reports/AngosturaDamtoMontanoBridge-GeomorphicanHydraulicAnalysis.pdf>.

Reclamation continues to assess river maintenance needs and opportunities for habitat restoration within the MRG area to support ESA compliance.

### **Sandia Priority Site Bendway Weir Repairs (Adaptive Maintenance Site)**

In collaboration with the Pueblo of Sandia, Reclamation constructed the Sandia Priority Site in 2008 as the river was approaching the east levee. Upon completion, Reclamation transitioned the site to the adaptive maintenance and monitoring phase. Post-project geomorphic monitoring such as cross section data collection, aerial flights, and longitudinal profile data collection on the Rio Grande have been performed since 2008 as part of the adaptive maintenance activities.

In 2016, there was new erosion along the east bankline at the site. With the approval of the Pueblo's Tribal Council, Reclamation strengthened the bankline at the bendway weirs in March and April 2017.

An investigation to evaluate the specific geomorphic and hydraulic conditions that led to the 2016 spring runoff bank erosion was completed in August 2018. As a result of this investigation, Reclamation plans to perform adaptive maintenance at the site as part of a longer-term repair project. The adaptive maintenance work consists of two phases. Phase I will include rehabilitating the side channels constructed on the western floodplain as part of the original 2008 project, and constructing a new side channel to facilitate water and sediment transport from an arroyo on the western floodplain. Phase II includes two new side channels just downstream of the project in an area that is also eroding. Construction on Phase I was completed in April 2021. Construction on Phase II is expected to start in fall 2022 or later.



Photo 2: Construction of new side channels on the western floodplain of the Sandia Priority Site (Reclamation, 2021)

### **Corrales Siphon (Adaptive Maintenance Site)**

The Corrales Siphon at RM 199.7 is in Corrales, NM, just north of Albuquerque and about 700 feet downstream of the Arroyo de la Barranca confluence. The siphon was constructed in the early 1930s by the MRGCD to supply irrigation water to the Corrales Main Canal. During river reconnaissance in 2012, Reclamation discovered that degradation in the area had exposed the siphon. MRGCD requested emergency technical assistance and construction support from Reclamation to temporarily protect it during the 2016 runoff.

Reclamation and MRGCD collaborated on a short-term project that placed riprap in the scour hole downstream of the exposed siphon. Approximately 1,800 cubic yards of riprap were placed upstream and downstream of the siphon along the west bankline.

The scour hole and exposed part of the siphon have moved away from the west bank toward the center and east bank of the river channel. In fall 2020, MRGCD placed more riprap downstream of the siphon extending the entire width of the river and keying a short distance into the bankline.



Photo 3: Looking east at the Corrales Siphon and the 2020 riprap protection placed downstream of the siphon (Reclamation, 2021)

### **River Mile 199 (New Maintenance Site)**

In spring 2017, Reclamation identified a new erosion site near RM 199 in the Corrales area. This site is on the west side of the river, approximately 120 feet from the west levee toe. The Angostura to Montaña reach plan provides a detailed geomorphic and hydraulic study of the reach and sub-reaches and has helped evaluate erosion at RM 199 in the context of the overall reach needs.

In 2019, Reclamation began alternative formulation and analysis to address bank erosion near the Corrales levee system. Project goals include dissipating energy in the surrounding two-mile reach between the Corrales Siphon and RM 198 and improving ecological function at this site. In 2021, the bank stabilization with channel raising plus cutoff channels alternative was selected. Design is currently underway. Construction is targeted for fall 2023.

### **Isleta to San Acacia Reach Planning (Existing Maintenance Reach)**

In 2014, Reclamation identified the stretch of the Rio Grande from the Isleta to the San Acacia Diversion Dams for further investigation to analyze the geomorphic and hydraulic trends. This investigation is especially relevant given the observed overbank flooding in portions of the reach during the 2017 and 2019 runoffs. Geomorphic and hydraulic analysis reports for this reach were

completed in March and December 2018, respectively. These analyses will be used to identify potential projects that have river maintenance and habitat value.

In 2021, Reclamation finished a report identifying sites that may need river maintenance or offer opportunities to perform habitat restoration in support of the 2016 MRG Biological Opinion (MRG BO)<sup>1</sup>. Part of that effort included a focused study on the Los Lunas subreach which has been completed and which identified Los Lunas RM 163 and RM 161 for future river maintenance work (please see the next section for more details).

### **Los Lunas River Mile 163 (Existing Maintenance Site)**

In 2020, Reclamation analyzed the hydrology, hydraulics, and habitat of the Los Lunas subreach. The Los Lunas subreach overbanks at low flows and due to the semi-perched nature of the floodway, the overbanked water often becomes trapped against the levee toes. Data shows that the flow at which overbanking occurs is getting lower over time. This investigation identified five locations along the eastern floodplain that overbank at flows less than the two-year return flow.

The 2020 analysis identified RM 163 as one of the first locations where water overbanks and saturates the levee toes during a rising hydrograph. In collaboration with NMISC and MRGCD, Reclamation plans to lower the banks of the channel to improve conveyance. Construction of Los Lunas RM 163 is tentatively targeted for fall 2022.

### **Escondida Burn Scar Habitat Restoration**

In June 2016, a wildfire burned approximately 524 acres in the bosque near Escondida, NM. Two aquatic habitat restoration sites were designed, and construction was completed in July 2018. The two sites include floodplain lowering at the Arroyo de la Parida delta and a side channel network just upstream of Nogal Arroyo. This work helps Reclamation and its partners meet MRG BO commitments.

In 2019, monitoring included surveying sedimentation changes; collecting inundation extents, flow velocity and depth, and water temperature; isolated pool monitoring; and noxious weed mapping. This monitoring data will inform future adaptive management decisions. No site visits were made in 2020 due to the COVID-19 pandemic and the low runoff year. Monitoring similar to what occurred in 2019 resumed in 2021.

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<sup>1</sup> See the MRG Programmatic Water Operations and River Maintenance ESA Compliance Section



Photo 4: Escondida side channel project during 2019 spring runoff (Reclamation, 2021)

### **Rhodes Property Habitat Restoration**

A multi-disciplinary design team assessed the Rhodes Property site located south of Socorro, NM, for opportunities to create aquatic habitat. This work supports Reclamation and its partners in meeting the commitments of the MRG BO. Project designs and environmental permitting were completed in December 2018. Construction of the project was completed in mid-February 2019, with as-built surveys collected at the end of February 2019. Monitoring will continue for the next five years.

### **Highway 380 to Elephant Butte Reservoir Reach Planning (Existing Maintenance Reach)**

Planning efforts are currently underway to identify river maintenance and habitat restoration sites along this 50-mile long stretch of the Rio Grande. This river reach has essential habitat for several federally listed threatened and endangered species, including the Rio Grande Silvery Minnow (RGSM), the Southwestern Willow Flycatcher (flycatcher), and the Yellow-billed Cuckoo (cuckoo). Riverside infrastructure in this reach delivers irrigation flows to the BDANWR to support terrestrial habitat for the endangered New Mexico Meadow Jumping Mouse (jumping mouse). In addition to providing critical habitat for these endangered species, this reach of the Rio Grande is critical for the delivery of surface water flows to Elephant Butte Reservoir. Reclamation's planning in this reach looks to balance water conveyance goals with creation of nursery and mature habitat sites for the



listed species. This reach planning effort complements the ongoing Evaluation of San Acacia Reach Options (ESARO) study.

### **Bosque del Apache River Realignment Upstream Phase (Existing Maintenance Site)**

Work is underway to plan the approximately 4.5-mile river realignment on the Rio Grande, extending from just downstream of the Highway 380 bridge near San Antonio, NM, to just below the north boundary of the BDANWR. This realignment is intended to prevent sediment plug formation in the main channel by redirecting river flows to a lower point of the active floodplain just to the east of the existing channel alignment. Like the downstream phase of this project, the upstream phase is intended to reduce river perching and reconnect floodplain areas with the main body of channel flow. It is expected that this project will improve riverside habitat and channel conveyance. The proposed alignment is in the eastern floodplain. The planning phase has begun and in 2021 and 2022 is focused on private landowner identification, outreach, and concurrence for the proposed alignment.

### **Bosque del Apache River Realignment Downstream Phase (Adaptive Maintenance Site)**

During the 2008 and 2017 spring runoffs, sediment plugs formed in the main channel of the Rio Grande at RM 81, located within the BDANWR. In 2014, a multi-agency project team began to pursue a realignment of the current channel to the east to address river maintenance concerns in the area. The project will move two river segments to the east, about 4.5 miles (Upstream Phase) and 2.5 miles in length (Downstream Phase), and then reconnect them with the current channel.

In 2016, Reclamation decided to first construct the Downstream Phase to learn from the observed channel response of the smaller realignment section before beginning work on the longer northern realignment. The southern realignment was termed the BDA Pilot Realignment Project.

Designs were completed on the BDA Pilot Realignment Project in 2017. Mowing began in January 2018. During the extended 2019 spring runoff, a plug again formed in the main river channel at the same location as in 2017. This plug completely blocked flow from the main channel, and water was forced into the area mowed for the Pilot Realignment Project. The necessary CWA compliance was obtained from USACE in summer 2019, and Reclamation's Socorro Field Division began excavating the pilot realignment channel at the beginning of September 2019, following the end of migratory bird season. By October, a pilot channel was excavated along the planned realignment, restoring river conveyance.

The excavation phase of the project was completed in September 2020, despite construction delays caused by the COVID-19 pandemic. Moving excavation spoil into the old river channel was completed in March 2021. A Reclamation-led hydraulic data collection effort through the realignment corridor was completed in March 2020 and March 2021. This monitoring is scheduled again for March 2022. Site revegetation began with the planting of the northern willow grid within the old river channel in January 2021. Ongoing project monitoring will continue with invasive species vegetation control performed by BDANWR field crews over the next several years, regular channel monitoring by Reclamation in coordination with NMISC, and RGSM studies conducted with funding by both the State and Federal stakeholders.



Photo 5: View of realigned Rio Grande channel on the BDANWR from the west bank following summer monsoonal flows (Reclamation, 2021)

### **Bosque del Apache, Tiffany, and San Marcial Levee and Delta Channel Capacity Analyses (Adaptive Maintenance Sites)**

The hydraulic channel capacity criteria used in the analysis of levee systems is to both effectively and safely pass the two-year flow of 7,700 cfs. The maintenance design criteria of the Delta Channel used in the analysis was to effectively convey a normal spring runoff peak flow of 4,000 to 5,000 cfs to the Elephant Butte Reservoir pool.

In 2021, spring runoff was below average for the Rio Grande resulting in no significant changes to the channel capacity findings from the previous year. Reclamation's Socorro Field Division completed channel excavation for approximately two and one-half miles through the BDANWR in September 2020. It is expected that downstream water conveyance will improve through this river section and that the excavation will minimize the risk of sediment plug formation in the channel at this location.

NMISC's contractor removed debris from the lower channel that deposited as reservoir levels dropped in summer 2021. Their focus was north of the Rio Grande at Narrows in 2021 with the NMISC contractor completing this effort in November 2022. Reclamation construction crews performed no Delta Channel maintenance work this year.

### **Fort Craig Bend and River Mile 60 (Existing Maintenance Site)**

Historically, the Rio Grande between Fort Craig and RM 60 was a wide, braided, and relatively straight river channel. During recent years, the degree of meandering has increased in several areas

as a more sinuous planform developed. This has caused the formation of multiple bends, including Fort Craig Bend near RM 64 and the S-curve bend at RM 60. The outsides of these bends are near the west edge of the confined floodplain and adjacent to the spoil levee and the LFCC. Continued bank erosion and lateral migration at these locations threaten to breach the spoil levee and cause damage to the LFCC and access road. Downstream water delivery and habitat for endangered species are likely to be negatively affected by a breach. In 2012, a rock windrow was placed on the west bank of the river as a temporary solution to erosion at the toe of the bank near the Fort Craig pump site. Recent observations show that the windrow has not launched into the channel, but the toe of the bank has had additional scour.

A multi-disciplinary project team will develop and evaluate alternatives to reduce maintenance frequency, increase water salvage, and enhance habitat. More repair work may be needed at the RM 60 bend in 2022. Currently the Fort Craig bend appears to be stable. A new project team will evaluate the feasibility of reconnecting the LFCC with the main river channel from San Acacia south to RM 60, and one possibility includes an outfall to the river at RM 60 consistent with the ESARO planning process.

### **Truth or Consequences (Existing Maintenance Site)**

Reclamation annually excavates sediment from the river channel to maintain the authorized 5,000 cfs capacity in the reach of the Rio Grande between Elephant Butte Dam and Caballo Reservoir. Maintenance is conducted each fall after releases are shut off from Elephant Butte Dam. Primarily, sediment is removed at arroyo mouths. Secondary activities include sediment removal in other areas throughout the reach and bank stabilization with riprap at selected sites. Work identified for 2022 involves sediment removal at the mouths of three major tributaries (Mescal, Cuchillo Negro, and Hondo).

In addition, during periods of non-release, Reclamation installs a dike in the river to increase the alluvial groundwater levels for the benefit of the artesian hot spring bathhouse owners in Truth or Consequences. A new regional Section 404 permit associated with this work for another 5-year period was issued by USACE in 2018.

### **Middle Rio Grande River Maintenance Plan**

The MRG River Maintenance program has developed a long-term River Maintenance Plan that will assist in accomplishing project purposes in an environmentally and economically sound manner that is consistent with the Middle Rio Grande Project Authorization (P. L. 81-858 and P. L. 86-645). A final report is posted at the following web address:

<https://www.usbr.gov/uc/albuq/envdocs/reports/mrgRivMaint/CompPlan/start.pdf>.

This maintenance plan is an engineering and geomorphic review that can be used to readily implement the most cost effective and environmentally sound strategies that reduce Reclamation's long-term commitment of resources. Ongoing work on the "living" long-term comprehensive plan and guide involves evaluating reach-based strategies for feasibility, prioritizing reaches, and evaluating effects of strategy implementation between reaches, including both upstream and downstream.

Work is also being pursued with respect to reach-based planning and developing ecological criteria for endangered species suitable habitat restoration to complement current water delivery as well as public health and safety factors. Reach-based planning is underway to evaluate the geomorphic

reaches from Angostura to Montaña Bridge, and Isleta downstream to Elephant Butte. This lower reach has been identified as a high priority reach for habitat restoration and meeting ecological goals. A report entitled “Lower Reach Plan” was completed in 2018. This document provides a strategic overview of reach projects and efforts underway for the river and LFCC from Isleta Diversion Dam to the Elephant Butte Reservoir pool.

### **Determination of River Maintenance Needs at Individual Sites and Reaches**

In 2014, Reclamation completed its “Determination of River Maintenance Needs” process, which involved a joint workshop between Reclamation’s Technical Service Center (TSC) and the AAO River Analysis Group. The workshop followed a developed rating system for sites and reaches along the river channel that considers geomorphic trends and conditions, public and infrastructure risk, and water delivery effects for the 260-mile reach of the Middle Rio Grande. All monitored, existing, and completed sites were rated using the system and criteria. A total of 86 sites and 11 reaches were evaluated. Monitoring during the spring runoff and monsoon season in 2018 and work progress were considered in the 2019 site and reach ratings. These ratings help prioritize project development and implementation.

The technical rating system integrates technical factors for channel instability, bank erosion, and loss of channel capacity with the potential for impacts to riverside infrastructure, public health and safety, and water delivery. In addition, five distinct maintenance classes are identified by the assessment. The maintenance class designation helps define the apparent urgency of addressing any need. The maintenance class designations are as follows:

- Maintenance Class 1 – Maintenance is required in the short-term (typically before the next high flow event or could be required immediately). High likelihood of substantial consequences if no action is taken.
- Maintenance Class 2 – Maintenance can be planned, but the consequences of no action could be substantial in the near-term (the next normal spring runoff or within the next few years). This class includes the majority of ongoing or normal river work at existing and new sites.
- Maintenance Class 3a – Maintenance can be planned, and the consequences of no action are less likely to be substantial in the near-term (the next normal spring runoff or within the next few years). Work can be described as preventative maintenance and includes habitat enhancement.
- Maintenance Class 3b – Maintenance can be planned, and the consequences of no action are less likely to be substantial in the near-term (the next normal spring runoff or within the next few years). Data collection and analysis are required to determine if preventative or normal maintenance (including habitat enhancement) is needed.
- Maintenance Class 4 – Maintenance is not anticipated to be needed in the near-term (the next normal spring runoff or within the next few years) because changes appear to be occurring at a slow rate. Work can be described as monitoring for changes that could accelerate the need for maintenance to the near-term.
- Maintenance Class 5 – Maintenance may be needed but is not within Reclamation’s authority. Responsible parties will be notified if it appears that consequences of no action could be substantial in the near-term.

This approach for the ratings and maintenance class designation complements what is in the long-term River Maintenance Plan and Guide and the MRG BO for River Maintenance Actions.

## **Delta Channel Maintenance with the State of New Mexico**

In 2017, a five-year Cooperative Agreement (17-WC-40-678) between Reclamation and NMISC was signed. It provides funding for joint benefits: water salvage within the MRG and reservoir vegetation management in the Rio Grande Project. It currently includes Delta Channel maintenance, river maintenance projects, and riverside irrigation drain improvements with water salvage potential. A new 5-year agreement is being developed.

Work continued through the Delta Channel to maintain a 20-mile temporary channel into the Elephant Butte Reservoir pool for effective water delivery. The maintenance work performed in 2021 was performed by the NMISC's contractor and focused primarily on sediment excavation from the channel near Nogal Canyon. Maintenance work included in-channel excavation and sandbar de-vegetation. Reclamation provided all necessary engineering and environmental compliance support for the continued maintenance of the Delta Channel through this Cooperative Agreement.

## **Programmatic Water Operations and River Maintenance ESA Compliance**

The U.S. Fish and Wildlife Service (USFWS) issued a final *Biological and Conference Opinion for Reclamation, BLA, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande* (Consultation Number 02ENNM00-2013-F-0033) (MRG BO) on December 2, 2016. The non-jeopardy determination in the MRG BO is based on the mandatory accomplishment of numerous commitments by Reclamation and the MRG BO partners (86 Conservation Measures, 11 Reasonable and Prudent Measures, and 50 Terms and Conditions). The USFWS provided an Incidental Take Statement (ITS) for the RGSM, flycatcher, and cuckoo.

### **Supplemental Water Program**

Reclamation initiated its Supplemental Water Program in 1996 to support water needs of the ESA-listed species in the Middle Rio Grande. The program originally included water acquisition, reservoir storage, and release of water to support river flows. From 2001 to 2020, it also included operation of a pumping network in the San Acacia Reach to pump water from the LFCC to the river. The Supplemental Water Program supports ESA coverage under Section 7(a)(2) of the MRG BO.

### **Water Acquisition and Management**

In 2021, a total of 10,364 ac-ft of supplemental water was released for endangered species purposes. Of that volume, 9,513 ac-ft was water that Reclamation leased from 2020 and 2021 SJ-C contractor allocations. Because of the extremely dry conditions, Reclamation also released 851 ac-ft of water leased from ABCWUA's SJ-C water stored in Abiquiu.

The release of supplemental water began at 50 cfs on June 19 as flow decreased in reaches prone to drying. Monsoons boosted river flows in July, allowing the release to either be reduced or stopped entirely for much of the month. Release of Reclamation's leased water reached a maximum of about 100 cfs on September 18 and remained there until September 29. MRGCD reduced deliveries beginning September 29 such that by October 5 they were only diverting for P&P lands.

The additional 851 ac-ft were released from October 8 to 21, at a rate intended to help keep the Rio Grande wetted from Cochiti Dam to Isleta Diversion Dam. This rate ranged from 0 to 75 cfs, and the last release of supplemental water was on October 21.

Reclamation ended 2021 with 4,149 ac-ft of the ABCWUA lease in storage. In 2022, Reclamation is negotiating leases of approximately 12,000 ac-ft from 2022 SJ-C allocations. However, water available from those leases could be much less than 12,000 ac-ft, depending on the SJ-C shortage.

**Other Sources of Supplemental Water**

In addition to the water released by Reclamation, two other sources of water were used to support the needs of the ESA-listed species in 2021. They were SJ-C water leased by Audubon New Mexico, and pre-1907 native water rights owned or leased by Reclamation. As shown in Table 11, approximately 619 ac-ft was released to the river by MRGCD at four wasteway outfalls in the Isleta Reach: Alejandro, 240, Los Chavez, and Lower Peralta Drain #2.

Table 11: 2021 Isleta Reach Outfall Deliveries

Isleta Reach Outfall Delivery Dates, 2021	Delivered Water Volume, ac-ft	Water Source
June 10 – 19	139.61	Native water acquired, permitted, and used for offset
June 30 – July 7	154	Native water acquired, permitted, and used for offset
September 9 – 14	325	SJ-C (Audubon New Mexico)

Initially, Audubon New Mexico acquired a total of 498 ac-ft of SJ-C water. They leased 200 ac-ft from the City of Belen, 100 ac-ft from the Village of Los Lunas, and 100 ac-ft from the Town of Bernalillo, all out of Heron Reservoir. Conveyance losses from Heron to Abiquiu were 4.4 ac-ft. They also leased 30 ac-ft of Los Lunas’ water stored in Abiquiu. Finally, they leased 68 ac-ft of SJ-C water stored in El Vado Reservoir for Santo Domingo Pueblo that was acquired by the Pueblo as part of a 2014 exchange with the City of Santa Fe. Evaporative losses while Audubon’s water was in storage in Abiquiu Reservoir were 14.82 ac-ft.

Deliveries of Audubon water were made to the four wasteway outfalls in the Isleta Reach. Release of 1 cfs from Abiquiu for the Alejandro wasteway began on June 22 with shut-offs when monsoon flows reconnected the Isleta Reach. The release was increased to 4 cfs on September 3 for delivery to all four wasteways. Releases continued until September 30.

A total of 293.61 ac-ft of pre-1907 native water rights owned or leased by Reclamation and permitted to be used for offsetting via the NMISC’s Strategic Water Reserve were released from the Los Chavez and Lower Peralta Drain #2 outfalls from June 10 to 19 and from June 30 to July 7.

**Low Flow Conveyance Channel (LFCC) Pumping Program**

As a result of adaptive management studies by Reclamation and the USFWS, Reclamation decommissioned its pumping stations that delivered water from the LFCC to the river in 2020. Therefore, Reclamation did not pump any water to the river in 2021.

The Neil Cupp pumping site, which Reclamation used to maintain, is now a permanent pumping site operated and maintained by MRGCD and capable of pumping to both the river and irrigation facilities. In 2021, MRGCD pumped 65 ac-ft from the Neil Cupp site to the river from June 16 to 20 to maintain river connectivity as flow into the reach declined.

### **Endangered Species**

Incidental take of RGSM is authorized for the Proposed Action if October density is greater than or equal to 1.0 fish per 100 m<sup>2</sup> for 10 of the 15 years, October density is less than 1.0 fish per 100 m<sup>2</sup> for no more than five of the 15 years of the MRG BO's duration, and October density is less than 0.3 fish per 100 m<sup>2</sup> for no more than two of the 15 years. Incidental take for the RGSM will be considered exceeded if these densities and time limits are not met because of the Proposed Action.

RGSM density, measured as Catch-Per-Unit-Effort (CPUE, number of RGSM per 100 m<sup>2</sup>), in October 2021 was 0.27 RGSM/100 m<sup>2</sup> which was slightly higher than the October 2020 CPUE of 0.23 RGSM/100 m<sup>2</sup>, but less than the October 2019 CPUE of 2.09 RGSM/100 m<sup>2</sup>. Based on 30 sampling sites, RGSM CPUE in October 2021 was 0.32 RGSM/100 m<sup>2</sup> which was slightly higher than the 20 sites estimate of 0.27 RGSM/100 m<sup>2</sup>. Reclamation continues to evaluate whether the low estimated CPUE in 2021 occurred due to the Proposed Action or, more likely, was the result of lack of storage or release of irrigation water as contributing to reduced flow availability from August through October 2021.

Incidental take of flycatcher would be considered exceeded if more than 26 flycatcher territories are displaced in any year because of the Proposed Action, or if more than 2,071 acres of suitable flycatcher habitat are impacted because of the Proposed Action over the 15-year MRG BO duration.

Incidental take of cuckoos would be considered exceeded if more than 11 cuckoo territories are displaced in any year because of the Proposed Action, or if more than 2,071 acres of suitable cuckoo habitat are impacted as a result of the Proposed Action over the 15-year MRG BO duration.

There was incidental take of two flycatcher nest territories in 2021 due to on the ground projects, with approximately 3.08 acres of moderately suitable habitat for the flycatcher, and 0.53 acre of suitable habitat for the cuckoo disturbed due to vegetation clearing for rangeline brushing maintenance and installation of two grazing allotment fence lines. There was no incidental take of cuckoo territories in 2021 due to on the ground projects.

In 2021, Reclamation and the MRG BO Partners continued implementing the commitments set forth in the BO. The Minnow Action Team, including Reclamation, the NMISC, MRGCD, and the USFWS, met on February 25 and June 10, 2021, to discuss the best use of available water. During 2021, 10,364 ac-ft of supplemental water was released by Reclamation for endangered species purposes.

Several large-scale projects, including LFCC and Delta Channel maintenance activities described below, had no effect on suitable flycatcher habitat due to avoidance measures or lack of suitable habitat affected by Reclamation grants, title transfer, leasing activities, the RM 202.2 Project, or the Bosque and Riverine Restoration activities on the Pueblo of Isleta. Project activities along the MRG occurred on the following in 2021:

- Title transfer of selected portions of land and infrastructure to the MRGCD

- Cooperative Agreement with the National Fish and Wildlife Foundation in partnership with the MRGCD to support flows in the Isleta Reach of the MRG through leasing, agricultural fallowing, and other projects for increasing efficiencies
- Monitoring of the fish community at MRGCD outfalls in the Isleta Reach and other research
- Clearing of vegetation along three range lines in the MRG
- Issuance of WaterSMART grants to municipalities, watershed groups, and irrigation districts for water or energy conservation and other related planning efforts
- Delta Channel maintenance on 18 miles of channel, including vegetation clearing along roads and within existing channel features
- Pueblo of Isleta Bosque and Riverine Habitat Restoration activities
- Maintenance on 9.5 miles of Low Flow Conveyance Channel, including vegetation clearing along roads and within existing channel features
- Fish passage at San Acacia and Isleta Diversion Dams (design-build procurement)
- Bosque del Apache Pilot River Realignment/Sediment Plug Circumvention (adaptive management phase)

The 2021 MRG BO annual report, due to the USFWS on April 1, 2022, will provide more information on the implementation of BO requirements and the Proposed Action.

### **Rio Grande Silvery Minnow**

Since 1993, Reclamation has funded or supported the systematic sampling of the fish community in the Middle Rio Grande with a focus on the endangered Rio Grande Silvery Minnow (*Hybognathus amarus*). With some exceptions (e.g., 1998), fish sampling by rapidly drawing a seine through the water column to capture fish has been conducted monthly from April to November at 20 standard monitoring sites along the MRG (Dudley et al. 2020a). For comparison among years, seasons, and sites, the catch of RGSM and other fishes is standardized to a density or CPUE. Since 2017, 10 additional sites are surveyed during October and CPUE is reported for both the 20 standard sites and 30 sites (standard and additional).

Based on monitoring data from the 20 standard sites, RGSM were present at nine of 20 sites with an overall CPUE of 0.27 RGSM/100 m<sup>2</sup> during October 2021 (Dudley et al. 2021b). At these 20 standard sites, the October 2021 CPUE of 0.27 RGSM/100 m<sup>2</sup> was slightly higher than the October 2020 CPUE of 0.23 RGSM/100 m<sup>2</sup>, but less than the October 2019 CPUE of 2.09 RGSM/100 m<sup>2</sup>. Based on all October surveys since 1993, the overall CPUE averaged 6.96 RGSM/100 m<sup>2</sup> and ranged from 0.00 to 37.86 RGSM/100 m<sup>2</sup>.

Based on the 30 sampling sites, RGSM CPUE in October 2021 was 0.32 RGSM/100 m<sup>2</sup>, slightly higher than the 20 standard site CPUE of 0.27 RGSM/100m<sup>2</sup>. The species was present at 15 of those 30 sites in October 2021.

In the annual reports, RGSM status, trends, and mixture model-estimated RGSM CPUE are used for long-term analyses, mesohabitat associations, sampling variation evaluation, and modeled to evaluate their relationships to flows or other environmental conditions (see Dudley et al. 2021a). A two-model approach is used to separate presence or absence of RGSM from their actual abundance so that the errors are properly estimated.



The changes in the occurrence and estimated CPUE of RGSM were reliably predicted by seasonal differences in flows across years (1993–2020; Dudley et al. 2021a). Extended high flow during spring runoff appears to be crucial in explaining why some years had dramatically elevated RGSM CPUE. In contrast, poor spring runoff and extended low flow during summer were key to explaining reductions in the occurrence of this species across years. Thus, prolonged high flow during spring runoff was most predictive of increased CPUE and prolonged low flow during summer was most predictive of decreased CPUE of RGSM over time in the MRG (Dudley et al. 2021a).

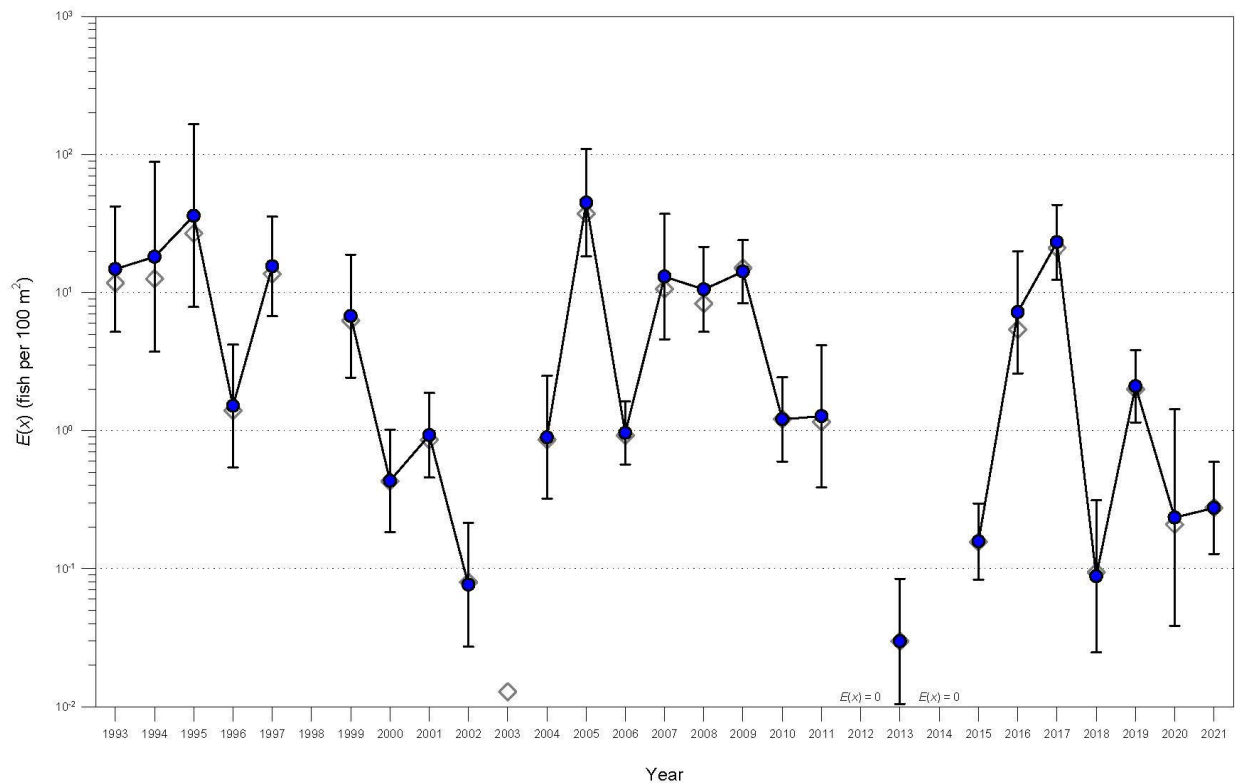


Figure 5: RGSM estimated CPUE ( $E(x)$ ) using standard site (20 sites) October data for 1993–2021. Solid circles indicate estimated CPUE, bars represent 95 percent confidence intervals, and hollow diamonds represent simple methods-of-moments estimates (Dudley et al. 2021a, and written comm.).

Literature Cited:

Dudley, R.K., S.P. Platania, and G.C. White. 2021a. Rio Grande Silvery Minnow Population Monitoring during 2020. Annual Contract 140R4019P0048 Report to Bureau of Reclamation, American Southwest Ichthyological Researchers, Albuquerque, NM.

Dudley, R.K., S.P. Platania, and G.C. White. 2021b. Rio Grande Silvery Minnow Population Monitoring during October 2021. November Contract 140R4019P0048 Report to Bureau of Reclamation, American Southwest Ichthyological Researchers, Albuquerque, NM.

### **Southwestern Willow Flycatcher**

The Southwestern Willow Flycatcher (*Empidonax traillii extimus*) was listed as endangered by the USFWS effective March 29, 1995. The 2013 final designation of critical habitat defines two units located along the Rio Grande in New Mexico: the Upper Rio Grande Management Unit and the Middle Rio Grande Management Unit. No critical habitat was designated for the Lower Rio Grande Management Unit (Elephant Butte Dam to El Paso, TX).

During the summer of 2021, Reclamation conducted surveys and nest monitoring of flycatchers in 10 distinct reaches along approximately 267 miles of the Rio Grande, between the Isleta Pueblo and El Paso, TX (Table 12). Surveys were performed to contribute to the baseline population data of the flycatcher along the Rio Grande, and to meet Reclamation's ESA compliance commitments for the MRG BO as well as the ESA compliance for the 2016 Rio Grande Project Biological Opinion (RGP BO<sup>1</sup>).

A total of 922 resident flycatchers were documented in 2021. These flycatchers established 503 territories, of which 419 had pairs. This represents a 31 percent increase in territory numbers from 2020. As in previous years, the San Marcial Reach was by far the most productive, containing 477 resident flycatchers and 252 territories, of which 225 were pairs – a 25 percent increase in territories from 2020 (although only selected sites were surveyed in 2020 and 2021).

The biggest increase, however, was documented within the Belen Reach of the Middle Rio Grande, which grew from 25 territories in 2020 to 85 in 2021 due to increases in suitable habitat in the reach.

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<sup>1</sup> See the Rio Grande Project Operating Agreement and Storage of SJ-C water ESA Compliance Section

Table 12: Southwestern Willow Flycatcher Territories 2013-2021<sup>1</sup>

Location <sup>2</sup>	2021	2020	2019	2018	2017	2016	2015	2014	2013
Frijoles	N/S <sup>3</sup>	N/S	N/S	0	0	0	0	0	1
Belen	85	25	N/S	20	17	20	17	18	23
Sevilleta	N/S	N/S	N/S	12	4	5	8	4	4
San Acacia	N/S	N/S	0	0	0	0	0	0	0
Escondida	2	3	9	4	8	5	7	4	8
BDANWR	39	35	24	24	16	14	11	23	27
Tiffany	N/S	N/S	0	0	0	5	1	8	4
San Marcial	252	200	293	277	257	302	300	307	266
MRG Subtotals	378	263	326	337	302	351	344	364	333
Caballo Reservoir	18	11	9	7	8	9	14	15	4
Caballo to El Paso, TX	107	109	91	77	60	41	31	26	34
RGP Subtotals	125	120	100	84	68	50	45	41	38
Total	503	383	426	421	370	401	389	405	371

In 2021, due to COVID-19 pandemic-related staffing limitations, rigorous nest monitoring was only conducted at certain sites. However, nest searching and monitoring was conducted when possible during protocol surveys within most sites. A total of 483 nests were discovered and roughly two-thirds were sufficiently monitored to determine success rates, productivity, and brown-headed cowbird (*Molothrus ater*) parasitism. The San Marcial Reach was most productive at 254 nests.

Other studies continued or updated in 2021 include 1) flycatcher nesting hydrology and habitat variable study; 2) river maintenance impact monitoring; 3) photo monitoring of habitat development in the Elephant Butte delta; 4) saltcedar leaf beetle (*Diorhabda spp.*) impact monitoring; 5) Elephant Butte delta hydrology monitoring; and 6) Hink and Ohmart vegetative community mapping and flycatcher and cuckoo habitat modeling. These studies are designed to provide insight into potential threats and habitat requirements of flycatcher and cuckoo populations.

At Elephant Butte Reservoir, flycatchers have expanded their occupied habitat south, to near Mitchell Point at RM 38. Flycatcher-occupied areas in the Elephant Butte Reservoir delta – RM 60 downstream to RM 54 – were previously mostly in dense Goodding's and coyote willow of various age classes, with water provided by the LFCC outfall. However, much of this willow-dominated habitat has declined in quality during the past 12 years due to drought and natural succession. Invasive saltcedar is also encroaching and becoming dominant. Although this provides some habitat characteristics for flycatchers, observations indicate that breeding flycatchers are not as successful or productive in saltcedar-dominated habitats. Additionally, the presence of the *Diorhabda spp.* is an issue as it will likely defoliate saltcedar during nesting periods, reducing foliage cover and making nests more vulnerable to predation, parasitism, and changes in microclimate.

<sup>1</sup> Breeding season only

<sup>2</sup> Table does not include detections outside of the active floodplain at BDANWR

<sup>3</sup> N/S = Not Surveyed

Habitat modeling since 2016 throughout the Middle Rio Grande has shown that some suitable habitat remains unoccupied, thus indicating that habitat is not a limiting factor for this population. However, the overall quality of the habitat is likely reducing success and productivity. It is likely that flycatchers do not expand into all areas of suitable habitat due to their nesting site fidelity and overall population size.

Nest success in the Middle Rio Grande has remained between 38 and 47 percent for the past four years following a study period low of 25 percent in 2017 (Figure 6).

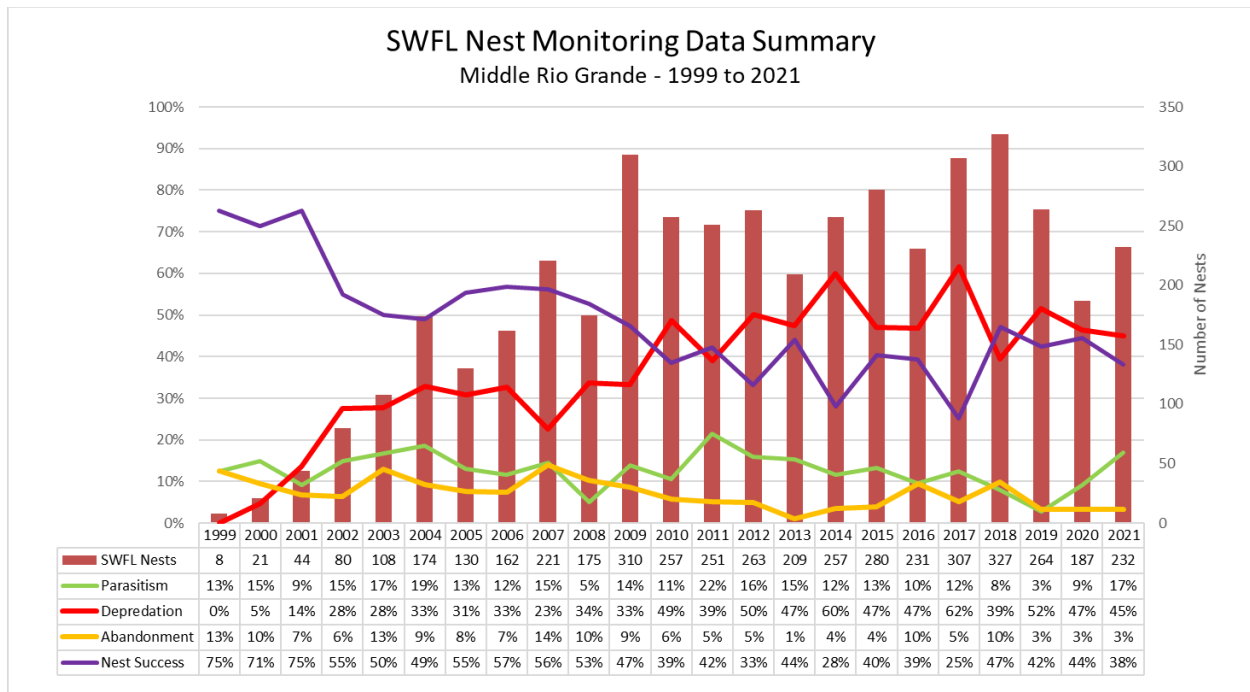


Figure 6: Summary of Flycatcher nesting in the Middle Rio Grande from 1999 to 2021

The decline in nest success from 2006 to 2017 may be related to the decline in habitat suitability and quality in heavily populated areas. Depredation, the biggest source of nest failure, averaged 27 percent from 1999 to 2011. Since 2012, the depredation rate has nearly doubled, averaging 50 percent. The depredation rate in 2017 was 62 percent, the highest recorded since 1999, but dropped back to 39 percent in 2018.

These changes may be a result of reduced habitat quality because of lower flows. Drought conditions, which typically result in reduced discharge and groundwater levels, reduce plant vigor and canopy cover. This reduces nest concealment, exposing the nest to predators and changes in microclimate conditions. The defoliation of saltcedar by *Diorhabda spp.* has similar effects and may be of greater concern in the future. Nest success in the Lower Rio Grande, particularly in sites downstream of Caballo Dam, has been higher in recent years, averaging 57 percent between 2016 and 2021. Flycatchers in the Caballo Delta have not been as successful, averaging 38 percent nest success during the same period (Figure 7, Figure 8).

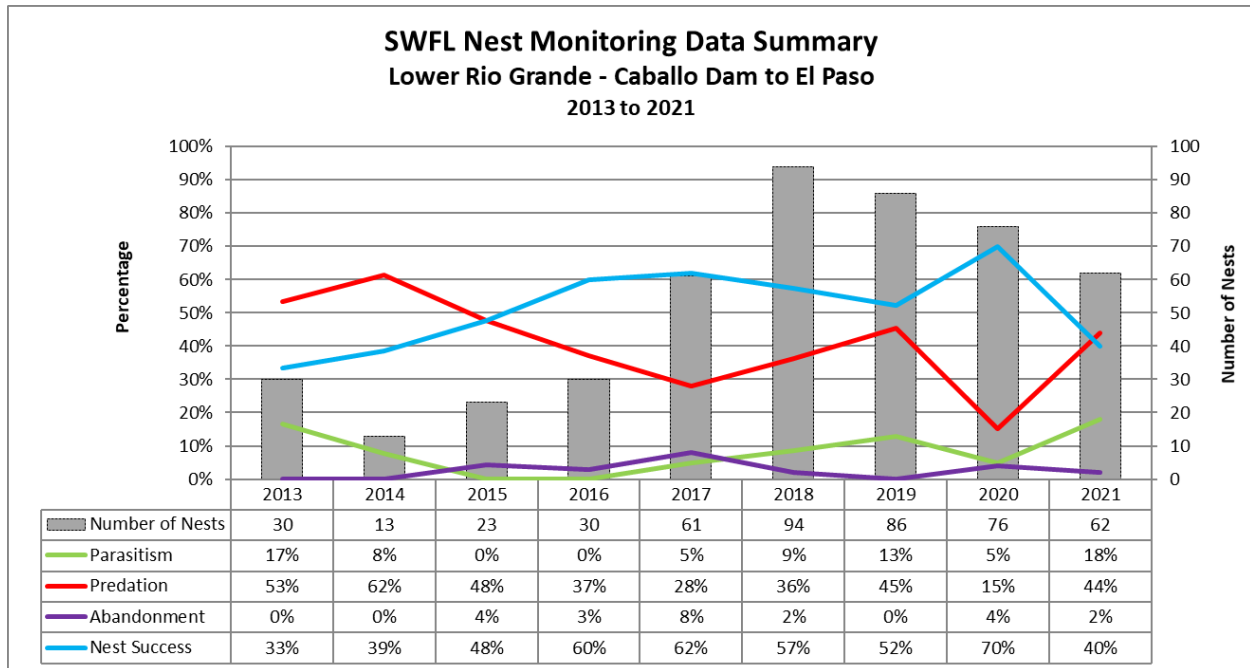


Figure 7: Flycatcher nest variables, Lower Rio Grande, Caballo Dam to El Paso, 2013 to 2021

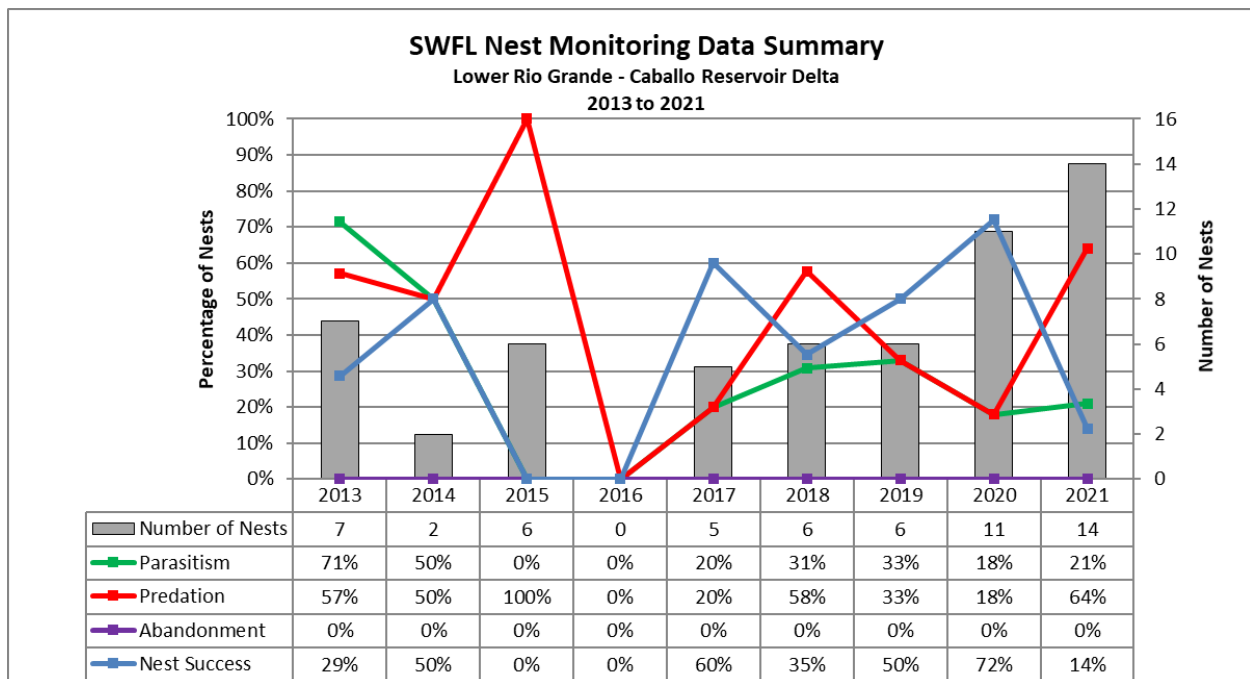


Figure 8: Flycatcher nest variables, Lower Rio Grande, Caballo Reservoir delta, 2013 to 2021

During 2017 and 2019, the Rio Grande and LFCC both saw higher flows compared to the past several years, resulting in extensive overbank flooding and higher groundwater levels in some areas. This improved plant vigor, structure, density, and overall habitat quality. Conversely, Rio Grande and LFCC flows were extremely low in 2020 which likely had negative impacts on habitat quality.

Also during 2020, a 330-acre fire burned suitable occupied flycatcher habitat in the vicinity of Fort Craig, including an area that in 2019 contained 14 flycatcher territories. Fire again impacted occupied habitat in 2021, burning roughly 100 acres near Bosque, NM, in an area that in 2020 contained a handful of flycatcher territories.

### **Western Yellow-billed Cuckoo**

The western distinct population segment of the Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) was listed as a threatened species by the USFWS in October 2014. Critical habitat for the cuckoo was finalized in the Federal Register in April 2021 (86 FR 20798).

Along the Rio Grande, two critical habitat units are included in the designation:

- Unit 35 (NM-4), Upper Rio Grande 1, Rio Arriba County: a continuous 5-mile segment of the Upper Rio Grande from Lyden to Alcalde in Rio Arriba County (518 acres)
- Unit 37 (NM-6B), Middle Rio Grande, Sierra and Socorro Counties: a continuous 109-mile segment, from river mile 54 within the Elephant Butte Reservoir pool upstream to Bosque Farms. The largest breeding population of cuckoos north of Mexico is within this reach (46,595 acres)

During 2021, Reclamation conducted cuckoo surveys in 10 distinct reaches of the Rio Grande, within sites also surveyed for flycatcher, from the south boundary of the Pueblo of Isleta to El Paso, TX (Table 13). Surveys were conducted to contribute to baseline population data of the cuckoo along the Rio Grande and to meet Reclamation's ESA compliance commitments for the MRG BO and RGP BO. In 2021, there were an estimated 90 breeding territories, all assumed to be pairs, derived from 424 cuckoo detections. The estimated territories and documented detections were most concentrated in the southern portion of the San Marcial reach, i.e., Elephant Butte Reservoir pool, and in the delta of Caballo Reservoir.

Table 13: Cuckoo Detections/Estimated Territories 2013- 2021<sup>1</sup>

Location <sup>2</sup>	2021	2020	2019	2018	2017	2016	2015	2014	2013
Belen	22/5	15/3	N/S	41/10	34/4	54/12	39/10	24/5	20/6
Sevilleta	N/S <sup>3</sup>	N/S	N/S	41/10	12/4	32/10	18/5	9/2	19/6
San Acacia	N/S	N/S	28/8	47/14	50/13	23/8	27/8	15/4	20/5
Escondida	13/2	16/5	51/11	55/10	44/11	58/16	62/16	27/7	80/23
BDANWR	70/15	49/11	59/14	46/13	43/10	32/11	40/12	34/12	29/8
Tiffany	N/S	N/S	0	0	2/0	9/0	2/0	2/0	4/1
San Marcial	198/45	68/17	190/42	193/49	227/56	220/59	215/59	190/61	219/70
MRG Subtotal	303/67	148/36	328/75	423/106	412/98	428/116	403/110	301/91	391/119
Caballo	90/18	72/16	47/11	58/13	64/16	62/15	48/15	28/8	N/S
Percha	13/2	22/4	13/2	7/1	8/2	3/1	1/0	0/0	N/S
Hatch	10/2	21/4	11/2	17/6	11/1	6/2	4/1	0/0	N/S
Radium Springs	8/1	19/5	9/3	25/7	10/4	16/6	10/4	8/2	N/S
Las Cruces	0	0	12/2	10/3	9/3	N/S	N/S	N/S	N/S
Mesilla	0	1/0	5/1	9/2	0	N/S	N/S	N/S	N/S
RGP Subtotal	121/23	135/29	101/21	126/32	93/23	87/24	63/20	36/10	N/S
Total	424/90	283/65	429/96	549/138	505/121	515/140	466/130	337/101	391/119

Literature Cited:

U.S. Fish and Wildlife Service. 2021. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Western Distinct Population Segment of the Yellow-billed Cuckoo. Federal Register 86: 20798-21005.

***New Mexico Meadow Jumping Mouse***

A final rule was published in the June 10, 2014, Federal Register to list the New Mexico Meadow Jumping Mouse (*Zapus hudsonius luteus*) as an endangered species under the ESA, with final critical habitat designation following in March 2016. While designated critical habitat units for the species occur in Colorado, New Mexico, and Arizona, only Unit 6 (BDANWR) is within the MRGV. Unit 6 consists of 995 acres along 13.1 miles of ditches and canals associated with managed irrigation for wildlife purposes on BDANWR in Socorro County, NM. This unit begins in the northern part of the BDANWR and generally follows the Riverside Canal to the southern boundary of the refuge. Jumping mice have not been found on the Rio Grande in this area. The BDANWR habitat adjacent

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<sup>1</sup> Breeding season only

<sup>2</sup> Table does not include detections outside of the active floodplain at BDANWR

<sup>3</sup> N/S = Not Surveyed

to the Riverside Canal is the only known occupied mouse habitat within the Middle Rio Grande Valley.

Except for BDANWR, systematic surveys for jumping mice and their habitat have not been conducted throughout the riparian corridor of the MRG. However, since its listing, surveys for suitable jumping mouse habitat have occurred in selected areas as part of environmental compliance activities for specific projects, such as the Delta Channel river maintenance project (Reclamation, 2014). The Delta Channel is located outside the southern edge of the geographic area that the jumping mouse could potentially inhabit. The habitat assessment determined that the Delta Channel area is not a suitable natural environment based on the herbaceous vegetation composition and structure, lack of soil moisture, high frequency and long history of disturbance, and lack of regular inundation necessary to support jumping mouse habitat. It is therefore unlikely that suitable or occupied jumping mouse habitat exists south of BDANWR and no additional populations have been identified along the MRG.

While the MRG BO does not provide any supportive analysis for jumping mouse ESA requirements, Reclamation is committed to support efforts by the BO Partners or others seeking to provide water to BDANWR when it is available, dependent on available water supply and the water rights of BDANWR and other users. Reclamation continues to partner with BDANWR and MRGCD to support water delivery infrastructure improvements on the refuge that are supportive of mouse habitat, including during 2021. Reclamation's activities have included design and construction support, planning, and compliance technical services to facilitate BDANWR infrastructure improvements.

Literature Cited:

- Frey, J.K., 2006. Status of the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) in the Sangre de Cristo Mountains, NM. Final Report submitted to New Mexico Department of Game and Fish, Santa Fe, 14 December 2006, 78 pp.
- Frey, J.K., and D.A. Kopp. 2014. Final Report: Preliminary Assessment of jumping mouse habitat associated with Middle Rio Grande Project U.S. Department of the Interior, Bureau of Reclamation, AAO, 18 pp.
- Frey, J.K., and G.D. Wright. 2012. Multiple scale habitat selection by a small mammal habitat specialist (*Zapus hudsonius luteus*) in a managed floodplain landscape. Final Report submitted to U.S. Fish and Wildlife Service, Cooperative Agreement 201819J806, 16 March 2012, 109 pp.
- Reclamation. 2014. River Maintenance Program: San Marcial Delta Water Conveyance Channel Maintenance Project Biological Assessment. Bureau of Reclamation, AAO, September 2014, 80 pp.
- U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the New Mexico Jumping Mouse Through Its Range; Final Rule. Federal Register 79: 33119-33137.
- U.S. Fish and Wildlife Service. 2013. Endangered and Threatened Wildlife and Plants; Proposed Designation of Critical Habitat for the New Mexico Meadow Jumping Mouse: Listing



Determination for the New Mexico Meadow Jumping Mouse; Proposed Rules. Federal Register 78: 37328-37363.

U.S. Fish and Wildlife Service. 2014. New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) Survey Results at Bosque del Apache National Wildlife Refuge, U.S. Government Memorandum. 12 pp.

## **Other ESA-Related MRG Projects**

### **RiverEyes**

The RiverEyes program was developed to provide current information on river flows and river drying, allowing action agencies to react quickly to changing river conditions. RiverEyes also facilitates coordination among agencies, helping to prevent unexpected drying, and prepare for and initiate RGSM salvage.

The MRG BO does not set specific flow targets or maximum rates of drying and instead focuses on thresholds of RGSM density in October. One of the critical efforts to maintain densities is the coordination of MRG water operations, and the RiverEyes' observations of flows and drying continues as an integral part of that coordination.

For the 2021 irrigation season, RiverEyes monitored river conditions along the Rio Grande from Isleta Diversion Dam into the full pool elevation of Elephant Butte Reservoir, with occasional spot-checks at the Albuquerque Water Treatment Plant. Monitoring occurred from mid-June through mid-October. Drying was first observed in the San Acacia and Isleta Reaches on June 17 and June 27, respectively. The total maximum extent of river drying during the 2021 RiverEyes monitoring period was 46.1 miles; 32.1 miles was in the San Acacia Reach and 14.0 miles in the Isleta Reach. Overall, the area near Peralta Wasteway was dry 70 days (four events), Abeytas Heading area was dry 38 days (four events), and San Acacia area was dry 50 days (five events). The last occurrence of drying was on October 3 in both the Isleta and San Acacia reaches.

### **Middle Rio Grande Endangered Species Collaborative Program**

In response to ESA species listings in the Middle Rio Grande, ESA-related litigation, and the 2003 BO, the Middle Rio Grande Endangered Species Collaborative Program (Collaborative Program) was formed, bringing various groups together to support ESA compliance for the RGSM and flycatcher, and address environmental issues along the MRG.

The Collaborative Program consists of stakeholders representing diverse interests including federal, state, and local government entities, Pueblos and Tribes, and non-governmental organizations working to protect and improve the status of listed species along the MRG while protecting existing and future regional water uses in compliance with applicable state and federal laws, including Compact delivery obligations.

The Collaborative Program is not included in the MRG BO and does not have responsibility or authority for meeting requirements. However, Reclamation and the partners work with the Collaborative Program to provide science recommendations in support of adaptive management. The Collaborative Program also hosts an annual symposium for entities conducting science within

the basin to share information and maintains the online portal and common database management system as common repositories for information, reports, and data.

In 2021, Reclamation funded third-party management of the Collaborative Program as well as ongoing monitoring activities and studies related to endangered species. This included funding in the amount of \$2,783,404 to the Collaborative Program as authorized by the Omnibus Appropriations Act of 2009 (P.L. 111-8). FY 2021 accomplishments include:

- Captive propagation of RGSM at the Southwestern Native Aquatic Resources and Recovery Center, the City of Albuquerque's BioPark Aquatic Conservation Facility, and the NMISC's Los Lunas Silvery Minnow Refugium
- Annual monitoring of RGSM population
- Ongoing genetics studies of RGSM
- RGSM rescue and salvage efforts during river drying
- Reproductive monitoring of RGSM
- Annual monitoring of flycatcher and cuckoo populations
- Reoccurring flycatcher and cuckoo habitat suitability was conducted
- Habitat Restoration Workshop
- RGSM habitat suitability modeling in the MRG
- Hydrobiological Objective was refined through modeling
- Program management, assessment, reporting, and outreach activities
- RGSM movement study being conducted in support of fish passage to be built

## **Rio Grande Project, New Mexico – Texas**

Reclamation's Albuquerque Area Office and the Elephant Butte Field Division are jointly responsible for the operations of the Rio Grande Project (Figure 9). Elephant Butte Field Division operates and maintains Elephant Butte and Caballo Dams and the Elephant Butte powerplant. The AAO determines the release from Elephant Butte Dam to meet irrigation demand while supporting hydropower production, maintaining compliance, and achieving other benefits. The release from Caballo Dam is based on irrigation demand to make water deliveries at the canal headings for the Elephant Butte Irrigation District, El Paso County Water Improvement District No. 1, and the Republic of Mexico (under the 1906 Convention).

EBID operates and maintains Reclamation's diversion dams on the Rio Grande – Percha, Leasburg, and Mesilla in New Mexico – under a contract with Reclamation. The IBWC owns, operates, and maintains the American Diversion Dam and the American Canal in accordance with the International Treaties with Mexico (1906 and 1933). In addition, the IBWC operates the International Diversion Dam, which diverts irrigation waters into the Acequia Madre head gates operated by Mexico.

Upon completion of title transfer in 1996, the irrigation and drainage system of the Rio Grande Project has been owned, operated, and maintained by EBID in New Mexico and EPCWID in Texas. Reclamation owns and administers the lands and rights-of-way activities of the reservoirs and diversion dam areas, including Percha, Leasburg, and Mesilla. Reclamation also retains the title and O&M responsibilities for Elephant Butte and Caballo Dams and Reservoirs and the Elephant Butte Powerplant.

In September 2003, Reclamation completed work to remove Riverside Diversion Dam and the adjacent coffer dam, both in Texas. Prior to removal, Riverside Diversion Dam had been inoperable since 1987 when flooding on the Rio Grande caused the structure to fail.

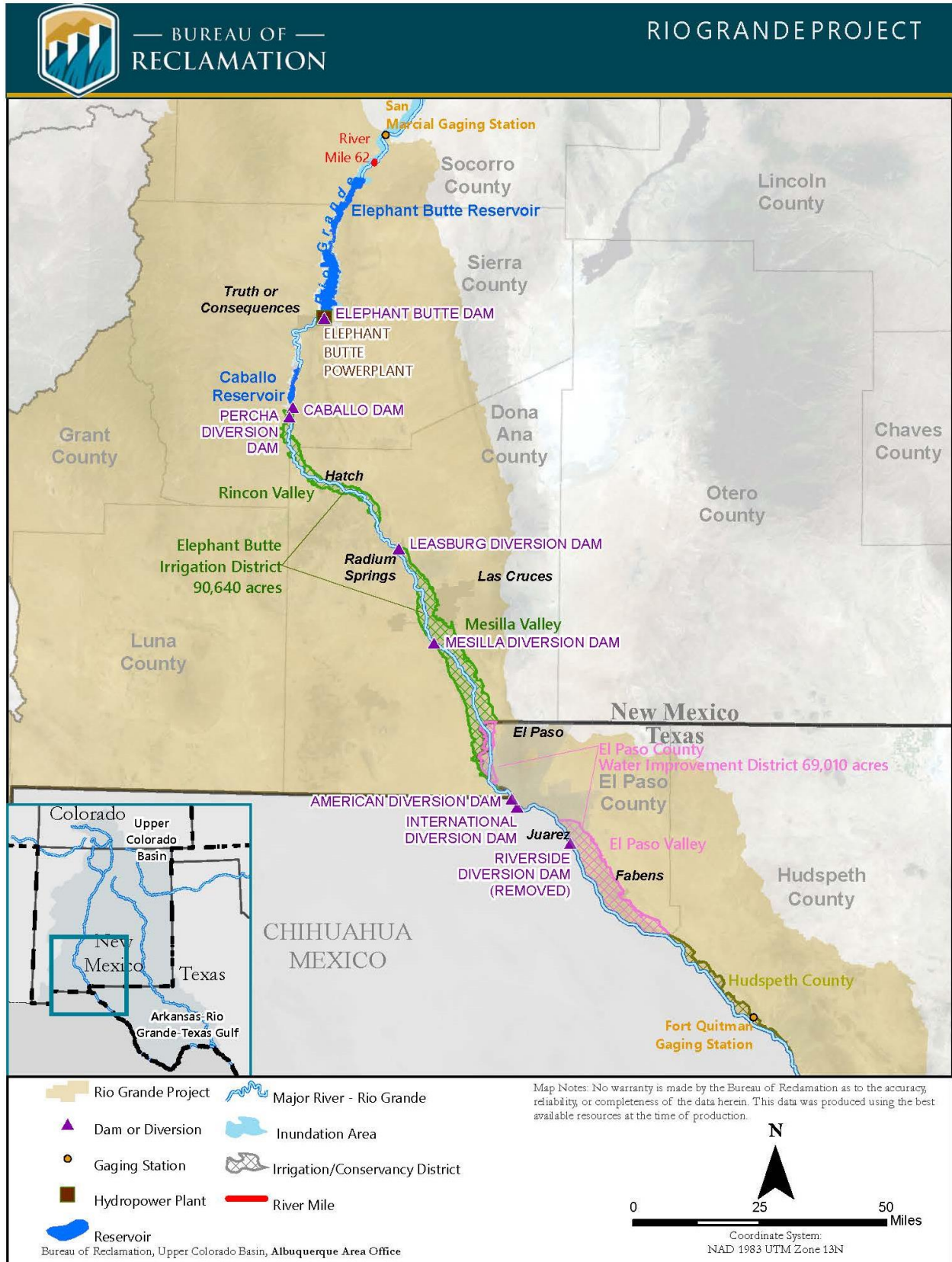


Figure 9: Area Map of the Rio Grande Project

## **Rio Grande Project Operations**

Combined total storage for Elephant Butte and Caballo Reservoirs for 2021 began with 157,600 ac-ft (or 7 percent of their total capacity) and ended with 182,811 ac-ft (8 percent). Maximum combined total storage was 283,951 ac-ft (13 percent) and minimum was 117,918 ac-ft (5 percent) on May 30 and August 30, respectively. Reclamation communicated with stakeholders to provide information and projections of reservoir elevations throughout the irrigation season.

### **Compact Accounting in RGP Storage**

Since 2011, the three Compact states have not reached consensus on the appropriate Compact accounting method. Because of that, Compact accounting has not been finalized since that year, and two sets of accounting sheets are currently maintained. Accounting method 1 is advocated by Texas, and accounting method 2 is advocated by New Mexico and supported by Colorado.

The Rio Grande Compact Commission (RGCC) determines final Compact accounting annually. Reclamation performs daily accounting of SJ-C, Compact Credit water, and native Rio Grande water on the Rio Grande in New Mexico, including the composition of water in reservoirs from Heron to Caballo. This accounting is needed to make daily water operations decisions.

To perform this accounting, Reclamation utilizes the interagency Upper Rio Grande Water Operations Model (URGWOM). Methods in URGWOM are consistent with accounting method 1 presented in various addendums to the RGCC Reports since 2011.

In the URGWOM, an account with a non-zero value is assessed gains and losses, so end-of-year debits are given a value of zero. All the numbers that follow reference accounting method 1 unless otherwise specified.

### **Usable Water**

Rio Grande Project supply available for release is determined from the usable water on January 1, as defined in Compact Article 1, and tracked daily for increases from inflows and decreases from evaporation and releases.

In 2021, the usable water in RGP storage (Elephant Butte and Caballo Reservoirs combined) was 156,139 ac-ft on January 1 and 181,019 ac-ft on December 31. Usable water in storage reached a high of 281,106 ac-ft on May 30 and a low of 115,314 ac-ft on August 30.

### **Article VII Restrictions**

Article VII of the Compact stipulates that when Usable water in Rio Grande Project storage is below 400,000 ac-ft, no native Rio Grande water will be stored in post-1929 reservoirs upstream of Elephant Butte Reservoir unless accrued credit water has been relinquished. Usable water in Project storage was below 400,000 ac-ft for all of 2021.

### **Compact Credit Water**

Compact credit water for Colorado and New Mexico is stored as wet water in Elephant Butte Reservoir and not included as Usable Water. New Mexico began 2021 with a 91,500 ac-ft debit (96,300 ac-ft debit under method 2). Colorado began 2021 with a 1,300 ac-ft credit (1,200 ac-ft credit method 2).

## **Elephant Butte Dam, Reservoir and Powerplant**

In 2021, the minimum daily storage at Elephant Butte Reservoir was 97,524 ac-ft (elevation 4,296.55 feet) on August 16. The maximum daily storage was 245,320 ac-ft (elevation 4,318.53 feet) on May 19, 2021.

Reclamation began intermittent releases at Elephant Butte Dam in April 2021 to perform, test, and complete several O&M projects at the facility. These minimal O&M-related releases totaled about 65 ac-ft. Releases for irrigation demand began on May 20 and continued through August 16. During this period, a release of 216,161 ac-ft was recorded by the USGS Rio Grande below Elephant Butte Gage. The 2021 annual volume measured was 216,751 ac-ft.

The total gross hydropower generation for 2021 was 14,993,080 kilowatt-hours (kWhr). Net hydropower generation was 14,533,604 kWhr, which is 4.3 percent of the 10-year average (2012 through 2021) of 337,388,868 kWhr. The Elephant Butte powerplant record showed releases of 187,859 ac-ft to meet downstream irrigation demand and manage Caballo Reservoir storage levels. Note that Elephant Butte operators consistently record a lower discharge than the USGS Gage.

## **Caballo Dam and Reservoir**

Caballo Reservoir started 2021 at 29,477 ac-ft (4,140.39 feet) and ended the year at 15,055 ac-ft (4,134.29 feet). During 2021, the maximum storage was 47,406 ac-ft (4,145.88 feet) on May 31. The minimum storage occurred on August 31, at 13,452 ac-ft (elevation 4,133.46 feet).

The irrigation release period extended from May 31 through August 31, 2021, releasing 229,455 ac-ft as measured at the Rio Grande below Caballo Dam Gage. During that period, Reclamation operated Caballo Reservoir to maintain storage levels adequate to respond to irrigation calls while protecting facilities and historic sites. The calendar year 2021 volume measured at the gage was 229,802 ac-ft.

The diversion from Caballo Dam for Bonita Lateral irrigation was 1,149 ac-ft from January through December.

## **Warren Act Deliveries**

Drainage waters from the RGP lands provide supplemental irrigation water for approximately 18,342 acres of the Hudspeth County Conservation and Reclamation District No. 1 (HCCRD). Total flows out of the project to HCCRD are measured at three gaging stations near the Hudspeth County line: the Hudspeth Feeder Canal, the Tornillo Canal at Alamo Alto, and the Tornillo Drain. Under the Warren Act contracts, HCCRD is charged for drainage water from the RGP between March 1 and September 30. For 2021, 20,951 ac-ft was diverted under the contract period and 25,020 ac-ft for the calendar year.

## **Rio Grande Project Water Accounting**

### **2021 Water Accounting**

In December 2020, Reclamation allocated zero (0) ac-ft as the initial allocation to Mexico for 2021. The provision of the 1906 Convention for extraordinary drought was applied and Reclamation provided Mexico with monthly updated allocations through May. The last in-season allocation to

Mexico, 12,129 ac-ft (20 percent of a full allocation), was made in May 2021. Mexico's allocation is calculated from the anticipated release of usable water, and once allocated to Mexico, the U.S. cannot reduce the allocation even if the anticipated or actual release is significantly less than originally anticipated. The actual release for the 2021 irrigation season was less than the anticipated release in May, when this occurs, an over delivery to Mexico is calculated the Rio Grande Project water accounting, this is further explained below in this section of the report.

The U.S. Districts, EBID, and EPCWID were provided an initial allocation in April 2021 after the 2020 water accounting had been finalized. The 2020 allocation balance was used to compute their 2021 allocations. Reclamation provided the U.S. Districts with updated allocations monthly as usable water in storage increased. The last in-season allocation was on May 26 due to below average inflows and usable water.

Releases from Caballo for irrigation deliveries began on May 31 and ended on August 31. EBID and EPCWID began the season with coordinated orders and diversions. Mexico delayed their initial order by one week and their diversions began on June 7. EBID ended their surface water diversions on June 28 with Mexico following on August 9. EPCWID ended release season on August 31.

The total Caballo release for Rio Grande Project water accounting was 229,418 ac-ft, which was used to calculate the diversion ratio, a quantitative measure of delivery performance. This is 37 ac-ft less than the volume reported for Compact water accounting. The difference is the seepage from Caballo Dam's gates on the days that irrigation releases started and ended, before and after the irrigation releases, and is therefore not charged to the Project. For 2021, the calculated diversion ratio was 0.830.

The measured delivery to Mexico was 12,145 ac-ft. The calculated charges to EBID were 57,704 ac-ft. EPCWID's calculated charges were 120,659 ac-ft. EBID and EPCWID were charged 857 and 1,390 ac-ft for the over delivery to Mexico, respectively, based on the proportion of the EOY 2021 allocation balances. The allocation balances at the beginning of 2022 were for 36,652 ac-ft for EBID and 59,430 ac-ft for EPCWID, respectively. See Table 14 for a summary of the 2021 water accounting.

Table 14: 2021 Rio Grande Project Water Accounting<sup>1</sup>

	Final Allocation	Final Charges	Caballo Release for Irrigation	Calculated Diversion Ratio	Adjustment for Over Delivery to Mexico	Account Balance for 2022
EBID	95,214	57,704	-	-	-857	36,652
EPCWID	181,479	120,659	-	-	-1,390	59,430
Mexico	12,129 <sup>2</sup>	12,145	-	-	-	-
Total	288,822	190,508	229,418	0.830	-	-

## 2022 Rio Grande Project Outlook

On December 1, 2021, usable water was 148,336 ac-ft. Note that this volume included provisional data and, with final data, is 148,876 ac-ft. This volume is below the range of the standard allocation equations used by the RGP. Therefore, Reclamation determined the initial 2022 allocation was 0 ac-ft. Reclamation will evaluate the usable water at least monthly to determine the RGP allocations.

In 2021, the NRCS updated the calculation of average and median snowpack and streamflow forecasts across the Western United States to the 1991-2020 period, from the previously used 1981-2010 period. Based on the March NRCS streamflow forecasts for the Upper Rio Grande and Rio Chama Basins, the current La Niña conditions and forecasts for El Niño Southern Oscillation activity, and current hydrologic conditions, Reclamation anticipates a near-record low allocation for 2022 and expects a shortened irrigation season beginning around June 1 and lasting one to three months.

## RGP River Gage Operation and Maintenance

The EBID and EPCWID operated and maintained gages for flow measurements at canal headings, river stations, and lateral headings during 2021. Reclamation operated and maintained the Rio Grande below Caballo gaging station, and coordinated and maintained central control of releases, river operations, and water accounting. To accomplish the water allotment accounting, the districts collect field flow measurements and coordinate data from all water user entities. Utilizing the summarized flow data submitted by the districts for their areas of responsibility, Reclamation calculated and summarized the monthly and end-of-year RGP water supply use and accounting for 2021.

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<sup>1</sup> Volumes in ac-ft

<sup>2</sup> 9,898 ac-ft was calculated for RGP accounting purposes, allocation under the 1906 Convention remains 12,129 ac-ft



## **Facility Review and Safety of Dams Program**

### **Elephant Butte Dam**

There are no significant dam safety-related O&M issues associated with Elephant Butte Dam other than aging infrastructure. There is currently one incomplete Safety of Dams recommendation and six incomplete Category 2 O&M recommendations for Elephant Butte Dam.

Recommendation 2005-SOD-A was identified and evaluated during the 2005 Comprehensive Facility Review. The recommendation was to evaluate breach parameters, breach outflow, and downstream consequences associated with specific failure modes, and it was completed in 2021. Two Category 2 O&M recommendations were also completed, 2020-2-C (updates to the Emergency Action Plan) and 2011-2-E (sandblast and re-coat the sluice gates).

Reclamation's TSC is working on O&M recommendation 2015-2-B, related to concrete repairs. A final design decision must be made before implementation.

### **Caballo Dam**

There are no significant dam safety-related O&M issues associated with Caballo Dam other than aging infrastructure. There are currently seven incomplete Category 2 O&M recommendations for Caballo Dam.

Four Category 2 O&M recommendations were completed in 2021: 2015-2-B and 2019-2-B, related to concrete repairs; and 2019-2-L and 2020-2-A, related to observation wells.

A video inspection of the toe drain was performed in June 2021 using a Remote Operated Vehicle (ROV). No new recommendations were made. However, a significant portion of the toe drain system was not inspected as the ROV could not access several sections due to sediment deposits. Periodic investigations will be made to see if there are any solutions to cleaning clay tile pipe without damaging it.

The Bonita Lateral irrigation pipe was inspected via a ROV in September 2021 and an Ultrasonic Thickness inspection in March 2021. This completed phase 1 of a multiphase project to repair or replace approximately 1,000 feet of the irrigation pipe from the head gate to the outlet gate. Phase 2, a feasibility study based on the inspection reports to determine possible repair methods, is starting in early 2022. Phase 2 is scheduled to be completed in FY22. Phase 3 is contract award and construction; the current schedule is to award in FY23 and begin work in first quarter of FY24.

## **Reservoir Vegetation Management**

The Vegetation Management Agreement with the State of New Mexico has been suspended indefinitely. Reclamation, however, still performed maintenance of vegetation at Caballo Reservoir primarily through mowing, which limits non-beneficial consumption of water by woody phreatophytes like saltcedar.

During 2021, Reclamation maintained areas previously cleared at Caballo Reservoir. Approximately 709 acres of phreatophyte vegetation at Caballo was managed utilizing mowers and mulchers in 2021.

## **ESA Compliance for Operating Agreement and Storage of SJ-C Water**

The USFWS issued a final *Biological and Conference Opinion on effects of actions associated with the proposed continuation of the Rio Grande Project Operating Agreement and storage of San Juan-Chama Project water in Elephant Butte Reservoir, NM* (Consultation Number 02ENNM00-2015-F-0734, RGP BO) on May 25, 2016. The non-jeopardy determination in the RGP BO is based on the mandatory accomplishment of numerous commitments by Reclamation (9 Conservation Measures, 4 Reasonable and Prudent Measures, and 9 Terms and Conditions). The USFWS provided an Incidental Take Statement for the flycatcher and cuckoo.

In accordance with the RGP BO, incidental take of flycatcher will be considered exceeded if more than 33 flycatcher territories or 24 nests (calculated as 96 eggs/nestlings) are taken as a result of high surface water events above the 2014 baseline data. If more than 81 acres of occupied suitable or marginally suitable habitat are inundated for two to five years, take may also be exceeded. Incidental take of cuckoos will be considered exceeded if more than 5 cuckoo territories or 3 nests (calculated as 12 eggs/nestlings) are taken as a result of high surface water events above the 2014 baseline. If more than 606 acres of occupied suitable or marginally suitable habitat are inundated for two to five years, take may also be exceeded.

In 2021, Reclamation continued implementing the commitments set forth in the RGP BO. There was no incidental take of flycatcher or cuckoo nests/territories in 2021. Annual survey data for the RGP BO is included in the MRG BO section of this report.

## **Active Rio Grande Project Litigation**

### **United States of America v. Elephant Butte Irrigation District**

The United States filed the case *United States of America v. EBID et al.*, Civ. No. 97-0803 JP/RLP/WWD (Quiet Title to the Waters for the Rio Grande Project) on June 12, 1997, in the U.S. District Court of New Mexico (D.N.M.), petitioning for quiet legal title to the waters of the Rio Grande Project in its name. The court dismissed the case in August 2000. On May 7, 2002, the U.S. Court of Appeals (10th Circuit) vacated the lower court's August 2000 decision and remanded the case for further proceedings. On remand, the court issued an order to stay the case and close for administrative purposes on August 15, 2002. The court further ordered that, if it becomes necessary or desirable during the pendency of water adjudications in New Mexico and Texas, any party may initiate proceedings as though the case had not been closed for administrative purposes.

Since 2010, interested parties have been proceeding with Stream System Issue No. 104, which involves the United States' water interests in the Lower Rio Grande in New Mexico. In 2012, the court determined that the United States did not have a groundwater right associated with the Rio Grande Project. However, the court did not rule on whether the various groundwater inflows into

the Rio Grande are considered “project water,” which – if so determined by the court – would mean the United States has a right to such inflows once they become surface water again. This proceeding is suspended while the parties negotiate. The suspension was continued on October 26, 2018, and all parties are required to file status reports with the court every 6 months.

### **State of New Mexico v. United States**

On August 8, 2011, the State of New Mexico filed a lawsuit against the United States (*State of New Mexico v. United States et al.*, D.N.M. Civ. No. 11-0691) regarding the Rio Grande Project 2008 Operating Agreement (OA) and a purported change in accounting of the water to be delivered to Texas from the Rio Grande. The case is stayed pending ruling by the Supreme Court on *Texas v. New Mexico*.

### **Texas v. New Mexico**

In January 2013, Texas filed a motion in the U.S. Supreme Court to receive a declaration of the rights of the State of Texas to the waters of the Rio Grande pursuant to, and consistent with, the Compact and the Rio Grande Project Act; issue its decree commanding the State of New Mexico to deliver the waters of the Rio Grande in accordance with the provisions of the Compact and the Rio Grande Project Act; and award damages and other relief for the injury suffered by the State of Texas.

Due to COVID-19, the court proceedings and trial were scheduled and delayed several times during 2021. Special Master Michael Melloy ordered the trial to be held in two phases. The first phase was held as a remote hearing commencing on October 4, 2021. At the conclusion of the first phase, the parties renewed mediation efforts with the newly appointed mediator, Judge Arthur Boylan. The parties continued to mediate through the remainder of 2021. In January 2022, the parties along with the mediator recommended a delay in the second phase of the trial, scheduled to commence in March 2022, to allow for further mediation. On January 24, 2022, based on the recommendation of the parties, Special Master Melloy ordered the case stayed. If the case resumes, it is anticipated that the second phase of the trial will begin in late August or early September 2022.

## **Related Reclamation Programs**

### **Native American Affairs Programs**

Reclamation has numerous projects underway with Pueblos and Tribes. These projects fall under several categories including the Native American Affairs Program, planning, water rights settlements, cooperative ventures with other federal agencies, and special projects funded through Congressional legislation.

Native American Affairs and other programs have provided funding to various Pueblos for water resource related issues as it is available. Pueblo projects funded in 2021 include emergency maintenance repairs on a ditch at Nambé Pueblo and funding to address erosion at a site on the Pueblo of Isleta's Rio Puerco lands. In addition, the Secretary's Indian Water Rights Office funded continuation of modeling efforts by the USGS in support of ongoing water rights negotiations for the Pueblos of Acoma and Laguna.

Contained in the Omnibus Public Land Management Act of 2009, P.L. 111-11 authorized up to \$4 million in federal appropriations to conduct a study of the 18 Rio Grande Pueblos' irrigation infrastructure, and up to \$6 million per year for construction through 2019. The Study Report was drafted in 2017 and has been in coordination with the Office of Management and Budget during 2021. When this last step is concluded, the report will be submitted to Congress. Since the expiration of the original legislation, the authorization has been extended annually. In addition to continued activities on previously awarded contracts, funds received in 2021 were utilized for a new contract with Santa Clara Pueblo to begin Main Ditch reconstruction and funding for design of irrigation improvements for the Pueblo of Zia.

### **Isleta Settlement**

Isleta Diversion Dam was built by the MRGCD on Pueblo of Isleta land in 1934 and rehabilitated by Reclamation in 1954. Long-standing issues from dam construction and operation on Pueblo lands were resolved when Reclamation, the Pueblo of Isleta, and the MRGCD signed a global settlement on October 21, 2016. This global settlement granted the United States easement for the next 100 years, provided the Pueblo of Isleta with a lump sum damage compensation, and established a team to plan and implement diversion dam modifications to better manage sediment transport into irrigation canals and provide fish passage through the dam, as well as bosque and riverine restoration.

In 2021, the settlement team achieved major milestones including completing the two-year physical modeling effort, allowing multiple sediment management alternatives to be tested, and concluding in identification of a preferred alternative. Design and construction will be through a design-build procurement action and combined with a parallel action at San Acacia Diversion Dam. A draft scope of work and procurement package were completed. Selection and contracting will continue through most of 2022.

The Pueblo of Isleta received incremental funding in 2021 to continue bosque and riverine restoration, another key Settlement commitment. In addition, a new contract was implemented to provide funding for the Pueblo of Isleta's ongoing participation in the Isleta Settlement Technical Team. The Tech Team will focus on the design-build procurement for most of 2022. The Settlement commitments are scheduled to be completed by 2026.

## **Indian Water Rights Settlements**

The Claims Resolution Act of 2010 was signed into law on December 8, 2010, authorizing the settlement of two long-running New Mexico Indian water rights cases. Title V, the Taos Pueblo Indian Water Rights Settlement Act, authorizes implementation of the Abeyta (Taos Pueblo) settlement. Title VI, the Aamodt Litigation Settlement Act, authorizes implementation of the Aamodt (Pojoaque, Nambé, Tesuque, and San Ildefonso Pueblos) settlement. Reclamation is working with BIA, the Pueblos, the State of New Mexico, and other involved parties to implement the provisions of these settlements.

### **Taos Pueblo Indian Water Rights Settlement**

Pursuant to Title V of the Claims Resolution Act, Reclamation is working on implementing their responsibilities under the Taos Pueblo Indian Water Rights Settlement. Under the terms of the Settlement, Taos Pueblo has a recognized right to 11,927.71 ac-ft per year of depletion, of which 7,249.05 ac-ft per year would be available for immediate use. The Pueblo has agreed to forbear using 4,678.66 ac-ft per year to allow non-Indian water uses to continue. Over time, the Pueblo would reduce the amount of the forborne water rights through purchase of surface water rights from willing sellers. Reclamation entered into contracts for SJ-C water with the Pueblo for 2,200 ac-ft per year; the Town of Taos for up to 366 ac-ft per year (in addition, Reclamation typically leases the Town of Taos' non-Settlement allocation of 400 ac-ft); and El Prado Water and Sanitation District for 40 ac-ft per year.

The Settlement Act authorizes and directs Reclamation to provide financial assistance in the form of grants on a non-reimbursable basis to plan, permit, design, engineer, and construct Mutual-Benefit Projects. These efforts will minimize adverse effects on the Pueblo's water resources by moving future non-Indian ground water pumping away from the Pueblo's Buffalo Pasture, a culturally sensitive wetland. Implementation of the Settlement is currently in the final, on-the-ground phase, and Reclamation is awarding grants to project entities as they move forward with their Mutual-Benefit Projects.

### **Aamodt Settlement**

The Aamodt Settlement Agreement provides for settlement of water rights claims in the Pojoaque Basin including claims of the Pueblos of Nambé, Pojoaque, San Ildefonso, and Tesuque; Santa Fe County; and the City of Santa Fe. The Secretary and all other governmental parties signed the Settlement Agreement, Cost Sharing, and System Integration Agreement on March 14, 2013.

The Aamodt Litigation Settlement Act authorized Reclamation to plan, design, and construct a Regional Water System (RWS). The RWS would consist of a water diversion, raw water transmission pipeline, and water treatment facility at San Ildefonso Pueblo on the Rio Grande, as well as storage

tanks and transmission and distribution pipelines that would supply up to 4,000 ac-ft of water annually to Pueblo and non-Pueblo customers within the Pojoaque Basin.

The Final Environmental Impact Statement (EIS) was published in the Federal Register in January 2018. The Record of Decision was signed on September 11, 2019. Reclamation completed designs for Phase 1 at the 100 percent level in August 2019 that included intake, water treatment plant, storage tanks, and pipelines on the northern end of the project area in San Ildefonso Pueblo and the northern part of Pojoaque Pueblo. A supplemental Environmental Assessment was completed in January 2020. Phase 2 designs at the 90 percent level were completed in December 2021 and include a conveyance system for treated water to existing and proposed distribution tanks within the Nambé, southern Pojoaque, and Tesuque Pueblos, and Bishops Lodge in Santa Fe County. The 30 percent level designs for Phase 3 are complete and include distribution piping for the Pueblos of San Ildefonso, Pojoaque, Nambé, and Tesuque, and Santa Fe County. Associated cost estimates are well above the amount authorized for the project. In accordance with the Act, the Secretary initiated negotiations with the parties for an agreement regarding non-federal contributions to ensure the RWS can be constructed.

An agreement pursuant to Section 611(g) of Title VI of the Claims Resolution Act of 2010 was signed by settlement parties on September 17, 2019, addressing the scope, funding shortfall, and extension of the project construction completion from June 2024 to June 2028. Santa Fe County's Board of County Commissioners approved the Cost Sharing, System Integration, and Contributed Funds Agreements (CFA) on May 26, 2020. The Santa Fe County CFA was signed June 18, 2020, by Reclamation's Upper Colorado Basin (UCB) Regional Director. The Cost Sharing, System Integration Agreement was signed by Reclamation Commissioner Brenda Burman on August 26, 2020, and the UCB Regional Director signed the Amended and Restated State CFA on October 2, 2020.

Federal funding was obligated to the design-build contractor for a limited construction contract at the intake area on the Pueblo de San Ildefonso in September 2019. The notice to proceed was issued on November 7, 2019, and construction was planned to begin in early 2020. The Construction Agreement was signed by the Pueblo de San Ildefonso on May 15, 2020, allowing for the notice to proceed for construction to be issued on May 18, 2020. The contractor mobilized on June 8, 2020, to start construction. The Omnibus Bill which included the increase in the project funding and time extension to 2028 was passed by the House and Senate and signed by the President into law on December 27, 2020. This passing of this bill allowed the remainder of Phase 1 Construction to continue as planned. The Limited Construction portion award amount was \$12,509,979 and was expected to be completed in April of 2021, however due to the COVID-19 pandemic, this portion of work was completed in January 2022. The contractors have completed the construction of the concrete caissons for Collector Wells 1 and 3 which will successfully produce high quality water. The next portion of Phase 1 construction is expected to begin in March 2022 and includes the installation of the raw water intake pumps for Collector Wells 1 and 3, completion of the intake area Mechanical & Electrical Building, and starting construction of the water treatment plant.

In 2021, about 1.9 ac-ft were withdrawn from the completed wells for construction purposes, such as dust abatement and compaction.

## Hydrologic Models

### Upper Rio Grande Water Operations Model (URGWOM)

URGWOM is a computational model developed through an interagency effort. It is used to simulate processes and operations in the Rio Grande Basin from the headwaters in Colorado to Fort Quitman, TX, and track delivery of water allocated to specific users within New Mexico.

URGWOM operates on a RiverWare software platform. RiverWare was developed at the Center for Advanced Decision Support for Water and Environmental Systems (CADSWES).

The primary purpose of URGWOM is to facilitate more efficient and effective accounting, forecasting, flood risk management operations, and management of water in the Upper Rio Grande Basin. URGWOM is used for accounting of SJ-C Project water and forecasting daily storage and delivery operations in the Rio Grande Basin. The model is used to simulate processes for Annual Operating Plans (AOP) that forecast the remainder of the year, and for long-term forecasts for planning studies. The model is currently being used for the Rio Grande Basin Study.

The URGWOM Technical Team (Team) generally meets monthly while the Executive Committee meets no less than annually. An Advisory Committee initially strengthened URGWOM's interagency nature, but this committee no longer meets as attendees were consistently the same as those present at the monthly Team meetings. The URGWOM website is updated with details on recent activities, postings of the latest documentation, and meeting notes. It can be accessed at:

<http://www.spa.usace.army.mil/Missions/CivilWorks/URGWOM.aspx>.

In 2021, work continued to implement the newly developed deep groundwater aquifer objects in the Middle and Lower Rio Grande portions of URGWOM so that URGWOM's shallow groundwater aquifer objects will no longer depend on input from USGS's Modular Three-Dimensional Finite-Difference Groundwater Flow Model (MODFLOW). It is expected to be completed by spring 2022. As needed, updated documentation for URGWOM is tracked, developed, reviewed, and finalized by the Team. In consultation with the Team, Reclamation is studying how to incorporate the National Weather Service River Forecast Center's ensemble forecast – in conjunction with the currently utilized NRCS forecast – into URGWOM forecast runs. Reclamation is also working with and funding two groups at the National Center for Atmospheric Research (NCAR) to create more accurate hydrographs at forecast locations in URGWOM and to better predict monsoon activity to incorporate into URGWOM forecasting runs. Reclamation also created objects to represent the City of Santa Fe's water system. This has not been added to the official model, but it will be used in the Rio Grande Basin Study. Work was also completed to better simulate Colorado deliveries to New Mexico. There were many other minor fixes and updates throughout the year.

The USGS began the process of shutting down the *myUSGS Confluence* website late in 2021. The website was the repository for URGWOM development files, documentation, model updates, Tech Team Meeting notes, and other information. The *myUSGS Confluence* site is expected to shut down by the end of January 2022. The Team agreed to use Reclamation's Sharepoint application as the new URGWOM repository. In November and December, Reclamation developed a new repository in Sharepoint and, with assistance from other agencies on the Team, began moving files from *myUSGS Confluence* to Sharepoint.

## **Rio Grande Transboundary Integrated Hydrologic Model (RGTIHM)**

RGTIHM is being developed through an interagency effort between the USGS and Reclamation and funded by Reclamation. The model is being developed to simulate the availability and use of surface water and groundwater in the Rincon and Mesilla Valleys, including surface-water deliveries by the Rio Grande Project and groundwater use for irrigation and non-irrigation uses. RGTIHM represents the dominant natural and human components of the hydrologic system, thereby providing a reliable assessment of surface-water and groundwater conditions and processes that can inform water users and help improve planning for future conditions and sustained operations of the Rio Grande Project.

Model development includes revision of the conceptual model of the flow system, construction of a Transboundary Rio Grande Watershed Model (TRGWM) water-balance model using the Basin Characterization Model (BCM), and construction of an integrated hydrologic flow model using the MODFLOW One-Water Hydrologic Flow Model (MODFLOW-OWHM). The conceptual model identifies surface-water and groundwater inflows and outflows, including the movement and use of water through both natural and anthropogenic processes. The groundwater-flow system is characterized by a layered geologic sedimentary sequence combined with the effects of natural runoff and recharge, operation of the Rio Grande Project, and groundwater pumping for irrigation and non-irrigation uses. Notably, operation of the Rio Grande Project includes the application of surface water for irrigation, recharge from applied irrigation water, return flows through drains and wasteways, and reuse of return flows to meet irrigation demands lower in the Rio Grande Project.

TRGWM and RGTIHM were developed for and calibrated to historical conditions of water and land use, and parameters were adjusted (calibrated) so that simulated values closely match available measurements. The calibrated model was then used to assess the movement and use of surface water and groundwater in the Rincon Valley, Mesilla Basin, and northern part of the Conejos-Médanos Basin. RGTIHM and TRGWM provide a tool for analyzing the hydrologic system response to the historical evolution of water use in the region, including development of surface-water and groundwater supplies for irrigation, municipal, industrial, and domestic uses. The models also provide a tool for evaluating the hydrologic system response to potential changes in water supplies and demands, including changes in irrigated acreage and cropping patterns, population and per capita water use, local and regional climate and hydrologic conditions, and surface water and groundwater management.

### ***RGTIHM development***

In 2021, USGS and Reclamation:

- Continued investigating possible factors controlling RGTIHM's over-simulation of observed surface-water flows at the Rio Grande at El Paso stream gage. Remedies that were explored included modifications to initial conditions, boundary conditions, and parameterization.
- Explored using the Newton (NWT) solver in RGTIHM, rather than the Preconditioned Conjugate Gradient Solver with Improved Nonlinear Control (PCGN) which was used in the version of RGTIHM published on April 7, 2020 (<https://doi.org/10.3133/sir20195120>). Initial tests showed lower mass balance errors, but longer run times with the NWT solver.



- Finished model recalibration runs for the all-layers confined model version using the NWT solver, because of the lower mass balance errors observed with the NWT solver as compared to PCGN. Model recalibration was performed using BeoPEST on the USGS Yeti and Denali supercomputers (<https://www.usgs.gov/core-science-systems/sas/arc>).
- Began drafting a USGS Scientific Investigations Report documenting edits to and recalibration of the version of RGTIHM published on April 7, 2020.
- Began preparing scope of work and level of effort estimates for extending the simulation period of the historical calibrated RGTIHM from 2015 through a recent year.

### ***MF-OWHM and related software development***

In 2021, USGS and Reclamation continued implementation of the Surface-water Operations Process in RGTIHM.

## **Water Accounting Reports Projects**

### **San Juan-Chama Project Water Accounting**

The 2021 SJ-C Project water accounting was accomplished using version 8.3.2 of the RiverWare modeling system software, and version 8.3 of the URGWOM accounting module. All accounting data and information are stored directly in the final version of the 2021 accounting model. Data are also sent to Reclamation's Hydrologic Database (HDB) via a Data Management Interface (DMI). Reclamation consulted with representatives of the NMISC and USACE – Albuquerque District to verify accounting data throughout the year. This ongoing discussion minimized concerns regarding year-end data quality and accounting methods.

### **Oracle Hydrologic Database (HDB)**

HDB is a specialized relational database for storing and recovering hydrologic data used by Reclamation in the management of river and reservoir systems. A generalized version of HDB was specifically developed for use by Reclamation with RiverWare models. HDB is an Oracle relational database application and includes connections to data sources such as Reclamation's hydrologic and meteorologic monitoring stations (HydroMet), Domestic Communications Satellite (DOMSAT), Data Storage System (DSS), and modeling software like RiverWare. HDB was originally developed at the University of Colorado's CADSWES. The HDB instance housing URGWOM data is in the UCB Regional Office and is maintained by that office, as well as through contract with Precision Water Resources Engineering. HDB has been customized by Reclamation consultants and offices for specific office and model requirements. The AAO and the El Paso Field Office depend on HDB installations for data storage and retrieval.

Development of water accounting and reporting functionalities for the UCB HDB installation continued during 2021. Input data are directly transferred from HDB to URGWOM via an HDB/RiverWare DMI. Once a model run is successfully completed, water accounting data and other output are directly transferred from the RiverWare URGWOM accounting model via a DMI to be stored in HDB. OpenDCS is an application that allows automated computations, data

manipulation, and decoding of satellite transmitted data. HDB-POET is an interface for data viewing and analyses.

UCB Region has maintained and updated their public websites. These websites have been a great asset for internal and public use in reporting, visualizing, and exporting data from Reclamation's HDB. The pages can be accessed under the *Reservoir Data* heading on this page <https://www.usbr.gov/uc/water/index.html>.

Planned work for 2022 includes continued maintenance of HDB, as well as continuing to back-populate historical data for both the Middle Rio Grande and Rio Grande Projects into HDB. Reclamation is investigating the ability to pull in Colorado Division of Water Resources' published gage data which would overwrite preliminary data, similar to the process used for USGS' gage data. Improvements to the newly developed websites that utilize HDB are also planned.

## **RiverWare**

Numerous improvements to RiverWare were accomplished during 2021 through contracts that Reclamation and USACE have with CADSWES at the University of Colorado. Work included developing a Window Layout Manager to help keep windows organized, as well as improvements to the rules, scripting, DMIs, and the geospatial view. An annual report produced by CADSWES summarizes the 2021 changes to RiverWare. The report is distributed to the RiverWare user community at CADSWES' annual meeting.

## **Evapotranspiration (ET) Toolbox**

ET Toolbox is an extension of Reclamation's Agricultural Water Resources Decision Support (AWARDS) system that provides high-resolution rainfall and real-time water use predictions and estimates via a dedicated website. Real-time water-use data include estimates of daily riparian and crop water use and open water evaporation. The ET Toolbox is used both within and outside of Reclamation as a tool for improving the efficiency of water management and irrigation scheduling. Rainfall coverage extends from the headwaters of the Rio Grande in Colorado to El Paso, TX. ET coverage begins at Abiquiu Dam on the Rio Chama, and Embudo on the Rio Grande in New Mexico, and extends south to El Paso, TX.

Initially, the ET Toolbox model processes and predictions primarily used local weather station data. However, many of these stations are no longer functional and other remote forms of data currently feed hourly weather data to ET Toolbox. Weather forecasts are now used for all ET Toolbox calculations.

ET Toolbox can be accessed at:

<https://www.usbr.gov/uc/albuq/water/ETtoolbox/riogrande.html>.

In 2021, general development and maintenance tasks were performed on ET Toolbox. In 2019, Reclamation began looking at how they could collaborate with National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory (JPL) to use their satellite-based ET product to replace ET Toolbox's calculated evapotranspiration. Through this collaboration, daily 30-meter ET data are being developed, along with corresponding updates to the forecast system and web

interface. Security concerns have delayed the project and it is not known when the transition will occur. As a result, maintenance and upkeep of the current ET Toolbox continues.

## **Aquatic Invasive Species- Zebra and Quagga Mussels**

Dreissenid mussels, including the zebra mussel (*Dreissena polymorpha*) and quagga mussel (*Dreissena rostriformis bugensis*), are invasive, freshwater, bivalve mollusks. These aquatic invasive species (AIS) impair water infrastructure and it is extremely costly to remove them or prevent their attachment to infrastructure. Dreissenid mussels proliferate; attach to infrastructure surfaces like dams, water intakes, pipes, and canals; and impact the operation and maintenance of water storage, water delivery, irrigation, and hydropower. Dreissenid mussels can also impair recreational use and aquatic ecosystems by destroying watercraft motors, becoming a beach nuisance, altering aquatic food webs, and fostering harmful algal blooms. A single mussel can produce hundreds of thousands of eggs, which hatch into microscopic larvae called veligers. Veligers spread within a waterbody in numerous ways, mainly by floating within the water column and can be taken up by outboard motors, pumps, or other water intake and storage on watercraft. Transport of dreissenid mussels can occur when watercraft used in an infested waterbody transport or discharge water containing veligers or adult mussels into non-infested reservoirs.

Reclamation does not have a direct role in the inspection and decontamination of watercraft. Reclamation manages invasive species through its Integrated Pest Management Program as well as various other authorities including the Fish and Wildlife Coordination Act of 1934. The Fish and Wildlife Coordination Act, as amended by section 7001 of Public Law 116-9, provides authority for Reclamation to “enter into any contract or cooperative agreement with another Federal agency, an eligible State, a federally recognized Indian tribe, a political subdivision of an eligible State, or a private individual or entity to assist with the control and management of an invasive species.” In New Mexico, Reclamation supports these AIS prevention activities by furnishing equipment and contractual support to the New Mexico Department of Game and Fish (NMDGF).

Reclamation has contracted AIS monitoring for the following:

- Inspections for watercraft entering Navajo and Elephant Butte Reservoirs
- Decontamination of watercraft considered “high risk” as defined by the NMDGF
- Coordination with law enforcement for issuance and removal of red warning tags

In general, AIS watercraft inspection efforts have increased in New Mexico since 2013, with the total number of watercraft inspections statewide increasing from 9,346 in 2013 to 42,929 in 2020, and 47,582 in 2021. Table 15, below, provides the number of watercraft inspections and decontaminations conducted in 2021 in coordination with the NMDGF at waterbodies in New Mexico. Of these, 42 percent of the inspections and 45 percent of the decontaminations were conducted at Elephant Butte Reservoir, due to its high risk of AIS invasion.

Table 15: 2021 AIS Inspection Data (compiled by NMDGF and Reclamation)

Waterbody	Inspections	Decontaminations
Conchas Reservoir	3,054	8
Eagle Nest Lake	48	0
Elephant Butte Reservoir	20,205	121
Lake Farmington	4,614	0
Navajo Reservoir	16,421	134
NMDGF Office-Raton	1	0
NMDGF Office-Santa Fe	5	0
Sumner Reservoir	0	0
Ute Lake	3,234	6
Totals	47,582	269

In 2008, Reclamation established an early detection and monitoring program and regularly conducts research to develop methods to monitor, control, and predict invasive mussel spread. Reclamation follows standard operating procedures and quality control and assurance practices, which are documented and available on the Reclamation website at

<https://www.usbr.gov/mussels/index.html>

In 2021, Reclamation collected and analyzed 71 water samples from seven of its New Mexico reservoirs (Navajo, Heron, El Vado, Elephant Butte, Caballo, Sumner, and Brantley). These samples were analyzed by microscopy and molecular methods, providing early detection, and can be used to trigger immediate containment action. In 2021, there were no detections of invasive mussels or their genetic markers by Reclamation's Ecological Research Laboratory.

## WaterSMART Program

Congress recognized the increasing stresses on water supplies in the Western U.S. with the passage of the Science and Engineering to Comprehensively Understand and Responsibly Enhance (SECURE) Water Act in 2009 (P.L. 111-11). The law authorizes federal water and science agencies to work together with state and local water managers to plan for threats to water supplies, as well as take action to secure water resources for the communities, economies, and ecosystems they support.

To implement the SECURE Water Act and ensure the Department of the Interior is positioned to meet these challenges, the WaterSMART Program (Sustain and Manage America's Resources for Tomorrow) was established in February 2010. The Program's framework allows all bureaus of the Department to work with States, Pueblos and Tribes, local governments, and non-governmental organizations to pursue a sustainable water supply for the Nation. This is accomplished by providing federal leadership and assistance on the efficient use of water, integrating water and energy policies to support the maintainable use of all-natural resources, and coordinating the water conservation activities of the Department's many offices.

As the Department's main water management agency, Reclamation plays a key role in the WaterSMART Program. Reclamation's portion of the WaterSMART Program is focused on improving water conservation and helping water resource managers make wise decisions about water use. Goals are achieved through administration of grants, scientific studies, technical

assistance, and sharing scientific expertise. Reclamation will continue to work cooperatively with States, Pueblos and Tribes, and local entities as they plan for and implement actions to increase water supply through investments to modernize existing infrastructure and give attention to local water conflicts.

These programs, funded and managed by Reclamation's Office of Policy and Administration, include:

- WaterSMART Grants
  - Water and Energy Efficiency Grants
  - Small-Scale Water Efficiency Projects
  - Water Marketing Strategy Grants
  - Environmental Water Resources Projects
  - Cooperative Watershed Management Program (Phases I and II)
  - Water Conservation Field Services Program
- Drought Response Program
  - Drought Contingency Planning
  - Drought Resiliency Projects
  - Emergency Response Actions
- Title XVI Water Reclamation and Reuse Program
  - Authorized Title XVI Projects
  - WIIN Eligible Projects
- Desalination Projects (WIIN Act)
- Basin Study Program
  - Baseline Assessments
  - Reservoir Operations Pilots
  - Basin Studies
  - Water Management Options Pilots
- Applied Science Grants
  - Applied Science Tools
- 2021 SECURE Water Act Report to Congress

More information about these programs, completed project reports, and funding opportunity announcements can be found at: <https://www.usbr.gov/watersmart/>.

A WaterSMART Data Visualization Tool showing project locations can be found at: <https://usbr.maps.arcgis.com/apps/MapJournal/index.html?appid=043fe91887ac4ddc92a4c0f427e38ab0>.

General information about Reclamation's WaterSMART Program is provided below. Not all programs have funding opportunities each year, so there may not be currently active projects under all programs. Ongoing, newly funded, and recently completed projects within the jurisdiction of the AAO in the Rio Grande Basin are listed in Table 16 near the end of this section.

## **WaterSMART Grants**

### ***Water and Energy Efficiency Grants***

Through Water and Energy Efficiency Grants (WEEG), Reclamation provides 50/50 cost-share funding to irrigation and water districts, Pueblos and Tribes, States, and other entities with water or power delivery authority. Projects conserve and use water more efficiently, increase the production of hydropower, mitigate conflict in areas at a high risk of future water conflict, and accomplish other benefits that contribute to water supply reliability in the Western United States. Projects are selected through a competitive process and the focus is on projects that can be completed within two or three years.

### ***Small-Scale Water Efficiency Projects***

Through the Small-Scale Water Efficiency Projects (SWEP), Reclamation provides 50/50 cost-share funding to irrigation and water districts, Pueblos and Tribes, States, and other entities with water or power delivery authority for small water efficiency improvements that have been identified through previous planning efforts. Projects eligible for funding include installation of flow measurement devices or automation in a specific part of a water delivery system, lining of a section of a canal to address seepage, or other similar projects that are limited in scope.

### ***Water Marketing Strategy Grants***

Through the Water Marketing Strategy Grants, Reclamation provides assistance to States, Pueblos and Tribes, and local governments to conduct planning activities to develop water marketing strategies that establish or expand water markets or water marketing activities between willing participants in compliance with State and Federal laws.

### ***Environmental Water Resources Projects***

WaterSMART Environmental Water Resources Projects is a new category of funding in 2021 to support projects focused on environmental benefits and that have been developed as part of a collaborative process to help carry out an established strategy to increase the reliability of water resources.

Unlike other WaterSMART programs, Environmental Water Resources Projects require only 25 percent cost share and therefore invites participation by parties that would not otherwise have resources to meet higher cost-share requirements of other WaterSMART programs.

Environmental Water Resources Projects may include water conservation and efficiency projects that result in quantifiable and sustained water savings and benefit ecological values; water management or infrastructure improvements to mitigate drought-related impacts to ecological values; and watershed management or restoration projects benefitting ecological values that have a nexus to water resources or water resources management.

### ***Cooperative Watershed Management Program***

The Cooperative Watershed Management Program (CWMP) contributes to the WaterSMART strategy by providing funding to watershed groups to encourage diverse stakeholders to form local solutions to address their water management needs. Funding is provided on a competitive basis for:

### **Watershed Group Development and Watershed Restoration Planning**

In 2012, Reclamation began providing funding for watershed group development, watershed restoration planning, and watershed management project design (Phase I). A watershed group is a self-sustaining, non-regulatory, consensus-based group that is composed of a diverse array of stakeholders, which may include, but is not limited to, private property owners; non-profit organizations; Federal, State, or local agencies; and Pueblos and Tribes. As part of Phase I activities, applicants may use funding to develop bylaws, a mission statement, perform stakeholder outreach, develop a watershed restoration plan, and design a watershed management project. For Phase I projects, Reclamation awards a successful applicant up to \$50,000 per year for a period of up to two years with no non-Federal cost-share required.

### **Implementation of Watershed Management Projects**

In 2017, Reclamation began to provide cost-shared financial assistance to watershed groups to implement watershed management projects (Phase II). These on-the-ground projects, collaboratively developed by members of a watershed group, address critical water supply needs and water quality concerns, helping water users meet competing demands and avoid conflicts over water. Reclamation currently provides funding to watershed groups for the implementation of watershed management projects through the Environmental Water Resources Projects funding opportunity.

### ***Water Conservation Field Services Program***

The Water Conservation Field Services Program (WCFSP) was established by Reclamation in 1996 to proactively encourage water conservation in the operations of recipients of water from Federal water projects and to assist agricultural and urban water districts in preparing and implementing water conservation plans in accordance with the Reclamation Reform Act of 1982. Funding is used to make cost-shared financial assistance available on a competitive basis at Reclamation's area and regional office levels, as well as for technical assistance from Reclamation staff. Funding may be used to develop water conservation plans, identify water management improvements through System Optimization Reviews, design water management improvements, and improve application of water conservation technologies through demonstration activities.

### **Drought Response Program**

Reclamation's Drought Response Program supports a proactive approach to drought by assisting water managers to develop and update comprehensive drought plans and implement projects that will build long-term resiliency to drought. Program areas are as follows:

#### ***Drought Contingency Planning***

Reclamation will provide financial assistance on a competitive basis for applicants to develop a drought contingency plan or to update an existing plan to meet the required elements described in the Drought Response Framework. Most drought contingency planning processes are structured to address the three following questions:

- How will we recognize the next drought in its early stages?
- How will drought affect us?
- How can we protect ourselves from the next drought?

The planning process is structured to help planners answer these three questions and to encourage an open and inclusive planning effort that employs a proactive approach to building long-term resiliency to drought.

### ***Drought Resiliency Projects***

Drought Resiliency can be defined as the capacity of a community to cope with and respond to drought. Under this element of the program, Reclamation will provide funding for projects that will help communities prepare for and respond to drought. Typically, these types of projects are referred to as "mitigation actions" in a drought contingency plan. Reclamation funds projects that build resiliency to drought by:

- Increasing the reliability of water supplies
- Improving water management
- Providing benefits for fish and wildlife and the environment

### ***Emergency Response Actions***

Reclamation continues to undertake emergency response actions under the Drought Response Program to minimize losses and damages resulting from drought, relying on the authorities in Title I of the Drought Act. Emergency response actions are crisis-driven actions in response to unanticipated circumstances. Eligible emergency response actions are limited to temporary construction activities and other actions authorized under Title I that do not involve construction of permanent facilities, including water purchases and use of Reclamation facilities to convey and store water.

### **Title XVI Water Reclamation and Reuse Projects**

Title XVI of P.L. 102-575, as amended (Title XVI), provides authority for Reclamation's water recycling and reuse program. Through the Title XVI Program, Reclamation identifies and investigates opportunities to reclaim and reuse wastewaters and impaired ground and surface water in the 17 Western States and Hawaii. Title XVI includes funding for the planning, design, and construction of water recycling and reuse projects in partnership with local government entities.

### ***Authorized Title XVI Projects***

Projects authorized under this authority are listed at:  
<https://www.usbr.gov/watersmart/title/authorized.html>.

### ***WIIN Eligible Projects***

Projects eligible to compete for Title XVI Program funding under section 4009(c) of the Water Infrastructure Improvements for the Nation (WIIN) Act are listed at:  
<https://www.usbr.gov/watersmart/title/wiin.html>.

### **Desalination Projects**

The WIIN Act provides new authority to Reclamation to develop a desalination construction program that will provide a path for ocean or brackish water desalination projects to receive Federal funding. Eligible projects are listed at: <https://www.usbr.gov/watersmart/desalination/eligible.html>.

In 2021, the AAO supported the development and implementation of three WIIN eligible Title XVI projects and one WIIN Act Desalination project.



Reclamation submitted its initial spend plan for fiscal year 2022 funding allocations authorized in the Bipartisan Infrastructure Law to the U.S. Congress ([https://www.usbr.gov/bil/docs/spendplan-2022/Reclamation-BIL\\_Spend\\_Plan\\_2022.pdf](https://www.usbr.gov/bil/docs/spendplan-2022/Reclamation-BIL_Spend_Plan_2022.pdf)). This spend plan represents a blueprint for how Reclamation will invest in communities to address drought across the West as well as greater water infrastructure throughout the country. Reclamation will implement many of these improvements through our existing WaterSMART Programs and under new authorities.

## **Basin Study Program**

Reclamation's Basin Study Program represents a comprehensive approach to identifying and incorporating the best available science into adaptation planning for the growing gap between water supply and demand due to climate change and other factors. Within the Basin Study Program, Reclamation and its partners seek to identify strategies for addressing imbalances in water supply and demand, as authorized in the SECURE Water Act. The Program includes the West-Wide Risk Assessment (WWRA) Program (now referred to as Baseline Water Assessments), as well as the Basin Studies themselves, Basin Study updates, Water Management Option Pilots, Reservoir Operations Pilots, Applied Science Grants (to outside parties), and Applied Science Tools (internal to Reclamation applied science projects). Further information about each of these sub-programs is provided below.

### ***Baseline Assessments***

Reclamation conducts Baseline Water Assessments to develop water supply and demand projections for the Western U.S., with emphasis on Reclamation's service areas, as well as guidance and tools needed to conduct planning activities across Reclamation's mission areas. Baseline Water Assessments support reservoir operations planning, appraisal and feasibility studies, basin studies, drought contingency planning, and environmental analyses. In 2020, new projections of future conditions, and paleoclimate analyses to refine those projections, were developed by Reclamation. They were published in March 2021 on Reclamation's SECURE Water Act 2021 Report website. It is currently available from a link at <https://www.usbr.gov/climate/secure/>.

### ***Reservoir Operations Pilots***

Reclamation is completing an analysis of water operations on the Rio Chama, located in northwestern New Mexico, as a Reservoir Operations Pilot project. This project seeks to evaluate the legal constraints to river and reservoir operations on the Rio Chama; evaluate the economic implications of reservoir operations and potential changes to them; and compile existing data and information on the impact of reservoir operations on the ecology, geomorphology, hydropower generation, and recreation potential of the designated Wild and Scenic reach of the Rio Chama. The Rio Chama Reservoir Operations Pilot Report is anticipated to be released to the public in 2022.

### ***Basin Studies***

Reclamation has entered partnerships with local water management agencies to perform basin studies. Basin studies in the Upper Rio Grande Basin build on the hydrologic projections developed by Reclamation as part of the Upper Rio Grande Impact Assessment (Llewellyn et al., 2013). The studies seek to develop adaptation and mitigation strategies for watersheds affected by climate change. Basin studies require a 50 percent cost-share by Reclamation's local water management partners and involve considerable cooperation with members of the water community in a basin.

### **Santa Fe Basin Study**

In 2015, Reclamation's AAO, in partnership with the City of Santa Fe and Santa Fe County, released the Santa Fe Basin Study: Adaptations to Projected Changes in Water Supply and Demand (Llewellyn et al., 2015; <https://www.usbr.gov/watersmart/bsp/docs/finalreport/SantaFe/Santa-Fe-Basin-Final.pdf>). This study evaluated projected impacts of climate change, population growth, and other stressors on the Santa Fe watershed and water supplies for the combined municipal water system of the City and County.

Based on the conclusions of this Basin Study, the City of Santa Fe received funding from Reclamation for a Title XVI Feasibility Study, which was completed in 2017. The completed study describes alternatives for implementation of a water reuse project for the City.

In 2016, the City of Santa Fe was also awarded funding from Reclamation for a Basin Study Update. In this project, Reclamation and Santa Fe collaborated to determine the likely timeline for projected impacts of climate change on Santa Fe's water supply over the coming century, empowering the Santa Fe water utility to plan for implementation of the remainder of its adaptation portfolio. In 2018, the City was awarded a Water Management Options Pilot Project to redevelop the system dynamics model used to simulate its water supply sources and distribution. Completion of the Basin Study Update has been postponed until the new system dynamics model is available to complete the assessments.

### **Rio Grande Basin Study: Lobatos to Elephant Butte**

Reclamation is now in partnership with the MRGCD, the ABCWUA, and a large number of Pueblos and Tribes and other basin stakeholders to perform a Basin Study for the portion of the Rio Grande under New Mexico's Compact jurisdiction from the Lobatos stream gage to Elephant Butte Dam. This study follows from the Middle Rio Grande Basin Study – Plan of Study and seeks to include a broad and diverse consortium of basin stakeholders, including State and municipal government entities, Pueblos and Tribes, irrigation districts, acequias, and non-governmental and community organizations. The study seeks to develop projections of future water supply and demand and collectively evaluate and model potential adaptations to the projected changes. No water management decisions will be made as part of the Basin Study; instead, the study partners will create an interactive decision-support tool for water managers to consider, along with other considerations such as political and economic factors, as they manage water in increasingly challenging conditions. The study is being funded as a 50/50 cost split between Reclamation and all other partners combined.

### **Applied Science Grants**

Through Applied Science Grants, Reclamation provides funding to external non-Federal entities and internal project teams for the development of tools and information to support water management for multiple uses. Eligible projects include the development of modeling and forecasting tools, hydrologic data platforms, and new data sets.

### **Applied Science Tools**

Reclamation's Water Resources and Planning Office provides funding to Reclamation staff on a competitive basis for projects that will build technical capacity within Reclamation. Funded projects will allow Reclamation to use the best available science to support optimal water management under

variable hydrologic conditions and to improve forecasting and reservoir operations. Eligible projects may not include research or development of new or novel methods or technologies.

### **2021 SECURE Water Act Report to Congress: SECURE Water Act Section 9503(c) — Reclamation Climate Change and Water 2021**

In 2021, the Bureau of Reclamation released final technical reports supporting the Water Reliability in the West - 2021 SECURE Water Act Report. Reclamation's 2021 West-Wide Climate and Hydrology Assessment

(<https://www.usbr.gov/climate/secure/docs/2021secure/2021SECUREREport.pdf>) and seven individual basin reports provide detailed information on climate change impacts and adaptation strategies to increase water supply reliability in the West. A new 2021 SECURE Report Web Portal (<https://experience.arcgis.com/experience/7461ca68b2da4620863ff27d65b8cf14/>) is also available to provide a user-friendly, web-based format for delivery of information in the reports.

The 2021 West-Wide Assessment provides estimates of changes in temperature, precipitation, snowpack, and streamflow across the West using consistent methodology, similar to previous SECURE Water Act Reports. For this report, additional drought analyses based on paleohydrology (using tree rings) were performed. These results will enable water managers to compare the frequency and severity of droughts that occurred several hundred years ago to projections of future droughts and develop water management strategies in time to take action.

The West-Wide Assessment finds that temperatures are expected to increase across the West while precipitation changes are variable. With warmer temperatures, more precipitation will fall as rain and snow will melt sooner, reducing snowpack and consequently affecting streamflow timing. These key findings on future climate and hydrology are consistent with the conclusions of the 2016 SECURE Water Act Report.

Table 16: Active WaterSMART Projects in the Rio Grande Basin Managed by the AAO<sup>1</sup>

Agreement No.	Program <sup>2</sup>	Completion Date	Recipient Name	Project Title	Federal Total Obligation Amount	Non-Federal Total Est Amount
R21AP10045	ASG	6/30/22	NM Office of the State Engineer/ Interstate Stream Commission	Developing a Projection Tool for Otowi Index Supply and Elephant Butte Index Supply	\$141,272	\$147,038
Agreement Pending	ASG	TBD	NM Institute of Mining and Technology	New Mexico Water Data Initiative: Improving Water Data Access for Modeling in the Middle Rio Grande	\$195,050	\$196,666
R19AP00264	CWMP	9/30/22	Santa Fe Watershed Association	Linking Shareholder Priorities with Water Management and Adaptation Strategies in the Santa Fe River Watershed	\$100,000	\$0
R18AP00114	CWMP	6/30/22	Cimarron Watershed Alliance, Inc. (Canadian River Basin)	Restoration Planning for Improved Water Quality and Quantity in the Cimarron Watershed	\$99,994	\$1,521
R19AP00267	CWMP	9/30/22	New Mexico Jornada Resource Conservation & Development Council	Furthering Watershed Restoration Planning	\$99,982	\$0
R19AP00276	CWMP	10/30/22	Chama Peak Land Alliance	Enhancing the Capacity of the San Juan - Chama Watershed Partnership	\$100,000	\$0

<sup>1</sup> As of February 15, 2022

<sup>2</sup> ASG = Applied Science Grants

CWMP = Cooperative Watershed Management Program

DROUGHT = Contingency Planning, Resiliency Projects, or Emergency Response Actions

WEEG = Water and Energy Efficiency Grant

SWEP = Small-Scale Water Efficiency Project

WCFSP = Water Conservation Field Services Program

Title XVI = Water Reclamation and Reuse Program

WIIN Act = Water Infrastructure Improvements for the Nation

Agreement No.	Program <sup>2</sup>	Completion Date	Recipient Name	Project Title	Federal Total Obligation Amount	Non-Federal Total Est Amount
R19AP00240	CWMP	3/31/23	New Mexico Wilderness Alliance	Employing Citizen Science to Establish Baseline Water Quality Conditions in the Wild and Scenic Reach of the Rio Chama to Assess the Environmental Impacts of Changing Water Quality	\$99,852	\$10,375
Agreement Pending	CWMP	TBD	Colorado Rio Grande Restoration Foundation	Conejos River Partnership Project - Phase 2	\$285,000	\$303,640
R22AP00074	CWMP	12/31/23	National Audubon Society	Isleta Reach Stewardship Association and Plan Development for the Middle Rio Grande	\$99,964	\$0
R18AP00120	CWMP	6/30/21 (Complete)	Northern Arizona University	Developing a Watershed Restoration Strategy for the Eastern Jemez	\$97,673	\$0
R18AP00119	CWMP	9/30/21 (Complete)	National Audubon Society, Inc.	Isleta Reach Watershed Restoration Group, Middle Rio Grande Basin Watershed Group Development and Restoration Plan	\$99,964	\$0
R19AP00115	DROUGHT	6/30/22	Santa Fe County	Aquifer Storage and Recovery in Rancho Viejo, Santa Fe County	\$286,520	\$659,480
R20AP00117	DROUGHT	5/31/2022	Village of Tijeras	Well No. 3 Drilling, Testing, and Construction (Drought Well)	\$748,980	\$748,980
R21AP10035	DROUGHT	12/31/22	Elephant Butte Irrigation District	Watershed Scale Stormwater Monitoring and Capture	\$180,670	\$181,784
R19AP00105	DROUGHT	9/30/21 (Complete)	City of Las Cruces	Better Managing Water Supplies with Neutral Output Discharge Elimination System (NO-DES)	\$238,696	\$239,696
R19AV00009 PL 93-638	DROUGHT	9/30/21 (Complete)	Pueblo of Zia	Zia Flume Reconstruction	\$750,000	\$1,113,391
R21AP10009	SWEP	6/30/21 (Complete)	Elephant Butte Irrigation District	Williams Lateral Piping	\$75,000	\$116,097

Agreement No.	Program <sup>2</sup>	Completion Date	Recipient Name	Project Title	Federal Total Obligation Amount	Non-Federal Total Est Amount
R19AP00207	SWEP	9/30/21 (Complete)	El Paso County Water Improvement District No. 1	Advanced Metering Infrastructure Upgrades to Irrigation Wells	\$74,000	\$82,922
R21AP10111	SWEP	6/30/22	County of Bernalillo	Well Meter Upgrade Project	\$28,156	\$28,156
R19AP00280	SWEP	9/30/22	Ponderosa Mutual Domestic Water Consumers Association	Meter Upgrade Project	\$24,000	\$29,531
R17AP00223	SWEP	9/30/22	City of El Paso, TX	Water Conservation in the City of El Paso Parks	\$70,500	\$75,000
R17AP00223	SWEP	9/30/22	El Paso Parks	Water Conservation in the City of El Paso's Parks	\$75,000	\$75,000
R20AP00155	SWEP	3/31/22	El Paso County Water Improvement District No. 1	Ysla Lateral Concrete Lining Project, Phase 3	\$75,000	\$122,294
R19AP00228	SWEP	9/30/21 (Complete)	El Paso County Water Improvement District No. 1	Montoya Main and Montoya A Laterals Concrete Lining Project	\$75,000	\$122,143
Agreement Pending	SWEP	TBD	City of Las Cruces	Water Conservation in the City of Las Cruces: Installing SMART Irrigation Technology for the Efficient Use of Water Supplies	\$75,000	\$150,000
R20AP00129	SWEP	TBD	Pueblo of Zia	Residential Metering Project, Phase 2	\$73,000	\$80,851
R22AP00052	SWEP	6/30/23	El Paso County Water Improvement District No. 1	Montoya Main Lateral Concrete Lining Project: Phase II	\$75,000	\$197,784
R18AP00255	SWEP	9/30/21 (Complete)	City of Rio Rancho	Ultrasonic Water Meter Replacement	\$70,000	\$92,470
R18AP00258	SWEP	9/30/21 (Complete)	City of Las Cruces	Smart Irrigation Technology Water Supply Reliability Project	\$73,920	\$74,420
R20AP00332	Title XVI (WIIN)	9/30/21 (Complete)	El Paso Water Utilities Public Service Board	El Paso Water Reclamation and Reuse Project - Advanced Water Purification Facility	\$3,500,000	\$10,500,000
R21AP10323	Title XVI (WIIN)	3/31/24	El Paso Water Utilities Public Service Board	El Paso Aquifer Storage and Recovery Using Reclaimed Water Project	\$400,000	\$1,200,000

Agreement No.	Program <sup>2</sup>	Completion Date	Recipient Name	Project Title	Federal Total Obligation Amount	Non-Federal Total Est Amount
Agreement Pending	Title XVI (WIIN)	TBD	City of Santa Fe	City of Santa Fe Pipeline Project	\$6,000,000	TBD
Agreement Pending	Water Marketing	TBD	Rio Grande Water Conservation District	Colorado's Rio Grande Basin Water Cooperative Project	\$212,755	\$212,757
R20AP00036	WCFSF	9/30/21 (Complete)	City of Rio Rancho	Water Resources Management Plan Update	\$16,925	\$16,925
R19AP00150	WEEG	6/30/22	El Paso County Water Improvement District No. 1	La Union Canal Concrete Lining Project	\$300,000	\$550,000
R18AP00197	WEEG	6/30/22	Elephant Butte Irrigation District	Picacho W-H-E-N Project	\$997,182	\$1,152,288
R20AP00056	WEEG	3/31/24	El Paso County Water Improvement District No. 1	Riverside Canal Concrete Lining Project (Phase III)	\$1,000,000	\$1,039,504
R18AP00193	WEEG	6/30/21 (Complete)	El Paso County Water Improvement District No. 1	Riverside Canal Lining Project (Phase I)	\$999,000	\$1,302,500
R19AP00150	WEEG	6/30/22	El Paso County Water Improvement District No. 1	La Union East Canal Concrete Lining Project	\$300,000	\$625,298
R20AP00339	WIIN Act (Desal)	10/31/22	El Paso Water Utilities Public Service Board	Kay Bailey Hutchison (KBH) Desalination Plant, Phase I Part A Expansion	\$2,050,000	\$6,050,000
<b>Total Funding</b>					<b>\$21,863,621</b>	<b>\$28,826,527</b>

## Science & Technology Program and Other Research Projects

Reclamation's Science and Technology (S&T) Program is a Reclamation-wide competitive, merit-based applied research and development program. The program focuses on innovative solutions for water and power challenges in the Western United States for Reclamation water and facility managers and the stakeholders they serve. The program has contributed many of the tools and capabilities Reclamation and Western water managers use today.

The AAO is an active participant in Reclamation's S&T Program, and initiates and participates in research to improve the services that Reclamation provides to its stakeholders. S&T Program projects in the Rio Grande Basin that are ongoing or were completed in 2021 include:

- FY 2018 Award – *Improving the Robustness of Southwestern U.S. Water Supply Forecasting in the Face of Climate Trends and Variability* (AAO partnership with the National Center for Atmospheric Research (NCAR), Boulder, CO). A real-time streamflow forecast system was calibrated for the Rio Grande and used to test ensemble streamflow prediction (ESP) forecasting strategies for the 2021 Annual Operating Plan. Final project report can be viewed at <https://www.usbr.gov/research/projects/detail.cfm?id=8117>.
- FY 2018 Award – *Collison Floating Evaporation Pan* (AAO Partnership with University of New Mexico). This project, funded by the S&T Program, the Upper and Lower Colorado Basin Regions, the AAO, and USACE – Albuquerque District, aims to improve reservoir evaporation monitoring through the development and calibration of an in situ floating evaporation pan. Through this project, floating evaporation pans have been deployed on Cochiti, Elephant Butte, and Caballo Reservoirs, as well as Zuni Salt Lake and Lake Powell in the Colorado River Basin. S&T Program-funded work at Cochiti and Lake Powell was completed in 2021 and the report can be viewed at <https://www.usbr.gov/research/projects/detail.cfm?id=8119>. Evaporation monitoring results are being integrated and compared with those generated by New Mexico State University in the project below.
- FY 2019 Award – ongoing, *Using Remote Sensing and Ground Measurement to Improve Evaporation Estimation and Reservoir Management* (AAO and Elephant Butte Field Office partnership with New Mexico State University). This project aims to improve reservoir evaporation monitoring and reservoir management through the comparison of evaporation estimates from in situ and remotely sensed measurements. In situ evaporation estimates for this project are measured through eddy covariance towers at Elephant Butte and Caballo Reservoirs and compared with those from the Collison Floating Evaporation Pans described above. Remotely sensed evaporation estimates are developed from Landsat-8 images.
- FY 2019 Award – ongoing, *Software Tool Development to Generate Stochastic Hydraulic Simulations using HEC-RAS* (AAO partnership with USACE and the Hydrologic Research Center of San Diego, CA). Main modules including Monte-Carlo sample generation and ingestion,



implementation of samples by modifying HEC-RAS input files, post-processing, statistical analysis, and visualization are nearing completion and will go to partners for beta testing.

- FY 2020 Award – ongoing, *Characterizing the Predictability and Sensitivity of Streamflow to Monsoon Season Precipitation* (AAO partnership with NCAR, Boulder, CO). This project builds on a previous S&T Program project characterizing extreme events in New Mexico <https://www.usbr.gov/research/projects/detail.cfm?id=1782>. It uses a process called "weather typing," along with statistical analyses, to begin to develop forecasts for summer monsoons in New Mexico. This process was tested in 2021 and Reclamation hopes to incorporate the results into streamflow forecasts in the future. Although this work will not predict specific monsoon events, it will provide information on the likely strength of the monsoon season, allowing for better water supply planning that was previously possible.
- FY 2021 Award – ongoing, *Utilizing Acoustic Sensors to Detect Streambed Mobilization* (AAO in partnership with the USGS California Water Science Center and the Christ in the Desert Monastery). This project deployed hydroacoustic sensors to determine the flows that initiate streambed mobilization on the Rio Chama. The goal is to improve management of high flow pulses by correlating the moment of mobilization to a flow rate.

In addition to the S&T Program, in 2021 Reclamation's Research and Development Office initiated a series of projects aimed at developing a snow monitoring program that takes advantage of new monitoring technologies. AAO is participating in development of this snow monitoring program through two funded projects:

- *A Testbed for Harnessing and Benchmarking Snow Data Observations and Watershed Modeling for Water Supply Prediction* (AAO in partnership with Reclamation's TSC and NCAR) – ongoing. Modeling study to test snow monitoring technologies.
- *Assessing the Utility of New Satellites to Advance State of the Art Snow Forecasting Capabilities: underway, with field studies on the Banded Peak Ranches in the San Juan-Chama Project* (AAO in partnership with the University of New Mexico, University of Washington, and University of Wyoming) – ongoing. Study involves remote sensing paired with field monitoring in the headwaters of the San Juan-Chama Project.

Through Reclamation's Power Resources Office, AAO partnered with the Department of Energy's National Renewable Energy Laboratory on a project to evaluate the feasibility of, and potential obstacles to, the installation of floating solar panels, or "floatovoltaics," on federal reservoirs to generate renewable electricity and reduce reservoir evaporation losses. The final project report can be viewed at [https://www.usbr.gov/power/NHRE/FPV\\_Considerations\\_Report\\_11-2021.pdf](https://www.usbr.gov/power/NHRE/FPV_Considerations_Report_11-2021.pdf).

Through Reclamation's UCB Regional Office, AAO is partnering with NASA's Jet Propulsion Lab on a project to update the technology used to produce evapotranspiration estimates in the Rio Grande Basin. This is described in more detail in the *ET Toolbox* subsection above. The project will provide daily ET estimates at 30-meter spatial resolution derived from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the Terra and Aqua satellites and Landsat imagery, and forecast ET estimates.

Reclamation is funding the recalibration of hydrologic models used by the National Oceanic and Atmospheric Administration's West Gulf River Forecast Center, which is responsible for development of streamflow forecasts for the Rio Grande. These hydrologic models support the development of ESP forecasts, similar to those available in the Colorado River Basin, which will supplement the volumetric forecasts available from the NRCS.

Literature Cited:

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